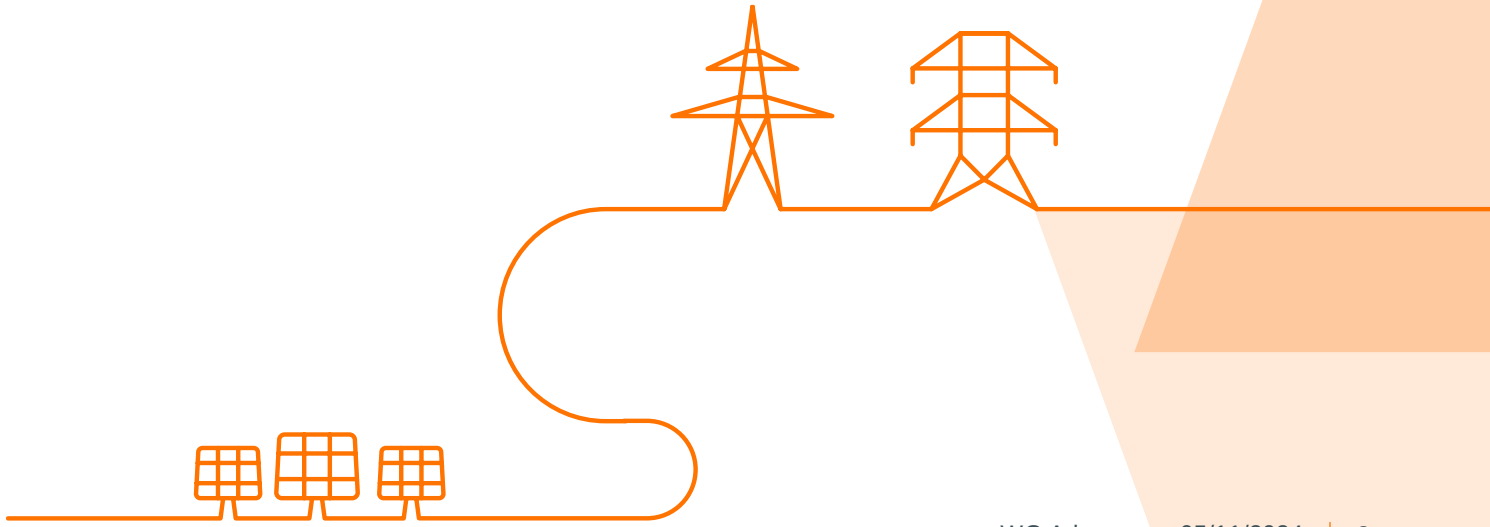
WG Adequacy #34

05/11/2024

Agenda

- Welcome
- Validation Meeting Minutes
- 2024 Auction results
- Public consultation for the next Adequacy & Flexibility study
- AOB & Next meetings



Welcome

Validation Meeting Minutes

2024 Auction results

2024 Auctions – results Y-4

Step 1: Setting the demand curve

The volume to be procured is determined by Ministerial Decree:

Demand curve	Volumes 28-29	Volumes 27-28	Volumes 26-27
Average load during simulated scarcity	15 453 MW	14 071 MW	14 089 MW
Balancing needs	1 127 MW	1 250 MW	1 179 MW
Average unserved energy during simulated scarcity	-478 MW	-453 MW	-577 MW
Target volume	**16 102 MW**	**14 868 MW**	**14 691 MW**
Non-eligible capacity (including nuclear prolongation)	-4 420 MW	-4 386 MW	-3 948 MW
Volume reserved for later Auctions (Y-2 / Y-1)	-1 461 MW	-1 285 MW	-1 249 MW
Reservation for foreign indirect contribution (GB & FR)	-389 MW	- 672 MW	- 657 MW
Reservation for foreign indirect contribution (NL & DE)	-629 MW	- 262 MW	- 796 MW
Already contracted capacity for the delivery period	-2 247 MW	-1 658 MW	-1 658 MW
Y-4 Auction volume (point B)	**6 957 MW**	**6 605 MW**	**6408 MW**

Reminder for all slides: volumes are derated unless otherwise mentioned

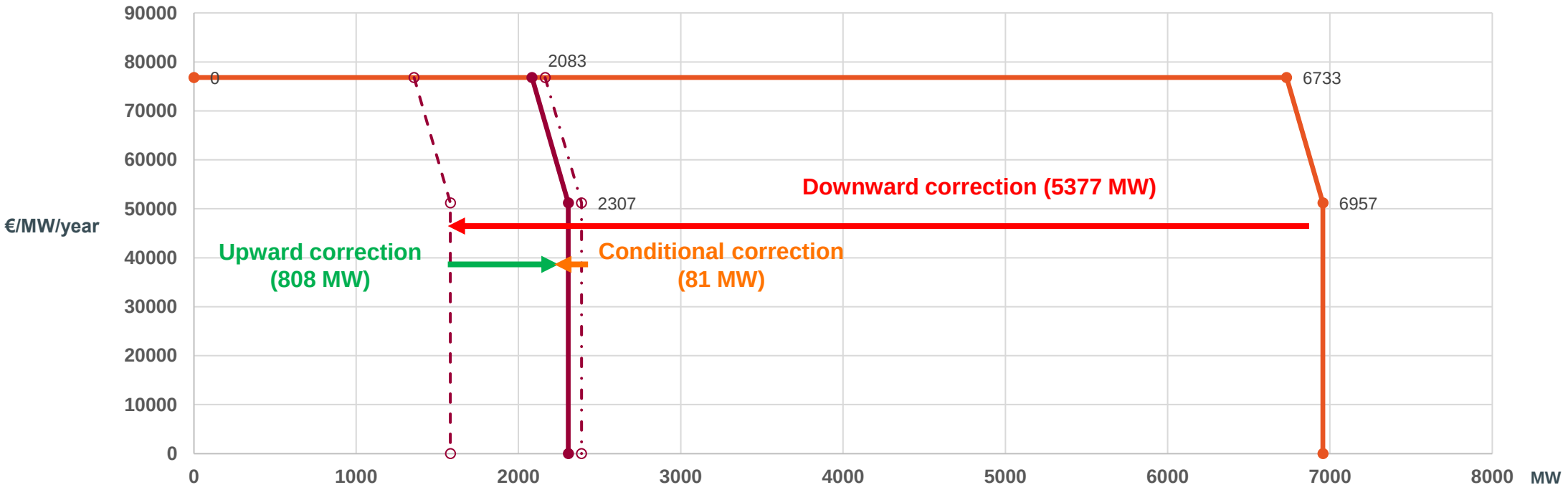
Step 2: Correcting the demand curve

Downward correction: All known volume that will contribute to adequacy
- example: Existing capacity that does not / may participate to the auction

Upward correction: Volume that was subtracted during the calibration, but participated anyway
- example: Non-eligible capacity (capacity with other subsidies)

Conditional correction: Volume of new build capacity that is only considered to be contributing if the capacity is selected

→ After corrections, the demand curve is reduced to **2 307 MW** (point B).



Y-4 2028-29 auction results – takeaways

A significant step has been taken in terms of security of supply for the delivery period 2028-2029:

- 1.926 MW of capacity has been contracted in this Y-4 auction, including:
  - 188 MW of different (6) new batteries
  - 246 MW of demand response is contracted
  - 1.723 MW of existing capacity (an increase of 751 MW compared to last year's Y-4 auction)
- In previous auctions, the CRM has already contracted 2.247 MW of new capacity for the delivery period 2028-2029.

A net volume of 381 MW is transferred to the Y-2 & Y-1 auctions for 2028-29 as a consequence of lower offered liquidity.

- Despite lower liquidity, the weighted average price (28,0 k€/MW/y) is significantly lower than last year's auction (36,4 k€/MW/y).
- Even though there was room for an additional 630 MW, the net volume transferred to later auctions is lower because of the dynamic correction

2024 Auctions – results Y-1

Step 1: Setting the demand curve

The volume to be procured is determined by Ministerial Decree:

Demand curve	Volumes 25-26
Average consumption during simulated scarcity	13 473 MW
Balancing needs	1 125 MW
Average unserved energy during simulated scarcity	-443 MW
Target volume	**14 155 MW**
Non-eligible capacity (including nuclear prolongation)	-4 393 MW
Reservation for foreign indirect contribution (GB)	-709 MW
Already contracted capacity	-4 457 MW
Y-1 Auction volume (point B)	**4 596 MW ***

*Of which a reservation for XB participation for NL & DE was subtracted from the target volume in the Royal Decree

Step 2: Correcting the demand curve

Downward correction: All known volume that will contribute to adequacy, but does not/may not participate in the CRM

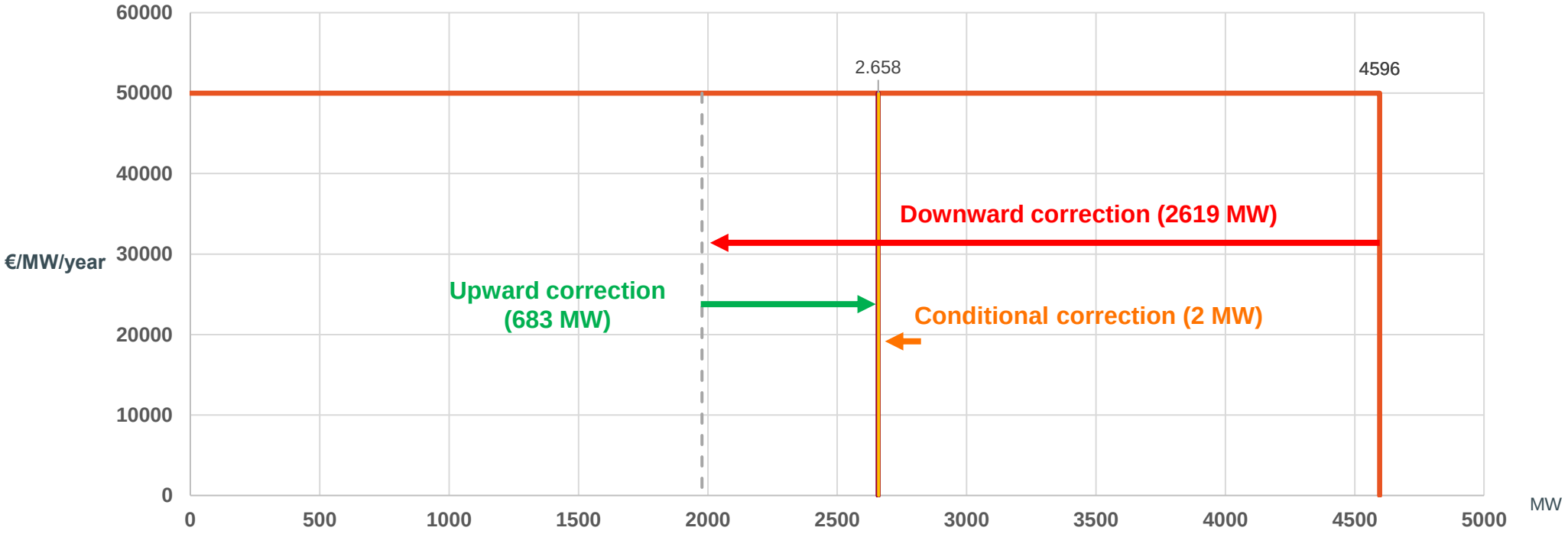
- example: Existing capacity that does not participate to the auction

Upward correction: Volume that was subtracted during the calibration, but participated anyway

- example: Non-eligible capacity (capacity with other subsidies)

Conditional correction: Volume of new build capacity that is only considered to be contributing if the capacity is selected

→ After corrections, the demand curve is reduced to **2658 MW** (point B).



Y-1 2025-26 auction results – takeaways

Security of supply for the delivery period 2025-26 is safeguarded

- 14.628 MW of capacity (will be) present in the system, while the target volume is 14.155 MW

High liquidity and a competitive Y-1 auction

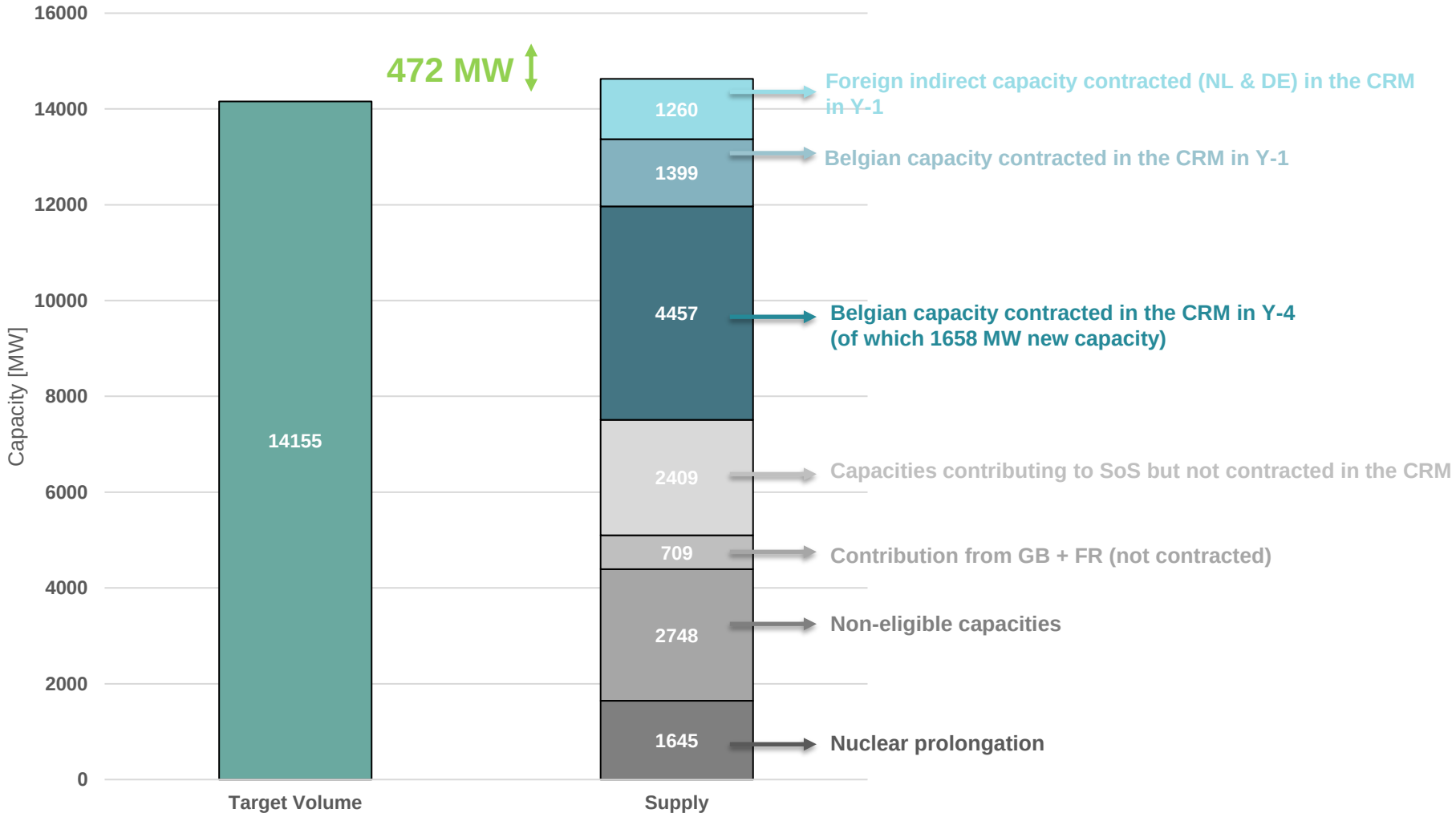
- Offered volume (3.131 MW) exceeded the demand by 472 MW
- Weighted average price well below intermediate price cap (IPC): 15,7 k€/MW/yr (⇔ IPC: 27,3 k€/MW/yr)
- 2659 MW was selected in this Y-1 auction, including:
  - 1054 MW existing capacity
  - 1260 MW indirect foreign capacity (DE: 284 MW & NL: 976 MW)
  - 345 MW of Additional capacity

First participation of foreign capacities to the CRM was successful

- 1.260 MW of foreign capacity selected (976 MW from NL & 284 MW from DE)

Total view on Security of Supply for Delivery Period 2025-2026

- Total cost of the CRM for 2025-2026 : 182 877 773 €
- Average cost of the CRM for 2025-2026 : 25 702 €/MW



Publication consultation of scenario data and methodology for the next Adequacy & Flexibility study

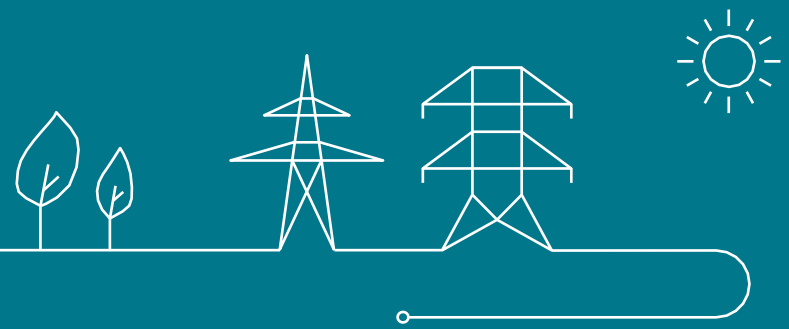
AdeqFlex’25 – Public consultation

5/11/2024

AGENDA

- **Regulatory** framework & **stakeholder** interaction
- **Adequacy** and **economic viability assessment** methodology
- **Flexibility study**
- **Scenario** – Supply & storage
- Break 15min
- **Scenario** – Demand
- **Scenario** – End-user flexibility
- **Scenario** – Cross-border exchanges
- **Scenario –** EU assumptions
- **Scenario** – Economical & other

Regulatory framework and stakeholder interaction



This study will be based on the requirements set in the electricity law and will use the expertise that Elia has developed in its past Adequacy and Flexibility studies

APR 2016

Adequacy & Flexibility 2017-2027

At the request of the Minister of Energy, an ad hoc study covering the adequacy and flexibility of Belgium's needs was published in April 2016. As requested by the authorities, an addendum was subsequently published in September 2016, based on a large stakeholder consultation which was undertaken following the publication of the initial study.

JUL 2018

Legal requirement in the Belgian Electricity Act

Art. 7bis, §4bis (Elia's translation into English): "*No later than 30 June of each biennial period, the system operator shall carry out an **analysis of the needs** of the Belgian electricity system in terms of the country's **adequacy** and **flexibility** for the next **ten years**.*
*The basic **assumptions** and **scenarios**, as well as the **methodology** used for this analysis, shall be determined by the system operator **in collaboration** with the **Directorate General for Energy** and the **Federal Planning Bureau** and in **concertation** with the **regulator**.*"

JUN 2019

Adequacy & Flexibility 2020-2030

The first study published in 2019 after the modified law.

JUN 2021

Adequacy & Flexibility 2022-2032

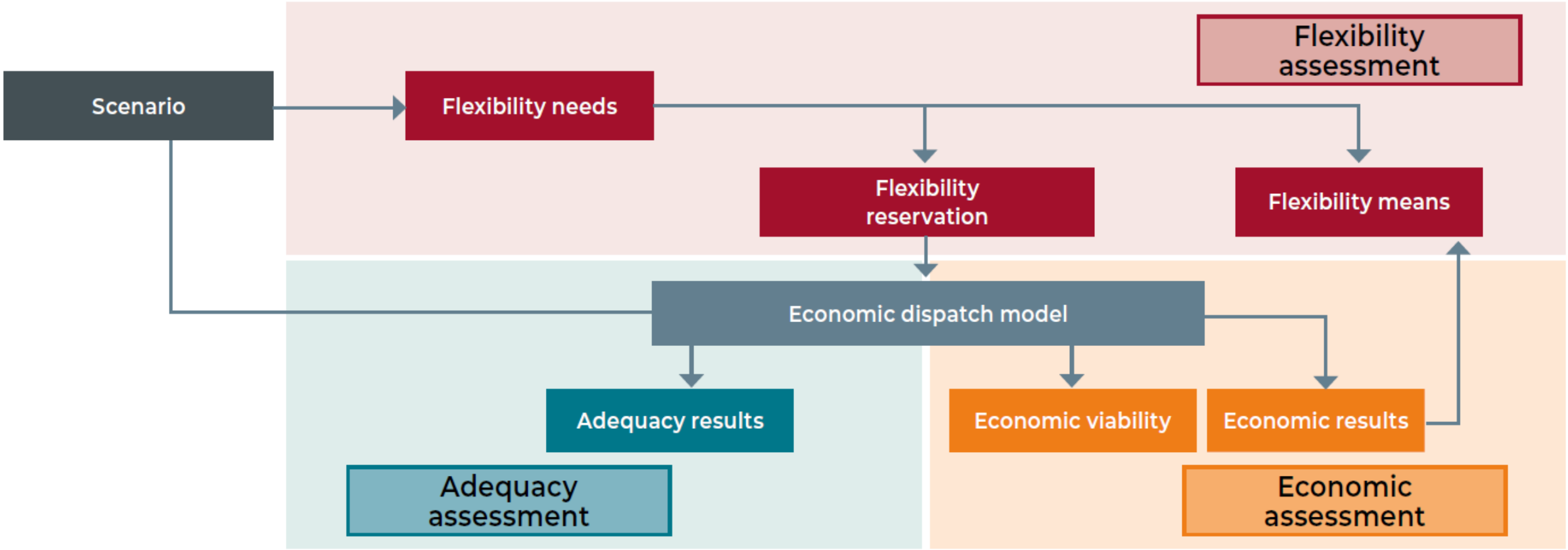
JUN 2023

Adequacy & Flexibility 2024-2034

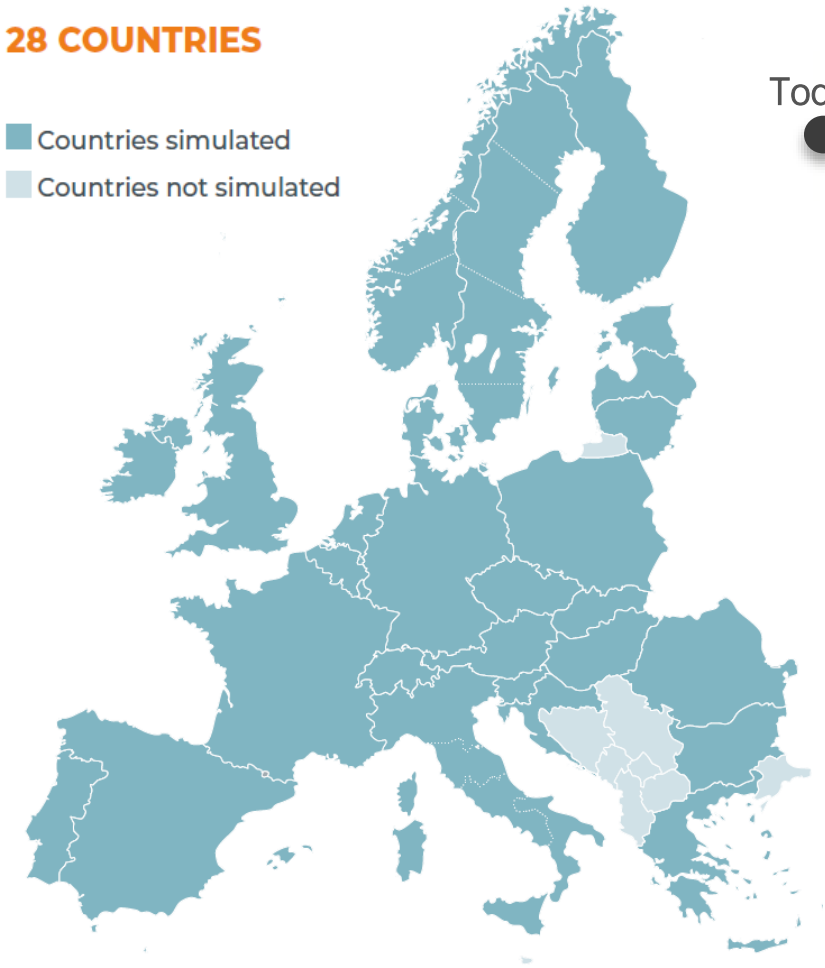
JUN 2025

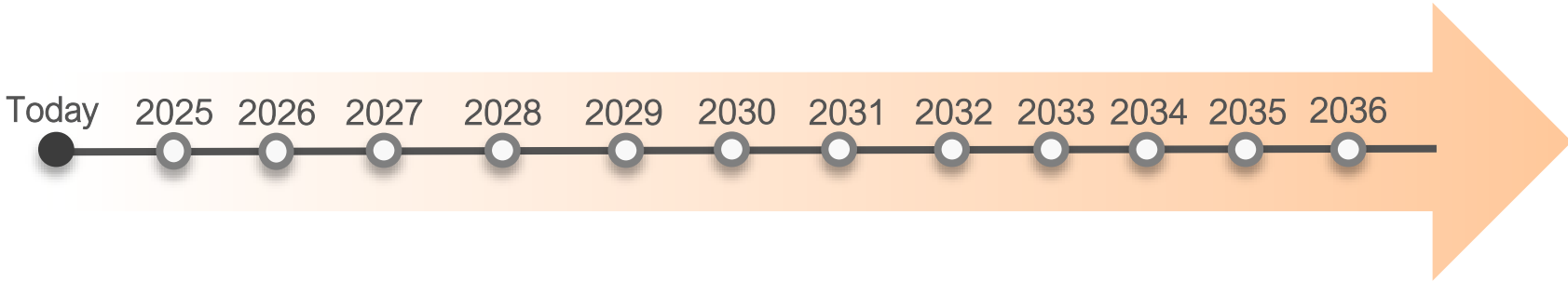
Adequacy & Flexibility 2026 – 2036

This study covers 3 main topics related to adequacy, flexibility and economics



The study will look 10 years ahead, and will simulate 28 countries





Adequacy assessment

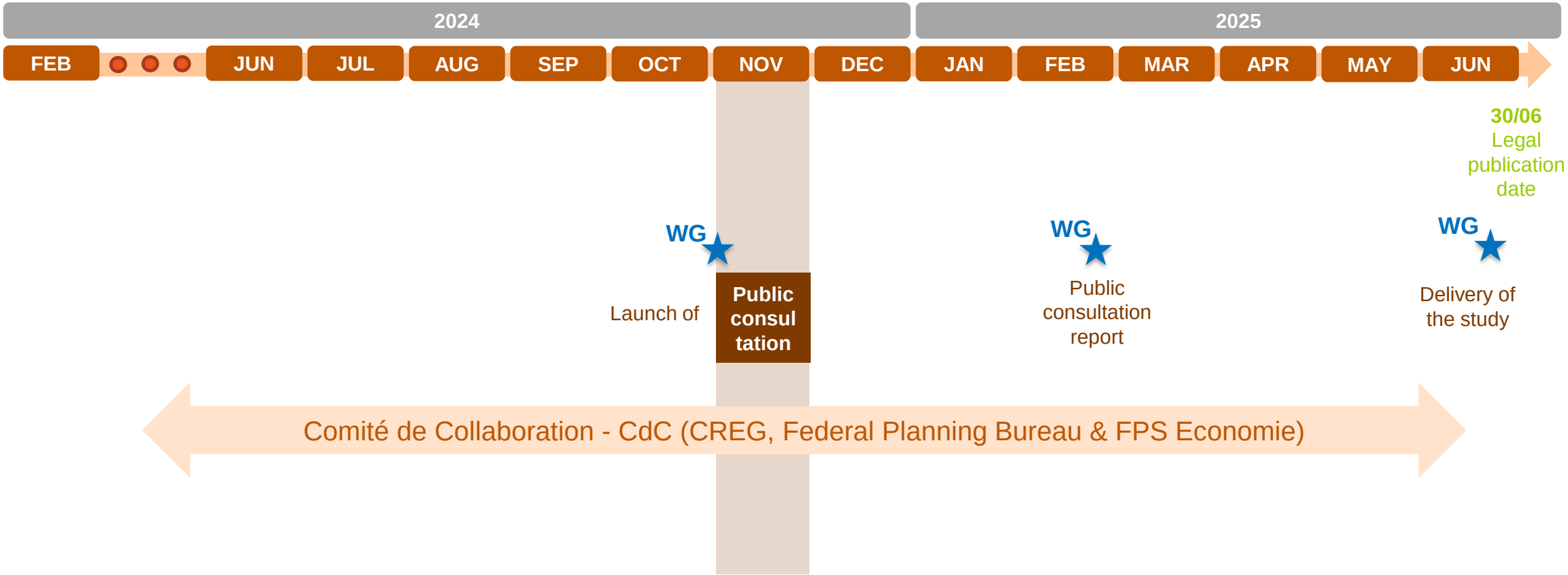
Economic assessment

Short-term flexibility assessessment

Depending on the amount of sensitivities, a more limited set of years will be chosen for certain of those

Years are simulated from 1 September Y to 31 August Y+1, hence 2025 corresponds to 1 September 2025 until 31 August 2026.

High level timeline of the study delivery



The scenario, methodology and request for sensitivities are submitted for a public consultation of 1 month starting today.

Scenario assumptions

- **A main document** describing the different data submitted to the consultation including explanations and sources used to make the different trajectories;
- **An Excel file** is also provided with the data for the proposed central scenario for Belgium, economic assumptions and EU-BASE scenario data assumptions for neighboring countries including the sources;

Study methodology: several methodological documents have been prepared (based on the previous study) but also integrating proposals for novelties;

External study submitted to consultation

- External study on hurdle rates for economic viability;
- External study on price-linked electricity demand evolutions (PRICED);

Sensitivities

- As the previous study, we are calling for quantified suggestions for sensitivities & scenarios from stakeholders and methodological improvements (in-line with the ERAA methodology). Those will be further analysed within the CdC;

As for any public consultation, feel free to ask for clarifications during the consultation period (if something is unclear to you).

More practical details on the public consultation will be provided at the end of this presentation

Adequacy

Methodology

The adequacy methodology used is in line with the ERAA methodology. Hourly simulations are performed on several hundreds of 'Monte-Carlo' years.

