ACER
European Union Agency for the Cooperation of Energy Regulators

PUBLIC

OPINION No 01/2025

OF THE EUROPEAN UNION AGENCY FOR THE COOPERATION OF ENERGY REGULATORS

of 3 February 2025

on the differences between the national resource adequacy assessment of Poland and the 2023 European resource adequacy assessment

THE EUROPEAN UNION AGENCY FOR THE COOPERATION OF ENERGY REGULATORS,

Having regard to Regulation (EU) 2019/942 of the European Parliament and of the Council of 5 June 2019 establishing a European Union Agency for the Cooperation of Energy Regulators[1], and, in particular, Article 9(2) thereof,

Having regard to Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity[2], and, in particular, Article 24(3) thereof,

Whereas:

1 INTRODUCTION

(1) Articles 20, 23 and 24 of Regulation (EU) 2019/943 (Electricity Regulation) set out that a Member State may conduct a national resource adequacy assessment (NRAA) to complement the European resource adequacy assessment (ERAA) when monitoring resource adequacy within its territory. Either assessment conducted in line with the methodology for the European resource adequacy assessment (ERAA methodology)[3] can identify resource adequacy concerns. The concerns identified through the ERAA or through the NRAA can be addressed by eliminating regulatory distortions or market failures, and, if necessary, by introducing dedicated measures, such as capacity mechanisms.

[1] OJ L158, 14.6.2019, p. 22.
[2] OJ L 158, 14.6.2019, p. 54.
[3] Annex I to ACER Decision No 24/2020.

(2) Where the NRAA, as defined in Article 24 of the Electricity Regulation, identifies an adequacy concern that was not identified in the ERAA, the NRAA must include reasons for the divergence between the two assessments, including details of the sensitivities used and the underlying assumptions. The NRAA must be published and submitted to ACER for an opinion. ACER's opinion assesses, on a case-by-case basis, whether the differences between the two assessments are justified. ACER primarily considers the differences identified and reasoned by the Member State in the submission, but may also identify further differences, if they also have a material impact on the results.

(3) The most recent ERAA (ERAA 2023) was approved on 2 May 2024[4]. Poland carried out its own resource adequacy assessment (the Polish NRAA) in 2024. The Polish NRAA was published on 15 November 2024[5]. On 3 December, ACER received the complete submission of the Polish NRAA along with the reasons for its divergence from ERAA 2023, including details of the sensitivities used and the underlying assumptions[6].

(4) This Opinion concerns the differences between the Polish NRAA and ERAA 2023 and evaluates whether these differences are justified.

2 SUMMARY OF THE POLISH ADEQUACY ASSESSMENT

(5) According to Article 8 of the ERAA methodology, an adequacy concern is identified when the Member State has a reliability standard in place and that is not fulfilled for the central reference scenario[7]. According to the Regulation of the Minister of Climate and Environment of 13 September 2024, the reliability standard in Poland, expressed as loss of load expectation, is 3 hours at the time of the submission of the NRAA to ACER[8].

(6) According to the ERAA methodology, the central reference scenario is the basis for identifying resource adequacy concerns. Thus, this Opinion compares the central reference scenario of ERAA 2023 with the corresponding central reference scenario in the Polish NRAA[9].

(7) The Polish NRAA models 16 target years (from 2025 to 2040). It shows an adequacy concern in all target years. On the other hand, ERAA 2023 models four target years (2025,

[4] ACER Decision No 06/2024.
[5] The Polish NRAA is available on the PSE website.
[6] The document describing the differences between the Polish NRAA and ERAA 2023 is also available at the link provided in footnote 5. To facilitate the preparation of such a document, ACER published a set of best practices in how NRAAs can outline the differences.
[7] This is when the LOLE result of the central reference scenario is higher than the reliability standard expressed as LOLE.
[8] See https://dziennikustaw.gov.pl/DU/2024/1389
[9] The Polish NRAA contains a central reference scenario without new capacity mechanism contracts (called 'base scenario' in the report) and a scenario with new capacity mechanism contracts. The former represents a corresponding and comparable approach to the ERAA 2023 central reference scenario which similarly did not include new capacity mechanism contracts.

2028, 2030 and 2033) and shows no adequacy concerns for target years 2025, 2028 and 2030. The results of the central scenario of the Polish NRAA hence diverge from ERAA 2023 for these three target years. This is summarised in Table 1.

Table 1: The reliability standard as LOLE (hours/year) and the results of ERAA 2023 and the Polish NRAA for corresponding modelled target years.

Assessment	2025	2028	2030	2033
Polish reliability standard	3.0	3.0	3.0	3.0
ERAA 2023	0.1	1.8	2.5	8.5
Polish NRAA	7.6	33.3	9.6	15.0

3 ASSESSMENT OF THE DIFFERENCES BETWEEN THE POLISH NRAA AND ERAA 2023

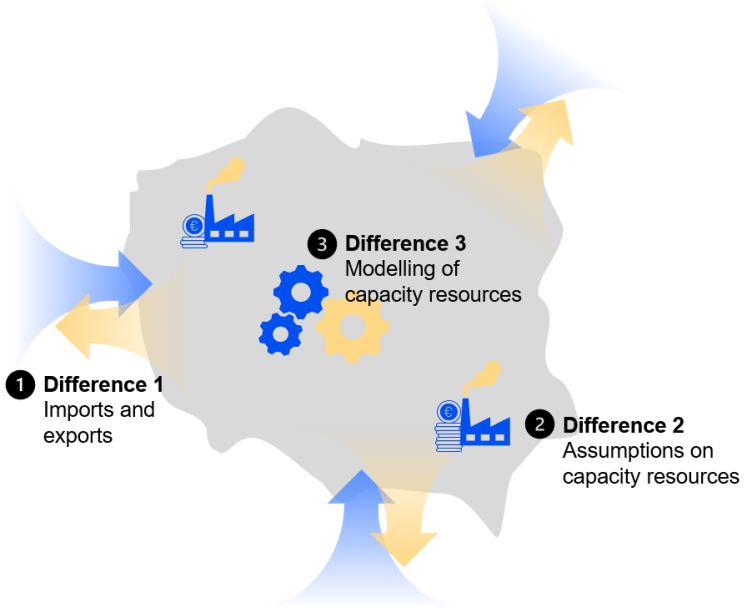
(8) ACER's assessment considered twelve changes implemented by the Polish NRAA vis-à-vis ERAA 2023. While analysing these changes, ACER found that they are interlinked and give rise to three main differences: assumptions towards cross-zonal exchanges and capacity resources and the modelling choices made. (See Figure 1.)

(9) Due to the interlinked nature of the individual changes, one should observe them simultaneously to understand their consequences comprehensively and capture their relevance within the assessment. Therefore, ACER examines the impact of the changes within each of the three main differences. It follows that a difference between the NRAA and the ERAA 2023 is justified only when each of these interconnected changes is substantiated.

(10) The purpose of an NRAA is to complement the ERAA. Therefore, ACER considered that a substantiated change is one that considers, for example, any national or regional aspects that are not (sufficiently) considered in ERAA 2023 or relies on newer information or data than those collected in ERAA 2023[10]. At the same time, the change in the NRAA should be applied in line with the ERAA methodology.

