WG Adequacy #14

16 December 2022

Agenda

- Welcome
- Minutes of Meeting WG Adequacy #12 & #13 (28.10.2022 & 17.11.2022)
- CRM : Calibration Report Elia 27-28
- CRM : Capacity contract planning
- CRM/LCT : Changes & Eligibility
- Final results for a CO2 threshold trajectory recommendation in the Belgian CRM
- Next meetings

Minutes of Meetings

Minutes of Meeting

- **WG Adequacy #12 – 28.10.2022 : To be approved**
- *The MoM were sent on 08.12.2022. No comments were received.*
- **WG Adequacy #13 – 17.11.2022 : To be approved**
- *The MoM were sent on 02.12.2022. No comments were received.*

CRM : Calibration Report Elia 27-28*

*Note that some corrections were applied in order to clarify naming between auction and CRM calibration report

Agenda

- Introduction
- Regulatory Context & Ministerial Decrees
- Overview of the TSO's CRM Calibration Report
  - Part I : Reference scenario and intermediate values selected by the Minister
  - Focus on scarcity situations
  - Part II : Information and input for the establishment of the demand curve
  - Part III : Proposals for the other auction parameters

Introduction

Introduction

- The report contains information, calculations and proposals for the Y-4 auction for delivery period 2027-28, that will take place in October 2023, that will serve as basis for the Minister to choose the parameters that determine the amount of capacity to be auctioned.
- The legal & regulatory framework is the Royal Decree determining a methodology to calculate the CRM auction volume and parameters.
- The report has been transmitted to the cabinet of Minister Van der Straeten, FPS Economy and CREG on the 15th of November 2022 and has also been published on Elia's website on the 29th of November 2022.
- The purpose of this presentation is to provide an overview of the TSO's CRM Calibration Report.

Overview of data published

Content of the publication:

- TSO’s CRM Calibration Report
  - Information and data for the demand curve building
  - Proposals for auction’s parameters (derating factors, IPC, Strike Price)
  - **(NEW)** Additional appendix to provide additional insights to stakeholders on the CRM calibration report. This appendix will focus on inputs data, output data (scarcity situations, average load, average ENS, XB participation and derating factors for energy-limited technologies) and will provide a comparison with previous TSO’s CRM Calibration Report.
- Assumptions Workbook
  - **(NEW)** Excel Table updated with feedback from public consultation and Ministerial Decrees in order to provide the final dataset used in the simulations.

Next Steps

Based on the Royal Decree Methodology, the next steps are the following:

- A proposal from CREG on the demand curve and Y-1 reserved volume is expected by 1/02/2023;
- An advice from Elia and FPS Economy on CREG's demand curve proposal is expected by 1/03/2023;
- A decision by the Minister on the volume to auction (demand curve), the Y-1 reserved volume and other parameters (strike price, reference price, derating factors and intermediate price cap) is foreseen by 31/03/2023.

Regulatory Context & Ministerial Decrees

Regulatory Context

The TSO’s CRM Calibration Report for the Y-4 auction with Delivery Period 2027-28 is based on Chapter 3 of the Royal Decree Methodology and on the CRM Law.

On basis of the reference scenario selected by the Minister, Elia’s report should at least contain :

Requested Input from Elia

1. the load duration curve required to determine the 200h reserved capacity for Y-1 auction
2. the available information from Elia regarding the non-eligible volume
3. the max entry capacity for indirect cross-border participation for each neighboring European Member State
4. the revenues from the energy market for each technology required for the net-CONE calculation
5. the average load during simulated scarcity hours
6. the upward balancing need
7. the average energy not served during simulated scarcity hours

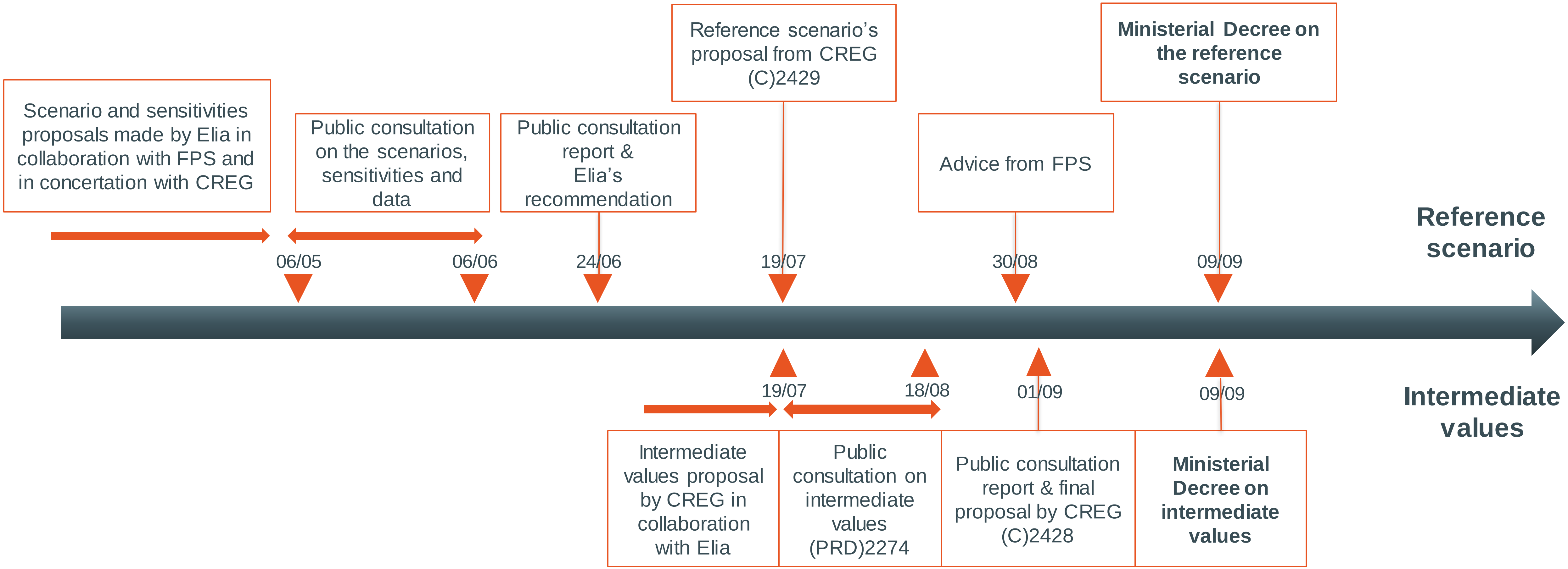
Proposal from Elia

8. a proposal for the derating factors
9. a proposal for the intermediate price cap
10. a proposal for the reference price
11. a proposal for the strike price

Overview of the TSO’s CRM Calibration Report

Part I : Reference scenario and intermediate values selected by the Minister

Reference scenario and intermediate values selected by the Minister



Reference scenario selected by the Minister on 09/09

- Based on ERAA21
- Dataset updated based on the latest information for Belgium and other countries as consulted upon from May to June 2022
- Integrate high prices based on trajectories derived from REPowerEU assessment from European Commission
- Integrate the sensitivity which assess the impact of high prices on electricity consumption, as presented by Climact during the WG Adequacy #9 from the 25th of August
- Integrate an additional unavailability of 4 units on French nuclear generation

Note that all assumptions and input data are summarized in the "Assumptions Workbook" published with the TSO's CRM Calibration Report. Among others, it contains all the data from the Ministerial Decree on the reference scenario

Intermediate values selected by the Minister on 09/09

- A list of technology and a gross-CONE for each technology as presented in the table below
- A correction factor X equal to 1,5
- Hurdle Premium in line with Royal Decree on Methodology
- WACC = 5,53 %

Referentietechnologie	EAC(€/kW/y)	Reductiefactor[%]	CONEfixed, RT (€/kW/y)
Gasturbine met open cyclus (OCGT)	75	91%	82,4
Gasturbine gecombineerde cyclus (CCGT)	106	92%	115,2
Verbrandingsmotor	72,3	95%	76,1
Warmtekrachtkoppeling (CHP)	162,5	93%	174,7
Fotovoltaïek	93,4	1%	9 340
Onshore windenergie	174,3	9%	1 936,7
Offshore windenergie	392,4	13%	3 018,5
Opslagbatterij (4h)	131,2	79%	166,1
Vraagrespons	50	66%	75,8

Note that all assumptions and input data are summarized in the “Assumptions Workbook” published with the TSO’s CRM Calibration Report. Among others, it contains all the data from the Ministerial Decree on the intermediate values.

Main changes compared to previous TSO's CRM Calibration Report in the Belgian area

1 Lots of changes on the Belgian input data

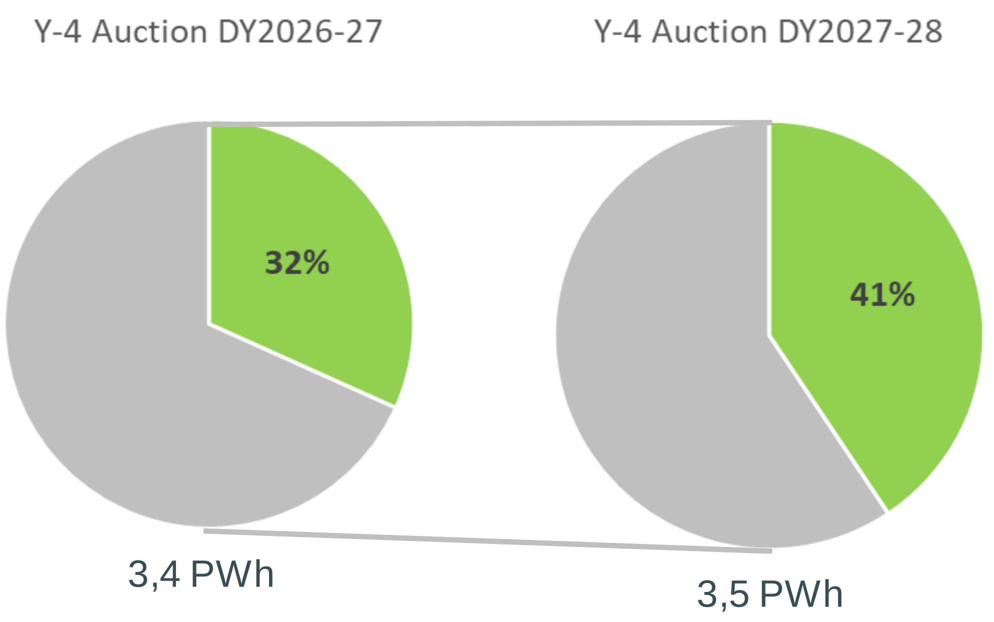
- Total load reduced compared to previous TSO's CRM Calibration Report (91.5 → 90.9 TWh) but more seasonality due to HP and intraday variations due to EV
- More residential batteries (+165 MW) and more solar photovoltaic (+1500 MW) installed capacity
- Coo extension projects taken into account compared to AdFlex 21 + updated DSM shedding capacity
- Reduced capacity for offshore wind (-700 MW) and Art. 4bis on Seraing ST and TJ Ixelles-Volta (< 200 MW)

2 As required by CREG and stakeholders during previous TSO's CRM Calibration Report presentation, the volume integrated in the model in order to make Belgium compliant with its reliability standard, using the preselected capacity types, will be presented in the CRM calibration report.

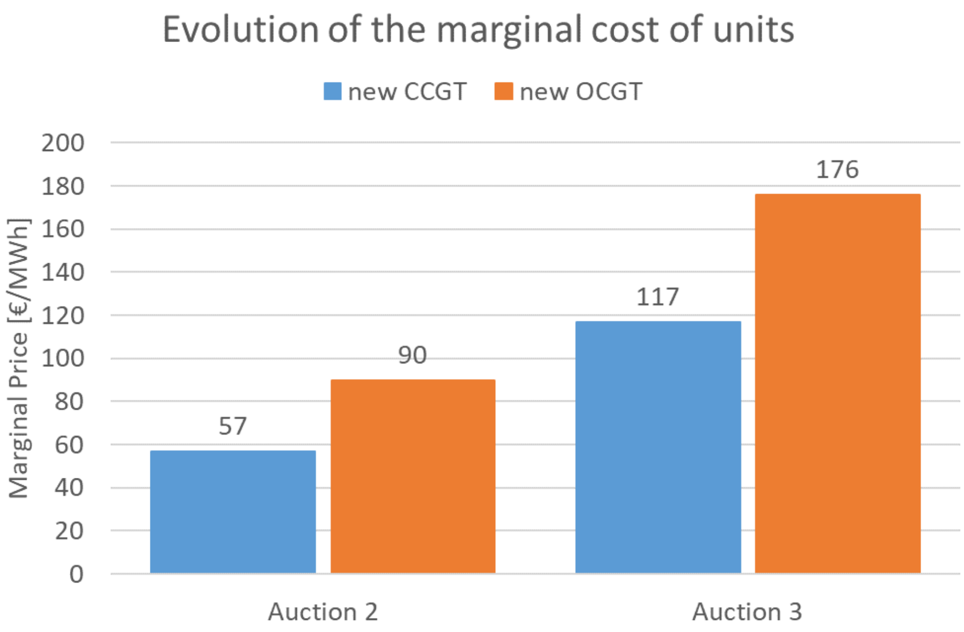
In this TSO's CRM Calibration Report, a volume of **1200 MW of OCGT** was needed in order to reach a 3h-LOLE for Belgium on top of the reference scenario selected by the Minister.

Dataset significantly changed compared to last year

1. Massive increase of RES generation compared to previous reference scenario



2. Significant increase of the fuel price



Dataset significantly changed compared to last year

3 Reduced share of thermal units in Germany and additional electrification (Easter Package)

4 Updated sensitivity on French nuclear availability

Sensitivity	Description
French nuclear availability - 2 units	**Decreased French nuclear availability in line with the reference scenario 2025-26 and 2026-27** Lower availability by 2 units on average during winter
French nuclear availability - 4 units	**Decreased French nuclear availability based on historical figures** Lower availability by 4 units on average during winter
French nuclear availability - 6 units	**Decreased French nuclear availability based on historical figures** Lower availability by 6 units on average during winter
French nuclear availability - 8 units	**Decreased French nuclear availability based on historical figures** Lower availability by 8 units on average during winter

Selected for the first 2 reference scenarios

Selected for the reference scenario of this calibration report

Overview of the TSO’s CRM Calibration Report

Focus on scarcity situations

A specific focus on scarcity situations is relevant as most of CRM parameters and calculations are derived from these

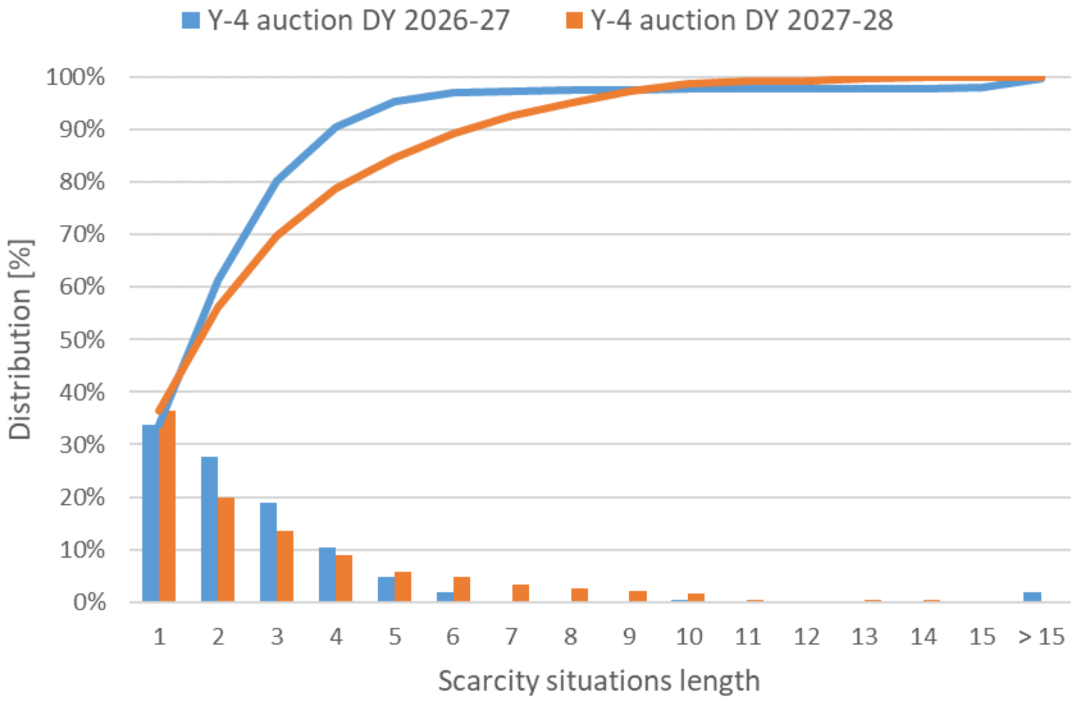
- Simulated scarcity situations are one of the main drivers in the calculation of CRM parameters
- Some volume parameters are calculated during these periods :
  - Average load during simulated scarcity hours
  - Average energy not served during simulated scarcity hours
  - Max-entry capacity for indirect cross-border participation
- Some parameters proposed by Elia are also calculated during these periods :
  - Derating Factors for SLA's and energy-limited technologies (market response, batteries, psp)
  - Derating Factors for RES (solar, onshore wind, offshore wind, hydro ror)
  - Derating Factors for aggregated thermal technologies

For these reasons, it seems relevant to have a close look at the evolution of simulated scarcity situations.
All information presented here is available in the "Appendix: Complementary analysis on results", published on Elia's website together with the TSO's CRM Calibration Report.

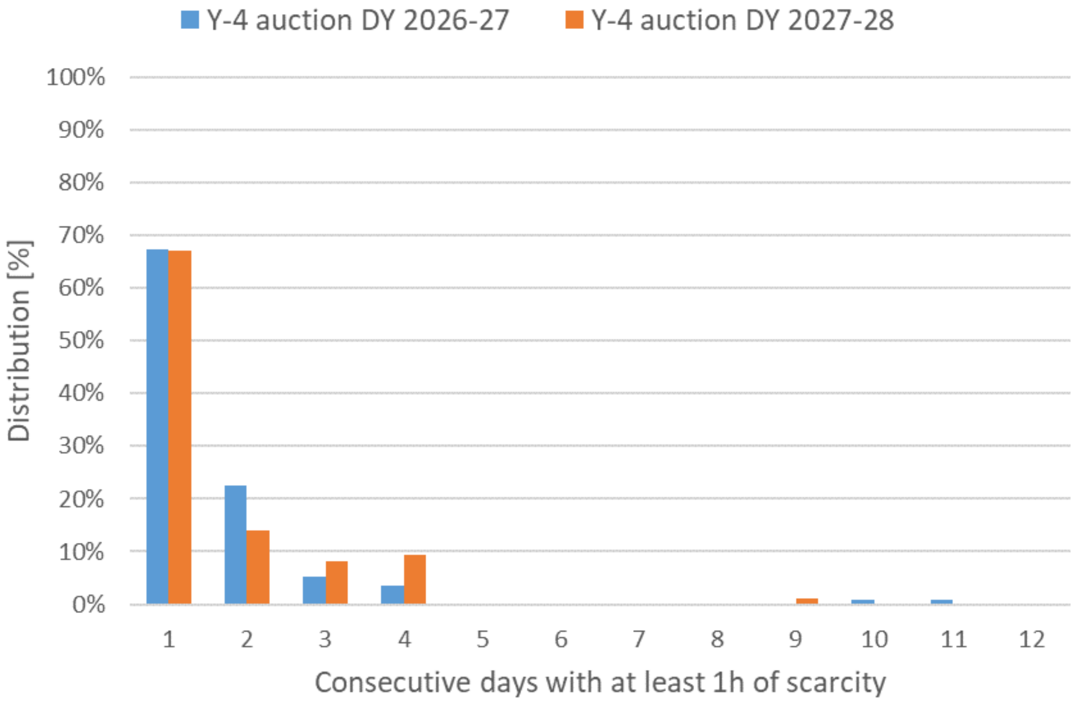
Note that the total number of scarcity situations doesn't evolve as it is related to the applicable reliability standard criteria (3h of LOLE)

Scarcity situations length increased on average

- In both TSO's CRM calibration reports, limited amount of scarcity situations with a length higher than 10h.
- More scarcity situations in this TSO's CRM calibration report with a length higher than or equal to 5h.
- In general the scarcity situations are a bit longer than in the previous TSO's CRM calibration report.
- This observation can be explained by the higher share of RES in Europe, especially in terms of offshore wind.



