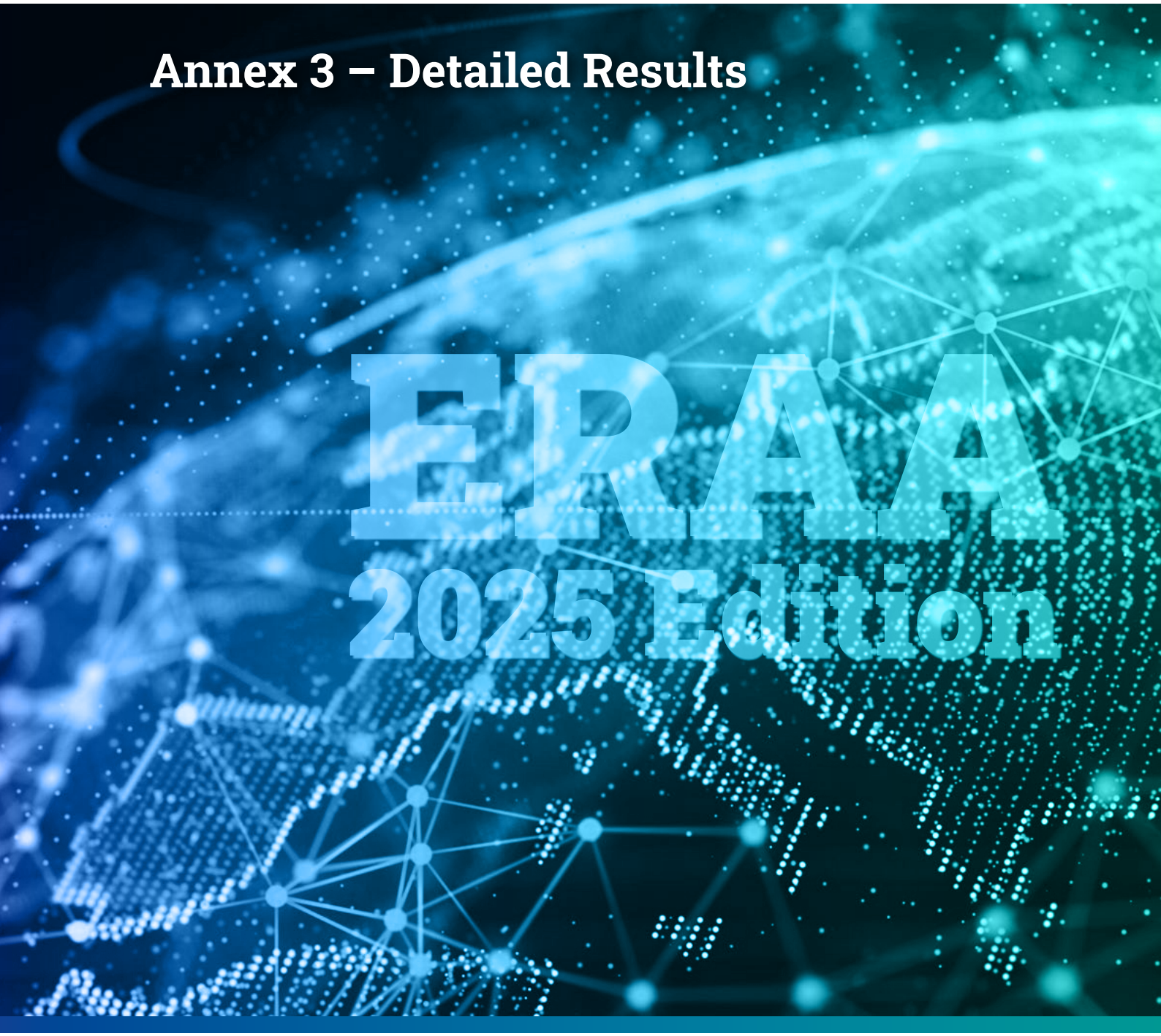
European Resource Adequacy Assessment

2025 Edition

ENTSO-E's proposal for ACER's approval

Annex 3 – Detailed Results



entsoe

Table of Contents

1 Introduction

This annex provides detailed tables and graphs to offer 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) 2025 detailed in Annex 2. The presentation includes results from the single reference tool.

The analysis is structured into two main sections, each focused on different aspects of the study. The economic viability assessment (EVA) obtains a range of results by implementing two different risk aversion modelling approaches: a) with the enhanced hurdle premium only, and b) with the enhanced hurdle premium combined with a revenue cap. This section examines the EVA results and provides insights into projections for new capacity entry, life extension, mothballing and early decommissioning. The second part focuses on adequacy results which are based on the analysis of loss of load expectation (LOLE) and expected energy not served (EENS) metrics.

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. 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 LOLE, EENS, P50 LLD, P50 ENS, P95 LLD, and P95 ENS, respectively.[1] For details on the calculation methodology and mathematical descriptions, refer to Annex 2.

The results for certain study zones are also available in aggregated form on 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.

For a geographical area with multiple study zones, ENS is calculated as the total ENS of all its zones. 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.

[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.

2 Central reference scenario Results

This chapter provides a comprehensive analysis of the central reference scenario for each target year (TY). EVA results are based on the national cost of new entry[2] (CONE) and harmonised 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, mothballing, and early decommissioning (Section 2.1.1). It is accompanied by an analysis of revenues for thermal expansion units (Section 2.1.2). Section 2.1.3 assesses system adequacy using LOLE and EENS metrics, while Section 2.2.1 evaluates the robustness of the adequacy results by examining whether the analyses converge to stable predictions across various weather scenarios (WSs). Section 2.2.2 highlights the main differences between ERAA 2024 and ERAA 2025.

Results should be interpreted under the given scenario and methodological framework. This implies that variations in the assumptions or 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 1 present the capacity change per decision variable for each technology and TY and for the affected study zones. The results are presented in a range that reflects investment uncertainty arising from possible different potential investor risk aversion strategies. This is based on two options explained in Annex2: with the enhanced hurdle premium only and with the enhanced premium combined with a revenue cap. 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 provided 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 2031, but EVA analysis shows that the unit is not viable in 2028 and 2030, then the net EVA effect will show:
2028: -100 MW
2030: -100 MW
2033: 0 MW
2035: 0 MW

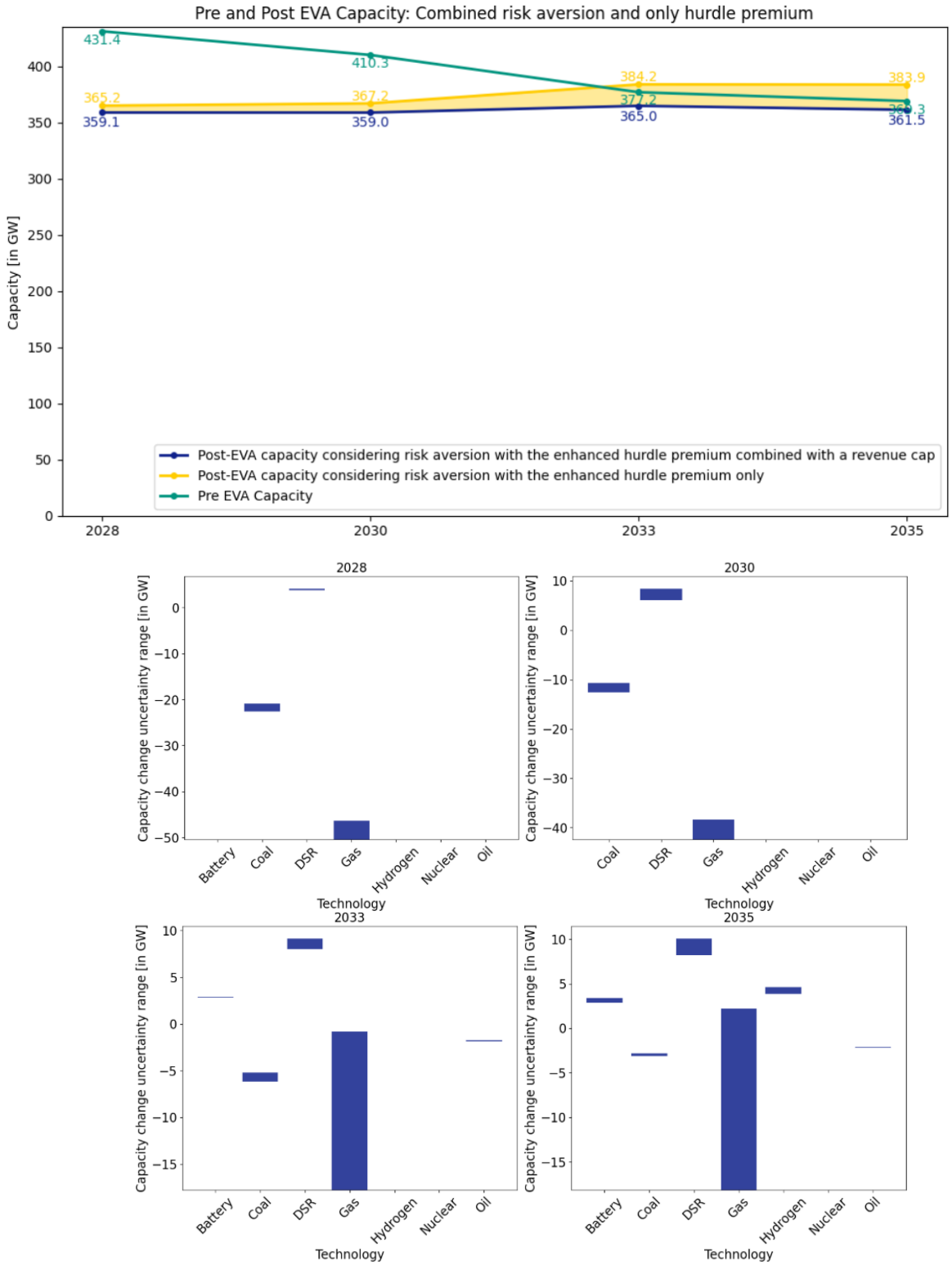


Figure 1: Net effect of the EVA on the European mix– presenting uncertainty range driven by risk aversion approaches

The trend indicates a substantial decrease in capacity in Europe for all TYs until 2035 in the central reference scenario with the enhanced hurdle premium combined with revenue cap (of about 72 GW in 2028, 51 GW in 2030, 12 GW in 2033, and almost 8 GW in 2035). The gross decommissioned

capacity between 2028 and 2035 exceeds these values, as some decommissioned capacities are offset by new entries or lifetime extensions in other study zones (cf. Table 1 and Table 2). Gross decommissioning will peak at 76 GW in 2028. By 2035, the expected retirement of thermal capacity is approximately 38 GW. Gas units are most exposed to decommissioning risks, accounting for over 66% of the total capacity decommissioned in 2028 and 86% in 2035, respectively, followed by lignite, hard coal, and oil units. 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 demand-side response (DSR) across all TYs, and in batteries, gas, and hydrogen-fuelled units in 2033 and 2035. Investments in 2028 and 2030 are expected to reach approximately 4 GW and 6 GW, respectively, while over 20 GW of capacity is projected to be built in 2033, increasing to almost 25 GW in 2035. The growth in new entries by 2035 aligns with an assumed increase in demand throughout Europe. In 2035, 70% of the investments are almost equally allocated among DSR and gas technologies, with DSR investments reaching more than 8 GW. In addition, life extensions are expected to add up to 6 GW in 2035, all of which are attributed to gas technologies across all TYs.