[10] As also set out in paragraph 17 of ACER Opinion 04/2024 on the differences between the national resource adequacy assessment of Estonia and the 2023 European resource adequacy assessment, available here.

Figure 1. Schematic representation of the three differences between the Polish NRAA and ERAA 2023



(11) The three differences are outlined in the sections below. Each section first describes the main elements of the difference. Secondly, it assesses its relevance in terms of its impact on the diverging adequacy results between the Polish NRAA and ERAA 2023[11]. Finally, it provides ACER's overall evaluation of the difference.

3.1 Difference 1: Assumptions regarding cross-zonal exchanges

(12) This section describes the difference in the assumptions regarding cross-zonal exchanges. The difference consists of two elements, which are outlined in Table 2 and described in detail in the remainder of this section.

Table 2. Summary of the difference in cross-zonal exchanges

Difference	No.	Change in the Polish NRAA compared to ERAA 2023
Assumptions regarding cross-zonal exchanges	1	Constrained contribution of foreign units
	2	No exports possibility for domestic units

[11] When the relevance of changes is discussed, the exact impact and often its direction cannot be ascertained by ACER – the quantification of the impact is the role of robust resource adequacy assessments. Changes often have a two-fold impact, firstly on economic viability of resources and hence the capacity mix, and secondly on adequacy results. Furthermore, the impact of changes is interlinked.

3.1.1 Description of the difference

(13) ERAA 2023 explicitly models all EU bidding zones[12]. In ERAA 2023, imports and exports of the different bidding zones are limited by net transfer capacities defined per border, or (where applicable) by flow-based domains.

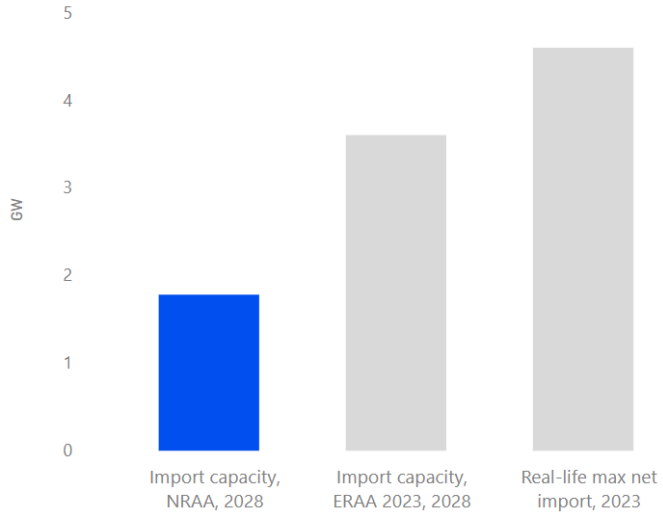
(14) The Polish NRAA does not explicitly model foreign bidding zones.[13] Instead, their contributions are considered in a simplified manner, as follows:

- Firstly, the Polish NRAA sets a constant maximum import limit applied all year-round[14].
- Secondly, the Polish NRAA considers no exports.

(15) The maximum import limit in the Polish NRAA is lower than the one assumed for Poland in ERAA 2023. In the target year 2028 (where the divergence in the results is the most significant) the import in the Polish NRAA is limited to 1.8 GW. This is around 50% lower than the maximum import possible in ERAA 2023 (3.6 GW[15]). While these two values refer to assumptions for the future, in real-life, for reference, the maximum actual net import of Poland in 2023 was 4.6 GW[16]. This is shown in Figure 2.

[12] In this context, explicit modelling means considering each element of the probabilistic model set in the ERAA methodology (as set out in Article 2(v) of the ERAA Methodology).
[13] In its Opinion on the Estonian NRAA, ACER pointed out that the fact that the Estonian NRAA explicitly models neighbouring bidding zones, as well as some additional bidding zones, is an example of good practice.
[14] This maximum limit is based on calculating the average (not maximum) import at times of scarcity as identified in ERAA 2023 and is further assessed in section 3.1.3. This calculation approach is alike the approach envisaged to calculate contributions of cross-border capacities in the context of cross-border participation in capacity mechanisms (as described in Annex I to ACER Decision 36/2020). In terms of modelling, the imports are modelled as an expensive generator which gets activated after all domestic resources have been activated. The maximum import in the Polish NRAA ranges from 1440-1780 MW, depending on target year.
[15] In target year 2028 of ERAA 2023, the sum of net transfer capacities into Poland is 4.3 GW (corresponds to borders with zones corresponding to Czechia, Germany, Slovakia and Sweden). In the EVA module of ERAA 2023, this sum is reduced to 3.6 GW by the net position constraint, which is applied to reflect the flow-based domain-based approach in the ED module of ERAA 2023.
[16] According to ENTSO-E Transparency Platform data as of 31 December 2024. All references to ENTSO-E Transparency Platform data in this document are based on the state of the database as of 31 December 2024. Any changes to the database after this point are not reflected in the figures in this document.

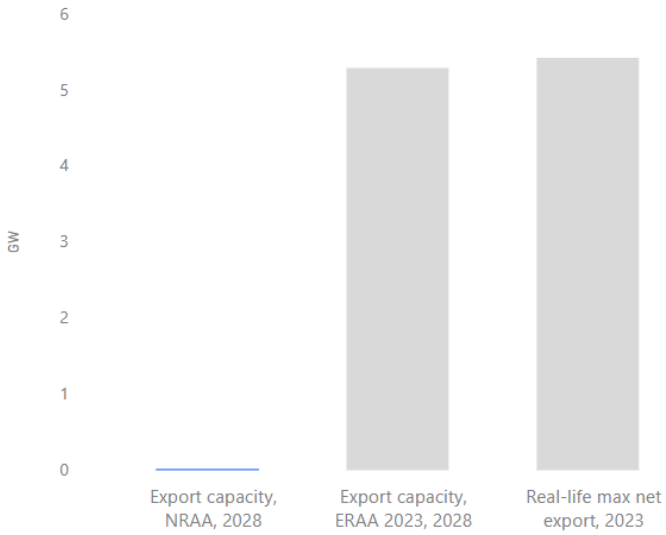
Figure 2. Maximum import capacity of Poland assumed in year 2028 in the Polish NRAA and in ERAA 2023, and the maximum net import realised in 2023



Source: ACER based on Polish NRAA, ERAA 2023 and ENTSO-E Transparency Platform data.

(16) The maximum level of exports in the NRAA is zero. The maximum possible export in ERAA 2023 in target year 2028 is 5.3 GW, while for reference, the maximum actual net export of Poland in 2023 was 5.4 GW. This is shown in Figure 3.

Figure 3. Maximum export capacity of Poland assumed in year 2028 in the Polish NRAA and in ERAA 2023, and the maximum net export realised in 2023.



Source: ACER based on Polish NRAA, ERAA 2023 and ENTSO-E Transparency Platform data.

3.1.2 Relevance of the difference

(17) The impact of the difference is two-fold. Regarding limited imports, the assumption in the NRAA[17] means that in some hours the actual maximum import would be different compared to a system where foreign zones are explicitly modelled[18]. This is further described in Section 3.1.3.

