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Consistency of TransGrid's proposed capital expenditure for the VNI upgrade with the NER requirements

Final report

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1. Introduction

The Victoria to New South Wales (NSW) Interconnector (VNI) upgrade[1] refers to transmission works in NSW and Victoria that will increase the capacity of the existing interconnector between NSW and Victoria.

These works were identified by the Australian Energy Market Operator (AEMO) in its inaugural 2018 Integrated System Plan (ISP) as a 'Group 1' investment that would provide substantive benefits to the National Electricity Market (NEM) as soon as they could be completed.[2]

The 2020 ISP released by AEMO in July 2020 reconfirmed that the VNI upgrade is an actionable ISP project which forms part of the optimal network development path, and labelled it a 'no regret' action.[3] AEMO has assumed the upgrade is commissioned in 2022-23 under the five core 2020 ISP scenarios, and also states that it will deliver benefits to consumers if it can be delivered earlier than this timing.[4]

TransGrid and AEMO have subsequently completed the formal Regulatory Investment Test - Transmission (RIT-T) process, which has confirmed that the VNI upgrade option identified in the ISP is the preferred option under the RIT-T and would provide a positive net market benefit based on an assumed completion date of 2022-23. The Project Assessment Conclusions Report (PACR) for the RIT-T was published in February 2020.[5]

1.1 TransGrid's contingent project application

TransGrid is now lodging a contingent project application (CPA) with the Australian Energy Regulator (AER), to vary its current regulatory determination by an amount that reflects the prudent and efficient costs of the NSW portion of works for the VNI upgrade.

TransGrid has an approved contingent project (the 'Reinforcement of Southern Network' project ($60 to $393 million[6])) in its current regulatory determination. The approved triggers for this project include that:

> New generation of more than 350 MW is committed in southern NSW at any current or future connection point(s) south of Bannaby and Marulan, or NSW import capacity from Southern Interconnectors is determined to be increased by more than 350 MW due to committed expansion of southern interconnections.
>
> Successful completion of the RIT-T demonstrating a network investment by TransGrid maximises the positive net economic benefits from increasing the capacity of the network south of Bannaby and Marulan at 132/330kV or other voltages.

These trigger conditions have been met. However, consistent with the new 'actionable ISP' provisions in the National Electricity Rules (NER), TransGrid is lodging its contingent project application for the VNI upgrade on the basis of the 'actionable ISP project trigger event' now included in the NER,[7] rather than under the triggers in its determination.

[1] We note that this upgrade is called 'VNI minor' in AEMO's 2020 Integrated System Plan. We have adopted the term 'VNI Upgrade' in this report to align with the term used in the RIT-T documentation.

[2] AEMO, Integrated System Plan, July 2018, p. 94.

[3] AEMO, *Final 2020 Integrated System Plan*, July 2020, p. 61.

[4] AEMO, *Final 2020 Integrated System Plan*, July 2020, pp. 64 & 84.

[5] AEMO and TransGrid, *Victoria to New South Wales Interconnector Upgrade | Project Assessment Conclusions Report*, February 2020.

[6] AER, *Final Decision | TransGrid transmission determination 2018 to 2023 | Attachment 6 – Capital expenditure*, May 2018, p 6-138

[7] NER clause 5.16A.5(b).

TransGrid's contingent project application puts forward an estimated capital cost for the NSW works associated with the VNI upgrade of $45 million ($2017-18). The cost profile for the VNI upgrade over the current regulatory period is set out in Table 1.

Table 1.1: Forecast capex for the NSW component of the VNI upgrade 2018-23 ($m, 2017-18, including overheads)

2018-19	2019-20	2020-21	2021-22	2022-23	Total
0.3	3.5	13.5	27.5	-	45.0

Note: Capex includes real labour costs escalation but excludes equity raising costs

1.2 Scope of this report

We have been asked by TransGrid to assess the consistency of its proposed capex for the VNI upgrade with the NER requirements against which the AER will assess TransGrid's contingent project application. The scope of our assessment comprises:

- project scope – specifically whether the proposed project is justified and whether it represents the efficient approach to meeting the objectives of the project; and
- the capex estimate – including how the capex estimate has been prepared and the assumptions adopted.

This report does not cover TransGrid's estimate of incremental opex.