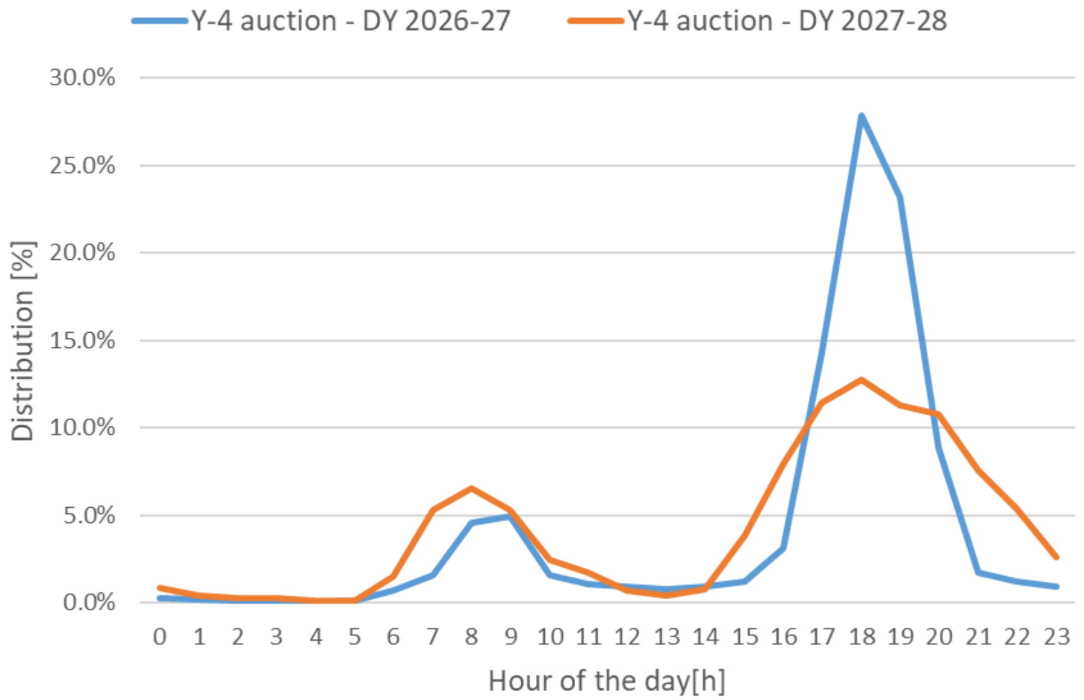
More consecutive days in which scarcity situations occur with at least 1h of scarcity (2 → 3 or 4) compared to previous TSO's CRM Calibration Report



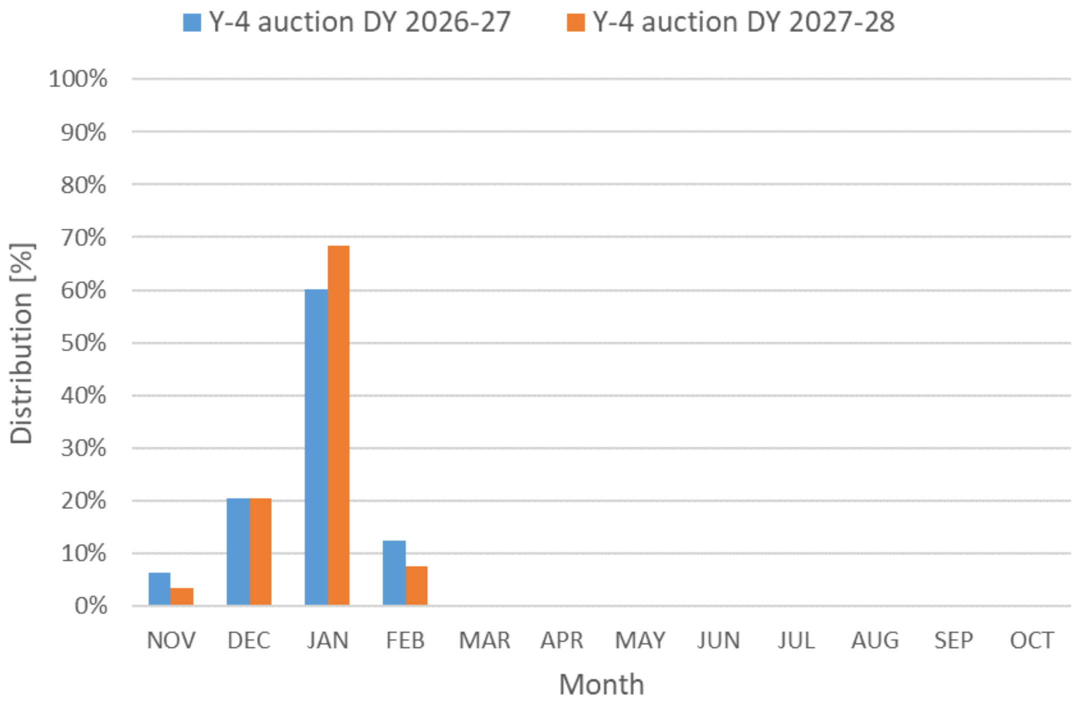
- Few periods of more than 1 day with scarcity situations
- This probability is similar in the last 2 TSO's CRM Calibration Reports.
- However, more scarcity situations have a higher recurrence (3-4 consecutive days).
- This observation can again be explained by the higher share of offshore wind but also by the reduced amount of thermal capacity.
- This will impact the derating factors of energy-limited technology as there are less periods to reload between scarcity situations.

Scarcity situations happen during longer periods around the evening peak, explaining the increased length of scarcity situations

- Main difference between the last 2 TSO's CRM calibration reports is the spread of scarcity moments around the evening peak.
- In the TSO's CRM calibration report for Y-4 auction with DY 2026-27, scarcity situations took place mainly during a 3h window (from 17 to 19h)
- In this TSO's CRM calibration report, the periods around the evening peak significantly increase. They start earlier and end later.



Most scarcity situations in Belgium happen in January



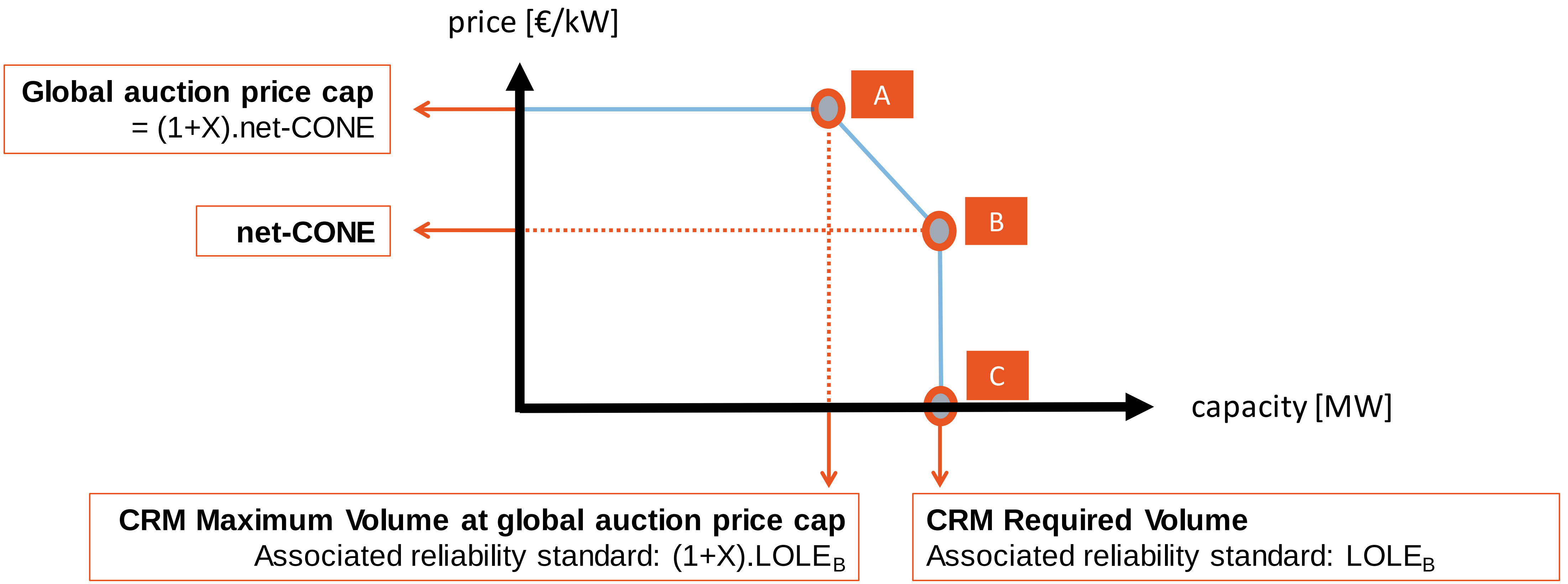
- The distribution of scarcity situations across the year shows that most of those events take place in January.
- Scarcity situations happen from November to February included.
- The distribution of scarcity moments across the year is similar to the last TSO's Calibration Reports calibration report.

Overview of the TSO's CRM Calibration Report

Part II : Information and input for the establishment of the demand curve

Part II : Information and input for the establishment of the demand curve

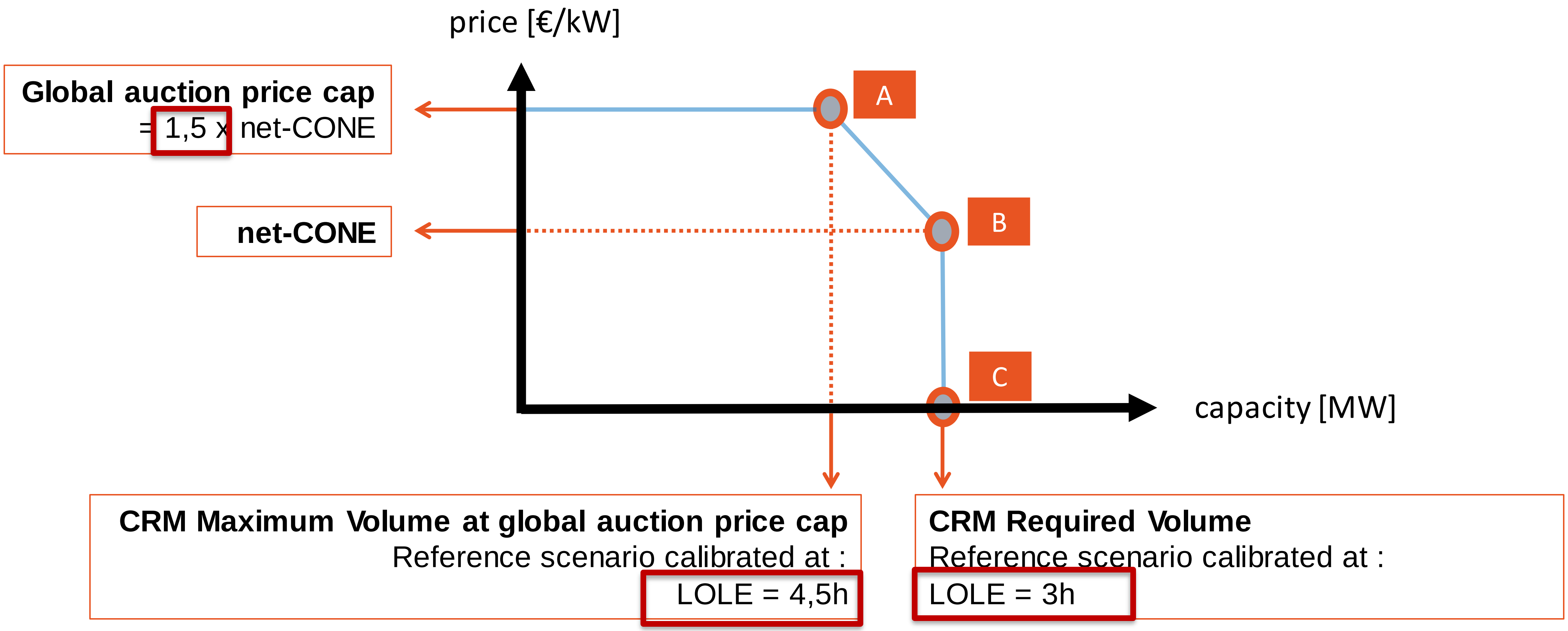
3 points (A, B & C) to be determined by CREG → 4 parameters (based on the input data from Elia)



Remark :
$LOLE_B$ corresponds to the Belgian reliability standard as defined in the CRM Law (Article 7undecies, §3)
X parameter has been defined by the Minister.

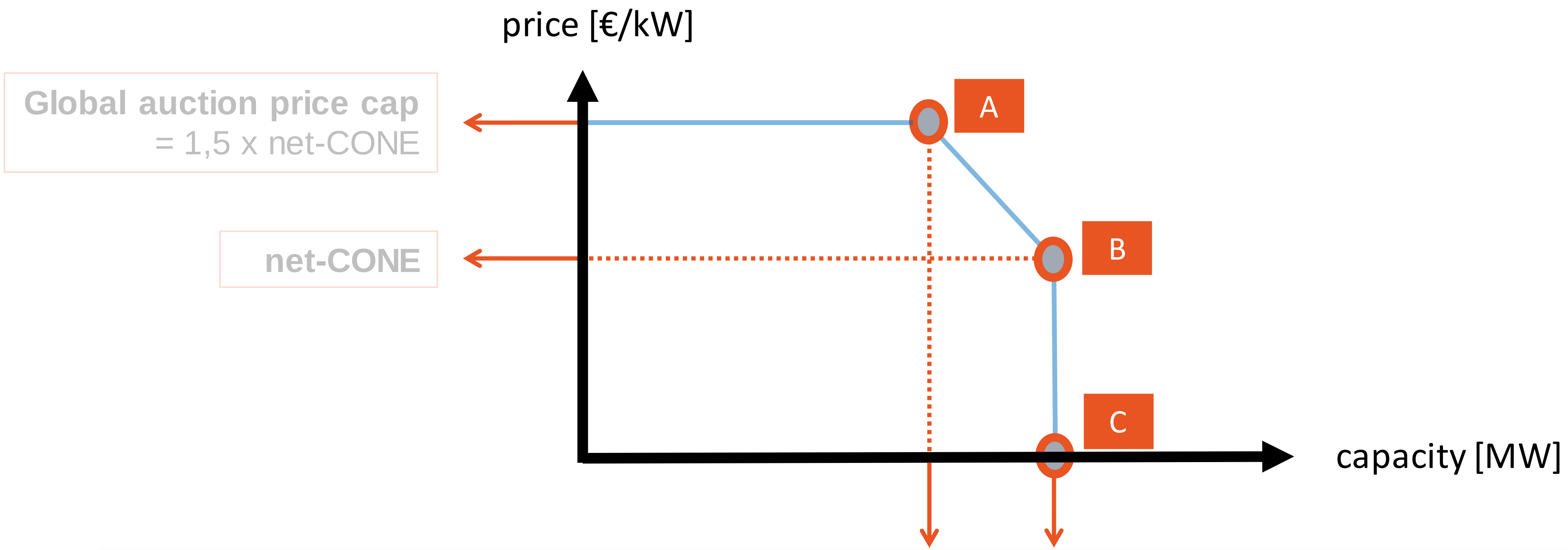
Part II : Information and input for the establishment of the demand curve

X parameter fixed to 1,5



Part II : Information and input for the establishment of the demand curve

Volume parameters



CRM Maximum Volume at global auction price cap Reference scenario calibrated at : LOLE = 4,5h	**CRM Required Volume** Reference scenario calibrated at : LOLE = 3h

Volume Parameters

Determination of the volume parameters according to the Royal Decree

Parameters calculated in Elia's report in order for CREG to establish the volume parameters of the demand curve :

- Average load during simulated scarcity hours from the calibrated reference scenario (for points A and B&C);
- Average energy not served during simulated scarcity hours from the calibrated reference scenario (for points A and B&C);
- Upward balancing need;
- Information available regarding the non-eligible capacity;
- Max-entry capacity for indirect cross-border participation of neighboring European Member State;
- Load duration curve.

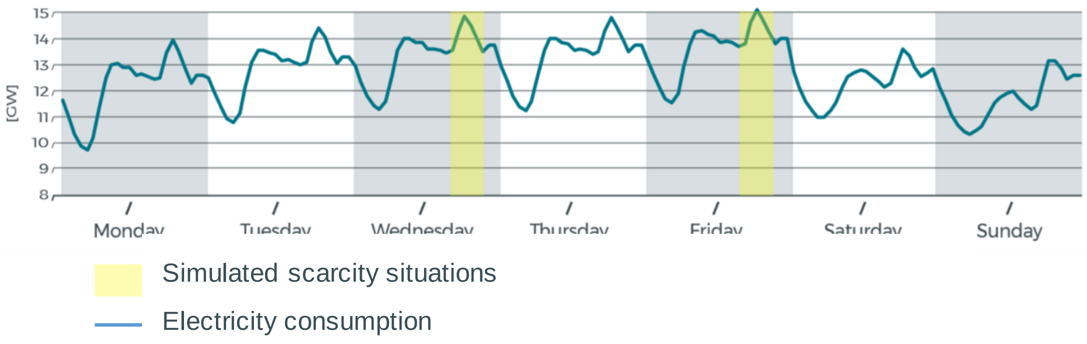
Volume Parameters

Parameters calculated in Elia's report in order for CREG to establish the volume parameters of the demand curve :

- **Average load during simulated scarcity hours from the calibrated reference scenario (for points A and B&C)**
- Average energy not served during simulated scarcity hours from the calibrated reference scenario (for points A and B&C)
- Upward balancing need
- Information available regarding the non-eligible capacity
- Max-entry capacity for indirect cross-border participation of neighboring European Member State
- Load duration curve

Volume Parameters - Average load in simulated scarcity hours

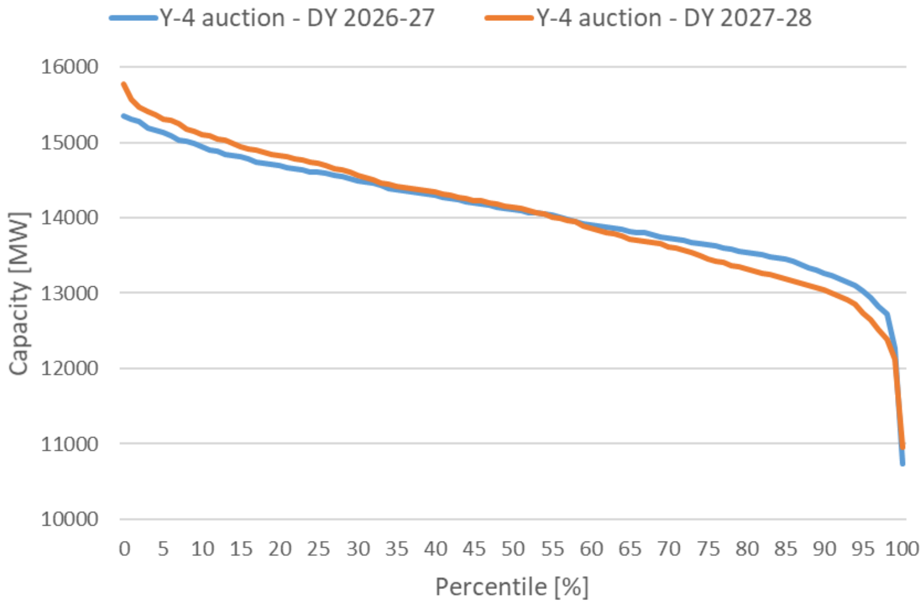
- Calculated based on the simulation's output for the calibrated reference scenario
- It is equal to the average load during each scarcity situation identified in the Monte-Carlo simulation
- This consumption corresponds to the consumption taking into account the « out-of-market » storage capacity (residential batteries and part of V2G) but is to be considered before the activation of any generation asset (centralized or decentralized), storage, market response or import capacity.