(18) Regarding exports, if none are considered, resources in the economic viability assessment (EVA) cannot receive revenues from exporting electricity into foreign markets. This can lead to lower revenues of domestic resources and more decommissioning in the EVA. As a consequence, the resulting lower capacity mix likely can lead to higher adequacy risks in terms of LOLE.

3.1.3 Evaluation of the difference

(19) Article 24(1) of the Electricity Regulation requires NRAAs to be regional in scope and to be based on the ERAA methodology and its requirements under points (b) to (m) of Article 23(5) of the Electricity Regulation. This implies, amongst others, that NRAAs need to comply with the requirement of taking into account the contribution of all resources, including imports and exports, set out in Article 23(5)(d) of the Electricity Regulation. Indeed, the interconnected electricity market enables Member States to import electricity in times of need and export electricity in times of surplus[19]. These dynamics should be accurately reflected in resource adequacy assessments.

(20) To set the maximum possible import, the Polish NRAA considers the results of ERAA 2023 by taking the average imports during those hours, when scarcity is expected to occur (this is, when there are insufficient resources to cover demand and load shedding is needed).

(21) However, in ERAA 2023 (in target year 2028) such scarcity events mostly happen when other neighbouring zones experience scarcity as well. For example, ERAA 2023 shows that when Poland is experiencing scarcity, in 80% of the time, its largest neighbour Germany does not have sufficient capacity available either,[20] and it will not export electricity[21]. Therefore, when Poland's neighbours experience scarcity, the Polish imports

[17] As described in Figure 4.11 of the Polish NRAA.
[18] In the ED module, this means higher risks. In the EVA module, changed (possibly increased) imports may reduce the number of hours of scarcity when domestic resources see the maximum price. However, and in the absence of explicitly modelling the neighbouring countries, since the imports are modelled as a very expensive generator, the price level would remain high in those hours, even if scarcity does not occur.
[19] Even in case a country is a structural exporter, it may rely in times of stress on its neighbours. For example, ACER market monitoring showed that in 2023 every Member State benefitted from imports at times, showing the importance of cross-border electricity capacity being available for trading with neighbours.
[20] In the analysis (based on results of the central reference scenario of ERAA 2023), ACER considered only events with ENS>0.1 MW, as scarcity events with ENS lower or equal than 0.1 MW were taken as insignificant.
[21] In ERAA, this is imposed by the so called local matching rule.

are minimised[22]. The Polish NRAA considers these moments of reduced imports (from ERAA 2023) as the year-round maximum import. This is not supported by evidence or modelling results.

(22) Additionally, the Polish NRAA anticipates several more additional scarcity events compared to ERAA 2023 occurring outside of the winter season (e.g. July of 2028).[23] However, even for these summer months, the Polish NRAA uses the same maximum import constraint based on winter conditions. This fails to take into account that imports may be higher in summer, when Poland could count on higher contributions from its neighbours mitigating the adequacy risks. Indeed, in ERAA 2023, Germany does not experience any scarcity during summer[24]. This means that it would be able to export energy into Poland.

(23) In sum, concerning **imports**, the Polish NRAA does not explicitly model foreign bidding zones and resorts to using an average import based on scarcity patterns in a multiple-bidding-zone ERAA 2023. It then applies this average as the maximum import limit in the national assessment, which has a different pattern of probable scarcity. This will result in the national assessment showing a different adequacy risk than ERAA 2023. The assumption introduces an inherent inaccuracy into the results of the national assessment. As a result, ACER considers that the Polish NRAA does not accurately take into account the required regional scope of an NRAA and the contribution of imports as per Article 24(1) and Article 23(5)(d) of the Electricity Regulation. The change made in the Polish NRAA is not sufficiently substantiated.

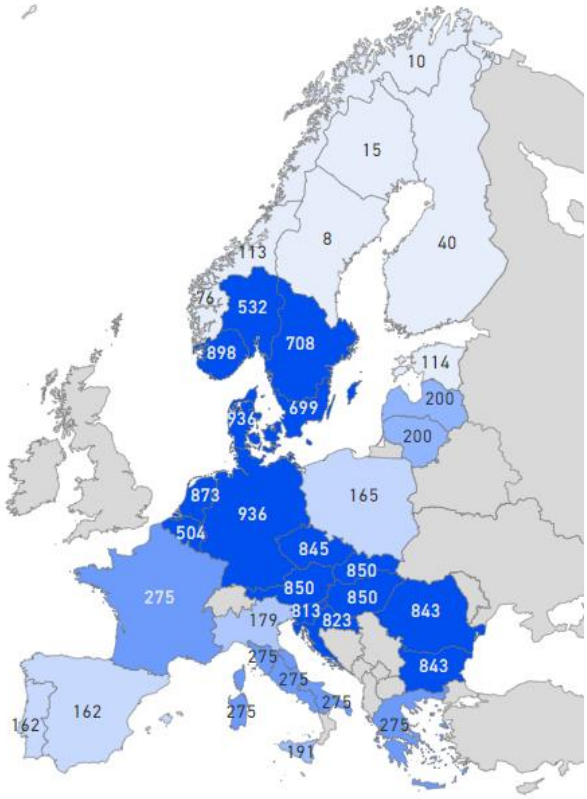
(24) When it comes to the contribution of **exports** (in particular as they impact the economic viability of domestic resources), the Polish NRAA does not consider exports at all.

(25) ACER understands[25] that this follows from the assumption that export from Poland would not occur unless the market price in Poland is comparably low[26]. Indeed, ACER finds that in some instances, Poland experiences a lower price than its neighbours but still does not export electricity – for example on 12 December 2024, as shown in Figure 4. In this case, the allocation constraint[27] applied by the Polish TSO limited the export to zero during a time when neighbouring countries were in need of cross-border contributions, as they

[22] As the proportion of simultaneous scarcity events increases, the average import during scarcity will be lower.
[23] In the central reference scenario of ERAA 2023, scarcity events in Poland in target year 2028 occur before 13 March and after 6 December – i.e., during the winter months.
[24] In the central reference scenario of ERAA 2023, Germany does not experience any scarcity between April and October of target year 2028.
[25] Based on the exchange with the Polish TSO after the submission of the NRAA.
[26] This is lower than the short-run marginal costs of Polish units subject to the EVA.
[27] Allocation constraint is the limit on the net position (total import/export of a zone) relative to bidding zones in the Single day-ahead Market Coupling. Effectively, for Poland, this the limit on the total import/export from Czechia, Germany, Slovakia, Sweden and Lithuania.

experienced a "Dunkelflaute"[28] event[29]. As cross-border exchanges were constricted, the price in the Polish bidding zone did not reflect the tighter supply/demand balance in Poland's neighbours[30].

Figure 4. Day-ahead prices (in euros/MWh) on 12 December 2024 at 16:00-17:00 UTC.



