Explanatory note for the public consultation on the scenarios, sensitivities and data for the CRM parameter calculation for auction Y-1 DY2025-26 and for auction Y-4 DY2028-29

April 2023

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Introduction

In the framework of the Capacity Remuneration Mechanism ('CRM'), Elia is provided with several tasks described in the Electricity Law[1] and the Royal Decree Methodology on the determination of volume and parameters[2].

Elia is requested to establish a CRM calibration report on volumes and parameters for the Y-1 auction with delivery year 2025-26 and for the Y-4 auction with delivery year 2028-29 and to publish it in November 2023 at the latest. The CRM calibration report will be based on the intermediate values and reference scenario that will be selected by the Minister in September 2023.

For the Minister to select the input data and assumptions which are part of the reference scenario, market parties are invited to be part of a public consultation on the data, scenario and sensitivities for this 4th CRM calibration report on volumes and parameters for delivery years 2025-26 and 2028-29.

This explanatory note gives stakeholders more context and guidance on the submitted consultation document, which is an Excel-file with the input data and scenarios for delivery years 2025-2026 and 2028-29. It also foresees some additional qualitative information, which is not quantified in the Excel. The documents submitted to public consultation have been established in collaboration with the DG Energy from the FPS Economy and in concertation with the CREG, as stated in the Royal Decree Methodology.

This explanatory note consists in 3 main sections:

- The legal and regulatory framework (§1);
- The scenario and sensitivities (§2);
- The other parameters which have to consulted (§3).

Should there be any remark or additional suggestion on this document, this can obviously be provided as part of the consultation contribution. Stakeholders are invited to comment sensitivities and/or propose additional quantified sensitivities or elements to be included to the reference scenario.

Note that the slide deck presented during the task force of the 14th April 2023[3] can also be considered as part of this public consultation.

[1] https://www.ejustice.just.fgov.be/eli/loi/1999/04/29/1999011160/justel
[2] http://www.ejustice.just.fgov.be/eli/arrete/2021/04/28/2021041351/justel
[3] https://www.elia.be/en/users-group/adequacy-working-group/20230414-meeting

1 Legal and regulatory framework

This public consultation takes place according to the Royal Decree on volume and parameters[4].

Article 3 presents the objective of the public consultation in the framework of the reference scenario selection process.

Royal Decree Reference	
Art. 3. § 1er. Le gestionnaire de réseau effectue, en collaboration avec la Direction générale de l'Energie et en concertation avec la commission, une sélection d'un ou de plusieurs scénarios et sensibilités selon les étapes décrites à l'article 4, §§ 2 à 4 inclus. § 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 alinéa, 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. § 4. En outre, d'autres sensibilités qui peuvent avoir un impact sur la sécurité d'approvisionnement de la Belgique, peuvent être définies, y inclus des	**Art. 3.** § 1. De netbeheerder maakt, in samenwerking met de Algemene Directie Energie en in overleg met de commissie, een selectie van één of meerdere scenario's en gevoeligheden volgens de stappen beschreven in artikel 4, §§ 2 tot en met 4. § 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, lid 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. § 4. Daarnaast kunnen andere gevoeligheden gedefinieerd worden die een impact kunnen hebben op de bevoorradingszekerheid in België, met

[4] http://www.ejustice.just.fgov.be/eli/arrete/2021/04/28/2021041351/justel

évènements en dehors de la zone de réglage belge.	inbegrip van gebeurtenissen buiten de Belgische regelzone.
§ 5. Les scénarios et sensibilités sélectionnés, en ce compris les données et hypothèses à partir desquelles ils ont été établis, sont soumis à une consultation publique telle que visée à l'article 5.	§ 5. De geselecteerde scenario's en gevoeligheden, inclusief de gegevens en hypothesen waaruit ze zijn opgebouwd, worden onderworpen aan een openbare raadpleging bedoeld in artikel 5.
§ 6. Sur la base du rapport de consultation, et en particulier des informations ayant trait à l'article 5, § 2, 1° et 2°, la commission rédige une proposition pour le Ministre de l'ensemble des données et hypothèses à retenir, qui constituent ensemble une proposition de scénario de référence. La Direction générale de l'Energie formule un avis sur cette proposition.	§ 6. Op basis van het consultatierapport en in het bijzonder de informatie die betrekking heeft op artikel 5, § 2, 1° en 2° maakt de commissie een voorstel op voor de Minister van de te weerhouden set van gegevens en hypotheses, die samen een voorstel van referentiescenario vormen. De Algemene Directie Energie formuleert een advies op dit voorstel.
§ 7. Compte tenu de la proposition de la commission, des recommandations du gestionnaire du réseau et de l'avis de la Direction générale de l'Energie, le Ministre décide, par arrêté délibéré en Conseil des ministres depuis la décision prise en 2021, au plus tard le 15 septembre de l'année précédant les enchères, de l'ensemble des données et des hypothèses qui doit être sélectionné comme scénario de référence. Le Ministre peut déroger à la proposition de la commission moyennant motivation adéquate.	§ 7. Rekening houdend met het voorstel van de commissie, de aanbevelingen van de netbeheerder en het advies van de Algemene Directie Energie, beslist de Minister, bij besluit vastgesteld na overleg in ministerraad vanaf de beslissing genomen in 2021, ten laatste op 15 september van het jaar voorafgaand aan de veiling welke set van gegevens en hypotheses moet worden geselecteerd als het referentiescenario. De Minister kan hierbij afwijken van het voorstel van de commissie mits passende motivatie

Article 5 sets the requirements of the public consultation and the data that need to be submitted to public consultation.

Royal Decree Reference	
Art. 5. § 1er. Le gestionnaire de réseau organise une ou plusieurs consultations publiques conformément à l'article 7undecies, § 3, alinéa 3, de la loi du 29 avril 1999 durant une période de minimum un mois. Le gestionnaire du réseau informe les acteurs de marché de la tenue de cette (ces) consultation(s). § 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 ; 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 annuelles visées à l'article 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.	**Art. 5.** § 1. De netbeheerder organiseert een of meerdere openbare raadpleging(en) met het oog op de opmaak van zijn verslag en zijn voorstel bedoeld in artikel 7undecies, § 3, derde lid van de wet van 29 april 1999, gedurende een periode van ten minste één maand. De netbeheerder informeert de marktdeelnemers over het houden van deze raadpleging(en). § 2. De volgende onderwerpen worden ten minste aan openbare raadpleging 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; 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 jaarlijkse inframarginale inkomsten, bedoeld in artikel 10, § 6; 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.

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 the Minister to select a reference scenario that will be used as basis for the CRM calibration report for delivery years 2025-26 and 2028-29.

This chapter contains two main parts: the main data and assumptions regarding the scenario (Article 5, §2, 1°) on §2.1 and the sensitivities that could be integrated in the reference scenario (Article 5, §2, 2°) on §2.2.

Note that when a sensitivity is proposed regarding one of the data and assumptions presented in §2.1, a black box with the reference to the associated sensitivity is added.

2.1 Data and assumptions for the scenario

The data for Belgium is based on the public consultation for the Adequacy and Flexibility study 2023 performed in October and November 2022[5] and is updated according to the most recent available information. The sources of the updates are mentioned in each sub-section (§2.1.1. to §2.1.3).

Regarding the flow-based parameters (see § 2.1.4), Elia proposes to keep the same model and assumptions as implemented in the Adequacy and Flexibility study 2023.

The data for all other countries is based on ERAA 2022 and is updated based on the most recent national/regional adequacy studies and known announcements and ambitions, as described in §2.1.5.

Finally, the economic parameters proposal presented in §2.1.7 are based on latest available information and aim to integrate the uncertainties due to the current geopolitical context.

2.1.1 Generation & Storage

First, the Belgian generation and storage capacities are presented. This sub-section also includes the forced outage rates. The data is in line with the data from the public consultation of the Adequacy and Flexibility study 2023, in line with article 3, §2 of the Royal Decree, and have been updated according to the most recent available information sources.

[5] https://www.elia.be/en/public-consultation/20221028_public-consultation-adequacy-study-2022-2032

Figure 1 graphically presents the main updates implemented for the Y-1 auction with delivery year 2025-26 compared to the Y-4 auction targeting the same delivery year. Note that the values mentioned for Y-4 auction DY2025-26 are the ones selected by the Minister in September 2020.

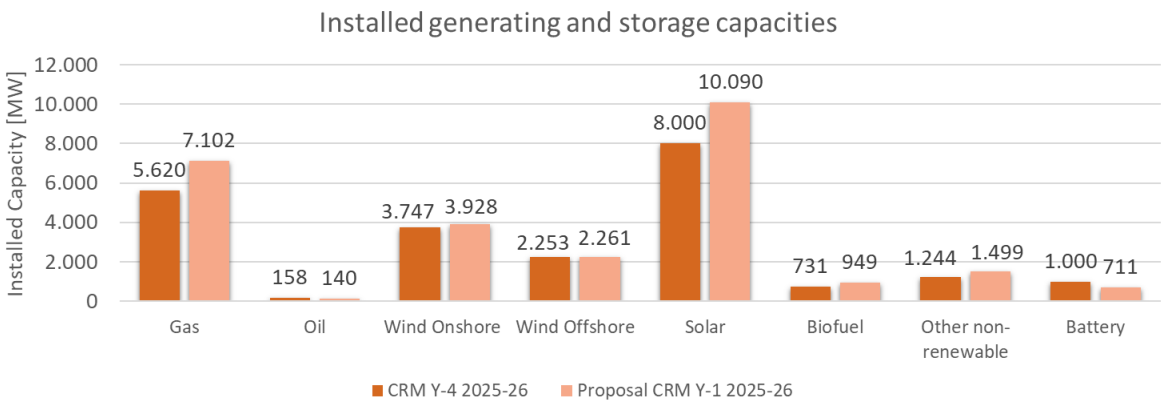

Figure 1: Installed capacity available to the market on Belgian market zone compared to the previous auction for the same delivery year (auctions Y-4 2025-26 vs Y-1 2025-26)

Figure 2 graphically presents the main updates implemented for the Y-4 auction with Delivery year 2028-29 compared to the previous Y-4 auction targeting the Delivery year 2027-28.

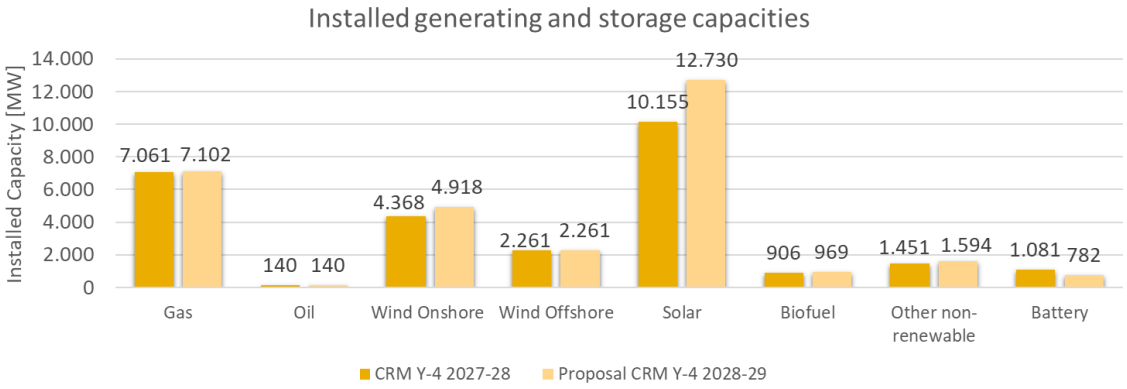

Figure 2: Installed capacity available to the market on Belgian market zone compared to the previous Y-4 auction (auctions Y-4 2027-28 vs Y-4 2028-29)

In the next sub sections, the main updates for the different technologies are discussed in detail.

2.1.1.1 Generation & Storage summary

A summary of the generation and storage installed capacities for the Delivery years 2025-26 and 2028-29 is presented in the Excel file (section 1.1).

Table 1 and Table 2 present the proposed installed capacities for delivery years 2025-26 and 2028-29 respectively for each technology, which includes demand-side response data as presented in §2.1.2.2. The tables also provide a comparison of the proposed values with those from the respective previous Y-4 auctions. In addition, a comprehensive explanation of the updates is presented.

The data presented in tables 1 and 2 are fully in line with the central AdeqFlex 2023 scenario for Belgium for the corresponding delivery years.

