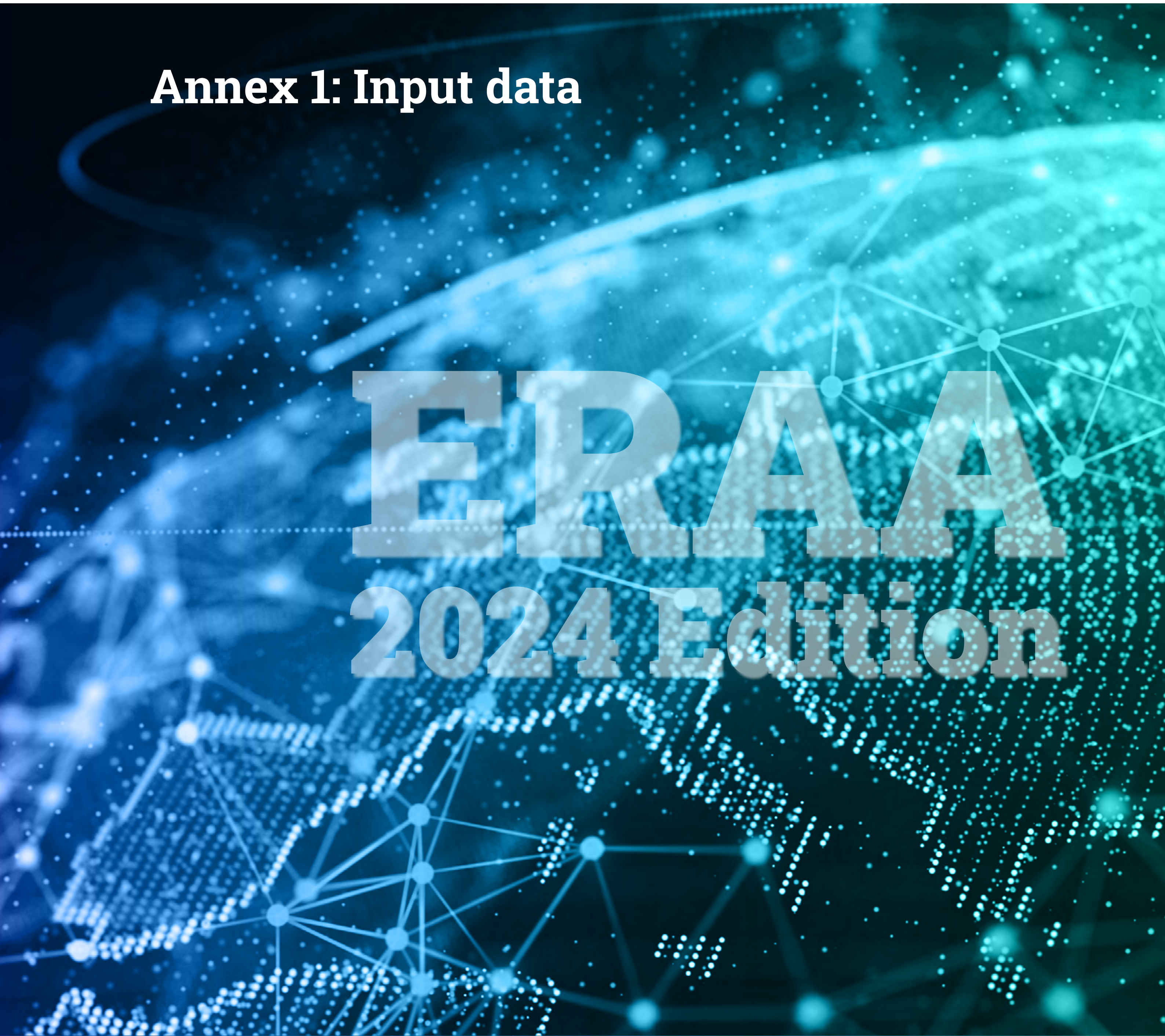
European Resource Adequacy Assessment

2024 Edition

ACER's approved and amended version (August 2025)

Annex 1: Input data



entsoe

European Network of Transmission System Operators for Electricity

Table of Contents

1 ERAA 2024 Scenario

1.1 Scenario description

The European Resource Adequacy Assessment (ERAA) builds on the most up-to-date expectations for the selected target years, guided by policy frameworks and stakeholders' expert views. ENTSO-E conducts an extensive data collection exercise, during which Transmission System Operators (TSOs) provide their views and estimations of the trajectories of demand, resource capacities and grid elements. The input data gathered from TSOs populate ENTSO-E's databases including the Pan-European Market Modelling Database (PEMMDB). These bottom-up datasets comprise ENTSO-E's National Trends Scenarios. The data collection for ERAA 2024 began in autumn 2023 and ENTSO-E provided guidance to TSOs on the assumptions for the scenario in addition to the data required to ensure a common understanding of all underlying assumptions, targeting a consistent data set among all modelled study zones. Quality checks and reviews were continuously conducted throughout this process, with updates integrated into the assessment until the launch of the study's main simulations in summer 2024. Impacts of the latest country-specific updates that could not be accounted for are discussed – when relevant – in Annex 5.

A pan-European study naturally requires an extensive amount of input data, which are mostly calculated by respective TSOs, but also centrally by ENTSO-E, based on national policies and trends. Data collection assumptions can be found in the published data collection guidelines. The National Trend Scenarios of ERAA 2024 are mainly based on the National Energy and Climate Plans (NECPs) available at the time of the data collection and - wherever possible - reflect the ambitions of the Fit for 55 (FF55) package. For more information on the drivers of the National Trend scenarios, please see the detailed TSO survey in the next sections.

The ERAA methodology defines the Central Reference Scenario:

Central Reference Scenario: This is based on the National Trends Scenario and is updated through applying the Economic Viability Assessment (EVA). Note that this scenario also considers Capacity Mechanisms (CMs) that already hold a CM contract for a given year assessed in ERAA that was granted in any previous auction of any existing or approved CM at the time of the assessment.

1.2 TSO Survey on scenario drivers

Nine scenario elements require an elaborate description of the different views of TSOs and their impact on ERAA 2024, namely: compliance with FF55, capacity projections, demand forecasts, interconnection data, efficiency, the consideration of 'Recovery and Resilience Facility', out-of-market measures available to TSOs, the latest market reforms in each country, and the evolution of trajectories and their potential impact on adequacy. The sections below summarise TSOs' views on the aforementioned topics based on survey responses from 35 TSOs. The interested reader can consult Appendix 1 for detailed TSO feedback.

1.2.1 Compliance with Fit for 55 (FF55)

According to the TSO survey responses, 26 out of the 35 TSOs submitted data for the National Trend Scenarios that are considered to be either partially or fully compliant with FF55. The survey results indicate varying levels of compliance with FF55. Countries such as Spain, Germany, and Finland have data that aligns with FF55 goals, considering ambitious targets for renewable energy, emissions reduction, and electrification. However, countries such as Belgium, Ireland, and Poland have data that partially complies with FF55, due to ongoing updates in their NECPs and national objectives. Some countries have mentioned that their NECPs are not yet updated with the latest FF55 targets and regulations. Overall, while many countries have taken steps towards FF55 compliance, some remain in the process of aligning their energy plans with the EU's FF55 objectives.

1.2.2 Capacity data drivers

Conventional generation data drivers
The primary drivers for the data regarding conventional generation were the NECP (or draft versions), TSO network plans, national studies, permits, investment plans, connection requests, input from market participants, and government decisions.

Renewable energy sources (RES) data drivers:
The primary drivers for the data related to generation from Renewable energy sources (RES) were the NECP (or draft versions), FF55 targets, national development plans, TSO and DSO estimates, national studies, political targets and ambitions, connection requests, transmission grid development plans, and information gathered from independent research institutions and government strategies.

These drivers played a significant role in shaping the data collection process and ensuring compliance with national plans, regulatory requirements and market trends for conventional and RES generation.

1.2.3 Demand data drivers

Primary drivers for demand forecasts and profiles included NECP, FF55 targets, TSO/DSO studies and plans, political targets, national energy strategies, connection requests, and studies from independent research institutions. These drivers considered factors such as electrification, Power-to-X, DSR, phase out 'line gas', and population and GDP growth. The data aligned with national resource adequacy assessments and reports.

1.2.4 Interconnections

Fulfilment of the 70% cross-border capacity rule
Article 16 (8) of the Electricity Regulation sets a minimum threshold of 70% for cross-border capacity to be available for market participants relating to both net transfer capacities (NTCs) and flow-based (FB) parameters. For regions with an FB approach already implemented, it builds on a minimum remaining available margin (minRAM) requirement. The National Regulatory Authority (NRA) of each Member State assess compliance with the requirement .

The 70% requirement is currently not applicable between EU and non-EU borders or between non-EU borders (e.g. Albania, Bosnia and Herzegovina, Serbia). For borders between EU members and non-EU members, the inclusion of third country flows on the 70% RAM depends on an agreement between the capacity calculation region and the third country that shall also cover other topics such as cost-sharing remedial actions. For this exercise, third-country flows are included in the 70% min RAM.

Regarding the FB market coupling geographical areas, the 70% requirement is integrated into the calculation of the FB domains, ensuring that all EU–EU borders modelled with FB comply with a 70% minRAM (see Annex 2, Section 4). By contrast, NTC values are collected from TSOs and thus, the provision of compliant assumptions depends on the border (for more information on the compliance for each border, see Appendix 1: TSO survey on scenario assumptions).

Primary drivers for interconnection data

The primary drivers for TSOs' NTC submissions are the 70% requirements, FF55, National Development Plans (NDPs) and anticipated delays in commissioning projects. Note that the final value for each interconnector shall account for the feedback of both relevant TSOs, which in principle should be coordinated. If this is not the case, the most conservative view is retained. Efforts were made to achieve compliance with the 70% target, and variations in NTC values were allowed within the ERAA methodology.

Other relevant assumptions for interconnection data

Several new questions were included in the survey for TSOs in ERAA 2024. First, based on stakeholder requests, it was asked to identify new nodes compared to ERAA 2023. This was only applicable for four countries: Denmark, Greece, the Netherlands and Norway.

Next, TSOs in the Core CCR (Austria, Belgium, Croatia, the Czech Republic, France, Germany, Hungary, Luxemburg, the Netherlands, Poland, Romania, Slovakia and Slovenia) were asked to clarify the calculation methods used in defining the NTC. The responses of the TSOs vary spanning from the FBMC methodology, the use of TYNDP results, and other individual approaches.

1.2.5 Efficiency

TSOs were also asked for more information regarding their targets for reducing their emissions through increasing efficiency by:

- Converting/upgrading heating technologies: 31 out of 35 TSOs responded that their country intend to reduce emissions through increasing efficiency by converting/upgrading heating technologies
- Electrifying transport: 31 out of 35 TSOs responded that their country intends to reduce emissions through increasing efficiency by electrifying transport
- Improving building insulation: 31 out of 35 TSOs responded that their country intends to reduce emissions through increasing efficiency by improving building insulation
- Reducing temperature-dependent load: 19 TSOs expect a reduction of emissions by reducing the temperature-dependent load whereas six see no such plans by their country.

However in some cases the shift from combustion heating to electrification might increase the electrical heat demand, which can have implications for emissions depending on the electricity generation mix.

1.2.6 Consideration of the ‘Recovery and Resilience Facility’ programme

Less than half of the TSOs (14 out of 35) confirmed that their submission accounts for the Recovery and Resilience Facility.

1.2.7 Out-of-market measures

This chapter provides a systematic characterisation of out-of-market measures as provided by TSOs (e.g. those characterised as ‘out-of-market’ or that have not been considered available for adequacy purposes). In addition, a quantification of out-of-market measures that could address adequacy crises (e.g. a reduction of demand through voltage reduction) – without necessarily modelling all of them – is also reported.

These measures – including frequency restoration reserve (FRR) and frequency containment reserve (FCR) balancing market products, strategic reserves, demand-side response and voltage reduction – can contribute to system adequacy by providing additional capacity, supporting grid stability, and managing supply–demand imbalances.

For a detailed table on out-of-market measures for each country or zone, please see Appendix 1.

1.2.8 Market reforms

Market reforms (Article 23(5)(e) and Article 20(3) of the Electricity Regulation) shall be considered in the ERAA scenario. Most of these reforms are captured through the input data collected. TSOs provided their feedback on whether their country was initiating (currently or in the future) national market reforms (e.g. price cap rules, scarcity pricing) and how these were considered when providing the ERAA input data (see Appendix 1).

Market reforms considered in the PEMMDB data include storage facilities, interconnection reinforcement, implicit DSR (flexible consumers), and explicit DSR. However, some countries have not implemented specific market reforms and rely on existing market structures. Overall, the extent and nature of market reforms vary among countries based on their energy policies and goals, whereby detailed answers and a detailed table on the market reforms per country or zone can be found in Appendix 1.

1.2.9 Drivers of evolution

ERAA 2024 focuses on four target years (TYs) for the adequacy assessment. Therefore, a qualitative understanding of the key capacity and energy mix evolution drivers (policy or otherwise) for the coming decade can provide valuable insights. Important drivers can be updates to the NECP, other national climate action plans and targets, and network development plans. Some countries also expect market-based developments to be important drivers (e.g. high fossil fuel and CO_2 prices).

2 Demand dataset

The demand (or 'load') dataset in ERAA 2024 represents the active power required by any end user installation/appliance connected to the grid, except for the major dispatchable consumption units, including hydro pumps in hydro storage facilities; battery systems, electrolysers, and power-to-heat facilities. The final demand in ERAA 2024 also considers the consumption of these major dispatchable consumption units, defined during the modelling stage when the dispatch of such units is optimised. However, in this annex, the consumption of such units is disregarded when we refer to demand.

Demand comprises several parts: part of demand that cannot be moved to another point in time by price incentives; part of demand that will only be consumed if electricity prices remain below certain threshold (referred to as explicit DSR); part of demand that would be consumed but could be shifted in time given sufficient price incentives (referred as implicit DSR, which generally represents the flexibility of some part of the heat pumps, electric vehicle (EV) charging and PV battery systems' operation). All information below refers to the demand before any decisions on demand reduction or shift in time are taken, or dispatch of major dispatchable consumption units.

For details on how the demand dataset is created, please refer to the demand methodology[1] (published on ERAA 2024 downloads section). Generally, demand is estimated for every hour of a considered year of the assessment considering the expected evolution of consumers (e.g. the expected evolution of various electrical assets such as EVs). It also considers a number of possible weather conditions for every hour, as a major factor of electricity demand. Weather conditions are interlinked between every hour and spatially, which is ensured within the weather scenario dataset. Section 3 provides more information about weather conditions[2] considered in ERAA 2024.

2.1 Overview of expected demand in the coming decade

A notable electrification is expected in Europe, with a 26% increase over nine years corresponding to a ~2.6% annual increase.

Figure 1 presents the evolution of expected annual consumption and average hourly demand values over the years assessed in ERAA 2024. For the annual consumption, the bars represent average values, and the brackets represent the range of values, depending on weather conditions. For the average hourly demand values, i.e. the expected demand under average weather conditions, the bars represent the average values, and the brackets the range of values depending on the hourly time period over the year. The upper (lower) bracket represents the maximum (minimum) hourly value of the average across weather conditions.

[1] https://www.entsoe.eu/outlooks/eraa/2024/eraa-downloads/

[2] A set of weather conditions representing whole year is generally referred as weather scenario.

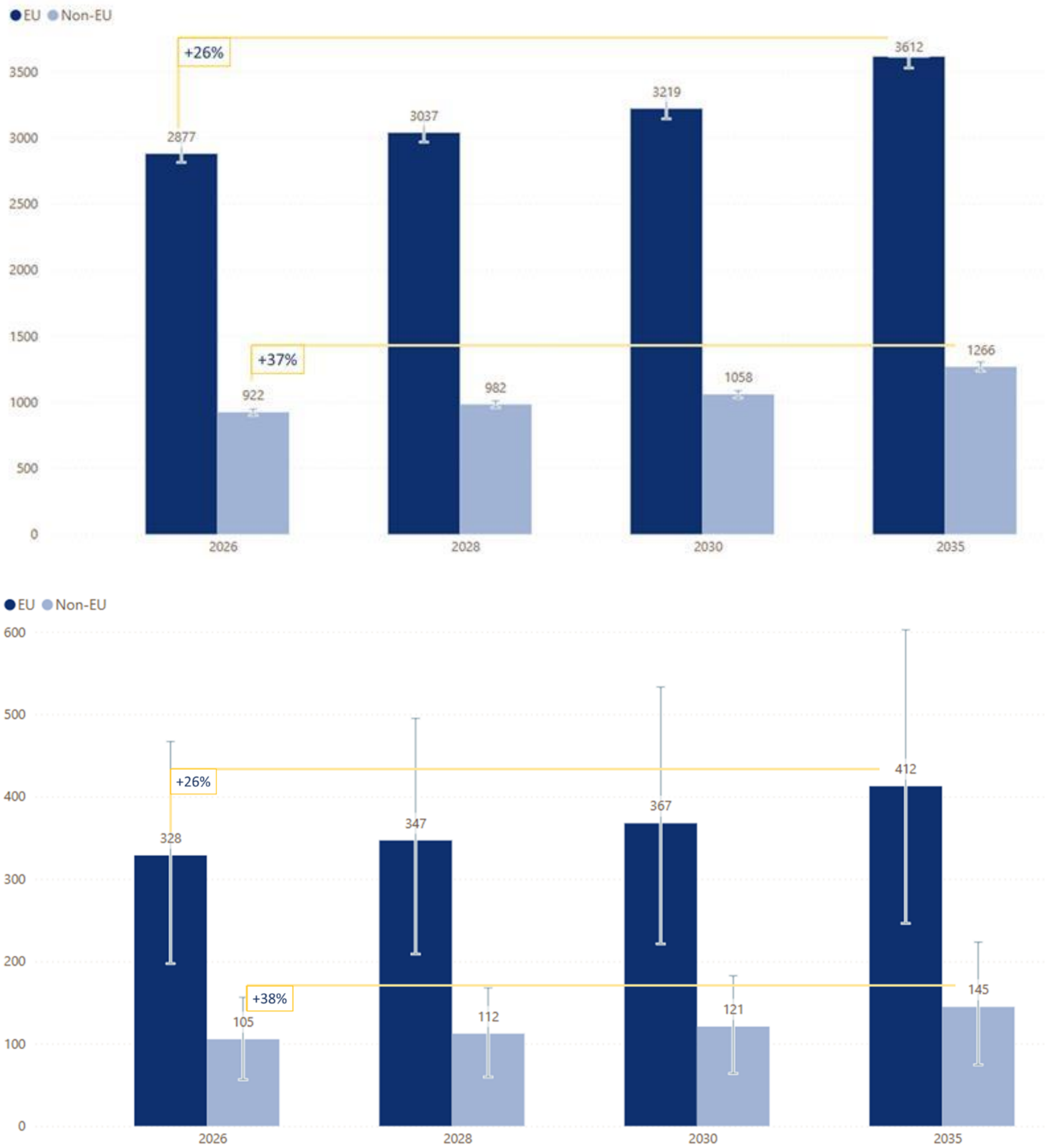


Figure 1: Yearly demand [TWh] and average hourly demand [GW]

3 Weather scenarios

Weather conditions[3] are a pivotal dataset for any power system assessment due to their impact on demand and supply. Demand is strongly influenced by weather conditions, especially during winter cold spells and summer heat waves. On the supply side renewable generation potential (wind, solar and hydro) is strongly affected. While conventional generation availability is also affected, it can diminish under unfavourable conditions such as high cooling water temperatures or low river levels. All of these weather conditions are described within Pan-European Climate Database (PECD).

ENTSO-E has co-developed and adopted the fourth version of the PECD together with ECMWF and C3S in ERAA 2024 (along with other ENTSO-E products as seasonal outlooks). For the first time, it considers the climate model outcomes where weather conditions and renewable generation potential are assessed considering assumptions on the future climate evolution. Details of the solution and technical documentation is accessible on the C3S website[4]. ENTSO-E has published the data package used in the study after any necessary processing, while the reader can also access even more granular data on the C3S website.

3.1 Requirements for the weather scenario dataset

It is necessary to have a comprehensive dataset describing possible simultaneous operational conditions across Europe at different hours of the year and in different areas. This is important because the European power system is highly interconnected and the situation in one region can influence neighbouring regions.

This dataset must be sufficiently granular, both spatially (e.g. the pan-European average temperature is not suitable for all study zones individually) and temporally (e.g. the annual average temperature is not suitable for representing different seasons). Furthermore, the climate data as a whole must represent a coherent set[5], ensuring that it represents reasonable situations in space (e.g. the temperatures in neighbouring study zones in given hour should be similar) and in time (e.g. the temperature does not drastically change from one hour to another). The PECD4 was developed to meet these requirements and PECD version 4.1 was used in ERAA 2024 assessment.

3.2 Representative weather scenarios for the EVA

Following the approach described in Annex 2 (Section 10.5), the full set of weather scenarios (WSs) is reduced for the EVA to a subset of three representative WSs to keep the complexity of the model manageable. Table 1 shows the selected WSs and their corresponding weights. These are applied to all TYs.

[3] Referred as *'climate data'* until ERAA 2024.
[4] C3S Climate Data Store - https://cds.climate.copernicus.eu/datasets/sis-energy-pecd?tab=overview (Copyright ©2024 ECMWF/C3S/ENTSO-E).
[5] Often referred to as 'spatial and temporal correlation'

Table 1: Selected WSs and assigned weights

Selected WSs	Weights
WS14	0.439
WS25	0.122
WS28	0.439

4 Resource capacities of National Trend Scenarios

As described in Section 1.1, the National Trend Scenario is the starting point for the Central Reference Scenario to which the EVA is applied. The EVA modifies the resource capacities between scenarios, while the remaining assumptions under the National Trend Scenario remain applicable.

In the context of ERAA 2024, a market resource (also called 'resource' for simplicity) is a market-participating unit that can be scheduled to meet demand at in time. Market resources include technologies that inject power into the grid and technologies that reduce or shift the demand to be met, such as DSR. DSR can be further categorised as explicit or implicit DSR: explicit DSR involves market-driven demand changes via accepted offers, including aggregated actions and foregone/time-shifted demand, while implicit DSR entails customer demand shifts in response to variable prices or incentives, with self-directed or provider-guided adjustments.

Error! Reference source not found. Table 2 below details the technology aggregations used in the figures of this section.

Table 2: Technology aggregations and classification used in installed capacity figures

Technology aggregation	Underlying technologies
Hydro	RoR and pondage, traditional reservoir, open PSP, closed PSP
Other RES	Geothermal, marine, small biomass, waste
Solar	PV (farm and rooftop), CSP
Wind	Onshore wind, offshore wind
Coal	Hard coal, lignite
Gas	Conventional, OCGT, CCGT
Nuclear	N/A
Other non-RES	Heavy oil, light oil, shale oil, other
DSR – Explicit	N/A
Battery	N/A
Storage	Battery (large scale and non-market)
Hydrogen	H_2 OCGT, H_2 CCGT

4.1 Resource capacities for National Trend Scenario

Figure 2 shows the resource capacities (net generation capacity and DSR) by technology, aggregated for the ERAA explicit region for each TY. The figure accounts for capacities using 1 July as a threshold date, i.e. only units commissioned before 1 July and decommissioned after 1 July are included for each TY.

The figure shows that total resource capacities increase throughout the TYs, with solar and wind demonstrating the largest capacity increases.

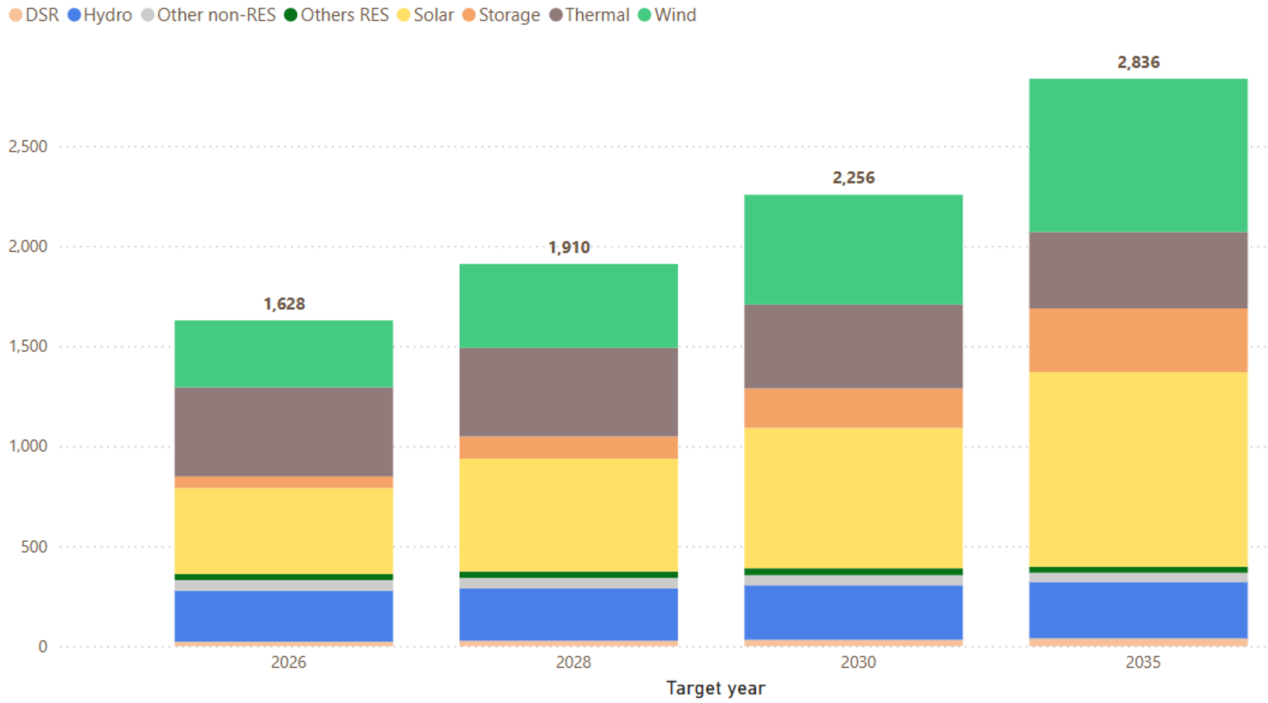


Figure 2: Resource capacity [GW]

Meanwhile some of the non-market resources dedicated for adequacy purposes which are contracted and hence could be anticipated to be available are given below.

Table 3: Non-market resources across Europe to be available for adequacy reasons

Study Zone	2026	2028	2030	2035	Comment
CH00	471	-	-	-	Only until 1 April 2026.
DE00	1093	-	-	-	Only available until 31 September 2026.
IE00	1491	1491	1491	1491	
MT00	175	175	175	175	
PL00	1313	853	-	-	

4.2 Storage capacities

Figure 3 shows the storage capacities by technology for each TY aggregated on the ERAA explicit region. The right side of the figure shows the evolution of hydro-based storage capacities (open and closed-loop pumping, pondage, and reservoir) across the TYs. The left side of the figure shows the evolution of battery-based storage (market based, i.e. large scale batteries and non-market, i.e. mostly household batteries) across the TYs. The figure accounts for capacities available in the market using 1 July as the threshold date for each TY.

The vast majority of the total storage capacity in the ERAA's explicit scope comprises hydro technologies and – more precisely – traditional reservoirs and open PSPs, whereas closed PSPs, pondage, and batteries represent only a minor proportion of the overall storage capacity.

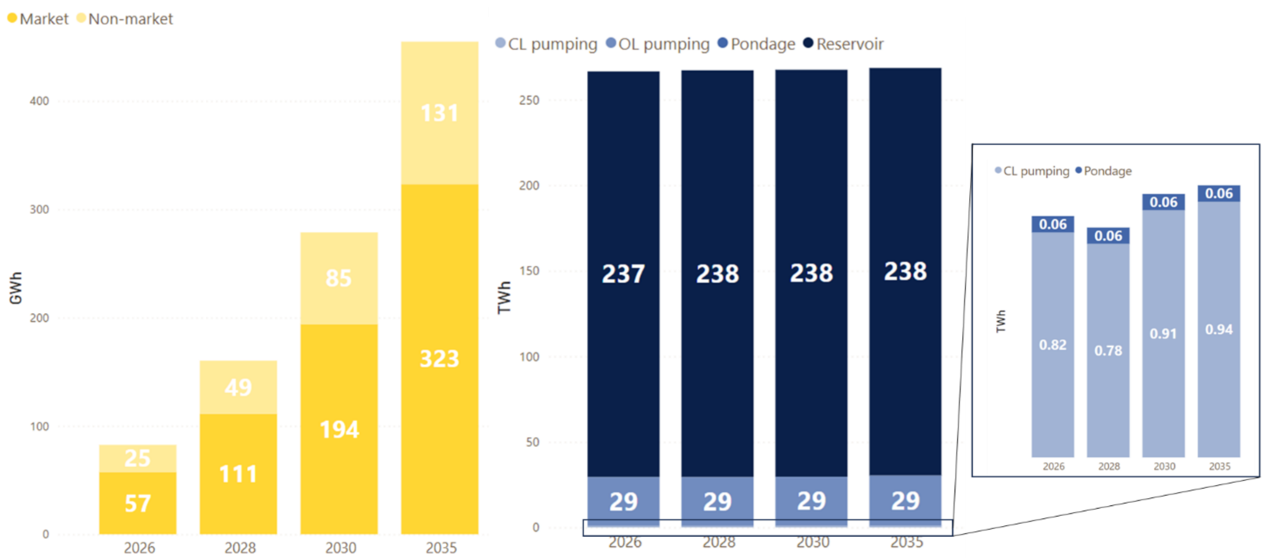


Figure 3: Hydro storage capacity [TWh], batteries storage capacity [GWh]

4.3 Reserve requirements in all scenarios

Some Frequency Containment Reserve (FCR) and Frequency Restoration Reserve (FRR) contracts have already been awarded, whereas others will be awarded in future auctions to satisfy Member State reserve requirements. Awarded/known capacities are deducted from the net generating capacities (NGCs) of thermal generation units or DSR units as reported by TSOs. The remaining capacity must be accounted for by withholding thermal or renewable capacities from the wholesale market and/or reducing available hydro turbining capacity (see Annex 2).

Figure 4 illustrates the FRR and FCR requirements of the entire system for all TYs in addition to the amount of the requirement accounted for by each method.

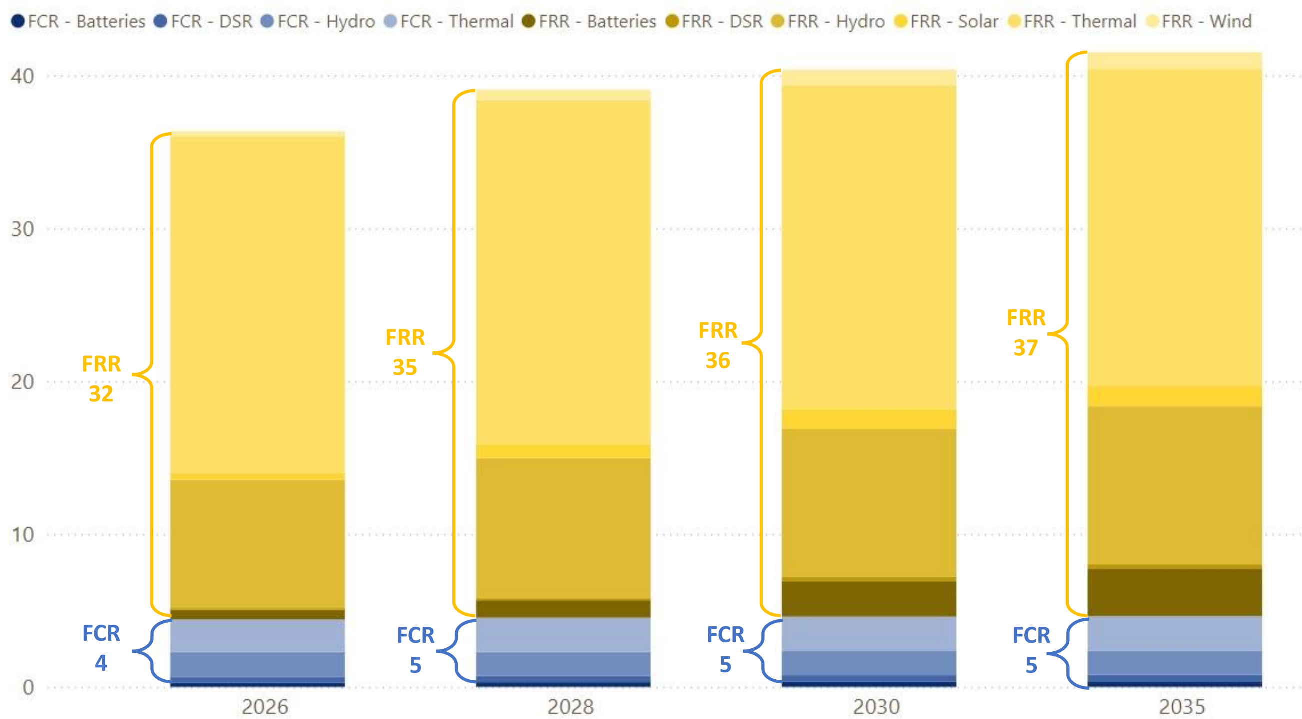


Figure 4: Reserve requirements [GW]

The figure shows that FRR (larger portion) and FCR either increase or remain steady throughout the TYs. An increase in the share of reserves provided by batteries, DSR, hydro, and RES can be observed, whereas a decrease in the share of reserves provided by thermal is evident. Figure 4also indicates that the awarded capacity is higher for later TYs.