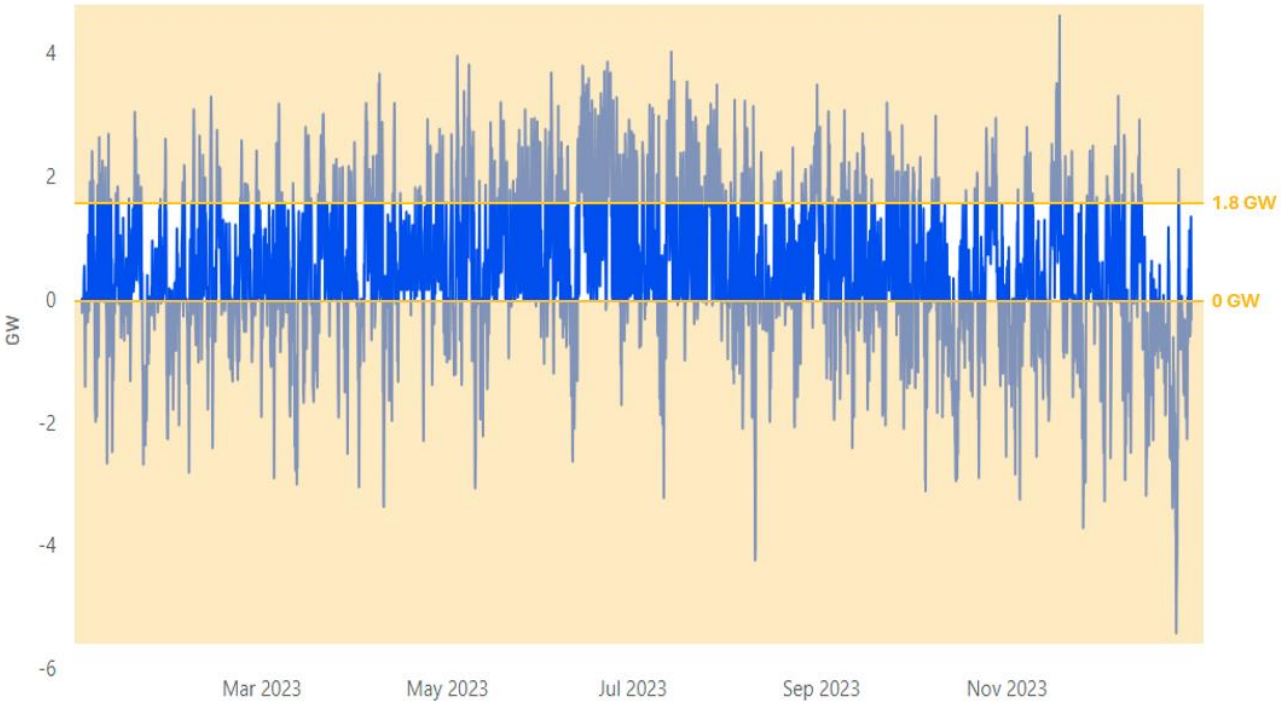
Source: ACER based on ENTSO-E Transparency Platform data.

(26) While constraints were applied in the past, limiting both imports and exports[31], the Polish NRAA does not clearly indicate that this is expected to remain the case for the next 15 years (i.e. the full modelling period from 2025 to 2040). This could have better explained the limitation on exports in the Polish NRAA.

[28] Dunkelflaute or 'dark doldrum' indicates a meteorological condition when little or no energy can be generated by wind or solar power for a whole day or longer (as defined in the report Flexibility solutions to support a decarbonised and secure EU electricity system).
[29] The Dunkelflaute in this case affected all of Central Europe, however the impact in Poland is different due to the comparatively lower share of variable renewable generation.
[30] Day-ahead prices in bidding zones reflect (limited) cross-zonal exchanges.
[31] As shown e.g. in Figure 24 of ACER's 2024 report on transmission capacities for cross-zonal trade of electricity and congestion management in the EU .

(27) ACER notes that in many other situations, Poland is a net exporter of electricity (this is the case in 30% percent of hours in 2023)[32]. This is shown in Figure 5, showing the hourly net import of Poland in 2023, together with the import and export limits considered in the Polish NRAA.

Figure 5. Hourly net import of Poland in 2023 (positive value indicates net import, negative value indicates net export).



Source: ACER based on ENTSO-E Transparency Platform data.

(28) All in all, limiting Polish exports to zero at times of tightness in neighbouring countries means that Polish generators are not contributing to the supply of the neighbouring countries and cannot receive the corresponding higher market revenues. The price in the Polish bidding zone is decreased to the detriment of the market revenues of Polish generation resources[33].

(29) ACER finds that the assumption of limiting exports to zero in the Polish NRAA is not substantiated. The Polish NRAA does not accurately take into account the required

[32] Even if on a yearly basis, Poland imported more energy than it exported (in both 2023 and 2024), benefitting from the interconnected market.
[33] Polish generation resources receive some (missing) revenues through the capacity mechanism, which is financed by the Polish consumers.

regional scope of an NRAA and the contribution of exports as in accordance with Article 24(1) and Article 23(5)(d) of the Electricity Regulation.

(30) Based on the above assessment, ACER finds that the difference in the assumptions regarding cross-zonal exchanges between ERAA 2023 and the Polish NRAA is not justified.

Recommendations:

(31) It appears that the Polish NRAA does not take into account the full benefits of the internal electricity market for the security of supply. ACER recommends that the import and export assumptions are improved in the Polish NRAA to better reflect the functioning of the interconnected European electricity market. For example, in the Opinion on the Estonian NRAA[34], ACER pointed out that explicitly modelling foreign bidding zones and regions is an example of good practice. To facilitate the accurate modelling of foreign bidding zones, the starting point can be the datasets available in ERAA.

3.2 Difference 2: Assumptions on capacity resources

(32) This section outlines the difference in the assumptions on capacity resources. The difference consists of several changes, which are outlined in Table 3 and described in detail in the remainder of this section.

Table 3. Summary of the difference in the input assumptions to the economic viability assessment

Difference	No.	Change in the Polish NRAA compared to ERAA 2023
Assumptions on capacity resources	1	Higher fixed operating costs for existing coal power plants
	2	Higher costs of potential new entry technologies (gas and batteries)
	3	Higher initial assumption of demand-side response and storage capacity
	4	Reduced assumption of nuclear capacity
	5	Changed assumptions of wind (decreased) and solar capacity (increased)

[34] See footnote 10.

3.2.1 Description of the difference

(33) In the Polish NRAA, several economic parameters of capacity resources are changed, compared to ERAA 2023[35].

(34) Firstly, concerning existing units (impacting decommissioning decisions), the Polish NRAA uses different fixed operation and maintenance (FOM) costs for existing coal units, higher than the costs considered in the ERAA 2023. The Polish TSO communicated to ACER that the actual fixed costs of some coal power plants exceed 140,000 euros/MW/year[36]. In contrast, in ERAA 2023, the FOM costs are 25,600 euros/MW/year for existing hard coal and 32,500 euros/MW/year for existing lignite power plants.

(35) Secondly, concerning potential new units, the Polish NRAA uses updated[37] country-specific economic parameters (including capital costs and FOM costs) for open-cycle gas turbines, combined-cycle gas turbines and batteries [38]. In ERAA 2023, the European default values were used for Poland.

