Capacity Remuneration Mechanism (CRM)

Best New Entrant Net Cost of New Entrant, 2026/27

Decision Paper

SEM-23-016

31 March 2023

Executive Summary

The Capacity Market Auction Price Caps (APCs) are currently defined within the capacity market regime with reference to the Best New Entrant Net Cost of New Entry (BNE Net CONE).

The SEM Committee published a consultation on 20 October 2022, Best New Entrant Net Cost of New Entry (BNE-Net CONE) Consultation Paper (SEM-22-076), setting out the results of a draft report prepared by independent consultants CEPA/Ramboll (SEM-22-076a), which was published alongside the consultation.

The consultation paper invited industry feedback on the assessment of the BNE Net CONE from CEPA\Ramboll for CY 2026/27.

Significant feedback was received from industry and TSOs arguing that CEPA/Ramboll had under-estimated BNE Net CONE and Gross CONE due to, inter alia:

1. Over-estimation of potential revenues, particularly in the case of IMR estimate for a CCGT, which did not take into account the effect of energy transition, which may result in reduced running in later years;
2. Under-estimation of investment costs, including under-estimating the effects of recent inflation on capex costs; and
3. Under-estimation of Weighted Average Cost of Capital (WACC).

The TSOs also argued that the CCGT used for BNE evaluation should be based on a multiple shaft CCGT with a by-pass stack, which would allow the CCGT to operate more flexibly in accordance with the needs of the system during the energy transition.

Following receipt of this feedback, CEPA/Ramboll made a number of updates, of which the following had the most material impact on Gross CONE and Net CONE estimates:

- Updated IMR estimation approach to take account of reduced running of thermal units by 2030 – this reduced the IMR of a CCGT by €48/kWd/year, but had limited effect on OCGTs, which had limited running, even in 2026/27;
- Updated investment costs estimates – including more recent inflation, and basing the CCGT estimates on a multi-shaft CCGT with a by-pass stack, a change endorsed by the SEM Committee.

Following the updates, the Net CONE estimates of all four reference technologies increased in both jurisdictions, making an OCGT in Ireland the lowest Net CONE and Gross CONE. The SEM Committee has approved the final CEPA/Ramboll study results, including:

- a Net CONE of €107.03/kWd/year based on an OCGT in Ireland (as opposed to the estimate in previous study of €58.31/kWd/year based on a CCGT in Ireland); and
- a Gross CONE of €115.99/kWd/year, also based on an OCGT in Ireland (as opposed to the estimate in previous study of €96.42/kWd/year based on an OCGT in Ireland).

The SEM Committee recognises that uncertainty exists around these estimates, particularly related to the running regime and hence IMR of thermal units, as Ireland and Northern Ireland is transitioning to low carbon economy and net zero. However, the IMR estimates have little impact on the IMR of an OCGT, the BNE Net CONE unit and thus, have a minimal impact on the Net CONE estimate of €107.03/kWd/year.

The SEM Committee notes the TSOs' desire to see flexible multi-shaft CCGTs built and recognises the role that they may play in the transition to the low carbon economy, having many of the flexibility benefits of an OCGT coupled with the greater efficiency benefits of a CCGT.

During previous auctions, the APC was set at 1.5 times the Net CONE. The SEM Committee set the APC for T- 4 2026/27 auction at €180/kWd/year (SEM-23-009), a level in excess of 1.5 x the new Net CONE. This was set in order to provide certainty to auction bidders and in the context of the litigation regarding Annual Run Hour Limits, which has now been resolved. The SEM Committee will continue to balance its objectives, including security of supply and mitigating market power when setting APC for future auctions. For the 2027/28 T-4 auction, the SEM Committee has decided to set the APC at 1.5 times the revised Net CONE, which equates to €163.757/kWd/year, including an inflation adjustment of 2% from 2026/27 to 2027/28 as set out in T-4 2027/28 IAIP.

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1. Introduction

1.1 Background

The SEM capacity market (or the Capacity Remuneration Mechanism (**CRM**)) is an auction-based mechanism where the most competitive capacity is most likely to be successful. The CRM seeks to identify the economically efficient combination of quantity and price of capacity. The target volume of capacity required for a capacity year is determined by the SEM Committee in advance of the relevant auction, based on future capacity requirements in the SEM. The capacity market auction price caps are currently defined within the capacity market regime with reference to the Best New Entrant Net Cost of New Entry (**BNE Net CONE**).

The SEM Committee published a consultation on 20 October 2022, *Best New Entrant Net Cost of New Entry (BNE-Net CONE) Consultation Paper* (SEM-22-076) (the **Consultation Paper**), inviting industry feedback on the assessment of the BNE Net CONE from CEPA\Ramboll for CY 2026/27 (SEM-22-076a) (hereafter, **BNE Assessment Paper**) which was published alongside the consultation paper.

The BNE Assessment Paper details estimates for the various capital and recurring fixed costs a rational investor would incur in the process of entering the SEM with a new generation unit through Capacity Auction T-4 2026/2027. By combining the recurring costs with annuitised fixed costs, and netting off market revenues, a Net CONE was estimated for a number of reference technologies considered as likely new entrants to the market.

The BNE Net CONE rate is set in advance of a capacity auction by the SEM Committee and is used to calibrate the Auction Price Caps (**APC**), the Existing Capacity Price Cap (**ECPC**) and the Demand Curve for each capacity auctions. These parameters are generally finalised in the Initial Auction Information Pack (**IAIP**). In the T-4 2026/2027 IAIP, the SEM Committee stated that the APC may be reviewed and updated in the Final Auction Information Pack (**FAIP**), based on the results from this BNE study. As the publication of this BNE Decision Paper was delayed due to the litigation regarding Annual Run Hour Limits, the SEM Committee published a Note[1] confirming the value of the APC for T-4 2026/27 at €180/kWd/year. This litigation is

[1] SEM-23-009, https://www.semcommittee.com/publications/sem-23-009-update-202627-t-4-auction-participants-auction-price-cap-value

now resolved, and has no impact on the BNE calculations. The publication of the revised BNE Net CONE value in this document has no impact on the T-4 2026/27 APC.