It should be noted that results should be read in light of the methodology and input data assumptions. Suggested hydrogen-fuelled generation expansion should not be interpreted as a definite signal of investment viability. Rather, it highlights the need to expand dispatchable thermal units, whose fuel supply could realistically be either gas or hydrogen, depending on future fuel cost developments across scenarios. Meanwhile, these findings are primarily driven by future assumptions, particularly assumed commodity prices (notably high CO_2 and gas blend costs-, and investment costs, which remain highly uncertain for emerging technologies. The actual deployment of hydrogen-fuelled generation would largely depend on investors' expectations of future fuel prices and their risk aversion, which may be mitigated or exacerbated depending on the development of hydrogen policies at the European or national level. Important factors in the deployment of hydrogen-fired capacity are the availability of fuel supply and its distribution infrastructure. Both factors and associated costs are neglected in the EVA assessment.

The central reference scenario with the enhanced hurdle premium only results in an overall decrease of capacity by 2030compared with the in the reference case (66 GW in 2028 and 43 GW in 2030), followed by a potential net increase of 7 GW in 2033 and almost 15 GW in 2035. The analysis indicates that nearly the same amount of lignite and oil capacity is decommissioned regardless of the price cap considered, and that the retirement of gas and hard coal capacity follows similar trends. Investments in new generation capacity reach almost 36 GW in 2033 and 44 GW in 2035 in the central reference scenario with the enhanced hurdle premium only, with gas accounting for 59% and 61% and DSR for 26% and 23%, respectively.

Table 1: Capacity change proposed by the EVA compared to the National Trends scenario [GW] – non-cumulative[4]

Decision variable	Technology	2028	2030	2033	2035	Affected study zones
New entry	Battery	0.00	0.00	2.83* up to 2.9	2.86* up to 3.4	ES00
	DSR	3.74* up to 4.07	6.06* up to 8.37	8.03* up to 9.11	8.2* up to 10.05	BG00, DE00, DKE1, DKW1, FI00, GR00, HR00, HU00, NL00, SE01, PT00, RO00, SE01, SE02, SE03, SE04, SI00, SK00
	Gas OCGT	0.00	0.00* up to 0.76	6.71* up to 20.83	8.88* up to 26.98	DE00, DKE1, DKW1
	Hydrogen CCGT	0.00	0.00	2.73 up to 2.74*	3.85 up to 4.61*	CZ00, PL00
	Total	3.74* up to 4.07	6.06* up to 9.13	20.31* up to 35.57	24.55* up to 44.28	-
Life Extension	Gas CCGT	0.14* up to 0.4	4.07* up to 5.09	4.75* up to 5.59	4.77* up to 6.01	BE00, DE00, HU00, NL00
	Gas OCGT	0.00	0.27 up to 0.3*	0.46 up to 0.55*	1.06 up to 1.15*	DE00, LT00
	Total	0.14* up to 0.4	4.37* up to 5.36	5.3* up to 6.05	5.92* up to 7.07	
Decommissioning	Gas CCGT	-34.5 up to -37.83*	-40.3 up to -41.9*	-26.38 up to -28.22*	-30.66 up to -31.54*	AT00, BE00, BG00, , FI00, FR00, GR00, HR00, HU00, IE00, ITCA, ITCN, ITCS, ITN1, ITS1, ITSI, MK00, NL00, PT00, RO00, SE03, SE04, UK00
	Gas OCGT	-12.26 up to -12.69*	-4.21 up to -4.82*	-1.28 up to -1.53*	-1.16 up to -1.4*	AT00, BG00, DE00, FI00, FR00, HR00, IE00, ITCS, ITS1, LT00, RO00, SE01, SE03, SI00, UK00
	Hard Coal	-4.19 up to -5.97*	-3.2 up to -5.01*	-0.69 up to -1.57*	-0.17 up to -0.5*	BG00, DE00, FI00, HU00, PL00
	Lignite	-16.63* up to -16.66	-7.5 up to -7.56*	-4.53 up to -4.58*	-2.63	BA00, BG00, CZ00, DE00, GR00, HU00, IE00, ME00, PL00, RO00, SI00
	Oil	-3.08 up to -3.1*	-2.4 up to -2.45*	-1.76 up to -1.84*	-2.1 up to -2.18*	CY00, DE00, FR00, GR03, HR00, IE00,

[4] * marks results for the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

						ITCS, SE03, UK00, UKNI
	Total	-70.69 up to -76.22*	-57.61 up to -61.74*	-34.64 up to -37.74*	-36.72 up to -38.25*	-
Total		**-66.22 up to -72.34***	**-43.12 up to -51.31***	**-12.13* up to 6.98**	**-7.78* up to 14.63**	-

Table 2: Capacity change proposed by EVA per study zone, PEMMDB technology, and decision variable compared to the National Trends scenario [MW] – non-cumulative [5]

Study Zone	PEMMDB Technology	Decision Variable	2028	2030	2033	2035
AT00	**Gas CCGT**	Retirement	-190 up to -330*	-190 up to -330*	0	0
	Gas OCGT	Retirement	-60* up to 0	-20* up to 0	0	0
		Total	-190 up to -390*	-190 up to -350*	0	0
BA00	**Lignite**	Retirement	-1480* up to -1490	-1490* up to -1500	-1490* up to -1500	-1510
		Total	-1480* up to -1490	-1490* up to -1500	-1490* up to -1500	-1510
BE00	**Gas CCGT**	Life Extension	140* up to 400	1470* up to 2440	1990* up to 2690	1990* up to 2690
	Gas CCGT	Retirement	-580 up to -600*	0	0	0
	Gas OCGT	Retirement	0	0	0	0
	Heavy oil	Retirement	0	0	0	0
		Total	-180 up to -460*	1470* up to 2440	1990* up to 2690	1990* up to 2690
BG00	**DSR**	Expansion	0	0	0* up to 60	0* up to 100
	Gas CCGT	Retirement	0	-20* up to -30	-30* up to -50	-610 up to -740*
	Gas OCGT	Retirement	-60 up to -360*	-290* up to 0	-290* up to 0	-290* up to 0
	Hard coal	Retirement	-110	-110	-110	-140 up to -160*
	Lignite	Retirement	-1940* up to -1980	-1480* up to -1490	-1310* up to -1320	-790
		Total	-2150 up to -2410*	-1630 up to -1900*	-1420 up to -1740*	-1440 up to -1980*

[5] * marks results for the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

Study Zone	PEMMDB Technology	Decision Variable	2028	2030	2033	2035
CY00	Gas OCGT	Retirement	0	0	0	0
	Heavy oil	Retirement	-40* up to 0	-40* up to 0	-40* up to 0	-40* up to 0
	Light oil	Retirement	-110	-110	0	0
		Total	-110 up to -150*	-110 up to -150*	-40* up to 0	-40* up to 0
CZ00	Gas CCGT	Retirement	0	0	0	0
	Gas OCGT	Retirement	0	0	0	0
	Hydrogen CCGT	Expansion	0	0	760 up to 900*	760 up to 900*
	Lignite	Retirement	-1730* up to -1760	0	0	0
		Total	-1730* up to -1760	0	760 up to 900*	760 up to 900*
DE00	DSR	Expansion	590* up to 820	800* up to 820	820	820
	Gas CCGT	Life Extension	0	0	160	180
	Gas CCGT	Retirement	0	0	0	0
	Gas OCGT	Expansion	0	0* up to 130	5590* up to 17050	7750* up to 23140
	Gas OCGT	Life Extension	0	210* up to 270	460	1060
	Gas OCGT	Retirement	-300* up to -330	-300* up to -330	-280* up to -320	0
	Hard coal	Retirement	-520 up to -1370*	-520 up to -1370*	-20* up to 0	0
	Heavy oil	Retirement	-290	0	0	0
	Lignite	Retirement	-5890* up to -5900	0	0	0
		Total	-6220 up to -7260*	-660* up to 370	6730* up to 18170	9810* up to 25200
DKE1	DSR	Expansion	0	0* up to 60	0* up to 60	0* up to 60
	Gas OCGT	Expansion	0	0* up to 630	1090* up to 2250	1090* up to 2300
		Total	0	0* up to 690	1090* up to 2310	1090* up to 2360
DKW1	DSR	Expansion	0	30* up to 220	70* up to 220	70* up to 230

