CONSULTATION REPORT

Report on the public consultation regarding the adequacy and flexibility study 2023-2034

FINAL VERSION

17/02/2022

Contents

1. Introduction

Elia organized a public consultation from 28/10/2022 to 28/11/2022 on the input data and assumptions, as well as on the methodology that will be used for the study regarding the adequacy and flexibility needs of the Belgian power system for the 2024-2034 time horizon. The documents were presented during the Adequacy Working Group on October 28, 2022.

The assumptions regarding the input data and changes to methodology were presented and discussed with the FPS Economy and the Federal Planning Bureau with whom this study is performed in collaboration and with the CREG, with whom this study is performed in concertation, following Article 7*bis* 4*bis* of the Electricity Law. Those discussions are held in the so-called 'CdC' (Comité de Collaboration).

The public consultation is a voluntary initiative by Elia in the framework of the Adequacy & Flexibility study in order to elaborate a robust study and to collect the valuable input from market parties, both on input data and the methodology. Note that the complete methodology (made of several appendix documents and which builds further on the methodology of the previous study) was also available within this public consultation.

As part of the public consultation for the Adequacy and Flexibility study, a separate public consultation on the input data to be used for the delivery period 2024-25 in the framework of the Low Carbon Tender (LCT) was also published. The report of the public consultation on the input data for the LCT will be published together with this public consultation report on the website of Elia.

Elia would like to draw the attention on the fact that this public consultation was taking place in a particular European context, with the ongoing energy crisis and invasion of Ukraine by Russia, while having gone through lock-downs in 2020 and 2021 due to the COVID-19 pandemic and while the climate crisis has also called for action. Important policies/announcements have been made in 2021 and 2022 by the European Commission (Fit-For-55 packages, RePowerEU) alongside new national ambitions for some countries. It is also foreseen that each Member State, including Belgium, will update its National Energy and Climate Plan by mid-2023.

As promised, Elia has also performed, when information available, an update of the assumptions, mainly the 2022 installed capacities to improve the short term projections.

The purpose of this report is to consolidate the feedback received from the public consultation, while at the same time reflecting Elia's position on these reactions which were discussed within the Comité de Collaboration (CdC).

This consultation report is publicly available, alongside with the non-confidential received stakeholder contributions and has been presented on 17 February 2023 to the market parties during an Adequacy Working Group. The slides, including the update of the trajectories, are also published on Elia website. Together with this report, it enables the reader to understand how the trajectories were adapted compared to the one submitted to public consultation.

2. List of stakeholders having reacted

In response to the public consultation, Elia received non-confidential replies from the following parties:

- Febeliec
- Fluxys
- FEBEG
- CREG
- Sebastien Gonzato (KUL)
- Johan Springael (Universiteit Antwerp)
- Pierre Kunsch (ULB)
- Citizen Task Force – Groupement de Citoyens Belges Inquiets
- 100TWh
- Keep The Lights On
- Maxime de Changy (independant expert)
- Organisatie Duurzame Energie

In addition, 3 responses were received that were designated as confidential. These responses will be answered with dedicated confidential reports.

All non-confidential contributions received are also available on Elia's website. These reactions, together with this consultation report, is available on Elia's website.

3. Instructions for reading this document

This consultation report is structured as follows:

- Section 1 contains the introductory context,
- Section 2 gives a list of the stakeholders of the responses received,
- Section 3 contains instructions for reading this document,
- Section 4 discusses the general comments received during the public consultation and the answers on these comments,
- Section 5 discusses the comments received during the public consultation regarding input data and the answers on these comments,
- Section 6 discusses the comments received during the public consultation regarding the methodology and the answers on these comments,
- Section 7 discusses the comments received on the hurdle rate study of Prof. K. Boudt,
- Section 8 discusses the comments received on the assessment of short-term flexibility,
- Section 9 discusses the comments received on the Low Carbon Tender and CRM,
- Section 10 discusses the comments received on the AFRY study on cost of capacity,
- Section 11 gives an overview of suggested sensitivities,
- Section 12 contains the next steps,
- Section 13 contains the list of annexes of the consultation report.

This consultation report is not a 'stand-alone' document, but should be read together with the proposal submitted for consultation, the reactions received from the market participants (annexed to this document) and the slides of the meeting Adequacy Working Group of 17/02/2023.

Sections 4 to 10 of the document are structured as follows with additional information on the content below.

[A] Subject/Article/Title

Stakeholder	Feedback received
B	C

[D] Answer from Elia

A. Subject matter covered by the various responses received.
B. Indication of the party that has introduced the comment.
C. This document contains an overview of the main, but also specific comments on the document submitted for consultation.
    - In doing so, an attempt was made to list/consolidate all comments received and to argue whether or not they should be taken into account.
    - In order to maintain authenticity, the comments have been copied as much as possible in this document. However, the comments have sometimes been shortened and uniform terms are utilized to make them easier to read.
    - For clarification purposes, it is recommended to always consider the original comment of the stakeholder concerned, as included in the appendix to this report and the slides of the meeting Adequacy Working Group of 17/02/2023.
D. This part contains Elia's answer and arguments as to why a comment was or was not considered, further explanation on the topic, proposed update for the topic.

4. General comments received

This section provides an overview of the general reactions and concerns of market players that Elia received on the document submitted for consultation.

STAKEHOLDER	FEEDBACK RECEIVED
100TWh	'100TWh, the citizen movement for a sustainable energy mix, is very enthusiast to contribute to this public consultation. We fully support the “voluntary initiative taken by Elia in order to elaborate a robust study and to collect the valuable input from market parties, both on input data and the methodology”, even if we regret this has only been announced on the Elia’s website.
Keep The Lights On	KTLO welcomes the opportunity given by Elia with this public consultation.
CREG	1. De CREG verwelkomt de inspanning van Elia om een exhaustieve publieke raadpleging te organiseren. The consultation period is extremely short considering the holiday period at the beginning of the consultation period and the vast amount of data and documents consulted upon. Een gebrek aan reactie op bepaalde gegevens of documenten impliceert niet dat de CREG deze gegevens of documenten volledig onderschrijft. Le document mentionne qu’Elia va publier son point de vue sur l’évolution de la consommation électrique des industries, centres logistiques et data centers jusqu’en 2050. Les profils de consommation seront également publiés ultérieurement. Cette analyse et ses données devront également être soumises à une consultation publique.
Febeliec	Febeliec would like to thank Elia for this consultation on the methodology, the basis data and scenarios used for the study regarding the adequacy and flexibility needs of the Belgian power system for the period 2024-2034 and including also the scenario parameters for the "Low Carbon Tender" (LCT) 2024-25. […] (see *Input data*) Febeliec will provide comments on the methodology, including some of the annexes, as well as the data in the excel file provided by Elia. Febeliec however wants to insist that a consultation period of only one month for the very large quantity of data and input is quite challenging and that as a result its input cannot be exhaustive. As a result, the omission of comments on certain points should in no case be interpreted as an implicit approval of Febeliec. Febeliec also wants to refer to its comments on the previous consultations for the Elia Adequacy and Flexibility studies as well as the related consultations for the determination of parameters and scenarios for the CRM.
Febeliec	As in previous years, Febeliec has some questions about the follow-up from Elia on this consultation. As Elia remarks that this is a voluntary initiative by Elia in order to elaborate a robust study and to collect the input from market parties (which Febeliec is not convinced of, as it is of the impression that at least the consultation on the input data is not voluntary), Febeliec wonders what, if any, will be the framework in which Elia will take into account the answers received on this consultation. Furthermore, Febeliec insists that, as this study will also be used

	for the determination of the volumes of the LCT, at least that part is not voluntary but covered by an obligation to consult.
Febeliec	As a conclusion, Febeliec as always remains available to discuss its comments to this consultation on the methodology and the input data. Febeliec is looking forward to the mathematical results of the adequacy and flexibility study from Elia, as input for the public debate on technological and policy choices, as well as in this case the preliminary projections which will be used to determine whether a Low Carbon Tender would be required for winter 2024-2025 in order to mitigate a possible adequacy concern.

ANSWER:

Elia thanks the stakeholders for their participation to the public consultation and for the many comments and suggestions provided during the public consultation. This consultation was indeed announced on the website of Elia but also via e-mail to all stakeholders and people subscribed to the newsletters. In addition, the WG Adequacy of 28/10/2022 was fully dedicated to the presentation of the data submitted to public consultation. It has therefore followed best practices in the matter.

Elia understands the timing is short in view of the numerous detailed documents submitted to consultation. It is indeed the first time that Elia consults on the full methodology of the study. Indeed, this was a critic received by stakeholders in the past. Launching the consultation earlier would result in outdated data and/or methodology given the current rapidly changing context. In any case, given the very uncertain context and the rapidly changing energy landscape, Elia proposed to update its assumptions if new information becomes available by the beginning of 2023. On the other side, a longer public consultation might have compromised the timely delivery of the Adequacy and Flexibility study. In any case, we thank the different stakeholders to have provided very valuable input during the public consultation.

Regarding the CREG's comment on the assumed consumption profiles and flexibility of the industrial loads and data centers, it is indeed planned to be presented to stakeholders during the Adequacy Working Group of 17/02/2023. The Elia Group study on industry electrification has been published shortly after the public consultation started[1] and couldn't therefore be already integrated. The slides of the Adequacy Working Group will be also published on Elia website.

Regarding Febeliec's comment on the voluntary aspect of this public consultation, we acknowledge that the 'voluntary' aspect relates to the Adequacy & Flexibility study only. Given that the design of the LCT is based on the design of the market-wide CRM, a public consultation on the input data of the LCT was necessary. For the question on the management of the received comments, Elia will answer all received comments and a rationale why to take to take them into account or not.

[1] Elia Group study on "Powering Industry towards Net Zero" notes one constant demand: electrification combined with access to low-carbon electrons at stable and affordable prices

5. Comments received on input data

This section provides an overview of the reactions and concerns of market players that Elia received to the document submitted for consultation regarding the input data.

In this document, it is usually referred to the “base scenario”. It should be understood as the “base case” or “reference” scenario, on which sensitivities will be performed.

5.1 General

Uncertainties & sensitivities

STAKEHOLDER	FEEDBACK RECEIVED
Citizen Task Force - Groupement de Citoyens Belges Inquiets	'Le chapitre 2 mentionne en gras le caractère incertain des inputs disponibles. Cela prouve l'importance d'inclure des marges dans les scénarios afin d'assurer une résilience suffisante du réseau. Certainement dans un contexte géopolitique délicat combiné à une transition énergétique qui transforme le secteur en profondeur. 'Nous recommandons d'inclure des graphiques avec les précédentes valeurs, afin de se rendre compte des tendances récentes (sous évaluation/sur évaluation entre la valeur projetée et la valeur vécue l'année écoulée) afin d'éviter d'être systématiquement dans un sens trop ou pas assez conservatif et de permettre de rendre l'étude plus robuste.
Keep The Lights On	'The report highlights the fact that in the beginning of 2023 some major decision has to be taken by the government. Unfortunately, our general impression is that this study is far from complete. So we see only two solutions: postponing this public consultation or making enough scenarios to cover all possible decision-outcomes (ref p9 and others). Indeed, referring to Elia’s statement in chapter 2 “given the uncertain context”, this uncertain context is only increasing further, therefore we would expect Elia to take sufficient margins and provide recommendations about how to ensure the grid remains reliable and resilient within that uncertain context by presenting scenarios (e.g. concerning import risks, see further in our specific questions).
Febeliec	Febeliec wants to point out that, despite the tile of the consultation, no proposals are presented concerning potential sensitivities. Moreover, it is unclear how the LCT, where only one single scenario will be selected by the Minister and where input will have to be delivered earlier than the deadline of 30/06/2023 for the Adequacy and Flexibility study 2023, will be aligned with the latter study which encompasses a broader analysis with hopefully different scenarios and different combinations of sensitivities to ensure that all relevant information is presented (e.g. impact of political and societal options on the system over the next decade). In general, Febeliec wants to insist that next to the central scenario, it is also very important to investigate a range of sensitivities and other scenarios, in order to guarantee to have a robust understanding of the adequacy implications and interactions of many of the data and parameters in the proposed spreadsheet. It is adamant to grasp to what extent some of these parameters could have a major impact on the outcome of the study. Febeliec nevertheless is very surprised to see that, contrary to previous years, no menu of possible sensitivities is included in the consultation.

	Febeliec insists that any sensitivities are in line with the applicable legislation, regulatory documents, decisions and communications, in particular the ERAA methodology. This implies that sensitivities can only be added on a national level in a NRAA and not cover elements in other countries (which have to be covered by those countries in their NRAAs).
Febeliec	On the general context, Febeliec appreciates that Elia will try to take the "latest policies and projections into account, including further developments and/or updates that might still occur in 2022 or beginning of 2023", by "performing possible updates on several assumptions beginning of 2023", Febeliec would like to know how will be determined which updates and developments will (or not) be taken into account and which cut-off point will be applied.
Febeliec	On the target years, Febeliec appreciates that a wider range of years will be modelled and quantified, in order to provide more detailed insights on the expected impact and interaction of the various parameters over time. Febeliec is a.o. very interested to see which will be the impact in the Elia modelling and results of the current on-going energy crisis related to the war in Ukraine (e.g. impact on energy prices, demand side response and demand destruction, …).
FEBEG	'FEBEG acknowledges and welcome the important efforts made by ELIA in order to document the sources and assumptions used by ELIA for the determination of the parameters it intends to use in the frame of the upcoming AdFlex study. We also recognize that the present exercise is particularly complex given the particular European context, with the ongoing energy crisis and Ukraine war, while having gone through lockdowns in 2020 and 2021 due to COVID-19 pandemic and while climate crisis has also called for action. We therefore welcome ELIA's commitment to perform an update beginning of 2023 of the assumptions which may need a reevaluation.

ANSWER:

The current context makes the quantification of scenarios difficult. The current high energy prices but also the many measures put in place by national and European authorities, the geopolitical context and COVID-19 lockdowns in the past years have had a strong impact on energy markets. Despite this, Elia did submit numerous and detailed information to the public consultation, ensuring a scenario dataset that is as complete as possible. Indeed, the goal of this public consultation was to receive feedback on the proposed dataset for the upcoming Adequacy & Flexibility study but also the LCT scenario. Elia agrees that one needs to be prudent on the assumed upcoming evolution of the different parameters and Elia is also in favor of considering sensitivities (both for LCT scenario and for the whole Adequacy & Flexibility study). Regarding the inclusion of graphics including previous values, Elia did present graphs of the input data trajectories including a comparison with the values used in the Adequacy & Flexibility study 2022-2032 in the general public consultation document and in the slides shown during the WG Adequacy on 28/10/2022.

Elia understands the comment of Febeliec regarding sensitivities. The goal of the public consultation was to collect the different potential sensitivities to be assessed in the Adequacy & Flexibility study. The suggested sensitivities would then also be considered for the choice of the scenario to be used for the LCT. This latter point was maybe not clear enough in the public consultation documents and we noted the point to insist on it in the upcoming consultations. The timing of the different studies is indeed not ideal as the full study (Adequacy & Flexibility) will be published end of June 2023 while the LCT scenario and a potential calibration report will need to be ready before that time.

As a reminder, in the context of the LCT, similarly to the market-wide CRM, Elia made a recommendation on a scenario (including sensitivities) to use for the assessment of the need for the tender and the determination the parameters of

the auction (if any). This recommendation was made by the end of January after which the CREG is expected to make a proposal and the FPS economy publish an advice. Ultimately it is the Minister that decides on the input scenario, sensitivities and intermediary values. If new relevant information is available to Elia after Elia's recommendation, it will hand it over to the authorities mentioned above.

Regarding new information for the Adequacy and Flexibility study that might come after the presentation of the public consultation report, Elia will always do its best to take it into account. It should be noted that a trade-off will however have to be made between respect of the timing and the added value of such update. Therefore, it will be case by case analysis and it is not possible to already assess what can or cannot be taken into account. Indeed, some changes can imply major changes in the tools and models used by Elia while other updates can be integrated more easily. In any case, computation time is also required to perform the needed simulations for the study.

As mentioned previously in this report, it is unfortunately not possible to extend the public consultation period without risking the timely implementation of the Adequacy and Flexibility study. Based on the sensitivities suggested in the public consultation and the discussions within the CdC, the reader can find a non-exhaustive list of sensitivities that will be analyzed within the frame of the Adequacy & Flexibility 2023-2034 study.

Regarding the legislation, Elia would like to recall that according to the Electricity Regulation, national resource adequacy assessments may take into account additional sensitivities on the particularities of national electricity demand and supply. This is not further detailed in the Electricity Regulation. ELIA considers that for Belgium, the high import dependency is such a relevant particularity of national electricity supply. Not only in terms of market functioning, but also in terms of energy being imported and import dependency during scarcity moments, the Belgian electricity supply cannot be considered without a particular focus on imports**.** Indeed, negative evolutions in surrounding markets compared to the base case and out of control of the Belgian authorities, create uncertainties as to whether the generation capacity on which Belgium 'relies' in neighboring countries will actually be available. Elia believes this particular element about the Belgian electricity supply is exactly within the scope of Article 24.1 of the Electricity Regulation. If this would not be the case, the Belgian State would be confronted with a paradox in which on the one hand, Belgium, more than many countries and in line with European ambitions, has invested significantly in interconnection capacity[1], maximally pursuing electricity market integration, but at the same time making Belgium more exposed to events and evolutions in surrounding markets, and on the other hand, Belgium would not be able to account for this specific context when aiming to guarantee its security of supply.

In particular, Elia has always considered scenarios considering additional unavailability of the nuclear units in France as very plausible and the latest months have unfortunately confirmed it. The goal of the study is to assess a large amount of sensitivities to give the reader an overview of the impact of those on the adequacy and flexibility requirements.

5.2 Generation in Belgium

5.2.1 Individually modelled thermal generation

DATA GRANULARITY

STAKEHOLDER	FEEDBACK RECEIVED
CREG	2. Wordt in de simulaties rekening gehouden met de werkelijke datum van uitdienstname van een capaciteit of wordt rekening gehouden met de situatie op het einde van het jaar zoals voorgesteld in sheet 1.1 van het Excelbestand?
CREG	3. L'unité de Zandvliet Power a communiqué une augmentation de sa capacité installée de 400 MW à 419 MW or Elia tient compte d'une puissance de 386,2 MW. Quelle est la raison de cet écart?

ANSWER:

For the granularity of the closure dates, Elia does take into account the exact expected decommissioning dates for the thermal power plants in its adequacy assessments. Hence if the closure is expected to happen within a simulated year, the exact date is taken into account. The table submitted to public consultation only contained one cell for each year for each unit for Belgium in order to ease readability (note that most of the commissioning/decommissioning date are mentioned in the "comment" column or will be added if missing). In addition, Elia would like to remind (as indicated in the consultation documents) that the simulated years are performed from September Y to August Y+1 (in order to keep winters within the same simulation period).

Regarding Zandvliet Power installed capacity, Elia was considering the capacity of 386.2 as communicated in the past by Zandvliet Power and also in line with the capacity mentioned on REMIT[2], namely 385 MW. Elia takes note that an increase of the capacity to 419 MW is foreseen on REMIT as of November 2024. Elia will take it into account.

PLANNING AND RECOMMENDATION

STAKEHOLDER	FEEDBACK RECEIVED
Citizen Task Force - Groupement de Citoyens Belges Inquiets	Est-il envisagé de prendre des marges ou de simuler que les nouvelles capacités pourraient avoir des retards de livraison ? Cela pourrait être dû à des raisons permitting, retard fournisseurs, retard chantier, problème technique lors de la construction, ...). Beaucoup de projets de construction sont à risque de retard en cette période de crise.
Citizen Task Force - Groupement de Citoyens Belges Inquiets	Pouvez-vous recommander de postposer les dates de fermeture de certaines capacités ? Par exemple, il semblerait plus prudent au moins d'étaler la sortie du nucléaire sur plus d'années (voir même de ne pas en sortir du tout !!!). Pouvez-vous mettre plusieurs scénario à l'étude,

[2] Nord Pool - REMIT UMM (nordpoolgroup.com)

	certainement un scénario ne considérant pas la fin du nucléaire, pour comparer le résultat et effectuer une recommandation sur le scénario le plus robuste pour notre pays. L'étude sur la météo en annexe mentionne que les phénomènes météo sont considérés comme impactant une région assez large (surtout avec les pays qui sont proches). Il semble donc très imprudent de miser tellement sur les énergies renouvelables intermittentes, plutôt que sur un mix énergétique bas carbone plus varié. Elia pourrait-il faire une recommandation dans ce sens ?
Keep The Lights On	In some parts of the study it is as if the nuclear power plants are omitted. We would insist on taking them along as they might be the only reliable source for covering the base load, in the future as well as today.
Keep The Lights On	Assumptions about unit availability over the years are considered as inputs for scenarii. However, it would be of added value to see recommendations about postponing the phase out of some production units and about adding some margin for potential delays in delivering new capacities (especially in a context of crisis/geopolitical conflicts/inflation that could have an impact on those important industrial projects).

ANSWER:

Elia thanks the different parties for their reactions on the topic. It should be clarified that Elia takes a technology neutral stance and has to apply the latest policy decisions when performing this study. The reference scenario is therefore based on the latest official information available for existing units and new capacities. This is also valid for the nuclear fleet and for existing thermal capacities in general, for which the announced closure dates are taken from legal documents published by capacity holders (either article 4bis notifications or data published through REMIT).

Elia bases its recommendations on capacity requirements that are identified in the study, in order to achieve the Belgian reliability standard. Those requirements are always expressed as volumes of 100% available capacity, and are as such technology neutral.

If policy announcements, decisions, or future assumptions in general are unclear or uncertain, sensitivities around the reference scenario can also be performed in order to better grasp the impact of some risks. A list of such sensitivities can be found at the end of this document (see also the next paragraph for sensitivities on gas and nuclear fleet).

SENSITIVITIES

STAKEHOLDER	FEEDBACK RECEIVED
FEBEG	FEBEG refers to the general remarks above and the perceived risks for the existing fleet in the framework of the CRM. We therefore recommend Elia to a least consider a sensitivity where some gas-fired power plants are excluded from the CRM and/or no longer investing due to the above mentioned reasons (*see document)* so that authorities can correctly assess the possible impacts on the adequacy. Considering the elements above, FEBEG would welcome following sensitivities: - Availability of gas-fired power plants in case of strict CO2 emissions' limits in the CRM (current rules – proposed trajectory (if known at the time) – ambitious trajectory)

	[…]
Febeliec	Febeliec also wonders whether no sensitivity should be added with additional nuclear availability (in Belgium and/or abroad) and/or retention of coal/lignite plants in light of the current discussions.

ANSWER:

On the sensitivity on gas capacity, Elia takes note of FEBEG's proposal for assessing the impact of lower availability of gas-fired power plants in case of stricter CO2 emissions limits in the CRM. Such sensitivity will be included in the study although for the moment, given that those stricter CO2 emissions limits in the CRM are not yet known, Elia will need to make assumptions on the level to be applied.

Regarding the availability of the nuclear fleet in Belgium, Elia understands the comment of Febeliec and agrees that sensitivities can be performed in order to cover some risks and/or remaining open points. To be concrete

- The base scenario would consider the agreement announced on the 09.01.2023 between the Belgian government and Engie, namely the 10 years extension of Doel 4 and Tihange 3, with both parties doing their best for the extension to start as of November 2026;
- Several sensitivities around the base scenario could be performed, such as
    - A delay in the extension that would start later than November 2026 as the timing for the extension is tight;
    - As mentioned in the press[3], a sensitivity could consider a short (e.g. 1-year) extension of some units during winter 2025-26, thanks to fuel savings during the summer.

The above proposal is subject to change if other information becomes available in the coming weeks.
On the remark for capacity abroad, this comment is answered in the section 5.7 "Data for other countries".

5.2.2 Non CIPU thermal units

Trajectories

STAKEHOLDER	FEEDBACK RECEIVED
Febeliec	On the thermal fleet, Febeliec takes note of the proposal by Elia, but wonders to what extent future (as of yet not linked to specific projects) generation assets (e.g. cogeneration assets) are taken into account (as also future as of yet not linked to specific projects industrial demand increases are taken into account) and to what extent the unavailability of nuclear units in parts of 2025-2026 can be mitigated with some short term solutions (Cf. similar to those applied in winter 2018-2019).
Febeliec	With regard to the CHP non-CIPU, biomass and waste categories, Febeliec notices that Elia has opted to apply a very conservative approach, with no additional projects beyond those already

[3] Une prolongation d'un an de Doel 1, Doel 2 et Tihange 1 est à l'étude | L'Echo (lecho.be)

	known by Elia and this despite a ten year time horizon as well as a period with significantly higher electricity prices supporting business cases. Febeliec also still regrets that it is not completely clear which power plants are included here, in particular diesel generators, emergency generators (all considered market response?) and process generators.

ANSWER:

Regarding the first question on future generation, Elia assumptions are based on existing and future projects. To do so, Elia uses the PISA database (ELIA internal database containing all units of the Belgian system (CIPU and non-CIPU) reported and updated by the DSOs on a regular basis). On one side, Elia takes future projects into account, even if additional projects on top are not considered, but, on the other side, Elia does not consider any decommissioning on those capacities. Elia has indeed limited information about it as it is most of the time only known limited time before the decommissioning actually takes place. Therefore, Elia believes that this estimation is more realistic than very conservative as it integrates known future projects but without considering potential decommissioning. Moreover, it should be noted that most existing CHP are located in Flanders where it is expected that many will have no more subsidies after 2026. However, CHP can still participate to CRM auctions and their business case might be influenced by high electricity prices. It is thus difficult to predict a trajectory for existing and new projects besides taking into account for the reference scenario that all existing units will stay in the market for the whole time horizon of the study and that all known and mature projects to Elia will be realized. Note that the Economic Viability of new CHP unit will be assessed via the EVA and that in order to consider a potential faster or slower evolution of new CHP non-CIPU capacity in the long term, sensitivities will be performed.

The non-CIPU thermal generation capacity has been reviewed in light of the 2022 reality checks. Several units that were considered as projects have now been reported as in service by DSOs in the last week of December 2022, leading to an increase in existing non-CIPU CHP capacity for 2022. The latest known projects are also included in the trajectory, leading to a total of nearly 1600 MW by 2027.

With this update, the biomass capacity has also slightly increased, with 547 MW of capacity in 2022.

On the shorter-term, solutions such as those applied in winter 2018-2019, if Febeliec refers to diesel generators and emergency generators, unless they are running with biofuel, those are not explicitly taken into account in profiled thermal generation (non-CIPU) but are included in the DSM shedding if they participate to the market via the quantification of the existing market response which serves as basis for the DSM shedding estimates. Regarding additional capacity of DSM shedding, this can be added to the system with the economic viability assessment.

Database

STAKEHOLDER	FEEDBACK RECEIVED
CREG	4. Selon les explications fournies, la base de données interne d'Elia répertorie les unités de production thermique non-CIPU raccordées aux réseaux publics de transport et de distribution d'électricité. Les installations sur les sites industriels et raccordées aux réseaux fermés de distribution sont-elles toutes répertoriées ? Les capacités inférieures à 1 MW sont-elles reprises ?

ANSWER:

In order to answer CREG's question on the PISA database, Elia can confirm that according to the network codes, production units in a Closed Distribution Network (CDS) from 1MW and upwards still have to report to Elia.

> *Art. 352. § 1er. Les équipements de mesure qui concernent un point d'accès au sein du CDS doivent satisfaire aux exigences de précision minimales imposées au gestionnaire de réseau de transport dans la partie 7, dès que l'utilisateur du CDS concerné par ce point d'accès dans le CDS a fait le choix d'un fournisseur, conformément à la loi du 29 avril 1999.*
>
> *§ 2. Les unités de production d'électricité de types B, C et D situées dans le CDS doivent disposer d'équipements de mesure. Pour les unités de production d'électricité, ces équipements de mesures doivent permettre de communiquer au gestionnaire de réseau de transport les informations visées aux articles 48 à 50 de la ligne directrice européenne SOGL, ainsi que précisé à l'article 351.*

The cooperation agreement TSO-DSO stipulates that static unit information is exchanged about all units >= 400 kVA. The metering data threshold is still set at 1MW. In addition, DSO often bundle units smaller than 400kVA into virtual aggregated units (e.g. "solar panels for municipality X").

5.2.3 Renewable energy sources

General comments on renewable energy capacity

STAKEHOLDER	FEEDBACK RECEIVED
Citizen Task Force - Groupement de Citoyens Belges Inquiets	D'importantes nouvelles capacités renouvelables sont considérées, est-ce que cela a été objectivés avec la disponibilité de terrains (pour le vent onshore)? Ou la disponibilité de matériaux à large échelle, voir même de capacité industrielle de fabrication ? Certainement au vu de la croissance similaire de l'ensemble des pays voisins.
Pierre Kunsch (ULB)	De multiples autres contraintes apparaissent qui ne sont pas prises en compte par un simple calcul arithmétique basé sur des moyennes annuelles. a. Contraintes d'occupation des territoires qui se chiffreraient en centaines de km2 pour un territoire densément peuplé comme celui de la Belgique donnant lieu à des impacts sociaux et environnementaux importants, comme perte de valeur des propriété, impact sur le bien-être des riverains, sur la biodiversité aviaire, etc. très difficiles à chiffrer en termes de coûts et d'impacts environnementaux et comprenant aussi de très nombreuses interconnexions par pylônes aériens mis en place par ELIA pour le transport et la distribution de cette électricité décentralisée […] c. Apparition de coûts systémiques importants d'équilibrage et de renforcements des réseaux, une subsidiation accrue des renouvelables et des centrales thermiques d'appoint (CRM), insuffisantes comme on l'a dit

	d. Contraintes créées par la durée de vie limitée des équipements renouvelables, leur remplacement périodique, les coûts et les limites d'approvisionnement en matières premières non domestiques, le traitement, le recyclage éventuel, et l'évacuation des déchets, dont certains comme les socles de béton des éoliennes enterrés définitivement …
100TWh	100TWh criticises the unrealistic assumptions in the evolution of the technologies to produce electricity in the period 2024-2034. Among others, we disagree with the assumptions for solar PV and onshore wind turbines. In the last 20 years, Belgium has only been able to install 6 GW PV's and 3 GW onshore wind turbines. So it seems for us unrealistic to jump to 17,5 GW PV's and 6,5 GW onshore wind in a period of 10 years. It is too optimistic, considering the opposition of a growing part of the population, even if today undemocratic processes are promoted at European and national level, which we blame. Furthermore, if we agree that the energy mix foreseen by Elia in 2034 will be able to raise the total yearly production of electricity from 87 TWh in 2024 to 131,4 TWh (document A – page 19), this doesn't ensure that there will be enough electricity at every moment from 2024 to 2034. If we consider the Elia's own derating factors, which measure the adequacy of the RES in situation of scarcity, the benefit of renewables to ensure our electricity supply is very limited (see annex table 1), Another problem is the inevitable increase of our gas production to reach 131,4 TWh with only 2 nuclear reactors. This implies that Belgium will never sufficiently reduce its CO2 emissions to contribute its share to the EC Fit-for-55 plan.
Keep The Lights On	A considerable growth of wind/solar capacity is considered. Several questions related to this fact: -- Especially for onshore wind, but in general for all new capacity planned: Have the potential new capacity volumes been compared to actual available projects/sites/permitting possibilities? Has NIMBY (not in my backyard) been considered? -- Especially for Solar: Is this compatible with production capacity and material availability? -- Seeing that most of the countries evaluated have important growing assumptions in renewable capacities, is this compatible with global market delivery capability (materials, factories, technical and operational talent, ...)?
FEBEG	The objectives are ambitious but the NIMBY-effect - and in particular the delaying effects of the appeal procedures - should unfortunately not be underestimated. Considering the elements above, FEBEG would welcome following sensitivities: […] - Lower RES development [...]

ANSWER:

From the comments received, Elia would like first to recall that the reference scenario is developed so that it follows the latest official ambitions. Unfortunately, it is only by mid-2023 that the updated National Energy and Climate Plans (NECP) of the Member States will be known. However, in the meantime, important policies/announcements have been

made in 2021 and 2022 by European Commission (Fit-For-55 packages, RePowerEU) but also at regional level in Belgium.

Elia has worked on updated trajectories that consider these announcements together with latest regional information. In particular, the updated trajectories were elaborated based on exchanges with the regions and based on latest data reported by DSOs on the existing capacities. The trajectories were also discussed in CdC. The following methodology was applied for elaborating the trajectories in terms of photovoltaic and onshore wind capacity in Belgium:

- For each region, a reality check of the installed capacity at the end of 2022 was performed, based on the preliminary information available on installed capacities;
- For each region, the trajectory is updated with the latest available information for the future evolution:
    - For Wallonia, the latest Plan Air Climat Energie (PACE) 2030 has been adopted in December 2022 in first reading by the Government of Wallonia[4]. A second reading is foreseen in March 2023, after having collected feedback from stakeholders. It will be then integrated in the Belgian NECP.
    - For Brussels, the PACE has been submitted to consultation in December 2022[5]. The current document does not include official targets in terms of capacity or production of green electricity by technology.
    - For Flanders, the updated Vlaamse Energie- en Klimaatplan is not yet available. No official updated targets towards 2030 are known in terms of photovoltaic and wind onshore. The Flemish region has communicated official targets for the yearly increases towards end 2023. Those values are then used to elaborate the future trajectories.

Elia understands that the RES trajectories can be seen as optimistic as many factors come into play and can alter the realized evolutions. This is also what sensitivities are meant to cover. The reference scenario will stick to the official ambition. However, Elia thanks FEBEG for its proposal of a lower RES sensitivity as Elia agrees that such sensitivity is relevant. Stronger penetration of RES technologies could also be considered as a sensitivity (as done in the previous studies).

One major concern that is shared by Elia is the availability of critical raw materials that are required for many technologies. It indeed appears that a shortage for some materials could materialize, with a high dependency on China for several of them[6]. It is expected that Europe will take actions, amongst others through its Critical Raw Material Act, towards a more resilient raw materials supply chain*, "supporting projects and attracting more private investment from mining to refining, processing and recycling"*[7]*.* In order to assess the potential impact of such shortage, a sensitivity could be studied, affecting both the deployment of certain renewable energy sources but also the deployment of storage means, namely the electric cars, home batteries and large scale batteries.

Regarding the land availability for onshore wind and the NIMBY effect, Elia understands the point of view and agrees that it should not be neglected. Elia assumes that for the base scenario, measures will be taken so that the official

[4] https://www.wallonie.be/fr/actualites/la-wallonie-revise-la-hausse-son-plan-air-climat-energie-2030

[5] https://environnement.brussels/citoyen/news/enquete-publique-projet-de-plan-regional-air-climat-energie-2023-2027

[6] https://www.euractiv.com/section/circular-economy/news/explosive-demand-growth-could-lead-to-supply-shortages-in-raw-materials/

[7] https://ec.europa.eu/commission/presscorner/detail/en/STATEMENT_22_5523

target set by the competent authorities will be reached. For example, Wallonia has now foreseen specific measures through its Pax Eolenica to ensure the deployment of onshore wind.

Regarding 100TWh's comment on the adequacy concerns (having enough electricity at every moment from 2024 to 2034), Elia refers to the answer given in Section 6.1 on the methodology. As explained there, Elia follows the European Resource Adequacy Assessment (ERAA) methodology by performing a probabilistic study to evaluate if the legal criterion defined in Belgium (LOLE) is reached. The probabilistic study allows to calculate the LOLE for every scenario/sensitivity defined in the study and hence calculate the needed additional capacity that is required to meet the legal reliability criterion.