- **Point A** : Reference scenario calibrated at 4,5h → Average load during simulated scarcity hours = **13981 MW**
- **Point B** : Reference scenario calibrated at 3h → Average load during simulated scarcity hours = **14071 MW**

Comparison of the average load in simulated scarcity hours between last 2 TSO's CRM Calibration Reports

- Volume at point B decreases by **18** MW compared to last TSO's CRM Calibration Report.
- This difference can be explained by several elements :
  - Reduction of the yearly electricity consumption (91,5 TWh → 90,9 TWh), which represents an average hourly decrease of 70 MW;
  - Increase of the number of heat pumps (more seasonality of the profile) and of the number of electric vehicles (more intraday variations). The share of V1G (optimised charging) also increased (41%)
  - Increase of the « out-of-market » volume (327 MW → 492 MW), mainly driven by the installation rate of residential batteries in Flanders
- These elements lead to :
  - More moments with higher load, driven by:
    - Heat pumps consumption
    - Days with less contribution of residential batteries
  - More moments with lower load, driven by:
    - Lower yearly consumption
    - More scarcity periods outside of the evening peak



Volume Parameters

Parameters calculated in Elia's report in order for CREG to establish the volume parameters of the demand curve :

- Average load during simulated scarcity hours from the calibrated reference scenario (for points A and B&C)
- **Average energy not served during simulated scarcity hours from the calibrated reference scenario (for points A and B&C)**
- Upward balancing need
- Information available regarding the non-eligible capacity
- Max-entry capacity for indirect cross-border participation of neighboring European Member State
- Load duration curve

Volume Parameters - Average energy not served in simulated scarcity hours

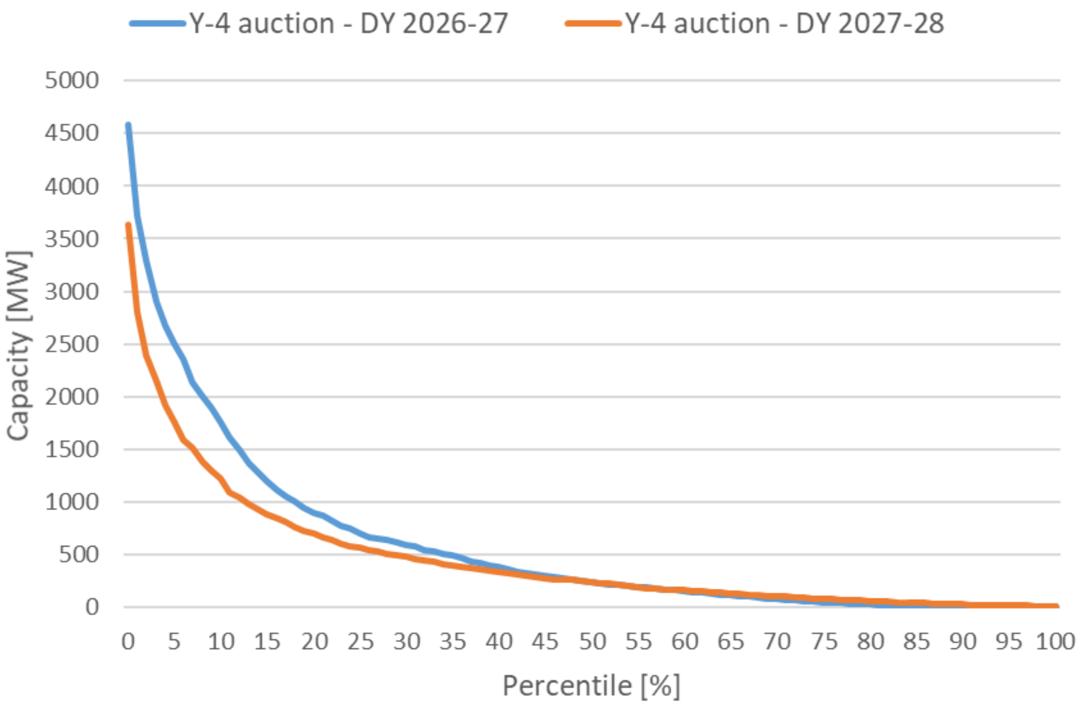
- Calculated based on the simulation's output of the calibrated reference scenario
- It is equal to the average energy not served during each scarcity situation identified in the Monte-Carlo simulation
- The methodology to calculate is the same as for the average load in simulated scarcity hours
- **Point A** : Reference scenario calibrated at 4,5h

  → Average energy not served during simulated scarcity hours = **518 MW**
- **Point B** : Reference scenario calibrated at 3h

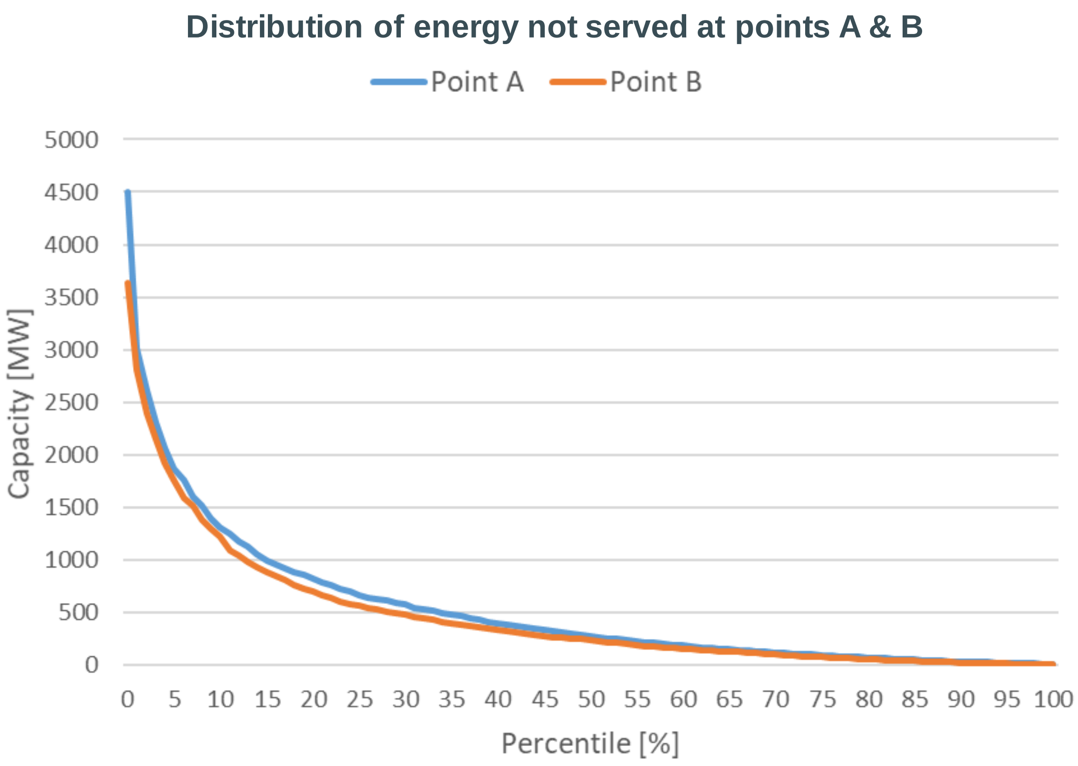
  → Average energy not served during simulated scarcity hours = **453 MW**

Comparison of the average energy not served in simulated scarcity hours between last 2 TSO's CRM Calibration Reports

- The average energy not served during simulated scarcity situations doesn't change significantly between the last 2 TSO's CRM Calibration Report.
- The average energy not served at point B decreases by 124 MW.
- It should be noted that less scarcity situations with high energy not served (> 1000 MW) are observed.
- This can be explained by the scarcity situations being more distributed during the evening peak.



The distribution of energy not served during simulated scarcity hours doesn't change significantly between points A and B



- Figure presents the distribution of energy not served during simulated scarcity situations.
- It should be noted that more scarcity situations take place at point A as it is calibrated with a higher LOLE (4,5h).
- The maximum energy not served at point A is higher (+ ~1000 MW) but a higher LOLE criteria induces also more "new" scarcity situations with limited energy not served (< 500 MW).
- The difference between points A and B is therefore limited (65 MW)

Volume Parameters

Parameters calculated in Elia's report in order for CREG to establish the volume parameters of the demand curve :

- Average load during simulated scarcity hours from the calibrated reference scenario (for points A and B&C)
- Average energy not served during simulated scarcity hours from the calibrated reference scenario (for points A and B&C)
- **Upward balancing need**
- Information available regarding the non-eligible capacity
- Max-entry capacity for indirect cross-border participation of neighboring European Member State
- Load duration curve

Volume Parameters – Upward balancing need

- Upward balancing need is part of the Ministerial Decree on reference scenario for 2023 auction.
- It has been established in the framework of the public consultation on the scenarios, sensitivities and data for the CRM parameter calculation for the Y-4 Auction for Delivery Period 2027-28

3. Balancing reserves

De volgende waarden moeten door Elia gebruikt worden:

Categorieën	Volume [MW]
Totaal FCR	75
Totaal FRR	1175
Totaal reserve capaciteit	1250

3. Réserves d'équilibrage

Les valeurs suivantes doivent être considérées par Elia :

Catégories	Volume [MW]
Total FCR	75
Total FRR	1175
Total reserve capacity	1250

Volume Parameters

Parameters calculated in Elia's report in order for CREG to establish the volume parameters of the demand curve :

- Average load during simulated scarcity hours from the calibrated reference scenario (for points A and B&C)
- Average energy not served during simulated scarcity hours from the calibrated reference scenario (for points A and B&C)
- Upward balancing need
- **Information available regarding the non-eligible capacity**
- Max-entry capacity for indirect cross-border participation of neighboring European Member State
- Load duration curve

Volume Parameters – Derated non-eligible capacity

- Elia's responsibility is to provide the information it owns regarding the non-eligible capacity.
- The eligibility criteria are introduced in article 4 of the CRM Law and developed in the Royal Decree related to « *l'établissement des critères et modalités d'éligibilité à la procédure de préqualification en ce qui concerne les règles relatives au seuil minimal et au cumul des mesures d'aides* ».
- 2 criteria have been analyzed separately :
    - RES Capacities that already receive subsidies
    - Thermal Capacities that already receive subsidies

Volume Parameters – Derated non-eligible capacity

Criteria 1 : RES Capacities that already receive subsidies

Assumptions :

- All the RES capacity (solar, onshore wind, offshore wind, hydro run-of-river) is considered as already receiving subsidies
- RES capacity is assumed to be equal to both existing + forecasted (to be commissioned between now and the delivery period)
- Derating factors applied as calculated in the framework of the TSO's CRM Calibration Report (cf. later slides)

Categories	Installed Capacities [MW]	Derating factor [%]	Non-eligible capacity [MW]
Offshore wind	2261	11	249
Onshore wind	4368	10	437
Solar	10155	1	102
Hydro run-of-river	143	46	66
TOTAL			**853**

Volume Parameters – Derated non-eligible capacity

Criteria 2 : Thermal capacities that already receive subsidies

Assumptions :

- The installed profiled thermal capacity is equal to the categories modelled through thermal profiles as selected in the Ministerial Decree. All this capacity is considered as receiving subsidies.
- All CHP, waste and biomass units individually-modelled are considered. Only the units that won't receive subsidies for the 2027-28 period are excluded from this list (meaning they are eligible) based on the latest information received by the regions.
- Derating factors applied as calculated in the framework of the TSO's CRM Calibration Report (cf. later slides).

Categories	Installed Capacities [MW]	Derating factor [%]	Non-eligible capacity [MW]
Profiled thermal	2003	63	1262
Individually modelled	723	63 or 93	609

Volume Parameters

Parameters calculated in Elia's report in order for CREG to establish the volume parameters of the demand curve :

- Average load during simulated scarcity hours from the calibrated reference scenario (for points A and B&C)
- Average energy not served during simulated scarcity hours from the calibrated reference scenario (for points A and B&C)
- Upward balancing need
- Information available regarding the non-eligible capacity
- **Max entry capacity for indirect cross-border participation of neighboring European Member State**
- Load duration curve

Volume Parameters – Max entry capacity for indirect cross-border participation

- This total volume is to be reserved for the Y-1 auction.
- The max entry capacity is equal to the average contribution of each neighboring European Member State to Belgian adequacy during simulated scarcity hours.
- The United Kingdom is also integrated in the calculation as the total contribution from neighboring countries has to be reserved for Y-1 auction.

Country	Volume [MW]
France	119
Netherlands	260
Germany	2
Great-Britain	553
Total	**934**

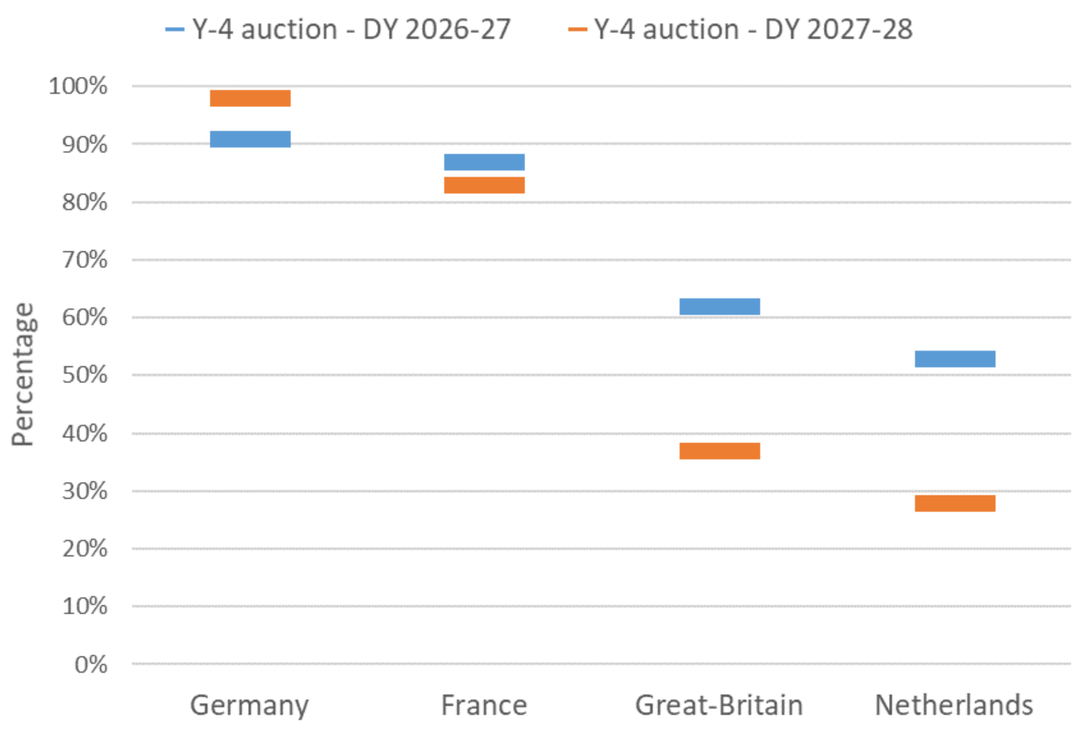
Total cross-border contribution significantly decreases compared to the previous TSO's CRM Calibration Report

- The max-entry capacity for cross-border participation is strongly correlated to the assumptions taken at European level:
  - Germany: Contribution decreases significantly (Higher demand, more RES, less thermal)
  - France: Lower contribution related to FR-NUC-4 sensitivity (FR-NUC-2 in previous CRM calibration report)
  - Netherlands: Lower contribution due to the correlation with DE
  - Great-Britain: Higher contribution due to high volume of capacity and diversification of the electricity sources

	Y-4 auction - DY 2026-27 Capacity [MW]	Y-4 auction - DY 2027-28 Capacity [MW]
France	196	119
Netherlands	646	260
Germany	125	2
Great-Britain	461	553
TOTAL	**1428**	**934**

Almost all scarcity situations are correlated with scarcity in Germany

- 99% of scarcity situations in Belgium are correlated with scarcity situations in Germany.
- Indirectly, this leads to less simultaneous scarcity situations with other countries than in previous TSO's CRM Calibration Report.
- Simultaneous scarcity situations were more evenly distributed between neighboring countries in previous TSO's CRM Calibration Report.



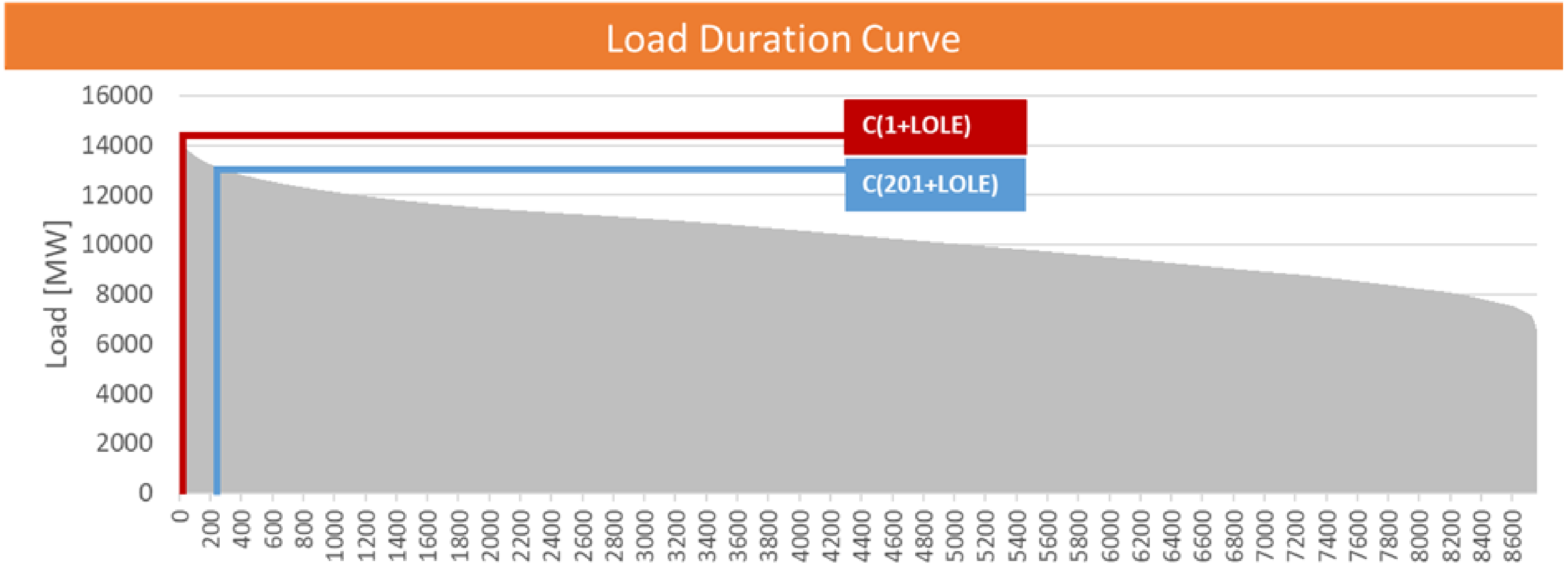
Volume Parameters

Parameters calculated in Elia's report in order for CREG to establish the volume parameters of the demand curve :

- Average load during simulated scarcity hours from the calibrated reference scenario (for points A and B&C)
- Average energy not served during simulated scarcity hours from the calibrated reference scenario (for points A and B&C)
- Upward balancing need
- Information available regarding the non-eligible capacity
- Max entry capacity for indirect cross-border participation of neighboring European Member State
- **Load duration curve**

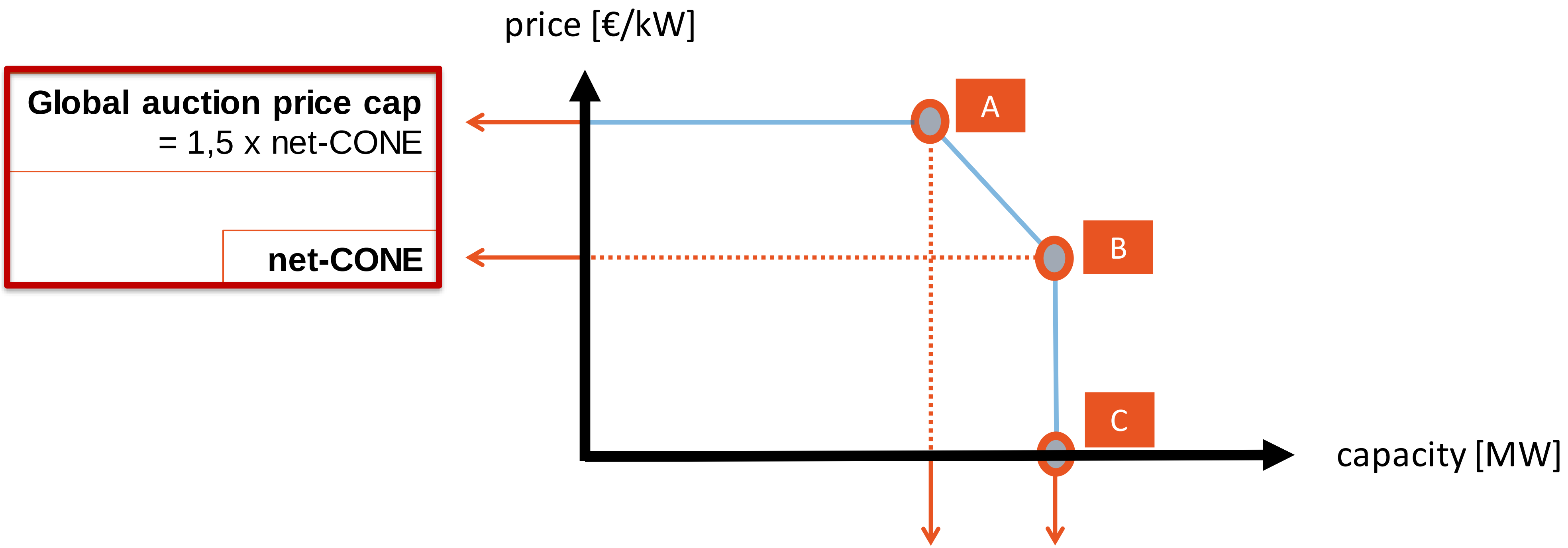
Volume Parameters – Load Duration Curve

- Elia's responsibility is to provide the "load duration curve" required in order for the CREG to calculate the 200h reserved capacity for Y-1 auction
- This curve is based on the electricity consumptions profiles integrated in the Monte-Carlo simulation.
- This curve is noted C(h), which represents the consumption to be covered during at least h hours per year.