INPUT DATA

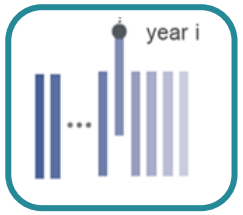
For each of the simulated areas

- Consumption
- Centralised thermal production facilities
- Decentralised thermal production facilities
- Renewable production
- Hydro
- Storage
- Demand flexibility
- Interconnection capacity between countries (NTC/FB)

Forward looking climate database
(200 climate years)

METEO FRANCE

antaressimulator



Monte Carlo years

SIMULATIONS

Hourly dispatch optimisation to minimise total costs of the system

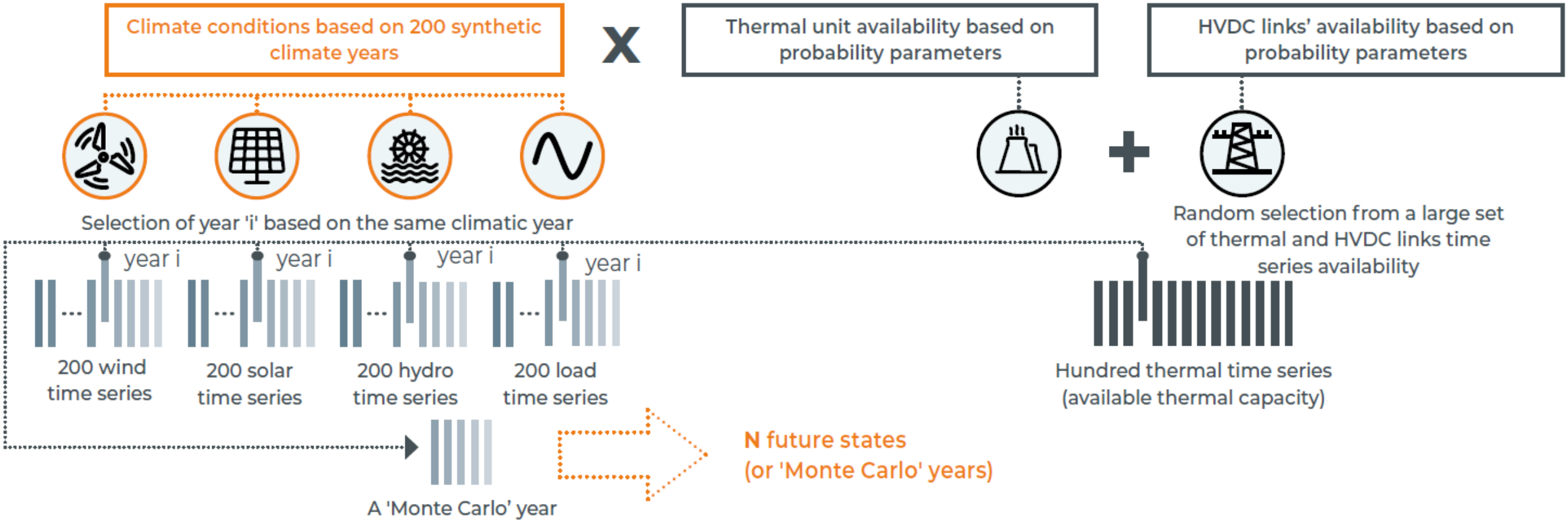
MODEL OUTPUT

- **Hourly dispatch** for all units in each area
- **Commercial exchanges** between areas
- **Hourly marginal prices**

- **Adequacy** indicators
  - LOLE, EENS
- **Economic** indicators
  - Market welfare, total costs, unit revenues, running hours
- **Sustainability** indicators
  - Emissions, RES share
- **Dispatch** indicators
  - Imports/exports, generation per type

- The **adequacy methodology** is fully compliant with the **ERAA methodology**
- The **amount of Monte Carlo** years simulated is based on a **convergence criterion**
- The currently **set reliability standard** for Belgium is used = **3 hours of Loss of Load Expectation (LOLE) on average**

For each scenario/sensitivity, a large amount of Monte-Carlo years are simulated in order to reach convergence of the relevant indicators



All countries are assumed to respect their national reliability standard or 3 hours if unknown as from 2029, following a similar approach as in AdeqFlex'23.

Starting point ⇨ **Applying a compliant methodology with the ERAA and MEC** ⇨ **Resulting scenarios**

ERAA24, latest national studies, official announcements

As from 2029, all countries assumed to respect their national reliability standard or 3 hours if unknown

Economic viability* check that no additional new capacities are viable

EU-BASE

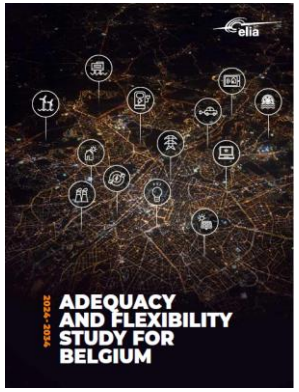
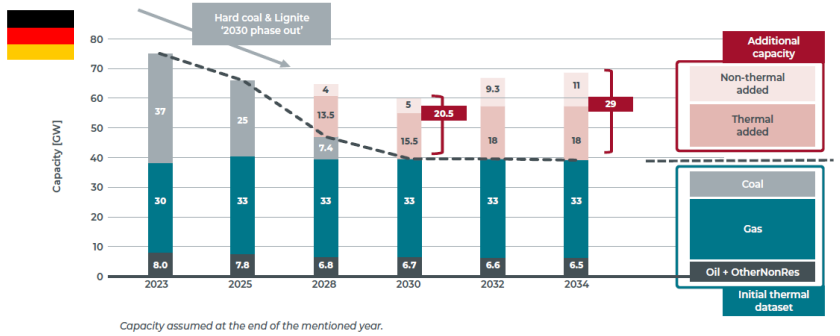
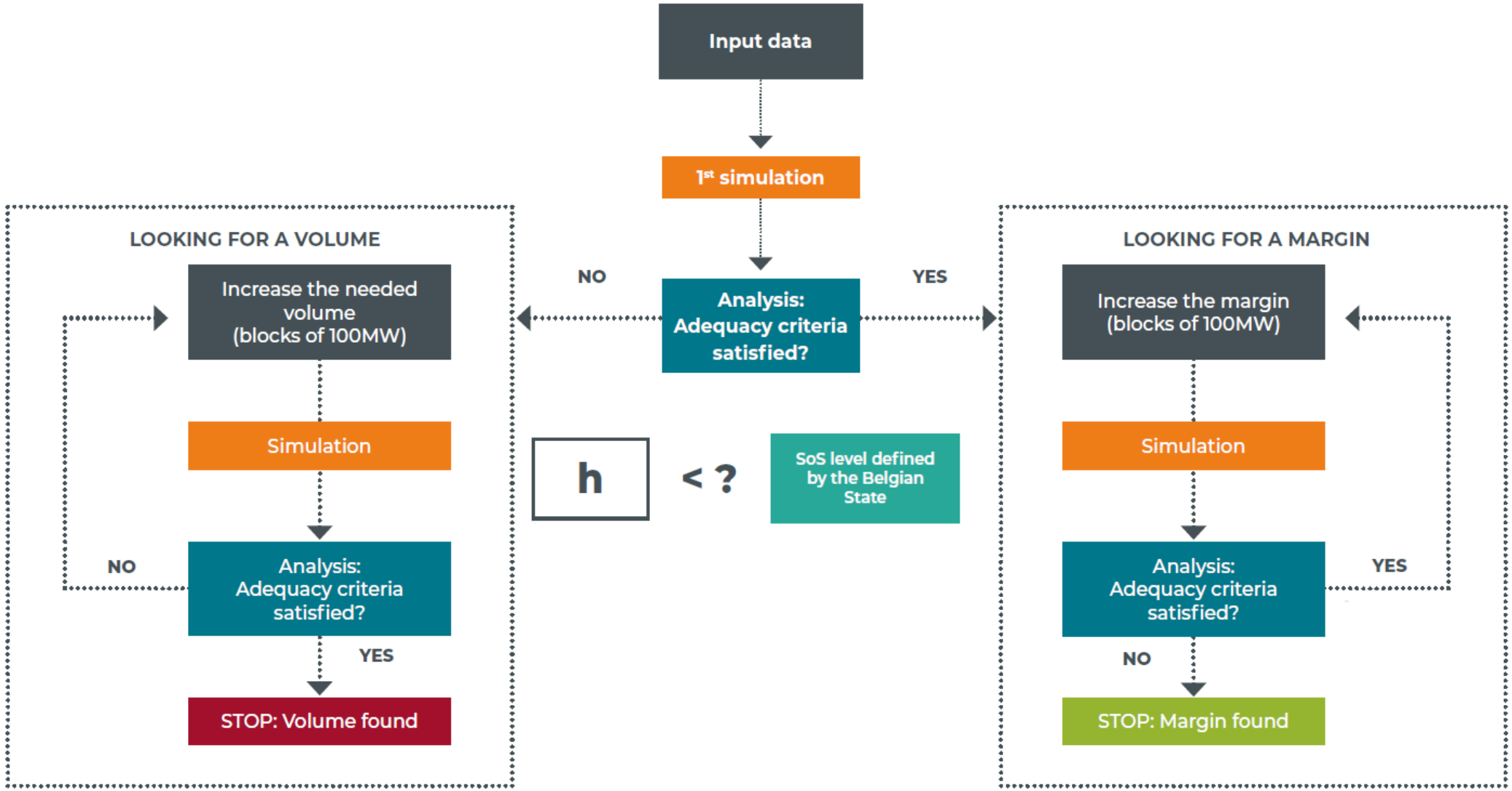


FIGURE 3-82 — ADDITIONAL CAPACITY ADDED TO COMPLY WITH THE GERMAN RELIABILITY STANDARD (CAPACITY FOUND TO BE NOT VIABLE WITHOUT SUPPORT) IN THE EU-BASE SCENARIO

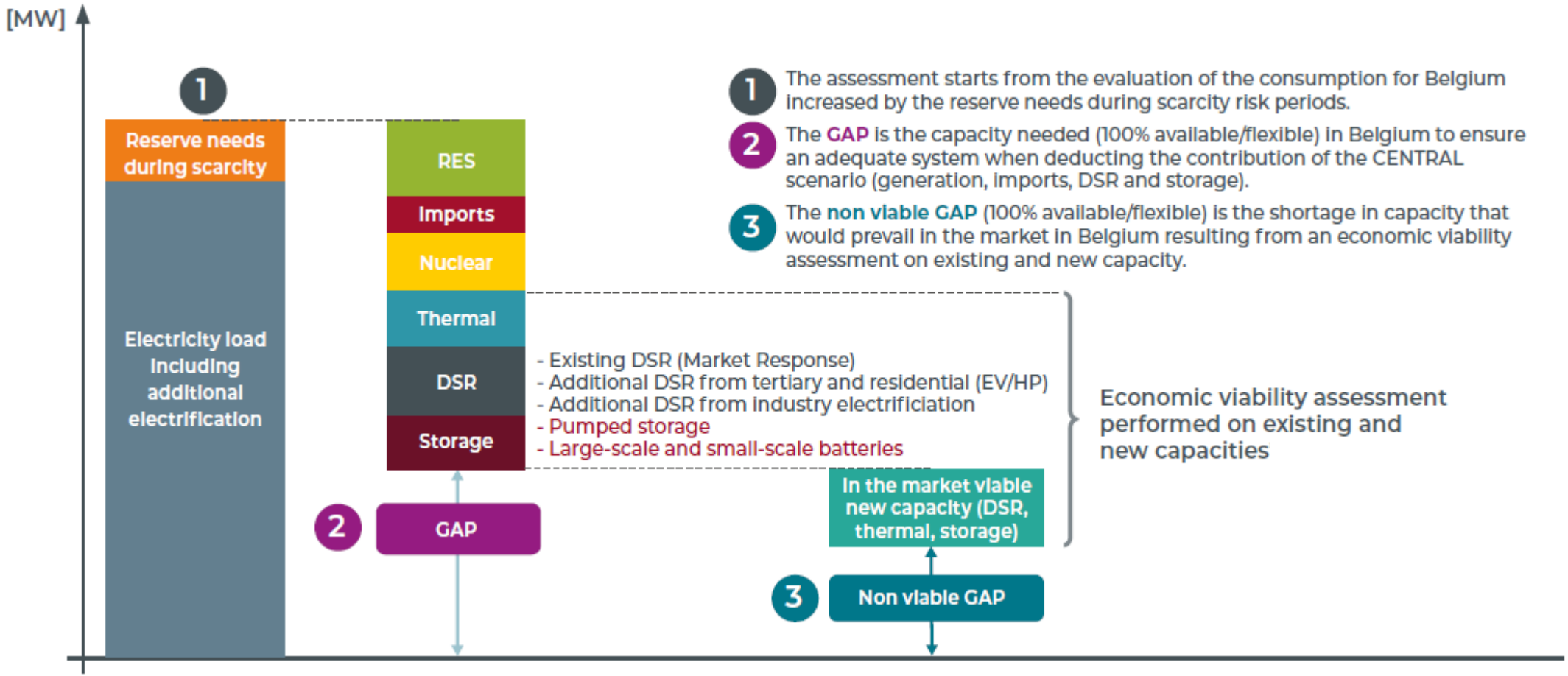


Capacity assumed at the end of the mentioned year.

An iterative process is performed to determine the needs or the margin for Belgium to meet the adequacy criteria



The adequacy assessment aims to determine the GAP while the EVA aims to calculate the non viable GAP



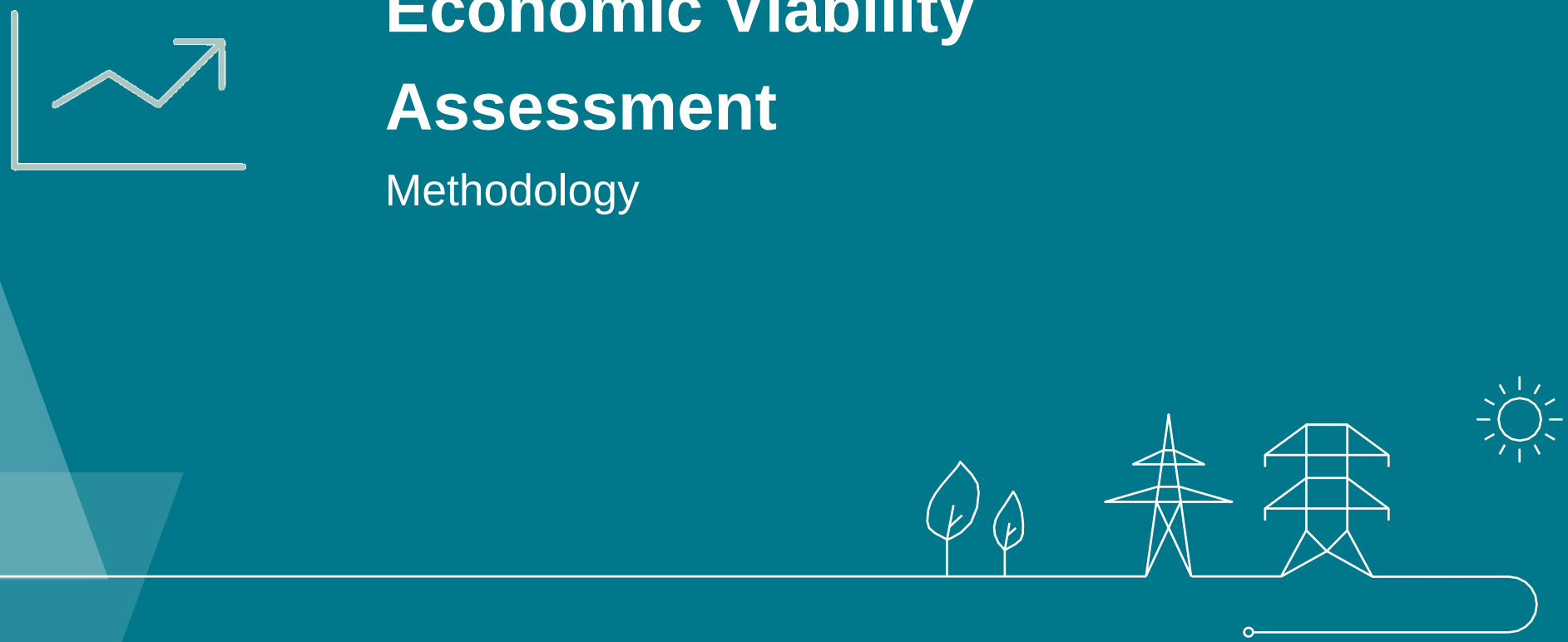
GAP = additional capacity 100% available needed

Overview of methodology related to adequacy documents available and submitted to public consultation

A. **Unit commitment & Economic dispatch -** Details the unit commitment model used for the adequacy and economic simulations
B. **Electricity consumption -** Details the way the electricity consumption is derived and the derivation of hourly profiles
C. **Thermal generation modelling -** Details the way thermal generation is modelled
D. **Electric vehicle modelling -** Details the way electric vehicle are modelled, including their flexibility
E. **Heat pump modelling -** Details the way heat pumps are modelled, including their flexibility
F. **Battery modelling -** Details the way large-scale and residential are modelled, including their flexibility
G. **Adequacy study -** Details the way that the adequacy simulations and Monte-Carlo approach are performed
H. **Reliability standard –** Details the Loss of Load Expectation metric
I. **Adequacy patch -** Details the way that curtailment sharing is dealt with
J. **Climate years -** Details on the content of the climate database
L. **Cross-border capacities -** Details the way that interconnections and flow based are modelled

Economic Viability Assessment

Methodology



What is the Economic Viability Assessment (EVA)?

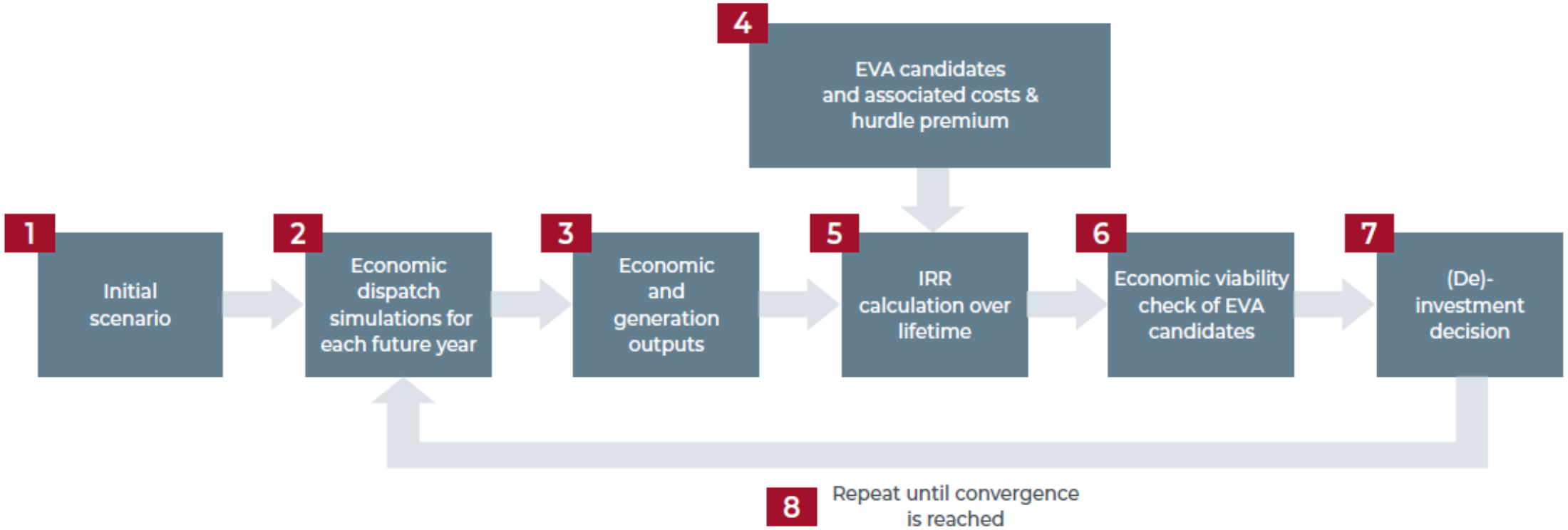
Will the Belgian reliability standard be met without 'market' intervention (i.e. no CRM)?

The EVA is a **complex** but **crucial** analysis which allows us to answer this question. Elia's EVA in particular:

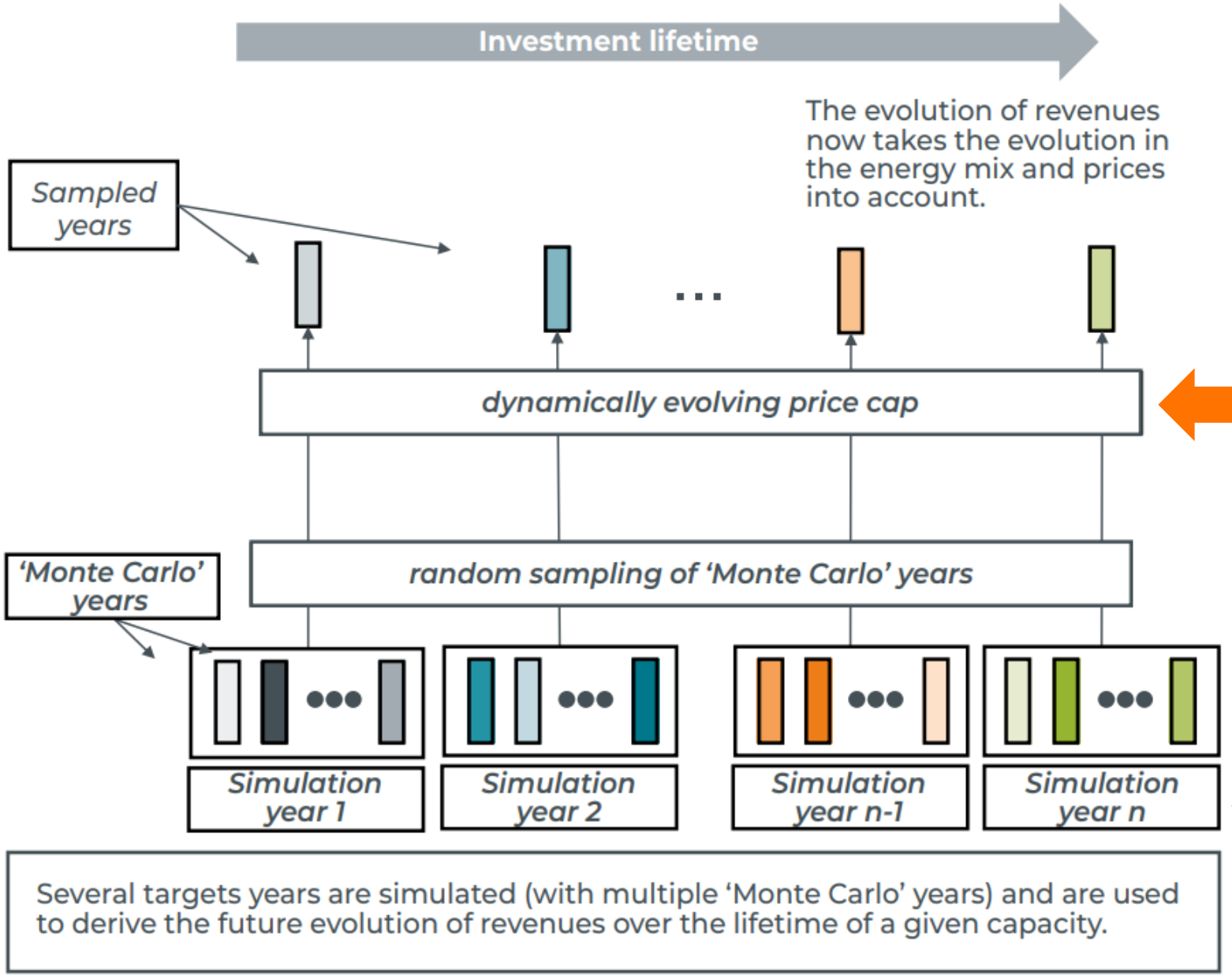
- was co-developed in **close collaboration with academia** (prof. K. Boudt);
- takes into account the latest (10/01/2023) **ACER decisions on price cap increases**;
- considers **recent market evolutions** following an **update of the parameters** by prof. Boudt;
- is **fully multi-year**, making it a **front-runner in EVA's** for adequacy and economic studies;
- …

Following an iterative approach an EVA equilibrium is found.

EVA process



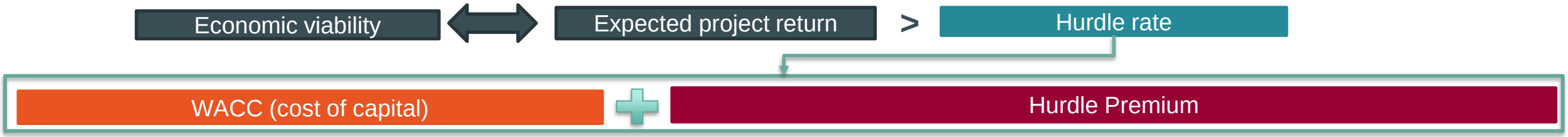
The EVA methodology is fully multi-year and takes into account price cap increases



Price cap evolves according to SDAC (HMMCP)

Energy mix and price evolution taken into account

Recap of the methodology which is not changed, only the level of the hurdle premium is updated in the new study



- ✓ Based on the classic **Capital Asset Pricing Model (CAPM).**
- ✓ The ACER-approved **ERAA methodology** provides for **(non-binding) guidelines** to calculate the WACC.
- ✓ A **reference WACC** is calculated taking into account publicly available data from energy market players in Europe.

➔ Based on the **(non-binding) guidelines of the ACER-approved methodology**, Prof. K. Boudt will propose real **WACC (value will be updated based on most recent market data in 2Q2025).**

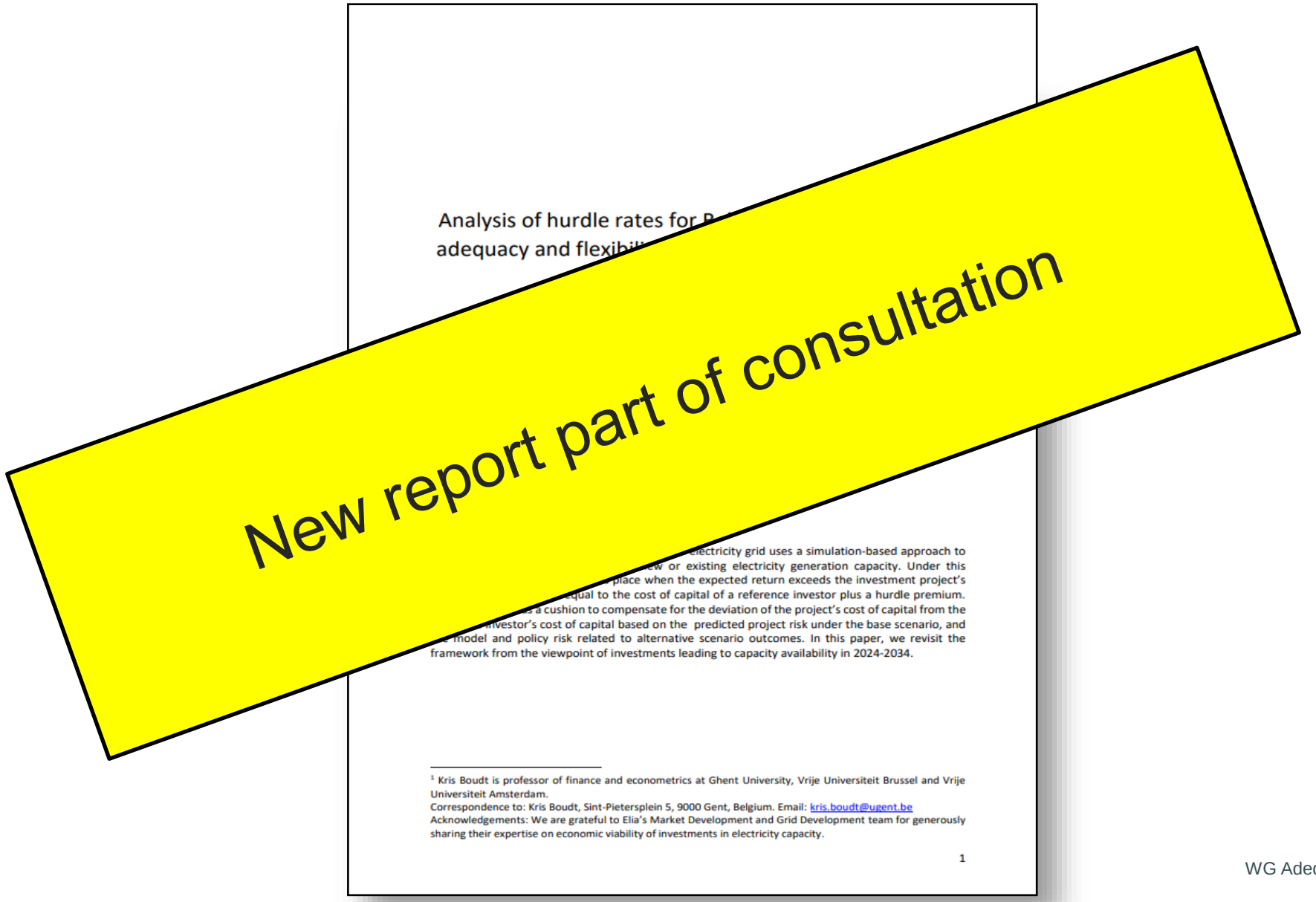
The **hurdle premium accounts for the following risks** :

	Revenue distribution & downside risk	Model risk & policy risk
Technology 1	Low/medium/high	Low/medium/high
Technology 2	Low/medium/high	Low/medium/high

- ✓ Risk differentiation per technology based on a **qualitative assessment.**
- ✓ The higher the identified risk, the higher the applied risk premium.

A correction for gearing level, capex intensity & hedging opportunities per technology will be made as well.

New report with updated hurdle premiums part of consultation



Net balancing revenues to be considered in the EVA revenues

Proposed approach

- For the yearly calibration of the CRM, Elia has to provide an estimation of **net balancing revenues** earned both for netCONE & IPC purposes :
    - To perform this estimation, Elia follows a methodology established in the Royal Decree Volume (respectively article 10 & 19 for netCONE/IPC).
    - This method was also followed in AdeqFlex'23 study regarding the period 2022-2032 (cf. section 3.6.8.1)
- The idea would be to follow the same approach for this AdeqFlex'25 study, with some modifications :
- **For capacity providing FCR, aFRR and mFRR**, Elia believes that the current market circumstances merit a re-evaluation of the approach considered and proposes to consider the following principles when going from balancing revenues to **net** balancing revenues :
    - take into account the foreseen trend regarding the volume of capacity and the mix of technologies able to provide such services and the potential evolutions of the prices of these products;
    - consider cost assumptions to deduce running, start-ups and operational costs for each technology;
    - deduce from direct costs and market prices opportunity costs, for each technology in activation and reservation;
- The Royal Decree foresees to **only** consider **reservation costs** and no activation costs from ancillary services --> Elia proposes to follow the foreseen methodology.

Overview of documents available and submitted to public consultation linked to the EVA

K. Appendix on Economic Viability Assessment

- Details the methodology to perform the economic viability assessment of technologies

Study by Prof. Boudt: 'Analysis of hurdle rates for Belgian electricity capacity adequacy and flexibility analysis over the period 2026-2036'

- Details the methodology and the calculations of the WACC and hurdle premiums for each technology

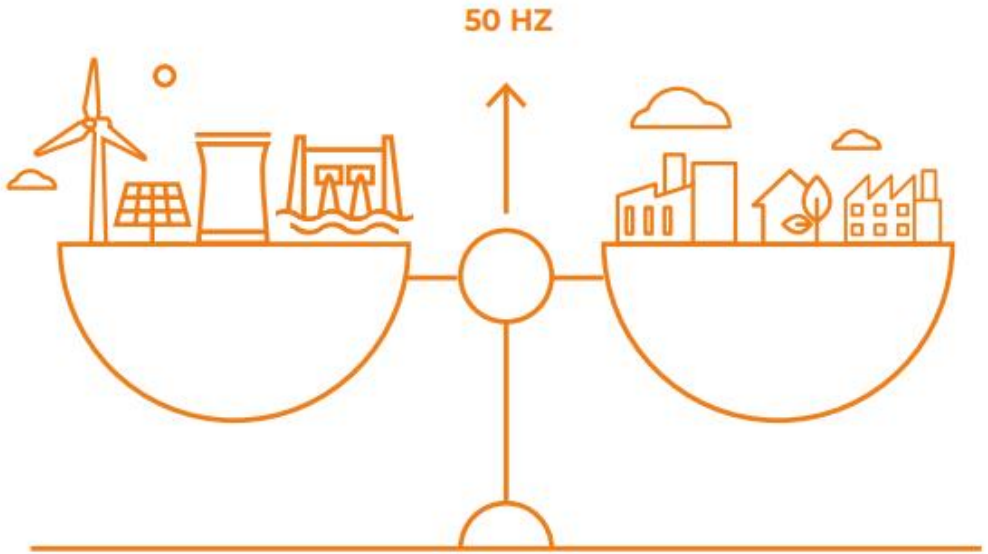
Flexibility study

Methodology

Scope of Elia's flexibility study

"The extent to which a power system can modify electricity production or consumption in response to variability, expected or otherwise" - International Energy Agency

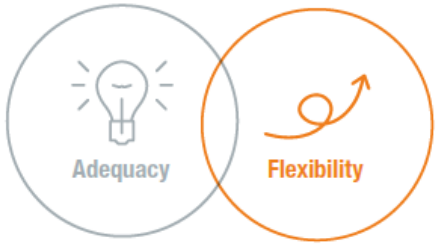
FLEXIBILITY DRIVERS
- Variability of the demand
- Variability of generation
- Forced outages



FLEXIBILITY SOURCES
- Generation units
- Demand-side assets
- Electricity storage
- Interconnectors

Adequacy study

The adequacy study investigates the required generation capacity to cover peak demand periods.

