ACER Decision on ERAA 2024: Annex I.e

To be read together with amendments set out in Annex II

European Resource Adequacy Assessment

2024 Edition

Annex 4: Case Study – Application of Revenue-Based EVA Approach on European Scale

entsoe

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1 Introduction

In parallel to the operational assessment presented in detail in Annex 3, ERAA 2024 includes the development of an alternative methodology for the Economic Viability Assessment (EVA), in compliance with the ACER methodology.[1] This methodology, already applied in several National Resource Adequacy Assessments,[2] aims to observe viability assessment as a direct comparative study of revenues and costs from the units' point of view rather than as the optimal state of the system. This methodology has been tested in the context of ERAA 2024 modelling and will be further consolidated with the goal of becoming the official EVA approach for future ERAA editions.

In EVA, the ACER methodology[3] allows for studying the direct difference between the costs and revenues of units subject to EVA. This method differs from the historical operation of EVA in ERAA, which focused on the global minimization of overall system costs.[4] Although the two approaches theoretically converge, in a system as wide and complex as Europe's they can yield substantially different net results both in the overall system and at the nodal level.

The revenue-based approach aims to evaluate the performance of each unit on the electricity-only market to estimate its profitability in given conditions. Units that are not profitable are at risk of decommissioning. Similarly, profitable investment candidates indicate potential for expansion.

This annex presents global insights on the methodology used to perform this revenue-based EVA, outlines two different approaches (Implementation A and Implementation B), in comparison with the operational assessment performed with global system cost optimization, and presents initial case study for each implementation options.

The goal of implementing revenue-based EVA is to enhance the understanding of EVA decisions. This years' implementation aims at benchmarking methodologies to allow transition to adopt revenue-based EVA in the upcoming ERAAs. The implementation of the revenue-based EVA in ERAA 2024 represents a case study, which needs to be further matured and consolidated for the application in upcoming ERAAs.

[1] (ACER, 2020)
[2] (ELIA, 2023; RTE, 2023; TERNA, 2023; Red Eléctrica, 2023) among others
[3] (ACER, 2020) Article 6 – 2 – (a) and 6 – 4, 6- 5
[4] See Annex 2

2 Methodology

2.1 Missing money analysis

Unit profitability is assessed through missing money analysis, an iterative process that aims to identify system equilibrium. Each iteration is composed of the following steps:

1. Simulating economic dispatch
2. Calculating the net revenues earned by each unit by subtracting short-run marginal costs from electricity market revenues
3. Computing the earnings before interest, taxes, depreciation and amortization (EBITDA) of each unit by deducting annual fixed costs from its yearly net revenues[5]
4. Calculating the unitary profitability (k€/MW/yr) for each unit by dividing the EBITDA (k€) by its capacity (MW).
5. Ranking all units based on their per-unit profitability.
6. Among units with negative profitability (EBITDA<0), removing those with the largest shortfall from the system in the next market simulation. In Implementation B, capacities where EBITDA exceeds CAPEX[6] can be expanded. If at least one capacity satisfies this condition, the most viable one is selected for expansion. The decommissioned and commissioned capacity is calculated for each study zone, decreasing as iterations progress. Through this process, analysis becomes increasingly precise. This *gradient descent*, explains the theoretical convergence with the optimization protocol.

The merit order and overall prices in the system will change due to global system evolution. Hence, units that were slightly missing money may become viable, while others may become unviable. The process ends when all the units remaining in the system are profitable (EBITDA>0). Figure 1 graphically represents the logic described above.

