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2025 Electricity Network Options Report, 2025 Gas Infrastructure Options Report Consultation and 2025 Forecasting Reference Group #4 – cost escalation factors

Submission to AEMO, 23 June 2025

The Centre for Applied Energy Economics and Policy Research (CAEEPR) is a collaborative partnership between Griffith Business School and energy sector participants in Australia's National Electricity Market.

CAEEPR aim to maximise the energy sector's potential to achieve emission reductions and contribute to inclusive, sustainable, and prosperous businesses and communities while building capacity in electricity economics. CAEEPR uses a national electricity market model to develop and analyse different scenarios to assess different policy positions for generator dispatch and transmission efficiency.

CAEEPR's sub aims/objectives that are most relevant to this submission:

- Supporting the transition to more sustainable and less carbon-intensive power generation and transmission system and address the accompanying policy, economic, technical and political challenges within the industry.
- Provide thought leadership and industry engagement strategies that our members can design and deliver best practice energy services with reduced emissions.
- Create and uphold advanced Electricity Market models for analysing wholesale spot and future markets, power system reliability, integration of dispatchable and intermittent resources, and network capacity adequacy.

This submission has been prepared by Andrew Fletcher who is an Industry Adjunct Research Fellow at CAEEPR. The views expressed in this submission are entirely the author's and are not reflective of CAEEPR.

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Introduction

I welcome the opportunity to provide feedback to AEMO on the 2025 Electricity Network Options Report, 2025 Gas Infrastructure Options Report Consultation and the 2025 Forecasting Reference Group #4 – cost escalation factors. The key theme of this submission is ensuring consistency of build cost forecasts methodologies, inputs and assumptions across technologies such as electricity transmission and distribution, gas infrastructure, generation and electrolysers. Thus it is relevant for all three consultations. The submission also further builds on the author's 2024-25 GenCost, Draft 2025 Stage 1 IASR Consultation Submission and Stage 2 Draft 2025 IASR Consultation Submission continuing the theme of improving transparency and the accuracy of technology build cost projections.

The frame of reference for this submission is AER's forecasting guidelines, with (Australian Energy Regulator, 2023) stating that:

"*The AER's forecasting guidelines require AEMO's forecasting practices and processes to have regard to the following principles:*

- *forecasts should be as accurate as possible, based on comprehensive information and prepared in an unbiased manner;*
- *the basic inputs, assumptions and methodology that underpin forecasts should be disclosed; and*
- *stakeholders should have as much opportunity to engage as is practicable, through effective consultation and access to documents and information."*

The submission identifies several opportunities to improve the key ISP input reports and underlying consultant modelling reports.

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1. Consistent approach to escalation forecasts across technologies

There are a range of material inconsistencies between escalation forecast models from GHD and Oxford Economics Australia (OEA) and it appears that AEMO does not intend to apply escalation to distribution network augmentation relating to CER. AEMO is encouraged to address these inconsistencies as they have the potential to materially bias long term ISP modelling outcomes.

1.1 Escalation should be applied to CER distribution network augmentation

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7. Is the planned approach for calculating opportunities for CER and associated distribution network costs reasonable? Noting time and data constraints, are there other factors AEMO and DNSPs could reasonably consider?

GHD's transmission escalation estimate should be applied to CER distribution network augmentation. GHD's estimates are the preferred source for electricity distribution escalation, as they include land cost escalation.

Per OEA's analysis flat construction productivity is a key driver of construction escalation forecasts. In addition, per GHD's transmission forecast, escalation is also being driven for increasing global demand for energy infrastructure equipment. Figure 1 shows that the cost stack for electricity transmission and electricity distribution are very similar. Similarity in equipment and workforces is demonstrated by Energy Queensland providing Field Services to Powerlink Queensland (AER, 2024).

Input	Onshore Wind	Offshore Wind	Large-scale PV	Battery storage	Pumped Hydro storage	Electricity Transmission	Electricity Distribution	Electrolysers	CCGT with CCS	Dual Fuel OCGT	Gas Plant	Gas Field	Gas Transmission	Gas Distribution	Coal
Design	10	10	4	5	10	5	5	10	10	10	10	10	5	5	10
Labour	30	35	40	45	38	40	45	50	50	50	50	50	40	55	50
Concrete	10	-	13.5	20	20	5	5	10	10	10	10	5	5	5	10
Steel	5	20	20	7.5	2	12.5	5	12	12	12	12	15	27.5	22.5	12
Cable	10	10	7.5	7.5	2	12.5	15	5	5	5	5	-	-	-	5
Plant	10	-	5	5	5	5	5	5	5	5	5	10	7.5	7.5	5
Freight	10	5	5	5	10	5	5	5	5	5	5	5	10	5	5
Logistics	5	-	-	-	-	5	-	-	-	-	-	-	-	-	-
Roads	10	-	5	5	3	10	-	3	3	3	3	5	5	-	3
Other	-	20	-	-	10	-	15	-	-	-	-	-	-	-	-

Figure 1: Installation cost escalation - Input weightings

Source: Oxford Economics Australia – 2025 IASR Planning and installation cost escalation factors

1.2 Consistent construction cost escalation and material and energy cost escalation should be used

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4. What feedback do stakeholders have about AEMO's proposed forecasting approach for transmission costs over the ISP horizon?