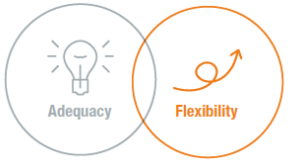


Flexibility Study

The flexibility study investigates the required technical characteristics to deal with demand and supply variations.

Objectives of the flexibility study

Adequacy & Flexibility
2020 - 2030



New legal requirement in the federal electricity law to publish a bi-annual adequacy and flexibility study for Belgium. Elia developed a new methodology to assess the future flexibility needs of the system

- **NEW SCOPE :** enlarge scope from Elia's balancing capacity needs to the system's total flexibility needs
- **NEW OBJECTIVE** : anticipate on balancing challenges following the renewable energy transition
- **NEW METHODOLOGY :** based on a probabilistic analysis of flexibility needs and available flexibility means

- The new methodology was discussed with NRA, Federal Public Services and stakeholders.
- The data and assumptions were subject to public consultation.

Adequacy & Flexibility
2022 - 2032

Adequacy & Flexibility
2024 - 2034

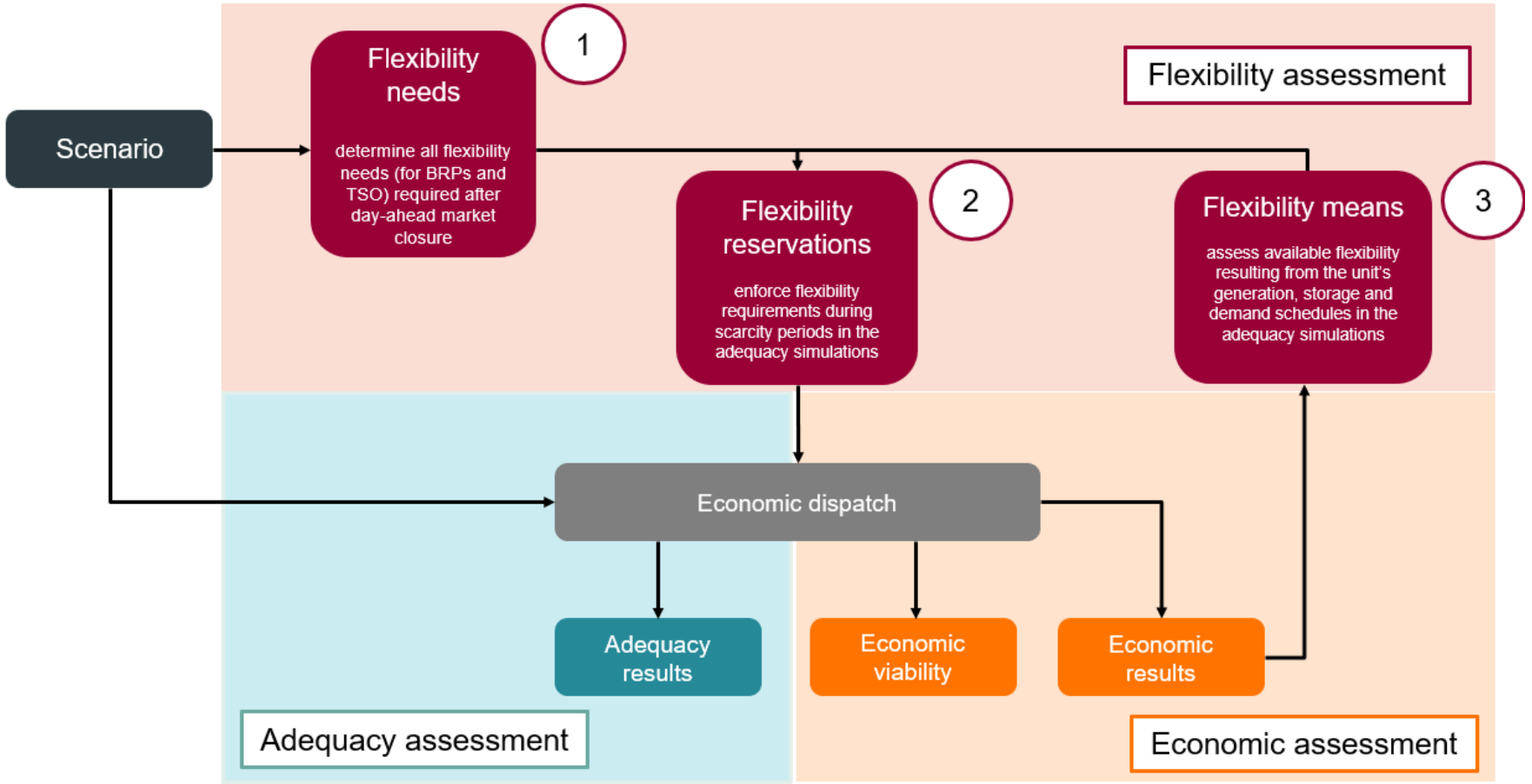
- Focus on evolution of the flexibility needs and flexibility shortages
- Latest version has put particular **attention to the value of unlocking new flexibility**

Adequacy & Flexibility
2026 - 2036

- Next study will focus on **the development of end-user flexibility** and particular energy transition challenges such as managing **balancing capacity needs, incompressibility and system integration of offshore wind power**

The flexibility study is integrated with the input data and method of the adequacy study

The flexibility study complements Elia's adequacy assessments. While the latter is based on economic dispatch simulations with a perfect forecast assumption and hourly resolution, the assessment of the flexibility needs focusses on fast and unexpected variations of generation and demand

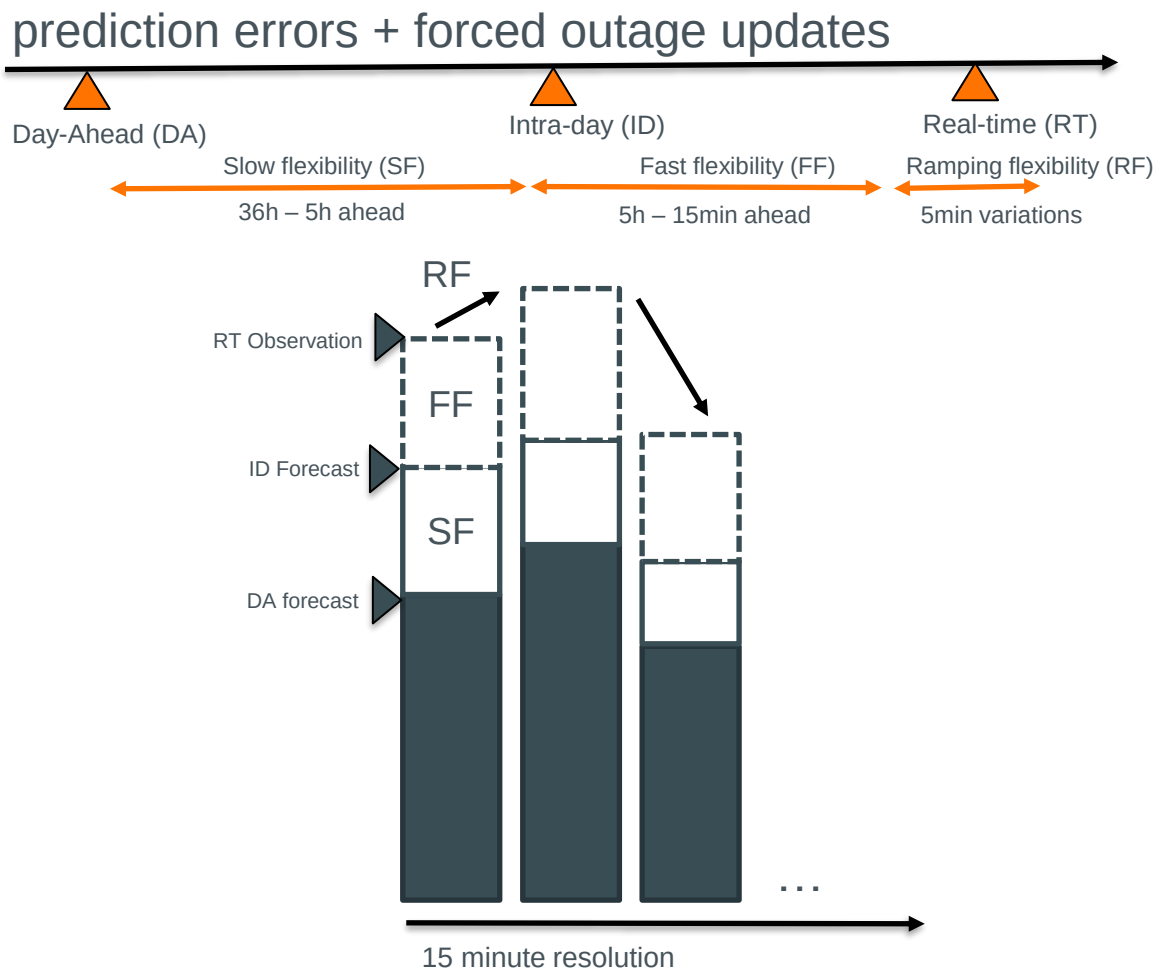


Short-term flexibility
Focus on the ability of the system to cover flexibility needs resulting from unexpected variations of demand and renewable generation (and asset outages) via intra-day and the balancing markets.

+

Covers the ability of the system to cope with expected hourly variations

The flexibility needs assessment is built around three metrics applied on historical time series of prediction errors of demand and generation, as well as forced outages of generation and transmission assets



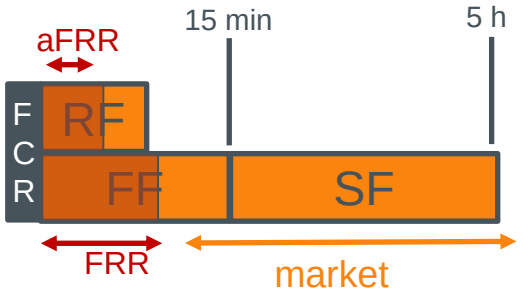
Type of Flexibility	SF Slow Flex	FF Fast Flex	RF Ramping Flex
Definition	Capacity which can be started or shut down until a few hours before real time	Capacity which can be regulated up- or downward close to real time	Capacity which can be regulated up- or downward in a timeframe of minutes
Objective	Deal with intra-day prediction updates of residual load and enduring forced outages	Deal with unexpected variations of residual load and forced outages	Deal with fast variations of residual load
Indicator	Future residual load forecast errors between day-ahead and intra-day	Future residual load forecast errors between intra-day and real-time	Variations residual load forecast errors between intra-day and real-time

The flexibility needs during scarcity risk periods are included in the adequacy simulations to ensure that the system has the capacity installed to deal unexpected variations, also during scarcity risk periods

- In line with the ERAA methodology, Elia reserves the system's reserve capacity needs on generation, storage and demand assets.
- FCR is calculated by ENTSO-E on a yearly basis and allocated towards LFC blocks trough share in total load and generation in Continental Europe..
- FRR / aFRR / mFRR are calculated on a daily basis on the dimensioning incident (approx. 1030 MW) and forecasted LFC block imbalance risks

- FCR are based on extrapolation of demand and generation and is expected to slightly increase to around 95 – 97 MW with the implementation of a probabilistic method
- FRR projections 'reserved' in adequacy simulations are capped to the dimensioning incident value (i.e. 1030 MW, Tihange 3) because prediction errors which may result in balancing shortages are observed to be lower during periods related to scarcity. This is explained as no or limited renewable generation is expected.

Link between flexibility and balancing reserves



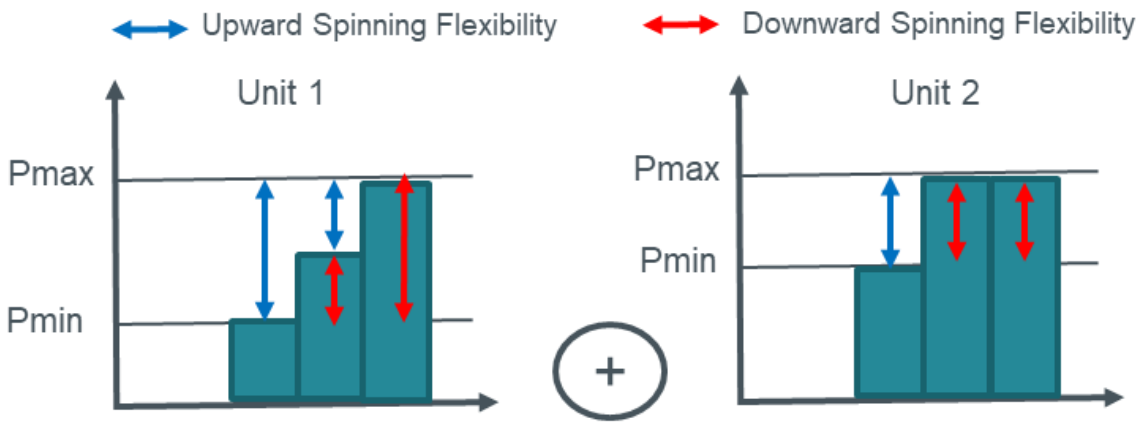
Part of the flexibility cannot be covered by the market and results in residual imbalances to be covered by FRR (aFRR/mFRR)*

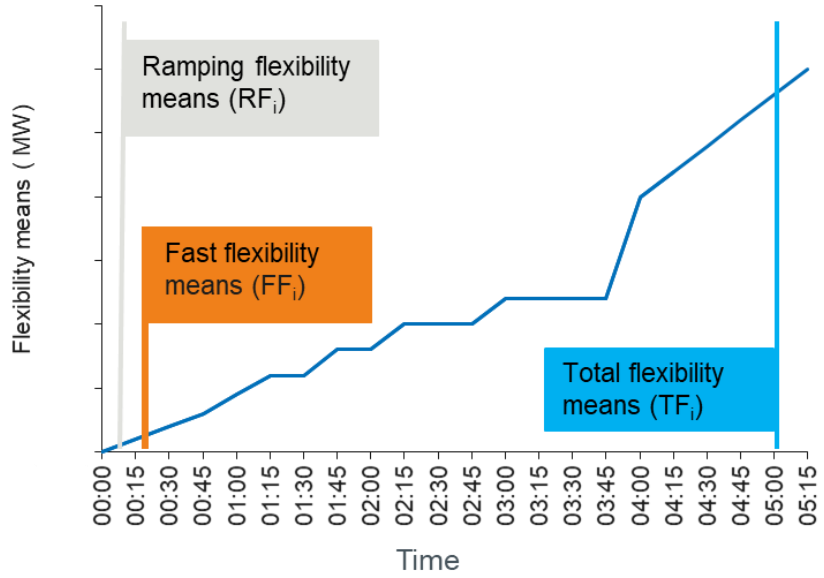
FCR is a separate flexibility type, driven by foreign CE N-1 conditions

The flexibility means are determined based on hourly simulated schedules of individual and aggregated generation, storage and demand response units

- **ANTARES** provides the schedule of all power plants (and other capacity) given a certain residual demand :
  - For every hour for an entire year (for different Monte Carlo years)
  - Including demand response, batteries and pumped storage (energy limits)
  - Complemented with available cross-border flexibility

- **This allows to determine total available flexibility for each hour and Monte Carlo simulation :**
  - How much capacity can be ramped in 5 minutes (RFi)?
  - How much capacity can be available in 15 minutes (FFi)?
  - How much capacity can be available in 5 hours (TFi)?
- **These time series of available flexibility are analyzed by means of statistical indicators (average, distributions, percentiles).**





Public consultation on the methodology

Methodology

- At this point, Elia has no information which should justify new modifications to the methodology. It welcomes any remarks based on the methodology.
  - ➢ No particular feedback was received on AdeqFlex'23 method or assumptions by stakeholders
  - ➢ Outcome of EMDR flexibility assessment methodology will come too late in time to be adopted in AdeqFlex'25 (approval of the ENTSO-E / EU-DSO proposals by ACER is not expected before Summer 2025)

Article 19(e) of the update of the Electricity Market Design Regulation published on June 26, 2024

Regulation - EU - 2024/1747-

Every two years, a report shall be adopted on the estimated flexibility needs for the next 5-10 years at national level. Key elements include of the reports include :

- Evaluate types of required flexibility on seasonal, daily, and hourly bases.
- Consider non-fossil flexibility resources like demand response and energy storage.
- Evaluate market barriers and propose mitigation measures.
- Evaluate the impact of digitalizing electricity networks.
- Account flexibility resources available in other Member States.

The need for flexibility at national level in the electricity system will be determined on the basis of the input of transmission system operators and distribution system operators and a common European methodology (drafted by ENTSO-E and DSO Entity) that is subject to public consultation and approval by ACER.

Flexibility study

Assumptions

Highlights public consultation on the assumptions

Assumptions

1. **Prediction data** used for determination of the flexibility needs will be updated based on the latest available data
2. **Forced outage characteristics** used in the determination of the flexibility needs will be updated based on the results of the forced outage study (cf. later in this presentation)
3. **Technology characteristics** used in the determination of the flexibility means include incremental improvements as well as modifications to the assumptions on end-user flexibility

- Elia made **assumptions on technical flexibility characteristics of generation, storage, demand-side and cross-border flexibility**. This was based on literature studies, Elia's expert view and information received from market players in the framework of the previous public consultations.
  - **For the study of 2023, the contribution of cross-border flexibility via the EU balancing exchange platforms is studied via sensitivities.** This approach will be followed for the upcoming study, but sensitivities might be finetuned following return on experience with PICASSO and MARI
  - **For the study of 2023, the contribution of wind and solar to downward flexibility is limited to large TSO connected units (+ 25 MW) and further studied via sensitivities.** This approach will be followed for the upcoming study.
- For the upcoming study, Elia **complemented and refined the assumptions on flexibility** from **residential users** (electric vehicles, heat pumps and home batteries) as well as **industrial users** (electric arc furnaces, electric boilers and ovens)

Assumptions on technologies providing short-term flexibility

Conventional Thermal CCGT, OCGT, small/large CHP, diesel and turbojets	↑ ↓	**Dispatch constraints** (according start-up time)
Large-scale storage pumped-hydro, large batteries	↑ ↓	**Energy reservoir** **Efficiency parameters**
Demand side response Existing processes (demand shedding)	↑	**Max activation duration**
Power-to-gas electrolysers	↑ ↓	**Energy limits (only for downward flexibility)**
Industrial flexibility Electric arc furnaces, E-boilers and electric ovens	↑ ↓	**Industry specific constraints** NEW

Nuclear power Doel & Tihange	↓	**Subject to technical constraints**
Interconnections	↑ ↓	**Mainly for the intra-day market** and later also via EU balancing energy platforms
RES based on generation profiles	↓	**Mainly 'Profiled'** (only large wind / solar power parks, biofuel)
EV, HP and HB Heat pumps (water and space heating), electric vehicles (smart charging and vehicle-to-grid) and home batteries	↑ ↓	**Comfort limitations** **Energy limits** Improved

↑ Upward flexibility considered in the calculations

↓ Downward flexibility considered in the calculations

↓ Downward flexibility not considered in the calculations (but additional potential is considered under exceptional conditions)

Capabilities of short–term flexibility for new industrial processes

New industry process technologies

- Electric arc furnaces
- P2H e-boilers
- Electric ovens
- P2H – heat pumps
- Data centers
- CCS
- Electrolysers

Assessment of short-term flex capabilities based on

- Load Survey'24
- Interviews
- Literature
- Expert view (consultants)

Short-term flexibility

Accounted in AdeqFlex'25 as up- and downward flexibility as slow flexibility (in intra-day markets).

Accounted in AdeqFlex'25 as up- and downward flexibility as ramping, fast and slow flex (in intra-day markets up to balancing markets).

Not accounted in AdeqFlex'25 unless additional information received during public consultation.

Modelling of AdeqFlex'23 as upward flexibility is confirmed.

ATTENTION POINT
New technologies, highly complex processes subject to high uncertainty

Methodology of short-term flexibility modelling of end-user flexibility
Changes compared to AdeqFlex'23

Electric vehicles (EV)

- EV's modelled for downward short-term flexibility (on top of upward flexibility)
    - When charging under Pmax anticipating lower prices later in time in day-ahead or intra-day
- Availability profiles updated based on observed EV charging profiles
- Participation in short-term flexibility (intra-day and balancing) is a subset of users participating in the market

Heat pumps (HP)

- HP's modelled for downward short-term flexibility
    - When heating under Pmax anticipating lower prices later in time in day-ahead or intra-day
- Participation in short-term flexibility (intra-day and balancing) is a subset of users participating in the market

Overview of methodology documents available and submitted to public consultation linked to the short-term flexibility assessment

Flexibility methodology

- Details the methodology to be used for the needs and means assessment

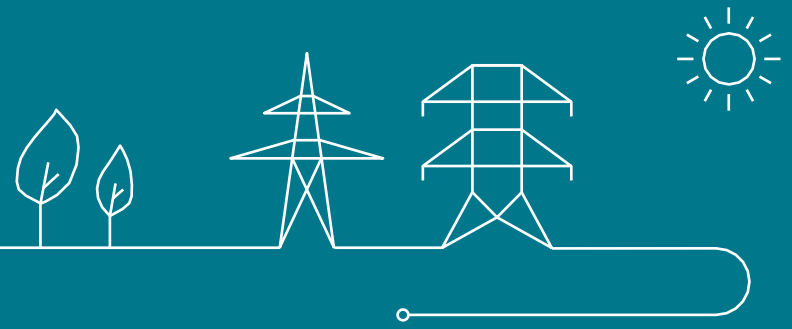
Flexibility assumptions

- Describes the assumptions regarding flexibility characteristics of the different technologies

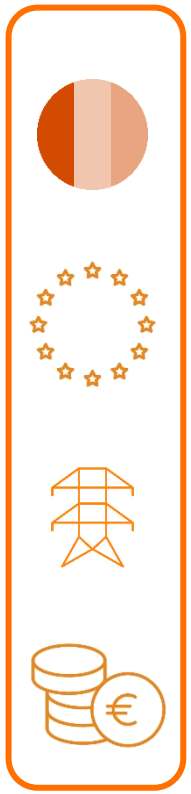
Excel workbook on the flexibility assumptions

- Details the assumptions regarding flexibility characteristics of the different technologies

Scenario



The CENTRAL scenario proposed for this study is aligned with the most recent figures and ambitions of Belgium and other countries

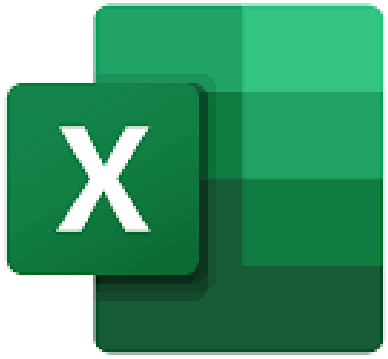


- aligned with the last published **draft updated Federal Energy and Climate Plan** for **Belgium or** with more **recent governmental announcements,** including feedback from DSO's and Regions**;**
- **data** for **other countries** are based on the **ERAA24** complemented with more recent information/ambitions and national studies;
- the approved **Federal Grid Development plan** for Belgian grid assumptions;
- the **Clean Energy Package** for the capacity calculation;
- the **TYNDP 2024** for countries outside Central Europe Region's **grid** assumptions;
- the **IEA** – World Energy Outlook 2024 for fuel and carbon prices complemented with **forward prices**;
- different **sources** for CAPEX and fixed costs of technologies;
- an **academic study** for defining the **economic viability metric**;
- **local flexibility profiles** considering regional tariffs evolution;

The scenario proposed follows the **current commitments of Belgium** and other countries. Elia is calling the stakeholders to react to the consultation with also suggestions for **sensitivities and alternative scenarios.**

Overview of scenario data submitted for public consultation

	2025-2036
Thermal	Large-scale thermal production Decentralised thermal production
RES	Solar PV Onshore & offshore wind
Load	Existing usage E-mobility & heat (EV, HP) New electrification in industry
Flexibility	DSR End-user (EV, HP, home batteries) DSR Industry
Storage	Pumped storage Large scale battery Residential batteries
Grid	Flow based domains & RAM Internal backbone and interconnections
Other	Fuel & CO2 prices Investment costs Outages
EU data	Load trajectories RES and thermal trajectories



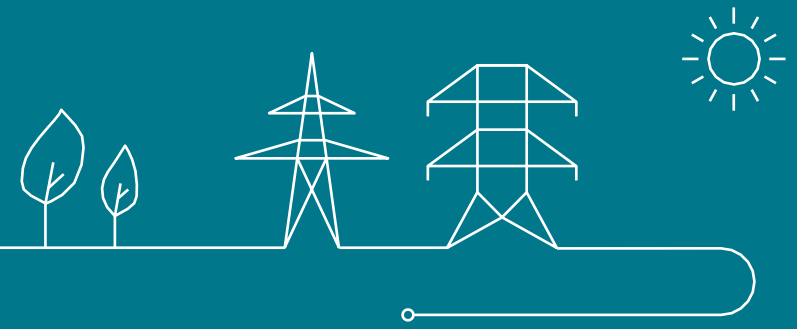
Excel tables with the data

Accompanying document describing the scenario

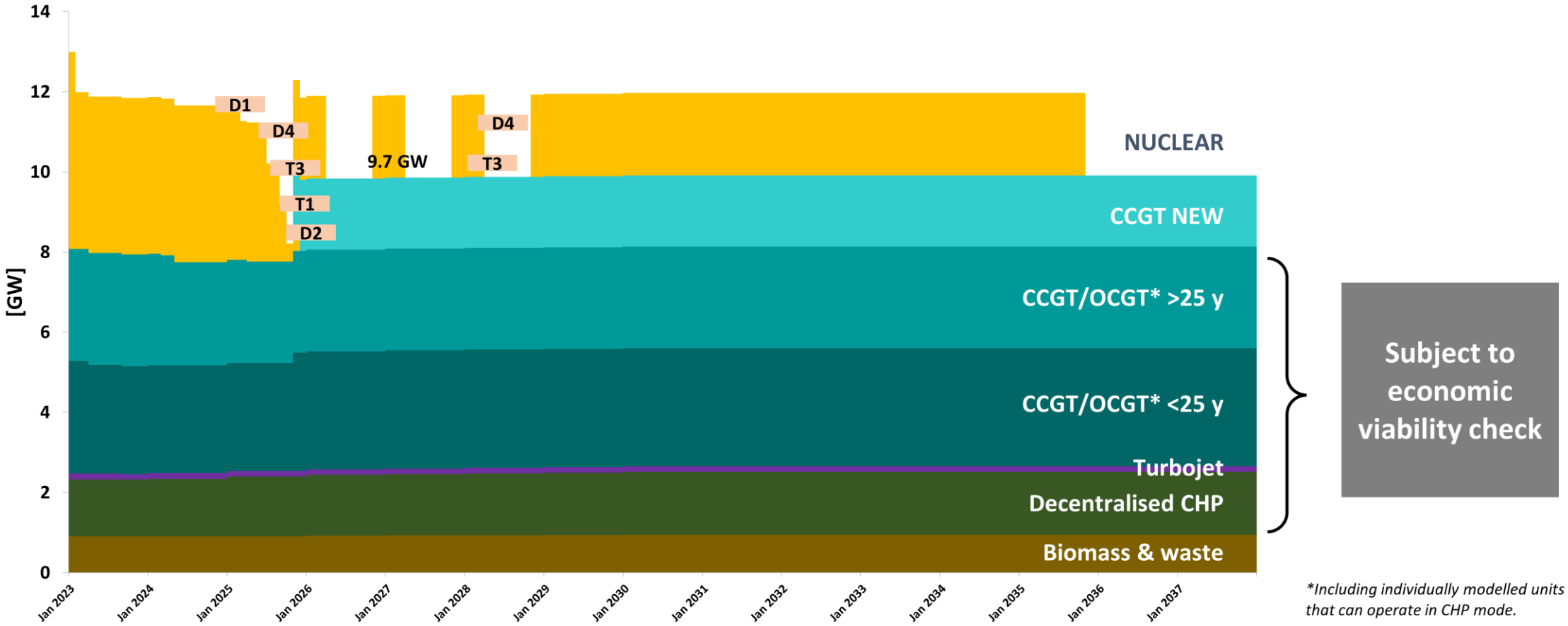
Belgian scenario

Supply & storage

Demand & flexibility



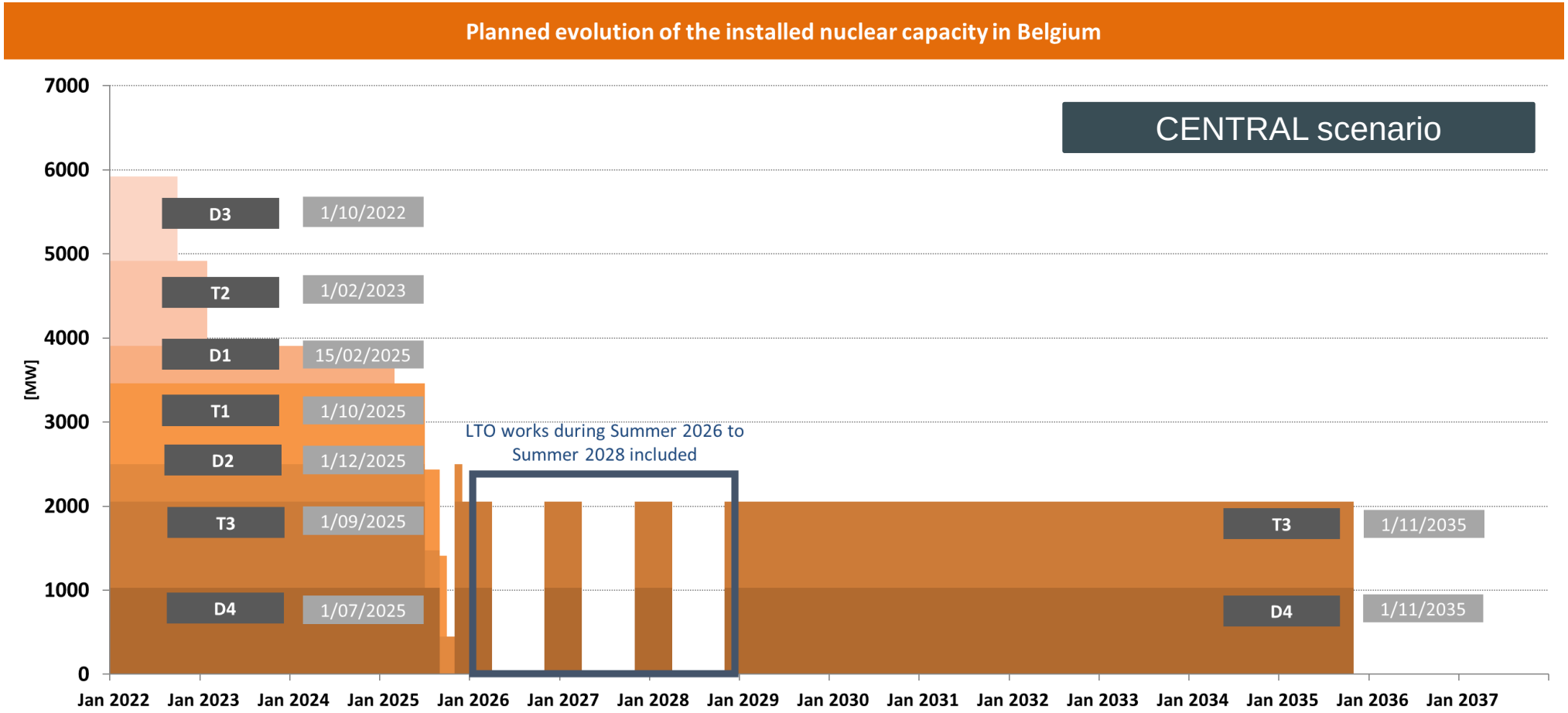
Proposal for thermal capacity based on official closures announced, capacities contracted in past CRM auctions and updated nuclear availability



- All existing units unless **official closures** announced (announced art. 4 bis)
- **2 new CCGTs + 1 GT extension** contracted in the CRM framework as from **winter 2025-26**
- Nuclear closure followed by nuclear extension of Doel 4 and Tihange 3 with partial availability during summer 2026 to 2028 included due to LTO works

Note that both 'individually modelled capacities' and smaller aggregated capacities are considered here.