Photovoltaïc

CREG	5. Un ralentissement du rythme d'installation des PV après 2024 ne semble pas compatible avec les hypothèses prises en matière d'électrification. La CREG propose d'envisager, dans le scénario de base, un maintien de la croissance de 1000 MW par an pendant la période de l'étude.
Organisatie Duurzame Energie	'Met betrekking tot de volumes (*van PV)*: - Verandert de markt zodanig hard dat we geen bestaande Europese marktvoorspellingen zien die we kunnen gebruiken. - Maken we daarom een best-effort inschatting waar zeker een foutenmarge op zal zitten. - We verwachten dat we voor 2022 voor gans België effectief rond de 1GWp zullen uitkomen, mogelijks iets eronder/erboven. - We verwachten voor de jaren erna niet dat we nog onder 1GWp zullen zakken. We zouden dus voorstellen om uit te gaan van ongeveer 1,5 GWp voor 2023, met een groei van ongeveer 15% per jaar voor de jaren erna.

ANSWER:

The methodology applied is described in the previous comment. It considers an update of the 2022 realized installed capacity together with official ambition for the next years. For the solar photovoltaic capacity, the following assumptions are considered:

- For Wallonia, based on temporary numbers from the SPW, the additional capacity in 2022 can be estimated to be slightly lower than 200 MW. For the long term trajectory, the latest PACE version is used, where a target of 5100 GWh in 2030 is proposed. By 2030, it would represent around 400 MW per year (twice as much as observed in 2022). No more slow-down after 2024 is considered, despite of the end of analogic meters running backwards for the new installations after 2024.
- For Flanders, the additional capacity installed during the year 2022 is was above 500 MW[8]. The official target for additional capacity in 2023 is 450 MW[9].
- For Brussels, a bit less than 20 MW has been installed during the year 2022[10]. There is no official updated target in terms of installed capacity by 2030. In the latest document from 2019, the official ambition for 2030

[8] https://apps.energiesparen.be/energiekaart/vlaanderen/zonnepanelen
[9] https://publicaties.vlaanderen.be/view-file/49040
[10] Brugel online PowerBI

was to produce about 185 GWh of green electricity from photovoltaic[11]. In the projection for this study, a 30 MW of yearly increase is considered here.

This leads to a yearly increase of around 900 MW for the whole Belgium until 2030. In view of the installation rate in 2022 and the available information on long term official target, considering around 1000 MW per year seems more realistic then 1500 MW. However, Elia takes note of the comment of Organisatie Duurzame Energie in the context of a high RES sensitivity.

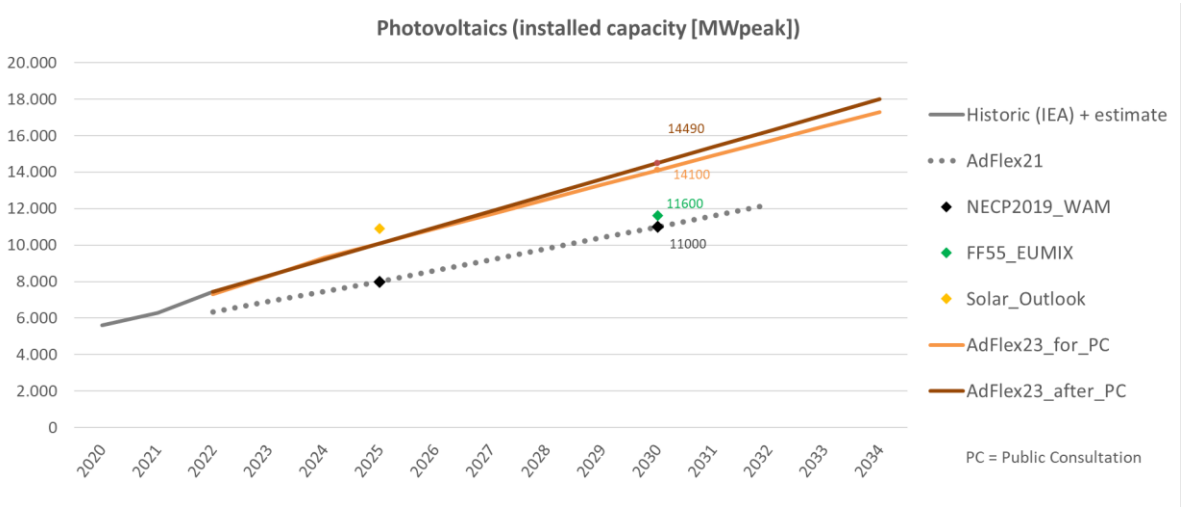

Figure 1 Proposed trajectory for solar photovoltaics (capacity assumed at the end of the mentioned year)

Onshore wind

Febeliec	On the renewable energy sources, Febeliec has at this point no specific remarks on the proposed PV and wind capacity (onshore/offshore) except that it is a bit surprised to see that despite a faster increase in onshore wind additions in Flanders for 2022 and 2023, the same target of 2500MW for 2030 is maintained, thus implying a slowdown after 2023 in additional capacity.

ANSWER:

The same approach as for photovoltaic is applied for the onshore wind reality check of 2022 installed capacity and for determining the trajectory considered.

- Based on information from Wallonia and Flanders from early January 2023, the estimated installed capacity of onshore wind 2022 amounts to 2940 MW.

[11] https://environnement.brussels/citoyen/outils-et-donnees/etat-des-lieux-de-lenvironnement/energie-etat-des-lieux#le-potentiel-photovoltaique-des-toits-bruxellois

- For the long term projection, the target of 5.1 TWh of wind production by 2030 in Wallonia is considered, together with yearly increase of 150 MW in Flanders.

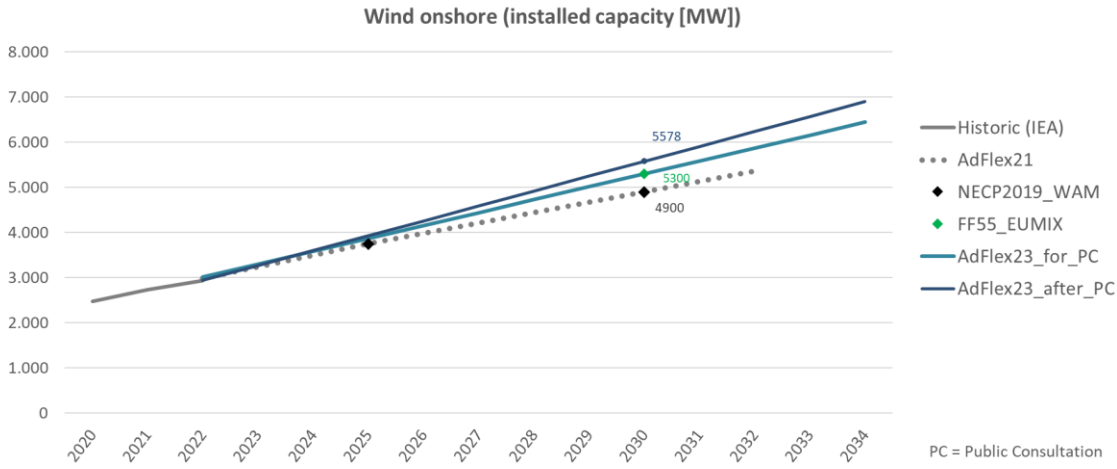

Figure 2 Proposed trajectory for onshore wind (capacity assumed at the end of the mentioned year)

Offshore wind, Ventilus and Boucle du Hainaut

STAKEHOLDER	FEEDBACK RECEIVED
Pierre Kunsch (ULB)	b. Une capacité de 5.760 MW n'est pas compatible avec les surfaces disponibles en mer du Nord et nécessiterait des travaux de génie civil importants et également des interconnexions coûteuses (Ventilus, boucle du Hainaut). Une production combinée d'électricité et d'hydrogène par électrolyse est exclue contrairement aux promesses du gouvernement actuel.
FEBEG	It should furthermore be noted that, for the offshore wind growth ambitions, the execution of these projects will also depend on the timely execution of the Ventilus project. Experience has taught the sector that such large-scale projects will face the necessary challenges before they can be realized, the fierce opposition from both the local residents as from the communes against the Boucle du Hainaut is a good illustration of this. Therefore, in the base case scenario, Elia should consider a postponement of the additional offshore capacities. The planning published on the SPF Economy website is indeed expected to be reviewed due to delays on linked projects. In addition, the extra 2.800 MW capacity is to be considered as a maximum (range is between 2.450 and 2.800 MW).
Maxime de Changy (expert indépendant)	Dans le cadre de la consultation publique, serait-il possible d'avoir une analyse de sensibilité autour du timing de renforcement du réseau (380 kVac) interne d'Elia. Comme plusieurs fois mentionné par Elia, sans "la Boucle du Hainaut" et "Ventilus", nous ne pourrons pas extraire un maximum de production offshore (notamment à partir de l'île énergétique). Etant donné la résistance très importante que rencontre les projets "Ventilus" et "Boucle du Hainaut", serait-il possible de savoir quel serait l'impact d'un retard de construction ou de la non-construction d'un des deux projets sur l'adequacy et le mix de production global en 2030 (ainsi que le curtailement résultant?).

ANSWER:

The projected offshore wind capacity for this Adequacy & Flexibility study is based on official information published by the SPF Economy[12].

On the capacity to consider for MOG II, Elia confirms that it is a range between 3,15 GW and 3,5 GW that is foreseen as mentioned on SPF Economy website. This means that the grid infrastructure needs to be ready for 3,5 GW (see also the press release of December 2021[13] on the 3,5 GW grid connection approved by the Council of Ministers). Elia proposes to consider the full 3.5 GW, which leads to a total capacity of 5761 MW by 2030. Elia would like to clarify that it is not Elia's responsibility to assess if the foreseen capacity is compatible with the available space in the Belgian EEZ in the North Sea.

Regarding MOG II planning, a high-level updated planning was presented by the Minister's cabinet on the 10/01/2023 during the MOG II Task Force, where delays of both the tendering and the commissioning of the wind farms were announced. The slides presented will be made available on Elia's website[14]. The SPF Economy published also recently (on 03/02/2023) an updated planning for MOG II[15]. Based on this high-level information, the offshore wind trajectory in this Adequacy & Flexibility study has been reviewed and it now considers the following elements:

- the first 700 MW offshore wind in operation for winter 2029/30 (first wind turbines are foreseen to be there already during Q4 2028, but it is supposed that they won't be in operation yet);
- the additional 2800 MW offshore wind in operation for winter 2030/31.

Elia agrees that Ventilus and Boucle du Hainaut are crucial for the evacuation of the electricity produced in the North Sea. Similar to the other production assumptions of this study and in order to assess its impact on adequacy, Elia considers relevant to perform a sensitivity on potential delays of MOG II. As potential delays on Ventilus or Boucle du Hainaut will likewise impact the MOG II project, such an event can be covered as well through the aforementioned sensitivity.

The hydrogen strategy from the federal government[16] foresees to mainly import Belgium's needed hydrogen from abroad. A certain amount of future electrolysers installed in Belgium is however considered in the study, based on potential projects known today. The trajectory of electrolysers was also included in the public consultation.

5.2.4 Storage

STAKEHOLDER	FEEDBACK RECEIVED

[12] https://economie.fgov.be/en/themes/energy/belgian-offshore-wind-energy
[13] https://news.belgium.be/fr/parcs-eoliens-en-mer-projet-dextension-du-reseau-modulaire-offshore
[14] https://www.elia.be/en/users-group/workshop
[15] L'énergie éolienne belge en mer | SPF Economie (fgov.be)
[16] Stratégie fédérale belge pour l'hydrogène | SPF Economie (fgov.be)

Febeliec	On storage, Febeliec appreciates that (finally) Elia is providing a bottom-up quantified approach, where Febeliec has to indicate that it is within the short timeframe foreseen for this consultation very difficult to validate or not the proposed data and methodology.
CREG	10. Large-scale batteries − Elia n'indique pas la source sur laquelle elle se base pour déterminer le ratio 70% batteries 4h/30% batteries 2h. Dans la mesure où tous les projets de batteries de grande taille offerts dans le cadre du CRM sont des projets de 4h, la part de ce type de projet devrait être de 100%. Zou Elia een geaggregeerd overzicht kunnen geven van de ingediende aanvragen voor aansluiting van grootschalige batterijen op het net (met vermelding van capaciteit en energie-inhoud)? − Pour 2024, aucun projet de batterie au stade de l'étude de faisabilité n'est pris en compte. Il s'agit d'une hypothèse trop restrictive tenant compte du court délai de réalisation et de conditions de marché favorables. − Jusqu'en 2029, Elia ne considère que les projets connus dont l'EVA est positif. Il s'agit d'une hypothèse restrictive qui suppose qu'au cours des 7 prochaines années, aucun projet additionnel ne pourra aboutir. La CREG est d'avis que tout projet dont l'EVA est positif et devrait être pris en compte, tenant compte d'un délai de réalisation raisonnable (tenant compte d'une learning curve par rapport aux projets déjà développés).
FEBEG	Storage FEBEG also observes high ambitions in terms of large-scale storage capacities. We understand that these assumptions are based on expressed ambitions and plans based on projects known today at Elia. However, at this stage, there are no guarantees that these will materialize. Most importantly, next to the economic viability analysis, it is crucial to check the connection possibilities to the grid in the short and medium term for this important volume of expected large-scale batteries. […] Considering the elements above, FEBEG would welcome following sensitivities: […] - Less DSM and storage capacity (compared to the base-case scenario which for which the values should already be lowered – cf. comment above) […]

ANSWER:

Elia would like to recall that two categories are considered:

- **In service capacity** (including the contracted battery capacity in the framework of the Y-4 auction for Delivery Period 2025-2026);
- **Additional potential if economically viable.** The additional potential is based on the project known at Elia as there is no guarantee for these projects to materialize. The capacity proposed is already seen as ambitious, therefore no extra potential capacity is foreseen before 2030;

The additional potential is based on large-scale battery projects known by Elia. Note that a close follow-up of the battery projects is performed by Elia and in this framework.

- In the meantime, one project of 50 MW was commissioned in December 2022 and two projects for a total of 100 MW will be commissioned within the first weeks of 2023, increasing the 'in service' capacity considered for the short term;
- The 'additional' potential capacity was reduced, as the best estimate commissioning date of each project has been reviewed based on the project status in January 2023. Note that this best estimate is optimistic as it considers the 'best case' date for each project. Therefore a percentage of the "connection studies" projects and "feasibility projects" is applied, as not all projects will be materialized.
- The ratio considered to determine the energy content of the large scale batteries has also been reviewed based on the following assumptions as this information is not always available:
    - Considering BloombergNEF's information on Belgian batteries (batteries in service or with financing secured). This leads to 51 MW of 4 hours and 74 MW of 2 hours as of 2023.
    - Considering that the other smaller existing batteries not mentioned on BloombergNEF database to be of 2 hours duration (corresponds to 27 MW);
    - Considering additional potential capacity would be of 4 hours.

Note that a forced outage rate on the batteries is also proposed to be considered for batteries (see 5.5.3 Outages section for more information).

Note that with the latest update of January 2023, the existing and potential capacity for winter 2024/25 is split within the following sub-categories:

- Existing;
- New Batteries 'in rea';
- New Batteries 'connection studies';
- New Batteries 'feasibility studies'.

There is therefore a certain capacity under the 'feasibility studies' status that is considered as potential additional capacity for 2024.

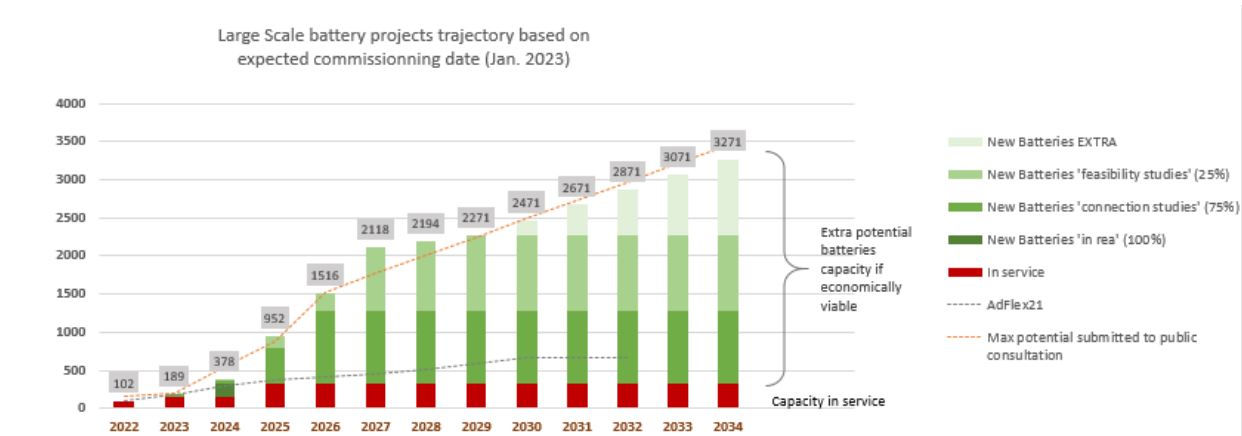

Figure 3 Proposed trajectory for large scale battery projects (capacity assumed at the end of the mentioned year)

Elia agrees to consider sensitivities with lower and higher large scale batteries volume for the longer term in order to account for the uncertainties and to assess the impact.

5.3 Demand in Belgium

As a summary to the responses to the public consultation, the proposed trajectory of the total electricity demand is shown in Figure 4 compared to the value proposed at the launch of the public consultation. Since the public consultation, several steps have been taken to improve the proposed projection:

- Feedback received during the public consultation on the assumptions for electricity demand due to additional electrification;
- Reality checks with data for 2022 have been performed. The total electricity demand for 2022 has been used as a starting point (5.3.1 Model & high-prices impact) and the 2022 numbers of EVs and HPs have been refined (5.3.2 Electrification);
- The observed impact of high prices on industry has been taken into account in the proposed central scenario (5.3.1 Model & high-prices impact)
- Wholesale prices used to quantify the high price impact on residential, tertiary and industrial demand have been updated using latest forward prices (5.3.1 Model & high-prices impact and 5.5.1 Fuel & CO2 prices);
- Refinements of the estimated demand for electric vehicles and heat pumps have been taken into account based on comments and data received during the public consultation (5.3.2 Electrification);
- The trajectories of new electrification in industry and data centers have been refined by taking into account confirmed and/or estimated project commissioning dates (5.3.2 Electrification).

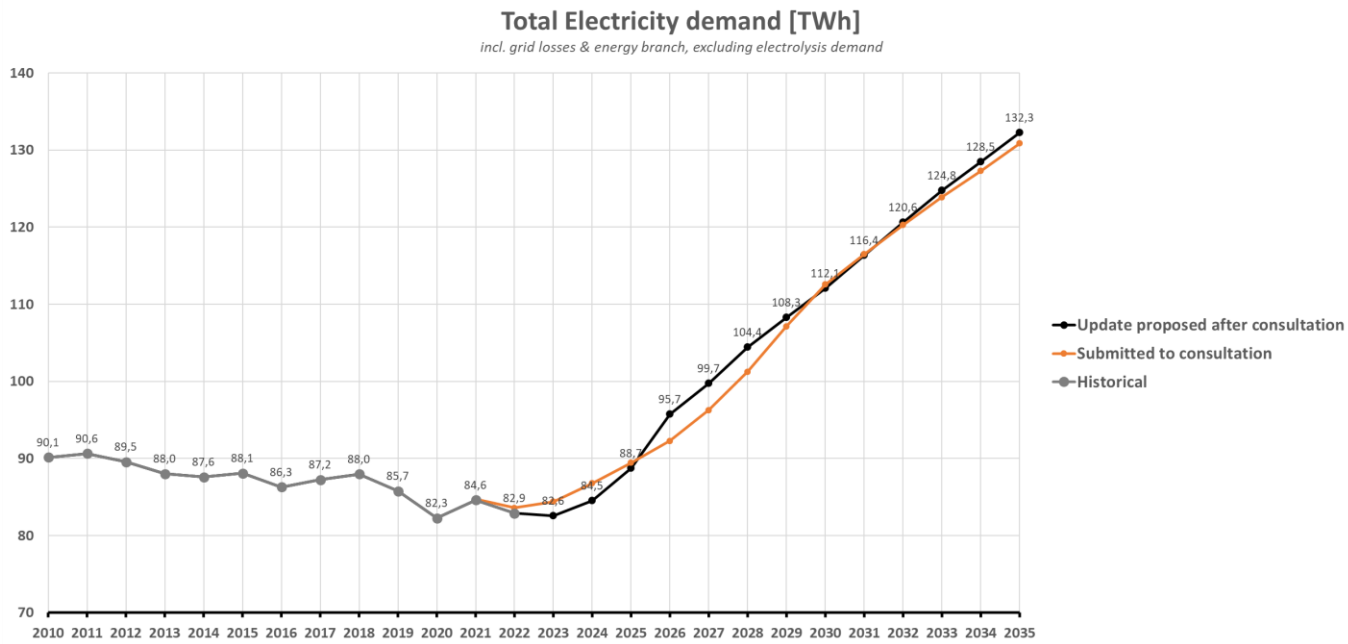

Figure 4 Proposed total electricity demand projection (before/after public consultation), incl. grid losses and energy branches, excluding electrolysis demand*

** Note that this total electricity demand is an estimate, as part of the consumption linked to the 'Power-to-heat' will be determined when performing the market simulations as those are used when electricity prices are below a certain level (see 5.3.2 DSR Industry).*

Figure 5 shows the assumed breakdown of electricity demand for the period until 2035.

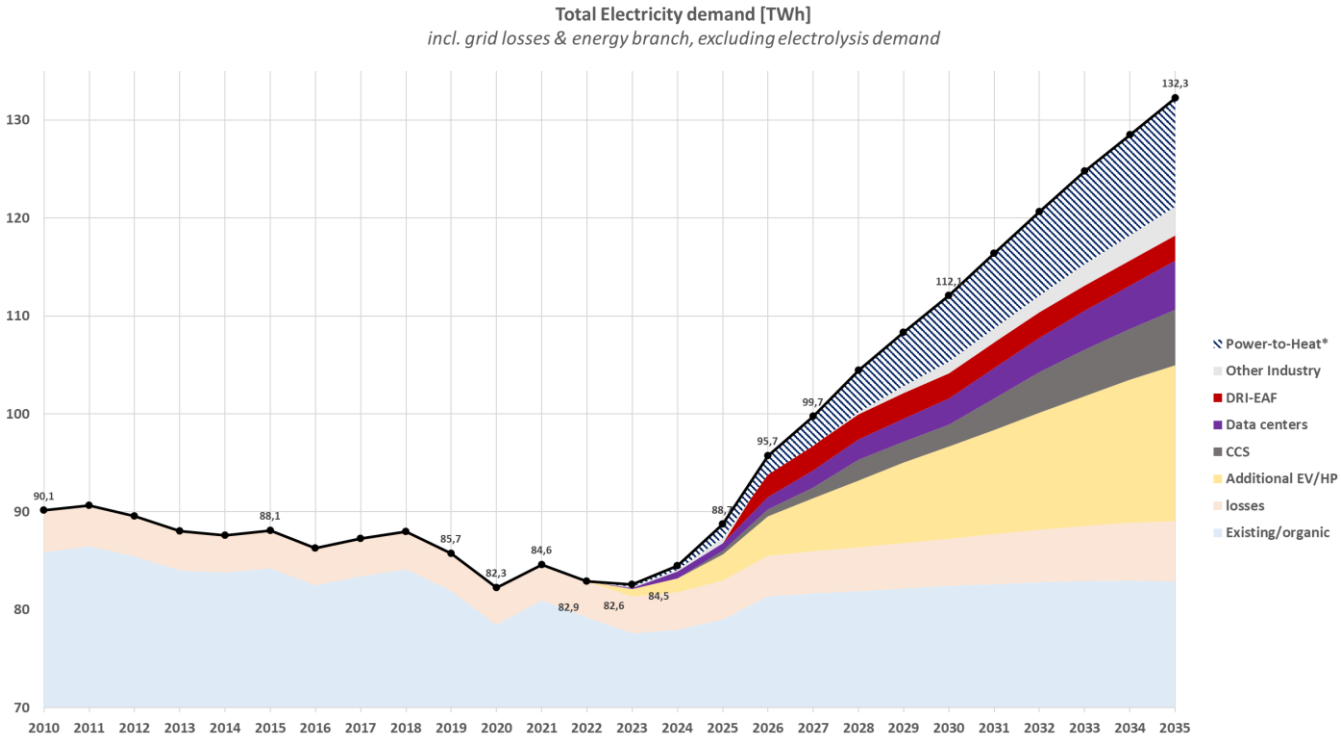

Figure 5 Proposed total electricity demand projection breakdown, incl. grid losses and energy branches, excluding electrolysis demand.

** Note that this total electricity demand is an estimate, as part of the consumption linked to the 'Power-to-heat' will be determined when performing the market simulations as those are used when electricity prices are below a certain level (see 5.3.2 DSR Industry).*

5.3.1 Model & high-prices impact

STAKEHOLDER	FEEDBACK RECEIVED
CREG	6. La prévision de la demande totale d'électricité pour la Belgique est basée sur l'outil développé par Climact et déjà utilisé dans la précédente étude Adequacy & Flexibility (2021). Cette prévision ne tient pas compte de la demande supplémentaire d'électricité qui pourrait se produire dans le secteur industriel et/ou de la croissance de nouvelles industries, notamment les data centers. Une fourchette est ainsi proposée par Elia pour prendre en compte cette électrification supplémentaire. Les principaux moteurs de l'augmentation de la demande d'électricité sont le secteur des transports et l'électrification de certains processus industriels ainsi que le développement de nouvelles industries (e.g. data centers). Selon les hypothèses retenues par Elia, la demande d'électricité du secteur des transports représente 4,9 % de la demande totale d'électricité en 2030 (5,6 TWh) et 6,9 % en 2034 (8,8 TWh), par rapport à la valeur 'Best Estimate'. En ce qui concerne le secteur industriel, la demande additionnelle d'électricité pourrait être comprise entre 11 et 22 TWh en 2030 et entre 17 et 33 TWh en 2034. Cette demande additionnelle représente 14,7 % de la demande totale d'électricité en 2030 et 19,4 % en 2034 (par rapport à

	la valeur 'Best Estimate'). Cette augmentation semble résulter de l'hypothèse que toutes les industries présentes actuellement resteront actives dans le futur. Une sensibilité à la baisse devrait être envisagée tenant compte de l'impact en termes de compétitivité d'un prix de l'énergie plus élevé en EU que dans d'autres zones. We stellen vast dat België, na Denemarken, de grootste stijging van het elektriciteitsverbruik kent over de bestudeerde periode (zie onderstaande figuur gebaseerd op de gegevens in de raadplegingsdocumenten van Elia).
CREG	7. La CREG note que les prévisions de la demande totale d'électricité à l'horizon 2030 et 2035 varient significativement par rapport aux trajectoires des différents scénarios développés dans le cadre du plan de développement fédéral du réseau de transport belge pour la période 2024-2034 (ci-après, 'PDF 2024-2034'). La quantification des scénarios du PDF 2024-2034 suggère une augmentation de la demande totale d'électricité comprise entre 97 et 108 TWh en 2030 et entre 103 et 120 TWh en 2035. Selon la trajectoire 'Best Estimate' de l'étude Adequacy & Flexibility 2022, la demande totale d'électricité pour la Belgique atteindrait 113 TWh en 2030 et 131,4 TWh en 2035. La CREG note que ces valeurs sont particulièrement élevées par rapport aux valeurs des différents scénarios développés dans le cadre du PDF 2024-2034.

ANSWER:

Regarding the differences with the Federal Development Plan (FDP), it is important to note that the main scenarios and assumptions for this study had been frozen by March 2022. Those were based on the latest NECP for Belgium for the Expected policies scenario. In addition, an additional scenario for 2030 was created following the FitFor55 package put forward by the European Commission. This considered additional electrification but not yet additional federal/regional measures announced in Belgium after the package. At the same time, due to the significant impact of the invasion of Ukraine by Russia and subsequent EU policies/strategies (i.e.REPowerEU[17]) an additional scenario had been added for the year 2030[18].

For Belgium specifically, the main starting point in terms of objectives and ambitions in the FDP was still based on the NECP published end of 2019[19], in the absence of renewed NECPs the increased EU ambitions were taken into account by creating two additional scenarios (FF55 and ReEU). The goal of the AdeqFlex 2023 study is to anticipate as much as possible the update of the NECP which is unfortunately only foreseen mid 2023 (after the final scenario data for this study are frozen). In light of this, a lot of work has been performed to refine the assumptions on the demand. Amongst others, the demand forecast has been updated such that:

- These include a better refinement of the assumptions on EVs and heat pumps by taking into account the latest regional policies and trends per region and sector.
- Elia Group has performed a viewpoint[20] in collaboration with some key industrial players and organizations, which allowed to obtain a detailed (bottom-up) view on their decarbonisation objectives and strategies. One of the key take-aways from this study was the focus on electrification (in the form of power to heat, CCS, data centers…) already in the period before 2030.

[17] REPowerEU: affordable, secure and sustainable energy for Europe (europa.eu)
[18] This scenario called ReEU was created even before the publication of the official RepowerEU plan on 18/05/2022
[19] Nationaal Energie- en Klimaatplan 2021-2030
[20] Powering industry to net zero by eliagroup - Issuu

- Since the publication of the FDP, Europe has been faced by high energy prices. Therefore, a methodology has been developed to take into account the impact of high prices on the electrical demand.

STAKEHOLDER	FEEDBACK RECEIVED
CREG	8. De CREG heeft dan ook een aantal vragen en bemerkingen over de evolutie van de elektriciteitsvraag. […] − Quelles sont les hypothèses de pertes réseau prises en compte ? Leur évolution tient-elle compte d'une part croissante d'autoconsommation ? − Comment Elia justifie-t-il la croissance organique de la demande ? Une décroissance de cette demande tenant compte des mesures d'efficacité énergétique n'est-elle pas plus réaliste (renouvellement de l'électo-ménager énergivore,…) ?

ANSWER:

Regarding CREG's question on the grid losses, Elia would like to precise that the grid losses are now split on the latest update (see Figure 5). Note that the estimates of grid losses (transmission and distribution) were updated in January 2023 with the latest load trajectories.

.The transmission losses are calculated on a transmission grid model taking into account the development of generation (including decentralized generation), evolution of load, EU market flows as well as a best estimate for the localisation of future load and generation. The effect of decentralized generation on the power exchange at the interface between transmission and distribution in then taken into account.

Regarding the DSO losses, Elia doesn't have the ability to calculate such losses and considers then, starting from the values observed in 2021, an evolution in line with the evolution of residential load, tertiary load (which includes EV & HP).

As illustrated on the updated load figure, the projections lead to an increase of the losses towards 2035, mainly driven by the increase of the load but also by the evolution of the federal grid (e.g. development of an offshore network and connection of offshore production, upgrade of overhead lines (HTLS), flows on the HVDC cable).

On the evolution of the organic demand, the load update is based on the CLIMACT projections presented during the Adequacy Working Group in August 2022. The projections done in August 2022 used the latest available macro-economic indicators published by the Federal Planning Bureau in June 2022. The evolution of the organic growth is mainly driven the tertiary sector added value, but also influenced by other factors such as population growth, … Regarding the energy efficiency, the model does consider energy efficiency in all demand sectors, in different sub-categories (building – renovation, appliances incl. lighting, heating and cooling, processes in Industry and Agriculture, etc.). A continuous improvement in energy efficiency is considered throughout the time horizon.

STAKEHOLDER	FEEDBACK RECEIVED
CREG	8. De CREG heeft dan ook een aantal vragen en bemerkingen over de evolutie van de elektriciteitsvraag. − In welke mate wordt bij de bepaling van de vraag rekening gehouden met de impact van hoge Europese energieprijzen en dus een mogelijke delokalisatie van de productie van goederen naar niet-Europese landen (“Make-or-Buy decision”)? De CREG meent dat deze economische realiteit moet worden opgenomen in het basisscenario. […]
Febeliec	On electricity demand, Febeliec is disappointed to see that Elia applies the macro-economic forecast of the Federal Plan Bureau of June 2022 as one of the main bases of its analysis, as this data and analysis clearly predates the summer period with absolute price records on the European gas markets and related extreme price levels on the electricity market. These very high prices have lead to significant demand side response and even demand side destruction, as can be observed in Elia’s own offtake and consumption data. Febeliec insists that at least for this component an additional update is conducted of the data in order to include these negative effects on demand and ensure that no overestimates of potential adequacy concerns are identified because of erroneous inputs. On the comparison of Elia’s estimates with different other studies, it is extremely important to identify that all studies have as a base assumption that all current industrial production (as well as other economic activities) will be maintained in Belgium, which is in light of the extreme impact of the current energy crisis on price levels, especially in comparison with most of the rest of the world where such price increases are inexistent or much less pronounced, is not guaranteed. The current high prices could lead to a permanent negative impact on economic activity in Belgium and Europe and would then also have a negative impact on overall energy and electricity demand. By not including updates on the economic impact of the recent high prices in its analysis, Elia might overestimate the needs concerning adequacy in Belgium and at least a sensitivity taking into account the negative impact hereof, which Febeliec still hopes to avoid if sufficient measures are taken to ensure the survival of the economic tissue in Belgium, should be considered. Febeliec further also wants to refer to its previous comments on Elia’s continuous estimates of increases in electricity demand in Belgium which never truly materialized (and for which Febeliec has already several times suggested an exercise in validation of Elia’s ability to correctly forecast future electricity demand based on its assessment sin previous studies), especially since also this year, taking into account the impact of the high prices, real electricity consumption will be lower than Elia’s forecasts and will also lead to a lower starting point for any future increases in a post-crisis landscape (whenever this might occur as the impact of the crisis seems to extend beyond the short term). Febeliec remains very surprised to see that Elia estimates that total electricity demand over the next decade spurts to never seen absolute levels. Febeliec furthermore appreciates that Elia (finally) has started providing bottom-up analysis on a.o. electrification of transport and heating (where Febeliec has to indicate that it is within the short timeframe foreseen for this consultation very difficult to validate or not the proposed data and methodology).

ANSWER:

When CLIMACT presented the update of the load in August 2022 the load, CLIMACT also presented a methodology to account for the impact of the high energy prices on the electricity consumption in Belgium. This methodology was developed during the summer 2022, based on a study from academics partners of CREG[21]. The impact analysis only focussed on the use of electricity in residential and tertiary buildings, as Elia did not observe any decrease in the industrial electricity consumption over the first half of 2022, the industry was still progressively recovering its pre-COVID levels of load. More information on the methodology applied by CLIMACT can be found in the slides presented during the Adequacy Working Group of 25/08/22[22].

In the last months of 2022, a reduction in demand in industry has been observed in Belgium. Therefore, the price sensitivity of high prices on industry has now explicitly been taken into account in this updated base scenario for this Adequacy & Flexibility study.

On the use of the macro-economic forecast of the Federal Planning Bureau of June 2022, Elia would like to recall no other updated macro-economic projections usable by the CLIMACT model is available for an update. However, it is also the reason why the impact of high energy prices on the residential and tertiary consumption was considered. Elia agrees that the industry consumption has been also impacted in the last months of 2022 and therefore proposes to consider also an impact on the industry load in the updated proposed load projection.

This base scenario considers thus both a lower residential & tertiary load and a lower industrial load. This base scenario demand for Belgium does not take into account a possible rebound effect of the economy, as experienced for instance after the COVID-19 pandemic. While the economic growth for Q4 2022 was expected to be negative, the draft values published by the National Bank of Belgium on 30/01/2023 show that there has been a little positive growth[23]. This a why a sensitivity with a rebound effect for the short term could be analyzed. More recently, the IEA has published its 2023 electricity market report[24] predicting such a rebound effect to be observed in the coming years. Such aspect will be considered as sensitivity in the study and was also part of the recommendation that Elia provided in the context of the LCT scenario for 2024-25.

Elia considers that the assumption of 'constant' industry level in Belgium is inherent to the definition of a base scenario, as no definitive closure of industries for high electricity prices as been observed in Belgium. Some companies have reduced/stopped their production but almost none have declared a definitive closure. Moreover, the European Commission has recently presented its Green Deal Industrial Plan[25] which presents goals and measures to increase investment and production of technologies and products critical for the green transition, as well as ensuring the EU's security of supply and strategic autonomy in key sectors. Therefore, in the base scenario, the implicit assumption remains that industry does not relocate. However, Elia agrees that a sensitivity on the industrial load can be relevant in the context of this study.

