February 2023

HumeLink Undergrounding Steering Committee (CCGSC)

Dear Rebecca, Peter and Andrea,

Thank you for your letter outlining the Community Consultative Groups representatives on the HumeLink Undergrounding Steering Committee (CCGSC) CCG Representatives' position on the HumeLink Undergrounding Study Report.

**Assessment of Undergrounding Study Report**

The National Electricity Law (NEL) establishes the overarching legal framework for the National Electricity Market and sets out the roles of governing bodies. These include the Australian Energy Regulator (AER) who is responsible for economic regulation of transmission in Australia. Under their rules, Transgrid, like all other Transmission Network Service Providers must propose the most efficient route for transmission that is the long-term interests of consumers of electricity with respect to price, quality, safety, reliability and security of supply of electricity.

As such, Transgrid's assessment of options considers relevant costs and benefits for supply of electricity to consumers including the capital cost of the solution, the ongoing operational costs, the market benefits, the expected reliability, and the costs associated with the impact on landowners, the community, and the environment.

In the following sections commentary is provided on capital cost comparisons, escalation, cost estimating methodologies, benefits assessment, community investment and project duration components of the report.

GHD has reviewed and considered all feedback provided by the community independent consultant. This response now concludes the valuable work and contribution of the Undergrounding Feasibility Steering Committee.

**Comparing the capital cost of undergrounding and overhead**

The capital cost of undergrounding HumeLink would be higher than the capital costs of an equivalent overhead line and as such would not be in alignment with the rules set by the AER.

Section 2.2 of your letter highlights the finding from the GHD report (Report) that the capital cost of undergrounding would be between 2.9 and 3.5 times that of overhead, but it also indicates that this could be expected to be "substantially smaller" based on the length of HumeLink.

We recognise that the cost of designing and constructing infrastructure is significantly more expensive in Australia than it is in other countries. Factors comparing the two need to be transparently included in capital estimates and we are confident, based on other evidence both in Australia and overseas, that the capital costs as represented by GHD in the report are reasonable for the purposes of options screening and comparison.

This evidence includes:

- A benchmarking study for the Australian Energy Market Operator[1] specifically addresses underground versus overhead cost and states, "*The costs of underground cables are approximately four to 25 times higher than overhead lines. Direct buried cables are at the lower end of this range, while tunnel installed cables are at the upper end.*"
- In the UK, an independent organisation oversaw a publicly available study to compare underground and overhead transmission cost. The study was commissioned by the UK National Grid and UK Department of Energy and Climate Change and finds build cost of 75km underground transmission lines ranging from 10.1 to 14.4 times the overhead line cost[2].
- With reference to the SuedLink project in Germany, reports indicate that costs are roughly tripled with underground cabling[3].

**Escalation**

*Historical Escalation*

In section 1.5 of your letter, concerns are raised that undergrounding report unfairly compares costs based on current market conditions for the underground cable options against previously developed 2020/21 estimates for the AC overhead option, especially given the sudden and dramatic increase in costs over the past 12 months. We agree that there is a difference between the currency of the two estimates and that this would favour the overhead option.

*Forward Escalation*

Neither the overhead estimate nor the underground estimate includes forward escalation. Transgrid understand there are uncertainties that make determination of forward escalation challenging but are of the view that this is a real cost that will ultimately need to be borne by consumers. When considering forward escalation, the following must be considered:

1. the forecast duration
2. the forecast outlook
3. the scale of the base estimate on which escalation is applied

Based on the analysis presented by GHD, we understand for the HVDC underground options the duration will be longer and the "tightness" of the supply chain more constrained when compared to overhead options. Both factors will drive the percentage increase associated with escalation. As the total cost of undergrounding is more than overhead, the increase in dollar terms will be greater for underground than overhead.

In aggregate, we agree that there appears to have been oversight on the historical adjustment for escalation. Rectifying this comparison will cause the overhead cost estimate to increase. We also are of the view that the forward escalation is likely to be at least as important as the historical escalation and most likely even more

[1] AEMO, 2021 Transmission Cost Report for the Integrated System Plan (ISP), Final report, August 2021
[2] Electricity Transmission Costing Study an Independent Report Endorsed by the Institution of Engineering & Technology
[3] https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/electric-power/092816-german-suedlink-grid-project-delayed-to-2025-as-cables-go-underground

important. Were the forward escalation be included in the results, the outcomes would likely be unfavourable for undergrounding, further increasing the cost differential.