4.4 Planned maintenance

4.4.1 Reference case

Planned maintenance of thermal assets is either calculated centrally or provided directly by TSOs to be incorporated in the models. The calculation methodology is presented in Annex 2 of ERAA 2024. Figure 5 shows, for illustration purposes the percentage share of total thermal capacity in maintenance in the ERAA explicit region per TY. For all TYs, the maintenance window is mainly during the European summer season.

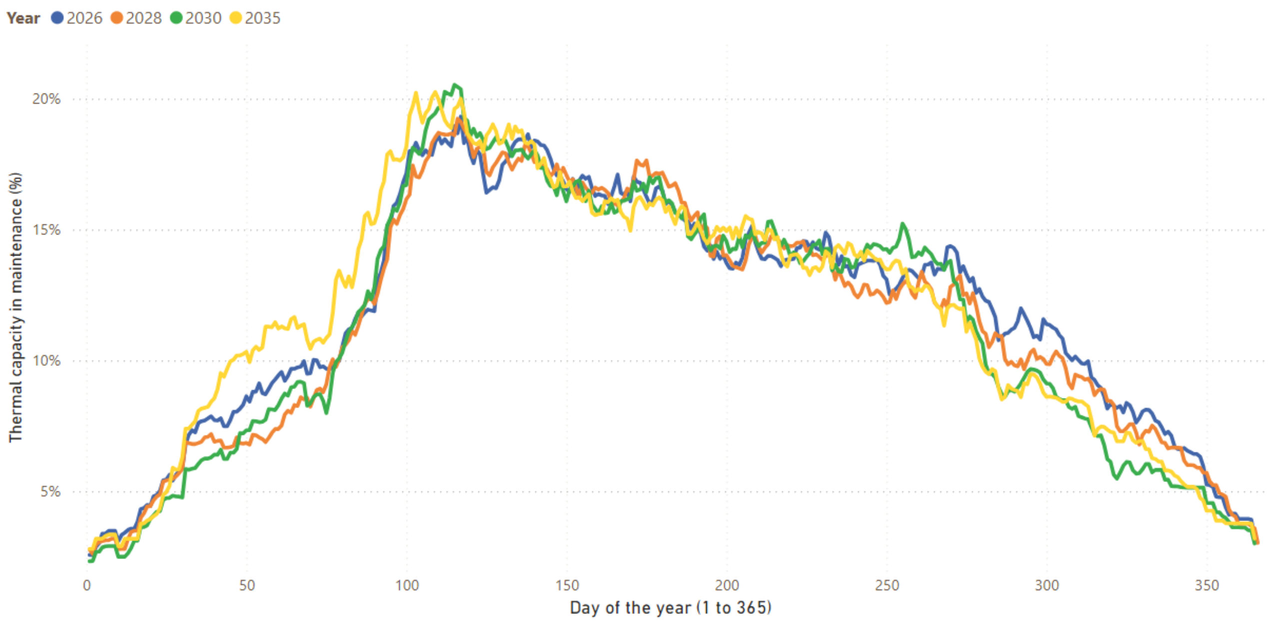


Figure 5: Pan-EU thermal capacity in maintenance [%]

4.4.2 Proof of concept: French nuclear availability insights

Compared to the ERAA 2023 report, ERAA 2024 features a proof of concept, where the reference availability time series of the French nuclear generation have been complemented with two additional cases representing a lower and a higher availability profile. This has been deemed necessary as the observed in the past, dispersion of the nuclear generation in France is gravely underestimated otherwise. As an example, comparing the actual dispersion in available capacity in the ERAA studies against the French NRAA (Figure 6) reveals that the amplitude of the dispersion in 2030 can be up to 10 times higher in the latter. In terms of annual production, the French NRAA, corroborated by actual observations, demonstrates up to 6 times higher dispersion.

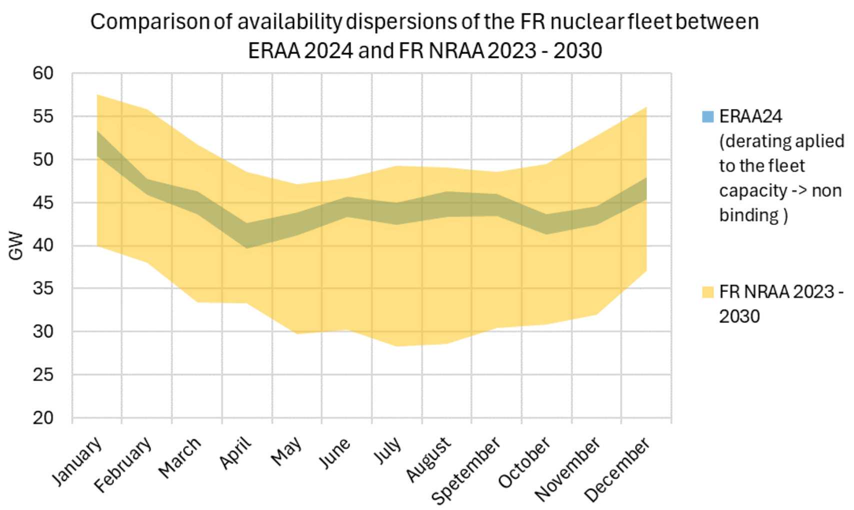


Figure 6: Comparison of dispersions of availability of nuclear power plants FR between ERAA and French NRAA

The two additional availability profiles that have been incorporated in the proof of concept are based on the following principles:

- Achieving a production level of 345TWh for the low and 375TWh for the high availability case;
- Ensure more capacity in the winter months for the high availability compared to the reference case;
- Represent low nuclear presence in the winter months for the low availability compared to the reference case;

Figure 7 and Figure 8 show the comparison of the additional cases of French nuclear generation availability (consideration of all sources of unavailability – planned maintenance, forced outages and any thermal deratings) against the reference case (consideration of planned maintenance with minimum and maximum forced outages and thermal deratings). The additional French nuclear availability cases were pre-determined taking into account all possible sources of unavailabilities already and therefore single French nuclear availability profile was defined. In the model the generation availability is composed of all aforementioned unavailability components. Sampling of forced outages probabilistically was considered when reference French nuclear availability was assumed. Hence French nuclear availability is represented as a range [6] in the reference case. However, when the low and high availability cases of French nuclear capacity were assessed, full probabilistic modelling (like for the reference case) was performed, except for pre-determined profiles for French nuclear capacity. The adequacy indicators of the proof of concept are averaged for the three cases for France and Belgium where the impact is considerable.

[6] This is applicable also for other technologies and other power systems in Europe.

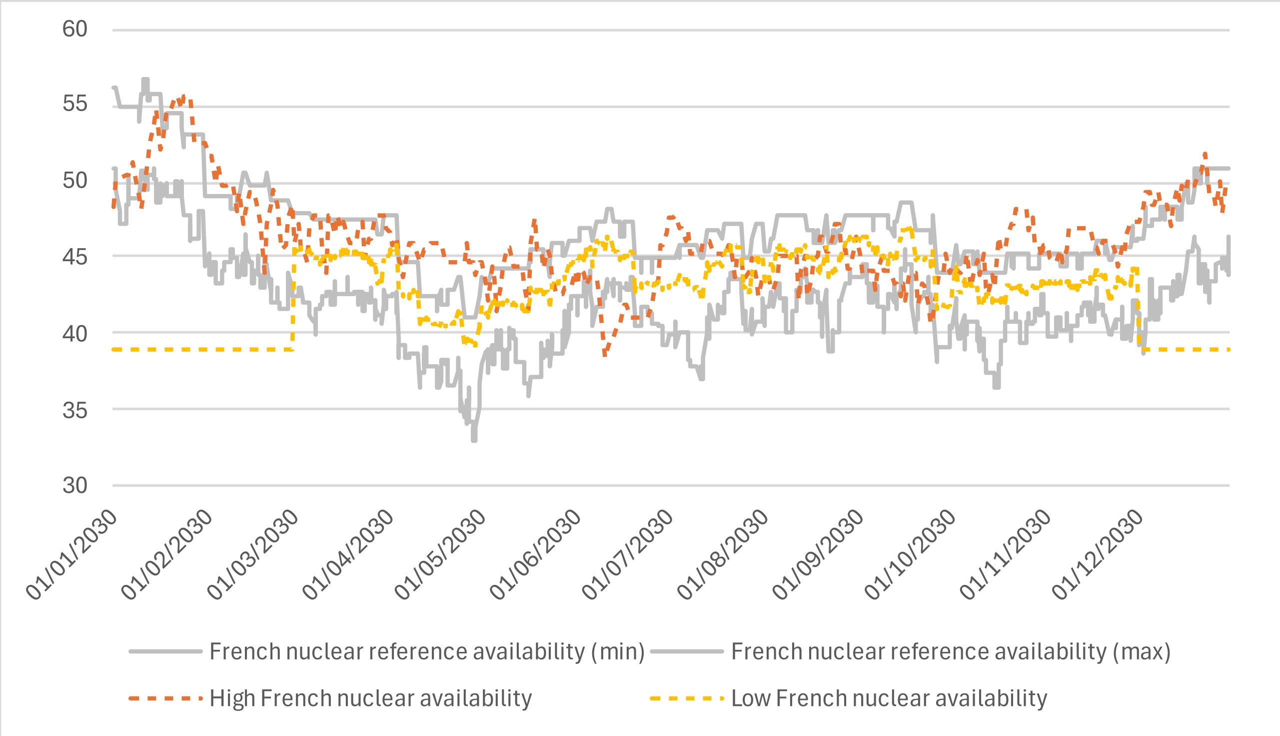


Figure 7: FR00 nuclear availability in TY2028 [GW]

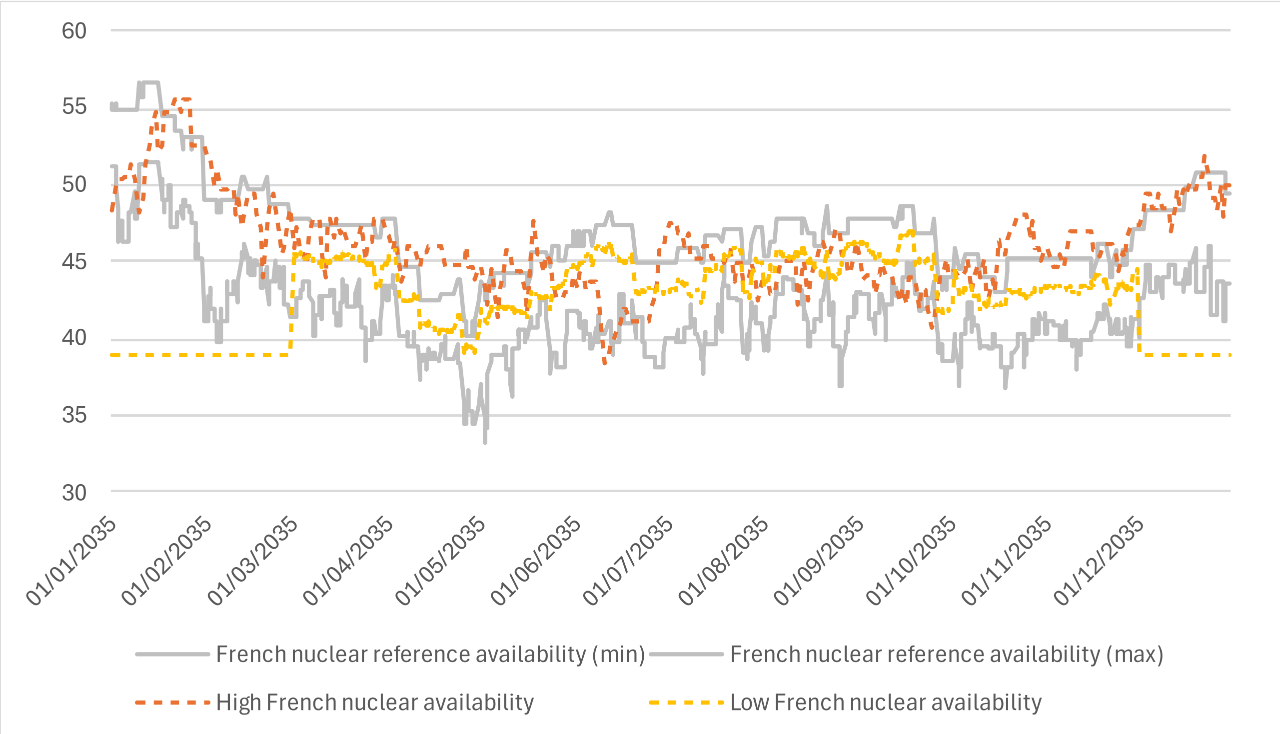


Figure 8: FR00 nuclear availability in TY2030 [GW]

4.5 Forced outage rates

As described in Annex 2, ERAA 2024 only models random forced outages (FOs) for thermal assets and not for all resources, as RES generation profiles are considered to already account for outages. By nature, outages are random and can take units out of the market at any moment. Table 4 illustrates that the ratios are very specific to the fuel types, and their distribution remains fairly similar across the TYs. Nuclear technologies show the lowest ratios on average, at around 4%. Gas and other non-RES technologies are slightly more subject to FOs on average, with ratios ranging from around 5% to 6%. Coal and lignite – the technologies with the highest forced outage ratios – range from 7.5% to 8.8%.

Table 4: 10th and 90th percentiles and average of FO ratios (%) per TY and generation technology aggregation type

TY	Coal			Gas			Nuclear			Lignite			Other non-RES		
	10th	90th	Avg	10th	90th	Avg	10th	90th	Avg	10th	90th	Avg	10th	90th	Avg
2026	6.4	10	**8.4**	4.7	8	**6**	2	5	**4**	2.1	10	**7.5**	0	8	**5.3**
2028	6.4	10	**8.5**	4.7	8	**6**	2	5	**4.1**	2.1	10	**7.5**	0	8	**5.4**
2030	5.9	10	**8.3**	4.7	8	**6.1**	2	5	**4**	2.1	10	**7.6**	0	8	**5.3**
2035	5.9	10	8.8	4.7	8	5.8	2	5	4	2.1	10	7.5	0	8	5.1

5 Network inputs

5.1 Net import/export capacities

Net Transfer Capacity (NTC) values represent the theoretical maximum commercial flows between two Member States in one of the two directions and under specific conditions. Figure 9 illustrates the average import and export NTCs per country and TY in the ERAA explicit region, with these values collected from the TSOs. In the Economic Dispatch (ED) and Economic Viability Assessment (EVA), NTC values were replaced – where relevant – by the corresponding FB constraints.

Figure 9 shows the maximum net import and export capacities averaged among all hours of the year, showing that the values increase in most countries throughout the TYs.

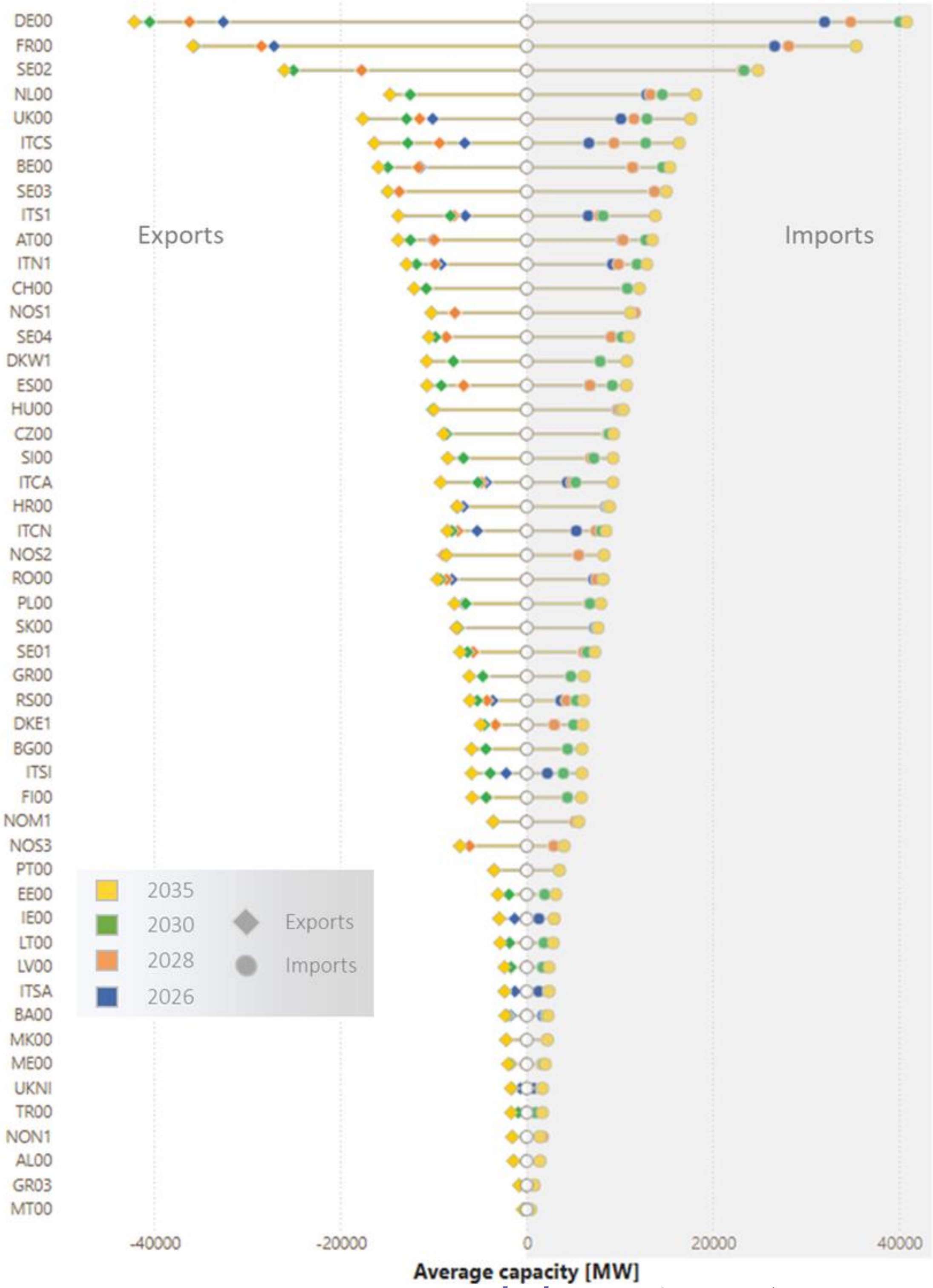


Figure 9: Average[7] maximum net import and export capacity [MW] by country for each TY (ordered by 2035 import capacity)

[7] The import and export capacities may depend on the operational conditions and time of the year. In this figure the average exchange capabilities are presented, while detailed values can be consulted in published datasets.

Figure 10[8] shows the minimum import capacity relative to peak demand for each study zone and for each TY. The higher the ratio, the more interconnected the study zone. The size of the bubbles corresponds to the absolute value of import capacity.

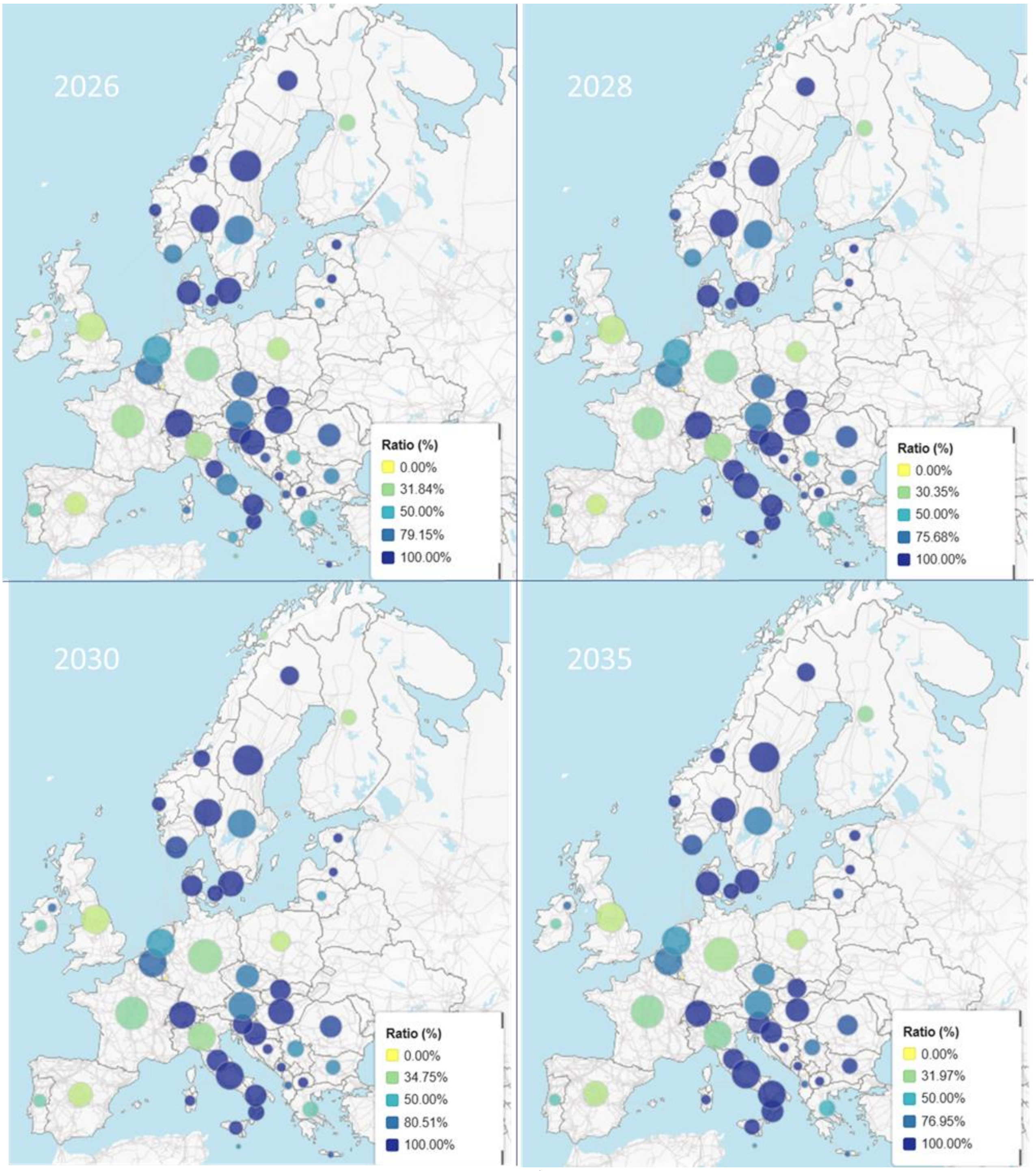


Figure 10: Average import capacity relative to peak demand (bubble size corresponds to the absolute value of import capacity)

[8] This figure presents alternative reference instead of interconnection targets fixed by the EU (15% in 2030), which refers to the total installed capacity (COM(2014) 330: link)

5.2 Flow-based domains

5.2.1 Core flow-based

Table 5 displays six typical flow-based (FB) domains per TY for ED and two typical flow-based domains per TY for EVA. They were identified using the clustering process (Porygon) described in Annex 2. Three clusters were identified for each of the summer and winter seasons for ED, while one domain is used per season for EVA due to complexity. A classification model also determined when each typical domain should be opted in Economic Dispatch simulations according to the operational conditions (demand, RES, etc.) in each Weather Scenario (WS) of the ERAA model. As described in Annex 2, the six timestamps for ED and two timestamps for EVA for which the representative FB domains were calculated are seen in Table 5. The year refers to the CY of ERAA 2023 used for the reference calculation.

Table 5: Initial market model timestamps for all TYs

Study	2026	2028	2030	2035
EVA	16-02-1988 02:00 – Winter	28-11-1988 23:00 – Winter	11-11-2010 01:00 – Winter	17-10-2010 05:00 – Winter
EVA	22-07-2014 22:00 – Summer	21-07-2014 07:00 – Summer	17-08-1988 07:00 – Summer	10-08-2014 07:00 – Summer
ED	07-02-1988 00:00 – Winter 1	01-11-2014 21:00 – Winter 1	03-02-1988 22:00 – Winter 1	03-02-1988 16:00 – Winter 1
ED	10-01-2014 23:00 – Winter 2	23-10-2010 20:00 – Winter 2	07-02-1988 22:00 – Winter 2	14-01-1988 07:00 – Winter 2
ED	05-10-2014 07:00 – Winter 3	26-10-1988 01:00 – Winter 3	15-12-2010 22:00 – Winter 3	14-10-2014 21:00 – Winter 3
ED	21-08-2014 02:00 – Summer 1	04-08-2010 16:00 – Summer 1	02-06-1988 04:00 – Summer 1	16-06-1988 23:00 – Summer 1
ED	27-07-2010 06:00 – Summer 2	12-06-2014 03:00 – Summer 2	26-06-2010 00:00 – Summer 2	10-06-2014 04:00 – Summer 2
ED	02-08-2014 12:00 – Summer 3	12-08-2014 13:00 – Summer 3	21-07-2010 07:00 – Summer 3	20-06-1988 14:00 – Summer 3

In ERAA 2024, all borders between Core and non-Core study zones are modelled as advanced hybrid coupling (AHC). There is one single evolved flow-based (EFB) element, namely the Alegro DC link between Belgium and Germany. With twelve Core study zones, one EFB link and up to 33 AHC links, the FB domain holds a total of 46 PTDF columns in TY 2035.

The maximum theoretical import and export net position of study zones quantifies the increased level of exchanges enabled by FB domains, as shown in Figure 11 These values are calculated by finding the maximum Core net position per study zone in both the import and export direction, respectively, subject to the FB constraints. It should be noted that these values are of a theoretical nature as an export or import of all other zones can be chosen with no restriction (and hence be not achievable in practice) for the calculation of these metrics for a given study zone. A second point is that the AHC borders were included in these calculations, so these maximum import and export capacities consider the additional capacity that optimising these elements could add. These minimum and maximum net positions enable an easy comparison between different FB domains but cannot be used as a metric to draw any conclusions on what could actually be feasible for specific power systems to import or export.

For example, stark increases in the minimum and maximum net position for Belgium can be observed between 2028 and 2030.

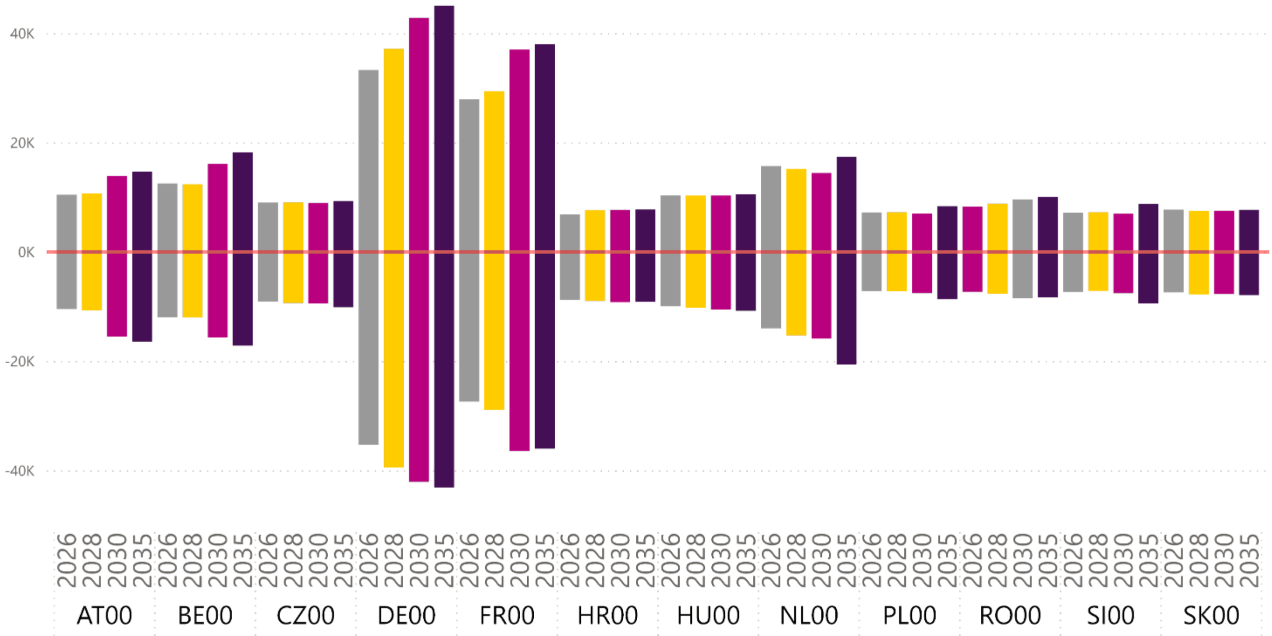


Figure 11: Illustrative theoretical maximum export and import capacities for all TYs[9]

5.2.2 Nordic Flow-based

The Nordic FB domain calculation has a three-hour time resolution, where the results are computed for each time step throughout the target year. The PTDF values computed were held constant over the TY, reflecting the static properties of the grid model. Combined with a unique set of RAM values computed for every three-hour time step, this resulted in 2912 unique FB domains for each target year for the Nordics. Each hour of the TY was then assigned the RAM value belonging to the corresponding three-hour time step in the model.

The Nordic FB domain calculation was originally computed for 29 historical WS (historical climate years from 1988 to 2006). This captures the variation of inflow in the many hydro reservoirs in the Nordics, and variations in temperature-dependent consumption. These WS have a considerable impact on the resulting flow, prices, and RAM values, but add complexity with a large amount of data. In order to reduce the amount of data, one climate year was chosen for the analysis and the remaining 28 WS were discarded. Analysing the different WS hydrological balances and consumption for the Nordics, 1999 was chosen to extract the FB domains as it was close to average in terms of hydrological balance, and representative in terms of consumption.

For ERAA 2024, PTDF values are calculated for all HVDC interconnectors in the Nordic region and within the Nordic synchronous area. With eleven study zones within the synchronous area and a

[9] A positive value shows the maximum export value, while a negative value shows the maximum import value.

total of fifteen HVDC links, the PTDF-matrix comprises 26 columns. For TY 2026 and 2028, 135 Nordic CNECs were included in the calculation, mainly Norwegian and Swedish CNECs. For TY 2030 and 2035, the domain was calculated based on 158 CNECs.

Figure 12 shows a notable expected increase of exchange capabilities within the Nordic FB region in 2030, with a marginal further increase anticipated by 2035.