Part II : Information and input for the establishment of the demand curve

Price Parameters



CRM Maximum Volume at global auction price cap
Reference scenario calibrated at :
LOLE = 4,5h
LOLE95 = 30h

CRM Required Volume
Reference scenario calibrated at :
LOLE = 3h
LOLE95 = 20h

Price Parameters

Price parameters - Determination of the missing money

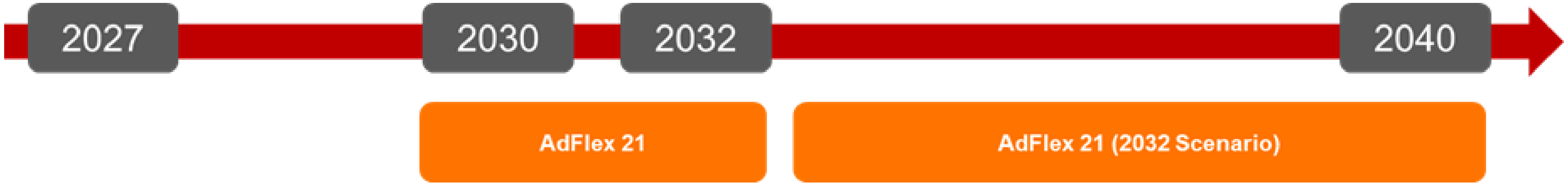
Net-CONE = missing money of the technology with the lowest missing money
Missing money = gross-CONE - Revenues

Price Parameters

- In the framework of the intermediate values selected by the Minister, a set of parameters has been determined. This includes among others :
  - the short-list of technologies for which the missing money should be calculated for net-CONE purposes
    - CCGT
    - OCGT
    - IC Gas Engine
    - CHP
    - Onshore Wind
    - Offshore Wind
    - PV
    - DSR
    - Batteries (4h)
  - the gross-CONE for the short-list of technologies
- The CRM calibration report from Elia aims to present :
  - the revenues from the energy market
  - the estimation of the expected net balancing revenues
- The energy market revenues for the list of technologies is provided for the entire assumed economic lifetime of each technology

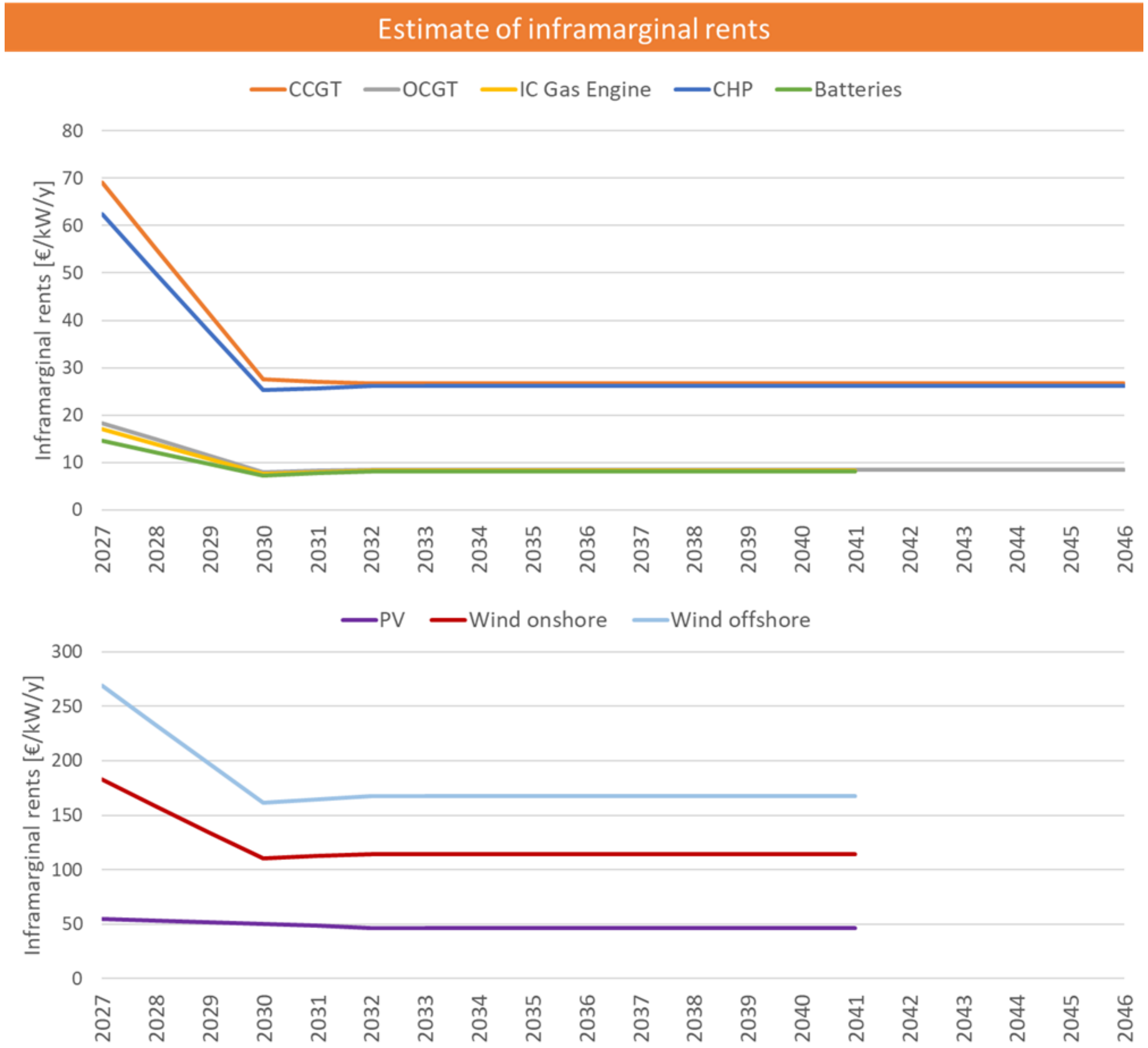
Price Parameters – Energy Market Revenues

- Market revenues have to be determined on the whole economic lifetime of the technologies
- For delivery period 2027-28, market revenues are calculated based on the calibrated reference scenario
- For delivery periods afterwards, the following studies have been used, in line with the RD:



- The scenario from AdFlex 21 selected was chosen in order to be coherent with the reference scenario :
  - **CENTRAL/EU-SAFE**: in line with the Ministerial Decree to select the FR-NUC-4 sensitivity;
  - **Efficient Gas**: in line with the results of first CRM auction, leading to 2 new CCGT being contracted;
  - **High price**: in order to follow the prices selected in the Ministerial Decree.

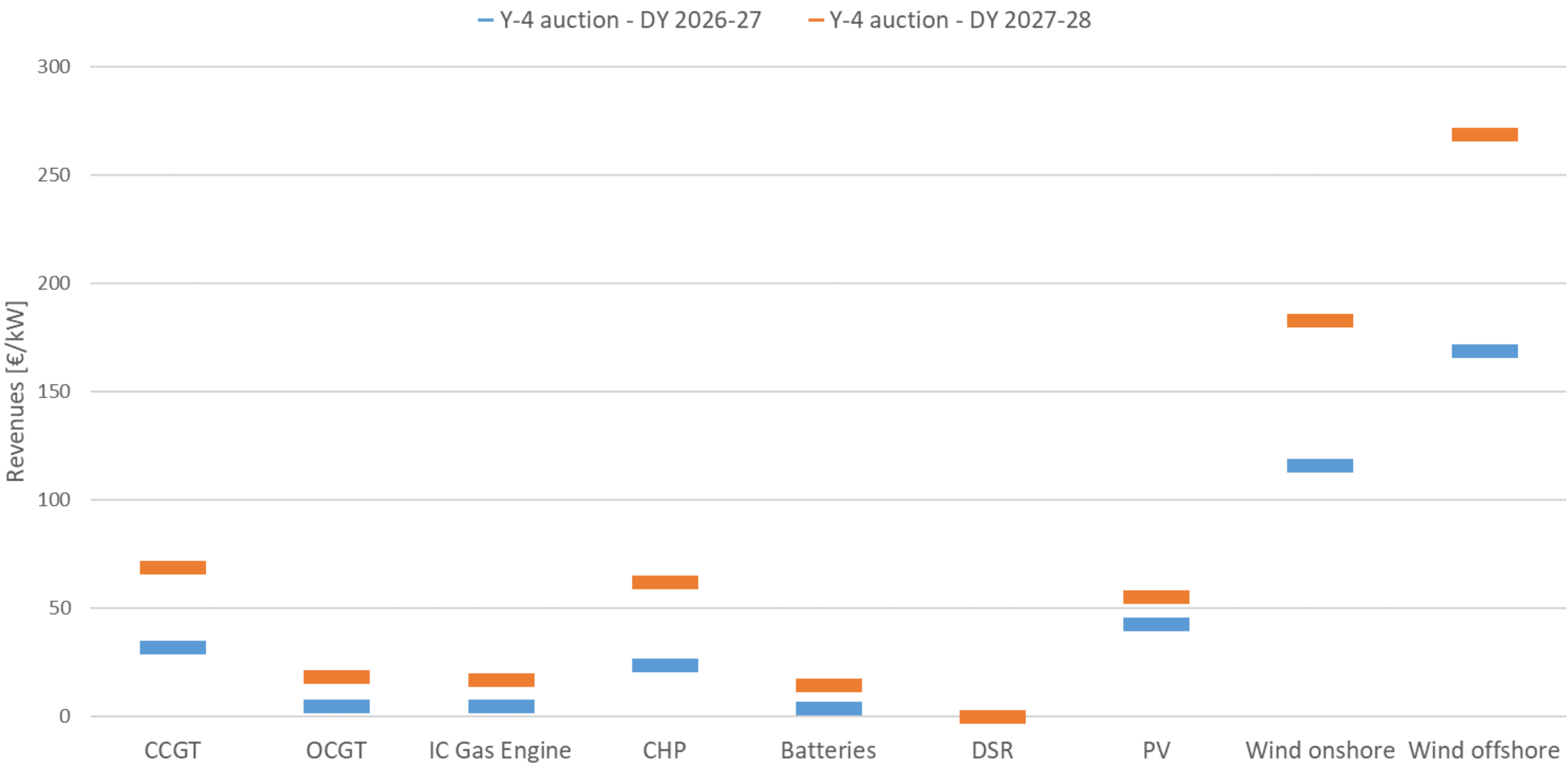
Price Parameters – Electricity Market Revenues



- Revenues are significantly higher for Delivery Period 2027-28, explained by the assumptions chosen in the reference scenario
- Revenues decrease for later periods, based on results from previous AdFlex 21 study.
- Fuel cost parameters were not that high in AdFlex 21 study.
- However, results obtained make sense when we compare the cost assumptions with the latest WEO 2022, used for AdFlex 23 public consultation.

Revenues significantly increase compared to previous TSO's CRM Calibration Report

- Due to the higher prices compared to the previous reference scenario for Delivery Year 2026-27, revenues are significantly higher than in previous TSO's CRM Calibration Report.

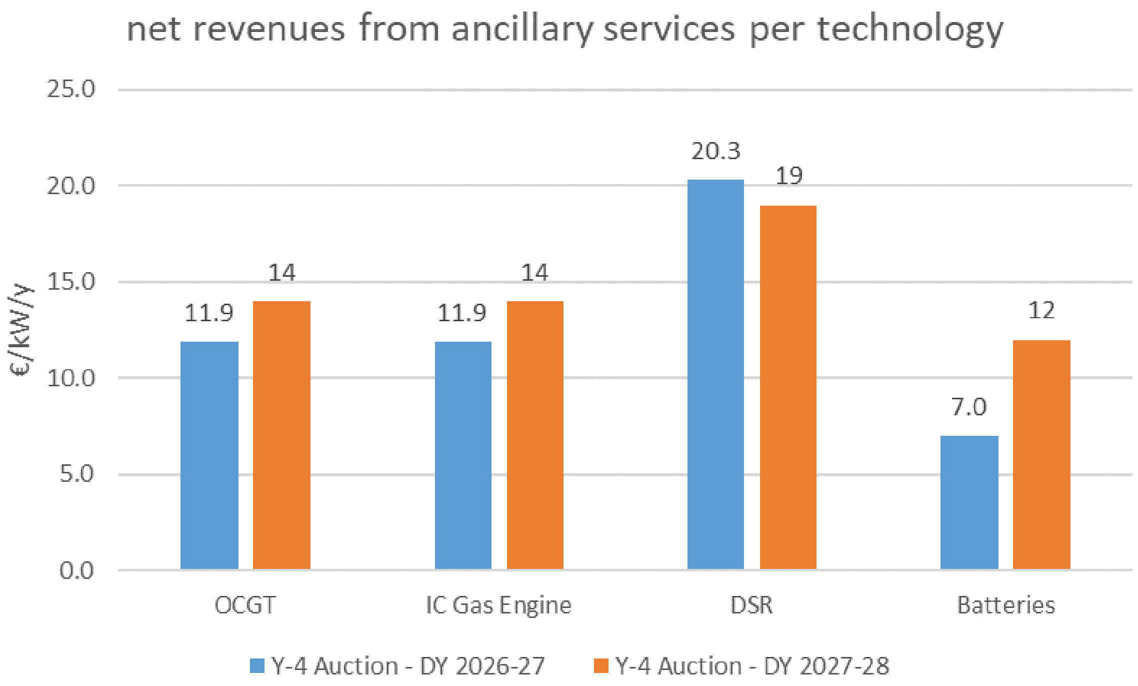


Price Parameters – net ancillary services revenues

- The estimation of the net revenues must be provided for the technologies listed earlier
- They are calculated in accordance with the Royal Decree Methodology : based on the net revenues arising from the reservation of frequency-related balancing services.
- The retained value for these revenues is equal to a percentage of the average historical reservation fee of balancing services, based on data of the last 36 months
  - The application of this percentage takes into account the arbitrage being made by these technologies between the energy and balancing markets.
  - Results obtained:
    - OCGT & IC Gas Engine : **14 €/kW/y** (based on mFRR Standard)
    - DSR : **19 €/kW/y** (based on mFRR Standard)
    - Batteries: **12 €/kW/y** (based on FCR)
    - CCGT & CHP : **0 €/kW/y** -> assumption made that these technologies arbitrage entirely between energy and balancing markets.

Price Parameters – net ancillary services revenues

Overview and comparison to previous TSO's CRM Calibration Report



- For most technologies, net revenues increase slightly compared to last year's calibration due to recent rising price levels
- DSR is the only technology with decreasing revenues, reflecting rising costs for these units

Overview of the TSO’s CRM Calibration Report

Part III : Proposals for the other auction parameters

Part III : Proposals for the other auction parameters

- In addition to the inputs for the determination of the demand curve, it is up to Elia to provide concrete proposals for several other parameters for the auction, according to article 6, §2° of the draft amendment to the Royal Decree Methodology.
- Elia's proposals concerns :
  - Derating Factors (Chapter 5 of the Royal Decree on Methodology)
  - Intermediate Price Cap (Chapter 6 of the Royal Decree on Methodology)
  - Strike Price & Reference Price (Chapter 8 of the Royal Decree on Methodology)

Purpose of the derating factors

CRM Law

« facteur de réduction: le facteur de pondération d'une capacité considérée, déterminant sa contribution à la sécurité d'approvisionnement afin de fixer le volume éligible à participer à la mise aux enchères »

“reductiefactor: de wegingsfactor van een bepaalde capaciteit, die diens bijdrage aan de bevoorradingszekerheid bepaalt, teneinde het volume vast te leggen dat in aanmerking komt om deel te nemen aan de veiling”

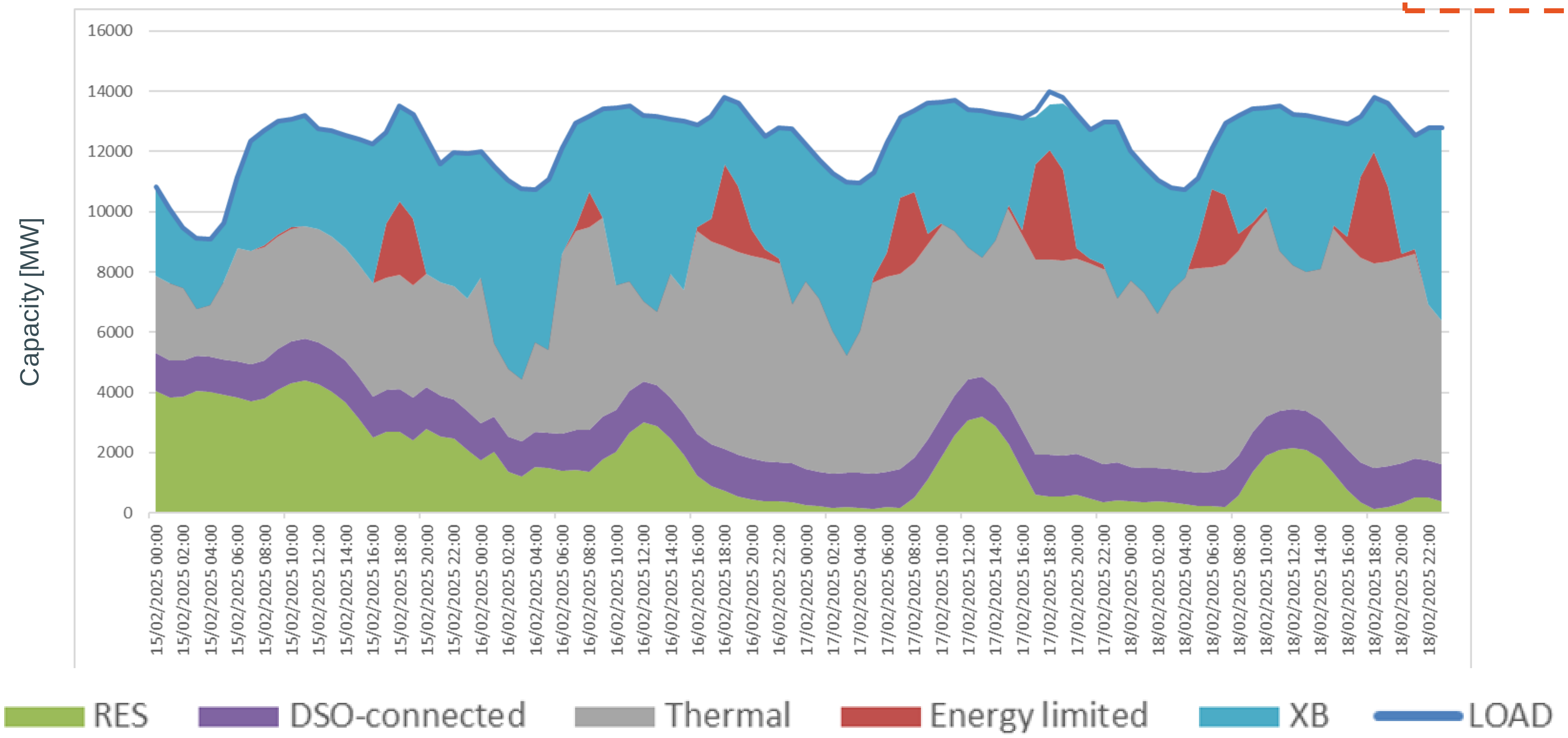
⇨ Evaluation of the contribution to security of supply of each technology

Each technology does not contribute the same way to adequacy

Each technology doesn't contribute the same way to adequacy

Illustrative example

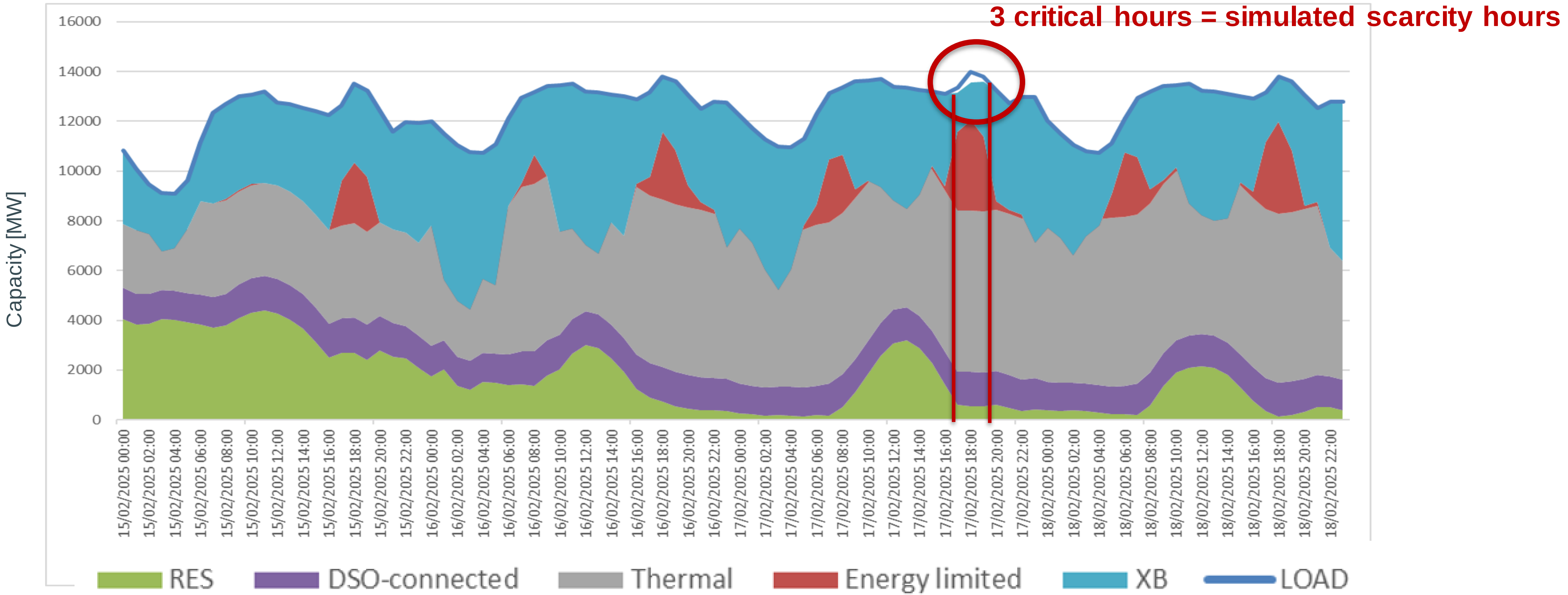
Analysis of the output of the simulation