5. What feedback do stakeholders have about AEMO's proposal to apply different forecasts for transmission project costs across each scenario?

Draft 2025 Gas Infrastructure Options Report – Consultation Questions

1. Do you have any feedback on the gas infrastructure base costs, adjustment factors and escalation indices provided by GHD?

Figure 2, Figure 3 and Figure 4 show escalation for electricity transmission, gas infrastructure and installation cost escalation respectively.

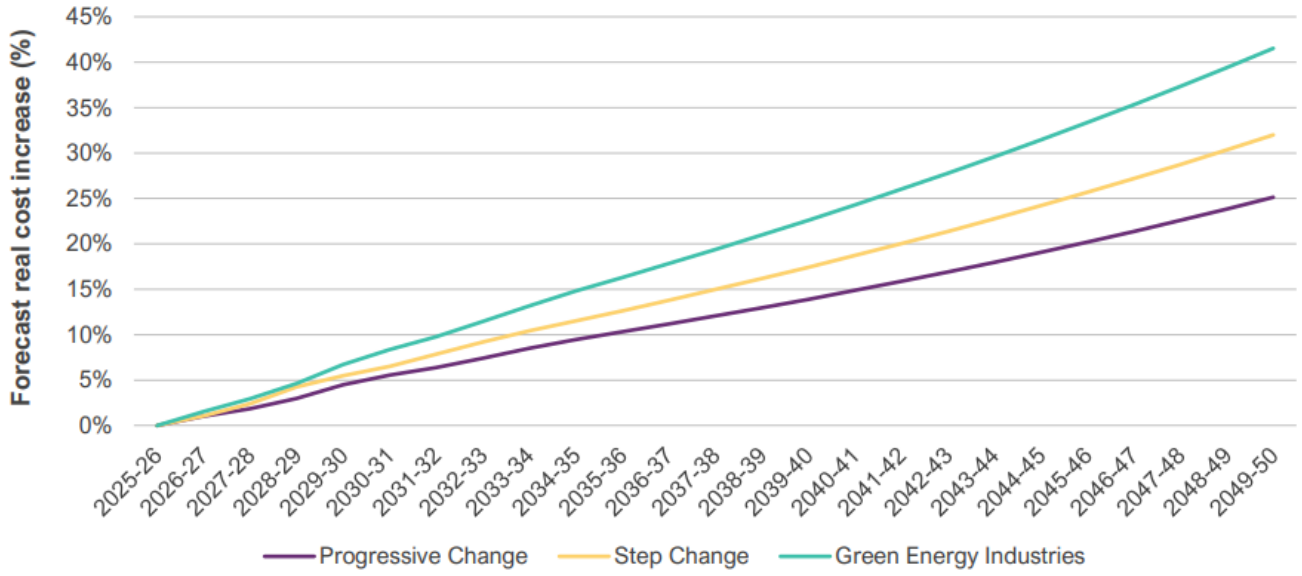

Figure 2: Transmission - Forecast average cost changes (real) for all project types, for all scenarios, 2025-26 to 2049-50

Source: Draft 2025 Electricity Network Options Report - May 2025 (GHD)