**Cost estimate methodology**

It is noted that the letter has raised concerns about the top down methods used to quantify the underground option cost and whether this method is appropriate. The following table sets out what we understand to be "top down" and "bottom up" methods for estimate quantification.

| Method | Descriptions | Top down/ bottom up |
|---|---|---|
| **Stochastic and parametric** | Stochastic estimating methods such as gross unit costs (cost/length) factoring and other parametric and modelling techniques | Top down |
| **Factored** | A portion may be generated using factors. A common example is design cost may be X percent of construction cost. The detail behind the design estimate is yet to be developed. | Top down |
| **Unit cost assembly/forced detail** | Cost and or quantities are derived using a library of parts. This approach can result in generation of a large number of line items, even without detailed engineering drawings to support the apparent level of detail. This detail is "forced" in so far as the input can all be traced back to a small number of input variables, not detailed drawing. | Top down |
| **Detailed material take off** | The bill of quantities can be traced back to detailed drawings | Bottom up |

It is self-evident that detailed estimating approaches (bottom up) are not appropriate where the underlying detail is either not available or not reliable. Seeking to use this method will cause the estimator to introduce more assumptions for missing detail, which can add complexity and bias. Similarly, where there is a large amount of detailed information available, the estimator should use that information to improve the estimate accuracy. The table below reflects application of each technique and reflects Association for the Advancement of Cost Engineering (AACE) International recommended practice.

| Method | Applicability | | | | |
|---|---|---|---|---|---|
| | Class 5 | Class 4 | Class 3 | Class 2 | Class 1 |

| | | | | | |
|---|---|---|---|---|---|
| Stochastic | ✓ | ✓ | | | |
| Factored | ✓ | ✓ | ✓ | | |
| Unit cost assembly/forced detail | | ✓ | ✓ | ✓ | |
| Detailed material take off | | | ✓ | ✓ | ✓ |

The table below summarise the use of estimate quantification techniques for HumeLink.

| Estimate | Observations |
|---|---|
| HumeLink overhead option | Mixture of factored and forced detail<br>Factors, costs and quantities derived from Transgrid experience with similar projects and from Transgrid in-house library of parts estimating database.<br>Methods generally consistent with class 4. |
| GHD undergrounding report | Stochastic methodology with reference to analogous projects. Adjusted using some parametric techniques and some factoring.<br>Method generally consistent with class 5. |

GHD has described the underground estimates as “no better than Class 4”. The AACE suggests the following methodologies are applicable for Class 5 and Class 4 estimates.

| | |
|---|---|
| Class 5 | Generally, use stochastic estimating methods such as gross unit costs (cost/length) factoring and other parametric and modelling techniques |
| Class 4 | Generally, use stochastic estimating methods such as adjusted gross unit costs (cost/length) with adjustments for specific design elements or approximate unit or assembly costs for conductor, structures and other major elements, factored design and installation costs, and other parametric and modelling techniques. |

Based on the AACE recommended practice above, Transgrid concludes that bottom up estimates are not the preferred method where the level of definition is consistent with Class 5 or Class 4 estimates.

Setting aside the estimate methodology, the letter outlined concerns that the failure to use bottom up methodology is causing higher forecast cost. We are not aware of any analysis that shows that top-down estimate methodology understates the final cost. It is an accepted, and recommended technique used for early phase estimates

Most studies that do identify concerns with early phase estimates, tend to point to issues where those estimates understate the costs. The understatement often comes from an underestimate of risk which is normally quantified in contingency provisions added to an estimate. Understatement of risk is potentially likely in the case of undergrounding HumeLink, which does not include contingency provision which is a concern. As an aside, we note that the overhead estimate is also developed using top down approach. Contingency is a significant component of the overhead estimate.

Under the 'middle case' P50 estimate (50 percent chance the estimate will be sufficient), contingency included in the overhead estimate is 21% of base cost (cost excluding contingency). Under the 'worst case' P90 scenario (90% chance the estimate will be sufficient), the contingency forecast increases to 60%. Because the underground estimate has exposure to different and greater risk drivers than overhead, we expect a greater risk profile.

Accordingly, the P50 contingency will be higher than overhead and the P90 contingency will be much higher than overhead. Inclusion of any contingency will increase the cost differential to overhead. Even if the same percentage factors were applied as per overhead, they would be applied to a larger base estimate, further increasing the cost premium of underground in dollar terms.

Based on the Report and observations recorded in other relevant reference projects and studies, Transgrid's position is that the capital cost of an underground transmission line would not be less than 3 times the cost of an overhead line.

It is understood that you were presented with an alternative view on costs at the "Bury our cables or bury our wildlife" meeting. Even if these costs were accurate, the best-case scenario of 1.6 times the costs of the HumeLink transmission project would be circa $1.98 billion higher than the cost of the overhead option. At 3.5 times, the cost of undergrounding would be $8.25 billion higher than the cost of overhead and for reasons outlined this cannot be supported in the regulatory submission.

**Valuing the benefits of undergrounding**

In your letter, it was suggested that the Report highlighted the negative aspects of undergrounding whilst downplaying the positive aspects.