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[21] Hindriks and Serse, The Incidence of VAT Reforms in Electricity Markets: Evidence from Belgium, 2021, International Journal of Industrial Organization

[22] https://www.elia.be/fr/users-group/adequacy-working-group/20220825-meeting

[23] nffe22iv.pdf (nbb.be)

[24] Electricity Market Report 2023 – Analysis - IEA

[25] https://ec.europa.eu/commission/presscorner/detail/en/ip_23_510

CREG	47. Sur quelles hypothèses reposent la construction des profils horaires de consommation (croissance économique, croissance de la population, efficacité énergétique? Kunnen de uurprofielen van het elektriciteitsverbruik voor elk klimaatjaar worden gepubliceerd alsook de verschillende componenten ervan (EV, HP, ….)?

ANSWER:

The hypothesis used to determine the total load are explained above for the organic load – incl. existing industry and grid losses, the hypothesis for electrification of mobility and heat, additional electrification of the industry and new data centres are explained in the next section. The construction of the profiles is not done ex-ante but is a result of the simulation as part of the load is flexible and thus optimised within the simulation. The starting inflexible load profiles are based on historical data. Regarding the profiles for electric vehicle and heat pump, the methodology can be found in DELTA-EE document and also partially recalled in the dedicated section of this section.

On the publication of the hourly profiles, Elia will include different indicators on the consumption profiles in the final report such as peak consumption, distribution of peaks… as Elia understands that this information can facilitate the comprehension of the final results by the stakeholders. On the raw data, it is Elia's intention to always act towards a better understanding of the results but this cannot happen through a massive pack of raw data.

5.3.2 Electrification

Industry & data-centers

STAKEHOLDER	FEEDBACK RECEIVED
FEBEG	'Electricity demand Elia expects a strong increase of demand in the coming years following further electrification. FEBEG supports such vision and also expects a strong impact of the electrification of the demand in the next years.
CREG	[55] … Les projections relatives à l'électrification de l'industrie, de la mobilité et du chauffage reposent sur des hypothèses. Il serait dès lors utile d'évaluer l'impact d'un scénario "low demand" sur l'adéquation.
Keep The Lights On	'Figure 18 [*Additional electrification in the industrial sector (on top of organic growth of existing electricity demand)*],: the 'high' curve could consider some additional capacity for projects not yet the object of a request.
Febeliec	For the electrification of industry, Febeliec wants to refer to its previous comment on the base assumption underlying Elia's demand forecast, which might due to the crisis no longer be guaranteed.

ANSWER:

Regarding the additional demand due to new industries, fuel switching and data centers, the forecast is a result of the work done in relation to the viewpoint performed by Elia Group on industry[26]. This study was published on 18/11/2022, hence not all results and details could yet be taken into account for the public consultation of this study. This includes quantified trajectories for industrial demand up to 2050 as well as intermediate values for 2030 & 2040. The forecast for 2030 is based on real-life observed requests from Elia-connected clients and in depth consultation with different industrial companies, sectoral organisations and researchers.

Since the study focused on target years 2030, 2040 and 2050, efforts were made to refine the proposed trajectory for the yearly evolution between 2023-2035. This was done by taking as much as possible known commissioning dates into account (both publically announced and bilaterally communicated with Elia).

The final trajectory is presented underneath:

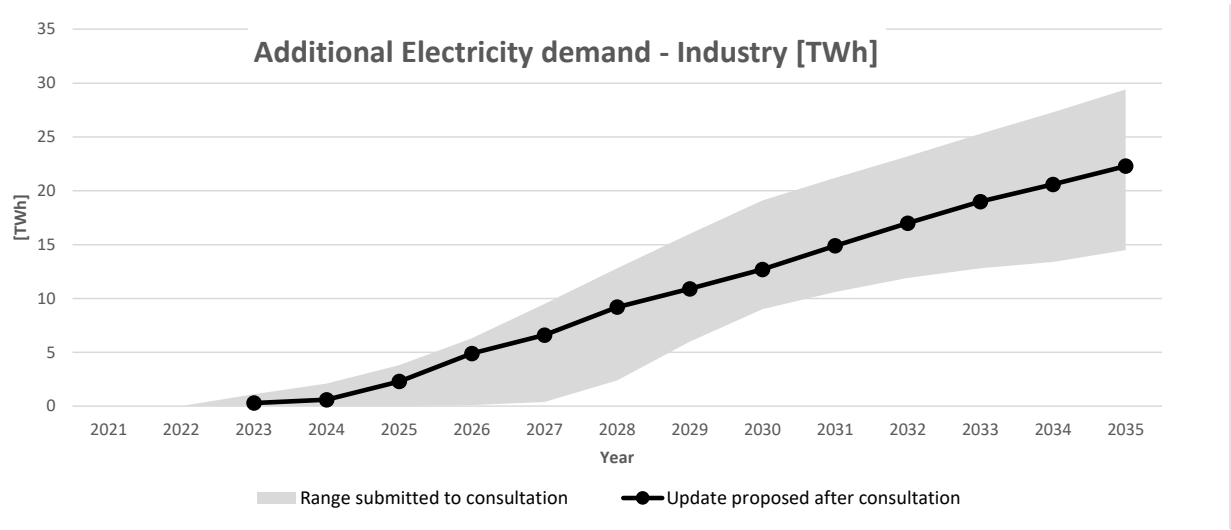

Figure 6 Additional electricity demand in the industry - range submitted to consultation and update proposed after consultation*

** Note that this total electricity demand is an estimate, as part of the consumption linked to the 'Power-to-heat' will be determined when performing the market simulations as those are used when electricity prices are below a certain level (see 5.3.2 DSR Industry).*

[26] Powering industry to net zero by eliagroup - Issuu

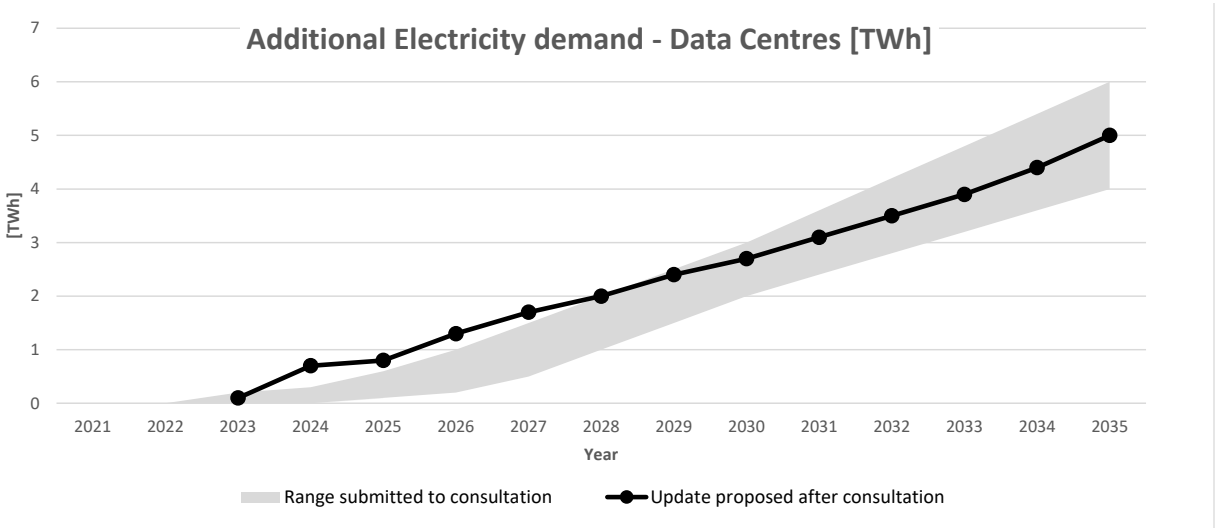

Figure 7 Additional electricity demand for the data centres - range submitted to consultation and update proposed after consultation

The trajectory presented indeed shows a best estimate 'base case' scenario, Elia agrees to also propose a low demand sensitivity where several of the electrification projects are delayed and/or are not completed. Such sensitivity could also be constructed by considering slower uptake of transport or heat electrification.

Similarly, a higher demand can also be considered taking into account an acceleration of certain projects or new projects not yet considered in the figures.

Regarding the remark on the base assumptions for industry Elia refers to the response in 5.3.1 model & impact high prices.

Heat pump

STAKEHOLDER	FEEDBACK RECEIVED
CREG	− Elia considère que le nombre de logements neufs va se maintenir à son niveau observé les cinq dernières années. Cette prévision devrait être revue à la baisse tenant compte de la forte réduction des demandes de permis observée en 2022. Cette remarque vaut aussi pour les bâtiments dans le secteur tertiaire. − Une estimation du nombre de logements neufs est établie sans distinguer la part des appartements et des maisons, or, au cours de la dernière décennie, le nombre de permis accordés à des appartements est majoritaire. L'impact sur la consommation a-t-il été pris en compte ? − Le taux de pénétration des pompes à chaleur dans les logements existants dépendra essentiellement de la rentabilité de l'investissement. Or, les hypothèses prises ne semblent pas en tenir compte. − Selon Stabel, la Belgique compte actuellement 5.680.956 logements. Or, en 2022, Elia évalue le nombre de pompes à chaleur à 544.000, ce qui représenterait 9% du "stock". Si ce "stock"

	représente le nombre de logements, ceux-ci représenteraient 6.044.444 unités. Elia peut-il justifier cette différence ? − Pour évaluer la consommation électrique des pompes à chaleur, Elia a-t-il tenu compte du stock de secondes résidences pour occupation occasionnelle ?
Keep The Lights On	- The energy needed for heat pumps is largely underestimated and does not consider the inefficiency of the system at lower temperatures.

ANSWER:

Regarding the 'stock' of heating appliances, it must be noted that both primary and secondary units for heating are counted. For example, a house with a gas boiler as main heating sources and a reversible Air-Air heat pump will be counted once under 'gas boiler' and once under 'HP AA (secondary)'. This is also especially the case for biomass (mostly wood stoves). Hence, the number of heating units is larger than the number of households. It must be noted, however, that these secondary heating units are assumed to supply only a share of the annual heating needs of a household as these usually only provide heat in a limited number of rooms and/or as additional heat source.

In order to obtain the best estimate of the current installed base of heat pumps, Elia updated the installed base by taking into account the most recent sales data from 2022 received from the ATTB.

Zooming in specifically on heat pumps there were around 21k Air-water, 6k Ground-water and 120k Air-Air (reversible units sold in 2022. As explained during the public consultation, the functioning of those Air-Air (reversible) units is not always clear. After discussion with sectoral organisations ATTB & FRIXIS, it is assumed that these units are used mostly as back-up heat and/or limited to a specific area of a dwelling. Hence it is proposed to assign 80% of these units in the Air-Air (secondary) category whereas the remainder is assumed to be a main heating system. Applying this reasoning gives following installed stock of heat pumps in the residential sector:

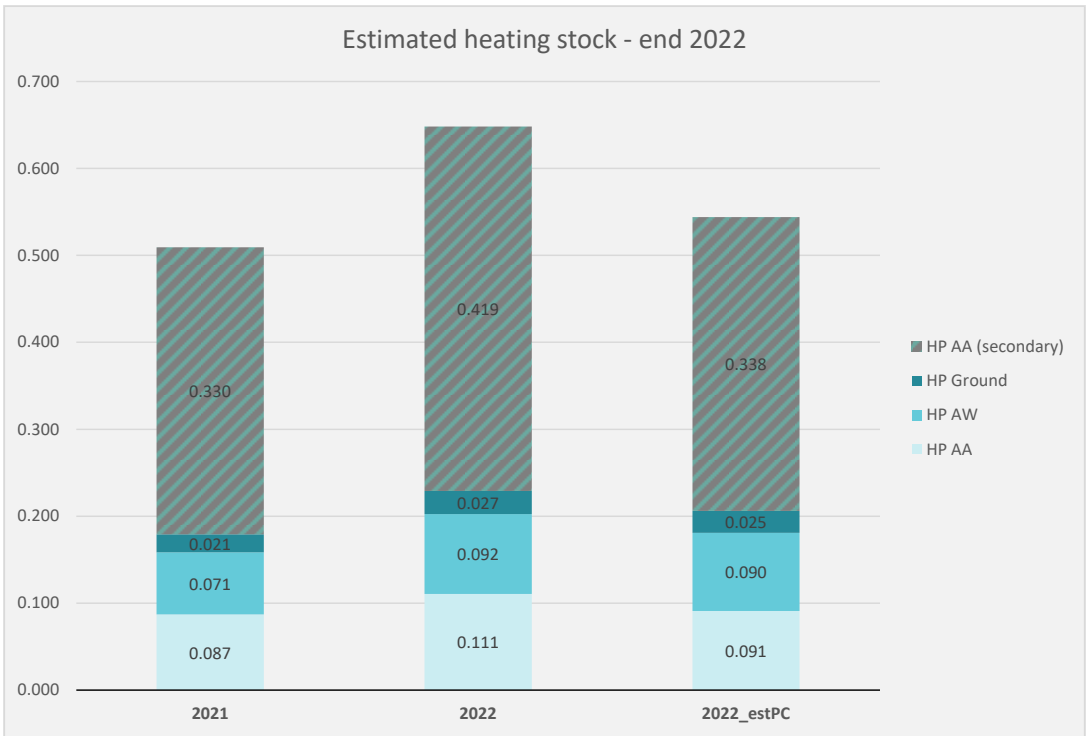

Figure 8 Estimated heating stock by end 2021, stock by end 2022 (latest estimates from Jan. 2023), and stock by end 2022 as estimated in the public consultation (Oct. 2022)

In the meantime Elia proposes to refine its assumptions for the heating demand for households based on data shared by Fluvius on the average heating demand for space and water heating per EPC class[27]. It is proposed to take for the heating demand of a new building the value corresponding to EPC A and for a renovated building the value corresponding to EPC C. Furthermore, the heating demand of Air-Air (secondary) units has been revised downwards to take into account the fact that these units do not deliver all heating needs of a household.

	Unit	Submitted to consultation	Updates after consultation
New buildings	thousand/y	55	55
Renovation rate average 2022-2035	%	1.00%	1.00%
Average Heating demand - new build	kWh/y	6500	4400
Average Heating demand - renovated building	kWh/y	10 200	8000
Heat supplied by secondary heater	%	Modelled as hybrid HP[28]	0.5
Average Hot water demand	kWh/y	1600	1800

Table 1 parameters related to heat pump projections

These updated assumptions give the following updated results on total heating demand:

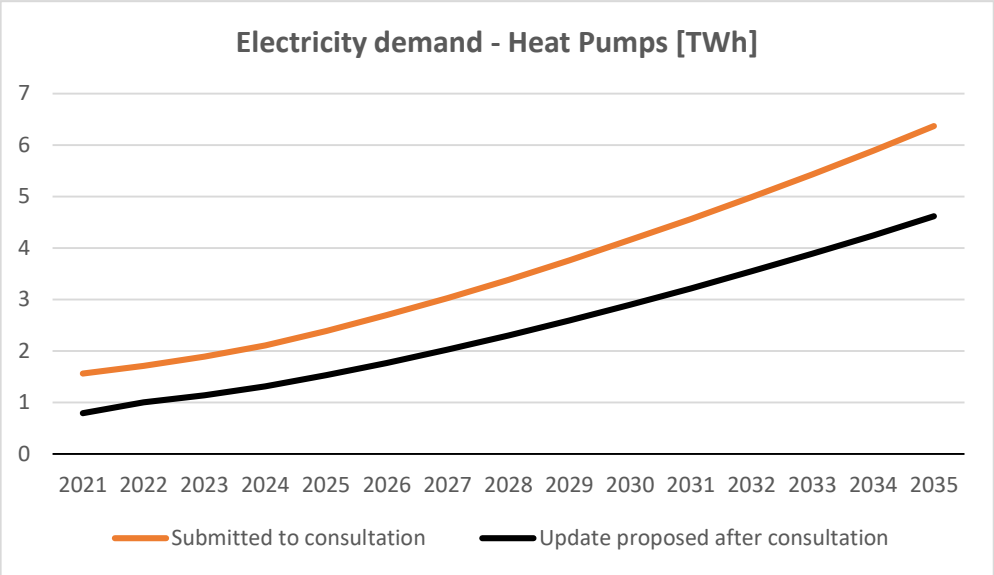

Figure 9 Proposed trajectory for the consumption of the heat pumps

Regarding the remark on the evolution of new buildings, the mentioned decrease in number of new building permits does not yet seem to materialize when looking at the most recent data available via Statbel[29]. Extrapolating the value until 08/2022 to the whole year gives around 55k new units for 2022, similar to previous years. Hence, Elia proposes to keep the value as such.

[27] This concerns measured heating demand data for more than 2M residential consumers

[28] Meaning heat supply switches to back-up only below 5°C

[29] Bouwvergunningen | Statbel (fgov.be) – consulted in January 2022

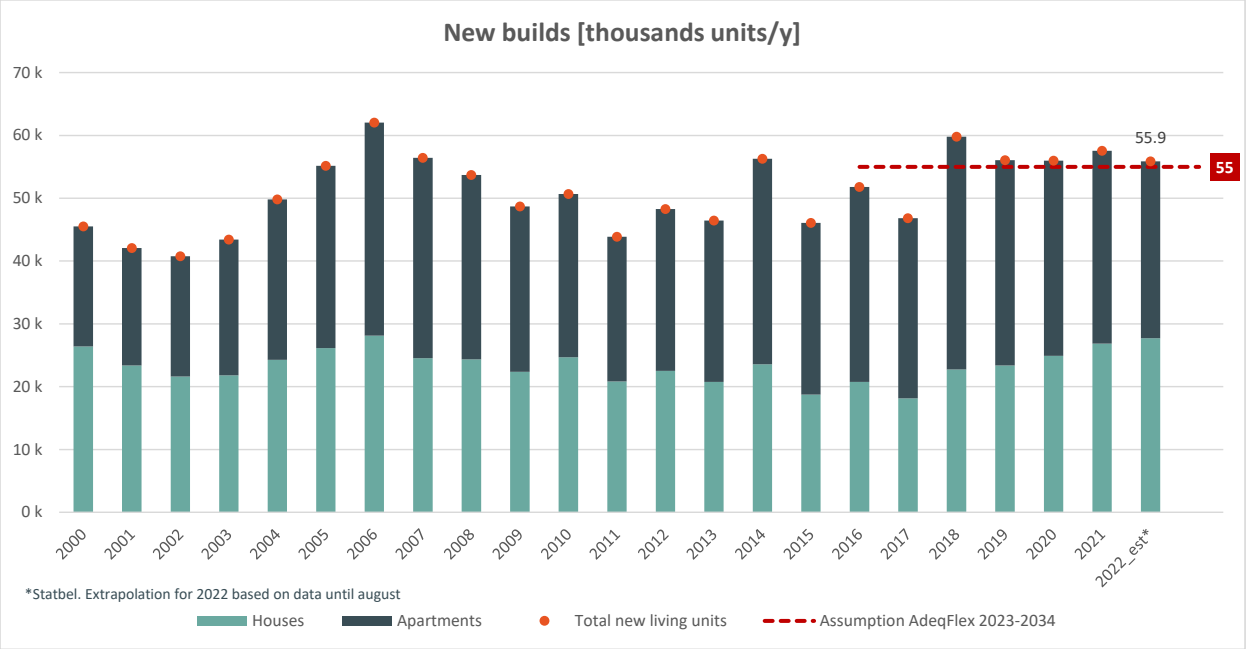

Figure 10 Proposed assumption on the new builds

Regarding the difference between heating demand in new built apartments and houses, the values taken for heating are based on measured data from Fluvius in buildings with an EPB score 'A'. It is assumed that this same proportion of houses/apartments will continue in the future, hence the heating demand of a given new building is assumed to remain the same. In the historical data there is no clear trend in more/less apartments in new buildings, with even a seemingly more important share of houses in the last 5 years:

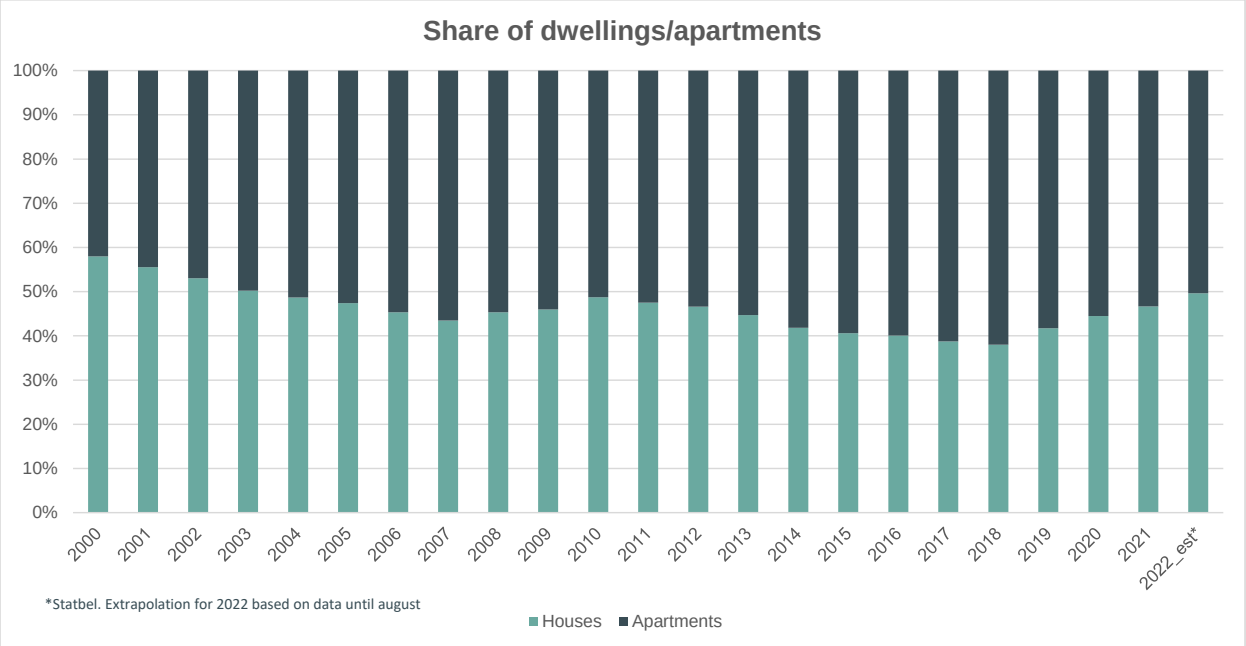

Figure 11 Historical share of dwellings/apartments

Regarding the remark on the profitability of heat pumps, the estimation was based as much as possible on policies and latest trends. For some of these (for example the phase-out of new gas connections in Flanders) the drivers are not purely financial. Although no legal obligations exist in renovations, a modest increase of the installation of heat pumps is assumed, as there is a consensus that their increased uptake will be required to meet climate targets in the near and long term.

The split between primary and secondary residencies has not explicitly been made. There does not exist a single data source which contains data with this granularity. Elia uses heating demand as measured by Fluvius in a sample of dwellings containing both primary and secondary units, hence using the average of this data already includes the reduced demand of a secondary dwelling.

Regarding the additional energy needs due to heat pumps, it is correct that these units have a decreased efficiency at lower temperatures. The COP curves which show the relation between outside temperature and heat pump efficiency are shown in the methodological appendix on 'hourly electricity consumption' (Figure 3). For the required annual heat, historical heating demand values are used based on measured data from Fluvius.

Electric vehicle

STAKEHOLDER	FEEDBACK RECEIVED
CREG	9. La CREG formule plusieurs remarques concernant les hypothèses retenues pour l'électrification du secteur des transports : − Elia ne justifie pas le choix de retenir l'hypothèse selon laquelle la consommation d'électricité annuelle d'une PHEV est deux fois moins élevée que celle d'une BEV; − La CREG tient également à souligner que plusieurs études sur l'utilisation en situation réelle des PHEVs ont prouvé que ces modèles de véhicules sont conduits bien moins en utilisant le moteur électrique que ce que les différentes procédures d'homologation le supposent. En particulier, selon une étude de l'ICCT , la part moyenne de conduite électrique en conditions réelles est d'environ 45 % à 49 % pour les voitures particulières et d'environ 11 % à 15 % pour les voitures de société. En revanche, la procédure officielle WLTP suppose que la part de la conduite en mode essentiellement, mais pas totalement, électrique est d'environ 70 % à 85 %. Ces résultats laissent supposer que l'hypothèse retenue par Elia concernant la consommation électrique annuelle des PHEVs par rapport à celle des BEVs pourrait être une hypothèse forte ; − Les résultats de l'étude de l'ICCT mettent également en lumière les différences d'utilisation qui existent entre les voitures privées et les voitures de société. Cependant, la CREG note qu'Elia ne fait pas de distinctions entre les voitures de société et les voitures privées au niveau de la consommation électrique pour le segment 'véhicules particuliers'. Ainsi, la CREG est d'avis que les prévisions de la consommation d'électricité résultant de la pénétration des véhicules PHEVs en Belgique pourraient être surestimées. La CREG joint à sa réponse à la consultation publique l'étude réalisée par l'ICCT intitulée 'Real-world usage of plug-in-hybrid vehicles in Europe – A 2022 update on fuel consumption, electric driving, and CO2 emissions'.
FEBEG	However, the penetration of EVs seems underestimated compared to regional ambitions.
Keep The Lights On	We see major shortcomings and underestimations in the forecast of the energy demand: – Recent studies pointed out that only the electric lease cars in Belgium would require an extra power plant like Doel 4. So expanding electric vehicles to the full fleet of Belgium comes with an extra demand of several times the current total energy.

ANSWER:

Based on the latest figures available from FEBIAC[30] it is clear that 2022 recorded a record low of 366k passenger car units sold.

The sector has been significantly faced with supply chain issues. However, latest months saw an uptake of sales (+20% dec 2022 vs dec 2021 and +17.4% jan 2023 vs jan 2022) as compared to last year. Elia proposes to keep the assumption of 415k new units sold yearly in the period 2023-2035 as it could be expected that car sales recuperate once supply chain issues are overcome (but still remain below pre-crisis levels).

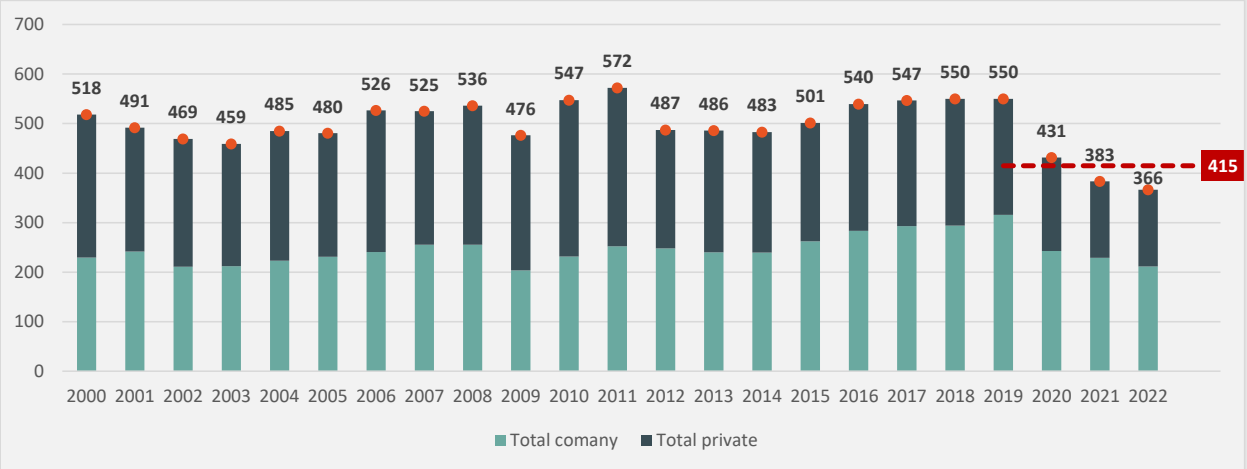

Figure 12 Historic evolution of the numbers of new company and private cars and the proposed value to consider in this study

In 2022, 26.5% of new vehicles were either EV or PHEV, of which around 90% of these were company cars. The estimated[31] stock of electric vehicles is slightly higher than was estimated during the public consultation:

[30] Analyse du marché automobile belge en 2022 (febiac.be)

[31] Estimated since only sales data for 2022 is available at this stage, no stock data

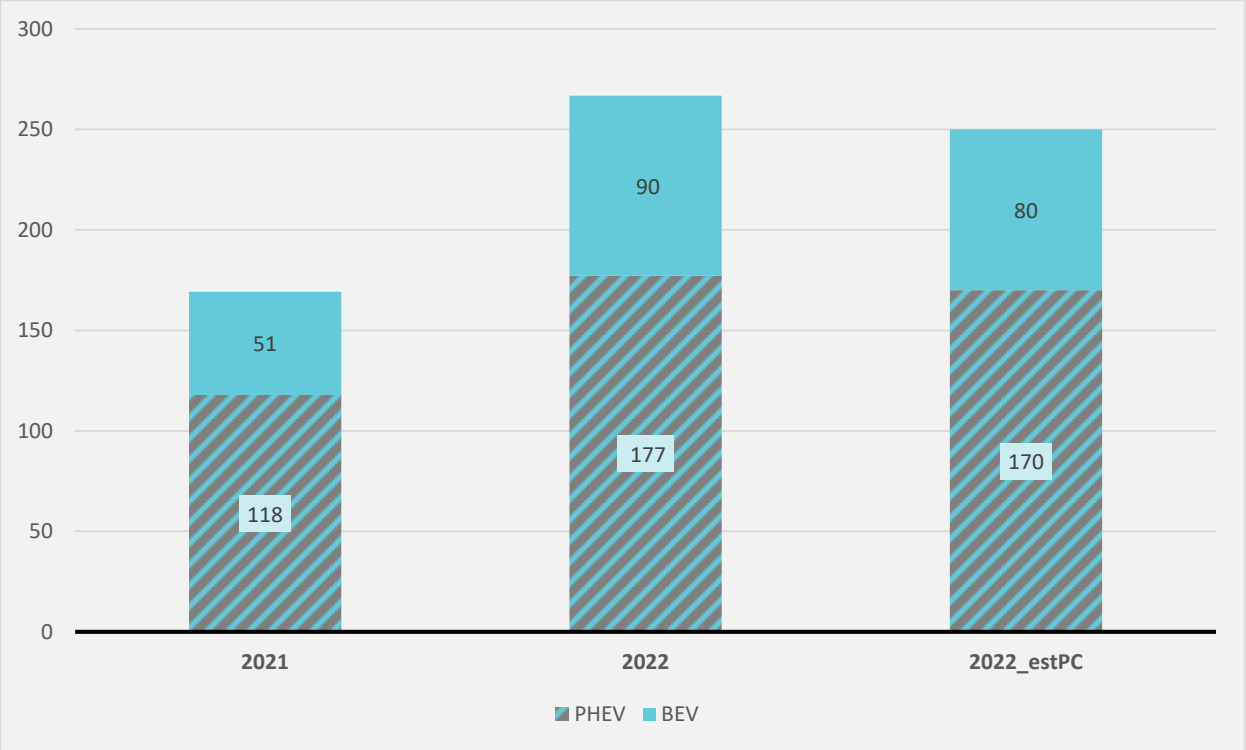

Figure 13 Estimated stock of Plug-in Hybrid EV and Battery EV by end 2021, estimated stock by end 2022 (latest estimates from Jan. 2023), and stock by end 2022 as estimated in the public consultation (Oct. 2022)

Elia thanks the CREG for sharing the study on the effective usage of PHEV within Europe. The original assumption that 1 PHEV ~ ½ BEV was conservatively derived from the assumption used by the Plan Bureau[32] where a PHEV has an assumed efficiency of 14kWh/100km as compared to 19kWh/100km for a BEV (meaning that the implicit assumption here is that 1 PHEV ~ ¾ BEV).

As electrification will most likely take place more rapidly in the company car segment, Elia agrees that different usage depending on the segment should be taken into account. As only a small sample size within Belgium is used within the referenced study, Elia proposes to take the European average usage of PHEV into account, such that:

- Private PHEV are used in electric mode for 47% of the kilometres.
- Company PHEV are used in electric mode for 13% of the kilometres.

At the same time, Elia is convinced that a more granular assumption must be taken concerning the effective usage of passenger cars. The original assumption of 14600 km/year concerns the historical average of the total passenger car stock in Belgium. However, when taking into account detailed data from FEBIAC[33], it is clear that company cars have a yearly mileage which is almost a factor 2 higher as compared to privately owned cars. Applying this factor, while keeping the 14 600 weighted average of the current vehicle stock gives a mileage per type of car:

- Private car: 12 350 km/y
- Company car: 22 750 km/y

Taking into account both adjustments, the impact on annual electricity demand specifically for electric passenger cars is shown in the figure below. Note that the impact of the reduction of the 'electric' mode within PHEV is quite limited,

[32] VOORUITZICHTEN (plan.be) – page 12, table 4

[33] 2.E.3.s. MONITOR 2017 - Principales caractéristiques des voitures et voitures de société.xls (live.com)

this is explained by the fact that PHEV are assumed to reach their peak in the company car segment by 2026 at around 350k units, and decreasing from there to nearly 0 by 2035. The impact of the mileage differentiation is more profound due to the fact that the company car segment is assumed to be electrified first with a larger distance travelled per year and hence annual energy need as compared to private cars.

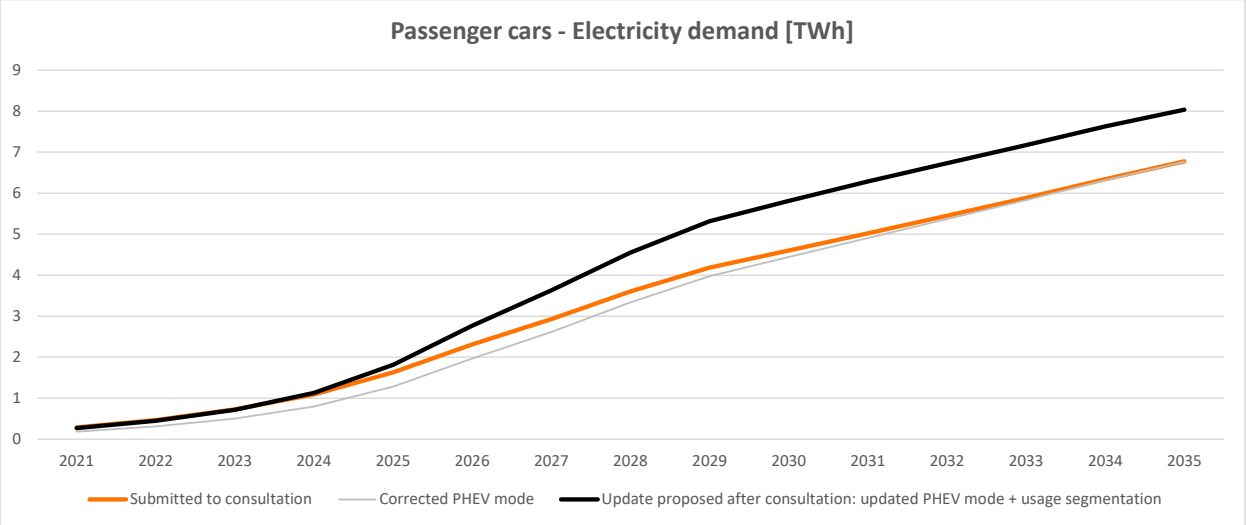

Figure 14 annual electricity demand (TWh) from passenger car usage

Regarding the point on the regional ambitions put forward by FEBEG, it must be noted that those regional ambitions are as much as possible taken into account:

- Flanders: even though point B.2 in the updated VEKP of 2021[34] is not to be considered a binding obligation, the phase out of ICE car sales by 2029 is explicitly taken into account as an assumption.
- For Brussels Capital Region: The low emission zone obligations are directly translated in a stop of diesel (2030) and gasoline (2035) car sales in this region.
- For Wallonia, no explicit targets have been identified. Here the EU phase out of ICE cars by 2035 and Belgian Federal tax measures for company cars are taken into account.