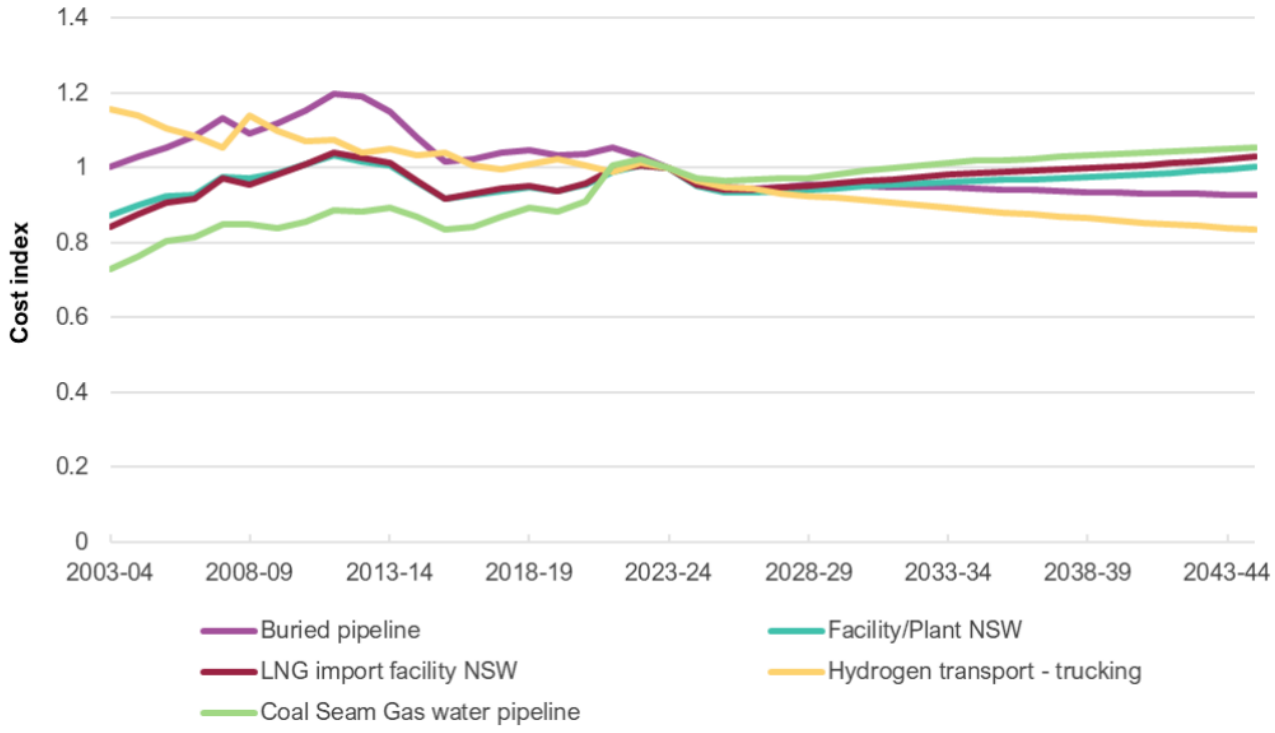

Figure 3: Gas infrastructure cost component indices, real (after inflation) price forecasts, indices 2023-24 = 1

Source: Draft Gas Infrastructure Options Report – May 2025 (GHD)

