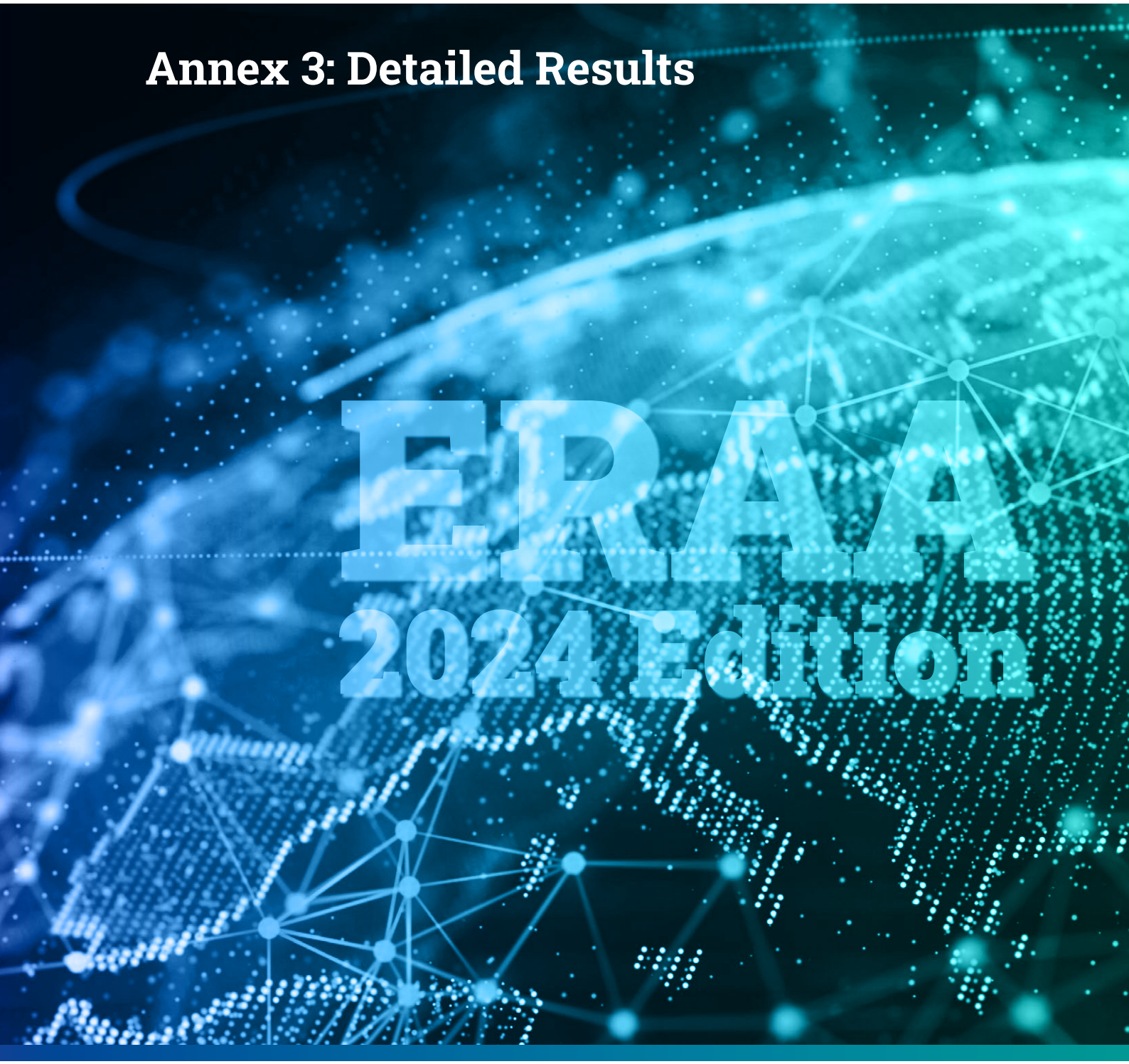
ACER Decision on ERAA 2024: Annex I.d

To be read together with amendments set out in Annex II

European Resource Adequacy Assessment

2024 Edition

Annex 3: Detailed Results



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1 Introduction

In this annex, detailed tables and graphs aim to provide insights into the results. These results cannot be separated from the assumptions outlined in Annex 1 and the overall methodology followed in the European Resource Adequacy Assessment (ERAA) 2024 detailed in Annex 2. The presentation includes results from the single reference tool.

The analysis is structured into two main sections, each focusing on different aspects of the study.

The first section (Section 2) presents the results of the Central Reference Scenario, which constitutes the primary framework, utilizing Harmonized Cost of New Entry (CONE) values as a reference. Within this section, the Economic Viability Assessment (EVA) results are examined providing insights into projections for new capacity entry, life extension, and early decommissioning. Furthermore, adequacy results are assessed based on the analysis of Loss of Load Expectation (LOLE) and Expected Energy Not Served (EENS) metrics.

The second section (Section 3) extends the scope beyond the Central Reference Scenario by considering two additional EVA-only comparisons, which incorporate alternative CONE assumptions. The first comparison analyses outcomes based on country-specific CONE values, while the second comparison conducts a comparative assessment of results under varying default CCGT CONE assumptions.

The results of each adequacy simulation include the values of Loss of Load Duration (LLD) and energy not served (ENS), which are aggregated in sets of LLDs and ENSs per study zone and modelling tool. LLDs are expressed as the number of hours within the simulation's time horizon when supply could not meet demand in a given study zone, while ENSs are expressed in GWh of unserved energy during the LLD hours. For each set of LLDs and ENSs, the mathematical expectation/average, the median/50th percentile and the 95th percentile value were derived. These values are defined as loss of load expectation (LOLE), expected energy not served (EENS), P50 LLD, P50 ENS, P95 LLD and P95 ENS, respectively.[1] In addition, the ratios between EENS and the annual demand by study zone were also calculated. For details on the calculation methodology and for mathematical descriptions, refer to Annex 2.

The results for certain study zones are aggregated at the country level, as follows:

- Danish study zones DKE1 and DKW1 are aggregated in DK00;
- Irish study zones IE00 and UKNI are aggregated in I-SEM;
- Italian study zones ITCA, ITCN, ITCS, ITN1, ITS1, ITSA and ITSI are aggregated in IT00;
- Norwegian study zones NOS1, NOS2, NOS3, NOM1 and NON1 are aggregated in NO00; and
- Swedish study zones SE01, SE02, SE03 and SE04 are aggregated in SE00.

[1] For a set of 100 calculated values, the 95th percentile (often abbreviated as P95) represents the value that is greater than or equal to 95% and lower than or equal to 5% of all values contained in the set. The 50th percentile is calculated accordingly.

For a geographical area with multiple nodes, ENS is calculated as the total ENS of all its nodes. EENS is the mathematical average of the ENS calculated over the total number of Monte Carlo (MC) sample/simulation years. Similarly, for a geographical area with multiple nodes, LLD represents the number of hours when at least one node in the area experiences ENS during a single MC sample/simulation year, while LOLE is the mathematical average of the LLD across all MC sample/simulation years.

2 Central Reference Scenario Results

This chapter provides a comprehensive analysis of the central reference scenario for each target year (TY). Economic Viability Assessment (EVA) results are based on national Cost of New Entry[2] (CONE) and harmonized values for gas candidate values across the study perimeter. The section is divided into two main parts: the first delves into the EVA results themselves, while the second addresses adequacy results related to reliability and system performance.

EVA results include new supply capacity entry, life extension and early decommissioning. It is accompanied by an analysis of revenues for thermal expansion units (Section 2.1.1). Section 2.2 assesses system adequacy using LOLE and EENS metrics. Furthermore, Section 2.2.2 evaluates the robustness of the adequacy results by examining whether the analyses converge to stable predictions across various weather scenarios (WSs).

Results should be interpreted under the given scenario and methodological framework. This implies that variations in the assumptions or in the modelling can impact the outcomes, which is especially relevant in adequacy assessment given the non-linearity of adequacy issues. More specifically, additional sensitivities and scenarios can help to better explore and understand a broader spectrum of possible system development states in the future and, if necessary, to implement planning measures sufficiently in advance. In this context, complementarity between European and National resource adequacy assessments is particularly relevant.

2.1 EVA results

2.1.1 Detailed EVA results

Figure 1 and Table 2 present the capacity change per decision variable, for each technology and TY, and for most affected study zones. The values represent capacity differences with respect to the 'National Trends' assumptions for each TY, i.e. if a capacity that has been deemed non-viable reaches its expected decommissioning date, it is excluded from the reported non-viable capacity starting from the TY of that date[3]. Detailed results per study zone are given in Table 2.

[2] Refer to Annex 1 for a complete list of CONE values

[3] For example, if a region indicates that Unit A (100 MW) is available until 2029, but EVA analysis shows that the unit is not viable in 2026 and 2028 then the net EVA effect will show:
2026: -100 MW
2028: -100 MW
2030: 0 MW
2035: 0 MW

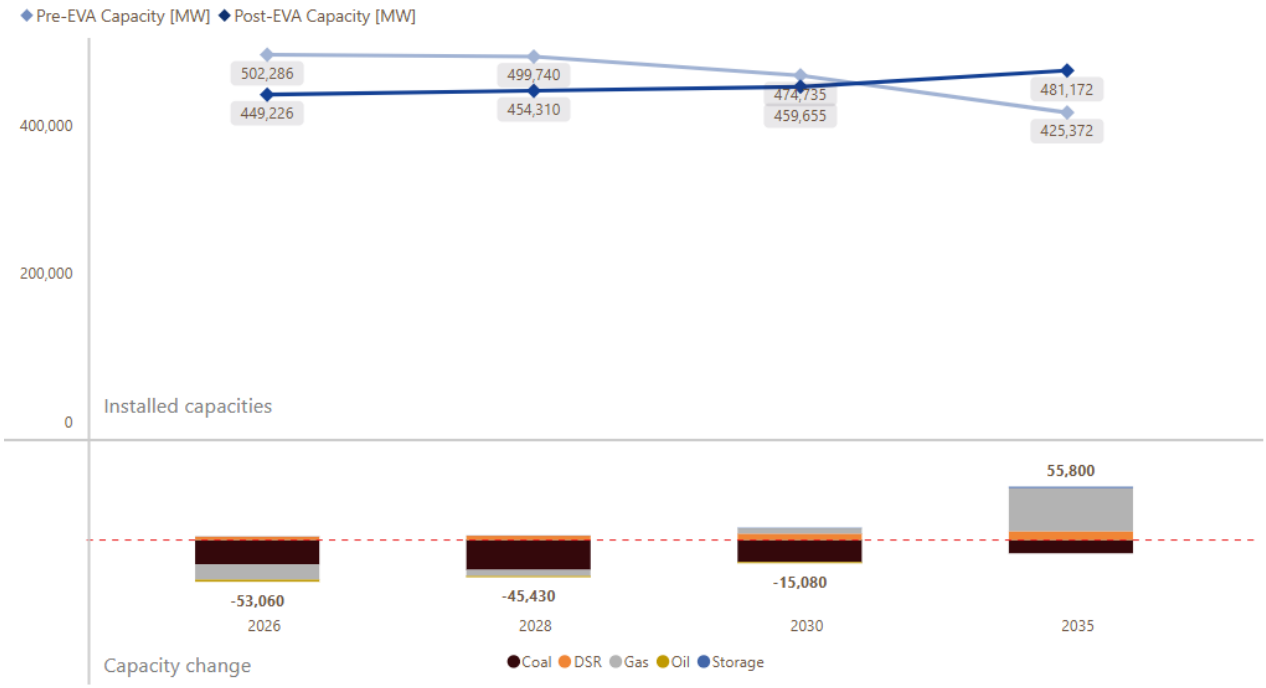

Figure 1: Net effect of the EVA on the European mix – focus on the technologies assessed

The trend indicates a substantial decommissioning of capacity in Europe until 2030 (53 GW in 2026 to 15 GW decommissioning in 2030) and a potential net increase of 55.8 GW in 2035. The gross decommissioned capacity between 2026 and 2030 exceeds these values, as some decommissioned capacities are offset by new entries or lifetime extensions in other study zones (c.f. Table 1 and Table 2). Gross decommissioning will peak at 67 GW in 2028. By 2035, the expected retirement of thermal capacity is approximately 42 GW. The higher decommissioning capacity in 2026, 2028 and 2030 will primarily come from coal units (hard coal and lignite), accounting for over 50% of the total capacity decommissioned, followed by gas units. However, a net increase in gas generation capacity could be expected in 2030 and 2035 as some gas decommissioning in those years is offset by new entries in other study zones. In 2030, decommissioned gas capacity is partially compensated by new entries. Note that hard coal and lignite capacity is heavily subject to exogenous phase-out trajectories due to policy targets in many Member States, which are already reflected in the 'National trends' data and as such do not appear as additional capacity changes in the EVA results.

The EVA also indicates investments in batteries, DSR and gas units across all TYs (note that the expansion of gas units is not allowed in 2026 due to the assumed construction period – see Annex 1, Section 6.4.1). Investments in 2026 and 2028 are expected to be approximately 5 GW and 16 GW, respectively, while over 32 GW of capacity is projected to be built in 2030, increasing to 87 GW in 2035. The growth in new entries by 2035 aligns with an assumed increase in demand throughout Europe. In 2035, most investments are allocated to gas technologies (83%), with DSR investments reaching up to 12 GW. In addition, life extensions are expected to add up to 11 GW in 2035, all of which are attributed to gas technologies across all TYs.