1.2 Purpose of this Decision Paper

This Decision paper summarises the BNE Net CONE assessment and decisions made by the SEM Committee, based upon views from the consultation responses and the updated analysis by CEPA\Ramboll. The detailed analysis carried out by CEPA\Ramboll, after considering the responses to the Consultation is published alongside this Decision paper (SEM-23-016a) (the **Revised BNE Assessment Paper**).

It should be noted that in general, the methodology applied is consistent with that used for the previous BNE calculation (SEM-18-025), as well as for the Capacity Payment Mechanism under the previous market arrangements, while also having regard to the ACER Methodology on the calculation of VoLL, CONE and RS (ACER Decision No. 23/2020).

The SEM Committee is of the view that the lowest Net CONE value should represent the Best New Entrant as it provides an appropriate expectation of a rational investor within a competitive capacity auction process whilst also being mindful of the need to protect consumers. The SEM Committee is also mindful of the current market situation where the market is moving towards achieving higher RES-E penetration targets and lower carbon budgets which has been flagged in the Consultation Paper as well as in the responses received.

Each chapter of this Decision paper sets out a summary of the consultation proposal, provides a summary of responses received, and sets out the SEM Committee's response and decision.

1.3 Responses to Consultation

A total of 15 responses were received to the Consultation Paper from the following entities. The non-confidential copies of these responses are published alongside this Decision paper.

- Andy Frew
- ART Generation
- Bord Gais Energy
- Bord na Mona
- DRAI
- EAI
- Echelon Data Centres
- Energia
- Energy Storage Ireland
- EPUKI
- ESB GT
- Kilshane Energy Ltd
- Shannon LNG
- SSE
- TSOs (EirGrid/SONI)

2. High-Level Consultation Feedback

The feedback received to the Consultation Paper broadly fell into two categories; the first primarily focused on the wider policy context within which the assessment has been carried out, and the second, detailed commentary on the parameters of the CEPA\Ramboll report and its assessment. In the sections below, the detailed feedback on specifics of the assessment are outlined, with some commentary from the SEM Committee and clarification of the SEM Committee position where appropriate. Many of the issues raised by respondents are accounted for in the Revised BNE Assessment Paper, with accompanying commentary from CEPA\Ramboll.

A significant proportion of the feedback from industry relates to the methodology itself, rather than the underlying assumptions, and whether it fully reflects the policy drive to decarbonisation in the two jurisdictions – specifically, the commitment from the UK Government to Net Zero by 2050, and the Government of Ireland's recent Sectoral Carbon Emissions Ceilings, and accompanying Climate Action Plans. The issues raised included questions relating to the need to potentially convert gas-fired units to hydrogen within the economic life of the unit, and whether indeed natural gas burning would continue to be permitted in an unabated form in future. Second-order issues relating to these wider questions were also raised, in particular, around the uncertainty in the Infra-Marginal Rent (**IMR**), unit running costs and running hours, which may impact on the modelled assumptions around system service revenues.

The Government of Ireland is in the process of developing its hydrogen strategy, with a consultation published in July 2022. Once the strategy is complete, it is likely that a significant amount of work needs to be undertaken before there is sufficient information which would inform timelines, market arrangements and investment requirements, and hydrogen costs/prices at the level of detail that is required to inform a quantitative study such as the BNE study.

Ireland sources around one-quarter of its gas from the Corrib gas field, and three-quarters via the UK, which has diverse sources of supply. From 2025 onwards, it is possible that natural gas imported via the UK may contain hydrogen blends (including blue or low-carbon hydrogen), which could be a factor in the deployment of hydrogen

in the Irish energy system if imported from the UK[2]. Therefore to some extent, investors on the island of Ireland may have to consider timelines decided in GB while developing plans for new power plants.

These issues prompted many respondents to encourage the SEM Committee to initiate a review of the BNE methodology itself, and how the results are used in the SEM. The SEM Committee recognizes these challenges but notes that the uncertainties cited by respondents, which relate to the evolution of arrangements over the next ten to twenty years, are unlikely to be materially resolved in short term. Whilst some arrangements may become clearer, significant uncertainty is still likely to persist over the next couple of years from now.

The SEM Committee also notes that Article 9 of ACER Decision 23-2020 Annex 1 requires the entity calculating CONE (the SEM Committee in the case of the SEM) to calculate CONE at least every five years, or earlier where it observes a significant change. The SEM Committee last calculated CONE in September 2018, so is required to re-calculate CONE in 2023, despite the uncertainties that pertain, and will continue to pertain throughout 2023 and beyond. For the above reasons, the SEM Committee is going to proceed with the publication of the current study, but may update the study significantly sooner than the end of the next five-year term in 2028, if and when material new information about the longer-term outlook becomes available.

The SEM Committee will reflect on this feedback and the potential for amendments to the methodology as part of the finalisation of its work on the next steps on the EY Report (SEM-22-054).

[2] See p21 https://www.gov.ie/en/consultation/5c087-consultation-on-developing-a-hydrogen-strategy-for-ireland/

3. Reference Technologies

The first step in the BNE Net CONE assessment is to propose suitable technology options, applicable for use in the Capacity Market for auctioning capacity for the capacity year 2026/2027.

3.1 Consultation Summary

A long-list of all available technology options which might reasonably be considered as candidate plants for a capacity auction were considered against ACER's requirements from its methodology for calculating the cost of new entry. This list included: aggregated generating units (AGUs); battery energy storage systems (BESS); compressed air energy storage (CAES); demand side units (DSUs); flywheels; interconnectors; pumped storage; combined cycle gas turbines (CCGT); open cycle gas turbines (OCGT); and reciprocating engines.

Out of these technologies, the following generation technologies were short listed for consideration in the BNE Assessment Paper, on the basis that they met the ACER requirements and, subject to further analysis had a reasonable chance of being least cost.