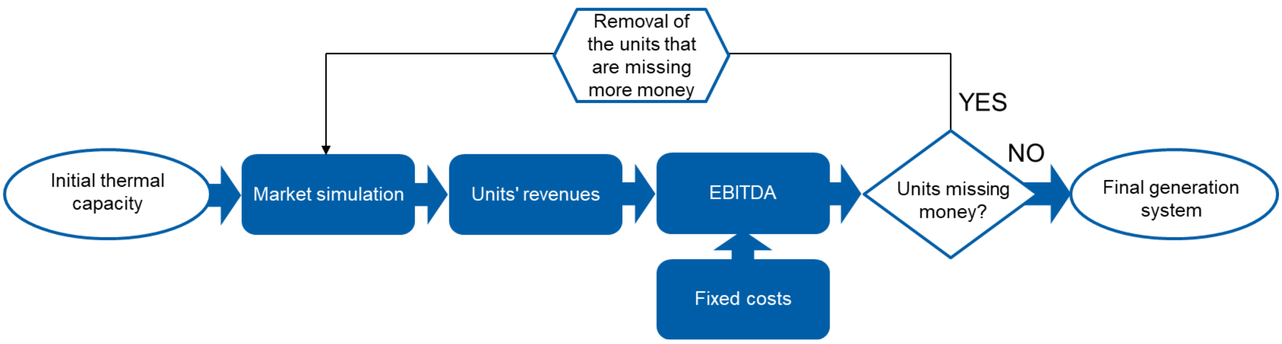

Figure 1: Iterative process of the missing money analysis

[5] Taking into account risk aversion
[6] Taking into account risk aversion

2.2 New entry simulation

2.2.1 Implementation A

To assess the feasibility of investing in new capacity, standard candidate units from expandable technologies are added to the system until the potential of each study zone is saturated. This results in a system that includes both existing and potential capacity. This system undergoes a missing money analysis, where, with each iteration, the direct competition between real and standard candidate units is observed. When computing the EBITDA of the latter units, net revenues are reduced by the annualized costs described in Section 10.11 of Annex 2, taking into account investor risk aversion. This allows for the combined assessment of the profitability of both existing and potential capacity, identifying the missing money units from both categories to remove from the system.

Once the iterative process concludes, the resulting system consists of a mix of existing units and standard candidate units, with the latter representing new entries.

2.2.2 Implementation B

In Implementation B, the starting point of the system is the generation fleet of the *National Trends* scenario. Candidates for commissioning are standardized to harmonized cost of new entry (CONE) data, as described in Annex 2.

2.3 Multi-year analysis

The scope of ERAA 2024 covers the time horizon (TH) from 2026 to 2035. The target years (TYs) explicitly modelled within this period are 2026, 2028, 2030 and 2035. Decisions regarding the expansion or decommissioning of capacity in a given TY must also consider the economic performance of that capacity in the subsequent years of the TH, reflecting the perspective of a real investor. Therefore, while assessing one TY, the following years are also simulated. The process for each TY is described below:

1. A simultaneous missing money analysis is conducted for all TYs between the current one and the end of the TH.
2. The Net Present Value (NPV) of the profitability of each unit is calculated by actualizing the EBITDA obtained in each TY to the current year.
3. Decisions on the system's evolution are made as follows:
   - Existing units with negative EBITDA in the last iteration of the current TY and negative NPV are decommissioned and removed from the system.
   - Standard candidate units with positive EBITDA in the last iteration of the current TY and positive NPV remain in the system and are considered new entries. In all other cases when the EBITDA and the NPV of a unit have opposing signs, no decision is made, and the unit remains in the system for the following TY.
4. The resulting system is then analysed in the next TY of the TH.

Figure 2 graphically represents this logic.