Table 1: Capacity change proposed by the EVA compared to the National Trends scenario [GW] – non-cumulative

Decision variable	Technology	2026	2028	2030	2035	Affected study zones
New entry	**Battery**	0.34	0.34	0.57	1.83	GR00, ITCN
	DSR	4.72	6.07	8.98	12.23	CZ00, DE00, DKE1, DKW1, FI00, HR00, HU00, LT00, NL00, SE03, SE04, SI00, SK00
	Gas CCGT	0	9.42	19.98	31.62	CZ00, MT00, PL00, TR00
	Gas OCGT	0	0	3.00	41.56	AT00, DE00, DKE1, EE00, FI00, SE04, UK00
	Total	5.06	15.83	32.53	87.24	
Life Extension	**Gas CCGT**	1.91	4.27	4.70	8.28	BE00, DE00, DKE1, HU00, NL00
	Gas OCGT	0.04	1.62	2.26	2.57	BE00, DE00, HU00
	Total	1.95	5.89	6.96	10.85	
Decommissioning	**Gas CCGT**	-22.71	-23.14	-21.59	-23.82	AL00, BE00, ES00, GR00, HR00, ITCA, ITCS, ITN1, PT00, RO00, TR00
	Gas OCGT	-0.63	-0.72	-0.62	0	AT00, DE00, HR00, LT00, RO00, SE01
	Hard Coal	-12.13	-18.03	-13.80	-6.07	BG00, DE00, FI00, FR00, HR00, NL00, PL00, RO00, TR00
	Lignite	-21.61	-23.46	-16.85	-12.40	BA00, BG00, CZ00, DE00, GR00, ME00, PL00, SI00, TR00
	Oil	-2.99	-1.80	-1.71	0	EE00, FR00, GR03, HR00, SE03, TR00
	Total	-60.07	-67.15	-54.57	-42.29	
Total		**-53.06**	**-45.43**	**-15.08**	**55.80**	

Table 2: Capacity change proposed by EVA per study zone, PEMMDB technology, and decision variable compared to the National Trends scenario [MW] – non-cumulative

Study Zone	PEMMDB Technology	Decision Variable	2026	2028	2030	2035
AL00	**Gas CCGT**	Decommissioning	0	-100	-100	-110
AT00	**Gas OCGT**	New Entry	0	0	0	330
	Gas OCGT	Decommissioning	-40	-40	-40	0
BA00	**Lignite**	Decommissioning	-1440	-980	-980	-980
BE00	**Gas CCGT**	Life Extension	1700	1700	1700	1700
	Gas CCGT	Decommissioning	-30	-300	0	0
	Gas OCGT	Life Extension	40	40	40	40

Study Zone	PEMMDB Technology	Decision Variable	2026	2028	2030	2035
BG00	Hard Coal	Decommissioning	-90	-90	-90	-90
	Lignite	Decommissioning	-1770	-1610	-1120	-1120
CZ00	DSR	New Entry	0	0	0	550
	Gas CCGT	New Entry	0	0	580	2640
	Lignite	Decommissioning	-1910	-2850	-330	0
DE00	DSR	New Entry	310	820	820	820
	Gas CCGT	Life Extension	0	1780	1780	2120
	Gas OCGT	New Entry	0	0	0	18270
	Gas OCGT	Life Extension	0	1580	2160	2470
	Gas OCGT	Decommissioning	-400	0	0	0
	Hard Coal	Decommissioning	-510	-3190	-3130	0
	Lignite	Decommissioning	-5320	-4780	-900	0
DKE1	DSR	New Entry	40	40	40	130
	Gas CCGT	Life Extension	70	70	70	70
	Gas OCGT	New Entry	0	0	0	1140
DKW1	DSR	New Entry	80	80	80	190
EE00	Gas OCGT	New Entry	0	0	920	920
	Oil	Decommissioning	-860	0	0	0
ES00	Gas CCGT	Decommissioning	-9240	-9240	-9240	-9240
FI00	DSR	New Entry	2000	2000	2000	2000
	Gas OCGT	New Entry	0	0	330	330
	Hard Coal	Decommissioning	-90	-90	0	0
FR00	Hard Coal	Decommissioning	-1720	0	0	0
	Oil	Decommissioning	-1330	-970	-970	0
GR00	Battery	New Entry	0	0	0	1260
	Gas CCGT	Decommissioning	-110	-470	-1430	-2870
	Lignite	Decommissioning	-660	-660	0	0
GR03	Oil	Decommissioning	-410	-410	-410	0
HR00	DSR	New Entry	0	0	0	110
	Gas CCGT	Decommissioning	-50	-50	-50	0
	Gas OCGT	Decommissioning	0	-490	-490	0
	Hard Coal	Decommissioning	-290	-290	-290	0
	Oil	Decommissioning	-300	-300	-300	0
HU00	DSR	New Entry	20	20	20	60
	Gas CCGT	Life Extension	0	0	430	780
	Gas OCGT	Life Extension	0	0	60	60
ITCA	Gas CCGT	Decommissioning	-1710	-1710	-1710	-1710
ITCN	Battery	New Entry	340	340	570	570
ITCS	Gas CCGT	Decommissioning	-4850	-4850	-4850	-4850

Study Zone	PEMMDB Technology	Decision Variable	2026	2028	2030	2035
ITN1	Gas CCGT	Decommissioning	-2890	-2890	-2890	-2890
LT00	DSR	New Entry	0	0	60	100
	Gas OCGT	Decommissioning	-90	0	0	0
ME00	Lignite	Decommissioning	-220	-220	-220	0
MT00	Gas CCGT	New Entry	0	0	40	40
NL00	DSR	New Entry	900	900	960	3120
	Gas CCGT	Life Extension	140	720	720	3610
	Hard Coal	Decommissioning	-3380	-3380	0	0
PL00	Gas CCGT	New Entry	0	0	3240	3690
	Hard Coal	Decommissioning	-4670	-4880	-4180	0
	Lignite	Decommissioning	-2100	-2340	-2460	0
PT00	Gas CCGT	Decommissioning	-1770	-1770	-780	0
RO00	Gas CCGT	Decommissioning	0	0	0	-2150
	Gas OCGT	Decommissioning	0	-90	-90	0
	Hard Coal	Decommissioning	-130	-130	-130	0
SE01	Gas OCGT	Decommissioning	-100	-100	0	0
SE03	DSR	New Entry	10	10	1010	1010
	Oil	Decommissioning	-90	-90	0	0
SE04	DSR	New Entry	1200	2040	3830	3830
	Gas OCGT	New Entry	0	0	1750	1750
SI00	DSR	New Entry	40	40	40	40
	Lignite	Decommissioning	-300	0	0	0
SK00	DSR	New Entry	120	120	120	270
TR00	Gas CCGT	New Entry	0	9420	16120	25250
	Gas CCGT[4]	Decommissioning	-2060	-1760	-540	0
	Hard Coal	Decommissioning	-1250	-5980	-5980	-5980
	Lignite	Decommissioning	-7890	-10020	-10840	-10300
	Oil	Decommissioning	0	-30	-30	0
UK00	Gas OCGT	New Entry	0	0	0	18820

Country-specific results show that investments in new gas capacities are distributed across various countries throughout the horizon, with the highest capacities in Turkey and the UK in 2035 (25 GW and 19 GW, respectively). DSR investments occur in multiple countries throughout the horizon. The highest expanded capacities are recorded in Sweden, the Netherlands and Finland in 2035, with 3.8 GW, 3.1 GW and 2 GW respectively. Grid-scale battery expansion is limited to Greece and Italy.

[4] The EVA model decommissions Gas CCGT capacity in TR00 and introduces new Gas CCGT capacity in the same TYs. This is due to the technology efficiency of the existing units (which are less efficient) compared to the new entries (which are more efficient). This makes operations of new units cheaper and the technology switch is pushed as an economically viable solution.

2.1.2 Revenue analysis for thermal expansion units

The analysis in this section indicates that new investments in EVA depend on scarcity revenues. In practice, it is crucial to monitor whether utility companies announce actual investments, as investments may not be based solely on reliance on peak pricing. Meanwhile, some investor risk aversion is factored in through hurdle rates (c.f. Annex 1 for hurdle rates and Annex 2 for methodology) and the results account for it.

Figure 2, Figure 3 and Figure 4 show the percentage of revenues the new gas capacity receives during near-scarcity hours (dots) and the average capacity factor[5] (bars) over the researched horizon. The figures look at how often the CCGT and OCGT expansion units operate during scarcity hours in TYs 2030 and 2035. As the new gas-fired capacity enters the market in 2028, 2030 and 2035, results include these TYs, based on the specific entry date in each study zone. Near-scarcity hours are defined as hours where the price of electricity exceeds arbitrarily defined thresholds (500, 1000 and 2000 Eur/MWh). It follows that scarcity hours (hours at market price cap) are included in the count of near-scarcity hours.

These figures highlight that weather conditions under WS25 result in a significant number of near-scarcity events with high prices. This is due to WS25 featuring more adverse weather conditions than usual, with reduced renewable energy availability combined with cold spells that push the electricity system to its limits.[6] This is displayed by scarcity revenues reaching high levels for nearly all new investments derived from modelling, including CCGT. In contrast, under other weather conditions (WS14 and WS28), scarcity revenues are recorded for fewer new investments and to a lesser extent.

The characteristics of CCGT and OCGT are also evident in the same figures. New CCGT units exhibit a higher capacity factor and lower reliance on scarcity revenues, while OCGT units show the opposite. This outcome is intuitive, given the higher marginal cost of OCGT units compared to CCGT units (despite slightly lower investment costs). OCGT units are naturally suited to be available during occasional high-demand hours (low frequency, high revenue instances), while CCGT units, with their lower marginal cost, are better suited for investments where more frequent dispatch is expected.

[5] Capacity factor = yearly generation [GWh] / (NGC [GW] x 8760 h)
[6] For detailed information into the weather scenarios used in ERAA 2025 please see Annex 1, Section 3

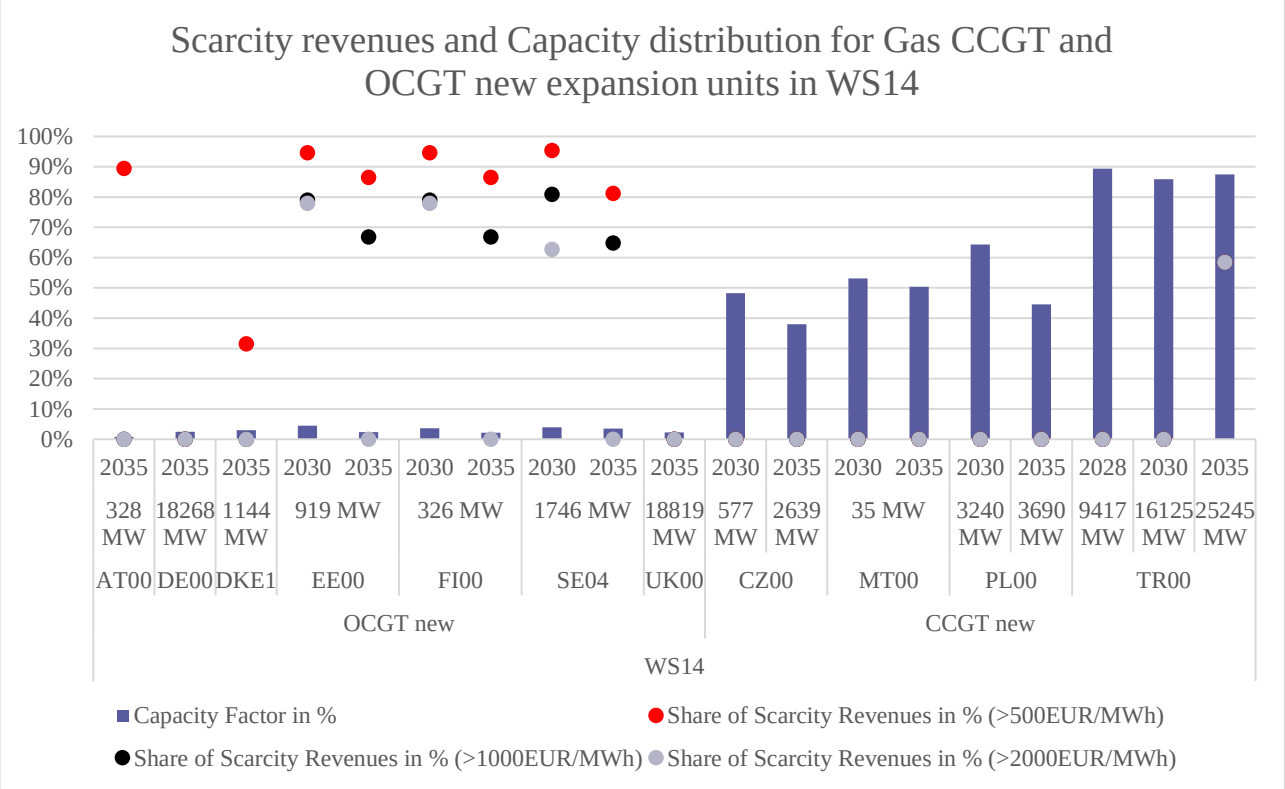

Figure 2: Scarcity revenues and average capacity factor (%) for new gas capacity (Weather Scenario 14)

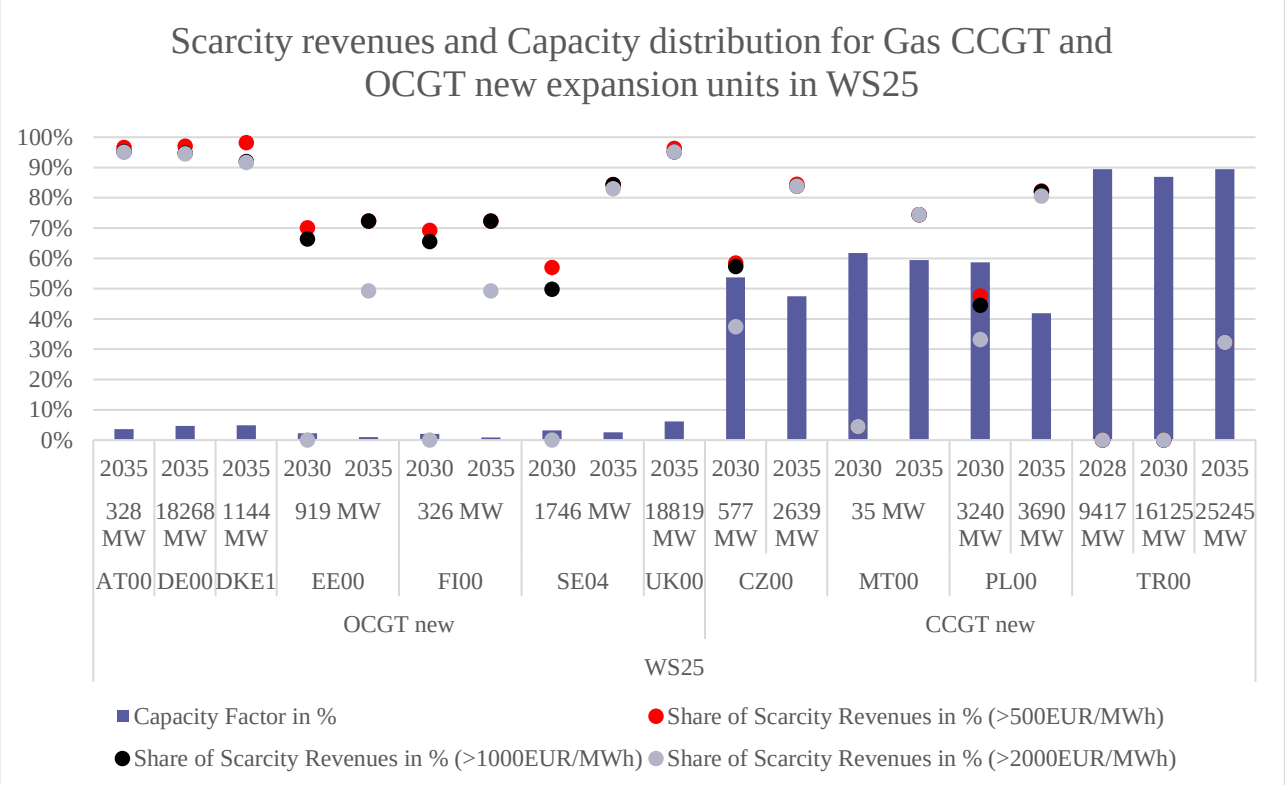

Figure 3: Scarcity revenues and average capacity factor (%) for new gas capacity (Weather Scenario 25)

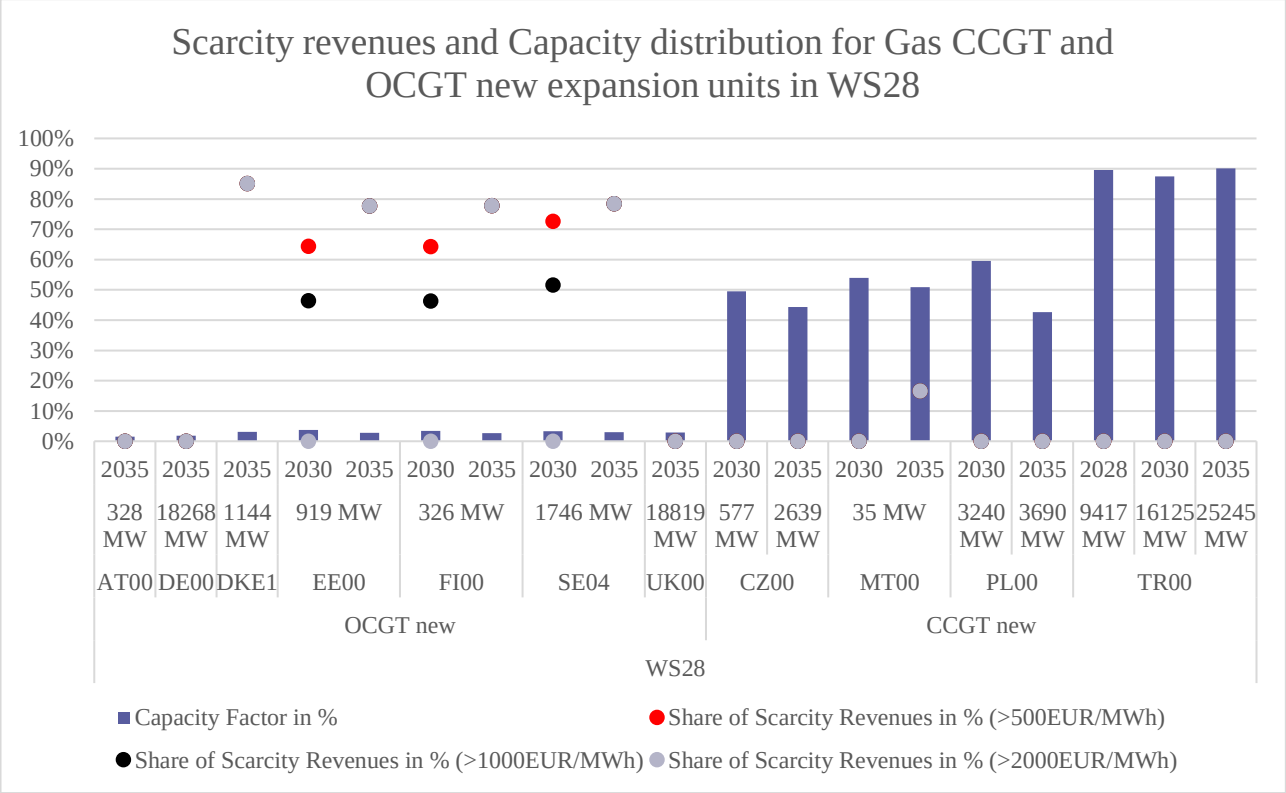

Figure 4: Scarcity revenues and average capacity factor (%) for new gas capacity (Weather Scenario 28)

In all three WSs, new OCGT units show significant shares of near-scarcity-based revenues in Denmark (2035), Sweden, Estonia and Finland (2030 and 2035). In WS14, 89% of the new unit's revenues from the OCGT in AT00 (Austria) come from generating at a day-ahead market price of more than 500€/MWh. Only the OCGT expansion units in Germany and the UK do not generate any scarcity-based revenues in both WS14 and WS28.