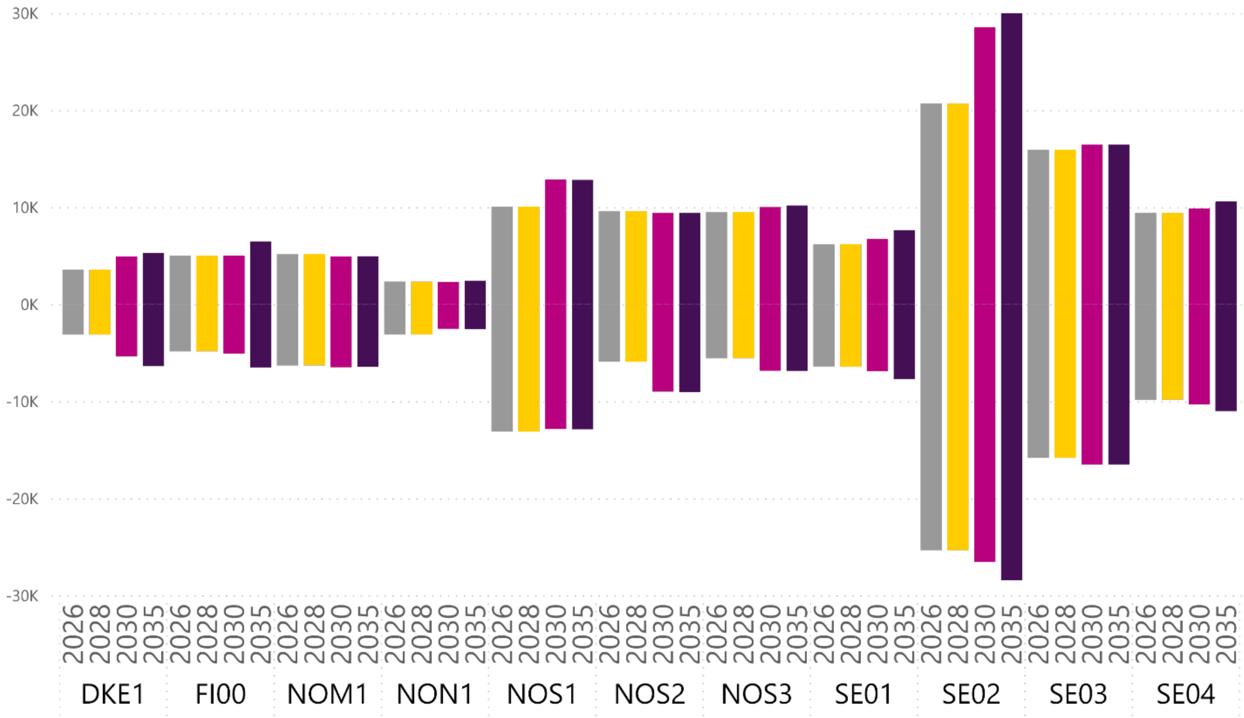


Figure 12: Illustrative theoretical maximum export and import capacities for all TYs

5.3 Forced outage rates

Table 6Table 6 shows the forced outage ratios (FORs) used per TY and technology type. For HVDC power lines, the average FOR is between 6% and 8%. For HVAC lines, the average remains around 1.8% for all TYs. The default ratio for the HVAC lines is 0%, as capacities delivered by TSOs are expected to respect the N-1 principle. If this is not respected, TSOs overwrite the default FOR by a non-zero value.

Table 6: 10th and 90th percentiles, average, and default values of FORs (%) per TY and technology type

TY	HVDC				HVAC			
	10th	90th	Avg	Def	10th	90th	Avg	Def
2026	3.2	11.3	7.2	6	0	5.9	1.8	0
2028	3	8.4	6.2	6	0	5.9	1.8	0
2030	2.7	8	6.1	6	0	5.9	1.8	0
2035	7.8	7.8	7.8	6	0	5.9	1.7	0

5.4 Exchanges with implicit regions

As described in Section 1 of the Executive Report, the regions modelled implicitly are accounted for due to fixed exchanges with countries within the ERAA explicit region. Figure 13 illustrates the hourly exchanges per border. Spain (ES00) is connected to Morocco (MA00), Ceuta (ESCE) and the Balearic Islands (ESIB), Romania (RO00) is connected to Moldova (MD00), Italy (ITSI) is connected to Tunisia (TN00), and Turkey (TR00) is connected to Georgia (GE00).

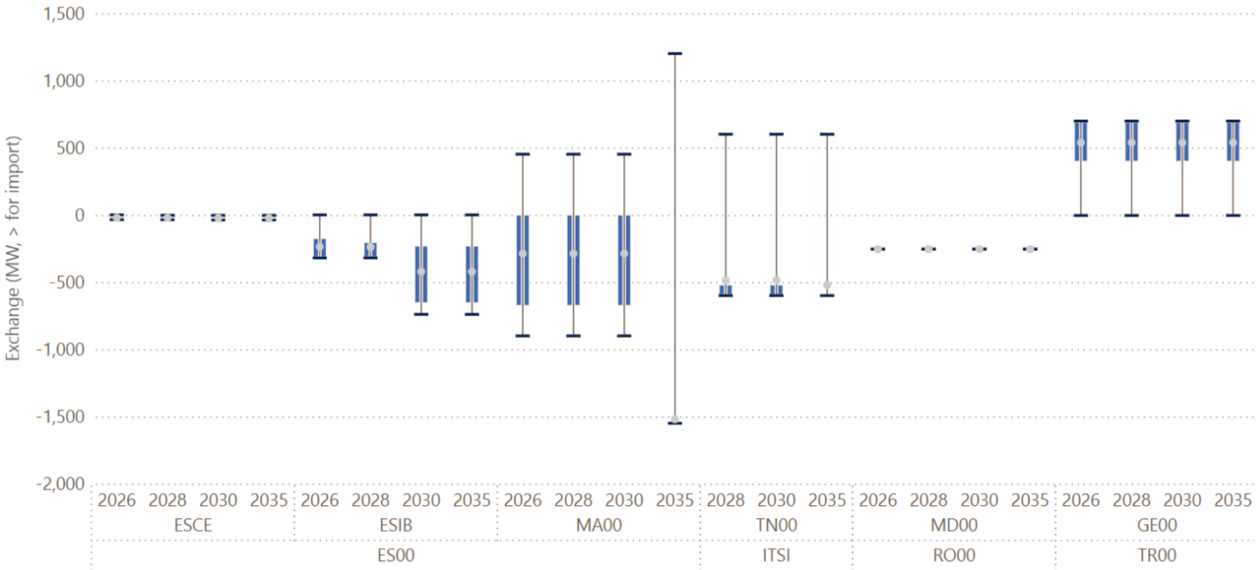


Figure 13: Fixed exchanges between implicitly modelled countries and the ERAA explicit region

6 Economic assumptions

6.1 Fuel and CO2 prices

Fuel and CO_2 prices are key inputs for the EVA as they determine the marginal cost of the thermal units and thus their hierarchy in the merit order, which is the key factor driving their optimal dispatch and ultimately affecting the revenue that they are capable of generating. This Section explains the references and assumptions considered to estimate the fuel and CO_2 prices. Table 7 summarises the specific price values used in ERAA 2024, reported in 2023€. When necessary, factors of 1.161 have been applied to convert prices from 2021€ to 2023€ and 1.064 to convert prices from 2022€ to 2023€. Furthermore, a 0.950 exchange rate has been applied to convert 2022$ to 2022€.

a. *Nuclear:* The reference for nuclear fuel prices is EIA 2022[10], aligned with current TYNDP estimates for 2030. The prices are considered constant over the horizon.

b. *Gas blend:* A blend of natural gas, biomethane and synthetic methane is considered as fuel for gas-fired thermal units. Average shares of biomethane and synthetic methane are based on internal assumptions derived from different sources (100% natural gas until 2028, 9% biomethane in 2030, 20% biomethane and 4% synthetic methane in 2040). Regarding natural gas prices, the references used are Bloomberg for 2025 and IEA WEO 2023[11] (Announced Pledges Scenario, APS) for 2030 and 2050, interpolating between 2025 and 2030 and 2030 and 2050 for intermediate years. Regarding biomethane prices, the reference is the Danish Technology catalogue [12]for 2030 and 2050, interpolating between these values for the intermediate years. Regarding synthetic methane prices, the reference is IEA WEO 2023 (APS) for 2030 and 2035. ‘Natural gas’, ‘biomethane’ and ‘synthetic methane’ fuels are only used for calculating the fuel cost of ‘gas blend’, which is used for simulations

c. *Shale oil:* The reference for price values is TYNDP[13] 2022 for 2025, 2030, and 2040, interpolating between these values for the intermediate years.

d. *Light oil and heavy oil:* The price values of light oil and heavy oil are calculated by upscaling the crude oil price with a price premium. Price premium factors are 28% for light oil and 5% for heavy oil. The references for crude oil prices are Bloomberg for 2025 and IEA WEO 2023 (APS) for 2030 and 2050, interpolating between 2025 and 2030 and 2030 and 2050 for

[10] EIA (2022): https://www.eia.gov/electricity/annual/html/epa_08_04.html
[11] IEA World Energy Outlook 2023: https://www.iea.org/reports/world-energy-outlook-2023
[12] Danish Technology catalogue: https://www.nordicenergy.org/wordpress/wp-content/uploads/2021/09/TechnologyCatalogue.pdf
[13] TYNDP 2022: https://2022.entsos-tyndp-scenarios.eu

intermediate years. ‘Crude oil’ fuel is only used for calculating the fuel cost of ‘light oil’ and ‘heavy oil’, which are used for simulations.

e. *Hard coal:* The references for hard coal prices are Bloomberg for 2025 and IEA WEO 2023 (APS) for 2030 and 2050, interpolating between 2025 and 2030 and between 2030 and 2050 for intermediate years.

f. *Lignite:* Lignite prices are reported for four different sub-groups, reflecting the prices peculiar to one or more regions. The reference for all is Booz&co, and constant prices are considered over the horizon.

g. *Hydrogen:* The method of producing hydrogen considered is steam methane reforming with carbon capture utilization. For 2026 and 2028, the hydrogen production cost has been obtained based on internal assumptions (considering natural gas as fuel). For 2030 and 2035, the reference used is IEA WEO 2023 (APS).

h. *CO_2:* The references for hard coal prices are Bloomberg for 2025 and IEA WEO 2023 (APS) for 2030 and 2050, interpolating between 2025 and 2030 and between 2030 and 2050 for intermediate years.

Table 7: Fuel prices [€2023/net GJ] and CO_2 price [€2023/tonne] per TY

Fuel Type	2025	2026	2028	2030	2035	2040	2050	Reference and assumption
Nuclear		1.95	1.95	1.95	1.95			a
Natural Gas	7.60	7.32	6.77	6.22	5.96		5.17	b
Biomethane		-	-	21.13	20.76		19.63	b
Synthetic methane				38.96	32.75			b
Gas Blend		7.32	6.77	7.68	8.75			b
Shale oil	1.81	1.88	2.02	2.16	2.65	3.15		c
Crude oil	11.58	11.82	12.29	12.76	12.15		10.34	d
Light oil		15.13	15.73	16.33	15.55			d
Heavy oil		12.41	12.90	13.39	12.76			d
Hard coal	2.97	2.84	2.59	2.34	2.21		1.83	e
Lignite 1[14]		1.63	1.63	1.63	1.63			f

[14] Group 1 applicable to: BG, MK, CZ

Fuel Type	2025	2026	2028	2030	2035	2040	2050	Reference and assumption
Lignite 2[15]		2.09	2.09	2.09	2.09			f
Lignite 3[16]		2.75	2.75	2.75	2.75			f
Lignite 4[17]		3.60	3.60	3.60	3.60			f
Hydrogen		22.74	22.18	23.47	21.69			g
CO_2	56.76	72.68	104.52	136.36	156.56		202.02	h

Figure 14 graphically shows the evolution of the commodity prices used in the simulation.

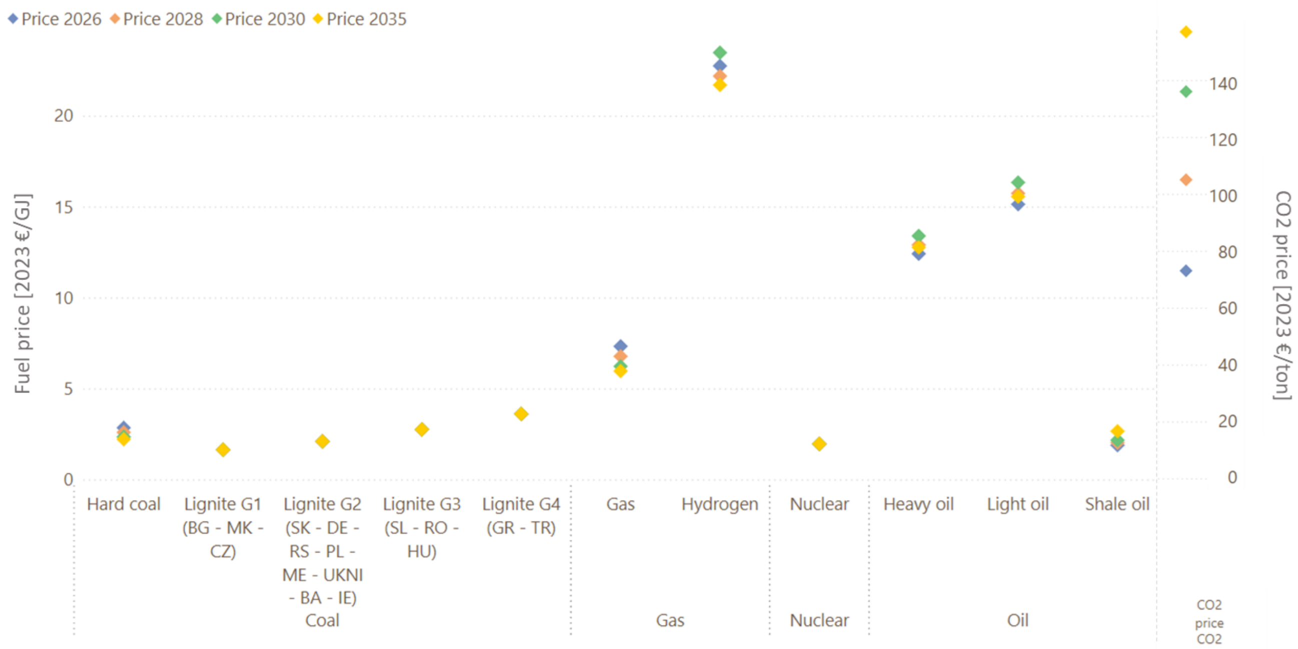


Figure 14: Evolution of fuel and CO_2 prices

6.2 Technologies and capacities subject to the EVA

As described in Annex 2, the EVA's objective is to identify and decommission non-economically viable capacity from the system and add additional economically viable capacities. As presented in Annex 2 (Section 10.3), the technologies and capacities considered eligible for retirement by the model are limited to thermal hard coal and lignite, natural gas, and oil. The capacity of nuclear and RES is based on the National Trend Scenario provided by individual TSOs (see Annex 2, Section 2) based on specific Member State policies. For this reason, nuclear and RES capacity are not subject to the EVA. Other considerations in the EVA are (i) (de-)mothballing of unviable capacity, as an

[15] Group 2 applicable to: SK, DE, RS, PL, ME, UKNI, BA, IE
[16] Group 3 applicable to: SL, RO, HU
[17] Group 4 applicable to: GR

alternative to permanent retirement[18]; (ii) consideration of heat and steam revenue stream for combined heat and P units; (iii) lifetime extension; and (iv) DSR and battery storage expansion.

Figure 15 illustrates the installed capacity subject to the EVA in addition to the capacity excluded from it. As described in Annex 2 (Section 10.4), the units with the new CM contract in place are not subject to the EVA, nor are the units subject to a must-run commitment or the policy units. Overall, in 2026, 148 GW of gas-fired units (62% of the total gas capacity) are assessed during the EVA, 73 GW of coal units (82% of the total coal capacity), and 7 GW of oil (48% of the total oil capacity), whereas nuclear and other non-RES are not subject to the EVA.

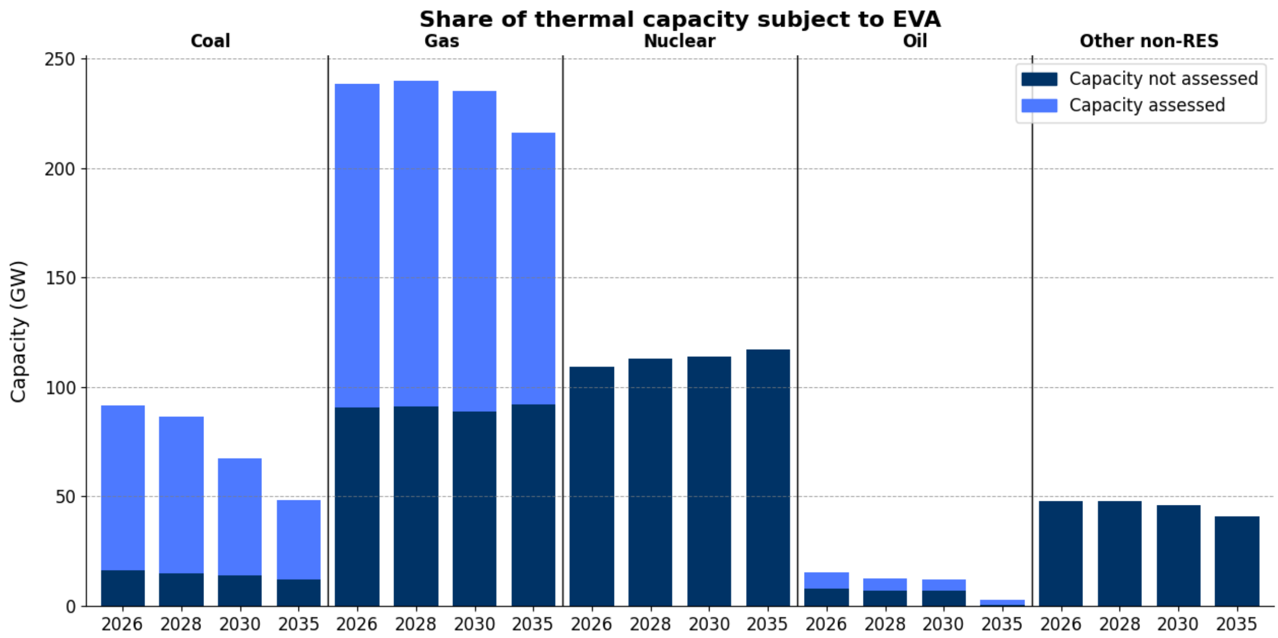


Figure 15: Share of thermal capacity subject to the EVA.

6.3 Cost of new entry

According to Regulation (EU) 2019/943, having a reliability standard (RS) in place is a necessary condition for implementing CMs in any given Member State. This reliability standard shall be based on the value of lost load (VoLL), cost of new entry (CONE), and the RS methodology proposed by ENTSO-E and approved by ACER in October 2020. In ERAA 2024, the reference scenario is based on harmonised (using default CONE only) CONE assumptions for gas-fired power plant investments across Europe. For additional insights, EVA comparisons related to CONE, with either harmonised or country-specific CONE assumptions, are presented in Annex 3. The default CONE was defined as the average of country-specific CONE values.

The actual values are shown in the next section. An update of the values considered in ERAA 2023 has been included when national data has been updated. Table 8 lists countries with the corresponding CONE studies:

[18] Mothballing options could not be considered in the Economic Viability Assessment of ERAA 2024, although the impact is expected to be minor.

Table 8: References to national CONE studies

Country	Reference	Year of publication
Belgium	SPF Economie (VOLL)	2022
	SPF Economie (CONE)	
Belgium[19]	Elia	2022
Czech Republic	MPO	2022
Germany, Luxembourg	BMWK	2021
Finland	Energiavirasto	2023
France	RTE	2022
Greece	RAE	2021
Italy	Terna	2020
Netherlands	ACM	2022
Slovenia	Eles	2022
Sweden	EI	2023
Poland	URE	2023
Ireland	SEM committee	2023

6.4 Techno-economic assumptions

This section describes the techno-economic values used in the EVA for commissioning, decommissioning, mothballing, and lifetime extension candidates.

6.4.1 Economic commissioning candidates

The capital expenditure (CAPEX), fixed operation and maintenance (FOM), economic life, and weighted cost of capital (WACC) values used in ERAA 2024 are taken from the aforementioned MS CONE studies. When such values were unavailable, ENTSO-E calculated and applied default values.

For most studies, the values were given for a specific forecasted year and are subsequently assumed to represent the entire horizon. Figure 16 toFigure 19 illustrate the CAPEX, FOM, economic life and WACC changes from TY 2026 to TY 2035 (values for the rest of the target and non-target years are not shown). Battery candidates are defined by the ratio of energy capacity over output power passed, labelled as *E/P = ratio,* representing the time to completely discharge a fully charged battery at maximum power. Only the default value and the information provided in the available CONE study are shown. To consider a future decrease in utility-scale battery costs, CAPEX and FOM costs after TY2030 are reduced by 1.37% each year[20]. Default values are calculated using all possible data points coming from national CONE studies, using the average function. Due to the high price of Estonian battery CAPEX and low FOM, they were treated as outliers and thus not included in the calculation.

[19] Besides data from the Belgium VOLL CONE study some data was obtained from the Adequacy and Flexibility Study for Belgium. It should be noted the values in the national CONE study is 4 years old.
[20] Cost reduction assumed from the NREL website for average 4h utility-scale batteries between 2030 and 2035

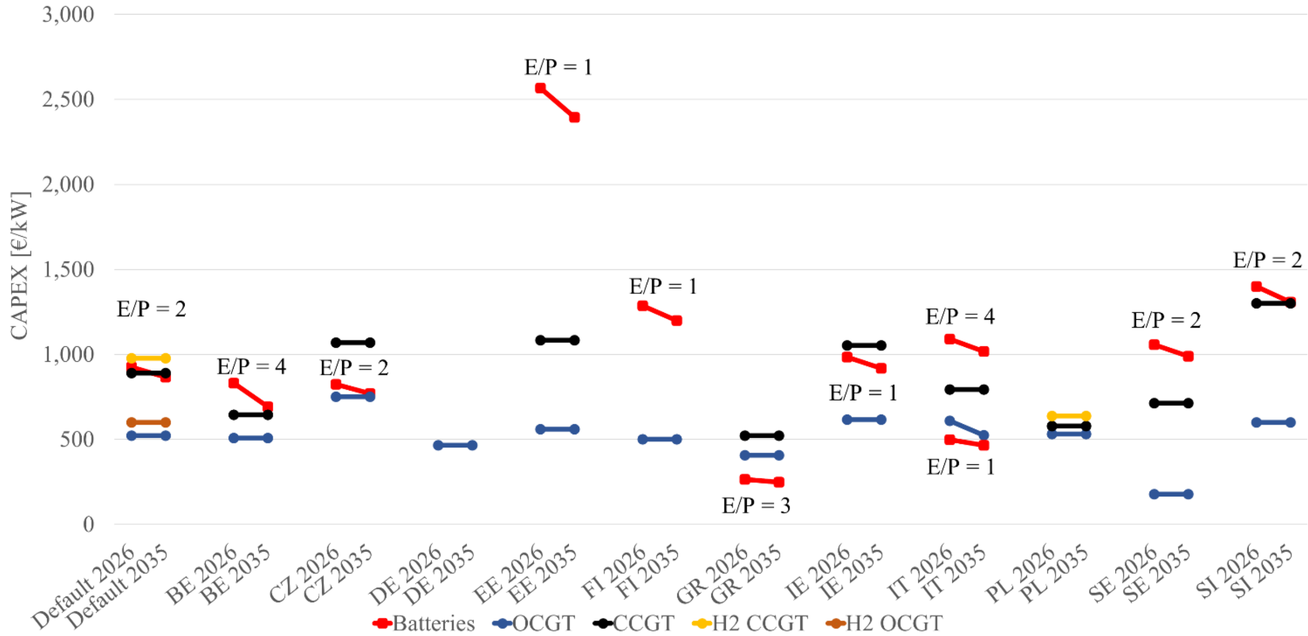


Figure 16: Default values and CONE values for CAPEX

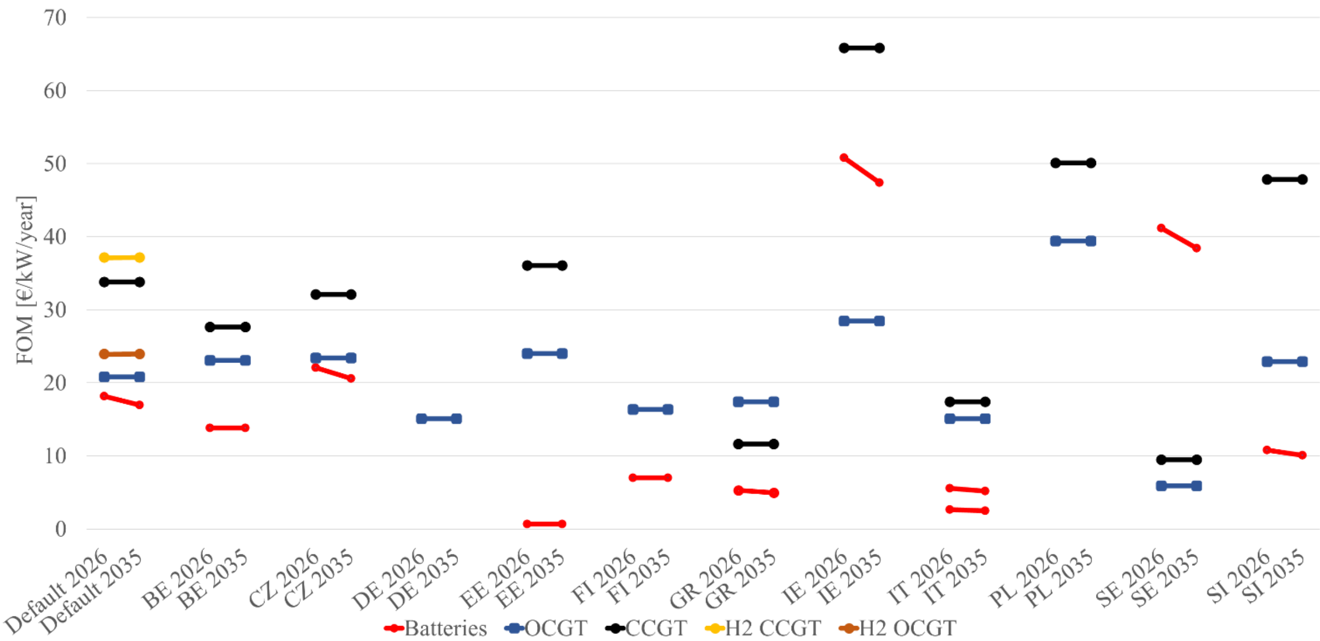


Figure 17: Default values and CONE values for FOM

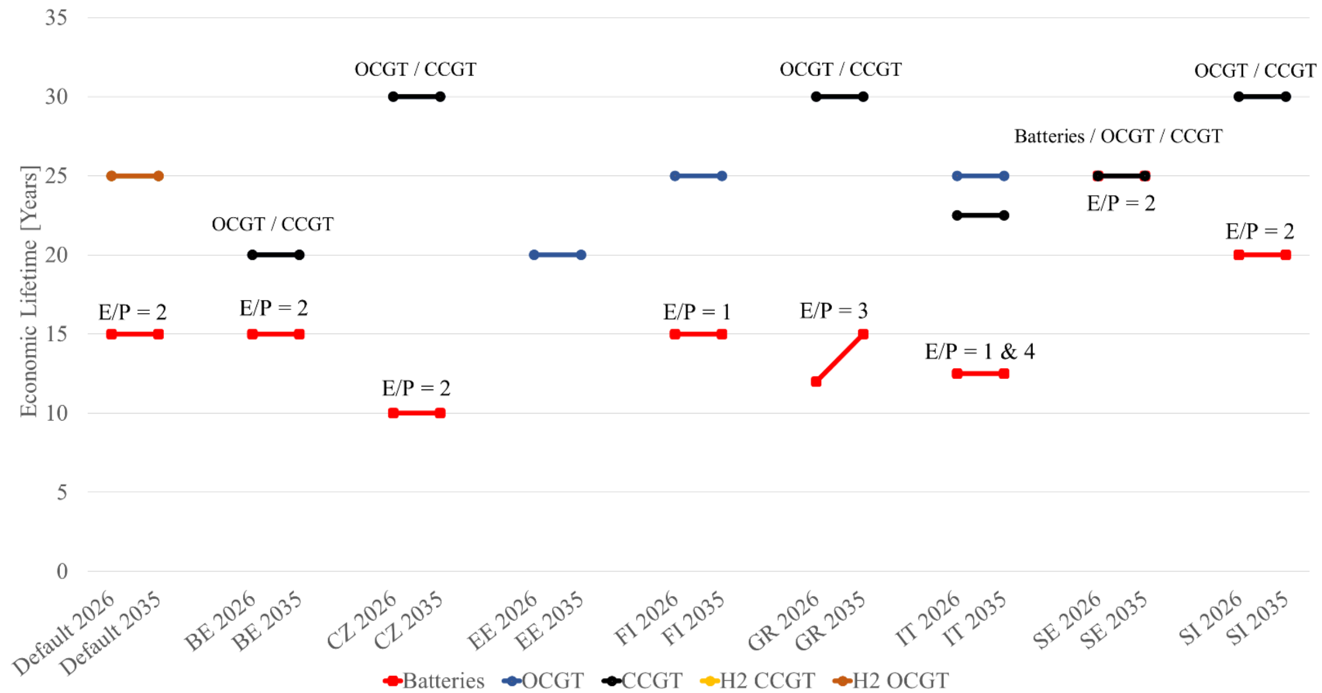


Figure 18: Default values and CONE values for economic life

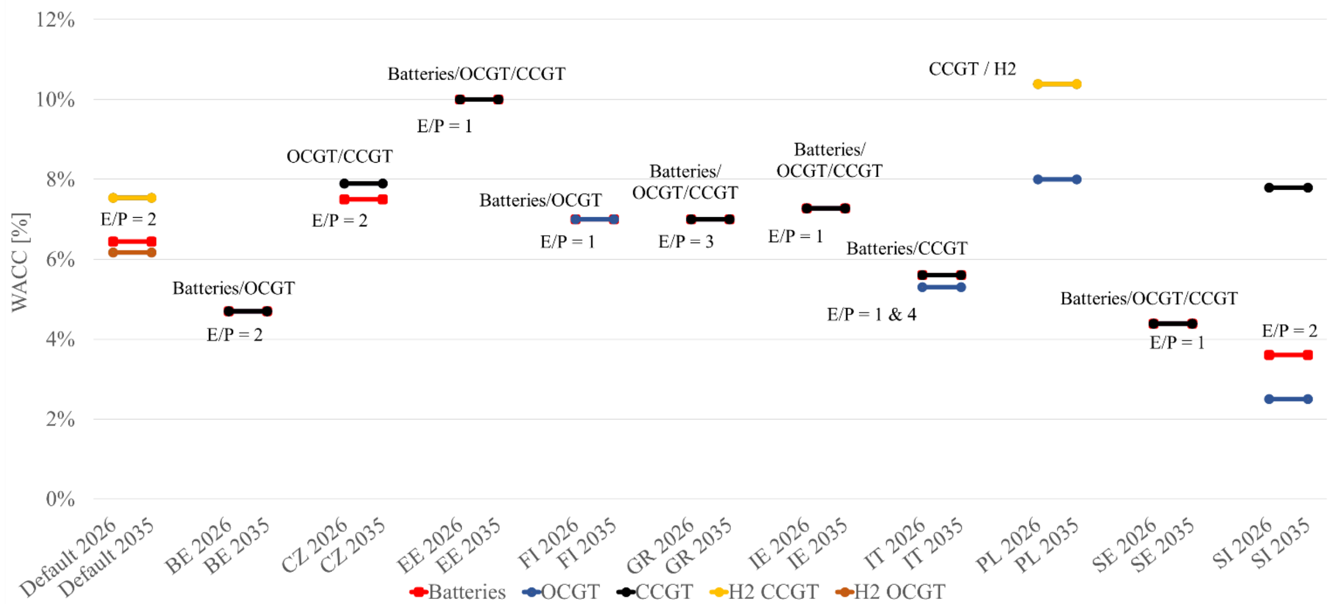


Figure 19: Default values and CONE values for WACC

The hurdle premium values used to compute the hurdle rate together with the WACC differ by technology, as shown in Table 9 (see also Annex 2, Section 10.11).

Table 9: Default values for the hurdle premium [%]

Battery	CCGT	OCGT
3	4.5	6

Construction period of commissioning candidates

Due to the construction period of thermal units, the commissioning of Gas CCGT and Gas OCGT units is not possible before TY 2028. Therefore, the only technologies available for commissioning in 2026 are grid-scale batteries and explicit DSR. Table 10 summarises of the first TY when a commissioning technology is available for a new entry.

Table 10: First TY when the new entry of capacity is available, according to harmonised construction period (CONE studies)

TY for new entry	
OCGT new	**2028**
CCGT new	**2028**
Grid-scale batteries	**2026**
Explicit DSR	**2026**

Additionally, the commissioning decisions of the EVA are constrained for individual countries. Table 11 provides an overview about limitations applied in the optimization and whether constraints stem from VoLL CONE studies or TSO estimations (e.g. due to technical constraints such as a lack of grid connection points). Capacities represent additional capacity that can be installed on top of the National Trends scenario capacity.