Study Zone	PEMMDB Technology	Decision Variable	2028	2030	2033	2035
	Gas OCGT	Expansion	0	0	30* up to 1530	40* up to 1540
		Total	0	30* up to 220	100* up to 1750	110* up to 1770
ES00	**Battery**	Expansion	0	0	2830* up to 2900	2860* up to 3400
	Gas CCGT	Retirement	-20	0	0	0
		Total	-20	0	2830* up to 2900	2860* up to 3400
FI00	**DSR**	Expansion	2000	2000	2000	2000
	Gas CCGT	Retirement	-70	0	0	0
	Gas OCGT	Retirement	-40	0	0	0
	Hard coal	Retirement	-560 up to -700*	-530 up to -680*	-300 up to -450*	-30 up to -280*
		Total	1190* up to 1330	1320* up to 1470	1550* up to 1700	1720* up to 1970
FR00	**Gas CCGT**	Retirement	-70 up to -1240*	-70 up to -1240*	-70 up to -1240*	-1860* up to -3780
	Gas OCGT	Retirement	-400 up to -430*	-400 up to -430*	-430* up to -450	-460* up to -550
	Light oil	Retirement	-1310	-1310	-1310	-1330
		Total	-1780 up to -2980*	-1780 up to -2980*	-1830 up to -2980*	-3650* up to -5660
GR00	**DSR**	Expansion	30	30	30	30
	Gas CCGT	Retirement	-3580 up to -3930*	-3980* up to -4110	-3980* up to -4110	-3460 up to -3510*
	Gas OCGT	Retirement	0	0	0	0
	Lignite	Retirement	-580* up to -590	0	0	0
		Total	-4140 up to -4480*	-3950* up to -4080	-3950* up to -4080	-3430 up to -3480*
GR03	**Light oil**	Retirement	-140	-140	-130 up to -140*	-130 up to -140*
		Total	-140	-140	-130 up to -140*	-130 up to -140*
HR00	**DSR**	Expansion	0	0	0	0* up to 30
	Gas CCGT	Retirement	-50 up to -90*	-50 up to -90*	-30 up to -70*	0

Study Zone	PEMMDB Technology	Decision Variable	2028	2030	2033	2035
	Gas OCGT	Retirement	-610 up to -650*	-620 up to -650*	0	0
	Hard coal	Retirement	-270* up to -280	-280	-280	0
	Heavy oil	Retirement	-290	-290	0	0
		Total	-1230 up to -1300*	-1240 up to -1310*	-310 up to -350*	0* up to 30
HU00	**DSR**	Expansion	0	0* up to 30	30* up to 40	40
	Gas CCGT	Life Extension	0	0* up to 50	0* up to 140	0* up to 540
	Gas CCGT	Retirement	-130 up to -280*	-130 up to -280*	-280* up to -290	0
	Gas OCGT	Retirement	0	0	0	0
	Hard coal	Retirement	-60* up to 0	-60* up to 0	-60* up to 0	-60* up to 0
	Light oil	Retirement	0	0	0	0
	Lignite	Retirement	-170	0	0	0
		Total	-300 up to -510*	-50 up to -340*	-110 up to -310*	-20* up to 580
IE00	**Gas CCGT**	Retirement	0	-80 up to -110*	-80 up to -110*	-80 up to -110*
	Gas OCGT	Retirement	0	0	0	-110
	Light oil	Retirement	0	-110* up to -140	-110* up to -140	-140 up to -160*
	Lignite	Retirement	0	0	0	-110
		Total	0	-220	-220	-440 up to -490*
ITCA	**Gas CCGT**	Retirement	-580	-580	-680	-770* up to -780
	Gas OCGT	Retirement	0	0	0	0
		Total	-580	-580	-680	-770* up to -780
ITCN	**Gas CCGT**	Retirement	-150 up to -210*	-230 up to -260*	-250 up to -260*	-250 up to -340*
	Gas OCGT	Retirement	0	0	0	0
	Light oil	Retirement	0	0	0	0

Study Zone	PEMMDB Technology	Decision Variable	2028	2030	2033	2035
		Total	-150 up to -210*	-230 up to -260*	-250 up to -260*	-250 up to -340*
ITCS	Gas CCGT	Retirement	-4790	-4790* up to -4800	-4790* up to -4800	-4840 up to -4870*
	Gas OCGT	Retirement	-80	-80* up to -90	-80* up to -90	-110
	Light oil	Retirement	-40	-40	-40	-70
		Total	-4910	-4910* up to -4930	-4910* up to -4930	-5020 up to -5050*
ITN1	Gas CCGT	Retirement	-8050* up to -8070	-8030* up to -8070	-8030* up to -8070	-8050* up to -8090
	Gas OCGT	Retirement	0	0	0	0
		Total	-8050* up to -8070	-8030* up to -8070	-8030* up to -8070	-8050* up to -8090
ITS1	Gas CCGT	Retirement	-2330	-2810* up to -2870	-2810* up to -2870	-2890 up to -3790*
	Gas OCGT	Retirement	-240 up to -260*	-260	-260* up to -280	-320* up to -340
		Total	-2570 up to -2590*	-3070* up to -3130	-3070* up to -3150	-3230 up to -4110*
ITSA	Hard coal	Retirement	0	0	0	0
	Light oil	Retirement	0	0	0	0
		Total	0	0	0	0
ITSI	Gas CCGT	Retirement	-580 up to -600*	-1460* up to -1470	-1460* up to -1520	-1940* up to -1960
	Gas OCGT	Retirement	0	0	0	0
		Total	-580 up to -600*	-1460* up to -1470	-1460* up to -1520	-1940* up to -1960
LT00	Gas CCGT	Retirement	0	0	0	0
	Gas OCGT	Life Extension	0	0 up to 90*	0 up to 90*	0 up to 90*
	Gas OCGT	Retirement	-70* up to -80	0	0	0
		Total	-70* up to -80	0 up to 90*	0 up to 90*	0 up to 90*
LV00	Gas CCGT	Retirement	0	0	0	0

Study Zone	PEMMDB Technology	Decision Variable	2028	2030	2033	2035
		Total	0	0	0	0
ME00	Lignite	Retirement	-210	-210* up to -220	-210* up to -220	-220
		Total	-210	-210* up to -220	-210* up to -220	-220
MK00	Gas CCGT	Retirement	0	0	0	-590
	Gas OCGT	Retirement	0	0	0	0
		Total	0	0	0	-590
MT00	Gas CCGT	Retirement	0	0	0	0
		Total	0	0	0	0
NL00	DSR	Expansion	410* up to 520	480* up to 1050	500* up to 1130	500* up to 1170
	Gas CCGT	Life Extension	0	2600	2600	2600
	Gas CCGT	Retirement	-1680 up to -1700*	-30 up to 0*	-30 up to 0*	0
	Gas OCGT	Retirement	0	0	0	0
		Total	-1160 up to -1290*	3080* up to 3620	3100* up to 3700	3100* up to 3770
NOS2	Gas OCGT	Retirement	0	0	0	0
		Total	0	0	0	0
NOS3	Gas OCGT	Retirement	0	0	0	0
		Total	0	0	0	0
PL00	Gas CCGT	Retirement	0	0	0	0
	Hard coal	Retirement	-2720 up to -3460*	-1760 up to -2510*	-650* up to 0	0
	Hydrogen CCGT	Expansion	0	0	1840* up to 1970	3090 up to 3710*
	Lignite	Retirement	-2940 up to -3010*	-2940 up to -3030*	-990 up to -1070*	0
		Total	-5660 up to -6470*	-4700 up to -5540*	120* up to 980	3090 up to 3710*

Study Zone	PEMMDB Technology	Decision Variable	2028	2030	2033	2035
PT00	DSR	Expansion	0	80* up to 440	100* up to 510	190* up to 730
	Gas CCGT	Retirement	-1770 up to -3060*	-1770 up to -3060*	-770 up to -2060*	-1270* up to 0
		Total	-1770 up to -3060*	-1330 up to -2980*	-260 up to -1960*	-1080* up to 730
RO00	DSR	Expansion	0	0	0* up to 30	0* up to 110
	Gas CCGT	Retirement	-1860 up to -1970*	-2130 up to -2210*	-2250* up to -2590	-3330 up to -3550*
	Gas OCGT	Retirement	-20* up to 0	-30 up to -80*	-30 up to -80*	-30 up to -90*
	Lignite	Retirement	-850	-850	0	0
		Total	-2710 up to -2840*	-3010 up to -3140*	-2330* up to -2590	-3250 up to -3640*
SE01	DSR	Expansion	150	150	300 up to 810*	790 up to 820*
	Gas OCGT	Retirement	-80	0	0	0
		Total	70	150	300 up to 810*	790 up to 820*
SE02	DSR	Expansion	50 up to 80*	160	450* up to 460	450* up to 460
		Total	50 up to 80*	160	450* up to 460	450* up to 460
SE03	DSR	Expansion	320* up to 360	1680* up to 2610	2520* up to 2620	2520* up to 2620
	Gas CCGT	Retirement	0	0	0	-150* up to 0
	Gas OCGT	Retirement	-20	-20	0	0
	Light oil	Retirement	-130	0	0	0
		Total	170* up to 210	1660* up to 2590	2520* up to 2620	2370* up to 2620
SE04	DSR	Expansion	70 up to 120*	610	610	610
	Gas CCGT	Retirement	-410* up to -420	0	0	0
		Total	-290* up to -350	610	610	610
SI00	DSR	Expansion	40	40	40	40

Study Zone	PEMMDB Technology	Decision Variable	2028	2030	2033	2035
	Gas OCGT	Retirement	-50 up to -80*	-50 up to -80*	-80	0
	Lignite	Retirement	-770	-500	-500	0
		Total	-780 up to -810*	-510 up to -540*	-540	40
SK00	**DSR**	Expansion	0* up to 30	0* up to 150	50* up to 180	110* up to 210
		Total	0* up to 30	0* up to 150	50* up to 180	110* up to 210
UK00	**Gas CCGT**	Retirement	-7570* up to -7580	-12650* up to -13690	-170	0
	Gas OCGT	Retirement	-10240* up to -10270	-2410 up to -2610*	-30	-20
	Heavy oil	Retirement	-670* up to -690	-210* up to -230	0	-80
		Total	-18480* up to -18540	-15470* up to -16330	-200	-100
UKNI	**Gas OCGT**	Retirement	0	0	0	0
	Light oil	Retirement	-80	-140 up to -200*	-140 up to -200*	-350 up to -360*
	Lignite	Retirement	0	0	0	0
		Total	-80	-140 up to -200*	-140 up to -200*	-350 up to -360*
Grand Total			**-66220 up to -72340***	**-43120 up to -51310***	**-12130* up to 6980**	**-7780* up to 14630**

2.1.2 Revenue analysis for thermal expansion units

This section assesses how new thermal investments in EVA depend on revenues earned during near-scarcity conditions. Because real-world decisions may not hinge solely on peak prices, it is important to track actual investment announcements and commissioning activity.