Proposal for nuclear capacity in Belgium based on planned evolution



In the framework of past CRM scenario process, it has been agreed with FPS/CREG to update the FO rate of Belgian nuclear units from 20.5 to 10% (see Forced Outage slide)

Forced Outage rate

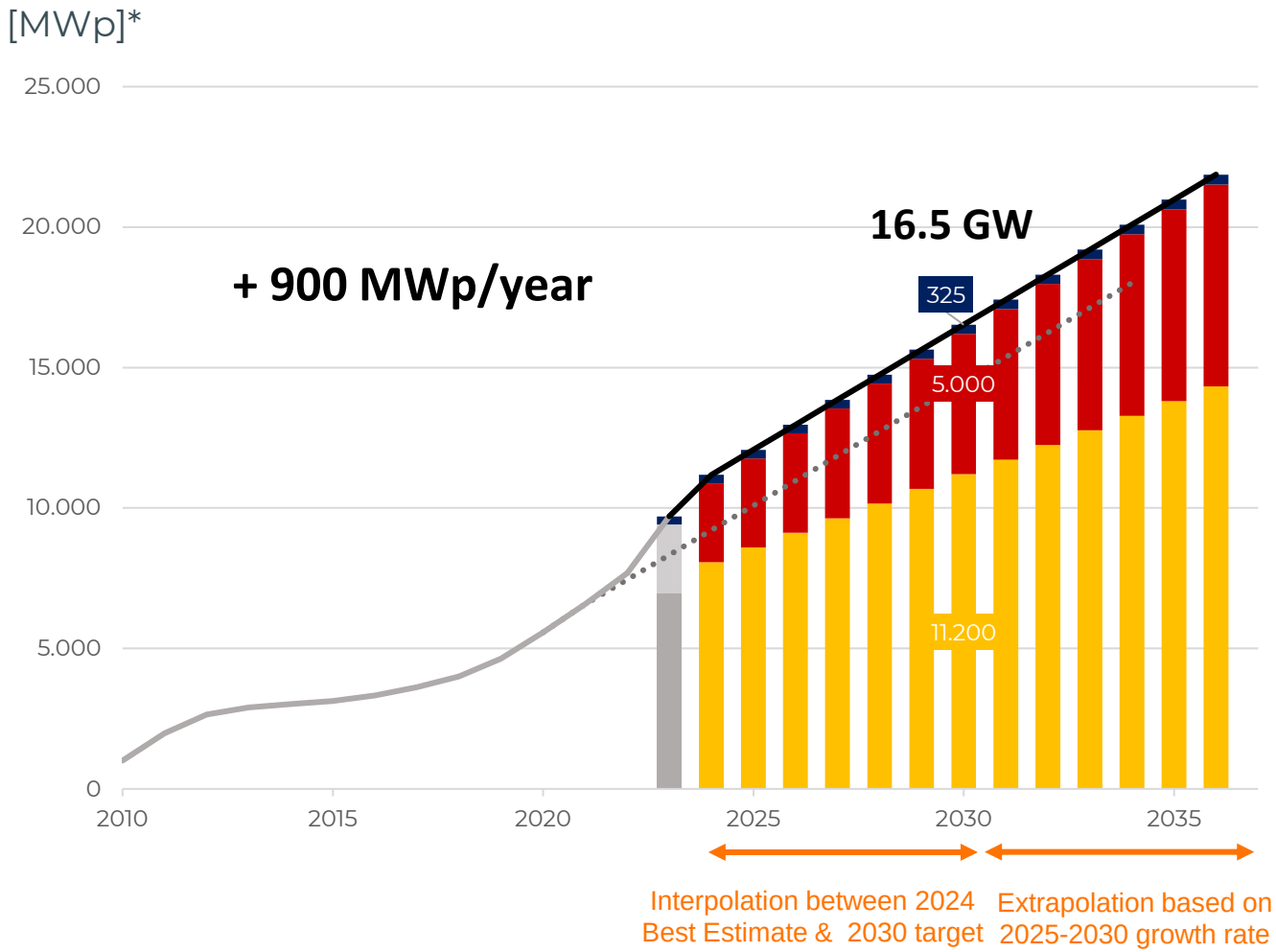
- The numbers for FO rate are updated based on the same methodology developed by N-SIDE for AdeqFlex'23.
- It was based on forced outage data from 2015 in Belgium and also in other countries in order to have a representative dataset (given the limited amount of assets for certain technologies Belgium).
- For AdeqFlex'25, the proposed FO rates are updated taking into account data from 2015 to 2023 included.

Category	Number of FO per year	Average FO rate [%]	Average duration of FO rate [hours]
Nuclear	1.2	10%*	576 hours [around 24 days]
CCGT	9.4	6.7%	117 hours [around 5 days]
OCGT	3.3	8.1%	217 hours [around 9 days]
TJ	4.3	10.1%	126 hours [around 5 days]
CHP, waste, biomass	3	6.2%	120 hours [around 5 days]
Pumped Storage	7	7.2%	177 hours [around 7 day]
DC links	1.8	6.1%	212 hours [around 9 days]

** Nuclear FO rate of 10% as agreed with stakeholders during the public consultation of the CRM scenarios 2024*

Proposal for solar PV in Belgium based on latest regional targets for 2030

- Aligned for 2030 with Brussels and Wallonia NECP 2030 target.
- Aligned with latest Flemish governmental agreement for Flanders 2030 target (10 GW-AC)**.



Brussels

NECP: 334 GWh (+/- 325 MW) in 2030

Wallonia

NECP: 5100 GWh (+/- 5000 MW) in 2030

AdeqFlex'23

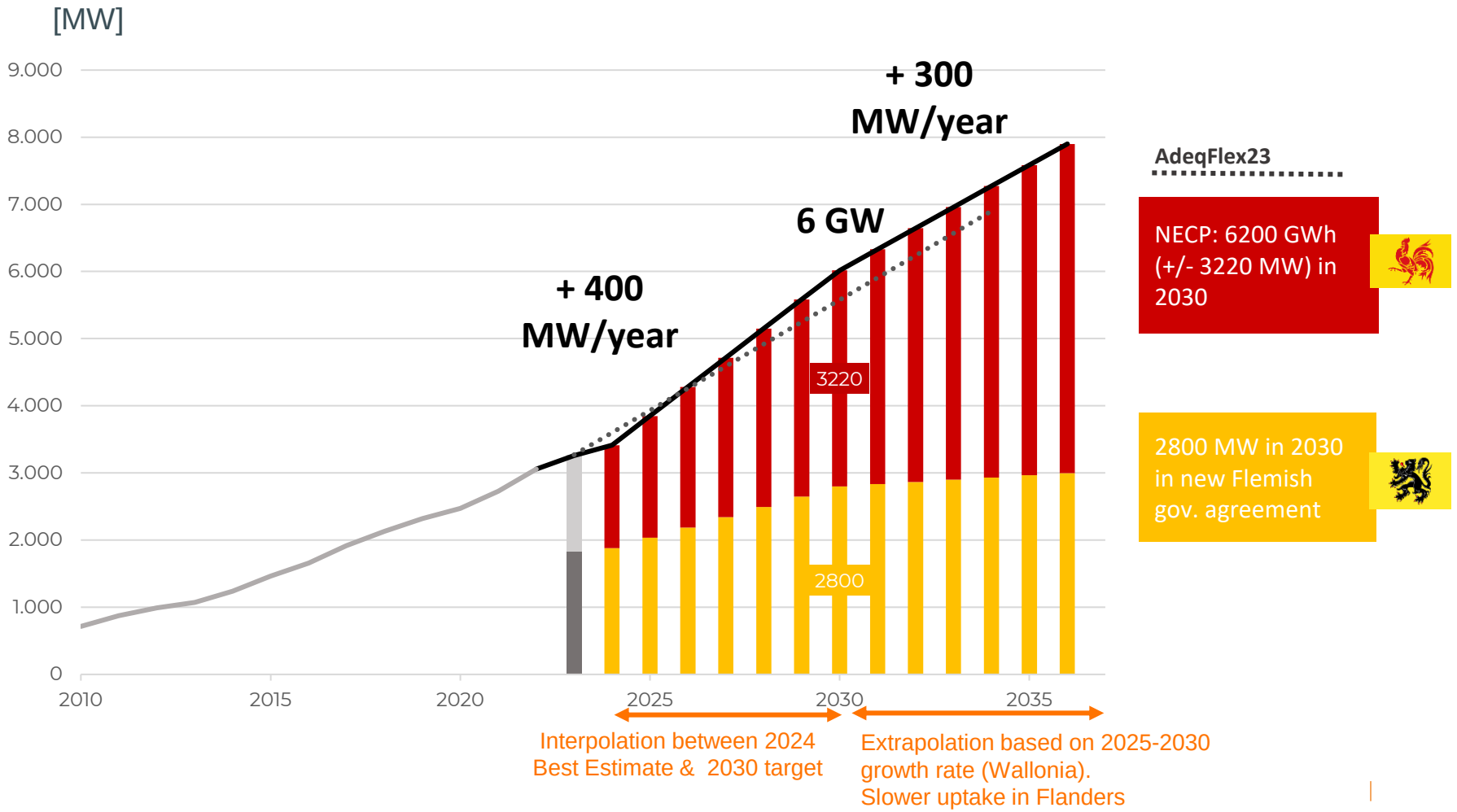
Flanders

Latest Flemish governmental agreement 10 GW (AC)

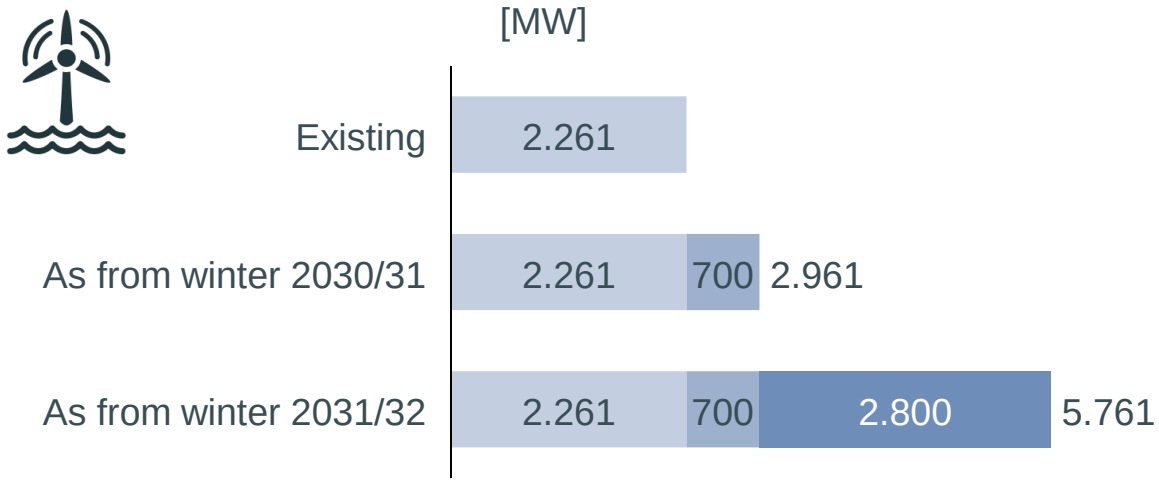
Best estimate for 2024 (extrapolation until end of year based on avail. Info)
**MWp = MW_peak = MW-DC (before the converter)*
***Flanders target assumed to be in [GW-AC]*

Proposal for onshore wind in Belgium based on latest regional targets for 2030

- Aligned with with NECP 2030 target for Wallonia (≈ 3.2 GW).
- Aligned with latest Flemish governmental agreement on the 2030 target for Flanders (2.8 GW).
- Slower uptake after 2030 in Flanders (limited additional capacity under current permitting conditions, according to exchanges with the Region).



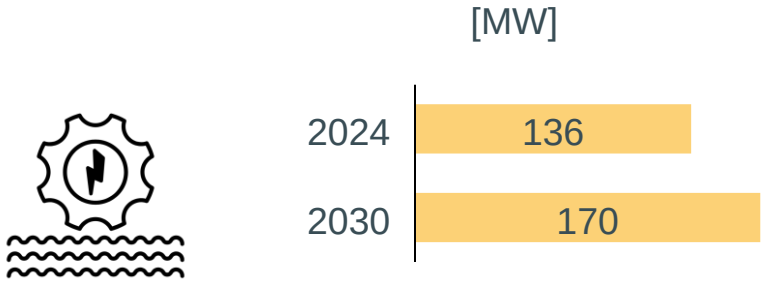
RES | **Offshore**



Proposal for offshore wind related to Princess Elisabeth Island

- Phase 1 **+700 MW** :
  - Realisation foreseen by end of 2029;
  - Assumed available for adequacy as from winter **2030/31.**
- Phase 2 **+ 2800 MW**
  - Realisation foreseen by end of 2030;
  - Assumed available for adequacy as from winter **2031/32.**

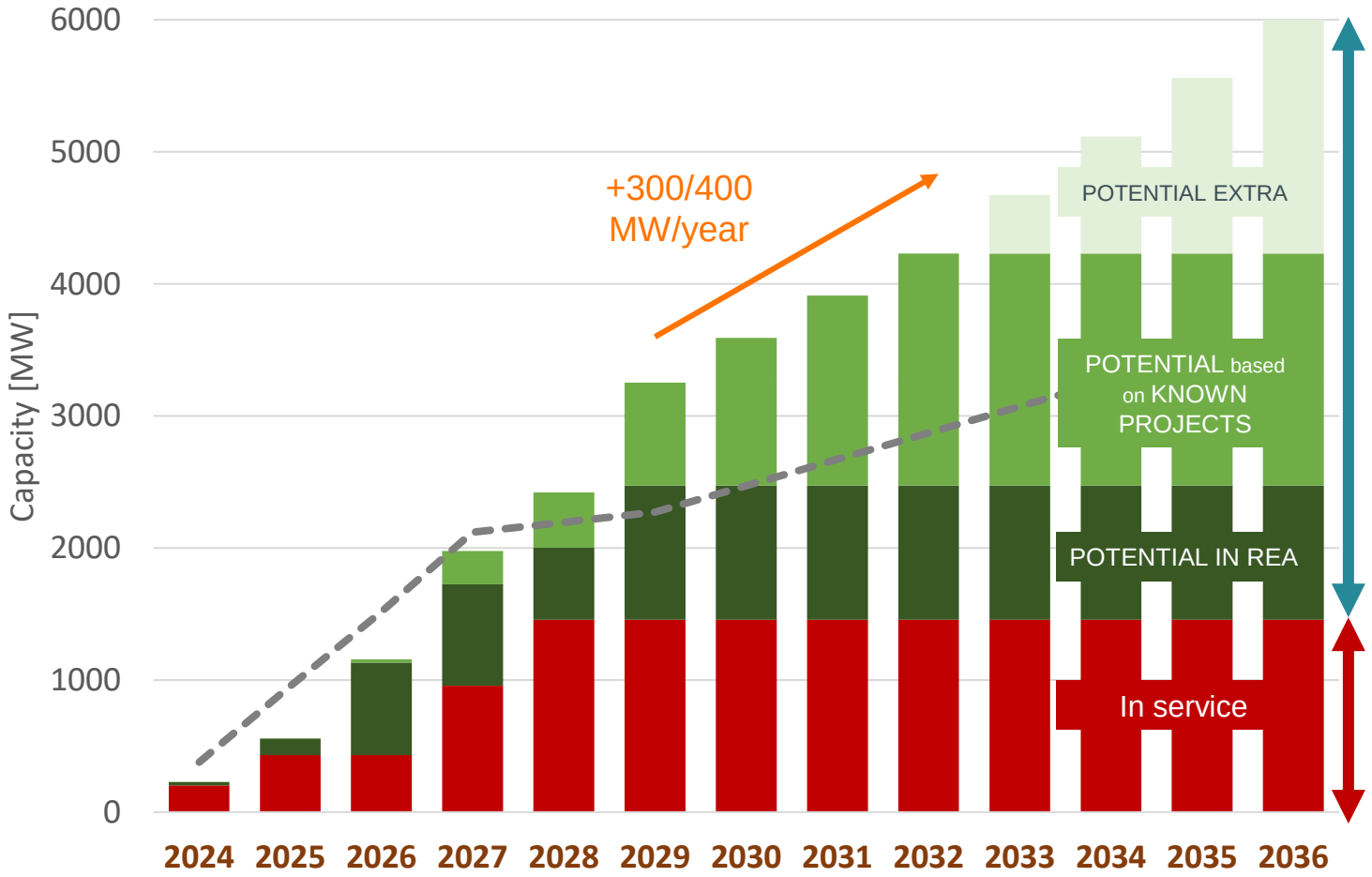
RES | **Hydro**



Proposal for hydropower (run of river)

- Estimated 2024 installed capacity (little recent evolution);
- Based on NECP, 170 MW assumed by 2030 (440 GWh for Wallonia).

Proposal to consider about 300 to 400 MW of additional large-scale batteries per year assumed as 'additional potential capacity' if economically viable within the study



Additional potential

33% of connection study projects
15% of feasibility study projects

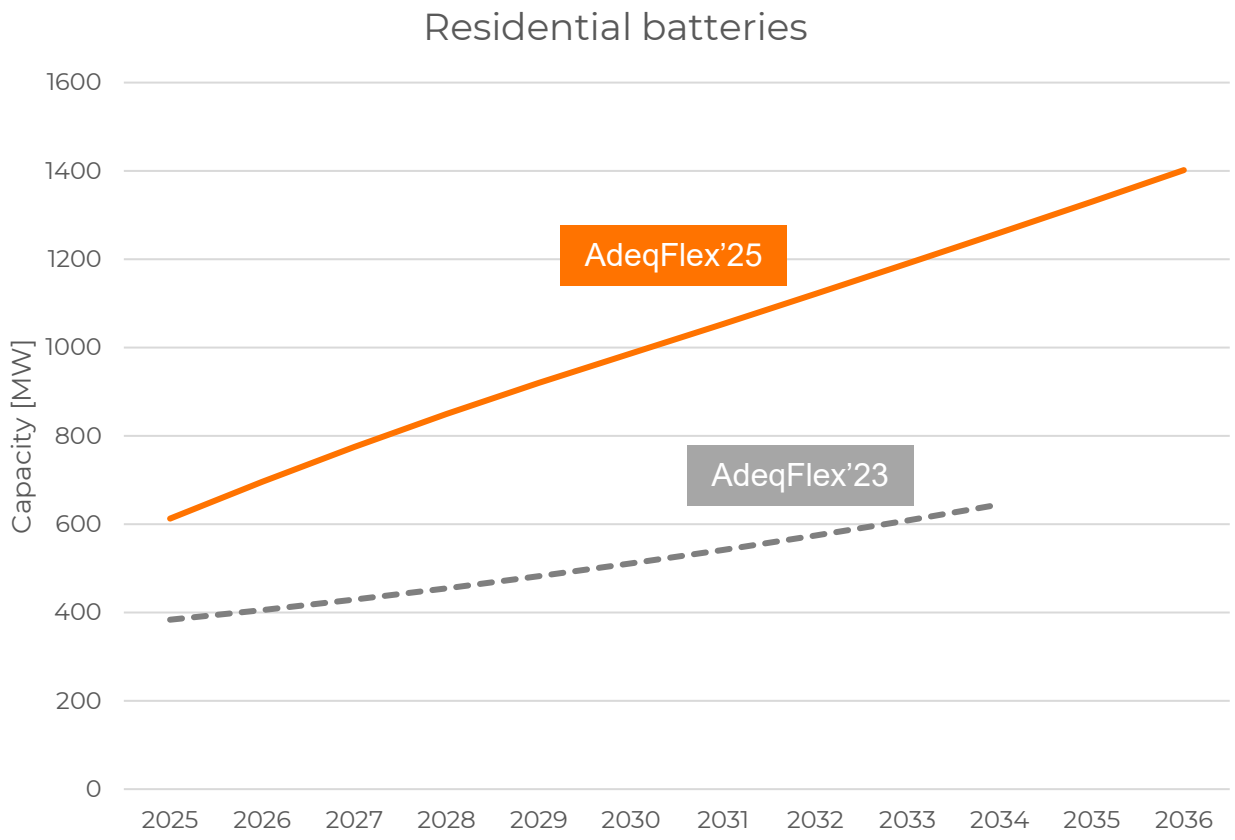
100% of project in realisation phase

In service
= existing + already contracted in a CRM auction volume.
.

% based on **expert view** of all projects.

Proposal for residential batteries based on latest regional information

- Flanders:
  - Alignment with VEKA/Fluvius
  - Historical data and best estimate for 2024
  - 200,000 units in 2030
- Wallonia/Brussels:
  - No quantitative information available
  - Proposal to assume a yearly additional capacity equivalent to 0.3% of the existing PV capacity in MW is installed.



Proposal for pumped storage based on Coo and Platte-Taille capacity

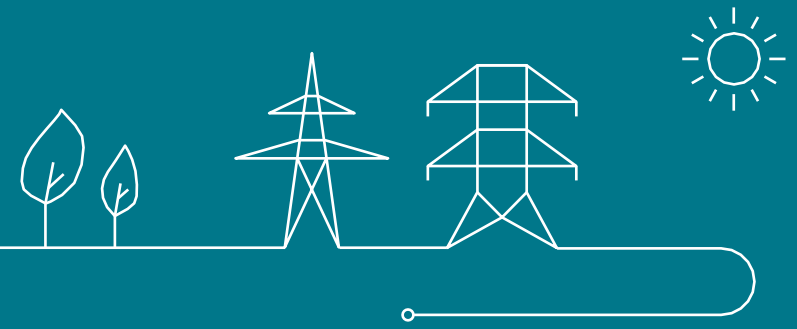
- All time horizons include Coo extension (reservoir + turbining capacity)
- No future projects known regarding pumped storage in Belgium

Unit	Capacity [MW]	Reservoir [MWh]
Coo	1161	5600
Platte-Taille	144	700
Storage reservoir derating (black-start services)		-500
TOTAL	**1305**	**5800**

Belgian scenario

Supply & storage

Demand & flexibility



AdeqFlex'25 electricity demand proposal is based on 5 building blocks

	Content	Update since AdeqFlex'23	**Expecting updates in Feb. 2025**
Existing usages	**Existing demand evolution** based on macro-economic projections, energy efficiency & price elasticity	Macro-eco projections Estimates for demand recovery (temp. results) Best estimate for 'realised 2024'	Updated estimates for demand recovery for resid. & tertiary (final results of PRICED study)
New building heat electrification New transport electrification	**New EV/HP trajectories** assuming new sales & old removals, based on past sales and ambitions/laws	HP sales EV sales and consumption parameters	
New large-scale loads (industry & data centers)	**Additional data centers** and **electrification of industry**	Data sent by TSO-connected clients ('Load Mngt')	Refined DSO-connected industry electrification (ongoing desktop studies with ORES, RESA and Fluvius).
Losses	Transport and distribution losses	Update based on total load	

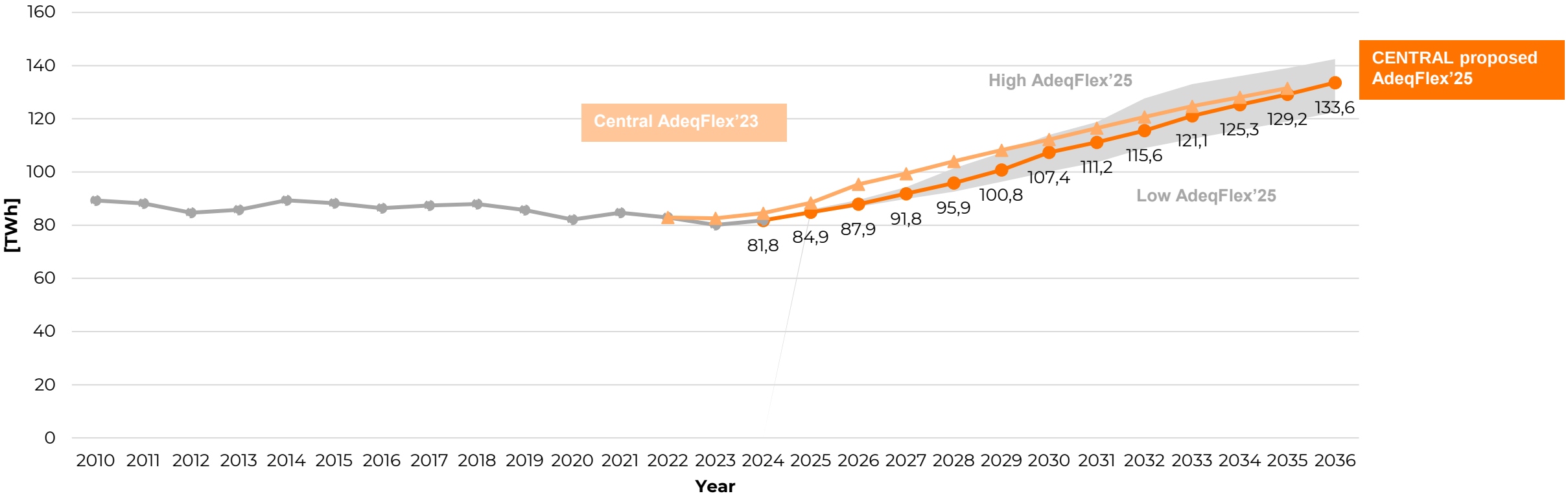
In general, **reality checks** on realised 2024 data (elec demand, EV/HP sales, etc.) will be performed with the available data in Jan. 2025.

Flexibility is associated to each component of the load

	Content	Associated flexibility	
Existing usages	**Existing demand evolution** based on macro-economic projections, energy efficiency & price elasticity	Market response (DSR from existing usage)	Existing DSR (or market response) in the system with potential new additional volumes
New building heat electrification New transport electrification	**New EV/HP trajectories** assuming new sales & old removals based on past sales and ambitions/laws	Smart heating Vehicle-to-X Smart charging	Flexibility from HPs while ensuring comfort of consumers Flexibility from EVs depending on the technology (capable or not of injection)
New large-scale loads (industry & data centers)	**Additional data centers** and **electrification of industry**	Power-to-heat, CCS, Power-to-H2, Data centres, DRI-EAF, Miscellaenous	Flexibility from the process Turned on when electricity prices below a certain thresholds
Losses	Transport and distribution losses		

More details are available in the related methodology appendices

AdeqFlex'25 load includes high & low trajectories based on updated Load Management – information from TSO connected customers



Note:

- *Updates planned for early 2025 based on (i) 2024 reality checks, (ii) PRICED study, and (iii) DSO industry - desktop studies*
- *The range is built on uncertainties on electrification of industry, other sensitivities could be included*

We can now zoom on existing usages and its associated flexibility

	Content	Associated flexibility	
Existing usages	**Existing demand evolution** based on macro-economic projections, energy efficiency & price elasticity	Market response (DSR from existing usage)	Existing DSR (or market response) in the system with potential new additional volumes
New building heat electrification			
New transport electrification			
New large-scale loads (industry & data centers)			
Losses			

We will now give a status on the PRICED study

Study Price-Linked Electricity Demand Evolutions (PRICED)

Why?

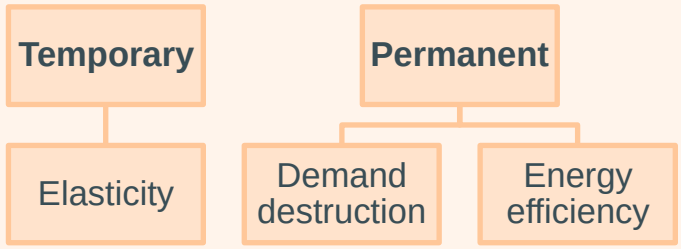
To review demand projections considering recent **energy crisis** and **high prices**

How?

Distinguish demand reduction per segment by

- capturing electricity demand evolution of the last 5 years (for each sector and end-use).
- computing elasticity of electricity demand.
- analysing appliances sales data for energy efficiency.

Demand reduction segments:



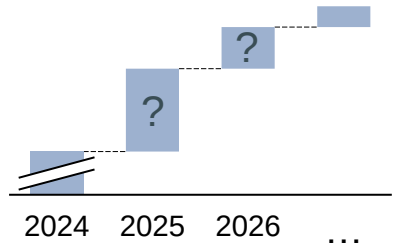
What?

- Energy efficiency quantification
- Definition of permanent demand destruction
- Electricity elasticity model

First estimated demand recovery*

Final estimated demand recovery

Model



Delivery of the study expected in early 2025

**E-CUBE carried out the first part of this project and delivered in Jul24. The results were used in CRM24 and in the load projection presented in this public consultation*

Final results of PRICED study are expected in early 2025

WG Adequacy 07/'24

- Energy efficiency quantification
- Definition of permanent demand destruction

WG Adequacy 11/'24

Electricity elasticity model – draft

First estimates show a demand recovery within the range estimated by E-CUBE, based on data up to 2022 included.

Public consultation report Early '25

Electricity elasticity model - final

Model update with 2023 data. Final demand recovery estimates, considering energy crisis impact & lag effects.

PRICED study estimates the consumption recovery in the coming years

For the residential and tertiary sector

Input → Model → Output

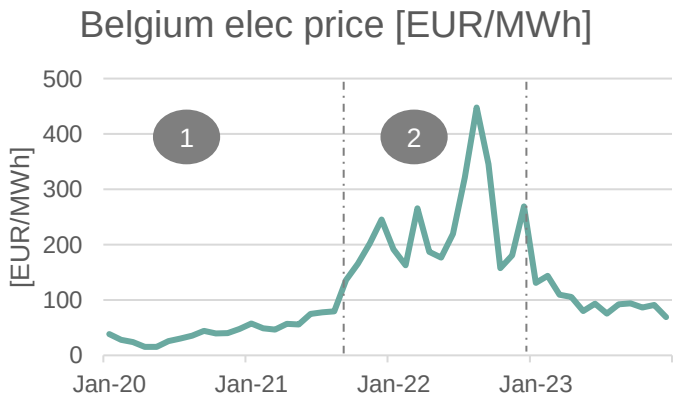
Elec prices
Energy prices, green quota, cogeneration fee based on contract from service providers
SOURCE: CREG

Elec consumption
Electricity flow at DSO level, including number of active EAN
SOURCE: Synergrid

Other
Relevant parameters that influence electricity consumption
(temperature, sun hours, humidity, self-consumption)

Multivariate regression analysis

Considering different period based on price level. Elasticity is different according to price.