We note that the Report states that "*A significant benefit of undergrounding cables is the reduction in visual impact. In certain areas … this benefit could be a primary consideration and outweigh disadvantages of undergrounding*". Furthermore, the Report identified benefits of undergrounding compared to overhead including negligible impact to public and wildlife activity following construction, better performance during a bushfire, and higher reliability of supply.

Based on our assessment of the Report, where possible, these benefits (referred to as non-market benefits) have been accounted for within the cost for both underground and overhead solutions where the non-market benefits are tangible costs to the project. This includes accounting for the environmental impact (via biodiversity offsets) and the impact on land use and agriculture (via payments to landowners).

Other non-market benefits such as visual amenity are currently not able to be accounted for in the rules for the economic regulation of transmission infrastructure. We acknowledge the importance of these non-market

benefits, and we appreciate that most landowners do not want a new transmission line on their property, and we are committed to minimise impacts to landowners wherever feasible.

**Community Investment and Benefits**

Transgrid receives funding from the AER for these capital projects. We accept that there are currently no applicable mechanisms to quantify non-market benefits and one of the ways we are addressing this is by advocating for landowners and communities around visual amenity. It is recognised that this has resulted in frustration in the development of the Report, and this has been shared with relevant state and federal government agencies.

Recently, we successfully advocated and worked with the NSW Government to introduce a strategic benefit payment for landowners impacted by infrastructure of critical state significance. We are now in discussion with the Government about how we may account for neighbour and visual amenity impacts, as we are aware other international jurisdictions have such schemes as do energy generation mechanisms such as wind farms.

We are also working with the community, local councils, and the potential construction partners on providing more benefits to communities and landowners through our Community Investment and Benefits strategy. This is in addition to the Community Partnership Program and aims to provide a significant and lasting positive social legacy to people living and working near our assets. Transgrid will be consulting the community on this in detail in the New Year.

**Comparing the schedule of undergrounding and overhead**

It is clear from the GHD report and the other international experiences we have cited here that undergrounding HumeLink would take longer to construct than an equivalent overhead line and will significantly increase the cost to the consumers with a delay of services.

NSW is at a critical juncture in our history where we have pressure to energise these new assets as soon as possible to ensure continuity and resilience of electricity supply. We are being held accountable by both state and federal government to ensure that Australia's network will deliver electricity as traditional energy sources such as coal and gas are retired within a very short timeframe.

Significant benefits are realised through the on-time delivery of the HumeLink transmission solution. This benefit is primarily related to the avoidance/deferral of cost of alternative solutions. Delay to completion of HumeLink would also threaten the timely connection of the new renewable energy and the related essential new interstate connections to the grid.

**Conclusion**

The findings in the GHD report are consistent with other national and international experiences and benchmark studies. There is broad acceptance that the cost of undergrounding HumeLink will be higher than the cost of an

overhead line and the additional time to complete an undergrounding solution further exacerbates the costs on the project.

Furthermore, there are no applicable mechanisms to quantify the non-market benefits of undergrounding as compared to overhead. The comparison and consideration of non-market benefits is based on qualitative and subjective assessments.

Based on the findings from the report, undergrounding HumeLink will not be consistent with the rules that require Transgrid to propose the most efficient option for consumers based on the capital cost of the solution, the ongoing operational costs, the market benefits, the expected reliability, and the costs associated with the impact on landowners, the community, and the environment.

In addition, the Australian Energy Market Operator (AEMO) Planning Committee is looking to provide guidance on decision criteria on undergrounding collectively for the National Electricity Market.

Transgrid wishes to continue being an active participant in the conversation on the prospective viability of undergrounding solutions for future transmission developments.

**To this end, we will take the feedback received from the community in relation to the HumeLink Undergrounding Feasibility study into the joint Transmission Network Service Provider and AEMO forum to undertake a whole of energy system assessment and develop a national policy on undergrounding solutions as we transition to a renewable energy future.[4]**

We look forward to our continued dialogue on the HumeLink Project as we progress its development.

Kind regards,

Nathan Rhodes
Major Project Delivery Director

[4] **This response has been superseded as of June 2023.** Consultation occurred in late 2022 with the Transmission Operators in the Planning Committee hosted by AEMO. It was decided there to engage Energy Networks Australia (ENA) to develop a technical guidance documentation that could assist in both the decision criteria for Transmission owners and to demonstrate the associated challenges of overhead and undergrounding transmission infrastructure. It was confirmed in May 2023 that The Energy Charter (on behalf of the ENA) would be best placed to lead and create this documentation in their series of Better Practice guidelines. Transgrid are participating and funding to The Energy Charter creation of the undergrounding transmission paper. Transgrid have appointed Rod Stowe as the community advocate to collate all the previous work from the HumeLink undergrounding steer co and any further information received post this groups last meeting.