Section 6.5 elaborates on constraints for DSR capacities.

Table 11: Overview of constraints in optimization and sources

Study zone	Technology	2026	2028	2030	2035	Source
BE00	Batteries	1190	1266	1542	2342	TSO expansion constraint
CH00	DSR potential	0	0	0	0	TSO expansion constraint
CH00	Gas (all)	0	250	250	2100	TSO expansion constraint
FI00	Batteries	400	800	1000	1000	CONE
FI00	Gas OCGT new	0	10000	10000	10000	CONE
FI00	Gas CCGT new	0	0	0	0	CONE
FR00	Gas CCGT new	0	0	0	0	TSO expansion constraint
FR00	Gas OCGT new	0	0	0	0	TSO expansion constraint
FR00	Hydrogen CCGT new	0	0	150	800	TSO expansion constraint
FR00	Hydrogen OCGT new	0	0	700	2500	TSO expansion constraint
GR00	Batteries	250	700	1100	1260	CONE
GR00	Gas CCGT new	0	2052	2652	2652	CONE
GR00	Gas OCGT new	0	0	0	0	CONE
IT00	Batteries_1	285	285	285	285	CONE with TSO revision[21]

[21] CONE data potential of CCGT/OCGT for Italy was divided between different study zones. Potential of Batteries was dived equally between 1 hour and 4 hour batteries.

IT00	Batteries_4	285	285	285	285	CONE with TSO revision
ITN1	Gas CCGT new	0	2800	2800	2800	CONE with TSO revision
ITN1	Gas OCGT new	0	2800	2800	2800	CONE with TSO revision
ITCN	Gas CCGT new	0	1000	1000	1000	CONE with TSO revision
ITCN	Gas OCGT new	0	1000	1000	1000	CONE with TSO revision
ITCS	Gas CCGT new	0	1000	1000	1000	CONE with TSO revision
ITCS	Gas OCGT new	0	1000	1000	1000	CONE with TSO revision
ITS1	Gas CCGT new	0	800	800	800	CONE with TSO revision
ITS1	Gas OCGT new	0	800	800	800	CONE with TSO revision
ITCA	Gas CCGT new	0	800	800	800	CONE with TSO revision
ITCA	Gas OCGT new	0	800	800	800	CONE with TSO revision
ITSA	Gas CCGT new	0	0	0	0	CONE with TSO revision
ITSA	Gas OCGT new	0	0	0	0	CONE with TSO revision
ITSI	Gas CCGT new	0	800	800	800	CONE with TSO revision
ITSI	Gas OCGT new	0	800	800	800	CONE with TSO revision
PL00	Gas CCGT new	0	1883	3252	3687	TSO expansion constraint
SI00	Batteries	711	711	711	711	TSO expansion constraint
SI00	Gas CCGT new	0	120	120	120	CONE
SI00	Gas OCGT new	0	56	56	56	CONE

6.4.2 Economic decommissioning candidates

A resource unit is considered not viable when its net revenues are lower than its FOM costs, which are independent of the unit's usage. The net revenues depend on random events and are subject to risks considered by the hurdle rate.

Table 12Table 12 lists the techno-economic parameters specifically used to assess the viability of existing and planned thermal units, stating the source of the FOM cost. WACC values come from CONE for gas-powered technologies and are assumed to be the same for the other technologies. The value used for hurdle premium comes from the Elia study[22].

Table 12: Default economic parameters for thermal economic units in the EVA

Resource Unit Category	FOM cost [€/kW/y]	WACC [%]	Hurdle Premium [%]	Source of Fixed Cost Value
Hard coal	26-39	6.2	3.5	EU reference scenario 2020
Lignite	33	6.2	3.5	EU reference scenario 2020
CCGT	34	7.5	3	Average of CONE studies
OCGT	21	6.2	3.5	Average of CONE studies

22 https://www.elia.be/-/media/project/elia/shared/documents/elia-group/publications/studies-and-reports/20210701_adequacy-flexibility-study-2021_en_v2.pdf

Light oil	21	6.2	3.5	EU reference scenario 2020/ASSET 2018
Heavy oil	21	6.2	3.5	EU reference scenario 2020/ASSET 2018
Oil shale	21	6.2	3.5	EU reference scenario 2020/ASSET 2018

6.4.3 Lifetime extension of thermal units

Units approaching their decommissioning date can be refurbished to remain operational for an extended period, which requires additional investment. A single CAPEX, lifetime extension duration, hurdle premium, and WACC value are assumed for each technology across all TYs. The values were extrapolated from the Elia adequacy and flexibility study**Error! Bookmark not defined.**, the EU Reference Scenario**Error! Bookmark not defined.** and the ASSET study[14]. Data are available in Table 13.

Table 13: Default economic parameters for lifetime extension in the EVA

Resource Unit Category	CAPEX [€/kW]	Life Extension [years]	Hurdle Premium [%]	WACC [%]	Source of Fixed Cost Value
CCGT	103	10	4 – 5	6.2 – 7.5	Elia
OCGT	82				Elia
Lignite	283				Extrapolation
Hard Coal	247				Extrapolation
Oil	193				Extrapolation

The modelling specificity of the lifetime extension is that it can only be triggered the year following the decommissioning year of the unit as provided by the TSOs.

6.4.4 Mothballing of thermal units[23]

Thermal units can be mothballed for brief or extended periods (up to several years) before being decommissioned. The costs involved arise from the necessary preparations to put the unit out of operation for a long period of time, as the preparations to put the unit back into operation (e.g. water, grid, new staff). The cost of de-mothballing is significantly higher than the cost of mothballing. For the mothballing duration, fixed costs are significantly reduced. These decisions are influenced by risks considered through the hurdle rate. The values are extrapolated from the TenneT *Monitoring Leveringszekerheid 2021* study[24] following the same approach used for the lifetime extension. Among the different types of mothballing introduced in the study – mainly defined by the duration of mothballing – the *Dry* modus has been used. Under this assumption, the

[23] Mothballing options could not be considered in the Economic Viability Assessment of ERAA 2024, although the impact is expected to be minor.
[24] https://tennet-drupal.s3.eu-central-1.amazonaws.com/default/202207/TenneT_Rapport_Monitoring_Leveringszekerheid_2021.pdf

duration of mothballing is assumed to be at least one year. Any mothballing situation that would last less than a year is not considered, with the capacity change being assessed at a yearly level of granularity.Table 14 shows that values for each technology across all TYs assumed in ERAA 2024.

Table 14: Default economic parameters for (de-)mothballing in the EVA

Resource Unit Category	Mothballing CAPEX [€/kW]	De-mothballing CAPEX [€/kW]	Fixed cost [€/kW/y]	Hurdle Premium [%]	WACC [%]	Source
CCGT	1.1 – 3.1	3.1 – 23.2	0.4	3	7.5	TenneT
OCGT	1 – 2.8	2.8 – 21.2	0.7	3.5	6.2	Extrapolation
Lignite	3 – 8.5	8.5 – 63.4	1.0 – 3.3	3.5	6.2	Extrapolation
Hard Coal	2.6 – 7.4	7.4 – 55.5	0.9 – 2.9	3.5	6.2	Extrapolation
Oil	2 – 5.8	5.8 – 43.2	0.7 – 2.2	3.5	6.2	Extrapolation

6.4.5 Short-run marginal cost of thermal units

The Short-Run Marginal Cost (SRMC) is the cost for a unit to generate electricity derived from three main components:

- Variable Operation and Maintenance (VOM) cost
- CO_2 price
- Fuel prices

These costs are then linked to the operation of the unit with its efficiency and CO_2 emission factor. The SRMC is then described as presented in the equation below:

$$\mathrm{SRMC} = \mathrm{VOM\ [EUR/MWh]} + \frac{\mathrm{CO_2\ emission\ factor\ [tCO_2/GJ]} \times 3.6\ \mathrm{[GJ/MWh]}}{\mathrm{efficiency\ [\%]}} \times \mathrm{CO_2\ price\ [EUR/tCO_2]} + \frac{\mathrm{fuel\ price\ [EUR/GJ]} \times 3.6\ \mathrm{[GJ/MWh]}}{\mathrm{efficiency\ [\%]}}$$

The VOM, unit efficiency and CO_2 emission factor values below are applicable for all units. The VOM is the operation cost of a unit (excluding fuel costs, CO_2 emission costs, and fixed costs). The assumptions used in ERAA 2024 come from the EU Reference scenario**Error! Bookmark not defined.** and the ASSET report[14]. Table 15 reports the values.

Table 15: VOM [EUR/MWh]

Generation Unit Category	2025	2028	2030	2035
CCGT	2.3 – 2.7	2.3 – 2.7	2.3 – 2.7	2.3 – 2.7
OCGT	2.4	2.4	2.4	2.4
Lignite	3.5 – 4.7	3.5 – 4.7	3.5 – 4.7	3.5 – 4

Hard Coal	2.8 – 4.1	2.8 – 4.1	2.8 – 4.1	2.8 – 4.1
Oil	3.2	3.2	3.2	3.2
Nuclear	8	8	8	8

The efficiency of the generators drives the impact of CO_2 and fuel costs, whereby the values are computed internally by ENTSO-E. Table 16 summarises the values.

Table 16: Efficiency [%]

Generation Unit Category	Efficiency
CCGT	40 – 60
OCGT	35 – 42
Lignite	35 – 46
Hard coal	35 – 46
Oil	29 – 40
Nuclear	33

The CO_2 emission factor represents the rate of CO_2 emission when the fuel is burnt to power the unit. The values are computed internally by ENTSO-E. Table 17 summarises the values.

Table 17: CO_2 emission factor [CO_2kg/GJ]

Generation Unit Category	CO2 emission factor
Gas (OCGT&CCGT)	57
Lignite	101
Hard coal	94
Oil	78-100
Nuclear	0

Figure 20 shows the SRMC calculated for the technologies. Although gas technologies are heavily penalised by high gas prices in the earlier years, they become more competitive in the later years due to a gas price decrease in addition to CO_2 and hard coal. For each fuel and technology shown, only the cheapest (plain line) and most expensive (dashed line) technology types of units are shown. The marginal price of the other technologies will fall between those two lines.

The marginal price of the CHP units is lower because the calculation has to consider the additional heat and steam revenues. Due to the wide spread of these additional revenues, the figure does not show the marginal price of CHP units.

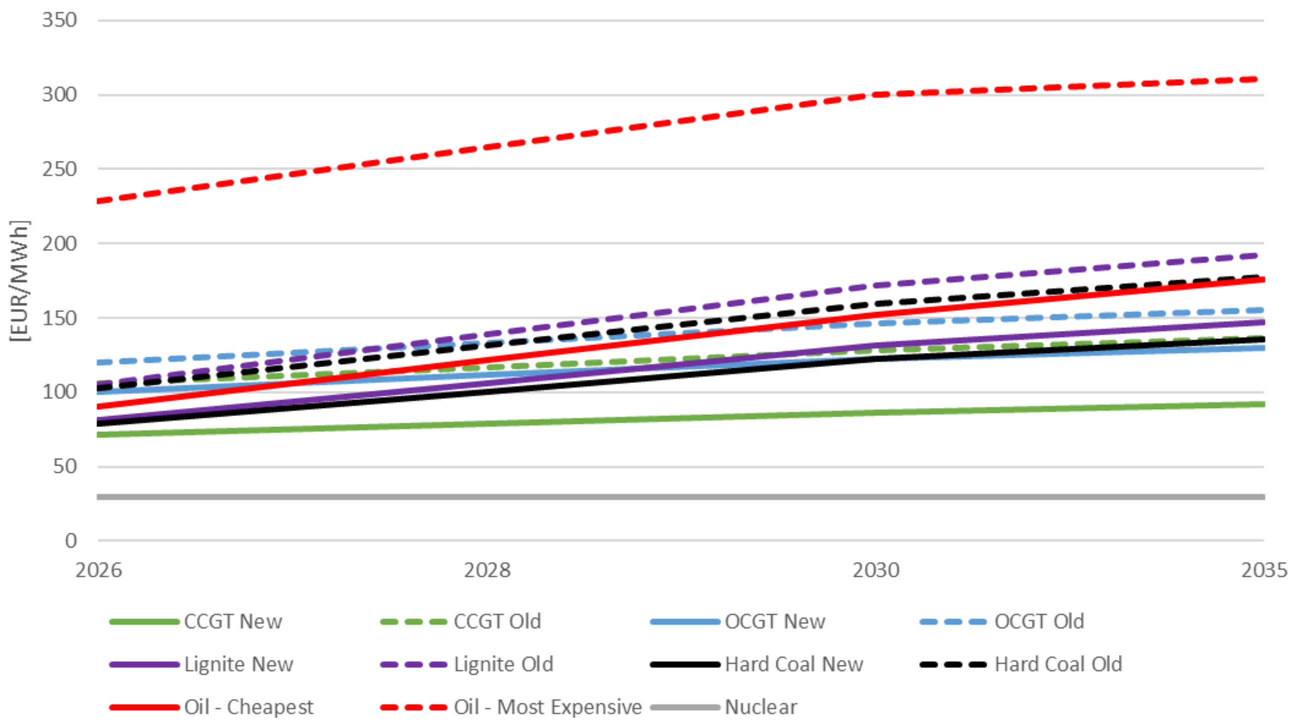


Figure 20: Marginal cost of thermal units

6.5 Explicit DSR commissioning potential

A stepwise approach is used to determine the additional DSR potential beyond the assumptions of the National Trend Scenario, depending on the availability of country-specific data, in the following order:

- A **published VoLL/CONE study** conducted according to the ACER methodology[25] that includes DSR as a reference technology with additional potential;
- Another **national study** of DSR potential provided by TSOs or ACER; and
- A **centralised bottom-up methodology** described in Annex 2.

Table 18 shows which approach is used per country, in addition to the net additional DSR potential that can be invested in by the EVA for selected TYs above what is considered in the National Trend Scenario. Note that these are total non-cumulative potentials covering the full horizon until 2035 (e.g. capacity invested in 2026 reduces the potential for 2035) For the countries of AL, BA, CH, IE, ME, MK, RS, TR, UA and UK, no additional DSR investments are considered because the centralised approach could not be applied due to insufficient data. Note that the retirement of DSR capacity is not considered; this is due to the assumption that investments intended to make processes more flexible and responsive to market prices would not be decommissioned.

[25] ACER Decision of 2 October 2020 on the Methodology for calculating the value of lost load, the cost of new entry, and the reliability standard in accordance with Article 23(6) of Regulation (EU) 2019/943 on the internal market for electricity.

Table 18: Net additional explicit DSR potential (GW) assumed per target year per zone

Zone	Approach	2026	2028	2030	2035
AT00	Centralised approach	0.25	0.25	0.25	0.25
BE00	National study / TSO estimate	0.60	1.20	1.80	3.00
BG00	Centralised approach	0.42	0.42	0.42	0.42
CZ00	National study / TSO estimate	0	0	0.10	0.55
DE00	National VoLL/CONE study	0.31	0.83	0.83	0.83
DKE1	Centralised approach	0.18	0.18	0.18	0.18
DKW1	Centralised approach	0.31	0.31	0.31	0.31
EE00	Centralised approach	0	0	0	0
ES00	National study / TSO estimate	1.99	1.99	1.40	0.00
FI00	National VoLL/CONE study	2.00	2.00	2.00	2.00
FR00	National study / TSO estimate	0	0	1.68	2.70
GR00	National VoLL/CONE study	1.37	1.60	1.78	1.80
HR00	Centralised approach	0.12	0.12	0.12	0.12
HU00	National study / TSO estimate	0.06	0.06	0.06	0.06
IT00	National VoLL/CONE study	0	0	0	0
LT00	Centralised approach	0.16	0.16	0.16	0.16
LV00	Centralised approach	0	0	0	0
MT00	National study / TSO estimate	0	0	0	0
NL00	National study / TSO estimate	2.93	2.93	3.12	3.12
NOM1	National study / TSO estimate	0	0	0	0
NON1	National study / TSO estimate	0	0	0	0
NOS0	National study / TSO estimate	0	0	0	0
PL00	National study / TSO estimate	0	0	0	0
PT00	Centralised approach	0.86	0.86	0.86	0.86
RO00	Centralised approach	0.84	0.84	0.84	0.84
SE00	National VoLL/CONE study	5.40	5.40	5.40	5.40
SI00	National VoLL/CONE study	0.13	0.13	0.13	0.13
SK00	Centralised approach	0.45	0.45	0.45	0.45

6.6 Wholesale market price cap

In ERAA 2024, the wholesale market price cap (i.e. the highest bid/offer that market players can submit) is a single value used across all bidding zones for each TY. The maximum price cap (also referred to as the 'maximum technical bidding limit') for the wholesale Single Day-Ahead Coupling (SDAC) market is set to 4,000 €/MWh at the time of writing[26]. The methodology for adjusting the harmonised maximum market clearing price (HMMCP) to future years is based on the evolution of

[26] https://eepublicdownloads.entsoe.eu/clean-documents/Network%20codes%20documents/NC%20CACM/SDAC%202022/SDAC_Comm._Note__HMMP_-_4000_clean.pdf

prices as seen in the previous ERAA 2023, with a triggering mechanism calculated as described by the updated guidelines as of 11 January 2023[27].

Following the approach proposed in Annex 2, the price cap evolutions over all the TYs are estimated (Table 19).

Table 19: Price cap [€/MWh] per TY

2026	2028	2030	2035
4,500	5,000	6,000	6,500

[27]https://www.acer.europa.eu/sites/default/files/documents/Individual%20Decisions/ACER%20Decision%2002-2023%20on%20HMMCP%20SIDC.pdf

7 Additional assumptions

7.1 Electrolyser and power-to-heat data

Figure 21 shows the electrolyser and power-to-heat (P2H) capacities aggregated for the ERAA explicit region for each TY (left part). The right side of the figure shows the countries with the highest shares of resource capacities averaged across all TYs. Figure 21 accounts for capacities using 1 July as a threshold date, i.e. only units commissioned before 1 July and decommissioned after 1 July are included for each TY.

The electrolyser and P2H capacity increases from around 13 GW in 2026 to around 140 GW in 2035, with the most significant capacity in Germany.

Hydrogen production efficiency was adopted based on data provided by the TSO and ranged between 59% and 85% (if not specified by the TSO, the default value of 68% is used). Table 7 in Section 6.1 presents the hydrogen price assumptions for each TY assumption. The approach used to compute these prices is described in Annex 2 (Section 7).

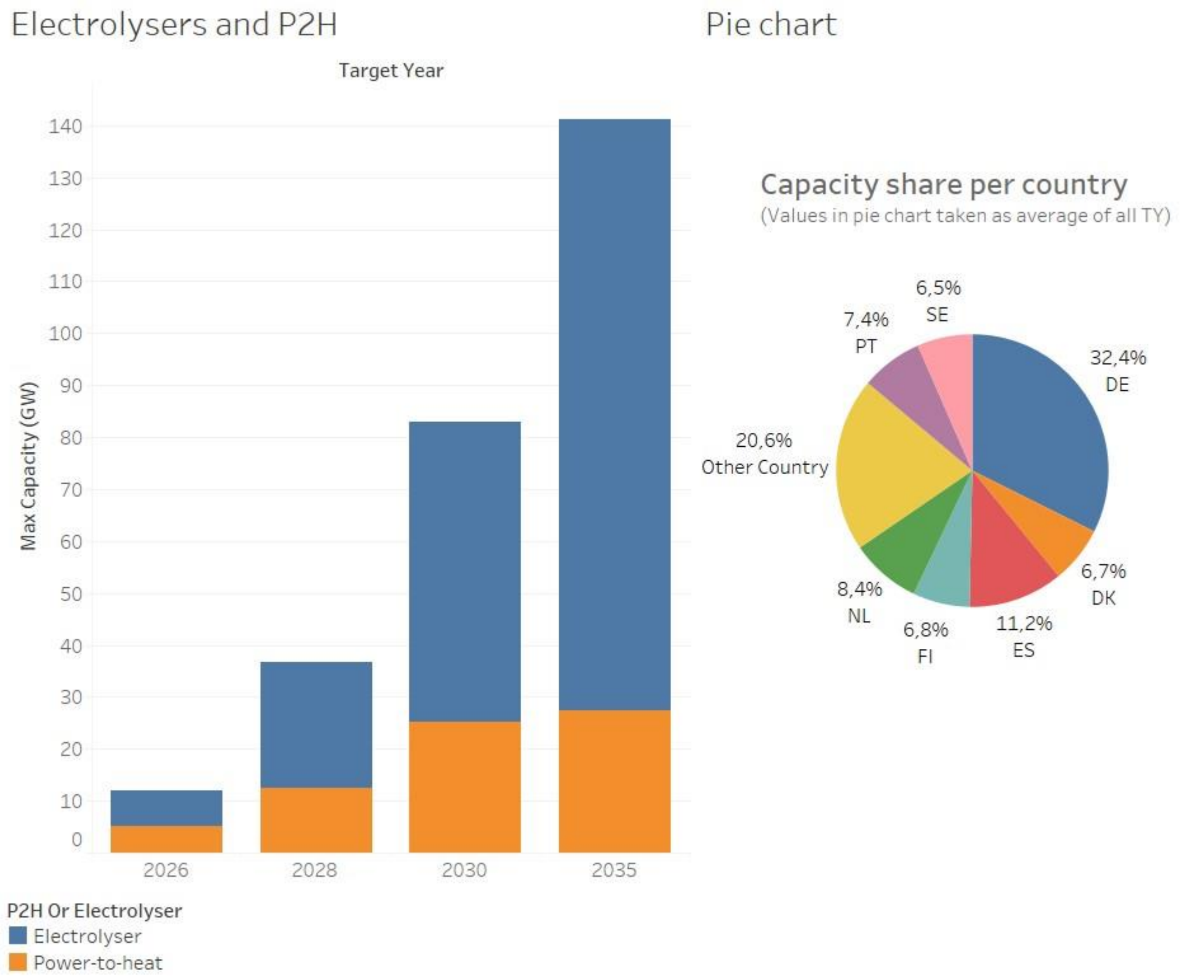


Figure 21: Electrolyser and P2H capacities and distribution across countries

8 Appendix 1: TSO survey on scenario assumptions

Complete TSO feedback

Compliance with Fit for 55

The question aimed to understand the extent to which the data delivered are compliant with FF55 and the rationale behind the scenarios.

According to the TSO survey responses, 26 out of the 35 TSOs submitted data for the National Trend Scenarios that are considered to be either partially or fully compliant with FF55. The survey results indicate varying levels of compliance with FF55. Countries such as Spain, Germany, and Finland have data that aligns with FF55 goals, considering ambitious targets for renewable energy, emissions reduction, and electrification. However, countries such as Belgium, Ireland, and Poland have data that partially complies with FF55 due to ongoing updates in their NECPs and national objectives. Some countries have mentioned that their NECPs are not yet updated with the latest FF55 targets and regulations. Overall, while many countries have taken steps towards FF55 compliance, some remain in the process of aligning their energy plans with the EU FF55 objectives.

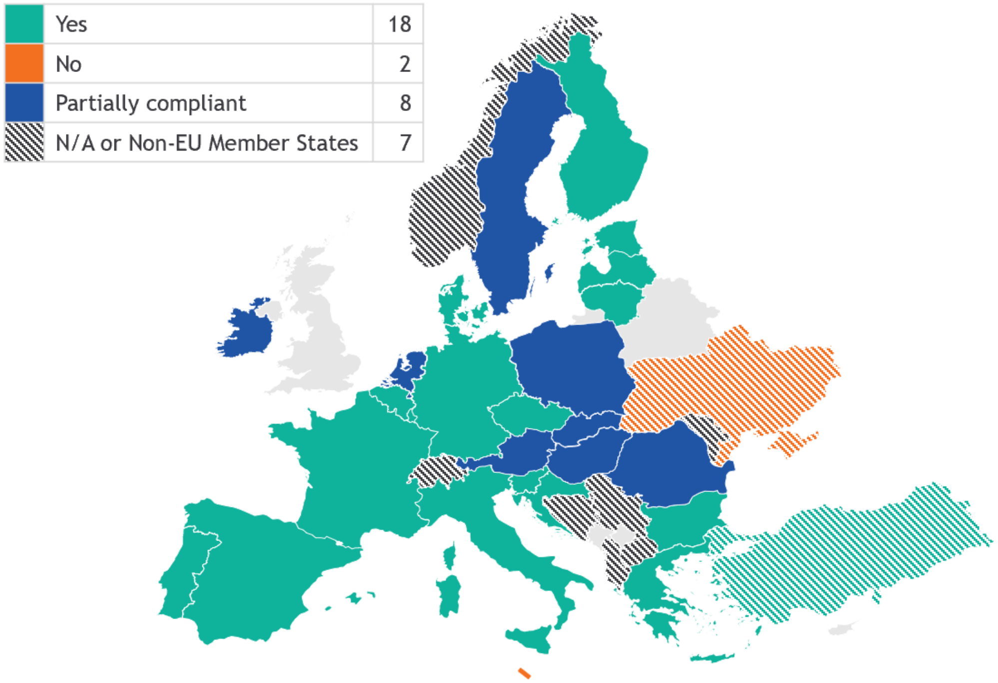


Figure 22: Were the data that you submitted for ERAA 2024 compliant with FF55?

Country	Was the data that you submitted in the PEMMDB app compliant with Fit for 55?	Please further explain the level of compliance with Fit for 55.
AL	Not relevant to my country	The aim of the submitted data is to be compliant with NECP, other strategic documents and internal future projections.
AT	Partially compliant	At the time of data collection, Austria had not updated its NECP. Values amount to best estimates from previous ERAA scenario taking into account the more ambitious Austrian target of reaching climate neutrality 2040, fully decarbonised electricity system (yearly balance) by 2030, the Austrian Integrated Network development plan (ÖNIP). Values were developed in coordination with the NRA (E-Control). In future years, recent policy developments will have to be considered.
BA	Not relevant to my country	My country is not EU member.

Country	Was the data that you submitted in the PEMMDB app compliant with Fit for 55?	Please further explain the level of compliance with Fit for 55.
BE	Yes	Draft NECP is meant to reflect Europe's strengthened ambitions, in line with the European Climate Law, 'Fit for 55' and 'REPowerEU'. Assumptions for Belgium are based on the latest official information available and on discussions or exchanges with competent authorities and/or market players.
BG	Yes	The data for the NT scenarios are based on the old BG NCEP as the new version of the Plan was not ready at the time of ERAA 2024 data submission. The creators of the BG NCEP should have aligned their data with Fit for 55 but I cannot confirm it with certainty.
CH	Not relevant to my country	
CZ	Yes	100%
DE	Yes	All data provided by the German LACs for the ERAA 2024 is compliant with government policies and national climate targets which require a 65% reduction of emissions by 2030. Primarily a high share in renewables along with a legally mandated coal-phase out as well as electrification in the transport and heating sector and energy intensive industries ensure this.
DK	Yes	The Project Assumptions of 2023, delivered by the Danish Energy Agency to Energinet, which has been utilized as the main scenario reported to the PEMMDB app, is evaluated as overall compliant with Fit for 55. The developments of the Project Assumptions for 2023 comply with Danish climate targets in 2030 (70% reduction of territorial GHG emissions compared to 1990 levels). They also internalise EU-requirements for transport regarding the prohibition of selling new internal combustion engine cars and vans, including plug-inhybrids, from 2035 and beyond.
EE	Yes	Fit for 55 goals were taken into account when determining electricity demand trends, capacity evolution and climate goals.
ES	Yes	The reference of the PEMMDB is the Spanish NECP. This plan considers as a reference source the "Fit for 55" packages and REPowerEU Plan.
FI	Yes	The scenario considers key policy decisions such as Finnish carbon neutrality target of 2035 and as such is estimated to be compliant with Fit for 55 decisions. The scenario has a high electrification of industries and RES development to support this, while most fossil fuel plants are phased out.
FR	Yes	The data provided comes from the 2023 National Study (Bilan Prévisionnel 2023), which includes the Fit for 55 objectives and France's commitment to strengthening energy sovereignty through reindustrialization and relocation
GR	Yes	The input data, provided during the ERAA24 data collection process, is in its vast majority aligned -if not identical- to the country's updated NECP, which in turn is aligned with Fit for 55.

Country	Was the data that you submitted in the PEMMDB app compliant with Fit for 55?	Please further explain the level of compliance with Fit for 55.
HR	Yes	The data is aligned with the NECP, the National Energy Development Strategy, the Hydrogen Strategy and the Low Carbon Strategy. Due to all of the above, it is assumed that they are compatible with fit to 55.
HU	Partially compliant	Data provided is based on the forecasts created as part of the National Network Development Plan process. During this, TSO and DSOs make their assumptions on capacity and demand evolution based on network connection requests, recent regulations, ongoing and planned state aids, investment plans and NECP (currently being updated). As highly ambitious renewable energy (mainly PV) development is ongoing in Hungary we consider this as a factor helping to achieve Fit for 55 aims.
IE	Partially compliant	Ireland has ambitious targets in the latest government Climate Action Plan (CAP) 2023 – which amount to at least 80% RES-E by 2030, and which is aligned with Fit for 55. The Renewable capacities submitted for ERAA24 are mostly derived from this CAP 2023. However, there are some deviations, as explained on page 15 of the latest Generation Capacity Statement 2023: “Climate Action Plan 2023 has set an ambitious target to achieve 80% RES-E by 2030 and substantial emissions reductions. This will require significant escalation in growth rates of renewables in the electricity sector. The current plan in Ireland includes delivering 5 GW of offshore wind by 2030. For GCS 2023–2032, EirGrid have taken a prudent approach and assumed renewable rollout is based on the capacities installed today, the projects coming through the RESS auction, and the SOEF v1.1 central emissions renewables trajectory.” https://cms.eirgrid.ie/sites/default/files/publications/19035-EirGrid-Generation-Capacity-Statement-Combined-2023-V5-Jan-2024.pdf
IT	Yes	The provided scenario data is compliant with FF55, since it is aligned with the latest Italy’s NECP shared with EU Commission in July 2024.
LT	Yes	The ERAA 2024 data is based on the most updated information available, and draft of the revised NECP, which sets out the measures that will enable the achievement of decarbonisation targets.
LU	Yes	The data provided in the context of the ERAA 2024 are compliant with the Fit for 55 targets. However, due to an update of the NECP by the Luxembourgish Government in July 2024. Some data provided in January 2024 are not compliant with the latest NECP update.
LV	Yes	Rather high development ratio of RES generation to reach Fit for 55 goal.
MD	Not relevant to my country	The data submitted in the PEMMDB app was not compliant with Fit for 55
MK	Not relevant to my country	N/A
MT	No	Projections for renewables are aligned with NECP 2019, whereas projections for conventional generation capacity, interconnector capacity and demand are aligned with a recent national electricity resource adequacy study (2023). Malta is still

Country	Was the data that you submitted in the PEMMDB app compliant with Fit for 55?	Please further explain the level of compliance with Fit for 55.
		in the process of finalising its final NECP update for 2024. Future data submissions will take into account updated 2024 NECP projections, which are aligned with FF55 objectives.
NL	Partially compliant	Expect to be largely compliant to the 55% target. Analysis on reduction of CO2 emissions of the energy system has been carried out. Most recent data from national member state plans have been used.
NO	Not relevant to my country	Not relevant for my country
PL	Partially compliant	The data submitted for the ERAA 2024 National Trends scenario is based on the most up-to-date information available for TSO. This is the “compilation” of the data from old PL NECP (submitted at the end of 2019), surveying of producers with necessary corrections based on current RES development trends (e.g. rapid increase of PVs). Therefore, PSE is unable to assess whether the data is in compliance with Fit For 55.
PT	Yes	Data submitted for TY2030 and 2035 is according to revised draft PT NECP (2023) that takes into account Fir for 55 and the most recent national adequacy assessment report (2023)
RO	Partially compliant	The data were provided based on the draft updated NECP, not approved yet. Final data for RO are not officially available.
RS	Not relevant to my country	Serbia is not an EU member, thus there was no need to check for compliance.
SE	Partially compliant	The data submitted are based on Svenska kraftnäts scenario "EF" reflecting a high integration of RES as well as a vast electrification of the industry and transport sector. Although, as exact targets have not been defined yet and the updated NECP was unavailable at the time of the data collection, it is not analyzed if the scenario are fully compliant to Fit for 55.
SI	Yes	Data provided for ERAA 2024 are primarily based on the NECP and on the study provided for ELES by an independent institute, which considers all available documents and policies, including documents such as NECP, to derive the future projections.
SK	Partially compliant	The data provided are based on assumptions that ongoing mainly from the National Development Plan, studies prepared by the external institute for development purposes SEPS, and partially also from the NECP. The trajectories of RES sources up to 2030 like (solar, wind) are based on study of Ministry of Environment of the Slovak Republic (https://www.minzp.sk/files/iep/iep_analyza_fit_for_55_.pdf) , whose goal was to evaluate the benefits and impacts of the Fit for 55 package for Slovakia. The electricity consumption outlook adopts the general conclusions and principles of the Fit for 55 package.
TR	Yes	Progress continues within the framework of legal regulations
UA	No	Ukraine is on the way to join European Community, hence currently is not included in the Fit for 55

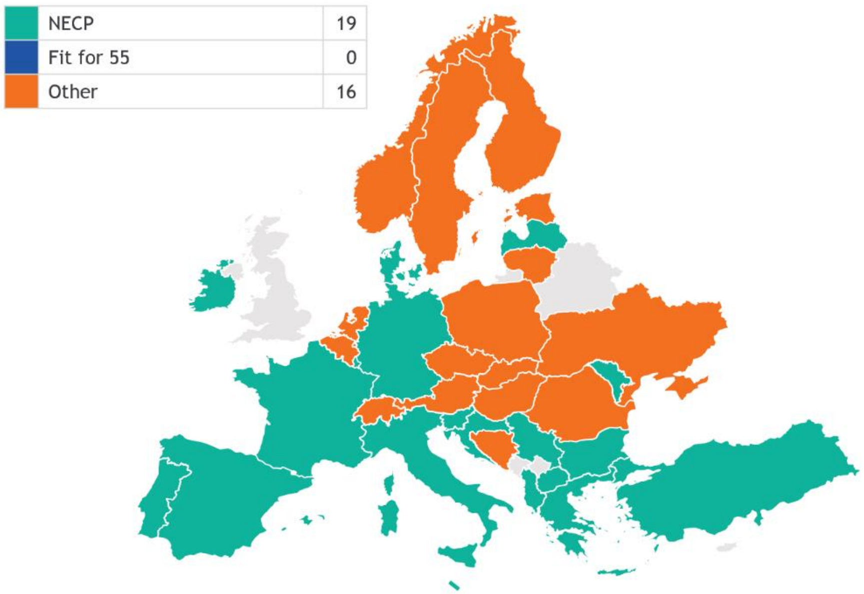
Capacity data drivers

This set of questions aimed to understand the drivers behind the data that TSOs provided on conventional generation and RES capacity. These drivers played a significant role in shaping the data collection process and ensuring compliance with national plans, regulatory requirements and market trends for conventional and RES generation.