Net Capacities in MW	CRM Y-4 25-26	Proposal CRM Y-1 25-26	Explanation of the updates
Nuclear	0	0	Doel 2 is only considered until 01/12/2025.
Gas	5620	7102	Comissionning of the new CCGT Flémalle (+890MW), new CCGT Seraing (+885MW) and Borealis Kallo Gent ST commissionned (+32 MW). Update of the nominal power of Ringvaart STEG (+28 MW) and Marcinelle Energie TGV (+8MW), Izegem (-2 MW), Jemeppes-sur-Sambre GT1 (+5 MW) and Jemeppes-sur-Sambre GT2 (+5 MW). Repowering of Saint-Ghislain STEG (+36 MW) and Zandvliet Power (+33 MW). Removal of Seraing TV (-170 MW), Vilvoorde GT (-255 MW), and Ham Gent ST (-13 MW)
Oil	158	140	Decomissioning of TURBOJET VOLTA (-18 MW)
Hydro - Run of River	134	137	A 151 MW increase by 2030 is predicted in the NECP, and a linear interpolation to this target is being considered.
Wind Onshore	3747	3928	Updated to consider latest ambitions (VEKA, SPW) and the feedback received during the AdeqFlex 23 public consultation
Wind Offshore	2253	2261	Updated based on previous SPF feedback
Solar	8000	10090	Increased PV ambition based on the feedback received from the regions and DSO's during AdeqFlex 23 public consultation.
Biofuel (including waste)	731	949	Increase based on the trend observed on Elia's internal database

Profiled thermal non-renewable generation	1244	1499	Increase based on changes observed on Elia's internal database
Batteries	1000	711	New approach in line with AdeqFlex 23 for large-scale batteries with expected and potential additional volumes. The value presented here is the sum of assumed installed large-scale batteries and small-scale batteries for the delivery year.
Pumped Storage	1395	1305	Reservoir extension of Coo 1-3 and total capacity of Coo was corrected based on feedback from stakeholders

Table 1: Update on generation & storage data for the auction Y-1 DY2025-26

Net Capacities in MW	CRM Y-4 27-28	Proposal CRM Y-1 28-29	Explanation of the updates
Nuclear	2077	2077	Lifetime extension of Doel 4 and Tihange 3
Gas	7061	7102	Repowering of Zandvliet Power (+33 MW) and Saint-Ghislain (+8 MW)
Oil	140	140	N.A
Hydro - Run of River	143	145	A 151 MW increase by 2030 is predicted in the NECP, and a linear interpolation to this target is being considered.
Wind Onshore	4368	4918	Updated to consider latest ambitions (VEKA, SPW) and the feedback received during the AdeqFlex 23 public consultation
Wind Offshore	2261	2261	N.A
Solar	8000	10090	Increased PV ambition based on the feedback received from the region and DSO during AdeqFlex23 public consultation.
Biofuel (including waste)	906	969	Increase based on the changes observed on Elia's internal database
Profiled thermal non-renewable generation	1451	1594	Increase based on changes observed on Elia's internal database
Batteries	1081	782	New approach in line with AdeqFlex 23 for large-scale batteries with expected and potential additional volumes. The value presented here is the sum of assumed installed large-scale batteries and small-scale batteries for the delivery year.
Pumped Storage	1305	1305	Reservoir extension of Coo 1-3

Table 2 : Update on generation & storage data for the auction Y-4 DY2028-29

The capacities already contracted in previous auctions are included in the scenario under the respective categories.

Note that additional capacity could 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), as mentioned in article 5 §1. For storage and DSR, a potential is now indicated that defines the maximum that could be added to the reference scenario in order to make the scenario adequate.

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 Delivery years 2025-26 and 2028-29. The Excel document describes for each unit, its name, owner, fuel type, derating factor type, used fuel and the associated net generation capacity. Furthermore, the unit's availability for the delivery years 2025-26 and 2028-29 is specified.

This list integrates the nuclear power plants of Tihange 3 and Doel 4, following the decision of the authorities to extend the lifetime of the 2 latest units. In the framework of the Y-4 auction with delivery year 2028-29, it is assumed that the 2 facilities will be available during the whole delivery year.

This list also integrates the two new CCGT contracted for 15 years in the framework of the Y-4 auction for Delivery year 2025-26[6], including the results of the CRM re-run[7].

Note that a sensitivity is proposed for auction Y-4 DY2028-29 on Belgium's TJ due to the introduction of a CO2 threshold (see § 2.2.52.2.4).

2.1.1.3 Profiled thermal

The capacities are based on the information that is available to Elia through the data exchanges with DSOs. The information on the different existing projects and projects assumed to be developed in the next years leads to an increase for gas profiled and biomass profiled units as presented in Table 2.

[6] https://www.elia.be/fr/donnees-de-reseau/adequation/resultats-de-l-enchere-crm
[7] https://www.elia.be/fr/actualites/communiques-de-presse/2022/04/20220414_rerun-crm

2.1.1.4 Storage

The installed capacity and reservoir for storage considered for Delivery years 2025-26 and 2028-29 are presented in the Excel (section 1.3).

Pumped-storage

Pumped-storage technology in Belgium exists at two different sites, namely Coo and Platte-Taille. Coo has a turbining capacity of 1161 MW and a storage capacity of 5100 MWh (after extension), which is available for economical dispatch, after reserving 500 MWh for black-start services, taking into account the reservoir extension of Coo 1-3. Platte-Taille has a turbining capacity of 144 MW and a reservoir volume of 700 MWh.

Batteries

2 categories of batteries are considered: large-scale batteries and small-scale batteries.

The installed capacity for large scale-batteries is divided in two categories:

- the expected capacity proposed for the reference scenario consisting of all existing capacities and already contracted capacities and;
- the potential additional capacity that could be added to the reference scenario in case the scenario was found to not be adequate (as part of model calibration to reach the reliability standard)

The expected capacity proposed for the reference scenario considers the projects “in service” and also the volume contracted in the framework of the Y-4 auction for delivery year 2025-26.

The additional potential capacity consists of future projects which are known today at Elia and could potentially join the market. The additional potential capacity is not included in the reference scenario, however, a sensitivity is proposed to account for it. During the calibration of the model, preselected capacity types will be added to the scenario until the adequacy criteria is met. Batteries are one of the proposed preselected capacity types which could be added in this step. The potential additional battery capacities proposed here represent the maximal battery capacity that could be added during the calibration step.

Figure 3 and Figure 4Figure 4 show the proposed large-scale battery capacities for delivery years 2025-26 and 2028-29 respectively.

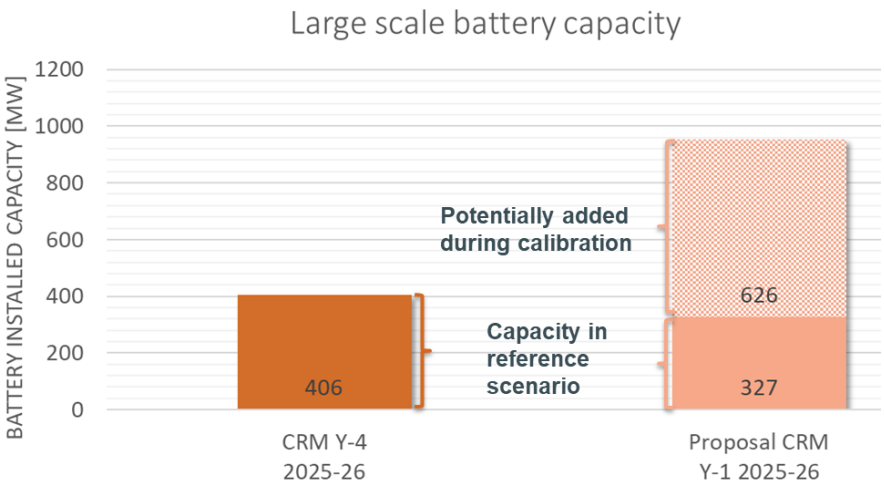

Figure 3: Capacity of large-scale batteries for auction Y-1 DY2025-26

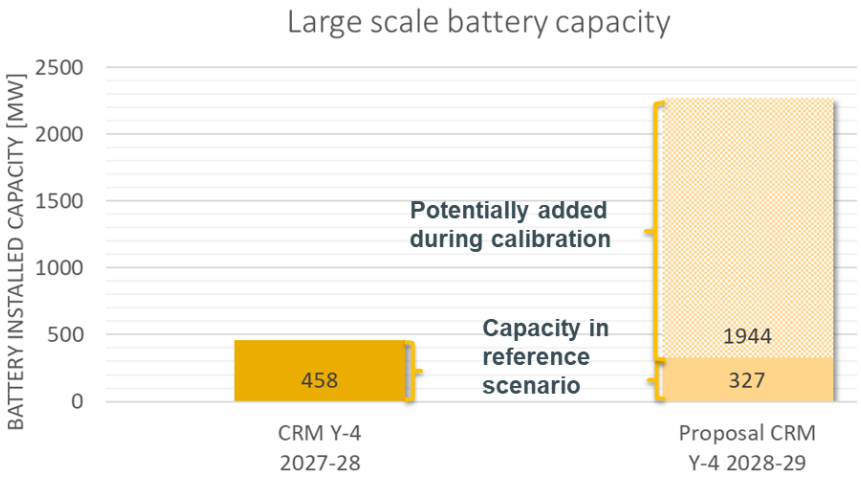

Figure 4 : Capacity of large-scale batteries for auction Y-4 DY2028-29

For large scale batteries a significant update concerns the energy content associated to this technology. Indeed, based on information available on existing and known projects, a split is performed between large scale batteries projects with respectively a 4h storage capacity and a 2h storage capacity.

Note that a sensitivity is proposed on higher amount of large-scale battery capacity in Belgium. (see §2.2.8 2.2.8)

Figure 5 and Figure 6 show the proposed capacities of small-scale storage for delivery years 2025-26 and 2028-29 respectively.

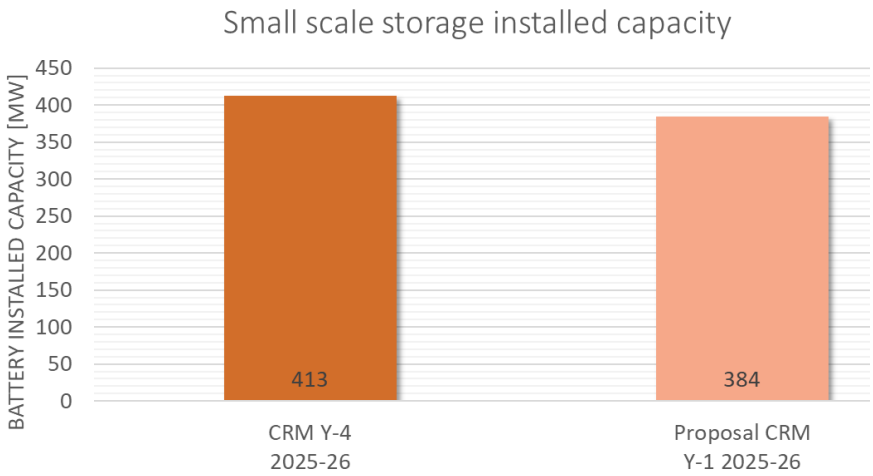

Figure 5: Capacity of small-scale batteries for auction Y-1 DY2025-26

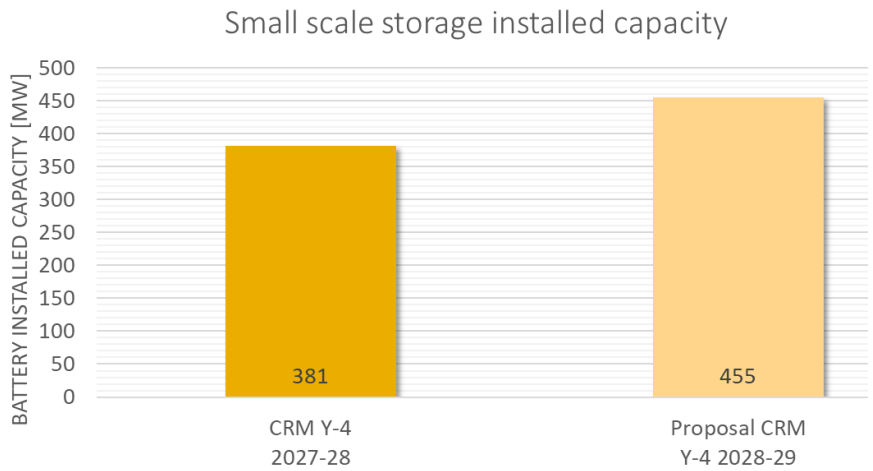

Figure 6: Capacity of small-scale batteries for auction Y-4 DY2028-29

For small scale batteries, a split is performed between the small-scale batteries considered “in-the-market” and “out-of-market”. EVs (V2G included) are integrated in the demand and are going to be discussed in the “demand” section.

The updated trajectory of small-scale batteries, as presented after the public consultation of the Adequacy & Flexibility study in February 2023 is based on the following assumptions:

- Update of the realized installed capacity for 2022 based on available Fluvius data (+ assuming jump in December 2022);
- Update of the future trajectory based on changes in subsidy scheme in Flanders which ends sooner than initially foreseen (end by March 2023).
- For later years, the following assumptions are kept
    - Each year, an additional capacity equivalent to 0.2% of the existing PV capacity in MW is installed.
    - 2 hours per battery.

2.1.1.5 Renewable and profiled non-renewable

Section 1.4 of the Excel file details the renewable energy and profiled thermal production.

Regarding onshore wind, the proposed capacities for delivery years 2025-26 and 2028-29 integrate the latest national ambitions (VEKA and SPW) and also integrate the feedback received during the public consultation of the Adequacy and Flexibility study 2023. The increase in capacities can be attributed to the slightly higher ambitions for onshore wind compared to previous auctions.

Regarding offshore wind, the proposed generation capacity is set to 2261 MW. According to the latest planning from the SPF Economy, the first turbines are foreseen for Q4 2028 but not yet in operation. In the context of the CRM this capacity will therefore not be considered as contributing to Security of Supply in delivery year 2025-26 nor in 2028-29.

Regarding photovoltaics, the proposed capacities for delivery years 2025-26 and 2028-29 integrate the feedback received from the regions and exchanges with DSOs during the public consultation of the Adequacy and Flexibility study 2023.

The proposed capacities for onshore wind, offshore wind and photovoltaic solar for delivery years 2025-26 and 2028-29 are respectively presented in Figure 7 and Figure 8, and compared to the values of the previous auction.