Elasticity

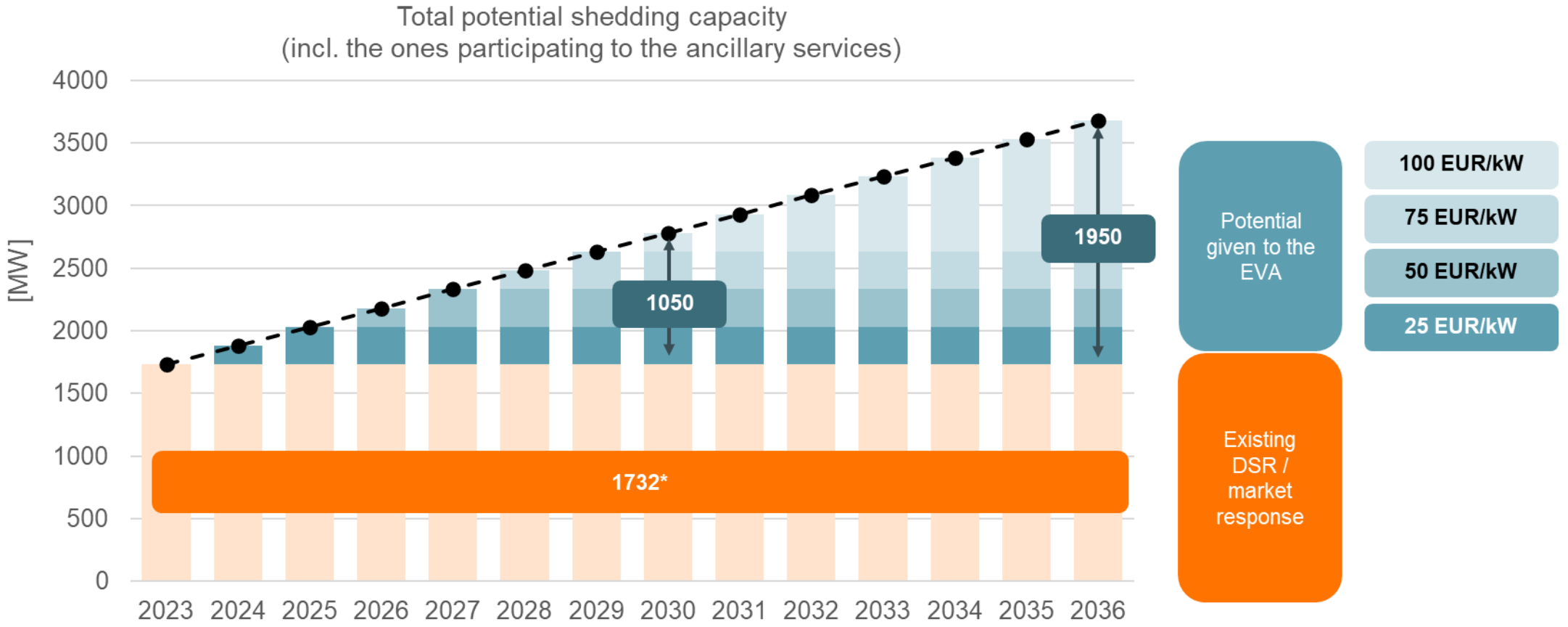
$$\varepsilon = \frac{\Delta\, load}{\Delta\, price}$$

Load recovery [TWh]
Projection for residential and tertiary sector, based on forward elec prices.

All data have a monthly granularity, and will look at residential and tertiary electricity consumption

Data span the period 2014-2022. 2023 data are expected to be available in the coming months.

Proposal for Demand Side Response from existing process (not linked to new electrification) starts from N-SIDE study and the proposed potential follows methodology from AdeqFlex'23



*1732 MW includes estimation from N-Side (1569 MW) – TJ volume (140 MW) + provision of balancing (303MW)
N-SIDE results was presented in WG adequacy on the 27th of August.

We can now zoom on electrification of building heat and transport

	Content	Associated flexibility	
Existing usages			
New building heat electrification	**New EV/HP trajectories** assuming new sales & old removals based on past sales and ambitions/laws	Smart heating	Flexibility from HPs while ensuring comfort of consumers
New transport electrification		Vehicle-to-X Smart charging	Flexibility from EVs depending on the technology (capable or not of injection)
New large-scale loads (industry & data centers)			
Losses			

Slides on end-user flexibility (EV, HP, residential batteries) will be presented after the total load.

HP consumption proposed parameters – reviewed by UGhent

- Consumption parameters were also aligned with Fluvius over the summer
- UGent reviewed the HP assumptions. Their review will be published with public consultation documents

	Unit	Residential	Tertiary
Thermal space Heating demand - new build	kWh/y	4400	17000
Thermal space Heating demand - renovated building	kWh/y	8000	25500
Heat supplied by secondary heater	%	20%	
Thermal hot water demand	kWh/y	1800	3600

EV consumption proposed parameters - Updated

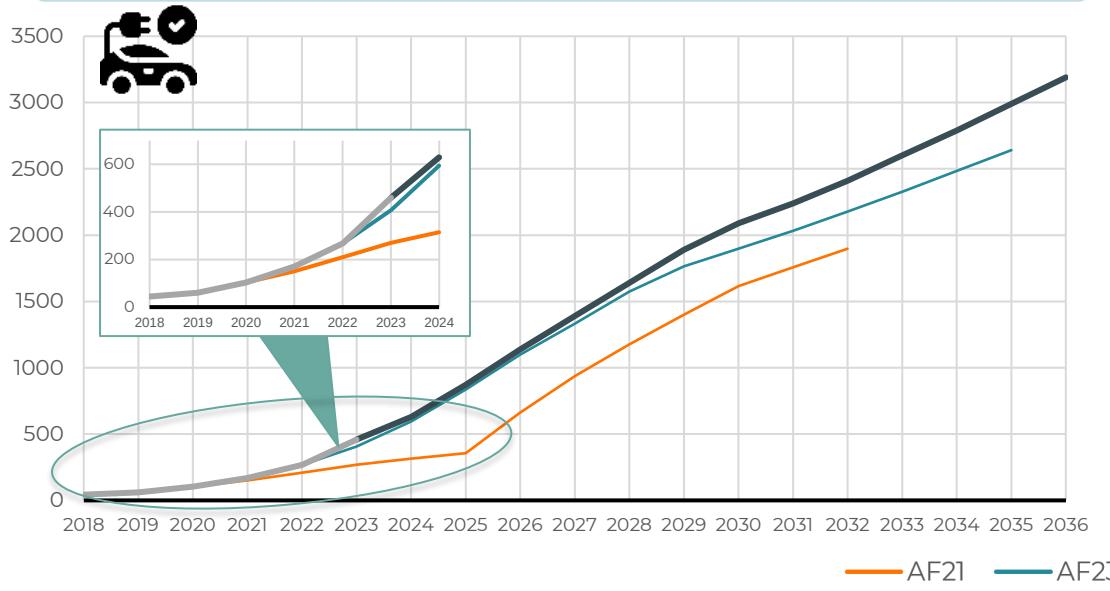
- Updated through literature review and exchanges with Fluvius (aligned on most parameters).

	Unit	Passenger cars	Vans	Trucks	Buses
Usage - company	km/year	22750	16 800	58 700	80 000
Usage - private	km/year	12350			28 000
Consumption - BEV	kWh/100km	19	30	120	125
Consumption - PHEV company	kWh/100km	3	15	na	68
Consumption - PHEV private	kWh/100km	9.5			

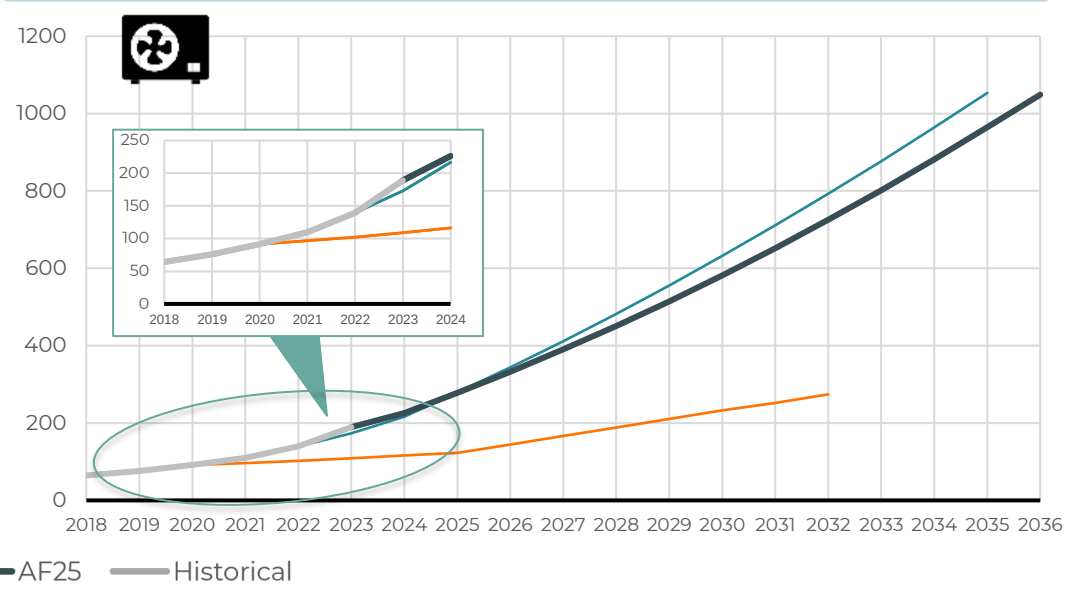
*flexsys-project.be – A flexible system contributing to security of energy supply

The uptake of electric vehicles & heat pumps is happening and has been somewhat underestimated in previous studies

Historical & projected BEV+PHEV stock [Thousands]



Historical & projected Hydronic HP stock [Thousands]



AF21 AF23 AF25 Historical

For HP the historical values were corrected with most recent data (ClimaFed)
AF 21 & AF 23 are presented with their relative increase from this updated historical starting point

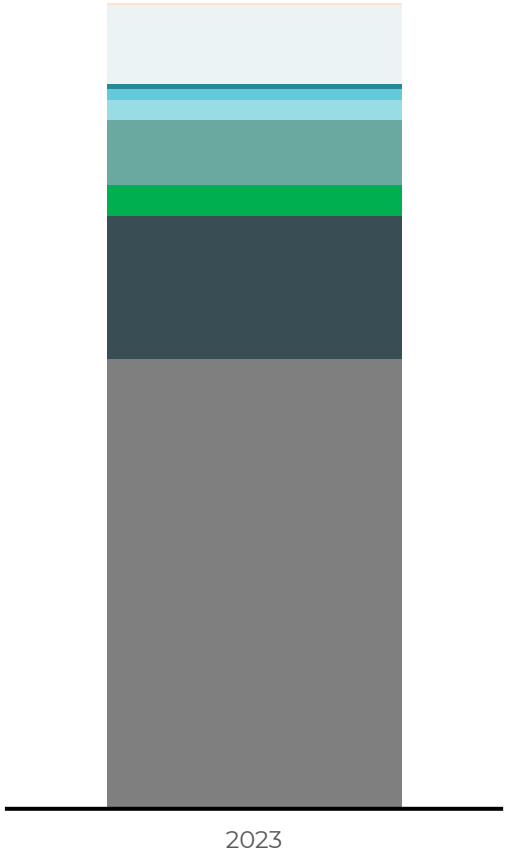
- 2024 is expected to witness a continued increase in EV sales; For the first time there were more BEV sold than gasoline cars*
- Belgium is a peculiar situation in EU, mainly explained by the large prevalence of company cars**

- 2024 is expected to have lower HP sales as compared to 2023***, however **sales in 2024 remain largely above historical trends.**
- This reduction is mainly explained by a **reduction in new buildings & renovations**, which according to ClimaFed could be a short-term effect.

*Voor het eerst meer elektrische dan benzineauto's verkocht | De Tijd
Aantal elektrische wagens in België in 1 jaar tijd bijna verdubbeld | VRT NWS: nieuws
** Voitures électriques: la Belgique est un des rares pays européens où le parc automobile se verdit assez rapidement | L'Echo (lecho.be)
***Warming to heat pumps: Belgian energy watchdog wants to turn sales slump around (brusselstimes.com)

HP stock evolution is obtained by taking sales & removals into account

Heating appliances – end 2023



For each year

\+ New appliances in **NEW DWELLINGS**

\+ New appliances in **RENOVATED DWELLINGS**

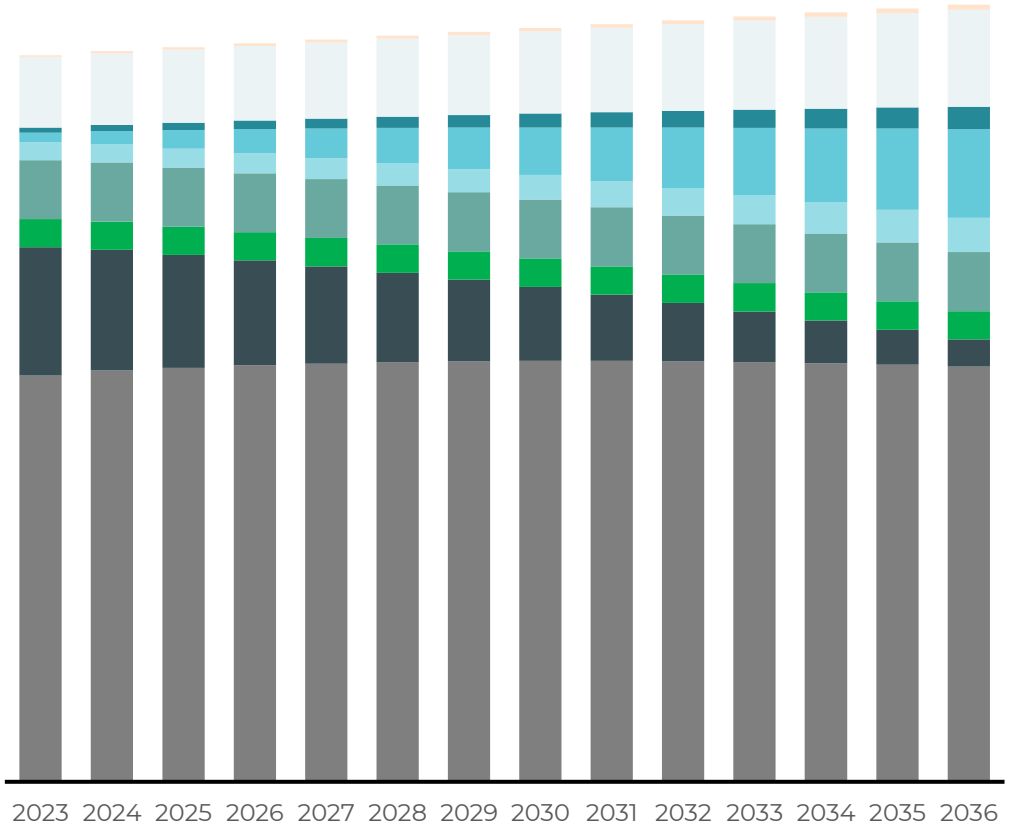
− Old appliances in **RENOVATED DWELLINGS**

− Old appliances in **DEMOLISHED DWELLINGS**

± Replacement appliances **(END OF LIFETIME)**

For each region
For each sector (residential, tertiary)

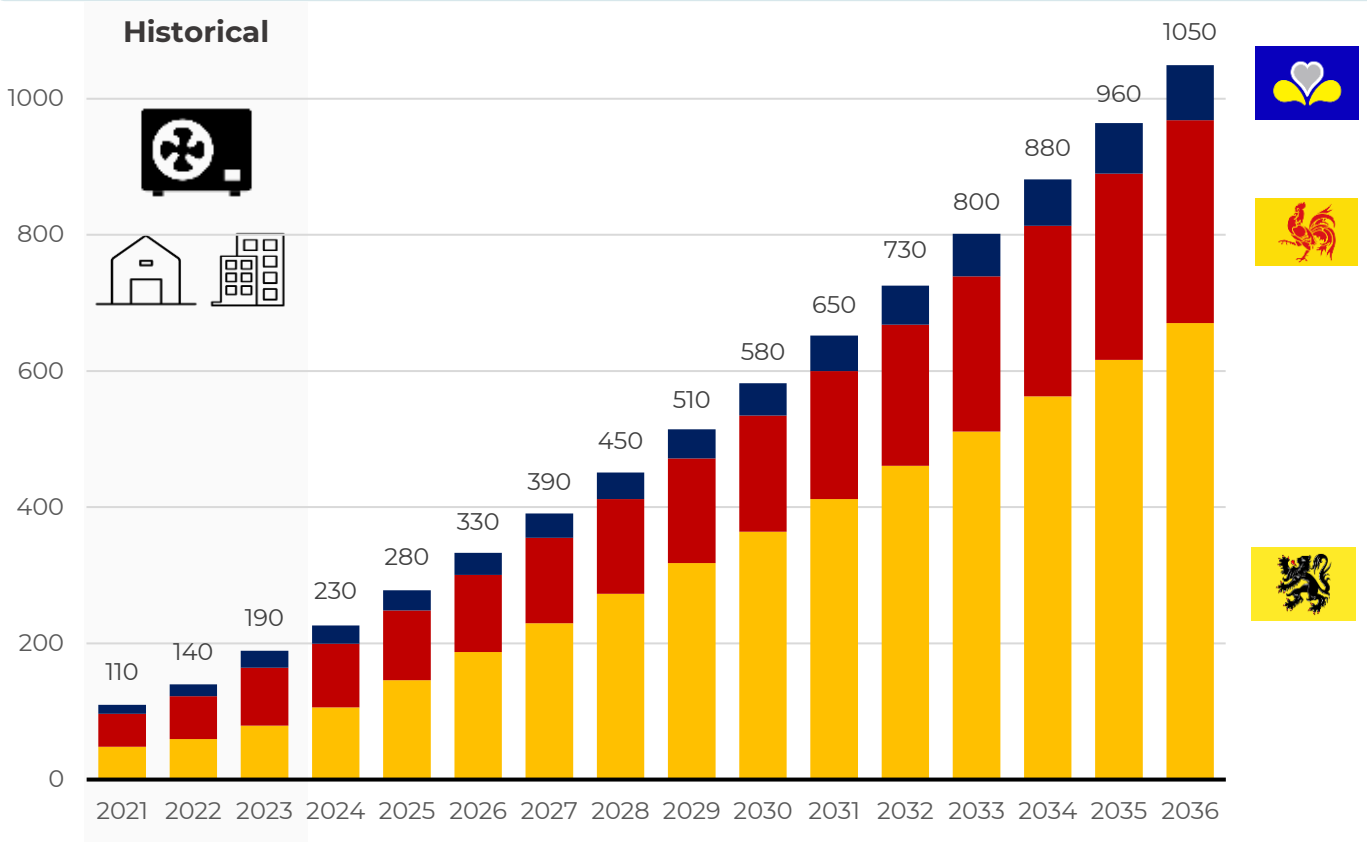
Evolution of heating appliances



Gas boiler | Oil boiler | Biomass | Direct electric | HP AA | HP AW | HP Ground | HP AA - secondary | District Heating

Proposed HP trajectory assuming heat pumps installed mainly in new buildings

Hydronic* HP fleet per region – residential+tertiary buildings [thousands]

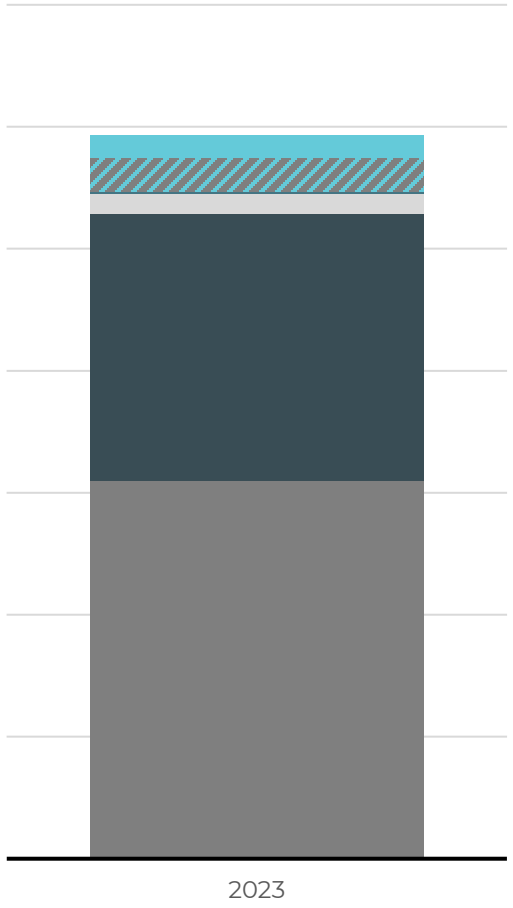


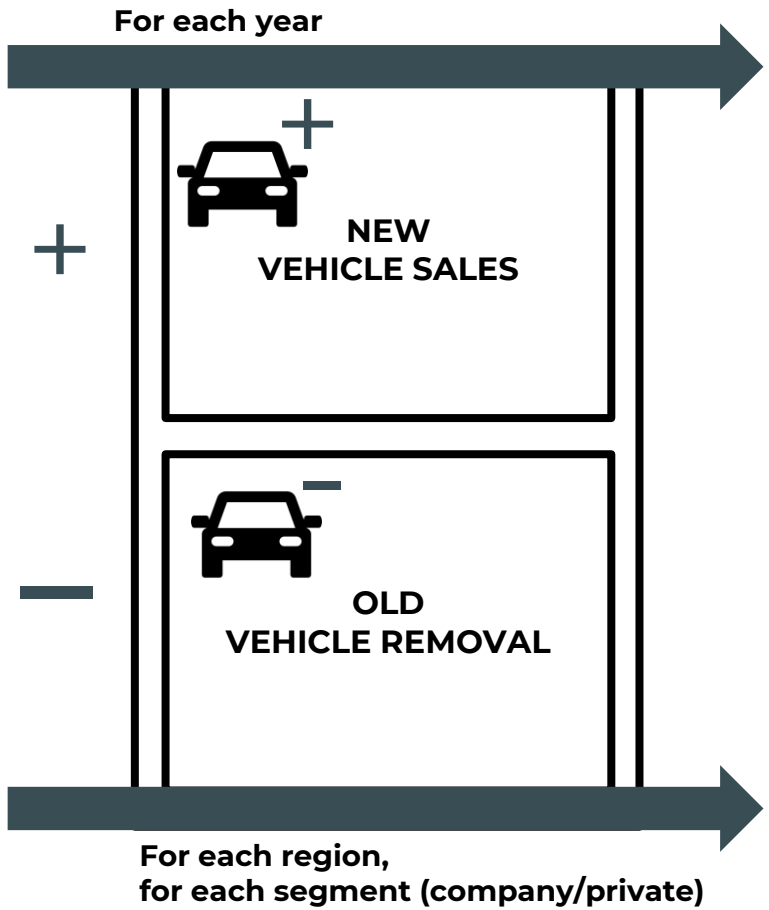
- **Brussels region:** conservative uptake assumed in renovations and boiler replacements
- **Wallonia:** conservative uptake assumed in renovations and boiler replacements
- **Flanders:** no new gas connection in new buildings from 2025. Aligned with Fluvius.

*includes Air-to-Water, Ground-to-water heat pumps. Excluding Air-Air units

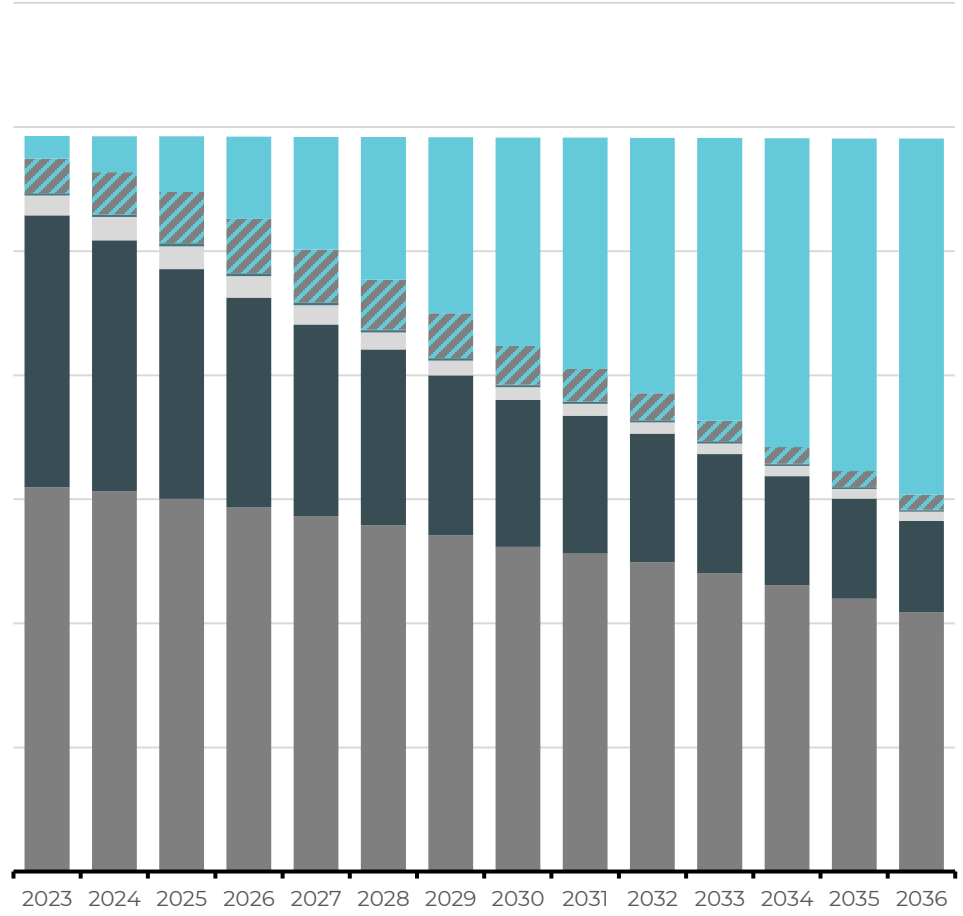
EV stock evolution is obtained by taking sales & removals into account

Car park – end 2023





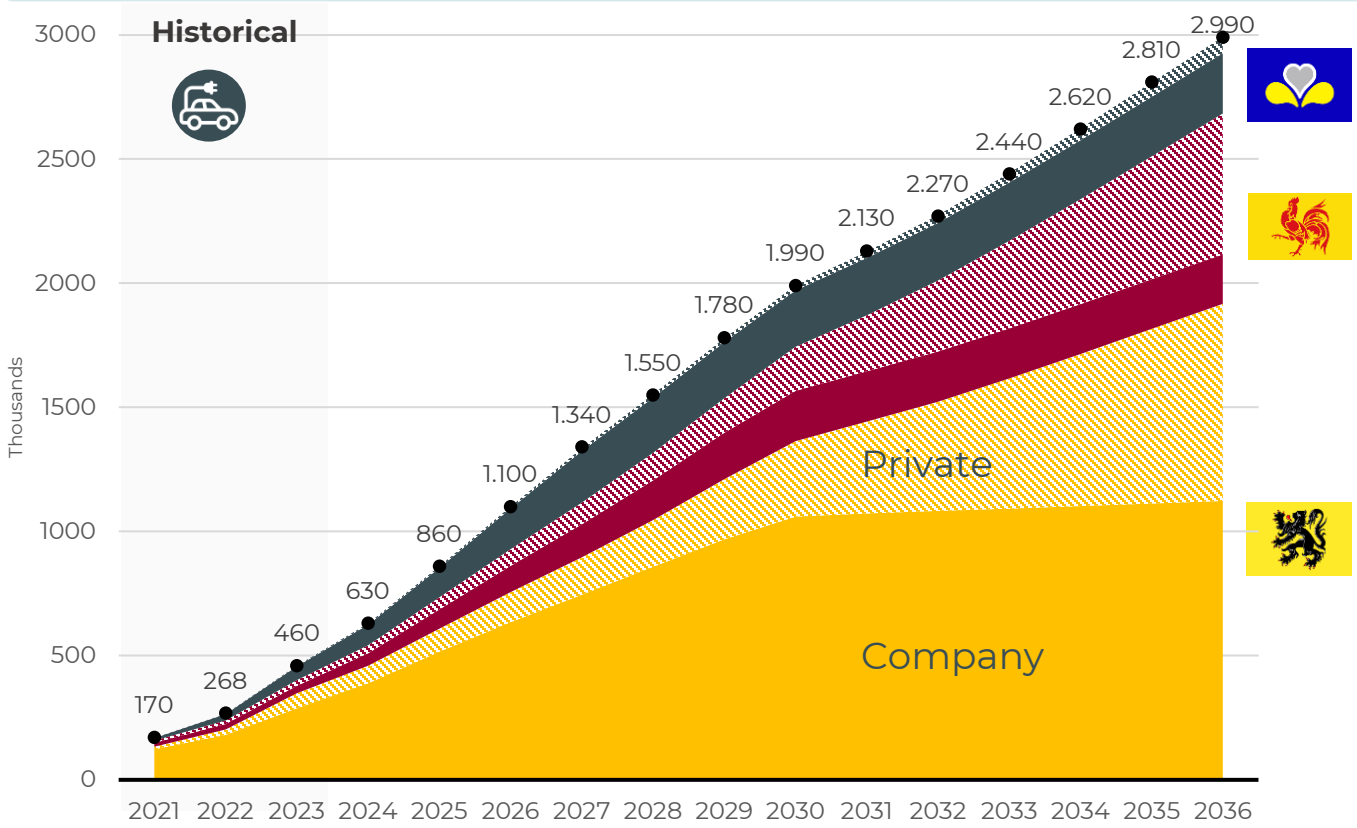
Evolution of car park



Gasoline Diesel Hybrid PHEV EV

Proposed EV trajectory for passenger cars assuming that company cars will electrify first in all regions

BEV+PHEV fleet per region – passenger cars [thousands]



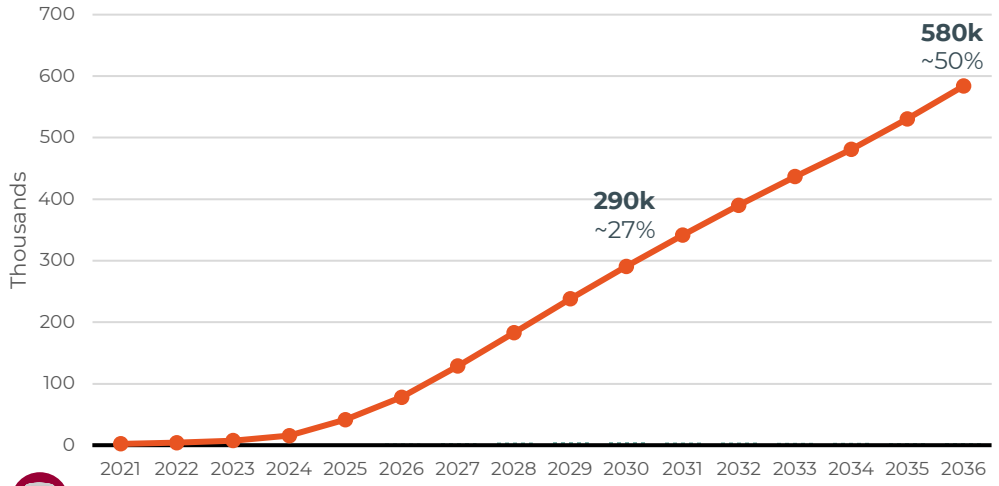
- **Company cars**: assumed 100% BEV/PHEV sales from 2026, 100% BEV from 2029 [BEL-1]
- **All regions**: from 2035 100% BEV sales [EUR-1]
- **Private cars**: Assumed faster uptake in Flanders as compared to Wallonia & Brussels following historic trends and projection of the DSOs & regions

https://vanpeteghem.belgium.be/nl/minister-van-peteghem-maakt-van-bedrijfswagens-en-laadpalen-de-hefbomen-naar-een-groener-wagenpark-0 [BEL-1]
https://www.europarl.europa.eu/news/en/press-room/20220603IPR32129/fit-for-55-meps-back-objective-of-zero-emissions-for-cars-and-vans-in-2035 [EUR-1]

Other transport segments assume a slower degree of electrification than the passenger car segment