In preparing this report we have had regard to:

- the Capex Forecasting Methodology report prepared by TransGrid, which covers both direct and indirect capex;
- the Labour and Indirect Costs Forecast report prepared by TransGrid;
- the underlying models relating to each of the above capex forecasts;
- the procurement process undertaken by TransGrid for the VNI upgrade and the tender costs provided to TransGrid by contractors; and
- the independent review by GHD of TransGrid's forecasting methodology and the reasonableness of the overall total capex and timing of the cost estimates.

We note that TransGrid is submitting all the above documentation as part of its contingent project application.

We have also held several discussions with TransGrid staff in the course the preparation of this report, in particular to clarify our understanding of the procurement process TransGrid has undertaken for key elements of the project.

The remainder of this report is structured as follows:

- section 2 sets out the NER requirements relating to the AER's determination on TransGrid's VNI upgrade contingent project application;
- section 3 presents our assessment of the justification for the project and associated timing, in light of the NER requirements;
- section 4 presents our assessment of each of the key elements of TransGrid's capex forecasts, in light of the NER requirements; and
- section 5 brings together our conclusions.

2. The regulatory framework applying to the AER's contingent project determination

This section sets out the regulatory framework that applies to the AER's consideration and determination of TransGrid's contingent project application for the NSW portion of the VNI upgrade.

2.1 Requirements under the NER

2.1.1 The basis for the AER's assessment of a contingent project application

When considering the appropriate amendment to a revenue determination in response to a contingent project application, the AER is required to determine the following:[8]

- the amount of capital expenditure (capex) and incremental operating expenditure (opex) that is reasonably required for each remaining regulatory year to undertake the contingent project;
- the total capex reasonably required for undertaking the contingent project;
- the likely commencement and completion dates for the contingent project; and
- the incremental revenue likely to be required by the TNSP for each remaining regulatory year of the current regulatory period as a result of undertaking the contingent project.[9]

In making the assessment above, the AER is required to accept the amounts and dates put forward by the TNSP if it is satisfied that the amounts of forecast capital expenditure and incremental operating expenditure:

- reasonably reflect the *capital expenditure criteria* and the *operating expenditure criteria* (as defined by the NER), taking into account
- the *capital expenditure factors* and the *operating expenditure factors* respectively (as defined by the NER), in the context of the contingent project.[10]

2.1.2 Proposed expenditure needs to be prudent and efficient

The capital expenditure criteria and the operating expenditure criteria are defined in the NER.[11]

In making a determination on a contingent project application, the AER must be satisfied that the expenditure reflects:

- the efficient costs of achieving the capital (operating) expenditure objectives;
- the costs that a prudent operator would require to achieve the *capital (operating) expenditure objectives*; and
- a realistic expectation of the demand forecast and cost inputs required to achieve the *capital (operating) expenditure objectives*.

These criteria are the same that apply to the AER when approving TransGrid's capex and opex allowances as part of its full regulatory determination.

[8] NER Ch 6A.8.2(e)(1).

[9] This amount will differ from that implied from the total expenditure for the contingent project where the expenditure for the contingent project spans more than one regulatory period. This is not expected to be the case for TransGrid's expenditure on the VNI upgrade.

[10] NER Ch 6A.8.2 (f)

[11] NER Ch 6A.6.7(c) and Ch 6A.6.6(c).

Assessment is against the capital (operating) expenditure objectives

The AER is required to consider a contingent project application on the basis of achieving the capital and operating expenditure objectives.

These objectives are defined in the NER as being to:

- meet or manage the expected demand for prescribed transmission services over that period;
- comply with regulatory obligations or requirements;
- maintain the quality, reliability and security of the network; and
- maintain the safety of the transmission network.

Assessment of compliance against the capital expenditure objective essentially requires an assessment of the reason why TransGrid is undertaking the project.

In the case of the VNI upgrade this requires an assessment of the rationale for the project, as demonstrated by the application of the RIT-T.

Assessment of prudent and efficient costs

The AER is required to consider:

- the efficient costs of achieving the capital (operating) expenditure objectives;
- the costs that a prudent operator would require to achieve the capital (operating) expenditure objectives; and
- a realistic expectation of the [..] cost inputs required to achieve the capital (operating) expenditure objectives.

All of these requirements go to the question of whether the proposed expenditure is prudent and efficient. This requires an assessment of:

- whether the proposed scope of the VNI upgrade represents the efficient approach to meeting the objectives of the project; and
- whether the costs TransGrid is proposing to meet this scope represent a realistic expectation of efficient costs.