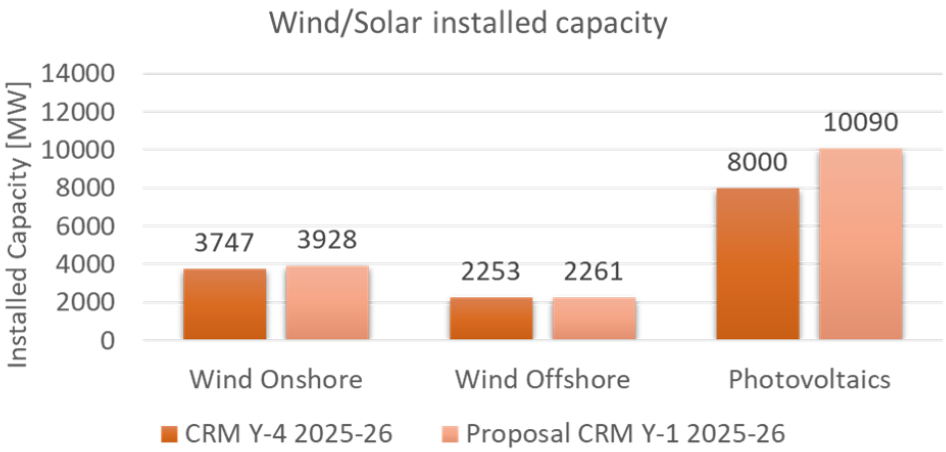

Figure 7: Overview of proposed RES capacities for Y-1 auction DY2025-26

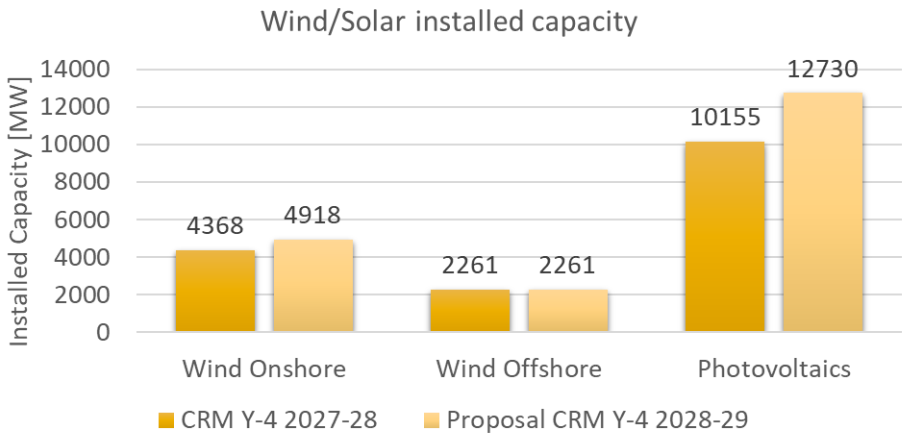

Figure 8: Overview of proposed RES capacities for Y-4 auction DY2028-29

The proposed capacities of profiled thermal units without daily schedule (gas CHP, biomass and waste) is determined based on the latest information from Elia's internal database, which gathers the latest information from the DSOs. Based on the information available on existing and projected projects, there is an overall increase in the profiled units for all types. Figure 9 and Figure 10 detail the proposals for delivery years 2025-26 and 2028-29 respectively.

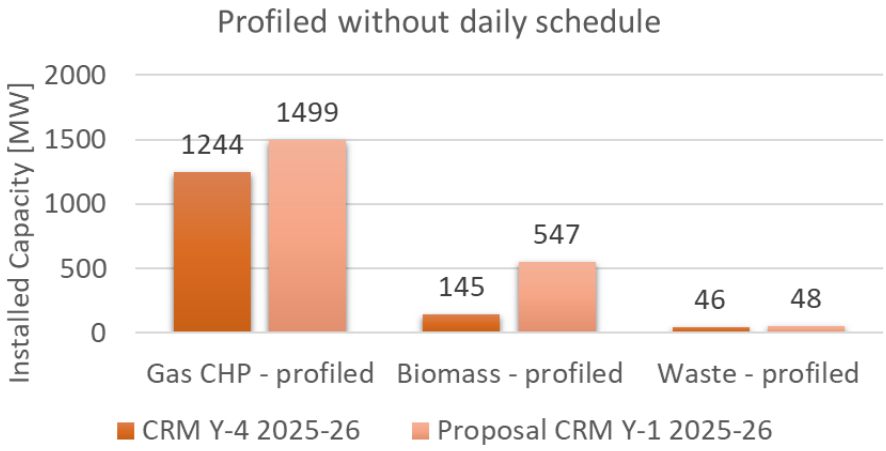

Figure 9: Overview of the proposed capacities for thermal unit without daily schedule for auction Y-1 DY2025-26

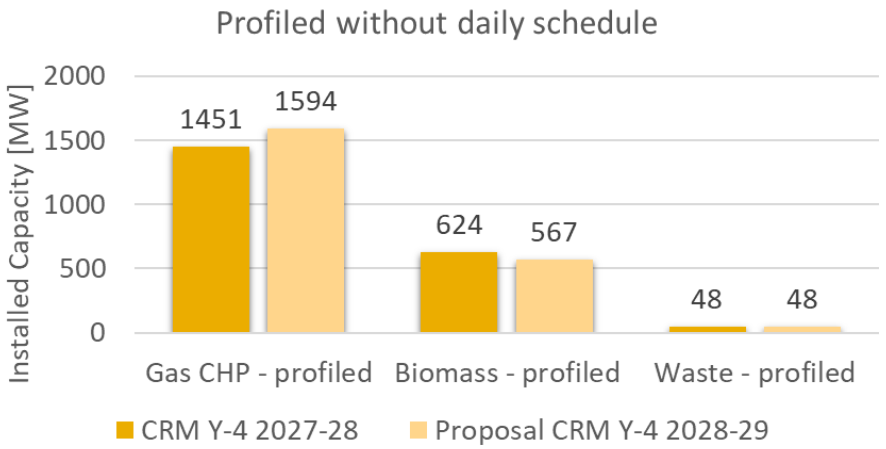

Figure 10: Overview of the proposed capacities for the thermal unit without daily schedule for auction Y-4 DY2028-29

2.1.1.6 Forced outage rates

The proposed forced outage (FO) rates are presented in the Excel (section 1.5) and were calculated by N-SIDE[8] in the context of a wider study around outages for Belgian production units.

For the previous CRM studies, including the auctions Y-4 DY2025-26 and Y-4 DY2027-28, the forced outages rates were calculated on a 10-years historic set of data. This set of data was limited to the Belgian units.

For the future CRM auctions, including the auctions Y-1 DY2025-26 and Y-4 DY2028-29, the proposed forced outage rates are calculated using the methodology developed by N-Side and presented in the framework of the public consultation of the Adequacy and Flexibility study 2023. Based on the feedback received during the public consultation, the forced outage rates for Pumped Storage and the batteries were also updated. The latest forced outage rates are presented in Figure 11.

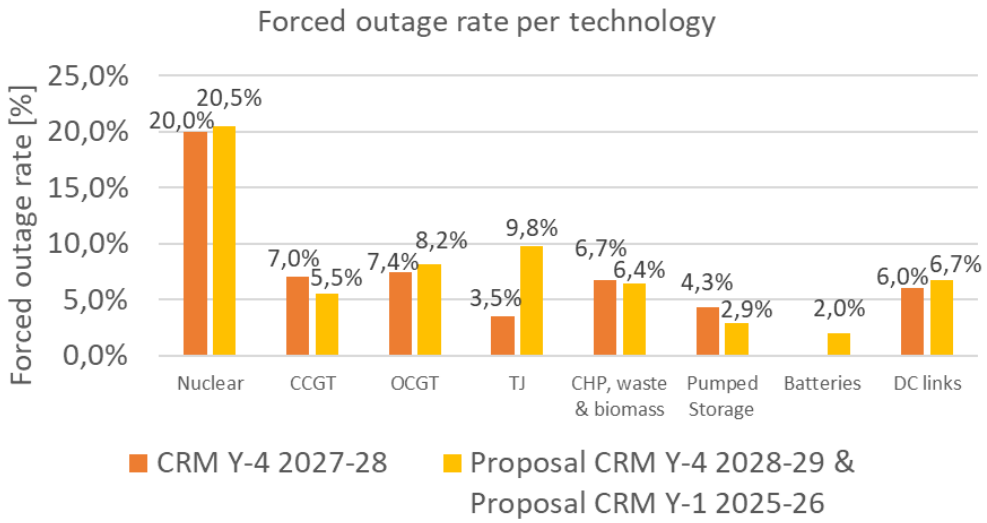

Figure 11 : Proposed forced outage per category based on the N-side study for auction Y-1 DY2025-26 and Y-4 2028-29

[8] https://www.elia.be/en/public-consultation/20221028_public-consultation-adequacy-study-2022-2032

2.1.2 Consumption & Demand-side response

The next sub-section is dedicated to the load, which comprises demand and demand-side response parameters. The data is based on the values presented during the public consultation of the Adequacy and Flexibility study 2023. The main updates implemented in the CRM calibration for the auctions Y-1 DY2025-26 and Y-4 DY2028-29 are listed in Table 3 and Table 4. Note that an additional electrification of the industry is foreseen (see 2.1.2.1). This additional electrification of industry increases the electricity consumption but also offer some additional flexibility. This additional flexibility is discussed in the sub-section 2.1.2.3.

Data	CRM Y-4 2025-26	Proposal CRM Y-1 2025-26	Sources
Electricity total consumption [TWh]	88,9	88,7	Climact calculations and Plan Bureau economic estimates published in June 2022. Industry electrification and EV/HP updates included. An update based on the latest Climact calculation is foreseen in June 2023.
Average electricity peak consumption [GW]	14	15	Peak demand without including the flexibility activations of EV's, HP's, industry and out-of-market batteries which will level out the peak load. An update based on the latest Climact calculation is foreseen in June 2023.
Demand-side response shedding from industry [MW]	1565	1798	Updated methodology based on existing DSR + potential capacity (+450 MW).

Table 3: Proposed electricity consumption data and demand-side response for auction Y-1 2025-26

Data	CRM Y-4 2027-28	Proposal CRM Y-4 2028-29	Sources
Electricity total consumption [TWh]	90,9	104,4	Climact calculations and Plan Bureau economic estimates published in June 2022. Industry electrification and EV/HP updates included. An update based on the latest Climact calculation is foreseen in June 2023.
Average electricity peak consumption [GW]	15	18	Peak demand without including the flexibility activations of EV's, HP's, industry and out-of-market batteries which will level out the peak load. An update based on the latest Climact calculation is foreseen in June 2023.
Demand-side response shedding [MW]	2226	1798	Updated methodology based on existing DSR + potential capacity (+900 MW).

Table 4 : Proposed electricity consumption data and demand-side response for auction Y-4 2028-29

2.1.2.1 Total electricity consumption

The proposed total electricity consumptions presented here are the total loads of the base trajectories for the upcoming AdeqFlex 23 for the respective delivery years. The total loads are only given as an indication as Elia proposes to update the load based on the new economic outlook to be published by the Planning Bureau in June 2023 and the additional parameters presented in parts 2.1 and 2.2 of the Assumptions Workbook. The load parameters are a proposal and part of the public consultation.

As indicated in Figure 12, the total load consists of 4 blocks:

- The organic load as calculated by Climact based on the parameters presented in 2.2 of the Assumptions Workbook and further detailed in Appendix B.
- The additional electrification from EV and HP included by Climact based on Elia estimates as presented in 2.1 (number of vehicles) and 2.2 (TWh) of the Assumptions Workbook .
- Grid losses from TSO and DSO
- Additional electrification from industry

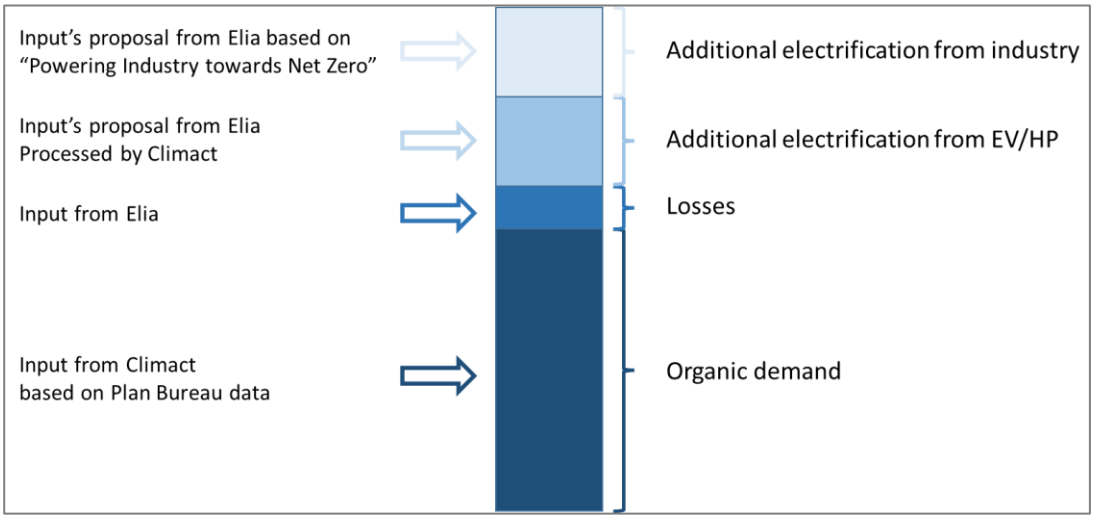

Figure 12: overview of the load components

Elia proposes to include the impact of high prices on the electricity consumption of both industry and households in line with AdeqFlex 23.

The methodology proposed to account for additional electrification from electric vehicles, heat-pumps, and industry is based on the one presented during the public consultation of the Adequacy and Flexibility study 2023. For future studies, the granularity of the types considered for each electrification has been refined. In the CRM auction Y-4 DY2028-29, electric vehicles and heat pumps were respectively accounted for as equivalent units. Please note that the flexibility associated with this additional electrification is discussed in sub-section 2.1.2.3.

Table 5 presents the proposal for EV's, HP's and additional electrification of industry for the auction Y-1 DY2025-26 and compares them to the previous auction.