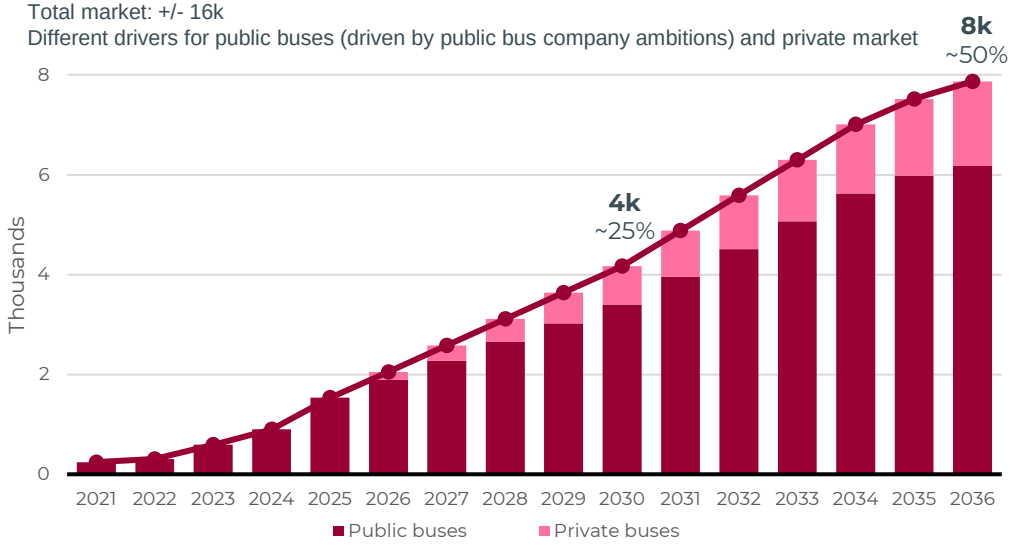
Assumed evolution of BEV+PHEV in the LDV freight fleet (vans)

- Total market +/- 850k with +/- 70k sales/y (counted both private & company)
- EU ICE ban from 2035 also applicable for LDV



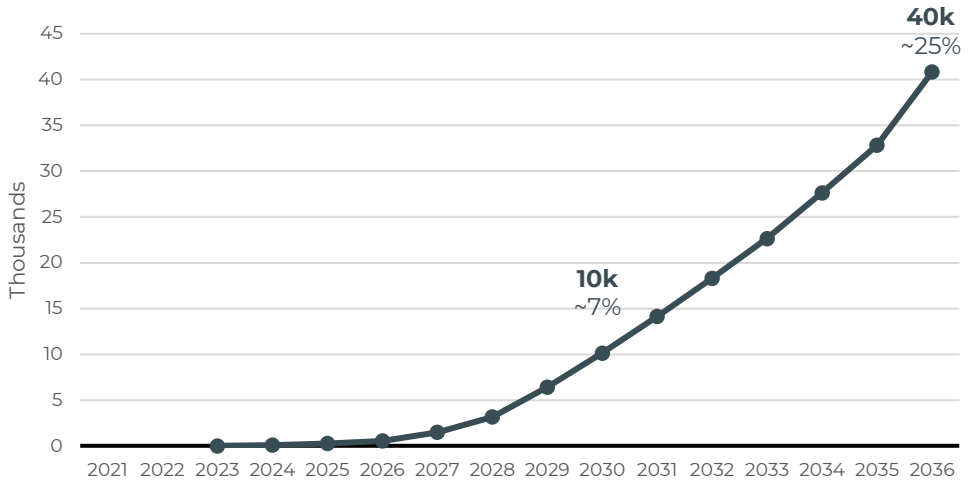
Assumed evolution BEV+PHEV in the bus fleet

- Total market: +/- 16k
- Different drivers for public buses (driven by public bus company ambitions) and private market



Assumed evolution of BEV in the HDV freight fleet (trucks)

- Total market +/- 160k with +/- 9k sales/y
- EU regulations on emissions require ZEV truck sales



Sources

LDV

- Fit for 55: MEPs back objective of zero emissions for cars and vans in 2035 | News | European Parliament (europa.eu)

Bus

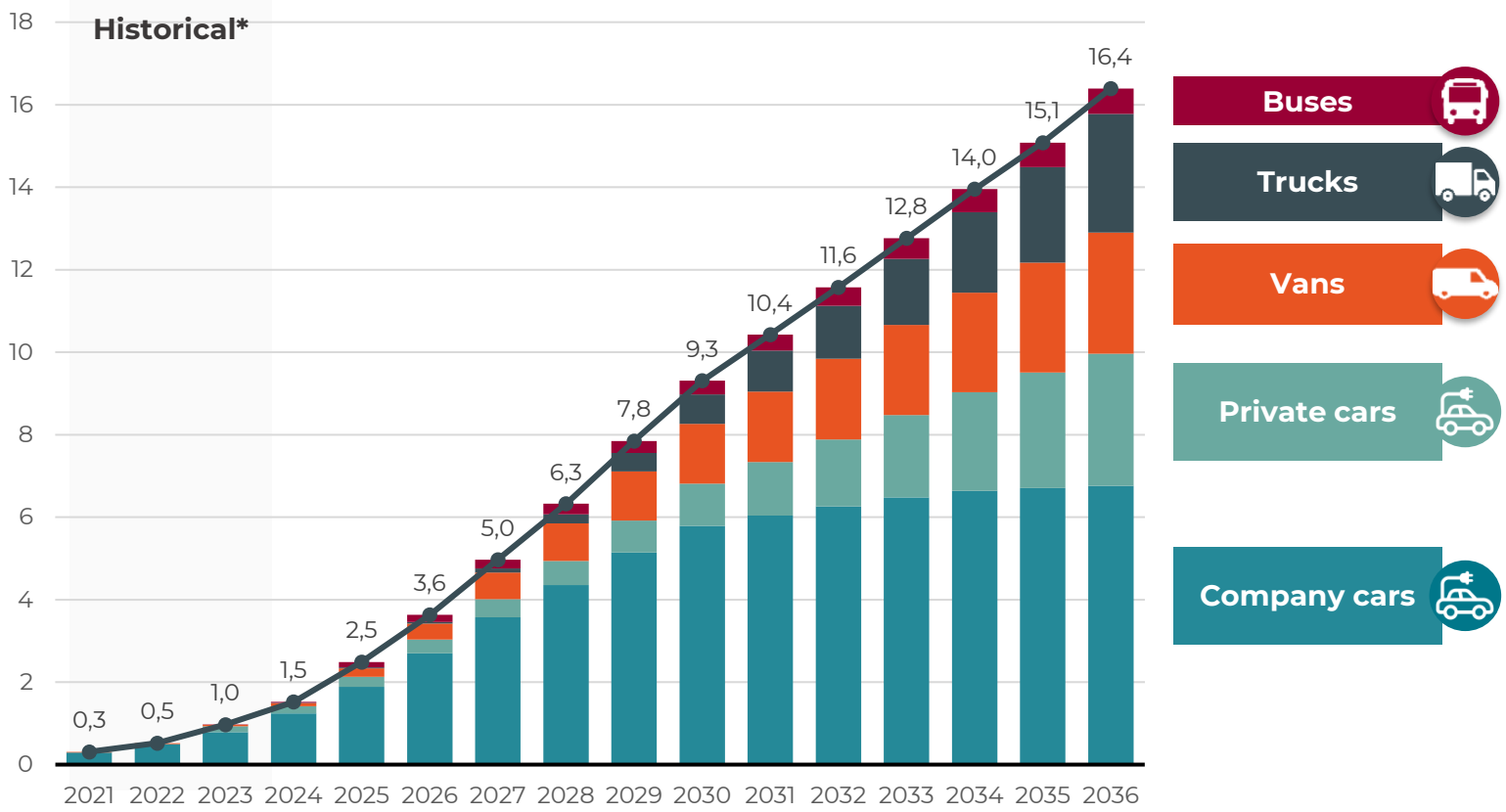
- VL: E-bussen: De Lijn gaat volop voor groen - De Lijn
- BXL & WL: Un nouveau pas à la STIB vers une décarbonisation complète des bus d'ici 2035, au TEC cela prendra un peu plus de temps - RTBF Actus

HDV

- Agreement on strong EU targets to reduce CO2 emissions (europa.eu)

Proposal for the electrification of road transport

Yearly electricity demand – Road Transport [TWh]



Public **buses** expected to electrify first in all regions, private buses later.

Increase in electricity demand for **trucks** mainly expected post 2030

Vans expected to follow cars evolution but with some delay

Electrification of **private cars** expected later due to decreasing purchase cost

Electrification already happening massively in the **company car** segment – expected near 100% BEV feet by 2030

*Estimated Based on amount of vehicles and assumed efficiency and usage

We can now zoom on new large-scale load and its associated flexibility

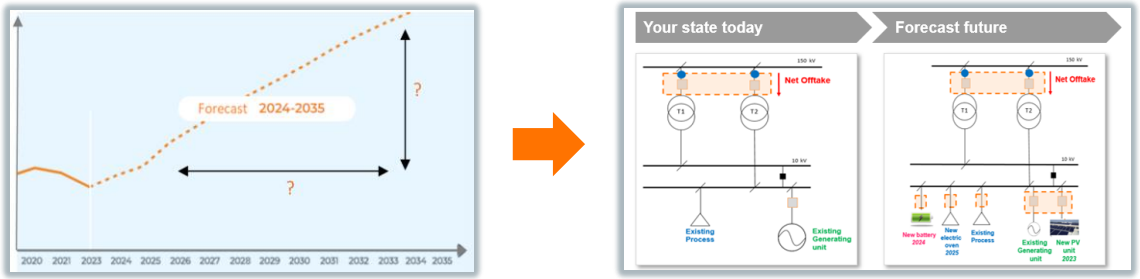
	Content	Associated flexibility
Existing usages		
New building heat electrification		
New transport electrification		
New large-scale loads (industry & data centers)	**Additional data centers** and **electrification of industry**	Power-to-heat, Power-to-H2, DRI-EAF, CCS, Data centres, Miscellaneous Flexibility from the process Turned on when electricity prices below a certain threshold
Losses		

In general, **reality checks** on realised 2024 data (elec demand, EV/HP sales, etc.) will be performed with the available data in Jan. 2025.

Consumption from new large-scale load comes from Elia's load mgmt.

An exercise gathering detailed bottom-up input from its industrial customers to help forecast industry electrification

Goal - detailed bottom-up input to improve forecasts

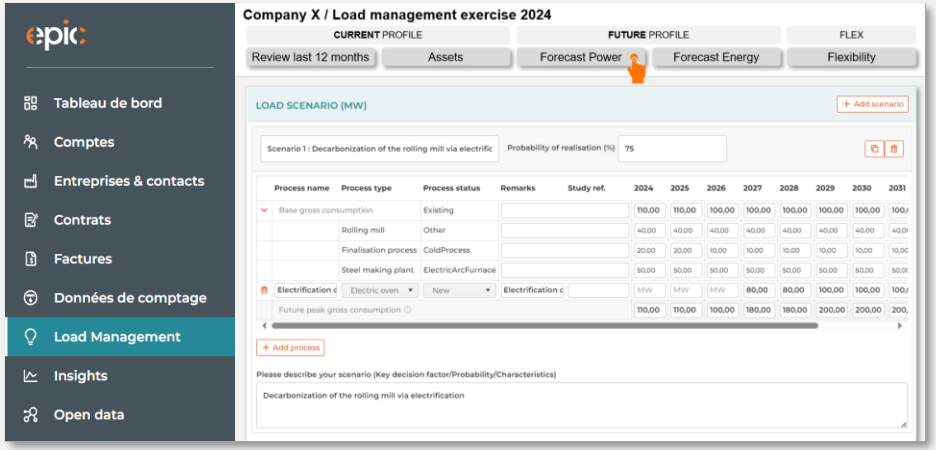


Focus of Load management data in 2024

- *Estimates of future gross consumption (peak power & energy)*
- *Scenario approach (with customer specified probabilities)*
- *Description of processes underlying gross consumption and flexibility (current & future)*

Illustration

Customers define scenarios for their future gross consumption through customer portal



Presented in WG Adequacy #32 27/08/2024

Submitted scenarios of biggest customers aligned to 3 scenarios

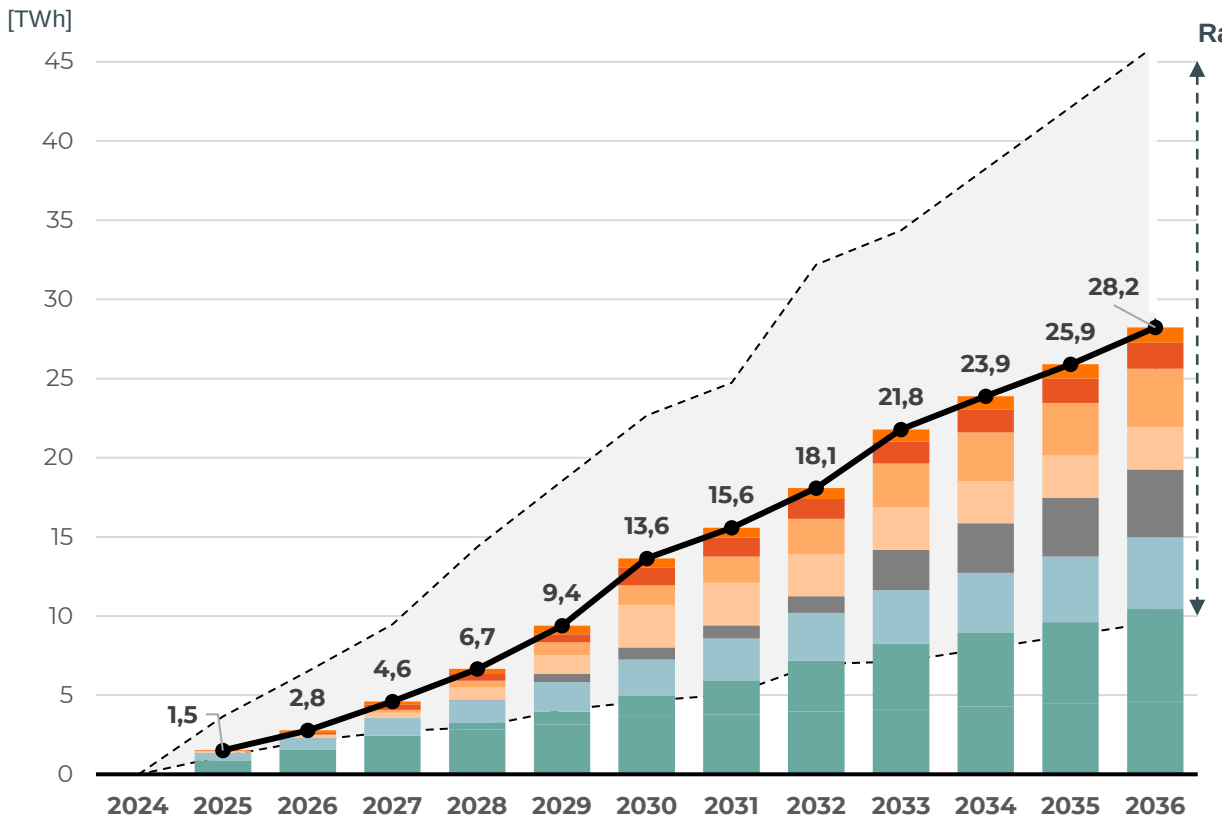
Aligned Elia scenarios

	High	Central	Low
For **15 biggest players** accounting for 80% of increase in power, scenarios are realigned			
Data centers	Datacenter consumption grows exponentially as uptake of AI demands more and more computing power	Growth materializes in next 3 years and then continues at the same rate as in '24-'27 after that	Growth materializes in next 3 years as players try to enter AI market first, but remains flat after
Heavy industry	Most optimistic customer scenarios materialize, thanks to positive technological results on electrification and strong governmental support	Companies electrify partially or with a 2-year delay compared to their most optimistic scenario, helped by moderate governmental support	Companies continue as-is or with a 4-year delay compared to their most optimistic scenario, due to technological infeasibility and/or low governmental support
Scenarios of **remaining tail of 112 grid users**, good for 20% of increase, are aligned mechanistically			
	Highest submitted forecast	Weighted combination of scenarios by reported probability	Lowest submitted forecast

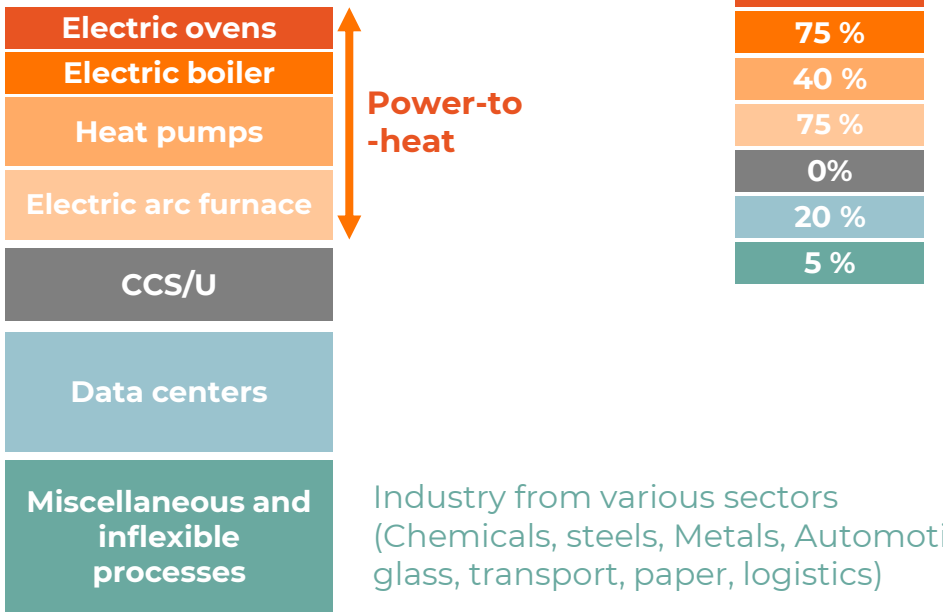
Presented in WG Adequacy #32 27/08/2024

Update of the new electrification trajectory and the associated flexibility with latest information from clients

Proposed CENTRAL additional electricity demand vs 2024 – Industry [TWh]



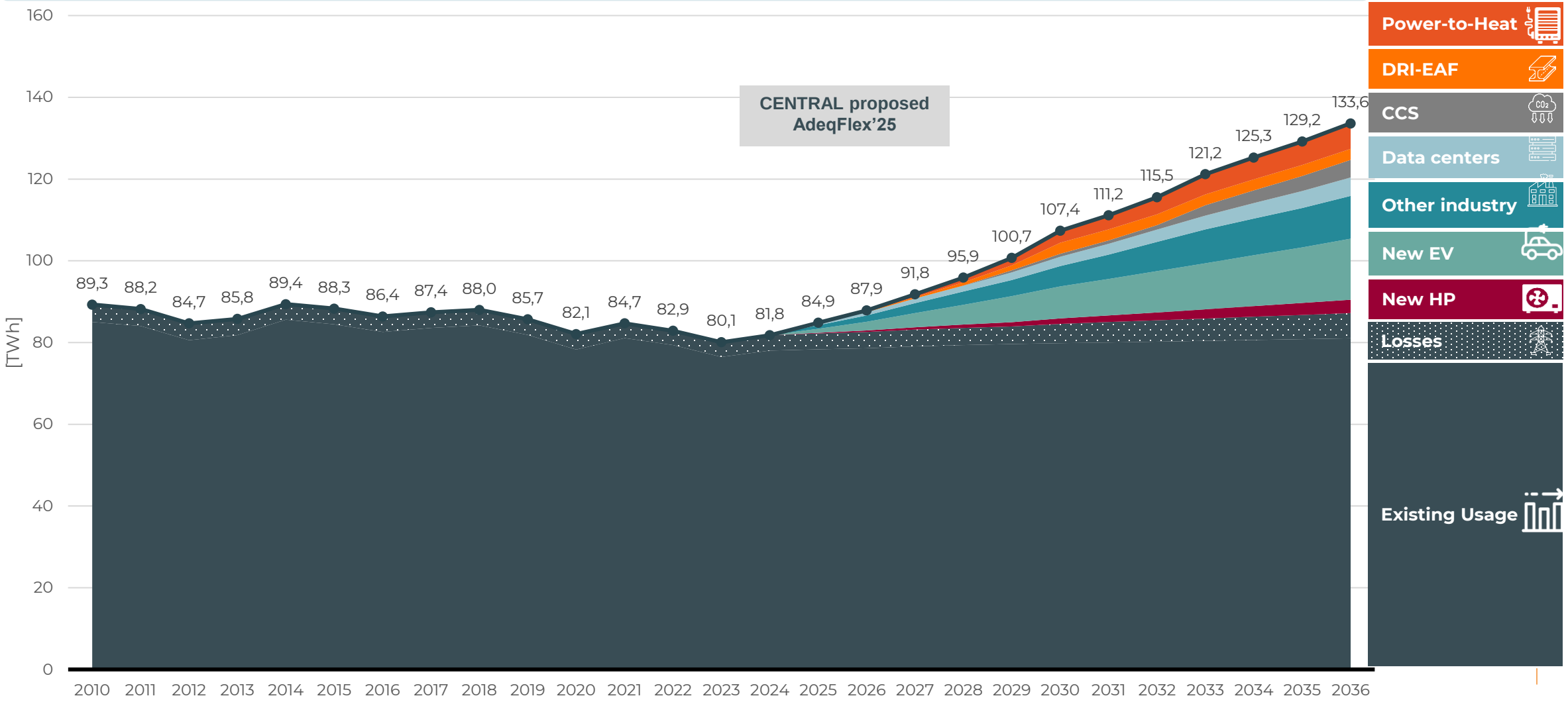
Proposed CENTRAL flexibility per process



Industry from various sectors (Chemicals, steels, Metals, Automotive, glass, transport, paper, logistics)

Overview of all components of AdeqFlex'25 proposed load for the current CENTRAL trajectory

Yearly electricity demand – Belgium [TWh]



Normalized (1990-2020), power-to-heat values depend on model dispatch

Proposal for hydrogen electrolysers installed capacity trajectory [MW]

- The ‘Vision and strategy Hydrogen’ (Oct. 22) aimed for 150 MW in 2025*.
- By end-October 2024, there is **1 publicly planned** project for electrolysers: Hyoffwind**, 25 MW.

General approach:

- AdeqFlex’25 proposal is to keep **25 MW** as total hydrogen electrolyser capacity for the studied horizon, as long as no other concrete project is known.
- Hydrogen electrolyser are assumed fully flexible, and dispatched when prices are low.
- Final consumption is an output of dispatch simulation

* economie.fgov.be/sites/default/files/Files/Energy/View-strategy-hydrogen.pdf
**Hyoffwind, première usine de production d'hydrogène vert en Belgique : John Cockerill et BESIX confirmés comme partenaires industriels de premier plan

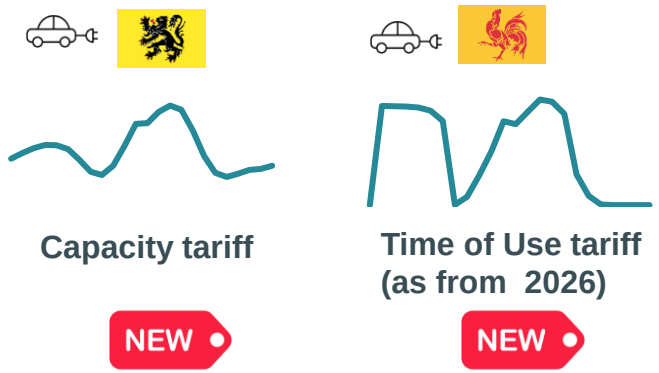
End-user Flexibility

HP, EV & residential batteries

Flexibility from electric vehicles, heat pumps and home batteries has been further improved to account for regional specificities

EV consumption profiles integrate now also **work and public charging** next to home charging (metered data).

Regional tariffs considered, impacting EV, HP and home batteries profiles for '**local optimisation**', considering solar PV auto-consumption.



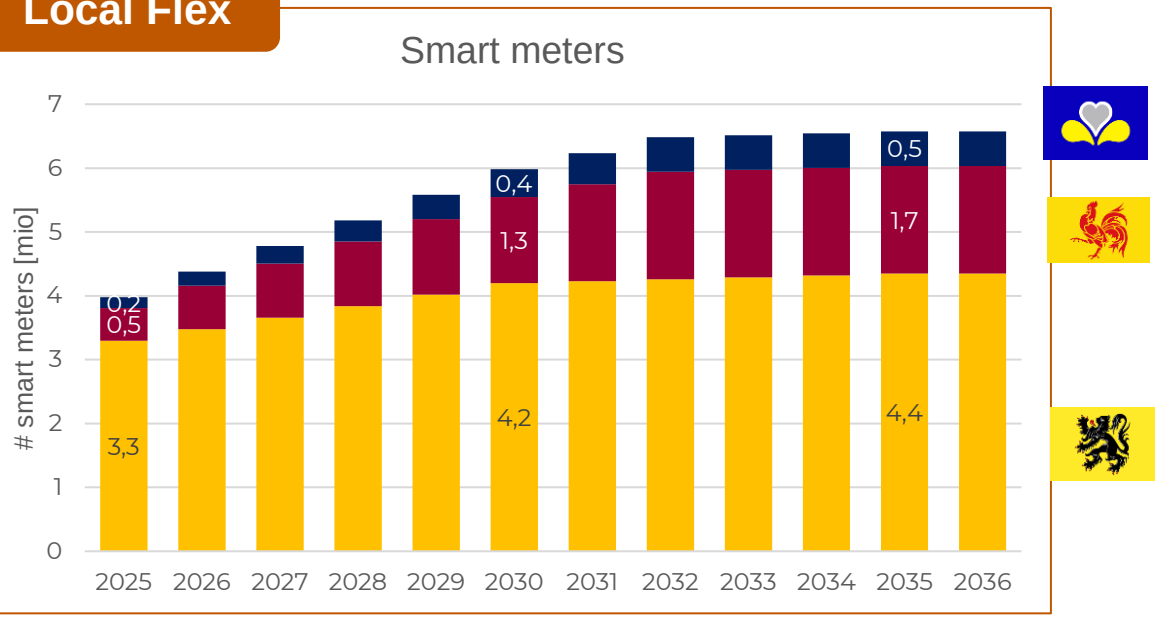
All improvements and related data are available in main documents of the public consultation

Proposal for trajectory of Key Drivers of end-user flexibility

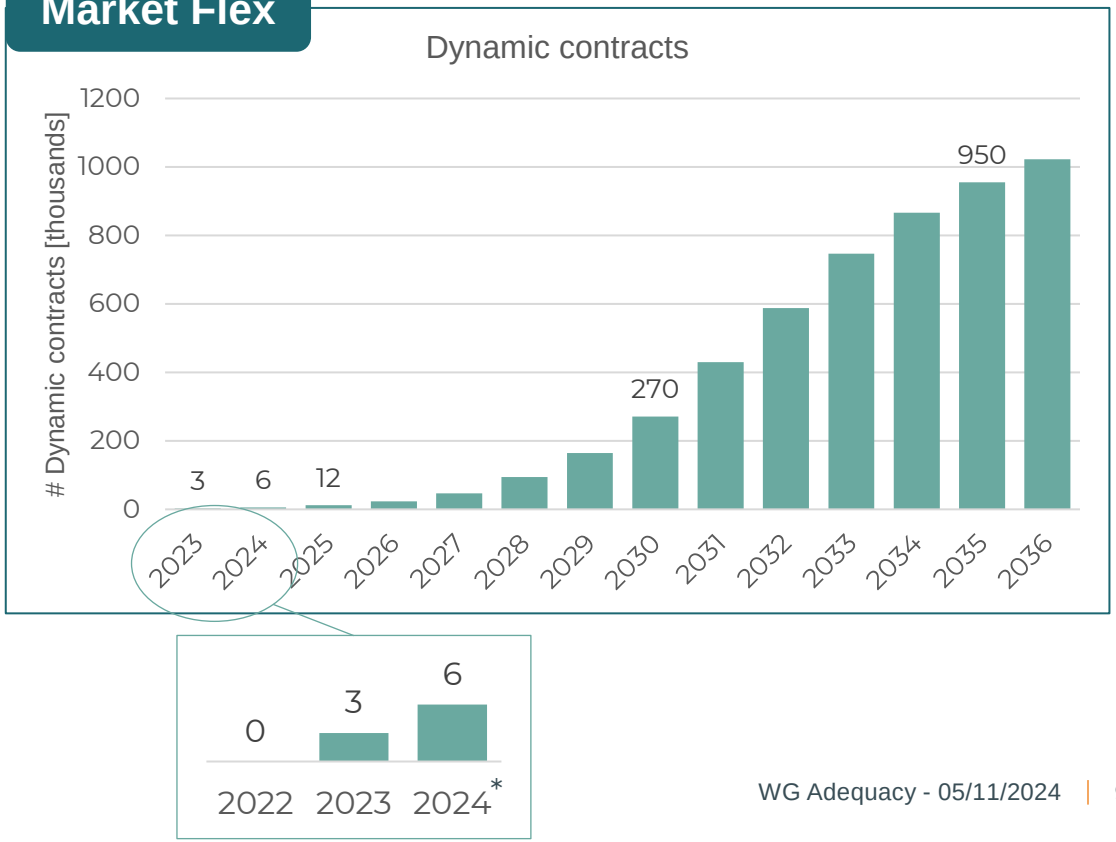
smart meters & dynamic projections

- Smart meters & dynamic contracts are expected to drive local and market flex respectively
- Smart meters values aligned with DSOs development plans
- S-curve growth assumed for dynamic contracts, under the right market reforms

Local Flex

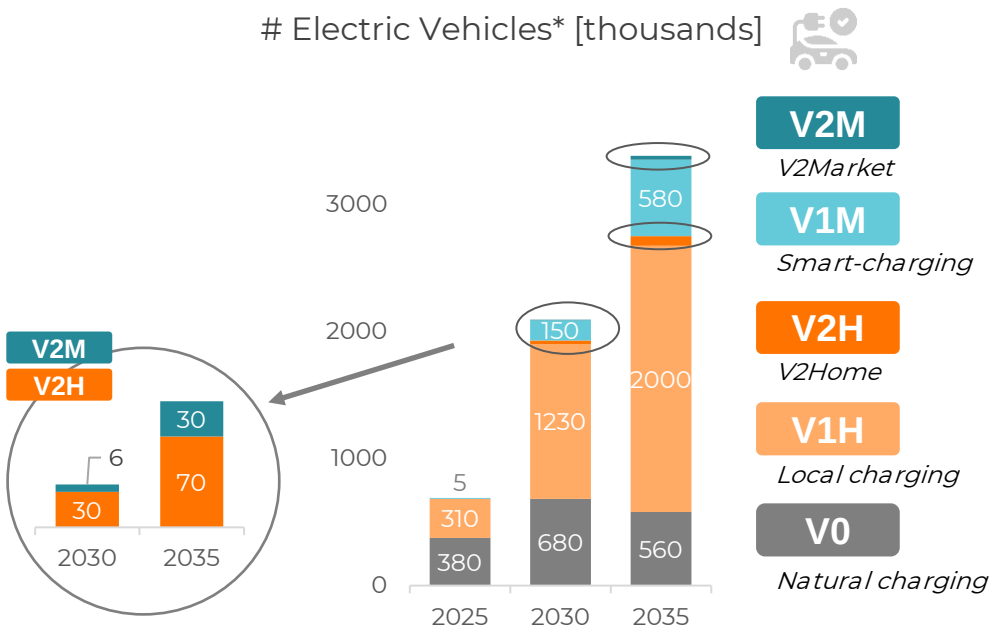


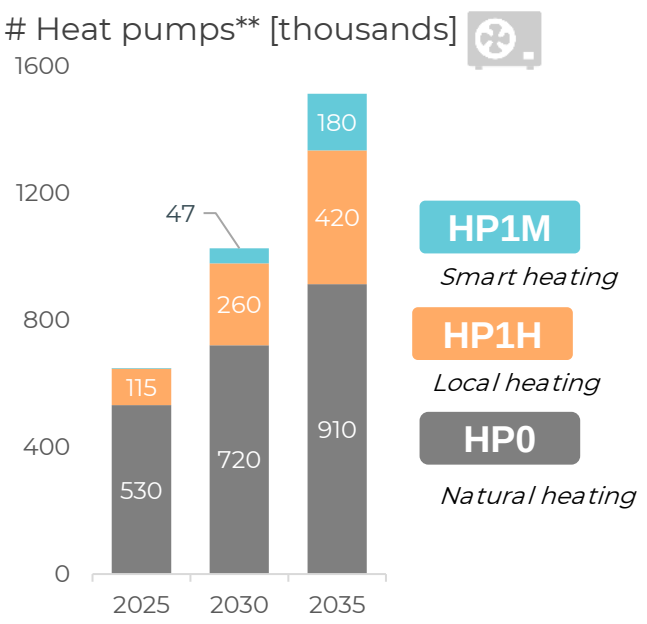
Market Flex

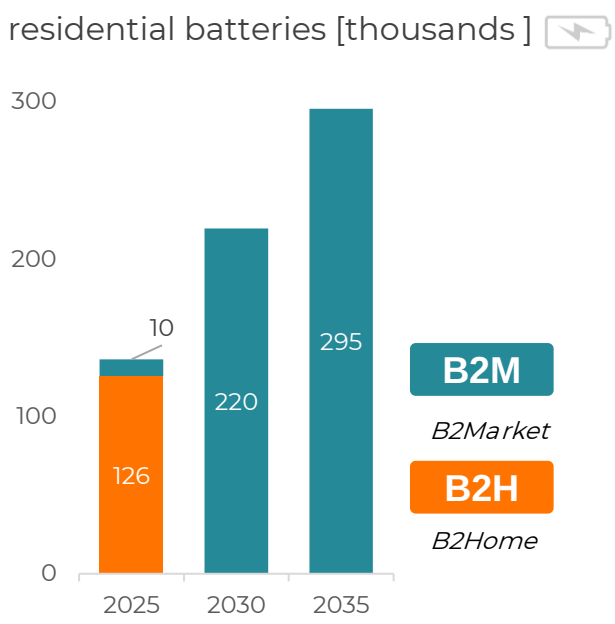


**Numbers will be updated early 2025 in the framework of the reality check*

Assumptions regarding the way that flexible additional electrical loads are used



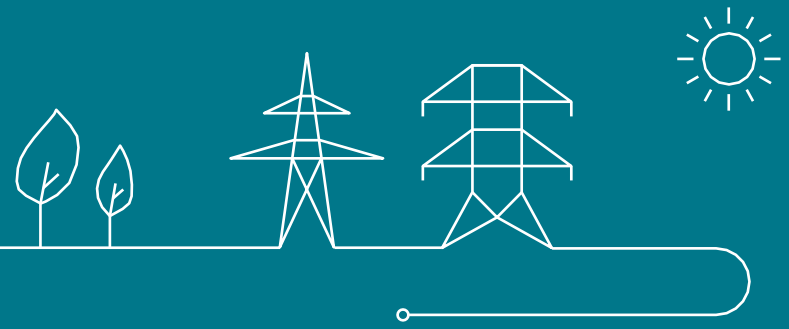




- With smart meters roll-out and regional tariffs, local flexibility is expected to have the largest impact on EVs and HPs
- V2X first affordable model is expected in 2026***.
- HPs are expected to be less controllable, and hence be less flexible.
- Batteries can offer most flexibility with no impact on the comfort of consumer. It is assumed that market flexibility from batteries follow dynamic contracts developments.