Regarding the feedback from 'Keep The Lights On', currently there are around 1.25M company cars on the road. Of which the total is assumed to remain constant towards 2035. The evolution of company cars (EV+PHEV) is shown in the figure below, which show that the segment is almost fully electrified by 2029 (either EV or PHEV) with a corresponding annual demand reaching almost 5 TWh by 2030, based on the mileage and efficiency explained above.

[34] (4) VR 2021 0511 DOC.1237-1 Visienota VEKP Bijkomende maatregelen.pdf (energiesparen.be) – point B.2

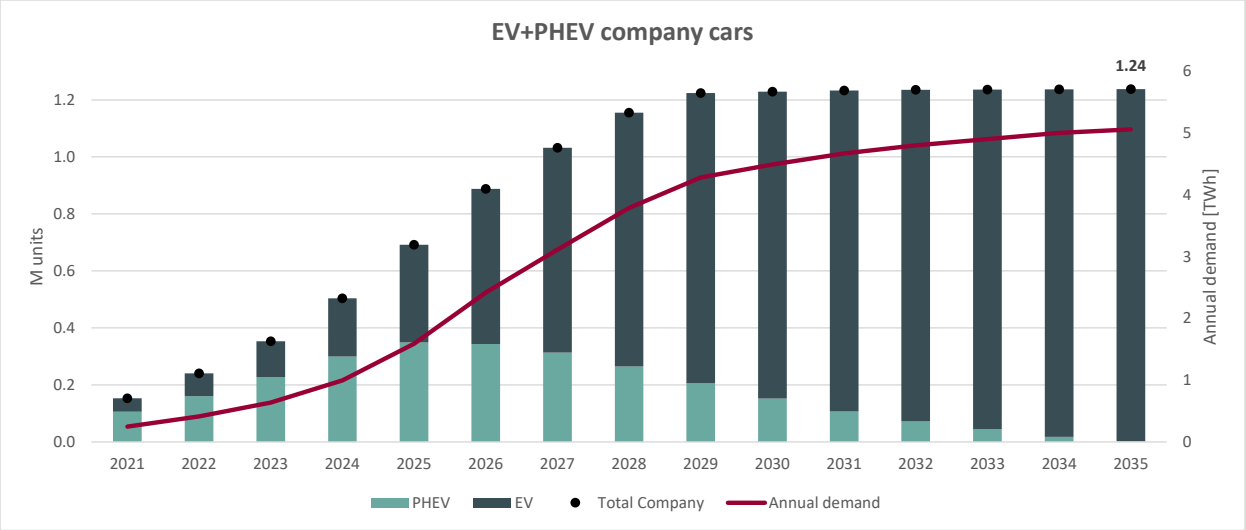

Figure 15 Proposed trajectory for the number of company cars

On the topic of heavy duty vehicles (trucks), Elia proposes to foresee an increase in the uptake of electrification as compared to the values initially proposed. The EU "Regulation 2019/1242" sets CO_2 emission performance standards for new heavy-duty vehicles of -15% and -30% respectively for 2025 and 2030[35]. Elia consulted with FEBIAC, which is of the opinion that such targets can only be reached by truck manufacturers switching from traditional drivetrains (i.e. diesel) to low carbon ones (such as battery electric).

In concrete the assumptions have been revised such that 30% new truck sales in Belgium are battery electric for 2030, 70% for 2035. This leads to around 25k unit in 2035 as shown in Figure 16.

[35] Carriages preview | Legislative Train Schedule (europa.eu)

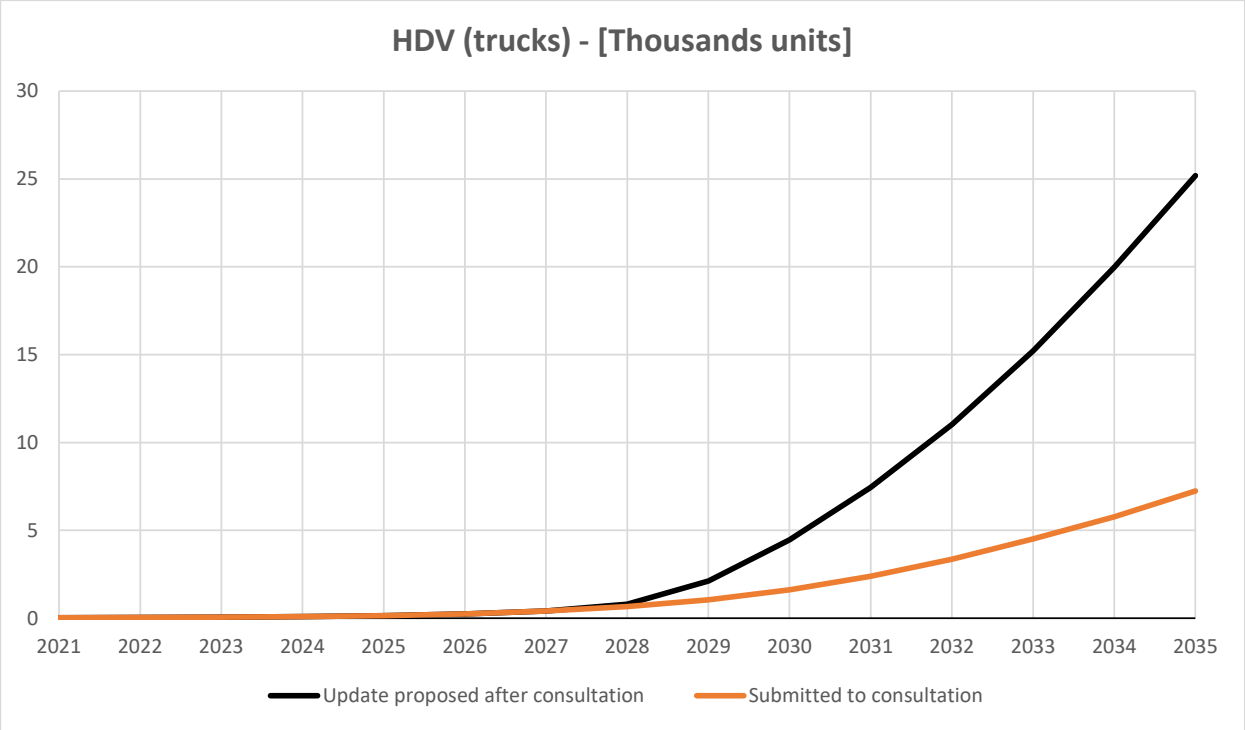

Figure 16 Proposed trajectories for the HDV (trucks)

5.3.3 Electrolyser

STAKEHOLDER	FEEDBACK RECEIVED
Febeliec	'Febeliec also wonders how the impact of electrolysers will be modelled, as this information is also not provided yet it is very unlikely that electrolysers will be running baseload or at moments of high demand/adequacy concerns, with correlated (very) high prices.
CREG	− Comment la production/consommation d'hydrogène est-elle modélisée ? (notamment comme substitut à l'électricité pour la propulsion des véhicules lourds). Une sensibilité pourrait en tenir compte. Elia n'a pas fourni d'informations sur les hypothèses retenues concernant le développement de la capacité installée d'électrolyseurs qui pourrait atteindre 373 MW en 2030 et 743 MW en 2034. Elia n'a pas non plus indiqué si les prévisions de la demande totale d'électricité prenaient également en compte la demande indirecte d'électricité pour la production d'hydrogène. Si ce n'est pas le cas, Elia devrait fournir ces prévisions.
CREG	15. Le profil de charge des électrolyseurs devrait être communiqué. Elia n'a pas non plus fourni d'informations sur les hypothèses retenues concernant le développement de la capacité installée d'électrolyseurs. Enfin, Elia n'a pas indiqué si les prévisions de la demande totale d'électricité prenaient également en compte la demande indirecte d'électricité pour la production d'hydrogène. Si ce n'est pas le cas, ces prévisions devraient être fournies.

Citizen Task Force - Groupement de Citoyens Belges Inquiets	L'illustration 10 mentionne "excluant la demande electrolyseur" > pourquoi les exclure, où est-ce considéré ?
Keep The Lights On	2.4.1 figure 10 mentions "excluding electrolyzers demand" - Why? Where are they considered then? For each graph, we advise to add previously modelled data with actual data to give the reader an impression about the accuracy of previous projections and discuss the relevance of the current margins considered.

ANSWER:

Concerning electrolysers, Elia confirms that the figures of total electricity consumption put forward during the public consultation exclude the electrolyser consumption. The operation mode of electrolysers is modelled explicitly in the simulations and hence its consumption is an output of the simulations, therefore not included in the consumption assumptions. It is assumed that electrolysers will not run baseload, but only when the price is lower than a certain threshold. Such assumption makes those devices not impacting the adequacy requirements calculated in this study. If electrolysers would also consume electricity during scarcity situations, adequacy requirements would then be increased by a similar amount of capacity assumed. Such approach could be dealt via a sensitivity in the study if deemed relevant.

The electrolyser capacity foreseen for the time horizon considered is based on the foreseen projects and official ambitions. As mentioned in the Excel file, the SPF Economy has published in October 2022 the update of its "Vision and strategy Hydrogen"[36] in which it is stated that *"Belgium has therefore set itself the target within the national Recovery and Resilience plan of having at least 150 MW of electrolysis capacity into operation by 2026".* Elia sees no reason to deviate from this short-term trajectory in the base scenario.

5.4 Demand Side Response in Belgium

5.4.1 DSR industry

STAKEHOLDER	FEEDBACK RECEIVED
CREG	11. DSR from industry − Pour les projections de court terme, Elia devrait envisager une baisse de la demande en réaction aux prix élevés de l'électricité ainsi qu'une augmentation de la flexibilité de la demande. − Fixer le plafond de DSR en 2034 à 25% de la pointe actuelle de consommation n'est nullement justifié. Des données observées en 2022 ne peuvent servir de référence pour 2034. Ce potentiel maximum devrait reposer sur des hypothèses spécifiques à l'évolution du secteur industriel en termes d'évolution du parc des gros consommateurs industriels et d'électrification de ce parc.

[36] https://economie.fgov.be/sites/default/files/Files/Energy/View-strategy-hydrogen.pdf

Febeliec	Febeliec also wants to clearly state that it has provided ample comments over the years (whether those are considered fundamental or not might be perceived different by Elia than by Febeliec), but remains a.o. with many questions regarding the way demand side response will be quantified for this study (related to the E-Cube study for which no new methodology has been proposed and for which Elia agreed that the currently applied methodology is not robust nor qualitative enough to discern a realistic overall demand side response reaction and potential).
Febeliec	On demand side response, Febeliec appreciates that Elia is providing a more detailed, bottom-up, quantified approach but wants to refer to its previous remark on the E-Cube study and the issues related to that analysis. Febeliec also insists that Elia includes the recent experience regarding demand side response (and even demand side destruction) in reaction to the (very) high prices in its analysis, as this provides valuable insight in potential reactions to high prices in periods of adequacy concerns and the related scarcity and high prices.
Febeliec	Febeliec also wants to refer to its previous comment on emergency generators, as it is unclear in which category they are tackled. Febeliec wants to stress that in Belgium literally 100s of MWs of emergency generators are installed, with its own members already having massive volumes of emergency generators (in at least one case even 100s of MWs for certain grid users), not even taking into account he 100s of MWs installed at a.o. hospitals, where a CREG study indicated an installed capacity of at least 200 MW. Due to the lack of any quantitative (or even qualitative) breakdown or background of the proposed values Febeliec can thus not validate any of them, but can only indicate that it is very concerned that the provided values underestimate reality
Febeliec	On unit commitment and economic dispatch, Febeliec does not validate the approach of modelling demand side response as “expensive generation units”, as it wants to refer to its comments on the (lack of an update of the) E-Cube study, where the current high (gas) prices lead to ample issues with estimations for demand side response in the current merit orders of the exchanges. Febeliec is worried that the combination of both approaches could lead to a severe underestimate of demand side response, as Elia’s own load and offtake data show more than significant reductions in the last months. If such demand side response (or even demand destruction) in light of high prices is not correctly captured, any potential future risk for adequacy will be overestimated and lead to additional yet unnecessary costly measures. Febeliec also wonders why in the assumptions for the assessment of short-term flexibility, demand side response is modelled as unlimited, 1h, 2, 4h and 5h, and not 8h as is the case in other analyses of Elia.
FEBEG	'Demand Side response FEBEG observes very optimistic assumptions on the evolution of market response capacity in Belgium. The forecast for industrial Demand Side Response (DSR) in Belgium is very high compared to neighboring countries. Table 1 presents a comparison between the proposed AdFlex assumptions (1.8 GW existing and an additional potential of 450 MW in 2025), and the values from ERAA2022 for the neighboring countries. When accounting for the size of the countries, it is clear that this forecasts for Belgium is high. We understand that the estimation for the existing industrial DSR is based on analysis from E-Cube for the winter 2021/2022, characterized by exceptionally high natural gas and power prices. Therefore the question arises whether this period can be extrapolated to the future. The

	sustained high power prices has lead to reduced industrial output, creating DSM capacity in the industrial sector. Therefore, the potential to react to prices could be artificially high. Consequently, we consider that Elia should be more prudent when extrapolating future DSM volumes. A too-optimistic view on these volumes could undermine perceived risks in terms of security of supply. In addition, it would be more prudent to back up the statical analysis with a more fundamental view: - Which industrial sectors contribute to DSR and in which industrial sectors do we expect further growth? - Is there a real commitment from the industry to further increase its ability and willingness to adjust its power demand to prices? Finally, on the methodological side, the statistical analysis from E-Cube, reveals a relatively important standard deviation, e.g EPEX 2021/2022, average 1.2 GW, Standard Deviation 0.3 GW. Is this uncertainty around the availability of DSR taken into account in the adequacy simulation?
100TWh	Next, 100TWh doesn't accept the evaluation of Demand Side Response. We wonder how those loadshedding contracts will be developed. In particular how much time industries will agree to be disconnected from the grid? We are very astonished by the Elia's figure of 25% of companies that are ready to cut their electricity supply on demand ! This is by far too simplistic and need a much finer evaluation !
Citizen Task Force - Groupement de Citoyens Belges Inquiets	Page 27 [*Figure 18 Additional electrification in the industrial sector (on top of organic growth of existing electricity demand)*], quelle est la portion considérée flexible ? Nous recommandons de rester réaliste, il n'est pas raisonnable de considérer que l'ensemble sera flexible. Aussi, sur quelle durée de privation ?
Keep The Lights On	Just above fig 18 "It must be noted that a significant share of this additional electricity demand is focused on the electrification of heat (industrial heat pumps, electric steam boilers, electric ovens…) & other types of flexible devices. Therefore, not all of this demand will result in additional peak demand and will likely be able to deliver flexibility services." What portion of these users is considered "flexible"?
Febeliec	On hourly electricity consumption, Febeliec wonders (as this input is to its knowledge not provided) how Elia will model the electrification of industry and its impact on hourly electricity consumption as it is clear that future consumption patterns will in many cases diverge from the current practice, as already can be observed in some investments (e.g. building overcapacity to be able to capture price spreads).

ANSWER:

Regarding existing capacity, the installed capacity is based on the study performed by E-CUBE, considering an extrapolation assuming a growth rate of 8% (highest rate from the E-CUBE study) for the assumed existing capacity end 2022. While Elia agrees that the method for the estimation of installed DSR as applied in the E-Cube study[37] should be updated to be better suited to a context with very high volatile electricity prices, there are currently no better estimates of the installed DSR volume for Belgium available. Belgium is also to date one of the few countries performing

[37] https://www.elia.be/en/users-group/adequacy-working-group/20220913-meeting

such a study. The growth rate applied for the trajectory is in line with historic trends and therefore there is no reason to deviate from the trajectory for the short-term. Elia would like to clarify that this DSR is only related to the 'existing' industry and does not consider additional electrification of the industry.

As explained in the Electrification section (5.3.2), it is expected that several industries will electrify their processes as published in Elia's study "Powering Industry towards Net Zero"[38]. This additional consumption comes with additional flexibility that is detailed just after in this section, where a bottom-up approach has been applied.

Regarding the question of CREG and 100TWh on the maximum potential additional DSR related to the 'existing' industry, Elia would like to clarify how the estimation is done. It corresponds to 25% of the total peak load for Belgium today (all sectors, not only the industry) which is therefore an overestimation of the potential. Such value corresponds to the maximum potential of the Gils study[39]. Other studies that have looked at the potential of DSR in Belgium obtain much lower values (e.g. Sia Partners[40]). Elia agrees that this potential can be seen as optimist as it is way beyond any study on the potential of DSR. Elia considers performing sensitivities on the foreseen trajectory.

On the topic of the flexibility potential of new electrification in industry, the potential depends largely on the origin on the type of demand. As shown in Figure 17, new demand can generally be split into 5 categories:

- Power to heat – heat pumps: additional electricity demand due to fuel switching, generally from gas to electricity and for processes which require heat <200°C. Their uptake is mostly expected in the food&drink, chemical, and paper industry. In a first phase it is expected that most of these systems are installed in combination with (existing) fossil based systems. This allows a hybrid running mode, using electricity when prices are low and vice versa. Due to their high efficiency, these units typically have a high amount of running hours;
- Power to heat – e-boilers: additional electricity demand due to fuel switching, generally from gas to electricity and for processes which require heat >200°C, typically steam. Here uptake is especially expected in the chemical industry and for the high temperature processes in the food & drink industry. As for heat pumps, it can be assumed these are installed in combination with (existing) fossil based systems, allowing a hybrid running mode. Using electricity when prices are low and vice versa. Since the efficiency is equivalent to that of traditional gas boilers, these units will have a lower amount of running hours than industrial heat pumps, typically being activated when units with low marginal cost are setting the price;
- Direct reduction Iron – electric arc furnace (DRI-EAF): This is a technology for making primary steel by first reducing iron ore with gas (and potentially hydrogen) after which it is finally treated using EAF**.** Especially the electric arc furnaces require a lot of additional electricity. However, it is estimated that due to build out of excess capacity, there is a potential for load shifting within a given timeframe while still meeting production targets.
- Carbon Capture and Storage (CCS): Different options exist to capture the CO_2 from industrial processes, however, all of these require additional electricity. It is expected this technology will take of in the petrochemical, cement and steel industry. Theoretically, it could be possible to deliver some flexibility, either by storing for the solvent and only heat the solvent when the market prices are low and/or to make a valve where you

[38] L'étude d'Elia Group « Powering Industry towards Net Zero » met en avant un besoin clair de l'industrie : l'électrification combinée à un accès à une électricité bas carbone, à des prix stables et abordables

[39] Gils H C 2014 Assessment of the theoretical demand response potential in Europe *Energy* **67** 1–18

[40] Demand Response : A study of its potential in Europe (sia-partners.com)

can choose to run the waste gas through the CCS system based on market prices. However, due to the high CAPEX costs and additional complexity, the potential flexibility from these processes are estimated low.

- Data centres: a gradual increase of data centres is expected already in the very near term. These have typically very baseload electricity requirements and a very high cost in case of failure and/or black-out. Hence, even though these units have back-up generators, the value of flexibility is considered low.

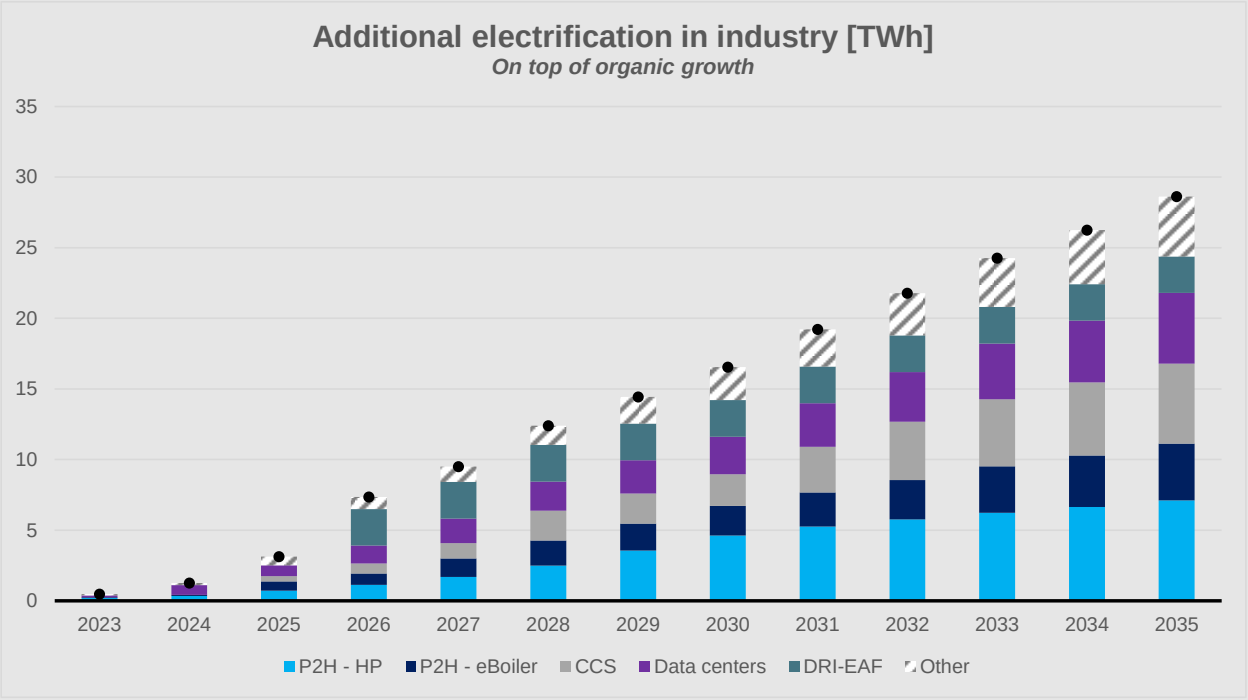

Figure 17 Proposed trajectory for the additional electrification in the industry, split per DSR type [TWh]*

** Note that this total electricity demand is an estimate, as part of the consumption linked to the 'Power-to-heat' will be determined when performing the market simulations as those are used when electricity prices are below a certain level (see 5.3.2 DSR Industry)*

Focusing on the potential flexibility that these forms of electrification can supply, Elia proposes to use different assumptions per type of demand. Note that for "Power to heat" technologies the activation price depends on the relation between the efficiency of the electric technology and the gas back-up, the gas price and the CO_2 price[41]. Sensitivities on the considered additional DSR could be performed.

Demand type	% of the load which is flexible (base scenario)
P2H - Heat Pumps	50%
P2H – e-boilers	100%
DRI-EAF	40%
CCS	0%
Data Centers	20%

[41] Meaning a different strike price is assumed per simulated year

5.4.2 DSR residential & tertiary (incl. DELTA-EE study)

STAKEHOLDER	FEEDBACK RECEIVED
Febeliec	Febeliec appreciates that Elia has included a more detailed approach towards demand side response from the residential and tertiary sector, yet regrets that the short timeframe foreseen for this consultation makes it very difficult to validate or not the proposed data and methodology.
CREG	12. Le profil de charge normal d'un véhicule électrique extrait d'une étude anglaise de 2018 constitue-t-il une référence pertinente pour la Belgique en 2024-2034 ? Le tarif jour/nuit devrait au minimum être pris en compte pour dévier du profil de charge "naturel". 13. Le profil de charge tient compte d'un rechargement quotidien. Or, l'autonomie d'un VE ne le nécessite pas pour de nombreux utilisateurs. Cette flexibilité de réaction à une annonce de tension sur le système devrait être prise en compte.
Citizen Task Force - Groupement de Citoyens Belges Inquiets	Certains de nos membres sont usagers d'EV et chargent en bornes publiques. Celles-ci sont parfois limitées en durée d'utilisation. Il n'est donc pas envisageable de rendre ces bornes flexibles, mais de les catégoriser en "natural" pour éviter les longues files d'attente !
Keep The Lights On	A few questions surrounding the adoption of EVs: – Figure 23: EV public charging points should not be considered as flexible as it could be anticipated that those points will be subject to limited time (in order to make them available for several EVs per day). Therefore an EV parked in a public charging point should often be considered charging. – Figure 23: what would be the impact of an EV being used as a home battery (with a bidirectional charger)? – Figure 26: is it considered that EV charging (even with smart flexible solutions) would still charge directly to a minimum level before enabling flexibility (natural first until for example 50% charge then only flexible)?

ANSWER:

About the charging profile, it is not expected that natural charging would be significantly impacted by any difference between the United Kingdom and Belgium. Elia would welcome relevant additional data to refine the model. This intra-day profile is supposed to be a statistical representation of the whole fleet: meaning some EVs will fully charge on some days, where some EVs will not charge, but on average, this is the profile which is expected to be observed form a TSO point of view. In other words, Elia does not model each EV individually but rather a statistical representation of the whole fleet.

The change in future charging profile over the 2024-2034 period is taken into account by a growing share of EVs charging with different "flexibility mode" (eg: V1H, V2H).

Regarding the estimation of flexibility among the base of asset, the portion of the asset base considered flexible is described in the DELTA-EE's report slide 23 for EV and slide 39 for HP.

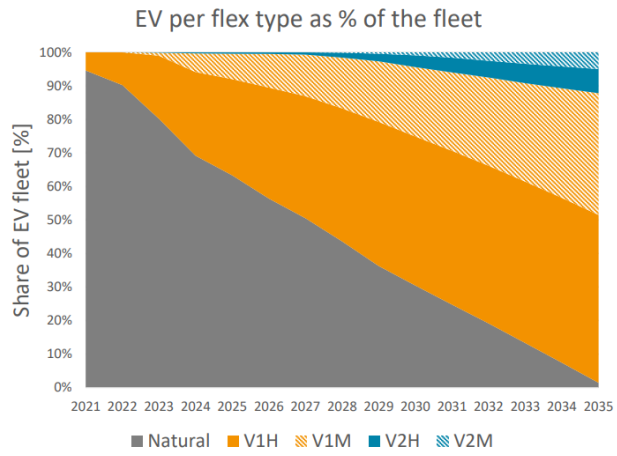

Figure 18 – [Slide 23 of DELTA-EE's report] proposed trajectory for the share of flexible EVs.
V1M and V2M cars are dispatched by the market in the model. V1H and V2H cars have a charging profile different than the natural profile, as described in the Excel submitted to consultation.

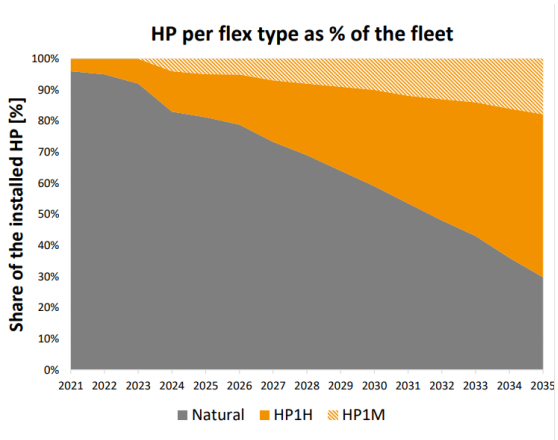

Figure 19 [Slide 39 of DELTA-EE's report] Proposed trajectory for the share of flexible HPs.
HP1M are dispatched by the market in the model. HP1H have a load profile different than the natural profile, as described in the Excel submitted to consultation

On the charging infrastructure, Elia would like recall that the nature of the charging point impacts directly the flexibility available. These can be smart / dumb uni-directional / bi-directional and public / home-based. The flexibility offered by each category is not the same. In the modelling, no flexibility is considered from public charging points (see also DELTA-EE report submitted to consultation, slide 40).

Regarding the state of charge, Elia assumes the following assumptions:

- Elia does not model the state of charge of every EV but rather an average representation of the whole fleet.
- For EV following a fixed load profile (natural, V1H or V2H), the state of charge is not considered as (i) the load profile covers the average daily energy needs and (ii) the average daily energy needs are much lower than the battery size.
- For EV dispatched by the market, Elia made sure that EVs should start each day with a battery charged to at least 50%.

On the use of an EV as a home battery (with a bidirectional charger), Elia recalls that part of the EV fleet is considered using V2G and being dispatched by the market, meaning that charging/discharging will occur at the most opportune

times for the market. This is shown in the DELTA-EE report, slide 23. According to the later report, the best estimate is not to consider all EVs as able to provide bi-directional flexibility because either the charger or the cars needs to be equipped with the technology. DELTA-EE expects this technology to be available in a share of new sales as of 2025.

5.5 Economic and technical variables

5.5.1 Fuel & CO2 prices

STAKEHOLDER	FEEDBACK RECEIVED
Citizen Task Force - Groupement de Citoyens Belges Inquiets	'L'étude précédente d'Adequacy mentionnait un prix de la tonne du CO2 beaucoup plus faible que les nouvelles valeurs considérées ici. Or, la projection pour les futures années, même si elle augmente, l'augmentation reste beaucoup trop faible par rapport à la tendance récente. Quelle est la source utilisée?.
CREG	'16. Elia indique que méthodologie pour les prix de carburant et du CO2 pour l'année 2022 est basée sur une moyenne historique. Cependant, Elia devrait préciser les années prises en compte pour le calcul de cette moyenne. Elia indique que les prix de long terme sont définis par le scénario 'Announced Pledges' du WEO 2022. Cependant, Elia n'a pas fourni de justifications sur le choix de ce scénario au détriment des deux autres ('Stated Policies', et 'Net Zero'). Une justification devrait être communiquée.
Febeliec	'On Fuel and CO2 Prices, Febeliec appreciate that the data of the latest WEO 2022 are sued and asks for a sensitivity analysis (in both directions) to be able to evaluate the impact of a strong increase or decrease of these prices on the analysis
Fluxys	'Fluxys recommends to use ZTP index for the future gas price to be used in the simulations for Belgium (instead of TTF or NBP).
Keep The Lights On	c. Gas prices are non-compliant with current levels and also the forecasts are not in line with what experts say the prices will be in the years to come.
Keep The Lights On	Figure 30 : CO2 prices - what are the sources? Given the increase over the last few years, the projected growth seems far too low. Especially as it was already too low in the previous adequacy study compared to the actual price observed recently (40€/t compared to 80 seen).

ANSWER:

Elia would like to state that any relevant sources and additional information or analysis is welcome to further improve this study. Elia acknowledges that the current prices are very volatile and has therefore proposed to update the fuel and CO2 prices based on the latest forecast of future prices available on the market when performing the simulations. Compared to what was submitted in the public consultation, the latest forward prices are proposed to be used for fuel and CO2 prices for the years where those are available. For the years where such prices are not available, an interpolation towards the World Energy Outlook published by the IEA end of October 2022 is done. This is to date, to our knowledge, the latest study that was published with such estimations. The latter study also contains several scenarios: Stated Policies, Announced pledges & Net-Zero. The scenario proposed to be used by Elia as reference is the "Announced Pledges" which assumes that all aspirational targets announced by governments are met on time and in full.

This is aligned with the philosophy used for other input variables (renewables installed capacity, number of EVs, number of HPs) which aims to be in line with announcements & pledges made by the EU & countries in the geographical scope of the study.

In the past studies, sensitivities on carbon and gas prices were taken into account. The proposal of Elia is to perform such sensitivities for the upcoming study as well. Indeed the very volatile context and the many uncertainties regarding those can have an impact on the economic results of the study.

A remark has been made on the index used for gas prices, that ZTP index would represent best the gas prices in Belgium. However, as exchanged bilaterally with Fluxys, there are no long term forward prices on the ZTP index. Hence, Elia suggests to still use forward prices based on TTF index that has several years of forward prices.

Note that as these prices are very volatile (as they have been for the past year), Elia takes a month average of these market forward prices.

Regarding the CREG comment on 2022 average CO2 prices, Elia apologizes for the unclear formulation. The paragraph the CREG is referring to should have been phrased like this: “No forward prices have been found from the UK CO2 market, the same methodology is applied than for EU CO2 prices, but with a different starting point. This starting point is on average of CO2 UKA ETS from 2022."
To clarify further, Elia assumes a CO2 price for 2022 of respectively 75 EUR22/t for the EU and 80 EUR22/t for the UK. Then these prices are interpolated according to the methodology described in the main document of the public consultation. The reader can find a depiction of the historical CO2 prices on the EMBER carbon viewer (https://ember-climate.org/data/data-tools/carbon-price-viewer/).

5.5.2 Investment costs

STAKEHOLDER	FEEDBACK RECEIVED
Keep The Lights On	Prices used in the study are underestimating the real cost: a. certainly for wind/solar as the ghost capacity needed to cover the non-operational time (about 90% for solar and between 70% and 80 % for wind) are not considered in the price of this renewable energy. This is misleading and disinformation. b. The system cost of renewables (primarily wind and solar) is not considered adequately. Scholars claim that the integration cost may equal up to 3x the production cost.
CREG	18. Selon les informations dont la CREG dispose, les montants de CAPEX pris en compte dans l’étude adeqflex de 2021 pour les unités CCGT et OCGT étaient supérieurs aux coûts d’investissement réels. L’étude Afry se limite à fixer un taux de croissance sans évaluer le montant auquel il est appliqué. Ceci donne des coûts d’investissements qui restent trop élevés et sont de nature à fausser l’EVA. Quelle que soit la terminologie utilisée par le consultant dans son étude, Elia doit utiliser les termes légaux. En conséquence, “WACC” doit être remplacé par le terme “rendement minimum” et “hurdle premium” doit être remplacé par “prime de risque”. Elia devrait notamment préciser les durées de construction prises en compte et la façon avec laquelle les intérêts intercalaires sont pris en compte dans l’EVA.

	L'annexe relative à l'EVA mentionne la prise en compte d'autres flux de revenus. Quel est leur mode de calcul ? La consultation aurait aussi dû porter sur ce point. Les durées de vie économiques des nouveaux projets devraient être allongées : 25 ans pour les nouveaux projets de CCGT, OCGT, CHP et 50 ans pour les nouveaux projets de PSP.
Febeliec	On investment costs, due to lack of time allowed by the consultation period, Febeliec cannot at this point provide an in-depth review of all assumptions made by Elia, in particular also related to the hurdle rates (see also below).
Keep The Lights On	'We deplore that in the text (p37) (*Table 1 Investment costs and parameters for the different technologies proposed for this study)* the new generation power plants aren't considered. However, they might be the solution to maintain supply stability and keep the cost acceptable.
FEBEG	Investment costs FEBEG supports the assumptions taken in terms of price evolutions (consideration of the inflation based on IPP) but will let its members comment on the CAPEX level considered for the different technologies.
Organisatie Duurzame Energie	[PV] Met betrekking tot de CAPEX kunnen we ons niet uitspreken over de exacte CAPEX-voorspellingen gezien we geen zicht hebben op de exacte prijzen van onze leden en dit op deze korte termijn niet anoniem kunnen bevragen. - We verwachten wel dat de inschatting die gemaakt wordt voor de korte termijn (2022 en 2023) een onderschatting is. - De vraag naar PV steeg wereldwijd en er zijn bottlenecks en prijsstijgingen voor de levering van materiaal. Vanaf midden 2023 en in 2024 zal er specifiek voor de panelen zelf extra productie-capaciteit in dienst genomen worden. - Daarnaast is er ook een beperkte installatiecapaciteit ten opzichte van de vraag, met volle orderboekjes, wat de prijzen deed stijgen. De extra productiecapaciteit lost dit probleem niet op. - Residentiële installaties zijn fors duurder zijn dan die grenzen en we zien daar de stijgende tendens op basis van volle orderboekjes. o Op basis van een markt-analyse die we elk jaar uitvoeren zien we dat de kostprijs van residentiële installaties gemiddeld 1,25 euro per Wp voor installaties van begin januari tot midden augustus. - VEKA hanteert een maximale CAPEX in het kader van call groene stroom (zie hieronder). Het is uiteraard een maximum, maar geeft enigszins een indicatie. VEKA heeft ook beter zicht op de effectieve prijzen die gehanteerd worden voor de call groene stroom, dus hen contacteren kan eventueel helpen.