However, in WS25, it can be observed that revenues from new OCGT units in Germany and the UK are primarily driven by occurrences of (near-)scarcity situations. Even with capacity factors of 4% for Germany's 2035 OCGT new unit and 6% for the UK's 2035 OCGT new unit, 95% of their revenues come from near-scarcity situations, with day-ahead market prices of more than 2000€/MWh. For CCGT new units, Poland, Malta, and Czechia also have large shares of near scarcity revenues (around 80% in 2035 and around 40% for Poland and Czechia in 2030), with capacity ranging from 40% to 60% in WS25.

In conclusion, the 2035 OCGT new units in Germany and the UK appear to be the units most reliant on revenues from WS25's scarcity situations.

2.2 Adequacy results

The following sections provide insights into the detailed results per study zone, in addition to the quantifications of the convergence of the model.

2.2.1 LOLE and EENS

The overview of LOLE results is provided in Figure 5 suggesting that risks of varying magnitude are present in most of the power systems across Europe.

Further in this section, detailed EENS and LOLE results, including the 50th and 95th percentiles, are presented for each study zone (as well as aggregates at the country level). The 95th percentile occurrences can be interpreted as a '1-time-in-20 years' occurrence, covering events with lower likelihood but higher impact on adequacy. The results account for both without and with the activation of already approved out-of-market resources[7] (see Section 4.1 in Annex 1). Meanwhile, hourly results are published alongside the ERAA report.[8]

[7] The ERAA accounts for CMs that already hold a CM contract granted in any previous auction of any existing or approved CM at the time of the assessment, including strategic reserves. For Poland, this DSR is coming from CM and is relevant for 2026 and 2028.
[8] ERAA 2024 page: download section

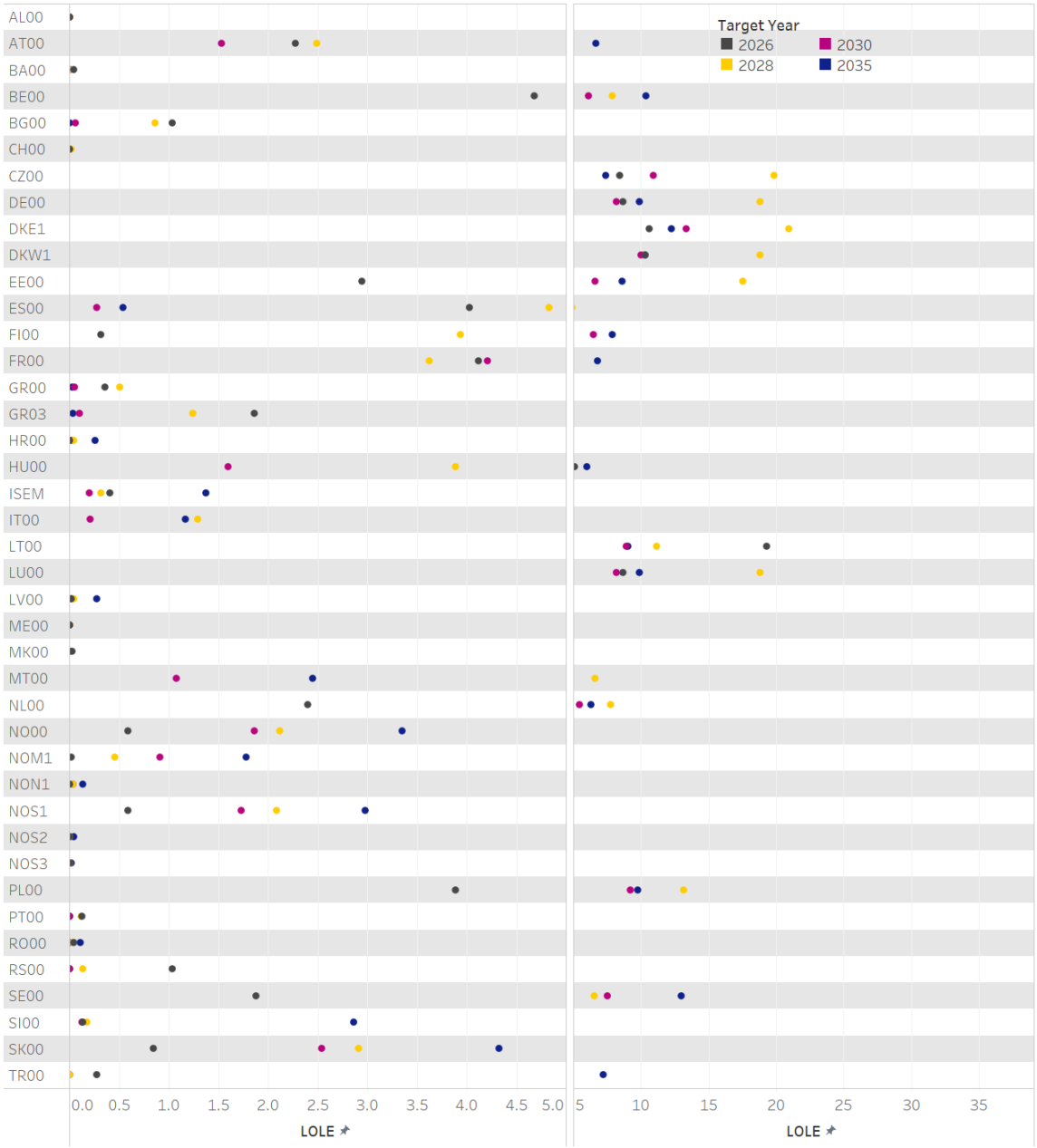

Figure 5: Adequacy risk overview

The 2026 results are presented below. Table 3 lists the LOLE and LLD percentiles for each study zone, while Table 4 provides the same information aggregated for countries with multiple study zones. EENS results are presented next, in Table 4 and Table 5. Study zones with two values reported suggest countries are affected by OOM measures ([with OOM measure / without OOM measure]). LOLE and EENS results for the other target years are provided thereafter.

Table 3: Study zone LOLE (average) and LLD percentiles, for TY 2026 [with OOM measure / without OOM measure][9]

Study zone	TY 2026		
	Average [h/year]	P50 [h/year]	P95 [h/year]
AL00	0	0	0
AT00	2.28	0	13
BA00	0.04	0	0
BE00	4.68	1	22.05
BG00	1.04	0	8
CH00	0 / 0.01	0	0
CZ00	8.4	4	29
DE00	8.7 / 10.79	5 / 8	32 / 37.05
DKE1	10.64	8	36.05
DKW1	10.33	7	36
EE00	2.95	0	17
ES00	4.03	1	17
FI00	0.32	0	1
FR00	4.12	1	21
GR00	0.36	0	2
GR03	1.86	0	16.05
HR00	0	0	0
HU00	5.04	2	21.05
IE00	0.01 / 18.17	0 / 15	0 / 47.05
LT00	19.3	10	77
LUG1	8.7 / 10.79	5 / 8	32 / 37.05
LV00	0.01	0	0
ME00	0	0	0
MK00	0.02	0	0
NL00	2.4	0	14
NOM1	0.01	0	0
NON1	0	0	0
NOS1	0.59	0	4
NOS2	0	0	0
NOS3	0	0	0
PL00	3.89	8	22
PT00	0.13	0	1
RO00	0.04	0	0
RS00	1.04	0	4
SE01	0	0	0
SE02	0	0	0
SE03	1.73	0	9
SE04	1.73	0	9
SI00	0.14	0	1

[9] Results of Italian study zones in TY 2026 are excluded. Please refer to the Executive report.

Study zone	TY 2026		
	Average [h/year]	P50 [h/year]	P95 [h/year]
SK00	0.85	0	4.05
UKNI	0.39	0	3
TR00	0.28	0	2

Table 4: Country LOLE (average) and LLD percentiles, for TY 2026 [with OOM measure / without OOM measure][10]

Country	TY 2026		
	Average [h/year]	P50 [h/year]	P95 [h/year]
DK00	10.84	8	37.05
ISEM	0.41 / 18.36	0 / 15	3 / 47.05
IT00	#N/A	#N/A	#N/A
LU00	8.7 / 10.79	5 / 8	32 / 37.05
NO00	0.59	0	4
SE00	1.88	0	10

[10] Results of Italian study zones in TY 2026 are excluded. Please refer to the Executive report.

Table 5 lists the average EENS and ENS percentiles for each study zone, and Table 5 the country average EENS and ENS percentiles for countries with multiple study zones.

Table 5: Study zone EENS (average) and ENS percentiles for TY 2026 [with OOM measure / without OOM measure][11]

Study Zone	TY 2026		
	Average [GWh]	P50 [GWh]	P95[GWh]
AL00	0	0	0
AT00	0.29	0	1.79
BA00	0.01	0	0
BE00	1.84	0.13	8.85
BG00	0.07	0	0.27
CH00	0	0	0
CZ00	2.21	0.24	9.83
DE00	22.01 / 28.64	6.18 / 12.73	93.38 / 112.67
DKE1	1.78	0.85	6.52
DKW1	2.99	1.32	10.5
EE00	0.37	0	2.09
ES00	5.16	0.12	26.32
FI00	0.09	0	0
FR00	5.86	0.06	31.98
GR00	0.04	0	0.02
GR03	0.1	0	0.48
HR00	0	0	0
HU00	1.75	0.28	8.38
IE00	0 / 5.02	0 / 2.77	0 / 17.14
LT00	3.64	0.72	19.52
LUG1	0.23 / 0.3	0.07 / 0.13	0.99 / 1.19
LV00	0	0	0
ME00	0	0	0
MK00	0	0	0
NL00	0.44	0	3.06
NOM1	0	0	0
NON1	0	0	0
NOS1	0.03	0	0.05
NOS2	0	0	0
NOS3	0	0	0
PL00	3.25	3.1	20.25
PT00	0.01	0	0.01
RO00	0	0	0
RS00	0.61	0	1.52
SE01	0	0	0
SE02	0	0	0

[11] Results of Italian study zones in TY 2026 are excluded. Please refer to the Executive report.

Study Zone	TY 2026 Average [GWh]	P50 [GWh]	P95[GWh]
SE03	0.67	0	4.07
SE04	0.19	0	1.09
SI00	0	0	0.01
SK00	0.02	0	0.09
UKNI	0.05	0	0.27
TR00	0.2	0	1.04

Table 6: Country EENS (average) and ENS percentiles, for TY 2026 [with OOM measure / without OOM measure][12]

Country	TY 2026 Average [GWh]	P50 [GWh]	P95 [GWh]
DK00	4.77	2.16	16.77
ISEM	0.05 / 5.07	0 / 2.82	0.28 / 17.58
IT00	#N/A	#N/A	#N/A
LU00	0.23 / 0.3	0.07 / 0.13	0.99 / 1.19
NO00	0.03	0	0.05
DK00	0.86	0	5.25

[12] Italian study zones are not modelled in TY 2026. Please refer to the Executive report.

For TY 2028, Table 7 lists the average LOLE and LLD percentiles for each study zone, and Table 7 the country average LOLE and LLD percentiles for countries with multiple study zones.

Table 7: Study Zone LOLE (average) and LLD percentiles, for TY 2028 [with OOM measure / without OOM measure]

Study Zone	TY 2028 Average [h/year]	TY 2028 P50 [h/year]	TY 2028 P95 [h/year]
AL00	0	0	0
AT00	2.49	0	18
BA00	0	0	0
BE00	7.89	1	32.15
BG00	0.86	0	9.05
CH00	0.01	0	0
CZ00	19.86	9	64.05
DE00	18.79	10	78.1
DKE1	20.96	10	93.05
DKW1	18.78	7	84.05
EE00	17.53	6.5	71.1
ES00	4.83	2	22
FI00	3.94	0	23
FR00	3.62	0	18
GR00	0.51	0	4
GR03	1.24	0	15
HR00	0.04	0	0
HU00	3.89	0	27
IE00	0 / 0.65	0	0 / 4.05
ITCA	0	0	0
ITCN	1.22	0	8.05
ITCS	1.14	0	7.05
ITN1	0.21	0	1
ITS1	0.07	0	0
ITSA	0.03	0	0
ITSI	0.42	0	1
LT00	11.19	0	54
LUG1	18.79	10	78.1
LV00	0.04	0	0
ME00	0	0	0
MK00	0	0	0
MT00	6.59 / 122.06	0 / 113	37.05 / 245
NL00	7.79	2	32.05
NOM1	0.46	0	0
NON1	0.03	0	0
NOS1	2.09	0	17
NOS2	0	0	0
NOS3	0	0	0

Study Zone	TY 2028		
	Average [h/year]	P50 [h/year]	P95 [h/year]
PL00	13.17	6	59
PT00	0.12	0	1
RO00	0.03	0	0
RS00	0.14	0	0
SE01	0.02	0	0
SE02	0	0	0
SE03	6.22	0	33
SE04	5.88	0	32
SI00	0.18	0	1
SK00	2.91	0	16
UKNI	0.32	0	2.05
TR00	0	0	0

Table 8: Country LOLE (average) and LLD percentiles, for TY 2028 [with OOM measure / without OOM measure]

Country	TY 2028		
	Average [h/year]	P50 [h/year]	P95 [h/year]
DK00	21.25	10	93.05
ISEM	0.32 / 0.65	0	2.05 / 5
IT00	1.29	0	8.05
LU00	18.79	10	78.1
NO00	2.12	0	17
SE00	6.53	0	34

For TY 2028, Table 9 lists the average EENS and ENS percentiles for each study zone, and Table 9 the country average EENS and ENS percentiles for countries with multiple study zones.