	CRM Y-4 2025-26	Proposal CRM Y-1 2025-26
Passengers Cars BEV [thousands]	N/A	400
Passengers Cars PHEV [thousands]		430
LDV freight BEV [thousands]		28
LDV freight PHEV [thousands]		10
HDV freight BEV [thousands]		0
Busses BEV [thousands]		2
Residential HP [thousands]	N/A	815
Tertiary HP [thousands]		70
Additional electrification from industry [TWh]	Not considered	2,3
Additional electrification from to data centers [TWh]		0,8

Table 5: Assumption for EV types, HP types and additional electrification of the industry for auction Y-1 DY 2025-26

Table 6 presents the proposal for EV's, HP's and additional electrification of industry for the auction Y-4 DY2028-29 and compares them to the previous auction.

	CRM Y-4 2027-28	Proposal CRM Y-4 2028-29
Passengers Cars BEV [thousands]	850*	1.170
Passengers Cars PHEV [thousands]		400
LDV freight BEV [thousands]		90
LDV freight PHEV [thousands]		24
HDV freight BEV [thousands]		1
Busses BEV [thousands]		4
Residential HP [thousands]	250**	1.061
Tertiary HP [thousands]		114
Additional electrification from industry [TWh]	Not considered	9,2
Additional electrification from to data centers [TWh]		2,0

Table 6 : Assumption for EV types, HP types and additional electrification of the industry for auction Y-4 DY 2028-29

2.1.2.2 Average peak electricity consumption

The average peak electricity consumption presented here is calculated using consumption profiles generated based on the total electricity consumption and climate years as further detailed in §**Error! Reference source not found.**. The increase in a verage peak consumption is related to the increase in total electricity consumption but further accentuated by the rise in heat-pump, electric vehicle and additional electrification of the industry assumptions (Table 5 and Table 6).

This average peak consumption is the average over the climate years and should rather be interpreted as a range. Additionally, the average peak consumption estimate does not take into account the flexibility activations of EV's, HP's, industry and out-of-market batteries which will help level out the peak consumption. The peak load presented here is calculated based on the presented total load which will be updated based on the new economic outlook to be published in June 2023.

2.1.2.3 Demand-Side Response

Section 2.3 of the Excel file presents the data associated to Demand-Side Response (DSR) in Belgium. For future auctions, especially Y-1 DY2025-26 and Y-4 DY2028-29, the demand-side response (DSR) from the industry will be divided into two categories: the capacity proposed for the reference scenario and potential additional capacity. The capacity proposed for the reference scenario consists of the existing DSR as calculated in the latest E-cube study which was also used as basis in the latest Adequacy and Flexibility study 2023[9].

E-cube is working on an updated methodology to determine the existing DSR volume. Part of this public consultation is also a consultation on the methodology to be applied by E-cube. Once a new methodology has been selected, a new existing DSR volume will be calculated and could be included in the scenario once determined. More details on the consultation on the methodology to be applied in the determination of existing DSR volume are given in appendix A.

DSR is subdivided in 5 categories depending on availability (1h, 2h, 4h, 8h or no limit), in line with the methodology proposed during the public consultation of the upcoming AdeqFlex 23 study. A volume is proposed for each category. Figure 13 Figure 13and Figure 14 Figure 14 provide a comparison of the proposed DSR volume for auctions Y-1 DY2025-26 and Y-4 DY2028-29 with that of auctions Y-4 DY2025-26 and Y-4 DY2027-28, which includes both the volume dedicated to the energy market and ancillary services. Previously, a demand-shifting category was incorporated in the CRM calibration, and this flexibility has now been included in the EV and HP flexibility.

[9] https://www.elia.be/en/public-consultation/20221028_public-consultation-adequacy-study-2022-2032

Similarly to the batteries, the assumed capacity in the reference scenario is the starting point proposed in the reference scenario. The additional potential capacity is not included in the reference scenario, however, a sensitivity is proposed to account for it. During the calibration of the model, preselected capacity types will be added to the scenario until the adequacy criteria is met. DSR are one of the proposed preselected capacity types which could be added in this step. The potential additional DSR capacities proposed here represent the maximal DSR capacity that could be added during the calibration step.

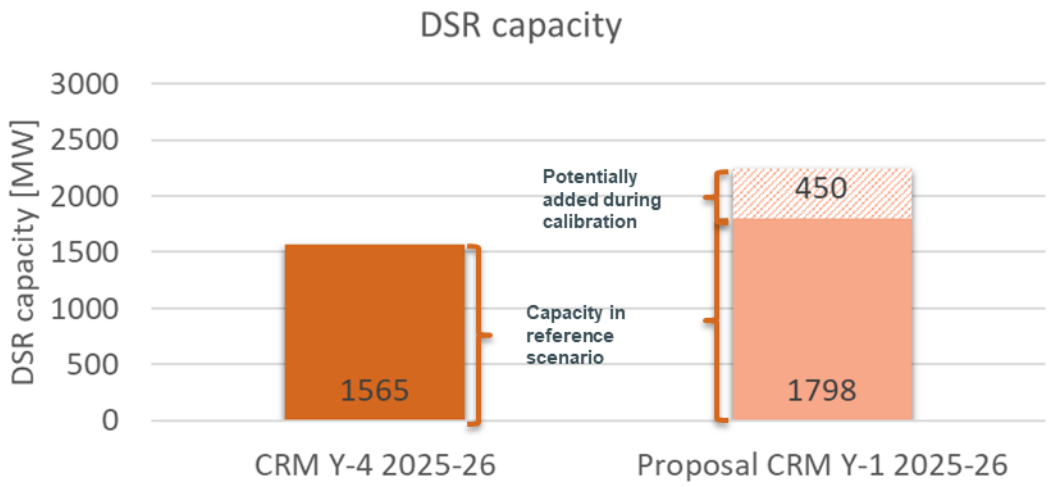

Figure 13 : DSR capacity from industry for auction Y-1 DY2025-26

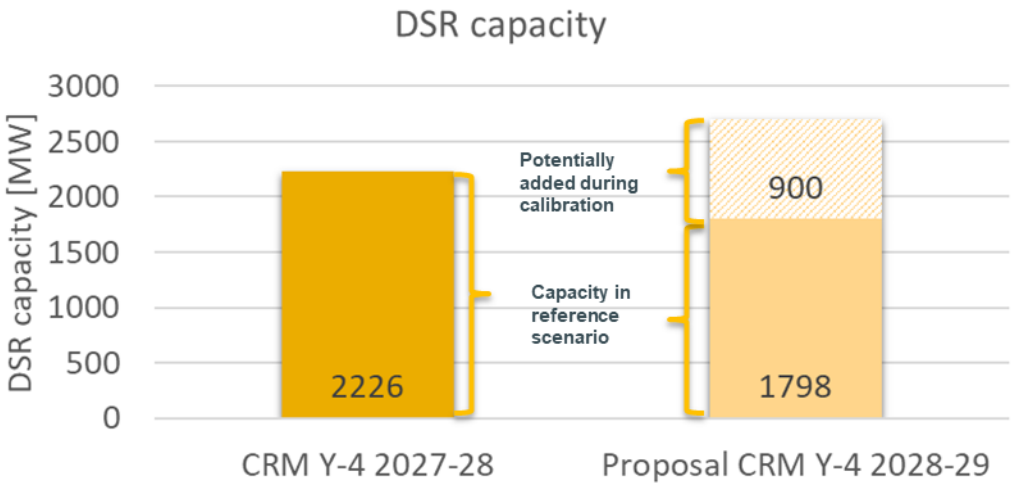

Figure 14 : DSR capacity from industry for auction Y-4 DY2028-29

Note that a sensitivity is proposed on higher existing DSR capacity in Belgium (see 2.2.8.)

In addition to the previously discussed demand-side response (DSR) volume, there is another capacity to consider that is associated with the additional electrification of the industry. The amount of flexibility this DSR provides varies depending on the type of demand. For DRI-EAF (steel), data centers and CCS, the proposed flexibility is respectively 75%, 50%, and 0%. However, for e-boilers and heat-pumps, the proposed flexibility is respectively 100% and 80%.

2.1.3 Balancing need

This subsection is dedicated to the required balancing need, i.e. reserve capacity, which needs to be provided to deal with unexpected variations in demand and generation. The proposed reserve capacity applied for the auctions Y-1 DY 2025-26 and Y-4 DY 2028-29 is presented in the Excel file (section 3).

The balancing need impacts the volume to be procured in each CRM auction. This estimation is required by article 11, §2, 2° of the Royal Decree. The balancing need 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 necessary total balancing need is defined as the sum of the FCR[10] reserve capacity and the total FRR[11] reserve capacity.

- The FCR capacity is expected to slightly increase in the next years. The latest expected value for auction Y-1 DY2025-26 is 95 MW. The latest expected value for auction Y-4 DY2028-29 is 97 MW. Currently, the capacity is determined based on the share of generation and demand of Elia's LFC[12] 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 Adequacy and Flexibility 2023 simulations.

- The upward FRR capacity (aFRR + mFRR) is expected to be 1221 MW for the auction Y-1 DY2025-26 and 1353 MW for the auction Y-4 DY2028-29. Currently, the capacity is determined on a 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.

[10] FCR: Frequency Containment Reserves
[11] FRR: Frequency Restoration Reserves
[12] LFC: Load Frequency Control

Based on the above-mentioned assumptions, the proposed balancing need volumes for delivery years 2025-26 and 2028-29 are therefore to 1316 MW and 1450 MW respectively.

2.1.4 Cross-border market capacities

The CRM calibration will use an up-to-date flow-based modelling as proposed during the public consultation of Adequacy and Flexibility study 2023. The parameters of this model are presented in the Excel file (section 4). More details on the modelling can be found in appendix B of the Adequacy and Flexibility study 2021[13].

The presented domain will be complemented with the NTC values taken from the European Resource Adequacy Assessment 2022 (ERAA22) of ENTSO-E for the borders which are not included in the flow-based region.

Note that a sensitivity is proposed to reflect possible smaller cross-border capacities due to the non/strict achievement of the FB CEP rules for 2025 and 2028 or less optimistic assumptions regarding grid availability during winter(see §2.2.2).

Figure 15 Figure 15provides 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). For the auctions Y-1 DY2025-26 and Y-4 DY2027-28, no external constraint is considered and only cross-border CNECs will be considered using the grid model from the 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 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.

[13] https://www.elia.be/en/news/press-releases/2021/06/20210625_elia-publishes-its-adequacy-and-flexibility-study-for-the-period-2022-2032

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.

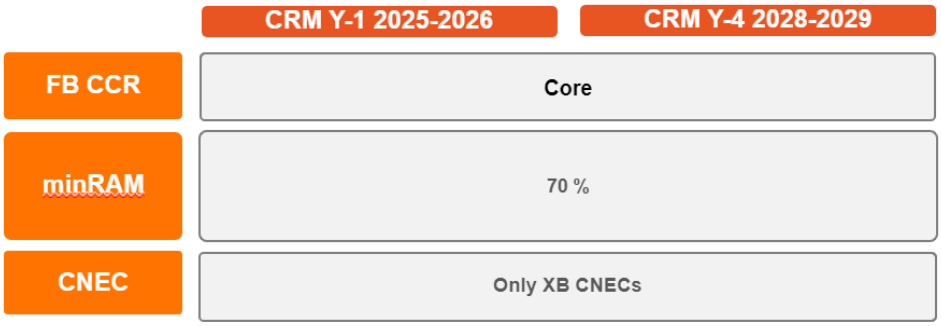

Figure 15: Overview of assumptions for the Core flow based domain creation

2.1.5 Other countries data

In the framework of the CRM calibration, the same perimeter as used for the Adequacy and Flexibility study 2022-32 will be taken into account and is represented in Figure 16Figure 16. It includes **twenty-eight countries**.

- 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 16: EU simulation area

The most recent European dataset available is the ERAA 22 data. Unfortunately only the 2024, 2025, 2027 and 2030 time horizons were made publicly available by ENTSO-E. A simulation was performed for years 2025, 2027 and 2030.

In the CRM calibration, the ERAA22 dataset is used as an initial dataset but updated with the latest public information available for neighboring countries. The updates made compared to the ERAA22 data can be consulted in the Excel file (section 5).

2.1.5.1 Overview of the updates for neighboring countries

Table 7 and Table 8 present the main updates proposed for the auctions Y-1 DY2025-26 and Y-4 DY2028-29 compared to ERAA22 data, taking into account updates for the total yearly consumption as well as some technologies, including coal/lignite, wind onshore, wind offshore and solar. For those categories, significant updates are considered based on information derived from recent national studies and ambitions. If no value is mentioned, it is assumed that the value will be directly derived from ERAA22 data. It is important to note that the data for the ERAA22 are only published for 2025 and 2030 by ENTSO-E and that therefore a linear interpolation was used to calculate values between these reference years. The sources of the update per country are listed in the Table 9.