ANSWER:

Regarding costs assumptions, first Elia would like to remind that the costs are expressed in Euros 2022 while the previous study was using Euros 2019. Since 2019, inflation but also costs of materials have increased. As already demonstrated by AFRY, this leads to an increase of the costs for new capacities as well.
The CAPEX costs are aim to reflect the investment in the specified technology. Those are based on a literature review of different sources. In order to better reflect the costs and based on additional information.

Based on the feedback received during the public consultation, Elia proposes to change the following figures:

For CCGT, a large amount of studies were consulted. The values are expressed in Euros2022. For studies published prior to 2022, the 'general' inflation was applied. The proposed value for large CCGTs (>800 MW) is 650 EUR/kW (compared to 750 EUR/kW initially proposed). For smaller sizes, a higher cost per MW is considered and an update is also proposed, similarly to the one applied for larger sizes. The figure below gives an overview of the values found in the literature review.

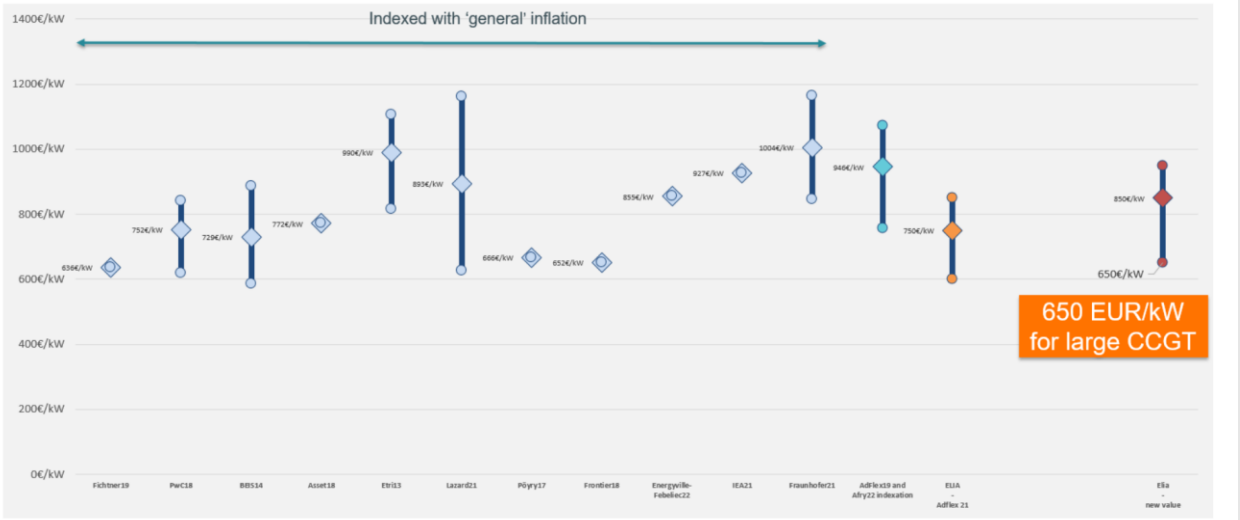

Figure 20 Literature review of CCGT investment costs (in Euros2022) and Elia's proposal

For OCGT, based on the feedback received, it is proposed to consider 550 EUR/kW for large OCGTs (>100 MW) (compared to 500 EUR/kW initially proposed). There is a wide range found in the literature and this value corresponds to the average cost per MW found in the literature.

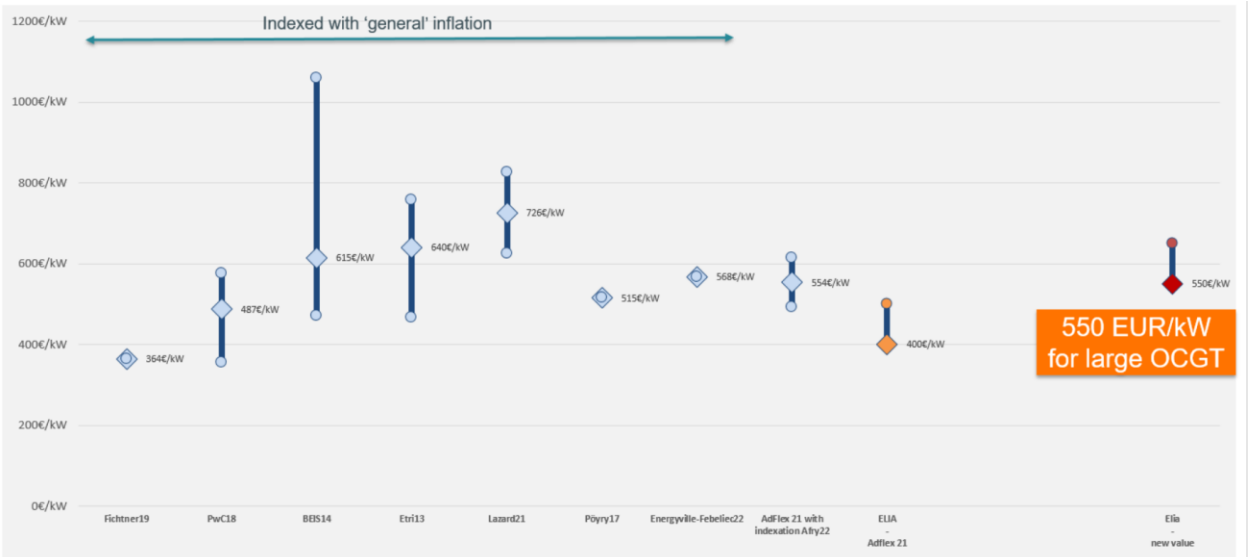

Figure 21 Literature review of OCGT investment costs (in Euros2022) an Elia's proposal

Regarding large scale batteries, given the feedback provided, the costs were updated with the most recent estimations from NREL. This leads to 1200 EUR/kW for the first 5 years considered in the study. The figure taken from the latest NREL study confirms this estimation.

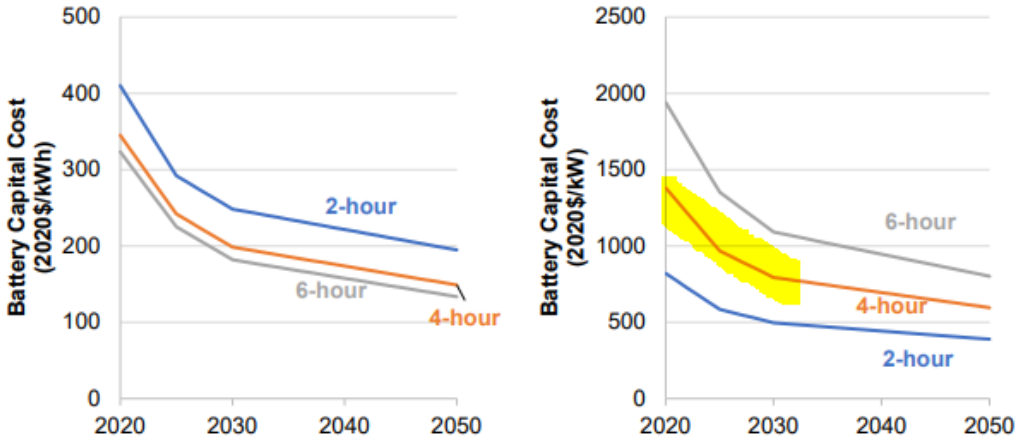

Figure 6. Cost projections for 2-, 4-, and 6-hour duration batteries using the mid cost projection.
Left shows the values in $/kWh, while right shows the costs in $/kW.

Figure 22 Cost projections for large scale batteries (source *Cost Projections for Utility-Scale Battery Storage: 2021 Update (nrel.gov))*

Regarding the other parameters of large scale batteries, the same study has performed a literature review. Based on the review it is also proposed to:

- Update the round trip efficiency to 85% (instead of 90% initially proposed). Indeed this corresponds better to what is observed in the different studies;
- Update the FOM to correspond to 20 EUR/kW (instead of 15 EUR/kW). This reflects better the average found in the literature as it can be observed in the figure below.

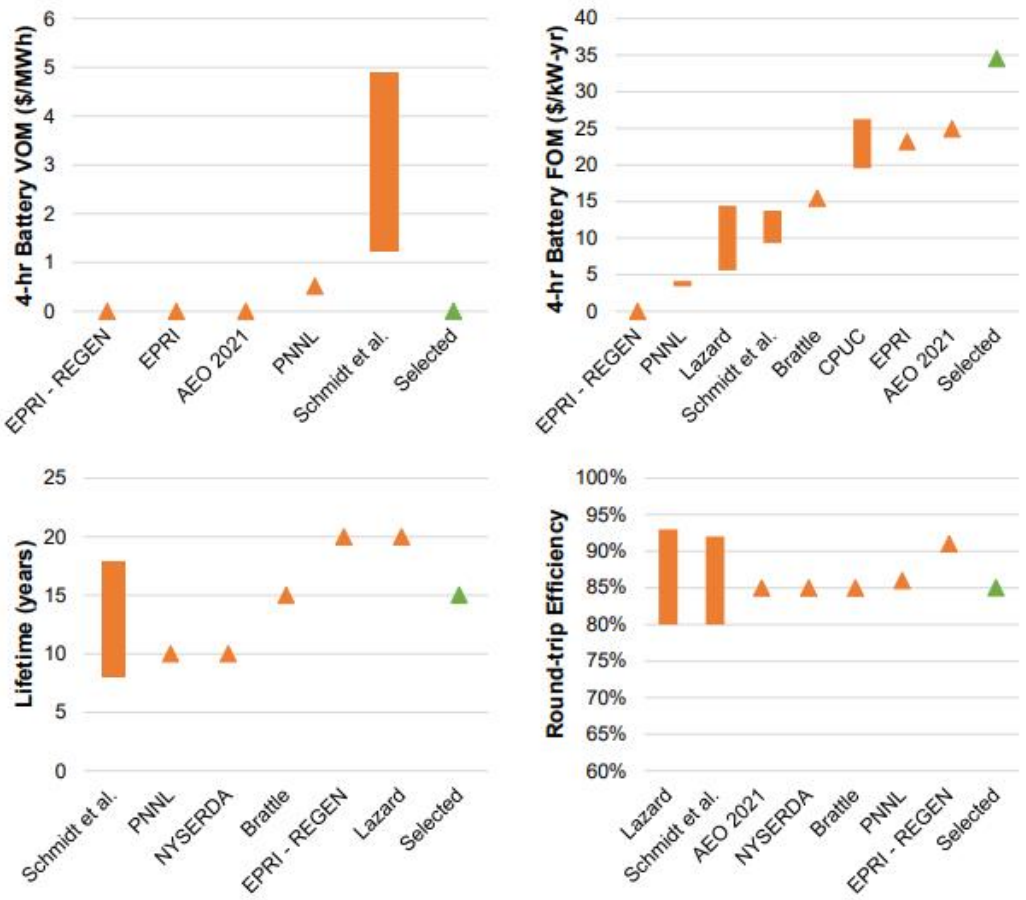

Figure 7. Variable O&M (top right), fixed O&M (top left), lifetime (bottom right), and round-trip efficiency (bottom left) from various published sources. The values selected for this study are the right-most values shown.

The lifetime we selected is 15 years, which is near the median of the published values. The round-trip efficiency is chosen to be 85%, which is well aligned with published values.

Figure 23 Variable O&M, fixed O&M, lifetime and round-tip efficiency of batteries (literature review from https://www.nrel.gov/docs/fy21osti/79236.pdf)

Regarding PV, it is also proposed to update the value with the latest IRENA study[42]. This leads to 800 EUR/kW for the first years in the study.

On Keep The Lights On feedback, Elia would like to point out that the investment costs are expressed in EUR per kW of installed capacity. It is different than the investment cost per kWh of electricity produced. Regarding the effective production, the model takes then into account capacity factors for each technology and runs hundreds of different climate years to account for a realistic final production. The integration costs are also not considered, it is the investment cost from the investor perspective that are considered.

[42] Renewable Power Generation Costs in 2021 - Executive Summary (irena.org)

In addition, even though no comments were received during the public consultation, Elia proposes to remove the 'IC gas engines' from the list of candidates as to date no known projects of this type are being developed or planned in Belgium. As replacement, Elia will consider using 'hydrogen fueled CCGT and OCGT' as from 2030 as alternative investment. For the costs, based on a literature review, the CAPEX of both technologies (running on 100% hydrogen) would be increased by 15%[43] to 30% (based on Bloomberg estimates). As from 2030, for CCGT Elia proposes to use 800 EUR/kW for a 100% hydrogen fueled large CCGT and 700 EUR/kW for a large OCGT, this is around +25% of the CAPEX costs considered for CCGT and OCGT.

Similarly for the additional pumped storage unit, Elia proposes to increase the CAPEX included in the public consultation as it was underestimated (it was based on public numbers found in 2015).
Based on NREL[44], the costs are estimated to be between $1999 to $5505/kW, for the International HydroPower Association it is estimated to be $2046/kW[45]. It is therefore proposed to use 2000 EUR/kW as basis.

The updates regarding the CAPEX costs are summarized in the table below.

		CAPEX [€/kW] in EUR 22						
		Initially proposed			Updated after PC			
		2022-2025	2026-2030	2031-2035	2022-2025	2026-2030	2031-2035	AdFlex 2021 (EUR 19)
CCGT	>800 MW	**750**			**650**			600
	400 < 800 MW	**950**			**850**			750
	< 400 MW	**1050**			**950**			850
OCGT	>100 MW	**500**			**550**			400
	<100 MW	**600**			**650**			500
Batteries/Storage	Large scale batteries (1h)	**400**	**280**	**260**	**450**	**300**	**300**	100
	Large scale batteries (2h)	**650**	**460**	**440**	**750**	**500**	**450**	NA
	Large scale batteries (4h)	**1000**	**850**	**750**	**1200**	**900**	**750**	NA
Pumped Storage - new unit	New unit in Coo	**1000**			**2000**			900
PV	New	**600**	**550**	**500**	**800**	**600**	**500**	600

Regarding the economic lifetime to be considered, Elia sees no reason to change the initially proposed values as no other sources were mentioned nor proposed as alternative.

As for the additional revenues pointed out by the CREG, ELIA would like to refer to the page 5 and 6 of the appendix on the Economic Viability Assessment (also submitted to consultation[46]) in which the way net balancing revenues and additional revenues from heat or steam are estimated is explained.

[43] Exploring the competitiveness of hydrogen-fueled gas turbines in future energy systems - ScienceDirect

[44] NREL includes pumped storage in 2022 electricity technology baseline report (hydroreview.com)

[45] 61432796645661f940f277a8_IFPSH - PSH Capabilities and Costs_15 Sept.pdf (website-files.com)

[46] Public consultation on the methodology, the basis data and scenarios used for the study regarding the adequacy and flexibility needs of the Belgian power system for the period 2022-2032 and including also the scenario parameters for the "Low Carbon Tender" 2024-25 (elia.be)

Concerning construction period, we propose to use the same values as used in the CRM[47]:

- <1 year for PV and DSR;
- 1 year for batteries, wind onshore;
- 2 years for OCGT and CHP;
- 3 years for CCGT and wind offshore.

For the capacities not included in the source used in the CRM, we would propose:

- 3 years for the biomass;
- 4 years for the pumped storage;
- 1 year for the diesels.

The CHP credit considered for the unit was inconsistent as it could lead to overall efficiencies (electricity generation and heat) higher than 100%. In order to avoid such situation, the overall efficiency (electricity and heat) will be set to 90% and hence the MWth/MWe will be set accordingly to reach the overall efficiency. The MWth/MWe will therefore depend on the electrical efficiency defined for the CHP units.

Note that based on bilateral feedback, several unit parameters were updated (mainly efficiencies).

5.5.3 Outages

STAKEHOLDER	FEEDBACK RECEIVED
Febeliec	On (forced) outage rates, Febeliec remains surprised of the very high values for some categories (e.g. CCGT, GT, Classical). Especially with the closure of assets over time, most of them presumably the oldest assets in their respective categories, Febeliec continues to find it strange that by removing those older assets, which are presumably also more prone to outages due to aging of the asset, the forced outage rate remains high (and in some cases higher than those applied in the past). Febeliec furthermore is concerned by the discrepancies which exist between Elia's internal databases and other databases such as even Elia's own Transparency Platform. Febeliec is concerned by the very small sample that was taken, as much larger samples should be available on the European level, as now some outlier years in many categories lead to surprising results and it is unclear to what extent this is merely the result of very small samples. On the impact of planned outages, Febeliec would like to get a more thorough analysis of the way Elia will calculate this for years beyond the timeframe of REMIT, as the methodology presented by ENTSO-E remains a blackbox, with however potentially significant impact for Belgium. Nevertheless, Febeliec insists that most planned outages should not have a significant impact on adequacy as they are mostly planned and conducted outside of the winter period.
CREG	The forced outage probability is determined based on the historic amount of forced outages per year, and aggregated per technology. More details on the applied method are needed to understand how the results are calculated, including which units are assumed to be operational in

[47] CRM-Note-Cout-d-un-nouvel-entrant-CONE-BE-10062022-SIGNED.pdf (fgov.be)

	a given year and how the aggregation is performed. The detailed calculations can be made transparent to better understand how the forced outage characteristics are calculated.

ANSWER:

On the comment regarding outages, Elia would like to stress that a thorough study was performed by N-Side on these outages. In this study, outage data for Belgium were combined with data from other EU countries from ENTSO-E's transparency platform. This expanded the dataset compared to previous years and gives statistically more robust results. As part of this analysis, a comparison was made between the forced outage rate of old and recent units and no significant difference was found.

For pumped storage (PSP), Elia proposes to deviate from the approach to include other countries than Belgium in the calculation of the outage rates as hydro units from other countries include run of river units which have different technical characteristics. Elia therefore proposes to calculate the outage parameters for PSP for Belgian units only, which results in a forced outage rate of 2.9%.

Regarding the CREG's comment on the methodology for determining the forced outage probability of the different technologies, Elia would like to refer to the study performed by N-Side which was published as part of the public consultation[48]. The study report gives an overview of the formulas to calculate the different parameters and how they are aggregated. The study report includes the following table:

	Planned unavailability	Forced outage
Average rate	$\frac{1}{T}\cdot\sum_{t=1}^{T}\left(\frac{PO\ energy_t}{Total\ energy_t}\right)$	$\frac{1}{T}\cdot\sum_{t=1}^{T}\left(\frac{FO\ energy_t}{FO\ energy_t + Available\ energy_t}\right)$
Average duration	$\frac{1}{T}\cdot\sum_{t=1}^{T}\left(\frac{1}{PO_t}\sum_{i=1}^{PO_t} PO\ duration_i\right)$	$\frac{1}{T}\cdot\sum_{t=1}^{T}\left(\frac{1}{FO_t}\sum_{i=1}^{FO_t} FO\ duration_i\right)$
Average number of events	$\frac{1}{T}\cdot\sum_{t=1}^{T} PO_t$	$\frac{1}{T}\cdot\sum_{t=1}^{T} FO_t$

Where T is the number of years considered
Where PO_t, FO_t are the number of events for year t

The amount of units per technology and the countries that are considered as relevant are also described in the study. All outages data reported by the units from 2015 are considered, meaning that for each technology all the units that are active in a given year are considered.

In addition as already mentioned in 5.2.4, Elia proposes to also include a forced outage rate for batteries. Elia proposes a forced outage rate of 2% for batteries, which covers various effects such as deterioration, self-discharge and the effect of temperature on battery performance[49]. The forced outage rate for batteries will be applied as a derating factor

[48] Public consultation on the methodology, the basis data and scenarios used for the study regarding the adequacy and flexibility needs of the Belgian power system for the period 2022-2032 and including also the scenario parameters for the "Low Carbon Tender" 2024-25 (elia.be)

[49] A comprehensive study on reliability performance of Photovoltaic-battery-based microgrids under different energy management strategies (aau.dk)

on the capacity of batteries. Reliable data on outages of large-scale batteries are not available as the currently installed large-scale batteries are smaller than 100 MW and are therefore not required to publish to REMIT. No other sources of outage data for specific units were found. If in the future, more data on these capacities would become available, this value could be further updated.

5.6 Grid & Flow based domains

Cross-border exchanges

STAKEHOLDER	FEEDBACK RECEIVED
Keep The Lights On	Can you please comment on how consistency between core region level assumptions is being verified? How do you ensure that each country takes compatible assumptions? For example, how do you ensure that two countries do not expect imports from their neighbours at the same time? Especially since the "climate year" statement that neighbouring countries are likely to have similar scarcity in wind/solar energy ("The meteorological data is also geographically correlated, as European countries are close enough to each other to be affected by the same meteorological effects"). The import from France and Germany often referred to, seems non-existing as France became a net importer and Germany is struggling with its own supply and had to reopen pit and coal plants.
100TWh	Finally, 100TWh doesn't agree to consider imports as a reliable source of supply. Every European country is obliged to reduce its pilotable electricity sources, like in Belgium, and in case of common electricity shortages, they will give the priority to their own consumers. Furthermore, if we apply the Belgian derating factors for their energy mix, we see that they will get in big trouble, especially the countries that have decided to suppress their pilotable sources (see annex table 2).
Citizen Task Force - Groupement de Citoyens Belges Inquiets	Comment les interactions entre les différents pays sont-elles considérées ? Est-ce qu'il est vérifié que les hypothèses sont cohérentes entre elles, que les pays prennent des hypothèses compatibles et pas opposées ?
Febeliec	'On cross-border capacity modelling, Febeliec agrees that 70% minRAM is applied, in line with the legal provisions (as all action plans will have to be concluded by 2026).
FEBEG	'Flow-based domains FEBEG considers that there remain uncertainties on whether the ambition of minRAM 70% will really be achieved as planned throughout Europe. For instance, we observe that derogations are still claimed by some countries, while for others action plans are put in place to reach the minRAM (e.g.: Germany). FEBEG considers that the risk of non-achievement of this rule should be included in the reference scenario. Considering the elements above, FEBEG would welcome following sensitivities: […] - non/strict achievements of the FB CEP rules

	[…]

ANSWER:

Elia would first like to state that the assumptions on which the flow-based models are built follow the current rules applicable to all bidding zones within the Core region. Elia therefore uses the latest currently known planned evolutions in the cross-border calculations: CEP rules, explicit and implicit market couplings, Standard and Advanced Hybrid Coupling (SHC/AHC) configurations, etc.. Those rules are common in all Core countries and hence coherent between them.

By running simulations that incorporate these market rules, no ex-ante assumptions on the energy available for import during scarcity situations are needed. Indeed, on one side, the available physical import capacity is computed and on the other side the demand, generation and storage technologies are explicitly modelled for each country. The simulations performed by Elia assess millions of hours where the European electricity market is simulated. The simulations do take the correlation of climate data into account. Assumptions for other countries are based on latest policy announcements. It is important to note that Elia will also perform sensitivities on the available generation abroad (such as done in previous studies). As in previous Adequacy & Flexibility studies, Elia will also provide information on the dependence of Belgium on imports during scarcity situations as well as on the correlation of scarcity situations between Belgium and its neighbor's (simultaneous scarcity situations) .

Finally, regarding FEBEG's comment on possible sensitivities regarding the Remaining Available Margin. Elia will consider what sensitivities could be performed to highlight the risks related to reduced available cross border capacity (such as done during the previous study). Indeed, as Belgium relies heavily on imports for its security of supply, such sensitivities can provide additional insights for policy makers on the impact of such risks.

5.7 Data for other countries

STAKEHOLDER	FEEDBACK RECEIVED
Febeliec	On other EU counties, Febeliec appreciates the transparency that is in this study given on the assumptions for a range of counties. Febeliec nevertheless continues to wonder the selection criteria for Elia to include some updates and assumptions as well as wonders which will be the cut-off point to include or not further updates (as the current winter 2022-2023 could be quite challenging and lead to many further updates and political decisions).

ANSWER:

The trajectories proposed for the other countries are elaborated based on ERAA22 database as basis, complemented with national reports or official announcements on updated targets when available. In the frame of this Adequacy and Flexibility, Elia has tried to perform, as much as possible, a continuous watch of the related news in order to adapt, if needed, the trajectories during the first weeks of 2023.

As already explained earlier in this report, regarding new information that might come after the presentation of the public consultation report, Elia will always do its best to take it into account. It should be noted that a trade-off will however have to be made between respect of the timing and the added value of such update. Therefore, it will be case

by case analysis and it is not possible to already assess what can or cannot be taken into account. Indeed, some changes can imply major changes in the models used by Elia while other updates can be integrated more easily. In any case, computation time is also required to perform the needed simulations for the study.

Keep The Light On	2.9.3 Netherlands > how is the 1.4GW hydrogen produced? The figures on p43 (concerning Germany) do not comply with real figures.

ANSWER:

According to the ERAA database, the Netherlands have foreseen to convert some coal-fueled units to biomass and hydrogen-fueled units by 2030. This assumption is also in line with the "Hogere Ambitie" scenario from the latest Monitoring Leveringszekerheid, published in December 2022[50], where it is considered that a unit (Magnumcentrale) will be switched to hydrogen in order to reduce the CO2 emissions. Even though it might seem ambitious, Netherlands have shown high ambition in terms of offshore wind and considers also electrolyser in the Netherlands[51] . Regarding this last point, the "Hogere Ambitie" scenario from the latest Monitoring Leveringszekerheid considers already 26,6 TWh of P2X in 2030, corresponding to 6GW of electrolyzers installed capacity. The Netherlands have also signed different MoU to facilitate the import of hydrogen from abroad, that would make Rotterdam an international hub for hydrogen imports[52]

On the data for Germany, Elia has performed a reality check of the 2022 values together with updates based on the latest announcements. In this context, next to the RES trajectory with the latest offshore planning, the coal capacity will be reviewed following BnetzA website and the latest announcements.

Febeliec	Febeliec also wonders whether no sensitivity should be added with additional nuclear availability (in Belgium and/or abroad) and/or retention of coal/lignite plants in light of the current discussions.
FEBEG	FEBEG also recommends Elia to carefully model the expected available capacity in neighboring countries in the short and medium term considering changing energy policies across Europe. Due to Belgium's particular situation, the availability of interconnected capacity will be heavily dependent on the situation abroad, more in particular in France and Germany. We underline that the current situation with the French nuclear units being much less available than announced, France will have to rely more on imports to ensure its security of supply, via Belgium in most cases. This will lead to higher transit flows on the Belgian network and thus heavily reduce the import possibilities for specific Belgian capacity needs and thus require more domestic capacities within the Belgian balancing zone to be available to guarantee security of supply in such cases.

[50] https://tennet-drupal.s3.eu-central-1.amazonaws.com/default/2023-01/Monitoring%20Leveringszekerheid%202022%20%28V2%29.pdf

[51] Hydrogen to Maasvlakte | Uniper

[52] Australia and the Netherlands sign milestone renewable hydrogen agreement - DCCEEW

	[…] Considering the elements above, FEBEG would welcome following sensitivities: […] - Non-availability of several French nuclear reactors (with various levels of unavailability) […]

ANSWER:

Elia agrees that sensitivities on neighbouring's countries assumptions should be carried out. Given the central position of Belgium in Central Western Europe, its high level of interconnections and its dependency on imports for adequacy, evaluating in the impact of changes abroad is a key aspect.

On the sensitivities, Elia agrees sensitivities on thermal capacity abroad are relevant:

- On the nuclear availability in France;
- On the coal capacity/lignite in Germany;
- …

The exact level of those sensitivities still needs to be defined.

CREG	20. Elia ne fournit des informations complètes sur le parc de production des pays voisins. Quelles sont les hypothèses prises pour l'évolution des capacités gaz,...ont-elles été adaptées par rapport à l'ERAA 2022? Les capacités hors marché (en réserve stratégique par exemple) doivent être prises en compte. L'actualité récente à démontrer que ces capacités étaient utilisées pour pallier un risque d'adéquation.
CREG	'55. Het basisscenario voorgesteld door Elia is onder meer gebaseerd op een aantal hypotheses en veronderstellingen inzake de beleids- en uitvoeringsmaatregelen die momenteel gekend zijn. Mogelijks leiden deze hypotheses tot situaties die quasi onrealistisch zijn. Indien de simulaties zouden aantonen dat een land, mede ten gevolge van de voorziene maatregelen, in een situatie terecht komt waarbij de geldende betrouwbaarheidsnorm niet gerespecteerd wordt, dan kan de vraag gesteld worden of dit een realistisch scenario is. Als concreet voorbeeld denkt de CREG aan de situatie van Duitsland : het is onwaarschijnlijk dat de Duitse overheid, alle voorziene maatregelen (zoals coal phase out) zal doorzetten indien dit tot een voorspelbaar bevoorradingszekerheidsprobleem leidt. De CREG meent dat in dergelijk geval moet rekening gehouden worden met remediërende maatregelen (die tot op heden ongekend zijn) waardoor de betrouwbaarheidsnorm gerespecteerd wordt. Als sensitiviteitsanalyse, stelt de CREG voor om een scenario te overwegen waarin de buurlanden van België hun betrouwbaarheidsnorm respecteren.

ANSWER:

Regarding gas capacities, those are taken from the ERAA2022 dataset and complement more recent information if available (e.g. with BNetza data for Germany). An overview will also be given in the final report for the relevant countries.

Out of market capacities are considered, if contracted for the different periods assessed but those are not taken into account as available for the market. Indeed, those reserves are contracted by countries in order to be dispatched after the market ("out of the market"). It should not be forgotten that when a country has contracted out-of-market capacities, it has done so because of specific reasons and to solve a 'problem' in that country. The conditions for their activation are most likely also to be arranged by very specific rules. Elia is not aware of any such contracted out-of-market capacities abroad for which the framework does foresee that they can easily be called upon for Belgian use.

Regarding installed capacities, Elia has proposed a scenario in-line with the data collected at ERAA 2022 level and complemented with the most recent information on the matter. Regarding Germany and the coal phase out, the proposal is to take the latest information available from BNetza. To the knowledge of Elia, there is to date not market wide/in the market capacity mechanism in Germany.
Regarding the proposal to perform sensitivities on those capacities, as proposed in the previous reaction above, it is indeed the goal to also perform sensitivities on the matter (e.g. considering that neighboring countries would take the needed measures to respect their adequacy criterion).

5.8 Other

STAKEHOLDER	FEEDBACK RECEIVED
CREG	'56. De CREG meent dat het nuttig zou zijn om de onderliggende cijfers van alle grafieken in de studie in Excel-vorm te publiceren.

ANSWER:

It is Elia's intention to facilitate the understanding of the study by the stakeholders. This is why Elia elaborated many meaningful and easily readable charts in his previous Adequacy and Flexibility study of 2021. In total, it is nearly 250 charts that have been published in the study of 2021. It is Elia's opinion that gathering all those charts in one single excel to publish would not facilitate the understanding of the study. Maintaining such file would moreover constitutes a non-negligible additional work for Elia. Elia would like to recall that, similarly to the study published in 2021, an Excel file with the updated detailed assumptions will be made available with the study report.

STAKEHOLDER	FEEDBACK RECEIVED
Keep The Light On	It would be great to integrate and map this report to previously released studies such as: https://www.vlaio.be/nl/nieuws/naar-een-koolstofcirculaire-en-co2-arme-vlaamse-industrie https://perspective2050.energyville.be/

ANSWER:

Elia is also in favor of comparison with similar studies. In the data submitted to consultation, the chart of the evolution of the total electricity demand for Belgium was already including a comparison with other recent studies, such as the of EnergyVille as mentioned by Keep The Light On. Elia notes down the request and will integrate such comparison when relevant. Note that, in view of the fast changing context, it is important to look at recent studies (Vlaio's study dates from 2020) that are targeting the same time horizon.

6. Comments received on methodology

6.1 General

Probabilistic VS deterministic

STAKEHOLDER	FEEDBACK RECEIVED
Pierre Kunsch (ULB)	'La méthodologie d'ELIA ne tient aucun compte des nombreuses contraintes qui vont inévitablement s'opposer à la croissance supposée de la demande d'électricité de 55% entre 2022 et 2034, passant de 85 TWh/an en 2021 à 131 TWh/an en 2034, soit une croissance de 4,2 %/an. Cette croissance devrait être assurée principalement par des sources dépendantes de la météo (éolien et solaire) passant de 11.400 MW à fin 2022 à environ 30.000 MW fin 2034, soit une croissance de 20%/an. Dans le même temps les sources pilotables resteraient à un niveau proche de 12.000 MW, légèrement en décroissance même après la sortie de 4 GW nucléaires en 2025. - Une première contrainte qui rend une telle progression des éoliennes et panneaux photovoltaïques improbable, si pas impossible, est celle de l'équilibre offre=demande qui doit être assurée à chaque fraction de seconde. La règle d'or serait dès lors de disposer d'une puissance pilotable égale à la pointe de puissance appelée qui devrait être d'environ 21.000 MW selon les hypothèses d'ELIA, soit une augmentation de 50% par rapport à la puissance de pointe de 14 GW environ en 2022. Or tenant compte des facteurs de réduction (derating factors) des différentes sources de production exposés par Elia dans son rapport de flexibilité et d'adéquation 2021, 30.000 MW renouvelables intermittents correspondrait à l'équivalent pilotable de 1.500 MW environ seulement*, de sorte qu'on ne disposerait au total que de 12.000 + 1.500=13.500 MW équivalents pilotables en 2034. Il manquerait donc 7.600 MW pour assurer avec une très grande probabilité la sécurité d'approvisionnement qui existait avant la sortie du nucléaire. *Eolien offshore 5.760 MW * 13%=747 MW Eolien onshore 6.500 MW * 9%= 585 MW Solaire PV 18.000 * 1%= 180 MW Total 2034 Supposé 1.512 MW Pour compenser ce manque de capacités de base ELIA compte sur les importations des pays voisins, sur le stockage à Coo et à Platte-Taille, et sur les batteries. Il faut alors noter les sérieuses objections suivantes : - Du fait de la diminution des puissances pilotables dans les pays voisins, il y a peu de garantie que des importations de cette importance seraient possibles. - Les capacités de stockage hydraulique en Belgique correspondraient à 1.215 MW pendant moins de 5h, soit l'équivalent de 5,8 GWh/jour bien en-dessous des besoins. - Les batteries supposées auraient une taille (irréaliste car plus grande que ce qui existe dans le monde aujoud'hui) de 3.448 MW pour un stockage entre 2h et 4h correspondant à une production reportée de 11,7 TWh=32 GWh/jour également très insuffisante.

Pierre Kunsch (ULB)	'En Conclusion - Cette analyse apparaît comme étant de type bilan comptable pour atteindre un objectif de production par des renouvelables intermittents, dicté non par des arguments techniques et scientifiques, mais par des décisions politiques de décarbonation par élimination des sources fossiles et aussi nucléaires. Elle part d'hypothèses audacieuses mais non validées sur les possibilités techniques de ces énergies et de leur stockage-déstockage, des importations par la 'copper plate' du grand réseau européen. Toutes sont non vérifiées et de fait non vérifiables. L'exemple de l' 'Energiewende' allemande procure pourtant de nombreux enseignements sur le fait qu'une démultiplication débridée de renouvelables intermittents entraîne de nombreux effets pervers, dont une fragilisation de la sécurité d'approvisionnement, une augmentation des coûts systémiques de maintien des réseaux, et même l'augmentation très importante des émissions de CO2 qui est pourtant l'objectif recherché au départ, ainsi que d'autres polluants nuisibles à la santé - par le retour du charbon moins cher et plus disponible que le gaz. Une analyse de type 'stress test' devrait être menée par ELIA pour analyser les risques et possibilités, et ce dès 2022-2023. Nul doute qu'elle montrerait déjà les limites et les risques de cette politique qui semble être menée avec le seul objectif déclaré d'éliminer le nucléaire du mix énergétique. Un tel test de faisabilité avec évaluation des multiples risques et effets pervers ne semble pas prévu – ou n'apparaît pas clairement - dans cette analyse d'ELIA qui n'est donc qu'un simple bilan arithmétique centré autour des renouvelables aléatoires. Faire des paris aussi risqués sur l'avenir énergétique même proche est donc très éloigné d'une évaluation scientifique sérieuse et fondée. Elle ne peut pas servir de fondement à une politique raisonnée et raisonnable.
100TWh	'100TWh does not agree with Elia's methodology. Our security of supply may not be evaluated using statistical simulations based on unrealistic assumptions, including optimistic interconnections and exchanges with our neighbouring countries. We need a much stronger analysis to evaluate the production means we need to secure the electricity supply that our society deserves (economy, industry, citizens), building enough redundancy to reduce the risks of power shortages. 100TWh therefore wants to promote its alternative methodology, based on a deterministic approach. With this methodology and with more realistic assumptions, it is obvious that Belgium needs to build 4 GW new nuclear to produce 131,4 TWh of low-carbon electricity in 2034.
100TWh	But most fundamentally, 100TWh fully disagrees with the Elia's methodology ! Elia's methodology is based on Monte-Carlo simulations, as it is described in the document "20221028_APPENDIX_ADEQUACY" (called document B). Even if "such an approach is compliant with the ERAA methodology" (document B – page 2). 100TWh reminds that a blackout could cost billions euros per hour to our economy and could cost a lot of human lives. Hence our security of supply cannot solely be based on statistical results. The risk of having a blackout due to a situation that has not been simulated is too high to rely only on this kind of methodology. That's why a deterministic approach is utmost necessary. 100 TWh recalls that this combination of approaches is used when it come to the evaluation of the safety of nuclear plants ! Moreover, the deterministic approach is the one on which nuclear licensing is based. 100TWh therefore wants to promote an alternative methodology, based on a deterministic approach, founded on 4 assumptions : 1. Belgium must ensure enough domestic productions, without optimistically relying on the neighbours (who may have their own production problems, as clearly demonstrated today – lessons should be learned !).