Moreover, the AER is required to determine not only whether the total proposed costs are prudent and efficient, but also whether the costs proposed in each year of the current regulatory period are prudent and efficient. This requires consideration of whether the proposed works schedule for delivering the VNI upgrade is consistent with that which would be adopted by a prudent and efficient TNSP.

Assessment against the relevant expenditure factors

In assessing whether the proposed costs are prudent and efficient, the AER is required to consider the relevant *expenditure factors*, as set out in the NER.[12]

For the VNI upgrade the following expenditure factors appear the most relevant:

- the relative prices of operating and capital inputs;
- the substitution possibilities between opex and capex in relation to the contingent project; and
- any relevant Project Assessment Conclusions Report (under the RIT-T).

[12] NER Ch 6A.6.7(e) and Ch 6A.6.6(e).

3. Project justification and timing

3.1 The rationale for the VNI upgrade

The VNI upgrade was identified by AEMO in its inaugural 2018 ISP as a 'Group 1' investment that would provide substantive benefits to the NEM as soon as it could be completed.[13] The minor augmentation of the existing interconnection would increase Victorian transfer capacity to NSW by 170 MW.[14]

The 2018 ISP stated that there was a need for greater Victoria to NSW transfer capability (together with enhanced Queensland to NSW transfer capability) in 2020, or as soon as it can be built. This will provide capital deferral benefits associated with the urgent need to invest in new flexible plant, arising from the closure of Liddell Power Station (then expected in 2022[15]). Further these investments would over time alleviate network congestion and provide additional benefits through fuel savings by allowing surplus generation to be shared between NSW, Queensland and Victoria, and reducing the need to utilise high-cost fuels such as gas.

The 2020 ISP published by AEMO in July 2020 reconfirmed the VNI upgrade is an actionable ISP project and labelled it a 'no regret' action.[16] AEMO has assumed the upgrade is commissioned in 2022-23 under the five core 2020 ISP scenarios, and further states that it will deliver benefits to consumers if it can be delivered earlier than this timing.[17] The 2020 ISP noted a potential capital cost range of $74 million to $137 million for the VNI upgrade, and modelled the mid-point of this range ($105 million).

The RIT-T process for the VNI upgrade has been undertaken jointly by TransGrid and AEMO, as the project involves investments in both NSW and Victoria. The RIT-T is an economic cost benefit test that is overseen by the AER and applies to all major network investments in the NEM. The PACR was published on 14 February 2020 and is the final step in the formal RIT-T process.[18]

The finding from the RIT-T process for the VNI upgrade is to implement 'Option 2' in the PACR, which comprises the following investments, to be in place by 2022-23:[19]

- install a second 500/330 kilovolt (kV) transformer at South Morang Terminal Station.
- re-tension the 330 kV South Morang – Dederang transmission lines, as well as associated works (including replacement of series capacitors[20]), to allow operation at thermal rating.
- install modular power flow controllers (MPFC) on the 330 kV Upper Tumut – Canberra and Upper Tumut – Yass lines to balance power flows and increase transfer capability.

Of these three elements of the VNI Upgrade, the third reflects the investments to be undertaken by TransGrid, which are the focus of its contingent project application.

[13] AEMO, Integrated System Plan, July 2018, p. 94.

[14] AEMO, Integrated System Plan, July 2018, p. 81.

[15] The first unit at Liddell is expected to close in April 2022, with the remaining three units now closing in April 2023.

[16] AEMO, *Final 2020 Integrated System Plan*, July 2020, p. 61.

[17] AEMO, *Final 2020 Integrated System Plan*, July 2020, pp. 64 & 84.

[18] AEMO and TransGrid, *Victoria to New South Wales Interconnector Upgrade | Project Assessment Conclusions Report*, February 2020.

[19] AEMO and TransGrid, *Victoria to New South Wales Interconnector Upgrade | Project Assessment Conclusions Report*, February 2020, p. 3.

[20] The capacitors will be replaced with higher rated capacitors to align with the new line ratings.

The RIT-T found that this option is expected to deliver net benefits to the NEM of approximately $268 million over the assessment period to 2033-34 (on a weighted basis in present value terms) through:[21]

- reducing dispatch costs, through more efficient dispatch of generation in Victoria and NSW; and
- reducing the capital costs associated with new generation in New South Wales.