Figure 2 and Figure 3 show the percentage of revenues the new gas/hydrogen capacity receives during near-scarcity hours (dots), the installed capacity in MW on the specified TY, and the average capacity factor[6] (bars) over the researched horizon. As the new thermal capacity enters the market in 2030, 2033, and 2035, results include these TYs, based on the specific entry date in each study

[6] Capacity factor = yearly generation [GWh] / (NGC [GW] x 8,760 h)

zone. Near-scarcity hours are defined as hours where the price of electricity exceeds arbitrarily defined thresholds (500, 1,000 and 2,000 €/MWh). It follows that scarcity hours (hours with prices at the market price cap) are included in the count of near-scarcity hours.

Figure 3 highlights that weather conditions under WS 23 result in a significant number of near-scarcity events with high prices. This is due to WS23 featuring more adverse weather conditions than the two other selected representative WSs , which push the electricity system to its limits.[7] This is reflected by scarcity-driven revenues reaching high levels for combined cycle gas turbine (CCGT) investments in the modelling. In contrast, this is not the case under WS 27 and WS 35. Overall, the results indicate that these units do not rely on extreme prices. Rather, expansion decisions appear to be mostly driven by the adverse WS 23.

Figure 2 shows that extreme price spikes are muted in the results when risk aversion of the enhanced hurdle premium is combined with a revenue cap. As a result, investment signals are less tied to scarcity hours in any single WS and more broadly supported by elevated prices across all three WSs, with a significant share of revenues still earned above the 500 and 1,000 €/MWh thresholds. In other words, decisions no longer hinge on WS-specific tail events: they become more robust across weather conditions and less driven by rare, extreme prices, relying instead on consistently high prices rather than isolated spikes.

The characteristics of combined CCGT and hydrogen/open cycle gas turbines (OCGT) are also evident in the two figures. New hydrogen/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 hydrogen/CCGT units (despite slightly lower investment costs), making them peaking assets — available during occasional high-demand hours (low frequency, high revenue). By contrast, hydrogen/CCGT units, with lower marginal cost, are better suited for investments expecting more frequent dispatch.

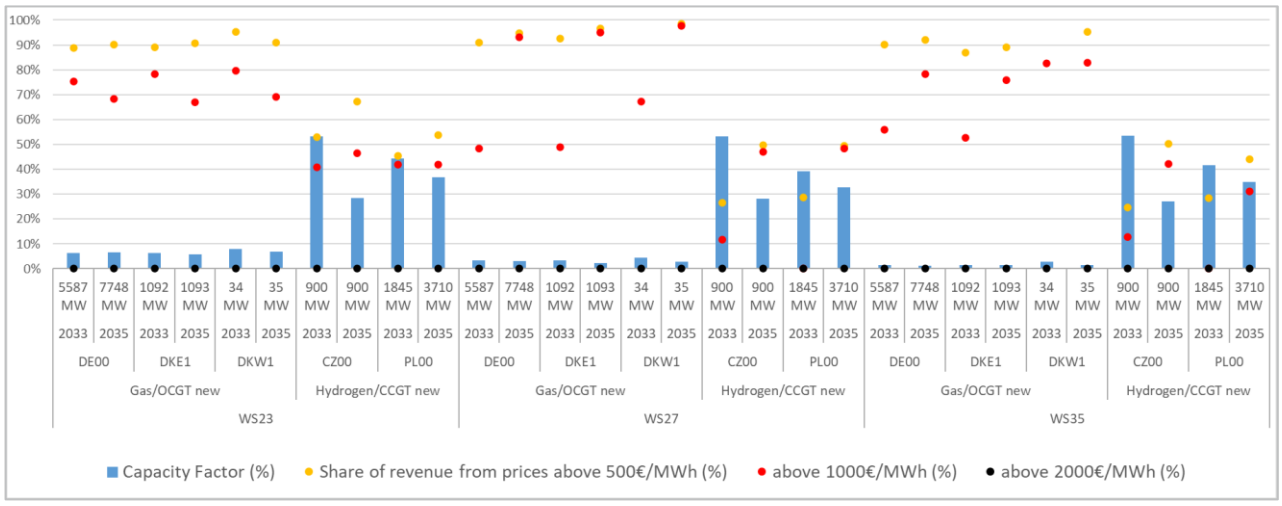


Figure 2: Scarcity revenues and average capacity factor (%) for new thermal capacity in the reference scenario with risk aversion with the enhanced hurdle premium combined with a revenue cap. (WSs 23, 25, and 35)

[7] For detailed information on the weather scenarios used in ERAA 2025 please see Annex 1, Section 3

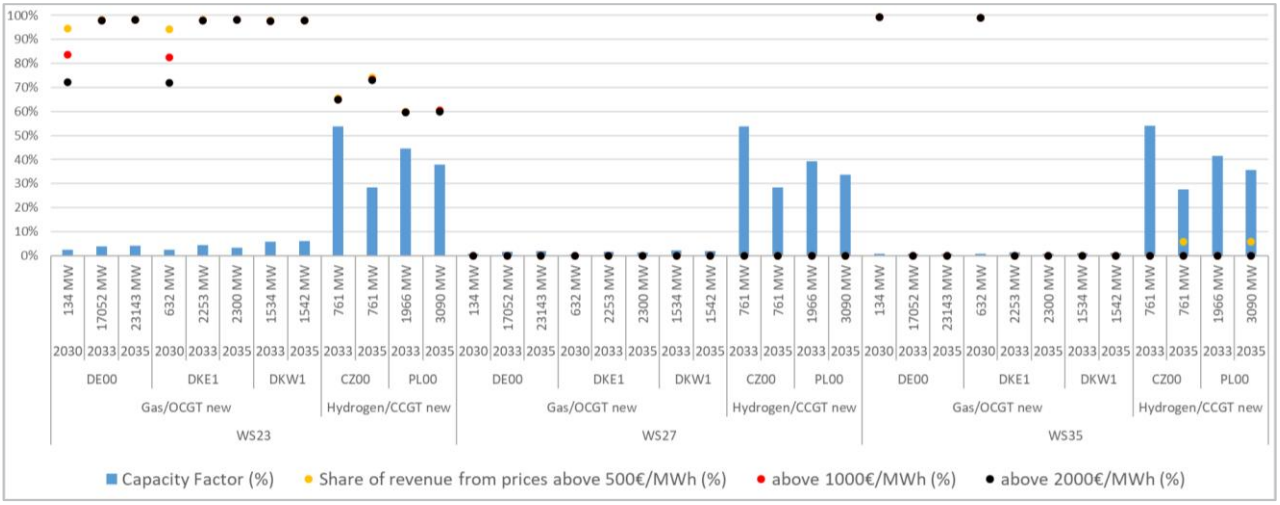


Figure 3: Scarcity revenues and average capacity factor (%) for new thermal capacity in the central reference scenario with risk aversion with the enhanced hurdle premium only(WSs 23, 25, and 35)

34In the central reference scenario with risk aversion with the enhanced hurdle premium only, most revenues from new CCGT units rely heavily on WS 23 near-scarcity events. An exception is capacity built in 2030 for Germany (DE00) and Denmark (DKE1), where dependence is relatively less extreme under WS 23: about 72% of revenues come from hours with prices exceeding 2,000 €/MWh, around 84% from >1,000 €/MWh, and about 95% from >500 €/MWh. For other target years, WS 23 concentrates revenues almost entirely in >2,000 €/MWh hours (≈97%). At the same time, WS 35 also contributes: in 2030 for DE00 and DKE1, revenues are even more concentrated in very high-price hours, with >99% earned when prices exceed 2,000 €/MWh.

For hydrogen CCGT, the pattern broadly repeats, with a strong reliance on WS23. However, WS 35 still adds a modest contribution in 2035 for CZ and PL, with roughly 6% of revenues earned at prices >500 €/MWh.

This shows that expansion outcomes are highly sensitive to WS 23's scarcity situations, but not exclusively so: in some target years, WS 35 also shapes the revenue mix.

2.1.3 Interpretation of EVA outcomes based on the chosen risk aversion approaches

The interdependencies described in the previous section align well with the chosen approaches to risk aversion.

The comparison of results indicates that investments in the construction of new CCGT power plants and a significant share of DSR applications can be considered less risky.

Even under the assumption that scarcity revenues only materialise to a limited extent, or are excluded from the evaluation at their theoretically possible level, these measures remain economically viable. An example of this can be seen in the hydrogen CCGT investments in Poland and Czechia, as well as the CCGT lifetime extensions in Belgium and Germany.

Across all study zones, particularly in the early years, it becomes evident that accounting for very high prices does influence the absolute level of installed capacity (e.g., 6.1 GW higher decommissioning in the central reference scenario with risk aversion using enhanced hurdle premiums combined with revenue cap in 2028).

However, when compared to the differences resulting from varying revenues in the phase of capacity expansion (22.3 GW less installed capacity in the central reference scenario with the enhanced hurdle premium combined with a revenue cap scenario in 2035), it can be concluded that decommissioning decisions are less dependent on rare scarcity revenues. Based on the largest differences in capacity addition decisions, it can be concluded that the economic viability of OCGT units in Germany from 2033 onwards (and to some extent also the DSR additions in various study zones) is most likely to be adversely affected by the "missing money" problem.

2.2 Adequacy results

The following sections provide insights into the detailed results per study zone, in addition to the model of the convergence quantifications. The reference scenario results are presented as a range, reflecting the inherent uncertainty of investor projections. The lower bound of the adequacy risks corresponds to when risk aversion is characterised by the hurdle premium only, and the upper bound corresponds to when risk aversion is characterised by the enhanced hurdle premium combined with a revenue cap.

Later 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 “one-time-in-20 years” occurrence, covering events with a lower likelihood but a higher impact on adequacy. The results account for both without and with the activation of already approved out-of-market (OOM) resources[8] (see Section 4.1 in Annex 1). Meanwhile, hourly results are published alongside the ERAA report.[9]

The 2028 results are presented below. There are respective tables listing the LOLE and LLD percentiles for each study zone and the same information aggregated for countries with multiple study zones. EENS results are presented further down.

Table 3: Study zone LOLE (average) and LLD percentiles for TY 2028 [without OOM resource/with OOM resource][10]

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
AL00	0.00	0.00	0.00
AT00	3.05-5.36*	0.00	28.10-42.05*
BA00	4.29-5.87*	0.00	46.05-62.00*
BE00	8.87-13.05*	0.00-2.00*	70.05-82.05*
BG00	8.68-15.22*	1.50-7.00*	65.05-73.00*

[8] 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.