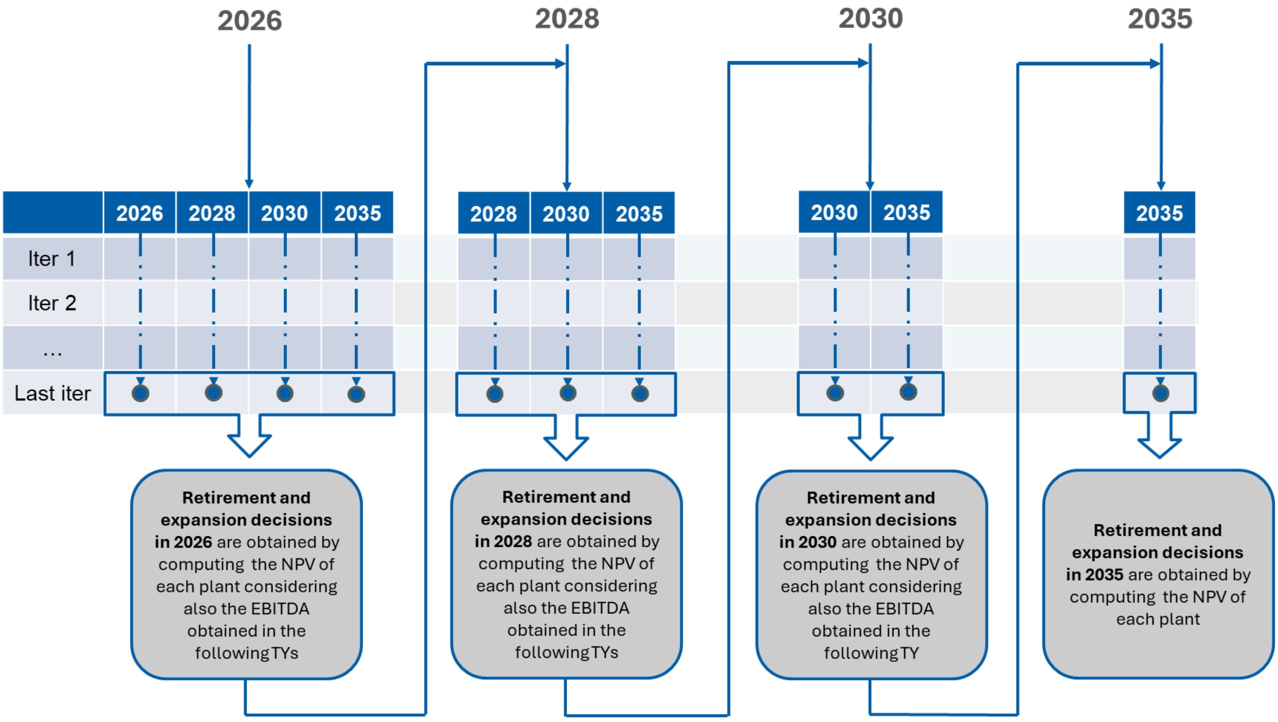

Figure 2: Multi-year analysis of TYs in the ERAA

2.4 Non-consecutive target years

The ERAA 2024 collected data for four non-consecutive TYs: 2026, 2028, 2030 and 2035. However, the EVA is an integrated model over multiple years spanning 2026 – 2035.
To overcome this issue, data for non-TYs are obtained as follows:

- In Implementation A: By interpolating the correspondent values of the previous and following TYs. For example, the EBITDA of a unit in the non-TY 2027 is computed by interpolating the EBITDA of that unit in TYs 2026 and 2028.
- In Implementation B: By repeating the previous results. For example, the EBITDA of a unit in the non-TY 2027 is taken as that of TY 2026.

These approaches help prevent discontinuity in the evolution of the units' economic performance over the TYs, which could lead to unrealistic commissioning or decommissioning decisions.

2.5 Years following the last TY

Section 2.4 shows that the number of simulated years decreases as the TH progresses. This suggests that the period during which investors expect to recover investment costs becomes shorter, which is unrealistic. To address this issue, the economic performance of each unit in the last TY of the TH is assumed to repeat in the subsequent years. Of course, the further ahead this repetition occurs, the smaller its contribution to the NPV.

This approach maximizes the use of results from the simulation of the last known scenario.

2.6 Mothballing simulation

Some units have been designated as eligible for mothballing. This means that if a unit is decommissioned due to economic unsustainability in a given year, the unit could instead temporarily exit the system, reducing costs. The unit could then re-enter at a later date, when market conditions are favourable.

To account for this phenomenon, in Implementation A, when a decision is made to decommission a unit eligible for mothballing, further assessment is performed on its economic performance. This includes mothballing costs, such as the cost associated with entering mothballing, low maintenance during this period and exiting mothballing. A new NPV is then calculated for the unit. If the new NPV is positive, it indicates that the unit has benefitted from mothballing, allowing it to re-enter the market in the future and become profitable again. If the new NPV remains negative, the unit is deemed unprofitable and is permanently decommissioned.

Mothballing is not modelled in Implementation B.

2.7 Life extension simulation

Some units decommissioned for policy reasons are eligible for lifetime extension. This means that if a unit is profitable enough to cover the life extension cost at the time of decommissioning, it can remain in the market for a specified number of additional years. This allows the unit's capacity to be preserved during these years at a cost lower than that of a new entry.

For interested units, the possibility of extending their lifetime is granted by keeping them in the market in the simulation of the first TY following their policy-driven decommissioning. In addition to confirming their profitability in that year, the NPV including the lifetime extension costs, is also assessed. If the NPV is positive, the unit remains profitable in the coming years and is not decommissioned. However, if the NPV is negative it indicates insufficient economic performance, and extending the lifetime of the unit is therefore not justified.

2.8 Different implementations

Table 1 describes the main differences between Implementations A and B, and with the cost-based (CB) algorithm.