*Passenger cars and LDV vans only, as BEV equivalent (each PHEV counted as half a BEV)
**Secondary Air-air HP accounted for as 20% of an equivalent HP
**Nissan to launch affordable vehicle-to-grid technology in 2026 (nissannews.com)

Grid and cross-border exchanges capacities



Proposal for cross-border capacity calculation parameters for central scenario

Market Parameters	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Comments
Flow-based perimeter	Central Europe CCR												
Bidding zones	As Is												*ACER Decision No 11-2022 on the alternative bidding zone configurations only refers to assessment by next BZR study, so no official new configuration is known at*
minMACZT	See table below												*Perfect model assumption https://acer.europa.eu/Official_documents/Acts_of_the_Agency/Publications%20Annexes/ACER%20Report%20on%20the%20result%20of%20monitoring%20the%20MA*
Treatment of external flows	Advanced Hybrid Coupling (AHC)												*Perfect model assumption*
External & Allocation constraints	No Allocation constraints												*Perfect model assumption*
Use of PST in capacity calculation	For Belgium: 1/2 For other: 1/3												*All get a setpoint based on the nodal flow estimation (FE). In capacity calculation only the currently known PST's are selected (BC). In capacity allocation none*
Use of HVDC in flow-based capacity allocation	ALEGrO HVDC Piémond-Savoie		ALEGrO HVDC Piémond-Savoie Celtic Interconnector										

Perfect market model

Country		2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Justification
Austria	CORE borders	60	70	70	70	70	70	70	70	70	70	70	70	*Action plan 2021-2025*
Belgium	CORE borders	70	70	70	70	70	70	70	70	70	70	70	70	
Netherlands	CORE borders	63	70	70	70	70	70	70	70	70	70	70	70	*Action plan 2020-2025*
Germany	CORE borders	60	70	70	70	70	70	70	70	70	70	70	70	*Action plan 2020-2025*
France	CORE borders	70	70	70	70	70	70	70	70	70	70	70	70	
Slovenia	CORE borders	70	70	70	70	70	70	70	70	70	70	70	70	
Kroatia	CORE borders	70	70	70	70	70	70	70	70	70	70	70	70	*Plans to adopt a action plan mid-2022*
Romania	CORE borders	63	70	70	70	70	70	70	70	70	70	70	70	*Action plan 2021-2025*
Czechia	CORE borders	70	70	70	70	70	70	70	70	70	70	70	70	
Slovakia	CORE borders	70	70	70	70	70	70	70	70	70	70	70	70	
Poland	CORE borders	63	70	70	70	70	70	70	70	70	70	70	70	*Action plan 2020-2025*
Hungary	CORE borders	70	70	70	70	70	70	70	70	70	70	70	70	
Ireland	CEC borders	70	70	70	70	70	70	70	70	70	70	70	70	
Italy Nord	CEC borders	70	70	70	70	70	70	70	70	70	70	70	70	

A perfect market model is proposed as reference. Reality is different for multiple reasons:

1. Electricity Regulation includes provisions to derogate or deviate (=validation step in capacity calculation) from the minimum 70% requirement, justified by the need to ensure the operational security of the grid. Facts and figures are available in ACER's 70% monitoring report.
2. UK and CH are not part of the single implicit price coupling. These borders are explicitly coupled and implemented through Standard Hybrid Coupling in capacity calculation, implying forecast inefficacies.
3. Allocation constraints are applied in market coupling in line with the legal framework (PL, IT, …)

➔ Candidate for sensitivity: a lower minimum available capacity assumption as proxy to model these differences

Proposal for main grid infrastructure in Belgium and other countries

Assumed available for adequacy as from winter…

Realization foreseen by…

25/26 | 26/27 | 27/28 | 28/29 | 29/30 | 30/31 | 31/32 | 32/33 | 33/34 | 34/35 | 35/36 | 36/37

End of 2028

End of 2029

End of 2030

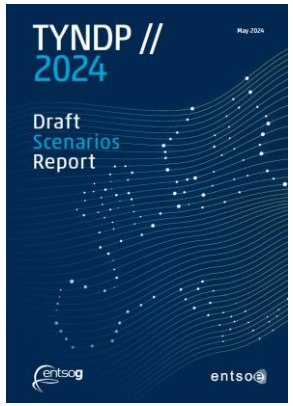
2036

Ventilus

Boucle du Hainaut

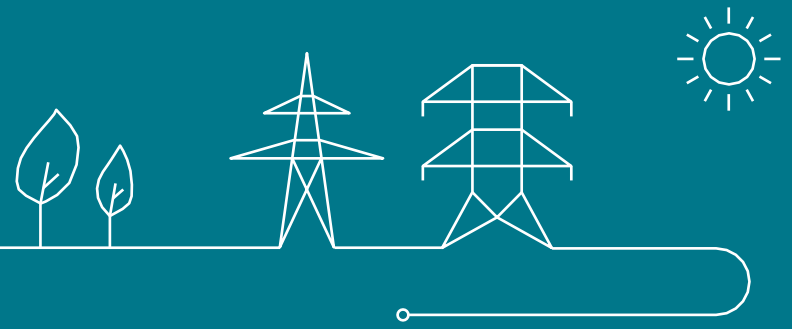
Nautilus (BE-UK)

Triton



Based on TYNDP2024 updated with latest official announcements for cross-border links outside Central Europe region.

Other European countries



The European scenario framework would be based on the ERAA24 dataset complemented with more recent data (if available)

- Starting point: European Resource Adequacy Assessment – Edition 2024 (ENTSO-E) – (*not yet published*)
- Complemented by latest policies/published studies
- Discussion with neighboring TSO's

+

National Studies

Government announcements

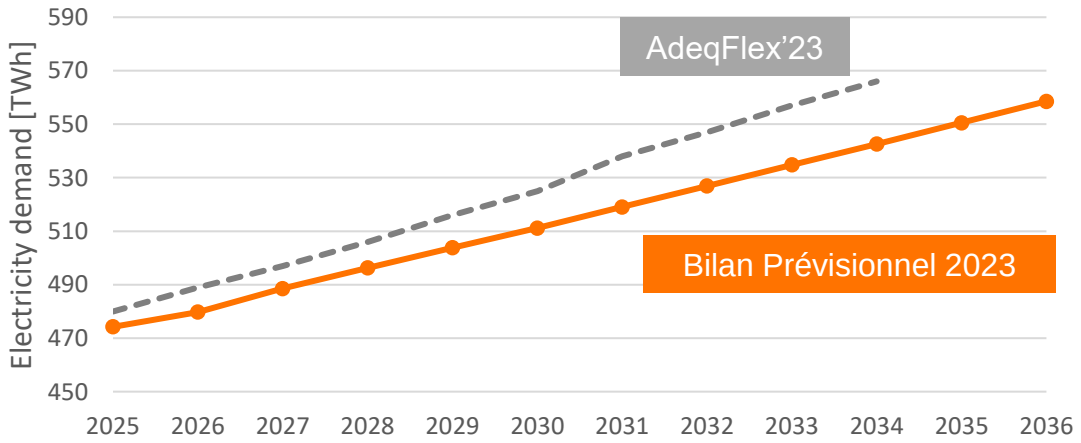
Public consultation excel table with the data

EU Assumptions - France

Sources

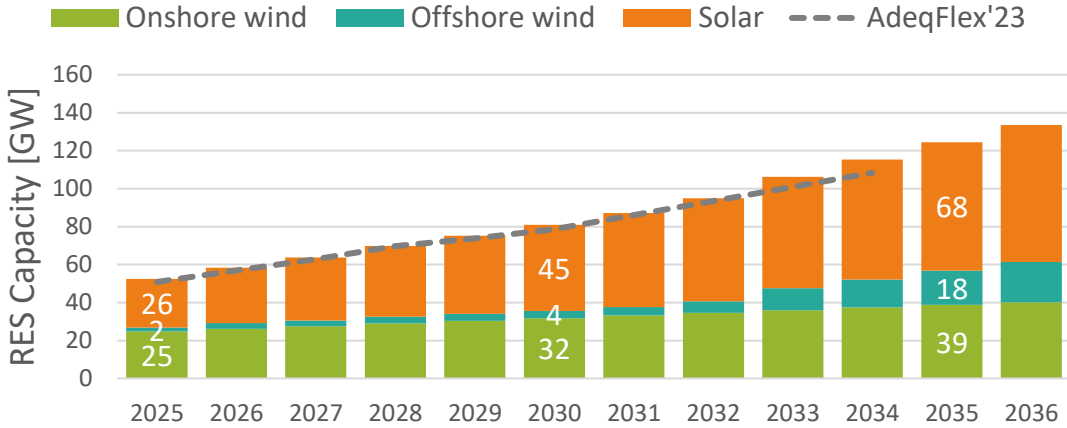
- ERAA 2024
- “Bilan Prévisionnel” 2023
- EDF announcements on nuclear (Flamanville availability, 2024 production forecast)
- EDF announcement on Cordemais
- Historical installation rate for onshore wind

Electricity demand [TWh]



RES Capacity [GW]

Capacity assumed by end of the year



Thermal

Capacity assumed by end of the year

- 61.8 GW of nuclear, including Flamanville
- No new nuclear assumed for the studied time horizon
- No coal after winter 2026-27, following Cordemais closure (EDF announcement from the 24th of September 2024 – link)

EU Assumptions - France

Improvement of the methodology to model French nuclear

Methodology – AdeqFlex'23

3.5.3.1. French nuclear availability

The EU-BASE scenario starts from the assumption that the French nuclear fleet will follow either:

- the forecast of the French producer as published in REMIT for 2023, 2024 and 2025, calibrated to an estimated yearly generation output; or
- the maintenance profiles used in the ERAA 2022 as a basis for the other years (2026 onwards).

In addition, forced outages are drawn and added to the unavailability.

Methodology – AdeqFlex'25

- Short-term:
  - REMIT + estimated yearly generation output (EDF)
  - Modelization of uncertainties on outages
- Long-term:
  - Maintenance profile from Bilan Prévisionnel (RTE)

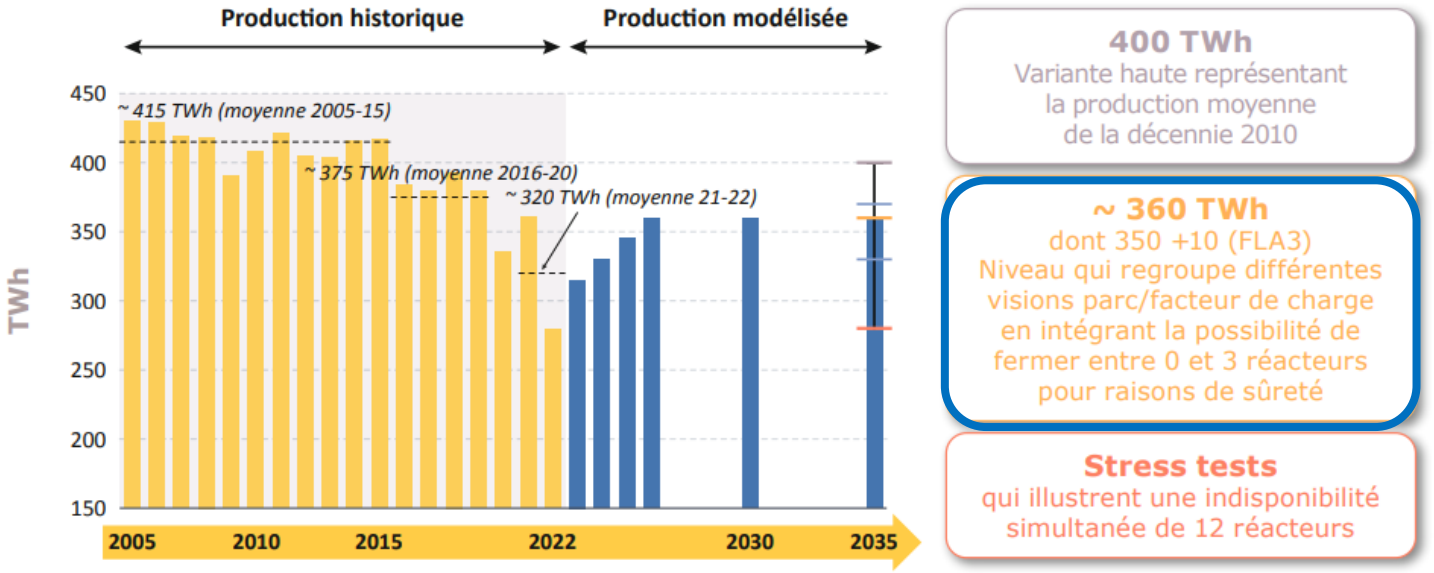
EU Assumptions - France

- Instead of using maintenance for French nuclear units from ERAA, information from the latest Bilan Prévisionnel (RTE) will be used to align with best modelization available.

RTE considers

- **3 scenarios:**
  - 'Cas de base' (360 TWh)
  - 'Variante basse' (330 TWh)
  - 'Variante haute' (400 TWh)
- 1 stress test sensitivity (280 TWh)

Figure 3.22 Trajectoires d'évolution de la production nucléaire (parc de deuxième génération et EPR de Flamanville)

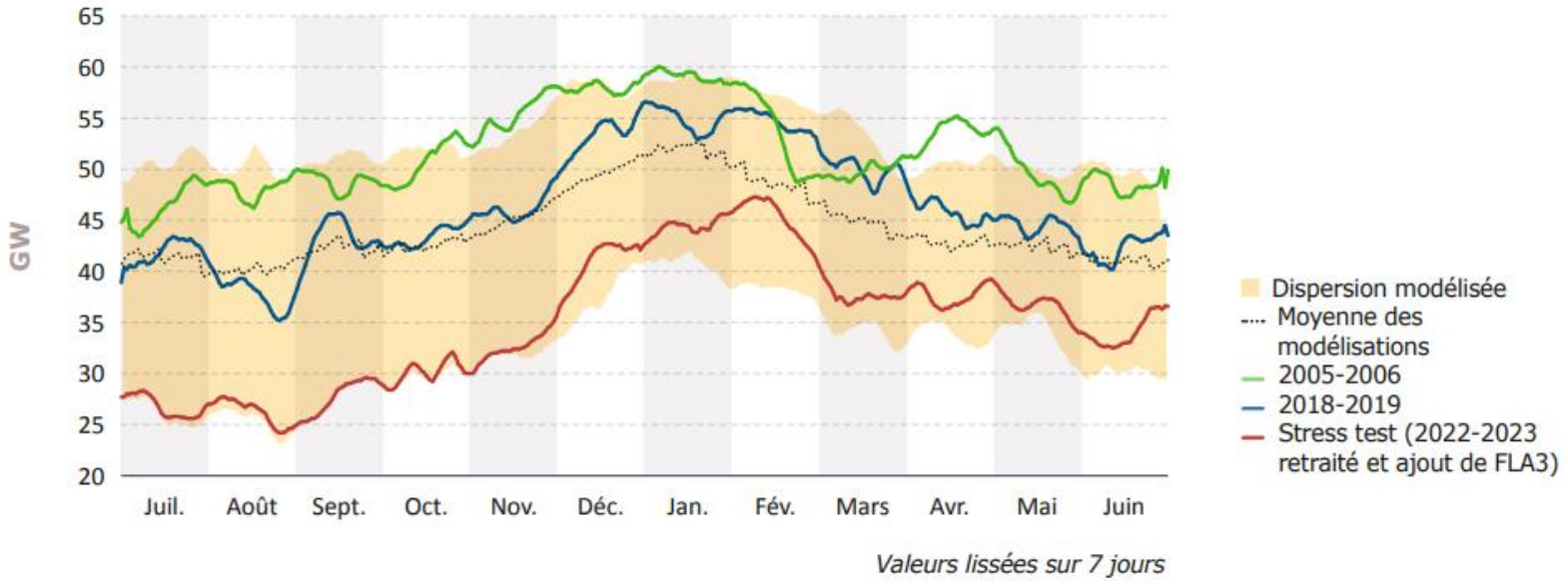


EU-BASE

EU Assumptions - France

- Not only the yearly generation in TWH is useful but also the availability of the French nuclear units in winter

Figure 3.21 Disponibilité du parc complet (63GW), issue de l'hypothèse de référence, aux horizons 2030 et 2035, et comparaisons à quelques observations historiques



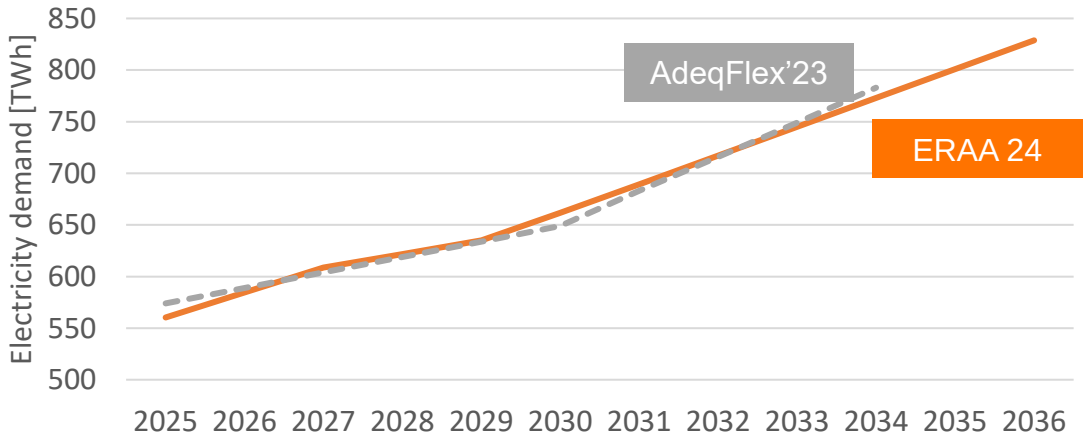
Additional information can be found on RTE's website

EU Assumptions - Germany

Sources

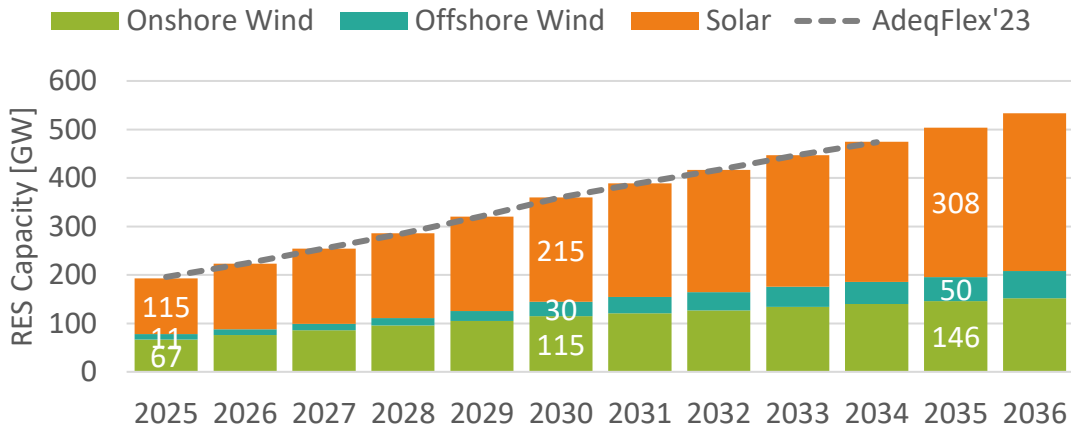
- ERAA24 (Oct. 24)
- NEP 2025, scenario for 2037 (Jun. 24)

Electricity demand [TWh]



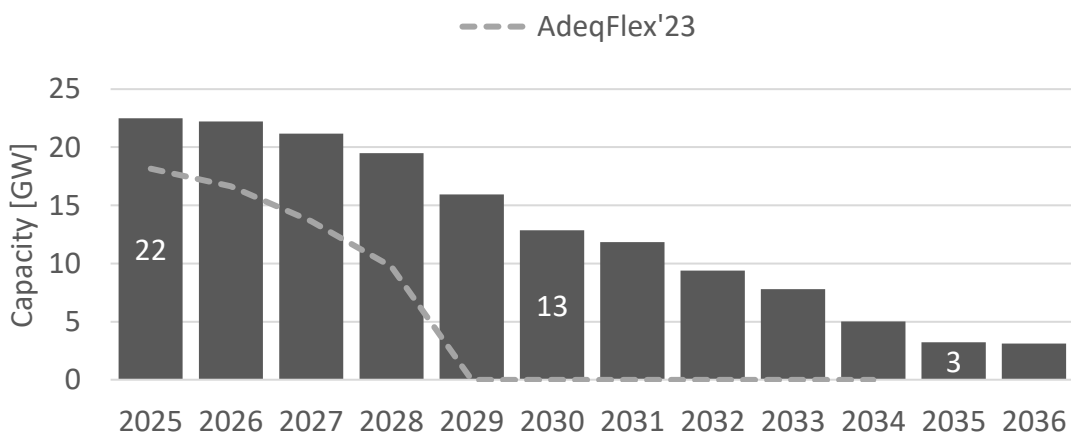
RES Capacity [GW]

Capacity assumed by end of the year



Coal phase-out*

Capacity assumed by end of the year



* Coal phase out by end 2038 (ERAA24). Previously assumed by end of 2029.

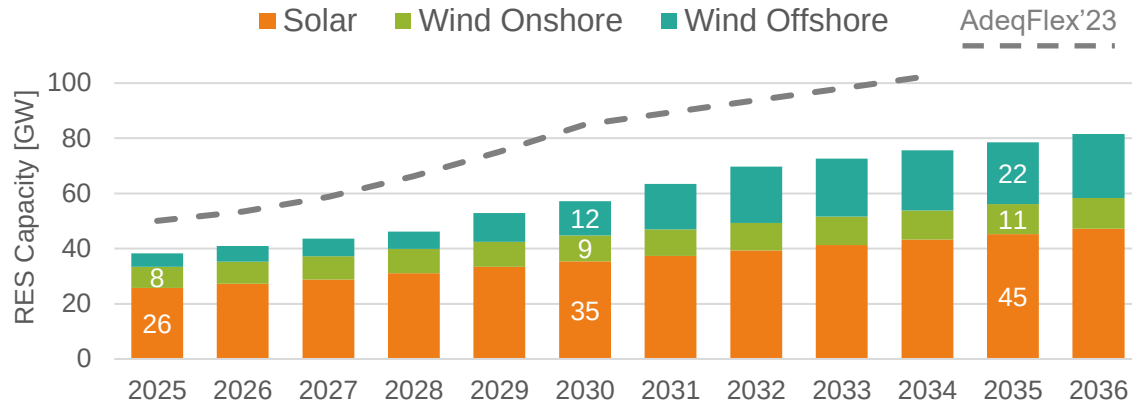
EU Assumptions - Netherlands

Sources

- ERAA24 (Oct. 24)
- Monitoring Leveringszekerheid 2024 (Jan. 24)
- Route kaart wind op zee (Apr, 24)

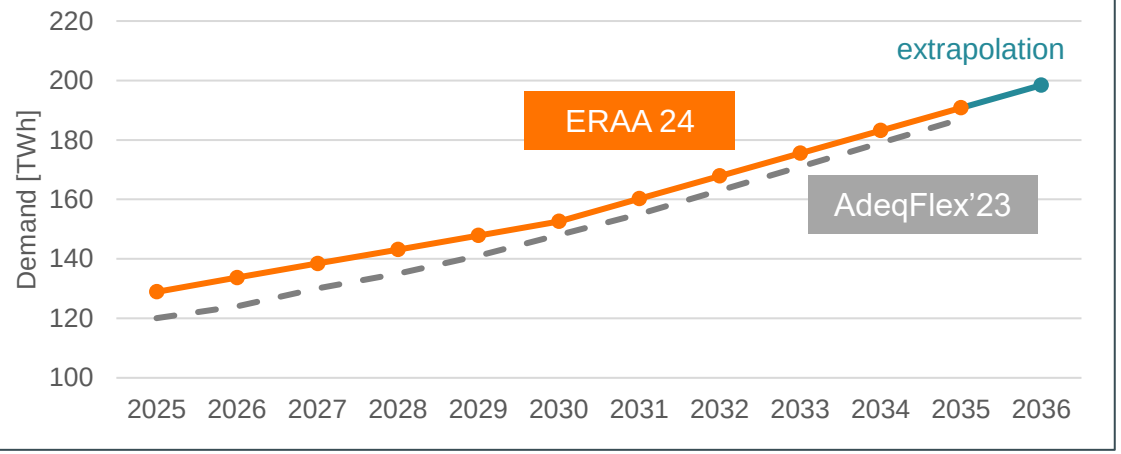
RES capacity [GW]

Capacity assumed by end of the year

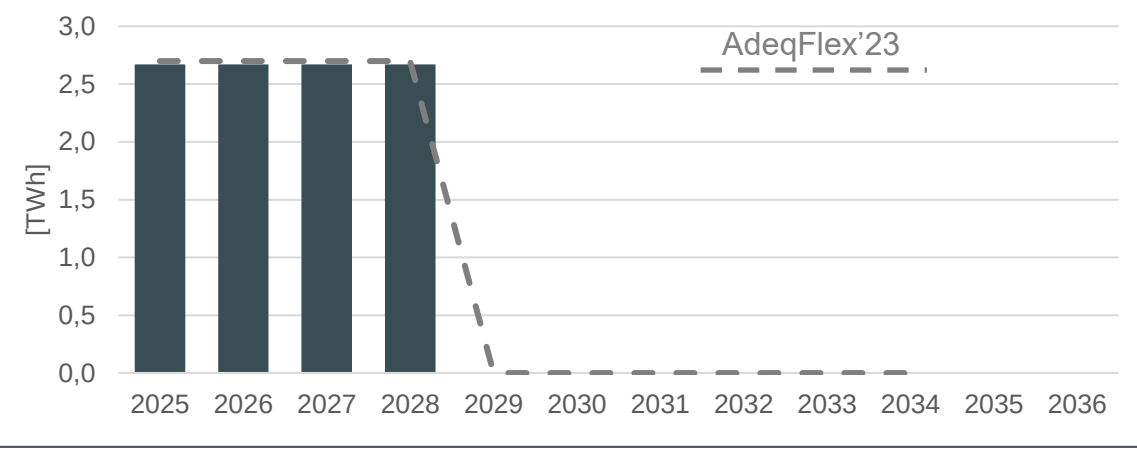


Based on ERAA24 for the Solar PV & onshore, and considering latest announcements in wind offshore projects.