Conventional generation data drivers:

The primary drivers for the data related to conventional generation were the NECP (or draft versions), TSO network plans, national studies, permits, investment plans, connection requests, input from market participants, and government decisions.

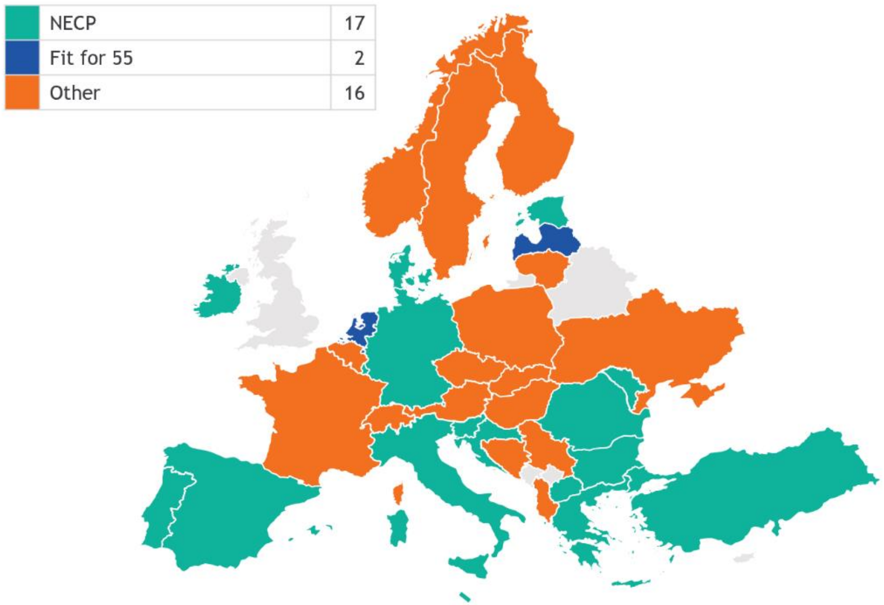
RES data drivers:



The primary drivers for the data related to generation from RES were the NECP (or draft versions), FF55 targets, national development plans, TSO and DSO estimates, national studies, political targets and ambitions, connection requests, transmission grid development plans, and information gathered from independent research institutions and government strategies.

Figure 23: What were the primary drivers of the data related to conventional generation?

Figure 24: What were the primary drivers of the data related to generation from Renewable Energy Sources?


NECP 17
Fit for 55 2
Other 16

Country	What were the primary drivers of the data related to <u>conventional generation</u>?	Please further explain the primary drivers	What were the primary drivers of the data related to <u>generation from RES</u>?	Please further explain the primary drivers
AL	NECP	Primary driver for data is mostly the NECP, as well as government and generation public utility's decisions regarding new conventional generation capacities.	Other: National Transmission Development Plan and connection requests	Latest version of NECP is not finalized and the current connection requests for RES generation capacities in which forecasts are based are significantly higher than NECP data.
AT	Other	In 2030, Austria will probably still depend on gas power to ensure security of supply (for transmission adequacy issues in Austria and neighbouring Member States). Additionally, gas power plants are expected to remain an important backbone of the security of heat supply in the winter season in the next decade	Other	Values amount to best estimates from previous ERAA scenario taking into account the legal framework of the Austrian EAG (Renewable Energy Expansion Act) for 2030 and the more ambitious Austrian target of reaching climate neutrality 2040, the Austrian Integrated Network development plan (ÖNIP). Values were developed in coordination with NRA (E-Control). In future years, recent policy developments will have to be considered.
BA	Other: Draft NECP & long-term TSO plans	Data from power companies	Other: Draft NECP & long-term TSO plans	Connection agreements issued by TSO
BE	Other	NECP + Official Generation unit(s) closure - announcements, lifetime extension, decommissioning's and latest known past CRM auction results. Draft NECP is meant to reflect Europe’s strengthened ambitions, in line with the European Climate Law, ‘Fit for 55’ and ‘REPowerEU’. Assumptions for Belgium are based on the latest official information available and on discussions or exchanges with competent authorities or market players.	Other	PV and Onshore in line with NECP/ 5.8GW in 2030 and 8 GW in 2040 Offshore Wind (Development of the Princess Elisabeth Island+ +Esbjerg Declaration May 2022 + Ostend Meeting April 2023)
BG	NECP	General figure from NECP	NECP	NECP
CH	Other: Swiss scenario framework for electricity network planning	Lifetime of nuclear power plants assumed to be 50 years for units younger than this and 60 for units already over 50 years.	Other: Swiss scenario framework for electricity network planning	Values for the present year are taken from the most up to date statistics from the Swiss Federal Office for Energy and Pronovo.

Country	What were the primary drivers of the data related to conventional generation?	Please further explain the primary drivers	What were the primary drivers of the data related to generation from RES?	Please further explain the primary drivers
CZ	Other: Questionnaire survey of power plant operators and FF55 targets	Questionnaire survey of power plant operators and FF55 targets	Other: Forecasts created by third-party consultancies (approved in coordination with the Ministry of Industry and Trade) in respect to FF55 targets and with respect to the local acceptance levels of municipalities	Forecasts created by third-party consultancies (approved in coordination with the Ministry of Industry and Trade) in respect to FF55 targets and with respect to the local acceptance levels of municipalities
DE	NECP	Data delivery based on current power plant park including: - decommissioning assumptions (age, technology) - legally mandated decommissioning (coal phase-out) - decommissioning notifications - commissioning of known power plant projects - assumptions on commissioning based on policy targets and legislation (EEG, German power plant strategy)	NECP	Installed capacities are in line with national policy targets which are compliant with NECP.
DK	NECP	The development of thermal capacity in the Project Assumptions for 2023 is evaluated by the Danish Energy Agency with point of departure in expectations for rentability of future thermal electricity and district heating production under consideration of current regulatory and political targets and ambitions. Among other things, it is assumed that the utilisation of gas, except for peak production, is phased out in district heating in the period up to 2030 and afterwards also biomass is assumed to be limited in use in district heating.	NECP	The developments in renewable capacity in the Project Assumptions for 2023 are especially driven by political targets and ambitions. Among other things, it is the ambition that land-based renewable electricity production (solar photovoltaics and onshore wind) quadruples towards 2030 to accommodate an expected large increase in electricity consumption from for example electrolysis. The developments in offshore wind capacity is conditional on the realization of two energy islands (Bornholm island with commissioning in 2030 and the North Sea island with first step commissioning in 2033), tenders of offshore wind farms before the end of 2030 and long term developments.

Country	What were the primary drivers of the data related to <u>conventional generation</u>?	Please further explain the primary drivers	What were the primary drivers of the data related to <u>generation from RES</u>?	Please further explain the primary drivers
EE	Other: Operators' plans for the capacity	In Estonia, there are relatively few market participants, and their plans are well known because of mandatory data collection conducted at the beginning of each year. The summary of these plans serves as a key driver for conventional power generation	NECP	The primary drivers for renewable energy capacity were the national climate goals and the schedule of reverse auctions designed to procure these capacities.
ES	NECP	The conventional generation data has been based on the most updated information available (decommission, overhaul...) for short-medium term and the NECP conventional capacity aim for long term. Main proposal: no coal capacity in the period of the analysis; official decommissioning of the nuclear capacity and maintaining of the CCGT capacity.	NECP	The renewable generation data has been based on the most updated information available for the short-medium term and NECP renewables aim for long term. Main inputs: strong growth in renewable power (especially wind and photovoltaic). Regarding storage: growth in both pump storage and batteries. Regarding electrolysers, it is included an evolution to the NECP values in 2030.
FI	Other: TSO's forecast compliant with Fit for 55	The development of conventional generation is based on TSO's forecast considering NECP and Fit for 55, known developments, specific policies such as coal phase-out, and market-based drivers.	Other: TSO's forecast compliant with Fit for 55	The RES development considers known projects under commissioning and planning, and is primarily driven by market-based drivers, i.e. RES is developed on a merchant basis.
FR	NECP	The data provided reflects the decommissioning of coal power plants (with optional conversion to biomass) and the prohibition under French law of commissioning new fossil-fuelled plants	Other: Fit for 55 & NECP trajectories	Fit for 55, which is reflected in the NECP and the 2023 National Study (Bilan Prévisionnel 2023). The data provided includes the national target of 18 GW of offshore wind by 2035 (Pacte Éolien en Mer 2022) and the acceleration of photovoltaic installations

Country	What were the primary drivers of the data related to <u>conventional generation</u>?	Please further explain the primary drivers	What were the primary drivers of the data related to <u>generation from RES</u>?	Please further explain the primary drivers
GR	NECP	Regarding the Greek Lignite fleet, there are concrete phase-out schedules, which although fluctuate every now and then, all converge to the complete phase out of Lignite by 2028. Regarding existing Gas-fired (and potentially Gas-blend fired) power plants, only end-of-life decommissioning is assumed. Regarding new entries of gas-fired units, one newly-constructed unit, one under-construction unit and one in mature development stage were declared to enter into operation. All assumptions are aligned with the NECP	NECP	The NECP was the main data source for the mid/long term horizon.
HR	NECP	All information about conventional power plants was obtained from the owners of the power plants.	NECP	The NECP is a key document related to the objectives of RES integration.
HU	Other: Permits, investment plans, connection requests and consultation	Permits, investment plans, connection requests and consultation.	Other: Updated NECP, investment plans, connection requests	The target values for PV capacity from the NECP (currently being updated) have been exceeded by the sum of the built-in capacity and the planned capacity increase originating from connection requests. Therefore, the primary source for the capacity evolution of renewable energy sources are the connection requests, based on the network connection process for generators.
IE	NECP	We are reporting ongoing issues for security of supply in Ireland, and so we see the need for this conventional generation.	NECP	Climate Action Plan 2023

Country	What were the primary drivers of the data related to conventional generation?	Please further explain the primary drivers	What were the primary drivers of the data related to generation from RES?	Please further explain the primary drivers
IT	NECP	Complete coal phase-out from December 2025 within the Italian mainland and from December 2028 in Sardinia (where the coal phase-out will be completed only after the 'Tyrrhenian Link' becomes operational); decommissioning of most of the oil units by 2028; and new thermal capacity additions according to national capacity market auctions for 2022, 2023 and 2024.	NECP	Target to reach 65% of renewable generation within the electricity sector, driven by growth in solar and wind. Onshore and offshore wind aligned to the last available NECP and general increase of solar in all bidding zones (distributed solar mostly in the North and utility scale in the rest of the peninsula).
LT	Other: Input form market participants	Data obtained during an annual survey of major electricity producers, who provided their best knowledge about changes in status (development/mothballing/decommissioning) and technical parameters of generating units for the next 10-15 years.	Other: Lithuania has an ambitious target to achieve that 100% of the country's electricity demand would be supplied by RES by 2030.	Considering the ongoing projects and the interest of investors in the development of RES energy in Lithuania, slightly more ambitious RES targets, agreed upon with the Lithuanian Ministry of Energy, were submitted to PEMMDB. The NECP is currently still being updated.
LU	NECP	N/A	NECP	N/A
LV	NECP	The power plants which are operation right now on natural gas, but after 2030 it is planned to switch those to hydrogen fuel. In Latvia then only RES generation units remain.	Fit for 55	High increase of RES production up to 2030 and 2040, in line with issued technical requirements for new generation connection to the transmission network.
MD	NECP	The primary drivers for the data related to conventional generation were based on the NECP and TYNDP which is currently in the process of revision	NECP	The primary drivers for the data related to generation from Renewable Energy Sources were based on the NECP and TYNDP which is currently in the process of revision
MK	NECP	In line with the National Energy Strategy and NECP	NECP	The primary drivers for Renewable Energy Sources (RES) generation data include alignment with the NECP targets and the increasing requests for new grid connections.

Country	What were the primary drivers of the data related to conventional generation?	Please further explain the primary drivers	What were the primary drivers of the data related to generation from RES?	Please further explain the primary drivers
MT	NECP	NECP and projections available to date	NECP	Projections for solar PV capacity are aligned with NECP 2019. Future ERAA data submissions will take into account updated projections for the 2024 NECP, which is in the process of being finalised. It is envisaged that this capacity will be reached by extending the current framework of RES support schemes for both residential and non-residential systems until 2030, including in the form of feed-in-tariffs (FITs)/ feed-in premiums. (Source: NECP 2019)
NL	Other: Government decisions on coal phase out, less methane usage, development of hydrogen usage. Data retrieved from generation companies.	Government decisions on coal phase out, less methane usage, development of hydrogen usage. Adaption of national climate agreement scenarios. Data from generation companies.	Fit for 55	Ambitions according to the National Energy Climate Agreement and increased ambition level of new Dutch coalition agreement regarding extending growth of renewables to meet FF55, solar PV and offshore wind growth 2024-2030 as well as beyond 2030 with usage of PtX and batteries
NO	Other: Increased growth in electricity demand	Increased growth in electricity demand	Other: Increased growth in electricity demand	Increased growth in electricity demand
PL	Other: Input from market participants and reviewed assumptions from old NECP	Ongoing transition	Other: Current development trends (e.g. rapid increase of PVs)	The forecasted values are higher than those from current NECP and are aimed at achieving the Fit For 55 preliminary targets.
PT	NECP	Data submitted for TY2030 and 2035 is according to revised draft PT NECP (2023) that takes into account Fir for 55 and the most recent national adequacy assessment report (2023)	NECP	Data submitted for TY2030 and 2035 is according to revised draft PT NECP (2023) that takes into account Fir for 55 and the most recent national adequacy assessment report (2023)

Country	What were the primary drivers of the data related to <u>conventional generation</u>?	Please further explain the primary drivers	What were the primary drivers of the data related to <u>generation from RES</u>?	Please further explain the primary drivers
RO	Other: Draft NECP & input from market participants, in line with the national commitments for coal phase-out of the market (decarbonisation plan).	The reference scenario was based on government decisions on sector's decarbonisation plan and the related trajectory for lignite and hard coal units phase-out of the market till 2026 , included also in the draft of the updated NECP, as well as on the most recent informations submitted by the generators and other market participants.	NECP	The RES growth has been considered based on the latest market data and the draft of the updated NECP, not yet approved. Also, the offshore wind projection for 2030 was included.
RS	NECP	The data was aligned with the official plans of Serbia in the energy sector.	Other: Realistic assumptions based on connection requests	Since the NECP defines the minimal values that energy sector in Serbia targets until 2030, the data based on the realistic assumptions that significantly exceeds those goals was taken as more realistic and, therefore, more relevant.
SE	Other	The generation capacities are mainly driven by the assessment of national political plans/goals as well as market trends and assessment of the profitability of different generation technologies. Current government has adopted a roadmap for new nuclear power with a total output equivalent to at least two large-scale reactors to be in place by 2035. Although for the ERAA2024 target year 2034, new nuclear in Sweden are not considered as it is deemed too uncertain that new project would have been completed by this time.	Other	The generation capacities are mainly driven by the assessment of market trends as well as profitability and potential for the different RES generation technologies.
SI	NECP, surveys	A survey has been done with all existing and other potential future owners of conventional power plants. The owners of these power plants provided excessive data and future development plans which were incorporated into the PEMMDB.	NECP, surveys	Energy Sources submitted in the PEMMDB RES capacity projections are based on projections developed by independent research institutions for ELES and are based mostly on NECP. Furthermore, an extensive survey and individual discussions were made with potential future investors.

Country	What were the primary drivers of the data related to conventional generation?	Please further explain the primary drivers	What were the primary drivers of the data related to generation from RES?	Please further explain the primary drivers
SK	Other	NECP (data available only up to 2030); Up-to-date information on conventional sources of electricity that was provided by operators.	Other: NECP (data available only up to 2030) and also study of Ministry of Environment of the Slovak Republic, the aim of which was to evaluate the benefits and impacts of the Fit for 55 package for Slovakia	NECP (data available only up to 2030). In addition to the NECP, the trajectories of RES evolution for the longer horizon (after 2030) are based on the assumed realizable potential made by SEPS, taking into account the available information on the evolution of RES at the time of data provision.
TR	NECP	Planning is being made by giving priority to renewable energy sources	NECP	Renewable resources are given priority and supported by the ministry.
UA	Other: National Emission Reduction Plan (regarding big thermal units)	The development/existence of conventional generation is in line with National Energy Strategy, National Energy and Climate Plan (adopted in 2024), National Emission Reduction Plan (regarding big thermal units), and National Plan for the Renewables Development until 20230 (adopted in 2024)	Other: National Plan for the Renewables Development until 20230 (adopted in 2024)	The development of the renewable generation is in line with National Energy Strategy, National Energy and Climate Plan (adopted in 2024), National Emission Reduction Plan (regarding big thermal units), and National Plan for the Renewables Development until 20230 (adopted in 2024)

Demand data drivers

The aim of this question was to understand the drivers behind the demand data provided by TSOs. Primary drivers for demand forecasts and profiles included NECPs, FF55 targets, TSO/DSO studies and plans, political targets, national energy strategies, connection requests, and studies from independent research institutions. These drivers considered factors such as electrification, Power-to-X, DSR, phase-out 'line gas', and population and GDP growth.

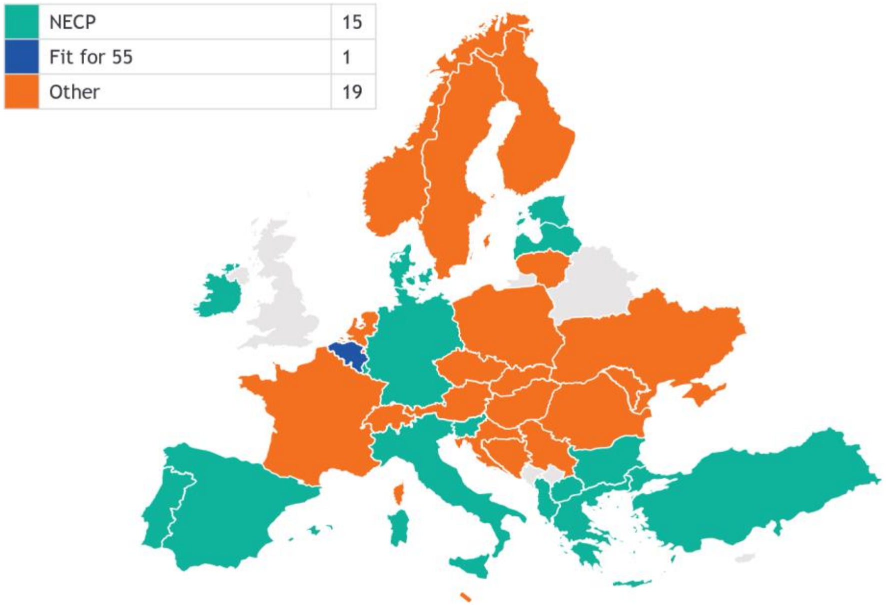


Figure 25: What were the primary drivers of the data related to demand forecasts and demand profiles?

Country	What were the primary drivers of the data related to demand forecasts and demand profiles?	Please further explain the primary drivers of the data related to demand forecasts and demand profiles submitted in the PEMMDB app
AL	NECP	Demand forecast is based on internal study, which is partly aligned with demand drivers projections from NECP.
AT	Other	Values amount to best estimates from previous ERAA scenario taking into account the more ambitious Austrian target of reaching climate neutrality 2040, the Austrian Integrated Network development plan (ÖNIP). Values were developed in coordination with NRA (E-Control). In future years, recent policy developments will have to be considered.
BA	Other: Draft NECP & long-term TSO plans	Indicative Generation Development plans
BE	Fit for 55	Industry electrification and flexibility. Electrification of transport and heating.

Country	What were the primary drivers of the data related to demand forecasts and demand profiles?	Please further explain the primary drivers of the data related to demand forecasts and demand profiles submitted in the PEMMDB app
BG	NECP	Demand time series produced with DFT of ENTSO-E with the energy rescaling option. Target demand is based on NECP gross yearly demand figures but decreased to account for the auto-consumption of power plants.
CH	Other: Swiss scenario framework for electricity network planning	Demand profiles for heat pumps, electrical vehicles and other big consumers are not included in the Swiss scenario framework for electricity network planning. The ones that were used are those from the Strategic Grid 2040 (not yet published at the time of writing). Some additional figures needed for the modelling of heat pumps and electrical vehicles were taken from the Energy Perspectives 2050+, published by the Swiss Federal Office for Energy.
CZ	Other	FF55 targets with focus on expected macro-economical development and future expected electrification and efficiency targets
DE	NECP	The electrification of the heating, transport and industry sectors are the most relevant drivers for an increase in electricity consumption. It is also important to point out that the policy targets and assumptions for load development in Germany were established in the years before the European energy crisis. From a current perspective, it appears challenging to achieve an electrification rate that is sufficient to meet the set goals (e.g., 750 TWh gross electricity consumption in 2030).
DK	NECP	The developments in electricity consumption in the Project Assumptions for 2023 are driven by an assumption of the general direct electrification of Danish society, which assists in achieving Danish climate targets. In addition to direct electrification, the Project Assumptions for 2023 assumes a largescale build-out of Power-to-X (PtX) technologies corresponding with the political ambition of commissioning 4-6 GW of electrolysis by 2030. In the long term, the Project Assumptions for 2023 assume that PtX contributes with the production of fuels for international shipping and aviation in Denmark alongside an expectation of direct export of hydrogen from Denmark to the EU. The developments in 'line gas' consumption is driven by the political ambition to phase out 'line gas' from the heating of households in 2035, which is why 'line gas' is expected to be utilized only in high temperature processes in the industrial sector in the long term. The decreasing consumption of 'line gas' combined with the increasing production of green gasses does so that 'line gas' is expected to be 100% renewable by 2029 and beyond.
EE	NECP	This is based on a study that considered the Fit-for-55 package, the National Energy and Climate Plan (NECP), and other relevant national regulations and trends from the transportation and heating sectors.
ES	NECP	The trajectory provided for the electricity demand and demand profiles have been based on the most updated information available in the short-medium term and the information in the Spanish NECP for the

Country	What were the primary drivers of the data related to demand forecasts and demand profiles?	Please further explain the primary drivers of the data related to demand forecasts and demand profiles submitted in the PEMMDB app
		long term. Demand growth due to installation of new data centres, additional industrial consumers linked to decarbonisation efforts, the evolution of electromobility, or extreme weather events.
FI	Other: TSO's forecast compliant with Fit for 55	Electrification of industry, heating and transport sectors are the main drivers. The demand development has been based on the latest ambitious government/industry scenarios, which consider the carbon neutrality target of 2035. In addition, the demand development is adjusted according to the latest developments seen in the market, such as the development of industry and data centres, and hydrogen production.
FR	Other: 2023 National Study (Bilan Prévisionnel 2023)	Reindustrialization and sovereignty targets (reflected in the connection requests for data centres, hydrogen), along with higher decarbonization objectives (EVs, heat pumps,…)
GR	NECP	NECP bottom-up data was used to update the demand forecasts for ERAA24.
HR	Other	Energy development strategy until 2030 with a view to 2050
HU	Other: Connection requests of large industrial consumers, TSO-DSO assumptions on the evolution of e-mobility, heat pumps etc. and the NECP (currently being updated). These assumptions were based on recent regulations as well as ongoing and planned state aids, including those based on Fit for 55.	Demand is based on the National Network Development Plan process. Input data considers connection requests of large industrial consumers, TSO-DSO assumptions on the evolution of e-mobility, heat pumps etc. and the NECP (currently being updated). These assumptions were based on recent regulations, ongoing and planned state aids, including those based on Fit for 55.
IE	NECP	The NECP assumes a certain growth in electricity demand from HPs and EVs; this, in turn, drives EirGrid demand forecast. Historical trends, economic growth, and the growth of large energy users are also considered.
IT	NECP	Main drivers are: GDP growth, green hydrogen production, and increasing share of electrification within the transport and civil sectors with the spread of electric vehicles and heat pumps.
LT	Other: Targets set in National Energy Independence Strategy; measures provided for in the plan for the implementation of the measures of the strategy; development of the Lithuanian economy in 2021–2024; scenario data, NECP, Plan for the Implementation of the Provisions of the	The demand forecast is updated annually in light of the guidelines set out in the documents listed above (GDP, efficiency, EV, heat pumps, electrification, DSR etc.) and the latest available information.

Country	What were the primary drivers of the data related to <u>demand</u> forecasts and demand profiles?	Please further explain the primary drivers of the data related to demand forecasts and demand profiles submitted in the PEMMDB app
	Program of the 17th Government of the Republic of Lithuania.	
LU	NECP	
LV	NECP (Forecast of independent consultant)	AST launched the study about demand forecast and consumption increase up to 2035, and output results have been used for demand forecast.
MD	Other: TYNDP	The primary drivers for the data related to demand forecasts and demand profiles were based on TYNDP which is currently in the process of revision
MK	NECP	In line with the National Energy Strategy and NECP
MT	Other	Population growth, economic growth and electrification of sectors (household electrification, uptake of EVs, shore-to-ship, etc.)
NL	Other	Ambitions according to the National Climate Agreement and increased ambition level of new Dutch government coalition agreement regarding growth of EV and HP demand; adding electrolysers, datacentres, batteries and Power to Heat.
NO	Other	Electrification and increased industrial demand
PL	Other: The most updated projections from available national project policies at the moment of data delivery	PL demand forecast is higher than in NECP. The increase of the demand for electricity is due to the ongoing transformation / electrification.
PT	NECP	Data submitted for TY2030 and 2035 is according to revised draft PT NECP (2023) that takes into account Fir for 55 and the most recent national adequacy assessment report (2023)
RO	Other	The expected moderate growth in demand is mainly driven by the expected economic growth and energy efficiency increase. Also, the assumptions about electromobility are reflected in the electricity demand forecast and load profile.
RS	Other: Official demand forecast done by JSC EMS and included in the National Development Plan.	The demand forecast was done in the scope of making National Development Plan of Serbia, after which it was used for several purposes, one of which being the ERAA process.
SE	Other: The consumption trend in Sweden is mainly based on the load connection applications with requests for increased	The ongoing electrification of sectors where fossil fuels are used today is the main drivers for the data related to demand forecasts. Fossil fuels are replaced by electricity produced from fossil-free energy sources and is expected to lead to a very large increase in electricity consumption for the next 25 years.

Country	What were the primary drivers of the data related to demand forecasts and demand profiles?	Please further explain the primary drivers of the data related to demand forecasts and demand profiles submitted in the PEMMDB app
	power output received by Svenska Kraftnät, but also on external forecasts from trade associations and other authorities.	Among the sectors expected to be electrified in the future are the transport sector and large parts of the industry. At the same time, the establishment of new industry contributes further to increase electricity consumption in Sweden. Within industry, the biggest increase in electricity consumption is in the iron and steel sector. Other industries where significant increases in electricity consumption are expected are the cement industry, the chemical industry, as well as the establishment of data centres and battery factories.
SI	NECP, a study of the forecast of long-term electricity consumption.	Demand projections are based on projections developed by independent research institutions for ELES and are based on historical demand, GDP projections and NECP projections.
SK	Other: Assumption of SEPS based on an external study of the forecast of electricity consumption to 2050, considering NECP as one of many inputs.	The demand forecast and also trajectory of electricity demand until 2050, which was provided during the data collection for PEMMDB are based on study of the forecast of electricity consumption to 2050 which are the basic inputs for the to the National Development Plan of the Slovak transmission system. The electricity demand evolution reflects the expected evolution of Slovakia's national economy. All relevant factors known at the time of providing data for the ERAA 2024 that could have a significant impact on the electricity demand evolution were considered.
TR	NECP	Demand forecasts are created within the scope of information received from distribution companies and industrial organizations.
UA	Other: NECP & the consultations with national authorities regarding possible scenarios and rates of post-war economy and society recovery	National Energy and Climate Plan (adopted in 2024) and the assessments regarding the date of the economy and society returning to the peaceful development, also considering the consultations with national authorities regarding possible scenarios and rates of post-war economy and society recovery

Interconnections

The aim of this set of questions was to understand whether cross-border capacities proposed by TSOs can be considered compliant with the 70% target for all borders.