Table 1: Overview of the differences of the EVA approaches and implementations

Feature	Revenue-based EVA		Cost-minimization EVA	Expected impact on results
	Implementation A	Implementation B		
Unit clustering	Single units	Clustered units	Clustered units	Minor
Decision protocol	Investment potential is saturated, then only decommissioning decisions are made iteratively	One commissioning and decommissioning decision is made in every iteration		Option B may see more replacement of least viable capacities (coal, lignite) with new ones.
Perpetuity	Implicit modelling to 2045 through repetition of 2035	Implicit modelling to 2045 through repetition of 2035	Repetition of investment costs to the economic lifetime and operation costs to infinity	Revenue based EVA implementation mitigates impact of last TY adequacy and economic situation.
Reserves	Not simulated	Dedicated percentage of capacities	Volume provision	Undefined
Flow-based modelling	NORDIC and CORE	NORDIC and CORE	NORDIC and simplified CORE	*Aligned*
Mothballing	Yes	No	No	Option B might replace mothballing decisions with decommissioning. Negligible considering volume of mothballed capacities
Generation capacity assessed in EVA	Data collection defined	Enlarged scope	Data collection defined	Total net capacity should remain aligned. Potential replacement of capacity expansion or decommissioning, especially for some specific study zones and technologies.

3 Revenue-based EVA approach results

The revenue-based EVA results show a similar trend to the reference scenario EVA, indicating that generation faces economic viability challenges from 2026 to 2030. Only in 2035 do additional investments globally become more viable. Implementation A returns the smallest system in comparison to the other EVA approaches.

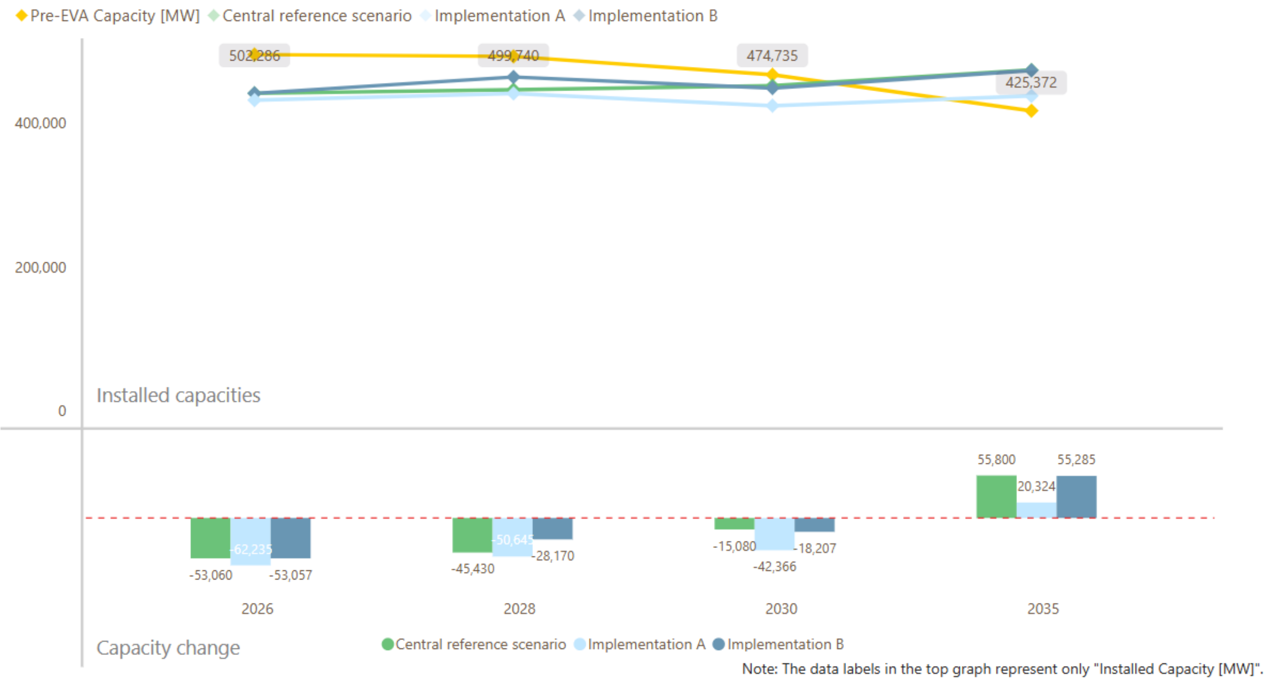

Figure 3 case study result overview – pan-European

3.1 Implementation A results

Implementation A of the revenue-based EVA suggests a net decrease in generation capacity between 2026 and 2030. However, by 2035, a net increase in Europe's generation capacity could be expected. In addition to the already announced and anticipated decommissioning of coal power plants, an overall decrease in coal-fired power plant generation is expected throughout the horizon due to a lack of economic viability. Moreover, notable demand side response (DSR) expansion potential is identified in all assessed TYs.