(36) Thirdly, the Polish NRAA uses higher initial assumptions of explicit demand-side response (DSR) and storage compared to ERAA 2023[39].

(37) Fourthly, the Polish NRAA uses a lower assumption on nuclear power plant capacity[40] in 2033 from 1110 MW in ERAA 2023 to 0 MW.

[35] Fuel prices and prices of emissions allowances are also updated.
[36] In some cases, the fixed costs include the fixed costs of coal mines belonging to the same economic entity as the generator.
[37] Except for batteries, these values are adjusted for inflation and stem from the 2023 CONE study that used data from 2020. The approach uses an adjustment where prices for 2023 are indexed at 134% of the values in 2020. Values for batteries were not included in the CONE study and in ACER's understanding stem from a survey.
[38] For example, the value used for FOM costs of open-cycle gas turbines are 16,000 euros/MW/year in ERAA 2023 and 59,000 euros/MW/year in the Polish NRAA. For illustration, the country-specific value for Poland in ERAA 2024 is 39,000 euros/MW/year. For combined-cycle gas turbines and batteries, the values are 18,000 and 19,000 euros/MW/year in ERAA 2023 and 75,000 and 23,000 euros/MW/year in the Polish NRAA, respectively. The complete set of values is set out in Figure 2.7 of the document describing the differences (see footnote 6).
[39] In ERAA 2023, there is 0 MW of explicit DSR and 0 MW of battery storage assumed in the national estimates dataset for Poland. The detailed LOLE and EENS results for 2025 for Poland are modified, to account for around 1 GW of explicit DSR that was not includes in the national estimates dataset. The ERAA 2023 results for target years 2028 and 2030 do not consider explicit DSR, however a separate set of modified LOLE results is provided, which does take into account explicit DSR. There is no explicit DSR considered in Poland at all in target year 2033 of ERAA 2023, as pointed out in footnote 48 of ACER Decision 06/2024. On the other hand, the Polish NRAA explicitly includes between 1.3 GW and 1.6 GW of explicit DSR, depending on target year, and 2.1 GW of storage in the years 2028, 2030 and 2033.
[40] The Polish NRAA modifies the assumptions on policy-driven units, which themselves are not subject to the EVA but do impact the economic viability of resources that are subject to the EVA. This impacts the final capacity mix that is used in the adequacy module.

(38) Fifthly, the Polish NRAA uses different assumptions regarding the installed capacity of wind and solar[41]. For example, in 2028, the wind onshore and wind offshore capacities are reduced while the solar capacity is increased[42].

3.2.2 Relevance of the difference

(39) The changes likely affect the results as follows:

1. The higher costs of coal (hard coal and lignite) can result in more decommissioning in the EVA and may increase adequacy risks[43].

2. The higher entry costs of new technologies can result in less commissioning in the EVA and may increase adequacy risks.

3. Initial DSR and storage assumptions for target year 2028 are higher than in ERAA 2023, which can decrease the profitability of other resources subject to the EVA or may decrease the adequacy risks of the assessment.

4. The updated assumption on nuclear capacity may improve the profitability of resources subject to the EVA. At the same time, less firm nuclear capacity is available in the final capacity mix. The change may impact both the investment and adequacy outcomes of the assessment.

5. The updated assumption on renewable energy sources (RES) may affect the profitability of resources subject to the EVA. At the same time, the updated assumption means that different RES capacities are included in the final capacity mix. The change may impact both the investment and adequacy outcomes of the assessment.

3.2.3 Evaluation of the difference

(40) According to Article 23(5)(d) of the Electricity Regulation, ERAA and NRAAs should appropriately take into account the contribution of all existing and future possible resources. Furthermore, as per Article 5(10) of the ERAA Methodology, the economic data used in the ERAA and NRAAs should be identical to the latest available best estimate used in the most recent cost of new entry (CONE) study pursuant to the

[41] See footnote 40.
[42] For example, for target year 2028, the national estimate assumption of solar capacity is 20.6 GW in ERAA 2023, 23.9 GW in the Polish NRAA and 23.7 GW in ERAA 2024. For offshore wind it is 5.9 GW in ERAA 2023, 4.1 GW in the Polish NRAA, and 6.0 GW in ERAA 2024. For onshore wind it is 12.4 GW in ERAA 2023, 11.6 GW in the Polish NRAA, and 12.7 GW in ERAA 2024. The RES technologies have different contributions to security of supply, with wind capacity being significantly more relevant for Poland. This is illustrated by the annual capacity factors listed in Figure 2.9 of the document describing the differences (see footnote 6).
[43] If all else is equal i.e. no additional contribution from domestic or foreign resource takes place.

methodology for the calculation of the adequacy metrics[44]. ACER assesses the changes as follows.

(41) Firstly, changes to economic parameters constitute reasonable updates, as long as they are consistent with the latest CONE study. Regarding fixed costs of existing coal power plants, as this technology is not covered in the national CONE study, other national specific costs assumptions may be used to improve the accuracy of the assessment. Hence, this change is substantiated.

(42) Secondly, ACER finds that the values used in the Polish NRAA (except for batteries[45]) are based on the latest CONE study and hence constitute a substantiated update.

(43) Thirdly, the updated DSR and storage assumptions in the Polish NRAA are based on the latest available information, hence the update is substantiated[46].

(44) Fourthly, updating the national estimate of installed capacity of nuclear is in line with the latest available information and is a substantiated update.

(45) Fifthly, updating the national estimates of installed capacity of wind onshore, wind offshore and solar is based on the latest available information and is a substantiated update[47].

(46) Based on the considerations above, ACER finds that the difference in assumptions on capacity resources between ERAA 2023 and the Polish NRAA is justified.

(47) It shall be noted that the above evaluation is based on the information provided by the Polish authorities, (primarily, the Polish TSO), and the presented insights are limited to the current case, considering the conditions and circumstances particular for the Polish power system.

Recommendations:

(48) ACER recommends that the same national-specific costs used in the NRAA are also used in ERAA. For example, if there is a specific cost parameter describing a country's generation sector better than the default value used in ERAA, the TSO should inform

[44] Methodology for calculating the value of lost load, the cost of new entry and the reliability standard, as set out in Annex I of ACER's Decision 23/2020.
[45] Batteries were not included as a potential expansion technology in the 2020 CONE study. Given the rapidly growing importance of storage technologies, this technology should be considered in the next CONE study.
[46] ACER notes that this significant change is driven by the contracts awarded to those technologies in the recent capacity mechanisms auctions.
[47] It can be expected that the update made in an NRAA – compared to the latest ERAA – would be reflected in the subsequent ERAA. In the case of the Polish NRAA, the same updated assumptions (in particular the decrease in wind offshore capacity in target year 2028) are not reflected in ERAA 2024 and will likely be reflected in ERAA 2025.

ENTSO-E and explore ways to reflect the national assumption in the annual ERAA assessment.

3.3 Difference 3: Modelling of capacity resources

(49) This section outlines the difference in the modelling of capacity resources, in particular the economics of the resources. The difference consists of several changes, which are outlined in Table 4 and described in detail in the remainder of this section[48].