Table 1: Reference technology types and sizes in BNE Assessment Paper

Technology type	Unit size	Reference unit
CCGT (single shaft)	Approximately 450 MW - 500 MW	AE 94.3A GE 9F.04 Siemens SGT5-4000F
Open cycle gas turbine	Approximately 200 MW	SGT5-2000E
Reciprocating engines	Approximately 200 MW	
BESS	100 MW/200 MWh	

3.2 Summary of Responses

A wide range of feedback was received on the technology choice. A number of respondents noted that the choice of reference CCGT/OCGT/gas engines were not necessarily hydrogen or renewable gas ready. The TSOs, amongst a number of other respondents, argued that it is essential that any investment in new fuel burning capacity should be future-proofed to meet the enduring security of supply needs. For

example, they argued that new gas turbines or engines should be renewable gas ready and the incremental CAPEX for this should be factored into any design.

The TSOs also argued that it is necessary to incentivise CCGT units. Where possible, these need to be flexible through multi-shaft design with a by-pass stack instead of a single shaft. However, the TSOs also stated that they "do not believe we should diverge from the broader principle of choosing the technology with the lowest net CONE as the reference technology."

The TSOs also mentioned that a "balanced portfolio" of onshore and offshore renewables, new renewable gas ready flexible CCGTs and unrestricted OCGTs, long duration batteries, highly available demand side management, and interconnection complimented by low carbon inertia services are needed to enable the delivery of a secure transformation to an emission target compliant power system. The TSOs argued that the SEM Committee should give strong consideration to technology specific auctions to ensure that a balanced portfolio is delivered.

More generally, the EAI and a number of market participants stated that there is a high degree of uncertainty faced by different technologies and there are challenges of adapting to a world of renewable gas, and proposed to:

- Complete an interim review of price caps for the forthcoming auction only (since the APC and ECPC are based on Net CONE); and
- Undertake a separate, holistic and future looking review of BNE and BNE alternatives in 2023.

A small number of market participants argued that the existing consultation paper should be withdrawn, pending a longer-term review, due to high level of uncertainty.

3.3 SEM Committee Response

The SEM Committee notes that investors in the SEM, like investors in many other European energy markets face significant uncertainty at this current time. In particular, it is likely that any investor in natural gas burning plant will face the need to either fit carbon capture and/or convert to burning either a mix of hydrogen and natural gas or convert to burning 100% green hydrogen within the lifetime of the asset (i.e. within 20 years of 2026/27).

The SEM Committee also notes the comments that there are no commercially available generation units that are capable of burning 100% or nearly 100% hydrogen blends currently, although some commercially available units are capable of handling hydrogen/natural gas blends with lower proportions of hydrogen[3]. Thus, the term "hydrogen ready" is not clearly defined, and may not be defined for a number of years. This view was supported by market participants and CEPA\Ramboll.

The SEM Committee notes the TSOs' preference for a more flexible multi-shaft CCGT with a by-pass stack, which would allow the open cycle element of a CCGT to operate independently and more flexibly than a single-shaft CCGT. CEPA\Ramboll advise that a multi-shaft CCGT is likely to have an investment cost approximately €30m greater than a single-shaft CCGT. The SEMC also notes that the TSOs stated that they do not believe that the capacity auction process should diverge from the broader principle of choosing the technology with the lowest Net CONE as the reference technology.

Following the consultation, CEPA\Ramboll has updated the CCGT reference unit to a multi shaft arrangement with a by-pass stack. However, CEPA/Ramboll have decided not to include any specific requirements in respect of hydrogen readiness, given the lack of precision of what hydrogen readiness means and the lack of certainty over costs.

3.4 SEM Committee Decision

After careful consideration of the responses to the Consultation Paper and discussions with market participants, the SEM Committee has accepted the updated CEPA/Ramboll recommendations with respect to the choice of reference technologies.

[3] During the technology selection process, CEPA/Ramboll considered the issue of hydrogen readiness and found that turbine manufacturers tend to identify tolerance for hydrogen mixes with 60-70% hydrogen content by volume, with ambition to reach 100% hydrogen firing in the coming years.

4. Gross CONE

Once the reference technologies were selected, the next step was to estimate the capital investment and annual fixed costs associated with that technology.

4.1 Consultation Summary

CEPA\Ramboll estimated the capital investment required for each of the four reference technologies in Ireland and Northern Ireland, with the results set out in Table 2. These estimates are for the current year, 2022/23.

Table 2: Summary of capital fixed costs, (€m)

Technology type	CCGT		OCGT		Engines		BESS	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
EPC contract	315.90	313.60	79.10	77.80	173.10	167.20	62.60	61.60
Site procurement cost	0.49	0.55	0.18	0.20	0.20	0.22	0.18	0.20
Electrical connection costs	6.75	6.81	6.75	6.81	6.75	6.81	6.75	6.81
Water connection	0.97	0.97	0.67	0.67	0.67	0.67	0.67	0.67
Gas connection	4.80	4.80	3.80	3.80	3.00	3.00	-	-
Owners contingency	15.80	15.68	3.96	3.89	8.66	8.36	3.13	3.08
Financing	6.32	6.27	1.58	1.56	3.46	3.34	1.25	1.23
Construction insurance	2.84	2.82	0.71	0.70	1.56	1.50	0.56	0.55
Initial Fuel working capital	5.76	5.76	2.24	2.24	1.76	1.76	-	-
Other non-EPC costs	28.43	28.22	7.12	7.00	15.58	15.05	4.38	4.31
Interest During Construction	7.25	6.54	1.99	1.47	4.05	2.94	1.51	1.11
Accession fee[4]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

[4] Figures are less than 0.01 when rounded to two decimal places.

Technology type	CCGT		OCGT		Engines		BESS	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
Participation fee[5]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total, €m	**395.31**	**392.02**	**108.10**	**106.14**	**218.78**	**210.85**	**81.03**	**79.58**

CEPA\Ramboll then estimated the recurring costs per year for each of the four reference technologies, in Ireland and in Northern Ireland. The 2022/23 values are shown in Table 3.