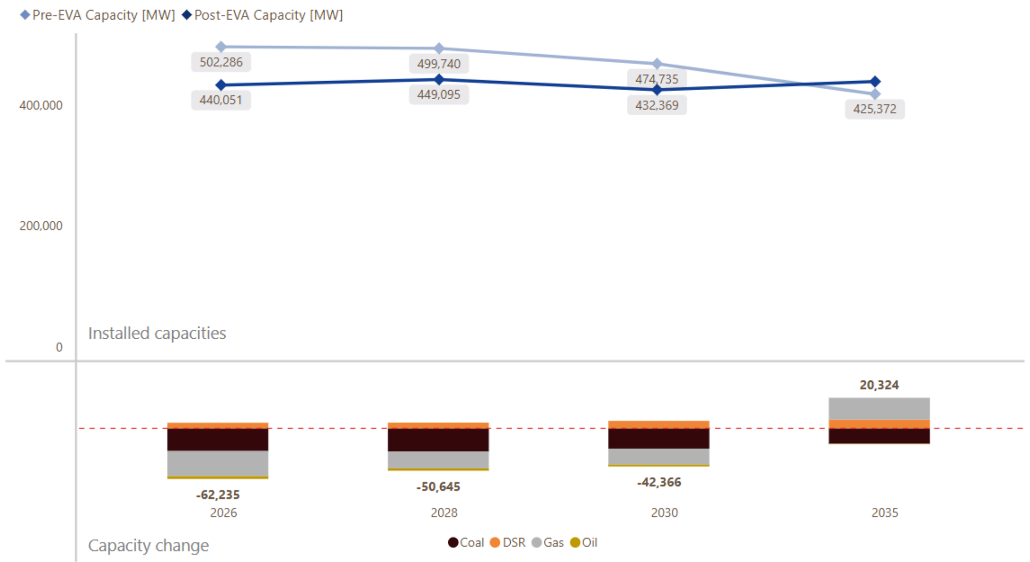

Figure 4 Net effect of the EVA on the European mix: Implementation A of revenue-based EVA

Country-level effects are also presented.

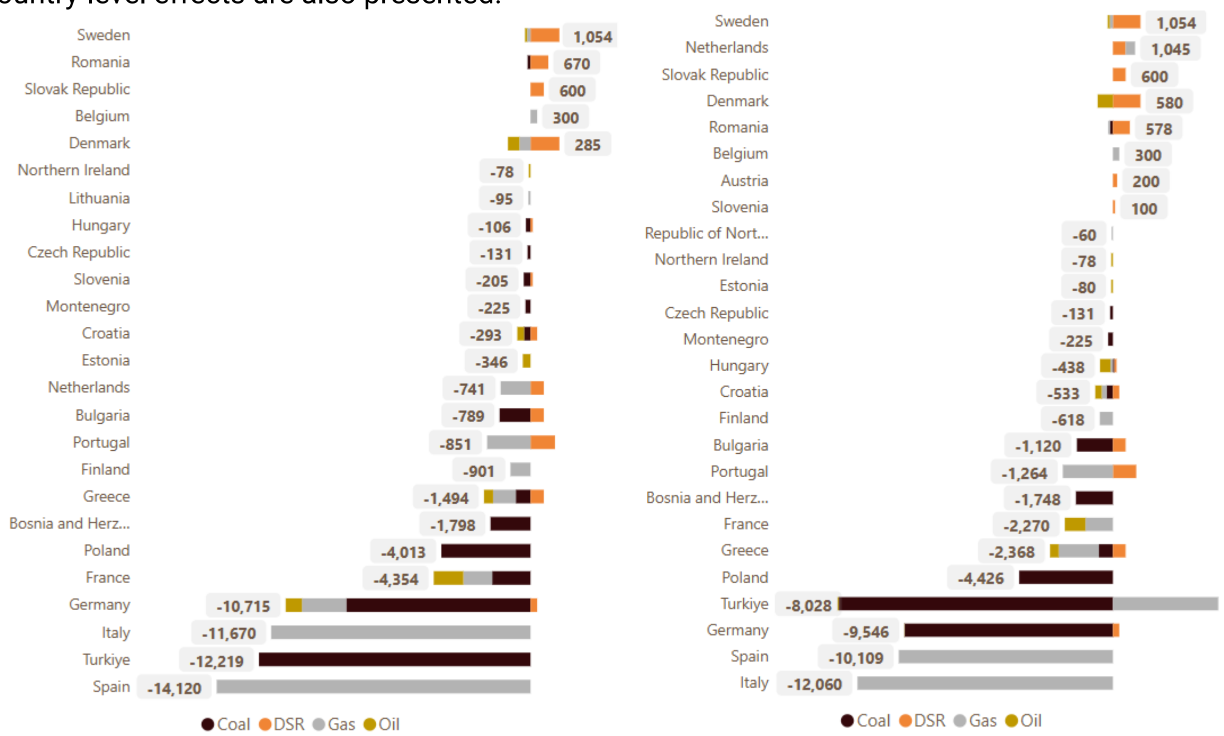

Figure 5 Detailed results for Implementation A of revenue-based EVA: 2026 (left) and 2028 (right)