Each technology doesn't contribute the same way to adequacy

Illustrative example

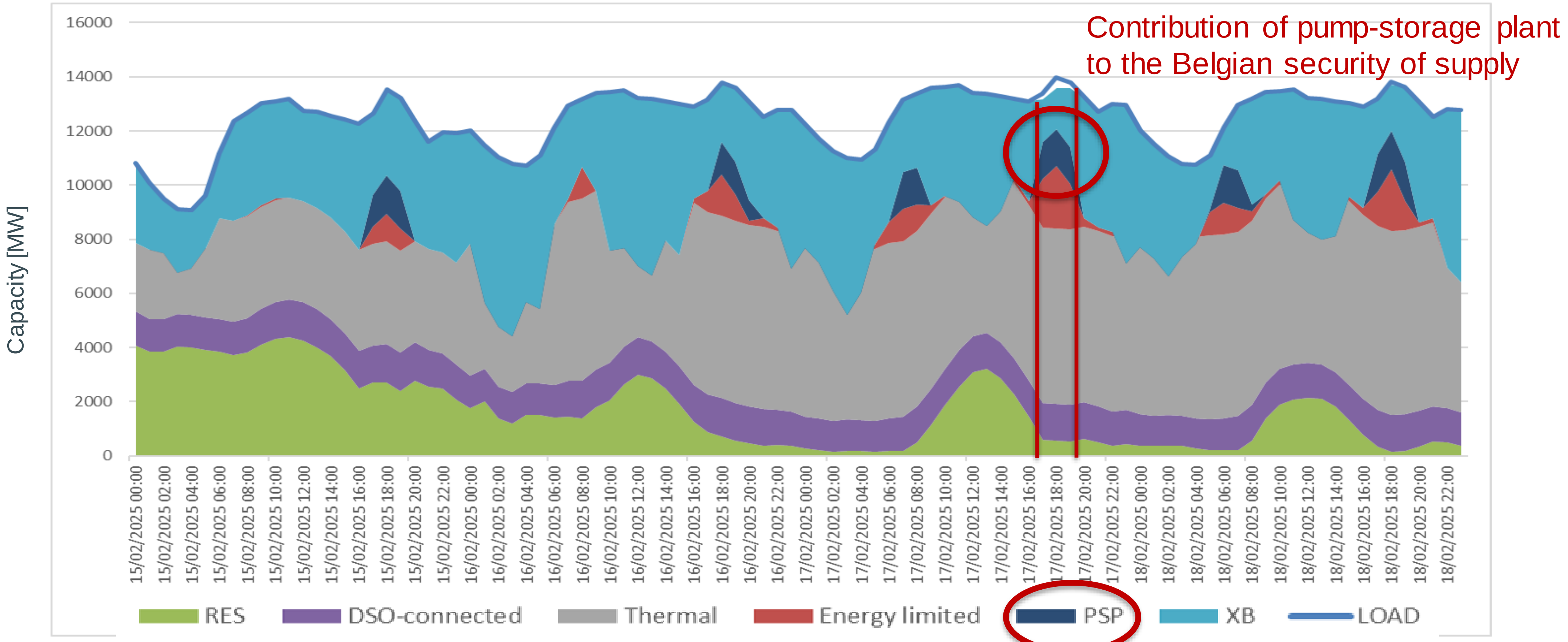
Analysis of the output of the simulation



Each technology doesn't contribute the same way to adequacy

Illustrative example

Analysis of the output of the simulation



Derating Factors : Categorization

- Derating factors categories in line with the Royal Decree Methodology:

Thermal technologies with daily schedule	Energy-limited technologies with daily schedule	Weather-dependent technologies	Thermal technologies without daily schedule	SLA (Service Level Agreement)
• CCGT • OCGT • Turbojets • IC Gas Engines • IC Diesel Engines • CHP • Biomass • Waste • Nuclear • Coal	• Storage (from 1h to 6h) • Pump-storage plants	• Offshore Wind • Onshore Wind • Solar • Hydro Run-of-River	• Aggregated thermal technologies	• SLA (from 1h to 12h) • SLA unlimited

Derating Factors : Calculation methodology

- Derating factors are determined based the methodology set in the Royal Decree Methodology.

Catégories	Calculation methodology
Thermal technologies with daily schedule	100 – FOR
Energy-limited technologies with daily schedule	Average contribution of each category of technology during simulated scarcity situations based on a fictive unit of 1 MW.
SLA (Service Level Agreement)	

Catégories	Calculation methodology
Weather-dependent technologies	Average contribution of each category of technology during simulated scarcity situations / Aggregated Nominal Reference Power of the technology
Thermal technologies without daily schedule	Maximum contribution of each category of technology during simulated scarcity situations / Aggregated Nominal Reference Power of the technology

Derating Factors - Thermal technologies with daily schedule

- Thermal technologies with daily schedules are determined based on the forced outage rate.
- The forced outage rate are in line with the values provided in the Ministerial Decree.

DRF [%] = 100 [%] - Forced Outage Rate [%]

Category II : Thermal technologies with daily schedule	
Sub-Category	Derating Factor [%]
CCGT	93
OCGT	93
Turbojets	96
IC Gas Engines	95
IC Diesel Engines	95
CHP/Biomass/Waste	93
Nuclear	80
Coal	90

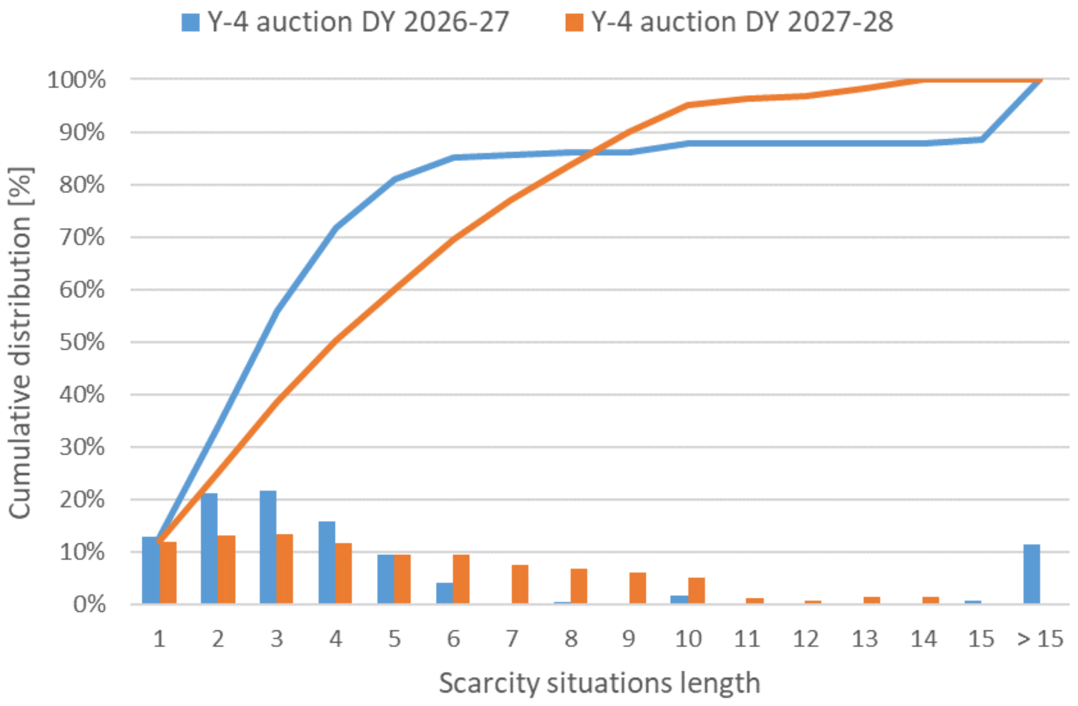
Derating Factors – SLA & energy-limited technologies

- Derating Factors for SLA & energy-limited technologies with daily schedule categories are calculated based on the average contribution of each category of technology during simulated scarcity situations based on a fictive unit of 1 MW.
- Units of 1 MW are considered in order to provide a value for each technology and category using the same methodology

Category I : SLA	
Sub-Category	Derating Factor [%]
SLA-1h	20
SLA-2h	35
SLA-3h	47
SLA-4h	57
SLA-5h	65
SLA-6h	72
SLA-7h	78
SLA-8h	83
SLA-9h	87
SLA-10h	90
SLA-11h	93
SLA-12h	95
SLA unlimited	100

Category III : Energy-limited technologies with daily schedule	
Sub-Category	Derating Factor [%]
Storage 1h	23
Storage 2h	39
Storage 3h	51
Storage 4h	60
Storage 5h	66
Storage 6h	71
PSP	48

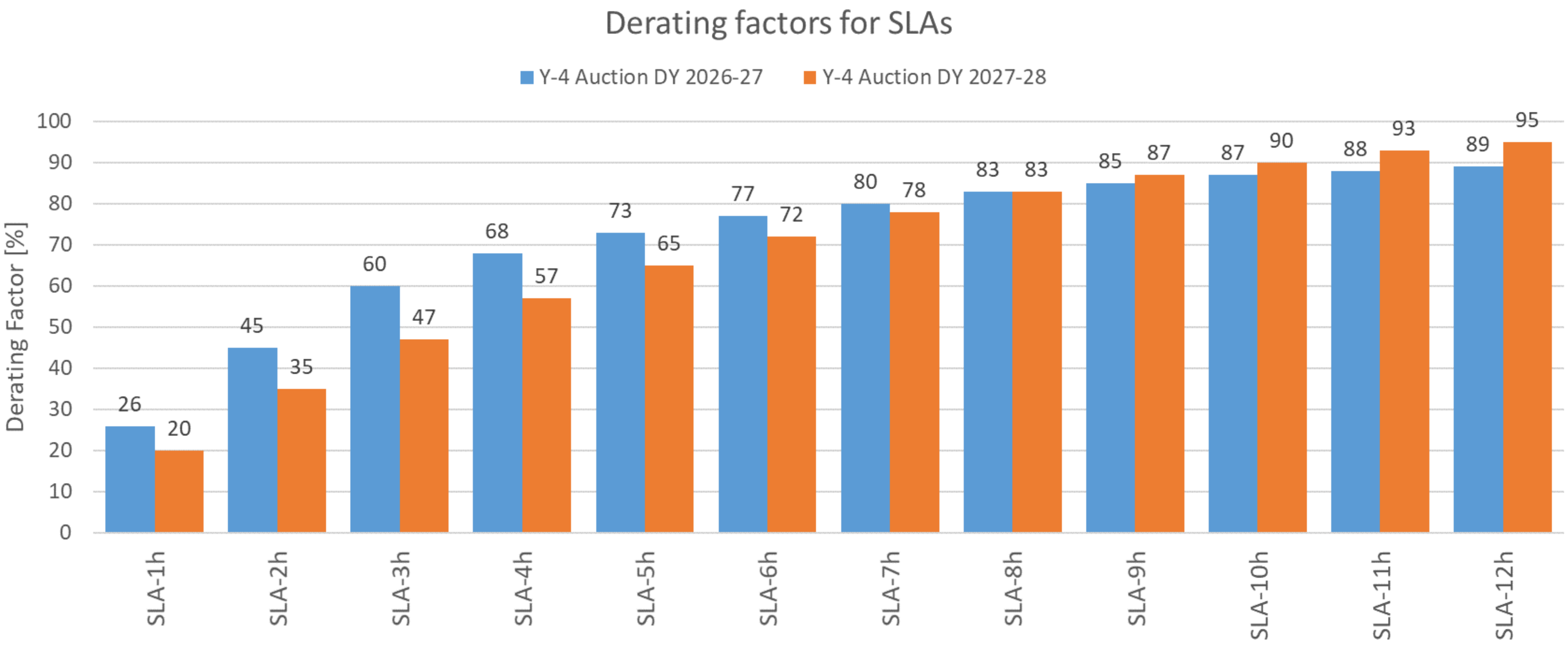
The contribution to adequacy of energy-limited technologies is dependent of the scarcity situations length



- Figure shows the cumulative distribution of scarcity situations.
- The distribution of scarcity situations length is multiplied by the length of the scarcity situations.
- This analysis shows a good representation of the derating factors to be expected.
- Due to the scarcity profiles (see explanation from slides on scarcity), the derating factors for energy-limited technologies are lower than in previous TSO's CRM Calibration Report.

Derating factors for energy-limited technologies are lower than in previous TSO’s CRM Calibration Report

- Derating factors for SLAs are lower than in previous TSO’s CRM Calibration Report for availability lower than 8h.



Derating Factors – Weather-dependent technologies

- Weather-dependent technologies categories are calculated based on the average contribution of each sub-category during simulated scarcity situations from the Monte-Carlo simulation's output of the calibrated reference scenario.

$$\text{DRF [\%]} = \frac{\text{Average contribution during simulated scarcity situations [MW]}}{\text{Nominal reference power [MW]}}$$

- Weather-dependent technologies have quite low derating factors due to their limitation in case of absence of appropriate weather conditions.

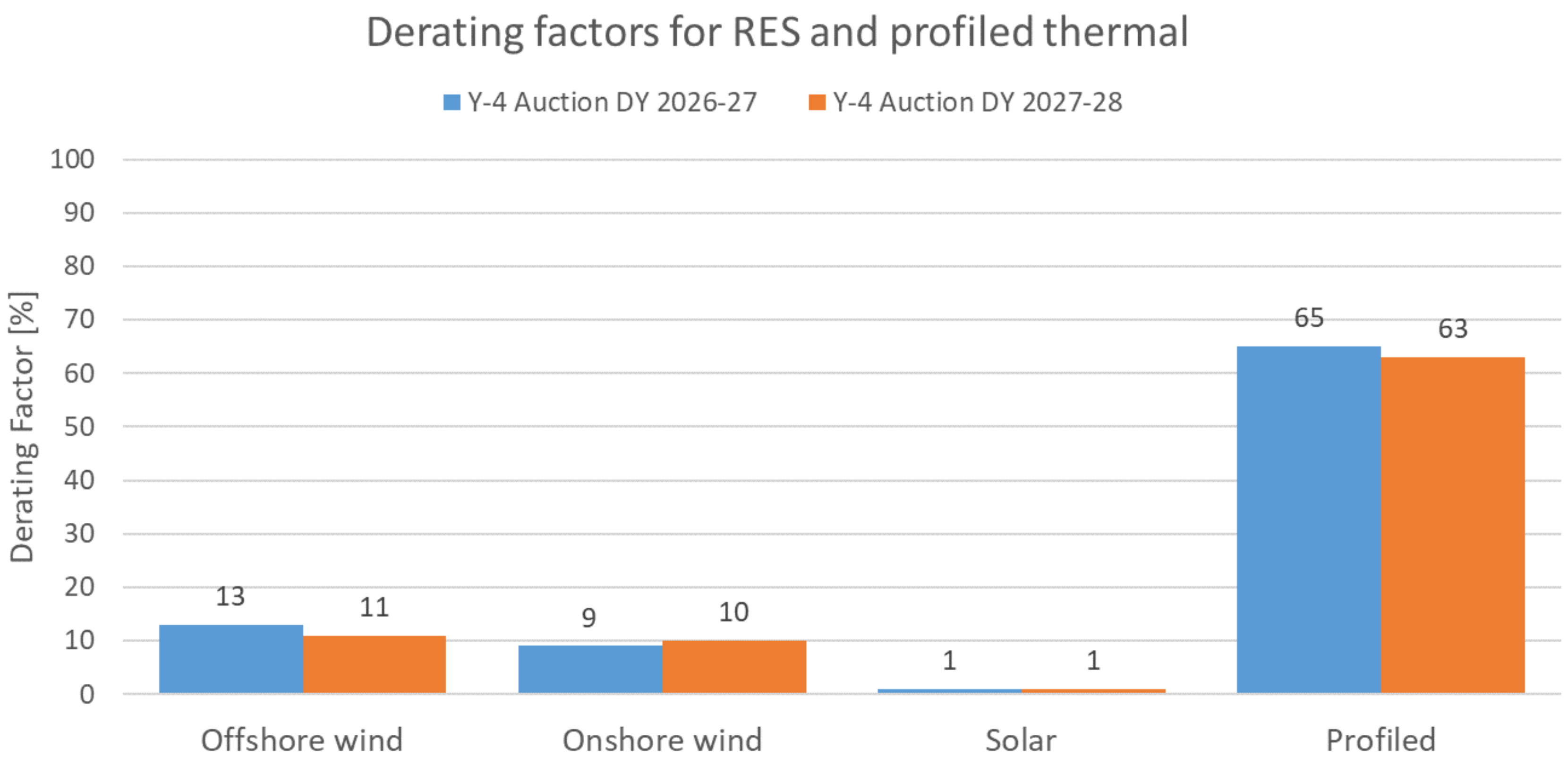
Category IV : Weather-dependent technologies	
Sub-Category	Derating Factor [%]
Offshore Wind	11
Onshore Wind	10
Solar	1
Hydro Run-of-River	46

Derating Factors – Thermal DSO- or CDS-connected technologies

- Derating factors for thermal technologies without daily schedule are calculated based on the maximum contribution of each sub-category during simulated scarcity situations from the Monte-Carlo simulation's output of the calibrated reference scenario.
- The maximum contribution is used rather than the average contribution as the TSO as the metering data are found to be insufficient according to the TSO.
- Additional analysis of the available metering data is foreseen in the framework of the next AdFlex study.

Category V : Thermal technologies without daily schedule	
Sub-Category	Derating Factor [%]
Aggregated thermal technologies	63

Derating Factors for weather-dependent technologies and profiled thermal are in line with values from previous TSO's CRM Calibration Report



Intermediate Price Cap

- In accordance with article 16 of the Royal Decree, the intermediate price cap (in €/MW/year) is equal to the estimated **“missing-money”** of the **technology** with the highest “missing-money” included in the **shortlist of existing technologies targeted in the Royal Decree Methodology.**

- Prior to the calculation work towards the proposal for the IPC, the following steps have been taken:

  1. **A Public consultation** on the shortlist of technologies considered for the IPC was held -> the list was **identical** to the one used for the previous calibration of the IPC.
  2. It was complemented by the following topics – although not strictly required according to the Royal Decree :
     - Cost estimations based on the studies from Fichtner reviewed by Afry used for the previous calibration were proposed. Following feedback from market parties, **an update of the Afry study** was performed.
     - The approach used to determine net revenues from frequency-related balancing services : similar as well to last year

  2. **A Public Consultation report** following the inputs received from market actors was published by Elia in June 2022
     Feedback from stakeholders was taken into account in the calibration of the IPC

Intermediate Price Cap: Shortlist of existing technologies

- The assessment on the technologies to be considered for the shortlist of this calibration was identical to the previous TSO's CRM Calibration Report :
  - **Combined Cycle Gas Turbine (CCGT);**
  - **Open Cycle Gas Turbine (OCGT);**
  - **Turbojet;**
  - **Pumped Storage Power (PSP);**
  - **Market response with 4-hour energy activation.**

- No additional inputs from market actors were received on this shortlist during the Public Consultation.

Intermediate Price Cap: cost estimations (1/3)

- The estimated costs considered for the **Fixed operation and maintenance (FOM) costs** come from the update of the Afry study:

Technology	FOM costs [€/kW/year] (incl. non-yearly maintenance costs such as major overhauls)		
	Low	Mid	High
CCGT	36	37	51
OCGT	24	24	48
Turbojet	28	35	35
PSP	19	31	39
Market response with 4-hour energy activation	5	10	15

Low → lowest FOM cost estimation among units considered
Mid → median of FOM cost estimations among units considered
High → highest FOM cost estimation among units considered

  - The **cost estimation for the Market response technology is derived from Elia's 'Adequacy and Flexibility 2022-2032' study**, which has been publically consulted upon as well in the past.
  - The assumptions taken by Afry in terms of provisions for major overhauls and running hours are considered as still relevant as well.