Moreover, the investment is expected to generate sufficient benefits to recover the project capital costs six years after the option is commissioned.[22]

The RIT-T assessment considered the following three scenarios, which covered a wide range of possible futures and are generally aligned with the AEMO's 2019 Planning and Forecasting Consultation Paper:[23]

- **Neutral** – a future where modest economic and population growth is experienced, and existing policies are delivered. Consequently, grid demand is relatively static, and change in the large-scale generation mix is largely driven by the timing of coal-fired generation retirements.
- **Slow Change** – a future where Australia's economic and population growth is weaker, the life of existing power stations could be extended, households and commercial businesses install rooftop photovoltaic (PV) systems to help reduce energy costs, and the transition towards zero emission vehicles is slower, as people have less disposable income and are buying new vehicles less often. Consequently, grid demand is in decline and the change in large-scale generation mix over time is less pronounced.
- **Fast Change** – a future where Australia's economy is booming, population growth is strong, and emission reduction targets are aggressive, leading to rapid decarbonisation of both the stationary energy sector and the transport sector. Consequently, growth in grid demand is relatively strong and there is a material change in the large-scale generation mix over time.

We note that following stakeholder consultations, AEMO adopted five scenarios for the 2020 ISP, with three of these scenarios (central, slow change, fast change), being analogous to the above three scenarios adopted in the RIT-T, with some minor variations in assumptions.

The PACR noted that the five 2020 ISP scenarios have a greater range of outcomes in the long term compared to the three scenarios used in the VNI upgrade RIT-T modelling. However, over the short to medium term the range of outcomes were similar. Consequently, the PACR concluded:[24]

> As the preferred option in this RIT-T has a payback period in the order of six years, it is considered that the PADR scenarios include a suitable [sic] wide range of reasonable scenarios for this RIT-T assessment. The PACR therefore continue [sic] to use the PADR scenarios.

The three scenarios differ in relation to key variables expected to affect the market benefits of the options considered, including demand outlook, assumed generator fuel prices, assumed emissions targets, retirement profiles for coal-fired power stations, and generator and storage capital costs. Under the scenario assessment:

- Option 1 – base option, had the second lowest cost and the second highest net benefit under all three scenarios;
- Option 2 (preferred option) – base option with MPFC, had the lowest costs and is expected to provide the highest net benefits in all three scenarios;

[21] AEMO and TransGrid, *Victoria to New South Wales Interconnector Upgrade | Project Assessment Conclusions Report*, February 2020, p. 4.

[22] AEMO and TransGrid, *Victoria to New South Wales Interconnector Upgrade | Project Assessment Conclusions Report*, February 2020, p. 44.

[23] AEMO and TransGrid, *Victoria to New South Wales Interconnector Upgrade | Project Assessment Conclusions Report*, February 2020, p. 23.

[24] AEMO and TransGrid, *Victoria to New South Wales Interconnector Upgrade | Project Assessment Conclusions Report*, February 2020, p. 25.

- Option 3 – additional higher capacity upgrade in NSW, had a positive net benefit in the neutral and fast change scenarios and a negative net benefit under the slow change scenario; and
- Option 4 - additional higher capacity upgrade in NSW and Victoria, had a negative net benefit under all three scenarios.

The assumed capital cost for Option 2 in the PACR was $105 million ($2019-20), which is the same as the capital cost adopted by AEMO in its 2020 ISP. Of this, $41 million ($2019-20) related to the cost of installing power flow controllers in NSW,[25] which equates to $40.5 million ($2017-18).

The PACR also investigated the sensitivity of the results to both higher and lower capital costs through a ±30 per cent sensitivity test. The ranking of the preferred option was found to not change and the average weighted net market benefits remained positive.[26]

Under the NER, there is a 30 day dispute notification period for stakeholders to dispute the outcome of a RIT-T, following publication of a PACR. This period ended on 15 March 2020 and there were no dispute notices lodged in relation to the VNI upgrade RIT-T.

TransGrid is lodging its contingent project application for the VNI upgrade on the basis of the 'actionable ISP project trigger event' now included in the NER,[27] rather than under the contingent project triggers in its regulatory determination.

On 26 October 2020, as one of the trigger event criteria in the NER, TransGrid wrote to AEMO requesting written confirmation that the preferred option from the PACR:

- addresses the identified need specified in the 2020 ISP; and
- aligns with the optimal development path.