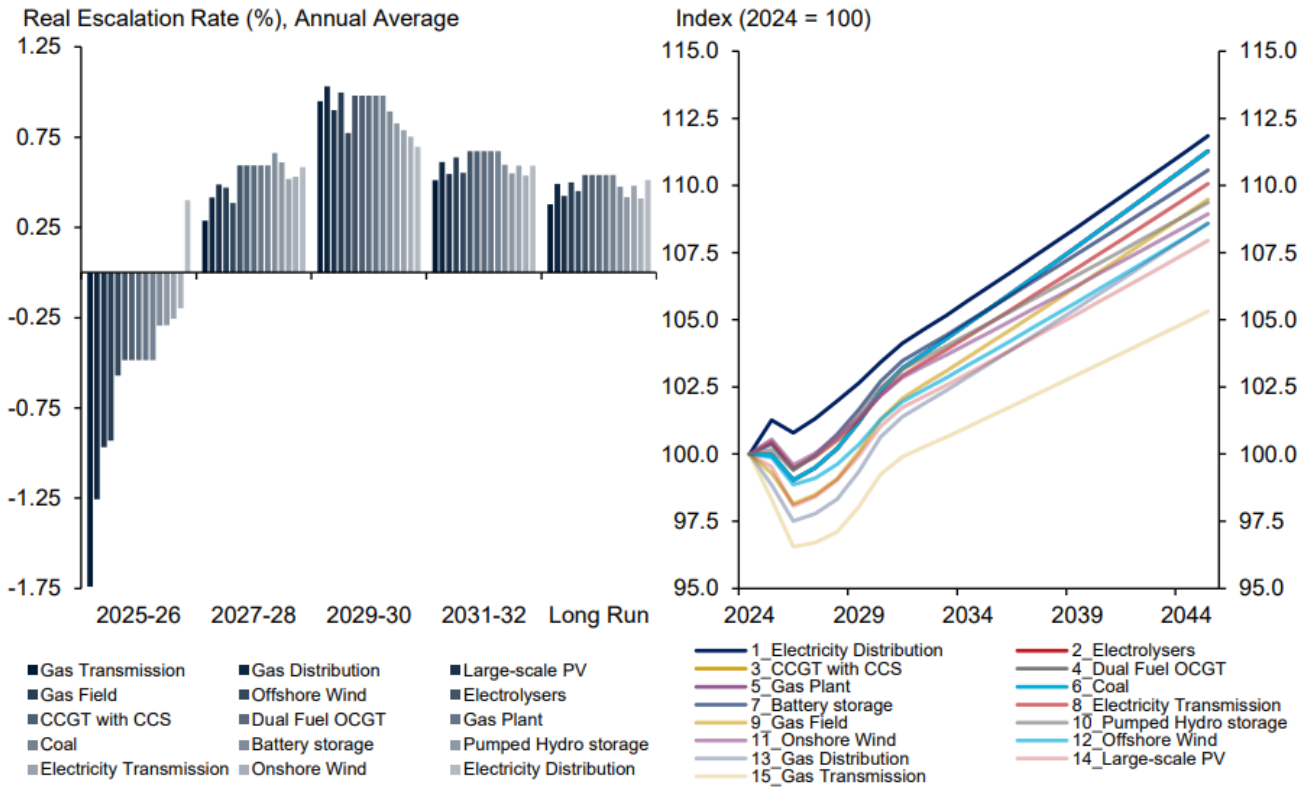

Figure 4: Installation cost index for the 15 asset types, NEM average

Source: Oxford Economics Australia – 2025 IASR Planning and installation cost escalation factors

OEA is a leading economic consultancy and forecaster and where possible GHD's material and energy forecasts should be adjusted to be consistent with OEA. GHD's transmission escalation forecast is driven by long run changes in material and energy costs, while for OEA material and energy costs are not a long term driver of installation escalation.

Differences in construction escalation forecasts between GHD for transmission and OEA, appear to be a key driver of the large divergence between transmission escalation (32% by 2050) and installation cost escalation (10% by 2050). To ensure consistency GHD's transmission Construction, Commission and Testing escalation factor (1.34%pa) should be reduced to be in line with OEA's transmission installation escalation factor (0.4%pa).

GHD's transmission escalation forecasts include a number of escalation factors for service industries such as Design (1.04%) and legal (0.94%). GHD should consider reducing the labour escalation factors for these service industries to account for productivity growth, for instance AI.

To ensure consistency AEMO is encouraged to model three scenarios for gas infrastructure escalation, consistent with electricity transmission and installation costs.

There appears to be five key drivers of material differences between GHD escalation forecasts for transmission, GHD escalation forecasts for gas infrastructure and Oxford Economics Australia installation cost escalation:

1. Land costs - Land cost escalation between ~100-250% depending on state by 2050, appear to be used in both GHD reports. Land/easements may be a larger portion of project costs for transmission. Land cost escalation is not included in OEA's installation cost escalation, as it is considered separately in GenCost.
2. Material and energy costs – While OEA appears to have forecast short term changes in material and energy costs, however they are not a driver of escalation in the medium to long term. This contrasts with GHD which forecasts long run changes in material and energy costs (see Figure 5). Most of the inputs underlying

GHD's cost categories are also modelled in OEA's installation escalation model.