- Estimation of **Activation costs for availability testing**:
  - Based on the average activation price for SDR for winter period 2015-2016 for a 4 hours activation, assuming one availability test of 15 minutes per year -> **0,2 €/kW/year**
  - This number used for the previous calibration remained valid since no more recent numbers were available. The number from last year was adapted for inflation.

Intermediate Price Cap: cost estimations (2/3)

- Revenues in the context of the IPC must be complemented by the addition of a risk premium to take investors' risk aversion into account.
  - These risk premia have been defined per technology in the Royal Decree Methodology for the IPC derogation process (annex 1).
  - The same premia can be used for the IPC calibration given that the context is similar to the one of the IPC derogation

Technologies	Total hurdle rate (WACC + risk premium)* (in %)	
	Without investments associated to an economic life time > 3y	With investments associated to an economic life time > 3y
CCGT	6,5%	9%
OCGT	7%	10,5%
TJ	7%	10,5%
PSP	8,5%	13%
MR (4h)	8,5%	13%

*in the WG on 16/12, this table was headed "Total risk premium", which caused some confusion among participants. It has afterwards been adapted to "hurdle rate" to be fully correct

Intermediate Price Cap: cost estimations (3/3)

- Total costs considered for the IPC calibration based on elements raised previously :

Technology	FOM costs [€/kW/year] (incl. non-yearly maintenance costs such as major overhauls)			Activation costs for availability testing (€/kW/y)	Total risk premia (in %)		Total costs (in €/kW/y) : FOM costs multiplied by (1+ risk premium)					
	Low	Mid	High		Without investments associated to an economic life time > 3y	With investments associated to an economic life time > 3y	Without investments associated to an economic life time > 3y			With investments associated to an economic life time > 3y		
							Low	Mid	High	Low	Mid	High
CCGT	36	37	51	0	6,5%	9%	38	39	54	39	40	56
OCGT	24	24	48	0	7%	10,5%	26	26	51	27	27	53
Turbojet	28	35	35	0	7%	10,5%	30	37	37	31	39	39
PSP	19	31	39	0	8,5%	13%	21	34	42	21	35	44
Market response with 4-hour energy activation	5	10	15	0,2	8,5%	13%	6	11	16	6	12	17

Intermediate Price Cap: revenue estimations

- Consisting of an estimation of **inframarginal rents earned on the energy market** and **net revenues from the provision of frequency-related balancing services**:

Technology	Average inframarginal rents earned on the energy market [€/kW/year]			Net revenues from the provision of frequency-related balancing services [€/kW/year]			Total revenues [€/kW/year]		
	Low	Mid	High	Low	Mid	High	Low	Mid	High
CCGT	32	42	57	/	/	/	**32**	**42**	**57**
OCGT	14	17	20	20	22	25	**34**	**39**	**45**
Turbojet	0	0	0	0	0	0	**0**	**0**	**0**
PSP	27	27	27	/	/	/	**27**	**27**	**27**
Market response with 4-hour energy activation*	0	0	0	19	23	27	**19**	**23**	**27**

- Revenues from the energy markets were capped at the level of the Strike Price : 417 €/MWh
  - As a result, **Turbojet revenues are set to zero since their marginal cost exceed the proposed Strike Price**
- No FCR or aFRR net revenues are considered relevant for the technologies included in the shortlist
  - FCR are entirely captured by batteries (not in the list).
  - mFRR net revenues are considered relevant for the **OCGT**, **Turbojet** and **Market response** technologies and have been calculated as a percentage of the average mFRR reservation fees of the past 36 months, in accordance the Royal Decree on Methodology

*considering their high variable costs, MR units are on average not expected to reap consistent inframarginal rents on the energy markets in a CRM with a reliability option.

Intermediate Price Cap: Missing-money estimations

- Bringing together the cost and revenue estimations in the formula to calculate "missing-money"

Technology	Derating factor [%]	"Missing-money" divided by Derating factor [€/kW-derated/year]					
		Level 1 – Mid cost high rev	Level 2 – Mid cost mid rev	Level 3 – Mid cost low rev	Level 4 – High cost high rev	Level 5 – High cost mid rev	Level 6 – High cost low rev
CCGT	92	0	0	9	0	15	26
OCGT	91	0	0	0	9	15	21
Turbojet	96	0	0	0	0	0	0
Market response with 4-hour energy activation	68	0	0	0	0	0	0

- **Six levels** of missing-money are calculated, **to account for the variation in cost and revenue estimations**.
- Last year only considered the Low and Mid cost levels. This year's IPC is calibrated using the **Mid and High cost levels**:
  - Cost estimations based on public sources might not fully take into account recent price increases
- Results are **divided by the Derating factor**, to account for the "missing-money" to be recovered through a bid in the auction, which is made on the level of eligible volume, i.e. after derating;
- Same as last year, the **PSP technology** is not retained in this final table.

Elia concludes on the existing **CCGT technology** as dimensioning technology for the intermediate price cap, and proposes **26 €/kW-derated/year as value for the intermediate price cap**.

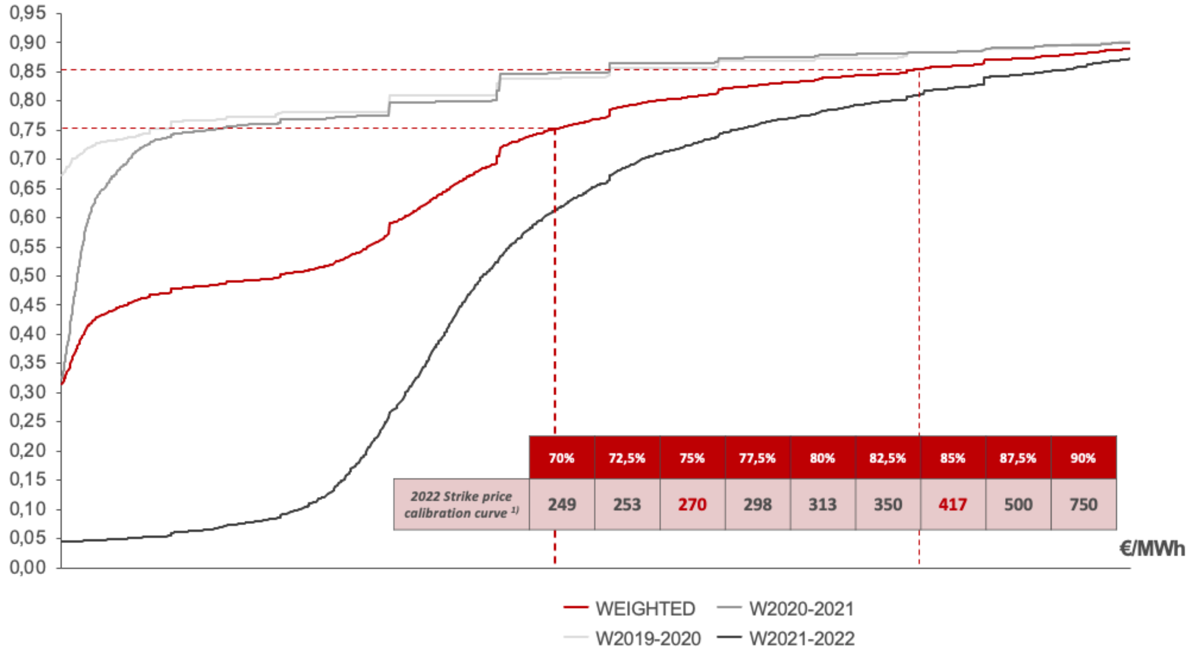
Reference price

- As a reminder, the **reference price** is defined in the Electricity Act as “the price reflecting the price that is supposed to be obtained by the capacity provider on the electricity market”.
- The aspects related to this reference price are further detailed in article 23 of the Royal Decree Methodology :
  - It must be observed for every single hour of the Payback Obligation in the spot Day Ahead market on a NEMO active in the Belgian bidding zone (EPEX or Nord Pool spot)
  - It must be expressed in €/MWh
  - The modalities related to such reference for indirect XB capacities are described in the draft Royal Decree Cross-Border and will be specified further in a future version of the Functioning Rules
  - All other practical related details are provided in the Functioning Rules (choice, modification, …)
- Given that all the parameters of the reference price have already been detailed in the Royal Decree Methodology and that further details are detailed in the Functioning Rules, there is **no quantitative calibration for the reference price**

The **reference price** is a price that must be selected by a Capacity Provider and must be observed, for every single hour, on a NEMO (currently EPEX or Nord Pool Spot) active in the spot Day-Ahead market in the Belgian bidding zone

Strike price calibration (step 1) : determination of the calibration curve and of the strike price range

- To construct the calibration curve used for the calibration of the strike price, E-CUBE analyzed the data of EPEX and Nord Pool Spot for the **peak hours of the winter weekdays** for the 3 previous years :
  - 2019-20
  - 2020-21
  - 2021-22
- This analysis is based on both aggregated curves and (complex) block orders
- As detailed in the Royal Decree Methodology, the strike price must be calibrated in a range equivalent to a volume of elastic reaction from the market of (75 -85) % from the constructed calibration curve corresponding to a price range of **(270 – 417) €/MWh**



	70%	72,5%	75%	77,5%	80%	82,5%	85%	87,5%	90%
2022 Strike price calibration curve 1)	249	253	270	298	313	350	417	500	750

Source : E-CUBE, Construction of the calibration curve for the calibration of the Strike Price linked to the Delivery Period 2027-28, June 2022

Strike price calibration (step 2) : application of the criteria of the Royal Decree Methodology (art. 27§2) (1/3)

- The second step of the strike price calibration takes places by applying in a similar way as last year the **5 criteria** listed in the Royal Decree on Methodology to the price window (270 - 417) €/MWh:

  1) The variable costs of the technologies with a daily schedule must be covered by the strike price :

     - The variable costs to be considered here are the highest within the cost range calculated in order to **avoid the exclusion of any technology** of the CRM and respect its technology neutrality principle.
     - The variable cost of Turbojets (TJ**) exceeds the highest value from the calibration window** (417 €/MWh).
     - This indicates that the strike price should be calibrated as high as possible. As such, following the first criterion **a value of 417 €/MWh should be considered.**

Technologies	Rendement [%]	VOM [€/MWh]	Prix CO2 [€/ton]	Prix Fuel [€/MWh]	CHP crédit [€/MWh]	Prix marginal [€/MWh]
CCGT	60%	2	97.3	44.4	NA	117
OCGT	42%	11	97.3	44.4	NA	176
TJ	26%	3.3	97.3	66.9	NA	438
CHP	33%	6.9	97.3	44.4	100	119

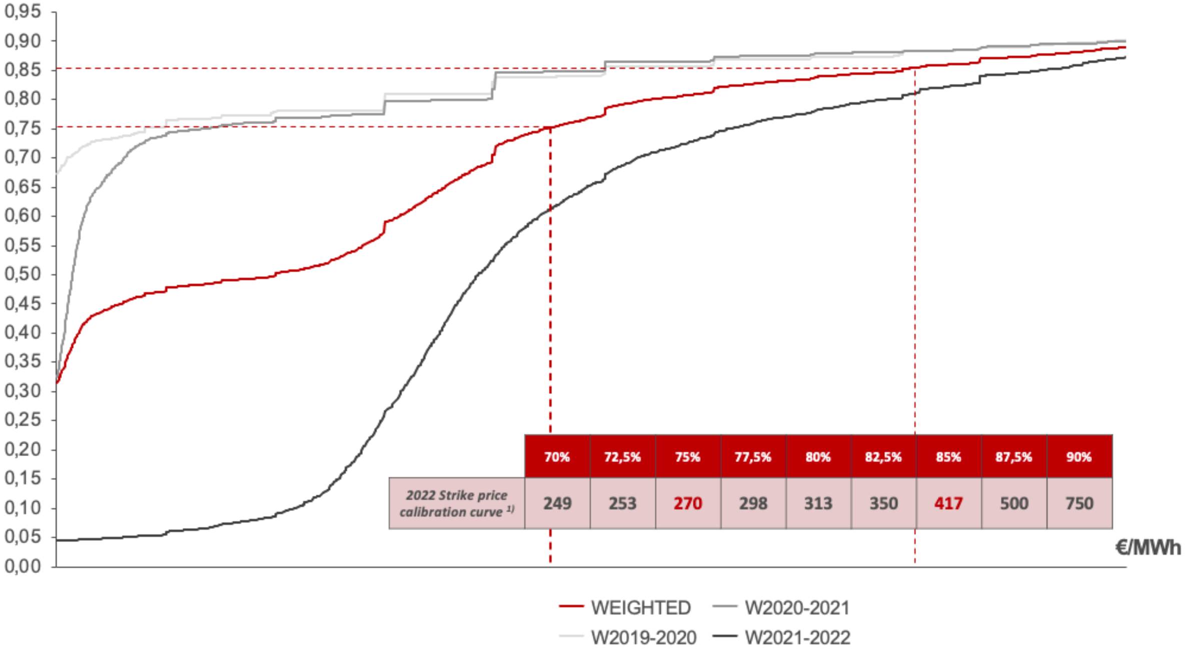
Tableau 18: Paramètres pour le calcul du coût marginal des unités

Source : ELIA, Rapport du gestionnarie du réseau contenant des informations pour la détermination du volume à contracter et des propositions de paramètres spécifiques, November 2022

Strike price calibration (step 2) : application of the criteria of the Royal Decree Methodology (art. 27§2) (2/3)

2) The strike price must consider the shape of the calibration curve :

- Contrary to previous calibration exercises, the curve of winter 2021-22 presents an extra elbow
- As a result the calibration curve only starts to reach an asymptotic value after surpassing the threshold of 85%.
- Targeting a higher value in the calibration range allows to capture the highest share of elastic volume possible.
- Based on this criterion, the strike price must be targeted in the upper range of the curve around **417 €/MWh.**



	70%	72,5%	75%	77,5%	80%	82,5%	85%	87,5%	90%
2022 Strike price calibration curve [1]	249	253	270	298	313	350	417	500	750

Source : E-CUBE, Construction of the calibration curve for the calibration of the Strike Price linked to the Delivery Period 2027-28, June 2022

Strike price calibration (step 2) : application of the criteria of the Royal Decree Methodology (art. 27§2) (3/3)

3) The calibration of the strike price must take the evolution of the energy market into account :

- Recent geopolitical events have pushed the values of the calibration window significantly upwards compared to previous iterations
- Prices are expected to remain high compared to previous years; the (lower) prices of previous years still have a negative impact on the calibration window
- To compensate the influence of last years' prices, Elia proposes to **consider the upper range of the calibration curve** around 417 €/MWh.

4) The stability of the strike price must be ensured over time :

- The calibration window differs radically from previous iterations
- The curves from W2019-20 and W2020-21 have a strong negative impact on the calibration window; the curve from W2019-20 will be replaced next year by W2022-23, which will likely result in a higher calibration window
- In order to anticipate this rising calibration window, Elia wishes to propose a strike price that is sufficiently high
- This 4th criterion pleads clearly in favor of a strike price calibrated **on the upper part of the calibration curve** close to 417 €/MWh.

5) The strike price must guarantee a reasonable chance of triggering a Payback Obligation

- An analysis of historical prices for the years 2006-2022 has been realized again for Day-Ahead market prices from 100 to 500 €/MWh and shows that as a result of recent high prices, even the value of 500 €/MWh was surpassed relatively often.
- This criterion argues in favor of calibrating a strike price **on the upper part of the calibration curve** close to 417 €/MWh.

Strike price calibration : conclusion and proposal

- The **5 criteria** from the Royal Decree Methodology were applied in a similar way compared to the last calibration process and are considered together to propose a **calibrated strike price :**
  1) The 1st criterion leads to a strike price of **417 €/MWh**, a price level that is still not high enough to cover Daily Schedule units ;
  2) The 2nd criterion leads to a strike price to be calibrated in the higher part of the range of the calibration curve preferably at **417 €/MWh** given the shape of the calibration curve ;
  3) The 3rd criterion leads to a calibration on the **upper end of the calibration curve towards 417 €/MWh** to take into account increasing price levels on energy markets;
  4) The 4th criterion pleads in favor of a calibration **on the upper end of the calibration curve towards 417 €/MWh** in order to anticipate expected higher calibration windows in the future, and a gradual evolution towards those;
  5) The 5th criterion pleads in favor of a calibration **on the upper end of the calibration curve towards 417 €/MWh**, since even this price level was often reached recently

Conclusion : **the 5 criteria** taken together lead to a calibration of the strike price in **the upper part of the range** of the calibration curve. As a result, Elia proposes to use the maximal value of the calibration window.

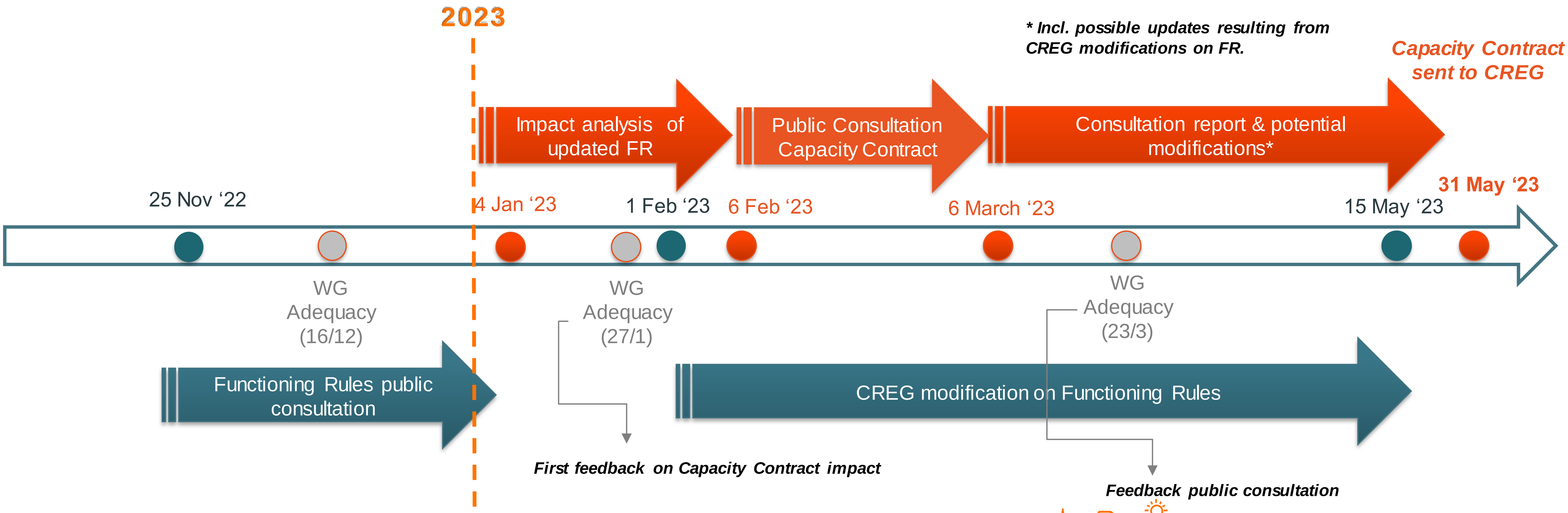
The **strike price** should be calibrated at a level of **417 €/MWh**

CRM : Capacity contract planning

CRM 2023 Capacity Contract timeline

Context:

- Analysis of the impact of the updated Functioning Rules V3 on the Capacity Contract for the 2023 Auction right after the public consultation on the FR (until 04/01/2023).



CRM/LCT : Changes & Eligibility

Timeline for the public consultation LCT Functioning Rules

In service definition

The "in service" definition from the design note should be clarified further

"Additional – New Build" capacities are eligible to participate in the LCT. New build capacities are defined as not in service at the moment of the Auction."

	"In Service" = "Participation in the energy markets" (at asset level)
What?	• Consider an asset as "in service" from the moment **it is active in the energy markets.** • **Broader** concept than CRM "New Build" definition (at connection level).
How to check?	1. For **assets directly connected to the TSO grid**: • Check if a BRP is assigned to the asset. If not ➔ not in service. • If BRP is assigned ➔ check if asset is already (i) prequalified for ancillary services or (ii) injecting/offtaking electricity. 2. For **"behind the meter"** TSO-connected assets : fallback solution needed, such as • Is there an AREI certification for the asset and/or • Check the expected commissioning date in the connection agreement. 3. For **DSO-connected assets**, Synergrid proposes to link the "in service" definition with the regional notification requirements (cf. the "ingebruikname" of new batteries/generation assets need to be notified to the DSO). *For CDS-connected assess: information exchange with CDS operator required.*
When?	• First eligibility check at moment of Prequalification File submission deadline ➔ eligible assets continue PQ process. • Check again at the moment of Auction Gate Opening ➔ eligible assets can be bid in the Auction.

➔ The "in service" concept is only used for the LCT eligibility check.