[9] ERAA 2024 page: download section

[10] * marks results of central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
CH00	0.00	0.00	0.00
CY00	0.16-0.44*	0.00	0.00-5.00*
CZ00	12.97-18.83*	1.00-8.00*	71.00-83.00*
DE00	14.30-20.94*	2.50-10.00*	73.05-82.05*
DKE1	14.63-21.04*	4.00-10.00*	74.00-80.05*
DKW1	12.98-18.87*	0.00-6.00*	63.15-73.10*
EE00	24.11-25.76*	14.00-16.00*	85.00-89.00*
ES00	6.35-11.32*	3.00-6.00*	35.05-43.00*
FI00	1.27-2.23*	0.00	9.05-14.00*
FR00	6.56-9.17*	0.00	60.00-72.00*
GR00	4.32-8.47*	0.00-2.00*	43.05-58.10*
GR03	8.35-14.74*	1.00-7.00*	62.05-70.05*
HR00	0.00-0.01*	0.00	0.00
HU00	9.53-16.02*	1.00-8.00*	71.10-82.00*
IE00	1.61-2.13*	0.00	13.00-16.00*
ITCA	0.00	0.00	0.00
ITCN	11.86-16.50*	5.00-8.00*	68.05-82.00*
ITCS	14.10-18.97*	8.00-12.00*	66.05-80.00*
ITN1	6.97-10.10*	0.00-2.00*	55.05-65.05*
ITS1	9.49-12.82*	6.00-7.00*	30.05-39.00*
ITSA	5.11-6.67*	1.00-2.00*	33.00-41.15*
ITSI	10.38-13.53*	6.00-7.00*	47.00-54.10*
LT00	14.54-15.80*	0.00-1.00*	67.00-69.00*
LUG1	14.30-20.94*	2.50-10.00*	73.05-82.05*
LV00	0.03-0.04*	0.00	0.00
MD00	0.00-0.01*	0.00	0.00
ME00	0.00	0.00	0.00
MK00	1.01-1.65*	0.00	5.05*-6.00
MT00	12.56/1.76-13.87/1.98*	6.00/0.00-7.00/0.00*	53.15/11.00*-57.10/11.05
NL00	9.01-13.06*	0.00-4.00*	52.05-63.15*
NOM1	0.98-1.79*	0.00	7.00-11.00*
NON1	0.01-0.02*	0.00	0.00
NOS1	3.96-5.61*	0.00	19.00-26.00*
NOS2	0.00-0.01*	0.00	0.00
NOS3	0.03-0.04*	0.00	0.00
PL00	11.73/8.85-18.06/13.34*	0/0-8.00/1.00*	48/44-65.00/55.05*
PT00	0.82-6.31*	0.00-3.00*	4.05-28.05*
RO00	7.59-13.30*	1.00-6.00*	49.05-57.05*
RS00	2.49-3.37*	0.00	32.05-45.05*
SE01	0.02	0.00	0.00
SE02	0.00	0.00	0.00
SE03	1.40-2.48*	0.00	8.05-12.05*

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
SE04	6.50-9.33*	0.00-1.00*	36.05-39.05*
SI00	5.21-7.67*	0.00-1.00*	56.00-66.00*
SK00	4.42-7.39*	0.00-3.00*	30.00-38.00*
UKNI	0.61-0.85*	0.00	5.00-6.00*

Table 4: Country LOLE (average) and LLD percentiles for TY 2028 [without OOM resource/with OOM resource][11]

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
DK00	14.80-21.49*	4.00-10.00*	74.05-84.05*
ISEM	2.04-2.70*	0.00	15.00-17.10*
IT00	16.05-21.84*	9.00-14.00*	70.00-83.05*
LU00	14.30-20.94*	2.50-10.00*	73.05-82.05*
NO00	4.03-5.70*	0.00	19.05-26.00*
SE00	6.51-9.37*	0.00-1.00*	36.05-39.05*

The Table 5 lists the average EENS and ENS percentiles for each study zone, and

[11] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

Table 6 presents the countrywide average EENS and ENS percentiles for countries with multiple study zones.

Table 5: Study zone EENS (average) and ENS percentiles for TY 2028 [without OOM resource/with OOM resource][12]

Study zone	Average [GWh]	P50 [GWh]	P95 [GWh]
AL00	0.00	0.00	0.00
AT00	0.68-1.34*	0.00	7.26-13.51*
BA00	2.75-3.65*	0.00	26.94-36.84*
BE00	9.73-13.67*	0.00-0.07*	99.64-129.13*
BG00	2.32-4.35*	0.05-0.51*	24.28-39.32*
CH00	0.00	0.00	0.00
CY00	0.01-0.02*	0.00	0.00-0.10*
CZ00	7.91-11.12*	0.03-0.96*	50.01-57.48*
DE00	62.13-92.13*	0.32-12.84*	457.51-585.32*
DKE1	4.79-6.70*	0.17-1.29*	34.31-37.86*
DKW1	5.65-8.22*	0.00-1.07*	32.82-38.94*
EE00	4.06-4.62*	0.95-1.17*	18.42-20.20*
ES00	9.87-16.65*	0.94-5.23*	68.38-77.53*
FI00	0.59-1.01*	0.00	2.59-4.98*
FR00	20.93-29.32*	0.00	204.56-269.71*
GR00	1.15-2.12*	0.00-0.06*	10.54-23.42*
GR03	0.66-1.04*	0.02-0.21*	6.24-7.85*
HR00	0.00	0.00	0.00
HU00	5.90-9.41*	0.05-1.79*	67.12-83.12*
IE00	0.23-0.36*	0.00	1.52-2.96*
ITCA	0.00	0.00	0.00
ITCN	4.68-6.39*	0.52-1.28*	48.67-60.79*
ITCS	7.47-10.20*	1.75-3.52*	69.83-88.43*
ITN1	7.68-10.20*	0.00-0.45*	74.36-82.47*
ITS1	1.38-1.93*	0.31-0.51*	4.61-6.28*
ITSA	0.24-0.32*	0.01-0.02*	1.22-2.76*
ITSI	1.21-1.65*	0.20-0.40*	8.98-11.50*
LT00	2.55*-2.56	0.00	15.65-15.70*
LUG1	0.88-1.31*	0.00-0.18*	6.48-8.29*
LV00	0.00	0.00	0.00
MD00	0.00	0.00	0.00
ME00	0.00	0.00	0.00
MK00	0.10-0.22*	0.00	0.23-0.59*
MT00	1.06/0.07-1.21/0.08*	0.23/0.00-0.41/0.00*	4.97/0.49*-5.72/0.44
NL00	6.05-8.20*	0.00-0.41*	58.95-76.86*

[12] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

Study zone	Average [GWh]	P50 [GWh]	P95 [GWh]
NOM1	0.10-0.21*	0.00	0.44-1.00*
NON1	0.00	0.00	0.00
NOS1	1.06-1.57*	0.00	7.47-9.27*
NOS2	0.00	0.00	0.00
NOS3	0.00	0.00	0.00
PL00	14.14/10.66-23.23/17.69*	0/0-2.97/0.10*	67.65/55.88-92.72/77.53*
PT00	0.14-1.85*	0.00-0.57*	0.64-10.30*
RO00	2.93-5.11*	0.03-1.09*	24.41-35.46*
RS00	2.68-3.37*	0.00	36.77-47.05*
SE01	0.00	0.00	0.00
SE02	0.00	0.00	0.00
SE03	0.29-0.61*	0.00	1.52-4.10*
SE04	2.34-3.26*	0.00	12.75-15.15*
SI00	0.82-1.13*	0.00-0.01*	8.31-12.15*
SK00	0.27-0.54*	0.00-0.04*	1.93-2.93*
UKNI	0.04-0.07*	0.00	0.22-0.39*

Table 6: Country EENS (average) and ENS percentiles for TY 2028 [without OOM resource/with OOM resource][13]

Study zone	Average [GWh]	P50 [GWh]	P95 [GWh]
DK00	10.44-14.92*	0.33-2.26*	67.94-80.12*
ISEM	0.27-0.42*	0.00	1.61-3.05*
IT00	22.67-30.69*	4.16-8.42*	229.97-278.22*
LU00	0.88-1.31*	0.00-0.18*	6.48-8.29*
NO00	1.16-1.78*	0.00	8.18-10.39*
SE00	2.64-3.88*	0.00	13.74-17.07*

For TY 2030, Table 7 lists the average LOLE and LLD percentiles for each study zone, and Table 8 presents the countrywide average LOLE and LLD percentiles for countries with multiple study zones.

Table 7: Study zone LOLE (average) and LLD percentiles for TY 2030 [without OOM resource/with OOM resource][14]

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
AL00	0.00	0.00	0.00
AT00	1.63-3.17*	0.00	13.10-23.00*
BA00	1.93-2.36*	0.00	23.05-25.05*
BE00	9.35-17.03*	0.00-6.00*	58.00-73.05*
BG00	2.31-4.01*	0.00	27.05-45.05*
CH00	0.00	0.00	0.00
CY00	0.30-0.62*	0.00	3.00-6.00*
CZ00	18.46-29.06*	6.00-16.00*	63.05-83.05*
DE00	19.64-30.70*	7.00-16.00*	65.00-89.10*
DKE1	19.38-45.66*	7.00-35.00*	62.05-114.00*
DKW1	19.17-30.14*	6.00-15.00*	64.00-90.00*
EE00	13.12-13.66*	0.00	56.05
ES00	11.09-15.98*	5.00-10.00*	60.00-73.00*
FI00	1.56-2.77*	0.00	14.00-18.00*
FR00	6.54-10.14*	0.00	47.05-62.10*
GR00	2.13-2.60*	0.00	32.00-36.05*
GR03	3.26-4.61*	0.00	35.15-51.05*
HR00	0.01	0.00	0.00
HU00	5.08-8.52*	0.00	45.15-64.05*
IE00	2.05-2.84*	0.00	17.00-19.00*
ITCA	0.00	0.00	0.00
ITCN	5.41-7.53*	0.00	48.10-60.00*