Table 3: Summary of recurring costs, (€m/year)

Technology type	CCGT		OCGT		Engines		BESS	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
Fixed market operator charges	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01
Electricity network charges	2.96	1.99	1.25	0.84	1.26	0.85	0.63	0.42
Gas network charges	10.75	10.68	0.00	0.81	0.00	0.63	0.00	0.00
Personnel costs	3.65	3.65	0.90	0.90	0.90	0.90	-	-
Fixed O&M costs	4.23	4.23	0.92	0.92	3.61	3.61	1.50	1.50
Insurance	1.90	1.88	0.47	0.47	1.04	1.00	0.38	0.37
Business rates	4.55	1.50	1.92	0.97	1.94	0.98	0.97	0.49
Total, €m/yr	**28.06**	**23.97**	**5.48**	**4.93**	**8.76**	**7.99**	**3.48**	**2.79**

CEPA\Ramboll then estimated the Weighted Average Cost of Capital (WACC) for capacity in Ireland and Northern Ireland, with the key input assumptions and final values of nominal pre-tax WACC set out in Table 4.

Table 4: Estimates of nominal pre-tax WACC for IE and NI

Parameter	IE	NI
Gearing	40%	40%

[5] Figures are less than 0.01 when rounded to two decimal places.

Parameter	IE	NI
Risk-free	1.14%	2.06%
ERP	7.55%	7.37%
Asset Beta	0.55	0.55
Equity Beta	0.92	0.92
Post-tax CoE	8.06%	8.82%
Tax rate	12.5%	25.0%
Pre-tax CoE	9.21%	11.75%
Cost of Debt	3.47%	4.61%
Vanilla WACC	*6.22%*	*7.13%*
Pre-tax WACC	**6.92%**	**8.90%**

CEPA/Ramboll then annuitised the capital costs at the cost of capital and combined them with the annual recurring costs and calculated the Gross CONE in 2022/23 money as shown in Table 5. CEPA/Ramboll then inflated the 2022/23 Gross CONE at 2% per annum, to calculate 2026/27 Gross CONE estimates, as shown in Table 6.

Table 5: Gross CONE estimates in 2022/23 money

Parameter	CCGT		OCGT		Engines		BESS	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
Capacity, MW	470.0	470.0	198.6	198.6	200.3	200.3	100.0	100.0
De-rating scalar	0.83	0.83	0.88	0.88	0.88	0.88	0.36	0.36
ARHL scalar	1.00	1.00	1.00	0.43	1.00	0.43	1.00	1.00
Capacity, derated MW	387.75	387.75	175.36	75.41	176.66	75.97	36.20	36.20
Annualised fixed costs, € / derated kW	95.64	109.97	57.82	153.10	116.17	301.90	317.54	341.02
Recurring costs, € / derated kW	72.37	61.81	31.25	65.36	49.59	105.17	96.12	77.10
Gross CoNE, € / derated kW	**168.00**	**171.78**	**89.07**	**218.46**	**165.76**	**407.06**	**413.66**	**418.12**

Table 6: Gross CONE estimates in 2026/27 money

Parameter	CCGT		OCGT		Engines		BESS	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I

Parameter	CCGT		OCGT		Engines		BESS	
Gross CoNE, € / derated kW (22/23)	168.00	171.78	89.07	218.46	165.76	407.06	413.66	418.12
Inflation adjustment	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08
Gross CoNE, € / derated kW (26/27)	**181.85**	**185.94**	**96.42**	**236.47**	**179.43**	**440.62**	**447.76**	**452.59**

According to the BNE Assessment Paper, an OCGT in Ireland had the lowest Gross CONE cost, at €96.42/kWd.

4.2 Summary of Responses

The EAI and the majority of respondents argued that the Gross CONE estimates were too low and outlined a number of reasons supporting their view.

A number of respondents relayed their concern with the EPC cost estimates being too low. In particular, it was noted that the reference date for EPC prices was February 2022, albeit prices had been uplifted for PPI inflation between February and June 2022. However, respondents stated that the EPC values used did not accurately capture the level of EPC cost inflation that market participants had faced throughout 2022. As some of the other capital cost estimates are expressed as a percentage of the EPC costs, it was argued that by under-estimating the effect of inflation on EPC costs, CEPA\Ramboll had also under-estimated these “other costs”.

In addition, it was noted that the capital cost estimates did not include any provision for the additional capital expenditure which may be required to convert existing plant to zero-emissions gas (hydrogen and/or carbon capture) in future.

It was argued that the CEPA\Ramboll study significantly underestimated the electricity connection costs faced by an entrant. In particular, it was argued that each project would require a new substation, the costs for which are likely to be significantly greater than what was assumed in the CEPA\Ramboll study.

Some respondents outlined their concerns that gas connection costs were also under-estimated (including in confidential responses). The RAs also note that significant evidence was submitted within the confidential responses to Call for Evidence (CfE) SEM-22-071 which outlined that GNI is being unwilling to provide fixed price gas

connection costs in Ireland. In addition, the responses noted that developers who have projected location further from an existing gas connection are facing significant increases in gas connection costs.

A number of respondents stated that site procurement costs used were too low, and noted that the costs used were significantly lower than in the equivalent Poyry 2018 report. Respondents also questioned the approach used with respect to the cost price of agricultural land.

Some respondents argued that the CEPA/Ramboll approach to calculating the cost of interest during construction was inappropriate. The consultants' estimates of the cost of capital during the construction only takes account of the cost of debt, and not the full cost of capital. That is, no allowance had been made for the opportunity cost of equity during the construction period. They argued that it would have been more appropriate to apply the WACC, rather than the cost of debt to the capital employed during construction.

Some respondents also mentioned that the approach of inflating 2022/23 Gross CONE estimates at 2% p.a. was inappropriate, and did not reflect current levels of inflation, and/or levels of inflation likely to occur between now and 2026/27. Respondents drew attention to the difference between the 2% p.a. inflation assumption, and the higher projections published by official organisations such as the Central Bank of Ireland, the Department of Finance and the European Central Bank, and noted that inflation had a material impact on recurring costs, as well as CAPEX.

The EAI's consultants estimated the CAPEX cost of a CCGT to be in the range of 20-25% higher than the CEPA\Ramboll estimates, and the CAPEX cost of an OCGT to be in the range of 15-20% higher than the estimates outlined by CEPA\Ramboll.