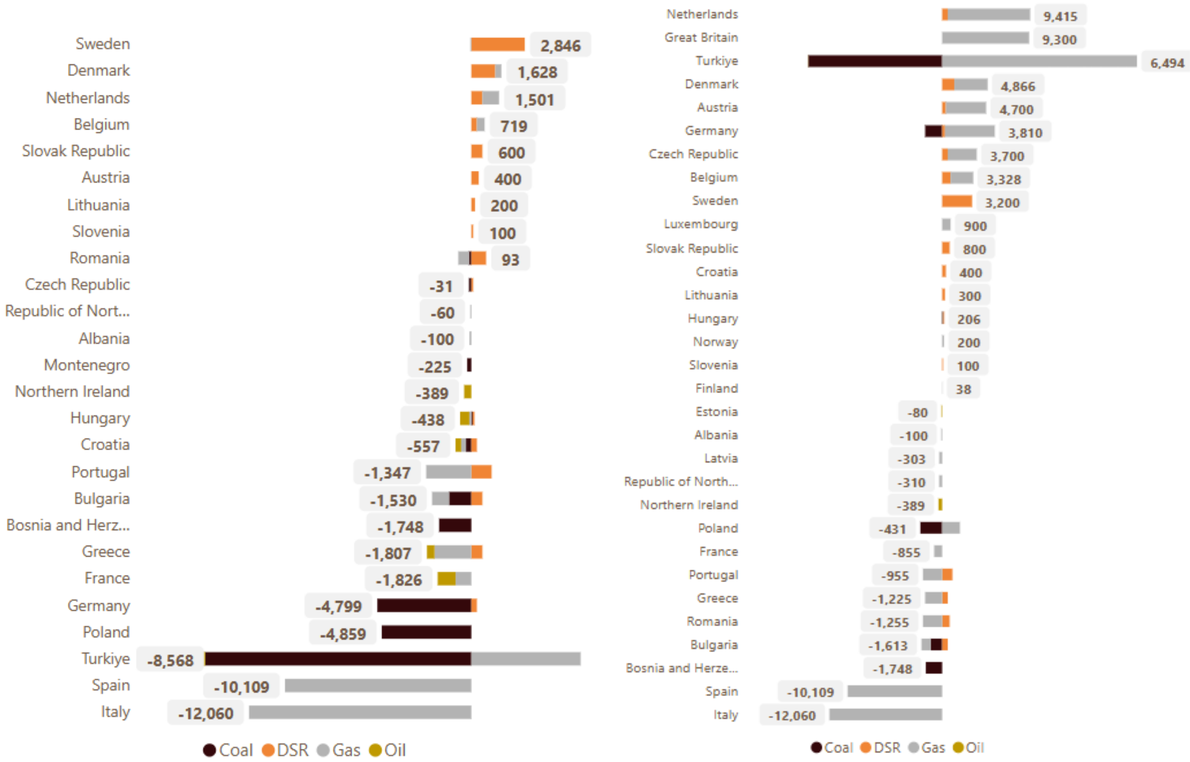

Figure 6 Detailed results of Implementation A of revenue-based EVA: 2030 (left) and 2035 (right)

3.2 Implementation B results

The revenue-based EVA Implementation B results suggest a potential net decrease in generation capacity between 2026 and 2030. However, by 2035, a net increase in Europe's generation capacity could be expected. In addition to the already announced and anticipated decommissioning of coal power plants, an overall decrease in coal-fired power plant generation is expected throughout the horizon due to a lack of economic viability.