Electricity demand [TWh]

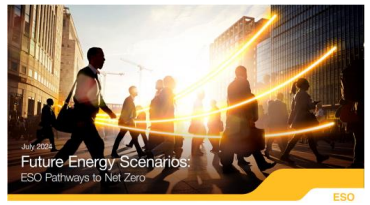


Coal phase-out



EU Assumptions – United Kingdom

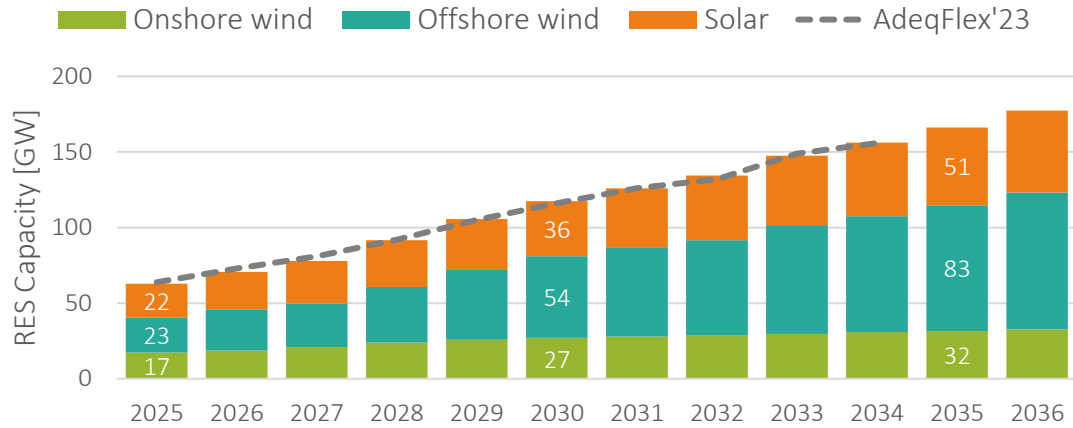
Sources



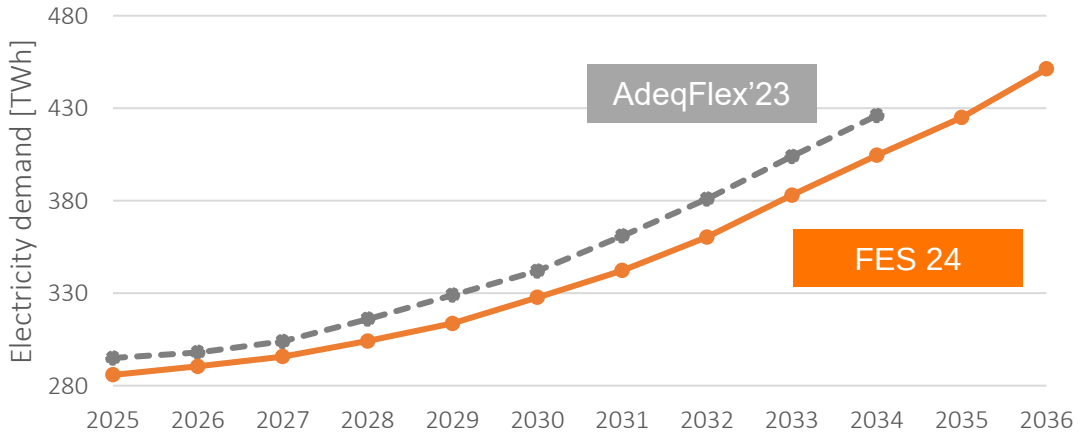
- ERAA24
- Future Energy Scenarios (July 2024)
- Unit-by-unit analysis for nuclear
- DUKES 5.11
- Capacity Market – Auction Results

RES Capacity [GW]

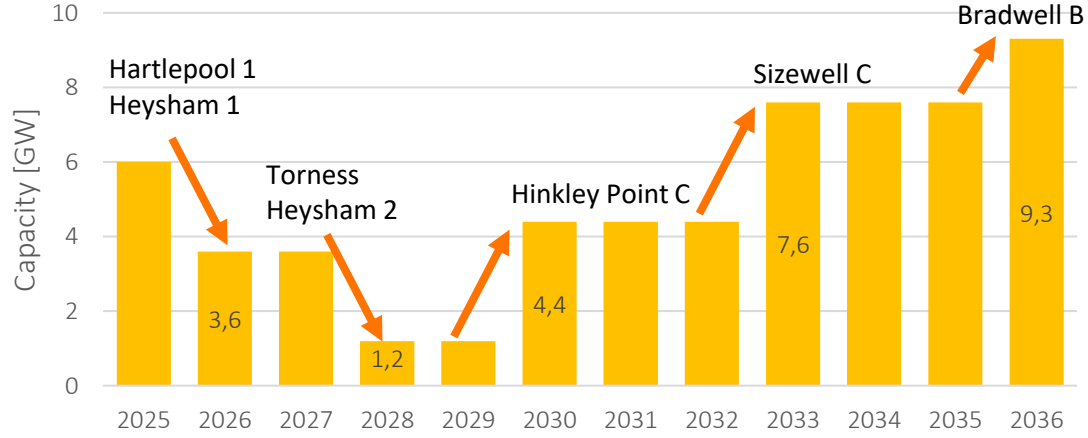
Capacity assumed by end of the year



Electricity demand [TWh]



Nuclear



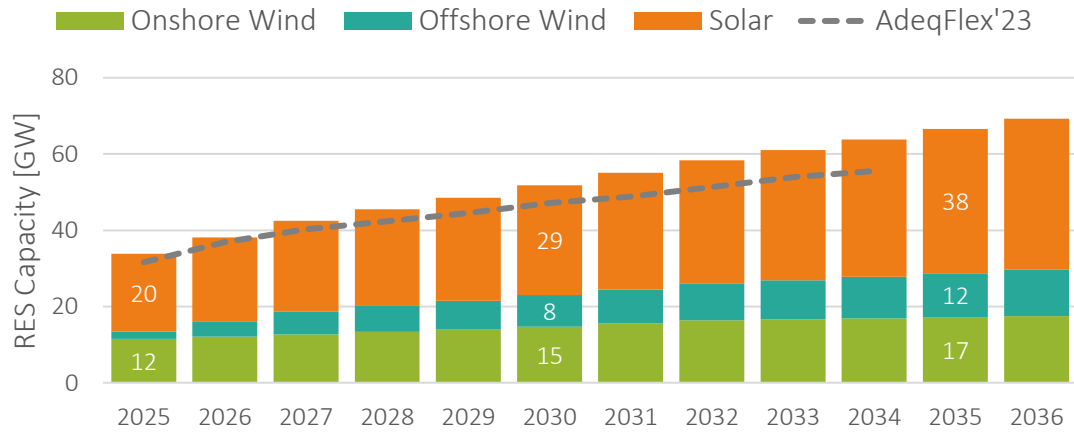
EU Assumptions – Poland

Sources

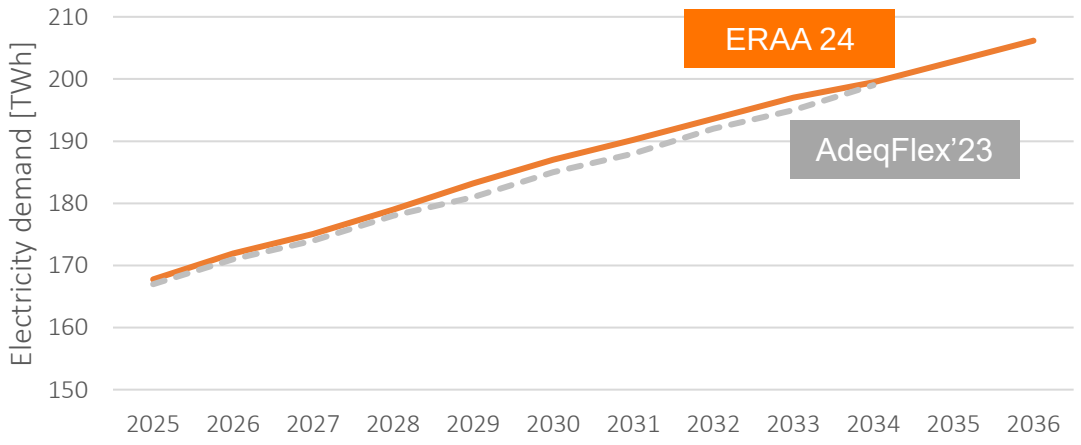
- ERAA24
- NECP Draft Updated (March. 2024)

RES Capacity [GW]

Capacity assumed by end of the year

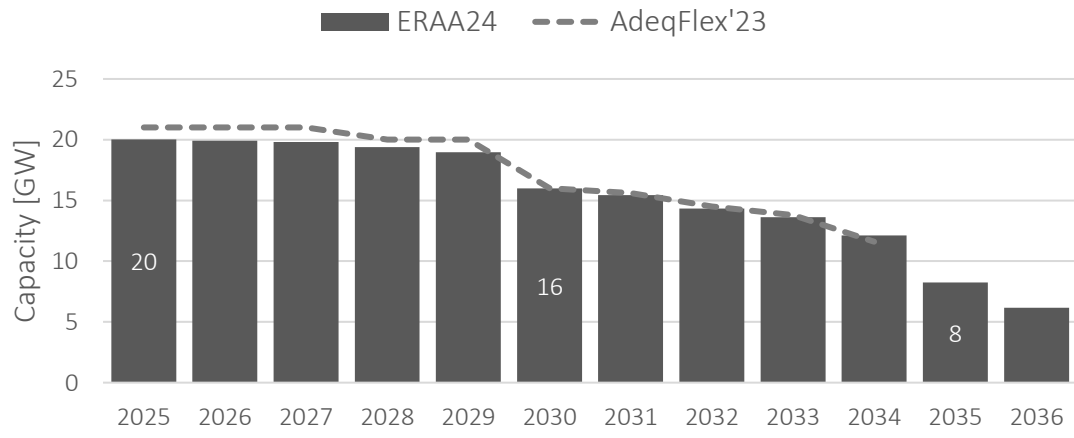


Electricity demand [TWh]



Coal phase-out*

Capacity assumed by end of the year



* Coal phase out assumed by end 2049

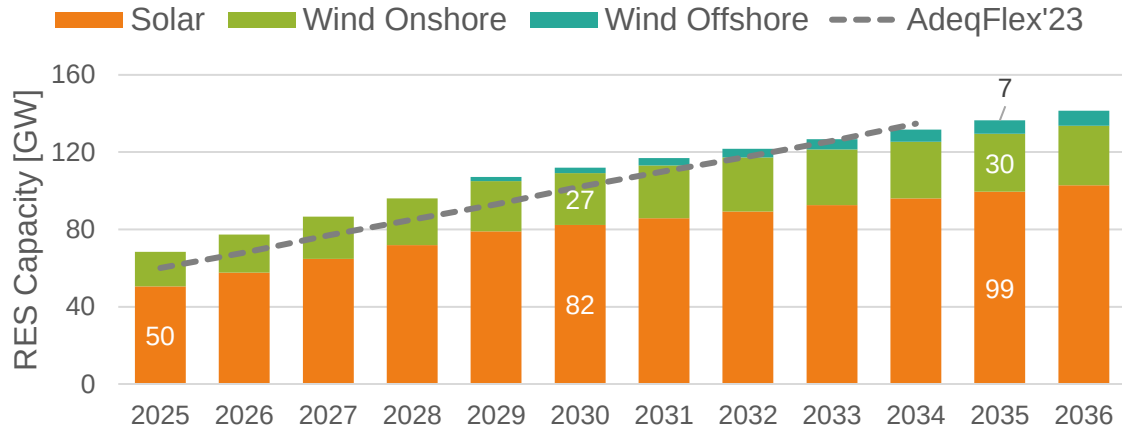
EU Assumptions – Italy

Sources

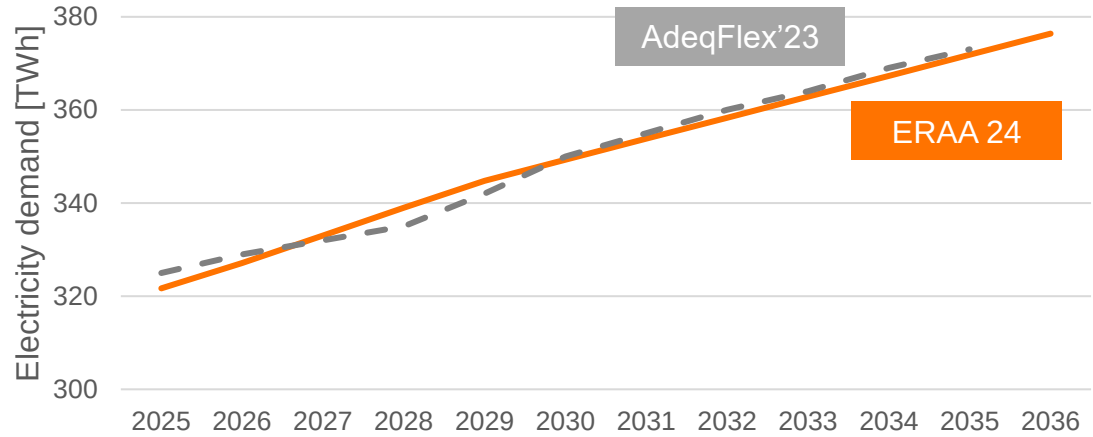
- ERAA24 (Oct, 24)
- Documento di Descrizione degli Scenari 2024 (Oct, 2024)

RES capacity [GW]

Capacity assumed by end of the year

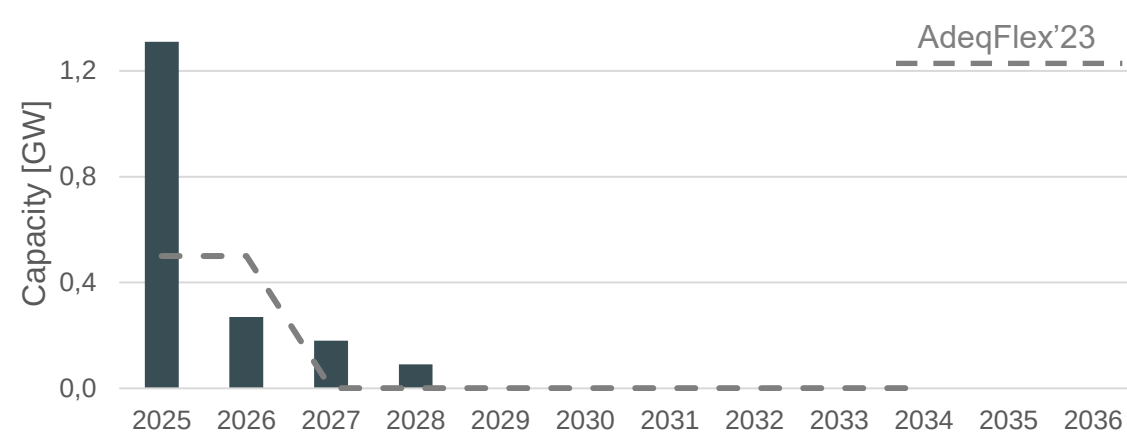


Electricity demand [TWh]



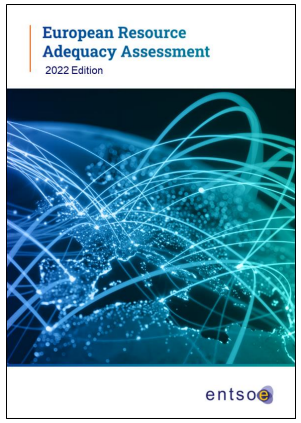
Coal phase-out

Capacity assumed by end of the year



EU Assumptions – Spain

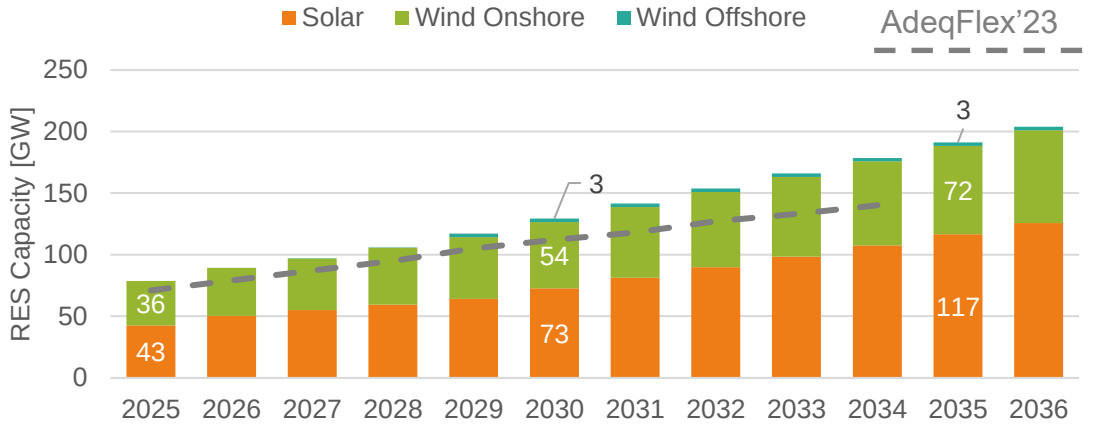
Sources



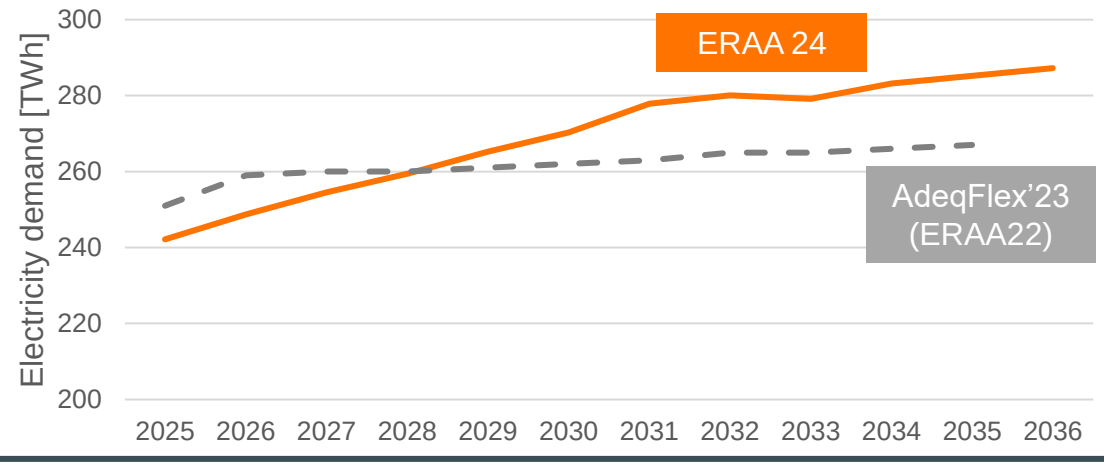
- ERAA24 (Oct, 24)
- NECP (Sept, 24)

RES capacity [GW]

Capacity assumed by end of the year

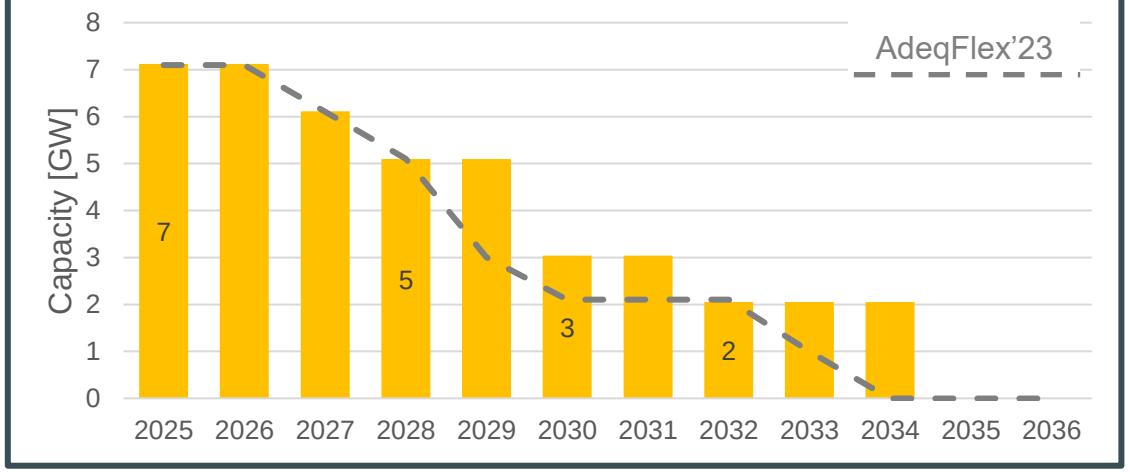


Electricity demand [TWh]

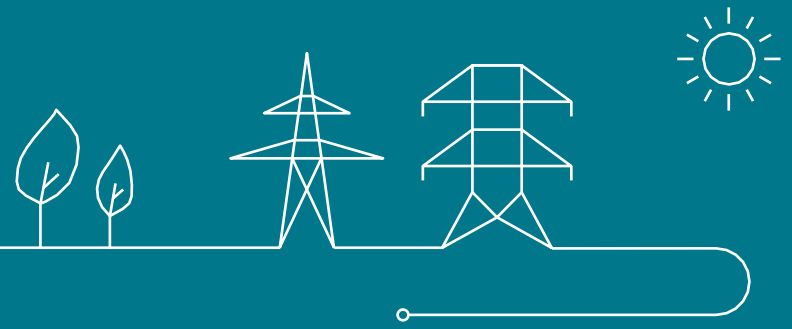


Nuclear phase-out

Capacity assumed by end of the year



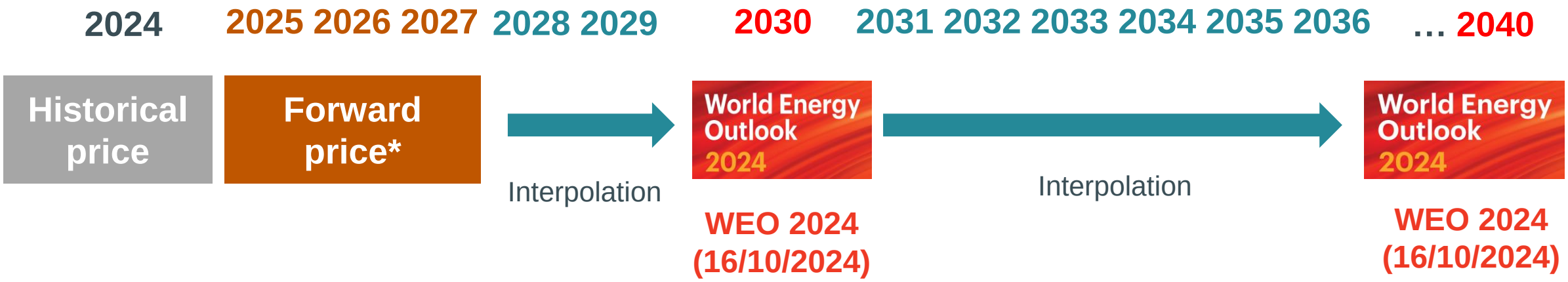
Economic and other assumptions



Proposal for fuel and CO_2 prices

General approach:

- The starting point is today historical price (average 2024).
- Then for the trajectory, values are interpolated to the World Energy Outlook 2024 published on 16th of October will be used as target value. The scenario 'Announced Pledges' is proposed to be used.
- **All prices will be expressed Euros2024**.



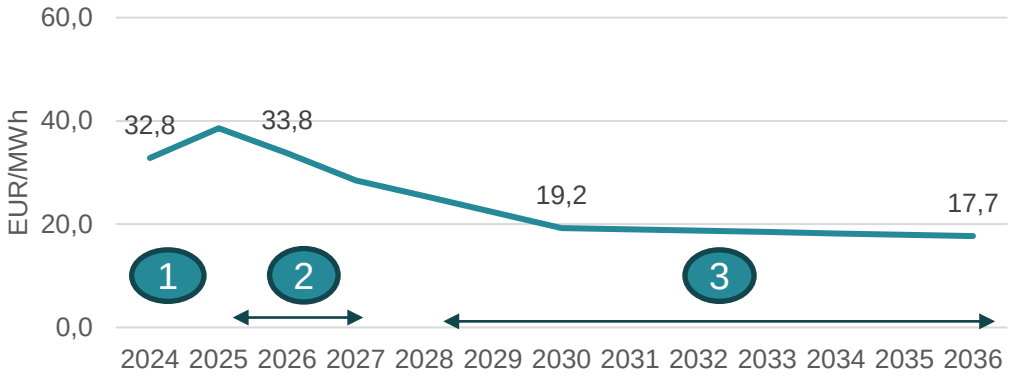
** Forward prices will be updated with latest market information beginning of 2025*

Proposal for fuel and CO_2 prices

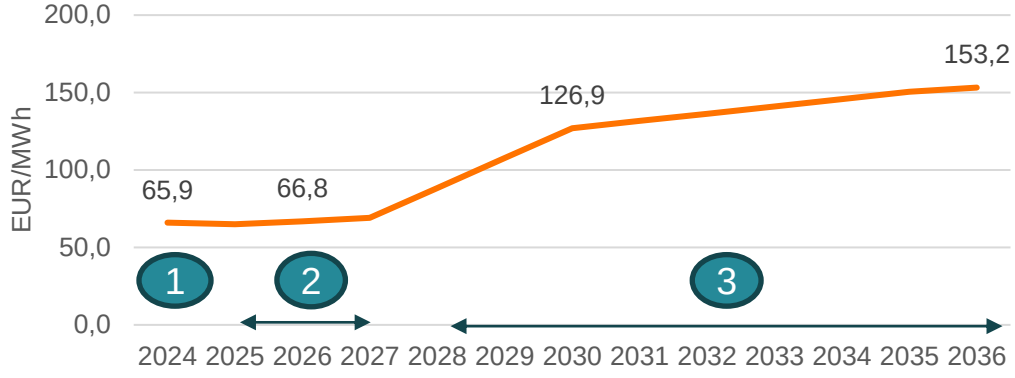
Note that given the volatility of fuel and CO_2 prices, sensitivities can be foreseen.

1. *2024 average*
2. *Forward prices*
3. *Interpolation towards WEO2024 data (2030 & 2040)*

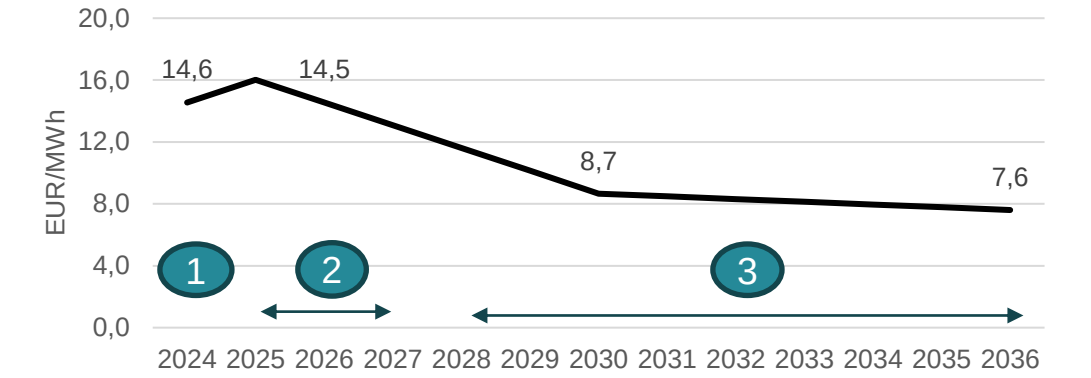
Proposal for gas price [€/MWh]



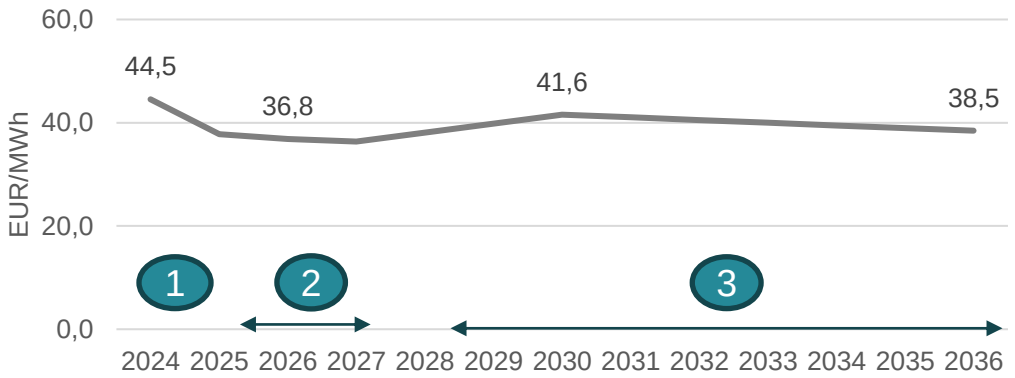
Proposal for carbon price [€/tCO_2]



Proposal for Coal [€/MWh]



Proposal for Oil price [€/MWh]



** Forward prices will be updated with latest market information beginning of 2025*

Proposal for investment costs

General approach:

- Consider different studies to deliver CAPEX numbers. Details given in the Excel.
- FOM will be aligned with ENTRAS (presented in WG adequacy last year) for thermal fleet, and with literature review for RES
- Data will be given for
  - Different time horizons
  - Different technology size (same nomenclature than last AdFlex)
- All costs of the study will be expressed in current Euros: **Euros 2024.**

Detailed information is to be found in the Excel file

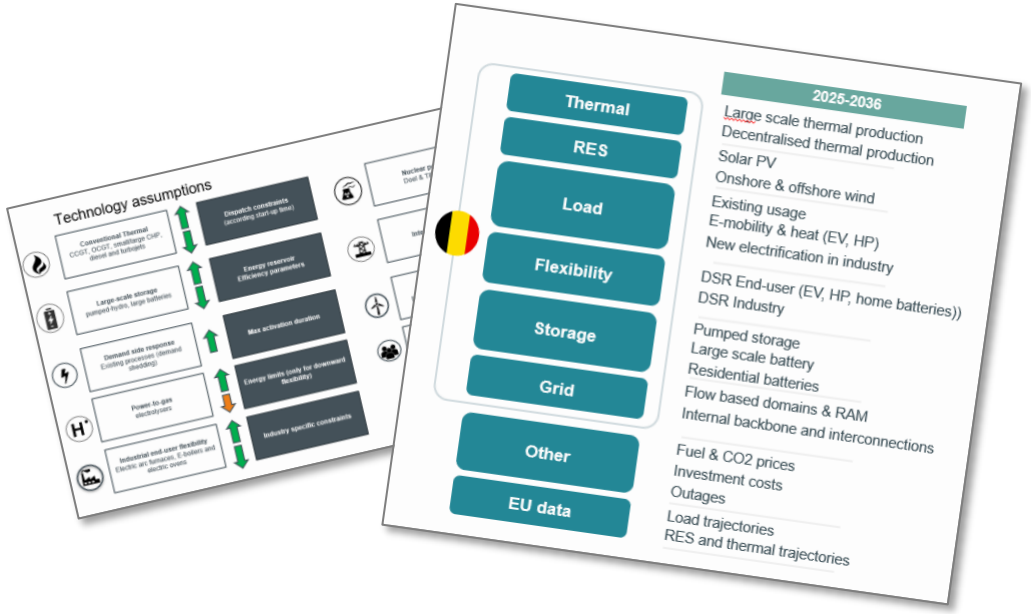
Public consultation will start today

Overview of documents submitted for public consultation

Scenario & data

Accompanying documents describing the scenario

Excel tables with the data



Methodology

+ Methodology documents

A. **Unit commitment -** Details the unit commitment model used for the adequacy and economic simulations
B. **Electricity consumption -** Details the way the electricity consumption is derived and the derivation of hourly profiles
C. **Thermal generation modelling -** Details the way thermal generation is modelled
D. **Electric vehicle modelling -** Details the way electric vehicle are modelled, including their flexibility
E. **Heat pump -** Details the way heat pumps are modelled, including their flexibility
F. **Batterie -** Details the way large-scale and residential are modelled, including their flexibility
G. **Adequacy study -** Details the way that the adequacy simulations and Monte-Carlo approach are performed
H. **Reliability standard –** Details the Loss of Load Expectation metric
I. **Adequacy patch -** Details the way that curtailment sharing is dealt with
J. **Climate years -** Details on the content of the climate database
K. **Economic Viability Assessment -** Details the approach of the economic viability assessment
L. **Cross-border capacities -** Details the way that interconnections and flow based are modelled
M. **Short-term flexibility methodology -** Details the way the short-term flexibility assessment is performed

- **Study by Prof. Boudt on hurdle rates**
- **PRICED study by E-CUBE**
- **UGent review of HP parameters**

Public consultation on data & methodology: How ?

From 5/11 until 05/12/2024 6 PM

WHAT ?

- **Scenario & sensitivities:**
  - Any feedback is welcome on the proposed values as well as suggestions for **sensitivities and alternative scenarios.**
- **Methodology:**
  - The methodology is also part of the public consultation. Any comments or suggestions are welcome taking into account the existing regulation on adequacy studies.

Any comments on above topics are more than welcome. This will help us make a valuable study for the stakeholders.

In case of questions during the public consultation (e.g. clarifications), you can contact: Maud.Perilleux@elia.be

Thank you for your attention

Overview of methodology related to adequacy documents available and submitted to public consultation

- **Unit commitment -** Details the unit commitment model used for the adequacy and economic simulations
- **Electricity consumption -** Details the way the electricity consumption is derived and the derivation of hourly profiles
- **Thermal generation modelling -** Details the way thermal generation is modelled
- **Electric vehicle modelling -** Details the way electric vehicle are modelled, including their flexibility
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- **Reliability standard –** Details the Loss of Load Expectation metric
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- **Climate years -** Details on the content of the climate database
- **Cross-border exchange capacities -** Details the way that interconnections and flow based are modelled
- **Economic Viability Assessment -** Details the approach of the economic viability assessment
- **Short-term flexibility methodology** - Details the way short-term flex assessment is performed
- **Short-term flexibility assumptions** - Details the assumptions for short-term flex assessment

AOB

Next meetings

Next meetings

- **Friday 22/11/2024 : WG Adequacy** (09:30 AM to 12:30 PM)
- **Wednesday 18/12/2024 : WG Adequacy** (09:30 AM to 12:30 PM)

Please find further information on the next meetings through the WG Adequacy webpage

Thank you.