A number of respondents argued that the costs of capital were too low, and did not reflect recent increases in the risk-free rate. In particular, it was noted that the CEPA\Ramboll study had estimated a lower WACC than the Poyry 2018 study, despite the fact that interest rates are now higher than in 2018. It was also argued that the study should use technology specific WACCs to account for technology specific risks. The EAI's consultants also argued that the CEPA\Ramboll estimates of the asset betas for CCGTs and OCGTs are too low, lower than used by Poyry in the 2018 study and lower than the recent estimates used by the UK's Department of Business

Energy and Industrial Strategy (BEIS). The TSOs' consultants provided their own estimate of the cost of capital of a generator in Ireland and Northern Ireland. The TSOs estimated the pre-tax nominal WACC at 9.3% in Ireland and 11.9% in Northern Ireland, compared to the CEPA\Ramboll estimates of 6.9% in Ireland and 8.9% in Northern Ireland.

Some respondents argued that given current uncertain market conditions, it was appropriate to use a shorter asset life, particularly for CCGTs. One respondent suggested that a 10-year asset life assumption is more appropriate for a CCGT, whilst another suggested 15 years.

One respondent compared the CEPA\Ramboll estimate of the capital costs of a CCGT (€670/kW), with a 2020 estimated published by UK BEIS of €813/kW.

The TSOs estimated the Gross CONE of an OCGT in Ireland at €150.30/kW/year (BNE Assessment Paper estimate was €96.42/kW/year) and the Net CONE of a CCGT at €125.90/kW/year (BNE Assessment Paper estimate was €58.31/kW/year).

4.3 SEM Committee Response

CEPA\Ramboll have considered the responses alongside the evidence and analyses submitted by the respondents and have updated a number of values used to calculate Gross CONE.

Prices for a range of technologies are increased in the updated version as the data has been updated to reflect Euro Area Producer Prices to that of November 2022 from June 2022. The change in the choice of reference CCGT to a multi-shaft CCGT with a by-pass stack has increased the CAPEX cost of a CCGT by about €30m (10%). These changes have resulted in a higher EPC Contract Prices in the Revised BNE Assessment Paper.

It is reasonable to use relevant TSO price lists for unit costs[6] to calculate electrical connection costs and there are credible scenarios for the BNE to connect to an existing 220kV substation, due to which no changes have been made to the electrical connection costs in the Revised BNE Assessment Paper.

[6] EirGrid, 2022 Standard Transmission Charges; NIE Networks, Transmission Charging Statement.

In the updated analysis, CEPA\Ramboll have used higher figures under electricity and gas network charges. The increase in other cost elements used to calculate Gross CONE is described in the Revised BNE Assessment Paper.

The underlying assumptions of WACC has not been changed from the previous version, though the risk-free rate, ERP and cost of debt rates have been updated to reflect latest values.

The SEM Committee notes that there are concerns among respondents that the inflation rate assumed by CEPA\Ramboll is low. CEPA\Ramboll notes that even though year-on-year inflation rate remains elevated given the increase in the price base in previous months, the forecast change in the inflation index itself is not significant enough to increase the inflation rate. It should be noted that approximately 8% (4 years of 2% compounded) inflation is applied to all costs including those that are incurred early during the construction period. The SEM Committee view is that this over-estimation of inflation offsets any possible under-estimation of inflation to some degree.

CEPA/Ramboll compared the updated prices with the generic costs published by DECC, BEIS in the UK and the US EIA, and CEPA/Ramboll's view is that these elements are now broadly comparable. It must be noted that the BEIS in the UK uses an 800 MW CCGT in their modelling, which is not an appropriate size for a CCGT in the SEM market, given the much smaller size. This was the reason that CEPA/Ramboll did not choose certain larger H-class CCGT, which may have lower unit costs.

After considering the responses received and following further analysis of the capital costs and the annual fixed costs associated with the reference technologies by CEPA\Ramboll, the final cost estimates – capital fixed costs, recurring fixed costs and pre-tax WACC – associated with this BNE assessment are outlined in Table 7, Table 8 and Table 9 respectively. These cost estimates are in 2022/23 money.

Table 7: Summary of capital fixed costs, (€m)

Technology type	CCGT		OCGT		Engines		BESS	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
EPC contract	377.70	374.50	87.90	86.50	191.40	184.70	73.80	71.30

Site procurement cost	2.69	2.98	0.98	1.08	1.08	1.19	0.98	1.08
Electrical connection costs	6.75	6.70	6.75	6.70	6.75	6.70	6.75	6.70
Water connection	0.97	0.97	0.67	0.67	0.67	0.67	0.67	0.67
Gas connection	8.57	8.57	6.36	6.36	4.84	4.84	-	-
Owners contingency	18.89	18.73	4.40	4.33	9.57	9.24	3.69	3.57
Financing	7.55	7.49	1.76	1.73	3.83	3.69	1.48	1.43
Construction insurance	3.40	3.37	0.79	0.78	1.72	1.66	0.66	0.64
Initial Fuel working capital	4.99	4.99	1.94	1.94	1.52	1.52	-	-
Other non-EPC costs	33.99	33.71	7.91	7.79	17.23	16.62	5.17	4.99
Interest During Construction	29.49	38.29	6.69	8.58	13.40	16.85	5.25	6.63
Accession fee[7]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Participation fee[8]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total, €m	**495.00**	**500.30**	**126.15**	**126.46**	**252.01**	**247.70**	**98.45**	**97.01**

Note that the values of certain costs categories, such as owners' contingency, financing and "other non-EPC costs" are estimated as a fixed proportion of total costs, so have increased due to the increase in other costs, such as EPC, interest during construction, and connection costs.

Table 8: Summary of recurring costs, (€m/year)

Technology type	CCGT		OCGT		Engines		BESS	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
Fixed market operator charges	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01

[7] Figures are less than 0.01 when rounded to two decimal places.
[8] Figures are less than 0.01 when rounded to two decimal places.