[13] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.
[14] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
ITCS	3.25-3.91*	0.00	40.10-56.05*
ITN1	5.57-8.21*	0.00	46.05-59.10*
ITS1	1.01-1.06*	0.00	3.05*-6.05
ITSA	0.71-1.05*	0.00	4.00-13.00*
ITSI	1.96-2.34*	0.00	25.15-38.00*
LT00	15.93-17.26*	0.00-7.00*	60.00-63.00*
LUG1	19.64-30.70*	7.00-16.00*	65.00-89.10*
LV00	0.09	0.00	0.00*-1.00
MD00	0.00-0.02*	0.00	0.00
ME00	0.00	0.00	0.00
MK00	0.00-0.03*	0.00	0.00
MT00	0.92/0.01-1.18/0.04*	0.00	5.00/0.00-8.00/0.00*
NL00	12.04-19.71*	0.00-8.00*	52.05-70.10*
NOM1	2.82-5.18*	0.00	16.00-23.00*
NON1	0.03-0.20*	0.00	0.00-1.00*
NOS1	5.88-9.62*	0.00-3.00*	28.00-37.00*
NOS2	0.44-0.45*	0.00	2.00
NOS3	0.08-0.16*	0.00	0.00
PL00	14.38-23.25*	0-14*	57-70.1*
PT00	0.00-1.28*	0.00	0.00-7.00*
RO00	1.37-1.95*	0.00	12.05-18.00*
RS00	0.41-0.60*	0.00	0.00
SE01	0.19-0.28*	0.00	1.00-2.00*
SE02	0.00	0.00	0.00
SE03	3.12-6.58*	0.00-1.00*	16.00-23.00*
SE04	7.81-13.25*	0.00-6.00*	36.05-45.00*
SI00	2.98-4.69*	0.00	34.05-53.00*
SK00	2.95-5.86*	0.00-2.00*	16.05-28.00*
UKNI	1.06-2.03*	0.00	7.00-11.00*

Table 8: Country LOLE (average) and LLD percentiles for TY 2030 [without OOM resource/with OOM resource][15]

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
DK00	20.13-46.02*	7.00-35.00*	65.05-114.00*
ISEM	2.66-4.13*	0.00	19.00-22.00*
IT00	6.35-9.15*	0.00	48.15-64.00*
LU00	19.64-30.70*	7.00-16.00*	65.00-89.10*
NO00	5.98-9.90*	0.00-3.00*	28.00-37.00*
SE00	7.90-13.52*	0.00-6.00*	36.05-45.00*

[15] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

For TY 2030, Table 9 lists the average EENS and ENS percentiles for each study zone, and Table 10 presents the countrywide average EENS and ENS percentiles for countries with multiple study zones.

Table 9: Study zone EENS (average) and ENS percentiles for TY 2030 [without OOM resource/with OOM resource][16]

Study zone	Average [GWh]	P50 [GWh]	P95 [GWh]
AL00	0.00	0.00	0.00
AT00	0.28-0.63*	0.00	2.34-6.80*
BA00	1.22-1.39*	0.00	8.84*-8.89
BE00	5.25-11.94*	0.00-0.58*	48.32-97.83*
BG00	0.54-1.05*	0.00	5.62-10.86*
CH00	0.00	0.00	0.00
CY00	0.01	0.00	0.04-0.12*
CZ00	16.30-24.41*	1.21-8.90*	76.58-89.52*
DE00	88.02-145.72*	4.56-32.27*	467.70-693.13*
DKE1	4.24-14.42*	0.72-8.37*	18.42-48.71*
DKW1	9.82-16.82*	0.61-4.85*	42.02-65.13*
EE00	1.91-2.23*	0.00	9.72-11.52*
ES00	22.67-35.66*	4.69-12.49*	148.17-233.61*
FI00	0.61-1.21*	0.00	3.78-8.02*
FR00	21.56-31.46*	0.00	166.35-251.49*
GR00	0.75-0.83*	0.00	8.29-10.34*
GR03	0.32-0.45*	0.00	3.08-4.85*
HR00	0.00	0.00	0.00
HU00	2.71-4.59*	0.00	29.92-48.00*
IE00	0.28-0.39*	0.00	1.78-3.10*
ITCA	0.00	0.00	0.00
ITCN	2.71-3.77*	0.00	30.50-43.20*
ITCS	2.56-3.06*	0.00	33.20-46.57*
ITN1	9.40-12.46*	0.00	117.79-141.23*
ITS1	0.25-0.28*	0.00	0.33*-0.53
ITSA	0.03-0.06*	0.00	0.16-0.40*
ITSI	0.41-0.51*	0.00	4.61-5.61*
LT00	4.54-4.56*	0.00-0.43*	25.17-28.74*
LUG1	1.20-1.99*	0.06-0.44*	6.38-9.45*
LV00	0.00	0.00	0.00
MD00	0.00	0.00	0.00
ME00	0.00	0.00	0.00
MK00	0.00	0.00	0.00

[16] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

Study zone	Average [GWh]	P50 [GWh]	P95 [GWh]
MT00	0.04-0.06/0.00*	0.00	0.14/0.00-0.3/0.00*
NL00	8.85-15.91*	0.00-1.77*	79.92-130.52*
NOM1	0.45-0.87*	0.00	3.17-5.55*
NON1	0.00	0.00	0.00
NOS1	1.60-2.70*	0.00-0.10*	8.44-11.63*
NOS2	0.02-0.03*	0.00	0.03-0.05*
NOS3	0.00-0.01*	0.00	0.00
PL00	22.54-38.02*	0-5.81*	130.45-175.08*
PT00	0.00-0.22*	0.00	0.00-1.44*
RO00	0.30-0.46*	0.00	1.63-3.64*
RS00	0.25-0.42*	0.00	0.00
SE01	0.00	0.00	0.00-0.01*
SE02	0.00	0.00	0.00
SE03	0.62-1.38*	0.00	4.15-7.63*
SE04	2.51-4.04*	0.00-0.28*	12.46-17.62*
SI00	0.49-0.75*	0.00	5.58-9.38*
SK00	0.21-0.49*	0.00-0.04*	1.38-3.36*
UKNI	0.07-0.15*	0.00	0.48-0.93*

Table 10: Country EENS (average) and ENS percentiles for TY 2030 [without OOM resource/with OOM resource][17]

Study zone	Average [GWh]	P50 [GWh]	P95 [GWh]
DK00	14.07-31.24*	1.44-12.96*	61.62-110.67*
ISEM	0.35-0.55*	0.00	2.31-3.75*
IT00	15.35-20.13*	0.00	189.59-256.54*
LU00	1.20-1.99*	0.06-0.44*	6.38-9.45*
NO00	2.07-3.61*	0.00-0.12*	10.19-14.03*
SE00	3.14-5.43*	0.00-0.33*	16.22-21.99*

For TY 2033, Table 11 lists the average LOLE and LLD percentiles for each study zone, and Table 12 presents the countrywide average LOLE and LLD percentiles for countries with multiple study zones.

Table 11: Study zone LOLE (average) and LLD percentiles for TY 2033 [without OOM resource/with OOM resource][18]

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
AL00	0.00	0.00	0.00
AT00	4.09-12.32*	0.00-2.00*	28.05-51.05*

[17] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.
[18] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
BA00	1.23-1.92*	0.00	16.05-21.05*
BE00	12.64-34.19*	0.00-15.00*	85.05-183.00*
BG00	1.64-4.53*	0.00	23.05-54.05*
CH00	0.00	0.00	0.00
CY00	11.50-21.75*	6.00-15.00*	42.00-69.00*
CZ00	15.18-54.82*	0.00-42.00*	61.05-156.00*
DE00	19.85-78.57*	0.00-60.00*	89.00-211.00*
DKE1	7.02-75.35*	0.00-58.00*	29.05-205.00*
DKW1	19.83-79.50*	0.00-60.00*	88.10-213.05*
EE00	43.01*-43.68	30.00*-31.00	127.10*-136.00
ES00	6.37-11.45*	0.00-4.00*	32.00-54.00*
FI00	8.82-12.44*	0.00	46.05-53.05*
FR00	6.40-14.74*	0.00-2.00*	60.00-113.05*
GR00	1.79-3.19*	0.00	26.00-43.10*
GR03	8.98-16.82*	4.00-7.00*	39.00-62.10*
HR00	0.01-0.06*	0.00	0.00
HU00	3.08-8.93*	0.00-1.00*	33.00-52.10*
IE00	2.99-4.93*	0.00	24.10-26.10*
ITCA	0.00	0.00	0.00
ITCN	4.29-9.41*	0.00-1.00*	45.00-81.10*
ITCS	2.96-5.51*	0.00	43.00-66.10*
ITN1	6.20-14.16*	0.00-3.00*	53.05-85.05*
ITS1	0.87-1.53*	0.00	5.05-7.00*
ITSA	0.44-1.34*	0.00	4.00-14.05*
ITSI	1.38-2.27*	0.00	17.00-32.00*
LT00	38.58-46.95*	25.50-38.00*	119.05*-126.10
LUG1	19.85-78.57*	0.00-60.00*	89.00-211.00*
LV00	2.80-3.21*	0.00	14.00-16.00*
MD00	0.00-0.03*	0.00	0.00
ME00	0.00	0.00	0.00
MK00	0.06-0.14*	0.00	0.00
MT00	0.76/0.03-0.82/0.01*	0.00	4.05/0.00*-5.00/0.00
NL00	15.39-54.02*	0.00-30.00*	88.10-196.05*
NOM1	6.45-21.87*	0.00-17.00*	30.00-64.00*
NON1	0.44-1.05*	0.00	3.00-6.00*
NOS1	10.60-32.67*	0.00-22.00*	54.00-101.05*
NOS2	0.89-2.30*	0.00	4.00-14.00*
NOS3	0.00-0.08*	0.00	0.00-1.00*
PL00	12.18-38.75*	0-27*	56-102.05*
PT00	0.02-1.71*	0.00	0.00-8.00*
RO00	0.97-1.53*	0.00	10.00-11.05*
RS00	0.02-0.09*	0.00	0.00

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
SE01	0.35-0.89*	0.00	2.00-5.00*
SE02	0.00	0.00	0.00
SE03	8.54-28.62*	0.00-23.00*	36.00-75.05*
SE04	10.03-35.22*	0.00-25.50*	41.05-98.05*
SI00	2.19-5.84*	0.00	26.00-61.05*
SK00	6.11-20.29*	0.00-15.00*	35.05-57.00*
UKNI	1.15-2.88*	0.00	8.00-16.00*

Table 12: Country LOLE (average) and LLD percentiles for TY 2033 [without OOM resource/with OOM resource][19]

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
DK00	19.97-80.88*	0.00-62.00*	89.05-215.05*
ISEM	3.48-6.30*	0.00	26.00-32.00*
IT00	6.75-15.51*	0.00-3.00*	54.15-93.25*
LU00	19.85-78.57*	0.00-60.00*	89.00-211.00*
NO00	10.64-33.36*	0.00-22.00*	54.00-103.10*
SE00	10.31-36.33*	0.00-26.00*	42.00-99.00*

For TY 2033, Table 13 lists the average EENS and ENS percentiles for each study zone, and Table 14 presents the countrywide average EENS and ENS percentiles for countries with multiple study zones.