Table 4. Summary of the difference in the EVA modelling and outcomes

Difference	No.	Change in the Polish NRAA compared to ERAA 2023
Modelling of capacity resources	1	Iterative revenue-based EVA is used
	2	Revenue-based EVA does not consider future revenues
	3	Constrained expansion potential (of gas, DSR and storage)
	4	Different pattern of planned maintenance
	5	Different set and weighting of climate years

3.3.1 Description of the difference

(50) The Polish NRAA performs an economic viability assessment that differs from ERAA 2023, changing the modelling of capacity resources. The five changes are listed as follows:

[48] During the follow-up discussions, the Polish TSO explained that the Polish NRAA also includes changes related to negative prices in the EVA (which could better reflect the economics of storage capacities and affect the economics of other power plants) and to modelling frequency containment and frequency restoration reserves (whereby in the Polish NRAA, the providers' bids are fully cost-based). ACER finds both changes to be examples of good modelling practice.

(51) **Firstly**, the NRAA introduces an additional EVA step[49] assessing the revenues of each resource for each modelled year (the so-called iterative, revenue-based EVA)[50]. This is shown in Figure 6 at the end of the section.

(52) **Secondly**, the additional EVA step does not consider future revenues and costs and only considers the revenue/costs balance in an individual year.

(53) **Thirdly**, the NRAA constrains the expansion potential of technologies[51]. New market-based storage and gas investment cannot occur in the EVA of the Polish NRAA in 2028. Based on the ERAA 2023 documentation, gas and storage could enter in the EVA of ERAA 2023[52] in all target years[53]. DSR cannot expand in any modelled year in neither the Polish NRAA nor in ERAA 2023.

(54) **Fourthly**, the Polish NRAA assumes a different pattern of planned maintenance of generators than ERAA 2023[54].

(55) **Fifthly**, the Polish NRAA uses a different set of climate years and a different approach to selecting representative climate years. ERAA 2023 uses the climate years 1985, 1988, and 2003, while the Polish NRAA uses the climate years 2001, 2008, and 2013. Importantly, the climate year 2001, labelled by the NRAA as the average climate year, results in higher adequacy risks than year 2013 (which is labelled as the high-risk year)[55].

[49] ERAA 2023 conducts sequentially an EVA and an ED, whereas the Polish NRAA conducts a two-step EVA and one ED. Hence, the Polish NRAA adds an additional viability check of adequacy resources compared to ERAA 2023.

[50] The first step of the EVA in the Polish NRAA, called the "system cost minimization model", minimizes the cost of the Polish power system. This step enables commissioning of new capacity, and decommissioning, mothballing, and life-extending of existing capacity, for three climate years (selected from the full set) over the modelled target years of the NRAA. A system cost minimisation EVA is also conducted in ERAA 2023. The second EVA step, called the "full energy market model", is an iterative, revenue-based check of the viability of capacities subject to the EVA. For each iteration, it computes capacities' revenues and costs in an individual target year. This EVA step uses three weather years. After each iteration, the model reruns the operation of the Polish power system with the adjusted capacity mix, resulting in novel price levels and revenues, to be used for a new economic viability check iteration. The resulting final capacity mix is used to run the ED module, which produces the LOLE and EENS results of the Polish NRAA.

[51] In target years 2025-2028, the Polish NRAA can only decommission capacity.

[52] There is no country-specific zero-value limit on potential included in the CONE dataset submitted to ACER, and no zero-value investment constraint listed in the relevant ERAA 2023 document (the CONE dataset for ERAA 2023 was not published, while the investment constraints are set out in Table 14 of Annex 2 to the ERAA 2023 report).

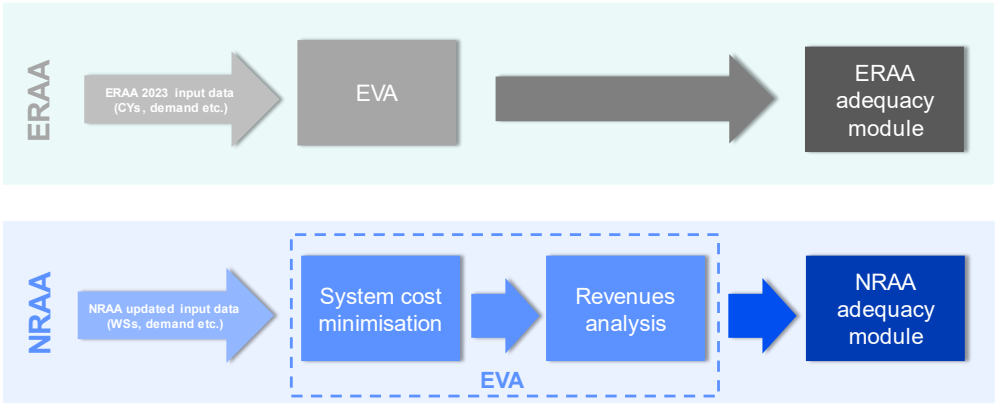
[53] However, the Polish TSO indicated to ACER that the information in the ERAA 2023 annexes regarding Polish batteries may not be fully accurate. The Polish TSO indicated to ACER that battery expansion was in fact not possible in ERAA 2023. The Polish TSO indicated that this is implemented directly in the Plexos model.

[54] For example, for January 2028, up to 4 GW more capacity is assumed to be in planned maintenance in the Polish NRAA than in ERAA 2023. It should be noted that ERAA 2023 and Polish NRAA outage patterns consider different technologies.

[55] The observation follows from the detailed results of the second step of the EVA which the Polish TSO shared with ACER after the submission of the NRAA.

(56) **Finally**, ACER notes that the combination of changes leads to a capacity exit in the EVA. This is despite implied revenues of capacity resources in the EVA being larger than the indicated costs of resources that exit the EVA.

Figure 6. Schematic representation of the modelling approach of ERAA 2023 and the Polish NRAA



3.3.2 Relevance of the difference

(57) The relevance of the five changes is assessed as follows:

1. After the first step of the EVA, the second additional EVA step was introduced to further evaluate revenues and costs for individual target years. This change decreases the amount of capacity that is deemed economically viable. This, in the end, may increase adequacy risks.

2. Not considering future revenues and costs impacts the market entry and exit decisions in a given calendar year. In addition, it means that mothballing of resources is not possible.

3. The inability to commission storage in the EVA during the most critical years – when the adequacy risk is the highest – may impact the capacity mix after the EVA (e.g. less flexible resources in the system) and increase the adequacy risks of the assessment.

4. The maintenance patterns in the Polish NRAA differ from the patterns used in ERAA 2023. In particular, the pattern in the Polish NRAA assumes a larger share of maintenance in the month of January. As many scarcity events in the Polish NRAA occur in this month, the limited resource availability may increase the risk of loss of load.

5. The different way of clustering climate years modifies demand profiles and weather-dependent generation. The climate year 2001, which is meant to represent an average climate year, results in a higher LOLE than the other two climate years

(2008 and 2013). The climate year with the highest weight has the biggest impact on EVA outcomes. The exact impact on adequacy risks is unclear.