Technology type	CCGT		OCGT		Engines		BESS	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
Electricity network charges	3.35	2.14	1.41	0.90	1.43	0.91	2.05	0.45
Gas network charges	11.95	13.59	-	0.90	-	0.70	-	-
Personnel costs	3.65	3.65	0.90	0.90	0.90	0.90	-	-
Fixed O&M costs	5.06	5.06	1.03	1.03	3.98	3.98	1.60	1.60
Insurance	2.27	2.25	0.53	0.52	1.15	1.11	0.44	0.43
Business rates	4.64	1.48	1.96	0.96	1.97	0.97	0.98	0.48
Total, €m/yr	**30.94**	**28.19**	**5.84**	**5.23**	**9.44**	**8.58**	**5.08**	**2.97**

Table 9: Estimates of nominal pre-tax WACC in IE and NI

Parameter	IE	NI
Gearing	40%	40%
Risk-free	2.07%	3.29
ERP	6.62%	6.14%
Asset Beta	0.55	0.55
Equity Beta	0.92	0.92
Post-tax CoE	8.14%	8.92%
Tax rate	12.5%	25.0%
Pre-tax CoE	9.30%	11.89%
Cost of Debt	4.23%	5.64%
Vanilla WACC	*6.58%*	*7.61%*
Pre-tax WACC	**7.27%**	**9.39%**

Using these estimates and annual inflation rate of 2.0% per annum, CEPA\Ramboll have calculated Gross CONE for the selected technology types for the year 2026/27 and the results are produced in Table 10 in terms of 2022/23 money and inflation adjusted Gross CONE in 2026/27 money in Table 11.

Table 10: Gross CONE estimates in 2022/23 money

Parameter	CCGT		OCGT		Engines		BESS	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
Capacity, MW	470.62	470.62	198.60	198.60	200.30	200.30	100.00	100.00
De-rating scalar	0.758	0.758	0.846	0.846	0.843	0.843	0.196	0.196
ARHL scalar	1.00	1.00	1.00	0.43	1.00	0.43	1.00	1.00
Capacity, derated MW	356.73	356.73	168.02	72.25	168.85	72.61	19.60	19.60
Annualised fixed costs, € / derated kW	133.77	157.93	72.38	197.12	143.88	384.17	724.21	784.52
Recurring costs, € / derated kW	86.74	79.03	34.77	72.39	55.92	118.20	259.18	151.65
Gross CoNE, € / derated kW	**220.51**	**236.97**	**107.15**	**269.51**	**199.80**	**502.38**	**983.39**	**936.18**

Table 11: Gross CONE estimates in 2026/27 money

Parameter	CCGT		OCGT		Engines		BESS	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
Gross CoNE, € / derated kW (22/23)	220.51	236.97	107.15	269.51	199.80	502.38	983.39	936.18
Inflation adjustment	1.082	1.082	1.082	1.082	1.082	1.082	1.082	1.082
Gross CoNE, € / derated kW (26/27)	**238.68**	**256.50**	**115.99**	**291.73**	**216.27**	**543.79**	**1,064.46**	**1,013.35**

4.4 SEM Committee Decision

The SEM Committee has accepted the updated CEPA/Ramboll cost and WACC estimates, and on that basis, the 2026/27 Gross CONE is €115.99/KWd/year, based on an OCGT in Ireland.

5. Revenues

To arrive at the BNE Net CONE an adjustment is required to subtract non-capacity market revenue streams from the Gross BNE price/Gross CONE. In addition to income from the Capacity Market, a generator operating in I-SEM would be capturing:

- revenues from the energy market(s):
  - a generating unit is expected to capture a certain amount of operating margin, commonly referred to as inframarginal rent, from selling electricity into different ex-ante markets and the balancing market.
- Income for the provision of DS3 System Services:
  - DS3 System Services are procured by the TSOs and potential providers capture a relevant payment.

5.1 Consultation Summary

The values used by CEPA\Ramboll used in the BNE Assessment Paper are set out in Table 12 below.

Table 12: Estimates of IMR and DS3 revenues

Parameter	CCGT		OCGT		Engines		BESS	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
Infra-marginal rent (€/ derated kW), 25/26	104.40	104.40	0.63	1.47	0.63	1.47	70.36	70.36
Infra-marginal rent (€/ derated kW), 26/27	106.48	106.48	0.65	1.50	0.65	1.50	71.77	71.77
DS3 revenue (€/ derated kW), 22/23	15.76	16.79	7.94	18.46	7.97	18.54	183.65	158.76
DS3 revenue (€/ derated kW), 26/27	17.06	18.17	8.59	19.98	8.63	20.06	198.78	171.84
Total revenues, (€ / derated kW), 26/27	**123.54**	**124.66**	**9.24**	**21.49**	**9.27**	**21.57**	**270.55**	**243.61**

The headline IMR values used by CEPA\Ramboll for the CCGT, OCGT and the gas engine were based on available PLEXOS runs for 2025/26, and was inflated to 2026/27. It should be noted that these PLEXOS runs were based on fuel curves before the Ukraine War, so did not contain inflated IMR values which may be a short-term effect of the war[9].

The BNE Assessment Paper estimated the value of IMR of a CCGT in Ireland to be €106.48/kW/year in 2026/27 and this figure is the principal reason why a CCGT was the least cost unit in the draft report.

5.2 Summary of Responses

5.2.1 Infra-Marginal Rent (IMR)

The EAI, and a number of other respondents argued that the IMR used was too high. In particular, the respondents' view was that a CCGT would not be guaranteed to earn IMR of €106.48/kWd/year in later years. The EAI's consultants suggested that IMR should be modelled separately for each year of a unit's economic life, rather than assuming that the relevant units earned IMR at 2026/27 levels for every year of its economic life. They also noted that the current modelling approach does not take into account the changing prices, increased RES penetration, and changing load factors over time as newer and more efficient plant enters. The respondents also argued that the projections do not take into account the potential need for gas plants to be retrofitted to ensure compatibility with low-carbon gases to remain in the merit order in future. It was pointed out that the IMR calculation is inherently very uncertain, and that the IMR makes up a proportionately larger proportion of the revenues for a CCGT, making the Net CONE for a CCGT particularly uncertain.

EPUKI argued that by using a 2025/26 run as a proxy for 2026/27, the IMR projections ignored the prospective entry of the Celtic interconnector, which would have a significant effect. SSE provided some estimates of the impact of the entry of the Celtic interconnector on a CCGT's IMR, along with the impact of an additional GB interconnector, and further highlighted that future interconnectors would also have an impact without seeking to quantify that impact.