Table 13: Study zone EENS (average) and ENS percentiles for TY 2033 [without OOM resource/with OOM resource]20

Study zone	Average [GWh]	P50 [GWh]	P95 [GWh]
AL00	0.00	0.00	0.00
AT00	1.67-4.44*	0.00-0.06*	10.05-24.05*
BA00	0.53-0.92*	0.00	6.43-9.35*
BE00	10.99-35.20*	0.00-6.32*	97.29-249.05*
BG00	0.37-1.16*	0.00	4.13-13.26*
CH00	0.00	0.00	0.00
CY00	0.50-1.00*	0.18-0.48*	1.94-3.70*
CZ00	11.83-34.13*	0.00-17.94*	69.30-107.42*
DE00	93.94-568.23*	0.00-262.81*	564.57-2,114.94*
DKE1	0.46-20.59*	0.00-11.41*	2.27-70.43*
DKW1	13.38-92.88*	0.00-45.43*	73.21-343.70*
EE00	6.98-7.86*	3.22-3.31*	24.72-33.29*
ES00	11.21-20.44*	0.00-2.77*	45.69-103.47*

[19] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.
[20] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

Study zone	Average [GWh]	P50 [GWh]	P95 [GWh]
FI00	3.52-6.07*	0.00	21.69-32.67*
FR00	20.34-39.76*	0.00-0.15*	199.03-348.45*
GR00	0.59-1.09*	0.00	6.82-13.20*
GR03	0.58-1.06*	0.02-0.22*	2.81-4.63*
HR00	0.00	0.00	0.00
HU00	0.98-2.49*	0.00-0.05*	7.10-18.16*
IE00	0.45-0.81*	0.00	3.91-5.06*
ITCA	0.00	0.00	0.00
ITCN	2.45-4.06*	0.00-0.03*	29.30-44.93*
ITCS	2.56-3.75*	0.00	32.19-50.69*
ITN1	10.62-20.40*	0.00-0.43*	132.23-194.45*
ITS1	0.26-0.35*	0.00	0.48-0.63*
ITSA	0.02-0.08*	0.00	0.10-0.94*
ITSI	0.27-0.39*	0.00	2.17-4.84*
LT00	12.12-15.67*	4.03-6.38*	49.02-63.25*
LUG1	1.21-7.31*	0.00-3.38*	7.27-27.22*
LV00	0.08-0.11*	0.00	0.41-0.64*
MD00	0.00	0.00	0.00
ME00	0.00	0.00	0.00
MK00	0.01	0.00	0.00
MT00	0.04	0.00	0.11/0.00-0.12/0.00*
NL00	19.72-72.53*	0.00-17.54*	169.71-439.99*
NOM1	1.51-5.70*	0.00-2.37*	8.76-19.47*
NON1	0.00	0.00	0.00
NOS1	3.75-14.13*	0.00-7.00*	21.77-51.08*
NOS2	0.09-0.23*	0.00	0.24-1.60*
NOS3	0.00	0.00	0.00
PL00	21.47-66.07*	0-24.02*	154-263.66*
PT00	0.00-0.28*	0.00	0.00-2.34*
RO00	0.26-0.35*	0.00	1.55-2.44*
RS00	0.00-0.03*	0.00	0.00
SE01	0.01-0.03*	0.00	0.02-0.15*
SE02	0.00	0.00	0.00
SE03	4.09-18.51*	0.00-9.58*	22.29-63.69*
SE04	3.71-14.67*	0.00-7.77*	17.70-44.15*
SI00	0.47-1.03*	0.00	5.66-11.08*
SK00	0.85-2.80*	0.00-1.00*	6.17-11.95*
UKNI	0.09-0.22*	0.00	0.51-1.13*

Table 14: Country EENS (average) and ENS percentiles for TY 2033 [without OOM resource/with OOM resource][21]

Study zone	Average [GWh]	P50 [GWh]	P95 [GWh]
DK00	13.84-113.47*	0.00-54.76*	74.19-416.93*
ISEM	0.53-1.03*	0.00	3.92-6.69*
IT00	16.18-29.04*	0.00-0.59*	205.90-322.34*
LU00	1.21-7.31*	0.00-3.38*	7.27-27.22*
NO00	5.34-20.06*	0.00-9.91*	27.38-74.15*
SE00	7.81-33.21*	0.00-18.35*	39.08-107.64*

For TY 2035, Table 15 lists the average LOLE and LLD percentiles for each study zone, and Table 16 presents the countrywide average LOLE and LLD percentiles for countries with multiple study zones.

Table 15: Study zone LOLE (average) and LLD percentiles for TY 2035 [without OOM resource/with OOM resource][22]

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
AL00	0.00	0.00	0.00
AT00	4.18-13.49*	0.00-2.00*	38.00-64.10*
BA00	1.43-2.02*	0.00	21.00-22.05*
BE00	11.83-24.52*	0.00-8.00*	92.05-176.15*
BG00	0.54-2.75*	0.00	5.00-35.05*
CH00	0.00	0.00	0.00
CY00	21.64-39.70*	14.50-29.00*	68.00-113.10*
CZ00	21.42-68.09*	0.00-54.50*	79.00-173.20*
DE00	24.00-97.44*	0.00-79.50*	125.10-302.05*
DKE1	16.50-93.73*	0.00-77.00*	80.25-278.30*
DKW1	23.14-96.72*	0.00-80.00*	123.05-302.05*
EE00	14.68-15.54*	0.00	68.00-70.10*
ES00	9.06-18.61*	3.00-8.00*	45.00-83.05*
FI00	2.76-4.15*	0.00	28.05-32.00*
FR00	6.29-10.11*	0.00	67.00-114.00*
GR00	2.39-4.64*	0.00	36.10-67.20*
GR03	14.32-26.48*	6.00-16.00*	56.05-90.05*
HR00	0.01	0.00	0.00
HU00	3.28-12.42*	0.00-4.00*	35.05-77.15*
IE00	3.52-6.11*	0.00	32.00-38.00*
ITCA	0.00	0.00	0.00

[21] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.
[22] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
ITCN	4.69-9.33*	0.00	61.05-92.20*
ITCS	4.35-8.67*	0.00	59.05-91.05*
ITN1	4.70-8.65*	0.00	58.10-88.00*
ITS1	1.08-3.39*	0.00	6.00-26.00*
ITSA	0.65-2.11*	0.00	4.00-21.00*
ITSI	2.25-3.73*	0.00	29.05-42.00*
LT00	19.54-23.45*	0.00-8.00*	75.00-87.00*
LUG1	24.00-97.44*	0.00-79.50*	125.10-302.05*
LV00	2.47-3.44*	0.00	14.00-18.00*
MD00	0.01-0.21*	0.00	0.00-1.00*
ME00	0.00	0.00	0.00
MK00	0.76-0.99*	0.00	7.00-12.05*
MT00	1.31/0.03*-1.71/0.04	0.00	8.05/0.00-9.00/0.00*
NL00	17.87-62.60*	0.00-36.00*	109.10-244.20*
NOM1	2.41-6.13*	0.00	18.10-37.00*
NON1	0.15-3.91*	0.00	1.00-22.05*
NOS1	2.30-6.20*	0.00	16.00-39.00*
NOS2	0.00-0.06*	0.00	0.00
NOS3	0.01-0.24*	0.00	0.00-1.05*
PL00	21.76-48.95*	0-41*	67.05-116*
PT00	0.06-4.11*	0.00	0.00-31.00*
RO00	0.20-0.66*	0.00	1.00-5.00*
RS00	0.06-0.08*	0.00	0.00
SE01	0.26-1.27*	0.00	2.00-6.00*
SE02	0.00	0.00	0.00
SE03	4.40-11.67*	0.00-3.00*	23.05-51.00*
SE04	6.61-26.13*	0.00-18.00*	37.00-75.05*
SI00	2.70-8.43*	0.00	40.05-79.05*
SK00	9.26-26.61*	0.00-20.00*	42.00-73.05*
UKNI	2.95-5.46*	0.00	20.00-28.00*

Table 16: Country LOLE (average) and LLD percentiles for TY 2035 [without OOM resource/with OOM resource][23]

Study zone	Average [h/year]	P50 [h/year]	P95 [h/year]
DK00	23.76-98.76*	0.00-84.00*	123.05-305.15*
ISEM	4.43-7.87*	0.00	33.10-41.05*
IT00	5.13-10.01*	0.00	63.05-97.05*
LU00	24.00-97.44*	0.00-79.50*	125.10-302.05*
NO00	2.91-11.24*	0.00-3.00*	20.05-56.00*

[23] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

SE00	6.86-27.18*	0.00-20.00*	37.00-77.00*

For TY 2035, Table 17 lists the average EENS and ENS percentiles for each study zone, and Table 18 presents the countrywide average EENS and ENS percentiles for countries with multiple study zones.