3.3.3 Evaluation of the difference

(58) According to Article 23(5)(b) of the Electricity Regulation, resource adequacy assessments should include an economic assessment of the likelihood of retirement, mothballing and new-build of generation assets. ACER assesses the changes as follows.

(59) **Firstly**, the Polish NRAA uses an iterative, revenue-based EVA which is the preferred approach to the EVA according to the ERAA methodology and is indicated as best practice in ACER's Decision on ERAA 2023[56].

(60) However, **secondly**, ACER finds that the implementation of the revenue-based EVA in the Polish NRAA is lacking, as it is short-sighted in that it does not consider future revenues and costs for entry/exit decisions. The EVA of ERAA 2023 considers revenues and costs during the entire modelled time period. For example, market entry/exit decisions for 2025 take into account revenues up to 2030 and beyond. The revenue analysis (the second EVA step) in the Polish NRAA only considers revenues and costs in an isolated year. This means, for example, that the entry/exit decision made in 2025 do not consider revenues and costs in future years. Consequently, some powerplants may exit the market prematurely even though they may be profitable over the economic lifetime of the asset. In addition, the economic decision of mothballing is not considered in the NRAA, although explicitly foreseen by Article 23(5)(b) of the Electricity Regulation. The Polish NRAA does not show that domestic power plants would not consider future revenues. ACER finds that this changed assumption to ERAA 2023 is not sufficiently substantiated [57].

(61) **Thirdly**, ACER notes that DSR and batteries cannot expand in the NRAA in the coming five years (i.e. until 2029)[58]. This feature of the model follows from the hypothesis that, in the medium term, neither DSR nor batteries would expand in Poland without the capacity mechanism. ACER could not ascertain why the market-based battery or DSR investment is considered unfeasible over this extended period[59].

(62) Furthermore, since DSR cannot expand in the EVA of the Polish NRAA, the maximum capacity of DSR is limited to the initial estimate (for example, 1.5 GW in 2028 and 1.6 GW in 2030). However, when setting the reliability standard in Poland, the assumed

[56] The approach is set out in paragraphs 4 and 5 of Article 6 of the ERAA methodology, referred to in footnote 3. The Decision on ERAA 2023 is referred to in footnote 4.
[57] During the follow-up to the submission, the Polish TSO explained that it can be deduced from ex-post statistical information that resources that exited based on the revenues of the isolated year would not break even in later years.
[58] Regarding the expansion of fossil technologies, ACER notes that gas can expand in ERAA 2023 in target year 2028 but can only expand from 2029 onwards in the Polish NRAA. ACER finds that this is a reasonable update as the Polish NRAA was finalised later than ERAA 2023.
[59] A similar observation regarding the Polish DSR was made in ACER's Decision on ERAA 2023 .

potential of DSR was 2.0 GW for 2028 and 2.5 GW for 2030[60]. ACER finds that this is an inconsistency[61]. The maximum possible potential of DSR in the Polish NRAA should be identical to the potential assumed to set the reliability standard. This is of fundamental importance, because the same reliability standard is used to interpret the results of the assessment in terms of identifying adequacy concerns.

(63) In fact, even beyond 2030, the NRAA considers the market-based expansion of the DSR impossible. Such an assumption appears difficult to understand in the context of the energy transition and gradual market entry of demand response providers. There could be a potential link between this assumption and the barriers that the DSR faces when entering the Polish market. In fact, ACER's report on the matter identified multiple barriers in Poland[62].

(64) Regarding battery storage, the technology was an expansion candidate in ERAA 2023 in all target years (2025, 2028, 2030 and 2033)[63]. The Polish TSO explained that it is not feasible that any additional battery storage project would enter the market in the period 2025-2028[64]. ACER was unable to assess this assumption in detail[65].

(65) **Fourthly**, updated maintenance patterns[66] can constitute a reasonable change if they reflect a national specificity of the Polish generator fleet. Following the submission, the Polish TSO confirmed that the changed assumptions correspond better to the maintenance patterns of different technologies observed in Poland[67]. ACER finds the difference reasonable in principle but was not able to assess it compared to actual maintenance profiles as the relevant data set on the ENTSO-E's Transparency Platform exhibits quality issues.

(66) **Fifthly**, the Polish TSO provided details on how the clustering and weighting of representative climate years was conducted. However, it did not explain why the year labelled as representative for the *average* adequacy risks cluster of climate years results in *higher* LOLE than the year that is labelled to represent the *high* adequacy risks cluster

[60] If the DSR potential in the study setting the RS was lower (e.g. 1.5 GW), the reliability standard would be higher.
[61] The Polish TSO indicated to ACER that the total capacity of DSR considered in the Polish NRAA is higher, as implicit DSR is also included. However, it was not shown that the implicit DSR considered in the Polish NRAA is an addition on top of the implicit DSR already considered in the setting of the reliability standard (where ENS patterns from ERAA 2023 were used, already including the contribution of implicit DSR.
[62] ACER's 2023 report on barriers to demand response and other distributed energy resources.
[63] See footnote 53.
[64] In ERAA 2023, the harmonised construction period (Table 6.1 in Annex 1 of the report) implies that battery storage projects can be completed in two years.
[65] For example, ACER was unable to assess if, beyond the battery storage capacity awarded in the capacity mechanism, any additional battery storage capacity might have been eligible to participate in auctions or, while eligible, was not awarded in the capacity mechanism.
[66] ACER also assessed the forced outage patterns in the EVA and the ED of the Polish NRAA and found that they were coherent.
[67] In the submission, the Polish NRAA did not provide this element as different from ERAA 2023. As part of its general screening of the Polish NRAA, ACER identified this as relevant difference.

of climate years. The climate year labelled as representative for the average adequacy risks cluster of climate years has the highest weight (55.3%) of all selected climate years and hence a notable impact on the results. ACER finds that this change is not sufficiently substantiated.

(67) **Finally**, ACER notes that the combination of the changes described above leads to a capacity exit in the second step of the EVA in the Polish NRAA, in particular in 2025-2029, decreasing the capacity mix. The economic equilibrium found by the EVA implies that capacity exits the market when its fixed costs exceed its revenues. However, ACER finds indications that in the Polish NRAA, resources may exit even when revenues should ensure profitable operations. This is elaborated in the following paragraphs.