Compliance with the 70% rule

Summary table of 70% compliance according to TSOs' responses	
Fully compliant	**16**
Partially compliant	**8**
Not compliant	**4**
N/A	**7**

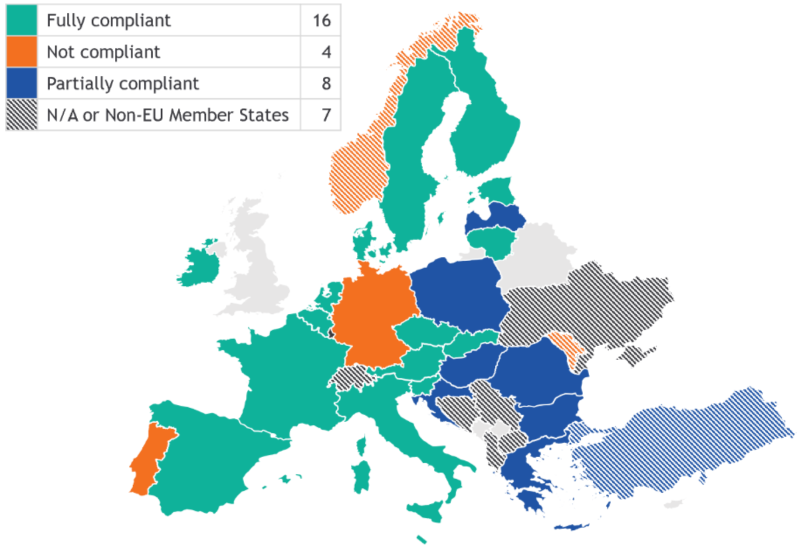


Figure 26: Summary of 70% compliance according to TSOs' responses

Country	All compliant borders	All borders with existing derogations of 70% rule compliance	All non-compliant borders	All borders that cannot be assessed	EU Member States' assessment
AL	N/A	N/A	N/A	N/A	**N/A**
AT	AT-DE, AT-CZ, AT-HU, AT-SI, AT-IT	AT-DE, AT-CZ, AT-HU, AT-SI	Most of the borders are subject to CORE flow based methodology. The border AT-IT is currently part of cNTC calculation. The border AT-CH is a border with a non-EU Member State		**Fully compliant**
BA	N/A	N/A	N/A	N/A	**N/A**
BE	BE-FR, BE-DE, BE-NL, BE-LU, BE-UK	Yes, all border are 70% compliant within the FB modelling	N/A	N/A	**Fully compliant**
BG	BG-RO, BG-GR	N/A	BG-MK, BG-TR, BG-RS	N/A	**Partially compliant**
CH	N/A	N/A	N/A	N/A	**N/A**

Country	All compliant borders	All borders with existing derogations of 70% rule compliance	All non-compliant borders	All borders that cannot be assessed	EU Member States' assessment
CZ	CZ-AT, CZ-DE, CZ-PL, CZ-SK	N/A	N/A	N/A	**Fully compliant**
DE	N/A	Until 2025: SE, NO, PL, CZ, AT, FR, LU, NL, BE, DK	N/A	CH	**Not compliant**
DK	DE, NO, SE, UK, NL	N/A	N/A	BE (cannot be evaluated as it is not built yet (2033))	**Fully compliant**
EE	EE-LV, EE-FI	N/A	N/A	N/A	**Fully compliant**
ES	ES-FR; ES-PT	N/A	ES-Morocco	N/A	**Fully compliant**
FI	EE, SE1, SE3	N/A	N/A	N/A	**Fully compliant**
FR	FR-ES, FR-IT, FR-BE, FR-DE	N/A	N/A	70% target not relevant for FR-UK and FR-CH (as not Member States)	**Fully compliant**
GR	IT,BG	N/A	N/A	AL, TR, NMK	**Partially compliant**
HR	SI, HU	N/A	N/A	RS, BA	**Partially compliant**
HU	AT, HR, RO, RS, SI, SK	N/A	N/A	UA	**Partially compliant**
IE	UK, FR	N/A	N/A	N/A	**Fully compliant**
IT	ITN1, ITCA, ITCN, ITCS, ITS1, ITSA, ITSI	N/A	N/A	N/A	**Fully compliant**
LT	LT-LV, LT-SE, LT-PL	N/A	N/A	N/A	**Fully compliant**
LU	N/A	N/A	N/A	N/A	**N/A**
LV	LV-EE, LV-LT	N/A	N/A	LV-SE	**Partially compliant**
MD	N/A	N/A	UA, RO	N/A	**Not compliant**
MK	N/A	N/A	N/A	RS,BG, XK,GR	
MT	MT-SIC	N/A	N/A	N/A	**Fully compliant**
NL	NL-NO, NL-DKW, NL-UK	NL-BE, NL-DE	N/A	N/A	**Fully compliant**
NO	NOS2-GB00, NOS2-NL00, NOS2-DE00, NOS2-DKW1		NON1-FI00, NON1-SE01, NON1-SE02, NOM1-SE02, NOS0-NOS3,		**Not compliant**

Country	All compliant borders	All borders with existing derogations of 70% rule compliance	All non-compliant borders	All borders that cannot be assessed	EU Member States' assessment
			NON1-NOM1, NOM1-NOS1, NOM1-NOS3, NOS1-NOS2, NOS1-NOS3, NOS2-NOS3		
PL	SE, LT[28], technical border with DE, CZ, SK	N/A	UA00, UA02	N/A	**Partially compliant**
PT	N/A	N/A	PT-ES	N/A	**Not compliant**
RO	N/A	RO-HU, RO-BG	N/A	RO-RS, RO-MD, RO-UA	**Partially compliant**
RS	N/A	N/A	N/A	N/A	**N/A**
SE	SE-LT, SE-DE, SE-PL, SE-FI, SE-DK, SE-SE	N/A	N/A	N/A	**Fully compliant**
SI	SI-AT, SI-IT, SI-HU, SI-HR	N/A	N/A	N/A	**Fully compliant**
SK	SK-CZ, SK-HU, SK-PL, SK-UA	N/A	N/A	N/A	**Fully compliant**
TR	TR-GR; TR-BG	TR-GR; TR-BG; TR-Georgia; TR-Syria	N/A	N/A	**Partially compliant**
UA	N/A	N/A	N/A	N/A	**N/A**

Primary drivers for interconnection data

The primary drivers for TSOs' NTC submissions are explained in the table below for each TSO. Note that the final value for each interconnector shall account for the feedback of both relevant TSOs, which in principle should be coordinated. If this is not the case, the most conservative view is retained. Drivers for the submission of these data are a combination of the 70% requirements, FF55, national development plans and anticipated delays in commissioning projects.

NTC values were coordinated with neighbouring TSOs to ensure consistency, except for specific interconnections where coordination was not possible. Efforts were made to achieve compliance with the 70% target, and variations in NTC values were allowed within the ERAA methodology.

[28] The Baltic countries, LT, LV and EE are scheduled to be synchronized with Continental Europe in February 2025. The current DC connection between PL and LT will become an AC connection with limited power that can be offered to the market.

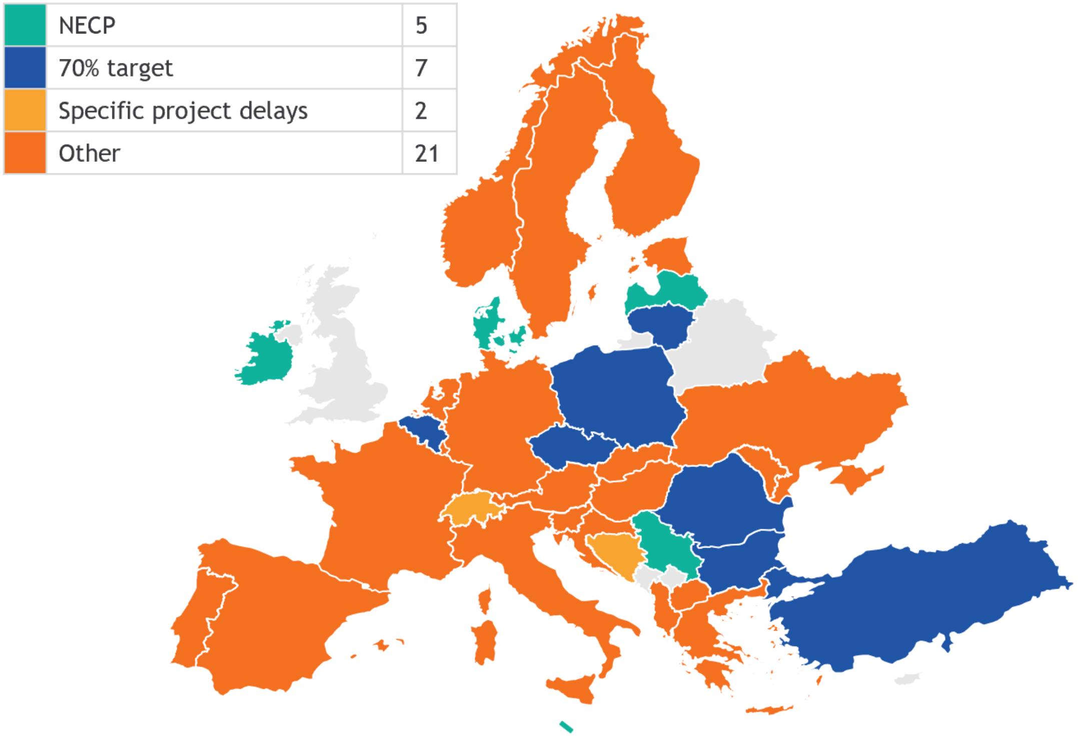


Figure 27: What were the primary drivers of the data related to interconnections?

Country	What were the primary drivers of the data related to interconnections?	Please further explain the primary drivers for the data related to interconnections submitted in the PEMMDB app.	In relation to interconnections, are your submitted NTC values coordinated with the neighbouring TSO and thus consistent?
AL	Other: Historical NTC data and expected impact of new projects	Data is based on historical NTC time series and expected future impact of new interconnection projects in implementation or planning phase.	Yes
AT	Other: Action plan for fulfilling the 70% target and valid derogation.	Compliant with the current MACZT% targets	Partially, coordination with DE and CH was executed. For all other countries the values provided were in line or no response received. In case no response received values were taken from ERAA 2023.

Country	What were the primary drivers of the data related to interconnections?	Please further explain the primary drivers for the data related to interconnections submitted in the PEMMDB app.	In relation to interconnections, are your submitted NTC values coordinated with the neighbouring TSO and thus consistent?
BA	Specific project delays	draft NECP, long term TSO plans	Yes
BE	70% target Interconnection infrastructure developments following the latest Federal Grid Development Plans	Interconnection infrastructure developments following the latest Federal Grid Development Plans All BE borders should be considered in FB according to the FBMC CORE CCM, which duly accounts for 70% Target.	Yes, interconnection infrastructure developments following the latest Federal Grid Development Plans and TSO grid development plans and TSO-TSO coordination.
BG	70% target	Compliant with the rule on EU borders With non-EU based countries, based on expected future projects and experts' analysis.	Yes
CH	Specific project delays		Partially, Values coordinated for the border DE00-CH00.
CZ	Other: TYNDP and National DP	Full compliance	No, there are discrepancies with several neighbours and these differences have not been resolved / agreed on
DE	Other: National Grid Development Plan and current TYNDP project state	NTC values are based on the current status of interconnection projects and bilateral exchanges with neighbouring TSOs. FBMC and DC borders are compliant to existing derogations and will be compliant to the 70% rule from 2026 onwards and are subject to derogations until end of 2025. For NTC borders and the NTC-values provided by the German LACs for the ERAA-process in the PEMMDB app, it is not guaranteed that they are CEP-compliant due to the fact, that there is no consistent method to determine the NTC values which fulfil the 70% minRAM requirements. German TSOs would appreciate, if ENTSO-E provides a consistent method for all TSOs.	Partially, where possible, NTC values were coordinated with neighbouring TSOs beforehand and should be consistent. German TSOs do not submit maintenance based NTC values, which is why there could be slight differences in some hours.
DK	NECP	For the ERAA 2024, interconnectors have been reported in compliance with the Project Assumptions for 2023 as the rest of the scenario.	No, all of them, as it was estimated to be too big of a task given the available time. Instead, coordination of inputs has been tried to be achieved through the DQTF and model building process. It was assumed that other TSOs would submit similar values.

Country	What were the primary drivers of the data related to interconnections?	Please further explain the primary drivers for the data related to interconnections submitted in the PEMMDB app.	In relation to interconnections, are your submitted NTC values coordinated with the neighbouring TSO and thus consistent?
EE	Other: Grid development plans	All available capacity is allocated to the reserve and energy markets to ensure compliance with the 70% target. This means that the necessary portion of transmission capacity is reserved for cross-border trading, in line with regulatory requirements.	Yes
ES	Other: Specific project delays & 70% target	Current interconnection data are based on the last two years historical data. Those historical data are compliant with 70% percent Target. Additionally, for future interconnection data, a methodology that covers the 70% criteria is used, as well as commissioning dates of future interconnection projects.	Yes
FI	Other: National and regional grid development plans	The primary drivers are known IC projects of Aurora Line (1 and 2) between FI-SE1 and Estlink 3 between FI-EE. The NTCs are set as such that over 70% of the transmission capacity is offered for cross-zonal trade.	Yes
FR	Other	Current NTC for FR-ES and FR-IT are based on close historical data that were in line with the 70% target. 70% assessment method for CORE region (Belgium and Germany borders) is only valid with flow-based method (which is the method used in ERAA). Status of NTC values regarding 70% target cannot be provided.	Yes
GR	Other: National and regional grid development plans	GR-IT border is compliant with the 70% Target. GR-BG border is also practically compliant with the 70% target, but small variations may be present due to minor uncertainties regarding future grid operation and possible constraints of non-EU27 neighbouring grids, after the completion of the Maritsa East 1 – N. Santa interconnector, which are to be resolved.	Yes
HR	70% target	Interconnection data is calculated for the needs of PEMMDB. Security of supply reports from previous years were used for verification.	Yes
HU	Other: Best estimation based on previously existing NTCs and new	The data is based on best estimation. Hungary has an Action Plan to achieve CEP70-compliance by the end of the	Yes

Country	What were the primary drivers of the data related to interconnections?	Please further explain the primary drivers for the data related to interconnections submitted in the PEMMDB app.	In relation to interconnections, are your submitted NTC values coordinated with the neighbouring TSO and thus consistent?
	interconnection projects (for the grid model: CEP70 Action Plan also).	derogation period (2025), which has been already fulfilled. This influences flow-based compliance (through the grid model), besides that no effects on long-term NTCs can be estimated.	
IE	NECP	CAP 2023 calls for: Delivery of at least three new transmission grid connections or interconnectors; Explore further interconnection potential, including hybrid interconnector	Partially, UK had submitted different NTC on UK00-IE00, but we submitted the more conservative values, which are used.
IT	Other: NECP and a subset of TYNDP scenarios (scenarios defined according to the National Development Plan)	The primary driver is improving electric market system efficiency indicators that the interconnection enables, such as the increase of the Social Economic Welfare (composed of consumer surplus, producer surplus, and congestion rent), the reduction of Market Prices for the consumers, taking into account the costs associated specified within the cost-benefit analysis. Moreover, to reach RES EU targets, the future grid needs to have an increasingly interconnected system to guarantee stability, quality and safety of the electricity system itself.	Partially, the NTC values sent by Terna to ENTSO-E during the data collection are compliant with the 70% minRAM requirement. Variations of these values are allowed by the ERAA methodology (e.g. adopting a conservative approach in case a neighbouring TSO communicates lower NTC values). In the future, Italian NTC values could be further upgraded in light of upcoming energy scenarios.
LT	70% target	Data submitted in accordance with Regional grid development plans and synchronisation project with continental EU.	Yes
LU	Other	LU-DE Interconnector is included in the DE-LU Bidding zone, so no capacity is allocated for this IC, the Interconnector BE-LU is not commercialised (in LT, DA or ID) due to operational constrains. However the IC BE-LU capacity is considered in the simulations for security of supply assessment (ERAA).	Yes
LV	NECP	N/A	Yes
MD	Other: TYNDP	The primary drivers for the data related to interconnections are based on the TYNDP, which is currently in the process of revision. Regarding compliance with the 70% target for	No

Country	What were the primary drivers of the data related to interconnections?	Please further explain the primary drivers for the data related to interconnections submitted in the PEMMDB app.	In relation to interconnections, are your submitted NTC values coordinated with the neighbouring TSO and thus consistent?
		interconnections, currently, our country does not meet this target.	
MK	Other: National Development Plan	MK is not EU Member	Yes
MT	NECP	Interconnection with Sicily is compliant with 70% target	Yes
NL	Other: National Investment Plan (IP), TYNDP, interconnection plans	70% included in FB calculations, but not part of NTC calculation as there is no aligned methodology to do so. However, considering that the most important calculations use FB, this is less relevant.	Partially, not a 100% sure whether BE and DE now submitted values that used some kind of 70% methodology.
NO	Other	Electrification and increased demand. Offshore wind	No, due to lack of time
PL	70% target	There is agreed trajectory for the period 2020-2025, specified in the Polish Action Plan (https://www.gov.pl/attachment/8f1ecddb-e974-4562-8768-219f7051a8cf) to be fully compliant with 70% minRAM criteria since 2026. The level of transmission capacities in 2025 resulting from the CNEC list provided for FB purpose in PEMMDB 3.4 (ERAA 2022) is consistent with the Polish Action Plan. 2024 and 2025 NTC values do not consider the 70% minRAM criteria for technical profiles with DE, CZ, SK, due to the inclusion in the calculations of unscheduled flows through Poland, which limits the NTC level.	Partially, SE and LT NTC is consistent. NTC with DE, CZ, SK is not coordinated as PSE provides NTC for common border with DE, CZ, SK (technical profile).
PT	Other: Most recent Grid Investment Plan of REN	Data submitted are based on most recent REN's Grid Investment Plan. Regarding the 70% minRAM requirement within the NTC simulations, and with respect to Portugal, the medium- to long-term NTC values do not yet consider the 70% minRAM requirement. The available values were calculated in joint studies with the neighbouring TSO before the publication of this rule	Yes
RO	70% target	The NTCs values provided for the EU borders are in line with the Action Plan developed by Romanian TSO in accordance with the provisions of Art. 15 of Regulation (UE) 2019/943 and the Derogation for 2024.	No, the NTC values provided are not coordinated with the neighbouring TSOs and represent the capacity of the electricity grid of Romania.

Country	What were the primary drivers of the data related to interconnections?	Please further explain the primary drivers for the data related to interconnections submitted in the PEMMDB app.	In relation to interconnections, are your submitted NTC values coordinated with the neighbouring TSO and thus consistent?
RS	NECP	The data was based on the harmonized projects included in TYNDP 2024. Serbia is not an EU member, so 70% target compliance was not checked.	Yes
SE	Other: Svenska kraftnät's best estimate based on existing ICs and known IC projects	SE fulfils the 70% rule on all borders for 2023. However, there are differences between ACER calculation and TSO (Svk) calculation on NTC data. It is assumed that with the transition to the flow-based market model, the different calculations will align.	Partially, connections SE-FI and SE-DE were explicitly coordinated in the submission. Remaining NTCs were not coordinated, but it was assumed that other TSOs would submit similar values.
SI	Other: NECP, National Grid Development Plan, TYDNP, 70% target	NTC values are based on the current status of interconnection projects and bilateral exchanges with neighbouring TSOs, and are in line with TYNDP projections.	Yes
SK	Other: National Development Plan	The primary drivers of the data related to interconnection are specified in the National Development Plan. The 70% target is fulfilled on the all borders at the present.	No, NTCs are taken from the National Development Plan and these were aligned with the values of the neighbouring TSOs by ENTSO-E after data collection.
TR	70% target	international agreements	Yes
UA	Other	The set and parameters of interconnection projects are discussing with neighbouring TSO	No, the set and parameters of interconnection projects are discussing with neighbouring TSO

Other relevant assumptions for interconnection data

In ERAA 2024, several new questions were included in the survey for TSOs. Firstly, based on stakeholder requests, new nodes were asked to be identified in comparison to ERAA 2023. This was only applicable for four countries: Denmark, Greece, the Netherlands and Norway.

Next, TSOs in the Core CCR (Austria, Belgium, Croatia, the Czech Republic, France, Germany, Hungary, Luxemburg, the Netherlands, Poland, Romania, Slovakia, and Slovenia) were asked to clarify the calculation methods used in defining the NTC. The responses TSOs of the TSOs vary from the FBMC methodology, the use of TYNDP results, and other individual approaches.

Country	Please list and provide more information on the new nodes included in ERAA 2024 data related to interconnections submitted in the PEMMDB app	For Core Region TSOs, please elaborate on the calculation methods employed in defining the NTC
AL		
AT		
BA		
BE		FBMC CORE Capacity Calculation Methodology
BG		
CH		
CZ	N/A	
DE	N/A	Expert based estimation on transfer capacities based on status quo, minRAM developments and projects in planning.
DK	DKHE, DKK2, DKKA, DKN1 and DKN2 are all new zones created in order to model overplanted offshore wind with PtX directly linked, as stated in the Project Assumptions for 2023 by the Danish Energy Agency.	
EE	N/A	N/A
ES		
FI		
FR		
GR	The interconnection between Greece and Egypt has been included in the NTC section of the ERAA24 data-collection process, which was not the case for ERAA23.	
HR	N/A	
HU		NTCs are based on historical values and TYNDP dNTC results for new interconnector projects.
IE	N/A	N/A
IT		
LT	N/A	N/A

Country	Please list and provide more information on the new nodes included in ERAA 2024 data related to interconnections submitted in the PEMMDB app	For Core Region TSOs, please elaborate on the calculation methods employed in defining the NTC
LU	No new nodes	Operational Agreement based on coordinated assessment with neighbouring TSOs (Elia and Amprion)
LV		
MD		
MK		
MT		
NL	NLLL and NL60, both located offshore. NLLL is connecting from NL00 to NLLL to UK00 1800 MW and from UK00 to NLLL to NL00 2000 MW; as from 2030. NL60 is connecting to NL00 as from 2035 (3300 MW)	NTCs are based on the TYNPD methodology and are not adapted for the 70% regulation. In TYNDP projects cause a delta NTC which is added for all reference projects.
NO	Southern Norway split in 3 sub-nodes. Offshore wind nodes also split	Norway not CORE
PL	No new nodes	When determining the NTC values, it was assumed that the CNECs at the PL-Core border are loaded by the natural loopflow in the DE->PL->CZ+SK direction at the level of 30% Fmax, which is equivalent to meeting the requirement of having 70% of their capacity available for trade. Then, a conservative assumption was made that the directions of power exchange would be unfavourable from the point of view of the CNEC load, i.e.: - for NTC calculations in PL -> Core direction, it was assumed that generation would be reduced in the south-eastern part of Europe, including in the CZ and SK zones, thus impacting mostly the load on the CNECs at the PL-CZ and PL-SK border; - for NTC calculations in Core <- PL direction, it was assumed that generation would be increased only in the DE zone, thus impacting mostly the load on the CNECs at the DE-PL border.
PT	N/A	N/A
RO		Flow -based method.
RS	N/A	N/A
SE		
SI	No new nodes	

Country	Please list and provide more information on the new nodes included in ERAA 2024 data related to interconnections submitted in the PEMMDB app	For Core Region TSOs, please elaborate on the calculation methods employed in defining the NTC
SK	N/A	NTC calculations are based mostly on A – method of generation shift (sometimes combination of A and C methods used) for a few simulated representative setpoints for given years.
TR	N/A	N/A
UA		

Efficiency

The aim of the following questions is to gain insights into each Member State's (and non-Members States') targets for reducing their emissions through increase in efficiency, e.g. by converting/upgrading heating technologies, electrifying transport, improving building insulation and reducing temperature dependent load.

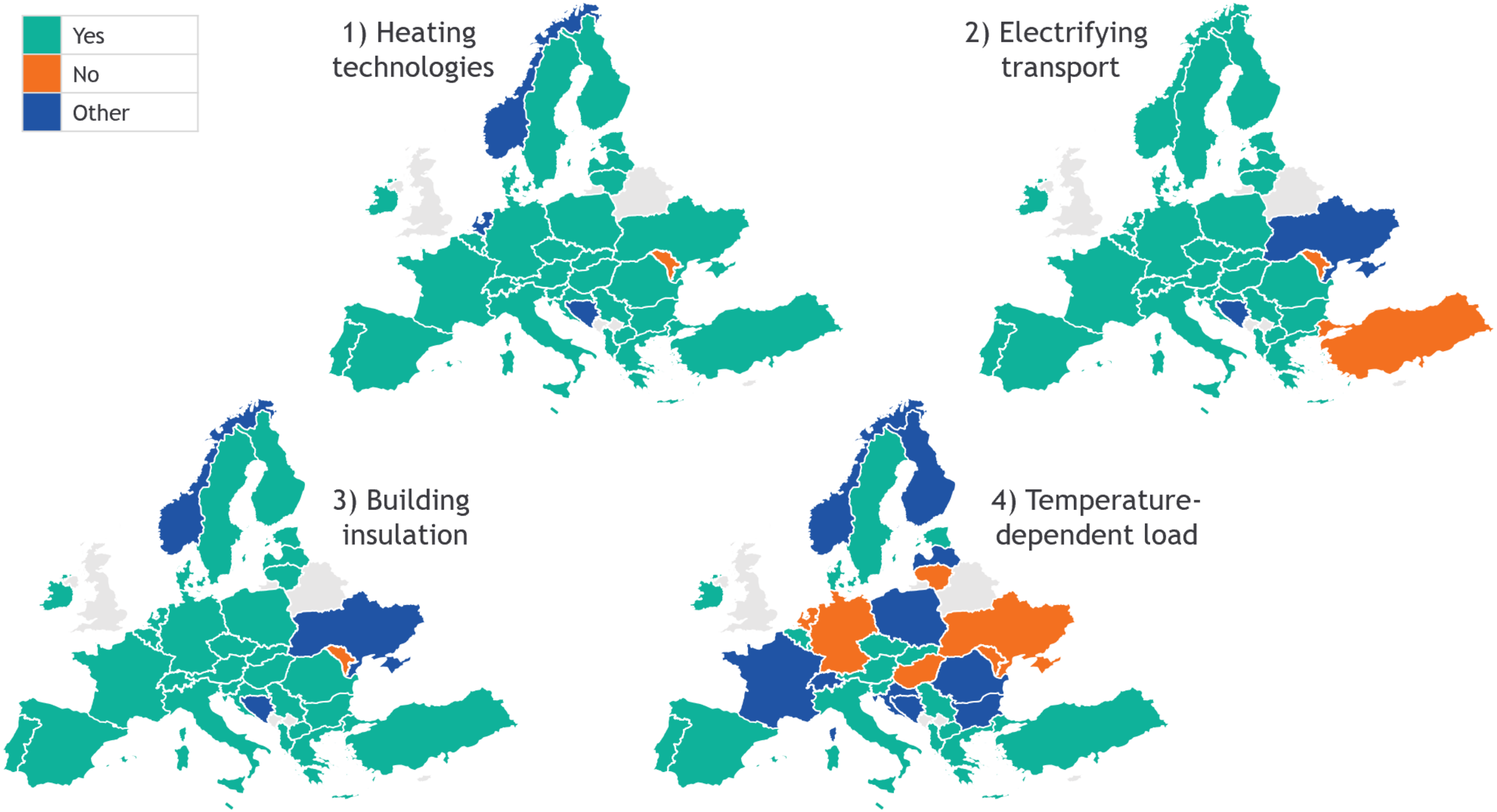


Figure 28: Does your country intend to reduce emissions through an increase in efficiency by 1) converting / upgrading heating technologies; 2) electrifying transport; 3) improving building insulation; 4) reducing temperature-dependent load?

Increase efficiency by converting/upgrading heating technologies

Most countries (31 out 35 responses) are taking various measures to reduce emissions by converting/upgrading heating technologies, including measures in substituting fossil fuel-based heating technologies (e.g. heat pumps) and measures to promote the renovation for increased efficiency.

Country	Does your country intend to reduce emissions through an increase in efficiency by converting/upgrading heating technologies?	Please further explain how your country intends to reduce emissions through an increase in efficiency by converting/upgrading heating technologies.
AL	Yes	National policy aims to increase the usage of efficient heat pumps and replacement of fossil fuel based heating technologies.
AT	Yes	Austria invests in climate-friendly technologies for heating (e.g. heat pumps, biomass) by financially supporting the switch from fossil fuels
BA	Other	It is specified in draft NECP.
BE	Yes	Assumptions provided in relation to Heating (see latest NRAA Adequacy & Flexibility study 2023)
BG	Yes	There is a whole chapter on the energy efficiency in the BG NECP where there are foreseen measures to substitute old heating technologies with heat pumps and other innovative technologies but no concrete data about the penetration of said technologies is provided, only expected energy savings.
CH	Yes	It is expected to increase efficiency in building heating and gradually replace fossil fuel based heating by heat pumps. Figures on this are available in the Swiss scenario framework for electricity network planning and in the Energy Perspectives 2050+.
CZ	Yes	Deployment of energy efficiency policies (subsidies for renovations of old houses, subventions for replacement of older gas boilers by new heat pumps etc.)
DE	Yes	The electrification in the heating sector reduces the primary energy consumption of heating technologies. Germany has set the goal to have 6 million heat pumps installed in 2030. To achieve this a law has been issued that newly installed heating systems starting in 2024 have to use 65% of renewable energy. The exchange of existing heating installations is encouraged by incentives.
DK	Yes	The political ambition is to phase out the utilisation of 'line gas' in individual heating in households towards 2035. The heating demand is expected to be covered by district heating and individual electricity-driven solutions, where district heating is not a possibility. District heating production is also expected to be increasingly driven by electricity due to the roll-out of heat pumps in the district heating mix.
EE	Yes	The adoption of heat pumps instead of electric radiators, along with efficiency subsidies for housing, have been key initiatives. Many district heating operators have expressed plans to transition to electrification
ES	Yes	The data provided includes measures in the residential sector for installations of heating and air conditioning. The measures contemplate the incorporation of renewable energy sources to cover demand in accordance with the final renewable energy consumption Spanish objectives. These

Country	Does your country intend to reduce emissions through an increase in efficiency by converting/upgrading heating technologies?	Please further explain how your country intends to reduce emissions through an increase in efficiency by converting/upgrading heating technologies.
		measures include hybridization of renewable technologies in converting/upgrading heating technologies. In the Spanish NECPC there are a group of measures focus on it. For example, Measure 6.5 Social Climate Fund; Measure 2.10. District heating and cooling networks; Measure 2.11. Energy efficiency in tertiary sector buildings; Measure 2.12. District heating and cooling networks in the tertiary sector.
FI	Yes	At the building level heat pumps replace fossil-fuel based heating, direct electric heating, and also older heat pump technologies. At the district heating number of heat pumps and electric boilers are increasing rapidly.
FR	Yes	Replacement of fossil fuel-based heating systems (oil, gas) by low-carbon solutions such as electric heat pumps, in addition to other low-carbon solutions such as wood-fired heating and heating networks powered by renewable and recovered energies
GR	Yes	Electrification of HVAC systems in existing and new buildings is promoted through several financial and legal tools.
HR	Yes	The implementation of advanced technologies such as heat pumps will be encouraged.
HU	Yes	Help households switch from wood-based heating to e.g. heat pumps combined with PV panels (state aids, development programs).
IE	Yes	We have targets for the installation of HPs in 700,000 dwellings by 2030
IT	Yes	Replacement of traditional boilers with heat pumps.
LT	Yes	The main goal of the strategy is still valid - to achieve consistent and balanced modernisation (optimisation) of district heating systems; ensuring efficient heat consumption as well as reliable, economically attractive (competitive) supply and manufacturing; enabling the introduction of modern and environmentally friendly technologies; using indigenous and renewable energy sources to secure systems' flexibility; and creating a favourable environment for investment.
LU	Yes	NECP includes measures to shift from fossil fuels (gas & oil) in heating technologies to green technologies e.g. heat pumps and/or green hydrogen supplied district heating systems.
LV	Yes	Existing heating of natural gas is upgraded to electrical heat pumps and in future existing high capacity gas CHPs are going to be fuelled with hydrogen instead of natural gas.
MD	No	Currently, our country does not have specific plans to reduce emissions through the conversion or upgrading of heating technologies.

Country	Does your country intend to reduce emissions through an increase in efficiency by converting/upgrading heating technologies?	Please further explain how your country intends to reduce emissions through an increase in efficiency by converting/upgrading heating technologies.
MK	Yes	North Macedonia aims to reduce emissions by increasing energy efficiency by converting and upgrading heating technologies. This includes replacing outdated and inefficient heating systems with modern, energy-efficient alternatives like district heating and heat pumps. These upgrades reduce fuel consumption and emissions, particularly in the residential and public sectors. Additionally, the country is promoting using renewable energy sources for heating, such as solar thermal collectors further contributing to emission reductions.
MT	Yes	It is expected that the share of households with heat pumps used for space heating purposes will continue increasing, with a corresponding decrease in the use of electric and LPG heaters. Moreover, financial support is provided to incentivise uptake of solar water heaters and heat pump water heaters through grant schemes. To note that Malta does not have any district heating networks and there are no plans for their development.
NL	Other	through ETS, regulations and subsidies, also governmental stimulation to reform gas firing processes towards electrifying processes
NO	Other	Still uncertainty on how to implement the new EU building directive Already high share of heat pumps and resistive heating. Some district heating
PL	Yes	Converting and upgrading heating technologies
PT	Yes	In NECP replacement of space and water heating systems is considered (e.g. heat pumps), mostly at residential level
RO	Yes	No data provided for any type of heat pumps.
RS	Yes	By stimulating the implementation of new and more efficient technologies through subsidies.
SE	Yes	The emissions from heating are very low in Sweden but increased energy efficiency in buildings and installation HPs instead of direct electricity heating, as well as upgrading existing HPs will lead to further emission reduction.
SI	Yes	NECP includes the necessary measures by investing in climate-friandly technologies. Slovenia invests in the renovation of old houses and the use of climatefriendly technologies (e.g. HPs, biomass) to heat new dwellings by providing financial support.
SK	Yes	Information about reduced emissions through an increase in efficiency by converting/upgrading heating technologies in detail are specified in the NECP and Slovakia’s recovery and resilience plan.