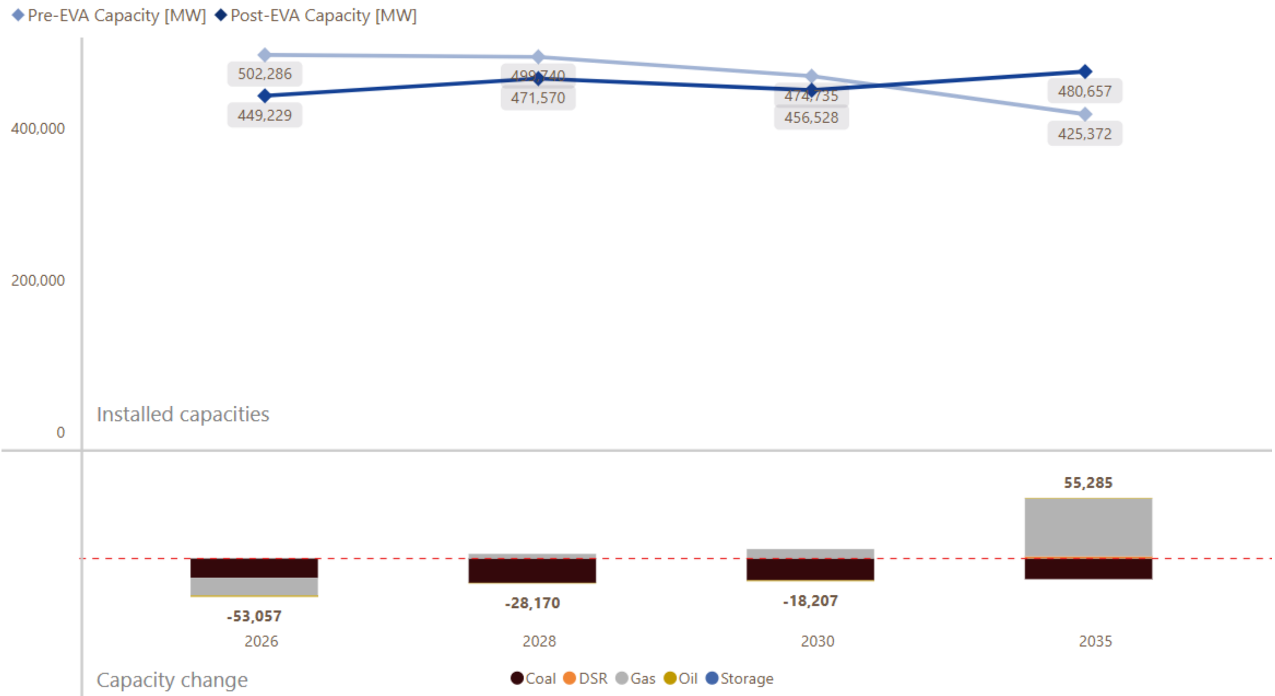

Figure 7 Net effect of the EVA on the European mix: Implementation B of revenue based EVA

Country-level results are also presented.