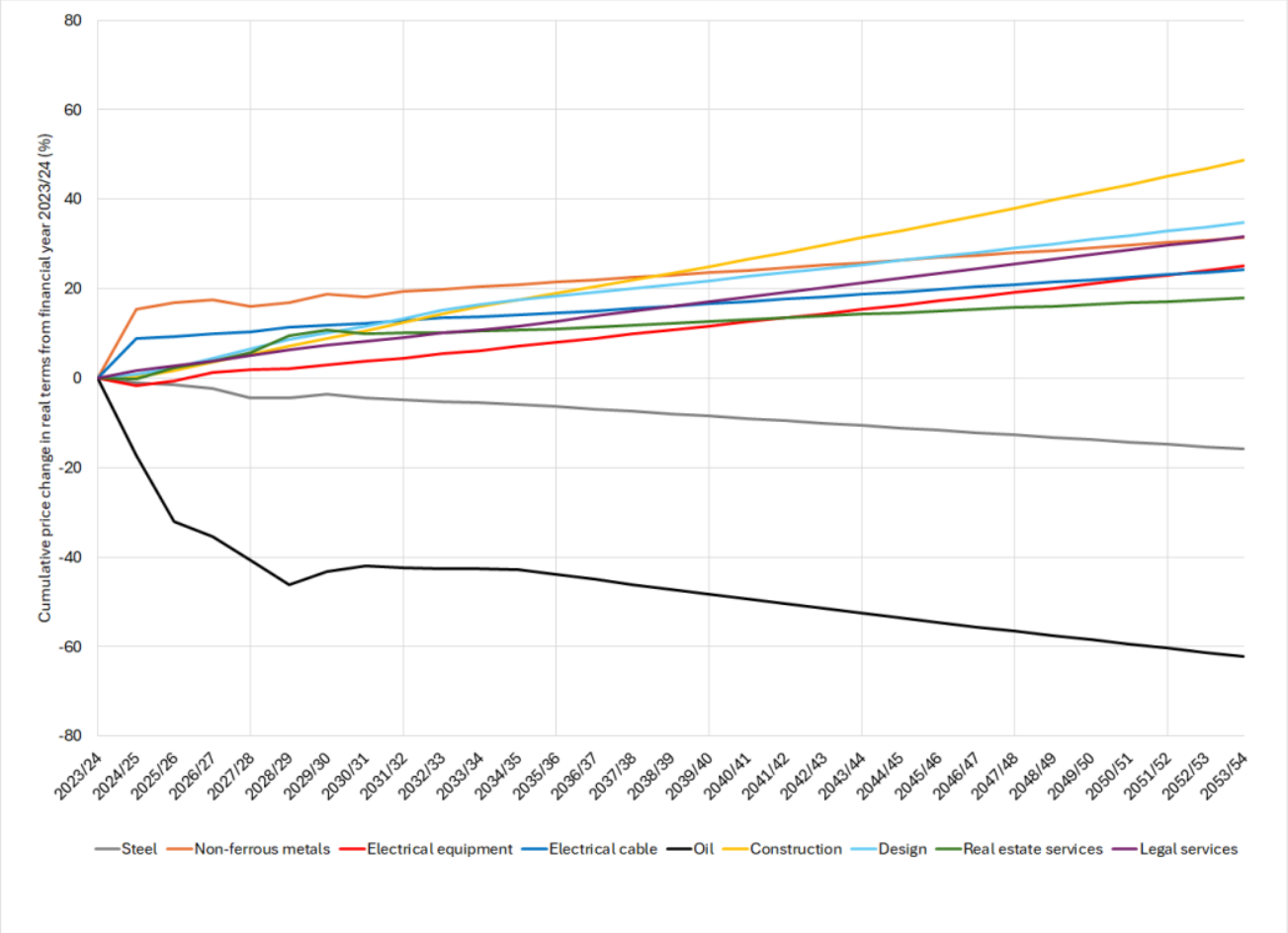

Figure 5: Transmission escalation - Forecast cumulative changes from 2023/24 in real price indices (Step Change scenario)

Source: 2025 TCD Price Forecasting Methodology Report, GHD

3. Labour costs – OEA assume long run labour escalation of 1%, consistent with historical real wage growth for the construction sector. For transmission GHD include a range of cost factors that are driven by labour costs. While construction is the highest at 1.34% escalation for Step Change, other labour driven cost factors such as Design (1.04%) and Legal (0.94%) are around 1%. GHD is encouraged to consider reducing labour escalation factors for these service industries to account for potential productivity growth, for instance form AI. GHD gas infrastructure construction labour escalation if forecast to be 0.54%, around half of OEA.

	OEA	GHD Transmission				GHD gas infrastructure	
	Construction labour	Construction	Design	Real Estate	Legal	Construction labour	Design & project management labour
Growth rate (2023/25-2049.50)	1%	1.34%	1.04%	0.59%	0.94%	0.54%	0.87%

Table 1: Labour related escalation factors – Step Change

Source: GHD and Oxford Economics Australia reports

4. Construction – GHD's Construction, Commission and Testing cost factor is mapped 100% to the Construction cost factor and is applied to the Civil and Electrical Works basket. GHD's escalation factor of 1.34% for Civil and Electrical works escalation is more than double OEA's installation cost escalation. OEA's long run escalation forecast is between 0.4% to 0.5% pa depending on technology and is driven by its ~1% labour escalation assumption, with labour accounting for around 40-50% of installation costs.

5. Scenarios – AEMO is proposing to use one escalation indices for gas infrastructure, while three scenarios are proposed to be used for electricity transmission and installation cost. Material differences in escalation can be seen between scenarios for electricity transmission and installation escalation, driven by different economic conditions.

2. Consistent approach to locational cost factors across all technologies

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2. What feedback do stakeholders have about any further work required to support finalising the updated Transmission Cost Database?

Per the author's Stage 2 Draft 2025 IASR Consultation Submission AEMO is encouraged to apply a consistent approach to locational cost factors, regardless of technology. Aurecon's locational cost factors are preferred as they are more detailed and represent the best available data source. In addition to generation, transmission and gas infrastructure, for GenCost covered technologies, such as gas-powered generation and electrolysers, AEMO is encouraged to use Aurecon's locational cost factors to ensure consistency.

While the Draft 2025 Electricity Network Options Report and Draft 2025 Gas Infrastructure Options Report are not clear as to what locational cost factors are used, it appears to be based on three regional zones. This compares to renewable generation where Aurecon provides locational cost factors based on Renewable Energy Zones, with some a multiple of the locational cost factors a multiple of that used for electricity transmission and gas infrastructure.