Table 9: Study Zone EENS (average) and ENS percentiles, for TY 2028 [with OOM measure / without OOM measure]

Study Zone	TY 2028		
	Average [GWh]	P50 [GWh]	P95 [GWh]
AL00	0	0	0
AT00	0.43	0	3.11
BA00	0	0	0
BE00	2.62	0.02	10.85
BG00	0.14	0	0.7
CH00	0	0	0
CZ00	16.82	2.39	73.97
DE00	55.46	16.37	228.1
DKE1	4.78	1.3	20.26
DKW1	6.86	1.31	27.51
EE00	2.4	0.16	10.92
ES00	6.46	0.14	33.51

Study Zone	TY 2028		
	Average [GWh]	P50 [GWh]	P95 [GWh]
FI00	1.41	0	9
FR00	4.86	0	17.3
GR00	0.06	0	0.11
GR03	0.08	0	0.37
HR00	0	0	0
HU00	1.64	0	10.03
IE00	0 / 0.12	0	0 / 0.34
ITCA	0	0	0
ITCN	0.35	0	1.55
ITCS	0.47	0	1.42
ITN1	0.04	0	0.16
ITS1	0	0	0
ITSA	0	0	0
ITSI	0.03	0	0.08
LT00	1.64	0	9.19
LUG1	0.61	0.18	2.5
LV00	0	0	0
ME00	0	0	0
MK00	0	0	0
MT00	0.32 / 7.54	0 / 5.74	1.61 / 21.54
NL00	1.77	0.06	10.05
NOM1	0.03	0	0
NON1	0	0	0
NOS1	0.36	0	1.31
NOS2	0	0	0
NOS3	0	0	0
PL00	15.452	0.01	94.08
PT00	0.01	0	0
RO00	0	0	0
RS00	0.04	0	0
SE01	0	0	0
SE02	0	0	0
SE03	3.48	0	20.23
SE04	1.06	0	6.24
SI00	0	0	0.02
SK00	0.09	0	0.43
UKNI	0.02	0	0.05
TR00	0	0	0

Table 10: Country EENS (average) and ENS percentiles, for TY 2028 [with OOM measure / without OOM measure]

Country	TY 2028		
	Average [GWh]	P50 [GWh]	P95 [GWh]
DK00	11.64	2.68	45.28
ISEM	0.02 / 0.14	0	0.05 / 0.44
IT00	0.9	0	3.61
LU00	0.61	0.18	2.5
NO00	0.39	0	1.31
SE00	4.54	0	26.04

For TY 2030, Table 11 lists the average LOLE and LLD percentiles for each study zone, and Table 11 the country average LOLE and LLD percentiles for countries with multiple study zones.

Table 11: Study zone LOLE (average) and LLD percentiles, for TY 2030 [with OOM measure / without OOM measure]

Study zone	TY 2030		
	Average [h/year]	P50 [h/year]	P95 [h/year]
AL00	0	0	0
AT00	1.53	0	16.05
BA00	0	0	0
BE00	6.14	0	33.05
BG00	0.06	0	0
CH00	0	0	0
CZ00	10.91	0	55
DE00	8.21	0	43
DKE1	13.34	0	58.05
DKW1	10.03	0	50
EE00	6.58	0	32
ES00	0.28	0	0
FI00	6.51	0	32
FR00	4.21	0	26
GR00	0.05	0	0
GR03	0.1	0	0
HR00	0.01	0	0
HU00	1.6	0	14
IE00	0 / 0.47	0	0 / 4
ITCA	0	0	0
ITCN	0.2	0	0.05
ITCS	0.19	0	0
ITN1	0.07	0	0
ITS1	0	0	0
ITSA	0.06	0	0
ITSI	0.03	0	0
LT00	8.89	0	40.05
LUG1	8.21	0	43
LV00	0.01	0	0
ME00	0	0	0
MK00	0	0	0
MT00	1.08 / 26.25	0 / 18	8 / 85.05
NL00	5.44	0	29.05
NOM1	0.91	0	7
NON1	0.03	0	0
NOS1	1.73	0	13.1
NOS2	0	0	0
NOS3	0	0	0

Study zone	TY 2030 Average [h/year]	P50 [h/year]	P95 [h/year]
PL00	9.19	0	53.05
PT00	0	0	0
RO00	0	0	0
RS00	0	0	0
SE01	1.3	0	5.05
SE02	0	0	0
SE03	7.42	0	33
SE04	5.64	0	27
SI00	0.13	0	1
SK00	2.54	0	17
UKNI	0.2	0	1
TR00	0	0	0

Table 12: Country LOLE (average) and LLD percentiles, for TY 2030 [with OOM measure / without OOM measure]

Country	TY 2030 Average [h/year]	P50 [h/year]	P95 [h/year]
DK00	13.38	0	58.05
ISEM	0.2 / 0.55	0	1 / 5
IT00	0.21	0	1
LU00	8.21	0	43
NO00	1.86	0	15
SE00	7.52	0	33.05

For TY 2030, Table 13 lists the average EENS and ENS percentiles for each study zone, and Table 13 the country average EENS and ENS percentiles for countries with multiple study zones.

Table 13: Study zone EENS (average) and ENS percentiles, for TY 2030 [with OOM measure / without OOM measure]

Study zone	TY 2030 Average [GWh]	P50 [GWh]	P95 [GWh]
AL00	0	0	0
AT00	0.32	0	2.08
BA00	0	0	0
BE00	2.91	0	18.49
BG00	0	0	0
CH00	0	0	0
CZ00	10.37	0	60.49
DE00	16.71	0	85.04
DKE1	3.16	0	14.64
DKW1	3.4	0	15.7
EE00	0.27	0	1.52
ES00	0.16	0	0
FI00	2.18	0	12.64

Study zone	TY 2030		
	Average [GWh]	P50 [GWh]	P95 [GWh]
FR00	8.03	0	46.77
GR00	0.02	0	0
GR03	0.01	0	0
HR00	0	0	0
HU00	0.42	0	1.87
IE00	0 / 0.06	0	0 / 0.2
ITCA	0	0	0
ITCN	0.03	0	0
ITCS	0.05	0	0
ITN1	0.01	0	0
ITS1	0	0	0
ITSA	0	0	0
ITSI	0	0	0
LT00	1.3	0	6.56
LUG1	0.19	0	0.98
LV00	0	0	0
ME00	0	0	0
MK00	0	0	0
MT00	0.04 / 1.55	0 / 0.67	0.26 / 6.38
NL00	1.28	0	4.97
NOM1	0.17	0	0.16
NON1	0	0	0
NOS1	0.66	0	1.74
NOS2	0	0	0
NOS3	0	0	0
PL00	10.48	0	73.42
PT00	0	0	0
RO00	0	0	0
RS00	0	0	0
SE01	0.03	0	0.15
SE02	0	0	0
SE03	5.21	0	31.25
SE04	0.75	0	4.73
SI00	0	0	0
SK00	0.09	0	0.42
UKNI	0.01	0	0.01
TR00	0	0	0

Table 14: Country EENS (average) and ENS percentiles , for TY 2030 [with OOM measure / without OOM measure]

Country	TY 2030		
	Average [GWh]	P50 [GWh]	P95 [GWh]
DK00	6.56	0	30.77
ISEM	0.01 / 0.07	0	0.01 / 0.26
IT00	0.1	0	0
LU00	0.19	0	0.98
NO00	0.83	0	1.93
SE00	5.99	0	35.83

For TY 2035, Table 15 lists the average LOLE and LLD percentiles for each study zone, and Table 15 the country average LOLE and LLD percentiles for countries with multiple study zones.

Table 15: Study zone LOLE (average) and LLD percentiles, for TY 2035 [with OOM measure / without OOM measure]

Study zone	TY 2035		
	Average [h/year]	P50 [h/year]	P95 [h/year]
AL00	0	0	0
AT00	6.66	0	42.05
BA00	0	0	0
BE00	10.39	0	57.05
BG00	0	0	0
CH00	0	0	0
CZ00	7.42	0	45.05
DE00	9.87	0	54
DKE1	12.25	0	50.05
DKW1	10.33	0	51.1
EE00	8.59	0	52
ES00	0.54	0	2
FI00	7.91	0	51.05
FR00	6.78	0	35
GR00	0.02	0	0
GR03	0.03	0	0
HR00	0.26	0	3
HU00	6.03	0	35
IE00	0 / 2.44	0	0 / 14.05
ITCA	0	0	0
ITCN	0.77	0	8
ITCS	0.63	0	4.05
ITN1	0.72	0	7
ITS1	0	0	0
ITSA	0.28	0	0
ITSI	0.12	0	0
LT00	9.01	0	43.05
LUG1	9.87	0	54
LV00	0.28	0	2
ME00	0	0	0
MK00	0	0	0
MT00	2.45 / 47.52	0 / 37	12 / 127.05
NL00	6.33	0	36.05
NOM1	1.78	0	10
NON1	0.14	0	0
NOS1	2.98	0	17
NOS2	0.04	0	0
NOS3	0.01	0	0

Study zone	TY 2035		
	Average [h/year]	P50 [h/year]	P95 [h/year]
PL00	9.75	0	50
PT00	0	0	0
RO00	0.11	0	1
RS00	0	0	0
SE01	5.08	0	21.05
SE02	0	0	0
SE03	12.75	0	59.1
SE04	9.8	0	42
SI00	2.86	0	24.05
SK00	4.33	0	29
UKNI	1.38	0	9
TR00	7.2	4	25

Table 16: Country LOLE (average) and LLD percentiles, for TY 2035 [with OOM measure / without OOM measure]

Country	TY 2035		
	Average [h/year]	P50 [h/year]	P95 [h/year]
DK00	13.26	0	58.1
ISEM	1.38 / 2.89	0	9 / 16
IT00	1.17	0	10
LU00	9.87	0	54
NO00	3.35	0	19
SE00	12.96	0	60.05

For TY 2035, Table 17 lists the average EENS and ENS percentiles for each study zone, and Table 17 the country average EENS and ENS percentiles for countries with multiple study zones.

Table 17: Study zone EENS (average) and ENS percentiles, for TY 2035 [with OOM measure / without OOM measure]

Study zone	TY 2035		
	Average [GWh]	P50 [GWh]	P95 [GWh]
AL00	0	0	0
AT00	3.6	0	30.81
BA00	0	0	0
BE00	13.01	0	76.55
BG00	0	0	0
CH00	0	0	0
CZ00	2.98	0	19.92
DE00	29.02	0	190.24
DKE1	2.79	0	13.11
DKW1	6.6	0	35.18
EE00	0.53	0	4.52
ES00	0.57	0	0.36
FI00	3.02	0	23.07
FR00	12.92	0	74.75
GR00	0	0	0
GR03	0	0	0
HR00	0	0	0.04
HU00	1.82	0	13.26
IE00	0 / 0.58	0	0 / 3.27
ITCA	0	0	0
ITCN	0.1	0	0.43
ITCS	0.15	0	0.41
ITN1	0.2	0	1.57
ITS1	0	0	0
ITSA	0.01	0	0
ITSI	0.01	0	0
LT00	1.48	0	8.11
LUG1	0.35	0	2.27
LV00	0	0	0.02
ME00	0	0	0
MK00	0	0	0
MT00	0.12 / 2.89	0 / 1.63	0.61 / 9.63
NL00	2.93	0	20.69
NOM1	0.18	0	0.28
NON1	0	0	0
NOS1	0.68	0	1.97
NOS2	0	0	0

Study zone	TY 2035		
	Average [GWh]	P50 [GWh]	P95 [GWh]
NOS3	0	0	0
PL00	11.96	0	76.14
PT00	0	0	0
RO00	0	0	0
RS00	0	0	0
SE01	0.3	0	2
SE02	0	0	0
SE03	11.92	0	65.23
SE04	1.56	0	8.55
SI00	0.18	0	1.62
SK00	0.27	0	2.13
UKNI	0.09	0	0.53
TR00	9.08	2.97	37.85

Table 18: Country EENS (average) and ENS percentiles for TY 2035 [with OOM measure / without OOM measure]

Country	TY 2035		
	Average [GWh]	P50 [GWh]	P95 [GWh]
DK00	9.39	0	47.01
ISEM	0.09 / 0.66	0	0.53 / 4.22
IT00	0.46	0	3.16
LU00	0.35	0	2.27
NO00	0.87	0	2.15
SE00	13.77	0	75.75

2.2.2 Convergence of results

The results are considered stable when the impact of additional simulation (such as an additional forced outage sample or weather scenario) is small or negligible (see Annex 2, Section 11.6). It can be concluded that the ERAA model has converged and the results are stable. This behaviour is observed once 540 MC realisations have been reached, as shown in Figure 6.

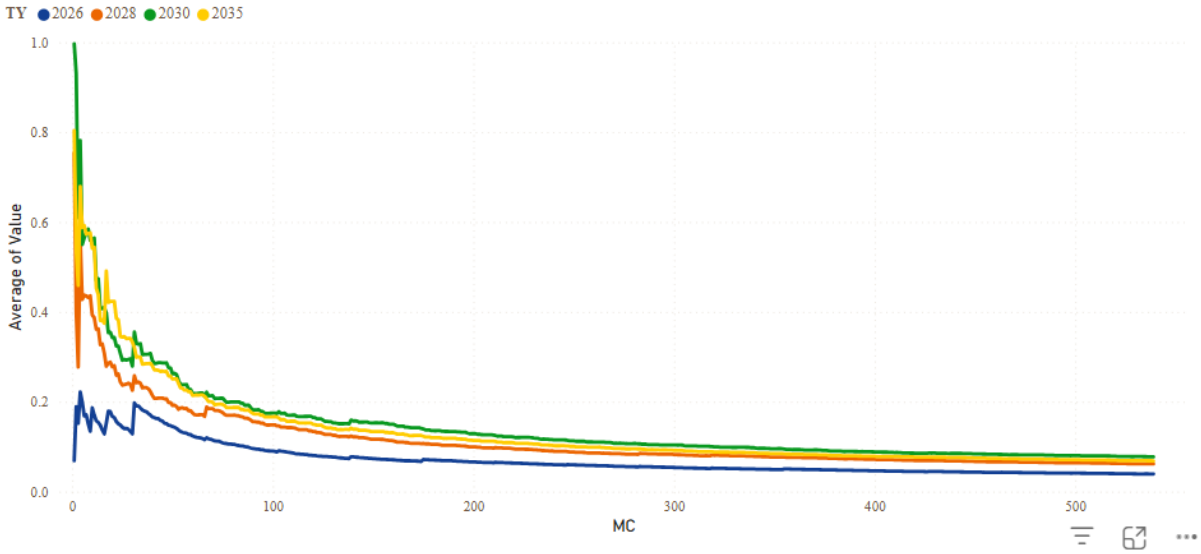

Figure 6: Coefficient of variation α

3 EVA comparisons related to CONE for gas investments

This section compares results of studies obtained from using CONE values in EVA which are different from the ERAA 2024 central reference scenario. CONE are fundamental assumptions for an EVA with considerable impact on the investment decisions. The comparisons shall foster the understanding of this impact. It is structured into two main parts: the first focuses on the EVA outcomes using country-specific CONE values, the second provides a comparative analysis of the outcomes under default CCGT CONE assumptions different to the central reference scenario.

The results presented in this section are not part of the official results of the 'Central Reference Scenario' of ERAA2024 and hence have no legal value.

Country-specific CONE values are derived from national VoLL/CONE/RS studies where available. For countries without such studies, the average of all country-specific CONE values is used. Table 6 in Annex 1 lists the countries for which a national VoLL/CONE/RS study is available.

Sections 3.1 and 3.2 present the EVA results of these comparison studies. Section 3.3 compares the results against ERAA 2024 central reference scenario results.