	2. Each energy source must be available 80% of the time to be included in our electricity mix. This means that intermittent sources must be packaged with other means allowing them to deliver 80% of the time. The only available solutions therefore are gas and storage. Also a full cost approach needs to be used, so that the cost of intermittency is taken by the intermittent sources. 3. For energy sources that are not 80% available, the derating factors used by ELIA in the previous studies (Oct 2021 and March 2022 - to service the Energy Minister nuclear phase-out plan) must be considered. For Belgium in 2022, the derated RES capacity is 665 MW, and its reliable production counts for 5.8 TWh (see table 1). 4. To limit our CO2 emissions, fossil fuel based solutions must be excluded, even the use of gas. With the 100TWh methodology and with more realistic assumptions, it is obvious that Belgium needs to build 4 GW new nuclear to produce 131,4 TWh in 2034 Using the figures of 2034 from Elia in our assumptions (electricity storage, RES capacities, thermal capacities), the acceptable electricity mix appears to be : 1. Reliable RES = 3,5 GW, that can produce 7,6 TWh per year 1 2. Derated RES = 1,6 GW (of the 30 GW installed) producing 13,7 TWh (see table 1) 3. Thermal capacities = 75,7 TWh 2 With this electricity mix, Belgium only reach 100 TWh per year ! Instead of installing 30 GW of expensive RES, our organisation finds that this amount of energy could also be reached, and with less CO2 emission, should we keep the set of thermal units available in 2022. In this scenario, the thermal electricity capacity of 11,2 GW (composed of 4.9 GW nuclear + 5.8 gas + 0,5 other), can produce 88,3 TWh. If we add 7,6 TWh reliable RES and 5,8 TWh derated RES, we get 102 TWh. But most fundamentally, the 100TWh methodology shows that to reach 131,4 TWh, while limiting our CO2 emissions, Belgium needs to add 31,4 TWh nuclear, which means that we need to install 4 GW new nuclear.

Elia thanks the stakeholders for their feedback and their own calculations. Elia understands from the feedback received from Pierre Kunsch and 100TWh that these stakeholders believe that a deterministic approach would be more appropriate for analyzing the security of supply over a ten-year horizon. The probabilistic approach which is considered by academia and most stakeholders as ‘state of the art’ is also used by Elia and other TSOs/academia/experts for more than 10 years for evaluating adequacy. The deterministic approach was used more than 10 (or 20) years ago when the interconnection capacity was limited and the penetration of renewable and storage technologies were limited.
It is also important to remind stakeholders that Belgium has defined its level of adequacy by the means of a probabilistic indicator (the LOLE), hence it is therefore not possible to use a method that does not allow to calculate such indicator.

Elia would like to clarify that this Adequacy and Flexibility study is to be considered as the National Resource Adequacy Assessment (NRAA) for Belgium. According to the ACER approved European Resource Adequacy Assessment

(ERAA) methodology[53] [54], "National resource adequacy assessments have a regional scope and are based on the ERAA methodology". Therefore Elia is following the methodological requirements required by ACER in the aforementioned methodology, namely: [55]

- Article 4.1.C. "Resource adequacy shall be assessed using the following two probabilistic resource adequacy metrics: EENS and LOLE".
- Article 4.2.A. "The ERAA shall use a probabilistic methodology to reflect the stochasticity of climate variables affecting supply and demand, as well as the expected availability of generation, storage and transmission resources."
- Article 4.2.B "The Monte-Carlo method shall be used for probabilistically assessing the availability of capacity resources and transmission resources."

Finally regarding the scenario(s) chosen and also according to both to the European ACER ERAA methodology, the central reference scenario of the study should be in line with the official ambitions (e.g. in terms of renewable energy sources) known at the moment of the assessment. However, Elia agrees that uncertainties exist and therefore a large number of sensitivities are typically performed within this study, already for several editions of the study.

6.2 Unit commitment & economic dispatch

STAKEHOLDER	FEEDBACK RECEIVED
Sebastian Gonzato (KUL)	'The methodology concerning the Unit Commitment and Economic Dispatch in ANTARES should state explicitly the operation of ELR during scarcity events. I believe that, for consistency with the reliability standard calculation, this operation should be severity minimising or LOLE maximising. In the same paper, for a base case I found that I could get between 2 and 6 hours of LOLE depending on the assumed storage operation, as shown in the figure below. I am not suggesting that this range would also occur in Elia's adequacy and flexibility studies. I am however suggesting that Elia explicitly mention the type of operation of ELR that is imposed in the methodology. As to which operation should be used, I suggest the "Max LOL" or severity minimising operation (DDVOLL in the figure above). This is because that I believe this operation is consistent with the reliability standard calculation. I elaborate this reasoning in my second working paper. It is a lengthy topic, so I will not elaborate on it further here.

ANSWER:

[53] European resource adequacy assessment | www.acer.europa.eu
[54] Microsoft Word - ERAA - Annex I (europa.eu)
[55] Microsoft Word - ERAA - Annex I (europa.eu)

Elia thanks the stakeholder for his comment. For the sake of clarity, we understand the acronym Energy Limited Resources (ELR) refers to DSM/DSR, Batteries, Short Cycle Storages… Indeed these ELR could be dispatched differently in hours of (near-) scarcity events depending on the shedding policy chosen.
The 'shedding policy' used by default in ANTARES (see ANTARES public description https://antares-simulator.org/) is shave peaks aiming at minimizing the depth of the ENS, in line with the reliability standard calculation and as mentioned by the stakeholder. This will be also explicitly written in the final report.
Regarding the results found in the paper mentioned, we believe the impact of the shedding policy to be much lower when simulating the whole interconnected system (whole Europe) although Elia agrees that such parameter can have an increasing impact depending on the penetration of ELR technologies

STAKEHOLDER	FEEDBACK RECEIVED
Sebastian Gonzato (KUL)	Does Elia aggregate technologies and solve a (relaxed) clustered unit commitment model? This was the impression I got from the methodology description of the last A&F study, but in the methodology given in this public consultation ("Unit Commitment and Economic Dispatch") I got the impression that individual units were modeled.

ANSWER:

Regarding thermal generation, as described in "Appendix – Unit Commitment and Economic Dispatch"[56], two modelling methods are applied:

- Individually-modelled thermal generation;
- Profiled thermal generation.

For Belgium, the split is defined in the excel "Assumptions Workbook" provided in the framework of the public consultation. Larger units which have a CIPU (Coordinating Injection of Production Units) contract are modelled individually and smaller smaller decentralised units which are usually connected to the distribution grid are aggregated (profiled thermal generation). It is the same approach that is used here than the one used in the previous Adequacy and Flexibility study of 2021.

For the others countries (not Belgium), an equilibrium has to be found between a very detailed (but heavy) model with all individual units being modelled and the aggregation of smaller units that leads to a lighter model with shorter running time. For some countries, there are more than 500 units of less than 100 MW. Modelling each of those units has an important impact on the simulation time. In such a case the smaller units are aggregated into clusters without losing economic or dispatch information. For example, if 2 units of 50 MW have the same marginal price and other economic parameters, they are added to a cluster considering 2 units of 50 MW. This eases the computation time but does not remove economic dispatch information from the model.

More details will be added to the final report in the appendix of the upcoming Adequacy and Flexibility study.

[56] https://www.elia.be/-/media/project/elia/elia-site/public-consultations/2022/20221028_appendix_unit_commitment.pdf

6.3 Adequacy study

STAKEHOLDER	FEEDBACK RECEIVED
Febeliec	Febeliec wants to reiterate its position on the methodological approach of increasing the margin by blocks of 100MW in the iterative process for the determination of the potential required volume. For Febeliec, a finer granularity than 100MW should be used, as even the lack of 1MW under the current approach would immediately lead to a need of 100MW additionally. Applying a finer granularity would avoid sourcing unneeded volumes. Alternatively, an approach could be implemented where very marginal transgressions of the LOLE criterion do not automatically lead to an increased contracting of strategic reserve volumes, through the application of a deadband, taking into account the multiple layers of sensitivity already applied by Elia in combination with low probability, high impact scenarios, which already skew all the results towards a very conservative approach. For Febeliec, it should in any case be avoided to increase the cost for the grid users unnecessarily by following a much too conservative approach.

ANSWER:

Elia would like to clarify that there is a difference to be made between the calibration reports where the parameters are expressed with 1 MW of granularity and adequacy studies (or when calibrating a country to its reliability standard in the model) where indeed the block size used is 100 MW.
Calibration reports are used to determine the parameters which determine how much will be effectively sourced in an auction and hence as put forward by Febeliec, in these cases, a finer granularity is used for all parameters: 1 MW.

For adequacy studies, the granularity of 100 MW as block size is used as in this case the needed GAP is calculated by adding/removing capacity until the reliability standard is reached (such aspect is not calculated, or only done once in the calibration report – to ensure that the scenario reaches the desired reliability level as described in the methodology). This block size of 100 MW was chosen to be as small as possible while still ensuring statistically robust results for the determination of the volume. Indeed, when searching for the tail of the distribution (e.g. LOLE), this statistical robustness was a limiting factor. Choosing smaller step sizes might lead to a calculation result that differs depending on the random seeding of the model. Higher granularity would exponentially increase the computation time. This would lead to reducing the amount of scenarios, sensitivities, time horizons or removing some key elements of the methodology (flow based, flexibility modelling in the economic dispatch, geographic scope…).

6.4 Climate years

STAKEHOLDER	FEEDBACK RECEIVED
CREG	36. Vooreerst dient opgemerkt te worden dat de database met synthetische klimaatjaren, opgesteld door Météo-France, en gebruikt door Elia, enkel door Elia gekend is. Gezien de klimaatjaren onder meer het geschatte elektriciteitsverbruik beïnvloeden, is meer transparantie over de gebruikte klimaatjaren wenselijk. L'hypothèse d'un climat constant est-elle compatible avec le dernier rapport du GIEC ?'Elia indique que pour l'étude adeqflex de 2021, les années climatiques tenant compte d'un climat constant de 2025 avaient été utilisées pour la période 2022-2032. Quelle année de référence Elia compte-t-il utiliser pour la période 2024-2034 ?

	La note méthodologique indique une calibration du modèle de Météo France permettant de faire converger les résultats du modèle avec les observations météorologiques de l'an 2000. Cette calibration est-elle encore pertinente en 2022 ? Météo France a-t-il vérifié la convergence des prévisions de son modèle avec les observations centrées sur l'année 2020 ? De klimaatjaren onder constant klimaat voor 2025 werden berekend door interpollatie tussen de klimaatjaren voor 2000 en deze voor 2050. Voor de klimaatjaren voor 2000 werd een kalibratie uitgevoerd. Voor de klimaatjaren "2025" is er geen kalibratie gebeurd. Gezien wellicht de klimaatjaren "2025" gebruikt zullen worden in de volgende A&F studie is het nuttig om deze set van synthetische klimaatjaren te toetsen aan de evolutie van de historische klimaatjaren. Eind 2022 zijn de data voor de historische jaren tot 2019 gekend in de ENTSO-E PECD (PECD 3.0). Hoe situeren de laatste 19 historische jaren (2001 tot en met 2019) zich ten opzichte van de synthetische klimaatjaren voor 2000 en die voor 2025. Een analyse hierover is nuttig.
Febeliec	On the climate years proposal by Elia, Febeliec still does not understand why Elia has opted to stop the previously applied approach with historic climate years (albeit adapted to reflect the ERAA methodology and thus limited to the 30 most recent years), to replace it with a still quite novel and untested black box approach, with a non-negligible impact on the results (which could be summarized as more scarcity periods but with shorter durations).
FEBEG	'Regarding the climate years Simulating consistent meteorological risk factors (wind, PV, temperature) over the full geographical scope of a power system is the current state of the art in power system modelling. FEBEG therefore supports this approach. It guarantees that geographical and spatial correlations are correctly reproduced. These correlations have an important impact on adequacy analyses. They help to reproduce events like the Dunkelflaute, hitting multiple European countries, and pushing the power system to its limits. Among the 4 traditional climate change scenarios, RCP 8.5 is the most aggressive scenario, leading to the highest level of climate change. FEBEG considers this scenario could not be sufficiently representative for the longer run and would recommend to use RCP 4.5 for instance if available.

ANSWER:

In the context of the previous Adequacy & Flexibility study published in June 2021 and with the goal to follow the ERAA guidelines, Elia bought a forward-looking climate database from MétéoFrance. Indeed this database has been used for several years by RTE (the French TSO) for its adequacy studies and contains forward looking data taking the climate changes into account (which was one of the main critics of the past Elia studies (prior to 2021)). For each time horizon considered by MétéoFrance, 200 synthetic climate years are derived. These 200 synthetic climate years are defined within a 'constant climate' set. The term 'constant climate' refers to the fact that all those 200 synthetic climate years are all plausible climate realizations which could occur within the target time horizon of 30 years around the central year used, in the case of the MétéoFrance databased used this is 2025 *ie* 2025 -15 (2005) & 2025 + 15 (2040). Notably the 'constant climate' set used by MétéoFrance indeed considers the change in climate with respect the past historical years (1982-2016) and thus looks forward the Climate evolutions expected towards 2050.

The approach followed by Elia is fully compliant with the ERAA methodology. It is also the goal that ENTSO-E moves towards such forward looking data in the upcoming ERAA studies[57]. Hence, using such kind of datasets is considered by Elia as best practice for the future.

Since the foreseen ENTSO-E future-proof climate database (refereed in Ref [57] as ENTSO-E PECD v4.0) is not yet available at the moment of this study, Elia still relies on its best available forward-looking climate database (Elia's forward-looking climate database from MétéoFrance). Elia would like to recall that MétéoFrance is renowned institute in France and that this climate database is also used by RTE, the French TSO. Elia therefore relies on MétéoFrance's knowledge on the choices made on the methodology to elaborate such databases. Furthermore, both MétéoFrance as well as the French TSO RTE and Elia, are involved in the development of the ENTSO-E PECD v4.0 within the Copernicus project. [57]

As explained in the dedicated appendix, the following steps are performed by MétéoFrance in order to get the 2025-climate database:

- First, two key time horizon, 2000 and 2050, are simulated;
- For the 2050-climate database, two databases are actually calculated, one following the Representative Concentration Pathway (RCP) 4.5 from the IPPC, the other following the RCP 8.5;
- As explained and shown by MétéoFrance[58], the interpolation to an intermediate climate between 2000 and 2050 (RCP 8.5) allows a representation of the climate for the target year (2025) to be approached with good plausibility without having to implement a simulation specific to that target year.

Therefore no calibration was performed by MétéoFrance on the 2025-climate database with recent climate data. To our knowledge, no updated usable dataset is available for this time horizon.

In this Adequacy and Flexibility study 2023-2034, the 2025-climate database will be again used as for the previous Adequacy and Flexibility study 2022-2032, as the period 2024-2034 still falls within the period of "constant climate' defined around 2025 (±15 years).

Elia understands that using the most aggressive scenario in terms of climate change for determining the 2025-climate database might be seen as pessimistic. This choice of MétéoFrance to use the 2050 RCP 8.5 climate database for the determination of the 2025-climate database was driven by the fact that the actual evolution of the GHG concentration seemed to follow the RCP 8.5[59], which leads to a higher increase in temperature. Elia agrees that the RCP 8.5 could indeed not be sufficiently representative for the longer run (if greenhouse gas emissions are reduced). When looking at short term horizon, the difference between both trajectories is limited which makes the trajectory still relevant for this Adequacy & Flexibility study 2023-2034.

[57] "Towards a future-proof climate database for European energy system studies" *by Dubus et al*, Environ. Res. Lett. 17 (2022) 121001 https://doi.org/10.1088/1748-9326/aca1d3

[58] https://www.elia.be/-/media/project/elia/elia-site/public-consultations/2020/20201030_203_meteofrance_dsm-cs-dc-enr_scen-clim2014_t2m_stations-v1-1.pdf

[59] https://www.elia.be/-/media/project/elia/elia-site/public-consultations/2020/20201030_202_meteofrance_dsm-cs-dc-enr_scen-clim2014_t2m_v1-1.pdf

6.5 Adequacy patch

STAKEHOLDER	FEEDBACK RECEIVED
CREG	35. De CREG vraagt om de eventuele activaties van de adequacy patch in de simulaties toe te lichten in de resultaten (met onder meer vermelding van de gecurtailde volumes en de netto posities van de ons omringende landen).

ANSWER:

In the simulations performed, the so-called “curtailed volumes” are equal to the reported Energy Non-Served (ENS). Furthermore, the corresponding ‘net positions’ of the neighboring countries are the ones reported in the results.

Finally regarding the activation of the "adequacy patch“, the simulations performed follow the rules defined within the EUPHEMIA algorithm and therefore the adequacy patch rules are applied at every hour in which ENS would take place in the simulation perimeter.

6.6 Cross-border exchange capacities

STAKEHOLDER	FEEDBACK RECEIVED
CREG	37. On the external constraints, Section 3.3, Elia mentions that the commissioning of these shunt capacitors seems to allow an increase of the allocation constraint to 8.000MW or even 9.000 MW. To which shunts is being referred?
CREG	38. On the FB operational process, Section 4.1, it is stated that each hour there may be a different FB domain because of topology changes, outages or maintenances on the grid. − What assumptions are used in this study on topology (and notably on the PSTs), outages or maintenance? − Today, the largest deviations come from differences in the base case (expected production, demand, loop flows, NEMO flows) • How do these inputs define the FB domains in this adequacy study? • Does Elia assume excess loop flows to be present in the studied horizon, i.e. > 30% - FRM for tie-lines? • Which FRM is taken? Latest studies show that the uncertainty on Belgian CNECs have reduced, allowing a downwards correction of the FRMs
CREG	39. On the calculation of zonal PTDFs from nodal PTDFs applying GSKs, Section 4.4, a GSK-computational formula is provided based on the installed production capacity. − Does this formula apply to all production capacity in Belgium (all technologies, all sizes) or only to a subset? − What about flexible demand (Load Shift Keys) and transmission-connected storage?
CREG	40. On the 2-dimensional flow-based domain representations, Section 4.6.2, it is stated that usually the Belgian adequacy situation is closely related to French SoS, and hence preferable to show a projection of the FB domain onto the Belgium-French plane. − What is the most relevant projection in case (also) Germany is in a SoS situation?

	− Can this projection be shown? Still in this Section 4.6.2, it is mentioned that the "explicit" allocation could lead to inefficient allocation of flows through Nemo Link in times of scarcity. − It is not clear if this risk really exists in scarcity conditions when the price differential with UK is expected to be large. − Does this problem occur in the Elia simulations for NEMO Link or the other Core-UK interconnectors?
CREG	41. On the use of PSTs in capacity calculation, Section 5.2.1, the CREG wonders how Elia incorporates the PST flexibility given to the market to provide further economic optimization (welfare maximization) in the simulation model.
CREG	42. On Flow-based for Core countries, Chapter 6, Elia mentions to forecast the integration of Advanced Hybrid Coupling instead of SHC. − How does this impact the set of CNECs considered in the simulations? − How does this impact the import capabilities for Belgium during scarcity conditions?
CREG	43. On the use of smart-slicing, Section 1.3.1.2, the exchanges between BE, FR, NL and the UK are considered as relevant dimensions for the security of supply study. If those exchanges are captured in the flow-based domain, does it mean that those exchanges are modelled through AHC?
CREG	44. On the clustering of domains, Section 1.3.2: − what drives the difference between the different hourly domains (and subsequently the 6 medoids resulting from the clustering) if at any time the 70% minRAM is provided irrespective of the initial grid loading? − Is 70% fixed RAM provided in summer? In the introduction of Chapter 7 it is stated that the domains generated for the summer months usually assume a specific percentage of fixed RAM as a proxy for the reduced grid availability.
CREG	45. On the resizing of the domains, Section 1.3.3., what assumptions are taken on the non-CWE and non-Channel borders? Everywhere 70% RAM?
CREG	46. On the incorporation of multiple flow-based domains into the adequacy assessment, Section 1.4, is it correct that climate conditions do not directly influence the size of the flow-based domain any longer (as was the case before the entry into force of 70% with CEP).

ANSWER:

Elia thanks CREG for the different questions related to cross-border exchange capacities.

The Shunt capacitors from the first question are referring to the capacitors banks of the program Voltage Control II that were listed as preconditions for the increase of the allocation constraint towards 7.500 MW. No additional capacitor banks are needed afterwards to further increase the allocation constraint to 8.000 – 9.000MW.

Next, Elia would like to mention that flow-based domains are based on Critical Network Element Contingencies (CNEC) which are contingencies limiting the flow on grid elements and therefore the flow-based domains. Outages and PSTs are therefore included in this definition. In summer, as a proxy for maintenances, a reduced fixed ram domain is used. Cross-border HVDC outages are sampled explicitly.

Flow-based domains are thus built through a set of simulations taking into account a range of values for different input parameters (expected production, demand…). Given that the market model of Elia applies "perfect foresight", market data is assumed to be perfectly known and no deviation is considered. The most representative flow-based domains

are then selected through the methodology presented in the flow-based methodology document. This selection of a subset of representative domains is needed to reach feasible simulation times. In the computation of flow based domains, no FRM is assumed which is an optimistic approach. This optimistic assumption could be revised in the future.

The computation of the zonal PTDFs uses GSKs which are based on dispatchable thermal capacity. In this calculation however, nuclear, DSR, transmission-connected storage and renewable capacities are excluded from the GSK calculation.

In the case of simultaneous scarcity in Belgium and Germany, the projection plane of Belgium-Germany is hence relevant. Elia can also show this projection in the final report of the study.

Explicit allocation means the flow over the interconnector is no longer available as a variable in the flow-based domain at the time of market coupling. This results in less degrees of freedom to maximize the Core region's welfare which in turn leads to smaller flow-based domains. Furthermore, it should be noted that the capacity of the 'explicitly allocated' interconnectors is still considered as an NTC interconnector in the simulation. Still this means that there is less room for optimization of the flow on these interconnectors in both scarcity and non-scarcity situations. Elia however agrees with CREG that for situations where large price differentials are expected in one direction, the flow could tend to settle itself in the most optimal direction regardless of flow-based optimization. This however remains to be shown and Elia would like to state that assessing the impact of the different flow-based market evolutions (SHC, AHC, explicit allocation…) are not within the scope of the Adequacy & Flexibility study. Indeed, those impact assessments are performed in the relevant bodies overarching the capacity calculation processes.

PST's are today not expected to be used in the capacity allocation nor are there concrete plans to do so in the coming years (despite the Elia's vision/proposals around it). It is indeed Elia's vision that the market would benefit from the integration of flexible devices in the capacity allocation. However, it is deemed unlikely that this vision will already become reality within the time window under investigation in this study. During the creation of flow-based domains, the initial setpoint of a PST is determined using a nodal model in order to maximize the size of the Flow-Based domain in the expected market direction. Afterwards, a subset of these PST's (= the selected PST's) are again allowed to play a role in the welfare-optimization problem during the capacity calculation part of the process.

Standard and advanced hybrid coupling are used to model capacity constraints on exchanges between the Core bidding zone and other bidding zones. CNECs are selected independently of the modelling choice between SHC and AHC. The type of hybrid coupling chosen could have an impact on scarcity moments as unlike standard hybrid couplings flows, advanced hybrid couplings flows are present as variables in the flow-based domain whereas SHC flows are not. Elia follows the still valid current regulatory framework, which recommends to all TSOs the implementation of AHC in CCR Core as indicated in ACERs decision (02/2019). Furthermore, Elia would like to state that neither providing detailed interconnection assessments nor assessing the impact of the different flow-based market rule evolutions (SHC vs AHC …) are within the scope of the Adequacy and Flexibility study.

A main driver for the differences between hourly flow-based domains is the difference in loop-flows observed in the market simulation. The subsequent application of minRAM targets therefore leads to different flow-based domains for each hour of the simulation. These differences can however be small if the market simulation in both timestamps is similar. As grid maintenances are typically planned in summer, a 70% fixed RAM domain is used as a proxy for this reduced grid availability. Note that for non-Core, non-Channel borders and non Advanced/Standard hybrid coupling

borders, the full capacity of the links is taken into account in winter and a rating factor is applied to this capacity in summer, to account for the decrease of thermal capacity due to the higher temperatures in summer or maintenances that are usually done outside of the winter.

Finally, as different climatic conditions result in different flows, the final size of flow-based domains will depend strongly on the climatic variables. For this reason, these are chosen by TSOs as variables upon which to assign the different representative flow-based domains ("typical days" domains) to each hour of each Monte-Carlo year of the simulation.

STAKEHOLDER	FEEDBACK RECEIVED
Keep The Lights On	Figure 31 [*Internal reinforcements expected to be realized by end of the mentioned year according to draft FDP (full details are available in the draft FDP 2024-2034)*]: Does this include risk of delays (permitting or local actions for example)?

ANSWER:

The base scenario follows the best estimate planning as detailed in the draft Federal Development Plan[60]. Elia however finds it relevant to perform sensitivities on impact of delays on adequacy, such as the impact of new delay of the MOG II offshore wind farm or delays of cross-borders projects.

6.7 Economic viability assessment

6.7.1 EVA loop & multi-years assessment

Multi-years assessment

STAKEHOLDER	FEEDBACK RECEIVED
Febeliec	Febeliec appreciates that some work has been done to look into profitability of assets over their lifetime, yet is not sure that the proposed approach covers this aspect completely, as it is unclear how Elia wants to tackle "future energy mixes" and their impact, as of course every asset individually does not have to be profitable every single year, as long as the overall profitability over the lifetime is sufficient to recover the costs and a profit margin.

ANSWER:

Elia takes into account an estimation of the revenues and costs over the full future expected lifetime of an asset when making a decision to invest or not. As a part of these revenues and costs are strongly dependent on the market situation

[60] Public consultation - Federal Development Plan for the Belgian transmission system (110 kV to 380 kV) over the period 2024-2034 (elia.be)

that will actually arise, the economic viability assessment is performed on a large number of series of probabilistically drawn incomes and expenses. The resulting IRR is then calculated for each of these draws and their average is taken and compared to the hurdle rate. This means that while the overall IRR might be higher than the hurdle rate, there could be sampled years or even full lifetimes where the unit is not profitable.

EVA loop

STAKEHOLDER	FEEDBACK RECEIVED
Sebastian Gonzato (KUL)	Elia's approach to EVAs is particular in that it doesn't fit the mould of any particular class of model that one may find in the literature, i.e. it's not a capacity expansion planning, equilibrium, agent based or system dynamics model. I would say it most closely resembles the flow-chart philosophy of agent based models without explicitly representing agents (see e.g. Figure 2 of this paper). For this reason I believe that a high degree of transparency regarding the EVAs would be beneficial to Elia and other stakeholders. While I do not have much experience with this sort of modeling, I presume that convergence is sensitive to user defined parameters. Elia states this explicitly: In order to ensure the convergence of the results, only a limited amount of candidates is moved from 'in-the-market' to 'out-of-the-market' status at each iteration. My specific requests on this subject: • I would like to know more about how the number of candidates is limited (see quote above). • I would be interested to see the results of an EVA loop, including but not limited to the evolution of candidate resources, the installed capacities, the distribution revenues of generators, in Elia's next A&F study. ◦ Ideally this would be done for several EVA loops so as to show the nature of the convergence that could occur. For example, Elia states that "oscillations" occur for some EVA loops. • Checking the agreement between the EVA and the adequacy assessment e.g. in terms of LOLE would be interesting. ◦ This was an issue raised by ACER for the last ERAA. ◦ As I understood Elia's methodology, when an EVA loop is finished the full set of MC years is used to validate the convergence. If this is the case then agreement should not be an issue, though this should be confirmed. I do not suggest this merely to create more work for those at Elia, but on the basis of results from Elia's last A&F study which piqued my interest. In it, I see that there is a difference of 0.9 GW in non-viable GAP when comparing the EU-BASE and EU-SAFE scenarios for 2032 (Figure 5-32 and 5-36). This implies that nuclear unavailability increases profitability of other units in the EVA, ultimately decreasing the non-viable GAP. Elia comes to the same conclusion (see comments under Section 5.2.3). This is an interesting result, and I wonder whether some of this change in non-viable GAP is actually due to practical issues regarding convergence.
Sebastian Gonzato (KUL)	For the EVAs, what features are used to perform the k means clustering? Why the choice of k means (which will produce different results for every run) and not e.g. hierarchical clustering?

ANSWER:

Elia thanks Mr. Gonzato for the detailed questions with relation to the Economic Viability Assessment. First of all Elia would like to specify that the goal of using a clustering is to reduce the time needed to achieve fully converged results without influencing the final results. When performing an iterative approach such as the one used by Elia for its EVA, investment decisions for the following iteration are based on the profitability of the unit in the latest completed iteration. In situations where there are sufficient revenues for new capacity to be added to the market, a multitude of units could present a positive business case. However, adding all of them could lead to a situation where the profitability of most if not all of them is no longer positive (usually called a 'cannibalisation' effect). The reverse could then happen in a subsequent iteration. To avoid such oscillations which could significantly increase the number of iterations needed to converge or even prohibit convergence, only the most profitable (not yet installed) and most "unprofitable" (installed) units are added/removed. In practice the number of GW which could be installed is automatically reduced by 2/3 once "full" oscillations like the one described above (all capacity added in the last iteration becomes unprofitable and all capacity removed becomes profitable) occur. At the end of the process several "full Monte Carlo year" simulations are performed to assure that all capacities have duly converged for the full set and for all units. This way Elia can assure that the solution is stable also without limiting capacity evolutions or the number of Monte Carlo years. Finally, Elia indeed uses a k-medoids algorithm to cluster climate years. There is no reason this is the only viable method, but one advantage is that it provides medoids naturally, whereas medoids would have to be calculated afterwards when using for example the hierarchical clustering method. The features used to cluster these years are the profitability of new units in Belgium of the different types. Elia is currently investigating using different clustering methods for its EVA, however as one or more full iterations are performed for every assessment, the validity of the final results is not expected to depend on the clustering method nor on the features used for the clustering.

6.7.2 Portfolio and price limit

STAKEHOLDER	FEEDBACK RECEIVED
CREG	17. La CREG a des réserves sur la méthodologie appliquée. Premièrement, la CREG est d'avis que le risque calculé au niveau d'un asset est surestimé, car l'effet au niveau du portefeuille du participant de marché n'est pas pris en compte. Lorsque deux actifs présentent des risques opposés dans un portefeuille, le risque total pour l'acteur est inférieur à la somme des risques. Un facteur de réduction devrait dès lors être appliqué aux primes de risques proposés. Pour cette raison, il parait discutable de simplement rajouter une prime de risque pour chaque type d'asset. Deuxièmement, la CREG pense que la manière dont les possibilités de hedging sont incluses pourrait être améliorée. A ce sujet, la CREG renvoie vers ces commentaires dans l'annexe de la note (Z)21541.
Febeliec	'Febeliec strongly insists that revenues from a.o. forward markets and portfolio effects will have an impact on the overall viability of assets. While assets individually might be confronted with certain negative effects, the combination of different assets can create on the one hand higher pooling effects but also and more importantly synergetic effects (e.g. in case of combinations of different assets classes that complement each other). Febeliec regrets that this is still not taken into account.

ANSWER:

FEBELIEC and CREG suggest to take into account portfolio effect in the economic viability assessment, but in line with ERAA, the economic viability check is performed at the level of the capacity resource (i.e. "capacity resource" means any generation, storage or DSR asset which may bring resource adequacy benefit).

ELIA understands from CREG's feedback that the latter supports the contours of the updated EVA methodology based on which a capacity is economically viable if the expected internal rate of return (IRR), calculated by taking the average of simulated inframarginal rents into account, exceeds a predefined hurdle rate (consisting of an industry-wide WACC and the hurdle premium). However, CREG is of the opinion that within those contours hedging opportunities on the forward markets are not fully reflected in the proposed methodology. Elia refers to its reply to CREG's note (Z)21541 as part of the public consultation report regarding the Adequacy and Flexibility 2022 – 2032.

STAKEHOLDER	FEEDBACK RECEIVED
Febeliec	On price limits in the electricity markets, Febeliec insists that these should not be modelled as too limiting as recent practices have shown that these limits can/could increase quite rapidly (and should, if all applicable rules were correctly have been applied already have reached 5.000€/MWh in the day ahead markets). Febeliec insists that Elia at least take into account the decision of ACER on this matter, which is expected in the near future and well in time for the analysis, in order to ensure that this aspect is correctly modelled, as it is clear that higher price caps in the electricity markets can only unlock further demand side response and other flexibility.

ANSWER:

Elia thanks Febeliec and FEBEG for the comment on the current evolutions in the harmonized maximum and minimum clearing price methodology. Elia confirms that it will take into account the decision on the HMMCP methodology as published by ACER (No 01/2023 of 10 January 2023). Elia will continue monitoring evolutions in HMMCP regulation.

On the proposal to include a sensitivity on a higher price limit in the electricity market, Elia will indeed take into account the decision of ACER related to this matter which was published[61] on 10/01/2023. The results of the decision are proposed to be included in the base scenario of the Adequacy & Flexibility study. A sensitivity on a higher price limit not linked to the decision by ACER does not seem justifiable. The starting price limit will be therefore set to 4000 €/MWh as proposed in the public consultation and which is now confirmed by ACER in its decision.

STAKEHOLDER	FEEDBACK RECEIVED
FEBEG	Finally, considering the on-going discussions regarding the revenue-cap at EU and Belgian level, the impact of such cap should duly be considered in the Economic Viability Assessment, either directly or in the form of a sensitivity.

[61] Microsoft Word - 20221222_BoR_Decision_HMMCP_SDAC_Clean (europa.eu)

ANSWER:

Elia thanks FEBEG for its proposal to include the effect of a revenue cap. The cap on revenues from the energy market introduced by the EU is a temporary and extraordinary measure which is for the moment only applicable 01/12/2022 to 30/06/2023[62]. The revenue cap introduced by Belgium is currently applicable from 01/08/2022 to 30/06/2023. The revenue cap introduced by the EU is a temporary and extraordinary measure and there are currently no plans to extend it. While the revenue cap introduced by Belgium is applicable in a period starting earlier than the measure decided upon at EU level, there are currently no talks about a possible extension. An extension of the revenue caps introduced by either the EU or Belgium that would affect the short-term horizons of this study is therefore not considered the most likely situation. In the context of the LCT, Elia will therefore recommend not to take a sensitivity on a revenue cap into account. For future years, a potential revenue cap (or the fact that such measure was introduced in the past creates a precedent) could indeed undermine investors for additional capacities. A sensitivity on such measures could therefore be included to reflect the impact such a measure could have on investments in the electricity sector.