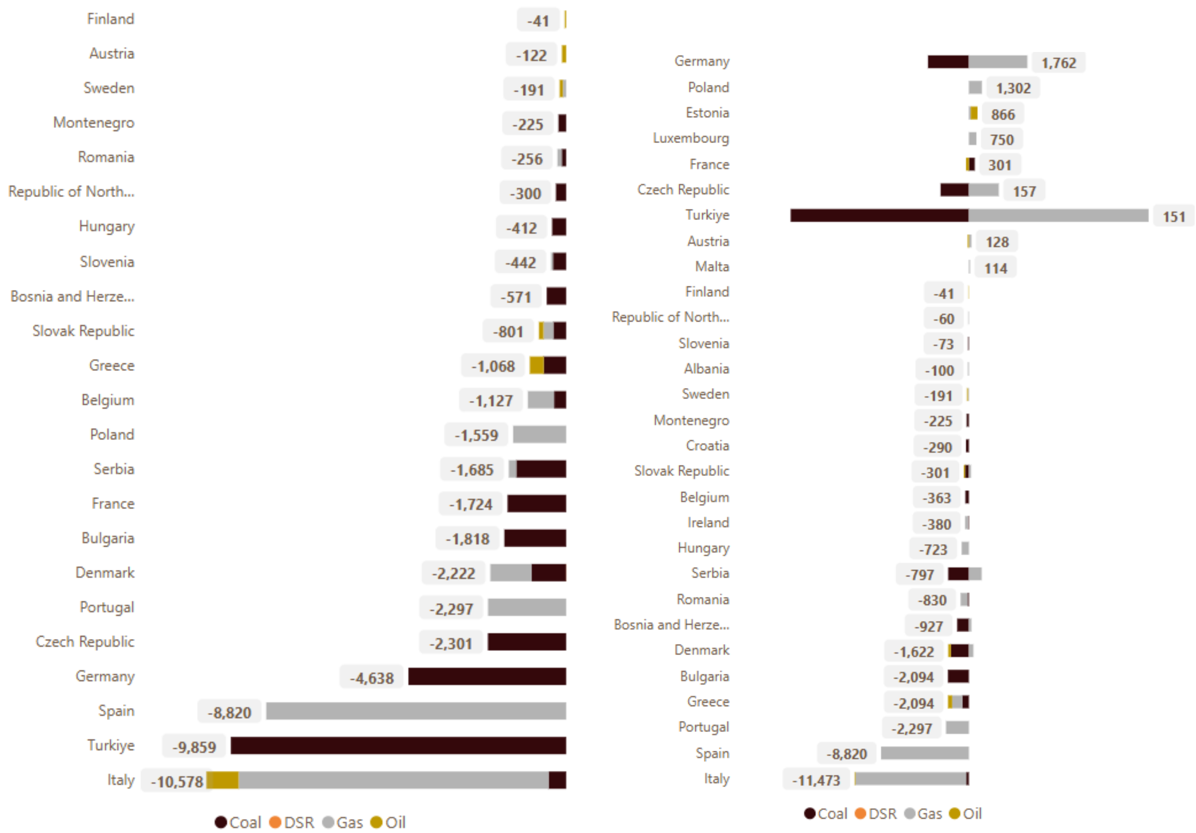

Figure 8 Detailed results of Implementation B of revenue-based EVA: 2026 (left) and 2028 (right)

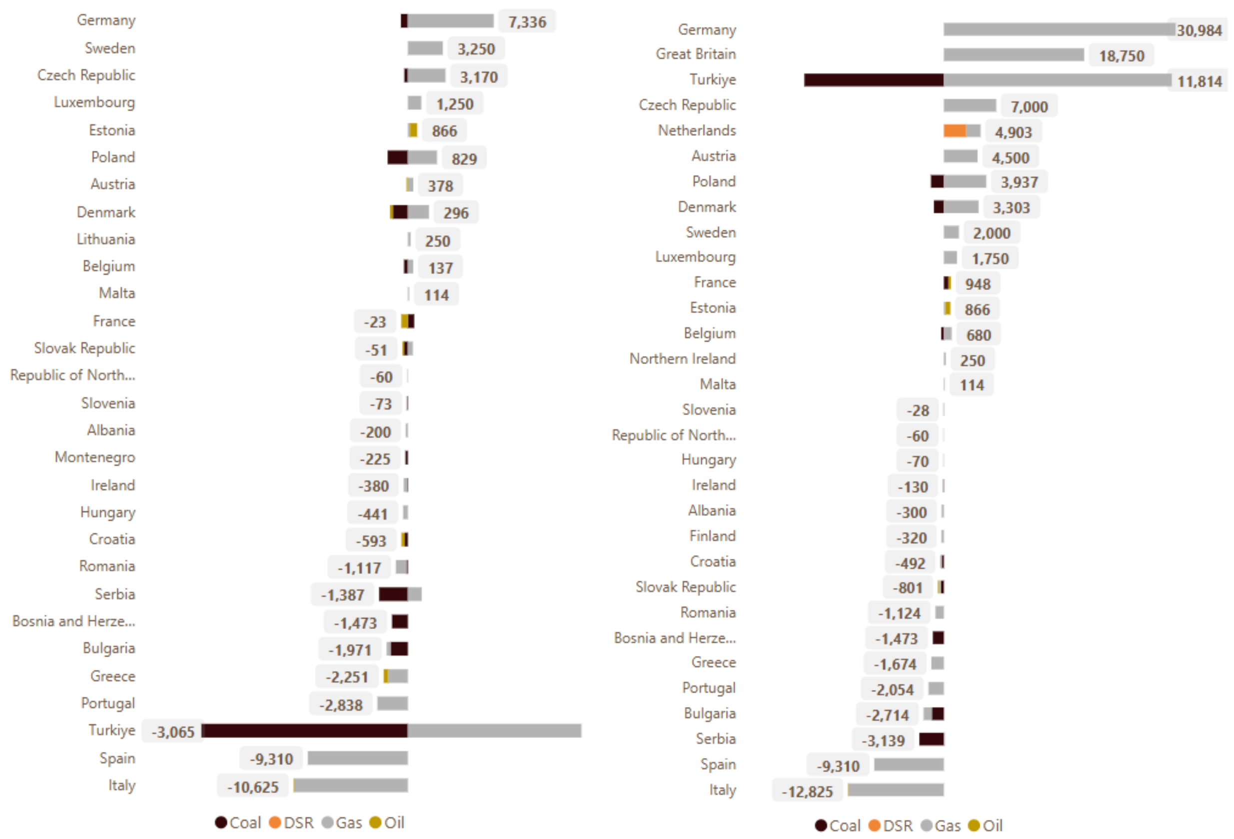

Figure 99 Detailed results of Implementation B of revenue-based EVA: 2030 (left) and 2035 (right)