DSR eligibility

LCT Eligibility design as presented in the Functioning Rules

1 | Full Exclusion → Partial Exclusion

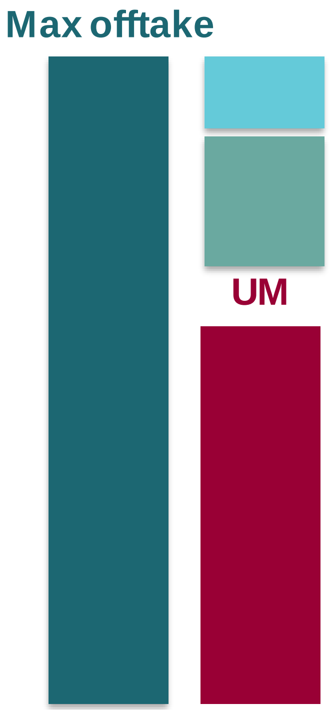
Non-eligible **only for the existing DSR** that has been identified during the Prequalification step, enabling new DSM under a certain DP.

Impact on other aspects besides Prequalification.

2 | Definition of “in service” and eligibility of non-DSM

Clarification of the “in service” definition mentioned in the last WG and the Design Note.

Example cases in which full exclusion could exclude legitimate capacities



Significant increase of DSR capabilities within current consumption

Include flexibility in increase of consumption (e.g. building new flexible electrolysers)

Existing DSR

Additional DSR for LCT

Relatively safe concept with regards to double counting ***but*** *would a priori exclude a lot of potential capacities.*

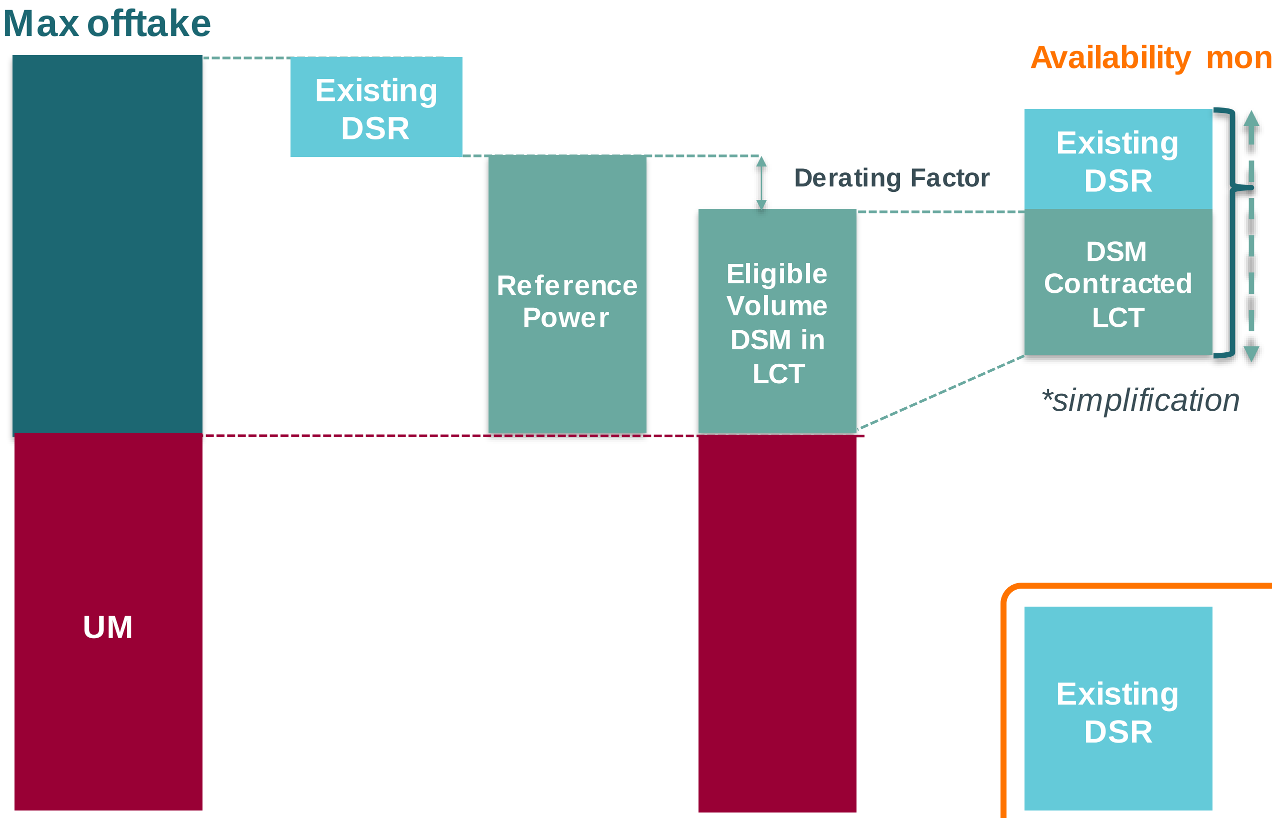
→ Rethink concept of full exclusion and move towards another way-of-working

→ Move towards the principle of "**Partial Exclusion**"

But: impact on different aspects of the current CRM and not just "eligibility"

Impact of “Partial Exclusion” on Eligible Volume and Obligated Capacity

Example: additional flexibility under the same DP (without changing the max offtake)



Availability monitoring: $DSR_{existing} + DSM_{contracted}$

Obligated capacity to be provided during **Availability Monitoring** (see further)
→ However, only $DSM_{contracted}$ is remunerated

Obligated capacity to be checked in Pre-Delivery test
→ Must prove availability of both contracted and existing

Further impact:

- No Multi-Year possible for DSM
- Higher commitment required
- Further impact covered in next slides

Existing DSR

Methodology to determine Existing DSR

= **NRP determination for DSR in Prequalification of the CRM (baseline method)** (defined to determine what DSR volume is “existing” and can be offered)

elia
Elia Group

Impact of “Higher Obligated Capacity” on Availability Monitoring

$$Weighted\ Contract\ Value\ (CMU,t) = \sum_{i=1}^{N} (Capacity\ Remuneration_i * Contracted\ Capacity_i)) / \sum_{i=1}^{N} Contracted\ Capacity_i$$

Availability Obligation & Penalties:

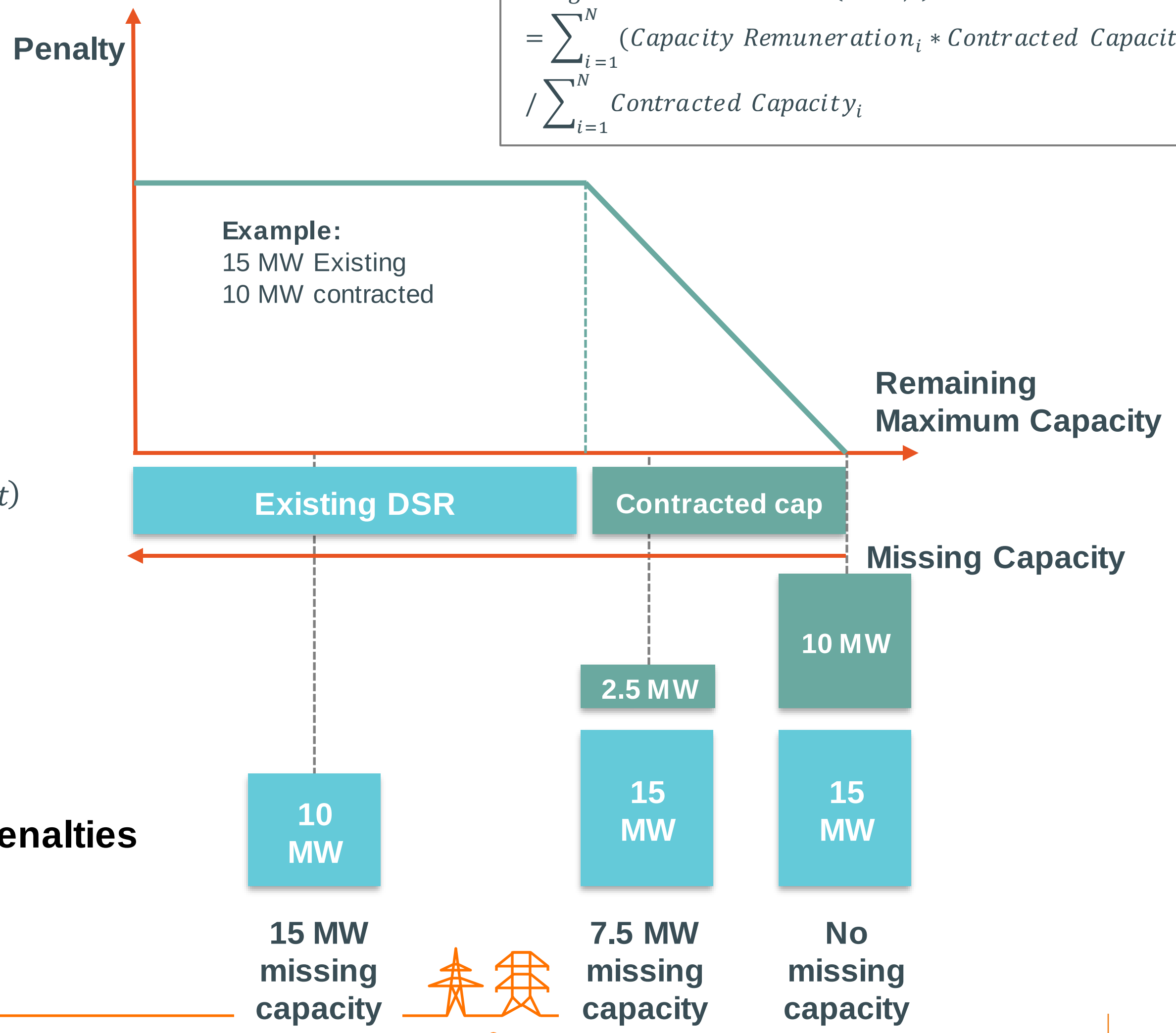
- **Any missing capacity** is immediately counted as missing from the capacity offered in the LCT.
- No increasing penalties for not delivering the Existing DSR, but steady penalty determined by Contracted Capacity

$$Unavailability\ Penalty\ [€] = \frac{1}{T * UP} [\sum_{t=1}^{T} (1+X) * Weighted\ Contract\ Value\ (CMU,t) * UMC(CMU,t)$$

Unannounced Missing Capacity

$$+ \sum_{t=1}^{T} (1+X) * Weighted\ Contract\ Value\ (CMU,t) * AMC(CMU,t)]$$

Announced Missing Capacity



/!\ Only when you reach Existing + Contracted volume, no penalties from AM.

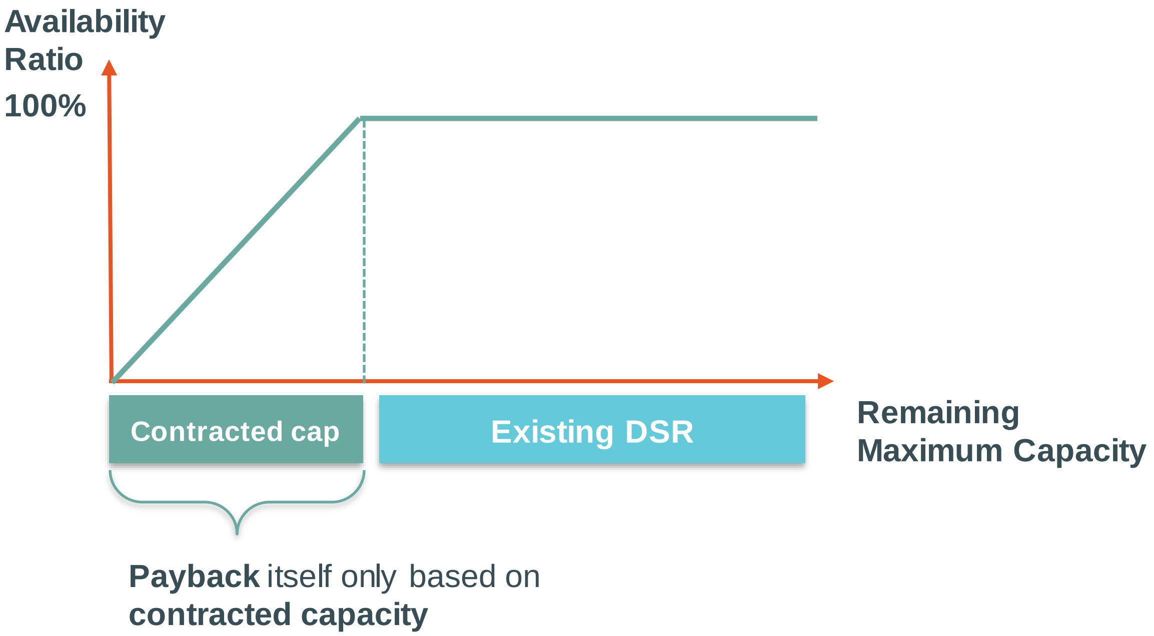
Impact of “Higher Obligated Capacity” on Payback Obligation

Payback Obligation:

Based on both **Contracted Capacity** and **Availability Ratio**

- **Contracted Capacity** is unchanged and is the capacity bid in to the LCT
- **Availability Ratio** determines how much of the total Payback Obligation is due → ratio goes up until you deliver the full contracted capacity and doesn’t increase further.

→ **Payback Obligation only due on the portion of Contracted Capacity**, but is immediately due as soon as any capacity gets delivered.



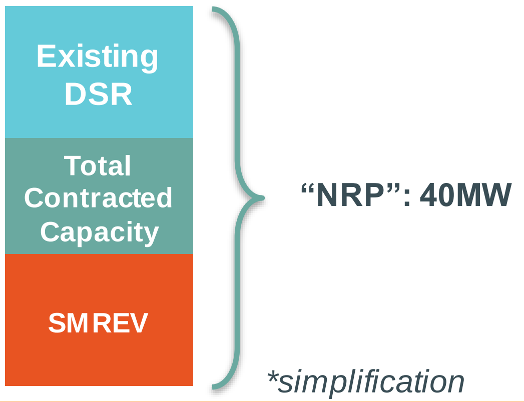
Impact of “Higher Obligated Capacity” on Secondary Market

General Modalities for Secondary Market

- Trading of “Contracted Capacity” between CMUs
- Each CMU then has an obligated capacity as the sum of their Existing DSR and their Contracted Capacities.
- **If no Contracted Capacity is left, they don’t have any Obligated Capacity either.**

Secondary Market Remaining Eligible Volume

- SMREV is calculated but with an additional term to be subtracted: **Existing DSR**



*simplification

Process for Existing DSR determination

1. **Quantitative Analysis by Elia**

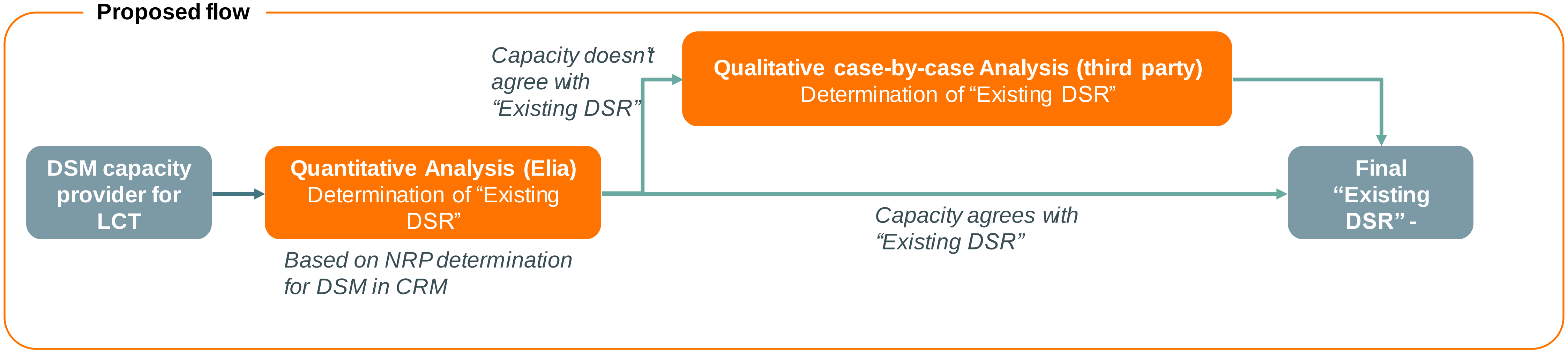
Based on determined methodology (NRP determination in PQ for DSM in the CRM)

Input from Market Parties possible in-line with that methodology (additional rules under review)

2. **Qualitative Analysis by third party**

Performed by recognized and agreed-upon third party. Elia takes the resulting Existing DSR at face value.

Under review @Elia for potential of external parties. To be discused at CdS.



Final results for a CO2 threshold trajectory recommendation in the Belgian CRM

Study of CO_2 emission reduction trajectories in the Belgian CRM

WG adequacy presentation

Dmitri Perekhodtsev, Nicolas Hary

16 December 2022

CONFIDENTIEL

economie
SPF Economie, P.M.E., Classes moyennes et Energie

COMPASS LEXECON

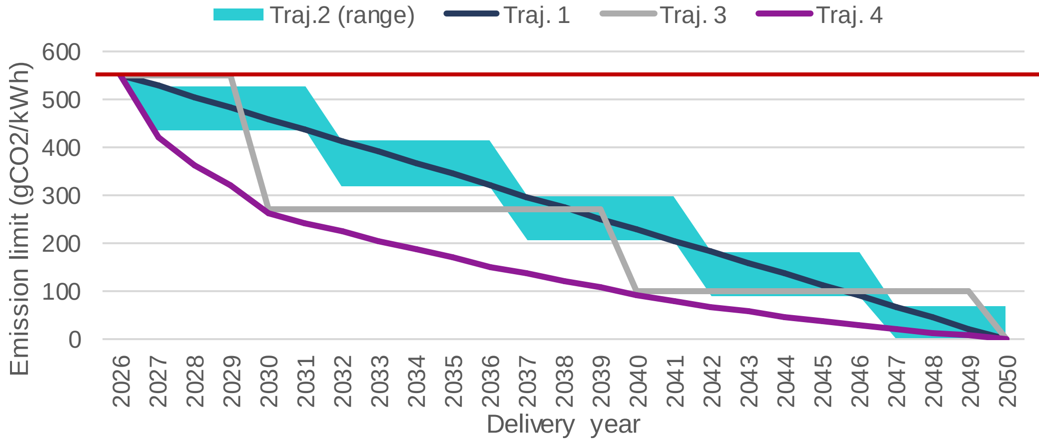
Disclaimer

- This presentation was prepared by FTI France SAS under the name of Compass Lexecon ("Compass Lexecon") for the Federal Public Service Economy, SMEs, Self-employed and Energy ("the Client") in accordance with the terms of the Client's letter of engagement (the "Contract").
- This presentation has been prepared solely for the benefit of the Customer as part of the Customer's European electricity market modelling analysis. No party other than the Customer is permitted to rely on this presentation for any purpose.
- This presentation may not be provided to third parties without the prior written consent of Compass Lexecon, which may be conditional upon entering into a letter of release with Compass Lexecon on the terms agreed by Compass Lexecon. Compass Lexecon accepts no responsibility or duty of care to any person (other than to the client under the relevant terms of the contract) for the content of the submission. Accordingly, Compass Lexecon accepts no responsibility for the consequences of any person (other than the Client on the above basis) acting or refraining from acting on the basis of the Submission or for any decision made or not made on the basis of the Submission.
- The presentation contains information obtained or derived from a variety of sources. Compass Lexecon accepts no responsibility for verifying or establishing the reliability of these sources or for verifying the information so provided.
- Nothing in this material constitutes investment, legal, accounting or tax advice, or a representation that any investment or strategy is suitable or appropriate for the recipient's individual circumstances, or otherwise constitutes a personal recommendation.
- No representation or warranty of any kind (whether express or implied) is given by Compass Lexecon to any person (other than the Client under the relevant terms of the Contract) as to the accuracy or completeness of the presentation.
- The presentation is based on information available to Compass Lexecon at the time of writing and does not take into account new information that becomes known to us after the date of the presentation. We accept no responsibility for updating the presentation or for informing the recipients of the presentation of such new information.
- This presentation and its contents are confidential and may not be copied or reproduced without the prior written consent of Compass Lexecon.
- All copyright and other proprietary rights in the presentation remain with Compass Lexecon and all rights are reserved.