Even within technologies covered by GenCost, AEMO assumes different locational cost factors. For instance, Aurecon's locational cost factors are applied for wind and solar PV generation, while gas powered generation and electrolysers use different locational cost factors.

3. Inclusion of the cost of transitioning to decarbonised materials and freight in escalation forecasts, consistent with ISP scenarios

Draft 2025 Electricity Network Options Report - Consultation Questions

4. What feedback do stakeholders have about AEMO's proposed forecasting approach for transmission costs over the ISP horizon?

5. What feedback do stakeholders have about AEMO's proposal to apply different forecasts for transmission project costs across each scenario?

To be consistent with ISP scenario, escalation for generation and electrolysers (Oxford Economics Australia), transmission network (GHD), distribution network CER augmentation (unclear) and gas infrastructure (GHD) should include the cost of transitioning to decarbonised materials and freight. By excluding these costs, escalation forecasts are potentially materially biased and not consistent with ISP scenario descriptions and the IEA World Energy Outlook scenarios that they are mapped to. If consultants are unable to include the cost of transitioning to decarbonised materials and freight, they are encouraged to include caveats in their reports that these potentially material costs are not included.

The inclusion of escalation forecasts for each ISP scenario by Oxford Economics Australia (OEA) and GHD are welcomed. OEA and GHD forecasts models are driven by factors including level of economic activity, material costs (eg. steel and concrete) and labour costs. Though the modelling methodology for Oxford Economics Australia and GHD differ, they are consistent in that they don't include the cost of transitioning to decarbonised materials and freight, which is inconsistent with ISP scenario descriptions.

The author's Stage 2 Draft 2025 IASR Consultation submission highlighted that including the cost of decarbonised materials and freight, has a far higher impact than OEA's installation costs escalation of ~10% by 2050, which is driven by real construction labour wage growth. OEA find that materials and freight represent 50% of installation cost for gas transmission, 46% for utility scale solar PV and 35% for onshore wind. A 50-100% real increase in these costs could lead to installation cost escalation of 25%-50% for gas transmission, 23%-46% increase for utility scale solar PV installation and 17.5%-35% increase for onshore wind installation.

Decarbonisation costs for materials and freight could vary materially by ISP scenario, due to different industry decarbonisation projections. For instance the 2024 World Energy Outlook assumes that by 2050 coking coal demand will reduce by 25% under the State Policies Scenario (maps to Progressive Change), 80% under Announced Policies Scenario (maps to Step Change) and 92% under Net Zero Emissions by 2050 Scenario (maps to Green Energy) (International Energy Agency, 2024).

The author's Stage 2 Draft 2025 IASR Consultation submission provide decarbonisation cost evidence for steel, concrete and freight. Notably the decarbonisation of steel production could lead to a ~50-100% increase in 2050 steel cost, which compares to GHD's transmission cost database 2049/50 Step Change steel price index forecast of 0.862x the 2023/24 steel price.

Additionally in relation to cables, for instance aluminium conductors for overhead lines, aluminium costs are driven by electricity costs and alumina costs.

Alumina energy costs are currently driven by coal and gas costs, however if decarbonised including by electrification or green hydrogen, electricity costs will be a key driver. HILT CRC research demonstrated that converting alumina refineries to utilise either electricity or hydrogen at current prices and efficiencies is likely to add approximately 50% to the cost per tonne of product alumina, which would translate to 15% addition to the cost per tonne of aluminium (HILT CRC, 2025).

Aluminium smelting requires 15MWh of electricity per tonne of production (Australian Aluminium Council, 2025) with the current aluminium price ~US2,500/tn. Aluminium prices will come under pressure from rising electricity costs. Figure 6 shows that real wholesale electricity prices and new entrant cost have grown significantly over the past 20 years. Figure 7 shows that AEMO's is forecasting real retail electricity costs to increase by 30% from current levels.