Country	Does your country intend to reduce emissions through an increase in efficiency by converting/upgrading heating technologies?	Please further explain how your country intends to reduce emissions through an increase in efficiency by converting/upgrading heating technologies.
TR	Yes	The ministry is taking steps to support heat pumps, especially in public heated areas.
UA	Yes	Ukraine NECP was adopted in 2024 and emissions reduction are in line with the WAM scenario

Increase efficiency by electrifying transport

Most countries (31 out 35 responses) are taking various measures to reduce emissions by electrifying transport, including implementing subsidy schemes for EVs, investing in charging infrastructure, introducing hydrogen, investing in public transport (railway infrastructure) introducing policies to replace fossil fuel-powered cars with EVs. These efforts aim to transition to cleaner and more energy-efficient modes of transportation and reduce GHG emissions in the transport sector.

Country	Does your country intend to reduce emissions through an increase in efficiency by electrifying transport?	Please further explain how your country intends to reduce emissions through an increase in efficiency by electrifying transport.
AL	Yes	The aim is to provide tax incentives to ease the market penetration of electric vehicles and improved charging infrastructure.
AT	Yes	Austria invests in electrifying transport by financially supporting the switch from fossil fuel driven transport to E-Mobility
BA	Other	It is specified in draft NECP.
BE	Yes	Assumptions provided in relation to Transport (see latest NRAA Adequacy & Flexibility study 2023)
BG	Yes	The penetration of the EV in BG is internally estimated by ESO EAD experts as there were no concrete figures for EVs in the BG NECP.
CH	Yes	Vehicles with internal combustion engines will be gradually replaced by electrical vehicles. Figures on this are available in the Swiss scenario framework for electricity network planning and in the Energy Perspectives 2050+.
CZ	Yes	National plan for the clean mobility
DE	Yes	There are several initiatives to support the electrification of the transport sector and to reach 15 million electric vehicles by 2030. This includes tax reductions for electric vehicles and fundings in the expansion of charging infrastructure. The electrification of commercial vehicles, buses and rail vehicles is supported. Additionally, it is

Country	Does your country intend to reduce emissions through an increase in efficiency by electrifying transport?	Please further explain how your country intends to reduce emissions through an increase in efficiency by electrifying transport.
		intended to strengthen and electrify the public transport, supported by high investments in the state-owned railway system.
DK	Yes	Fossil cars are assumed to be replaced by EVs, among other things due to EU-requirements.
EE	Yes	Estonia will introduce a motor vehicle tax that favours vehicles with lower emissions and higher efficiency. In addition to regional plans to convert public transportation to electric or bio-fuelled.
ES	Yes	The electrification of the economy increases over the decade as one of the key vectors of decarbonisation, increasing to 34% by 2030. Some important measures regarding this issue are included in the demand forecasts, including: promotion of the modal shift towards more efficient modes of transport, accelerated introduction of EVs, and increased mobility through electrified rail transport.
FI	Yes	Finland will reduce emissions from domestic transport by electrifying transport. The objective in the Medium-term Climate Change Policy Plan (2022) is to increase the number of electric cars to at least 750,000, the number of electric lorries and buses to at least 8,000.
FR	Yes	Phasing out the sale of new thermal vehicles by 2035 and progressive deployment of electric vehicle
GR	Yes	Subsidies for Electric Vehicles (private / professional / public transport) are in place to enhance the electrification of road transportation.
HR	Yes	The implementation of advanced technologies related to the electrification of transport and the application of hydrogen will be encouraged.
HU	Yes	Reducing transport emissions by improving rail transport, operating zero emission buses, providing state aids for buying electric vehicles.
IE	Yes	We have targets for up to 1 million EVs by 2030
IT	Yes	Replacement of old polluting vehicles with less polluting, electric and biofuels options. Gradual reduction of the use of cars increasing smart and flexible working, improving local public transport, as well as increasing the use of railways for both passengers and goods.
LT	Yes	The railway electrification project and the development of electric vehicle infrastructure is underway, support schemes for the purchase of electric vehicles (EVs) have been created.
LU	Yes	Public transport system (bus fleet) are supposed to be electrified by 95% until 2030. NECP increased targets for EV significantly.
LV	Yes	In Latvia there is a state subsidy for electrical vehicle for households. It has to increase the amount of EV.

Country	Does your country intend to reduce emissions through an increase in efficiency by electrifying transport?	Please further explain how your country intends to reduce emissions through an increase in efficiency by electrifying transport.
MD	No	Currently, our country does not have specific plans to reduce emissions through an increase in efficiency by electrifying transports.
MK	Yes	North Macedonia plans to reduce emissions by increasing efficiency through the electrification of transport. The strategy includes promoting electric vehicles (EVs), expanding charging infrastructure, and incentivizing public and private EV adoption. By replacing conventional internal combustion engine vehicles with EVs, the country aims to lower greenhouse gas emissions, improve air quality, and enhance energy efficiency in the transport sector.
MT	Yes	In line with Malta's Low Carbon Development Strategy (LCDS), Malta aspires to have introduced 65,000 EVs (including PHEVs) by 2030. Uptake of electric vehicles is promoted through grant and scrappage schemes. The roll-out of electric route buses is also projected through the integration of 141 electric buses in the public transport fleet (of which 102 will be financed through Malta's allocated RRP funds). (Source: Malta Draft NECP 2021 - 2030)
NL	Yes	by new plans, technology and financing possibilities focus on emission levels, making fossil fuels expensive and subsidize EV, promote electrification possibilities
NO	Yes	Subsidies and advantages for electrical vehicles. But these have been reduced, and may be terminated. High share of electrical cars in Norway
PL	Yes	E.g. support schemes for EVs
PT	Yes	Regarding electric mobility, estimates based on NECP consider the expected evolution of the number of light passenger vehicles with Plug-in Hybrid Electric Vehicle (PHEV) and Battery Electric Vehicle (BEV) technologies, of light goods vehicles with BEV technology, heavy passenger and freight vehicles with BEV technology, as well as electric passenger river ships.
RO	Yes	Assumptions provided in relation with the expected growth of EVs, given the incentives granted and the development of the charging infrastructure (some projects funded by the Recovery and resilience plan)
RS	Yes	By stimulating the implementation of new and less emitting vehicles through subsidies.
SE	Yes	By taxes on fossil fuels, subsidy schemes and building out charging infrastructure which provides incentives for consumers to switch to EVs. However, the former investment subsidy for the purchase of new low-emission passenger cars was abolished in November 2022 and the current government has also announced that the tax on petrol and diesel will be reduced in 2025. The full effects on how these measures impacts the transition to electrified transports are not yet analysed.
SI	Yes	Slovenia is investing into electrifying transport by providing subsidies. New charging stations for EVs are constantly being built, in particular considerable effort is being made in building fast charging stations near the

Country	Does your country intend to reduce emissions through an increase in efficiency by electrifying transport?	Please further explain how your country intends to reduce emissions through an increase in efficiency by electrifying transport.
		highways, especially for preparing for the introduction of e-trucks. Slovenia also promotes the use of public transport.
SK	Yes	Information about reducing emissions through an increase in efficiency by electrifying transport in detail are specified in the NECP and Slovakia's recovery and resilience plan.
TR	No	
UA	Other	There is no special deeply elaborated national level program/study dedicated to the emissions reduction due to EV implementation

Increase efficiency by improving building insulation

Most TSOs (31 out of 35) mention that an improvement in building insulation is foreseen. Countries are implementing various measures to reduce emissions by improving building insulation, such as regulations with stricter building codes with higher insulation requirements for new buildings, providing government subsidies for upgrading the energy efficiency of existing buildings renovations), promoting he comprehensive renovation of residential and public buildings, and incentivising the population to improve building insulation. These efforts aim to enhance energy efficiency, and reduce heat loss and energy consumption in buildings, leading to lower GHG emissions.

Country	Does your country intend to reduce emissions through an increase in efficiency by improving building insulation?	Please further explain how your country intends to reduce emissions through an increase in efficiency by improving building insulation.
AL	Yes	There are national objectives regarding the gradual renovation of existing public building stock, as well as national measures to provide financial aid for private renovation of old buildings with improved insulation.
AT	Yes	Austria has been investing for years in improving house insulation (often combined with switching to climate friendly heating systems) by providing financial support for loan repayments. However, an increase in the annually implemented house insulation is necessary to achieve climate neutrality in 2040.
BA	Other	It is specified in draft NECP.
BE	Yes	Assumptions provided in relation to Building (see latest NRAA Adequacy & Flexibility study 2023)
BG	Yes	There is a whole chapter on the energy efficiency in the BG NECP dealing energy efficiency.

Country	Does your country intend to reduce emissions through an increase in efficiency by improving building insulation?	Please further explain how your country intends to reduce emissions through an increase in efficiency by improving building insulation.
CH	Yes	Improved building insulation should reduce heating needs in the future. Figures on this are available in the Energy Perspectives 2050+.
CZ	Yes	Governmental subsidies for renovation and Modernisation Fund
DE	Yes	Building insulation is supported by different measures, mainly in terms of incentives and regulations. Incentives include the support of energy advice measures as well as incentives and tax advantages for investments in the insulation of residential and non-residential buildings. Regulations include the increase of the minimum construction standard for newly built buildings in terms of permitted primary energy demand to a "KfW Efficiency House 55 standard" which applies as the minimum standard for new buildings. To encourage the insulation of rental properties, landlords are obliged to finance parts of the co2 costs caused by heating.
DK	Yes	Renovation of buildings and efficiency gains are internalized in the modelling of the consumption side of the Project Assumptions for 2023.
EE	Yes	The government approved a long-term building renovation strategy aiming to fully renovate all buildings constructed before 2000 by 2050. The strategy established minimum energy efficiency standards, requiring new and renovated buildings to meet class A (nearly zero-energy) standards. The installation of local renewable energy systems, like solar panels, is also a key part of the strategy to improve energy efficiency.
ES	Yes	In the Spanish NECPC there are a group of measures focus on it. For example: Measure 2.8. Energy efficiency in existing buildings in the residential sector; Measure 4.2. Fight against energy poverty; Measure 2.4. Improving the energy efficiency of ports (port infrastructure).
FI	Yes	Finland is committed to EU targets in energy efficiency improvements. These include energy efficiency improvements in renovations as well as improved building maintenance and automation practices.
FR	Yes	Thermal renovation of buildings and construction of energy-efficient buildings
GR	Yes	New buildings are obliged to have insulation installed, as well as meeting several energy-efficiency targets. For existing buildings, there are periodical support schemes for insulation installations and efficiency-related renovations.
HR	Yes	Funds for the renovation of buildings are awarded in tenders every year.
HU	Yes	There are state aid programs for improving energy efficiency of buildings, further development programs for buildings are under consideration.

Country	Does your country intend to reduce emissions through an increase in efficiency by improving building insulation?	Please further explain how your country intends to reduce emissions through an increase in efficiency by improving building insulation.
IE	Yes	We have retrofit programmes for 500,000 dwellings to have BER B2 rating; and a target to have all new dwellings at ZERO-EMISSION Building standard by 2030
IT	Yes	Keep in place measures already introduced in the past such as building insulation of houses and possibly incentivize the change windows/glasses for more performing ones.
LT	Yes	By promoting the comprehensive renovation of multi-apartment residential and public buildings.
LU	Yes	NECP includes concrete political measures to improve mandatory building energy class for new buildings and fixes renovation targets.
LV	Yes	Some state subsidy for house insulation.
MD	No	Currently, our country does not have specific plans to reduce emissions through an increase in efficiency by improving building insulation.
MK	Yes	North Macedonia plans to reduce emissions and increase energy efficiency by providing subsidies for upgrading building insulation, windows, and doors. These subsidies help homeowners and businesses improve the thermal performance of their buildings, leading to lower energy consumption for heating and cooling.
MT	Yes	Technical guide F is a local guide establishing minimum energy performance requirements applicable to new and renovated dwellings, as well as non-residential buildings intended for human occupancy. These include minimum requirements for building fabric. It is important to note that the effects of this measure are not reflected in electricity demand data provided for ERAA 2024.
NL	Yes	by new plans, technology and financing possibilities making fossil fuels expensive and subsidize insulation and electrification as well as adapt law how to build properly.
NO	Other	Still uncertainty on how to implement the new EU building directive
PL	Yes	E.g. support schemes for building insulations
PT	Yes	The national Long-Term Strategy for the Renovation of Buildings 2050 (ELPRE 2050) was taken into account, with a view to renovating the national residential and non-residential, public and private buildings, to convert it into a decarbonised and highly energy efficient real estate park.
RO	Yes	Assumptions provided in relation with the expected energy efficiency improvements in buildings.
RS	Yes	By stimulating the implementation of new and more efficient technologies through subsidies.

Country	Does your country intend to reduce emissions through an increase in efficiency by improving building insulation?	Please further explain how your country intends to reduce emissions through an increase in efficiency by improving building insulation.
SE	Yes	Yes, through incentives to building owners to improve energy efficiency
SI	Yes	Slovenia is promoting and financially supporting the renovation of buildings/apartments/houses as is foreseen in NECP.
SK	Yes	Information about reduced emissions through an increase in efficiency by improving building insulation in detail are specified in the NECP and Slovakia's recovery and resilience plan.
TR	Yes	Newly constructed buildings are required to obtain energy efficiency certificates. Otherwise, residence permits are not given for these buildings.
UA	Other	The State Agency on Energy Efficiency and Energy Saving of Ukraine has several programs for improving building insulation, for example, incentive loans for building owners and communal owned buildings

Increase efficiency by reducing temperature-dependent load

Improving efficiency by reducing temperature-dependent load is the least considered alternative during ERAA 2024, compared to the other efficiency measures. According to the responses, nineteen TSOs expect reduced emissions by reducing the temperature-dependent load whereas six see no such plans in their country. Countries are taking measures to reduce emissions by reducing the temperature-dependent load, primarily through improving the efficiency of heating and cooling systems, increasing building renovations, promoting the usage of HPs, and supporting demand-side management programmes. However, it is worth noting that the shift from combustion heating to electrification might increase the electrical heat demand in some cases, which can have implications for emissions depending on the electricity generation mix.

Country	Does your country intend to reduce emissions through an increase in efficiency by reducing temperature-dependent load?	Please further explain how your country intends to reduce emissions through an increase in efficiency by reducing temperature-dependent load.
AL	Yes	Yes, through the increase in usage of heat pumps and incentives to install solar panels.
AT	Yes	By an increase of heat pumps and their availability to shift the load.
BA	Other	It is specified in draft NECP.
BE	Yes	Assumptions provided in relation to thermal sensitivity of Demand (see latest NRAA Adequacy & Flexibility study 2023)

Country	Does your country intend to reduce emissions through an increase in efficiency by reducing temperature-dependent load?	Please further explain how your country intends to reduce emissions through an increase in efficiency by reducing temperature-dependent load.
BG	Other (No information (yet))	
CH	Other	
CZ	Yes	Partially through heat pump flexibility
DE	No	The opposite effect is expected, as support schemes for electric heat pumps replacing fossil fuel based heating systems will increase the temperature dependent load.
DK	Yes	For industry demand, a decrease in emissions is seen after 2035 due to the substitution away from coal and petrol and towards increased use of green gases for high-temperature processes. Additionally, it is expected that low temperature process will be altered in order to use heat from heat pumps, when possible and economical beneficial.
EE	Yes	Various targets, goals and plans will have indirect result to decrease temperature dependant load
ES	Yes	Efficiency is the basis of all national policies and has been considered in the demand value. It is applicable the measures indicated in the question 17.
FI	Other	The main method to reduce temperature-dependent load is to replace direct electric heating and old heat pumps with more efficient heat pumps. Overall, however, temperature-dependent load might increase as heating is electrified both in households and district heating. In district heating, many electric boilers and large-scale heat pumps are planned to be commissioned, but at the same time there are plans to increase heat storages, which add flexibility to the load. Flexibility is assumed to also increase in households' heating, with smart solutions optimising the load according to the electricity price. Increased flexibility is considered in the inputs.
FR	Other	Replacement of fossil fuel-based heating systems (oil, gas) with low-carbon solutions such as electric heat pumps will increase the temperature-dependent load in medium term, but the impact will be mitigated by better insulation of buildings
GR	Yes	Mainly by increasing efficiency and building renovations
HR	Other	N/A
HU	No	N/A
IE	Yes	Overall emission will reduce with the electrification of heating and an increase in home insulation
IT	Yes	Improving building insulation reduces its temperature – dependency

Country	Does your country intend to reduce emissions through an increase in efficiency by reducing temperature-dependent load?	Please further explain how your country intends to reduce emissions through an increase in efficiency by reducing temperature-dependent load.
LT	No	No such intention yet
LU	Yes	Demand reduction of direct electric heating systems.
LV	Other (No information (yet))	No detailed information
MD	No	Currently, our country does not have specific plans to reduce emissions through an increase in efficiency by reducing temperature dependent load.
MK	Yes	North Macedonia intends to reduce emissions and increase efficiency by lowering the temperature-dependent electricity load. This strategy includes promoting energy-efficient heating and cooling systems, such as heat pumps, and encouraging better insulation in buildings to stabilize indoor temperatures. Additionally, the country supports demand-side management programs that optimize electricity usage during peak times.
MT	Yes	Refer to reply to questions 17 & 19.
NL	No	N/A
NO	Other	Still uncertainty on how to implement the new EU building directive
PL	Other	No information (yet)
PT	Yes	Conversion of space and water heating system along with insulation are expected to reduce temperature dependent load
RO	Other	Lack of specific measures/data.
RS	Yes	By stimulating the implementation of new and more efficient technologies through subsidies.
SE	Yes	Yes, through incentives to building owners to improve energy efficiency and also by information and advice to households on how they can reduce heating costs.
SI	Yes	By the renovation of buildings and installation of efficient HPs, which decreases the temperature dependent load. Slovenia is promoting to build storage next to PV, to work in combination.
SK	Yes	By the introduction of low carbon alternatives such as HPs. Information about reduced emissions through an increase in efficiency by reducing temperature dependent load in detail are specified in the NECP and Slovakia's recovery and resilience plan.
TR	Yes	

Country	Does your country intend to reduce emissions through an increase in efficiency by reducing temperature-dependent load?	Please further explain how your country intends to reduce emissions through an increase in efficiency by reducing temperature-dependent load.
UA	No	This is a very sophisticated instrument, Ukraine now is solving the power system resilience task

Consideration of the 'Recovery and Resilience Facility' programme

This question aimed to understand whether the data provided considered the 'Recovery and Resilience Facility', whereby less than half of the TSOs (14 out of 35) confirmed that their submissions consider this. Specific responses are listed below.

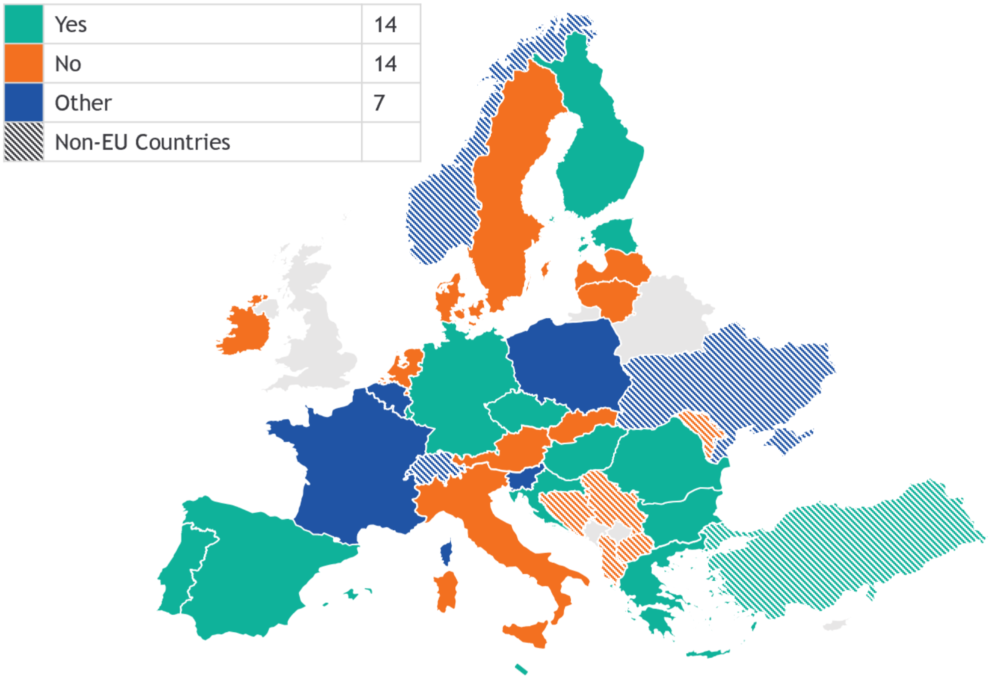


Figure 29: Did your country consider the Recovery and Resiliency Facility in the completion of this data?

Country	**Did your country consider the Recovery and Resiliency Facility in the completion of this data?**	**If other, please specify.**
AL	No	
AT	No	
BA	No	
BE	Other	N/A
BG	Yes	In the case of BG, the large scale BESS project that was laid out in the NRRP was reflected in the ERAA 2024 data submission.
CH	Other	N/A
CZ	Yes	Mainly for Energy Data Centre and flexibility
DE	Yes	
DK	No	
EE	Yes	
ES	Yes	
FI	Yes	
FR	Other	N/A
GR	Yes	
HR	Yes	
HU	Yes	
IE	No	
IT	No	
LT	No	
LU	Yes	
LV	No	
MD	No	

Country	Did your country consider the Recovery and Resiliency Facility in the completion of this data?	If other, please specify.
MK	No	
MT	Yes	
NL	No	Individual investments from this program did not affect national transition targets and the input data for ERAA
NO	Other	I do not understand the question
PL	Other	No information
PT	Yes	
RO	Yes	
RS	No	
SE	No	
SI	Other	Recovery and Resiliency is a priority topic and strategic goals of ELES. There are ongoing activities in this field. However, for now no concrete measures are considered.
SK	No	
TR	Yes	
UA	Other	Ukraine now has different supporting instruments/funds, not RRF

Out-of-market measures

This question aimed to understand which out-of-market measures TSOs have at their disposal, their volume, and how they contribute to the system's adequacy. Some countries are highlighted in the text. Detailed answers can be found in the table below.

The main out-of-market measures reported by TSOs are balancing market products (FRR, FCR) and strategic reserves. Demand-side response and voltage reduction have also been mentioned by various TSOs as contributing to system adequacy by providing additional capacity, supporting grid stability and managing supply–demand imbalances.

Country	What out-of-market measures (e.g. capacity market strategic reserves, voltage reduction, eco gestures, FRR, FCR, etc.) do you have at your disposal to address potential shortfalls in supply?	Please provide a quantification of the out-of-market measures that could be used to address potential shortfalls in supply (in MW or % peak demand)	Please explain how the out-of-market measures listed above contribute to system adequacy for your country.
AL	FRR and FCR	The balancing reserve requirements are dimensioned according to the peak system load.	Improving the adequacy of the system
AT	N/A	N/A	N/A
BA	FRR and FCR	positive mFRR 196 MW negative mFRR 68 MW	By balancing the mismatch between supply and demand.
BE	N/A	N/A	N/A
BG	aFRR and mFRR are market measures and are activated according to merit order lists. Only voltage reduction can be considered out-of-market measure.		
CH	Strategic reserves are available to address potential shortfalls in supply.	336 MW in reserve power plants are available until April 2026. Additionally, there are around 135 MW from pooled generators, also available until April 2026. Replacement of these reserve resources is undergoing and planned for the period 2026-2036.	They can be activated when shortage of supply.
CZ	Only ancillary services and a special form of DSR for industry stakeholders	We do not have such a value, only load shedding based on emergency plans	Limited impact
DE	The out-of-market resources for Germany include: - Capacity reserve: Reserve for unforeseeable events, which are activated in case of a lack of market clearance (D-1 and ID). They can also be used to resolve grid congestions. - Grid reserve: Used to resolve congestions and contains different types of power plants located in Germany. In emergency situations, it can be used for adequacy in grid operation, if not yet in operation for solving grid congestion. However, in terms of system forecasting, its availability is not	- Capacity reserve: Since 1 October 2024 and until 30 September 2026, a total capacity of 1205 MW of gas-fired power plants outside the market is available. These power plants have to be available within maximum 12 hours. - Out-of-market demand-side response: A mechanism with up to around 600 MW has been implemented to support system stability. However, due to a lack of offers, this reserve cannot yet be called up in full. - Grid reserve: Currently, it comprises a total	The capacity reserve of 1205 MW contributes to national adequacy (from October 2024 until September 2026). Other reserves have a different purpose than coping with resource adequacy, such as grid stabilization. Even though they shall be activated to ensure resource adequacy as last resort, these may already be partly exhausted when operating for their primary purpose.

Country	What out-of-market measures (e.g. capacity market strategic reserves, voltage reduction, eco gestures, FRR, FCR, etc.) do you have at your disposal to address potential shortfalls in supply?	Please provide a quantification of the out-of-market measures that could be used to address potential shortfalls in supply (in MW or % peak demand)	Please explain how the out-of-market measures listed above contribute to system adequacy for your country.
	sufficiently reliable to be counted on during national scarcity situations. Therefore, it is excluded in ERAA24. - Out-of-market demand-side response - Frequency restoration reserves - Special network equipment: used only for redispatch	capacity of 8.1 GW, which covers the. capacity need of 6.9 GW for winter 2024/25. - Special Network Equipment: a total of 1200 MW are available for curative redispatch. - Ancillary services: FCR of 564 MW and FFR of 2533 MW (positive)/ 2200 MW (negative)	
DK	Besides FRR and FCR, Denmark has not reported any out-of-market measures as part of the ERAA dataset, because capacity mechanisms/capacity markets/strategic reserves are not utilised in the country. Reserve/ancillary service capacity is normally considered out-of-market (day-ahead market). Data for both FCR and FRR have been provided. The National Resource Adequacy Assessment 2023 of Denmark, performed by Energinet, proposed, in cooperation with the Danish Energy Agency, an investigation of the possibility of and impact of establishing a capacity mechanism in Denmark. The result of this analysis is not yet finalized.	Total reserve requirement in the ERAA 2024 is estimated for DKE1 to be 731 MW in 2030 and 758 MW in 2035. For DKW1, the requirement is estimated to be 833 MW in 2030 and 906 MW in 2035.	Within the hour of operation, FCR will be activated with the shortest possible response time (a few seconds), whereafter aFRR and mFRR will be activated further to meet any imbalance. These response times are faster or as fast as decoupling demand (brown out), hence it is expected to utilize reserves before decoupling demand.
EE	FRR and FCR- providing capacities might address potential shortfalls. Out of market powerplants could be called to action if there is a certainty that otherwise there would be a shortage.	250-400 MW	Mothballed unit could be brought back to the market if necessary. TSO-owned gas power plant, which can be used for emergencies after significant forced outages could be used if the market is unable to provide the necessary response.
ES	N/A, as no specific out-of-market products are available	N/A	N/A

Country	What out-of-market measures (e.g. capacity market strategic reserves, voltage reduction, eco gestures, FRR, FCR, etc.) do you have at your disposal to address potential shortfalls in supply?	Please provide a quantification of the out-of-market measures that could be used to address potential shortfalls in supply (in MW or % peak demand)	Please explain how the out-of-market measures listed above contribute to system adequacy for your country.
FI	Finland has a strategic reserve measure in place until 2032; however, the reserve is procured on an annual basis and currently there is no capacity contracted to the reserve. According to the revised national regulation, Fingrid should primarily use mFRR capacity for potential shortfalls in supply to the extent that operational security can be upheld. In addition, National Emergency Supply Agency has reserved the production of the Meri-Pori coal condensing power plant for severe disruptions and emergencies to guarantee security of supply in the electricity system in Finland.	No capacity is contracted to the strategic reserve currently and due to the annual procurement, reserve capacity for the upcoming years is unknown. The expected development of mFRR capacity is given in the reserve inputs. Power generation capacity of Meri-Pori power plant is 565 MW.	The strategic reserve does not currently contribute to system adequacy as no capacity is contracted to the reserve. The mFRR are mainly used for frequency restoration but can also be used for system adequacy for short periods of time. Meri-Pori power plant is not available to contribute to system adequacy in normal conditions. Meri-Pori production is reserved only for severe disruptions and emergencies to guarantee security of supply in the electricity system.
FR	The various post-market measures that RTE can activate before resorting to targeted load shedding are highly heterogeneous and include: -reducing voltage on distribution networks, -contractual interruptibility for large consumers, -public calls for citizen action, and -margins generated by exceptional agreements with neighbouring grid operators (via 'back-up contracts').	Voltage reduction results in approximately a 4% load reduction but is limited to a few consecutive hours. The impact of other measures are more uncertain in terms of load reduction and duration.	Out-of-market measures are activated by RTE when needed
GR	There are no out-of-market measures currently in place. FRR/FCR products are available in the balancing energy and capacity markets (executed daily, no long-term capacity markets)	There are no out-of-market measures currently in place. FRR/FCR products are available in the balancing energy and capacity markets (executed daily, no long-term capacity markets)	There are no out-of-market measures currently in place. FRR/FCR products are available in the balancing energy and capacity markets (executed daily, no long-term capacity markets)
HR	FRR and FCR	10 %	Out-of-market measures are improving system adequacy
HU	Balancing market products (FRR, FCR) are available, however, these are used for frequency containment and restoration, not for addressing potential shortfalls in supply. There is a process in place for	The capacity available for rotational load shedding is ~230 MW without the key consumers (based on their role in providing indispensable services for the residential sector). Additional	Rotational load shedding is available as a last resort when all market-based mechanisms fail to solve the adequacy problem.

Country	What out-of-market measures (e.g. capacity market strategic reserves, voltage reduction, eco gestures, FRR, FCR, etc.) do you have at your disposal to address potential shortfalls in supply?	Please provide a quantification of the out-of-market measures that could be used to address potential shortfalls in supply (in MW or % peak demand)	Please explain how the out-of-market measures listed above contribute to system adequacy for your country.
	rotational load shedding, based on national regulation. This can be activated as a last resort, after all market-based methods are deemed insufficient to solve the shortfall in supply.	~100 MW is available with the key consumers mentioned before, but the requirement is that the electricity supply of these key consumers need to be maintained as long as possible even during a crisis situation.	
IE	Voltage reduction Temporary Emergency Generation (TEG)	650 MW of Temporary Emergency Generation has been procured.	The out-of-market measures contribute positively to system adequacy.
IT	N/A	N/A	N/A
LT	N/A	N/A	N/A
LU	EV Charging infrastructure could be disconnected in case of emergency situation, additional measures are currently under development (e.g. load reduction of heat pumps)	Out-of-market measures are included in national defence plans and should not be considered in the ERAA methodology.	These are last-resort measures activated in case of an emergency situation and not considered in the system adequacy!
LV	None of those mentioned above. Baltic States still are operating in synchronous mode with Russian and Belarus power systems.	Not assessed.	System adequacy risks are not forecasted.
MD	We implement low shading measures by load disconnections in the 6-10 kV voltage range. We have established emergency help contracts with neighbouring TSOs.	400 MW (by low shading)	Out-of-market measures such as those listed above help to balance the system
MK	N/A	N/A	N/A
MT	Malta has 175MW at out-of-market resources which are fully and immediately available for dispatch, if required. Such capacities should be taken into account for adequacy purposes in the ERAA (and in the other seasonal adequacy assessments). A minimum of 10MW NGC of a thermal plant are also considered as FCR.	175MW	Refer to reply to question 27.