6.7.3 Balancing revenues

STAKEHOLDER	FEEDBACK RECEIVED
CREG	48. La proposition d'Elia est de considérer la même approche que celle considérée pour le « CRM Calibration » pour calculer les revenus nets des revenus provenant de la fourniture de services d'équilibrage, tout en considérant certaines différences. 49. Tout d'abord, la CREG considère que le calcul des revenus nets ne doit pas se limiter à considérer les coûts des 36 derniers mois mais doit également prendre en compte les revenus nets résultants de l'activation des services d'équilibrage. Selon notre compréhension, ELIA ne prend pas en compte les revenus additionnels résultant du marché intraday et des activations du marché d'équilibrage. Cette simplification surestime le missing money des unités flexibles. En effet, une partie importante du revenu de ces unités provient des marchés intraday et de l'équilibrage. La CREG illustre ce point sur l'exemple suivant. Sur base des hypothèses suivantes : (i) une unité avec un coût marginal de 200 Eur/MWh; (ii) le prix day-ahead suit une distribution uniforme entre 0 et 200 Eur/MWh; et (iii) le prix en temps réel suit une distribution uniforme entre – 200 et 400 Eur/MWh (même moyenne qu'en day-ahead), la simulation d'ELIA estimerait que le revenu de cette unité est de 0 Euro alors que si les revenues du marché d'équilibrage étaient pris en compte, nous obtiendrions un revenu de 33,5 Eur/MW/h. La CREG estime que cette simplification impacte les résultats. Un exemple est l' « internal rate of return » (tableau 2 de l'étude du Professeur Boudt) obtenu par le modèle pour les batteries donné qui est négatif, ce qui signifie qu'on ne devrait voir aucun investissement dans cette technologie. Néanmoins, nous observons, en pratique, que de plus en plus de projets sont développés.
CREG	50. Ensuite, pour le FCR et l'aFRR,

[62] Council agrees on emergency measures to reduce energy prices - Consilium (europa.eu)

	− Elia considère que l'estimation faite devrait prendre en compte la tendance prévue concernant le volume de capacité et le mix de technologies capables de fournir ces services et les évolutions potentielles des prix de ces produits. La CREG considère que les hypothèses prises par Elia pour estimer l'impact de ces évolutions devraient faire l'objet d'une consultation. − Elia envisage d'appliquer un pourcentage limitatif aux revenus des services d'équilibrage pour tenir compte des coûts d'activation et de maintenance liés à la fourniture de ces services. La CREG considère que les coûts d'activation et de maintenance sont pris en compte par les acteurs dans les prix d'activation aFRR. Par ailleurs, la CREG considère que ce pourcentage limitatif devrait faire l'objet d'une consultation. − Elia envisager d'appliquer un pourcentage limitatif afin de tenir compte de l'arbitrage effectué par les technologies participant potentiellement aux services d'équilibrage, y compris leurs coûts d'opportunité. La CREG est d'avis que ce pourcentage limitatif ne peut pas être fixé arbitrairement mais qu'ELIA devrait estimer ce coût d'opportunité pour les différents types d'unités sur base de données historiques. Par ailleurs, la CREG considère que l'estimation réalisée par Elia devrait faire l'objet d'une consultation.
CREG	51. De plus, pour le mFRR, Elia considère que l'estimation devrait envisager d'appliquer un pourcentage limitatif afin de prendre en compte l'arbitrage effectué par les technologies participant potentiellement aux services d'équilibrage, y compris leurs coûts d'opportunité. A nouveau, la CREG est d'avis que ce pourcentage limitatif ne peut pas être fixé arbitrairement mais qu'ELIA devrait estimer ce coût d'opportunité pour les différents types d'unités sur base de données historiques. La CREG considère ainsi que certaines unités ne présentent pas de coût d'opportunité, comme par exemple, une unité qui aurait un coût d'activation de 2000 Euro/MWh. Par ailleurs, la CREG considère que l'estimation réalisée par Elia devrait faire l'objet d'une consultation. 52. En conclusion, la CREG est d'avis que, cette simplification utilisée par ELIA, conduit à des résultats non conformes aux décisions d'investissement observées.
Febeliec	'With respect to the net revenues from the provision of balancing services, Febeliec considers Elia's approach with a discarding/derating of most of the revenues from ancillary services too conservative, as in case scarcity situations would occur, it can be expected that these revenues for all asset types would increase, especially in combination with switching towards pay-as-cleared in these markets (after connection to the European balancing platforms).

ANSWER:

ELIA remercie la CREG pour ses questions et sa réaction détaillée relatives à la proposition d'Elia en matière de revenus nets de balancing dans le cadre de l'EVA réalisé par Elia pour les capacités en présence sur les marchés de l'électricité belge. Tout d'abord, ELIA souhaite rappeler et insister sur le fait que cette proposition a trait aux revenus nets pouvant être obtenus par des acteurs de marché via les marchés d'équilibrage et non pas au marché infra-journalier. Dans cette optique, ELIA souligne que cet exercice est complexe à réaliser puisqu'il consiste à déterminer la partie supplémentaire pouvant être obtenue sur les marchés d'équilibrage par ces acteurs de marché suite à l'arbitrage effectué par ceux-ci par rapport aux marchés de l'énergie estimés grâce au modèle simulé. Pour ce qui est des revenus provenant de l'activation de ces différents services, ELIA souhaite rappeler qu'il n'y a pas de revenus considérés (nets de surcroit) provenant de l'activation de FCR. ELIA souhaite par ailleurs souligner que la mFRR n'est que proportionnellement activée qu'une partie infime de l'année menant dès lors à des revenus à priori limités (et donc à des revenus nets vraisemblablement négligeables). Enfin, ELIA souhaite souligner que la règle de paiement de services auxiliaires

tels que le mFRR et l'aFRR étant appelée à devenir de type 'Pay-as-Cleared' et ce alors que les connections aux plateformes MARI et PICASSO sont également prévues pour le futur rend l'estimation de ces revenus d'activation d'autant plus complexe, voire impossible. L'impact futur de la connexion à ces plateformes est donc impossible à estimer à l'heure d'aujourd'hui. Il n'est pas impossible que l'arbitrage considéré dans le cadre de cette estimation reste d'application mais cela doit être et sera investigué par ELIA dans le futur.

De plus, ELIA rappelle que l'estimation de ces revenus nets est un exercice réalisé sur une base technologique (et non pas unitaire) raison pour laquelle l'utilisation de données liées au marché infra-journalier ne semble pas pouvoir être appliquée dans le cadre de cette estimation.

Pour ce qui est des pourcentages appliqués par ELIA au niveau des différents produits de service d'équilibrage en fonction des critères considérés, ELIA rappelle que le pourcentage appliqué pour l'arbitrage effectué par les technologies participant aux services d'équilibrage se base notamment sur des données historiques (la participation observée de différentes unités des technologies aux différents services d'équilibrage - il s'agit de données confidentielles). ELIA souhaite également ajouter que le pourcentage appliqué pour considérer l'évolution de la capacité attendue pour les technologies participant aux services d'équilibrage est chaque fois justifié de manière transparente et factuelle par ELIA dans le calcul fourni pour ces revenus nets estimés (par exemple dans le rapport de calibration annuel relatif au CRM).

Regarding FEBELIEC's contribution on net balancing revenues, ELIA thanks FEBELIEC and would like to raise mainly 2 points :

First of all, FEBELIEC points out a potential situation of scarcity which might lead to an increase in revenues for all assets potentially participating to balancing. Here, ELIA would like to remind that this calculation aims at estimating net balancing revenues. In other words, ELIA is not convinced that an increase of prices on energy markets due to scarcity would automatically lead to an increase in net balancing revenues for technologies participating to it since these technologies are likely to arbitrage between the 2 markets.

Secondly, ELIA agrees with FEBELIEC statement on the fact the switch of the pricing rule to PAC coupled to a connection to European balancing platforms may lead to different figures than the ones estimated today. In any case, ELIA has, at this time, no insights on the impact on the long term pricing of the future connection to such platforms. It could be assumed that this connection would lead to increased competition and a reduction of the linked revenues. ELIA would like to stress that the revenues arising from such connection (or even from a potential switch in the pricing rule from PaB to PaC) will only be revenues linked to activation (and not to reservation). ELIA will investigate these effects in the future once data will be available on the matter while keeping in mind that an arbitrage must be considered since only net revenues should be considered here.

7. Comments received on hurdle rates and Prof. K. Boudt study

STAKEHOLDER	FEEDBACK RECEIVED
Febeliec	'On the Economic Viability Assessment (EVA), Febeliec considers the approach of Elia with high hurdle rates leading to very high ROI/ROE, especially for units which are covered by some sort of subsidy schemes and thus much less exposed to market risks. Febeliec wants to reiterate its comments on the risk averseness that Elia is always citing and applying for investors, where Elia seems to consider BRPs, suppliers, consumers etc, all to be extreme risk takers and not risk averse at all. Febeliec opposes such view, as it is clear that also these actors will make economically rational decisions, including hedging of costs via forward markets (e.g. for suppliers and consumers, to avoid to be exposed to greatly varying costs with locked-in revenues from long term sales contracts) or avoidance of high penalties (e.g. BRPs to avoid being exposed to extreme imbalance tariffs and costs). These aspects will clearly also have an impact on the decisions of market actors and are (or should be) taken into account by investors in new capacity or maintaining existing capacity and will thus impact the EVA.

ANSWER:

In line with the ERAA methodology, ELIA applies an increase of the WACC to cover for the price risk of investors during the time horizon beyond the forward markets. This price risk is driven by several risk parameters, such as the “revenue distribution and loss aversion” (e.g. the higher the risk on negative returns, the higher the price risk and thus the hurdle premium), as well as the model risk and policy risk (the less robust the simulated inframarginal rents are to different scenarios and policy choices, the higher the price risk and thus the proposed hurdle premium). Where part of the top-up of the WACC can be explained by the applied modelling set-up, another part is explained to accommodate for the limitations of the standard CAPM model that does not fully account for the particular statistical distribution of revenues in the energy market.

FEBELIEC seems to challenge the hypothesis of a risk-averse investor. However, risk aversion is commonly accepted as an assumption for a rational investor in many economic studies and academic works. In addition, the increase of the WACC to account for the price risk is in line with the ACER-approved ERAA methodology. Hedging is taken into account in the hurdle rate methodology (see also answer below), but in the current market, revenues cannot be hedged for more than 3 years (with already low liquidity on the Y+3 forward market) which falls significantly short in view of the tenor of investments.

Finally, Elia would like to clarify that the hurdle rates proposed by Prof. K. Boudt are applicable in an EOM context, so without accounting for subsidy schemes such as the CRM that reduce the market risk for investors.

STAKEHOLDER	FEEDBACK RECEIVED
CREG	Etude Boudt 19. Pour le rendement minimum, Elia propose de reprendre la valeur de 4,89 % de l'étude du professeur Boudt du 26 octobre 2022. Cette valeur est obtenue en utilisant un gearing ratio de 44 %. Dans les faits, un investissement dans une nouvelle capacité donne, dans la majorité des cas, lieu à la création d'une société dédiée au projet et le financement par emprunt avoisine plutôt les 80 %. Le calcul du rendement minimum devrait donc être réalisé tenant compte d'un gearing ratio adapté au type de projet visé. Pour la CREG, l'inflation devrait être intégrée dans le rendement minimum, pas dans la prime de risque. En outre, rien ne justifie de considérer à priori que le taux de croissance des FOM sera plus rapide que la croissance des revenus. Il ne s'agit donc pas, du point de vue de la CREG, d'une base objective pour moduler la prime de risque. La prime de risque couvre le risque que le rendement attendu d'un projet soit inférieur au rendement simulé dans le scénario de base. Dès lors, une prime de risque différente devrait être associée à chaque sensibilité impactant les revenus (par rapport au scénario de base) faute de quoi, le risque sera pris en compte deux fois. De façon à assurer la conformité avec la méthodologie ACER, la prime de risque doivent être différenciés entre enchère Y-4 et enchère Y-1 pour tenir compte des possibilités de hedging accrues pour l'enchère Y-1. L'enchère LCT peut être assimilée à une enchère Y-1. Les primes de risques soumises à la consultation ne peuvent donc être appliquées à cette enchère. En page 40 de son étude, le professeur Boudt soutien ce principe "we recommend applying a discount in the hurdle premium calibration when hedging is feasible to reduce the observed downside risk under the base scenario". La CREG ne perçoit pas la logique qui consiste à augmenter la prime de risque par rapport aux valeurs de 2021 tenant compte du risque de taxation des revenus excessifs. Ceci suppose que la prime de risque proposée en 2021 était favorablement influencée par la probabilité de recevoir des revenus exceptionnels liés à un évènement imprévisible impactant durablement le fonctionnement du marché.
Febeliec	On the study on the hurdle rates while Febeliec does not want to undermine the potential merits of the theoretical analysis as such, Febeliec remains with many questions towards the applicability of this model in the real world. Febeliec would thus request to have a more in-depth presentation of this analysis and its underlying theoretical basis, by preference presented by those having performed the analysis. In any case, Febeliec wants to refer to its comments on the high hurdle rates, which in combination with the WACC lead to very high ROE due to leverage, but also forward market revenues and hedging, risk averseness of consumers, suppliers and BRPs, portfolio effects, lifetime economic viability, etc. Furthermore, Febeliec continues to wonder what the inherent difference is between investments in the electricity sector and other markets, as apparently this issue only seems to play in the electricity sector in Belgium. Indeed, all investments and investors in other segments and markets encounter the same or similar issues, yet however without resulting in such claimed apparent issues. While electricity as a product might by its nature introduce some additional complexity in market functioning (due to the lack of storage capacity), Febeliec does not see how this would have an inherent impact on investment risk, model risk, policy risk, WACC, … The only potential difference Febeliec can

	observe in comparison with most (but not all) other segments and markets is the non-normal distribution of revenues due to extreme price spikes, which however over the lifetime of assets should be included with a probability. Febeliec is also very surprised by the reasoning about the system going from inadequate to adequate and the issue of "cannibalization", as it is clear that the season has to go towards adequate, as that is the purpose of the exercise by Elia in its study but also the purpose of the CRM (and LCT). Febeliec wonders whether this implies that the CRM itself erodes the business cases of investors and is thus a self-fulfilling prophecy which cannot solve adequacy unless all assets are covered by it (leading to many questions about overall costs and functioning of a liberalised market). Also less scarcity seems to create, according to the analysis, to issues for return on investment, yet all endeavours from Elia seem to be towards reducing scarcity and thus yet again eroding business cases. Because of the very short timeframe of this consultation, Febeliec has not had the opportunity to deep-dive into all the assumptions and calculations presented. Nevertheless, Febeliec is also very surprised to see that the analysis considers simulated rents under lower market price caps (e.g. 300, 1.000, 2.000 €/MWh) compared to 3.000 €/MWh, while the price cap is conceived to only increase, already having reached 4.000 €/MWh (and should have been 5.000 €/MWh if all rules would have been correctly applied) and no mechanism exists currently which would bring this price cap down (and in any case never to price levels that have been observed quite frequently in the recent past), and thus wonders to what extent any theoretical fundaments and understanding of the functioning of the market are actually reflected in the model. Febeliec wants to refer to its abovementioned comment on the potential merits of the theoretical analysis versus real world applicability and relevance.
FEBEG	FEBEG refers to past comments on the Study of Professor Boudt. In addition, FEBEG has a general comment on the build-up of the WACC. Despite mentioning its sources (study from Professor Boudt), the Risk-free rate and inflation rate seem underestimated given the current market evolution. Indeed, the On Risk-free rate, the long term interest rate in Belgium has risen by 1% between August and today2. FEBEG asks to review the WACC considering the changes of the underlying parameters. We invite ELIA to use the latest known figures in the final study.

ANSWER:

In line with the initial study Prof. K. Boudt has calculated the reference WACC for a reference investment in the energy sector, taking into account industry averages, leading to a gearing percentage of 44%. Technology-specific corrections to this reference WACC are made via the hurdle premium. Moreover, Elia would like to clarify that the impact of inflation is indeed taken into account in the calculation of the real reference WACC instead of via the hurdle premium. In other words, inflation has not been identified as one of the drivers to size the hurdle premium for each technology. The only sensitivity related to costs included in the study consists of the impact of capex and FOM costs that would exceed the assumed costs in the model, which represents an actual project risk (cf. budget overruns).

Elia takes note of CREG's comment on the hurdle rate applicable for a Y-1/LCT Auction. Elia understands CREG's concern, but would like to clarify that the hurdle rates as publicly consulted upon are calibrated by Prof. Boudt in an EoM context. The calibration of the hurdle rate in EoM context was explicitly done as input for the study regarding the

Adequacy and Flexibility needs of the Belgian power system for the 2024-2034 time-horizon, which includes the delivery period for the LCT (2024-2025). For this reason, Elia is of the opinion that the proposed hurdle rates can apply to the LCT.

Elia would like to clarify that Prof. K. Boudt has taken into account the scenario with taxation of excess revenues in both the 2020 study and the recent 2022 study. However, in the 2022 study, the probability of occurrence of such scenario is increased given the new policy measures that target such taxation of excess revenues.

Following Febeliec's request, Elia confirms that Professor K. Boudt will give an in-depth presentation of the hurdle rate methodology during the Working Group Adequacy of 27/1/2023. As to Febeliec's comment on the scenario going from an inadequate to an adequate system and the link with the CRM/LCT, Elia would like to clarify that the hurdle rates proposed by Prof. K. Boudt are applicable in an EOM context. In the absence of a CRM, investors have to make an assumption on the level of installed capacity in the system, while they lack perfect insight in the decisions of other investors increasing the uncertainty due to this lack of coordination.

As was the case for the first study performed by prof. K. Boudt in the framework of Elia's previous Adequacy & Flexibility study Elia bases itself on market simulations performed in the previous Adequacy & flexibility study to provide data with high granularity under sufficient sensitivities. In the data provided to prof. K. Boudt the initial price cap was therefore dependent on existing simulations and hence set at 3000 Euro/MWh. This data is then subject to an extensive sensitivity analysis, estimating the impact of different risks to the investor in terms of prices, adequacy level, price caps … These technology-specific drivers of the hurdle premium are then used in the final proposals for hurdle premia.

Elia takes note of FEBEG's comment on the values for the underlying parameters of the WACC calculation and confirms that Prof. K. Boudt will update the value of the reference WACC in 1Q2023 to account for most recent market evolutions.

8. Comments received on assessment of short-term flexibility

8.1 Methodology for the assessment of short-term flexibility

STAKEHOLDER	FEEDBACK RECEIVED
CREG	53. The study determines the flexibility needs from the day-ahead timeframe to the real-time timeframe, with the timeframe corresponding to slow flexibility ending 5 hours before real time. Considering that market participants are not required to be balanced in day-ahead, given that market participants wait with trading until the very last moments of the intraday market based on most accurate forecasts, and given that the intraday market is becoming more and more liquid because of cross-border competition, the relevance of the timeframe up to five hours before real-time is questioned.

ANSWER:

Elia justifies the choice of the three selected time horizons in Section 2 of the "Appendix on methodology for the assessment on short-term flexibility." Elia reminds that the adequacy simulations correspond to the schedules of generation, storage and demand under perfect forecast assumptions, while using a simulation resolution of one hour. The results of these simulations can therefore be seen as representative for the day-ahead market.

With the short-term flexibility study, Elia wants to complement the adequacy simulation with an investigation of the potential implications of unexpected variations after the day-ahead time frame, as well as the variations within the hour. Elia stresses that the flexibility study therefore focuses on total flexibility needs of the system and focuses therefore also on the flexibility used by market players to balance their portfolio (e.g. via the intra-day market), as well as flexibility used by the TSO to balance the residual imbalances (via reserve capacity).

The methodology clarifies that "*The slow flexibility represents the ability of the system to deal with expected deviations in demand and generation following the intra-day forecast update. It concerns information received between the day-ahead market (up to 36 hours before real-time) and the intra-day forecast received several hours before real-time, depending on the forecast service. Additionally, this flexibility deals with power plant or transmission asset outages which are announced several hours before real-time (or still not resolved after several hours). This flexibility can be provided with most of the installed capacity, as there are several hours to change the output of a generation, storage or demand unit and even start or stop a power plant.*" While Elia agrees that the liquidity of intra-day markets improves the ability of market players to balance their portfolio, this still relies on flexibility available in the system, i.e. units which can re-schedule their positions up to several hours before real-time. This capability of the system is what is investigated by the short-term flexibility study.

STAKEHOLDER	FEEDBACK RECEIVED
CREG	The study calculates for each type of flexibility the needs, assuming also a need over a period of 5 minutes. Can Elia make transparent the assessment of this short-term need as a TSO must restore frequency within 15 minutes of the disturbance and given that temporary large FRCEs within a period of 15' are allowed ?

ANSWER:

In this study, dealing with total flexibility needs (covered by the market players and the TSO) of the system, the requirements are determined in order to balance the off-take and injections in the system has to be maintained at all times. Deviations from this principle results in unscheduled exchanges (FRCEs) with other countries which can be managed to certain extent (though correlation over larger geographical areas and European solidarity), but this is to be avoided as much as possible.

The approach of the flexibility study needs to be distinguished from the day-ahead reserve dimensioning of the TSO where reserve capacity and balancing capacity procurements are determined to cover residual system imbalances based on minimum requirements set by legislation. The current reliability criterion of 99% used will indeed result in an acceptable frequency and size of FRCEs.

STAKEHOLDER	FEEDBACK RECEIVED
CREG	53. Forced outages are taken into account by considering the maximum generation or transmission capacity and the outage rate probability and duration. Considering that BRPs can react with available (but not offered as flexibility nor known by Elia via a CIPU-contract) generation capacity to offset the impact of a forced outage, a first remark is to understand how Elia takes into account such implicitly available volumes (that may not participate in the CRM either)? A second remark concerns the capping of the outage duration to 5 and 24 hours respectively. Can Elia share the assessment of the duration of the fast flexibility based on historical data ? Given the increasing importance of the intraday market and given implicitly available volumes of flexibility, activation of fast flexibility of 1 or 2 hours seem more realistic

ANSWER:

Elia stresses again that the calculation of the short-term flexibility needs entails the flexibility needs used by the market, as well as the TSO. A forced outage creates an imbalance in the BRP portfolio which will be partially balanced by the BRP itself (or even other BRPs) while the residual imbalance is managed by the TSO. The flexibility study determines the flexibility needs following forced outage risks (aggregated with prediction risks) rather than the share which will be covered by the market, and which share is covered by the BRPs.

This distinction, i.e. the share that needs to be covered by the TSO through reserve capacity, is assessed when determining the reserve capacity needs. This is determined in day-ahead based on machine learning algorithms determining the risk for remaining imbalances (not covered by the market) based on historic observations. In addition, projections

are made as presented in the TF MOG 2 (January 10, 2023) which will be used in the adequacy simulations as explained in Section 3.2 on the Annex on the methodology for the short-term flexibility assessment (cf. public consultation).

On the assumptions taken for distinguishing the impact of forced outage on fast and slow flexibility, Elia explains that when facing a forced outage, fast flexibility means (including aFRR, mFRR and BRP management) are used at first, followed by slow flexibility means (mainly via BRP management and intra-day market). Also the latter requires the availability of remaining flexibility in the system. The ratio itself on which volume (and how long) needs to be covered by the TSO is not in scope of the flexibility study.

STAKEHOLDER	FEEDBACK RECEIVED
CREG	53. The reliability level of flexibility needs is set at 99.9%, including flexibility that must be covered by FRR. Such reliability level for reserves is much larger than the 99%-criterion used today in the dimensioning rules.

ANSWER:

Elia agrees but refers to the previous answer that the flexibility study should be distinguished from the reserve dimensioning. The methodology clarifies that: *"A criteria of 99.9% is selected as the trade-off between accuracy and reliability, as there is no legal framework for covering flexibility needs. Choosing the LOLE criteria for both flexibility and adequacy models might have "pushed" the overall reliability criteria below the legal criterion of 3 hours per year. In view of this, a 100% target reliability need to be strived for. However, setting the percentile too high could have made the results too sensitive for extreme events and data problems specific to the historical years considered*."

STAKEHOLDER	FEEDBACK RECEIVED
CREG	53. The study assesses the available flexibility means. Firstly, some flexibility is present in the system in the form of demand destruction when prices are very high (such as in scarcity situations). Secondly, according to implementation plans communicated by Elia, after 2024 the Belgian system can expect the participation of low voltage demand response to fast flexibility and ramping flexibility. It is unclear how this future participation is accounted for in the study. Thirdly, existing flexibility does not always have an obligation to submit a schedule as it is implicitly available. It is also unclear how the study determines these available means.

ANSWER:

The assessment of available flexibility means through demand response is conducted through the remaining flexibility on the existing demand response categories, as well as the flexibility from new technologies such as heat pumps and electric vehicles, as specified in the consulted excel sheet with the input data (cf. sheet on flexibility characteristics). This remaining flexibility is determined based on the difference between the maximum power and the scheduled power of these demand response units in the market simulations. Regarding reaction of consumer to long lasting high prices, such reaction is already included in the consumption figures (see also the section on demand for more information)

used in the simulations. “Demand destruction” is a reaction of consumers to long lasting high prices and hence it is assumed that it does not provide short-term flexibility (in the intra-day or balancing time frame).

The participation of new low voltage flexibility is included under the categories “new technologies” in the sheet on flexibility characteristics in the Excel with input data. These are all assumed to be able to deliver short-term flexibility, at least in the upward direction (flexible heat pumps and electric vehicle charging) and for some technologies even in both directions (home batteries and vehicle-to-grid).

The demand response categories described in the flexibility characteristics in the Excel file (demand response categories, new technologies) are assumed to make the remaining capacity after the day-ahead market (represented by the adequacy simulations) for short-term flexibility (intra-day and balancing time frame) in line with technical constraints. In practice, this flexibility can be used by the market players to balance their portfolio (implicitly) and the TSO to balance residual imbalances (explicitly). Again, Elia stresses that making this distinction is currently not in scope of the methodology.

STAKEHOLDER	FEEDBACK RECEIVED
Keep the lights on	One other major shortcoming is limiting its calculations to a time tick of one hour. All events of less than one hour will be completely missed. Integrating over one hour may mask severe blackouts without notice.

ANSWER:

The short-term flexibility study, an integrated part of the Adequacy and Flexibility study, will study the flexibility needs of the system up to a resolution of 15 and even 5 minutes (based on expected and unexpected variations of renewable energy). This complements the adequacy simulations based on a unit commitment and economic dispatch model with a resolution of one hour and perfect forecasts. Note that flexibility needs under 5 minutes relate to management of the frequency on European level, as is today managed by means of FCR. This part is outside the scope of this national study and is studied on the European level[63].

STAKEHOLDER	FEEDBACK RECEIVED
Keep the lights on	This same volatility almost caused a breakdown of the Belgian electricity system in early July 2022, when suddenly and in a never before seen amplitude, all offshore wind was cut to zero in a few minutes time. The reserves of Coo had to be used for keeping the lights on instead of being used for covering peak consumption. Luckily the nuclear power plants were still active and constituted a firm part of the base load. If the same base load would have been provided by offshore wind, a major blackout would have happened. In the light of the foregoing we would like to see a few “extreme” situations in the calculations where at some point, and inspired by

[63] https://www.entsoe.eu/network_codes/eb/fcr/

	some real events (as the one of beginning of July 2022) suddenly and within a very short time all off-shore capacity is switched off. We would like to see how the system would react to such a disruptive event.

ANSWER:

It is not clear towards Elia to which day is being referred and does not have any information on severe offshore wind power incidents in the first part of July 2022.

Elia clarifies it studies the impact of exceptional balancing events following offshore wind power in several studies, and in particular in view of the foreseen increase in offshore capacity towards 5.8 GW by 2030. It therefore refers to the previously published reports on the system integration of offshore wind power[64]. Specific sections are dedicated to simulating the impact of storms and ramps on the system, and the recommendation of mitigation measures. These mitigation measures are currently further discussed with stakeholders in the framework of the Task Force MOG 2.

Elia will also dedicate a specific section on flexibility challenges related to the offshore wind power developments in the Adequacy and Flexibility study.

STAKEHOLDER	FEEDBACK RECEIVED
Johan Springael (Universiteit Antwerp)	In de appendix betreffende het “unit commitment and economic dispatch”-probleem (UCED), wordt er in al de simulaties verondersteld dat de productie op basis van wind- en zonne-energie de “must run” eigenschap heeft. Het gevolg hiervan is, gegeven het transiënte en intermittente karakter van deze bronnen dat er een verhoogde volatiliteit geïntroduceerd wordt in de elektriciteitsproductie, meer bepaald als deze de uitfasering van de stabiele base-load-productie a.h.v. bvb. kernenergie moet opvangen. In het UCED wordt ook als zeer restricitieve hypothese aangenomen dat het voldoende is om op een tijdschaal met als eenheid 1u te werken. Gegeven de verhoogde volatiliteit van de beschikbare elektriciteit, dient de tijdseenheid in het UCED veel kleiner te zijn, bvb. 15min, daar anders tekorten weggemiddeld worden. Het risico bestaat dat bvb. in het tweede kwartier er een (per definitie) niet geforecast tekort ontstaat door het plots uitvallen de productie op basis wind. Echter in de aggregatie over 1 uur worden dergelijke incidenten en risico’s niet waargenomen. Wat wordt er voorzien om deze hoogfrequente tekorten op te vangen? Wordt er voldoende snelschakelende spookcapaciteit, vergelijkbaar met een safety stock in het beheer van voorraden, voorzien? Hoe groot is het service level dat gehanteerd wordt naar de consument toe? Het gesimuleerde service level zal artificieel hoog zijn in het geval van de simulaties met als tijdseenheid 1u omdat de variantie van de productie veel kleiner zal zijn, t.o.v. een hoogfrequentere situatie.

[64] https://www.elia.be/en/public-consultation/20201001-public-consultation-on-integration-of-additional-offshore-capacity---mitigation-measures

	Hoe gaan lokale tekorten opgevangen worden, gegeven de capaciteit van de lokale transmissienetwerken? Werden de beperkingen op de transmissienetwerken meegenomen in de UCED analyse? (niet ex post!) Zoals het systeem nu lijkt en beschreven staat, worden al de problemen te wijten aan hoogfrequente fluctuaties in de productie opgevangen met reservecapaciteit. Als het aandeel intermittente bronnen stijgt, zal bijgevolg de reservecapaciteit (spookcapaciteit) mee moeten stijgen. In welke mate werd dit fenomeen mee opgenomen in de UCED analyse? Werd de kost van deze reservecapaciteit mee verrekend in de kost van de productie op basis van wind- en zonne-energie? Indien niet is het resultaat van de UCED niet-optimaal en zal de prijs voor de consument hoger uitvallen.

ANSWER:

The short-term flexibility study, an integrated part of the Adequacy and Flexibility study, will study the flexibility needs of the system up to a resolution of 15 and even 5 minutes (based on expected and unexpected variations of renewable energy). This complements the adequacy simulations based on a unit commitment and economic dispatch model with a resolution of one hour and perfect foresight. Note that flexibility needs under 5 minutes relate to management of the frequency on European level, as is today managed by means of FCR. This part is outside the scope of this national study and is studied on the European level[65].

The variability of renewable energy sources is thus exactly what is being treated by the short-term flexibility study. Unexpected variations are studied and translated towards ramping, fast and slow flexibility needs of the system. After this, it is checked if these flexibility needs are well covered or not by available flexibility means in the system (based on the simulation results of the unit commitment and economic dispatch model).

In its study, Elia will study the flexibility needs in the assumption that the balance between off-take and injections has to be maintained at all times and therefore determines the flexibility needs with a high reliability level of 99.9%. It is important to understand this is not a legal requirement, and concerns the total flexibility needed to balance the system, to be provided by market players to balance their portfolio, and Elia, by means of its reserve capacity, to balance residual imbalances.

These reserve capacity requirements are determined to cover residual system imbalances based on minimum requirements set by legislation. The methodologies, specified in Elia's LFC block operational agreement[66], determine reserve capacity in day-ahead based on covering the forced outage risk (e.g. covering the largest generation outage) and the prediction risk (e.g. covering 99% of the expected system imbalances through a probabilistic method). These reserve requirements are also integrated by means of projections towards 2034 as a constraint in the market simulations to ensure sufficient flexibility to manage forced outages and unexpected renewable variations, even during adequacy

[65] https://www.entsoe.eu/network_codes/eb/fcr/

[66] https://www.elia.be/en/electricity-market-and-system/system-services/keeping-the-balance

events. This approach is explained in Section 3.2 of the Annex on the short-term flexibility study (public consultation) while new projections are currently being discussed with stakeholders in the TF MOG 2 and WG Balancing.

Note that when these requirements result in not covering all the flexibility needs, this results in unscheduled exchanges with other countries which can be managed to certain extent (though correlation over larger geographical areas and European solidarity), but this is to be avoided as much as possible.

8.2 Assumptions for the assessment of short-term flexibility

STAKEHOLDER	FEEDBACK RECEIVED
CREG	54. The forced outage probability is determined based on the historic amount of forced outages per year, and aggregated per technology. More details on the applied method are needed to understand how the results are calculated, including which units are assumed to be operational in a given year and how the aggregation is performed. The detailed calculations can be made transparent to better understand how the forced outage characteristics are calculated.

ANSWER:

As the forced outage probability is part of an integrated approach to determine the forced outage statistics (rate and duration) following a specific study on the matter. This question is treated in the section on input data (cf. 5.5.3).

STAKEHOLDER	FEEDBACK RECEIVED
CREG	Demand response is considered to have a limited energy reservoir (e.g. consumption shifting, demand shedding). The energy crisis we live through today shows a third demand response option, namely demand destruction, where companies are not consuming energy and/or individuals and households are reducing their comfort level to reduce their energy consumption. How is acute demand destruction during periods of scarcity integrated in the study ?

ANSWER:

Elia would like to refer to the answers on the questions on the methodology of the short-term flexibility assessment. At this point, there is no additional category foreseen with demand response volumes based on shutting down activities during very high prices. It is assumed that this reaction is already included in the load profiles of the simulations. Demand destruction is not assumed to provide short-term flexibility (in the intra-day or balancing time frame) as it is a reaction to long lasting high price events.

STAKEHOLDER	FEEDBACK RECEIVED
CREG	Available cross-border flexibility depends indeed on liquidity in cross-border intraday and balancing markets. The study only takes the full capacity into account for slow flexibility when

	prices are between 0 euro/MWh and 300 euro/MWh with the argument that below are above these threshold, regional excess or shortage is indicated. In these cases, a limited available capacity in intraday and balancing timeframes are assumed. A first remark is how these absolute thresholds that indicate regional scarcity or excess are determined and to make transparent the input data and method behind the assessment? A second remark is whether the thresholds were corrected during the period with high gas prices, since the market saw prices of above 300 euro/MWh without regional scarcity being the issue. A third remark is that prices can be high in Belgium and low in other countries, resulting in the full available capacity being used to redirect flows to Belgium.

ANSWER:

These thresholds are determined arbitrarily as representative for regional excess energy (≤ 0 €/MWh) or shortage energy (≥ 300 €/MWh). Elia is open for suggestions on alternative thresholds but believes the impact is limited considering the large contribution of cross-border flexibility in covering the slow-flexibility needs and knowing that the previous analyses in 2021 and 2019 show that slow flexibility needs are adequately covered by the available slow flexibility means (as long as the system is adequate).

STAKEHOLDER	FEEDBACK RECEIVED
CREG	Elia considers the current firm 250 MW (positive) and 350 MW (negative) fast flexibility available, and 0 MW of IGCC. How do these values correspond with a historical analysis of the available ATCs during periods of peak demand in Belgium ?