2025-2026	France	Germany	Netherlands	United Kingdom	Spain	Italy	Poland	Denmark
Demand [TWh]	480	574	124	295	259	329	167	41
Onshore Wind [GW]	25	77	10	20	37	14	11	6
Offshore Wind [GW]	2	11	6	23	0	3	0,6	3
Solar [GW]	24	108	34	21	34	43	20	8
Coal [GW]	1,1	25,1	2,7	0,0	0,0	0,5	21	0,4
Nuclear [GW]	62,9	0,0	0,5	5,9	7,1	0,0	0,0	0,0

Table 7 : Updates for neighboring countries based on latest available information for Delivery-Period 2025-26

2028-2029	France	Germany	Netherlands	United Kingdom	Spain	Italy	Poland	Denmark
Demand [TWh]	506	619	141	316	261	342	178	50
Onshore Wind [GW]	27	99	11	27	45	17	11	7
Offshore Wind [GW]	3	15	12	36	0	6	6	5
Solar [GW]	40	172	43	29	50	62	25	15
Coal [GW]	0,0	7	2,7	0,0	0,0	0,0	20	0,4
Nuclear [GW]	62,9	0,0	0,5	4,4	5,1	0,0	0,0	0,0

Table 8 : Updates for neighboring countries based on latest available information for Delivery year 2028-29

Country	Main sources used to update ERAA 22 data
	➢ Futurs Energétiques (October 2021)[14] ➢ Public consultation for the next “Bilan Prévisionnel” (March 2023)[15] ➢ Macron’s announcement from February 2022 (lower investments in onshore wind* + nuclear extension**)[16]
	➢ Easter package (April 2022)[17] ➢ NEP 2023, scenario from 2037 (January 2023)[18]
	➢ Monitoring leveringszekerheid 2022 (TenneT, January 2023)[19]

[14] https://www.rte-france.com/analyses-tendances-et-prospectives/bilan-previsionnel-2050-futurs-energetiques
[15] https://www.rte-france.com/analyses-tendances-et-prospectives/les-bilans-previsionnels#Lesdocuments
[16] https://www.elysee.fr/emmanuel-macron/2022/02/10/reprendre-en-main-notre-destin-energetique
[17] https://www.bmwk.de/Redaktion/EN/Downloads/Energy/0406_ueberblickspapier_osterpaket_en.pdf?__blob=publicationFile&v=5
[18] https://www.netzentwicklungsplan.de/nep-aktuell/netzentwicklungsplan-20372045-2023
[19] https://www.tennet.eu/nl/nieuws/monitoring-leveringszekerheid-2022

	➢ Unit-by-unit analysis for nuclear ➢ Future Energy Scenarios (July 2022)[20], Consumer Transformation scenario ➢ EDF announcement of nuclear extension[21]
	➢ Spanish Roadmap ○ Hoja de Ruta para el desarrollo de la Eólica Marina y de las Energías del Mar[22] ○ Hoja de Ruta del Autoconsumo[23] ○ El Gobierno aprueba la Estrategia de Almacenamiento Energético, clave para garantizar la seguridad del suministro y precios más bajos de la energía[24] ➢ Available data from Red Electrica ○ Estado del acceso y conexión de la generación renovable eólica y solar fotovoltaica[25]
	➢ DDS2022 (Terna): «Documento di descrizione degli scenari 2022»[26]
	➢ Energy Policy of Poland until 2040 (EEP2040)[27] (February 2021) ➢ Latest trends (solar, onshore wind), press articles
	➢ Analyseforudsætninger til Energinet[28] (September 2022)

Table 9 : Sources used to update ERAA 22 data

[20] https://www.nationalgrideso.com/future-energy/future-energy-scenarios/documents
[21] https://www.edfenergy.com/media-centre/news-releases/edf-confirms-plans-keep-turbines-turning-heysham-1-and-hartlepool-power
[22] https://www.miteco.gob.es/es/ministerio/planes-estrategias/desarrollo-eolica-marina-energias/
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[25] https://www.ree.es/es/clientes/datos-acumulados-generacion-renovable
[26] https://download.terna.it/terna/Documento_Descrizione_Scenari_2022_8da74044f6ee28d.pdf
[27] https://www.gov.pl/web/climate/energy-policy-of-poland-until-2040-epp2040#:~:text=The%20EPP2040%20responds%20to%20the,national%20economy%20and%20industrial%20degradation.
[28] https://ens.dk/service/fremskrivninger-analyser-modeller/analyseforudsaetninger-til-energinet

Note that different sensitivities are proposed on French nuclear availability (see §2.2.1) and GB nuclear availability (see §2.2.2).

2.1.6 Climate years

Regarding climatic years, Elia will use the 'forward looking' climate database developed by Météo-France and also used by RTE in its adequacy assessment. This methodology is detailed in the Adequacy & Flexiblity study 2021 and as part of the public consultation for the Adequacy and Flexibility study 2023**Error! Bookmark not defined.**.

Such approach is fully in-line with the requirements of the adopted ERAA methodology which 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 only be 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 CRM calibration report).

It is also worth noting that the latest European adequacy study on which such calibration report should be based (ERAA22) is still based on the previous PECD containing more than 30 historical climate years.

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.

In the base case presented here, the prices are calculated as an interpolation between the latest forward prices on 28/02/2023 and the price forecasted for 2030 in the World Energy Outlook of 2022[29], expressed in €2022.

The prices include the fuel cost for oil, gas and coal, expressed in € 2022/MWh, and the CO_2 cost, expressed in €2022/tCO_2.

[29] https://www.iea.org/data-and-statistics/data-product/world-energy-outlook-2022-free-dataset

Elia would like to stress the volatile and therefore difficult to forecast nature of fuel and CO_2 prices. Various sources for future fuel prices exist but give a wide range of estimates based on different macro economical and geopolitical assumptions which are inherently uncertain. As such, Elia proposes to update the base case prices if these change significantly for the consultation report and proposes both a high and low price sensitivity for fuel & CO_2 prices for both the Y-1 DY 2025-26 and the Y-4 DY 2028-29 auctions to account for uncertainty in prices.

The proposed fuel and CO_2 prices for the base case of both auctions are presented in Figures Figure 17 andFigure 18 below.

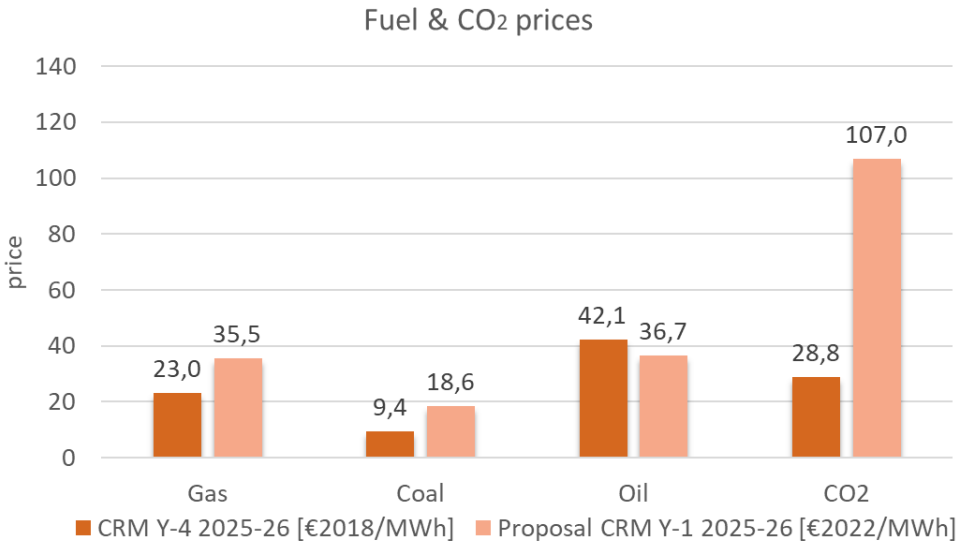

Figure 17: Overview of fuel & CO2 prices proposed for Y-1 DY 2025-26

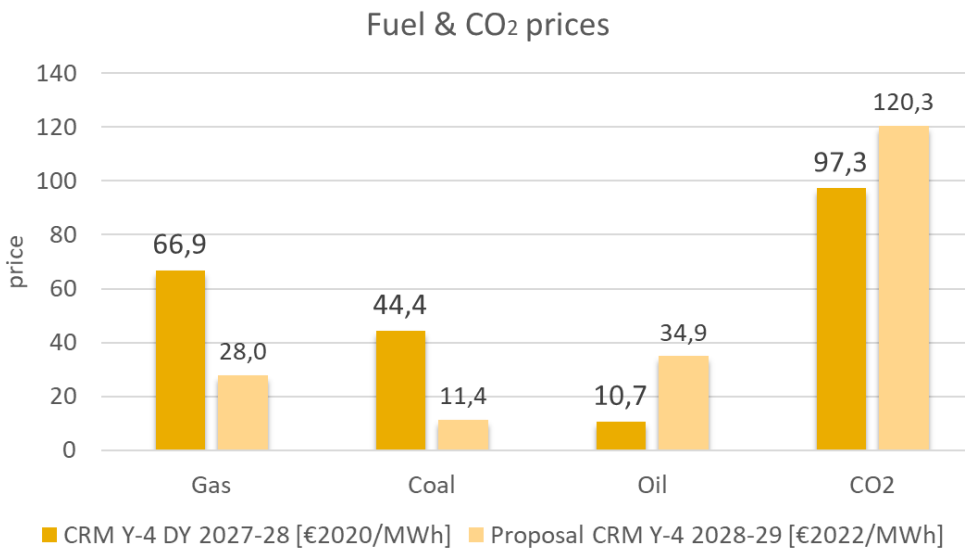

Figure 18: Overview of fuel & CO2 prices proposed for Y-4 DY 2028-29

The 2 proposed sensitivities regarding the economic parameters, with higher and lower fuel prices respectively, will be detailed in §2.2.6

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. Stakeholders are also free to propose additional quantified sensitivities.

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 will then provide a public consultation report integrating the feedback from the stakeholders and recommendations.

Based on this report, the 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 by September 2023.

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

Figure 19 presents the different sensitivities proposal for the Y-1 auction of 2025-26 delivery year. It includes:

- 4 sensitivities on the French nuclear availability;
- 1 sensitivity on the UK nuclear availability;
- 1 sensitivity on the non/strict achievements of the FB CEP rules;
- 1 sensitivity related to export restrictions in Norway;
- 2 sensitivities on fuel & CO2 prices;
- 2 sensitivities on the electricity consumption;
- 2 sensitivities on higher flex (DSR and large-scale batteries) capacity in Belgium;

Figure 19 : Proposed sensitivities menu for the reference scenario of the auction Y-1 DY2025-26

Figure 20 presents the different sensitivities proposed for the Y-4 auction of 2028-29 delivery year. It includes:

- 4 sensitivities on the French nuclear availability;
- 1 sensitivity on TJ closures related to CO2 thresholds.
- 1 sensitivity on the non/strict achievements of the FB CEP rules;
- 1 sensitivity related to export restrictions in Norway;
- 2 sensitivities on fuel & CO2 prices;
- 2 sensitivities on the electricity consumption;
- 2 sensitivities on higher flex (DSR and large-scale batteries) capacity in Belgium;

Figure 20 : Proposed sensitivities menu for the reference scenario of the auction Y-4 DY2028-29

Any feedback on the proposed sensitivities or additional proposals for sensitivities (ideally including sources) are more than welcome and will be dealt with carefully by Elia.

2.2.1 French nuclear availability

As demonstrated in the Adequacy and Flexibility study 2022-32 (Figure 5-11), the availability of French nuclear units can have a strong impact on the Security of Supply of Belgium. Therefore, for both auctions, 4 different sensitivities associated to the French nuclear availability are proposed.

The reasoning behind these sensitivities are historical observations complemented with recent observations on the unavailability of the French nuclear fleet:

- The French nuclear fleet is going through major overhauls to extend the lifetime of its ageing fleet beyond 40 years. Those overhauls will last a decade at least.
- The maintenance calendar was greatly affected by the COVID sanitary restrictions leading to the situation experienced the last 2 winters in France with consequences for the upcoming winters as well.
- In addition, found corrosion defects in some weldings are and will greatly impact the availability of all nuclear reactors in the coming years as they will be undergoing inspections and possible additional maintenances/works[30].
- The nuclear fleet is very vulnerable to generic issues given the same technological conception used in the reactors. A similar situation was already experienced during winter 2016-17.
- RTE expects that the nuclear uncertainty is of about 100 TWh in 2030[31], corresponding to around 11 GW if spread over the year.
- RTE proposes a nuclear generation of 350 TWh from 2025 onwards in the framework of the public consultation of the next 'Bilan Prévisionnel'[32], while the historical generation was above 400 TWh.
- The EDF generation forecasts for the coming years do not match with the sum of unit availability reported on REMIT.

[30] https://www.ouest-france.fr/environnement/nucleaire/nucleaire-edf-recherche-nouvelles-corrosions-sur-ses-reacteurs-une-vague-d-arrets-a-prevoir-8da40d82-8dc2-11ec-a6c9-d7629bbac447

[31] https://assets.rte-france.com/prod/public/2022-06/FE2050%20_Rapport%20complet_14.pdf

[32] https://assets.rte-france.com/prod/public/2023-03/2023-03-01-bilan-previsionnel-2023-consultation-publique.pdf, See section 5.2 & Question 5.9

These sensitivities propose unavailability of the nuclear units in France in addition to the considered maintenance profiles. For the auction Y-1 DY 2025-26, the maintenance profile published according to REMIT is considered as base. For the Y-4 DY 2028-29 auction, the maintenance profile provided by RTE in the context of ERAA 2022 is considered as base.

Determination of the nuclear unavailability for auction Y-1 DY2025-26

The French nuclear unavailability sensitivities for the Y-1 DY2025-26 auction are calculated using a combination of the REMIT data and the yearly EDF generation forecast, such as defined in the framework of the LCT reference scenario. While the REMIT data provides a reference profile, it tends to be overly optimistic [33]. EDF generation forecasts are available for 2023 and 2024[34], but not yet for 2025.

To obtain an availability profile matching with a certain amount of generation for a given year, the REMIT profile is scaled by considering an additional amount of unavailable unit(s). The additional unavailable capacity is obtained by comparing the forecast production based on the REMIT data with the EDF forecast or assumption, and deducing the corresponding capacity, expressed as a number of equivalent units. Figure 21 provides an overview of this calculation. For the sensitivities labeled "French nuclear unavailability" 1, 2, and 3, the three scenarios of EDF generation forecast (high, average, and low) adapted to only consider the winter months, which are critical for ensuring adequacy, are considered. In the last sensitivity, the scenario with the lowest availability published by EDF is considered and the same methodology is applied to the entire year.