Table 17: Study zone EENS (average) and ENS percentiles for TY 2035 [without OOM resource/with OOM resource][24]

Study zone	Average [GWh]	P50 [GWh]	P95 [GWh]
AL00	0.00	0.00	0.00
AT00	1.32-3.99*	0.00-0.08*	14.11-26.78*
BA00	0.77-1.16*	0.00	8.43-9.76*
BE00	10.27-26.23*	0.00-0.58*	108.70-280.36*
BG00	0.06-0.39*	0.00	0.21-4.57*
CH00	0.00	0.00	0.00
CY00	1.09-2.15*	0.54-1.32*	3.97-6.90*
CZ00	16.78-41.24*	0.00-22.97*	74.12-109.98*
DE00	130.72-888.17*	0.00-510.84*	688.57-3,343.67*
DKE1	2.05-42.92*	0.00-28.76*	10.78-145.54*
DKW1	17.61-131.20*	0.00-78.89*	102.54-504.35*
EE00	2.61-3.36*	0.00	13.82-19.34*
ES00	16.91-36.41*	1.15-7.95*	78.29-182.31*
FI00	1.02-1.88*	0.00	8.29-19.58*
FR00	20.79-26.97*	0.00	238.18-332.08*
GR00	1.34-2.53*	0.00	17.17-38.32*
GR03	0.92-1.72*	0.21-0.62*	4.10-6.84*
HR00	0.00	0.00	0.00
HU00	1.01-3.96*	0.00-0.23*	9.18-31.74*
IE00	0.72-1.23*	0.00	5.54-8.32*
ITCA	0.00	0.00	0.00
ITCN	2.87-5.01*	0.00	37.41-69.35*
ITCS	3.43-6.00*	0.00	37.66-69.59*
ITN1	9.44-14.98*	0.00	124.46-201.04*
ITS1	0.23-1.07*	0.00	0.55-6.03*
ITSA	0.03-0.14*	0.00	0.17-1.11*
ITSI	0.44-0.73*	0.00	5.54-11.27*
LT00	6.97-8.86*	0.00-0.85*	41.48-47.78*
LUG1	1.64-11.16*	0.00-6.42*	8.65-42.01*
LV00	0.09-0.17*	0.00	0.62-0.99*
MD00	0.00	0.00	0.00-0.03*

[24] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

Study zone	Average [GWh]	P50 [GWh]	P95 [GWh]
ME00	0.00	0.00	0.00
MK00	0.16-0.25*	0.00	0.99-3.14*
MT00	0.07/0.00*-0.10/0.00	0.00	0.37/0.00-0.39/0.00*
NL00	19.90-82.46*	0.00-18.64*	160.36-507.62*
NOM1	0.71-2.12*	0.00	2.01-14.80*
NON1	0.00	0.00	0.00
NOS1	0.46-1.39*	0.00	1.64-8.86*
NOS2	0.00	0.00	0.00
NOS3	0.00	0.00	0.00
PL00	56.59-111.21*	0-53.34*	298.66-349.08*
PT00	0.00-0.59*	0.00	0.00-4.09*
RO00	0.06-0.17*	0.00	0.06-0.78*
RS00	0.03-0.04*	0.00	0.00
SE01	0.00-0.01*	0.00	0.00-0.05*
SE02	0.00	0.00	0.00
SE03	1.31-5.17*	0.00-0.02*	6.68-38.38*
SE04	1.88-6.01*	0.00-0.79*	12.61-32.86*
SI00	0.62-1.47*	0.00	7.73-17.44*
SK00	2.07-5.80*	0.00-2.70*	14.55-22.86*
UKNI	0.23-0.43*	0.00	1.68-2.79*

Table 18: Country EENS (average) and ENS percentiles for TY 2035 [without OOM resource/with OOM resource][25]

Study zone	Average [GWh]	P50 [GWh]	P95 [GWh]
DK00	19.66-174.12*	0.00-109.09*	113.91-652.45*
ISEM	0.95-1.66*	0.00	7.02-11.36*
IT00	16.45-27.91*	0.00	206.24-383.61*
LU00	1.64-11.16*	0.00-6.42*	8.65-42.01*
NO00	1.17-3.51*	0.00	3.41-22.39*
SE00	3.19-11.18*	0.00-0.86*	18.30-74.61*

2.2.1 Convergence of results

The results are considered stable when the impact of additional simulation (such as an additional forced outage sample or WS) 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 4 below.

[25] * marks results of the central reference scenario with the enhanced hurdle premium combined with a revenue cap. The other value refers to the results of the central reference scenario with the enhanced hurdle premium only. If a single value is reported, both scenarios are identical for the specified TY and technology.

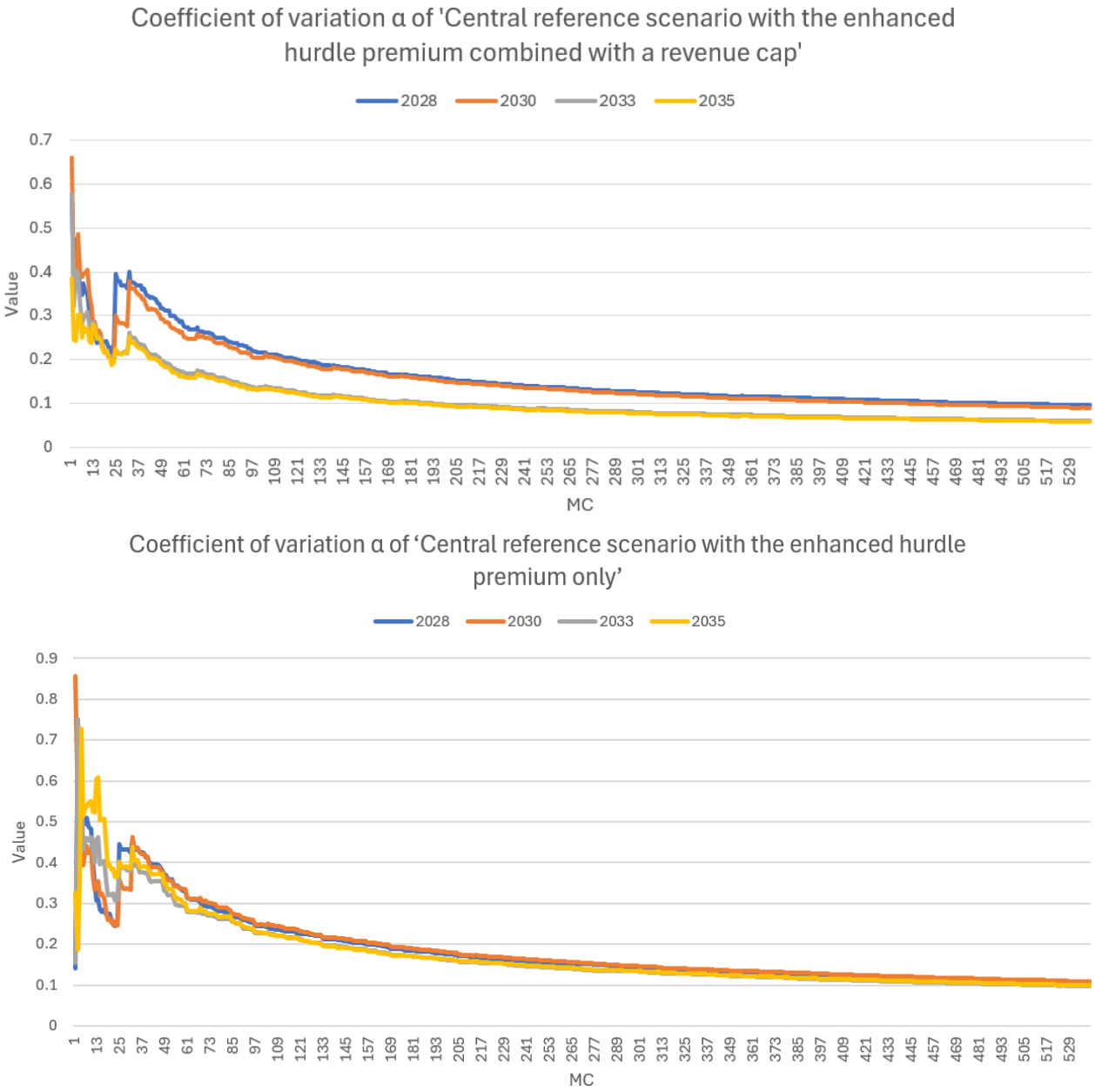


Figure 4: Coefficient of variation α

2.2.2 Changes in the number and distribution of scarcity events from ERAA 2024 to ERAA 2025

Differences in results across ERAA editions are driven by input data updates and modelling enhancements. Input data updates inform the models with recent developments or policy revisions and are essential for keeping simulation results meaningful and up-to-date. Modelling enhancements are included, when feasible and relevant, to reflect the latest developments and needs identified through ongoing exchanges with internal and external stakeholders, while aiming to improve the quality and robustness of the results.

Compared to ERAA 2024, three notable methodological enhancements were introduced in the EVA context: a refined WS selection, an enhanced hurdle premium calculation methodology, and a revenue cap. All enhancements increase the quality and robustness of ERAA 2025. An extended dataset (net revenues from EVA technologies extracted from the full ERAA 2024 post-EVA economic dispatch (ED) results was used for the weather selection to ensure better representativity by considering information from all TYs (previously only one) and from all possible forced outage scenarios (previously only one). The hurdle premium calculation methodology enhancement provides more tailored representative hurdle premium rates for gas-fuelled new OCGT and CCGT investments in ERAA by leveraging a utility-based approach using the constant absolute risk aversion (CARA) function. The CARA utility function approach is a standard method of including risk considerations in investment modelling, significantly impacting hurdle rates and differentiating technologies like OCGT and CCGT based on their revenue distribution over the full ERAA 2024 ED results. The revenue cap was introduced based on the observed cumulative probability of ERAA 2024 ED hourly market prices and benchmarked against historical day-ahead prices to extrapolate a distribution and derive reliable revenue expectations from the perspective of rational investors, as highlighted by the majority of respondents to the latest ENTSO-E investor survey.[26] The analysis showed that a threshold of 1.000 €/MWh could effectively capture more than 99.85% occurrences of hourly prices.

Investments in gas-fuelled generation capacities are expected to be more conservative compared to ERAA 2024 due to the hurdle update. The revenue cap generally affects EVA results by proposing a less optimistic viability of generation capacity than the one implicit into the long-term (quasi) equilibrium reached by the overall cost EVA model, where the optimal viable capacity tends to align with a range of price spike hours equal to the ratio between the modelled market price cap (up to 7.500 €/MWh in 2035) and the CONE of the marginal technology in each area. The objective of the revenue cap is therefore a simple yet effective attempt to prevent investment decisions from being based on extremely high but extremely rare and uncertain revenues driven by a few price spike hours, occurring only under very specific circumstances, e.g. extreme climate or outage conditions. Complete information on the methodology and it's changes are provided in Annex 2.

[26] The results of this survey were published by ENTSO-E and can be found at the following link: https://eepublicdownloads.blob.core.windows.net/public-cdn-container/clean-documents/sdc-documents/ERAA/ERAAMethodology_InvestorSurvey_Results_Publication.pdf