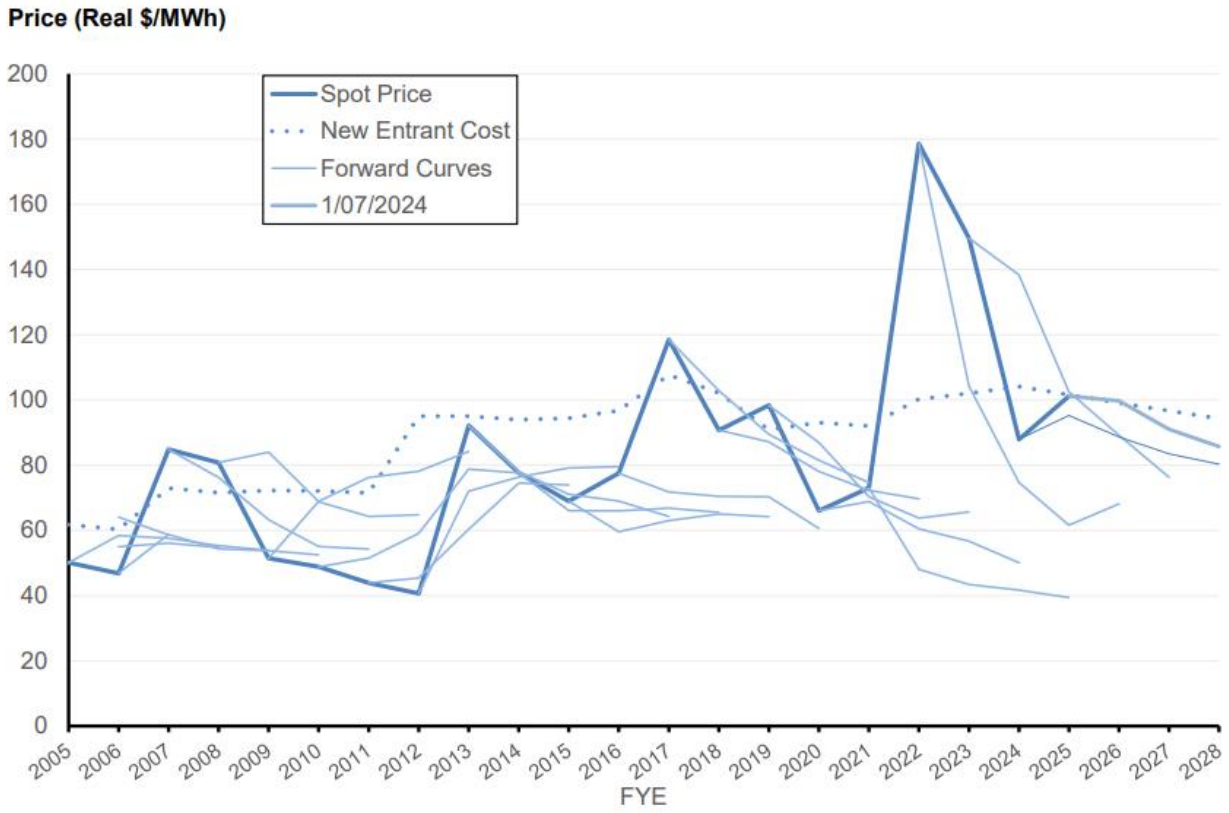

Figure 6: Spot and 3-year Forward Curves (Queensland region, 2005-2025) | Source: (Simshauser & Gilmore, 2025)