[33] https://assets.rte-france.com/prod/public/2022-10/Analyse-passage-hiver-2022-2023-actualisation-18octobre.pdf

[34] https://www.reuters.com/business/energy/edf-forecasts-2024-nuclear-output-rising-315-345-terawatt-hours-2022-09-13/

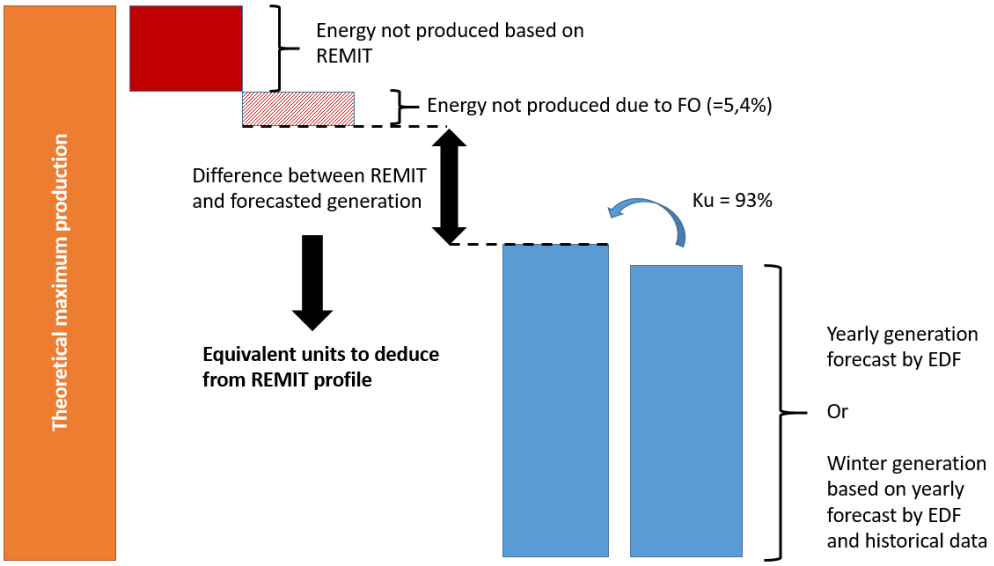

Figure 21 : Description of the methodology to determine the number of unavailable nuclear units

Determination of the nuclear unavailability for auction Y-4 DY2028-29

Regarding the sensitivities associated with the auction Y-4 DY2028-29, a different approach is taken due to the unavailability of EDF's yearly generation forecast. These sensitivities take into account a higher unavailability of nuclear units, resulting in a reduction of 2, 4, 6, or 8 units compared to the availability profiles used under the ERAA 2022 framework.

2.2.2 UK nuclear availability

The EDF recently announced the extension of the Heysham 1 and Hartepool nuclear units[35]. Those units are assumed as available in the dataset of Great Britain although there are some uncertainties on their future availability. Indeed, the extension will require some investments in the plants to guarantee safety and the safety operations will have to be demonstrated to the UK Office for Nuclear Regulation before approval[36]. Since the extension of the plants is pending approval, a sensitivity on the aforementioned units not being extended is relevant.

35 https://www.edfenergy.com/media-centre/news-releases/edf-confirms-plans-keep-turbines-turning-heysham-1-and-hartlepool-power

36 https://news.onr.org.uk/2023/03/edf-announces-operating-life-extensions-for-heysham-1-and-hartlepool/

2.2.3 Flow-based CEP rules

Several reasons can be put forward to justify the addition of a sensitivity on the applied flow-based domains for both the Y-1 DY2025-26 and the Y-4 DY2028-29 auctions.

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[37]). 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. For instance, 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[38]. 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.

[37] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32019R0943&from=EN#d1e2713-54-1
[38] https://www.apg.at/en/Energiezukunft/Strompreiszone

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.

The abovementioned arguments justify the consideration of a sensitivity fixed RAM 70% instead of a minRAM 70% in both the Y-1 DY2025-26 and the Y-4 DY2028-29 auction.

2.2.4 Export restrictions in Norway

Norway is a large exporter of electricity due to its large capacity of hydropower. Norway has recently announced new measures to ensure its security of supply which could impact the export of electricity from Norway when there is an increased risk to security of supply, for instance due to low hydro reservoir levels[39]. The measures were taken after the summer of 2022 saw hydro reservoir levels drop to very low values due to low precipitation and high export. The announced measures could result in export restrictions if a similar situation occurs.

As an important electricity exporter to mainly the UK and Germany, possible export restrictions in Norway could impact the cross-border contribution of foreign capacities to the security of supply in Belgium as well.

2.2.5 Uncertainty on Belgian Turbojet units related to the new CO_2 thresholds

In this sensitivity, it is assumed that all turbojets in Belgium will close due to the new CO_2 thresholds. This sensitivity is only applicable on the Y-4 DY2028-29 auction and would results in 140 MW not being available in the Belgian electricity market.

2.2.6 Uncertainties on prices

The high prices and volatility observed on the energy markets in recent years make it very difficult to provide accurate estimates of fuel prices for the Y-1 DY2025-26 and especially Y-4 DY2028-29. The current uncertain geopolitical and economic context could impact fuel prices both upwards and downwards. Further sanctions or cut-offs of energy supply could push prices up while an economic downturn could push prices down.

As such, Elia proposes both a high and a low prices sensitivity for gas and coal. Oil prices are less impacting for the electricity market and CO_2 prices are very much driven by EU policies rather than geopolitics.

[39] https://watt-logic.com/2023/01/30/norway-restricts-electricity-exports/

There are many available sources for estimates of future gas and coal prices giving both high and low prices. However, each of these estimates is based on lots of assumptions over a long time-frame and it is therefore difficult to assess the correctness of these estimates. Elia therefore proposes to simply use half the prices of the base case for the low prices sensitivity and double the base case for the high prices sensitivity. An overview of the proposed price sensitivity is given in the Figures Figure 22 and Figure 23 below.

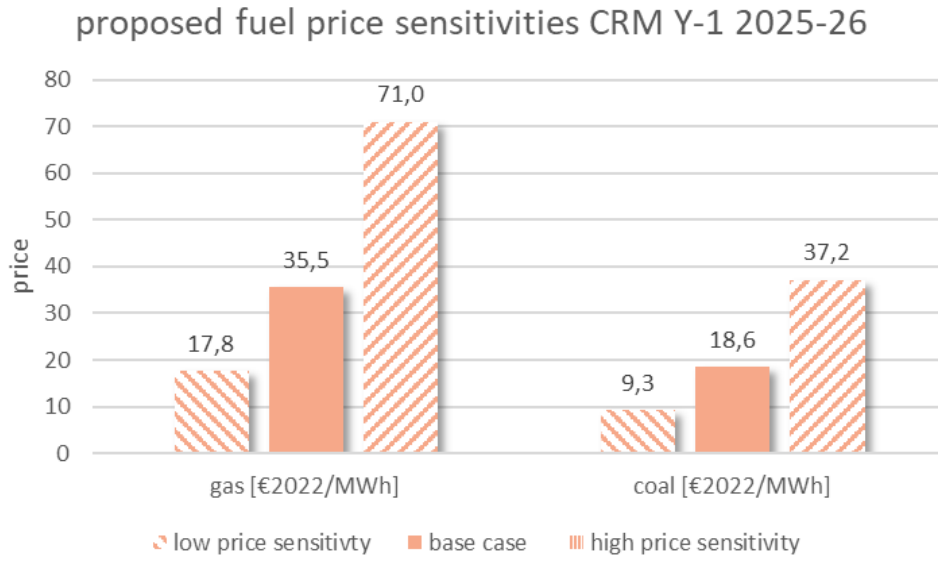

Figure 22: Proposed fuel price sensitivities for Y-1 2025-26

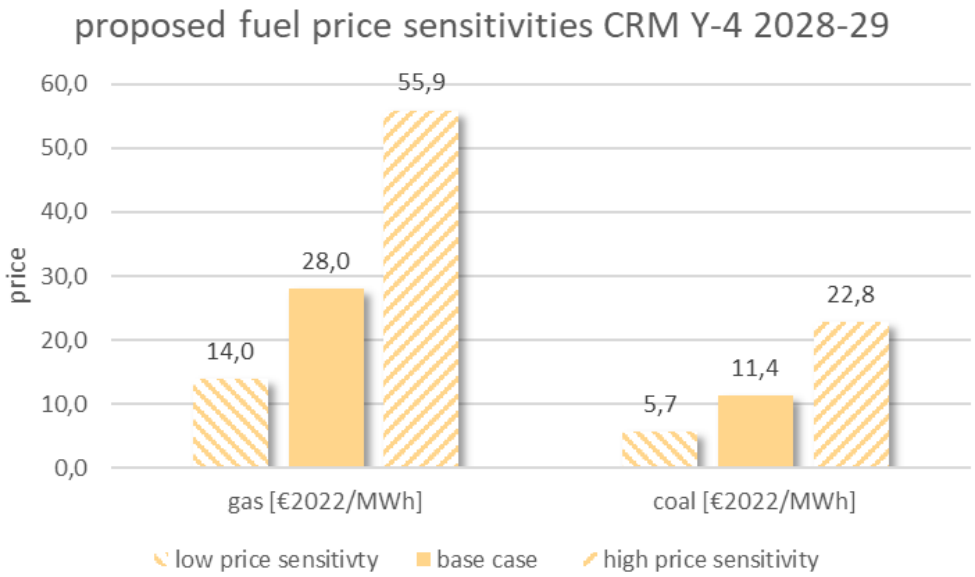

Figure 23: Proposed fuel price sensitivities for Y-4 2028-29

2.2.7 Uncertainties on demand

Additional electrification and economic developments are the main drivers for the demand for electricity in Belgium. Both economic developments and the electrification rate could have both an upward and a downward impact on the demand for electricity in both delivery year 2025-26 and especially 2028-29.

Cases could be made for both a faster and a slower electrification rate in Belgium. Recent years have seen quicker than expected uptake of technologies such as EV's, heat-pumps and home batteries driven by both market dynamics and government support. The high fuel prices have incentivized a shift towards more electrification in industry as well[40]. The Inflation Reduction Act signed in the US and a possible European response will draw additional investments in clean technologies such as batteries and heat-pumps which should increase production and innovation and as such further drive down prices in the US as well as in Europe[41].

On the other hand, there are several risks to the supply side which could slow the electrification rate in Belgium. Electrification is occurring across the world and requires vast amounts of raw materials and complex supply chains. The growth in demand for raw materials needed for the electrification could outpace the supply. Trade barriers could disrupt the complex world-wide supply chains.

The economic growth for Belgium for future years is another factor which could influence the electricity either upward or downwards compared to the base case. The persistently high fuel prices, inflation and rising interests have a profound impact on the Belgian economy as was observed in 2022. Fuel prices remain historically high and could remain so in the near future, driving up costs for both households and industry. Persisting high inflation would further drive up interest rates and put downward pressure on economic growth.

The upward and downward uncertainty regarding the demand for electricity justifies both a higher and a lower demand sensitivity compared to the base case. Since the base demand for both the Y-1 DY2025-26 and the Y-4 DY2028-29 auction still needs to be recalculated based on the latest economic assumptions and results of the public consultation, Elia proposes to calculate the high and low demand sensitivities based on this input as well. This allows Elia to provide more accurate estimates which will take into account the economic data which will be published by the Federal Planning Bureau in June 2023.

[40] https://www.iea.org/commentaries/global-heat-pump-sales-continue-double-digit-growth
[41] https://www.economist.com/europe/2023/02/09/europe-should-not-respond-to-americas-subsidies-binge-with-its-own-blunders

2.2.8 Sensitivities on increased flexibility

The existing capacities proposed for both batteries and DSR are the minimal capacities which Elia assumes will be in the market for the respective delivery years based on concrete project plans and currently existing capacities. Faster than expected electrification, however, could lead to more installation of DSR and large-scale battery capacities. As such Elia proposes 1 sensitivity where 50% of the potential additional capacity of DSR is considered as existing and 1 sensitivity where 50% of the potential additional capacity of large-scale batteries is considered as existing for both the Y-1 DY2025-26 and the Y-4 DY2028-29 auction.

3 Other parameters

This chapter describes the additional parameters that have to be submitted to public consultation according to article 5, §2, 3° to 5° of the Royal Decree, but that are not fixed by the Minister. This includes the sources of scenarios for periods after the Delivery year 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.

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-1 DY2025-26 and Y-4 DY2028-29 auctions.

Once the reference scenario for each auction 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-1 DY2025-26 and Y-4 DY2028-29 auctions.

The proposed preselected capacity types are presented in the Excel file (section 8). The proposed preselected capacity types are different for the Y-1 DY2025-26 and the Y-4 DY2028-29 auctions given that the lead time between the moment of auction and the delivery year is different for both auctions.

As visible in table Table 10 the proposed preselected capacity types for the Y-1 DY2025-26 auction are batteries and DSR. For the Y-4 DY2028-29 auction capacity types also includes the categories semi-baseload and peakers on top of batteries and DSR.

	Y-1 DY2025-26	Y-1 DY2028-29
Semi-baseload	No	Yes
Peakers	No	Yes
Batteries	Yes	Yes
DSR	Yes	Yes

Table 10: overview of the proposed preselected capacity types for each auction

- **Volume**
  For DSR, 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. For the other categories, incremental capacity of the reference technology (new CCGT, new OCGT, and new large-scale batteries) is added step by step. In addition a maximum potential is defined for batteries and DSR as explained in sub-section 2.1.1.4 and 2.1.2.3.