[9] The Ukraine War has a more limited effect on fuel curves 2025/26 than for, say 2022/23.

Some market participants stated that they had undertaken their own IMR modelling exercises, and that the results were generally lower than those assumed by CEPA\Ramboll.

Energy Storage Ireland disagreed with the assumption that a BESS unit would be able to carry out 1-full charge cycle per day. ESI added that if this is the case then batteries would be fully discharged for a significant period, and would not be able to earn the assumed DS3 revenue.

The TSOs also argued that it was unrealistic to assume that a CCGT would continue to earn the projected level of IMR, and that their modelling suggested that no thermal unit would continue to operate baseload or at high load factors post 2030. The TSOs' consultants estimated the IMR of a new CCGT commissioned in the mid-2020s and found that the CCGT would initially start running close to baseload but would then very quickly shift towards more mid-merit and then peaking operation. According to their analysis, considering commodity prices and a wider underlying capacity mix that is in line with the policy objectives, the IMR would start off at around 95€/kW-installed (in 2026 money terms), but would gradually drop to 70€/kW-installed (in 2026 money terms) by the 10th year of operation and to 60€/kW-installed (in 2026 money terms) by the 20th year of operation. These projections were based on the consultant's assumptions of the costs of hydrogen in later years, with that hydrogen assumed to be produced by Steam Methane Reform (SMR) with carbon capture and storage, and these costs were not Ireland specific estimates.

5.2.2 System Services (DS3) revenue

The EAI and a number of their member organisations argued that estimates of DS3 revenue in the BNE Assessment Paper are higher than in reality. In particular,

- The load factor estimates which underpin the DS3 revenue estimates were too high for later years. In particular, it was mentioned that it is not reasonable to assume that a CCGT would have a load factor of 65% in later years, and that a lower load factor would imply lower availability for key DS3 service and thus lower DS3 income;
- The 20% reduction in DS3 tariffs assumed is not consistent with the SEM Committee policy directions, including proposals to reduce tariff rates and scalars, and the introduction of competition.

The TSOs also argued that the assumed DS3 income was too high and recommended that a value of €10/kW of DS3 revenue should be used in the case of a CCGT for BNE determination.

5.3 SEM Committee Response

5.3.1 Inframarginal Rent

Since the Consultation Paper was published, the RAs have completed further PLEXOS modelling to estimate the IMR for a CCGT, an OCGT and a gas engine for 2026/27, and 2030. The 2026/27 modelling run used the latest validated PLEXOS dataset, with appropriate capacity adjustments which ensures that installed capacity is broadly consistent with the 2026/27 Capacity Requirement. The 2026/27 model run assumed that the Celtic Interconnector would be operational from early 2027, consistent with the date set out in the EirGrid/SONI Generation Capacity Statement 2022. This is in addition to the Ireland-GB Greenlink Interconnector, which had already been included in the projections presented in the BNE Assessment Paper.

The updated 2026/27 run was based on updated, post-Ukraine invasion fuel curves taken from late October/early November 2022.

For the 2030 PLEXOS modelling, the RAs recognised that the 2030 portfolio set out in EirGrid's Shaping Our Energy Futures (Version 1) falls significantly short of delivering on latest RES-E targets. The Version 2 of Shaping Our Energy Futures is currently being developed by EirGrid an updated 2030 generation portfolio was presented in September 2022 which goes further towards meeting the RES-E targets. This presentation provides a range of potential additions to onshore wind, offshore wind and solar capacity that would help in achieving the latest RES-E targets, and the RAs defined a 2030 PLEXOS portfolio consistent with this range. The 2030 run was based on observed market for fuels (including NBP gas) for 2029, extrapolated to 2030. The 2030 run also assumed that a fourth GB interconnector was in place by 2030, in addition to the Celtic Interconnector.

As stated in the Consultation Paper, the SEM Committee recognises that in practice, it is reasonable to expect that the IMR of a CCGT is uncertain for later years of the assessment, as the installed RES-E capacity grows, and the system moves towards being able to accommodate SNSP at levels close to 100%.

The RAs considered undertaking further PLEXOS modelling runs for years beyond 2030, including 2035 and 2040. However, the RAs decided that any estimates generated would be subject to a high degree of uncertainty. Specifically, the SEM Committee recognises that it is likely that the SEM will need to have more storage capacity to manage the intermittency of renewables, and that storage capacity may involve hydrogen in order to achieve decarbonisation targets. Any commercial arrangements for hydrogen are yet to be developed. Therefore, there is uncertainty with respect to how much hydrogen will be in the generation mix in any given year, how it will be produced (e.g. green hydrogen, blue hydrogen, grey hydrogen etc.) and associated cost.

CEPA\Ramboll have used updated IMR from the SEM PLEXOS model with assumptions for 2026/27 and 2030. They have linearly interpolated between the 2026/27 and 2030 results and then assumed that the 2030/31 IMR is maintained across the life of the asset. The updated IMR values represent the value of an annuity equal to the Net Present Values of future cash flows discounted by the corresponding, nominal pre-tax WACC.

5.3.2 System Services Revenue

In the updated version, CEPA\Ramboll have used a load factor of 55.4% for a CCGT in 2030. This is based on the new modelling results from the SEM PLEXOS model run for 2026/27.

The assumptions regarding the discount off 2021/22 tariffs made by CEPA\Ramboll in the calculation of system services revenue has been upheld in the Revised BNE Assessment Paper. The evidence from EirGrid/SONI consultation[10] is not ideal to be used in this study, as the purpose of this consultation is different from that of this analysis. It must also be noted that the CEPA\Ramboll analysis is more conservative as CEPA\Ramboll does not include Temporal Scarcity Scalar product in their analysis.

Table 13 below summarises the updated figures for IMR and DS3 revenues, which CEPA/Ramboll used to calculate BNE Net CONE in their revised paper.

[10] EirGrid/SONI, 2022, DS3 System Services Tariffs, consultation document, 16 September 2022.