Country	What out-of-market measures (e.g. capacity market strategic reserves, voltage reduction, eco gestures, FRR, FCR, etc.) do you have at your disposal to address potential shortfalls in supply?	Please provide a quantification of the out-of-market measures that could be used to address potential shortfalls in supply (in MW or % peak demand)	Please explain how the out-of-market measures listed above contribute to system adequacy for your country.
NL	For ERAA 2024 no Out-of-market measures for the Netherlands were taken into account. Data for FCR/FRR has been provided.	N/A	N/A
NO	FRR and FCR	Ca. 1000 MW	No idea
PL	1. DSR contracted for the period 2025-2028 as a part of the already concluded Capacity Market auctions. 2. Voluntary DSR contracted with consumers for the period from April 2024 till March 2025. 3. Additional must-run understood as the increase of the contracted infeed of CHPs. 4. Administrative load reduction according to the national legislation: ˜Regulation of the Council of Ministers of 23 July 2007 on the Detailed Principles and procedures of Introducing Limitations on Sale of Solid Fuels and Supply and Consumption of Electricity or Heat (Journal of Laws of 2007, No. 133, item 924). The description of this measure is also described in the draft of Risk-preparedness plan (draft is not publicly available). 5. Agreements on emergency energy exchange with neighbouring TSOs / Agreement on assistance for active power delivery with CEPS ("NCER 21").	1. Average values: - 2025: 1131-1400 MW a), b) - 2026: 1509 MW c) - 2027: 1539 MW c) - 2028: 981 MW c) a) level dependent on quarter; b) values from main and additional CM auctions; c) reduction tests did not proceed yet, effective level may be lower; 2. Up to 100 MW (based on a recent PSE survey). Availability not guaranteed and depends on voluntary counterparty offers. 3. Up to 300 MW. Availability depends on weather conditions (heat demand). 4. Administrative load reduction refers to electricity consumers throughout the year, for which the contracted power is set above 300 kW. There are many exceptions for the above-mentioned consumers, for which load curtailment cannot be used. 5. Level depends on availability of interconnections and power in neighbouring TSOs	These out-of-market measures are operational ones, their role is to restore reserves in the system and therefore they do not contribute to the system adequacy in medium- and long-term perspective. The exception is DSR within CM, which can be applied in sc. with CM during the post process of ERAA preparation.
PT	For ERAA 2024 purposes, there were no out-of-market measures indicated by REN, according to the PT national adequacy assessment report.	For ERAA 2024 purposes, there were no out-of-market measures indicated by REN, according to the PT national adequacy assessment report.	For ERAA 2024 purposes, there were no out-of-market measures indicated by REN, according to the PT national adequacy assessment report.

Country	What out-of-market measures (e.g. capacity market strategic reserves, voltage reduction, eco gestures, FRR, FCR, etc.) do you have at your disposal to address potential shortfalls in supply?	Please provide a quantification of the out-of-market measures that could be used to address potential shortfalls in supply (in MW or % peak demand)	Please explain how the out-of-market measures listed above contribute to system adequacy for your country.
RO	No out-of-market measures considered for ERAA2024. Data for both FCR and FRR have been provided. In crisis situations in the operation of the national power system, the Romanian TSO may apply the safeguard regulation issued by the NRA.	N/A	N/A
RS			
SE	Strategic reserve, disturbance reserve	562 MW	The strategic reserve ensures that a power plant which would otherwise probably have been closed down is ready for operation in case the spot-market does not clear or if it is otherwise forecast that there will be a lack of generation capacity in the system.
SI	Measures to address decreases and increases in frequency; measures to address voltage drops and surges; measures to prevent overloading of elements (DSR, FRR, FCR, DTR etc.). This also includes the batteries the primary goal of which is FRR etc.	Roughly few percents.	The out-of-market measures contribute positively to system adequacy.
SK	Measures to address decreases and increases in frequency (FCR); measures to address voltage drops and surges; measures to prevent overloading of elements; measures to prevent imbalance (ancillary services in general)	Regarding FCR, aFRR and mFRR, the estimated total market node requirements in the years relevant to ERAA 2024 are as follows: - 2026: total market node requirement: 676MW - 2028: total market node requirement: 682MW - 2030: total market node requirement: 682MW - 2035: total market node requirement: 682MW	To prevent the emergence and spread of major system failures (management of critical conditions in the ES SR), a system of preventive measures (Defence Plan) has been created with the aim of keeping the power system of the SR in stable operation as much as possible. These measures are described in the Technical Rules of SEPS.
TR	By making agreements with various consumers, these consumers are separated from the system in case of a possible supply-demand imbalance.	It will provide approximately 5% support	

Country	What out-of-market measures (e.g. capacity market strategic reserves, voltage reduction, eco gestures, FRR, FCR, etc.) do you have at your disposal to address potential shortfalls in supply?	Please provide a quantification of the out-of-market measures that could be used to address potential shortfalls in supply (in MW or % peak demand)	Please explain how the out-of-market measures listed above contribute to system adequacy for your country.
	Additionally, agreements have been made for high-power power plants to support the system with full power in case of a possible crisis.		
UA	Ukraine makes all possible to balance the national power system	Ukraine makes all possible to balance the national power system	Substantially

Market reforms

The question aimed to understand whether the different Member States have initiated national market reforms , as well as which reforms were considered to what extent in the data provided. Market reforms most considered in the PEMMDB data include storage facilities, interconnection reinforcement, implicit DSR (flexible consumers), and explicit DSR. However, some countries have not implemented specific market reforms and rely on existing market structures. Overall, the extent and nature of market reforms vary among countries based on their energy policies and goals. Detailed answers can be found below.

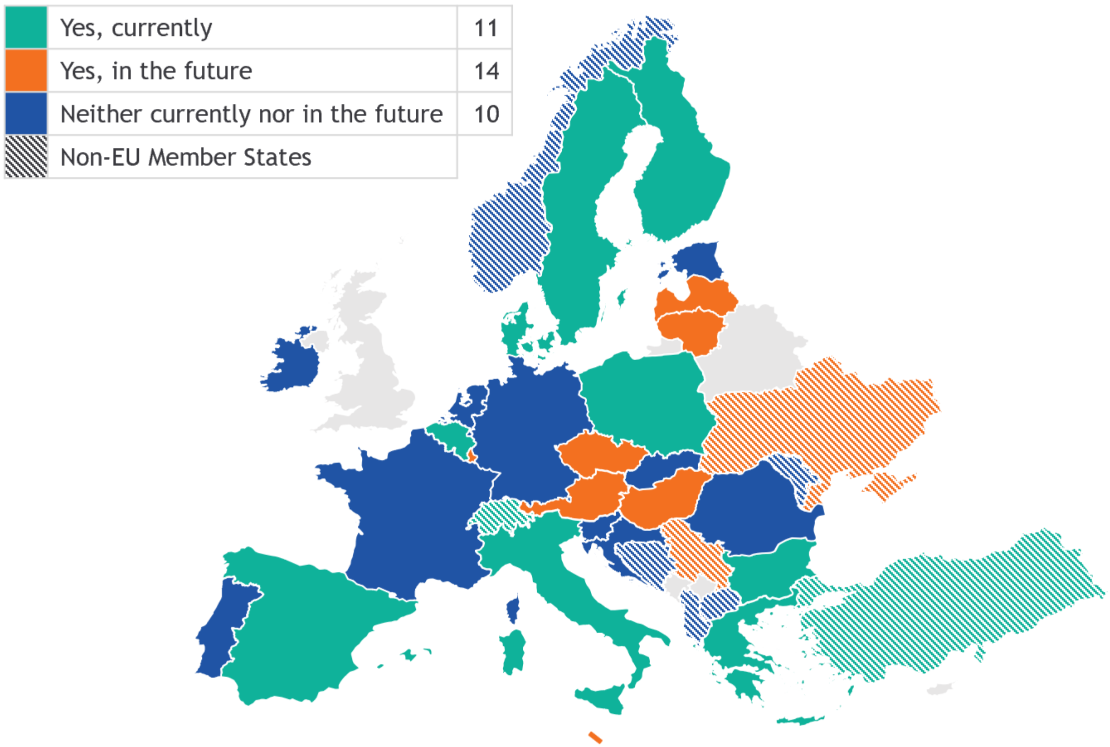


Figure 30: Market reforms (Article 23(5)(e) and Article 20(3) of the Electricity Regulation) shall be considered in the ERAA scenarios. Has your country initiated national market reforms?

Country	Has your country initiated national market reforms?	Please further explain whether or not your country is initiating national market reforms	How were the reforms listed above considered when providing data for PEMMDB?
AL	Yes, in the future	In consideration phase	No new information regarding these market reforms
AT	Neither currently nor in the future	N/A	N/A
BA	Yes, in the future	It is expected that regulation regarding electricity market establishment would be adopted soon on the national level .	There is still not established electricity market.
BE	Yes, currently	See Belgian Electricity Market : Implementation plan	Data in the filled "ERAA_2024_BE00_Electrolysers_FuelCells_Batteries_DSR_/Main Thermal/Exchanges_and_Limits/PEMMD Demand" templates reflect - DSR (Explicit) - iDSR (Implicit) - Interconnection reinforcements plans - Storage facilities
BG	Yes, currently	Balancing market reforms have already been introduced. Full liberalization of the energy market is expected in the next couple of years.	
CH	Yes, currently	Switzerland has introduced measures similar to the ones mentioned in Art. 20 (3) c, d, e and f according to Swiss national law. Other measures are under discussion.	Same base assumptions as in the Swiss scenario framework for network planning
CZ	Neither currently nor in the future	None	N/A
DE	Yes, in the future	In 2023, Germany has started a stakeholder discussion "Climate-Neutral Electricity System Platform" to develop market design options for a climate neutral energy system. The developed proposals and options for the development of the electricity market design within the Climate-Neutral Electricity System Platform are an important basis for the drafting of specific adjustments to the regulatory framework for the electricity market. At the beginning of 2024, the German government published initial ideas on this. These include the plan to introduce a capacity mechanism from 2028. The key points of the market	N/A

Country	Has your country initiated national market reforms?	Please further explain whether or not your country is initiating national market reforms	How were the reforms listed above considered when providing data for PEMMDB?
		reform are to be discussed from October 2024. For further information see: https://www.bmwk.de/Redaktion/DE/Downloads/U/umsetzungsplan-fur-deutschland-marktreformplan-nach-art-20-verordnung-eu-2019-943-uber-den-elektrizitatsbinnenmarkt.pdf (Umsetzungsplan für Deutschland („Marktreformplan“) nach Art. 20 Verordnung (EU) 2019/943 über den Elektrizitätsbinnenmarkt)	
DK	Yes, currently	The Project Assumptions for 2023 does not internalise new market reforms, when made by the Danish Energy Agency. Modelling of the electricity system is based on current market structures. The Project Assumptions for 2023 is developed by the Danish Energy Agency based on a so-called ‘Frozen policy approach’, which means that the Danish Energy Agency does not internalise new actions, which is supposed to ensure power adequacy in Denmark. It is the task of Energinet to, subsequently, develop physical and market-based solutions, which are to accommodate challenges regarding security of supply based on the implementation of the Project Assumptions for 2023 and the analysis and conclusions that the utilisation of these lead to. Consequently, such measures have not been implemented in the PEMMDB app reporting as the analysis outcome of the utilisation of this scenario is, amongst other things, supposed to identify such measures and the need for them. Additionally, there’s an ongoing work to enhance market efficiency through changes in market regulation. These types of adjustments, however, are not included explicitly in the project assumptions and /or the data collection for ERAA 2024. Adjustments could be full implementation of aggregators or application of implicit rather than explicit grid loss on interconnectors.	Many potential changes to the market are considered in an ongoing process of political, technical and economic analysis’s, estimations and market consultations. This is done to ensure the best possible view on what could be done to enhance market performance and overall system performance. If major changes are adopted, such as increased interconnector capacity, it will be incorporated into the project assumptions. More market narrow changes might not be incorporated into the Project Assumptions.

Country	Has your country initiated national market reforms?	Please further explain whether or not your country is initiating national market reforms	How were the reforms listed above considered when providing data for PEMMDB?
		Lastly, The National Resource Adequacy Assessment 2023 of Denmark, performed by Energinet, proposed, in cooperation with the Danish Energy Agency, an investigation of the possibility of and impact of establishing a capacity mechanism in Denmark. The result of this analysis is not yet finalized.	
EE	Yes, in the future	Estonia is planning on applying for a capacity mechanism to ensure resource adequacy	No changes were made between PEMMDB 3.5 and data submission this year.
ES	Yes, currently	Input data provided in line with market arrangements expected from 2022 onwards. - Market reforms recently carried out: *Demand-side and storage facilities can participate in balancing services (after the corresponding prequalification process) since January 2020. *Modification of price caps and floors have been modified to +4000 €/MWh and -500 €/MWh in day-ahead market and to +/-9999 €/MWh in intraday market. *Connection to the European RR platform (March, 2020). *Integration into Imbalance Netting process through IGCC platform (October 2020). - Foreseen reforms: *Interconnection reinforcement; however, interconnection targets as set out in Art. 4 of Regulation (EU) 2018/1999 are not expected to be reached in the 2030 timeframe, although significant progress is expected with the new Bay of Biscay and Transpyrenean projects. *Imbalance Settlement Harmonisation in April 2022. *Programming QH in real-time markets: National approaching to the mFRR standard product (may 2022). *Participation of demand-side and storage facilities in the redispatch market (foreseen Q4 2023). *Participation of independent aggregators in the markets (foreseen in Q3 2024). *Market for voltage control (pilot project developed in Q1-Q2 2022; final implementation foreseen in Q4 2024). *National project approaching the aFRR standard product (foreseen in Q1 2024). *Connection to mFRR European platform (MARI) in Q2 2024 and aFRR European platform in Q3 2024 *Implementation of 15' Imbalance Settlement Period in April 2024	Interconnection reinforcements already considered in the future expected NTC values in the different time horizons of the study. The possibility for DSR to participate in the markets opens the possibility that new developments may play a role in adequacy.

Country	Has your country initiated national market reforms?	Please further explain whether or not your country is initiating national market reforms	How were the reforms listed above considered when providing data for PEMMDB?
FI	Yes, currently	Significant market reforms include an EU-wide harmonised balancing market, imbalance settlement and requirements for the procurement of reactive power. In addition, price cap of balancing market has been increased to the technical price limit and independent aggregation is allowed in most of the reserve market products. The current government programme also states that a study will be conducted to create a cost-effective capacity mechanism that will ensure a sufficient amount of available electricity at all times.	The direct effect of the market reforms cannot be precisely quantified; however, e.g. balancing market reforms are expected to support price signals that incentivise DSR development in the balancing timeframe. The market reforms were considered to the extent possible when providing the data. The impact of a possible CM or other similar measures was not considered. TSO's investment plan which includes significant network investments in both the internal network and interconnectors has been considered in the data. As weather-dependent electricity production increases, the electricity system needs more flexibility, and part of it is assumed to be different storages, which have been considered in the data collection. TSO's connection enquires also support the development in which storage capacity would increase in the power system.
FR	Yes, in the future	Country is initiating reform on CRM. French generation in PEMMDB is supposed to be meeting its RS thanks to CRM reform.	N/A
GR	Yes, currently	Greece has submitted a Market Reform Plan for approval by the EU Commission.	Mainly the reforms that will enable participation of DSR in electricity markets
HR	Yes, in the future	In the near future, the organization of the market will be aligned with EU regulations	The data submitted to PEMMDB is updated with the current situation in the energy system
HU	Neither currently nor in the future	No information on any plans related to national market reforms.	N/A
IE	Yes, in the future	The SEM (our Single Electricity Market) already incorporates scarcity pricing. There are some non-energy reforms that could have an impact on the business cases for investment in new capacity, such as significant systems service changes. RAs are leading a review of network tariffs. Future considerations include: FASS (Future arrangements for System Services) and Scheduling & Dispatch and New market design	expansion of battery storage included

Country	Has your country initiated national market reforms?	Please further explain whether or not your country is initiating national market reforms	How were the reforms listed above considered when providing data for PEMMDB?
IT	Yes, currently	Market reforms will be considered according to the plan	Data for demand, interconnection and storage capacity updated according to the planned market reforms.
LT	Neither currently nor in the future	No market reforms considered. Peak shaving products might increase demand response capacities.	No market reforms considered. A higher amount of DSR capacities is expected.
LU	Neither currently nor in the future	The Luxembourgish authorities have not developed nor published an implementation plan according Art 20 (3). We can unfortunately not confirm if this is not intend in the future.	Implicit: new tariff structure, higher degree of self-consumption, Storage "behind-the-meter" batteries are included in the consumption numbers
LV	Neither currently nor in the future	No detailed information.	N/A
MD	Yes, in the future	In our case market is not at the level of pan-European countries . We try to reach level of pan-European market and ensure implementation of market coupling as well as integration to pan-European. We have only balancing contract market, balancing market and imbalance settlement. It is expected to load Intraday D-1 and ancillary market. The next step is be to integrate DAM and IDM in to SDAC and SIDC as well as integration in to the MARE, TERRE and PIKASSO/INN.	N/A
MK	Yes, in the future	Yes, North Macedonia has initiated national market reforms in line with Article 23(5)(e) and Article 20(3) of the Electricity Regulation. These reforms focus on enhancing the electricity market's efficiency and integration, promoting competition, and supporting the transition to a more sustainable and resilient energy system. The reforms include measures to improve market transparency, facilitate cross-border electricity trading, and support the integration of renewable energy sources	N/A
MT	Neither currently nor in the future	Not Applicable	N/A
NL	Yes, in the future	As an alternative for the ORDC, there is now a proposal to introduce a simpler and transparent form of scarcity pricing. This proposal could be introduced on short term.	N/A

Country	Has your country initiated national market reforms?	Please further explain whether or not your country is initiating national market reforms	How were the reforms listed above considered when providing data for PEMMDB?
NO	Yes, in the future	Don't understand the question	Some price sensitivity in demand. New industries can connect to grid if they are able to shut down in case of networkork supply problems.
PL	Yes, currently	Nothing to add	Not considered
PT	Yes, in the future	No market reforms were considered in the provided data, but are expected in the future	No market reforms were considered in the provided data, but are expected in the future
RO	Yes, in the future	No specific plans were considered.	No specific plans were considered.
RS	Neither currently nor in the future	At the moment, I am not aware of such efforts. Serbia is not an EU member, so the regulations are not strictly obligatory for it.	
SE	Yes, currently	SE will be investigating the possibility of introducing a capacity market after contract for the current strategic reserve runs out in 2025. Most likely, some interim solution will be required to bridge the time until a capacity market can be implemented.	N/A
SI	Neither currently nor in the future.	No specific market reforms are considered when providing the data.	The data submitted to PEMMDB is updated with the current situation in the energy system
SK	Yes, in the future	So far, the results of the adequacy calculations at the European level (as well as Slovakia's own calculations at the national level) do not point to problems with the adequacy of resources in Slovakia. For this reason, it was not currently necessary to apply the principles (market reforms) of Article 20(3) of Regulation (EU) 2019/943 to eliminate possible regulatory distortions.	For example: increasing NTC on the SK–HU interconnection profile; the planned doubling of the cross-border connection to UA; increasing the share of electrical energy storage facilities which is the best estimate of the TSO.
TR	Yes, currently		
UA	Neither currently nor in the future	Ukraine current general task is to adopt and fully implement Energy Package IV	Ukraine is planning to adopt and fully implement Energy Package IV, cancel price-caps, increase NTC of interconnectors, further development of Hydro pumping storages, join electricity markets

Country	None	Price cap rules	Scarcity pricing	Explicit DSR	Implicit DSR[29]	Interconnection reinforcement	Storage facilities	Other
AL	X							
AT	X							
BA	X							
BE		X		X	X	X	X	
BG	X							
CH								Other
CZ	X							
DE	X							
DK				X	X	X	X	
EE				X			X	
ES				X		X		No price cap other than harmonised ones. No specific policies on DSR available at the moment, although demand is allowed to participate in balancing and non-frequency services.
FI					X	X	X	
FR	X							
GR				X				
HR					X		X	
HU	X							
IE			X				X	
IT						X	X	Increase of interconnection capacity, enabling self-generation, energy storage and demand side measures and the promotion of European Market Integration.

[29] Shares of flexile consumer

Country	None	Price cap rules	Scarcity pricing	Explicit DSR	Implicit DSR[29]	Interconnection reinforcement	Storage facilities	Other
LT	X							
LU					X			
LV	X							
MD	X							
MK	X							
MT	X							
NL	X							
NO			X		X	X		
PL								To be developed on MS level
PT	X							
RO	X							
RS	X							
SE	X							
SI	X							
SK						X	X	
TR		X		X	X	X	X	
UA		X				X	X	

Drivers of evolution

The next question aims to understand whether the data provided would still be valid in November 2024 in the opinion of each TSO, as well as the factors that would influence the eventual evolutions.

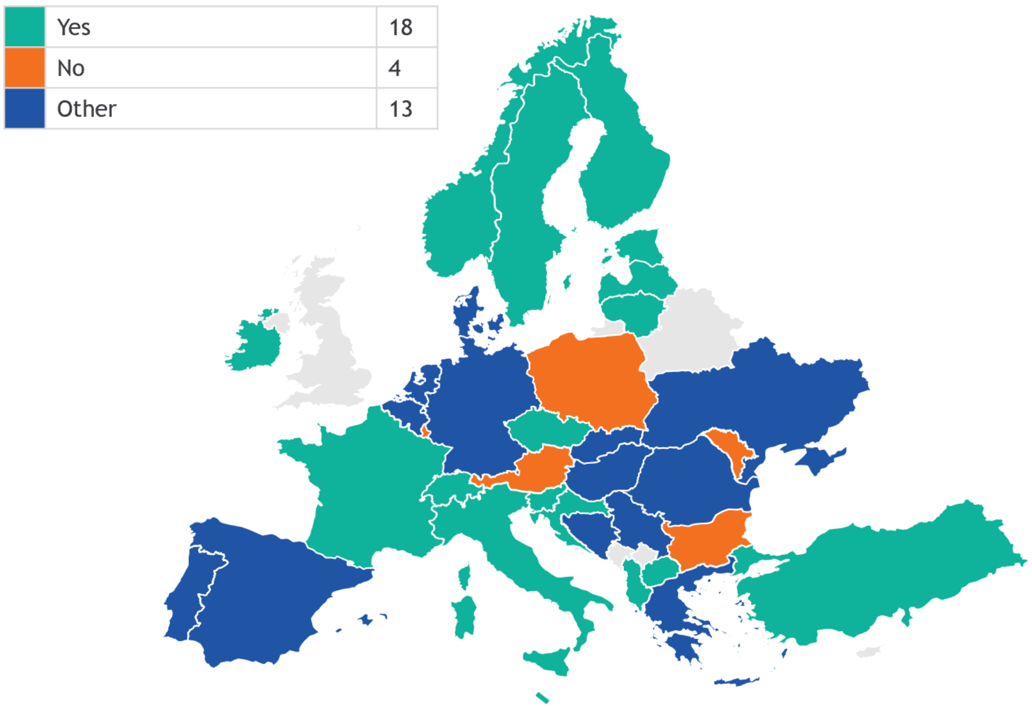


Figure 31: Do you expect that the assumptions of the key drivers (policy or otherwise) of the capacity and energy mix evolution for the data provided will continue to be valid in November 2024?

Country	Do you expect that the assumptions of the key drivers (policy or otherwise) of the capacity and energy mix evolution for the data provided will continue to be valid in November 2024?	Describe the key capacity and energy mix evolution drivers (policy or not) for all the data provided.
AL	Yes	The main drivers are the national energy targets and the increased interest in new RES capacity investments.
AT	No	Austrian Ministry for climate and energy released in 2024 the ÖNIP - Austrian integrated network infrastructure plan and updated its NECP. Some drivers have been adapted accordingly for ERAA 2025 input data collection.
BA	Other	draft NECP

Country	Do you expect that the assumptions of the key drivers (policy or otherwise) of the capacity and energy mix evolution for the data provided will continue to be valid in November 2024?	Describe the key capacity and energy mix evolution drivers (policy or not) for all the data provided.
BE	Other	Nuclear Phase out and extension, RES development, Electrification and Flexibility, Interconnection capacity, reducing the dependency on imported fossil fuels (in line with the REPowerEU objectives)
BG	No	
CH	Yes	These are based on the Swiss scenario framework for electricity network planning.
CZ	Yes	Expected NECP targets
DE	In the ERAA 2024 the German power plant strategy as of February 2024 has been considered. This means, that additional 10 GW of H2-ready power plants as well as 0.5 GW H2 power plants are considered as policy units. Assumptions regarding commissioning dates have been made based on planned call for tenders and expected realization times. This strategy has been revised in July 2024 and differs in parts. It now foresees incentives for 13 GW additional capacities, consisting of 5 GW new gas power plants, 5 GW of new H2-ready power plants, 2 GW of modernization measures, 0.5 GW of new H2 power plants and 0.5 GW of new long-term storages. Due to the remaining uncertainties regarding the implementation the submitted data can still be considered appropriate. Other drivers are expected to stay valid.	There are numerous legislations in place with impact on the German capacity and energy mix in the direction of reaching climate neutrality in 2045. These include the coal-phase out latest by 2038, targets for renewable capacities and renewable shares in gross electricity consumption, energy requirements for buildings, electrification in different energy sectors as well as the evolution of hydrogen and its infrastructure.
DK	Other	The Project Assumptions of 2024, delivered by the Danish Energy Agency to Energinet, is expected to be published in October. The expectation is that the key drivers are mainly unchanged, but some variations is expected to occur do to updated knowledge and political plans.
EE	Yes	Most important drivers are the market participants plans, countries reverse auctions timelines and climate goals
ES	The drivers of Spain's ERAA 2024 data are based on the best information available; however, an update of the NECP is expected in coming weeks.	The ERAA 2024 dataset reflects the rapidly energy evolving and consider the best data right now (roadmaps, stakeholders information,…). We could expect that a future update of the NECP could introduce enforcement and / or additional targets for the fulfilment of the European energy objectives.

Country	Do you expect that the assumptions of the key drivers (policy or otherwise) of the capacity and energy mix evolution for the data provided will continue to be valid in November 2024?	Describe the key capacity and energy mix evolution drivers (policy or not) for all the data provided.
FI	Yes	Market-based development is the main driver as high fossil fuel and CO2 prices drive the development of RES and storages. There are also government policies including phase-out of coal in energy use and many energy companies have published their plans to phase-out coal. There are many confirmed and expected investments on RES that are done on a merchant basis. These developments have been considered in the capacity and energy mix evolution.
FR	Hypothesis are compliant with current NECP and remains the best assumption as for today (but changes are still possible)	Capacity and energy mix evolution will be mainly drive by: - national target of 18 GW of offshore wind by 2035 - acceleration of PV deployment - maximisation of nuclear production
GR	A slightly updated version of the NECP is to be finalized soon, thus, minor differences may occur	The main drivers for all the data provided are the country's first draft (Jan 2023) revised NECP, which incorporates the Fit for 55 targets, including energy security, GHG emissions reduction, low cost, and reduction of energy dependence
HR	Yes	the submitted data is aligned with the NECP, the National Energy Development Strategy, the Hydrogen Strategy and the Low Carbon Strategy.
HU	Basically yes, but National Network Development Plan process can overwrite part of the capacity and energy mix evolution. Also, NECP is currently under review by the Ministry of Energy. The result of this review can affect assumptions.	The yearly process of gathering input data and assumptions for National Network Development Plan (every year a period starting in autumn and ending in winter) can overwrite the provided data as this process is designed to consider changing policy drivers, investment plans and all the other factors that can be relevant. Furthermore, the network connection process for generators is currently being updated, which will affect the foreseen capacity and energy mix evolution.
IE	Yes	Climate Action Plan 2023. We intend for the data submission for ERAA 2025 to be based on the updated Climate Action Plan 2024.
IT	Yes	General drivers for collected data: - 2030 RES capacity: new policy targets - 2030 demand: updated to reflect increase in GDP growth and further electrification of transport and heat, green H2 production - New storage capacity assessed to support the renewables deployment to reach the targets and including qualified units in the 2023/2024 capacity market auctions. Demand-side response is in line with the actual capacity qualified for participating in the ancillary services market for the mid-term;

Country	Do you expect that the assumptions of the key drivers (policy or otherwise) of the capacity and energy mix evolution for the data provided will continue to be valid in November 2024?	Describe the key capacity and energy mix evolution drivers (policy or not) for all the data provided.
		- Complete coal phase-out by December 2025 for the mainland; and by December 2028 in Sardinia, where the coal plants will be phased out by 2028 after Tyrrhenian Link enters into operation - New thermal capacity in line with capacity market results with delivery year 2022/2023/2024
LT	Yes	Electricity price, synchronisation with Continental Europe Synchronous Area and national targets for RES.
LU	No	Higher PV and Wind capacity target capacities included in the new NECP (approved in July 2024)
LV	Yes	The issued technical requirements for new generation connection to the transmission network - solar, wind and huge offshore wind potential.
MD	Yes	
MK	Yes	
MT	Yes	
NL	Yes, but at every time stamp for data collection new insights and policy can be incorporated in new data sets. The national climate and energy outlook and policies towards an sustainable future targeting CO2 reductions 2030-2035, coal phase out 2030 and stimulating hydrogen above methane fuel usage, towards zero CO2 emissions at 2050. Also with massive growth in solar PV and strong development of offshore wind energy to hubs for flexible and dedicated electrolysers with connections to other countries; and usage of storage, most batteries.	Ambitions according to the National Climate Agreement and increased ambition level of the Dutch government coalition agreement regarding growth of EV and HP demand have been used; adding electrolysers, data centres, batteries and extra offshore wind hubs and interconnectors. Alongside, usage of methane will be reduced by changing the fossil fuel tax and subvention levels and rules concerned.
NO	Our own long-term market analysis should be updated then	Reduce CO2 emissions
PL	Data was up to date only at the moment of delivery to ENTSO-E	Changing policies as well as current and forecasted market environment
PT	In principle yes, but a revised NECP as well as a new National Adequacy Assessment Report with updated data is expected to be delivered before the end of 2024.	- Decommissioning of old CCGT (1 GW) in 2029 - 25.7 GW of new RES between 2022–2030 (of which 18.5 GW are solar) - RES share in 2030 is expected to reach 85%

Country	Do you expect that the assumptions of the key drivers (policy or otherwise) of the capacity and energy mix evolution for the data provided will continue to be valid in November 2024?	Describe the key capacity and energy mix evolution drivers (policy or not) for all the data provided.
RO	The final NECP may deviate from the draft version considered. Also, due to different investment plans or changes in some economic, political, social drivers, the data may deviate from the current scenario.	The current scenario dataset reflects the policy measures and the information available from the different market participants on the date of collection, elaborated in the light of the more ambitious national targets expected to be adjusted in response to FF55 -available in the draft updated NECP trajectory data (related to the evolution of RES capacity and the penetration of Electrolyser/Batteries in the market etc) .
RS	There has been an update regarding the RES capacities in Serbia, which will be included in the next ERAA edition.	An effort was made to submit the most realistic (from the current point of view) set of assumptions regarding the requested data. This was partially based on the political decisions and official plans, and partially on the requests for the connection to the transmission grid.
SE	Yes	Electrification increases demand in industry and transport sectors. It is though uncertain how fast the transition of the industry will take place and recent trends indicates that it will be slower than previously communicated. Buildout of renewables further increases the share of renewables in the generation mix. One of the biggest uncertainty is the future role of nuclear in the generation mix, if existing nuclear reactors can be operated beyond their projected technical lifetime and if new nuclear reactors will be constructed. Several initiatives have been taken by the current government to promote the expansion of nuclear power in the system, including a roadmap for nuclear power and an investigation on how new nuclear power reactors should be financed and the risks can be shared.
SI	Yes	The main driver is the draft NECP, supplemented by the information gathered by plant owners, investors, policymakers, internal projections, etc.
SK	The assumptions of the key drivers of the capacity and energy mix evolution probably will continue to be valid in November 2024. However, they may be updated with the release of a new NECP (release expected by the end of 2024)	The electricity demand evolution reflects the expected evolution of the national economy in Slovakia. All relevant factors known at the time of providing data for the ERAA 2024 that could have a significant impact on the electricity demand evolution were considered. The resource energy mix evolution in the ERAA reflects the national policies translated into the NECP. A significant development in increasing production capacity is expected in nuclear technology. In addition, a significant increase in RES (especially solar and wind) is expected. This is also in line with the NECP. The assumed evolution of the energy mix, affected by an increase in nuclear capacity, indicates an increase of resource adequacy margins. However, they may be updated with the release of a new NECP.
TR	Yes	

Country	Do you expect that the assumptions of the key drivers (policy or otherwise) of the capacity and energy mix evolution for the data provided will continue to be valid in November 2024?	Describe the key capacity and energy mix evolution drivers (policy or not) for all the data provided.
UA	It depends from our enemy actions aimed on destroying Ukraine power infrastructure	For Ukraine is important to consider our enemy (Russia) actions aimed on destroying Ukraine power infrastructure, thus it will be wise to make modelling with higher levels of forced outages for generation and transmission infrastructure, and lower rate of economy and demand growth development