Context of the study - different CO_2 trajectories proposed by SPF Energie that could have a strong impact on the Belgian mix

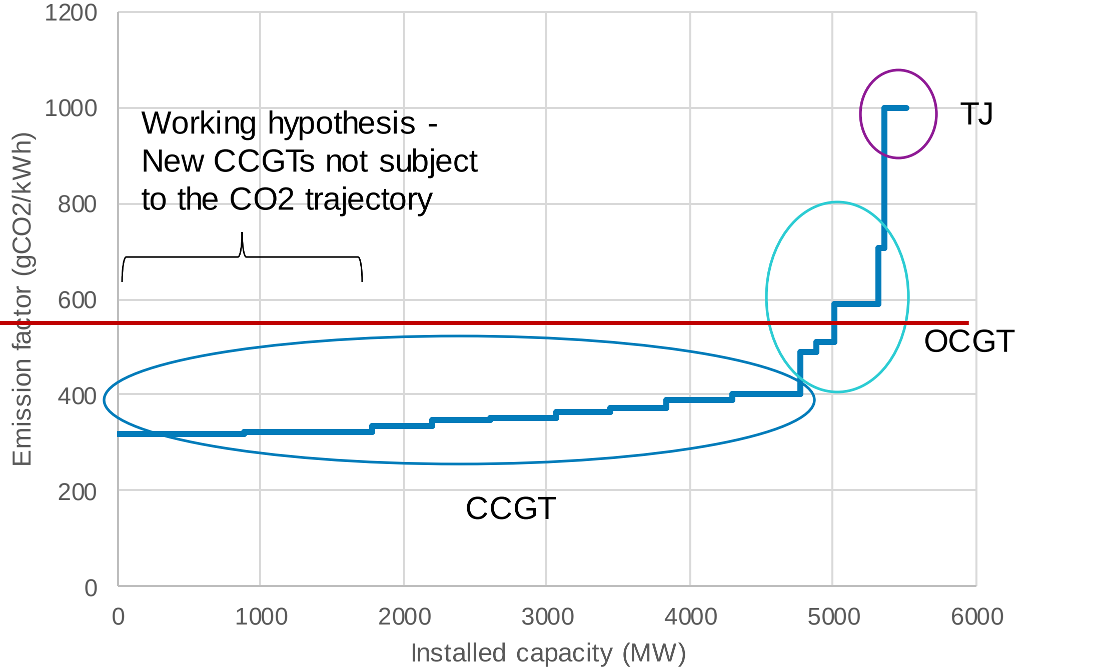
CO_2 evolution trajectories proposed by FPS Energy

- FPS Economy has considered introducing stricter eligibility rules for the Belgian MRC to support the transition to Net Zero in 2050.
- In particular, FPS Economy consulted in the summer of 2022 on the proposal for more restrictive CO_2 eligibility thresholds than the European regulation and proposed 4 more or less ambitious trajectories (+ one 5th which has not been quantified)



- Trajectry 5: combining a specific threshold and the reintroduction of an annual threshold

Emission factor of the thermal fleet in Belgium in 2026 (excluding CHP)



- Compared to the Belgian fleet planned for 2026, the CO_2 trajectories may impact a significant part of the Belgian thermal mix and therefore have strong consequences on the functioning of the Belgian market

Objectives of the mission entrusted to Compass Lexecon

Following this summer's consultation, FPS Economy entrusted Compass Lexecon with this mission with the following objectives

- **Analyse similar initiatives in European countries** to accelerate the greening of electricity production
- **Review the availability and competitiveness of different technologies for greening thermal generation**
- Propose a **trajectory n°5** reintroducing annual emission limits
- Carry out a **trajectory impact analysis** to compare the impact of trajectories on the electricity system
- Define the **most suitable trajectory**.

Review of European initiatives to accelerate the greening of electricity production

Eligibility thresholds for capacity mechanisms in European regulation

- The European Electricity Regulation 2019 sets out the eligibility rules for capacity to receive revenue in CRMs based on CO2 emissions
- In particular, the European regulation sets a specific CO2 emission threshold of 550gCO2/kWh. Existing capacity with an emission factor above the threshold may still be eligible if it limits its annual emissions to 350kgCO2/kW/year.
- All capacity mechanisms implemented so far in Europe apply these eligibility rules.

Implementation of the European regulation

- In addition, a more recent CEEAG regulation allows Member States to introduce stricter eligibility rules based on CO2 emission factors.
- Currently, France and the UK provide examples of stricter rules for new capacity, setting them at 200gCO2/kWh in France and 450gCO2/kWh in the UK (however, neither considers a trajectory to 2050). Belgium removed the annual threshold for existing capacity in the last auction in 2026/27.

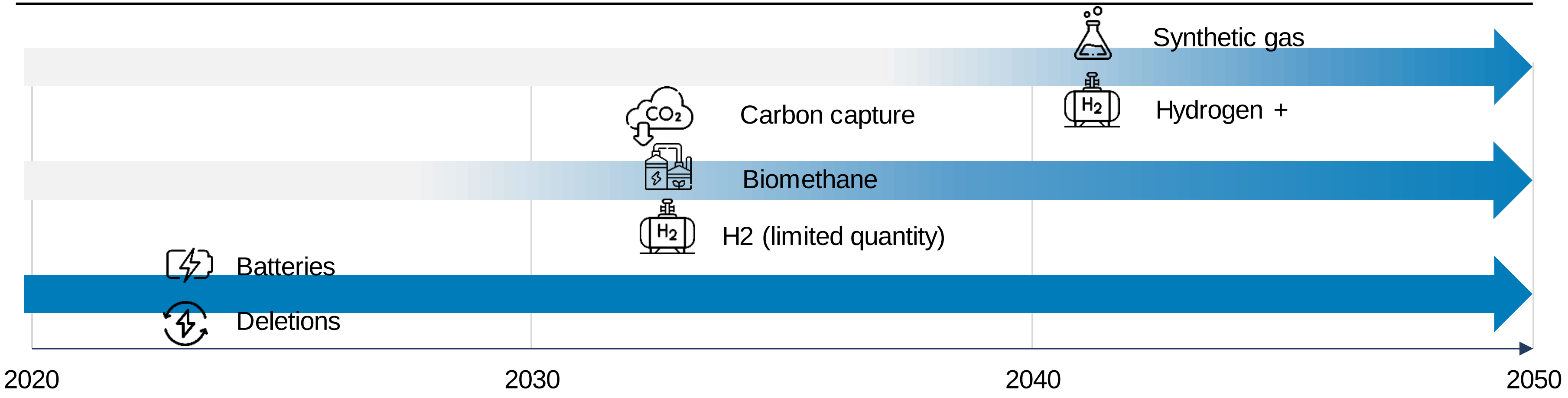
Initiatives limiting the operation of thermal capacity outside CRM

- Beyond CRM eligibility, European countries have other policies, limiting the use of new and existing technologies according to their CO2 emissions as part of their decarbonisation plans.
- For example, France limits the CO2 emissions per kW per year from its existing coal-fired power plants
- Germany plans to phase out its coal and lignite-fired power plants in return for negotiated or market-based compensation for operators.

The success of implementing stricter eligibility rules in Belgium for existing capacity in the absence of similar measures in neighbouring countries is therefore very uncertain given the strong coupling with other European countries

Review of the availability and competitiveness of different technologies for greening electricity production

Approximate availability of different technologies to green the electricity mix



- Before 2030, the existence of a solution that can be deployed on a large scale (i.e. on the entire Belgian thermal fleet) and at a reasonable cost **to green thermal production is unlikely** (technical, potential, cost constraints, etc.). Batteries/shavers can be deployed but (i) will not be able to fully replace thermal production (stock constraints in particular) and (ii) are available in limited potential.
- In the medium term (2030-2040), **more promising solutions could be developed** to make thermal production greener (hydrogen, biomethane, etc.) but this remains uncertain from a technological and financial point of view. The question of the priority of uses between the electricity sector and the other sectors is also essential.
- In the very long term (>2040), the technological uncertainties should be overcome and solutions for greening thermal production available on a larger scale (hydrogen in particular).

CO2 trajectories must therefore take into account this strong uncertainty about the availability of alternative technologies in the medium term to green thermal generation. If these technologies do not develop quickly enough, there is a risk that CO2 trajectories will force the closure of generation facilities without an equivalent alternative.

Methodology used in the impact assessment

- Our impact assessment compares the results of the European dispatch between the base case in which the CO_2 thresholds for CRM eligibility in Belgium are maintained at the current level (550gCO_2/kWh and no annual limit for existing capacity) and trajectories 1 to 4 proposed by the FPS Economy and trajectory 5 considered by Compass Lexecon.
- The impact assessment focuses on two years, 2030 and 2035, which are the most critical in terms of expected impacts on existing capacity, risk to security of supply and uncertainty about the technical feasibility of technologies to green thermal generation.
- Given the many uncertainties in the short term about the availability and competitiveness of solutions to decarbonise thermal generation, we assess the impact of trajectories for two contrasting scenarios of availability of these solutions

Scenario 1 (pessimistic)

- Decarbonisation solutions are not available (technical constraint, potential limit, etc.).
- As soon as the CO_2 constraint is reached, the thermal power plant is no longer eligible for the CRM and must soon leave the market because the market revenues do not cover the fixed operating costs and the investments needed to extend their life
- Closed capacity is replaced by batteries and DSRs to maintain system adequacy within the maximum available potential

Scenario 2 (optimistic)

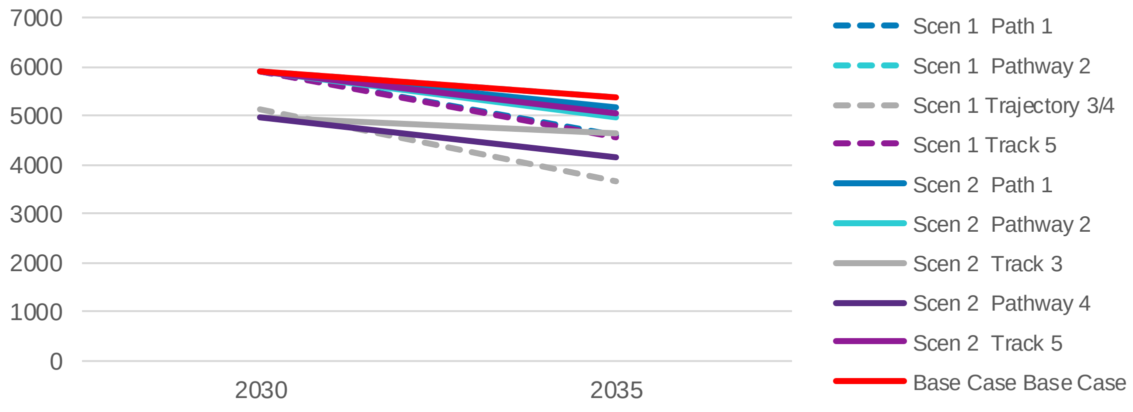
- Biomethane is available and can be used by existing capacity to meet specific CO_2 thresholds.
- Because of the high price of biomethane, using biomethane is more expensive than burning natural gas and emitting CO_2
- This allows existing capacity to remain in the CRM and in the market, contributing to adequacy while making higher offers in the energy market, thus impacting dispatch.

- We use a European dispatch model to quantify the impact of these scenarios for each trajectory on production and imports in Belgium, CO_2 emissions in Belgium and Europe and on electricity prices in Belgium.

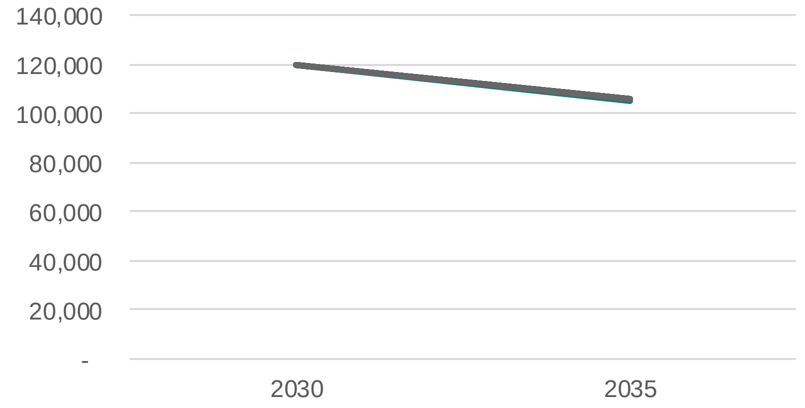
The main results of the impact assessment

- CO2 emissions are expected to decrease in the absence of CO2 trajectories both in Belgium and in Europe due to national RES plans, expected CO2 allowance prices and the planned phase-out of thermal power plants (e.g. in Germany).
- The introduction of trajectories 1 to 4 can further reduce CO2 in Belgium, especially in the most constraining trajectories 3 and 4 and the pessimistic scenario (scenario 1) where existing capacity is forced out of the market.
- However, the trajectories also lead to an increase in thermal generation elsewhere in Europe to substitute for the Belgian plants, which leads to **very little CO2 reduction at the European level and a considerable increase in Belgium's dependence on imports**.
- The most ambitious trajectories 3 and 4 could also **lead to security of supply problems in Belgium**.
- Furthermore, the reduction of CO2 emissions achieved as a result of the trajectories would be at a **very high cost to society and to Belgian customers who would see a significant increase in electricity** and capacity prices.
- Finally, a too strict definition of the annual threshold (in the case of trajectory 5) could even lead to an **increase in CO2 emissions at the European level** because Belgian power plants would then be replaced by less efficient and therefore more polluting plants in foreign countries.

CO2 emissions (thousand tonnes) - Belgium



CO2 emissions (thousand tonnes) - CWE+GB



Our recommendations for CO2 trajectories in Belgium

Specific CO2 emission limits should be considered separately for new and existing capacity

New capabilities

New CCGTs accepted at the DY25-26 auction

- It is not yet clear whether the two new CCGTs with 15-year contracts will be subject to these trajectories (legal analysis required)
- In any case, the operators of these new GCCCs commit to reducing specific CO2 emissions to zero by 2050 and to proposing action plans with intermediate targets.

New capabilities not yet accepted in CRM

- Stricter CO2 emission thresholds (than for existing capacity) can be introduced as in France and the UK.
- The trajectory should remain stable over relatively long periods in line with investment cycles, e.g. 5 years, as in trajectory 2 proposed by the FPS Economy.
- Thresholds should be consistent with the technical feasibility/availability of solutions to green thermal generation in case new capacity is needed for security of supply

Existing capacity

Eligibility criteria in the CRM for existing capacity

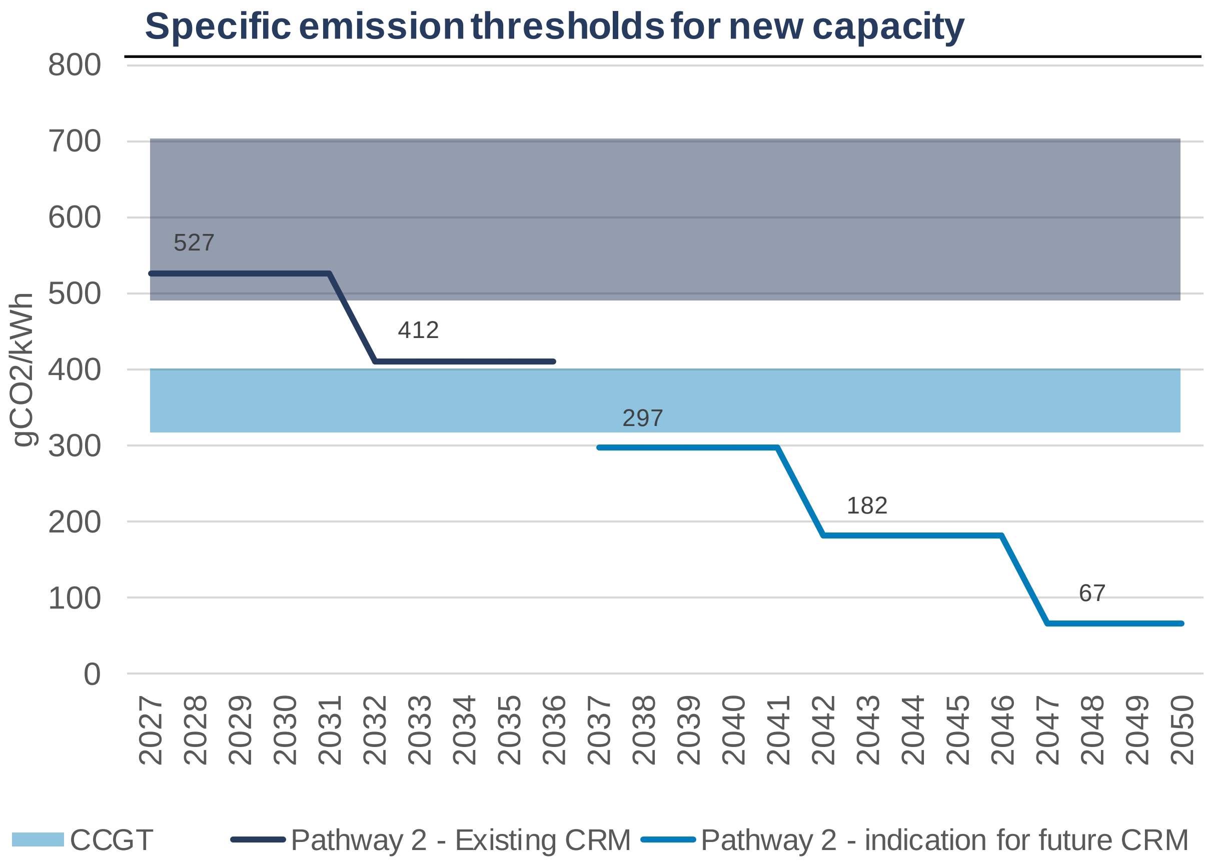
- Strict eligibility criteria that are incompatible with technical feasibility/availability can create significant risks for operators and for security of supply.
- The approach for existing capacity should be flexible enough to allow it to remain in the market and contribute to adequacy as long as its impact on CO2 emissions remains limited.

Recommendation on CO2 thresholds for existing capacity

- Do not apply a CO2 trajectory and keep the current specific threshold of 550g/kWh
- Reinstate and maintain the annual CO2 thresholds of the EU regulation (350kgCO2/kW/year) for existing capacity (before 2019)
- The application of specific and more binding annual thresholds for existing capacities is not desirable as it may lead to an increase in CO2 at the European level and create residual risks for operators and for the security of supply, as well as an additional cost for the Belgian consumer
- It may be necessary to revisit these conclusions in the event of significant market developments, including (i) the availability of technologies to green the thermal fleet or (ii) the implementation of similar measures in several European countries

Specific emission thresholds for the new heat capacity

- The upper bound of trajectory 2 proposed by FPS Economy could be proposed for the new capacity for the duration of the current CRM and as an indication for future CRMs.
- This would reasonably limit the entry of new capacity without relying on the uncertain feasibility of green gas technologies and without compromising security of supply over the next decade
- It should be noted that even in this case, the trajectories for the new capacity may be redundant with the CRM operating rules requiring the operator of the new capacity to decarbonise its capacity by 2050 as is the case for the new CCGTs cleared in the Belgian CRM for 2025 delivery.



CO2 emission threshold considerations for existing capacity

Reinstatement of annual CO2 thresholds for electricity regulation (350kgCO2/kW/year for capacity that emits more than 550gCO2/kWh)

- These annual thresholds for existing capacity are part of the European Regulation and allow existing peak capacity (TJ and OCGT) to remain on the market and contribute to security of supply in the spirit of the trajectory 5 proposed by FPS Economy
- The low number of operating hours of these capacities allows them to be well below the annual threshold of 350 and the impact on overall CO2 emissions of keeping these units is negligible (but not in terms of security of supply).

Combination of specific and annual threshold trajectories for existing capacity

- If it is also decided to apply a specific threshold trajectory to existing capacity (which we do not recommend), this should be accompanied by annual thresholds, which can be
  - Or serve as **safety nets**, ensuring that capacities with high specific emission rates do not emit more CO2 on average per year than capacities with specific emissions in line with thresholds.
  - Or create a **strong constraint on the operation of** these plants, leading them to run much less on average

However, binding annual thresholds applied to existing capacity pose several risks

- A binding annual limit would be incompatible with the MRC Rules, which require that capacity be available throughout the delivery year (on pain of penalties). It may also be incompatible with the obligation to offer available capacity on the energy market
- A binding annual limit can be detrimental to the SoS in the event of exceptional events, such as a sudden drop in available capacity in neighbouring countries that would require a higher use of Belgian power plants (see current situation on the electricity market).
- Our impact analysis of trajectory 5 suggests that an overly stringent annual threshold could increase overall CO2 emissions as the output of efficient Belgian power plants subject to this threshold would be replaced by the output of less efficient European power plants.

Reinstating the annual CO2 thresholds of the electricity regulation will allow peak capacity to remain in the market and contribute to security of supply without risk to CO2 emissions
Stricter specific and annual thresholds could have a negative impact on CO2 emissions and create a risk for the capacity operator and security of supply

EMEA Locations

Berlin
Kurfürstendamm 217
Berlin, 10719

Brussels
23 Square de Meeûs
Brussels, 1000

Copenhagen
Bredgade 6
Copenhagen, 1260

Düsseldorf
Kö-Bogen
Königsallee 2B
Düsseldorf, 40212

Helsinki
Unioninkatu 30
Helsinki, 00100

London
5 Aldermanbury Square
London, EC2V 7HR

Madrid
Paseo de la Castellana 7
Madrid, 28046

Milan
Via San Raffaele 1
Milan, 20121

Paris
22 Place de la Madeleine
Paris, 75008

Tel Aviv
Yigal Alon Street 114
Toha Building
Tel Aviv, 6744320

Next meetings

Foreseen timeslots for next meetings

- Friday 27th January 2023 **am**
- Friday 17th February 2023 **am**
- NEW Thursday 23th March 2023 **am**
- NEW Friday 14th April 2023 **am**
- NEW Tuesday 23th May 2023 **am**
- NEW Friday 16th June 2023 **am**

Thank you !