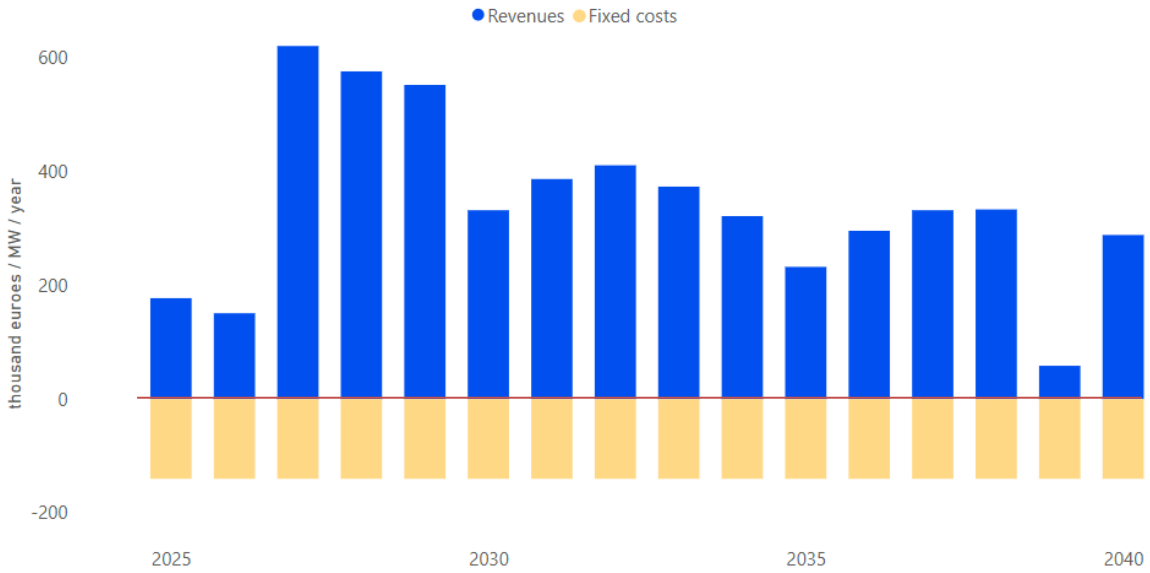
(68) The result of the EVA is the final capacity mix corresponding to the economic equilibrium. It leads to a considerable number of scarcity events (up to 40 hours in a year), as seen in Table 6 in the Annex.

(69) The available resources that are available at times of scarcity should, in principle, receive the maximum hourly price, which in the Polish NRAA is 15,000 euros/MWh[68]. This means that the scarcity revenues[69] can amount to more than 600,000 euros/MW annually (illustrated in Table 7 in the Annex).

(70) Business decisions by generators consider the expected revenues and expected costs. Fixed operation and maintenance costs of coal (hard coal and lignite) power plants are assumed at up to **32,500** euros/MW/year in ERAA 2023[70]. The Polish NRAA uses higher assumptions. As mentioned in section 3.2.1, the Polish TSO communicated to ACER that the actual annual fixed costs of Polish coal power plants can exceed[71] **140,000** euros/MW[72].

[68] The Polish NRAA uses updated market price caps that are closer to the Polish value of lost load; this constitutes an improvement to ERAA 2023. ACER considers that this change is a reasonable update and an example of good practice.
[69] In this case, scarcity revenues refer to the revenues that an available capacity resource makes in times of loss of load (i.e., scarcity).
[70] As described in paragraph (34).
[71] The exact assumptions were not accessible to ACER due to their confidential nature.
[72] For illustration, this corresponds to 140 euros/kW. This is a high cost of marginal capacity, for example when compared to the costs of residential DSR (where country-specific FOM in ERAA 2023 ranges from 0 to 18.8 euros/kW of demand-side flexibility), which may provide the same service of helping the system during tight situations (by reducing their offtake). As noted, residential explicit DSR is not considered as an expansion candidate in Poland. This may be also linked to administrative barriers. ACER's 2023 barriers report revealed that that, in 2022, demand response by residential consumers was not eligible to access day-ahead, intraday and balancing market products in Poland (see Tables 4 and 5 in the report).

Figure 7. Implied scarcity revenues (blue) compared to high fixed costs of existing units (orange), for each modelled year



(71) Even when the higher value of 140,000 euros/MW/year is used as the fixed costs in the illustration above, the assumed revenues of powerplants are substantially higher than the costs during most years[73]. However, exit of coal capacity in the Polish NRAA occurs in all years between 2025 and 2029[74]. Based on the information available, ACER is unable to assess how the changes to the EVA as described above impact the economic equilibrium to the extent that would explain the capacity exiting the market.

(72) ACER considered the interconnected nature of the changes described in this chapter and the finding regarding the scarcity revenues. Based on the submitted report, the follow-up discussions with the Polish authorities, and ACER's reasonable efforts in assessing the changes, ACER could not conclude whether the difference is justified. In order to reach a definite conclusion in this regard, ACER's assessment would have required examining the underlying power system simulation model run to an extent that was not possible in the course of the legally allotted 2 months in this case.

[73] This is assuming that any additional resource that would be considered in EVA would receive, if added to the capacity mix, the same revenues. Indeed, by adding an additional resource, the scarcity hours and revenues would to some extent decrease, however in ACER's view revenues in most years are so much higher than the costs that the general conclusion of the comparison holds true even if a marginal resource was added to the capacity mix.

[74] The years most relevant to the period when the results of ERAA 2023 and the Polish NRAA diverge.

Recommendations:

(73) ACER recommends that the economic viability assessment considers future revenues and costs. ACER also recommends that further clarity is provided as to the economic outcomes of the economic viability assessment. In particular, the Polish NRAA should explain the factors resulting in the exit of coal capacity despite the assumed market revenues, and how these factors may be addressed to best improve the security of supply of the Polish electricity system.

(74) ACER also recommends that the Polish NRAA substantiates the assumption that no additional DSR or storage will enter the Polish system beyond the capacity contracted in the capacity mechanism. In particular, the Polish NRAA can explain how the barriers that impede the participation of DSR and storage (including smaller scale units) in energy markets influence the assumptions of the assessment, and whether such barriers cannot be removed or mitigated.

4 CONCLUSIONS

(75) ACER has assessed the differences between the Polish NRAA and ERAA 2023 as listed in Table 5. The combination of these differences leads to a divergence in the adequacy results between the two assessments.

Table 5: Summary of the differences between the Polish NRAA and ERAA 2023

	Difference	Reason for difference	ACER's evaluation
1	Assumptions regarding cross-zonal exchanges	Constrained contribution of foreign units and no possibility for export for domestic units.	Not justified
2	Assumptions on capacity resources	Updates due to new information available.	Justified
3	Modelling of capacity resources	Different modelling of the economics of power plants.	ACER cannot conclude whether the difference is justified

HAS ADOPTED THIS OPINION:

1. ACER considers that that the differences between the Polish NRAA and ERAA 2023 are justified in terms of the assumptions on capacity resources but not justified when it comes to the assumptions regarding cross-zonal exchanges, as set out above. Regarding the difference in the modelling of capacity resources, ACER cannot conclude whether the difference is justified.

2. To address the identified issues, ACER's recommendations set out above can be considered.

This Opinion is addressed to the Ministry of Climate and Environment of Poland.

Done at Ljubljana, on 3 February 2025.

- SIGNED -

For the Agency
The Director

C. ZINGLERSEN

Annexes:

Annex – Additional figures

ANNEX – ADDITIONAL FIGURES

Table 6. EVA results in terms of LOLE, for each modelled year

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
LOLE (hrs)	11.8	10.0	41.3	38.4	36.8	22.1	25.8	27.4	24.9	21.4	15.5	19.7	22.1	22.2	3.9	19.2

Table 7. Implied scarcity revenues based on EVA LOLE results, for each modelled year

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Scarcity revenue (k€/yr/MW)	177.2	150.7	620.0	575.4	551.6	331.6	386.3	410.4	373.0	321.3	232.1	295.4	331.6	332.9	58.4	288.1