- **Marginal Price**
  For demand-side response, the marginal price is defined based on a weighted average of the existing demand-side response categories. No marginal price is associated to large-scale batteries. For the remaining categories, the marginal price will be calculated based on the parameters associated with a new entrant of each technology.

Note that the data proposed in the framework of Y-1 DY2025-26 and the Y-4 DY2028-29 auctions also includes CAPEX [€2022/kW], FOM [€2022/kW] and economic lifetime [years]. This data is in line with the Adequacy and Flexibility study 2023.

As long as the security of supply criteria is not reached, additional capacity from one of the preselected 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 is 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 used for post-Delivery years

This section details the parameters included in the scope of this public consultation towards the scenarios for the periods after the delivery years of both auctions 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 year 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 year scenarios are presented in the Excel file (section 9).

Y-1 auction – DY 2025-26

For 2026, 2030 and 2032 and 2034, the proposal is to take the upcoming Adequacy and Flexibility study of 2023 as source for the targeted year. For 2028 the proposal is to use the CRM Y-4 DY 2028-29. For years after 2034, it is also proposed to use the Adequacy and Flexibility study of 2023 using the last year simulated, being 2034 as a proxy in order to keep consistency with the other time horizons and to use recent data. For each of these time horizons in the Adequacy and Flexibility study, a scenario as close as possible to the reference scenario of the 2025-2026 delivery year defined by the Minister will be selected.

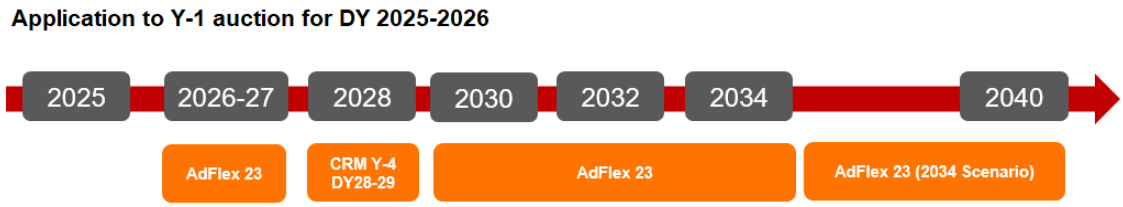

Figure 24: Selection of the scenarios and sources post-Delivery Year for the market revenues calculation in Y-1 DY 2025-26

Y-4 auction – DY 2028-29

For 2030, 2032 and 2034, the proposal is to take the upcoming Adequacy and Flexibility study of 2023 as source for the targeted year. For years after 2034, it is also proposed to use the Adequacy and Flexibility study of 2023 using the last year simulated, being 2034 as a proxy in order to keep consistency with the other time horizons and to use recent data. For each of these time horizons in the Adequacy and Flexibility study, a scenario as close as possible to the reference scenario of the 2028-2029 delivery year defined by the Minister will be selected.

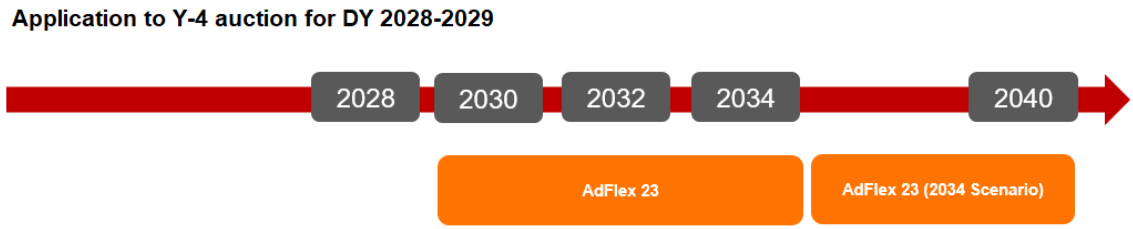

Figure 25: Selection of the scenarios and sources post-Delivery Year for the market revenues calculation in Y-4 DY 2028-29

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 described 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 year 2028-2029 and the Y-1 Auction for Delivery Year 2025-2026.

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 year 2027-2028, 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)[42] followed by a peer review realized by AFRY (2020) and updated again in 2022, as well as Elia's assessment taking into account the remarks of the public consultation done by Elia on the same matter in view of Delivery year 2027-2028, 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 delivery year 2025-2026 (Y-1 auction) and 2028-2029 (Y-4 auction). 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 2022 as well as on the feedback received from market parties during the public consultation, Elia considers that the shortlist of technologies that was initially defined for the calibration of the IPC for the Delivery year 2025-26 (including PSP) is still relevant and should apply for the calibration of the IPC for the Delivery year 2028-29 as well. Recent evolutions on both Belgian and international energy markets have caused market parties to request a general update, as also foreseen according to article 17 of the Royal Decree of the Fichtner study. Elia recognizes this need and aims to launch a new study with an external expert soon. The numbers included in the excel come from the most recent update of the AFRY study and serve as a first indication but will be updated based on the input received from the external consultant realizing the study. Likewise, the update of the study could also result in a revision of the shortlisted technologies. In particular, it is not unlikely that RES technologies will be added. Be that as it may, due to their severe deratings these technologies are not expected to have an impact on the calibrated IPC.

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.

[42] 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.

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 year 2025-2026, 2026-2027 and 2027-2028, 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) and updated in 2022. As mentioned above, Elia aims to launch an update of these studies soon, which includes a revision of the cost components that are taken into account. 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 intra-year maintenance and a provision for major overhauls that do not necessarily take place on a yearly basis.

The variable operation and maintenance (O&M) costs are based on a study performed by the Joint Research Centre of the European Commission for CCGT and OCGT units, and from the ENTSO-E database for Turbojets. They are included in section 10.1 where they have been adapted for inflation.

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 to be 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 *Demand Side 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 *Demand Side Response* technology and is derived from the historical data published on the Elia website regarding contracted volumes and prices for Strategic Demand Reserves (SDR).[43] Considering the average activation price for SDR for winter

[43] https://www.elia.be/en/suppliers/supplier/energy-purchases/strategic-reserve-volume-and-prices

period 2015-2016[44] 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[45]:

$$\frac{0{,}82€}{kWh} * 0{,}25h * \frac{1}{X}.$$

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 still expected to bethe dominant technology to provide FCR towards the relevant Delivery year, i.e. by respectively November 2025 and 2028. 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".*

[44] Winter 2015-2016 is still the most recent winter period in which SDR was contracted.
[45] This value was originally expressed in €2015 and equaled 0,74 €/kWh. The result has been indexed to €2022.

- ***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 *Demand Side 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 in the future. 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 *Demand Side 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.

Based on discussions taking place in several Working Group Adequacy, Elia reminds that it has to base itself on the methodology laid down in the RD Methodology to perform such estimation. Nevertheless, Elia is still investigating how to improve the estimation of such net balancing revenues. Elia would welcome any input/suggestion from market parties on the way to achieve such improvement of this estimation.

Finally, Elia would like to highlight that potential conclusions from the update of the study of the above-mentioned consultant could be considered as well in this exercise if they are deemed relevant.

4 Appendix A: consultation on potential improvements to the DSR volume estimation method applied by E-CUBE

4.1 Challenges with the current DSR estimation method

Quantitatively estimating the volume of existing DSR in Belgium is a difficult exercise. A variety of industrial processes with different cost structures provide DSR and there is only a limited amount of public information available based on which the DSR volume could be determined.

E-CUBE established a quantitative method to estimate the existing DSR volume in Belgium in 2017 in discussions with relevant stakeholders and updated the methodology in 2020. The method provides a transparent, quantitative approach to determine the volume of DSR offered in market bids on Belgian NEMOs.

In short, the method consists of counting NEMO bids above a certain threshold as DSR. In the past, 2 thresholds were applied above which bids were considered as DSR, namely 150 €/MWh and 500 €/MWh. The method developed by E-CUBE was established under 2 assumptions:

1. That DSR bids are more expensive than generation bids.
2. That there should be no generation bids above these thresholds.

These assumptions were considered robust under the known market conditions on the Belgian electricity market. However, recent market developments challenge the assumptions under which the method was established.

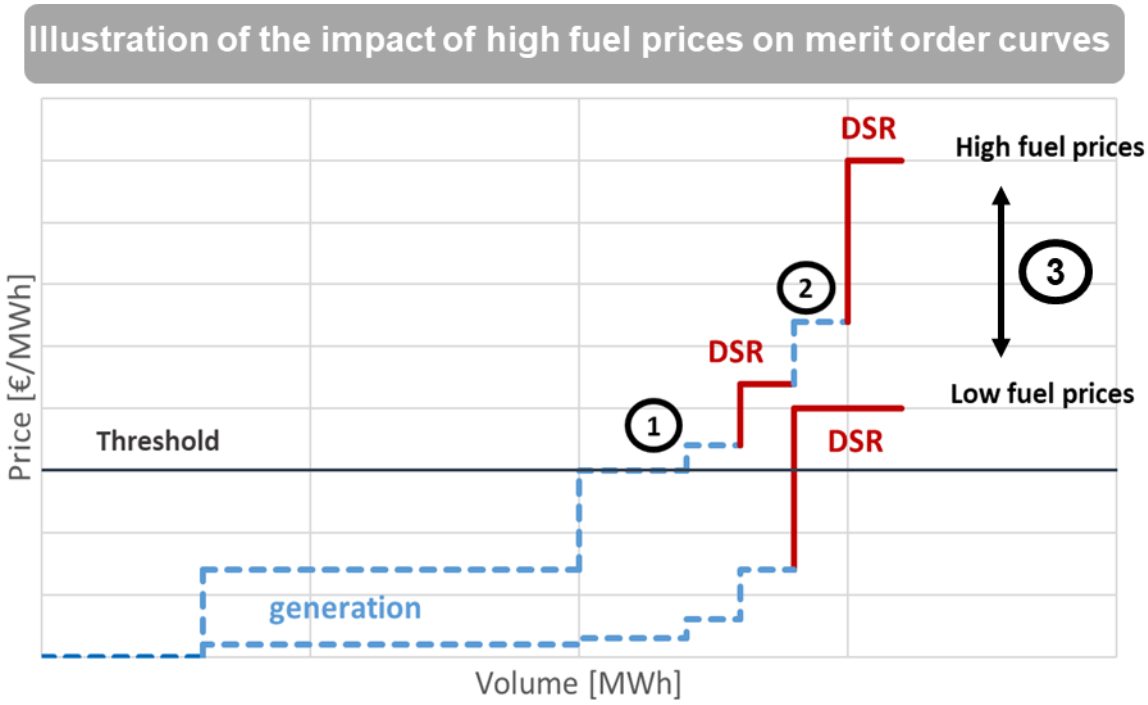

Figure 26: illustration of the impact of high fuel prices on merit order curves

Figure 26 graphically illustrates the impact of the high fuel prices, as recently observed, on a theoretical merit order curve.

1. The cost of both DSR and generation increases and can be above the defined thresholds. By having generation capacity with a price above the defined thresholds, this generation capacity can be incorrectly counted as DSR. This could be fixed by calibrating the price thresholds to take into account price increases.

2. The price of some DSR capacity may be less impacted than some generation capacity and therefore a shift in the merit order between technologies can be observed. This can cause generation bids to have a higher price than DSR. This means that even with a price threshold at the price of the cheapest DSR capacity, some generation capacity would be counted as DSR capacity. This could be fixed by identifying generation capacity with prices above the threshold.

3. Price volatility on the electricity market has increased together with the general price increase. Fixed thresholds don't capture the impact of this price volatility.

These developments mean that the assumptions on which the methodology was established are not always valid anymore and create room for potential improvements. However, potential improvements should still be quantitative and based on NEMO bids.

4.2 Improvements to make to the DSR estimation method

As explained in the previous paragraph, in a market with high fuel prices and volatility, the assumptions under which the DSR estimation method was established are no longer always valid. This creates room for potential improvements to the established method in order to still be applicable in a market with high fuel prices and volatility where some generation capacity can be more expensive than the applied thresholds and more expensive than some DSR capacity.

Elia and E-CUBE therefore propose potential improvements to the DSR volume estimation method. Firstly, a calibrated price threshold could be applied to capture price changes. Secondly, a method could be established to avoid overestimating or underestimation of the DSR volume.

The list of potential improvements should be considered as non-exhaustive and Elia and E-CUBE welcome suggestions regarding the proposed options as well as other proposals by stakeholders. However, Elia and E-CUBE would like to stress that changes to the method should still be in line with the requirements of a quantitative methods based on NEMO bids.

Stakeholders are invited to provide feedback on the proposed improvements and provide additional improvements while keeping a method that is quantitative and based on NEMO bids.

4.2.1 Using a calibrated price threshold

The fixed price thresholds to calculate the DSR volume are no longer valid if the price of some generation capacity rises above that threshold. In that case, some generation capacity can incorrectly be counted as DSR. In order to avoid this, the price threshold should be calibrated to take into account changes in DSR and generation costs. In addition, the price threshold should be calibrated on shorter time intervals to take into account price fluctuations and be relevant for each time interval. The appropriate length of the time interval should be determined.

Elia and E-Cube propose several options to calibrate the price threshold. These should be considered as first proposals and all need to be further investigated.

Calibration on the expected DSR marginal cost

A correlation between the marginal cost of DSR and fuel and CO2 prices could be estimated based on historical data from before the price increase. If the correlation is strong enough, it could then be applied on to determine new price thresholds in a dynamic manner.

Figure 27 provides a graphic illustration of how the changes in DSR price could be determined based on historic data from before the price and volatility increase.