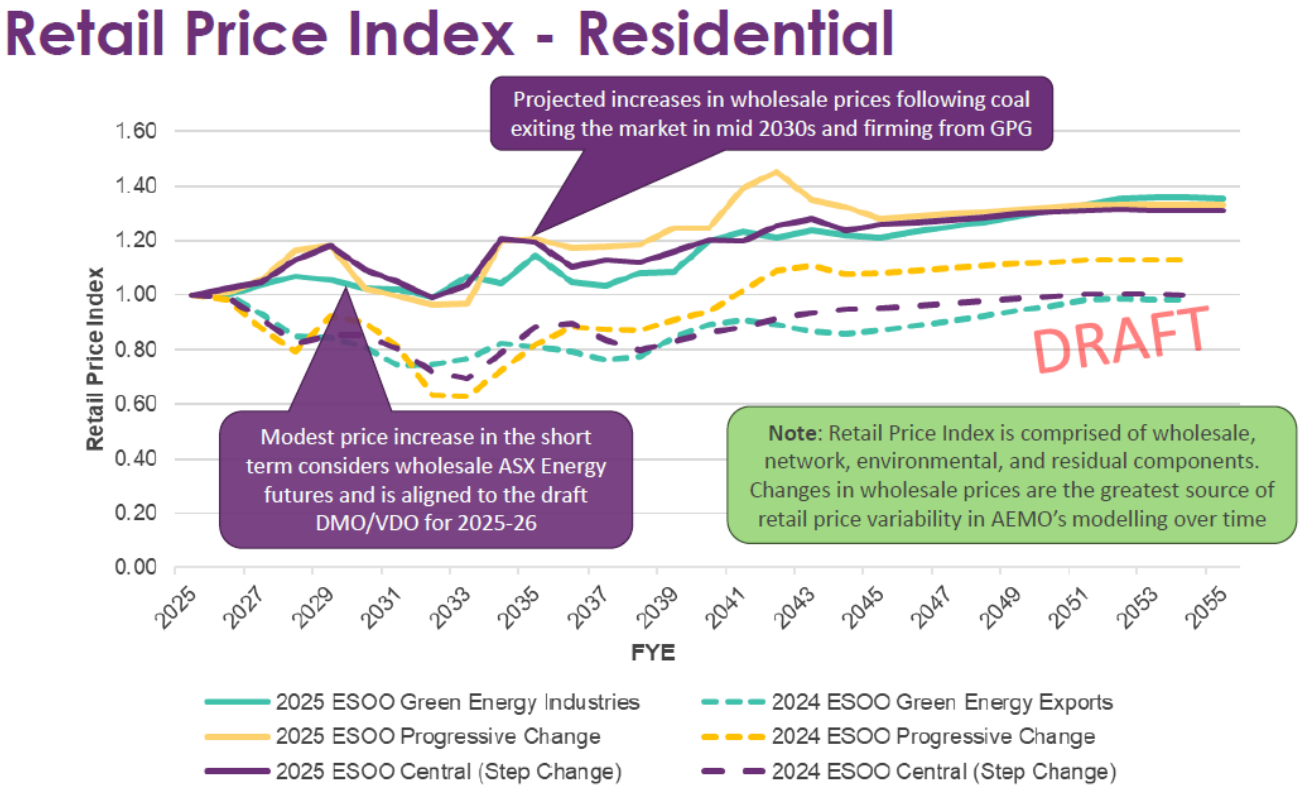

Figure 7: Retail Price Index – Residential | Source: (AEMO, 2025)

4. Distribution Scale Solar PV and BESS cost and technical parameters review

4.1 Inclusion as part of future GenCost consultation

AEMO is encouraged to consider including this Aurecon's Mid Size Solar PV and BESS cost and technical parameters review report as part of future GenCost consultation processes. GenCost attracts a much broader range of stakeholders than a network options consultation, are focussed on generation technologies.

The publishing of *Aurecon's 2024 Energy Technology Cost and Technical Parameter Review – Mid Size Solar PV and BESS* is welcomed and AEMO's focus on DNSP augmentation cost and connection application cost is noted. However, build cost estimates have been released into the public domain and stakeholders may use this information for other analysis. In addition, in the future there is the potential for the build cost estimates to be used in other AEMO consultant reports, for instance as in input into CSIRO large scale CER projections.

4.2 Inclusion of longer duration BESS build cost assumptions

Aurecon/ AEMO is encouraged to provide build cost estimates for longer duration BESS. While storage duration is not relevant for AEMO's analysis of DNSP augmentation cost and connection application cost, build cost estimates for longer durations such as 4hr and 8hrs could also be valuable for stakeholders, allowing cost comparisons with utility scale BESS. This is particularly the case as there is a trend of increasing duration for utility scale BESS.

5. Transmission Network Augmentation Costs

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1. Do stakeholders agree with the approach taken to reflect recently observed transmission market cost increases in the updated Transmission Cost Database? Do the updated Transmission Cost Database and subsequent cost estimate updates in this report reflect stakeholders' market observations in the NEM

2. What feedback do stakeholders have about any further work required to support finalising the updated Transmission Cost Database?

5.1 Validation of transmission cost database to committed and anticipated project capital costs

In order to improve confidence in these estimates, AEMO is encouraged to validate transmission cost database estimates against cost estimates for committed and anticipated projects.

A key theme of the author's ISP submissions has been that project costs estimates based on detailed studies for actual projects have been significantly higher than earlier stage generic cost estimates including for electrolysers (2024-25 GenCost) and biomethane (Stage 2 Draft 2025 IASR Consultation Submission). This theme also applies to electricity transmission with significant increases in project capital costs in recent years for projects such as Project Energy Connect, Marinus Link, Humelink and Copperstring 2.0. Though the author has not undertaken any detailed analysis the headline increases in capital cost estimates for these projects appears to be far higher than increases in transmission cost database estimates.

5.2 Transparency of committed and anticipated project capital costs

While it is acknowledged that the capital cost and benefits for committed and anticipated projects are not evaluated as part of the ISP modelling process, transparency of these cost estimates within in the ISP is encouraged to improve stakeholder confidence in transmission cost estimates. While AEMO publishes the status and details of these projects on AEMO's Generator Information Page and Transmission Augmentation Information Page, costs estimates are not included. AEMO is encouraged to include cost estimates in this report.

6. Distribution Network CER modelling

Draft 2025 Electricity Network Options Report - Consultation Questions

15. Do you agree with the proposed DNSP cost tranches and the methodology AEMO has used to identify these? If not, do you have recommendations for how the methodology can be enhanced?

6.1 DNSP CER augmentation costs

AEMO is encouraged to consider how DNSP CER augmentation costs can be independently verified.

Insufficient information has been provided to assess whether DNSP costs estimates are reasonable. Rather than being sourced from industry consultants the estimates have been sourced directly from DNSP. DNSP's have been subject to similar significant escalation pressures as TNSP and it is uncertain whether this has been captured in DNSP capital cost estimates.

7. References

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