3.1 EVA outcomes using Country-specific CONE

Figure 7 presents the general overview of EVA results in Europe. It shows a similar trend to the central reference scenario results presented in Section 2.1, with net decommissioning until 2030 and net commissioning in 2035. This information is detailed by technology in Table 19, which shows capacity differences relative to the initial generation capacity assumptions for each TY. Detailed results per study zone are provided in Table 20.

Section 6.4 of Annex 1 includes both country-specific and default values used in this EVA simulation for commissioning, decommissioning, mothballing and lifetime extension candidates.

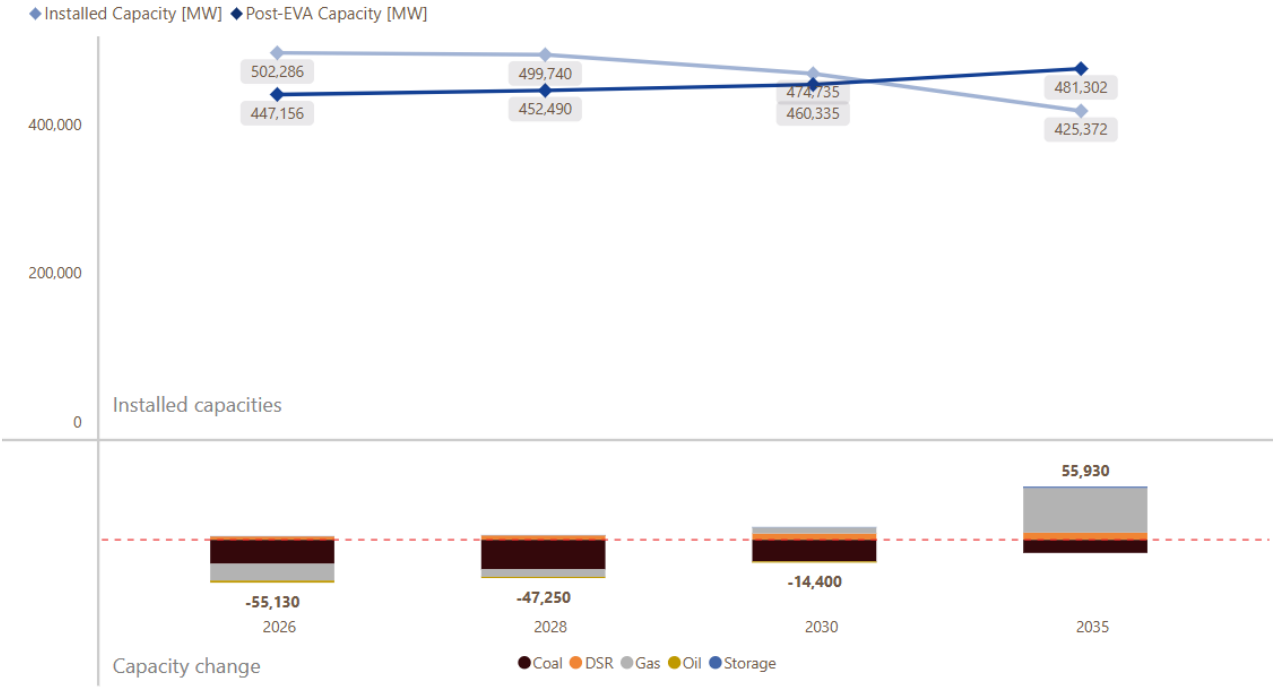

Figure 7: Net EVA impact of comparison study on the European generation mix: country-specific CONE

Table 19: Capacity change proposed by the EVA compared to the National Trends scenario [GW] – non-cumulative

Decision variable	Technology	2026	2028	2030	2035	Affected study zones
New entry	**Battery**	0.43	0.43	0.57	1.83	GR00, ITCN
	DSR	4.60	6.03	8.77	10.01	CZ00, DE00, DKE1, DKW1, FI00, HR00, HU00, NL00, SE03, SE04, SI00, SK00
	Gas CCGT	0	9.42	21.27	38.79	BE00, CZ00, ITN1, MT00, PL00, TR00
	Gas OCGT	0	0	4.33	39.08	AT00, DE00, DKE1, FI00, SE03, SE04, UK00
	Total	5.03	15.88	34.94	89.71	
Life Extension	**Gas CCGT**	1.91	4.27	4.70	8.28	BE00, DE00, DKE1, HU00, NL00
	Gas OCGT	0	1.58	2.22	2.53	DE00, HU00
	Total	1.91	5.85	6.92	10.81	
Decommissioning	**Gas CCGT**	-24.78	-25.45	-23.90	-26.12	AL00, BE00, ES00, GR00, HR00, ITCA, ITCS, ITN1, LV00, PT00, RO00, TR00
	Gas OCGT	-0.63	-0.29	-0.28	0	AT00, DE00, HR00, LT00, RO00, SE01

Decision variable	Technology	2026	2028	2030	2035	Affected study zones
	Hard Coal	-12.03	-17.78	-13.52	-6.07	BG00, DE00, FI00, FR00, HR00, NL00, PL00, RO00, TR00
	Lignite	-21.64	-23.66	-16.85	-12.40	BA00, BG00, CZ00, DE00, GR00, ME00, PL00, SI00, TR00
	Oil	-2.99	-1.80	-1.71	0	EE00, FR00, GR03, HR00, SE03, TR00
	Total	-62.07	-68.98	-56.26	-44.59	
Total		**-55.13**	**-47.25**	**-14.40**	**55.93**	

Table 20: Capacity change proposed by EVA per study zone, PEMMDB technology, and decision variable [MW] – non-cumulative

Study Zone	PEMMBD Technology	Decision Variable	2026	2028	2030	2035
AL00	**Gas CCGT**	Decommissioning	0	-100	-100	-100
AT00	**Gas OCGT**	New Entry	0	0	0	1670
	Gas OCGT	Decommissioning	-40	-40	-40	0
BA00	**Lignite**	Decommissioning	-1440	-980	-980	-980
BE00	**Gas CCGT**	New Entry	0	0	0	6660
	Gas CCGT	Life Extension	1700	1700	1700	1700
	Gas CCGT	Decommissioning	0	-300	0	0
BG00	**Hard Coal**	Decommissioning	-90	-90	-90	-90
	Lignite	Decommissioning	-1770	-1610	-1120	-1120
CZ00	**DSR**	New Entry	0	0	0	550
	Gas CCGT	New Entry	0	0	0	1290
	Lignite	Decommissioning	-1920	-2850	-330	0
DE00	**DSR**	New Entry	310	820	820	820
	Gas CCGT	Life Extension	0	1780	1780	2120
	Gas OCGT	New Entry	0	0	0	15580
	Gas OCGT	Life Extension	0	1580	2160	2470
	Gas OCGT	Decommissioning	-400	0	0	0
	Hard Coal	Decommissioning	-510	-2910	-2850	0
	Lignite	Decommissioning	-5340	-4980	-900	0
DKE1	**DSR**	New Entry	40	40	40	100
	Gas CCGT	Life Extension	70	70	70	70
	Gas OCGT	New Entry	0	0	0	500
DKW1	**DSR**	New Entry	80	80	80	190
EE00	**Oil**	Decommissioning	-860	0	0	0

Study Zone	PEMMBD Technology	Decision Variable	2026	2028	2030	2035
ES00	Gas CCGT	Decommissioning	-9740	-9740	-9740	-9740
FI00	DSR	New Entry	2000	2000	2000	2000
	Gas OCGT	New Entry	0	0	680	680
	Hard Coal	Decommissioning	-90	-90	0	0
FR00	Hard Coal	Decommissioning	-1720	0	0	0
	Oil	Decommissioning	-1330	-970	-970	0
GR00	Battery	New Entry	0	0	0	1260
	Gas CCGT	Decommissioning	0	-470	-1430	-2960
	Lignite	Decommissioning	-660	-660	0	0
GR03	Oil	Decommissioning	-410	-410	-410	0
HR00	DSR	New Entry	0	0	0	110
	Gas CCGT	Decommissioning	-50	-50	-50	0
	Gas OCGT	Decommissioning	0	-150	-150	0
	Hard Coal	Decommissioning	-290	-290	-290	0
	Oil	Decommissioning	-300	-300	-300	0
HU00	DSR	New Entry	20	20	20	60
	Gas CCGT	Life Extension	0	0	430	780
	Gas OCGT	Life Extension	0	0	60	60
ITCA	Gas CCGT	Decommissioning	-1830	-1830	-1830	-1830
ITCN	Battery	New Entry	430	430	570	570
ITCS	Gas CCGT	Decommissioning	-4850	-4850	-4850	-4850
ITN1	Gas CCGT	New Entry	0	0	1880	1880
	Gas CCGT	Decommissioning	-4440	-4440	-4440	-4440
LT00	Gas OCGT	Decommissioning	-90	0	0	0
LV00	Gas CCGT	Decommissioning	-140	-140	-140	-140
ME00	Lignite	Decommissioning	-220	-220	-220	0
MT00	Gas CCGT	New Entry	0	0	20	20
NL00	DSR	New Entry	900	900	960	1180
	Gas CCGT	Life Extension	140	720	720	3610
	Hard Coal	Decommissioning	-3380	-3380	0	0
PL00	Gas CCGT	New Entry	0	0	3240	3690
	Hard Coal	Decommissioning	-4570	-4910	-4180	0
	Lignite	Decommissioning	-2100	-2340	-2460	0
PT00	Gas CCGT	Decommissioning	-1770	-1770	-780	0
RO00	Gas CCGT	Decommissioning	0	0	0	-2060
	Gas OCGT	Decommissioning	0	0	-90	0
	Hard Coal	Decommissioning	-130	-130	-130	0
SE01	Gas OCGT	Decommissioning	-100	-100	0	0
SE03	DSR	New Entry	10	180	2860	2860

Study Zone	PEMMBD Technology	Decision Variable	2026	2028	2030	2035
	Gas OCGT	New Entry	0	0	1080	1080
	Oil	Decommissioning	-90	-90	0	0
SE04	**DSR**	New Entry	1080	1830	1830	1830
	Gas OCGT	New Entry	0	0	2570	2570
SI00	**DSR**	New Entry	40	40	40	40
	Lignite	Decommissioning	-300	0	0	0
SK00	**DSR**	New Entry	120	120	120	270
TR00	**Gas CCGT**	New Entry	0	9420	16130	25250
	Gas CCGT	Decommissioning	-2060	-1760	-540	0
	Hard Coal	Decommissioning	-1250	-5980	-5980	-5980
	Lignite	Decommissioning	-7890	-10020	-10840	-10300
	Oil	Decommissioning	0	-30	-30	0
UK00	**Gas OCGT**	New Entry	0	0	0	17000

3.2 EVA outcomes using country-specific CONE and EU 2020 Reference Scenario for default CCGT costs

The following results show the outcomes of an EVA simulation performed with a similar set of country-specific CONE data (as in Section 3.1) except that default CCGT technology CONE data was taken from the EU 2020 Reference Scenario[13] instead of using the average of available national values. This default CCGT CONE data is only applied when country specific values are not available.

The decision to compare with the EU 2020 reference scenario CCGT investment costs as the default CONE was motivated[14] by the findings of the country-specific CONE comparison (see Section 3.1), which identified regionally biased investments. Furthermore, the default (average) CONE value in ERAA 2024 has increased compared to ERAA 2023 due to more recent national CONE studies.

The electricity sector has been drastically impacted by economic turbulences since the EU 2020 reference scenario study was conducted, leading to substantial cost increase. Therefore, performing an EVA simulation using EU Reference Scenario 2020 assumptions for CCGT technology may appear outdated. Moreover, after detailed review of the scenario, concerns remain about the robustness of the economic parameters used in the study. The parameters are said to be sourced from a workshop with market players, however no further information are provided which would allow an assessment on the solidity of these data.

These recent economic trends may also not be fully captured in existing national CONE studies, depending on when they were conducted. Additionally, spatial discrepancies could exist,

[13] https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en
[14] This additional EVA study was initiated as a result of close dialogue with ACER in late 2024. The alternative default CONE value for CCGT was suggested by ACER as potentially more accurate reference than the default CONE derived by ENTSO-E.

particularly for close neighbouring systems, based on the timing of the CONE studies and their specific definitions and interpretation of CONE.

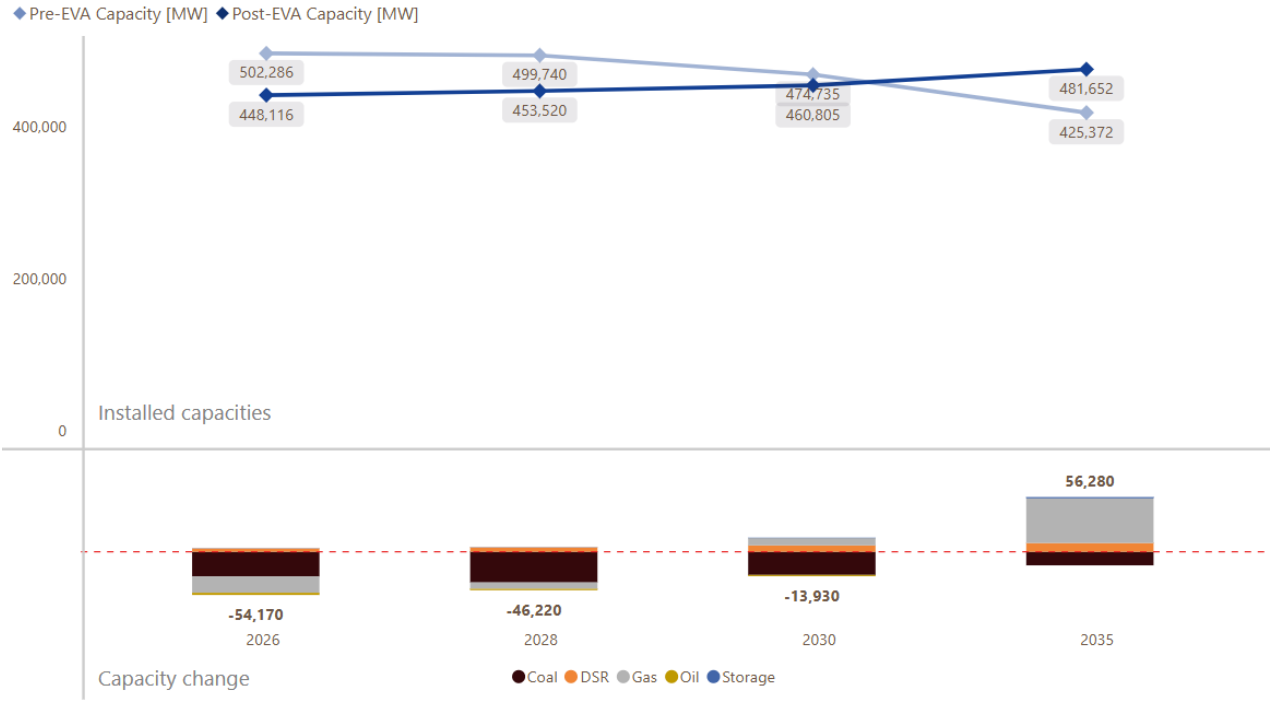

Figure 8: Net EVA impact of comparison study on the European generation mix: country specific CONE with EU reference scenario CCGT CONE as default

Table 21: Capacity change proposed by the EVA compared to the National Trends scenario [GW] – non-cumulative