Table 13: Summary of IMR and DS3 revenues

Parameter	CCGT		OCGT		Engines		BESS (2hr)	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
Infra-marginal rent (€/ kW), 26/27	58.72	60.20	0.02	0.02	0.08	0.09	29.67	29.91
DS3 revenue (€/ kW), 26/27	16.99	16.39	7.56	6.90	7.59	6.93	71.96	61.86
Total revenues (€/ kW), 26/27	75.70	76.59	7.58	6.92	7.67	7.02	101.63	91.77
Total revenues, (€ / derated kW), 26/27	**99.87**	**101.04**	**8.96**	**19.02**	**9.10**	**19.38**	**543.46**	**490.75**

5.4 SEM Committee Decision

The SEM Committee recognises the uncertainty surrounding future IMR and DS3 revenues, and accepts the revised approach taken by CEPA/Ramboll.

6. Net CONE

6.1 Consultation Summary

CEPA\Ramboll subtracted the revenue estimates from the Gross CONE estimates to calculate the Net CONE for each short-listed technology in Ireland and Northern Ireland. The results are shown in Table 14.

Table 14: Consultation Paper Net CONE estimates

Parameter	CCGT		OCGT		Engines		BESS	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
Gross CoNE (€ / derated kW), 26/27	181.85	185.94	96.42	236.47	179.43	440.62	447.76	452.59
Revenues (€ / derated kW), 26/27	123.54	124.66	9.24	21.49	9.27	21.57	270.55	243.61
Net CoNE (€ / derated kW), 26/27	**58.31**	**61.28**	**87.18**	**214.99**	**170.15**	**419.05**	**177.20**	**208.98**

Based on these results, a CCGT in Ireland was the lowest cost new entrant at €58.31/kWd/year. This compared to a Net CONE of €87.18/kWd/year for an OCGT in Ireland.

The previous 2018 Poyry BNE Net CONE study had found that an OCGT was the lowest cost new entrant at €92.30/kWd/year.

6.2 Summary of Responses

A number of respondents expressed concern that the Net CONE estimate is too low, and that no investor would invest if the SEM Committee set APC at 1.5 x €58.31/kWd/year (=€87.47/kWd/year). It was also pointed out that if the SEM Committee sets the ECPC at 0.5 x €58.31/kWd/year, it would have adverse consequences for Existing Capacity.

The TSOs stated that they agree with the choice of a CCGT as the reference technology with the lowest Net CONE. However, an estimate of €128/kWd for the Net CONE of a CCGT in Ireland for 2026/27 in nominal money terms was provided.

6.2 SEM Committee Response

Following the consultation, CEPA/Ramboll have updated their model including updates to some assumptions (e.g., location of plant, connection costs) which are detailed further in this paper and also in the Revised BNE Assessment Paper.

Table 15 below provides a summary of the updated 2026/27 Net CONE estimates for the different reference technologies in Ireland and Northern Ireland.

Table 15: Updated Net CONE estimates

Parameter	CCGT		OCGT		Engines		BESS (2hr)	
	Ireland	N.I	Ireland	N.I	Ireland	N.I	Ireland	N.I
Gross CoNE (€ / derated kW), 26/27	**238.68**	**256.50**	**115.99**	**291.73**	**216.27**	**543.79**	**1,115.69**	**1,062.12**
Revenues (€ / derated kW), 26/27	99.87	101.04	8.96	19.02	9.10	19.38	543.46	490.75
Net CoNE (€ / derated kW), 26/27	**138.81**	**155.46**	**107.03**	**272.70**	**207.17**	**524.41**	**572.22**	**571.37**

After making changes to the assumptions based on the responses received, the BNE with lowest Net CONE, with a value of €107.03/de-rated kW/year for Capacity Year 2026/27 corresponds to an OCGT plant in Ireland.

6.3 SEM Committee Decision

The SEM Committee accepts CEPA/Ramboll's estimate of €107.03/kWd/year of Net CONE for 2026/27.

7. Auction Price Caps (APC)

During the CRM Detailed Design phase, the SEM Committee consulted on how the APC should be set. In previous auctions the SEM Committee has generally set the APC by applying a multiplier to the estimated Net CONE.

In the first CRM Parameters Consultation (SEM-16-073) the SEM Committee noted that "the Auction Price Cap parameter should be set at a level which balances:

- The risk that the Auction Price Cap is set at too low a level to incentivise new investment when it is needed, jeopardising system security; and
- The risk that the Auction Price Cap is set at too high a level, allowing market participants with market power to abuse their market power and drive up the auction clearing price, i.e., have negative effects with respect to competition and efficiency objectives."

The SEM Committee decided that the appropriate balance for the first auction was to set the APC at 1.5 x Net CONE. In subsequent auctions, the SEM Committee continued to consult on the appropriate multiplier on a regular basis and continued to set APC at 1.5 x Net CONE, with some adjustments in the value of APC for the impact of inflation on Net CONE, but no changes in the multiplier, prior to the 2026/27 T-4 auction.

When the SEM Committee issued its Parameters Decision paper (SEM-22-044) for the T-4 2026/27 auction on 16 August 2022, the SEM Committee approved a value of €146,920/de-rated MW/year for inclusion in the T-4 2026/27 auction IAIP. The SEM Committee noted that:

- It was undertaking a Best New Entrant Net CONE study, which may be complete prior to the issue of the T-4 2026/27 FAIP.
- Depending on the outcome of that study, the SEM Committee may choose to revise the APC before the auction.

On 3 February 2023, recognising that investors would be making investment decisions for the T-4 2026/27 auction imminently, and in order to provide a clear and immediate signal to investors in the T-4 2026/27 auction, the SEM Committee published an information note (SEM-23-009), setting the T-4 2026/27 APC at €180,000/MWd/year.

This was also set in the context of ongoing litigation regarding Annual Run Hour Limits, which has now been resolved.

For the T-4 2027/28 auction, as set out in the CRM Parameters Decision (SEM-23-017) published on the 3 March 2023, the SEM Committee decided to set the APC at a 1.5 x multiple of the revised Net CONE. The value of €163,757/MWd/year has been calculated as 1.5 x the multiple of 2026/27 Net CONE with a 2% allowance for expected inflation between 2026/27 and 2027/28. The SEM Committee will continue to balance objectives, including security of supply and mitigating market power when setting APC for future auctions.