ANSWER:

In this study, Elia is making projections towards the potential contribution of cross-border flexibility. This is estimated based on the hourly import/export schedule following the adequacy simulations, which are compared with a reference representing the maximum import/export schedules. Note that to simplify the process, this maximum is fixed at 7500 MW (import) and 8000 MW (export) for the investigated period between 2024 and 2034 but that in reality this value can vary on hourly basis. Elia thinks this approach is more suitable for future projections, particularly towards 2034, than the historic ATC values observed.

Nevertheless, as also explained in Section 3 of the annex on flexibility characteristics, available cross-border flexibility also depends on the liquidity in cross-border intra-day and balancing markets. It is possible that not all required flexibility is available in other regions as this flexibility might also be constrained, or already used to deal with unforeseen variations in these countries. While for slow flexibility, a liquid intra-day market is assumed and full capacity is taken into account, a sensitivity approach is applied for ramping and fast flexibility where analyses start from 250 / 350 MW for fast (as currently considered firm in the reserve dimensioning) and 0 MW for iGCC (as not considered firm and subject to large variations and limited predictability). As mentioned in the sheet on flexibility characteristics, sensitivities up to 50% of the mFRR / aFRR needs will be conducted, respectively. This sensitivity approach seems the best suitable approach in view of the current uncertainty on available liquidity in balancing platforms.

STAKEHOLDER	FEEDBACK RECEIVED
Febeliec	On the assumptions on short-term flexibility, Febeliec refers to the many comments it has made in the past on this topic and wishes to highlight the fact that BRPs (and not market players) are responsible for maintaining balance in their portfolios, with Elia only responsible for the residual imbalances. As Elia is pushing towards the abolishment of the day-ahead balancing obligation for BRPs, for which Elia states that this should enhance flexibility management at all times from day-ahead to the end of the intraday market, this should then according to Febeliec lead to better market functioning and in the end less reservation of balancing capacity.

ANSWER:

Elia took well note of this remark of Febeliec (as also made in various other consultations) but explains that this remark is out of scope of the flexibility study focusing on the total flexibility needs of the system, rather than on the calculation of the reserve capacity needs and balancing capacity to be procured by Elia.

Elia refers to the answers given in the latest consultations on reserve capacity dimensioning and balancing capacity calculation and wants to stress that it:

- constantly looks for opportunities to decrease balancing capacity, while ensuring operational security, as also demonstrated by the latest reserve projections (presented in the TF MOG 2, and to be further discussed in the WG Balancing) in which it presents optimistic scenarios where balancing capacity procurements can be reduced compared to current levels thanks to market innovations on partial procurement strategies and CCMD.
- Elia strives for providing adequate price signals to BRPs to minimize the residual actions to be taken by the TSO (SI and NRV publications, imbalance price indicator, alpha,…), resulting so far in a stable or even decreasing volume of balancing capacity despite a significant increase in RES. Elia continues these efforts in the context of CCMD.

STAKEHOLDER	FEEDBACK RECEIVED
Febeliec	Febeliec also wonders why in the assumptions for the assessment of short-term flexibility, demand side response is modelled as unlimited, 1h, 2, 4h and 5h, and not 8h as is the case in other analyses of Elia.

ANSWER:

Elia confirms that the categories will also include an 8h-category, as done in the previous years, as well for the adequacy simulations as for the short-term flexibility analyses. This is also correctly mentioned in the cell R42 of the sheet on the flexibility characteristics in the excel file with the input parameters.

Elia thanks Febeliec for specifying this error in the annex on the flexibility assumption and the reference to the 8 hours will be included in the description when publishing the final report.

STAKEHOLDER	FEEDBACK RECEIVED
FEBEG	Regarding the need for flexibility, FEBEG would like to refer to the WG MOG II sessions which have been organized by Elia in the past months and years, and in which FEBEG and the members of FEBEG have participated actively. FEBEG also did react via various ways on the topic of the integration of (additional) offshore in the Belgian system. Despite the significant and detailed analysis that was performed (with the University of Denmark for example) we find little information on how Elia will take into account the lessons learnt from these MOG II sessions and interactions.

ANSWER:

Elia took note of the questions of FEBEG, and very much appreciates the active role of FEBEG in these discussions. The questions related to mitigation measures and balancing implications of an offshore bidding zone will also be answered in the TF MOG 2.

Elia also commits to give some attention on the implications of offshore evolutions towards short-term flexibility in the Adequacy and Flexibility study. These conclusions will be aligned with the material presented in the TF MOG 2.

STAKEHOLDER	FEEDBACK RECEIVED
FEBEG	FEBEG recalls that the analysis demonstrated that the needs for flexibility could increase significantly in the coming years due to the increase in offshore wind capacity. In addition, since the ambitions of the federal government regarding offshore have reached new heights (of up to 8 GW), the needs for flexibility will automatically become even more important than previous estimates have indicated.

ANSWER:

Elia already demonstrated the increasing short-term flexibility needs in function of renewable developments, including offshore developments (up to 4.4 GW by 2028 in the central scenario and even up to 6.0 GW by 2032 in the high renewable scenario). It will now re-assess the evolution of the flexibility needs in function of the latest renewable projections (up to 5.8 GW offshore by 2030 in the central scenario, in line with latest communications of the government). As mentioned previously in the report in section 5.2.3, a “high RES” scenario in which sensitivity on the installed renewable generation (including offshore) could also be studied.

STAKEHOLDER	FEEDBACK RECEIVED
FEBEG	On the other hand, regarding the means to offer such flexibility, FEBEG has doubts about the assumptions put forward by Elia. While we hope that more flexibility can be unlocked in the coming decade, we are also concerned that there will be many hurdles still to overcome to tap into the flexibility, especially at the level of the household. We urge Elia to consider scenario’s in which flexibility from the DSO grid (from EVs or heat pumps) will not be easily accessible (for

	example due to limited consumers interest in such services) as this would be a prudent and correct approach. Indeed, to count on such flexibility to be there to balance out many GWs of intermittent wind and solar energy is very optimistic or even dangerous.

ANSWER:

Elia will consider different scenarios in the Adequacy and Flexibility study concerning the participation of new flexibility providers (on low voltage levels). These scenarios will be based on the results of the study on the study on the "quantification of Belgian residential and tertiary future consumer flexibility" as presented in the public consultation. These scenarios will be based on the state of electrification and digitalization, as well as the roll-out of an adequate market design for facilitating the participation of flexibility in the market, i.e. Elia Consumer-Centric Market Design.

Elia also refers to the scenarios used for reserve projections presented in the Task Force MOG 2 (and to be further discussed in the WG Balancing) based on different levels of performance of BRPs to balance their portfolio in function of available flexibility unlocked through CCMD.

9. Comments received on Low Carbon Tender & CRM

STAKEHOLDER	FEEDBACK RECEIVED
CREG	21. Pour les raisons développées dans le commentaire relatif aux “investment costs”, des primes de risques adaptées pour l’enchère Y-1 doivent être appliquées.
Febeliec	'On the LCT scenario, Febeliec wants to refer to its many comments during the WG Adequacy and the related consultations on a.o. the design note, and wants to highlight here specifically its questions regarding the required approval of a “targeted” (non-system-wide) and “low carbon” (not technology-neutral) subsidy mechanism and its many questions regarding eligibility, related to the definition of a.o. “new” and “low carbon”. Febeliec does also not completely understand the “fundamental difference between the LCT and the market-wide CRM” and its impact on the required additional capacity and in any case wonders, as mentioned above, about the approval of this new (yet according to Elia fundamentally different but nevertheless apparently seamlessly integratable with the CRM over the lifetime of both products concerning overlap for multi-year contracts, secondary markets, …) mechanism. Febeliec also wonders whether, if the risk is mostly linked to the risk of existing capacities leaving the market, a strategic reserve or other specific measure is not better suited and more in line with legislation. On technology-neutrality, Febeliec is strongly surprised about the exclusion of most technologies and wonders whether this is in line with the applicable legislation. Furthermore, Febeliec is surprised to see that cross-border participation is excluded and wonders what all these exclusions will have as impact on the overall cost of the LCT mechanism. Moreover, Febeliec was also surprised to see that the preselected capacity types now also included DSR, which was not the case for the CRM, but which has potentially a very important impact on CONE and net-CONE and thus on the overall outcome. Febeliec wonders how this different treatment is justified, as the product will afterwards be integrated and compatible with the CRM, according to Elia.
FEBEG	FEBEG is convinced that the existing thermal fleet will continue to play a crucial role for the security of supply of Belgium for the coming decades. For this reason, FEBEG considers of upmost importance to keep a stable and favourable investment framework for those assets to remain on the market in the transition phase towards a fully decarbonized world. In this respect, FEBEG appreciates the efforts of Elia to continue improving the CRM design but would like to remind that, for the moment, there are still some important uncertainties or problematic elements that may impact the future of the existing thermal fleet in Belgium, and in particular: - the current modalities of the payback obligation. We urge Elia and the authorities to further implement the changes with respect to the strike price indexation formula discussed in the WG Adequacy and to ensure that the payback obligation does not negatively impact existing plants over the long run. It is indeed essential that the strike price follows closer the evolution of the electricity market and the underlying costs of the existing thermal fleet to avoid undue payback of revenues. - the evolutions of the CO2 emissions’ limit to participate in the CRM. Last June, the SPF Economy launched a consultation on possible trajectories to reduce the current limit in CO2

	emissions in future CRM auctions. FEBEG members are very concerned with the recommended trajectory, possibly making the participation of most gas-fired plants no longer possible as from delivery year 2027-28. FEBEG considers this initiative particularly impacting and should definitely be considered, if this materializes, in the upcoming AdFlex study. FEBEG has already alerted the authorities on such overly ambitious trajectory because it could lead to closure announcements in the next decade. Clearly, given the limited possibilities to decarbonize the gas-fired power plants, we recommend authorities to allow the existing gas plants to remain in the market until 2035 at least. Their limited running hours in the future, combined with increased RES and batteries, will contribute to an overall reduction of CO2 emissions of the power sector while ensuring the Security of Supply. - In addition, FEBEG also calls for a revision of the IPC derogation files' procedure to ensure that the needed investments in existing plants can be financed through the CRM (to the extent the concerned assets remain competitive). - Finally, the increased pressure on the T-4 with participation or opt-out (IN) of DSM, could potentially at some point exclude some existing gas plants, while their participation in the T-4 would actually be required to unlock an investment decisions. We also recommend Elia and the Belgian authorities to review the split between volumes open in the T-4 and the T-1 auctions. FEBEG has always pleaded for a strong base of flexible and steerable capacities located in Belgium to ensure the security of supply in the long run. In this respect, FEBEG also has and continues to plead to have sufficient "local" margin allowing the country to face events limiting its import capabilities such as unavailability of capacities abroad, minRAM 70% not reached, change in foreign policies, …. Indeed, when it comes to power generation capacity, there are not so many short-term solutions bringing significant MW's to palliate complex problems. The structural issues impacting the availability of the French nuclear fleet and the consequences of the war in Ukraine demonstrate that having sufficient national capacity is actually beneficial for the country. Security of supply is a serious matter and implies the implementation of robust, fair and long-term solutions for market parties. FEBEG calls authorities to anticipate future capacity needs by (i) reviewing the volume split between the T-4 and T-1 auction, allowing to secure more new capacity in the T-4, (ii) taking realistic hypothesis in terms of contribution of foreign capacity to secure sufficient margin on the Belgium territory and (iii) by avoiding to take 'ad-hoc' last-minute palliative measures such as the low-carbon tender currently in development that could undermine the investment climate and increase the perceived regulatory risks in Belgium. In conclusion, the electricity sector is characterized by highly capitalistic investments with a lifetime of more than 20 years. FEBEG once again underlines the need to have a stable long-term investment framework in order to give investors the necessary confidence that will result in attracting capacity to ensure security of supply.

ANSWER:

Elia takes note of CREG's comment on the hurdle rate applicable for a Y-1 Auction. Elia understands CREG's concern, but would like to clarify that the hurdle rates as publicly consulted upon are calibrated by Prof. Boudt in an EoM context.

The calibration of the hurdle rate in EoM context was explicitly done as input for the study regarding the adequacy and flexibility needs of the Belgian power system for the 2024-2034 time-horizon, which includes the delivery period for the LCT (2024-2025). For this reason, Elia is of the opinion that the proposed hurdle rates can apply to the LCT.

For a detailed answer to Febeliec's comments on the LCT legal framework and design, Elia refers to the public consultation report on the LCT design note, published on January 13 2022. In the public consultation report on the LCT design note, Elia takes note of Febeliec's comments on the legal framework of the LCT, but remarks that such comments are out of scope of the public consultation, given that Elia designs and implements the LCT on request of the Federal Government (cf. Winter Plan). In any case, LCT contracts will only be signed after EC state aid approval for the mechanism is obtained. On the technology-neutrality principle, Elia would like to clarify that the mechanism is designed in a technology-neutral way as all new capacities within the CO2 emission limits (proposed by FPS Economy) are eligible to participate.

Elia has addressed Febeliec's many concerns on the definition of new demand response capacities via an updated proposal of the eligibility criteria (cf. public consultation on the LCT Functioning Rules). The fundamental difference between the LCT and CRM stems from the fact that the CRM is a market-wide mechanism, whereas the LCT constitutes a targeted tender for new capacities, mainly affecting the eligibility criteria and the determination of the volume to be procured in the Auction. However, the fundamental design principles for the eligible capacities are aligned with the CRM, ensuring the compatibility of the two mechanisms.

Febeliec correctly observes that foreign capacity cannot participate to the LCT, Elia proposed this on the basis of several arguments. First, it should be noted that the contribution of cross border capacity to the Belgian adequacy is already considered during the calibration of the LCT. Hence existing or new foreign capacity will contribute to the security of supply in winter 24-25. Allowing the participation of indirect cross border capacity would not lead to an increased contribution to security of supply as it would not increase the total cross border contribution (rather it would only increase the cost of the mechanism). Second, Elia is currently developing the cross border aspects of the CRM for the first delivery year 25-26 together with all foreign TSOs. It is deemed impossible to advance the implementation forward with one year.

Elia takes note of Febeliec's remark on the preselected capacity types and would like to clarify that DSR was also part of the preselected capacity types in the CRM 2027-28 calibration process. The capacity types proposed for the LCT include all preselected capacity types of the CRM 2027-28 calibration that are eligible for the LCT.ELIA thanks FEBEG for its contribution and remarks provided regarding the LCT & CRM. With respect to the different points raised, ELIA would like to answer the following:

- On the need to amend the current modalities of the payback obligation: ELIA refers to the public consultation on the CRM Functioning Rules V3[67] in which ELIA has made a proposal which will also be applicable for the LCT. ELIA understands FEBEG's concerns and has made a proposal taking into account the feedback expressed.

[67] https://www.elia.be/en/public-consultation/20221125-formal-public-consultation-on-the-crm-functioning-rules

- On the evolutions of CO2 limits for the participation to the CRM: ELIA would like to highlight the fact that this is managed and proposed by the Belgian authorities. Therefore, this comment is out of scope of the current public consultation.

- On the need for a revision on the way the IPC derogation can be granted, ELIA points out the fact that such revision can but only happen following a review from the Royal Decree which describes extensively the way it must take place (including the requirements & conditions to be fulfilled to be granted an IPC derogation). Hence, this point raised by FEBEG is out of scope of the current public consultation.

- On the rules regarding the treatment of opt-out volume, ELIA refers again to the public consultation which has just taken place on CRM Functioning Rules V3 where such matter should be discussed.

As to FEBEG's concern on the impact of the LCT development on the investment climate, Elia refers to the public consultation report on the LCT design note and repeats that it designs and implements the LCT on request of the Federal Government (cf. Winter Plan).

10. Comments received on AFRY study on cost of capacity

STAKEHOLDER	FEEDBACK RECEIVED
CREG	'22. La CREG souhaite tout d'abord attirer l'attention que la détermination des coûts fixes considérés dans l'Etude Afry doit se faire en cohérence avec les coûts variables établis par Elia. Il est ainsi important pour la CREG de connaître la répartition des coûts entre les coûts fixes et les coûts variables afin de s'assurer que certains coûts ne soient pas omis ou comptés deux fois tant dans l'établissement de la recommandation d'Elia pour l'IPC que dans l'évaluation des dossiers de dérogation à l'IPC. Cette répartition des coûts entre coûts fixes et les coûts variables doit par ailleurs se faire en cohérence avec l'utilisation qui en sera faite dans le modèle de calcul de l'évaluation des revenus du marché développé par Elia.
CREG	'23. Afry indique que pour les OCGT, la redevance de transport de gaz a été fixée à zéro sur la base du fait que des produits de capacité de gaz à court terme sont disponibles et que les unités de pointe les traitent comme des coûts variables. Elia inclut-elle ce coût dans le coût variable des OCGT ? La CREG considère par ailleurs qu'il serait justifié pour une OCGT de souscrire sa capacité « Exit » pour le transport du gaz sur la base d'un contrat annuel. Nous recommandons donc que ce coût soit considéré comme fixe.
CREG	24. Pouvez-vous confirmer que ces coûts variables liés aux coûts des produits chimiques, de l'eau et du rejet des eaux usées sont pris en compte par Elia ?
CREG	25. Afry indique que le coût de l'électricité importée est traité comme un coût variable étant donné la forte corrélation entre le montant de l'importation et les heures de fonctionnement de la centrale.

	La quantité d'électricité importée augmente avec la diminution des heures de fonctionnement de la centrale. Ce coût ne doit donc pas être inclus dans les coûts variables pris en compte pour le calcul des revenus du marché, mais doit être considéré comme une déduction des revenus du marché calculés sur la base des heures où la centrale ne produit pas d'électricité. Ce coût implique un coût lié à l'électricité importée mais également lié aux CV et aux surcharges. De plus, le coût ne se limite pas à un coût variable. En effet, cette énergie importée implique également un coût de souscription annuelle de capacité de soutirage auprès d'Elia. Nous recommandons donc que les coûts de capacité de soutirage d'Elia soient considérés comme des coûts fixes et que les coûts variables de l'énergie importée mais aussi le coût des CV et des surcharges soient considérés par Elia comme une déduction des revenus du marché calculés sur la base des heures où la centrale ne produit pas d'électricité. S'il n'est pas possible de modifier le modèle d'Elia pour le calcul des revenus du marché, nous recommandons que le coût total soit considéré comme un coût fixe basé sur une estimation du nombre d'heures où l'unité de référence ne produit pas.
CREG	26. Afry indique qu'étant donné la forte corrélation entre le coût de la maintenance non planifiée et le nombre d'heures de fonctionnement/démarrage de la centrale, il est généralement traité comme un coût variable. Elia peut-elle confirmer que ce coût est considéré comme un coût variable dans l'évaluation des revenus du marché ? Est-il considéré par rapport au nombre d'heures de fonctionnement ou au nombre de démarrages ?
CREG	27. Pourriez-vous expliquer plus en détail pourquoi les impôts fonciers et les coûts de location des terrains sont exclus dans l'estimation des coûts fixes par Afry ? La CREG recommande que les coûts de location des terrains et les taxes locales soient pris en compte dans l'évaluation des coûts fixes.
CREG	28. Pouvez-vous détailler les coûts qu'Afry considère comme éligibles pour les coûts administratifs? En particulier, Afry indique qu'il n'est pas en mesure de se prononcer sur une vision bottom-up détaillée des coûts de gestion de portefeuille. La CREG considère que les coûts de gestion de portefeuille sur les marchés à terme ne devraient pas être inclus. Leur exclusion serait cohérente avec le modèle d'évaluation des revenus du marché développé par Elia basé sur l'évaluation des revenus day-ahead. Par ailleurs, pouvez-vous confirmer qu'Afry considère que les frais généraux doivent être limités aux frais de trading et de settlement ?
CREG	29. Afry indique que le coût de transport d'électricité a été calculée sur la base des données tarifaires publiées par Elia. Dans l'étude 2020, Afry a estimé un coût de transport d'électricité qui inclut le coût d'injection de 0,6169 Eur/MWh. Nous recommandons que le coût de raccordement soit considéré comme un coût fixe et que le coût d'injection en Eur/MWh soit considéré par Elia dans son coût variable. Il convient donc de s'assurer que le montant fixe calculé par Afry n'inclut pas le coût d'injection variable.
CREG	30. La CREG considère que les provisions pour les entretiens majeurs devraient être estimées, par technologie, par un montant en euros, par heure de fonctionnement ou par démarrage. Par ailleurs, l'Arrêté Royal méthodologie prévoyant que le coût des investissements récurrents (entretiens majeurs) soit multiplié par un facteur « un plus le coût moyen pondéré du capital », la CREG considère que le montant en euros par heure de fonctionnement doit être

	calculé en divisant le coût de l'entretien majeur par le nombre d'heures de fonctionnement qu'il permet de réaliser. Il en va de même pour le coût en euros par démarrage, il doit être calculé en divisant le coût de l'entretien majeur par le nombre de démarrages qu'il permet de réaliser. L'Etude Afry ne permet pas de confirmer ce mode de calcul a été appliqué. Ainsi, Elia utiliserait donc ce montant multiplié par le nombre d'heures de fonctionnement ou le nombre de démarrages résultant de son calcul des revenus du marché pour estimer le coût des entretiens majeurs. La CREG considère qu'il n'est pas opportun qu'Afry réalise le calcul de la provision pour les entretiens majeurs sur base d'un nombre d'heures de fonctionnement estimé.
CREG	31. Dans son étude, Afry considère une indexation du coût salarial basée sur l'indice du coût du travail pour le secteur de la fourniture d'électricité, de gaz, de vapeur et d'air conditionné. Cependant, dans son étude 2020, Afry a basé son évaluation sur une étude de Pöyry de 2018 pour une OCGT irlandaise et une CCGT irlandaise. Cette étude a utilisé un coût par ETP de 78 000 euros/an pour une OCGT et de 83 000 euros/an pour une CCGT. La CREG recommande d'adapter cette référence sur base des coûts effectivement observés en Belgique.
CREG	32. L'évolution des indices observés entre mars 2021 et mars 2022 semble être appliquée aux estimations 2019 de l'Afry pour obtenir la référence 2022. Pourquoi ne pas prendre l'évolution depuis 2019 ? Au vu de l'évolution observée depuis mars 2022, n'est-il pas justifié de prendre l'évolution de ces indices jusqu'à ce jour ? Par ailleurs, certains montants pris en compte dans l'étude Afry 2019 ne semblaient pas être des montants en euros 2019, par exemple l'étude Pöyry 2018. Il est important que chaque coût pris en compte par l'Afry soit indexé sur base de la date de référence de cette donnée.
CREG	33. Les coûts sont basés sur le GTW 2019. Pour quelle raison le GTW 2021 n'a-t-il pas été considéré comme nouvelle référence ? Un indice de prix allemand est appliqué sur les coûts EPC et un indice de prix américain est appliqué sur les coûts LTSA. Pourquoi ne pas appliquer une pondération des deux indices sur les deux coûts en tenant compte du fait qu'une partie des CCGT/OCGT est basée sur des composants américains ? Le taux de change USD/EUR a changé depuis 2019. Pourquoi n'est-il pas pris en compte ? Thermoflow et PEACE donnent-ils les mêmes résultats? Pourquoi ne pas utiliser également ces sources?
CREG	34. La CREG souhaite clarifier la prise en compte des coûts variables et des coûts de démarrage dans l'évaluation des revenus nets du marché. La CREG considère que tous les coûts variables et les coûts de démarrage doivent être pris en compte lors de l'établissement du merit order de la CMU. La CREG considère que les coûts variables doivent être déduits des revenus du marché lorsqu'Elia établit les revenus nets du marché. Au contraire, la CREG considère que seuls les coûts de démarrage qui ne correspondent pas à des provisions pour maintenance future doivent être déduits des revenus du marché pour établir les revenus nets du marché. En effet, le coût de la maintenance est inclus dans les coûts fixes d'O&M ou dans les coûts d'investissement récurrents. La CREG estime toutefois que ces coûts d'investissement doivent être évalués sur base du nombre d'heures de fonctionnement ou du nombre de démarrages résultant du calcul des revenus du marché d'Elia comme expliqué précédemment.
FEBEG	Investment costs

	FEBEG supports the assumptions taken in terms of price evolutions (consideration of the inflation based on IPP) but will let its members comment on the CAPEX level considered for the different technologies.

ANSWER:

Before going more into detail for the individual questions that were raised concerning the AFRY study, Elia would like to note that the AFRY study involved an update of the report that was provided in 2020, which in turn was a peer review of the study provided by Fichtner. The scope of this update was never to completely revamp the methodology on how the Fixed O&M is calculated; indeed, given the sudden changes on the energy markets, timing did not allow for such an approach.

Furthermore, many questions were raised on the details of the Variable O&M costs. Regarding this parameter, Elia takes into account a study performed by the Joint Research Centre of the European Commission for CCGT and OCGT units and the ENTSO-E database for the other generation units, as performed in previous Adequacy and Flexibility study of 2021 (see extract below – note that the table submitted to public consultation included some inconsistencies on a unit per unit basis between categories, the table below is correct). In this framework, the Variable O&M costs of units were defined as "*costs that are linked to the electrical output of a generation facility (excluding fuel, emissions and personnel costs)*". However, no further details were available. In the simulations performed by Elia, this parameter is taken into account in line with European methodologies in order to ensure coherency in the model at European level.

3.6.3. VARIABLE OPERATION AND MAINTENANCE COSTS

The **Variable Operation and Maintenance (VOM) costs** of units are costs that are linked to the electrical output of a generation facility (excluding fuel, emissions and personnel costs). The VOM costs were taken from a study performed by the Joint Research Centre of the European Commission for CCGT and OCGT units [ETR-1] and from the ENTSO-E database for the other generation units, as shown in Figure 3-69.

[FIGURE 3-69] — VOM PER TECHNOLOGY

Technology	[€/MWh]	Source
CCGT	2	ETRI
OCGT	11	ETRI
Gas engines	11	assumed same as OCGT
Oil	3.3	ENTSO-E
Coal	3.3	ENTSO-E
Lignite	3.3	ENTSO-E
Nuclear	9	ENTSO-E

In order to settle the matter, Elia would propose to rediscuss the necessity of a new study on this subject. The scope of such a study would still need to be determined. In any case, Elia would recommend to extend the scope of the study in order to provide a clear distinction between the costs associated to Variable O&M and Fixed O&M costs.

22. Elia agrees with the CREG that the modelization of the power plants in Elia's simulation tool needs to be consistent with the different cost components that are highlighted by AFRY. However, it is important to stress that, as in every simulation exercise, abstraction is made of certain specific elements that are then taken into account implicitly in general cost components.

The AFRY 2022 study already explicitly excludes in section 3.1.1 certain elements that are not considered. However, in addition to the specific elements that are included in the Fixed O&M, AFRY also provides that "other miscellaneous expenses" are also taken into account, exactly because it is impossible to make an exhaustive list of all elements that can or should be included. Likewise, the Elia simulations make use of a Variable O&M cost component that aggregates a variety of cost components that increase with the output of an asset and has been based on a peer review of studies To the best of its abilities Elia strives to make sure that these variables are accurate and that no double counting occurs between the Fixed O&M on the one hand and the Variable O&M on the other. In the current framework, the Variable O&M costs of units were defined as "*costs that are linked to the electrical output of a generation facility (excluding fuel,*

emissions and personnel costs)". In order to provide further details and split, Elia would advise to rediscuss the necessity of a new study, integrating Variable O&M costs and including a clear distinction between the costs associated to Variable O&M and Fixed O&M costs, which is not available at this moment.

23. With regards to the Fixed gas transmission charges, Elia follows the reasoning that was proposed by AFRY: considering the modest amount of running hours for OCGT units, it is understandable that these units consider this as a variable rather than a fixed expense.

24. Concerning CREG's comment related to the chemicals cost, raw water cost and wastewater discharge cost, Elia would like to refer to its earlier reply related to the cost components that are explicitly and implicitly included in the Fixed O&M and Variable O&M, respectively.

25. Elia does not agree with CREG concerning the comment on the imported power. Indeed, CREG's statement that imported power increases with diminishing running hours suggests that a CCGT or OCGT plant with high marginal costs that is often out of the money will have higher expenses for imported power, which is not the case. AFRY highlights themselves that this cost component refers to shutdowns due to planned maintenances or forced outages, which should not be confused with plants that are not running due to their higher marginal cost.
Seeing as planned maintenances and forced outages are strongly correlated with running hours, Elia therefore follows AFRY's reasoning that this cost component should be considered as variable.

26. The Variable O&M cost used by Elia is based on a peer review of available studies that does not specify details on the cost components that are explicitly taken into account. The Variable O&M costs of units were defined as "costs that are linked to the electrical output of a generation facility (excluding fuel, emissions and personnel costs)". Elia takes into account a study performed by the Joint Research Centre of the European Commission for CCGT and OCGT units and the ENTSO-E database for the other generation units, as performed in previous Adequacy & Flexibility study. In the simulations performed by Elia, this parameter is taken into account in line with European methodologies in order to ensure coherency in the model at European level. In order to provide further details and split, Elia would advise to rediscuss the necessity of a new study, integrating Variable O&M costs and including a clear distinction between the costs associated to Variable O&M and Fixed O&M costs, which is not available at this moment.
27. Elia acknowledges that the CREG does not agree with AFRY's assumption that property taxes and land lease costs are excluded. As pointed out by market parties, these costs can differ wildly between plants and are hard to estimate. Elia has taken into account these considerations from market parties and other market parties in the context of the IPC determination by switching from the low-mid range to mid-high in order to prevent a possible underestimation. Elia furthermore wants to stress again that a Capacity Provider can indicate these individual costs in the framework of an IPC derogation process.

Elia will take into account comments related to property taxes and lease costs in any possible future update of the study described in Article 17 of the Royal Decree Methodology.

28. As indicated in section 3.1.1 of the AFRY study, the trading and admin costs include trading and settlement, overhead costs, bank fees, security expenses, public relations, legal fees, freight and import duties, auditing fees, safety equipment, office equipment expenses and other miscellaneous expenses.

Following the public consultation on the scenarios, sensitivities and data for the CRM parameter calculation for the Y-4 Auction for the Delivery Period 2027-28, Elia gave market parties the opportunity to submit the cost components that according to them should be considered for the Fixed O&M. The trading and settlement costs were one cost components that were as such submitted to Elia, and were as such considered by AFRY. Elia understands that this might seem contradictory with the DA revenues model, but wishes to highlight that these trading and settlement costs only make up a fraction of the total admin costs that were as such considered by AFRY.

29. Elia confirms that the "no elec"-results exclude the injection cost of 0.6169 €/MWh, which is considered as variable. In contrast, the fixed connection cost is still considered for the Fixed O&M, as explained in section 3.1.1 in the bullet about fixed electricity transmission charges.

30. Elia understands the position of the CREG with regards to the provisions for maintenance. Be that as it may, as explained by AFRY in section 4.1.5 of their report, capacity owners often do not pay a fee per major maintenance but enter into a long-term service agreement (LTSA). Even though the maintenance itself might then be based on either running hours or number of starts, the agreement eradicates any such variability and replaces it with a fixed fee that is paid every year. Based on that assumption, it is logical that the expenses for major maintenance are included as a fixed component of the Fixed O&M.

31. With regards to the labour costs that are taken into account by AFRY, Elia wishes to highlight that it is extremely hard to get an overview of the evolution of wages and the associated labour costs. This information is highly confidential and is rarely made publicly available. Moreover, even though certain overviews do exist, the profiles that are employed in power plants are often very technical and specialized, making it so that the numbers included in said overview might not give an accurate picture.

In a largely internationalized labour market, wages converge, and Elia believes that the estimate that was made for 2018 is still relevant. To reflect the unique Belgian policy of automatically indexed wages, the STATBEL index was applied.

32. The CREG correctly observes that only the indexes between March 2021 and March 2022 have been taken into account. However, one can observe that the Producer Price Index remained extremely stable in the period before that, with the vast majority of the data points not exceeding 1%. Taking this period into account does not have a significant impact on the result obtained.

It is also true that some of the data that is used as a starting point originates from studies expressed in €2018. These amounts are then modified using the indexes calculated by AFRY (for example, the calculation of the 2022 EPC cost below exhibit 4.3) in order to arrive at a result expressed in €2022, as stated in section 2.3.

33. AFRY themselves highlight in section 4.1.4 why they did not use the GTW 2022 numbers. Among other things, GTW 2022 lacks data concerning specific gas turbine models. Moreover, AFRY found that the price increases mentioned in GTW 2022 did not fully reflect the recent price shocks. Hence, AFRY decided to update the EPC cost based on different data.

With regards to the distinction between the Producer Price Index used for the EPC cost and the one for the LTSA cost, AFRY highlighted that the specific characteristics of the EPC and the LTSA, respectively, result in different indexed

that are taken into account. Indeed, the EPC looks broader at the industry as a whole, whereas the LTSA is much more focused on the material cost. It is worth pointing out that the total Fixed O&M is calculated based on a formula consisting of, among others, the EPC and the LTSA cost levels. To that extent, one could argue that the weighted average of these indexes is already used.

The exchange rate of 0.86, as explained in footnote 4, refers to the exchange rate that was used in 2019 and the resulting price in euros that was calculated then. As mentioned before, the figures from AFRY 2019 then serve as a starting point and are adapted based on indexes such as the German Producer Price Index.

34. Elia would like to remind the CREG that in order to calculate the yearly revenues from inframarginal rents it follows the stipulations set out in Article 19, §2 and Article 18, §2, 3° of the Royal Decree Methodology, meaning that it corrects the gross revenues with, among others, the variable operation and maintenance expenses. On that note, Elia would like to point out that the variable maintenance expenses as such need to be set apart from the fixed maintenance expenses, which are considered by AFRY in the Fixed O&M.

11. Suggestions for sensitivities

An overview of the received proposals for sensitivities is given here. More information on each such sensitivity is deemed relevant can be found in the related section of the report. This section gives a non-exhaustive list of sensitivities that could be performed.

Note that data and sources needed to build those sensitivities and quantify them still need to be studied and discussed within the CdC.

Non-exhaustive list of sensitivities:

- On a different **load** trajectory in Belgium (e.g. higher/lower load due energy-crisis recovery, on relocalisation of industry outside Belgium, …);
- On the availability of **gas-fired power plants in Belgium** (e.g. in case of strict CO2 emissions' limits in the CRM) and on the availability of **nuclear power plants in Belgium;**
- On the **Renewable Energy Sources**, with lower and higher RES development (e.g. a delay of MOG II offshore wind farm);
- On the **DSR capacity and volume**, e.g.: lower/higher residential & tertiary DSR, industrial DSR);
- On the **storage capacity and volume** (e.g. in a context of shortage of critical raw material);
- On the **available capacity abroad**, e.g: **nuclear** availability in **France** (with various level of unavailability), **coal/lignite** capacity in **Germany**, …;
- On possible measures to **guarantee the reliability standard in other countries** (Germany), irrespective of the presence of dedicated mechanism.
- On lower **RAM assumption** for flow-based (e.g. 50% RAM);
- On the impact of **revenue-cap** at EU and BE level;

Note that a combination of several sensitivities to better understand the combined effect of the most likely ones for an highly interconnected country such as Belgium will also be studied;

12. Next steps

Elia thanks all the market players for their participation to this public consultation. Based on the reactions received from market players and the answers given, as set out in this consultation report, Elia will implement the changes.

Elia continues working on this study by integrating the feedback, discussing the specific topics within the CdC and implementing the methodology in order to carry out the analysis of the Adequacy and Flexibility needs for the 2023-2034 time horizon by June 2023. The results will be presented on 29 June of 2023 to the market parties during the Working Group Adequacy and the final report will be made available.

13. Attachments

The reactions Elia received to the document submitted for consultation from the following market parties can be found on Elia website together with this consultation report.

On Elia sebsite, the feedback from the following market parties can be found:

- Febeliec
- Fluxys
- FEBEG
- CREG
- Sebastien Gonzato (KUL)
- Johan Springael (Universiteit Antwerp)
- Pierre Kunsch (ULB)
- Citizen Task Force – Groupement de Citoyens Belges Inquiets
- 100TWh
- Keep The Lights On
- Maxime de Changy (independant expert)
- Organisatie Duurzame Energie

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