Decision variable	Technology	2026	2028	2030	2035	Affected study zones
New entry	**Battery**	0.37	0.37	0.57	1.83	GR00, ITCN
	DSR	4.55	5.95	8.72	11.95	CZ00, DE00, DKE1, DKW1, FI00, HR00, HU00, NL00, SE03, SE04, SI00, SK00
	Gas CCGT	0	10.70	22.64	68.63	AT00, CZ00, DE00, DKE1, ITN1, MT00, PL00, SK00, TR00, UK00
	Gas OCGT	0	0	4.22	6.22	BE00, FI00, SE03, SE04, UK00
	Total	4.92	17.02	36.15	88.63	
Life Extension	**Gas CCGT**	1.91	4.27	4.70	8.28	BE00, DE00, DKE1, HU00, NL00
	Gas OCGT	0	1.58	2.16	2.47	DE00
	Total	1.91	5.85	6.86	10.75	

Decision variable	Technology	2026	2028	2030	2035	Affected study zones
Decommissioning	**Gas CCGT**	-23.68	-24.51	-22.88	-24.54	AL00, BE00, ES00, GR00, HR00, ITCA, ITCS, ITN1, PT00, RO00, TR00
	Gas OCGT	-0.63	-0.82	-0.72	0	AT00, DE00, HR00, LT00, RO00, SE01
	Hard Coal	-12.12	-19.14	-14.76	-6.16	BG00, DE00, FI00, FR00, HR00, NL00, PL00, RO00, TR00
	Lignite	-21.58	-22.82	-16.87	-12.40	BA00, BG00, CZ00, DE00, GR00, ME00, PL00, SI00, TR00
	Oil	-2.99	-1.80	-1.71	0	EE00, FR00, GR03, HR00, SE03, TR00
	Total	-61.00	-69.09	-56.94	-43.10	
Total		**-54.17**	**-46.22**	**-13.93**	**56.28**	

Table 22: Capacity change proposed by EVA per study zone, PEMMDB technology, and decision variable [MW] – non-cumulative

Study Zone	PEMMBD Technology	Decision Variable	2026	2028	2030	2035
AL00	**Gas CCGT**	Decommissioning	0	-100	-100	-120
AT00	**Gas CCGT**	New Entry	0	0	0	1160
	Gas OCGT	Decommissioning	-40	-40	-40	0
BA00	**Lignite**	Decommissioning	-1440	-980	-980	-980
BE00	**Gas CCGT**	Life Extension	1700	1700	1700	1700
	Gas CCGT	Decommissioning	0	-300	0	0
	Gas OCGT	New Entry	0	0	0	1770
BG00	**Hard Coal**	Decommissioning	-90	-90	-90	-90
	Lignite	Decommissioning	-1770	-1610	-1120	-1120
CZ00	**DSR**	New Entry	0	0	0	550
	Gas CCGT	New Entry	0	0	0	380
	Lignite	Decommissioning	-1890	-2850	-330	0
DE00	**DSR**	New Entry	310	820	820	820
	Gas CCGT	New Entry	0	0	610	18500
	Gas CCGT	Life Extension	0	1780	1780	2120
	Gas OCGT	Life Extension	0	1580	2160	2470

Study Zone	PEMMBD Technology	Decision Variable	2026	2028	2030	2035
	Gas OCGT	Decommissioning	-400	0	0	0
	Hard Coal	Decommissioning	-510	-3910	-3850	0
	Lignite	Decommissioning	-5310	-4140	-920	0
DKE1	**DSR**	New Entry	40	40	40	100
	Gas CCGT	New Entry	0	0	520	520
	Gas CCGT	Life Extension	70	70	70	70
DKW1	**DSR**	New Entry	80	80	80	190
EE00	**Oil**	Decommissioning	-860	0	0	0
ES00	**Gas CCGT**	Decommissioning	-9710	-9710	-9710	-9710
FI00	**DSR**	New Entry	2000	2000	2000	2000
	Gas OCGT	New Entry	0	0	680	680
	Hard Coal	Decommissioning	-90	-90	0	0
FR00	**Hard Coal**	Decommissioning	-1720	0	0	0
	Oil	Decommissioning	-1330	-970	-970	0
GR00	**Battery**	New Entry	0	0	0	1260
	Gas CCGT	Decommissioning	-70	-720	-1600	-3030
	Lignite	Decommissioning	-660	-660	0	0
GR03	**Oil**	Decommissioning	-410	-410	-410	0
HR00	**DSR**	New Entry	0	0	0	110
	Gas CCGT	Decommissioning	-50	-50	-50	0
	Gas OCGT	Decommissioning	0	-590	-590	0
	Hard Coal	Decommissioning	-290	-290	-290	0
	Oil	Decommissioning	-300	-300	-300	0
HU00	**DSR**	New Entry	20	20	20	60
	Gas CCGT	Life Extension	0	0	430	780
ITCA	**Gas CCGT**	Decommissioning	-1820	-1820	-1820	-1820
ITCN	**Battery**	New Entry	370	370	570	570
ITCS	**Gas CCGT**	Decommissioning	-4850	-4850	-4850	-4850
ITN1	**Gas CCGT**	New Entry	0	0	190	190
	Gas CCGT	Decommissioning	-3430	-3430	-3430	-3430
LT00	**Gas OCGT**	Decommissioning	-90	0	0	0
ME00	**Lignite**	Decommissioning	-220	-220	-220	0
MT00	**Gas CCGT**	New Entry	0	0	240	240
NL00	**DSR**	New Entry	900	900	960	3120
	Gas CCGT	Life Extension	140	720	720	3610
	Hard Coal	Decommissioning	-3380	-3380	0	0
PL00	**Gas CCGT**	New Entry	0	320	3240	3690
	Hard Coal	Decommissioning	-4660	-5180	-4330	0
	Lignite	Decommissioning	-2100	-2340	-2460	0

Study Zone	PEMMBD Technology	Decision Variable	2026	2028	2030	2035
PT00	Gas CCGT	Decommissioning	-1770	-1770	-780	0
RO00	Gas CCGT	Decommissioning	0	0	0	-1580
	Gas OCGT	Decommissioning	0	-90	-90	0
	Hard Coal	Decommissioning	-130	-130	-130	0
SE01	Gas OCGT	Decommissioning	-100	-100	0	0
SE03	DSR	New Entry	20	250	2960	2960
	Gas OCGT	New Entry	0	0	1020	1020
	Oil	Decommissioning	-90	-90	0	0
SE04	DSR	New Entry	1070	1730	1730	1730
	Gas OCGT	New Entry	0	0	2520	2520
SI00	DSR	New Entry	40	40	40	40
	Lignite	Decommissioning	-300	0	0	0
SK00	DSR	New Entry	70	70	70	270
	Gas CCGT	New Entry	0	0	820	820
TR00	Gas CCGT	New Entry	0	10380	17020	25420
	Gas CCGT	Decommissioning	-2060	-1760	-540	0
	Hard Coal	Decommissioning	-1250	-6070	-6070	-6070
	Lignite	Decommissioning	-7890	-10020	-10840	-10300
	Oil	Decommissioning	0	-30	-30	0
UK00	Gas CCGT	New Entry	0	0	0	17710
	Gas OCGT	New Entry	0	0	0	230

3.3 EVA comparisons related to CONE analysis

The ERAA methodology prescribes the use of country-specific CONE data where available. However, for CONE for gas-fired generation technologies, which can be considered as mature and less prone to the cost variations, this approach may potentially lead to biases, particularly if the CONE figures vary significantly between countries in a region with strong needs for and economic value of investments. Significant geographic discrepancies in country-specific CONE are observed for gas-fired generation technologies, particularly among neighbouring countries, which can result in a biased distribution of investments.

Regarding the robustness of the data, some country-specific CONE data could be outdated or affected by diverging definitions or interpretation, as highlighted in a recent security of EU electricity supply 2024 by ACER[15] (Section 2.1.2.3).

Moreover, country-specific CONE values may suffer from partial information, such as assumptions about expansion potential, which can lead to an incomplete picture. For instance, the expansion

15 https://www.acer.europa.eu/sites/default/files/documents/Publications/Security_of_EU_electricity_supply_2024.pdf

cost for specific marginal units assessed may be used as a reference for unlimited capacity in the country.

In the central reference scenario of ERAA 2024, ENTSO-E therefore uses a set of harmonized CONE values for investments in gas-fired generation technologies to establish coherence across Europe. All other investments (batteries, DSR) are kept country specific, because they may be typically subject to national policies and incentives.

3.3.1 Comparing harmonized CONE (central reference scenario) against country-specific CONE

The results in this section reveal a strong regional investment bias when using country-specific CONE values for investments in gas-fired generation technologies. Some impact can also be observed for the pan-European results.

In Figure 9, differences in EVA results can be observed due to the varying CONE values (harmonised vs. country-specific) for investment in gas-fired generation technologies by target year. The largest difference appears in TY 2035 with a 4290 MW difference in expansion capacity and a 2300 MW difference in retirement on a European scale. This variation is driven by discrepancies in CONE values between the two comparisons, leading to higher expansion and increased retirements when specific CONE values are used.

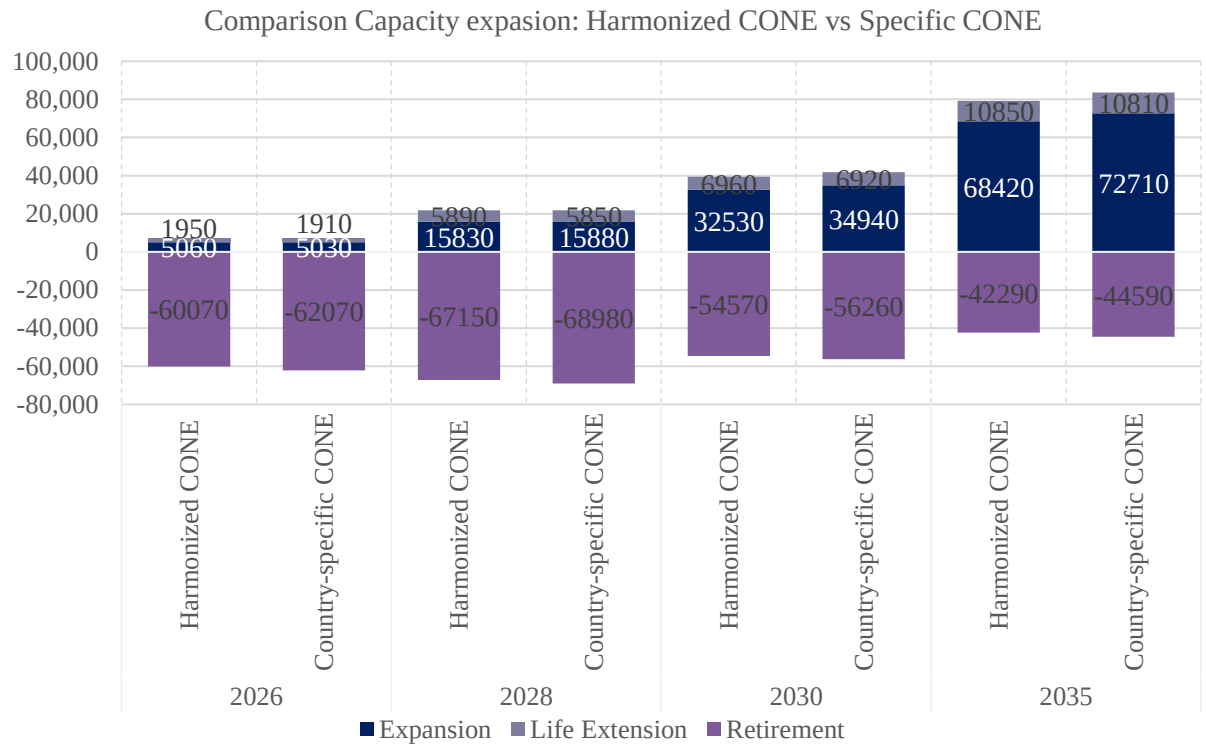

Figure 9: Comparison of capacity expansion per TY in the central reference scenario (with harmonized CONE for gas investments) and country-specific CONE values

The figures below show that when country-specific CONE values for investments in gas-fired generation technologies are used, strong a regional bias emerges between Belgium and Germany. When applying country-specific CONE values, 6.6 GW of additional capacity would be expected in Belgium in 2035, while in Germany it would decrease by 2.7 GW in the same year (c.f. Figure 13). This would be mainly driven by the significantly differing investment cost assumptions, which appear not reasonable for mature gas-fired generation technologies. Similar phenomena could be observed in other areas.

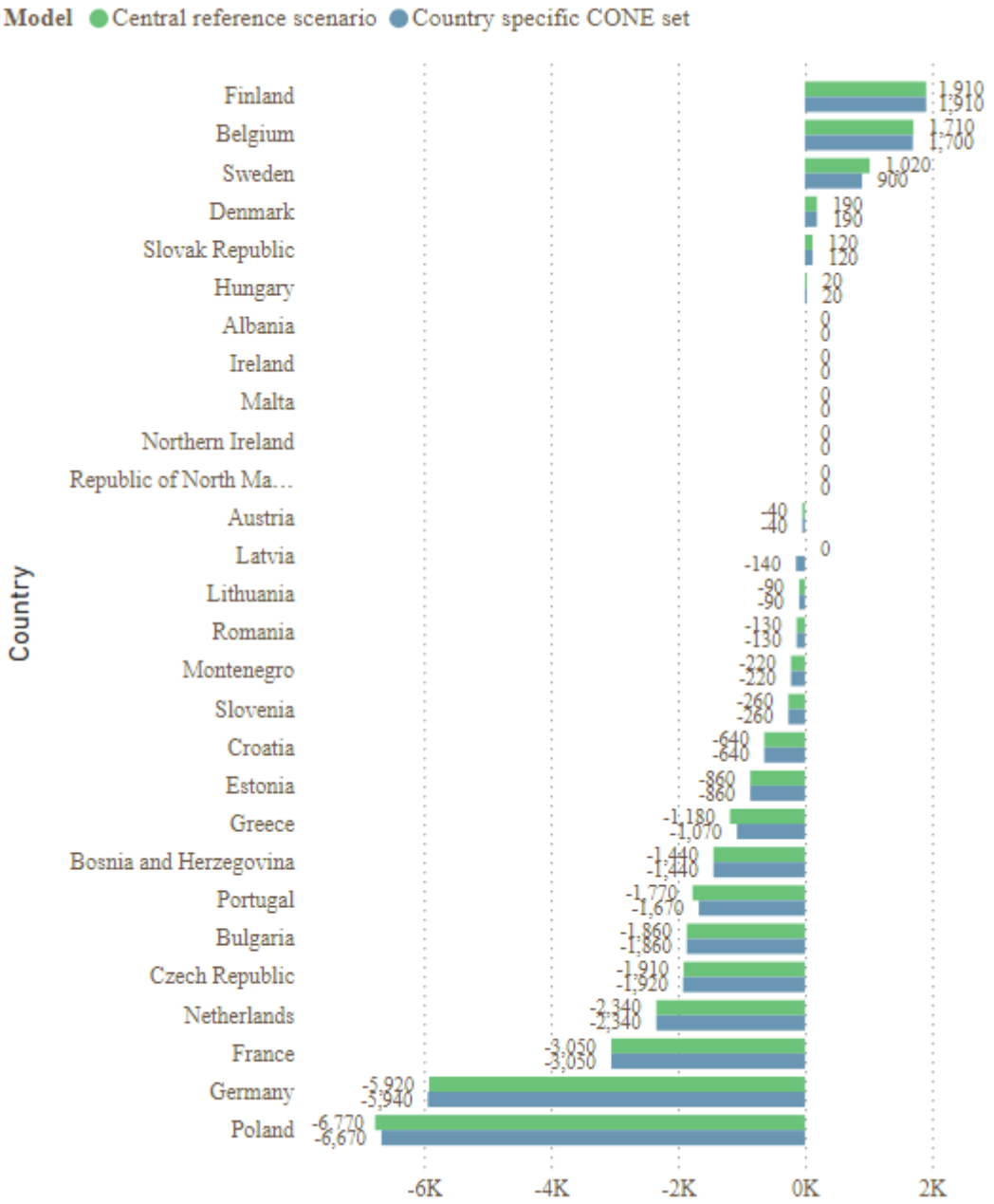

Figure 10: EVA comparison of harmonized CONE (central reference scenario) and country-specific CONE: 2026