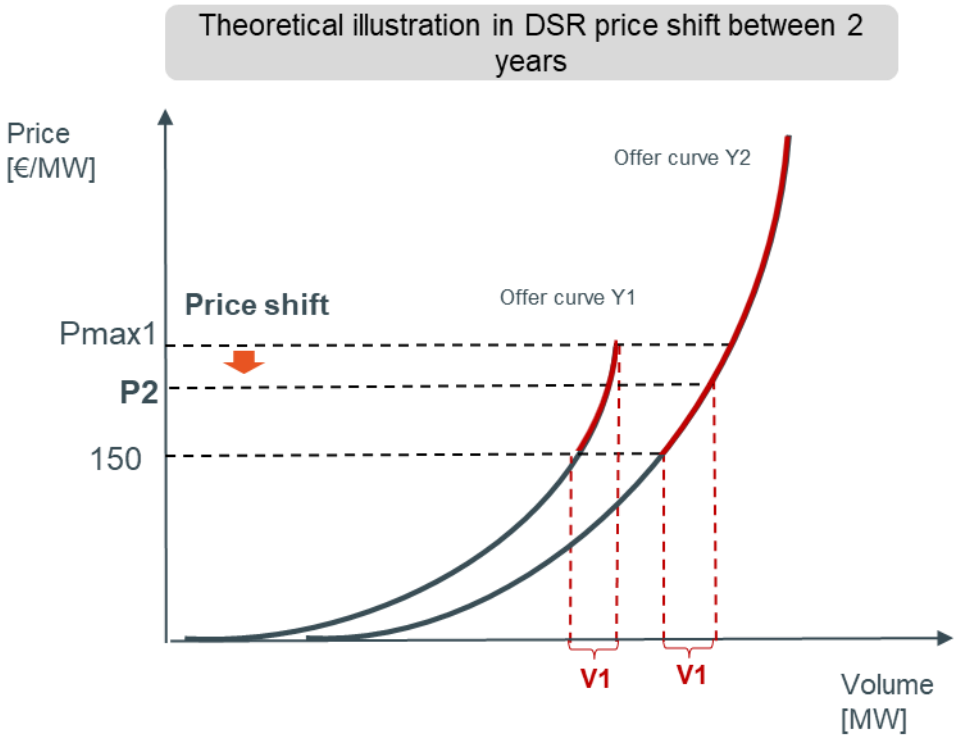

Figure 27: Graphic illustration of how to determine changes in DSR price

Here V1 is the DSR volume that was found in a certain year Y1 using for example the 150 €/MWh threshold. Pmax1 is the maximum price found for DSR in that same year.

In a second year Y2, the offer curve has shifted, there is more volume of both generation and DSR available on the market and the costs have changed. Using the same threshold a new volume of DSR is determined. To capture the price change of DSR, it should be determined at which price cap P2 the same volume V1 as in Y1 would be found in Y2. The difference between Pmax1 and P2 is the price shift of the DSR volume V1 between Y1 and Y2 and can be interpreted as the historic difference in marginal cost of DSR.

In both years it is assumed that the base assumptions of the DSR estimation method are valid and that the DSR volume is determined correctly.

The calculated difference in marginal cost of DSR could then be combined with fuel and CO2 price data to determine potential statistically robust relationship which could be applied for future price threshold calibrations. There could still be generation bids above the calibrated threshold and a method to avoid this overestimation should be established, potential methods to do this are further detail in 4.2.2.

Elia and E-CUBE are of the opinion that this is the most promising method to calibrate the price threshold while still requiring further investigation.

Calibration on the highest generation marginal cost

Based on fuel and CO2 costs, it is possible to estimate the marginal cost of the most expensive generation bid in each time interval. All bids above this price could then be considered as DSR. This could create the risk that DSR bids under this price are considered as generation and therefore the DSR volume would be underestimated.

Calibration on a percentile of the electricity price

A simple method to calibrate the price threshold in each time interval would be to use a percentile of the electricity price such as the P90. This would be a simple method but create the risk of over or underestimating the DSR volume while not knowing if an over or under estimation is occurring and this would therefore be hard to correct. Suggestions by stakeholders to do so are welcomed.

4.2.2 Avoiding miscounting of generation as DSR

If the price threshold is calibrated on the lowest DSR marginal cost, it can be assumed that all DSR bids would correctly be considered as DSR. However, there could be generation bids above the price threshold which would be considered as DSR and as such create an overestimation of the DSR volume

If the price threshold is calibrated above the lowest DSR marginal cost, some DSR bids would not be considered and the DSR volume could be underestimated. Correcting for this more difficult since no information on the cost structure of individual DSR. Elia welcomes suggestions by stakeholders on how to do so.

Filtering out the generation capacity with a marginal cost above the threshold

The marginal cost of generation capacity can be calculated on fuel and CO2 prices as is done for the Antares modelling of generation units. In each time interval, the marginal cost of the different generation types can be calculated and the sum of the generation capacities that have a higher marginal cost than the price threshold could be removed from the total bid volume above the price threshold.

Applying a fixed percentage

Applying a fixed percentage of over/under estimation could be a simple solution but has severe limitations. The percentage over or under estimation could be calculated based by comparing the over or under estimation that a calibrated threshold would create on historic data. This percentage could then be applied for other years.

Problems with this method are that over/under estimation would be considered fixed while this could change from year to year and the percentage would be calculated under the assumptions that no over/under estimation occurred in the DSR estimation exercises performed in the past.

4.2.3 Other changes

Elia and E-CUBE further propose to use only 1 threshold for future DSR volume estimations rather than 2 in the past. In addition Elia and E-CUBE propose not to consider complex bids anymore as these provide little to no added value in the DSR volume estimation.

4.3 Conclusion

The listed potential improvements are still under investigation and should not be considered as final. These are proposals based on first discussions. Stakeholders are welcomed to provide additional feedback on these options as well as other options. Further discussions between Elia, E-CUBE and stakeholders can take place based on the inputs received during this public consultation.

The goal of the proposed improvements is to keep a quantitative method based on NEMO bids as was established in discussions with stakeholders in 2017.

5 Appendix B: Public consultation on data used for the assessment of the total electricity consumption for the CRM

Scope of this document

This document accompanies the Excel file containing the data used to compute the evolution of the total electricity demand in Belgium in the context of the CRM auctions. This computation has been performed by Climact in 2022 based on the Pathways Explorer model and macro-economic projections from the Federal Planning Bureau [46].

The present document aims at giving context about the data and methodology used for this computation.

1. Methodology reminder

The complete description of the methodology is out of the scope of the present document and can be found on Elia's website[47].

An excerpt of this methodology is shown below.

> The Pathways Explorer is a multi-energy model that allows to compute the energy use due to the activity in the different considered sectors: transport, industry, residential and tertiary buildings, agriculture, land-use and energy production;
>
> The goal of the tool is to determine how energy use is going to evolve up to 2050 depending on future technological and behavioral/societal evolutions;
>
> These evolutions are represented by levers specific to each sector, e.g. the electrification of vehicles for the transport sector or the switch from fossil fuels to biomass in building heating systems. These levers are thus the main parameters driving the evolution of energy consumption and in each sector. A lever can take several different values representing different levels of decarbonization ambition. For example, the fuel switch lever in the building sector can be set to a low value, leaving the fuel mix of heating bodies unchanged, or a very high value where there is a strong uptake of gaseous and liquid biomass;
>
> It aims at modelling interactions between various sectors, e.g. between transport and industry: if the road passenger transport demand increases more vehicles need to be produced by the industry sector (in Belgium or abroad);
>
> The model is sequential and does not perform any kind of cost optimization.

[46] Bureau Fédéral du Plan, Perspectives économiques 2022-2027, Juin 2022

[47] https://www.elia.be/-/media/project/elia/elia-site/public-consultations/2020/20200603_total-electricity-demand-forecasting_en.pdf

To assess the evolution of the total electricity demand, the Pathways Explorer is used in combination with macro-economic projections from the Federal Planning Bureau.

In this methodology, we (i) identify which macro-economic variables influence the energy consumption the most and (ii) make the link between these macro-economic variables and Pathways Explorer variables (see Figure 28 below).

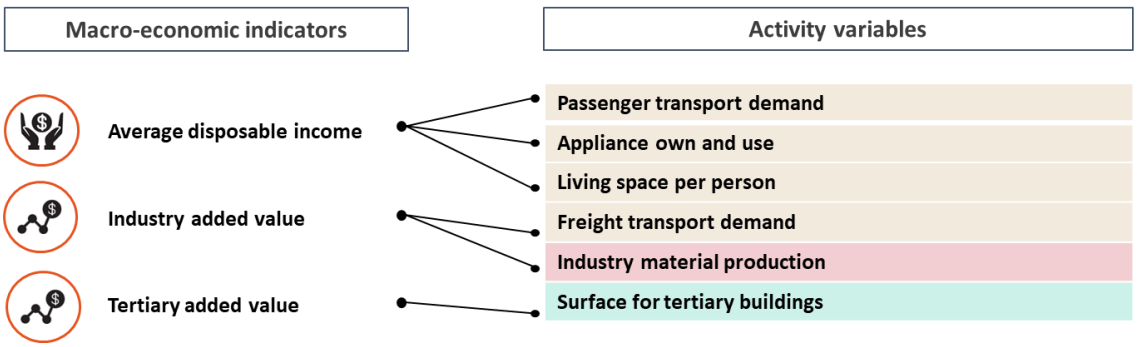

Figure 28 Links between macro-economic and Pathways Explorer variables

This allows to drive the evolution of some of the model variables based on projections of macro-economic variables determined by the Federal Planning Bureau.

To quantify this link between a macro-economic variable and a Pathways Explorer variable, we perform a linear regression between their historical values as illustrated on Figure 29. The parameters of the linear regression are then used to build a projection of the Pathways Explorer variable based on the available projection for the considered macro-economic indicator.

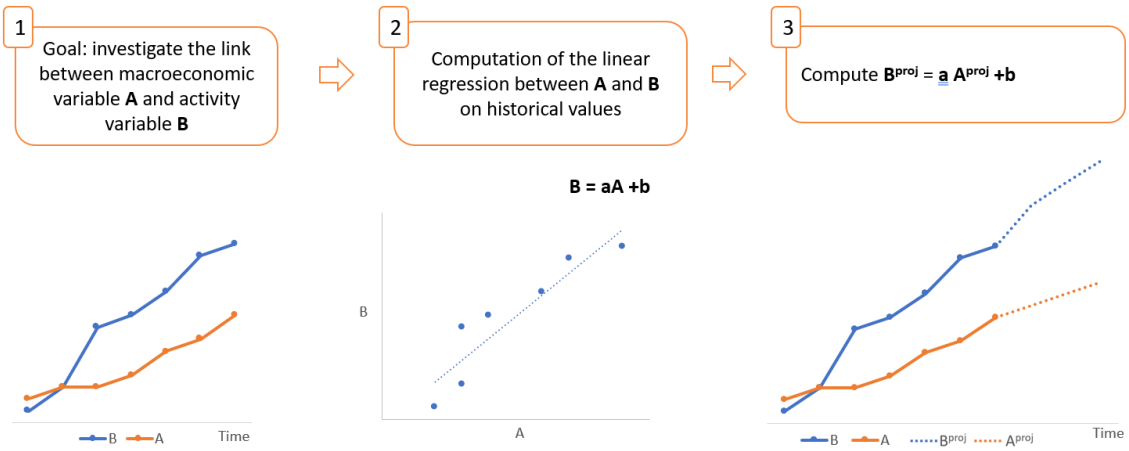

Figure 29: Linear regression method to assess the link between two variables
Source: Climact

For other Pathways Explorer variables not affected by macro-economic variables, the level of levers influencing them has been chosen to reflect expected evolutions as best as possible (e.g., renovation rate for coming years, based on current context and expected evolutions).

2. Specific assumptions

Industry

For the 2022 exercise, a significant added value growth was foreseen by the Federal Planning Bureau for the "intermediary goods" category[48], which is mapped to the following industry sectors in the Pathways Explorer: lime, chemicals, glass, ceramic, cement, steel, aluminium and non-ferrous metals. As mentioned in the same source, this growth is mainly due to the role of the pharmaceutical sector in Belgium during the Covid-19 pandemic.

Yet, the pharmaceutical sector was only accounting for ~3% of the broader chemical sector electricity consumption in 2015[49], which led to the assumption that the added value growth in the "intermediary goods" sector was entirely due to the pharmaceutical sector which has a neglectable electricity consumption and that the resulting electricity growth for the abovementioned industry sectors was also neglectable. Hence, for these sectors, the material output (in kt) has been considered stable over the 2022-2028 period.

The Federal Planning Bureau publication does not provide growth rates for the year 2028. To avoid the risk of overestimating the industrial electricity consumption, the

[48] Bureau Fédéral du Plan, Perspectives économiques 2022-2027, Juin 2022
[49] JRC-IDEES - Integrated Database of the European Energy System (2000-2015)

choice has been made to consider a stagnating industry output between 2027 and 2028, hence a 0% growth rates for all industry sectors.

Buildings

The goal is to reflect a business-as-usual situation in terms of renovation rates. Therefore, the 'Builidings renovation rate' lever is set on 1, which corresponds to the lowest possible value, i.e. a 1% yearly renovation rate.

Regarding the evolution of heating, Elia provides a trajectory of additional electrification attributable to heat pumps. The level of the "Electrification of space and water heating' lever is chosen to best fit to this trajectory. The level 2 is chosen as is the one for which the corresponding electricity consumption for heat pumps best fits Elia trajectory.

3. How to to read the data file

The data presented in the accompanying excel document is structured as shown on Table 1. In this document, there are two types of data points.

1. External values: directly used in the Pathways Explorer model. For these data, the source is indicated
2. Computed values: these values are computed within the Pathways Explorer model based on other variable values. For these values, the driver influencing them is indicated.

Some of the external values are directly provided by Elia: the electricity consumption from electric vehicles and heat pumps. These are computed by Elia based on public consultation inputs.