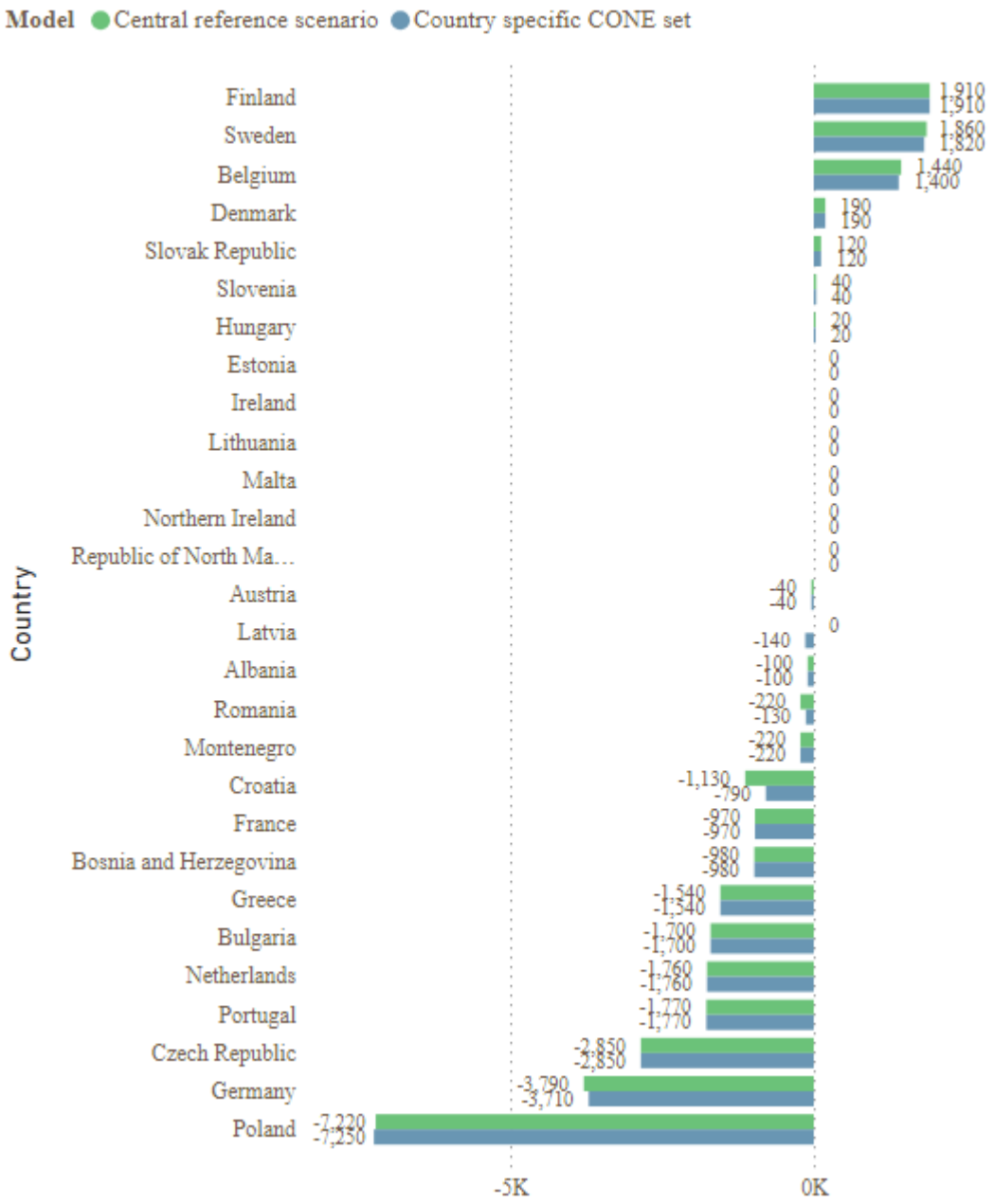

Figure 11: EVA comparison of harmonized CONE (central reference scenario) and country-specific CONE: 2028

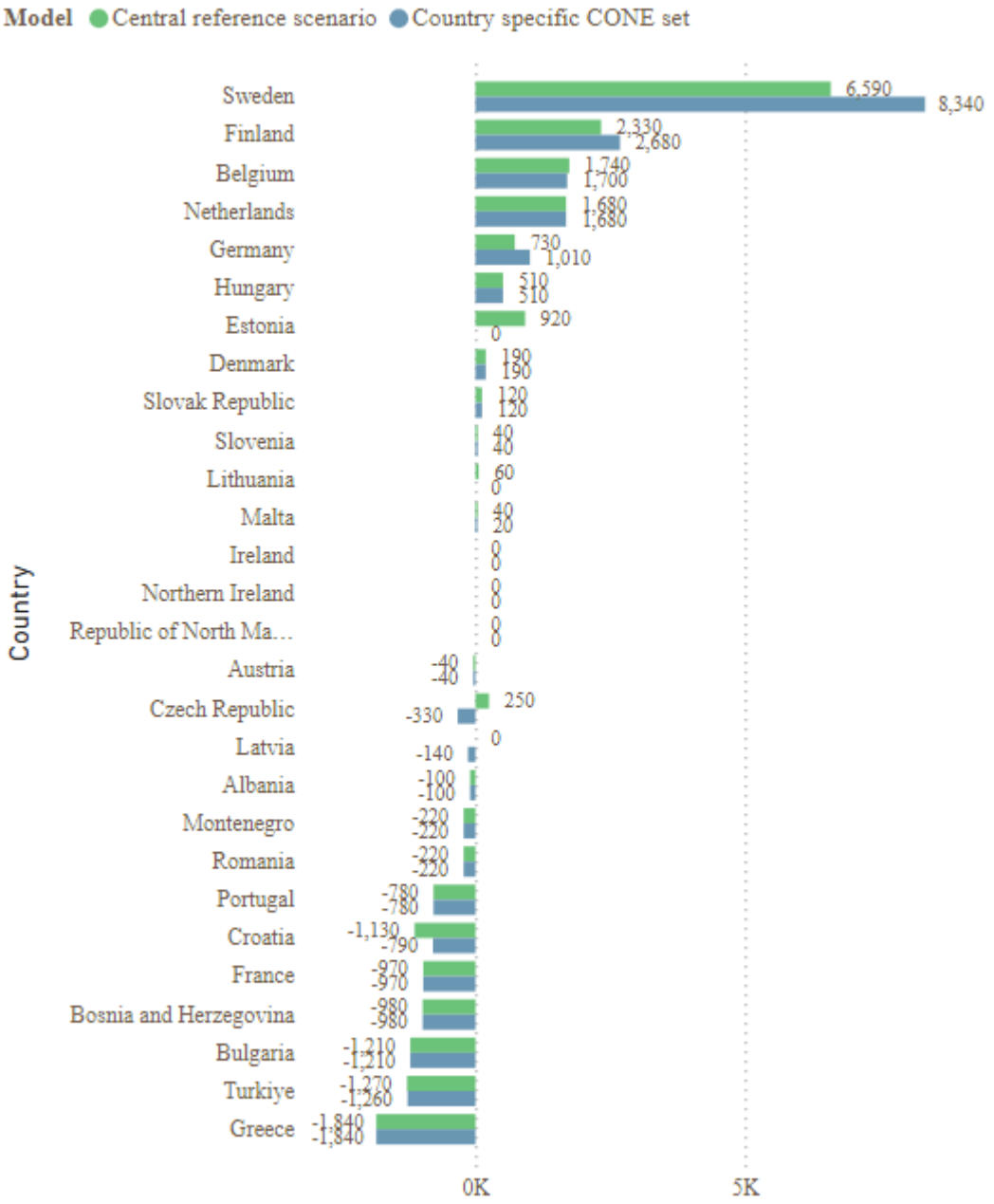

Figure 12 EVA comparison of harmonized CONE (central reference scenario) and country-specific CONE: 2030

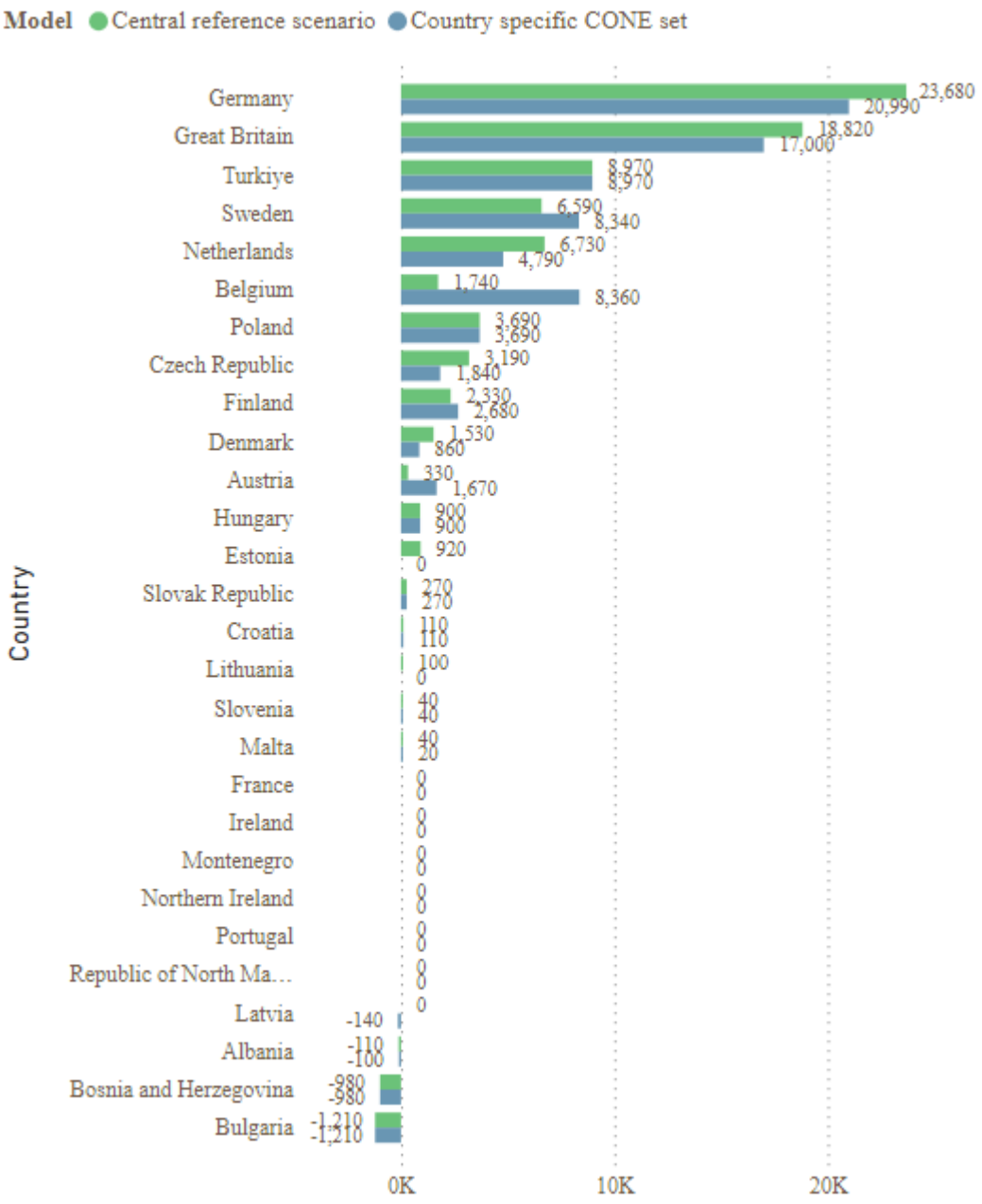

Figure 13 EVA comparison of harmonized CONE (central reference scenario) and country-specific CONE: 2035

3.3.2 Comparing harmonized CONE (central reference scenario) against country-specific CONE and the EU 2020 Reference Scenario default investment cost

When using the EU 2020 Reference Scenario CONE values for CCGT investments for countries without a specific CONE compared to the harmonized CONE approach, the most significant difference in overall EVA result is observed for TY 2030, with a 3620 MW reduction in capacity expansion and a 2370 MW increase in retirements (c.f. Figure 14). However, the more serious

concern when applying the EU 2020 Reference Scenario CONE values is that these values are considered outdated.

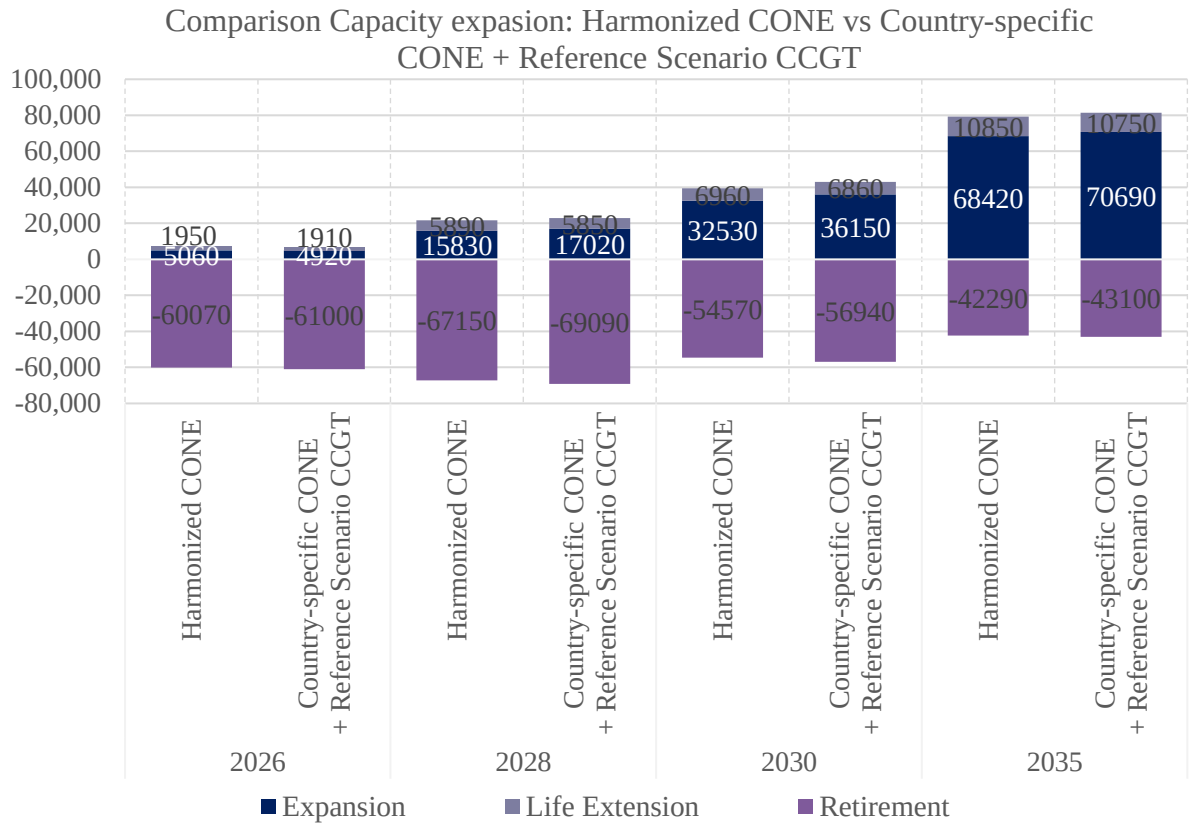

Figure 14: Comparison of capacity expansion per TY in the central reference scenario (with harmonized CONE for gas investments) and country-specific CONE values with EU 2020 Reference Scenario default investment cost

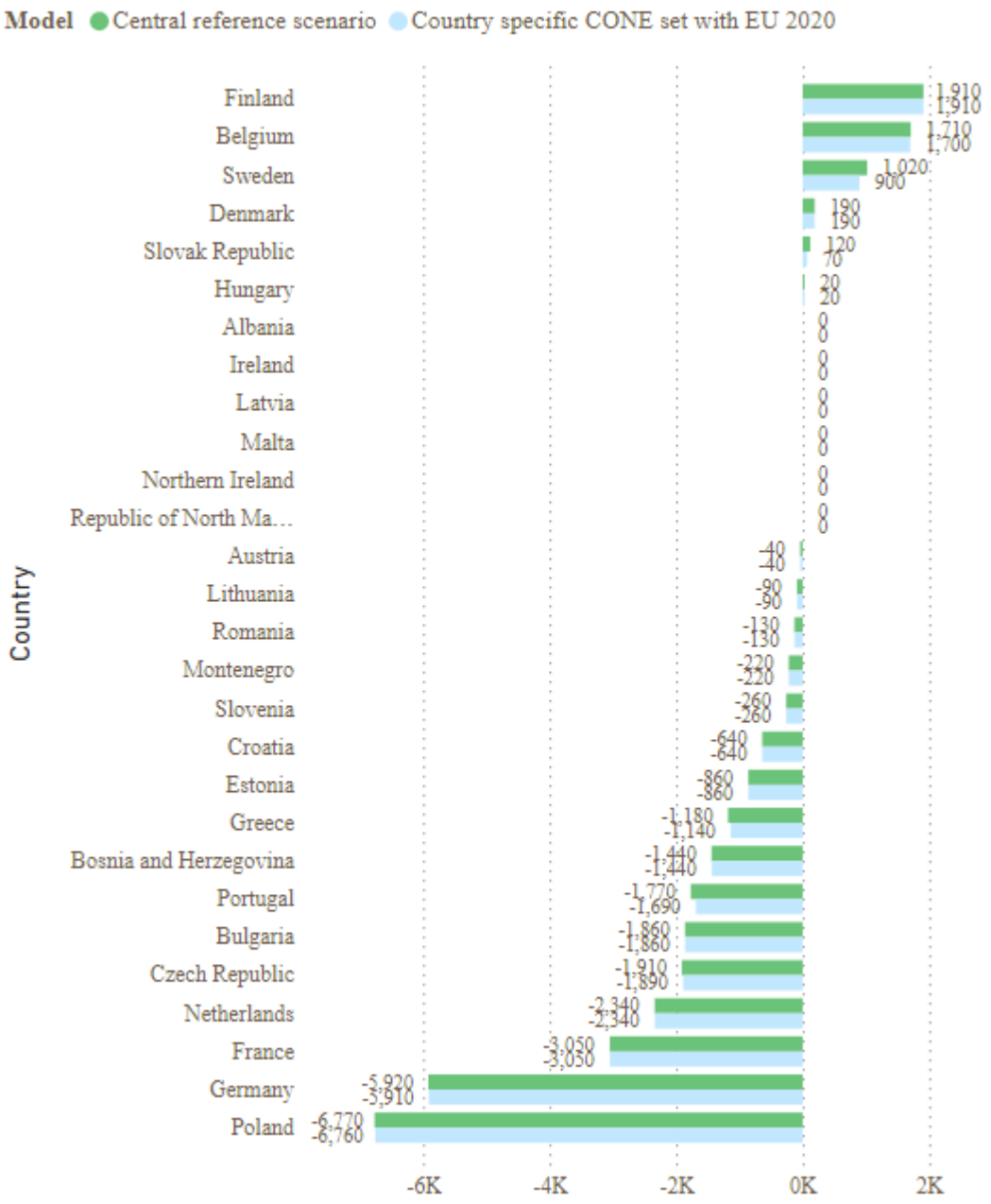

Figure 15 EVA comparison of harmonized CONE (central reference scenario) and country-specific CONE with EU 2020 Reference Scenario default investment cost: 2026

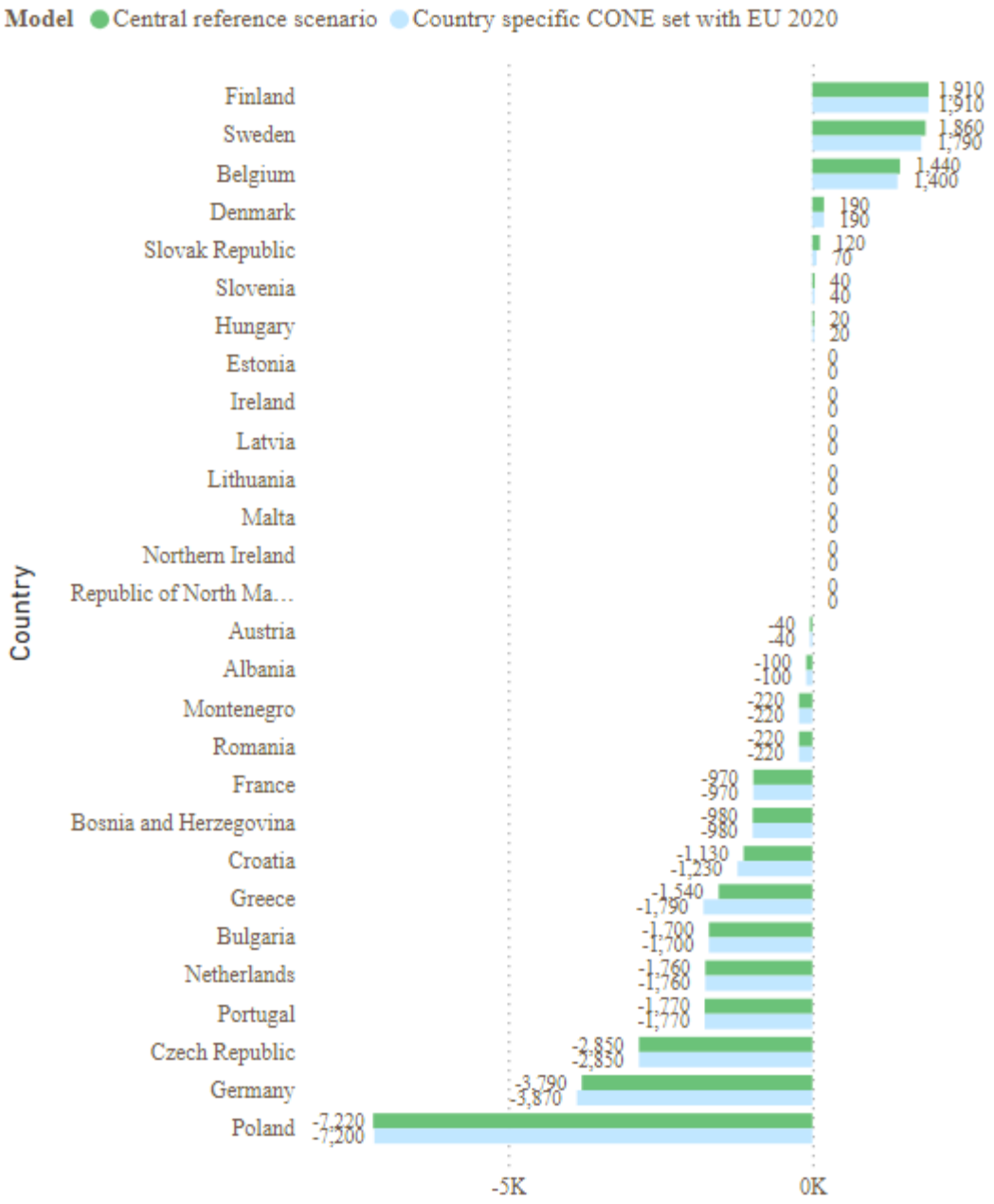

Figure 16 EVA comparison of harmonized CONE (central reference scenario) and country-specific CONE with EU 2020 Reference Scenario default investment cost: 2028

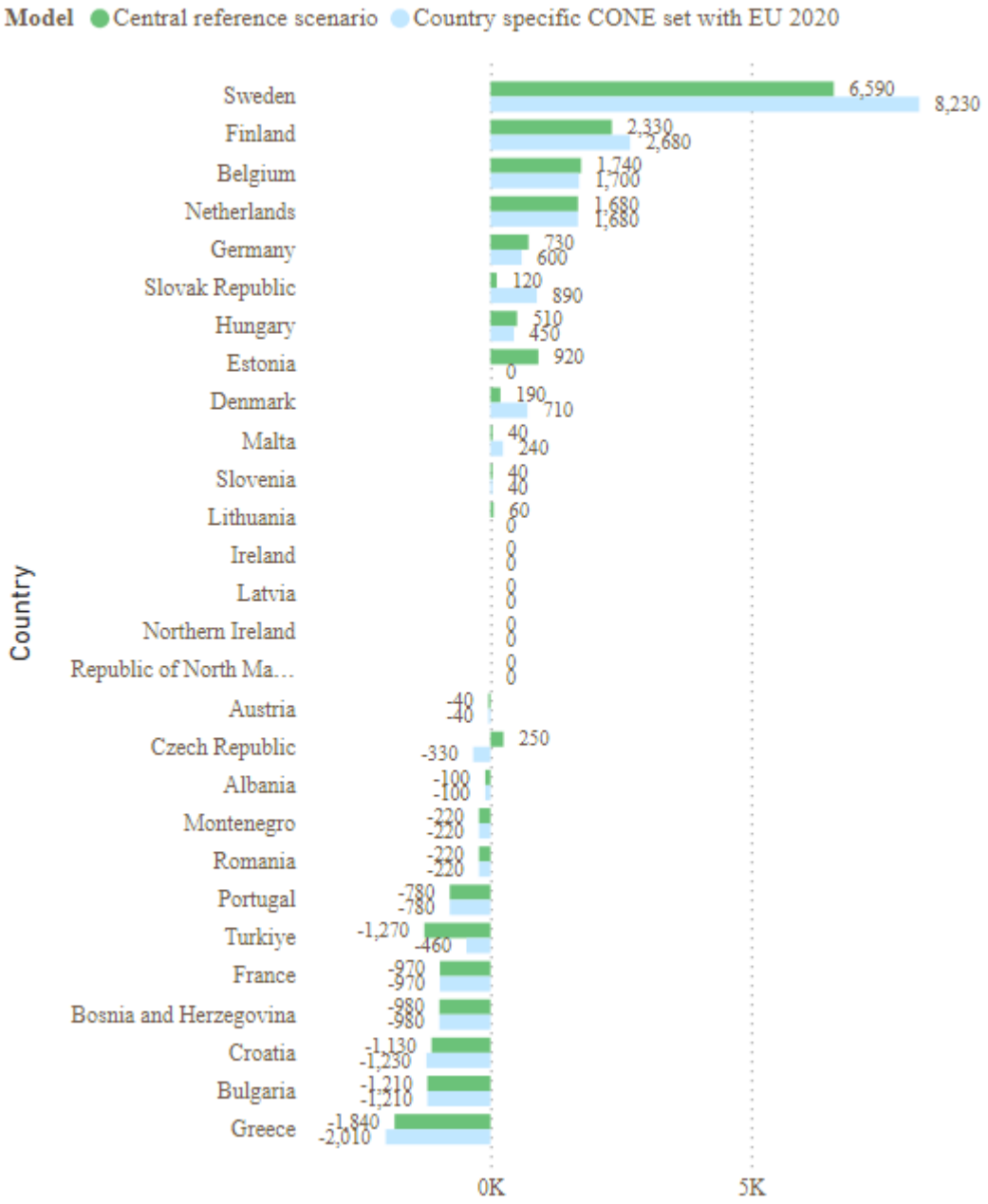

Figure 17 EVA comparison of harmonized CONE (central reference scenario) and country-specific CONE with EU 2020 Reference Scenario default investment cost: 2030

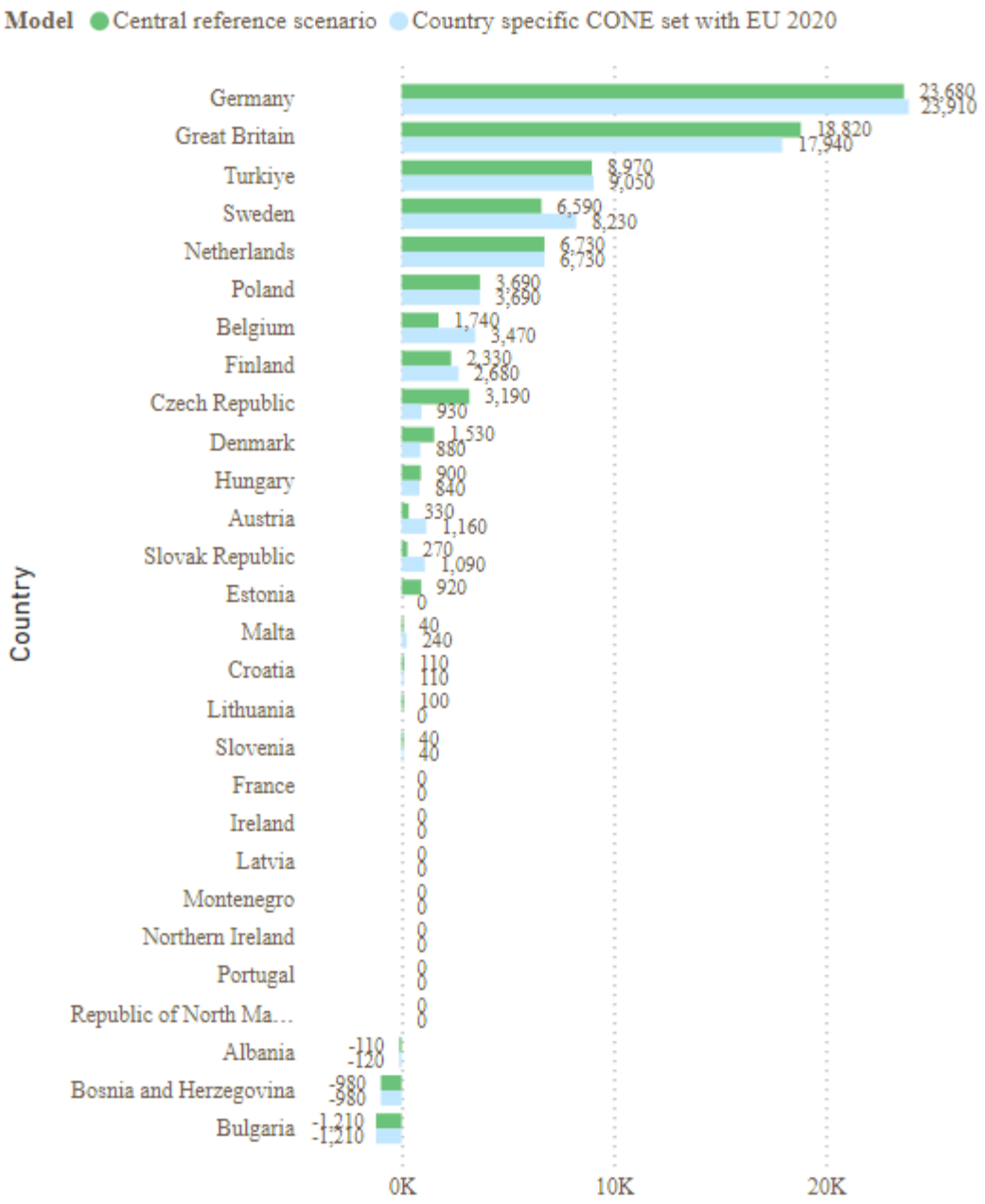

Figure 18: EVA comparison of harmonized CONE (central reference scenario) and country-specific CONE with EU 2020 Reference Scenario default investment cost: 2035