This process is referred to as the AEMO 'feedback loop', and has been introduced as part of the recent set of NER changes to convert the ISP into action.[28] The VNI upgrade is the first project in the NEM to have the new 'actionable ISP project trigger event' (including AEMO's 'feedback loop' process) applied to it.[29]

Under the NEM, AEMO will apply its feedback loop to the total cost of the VNI upgrade (across both the NSW and Victorian works). The estimate for the NSW component, as set out in TransGrid's letter to AEMO, is $47.0 million ($2017-18), which comprises capex of $45.0 million ($2017/18) and opex of $2.0 million ($2017/18) and is equivalent to $47.6 million (2019/20). We understand that AEMO has already received the costs of the Victorian component of the VNI upgrade, although we are not aware of whether these costs have been revised since the PACR analysis.

As of the date of this report, AEMO has not yet provided its feedback loop confirmation.

3.1.1 Our assessment

As discussed in section 2.1.2, the AER is required to assess the proposed expenditure in TransGrid's contingent project application by reference to achieving the capital expenditure objectives set out in the NER.

[25] AEMO and TransGrid, *Victoria to New South Wales Interconnector Upgrade | Project Assessment Conclusions Report*, February 2020, p. 18.

[26] AEMO and TransGrid, *Victoria to New South Wales Interconnector Upgrade | Project Assessment Conclusions Report*, February 2020, p. 47.

[27] NER clause 5.16A.5.

[28] NER clause 11.126.5.

[29] The transitional provisions in the NER (clause 11.126.5) allow the proponent(s) for an actionable ISP project, where the RIT-T proponent(s) has not requested the AER to make a determination under the former clause 5.16.6, to instead elect to apply the new NER provisions. The VNI upgrade falls under this provision, and TransGrid has elected to have these new rules apply.

This essentially requires an assessment of whether TransGrid's rationale for undertaking the project is justified.

Our assessment is that the decision to proceed with Option 2 is justified because it reflects the preferred option under the RIT-T and is expected to deliver benefits that exceed costs, provided that that costs of the Victorian component of the upgrade have not increased by more than 30 per cent.

The scenarios considered in the RIT-T have tested the identification of the preferred option in the context of differing assumptions about future demand and future capital costs, as well as different future policy settings in relation to emissions and different future rates of technology development. Option 2 is identified as the preferred option in all of the three scenarios considered in the RIT-T, and so its identification as the preferred option overall is not dependent on scenario weightings.

Further, Option 2 remains the preferred option and has a positive market benefit across all of the sensitivities considered in the RIT-T assessment, ie:

- changing capital costs by ±30 per cent;
- increasing the discount rate to either 8.6 per cent or decreasing to 3.2 per cent; and
- lower demand forecasts, with the adoption of 50% POE, rather than 10% POE.

The RIT-T is the standard process under the NER for assessing transmission investments. Where a project is justified under the RIT-T, it can be assumed to be consistent with the capital expenditure objectives in the NER.

Further, we note that while the capital costs in TransGrid's contingent project application have increased since the PACR, the increase (ie, approximately 11 per cent) is within the ±30 per cent range tested in the RIT-T.

As noted above, we are not aware of whether and to what extent to AEMO's cost estimate for the Victorian component of the VNI upgrade may have increased since the RIT-T, and whether any such increase also remains within the ±30 per cent range tested in the RIT-T. However we note that AEMO's 'feedback loop' confirmation will directly consider whether the change in the cost estimate for the VNI upgrade changes the status of the project as part of the optimal development path.[30] Confirmation via the AEMO feedback loop will therefore demonstrate the continuing justification for the VNI upgrade on the most recent cost estimates.

The RIT-T analysis, assuming it is supported by confirmation under the AEMO 'feedback loop', therefore demonstrates that the VNI upgrade is justified under on the basis of the capex estimate put forward in its contingent project application.

Finally, we note that GHD has verified that the project scope is reasonable and realistic to meet the investment need. More specifically, GHD concludes that:[31]

> … the project investment scope aligns with the investment need and has undergone appropriate option analysis.

[30] NER, clause 5.16A.5(b)(2).

[31] GHD, *VNI - Independent Verification and Assessment*, 24 October 2020, p 23.

3.2 Efficient timing

The preferred option is scheduled to be completed by 2022/23, in advance of the Liddell Power Station closure in 2023.[32]

As noted earlier, in its 2018 ISP, AEMO identified that the minor upgrade of VNI would provide benefits as soon as it could be constructed and recommended that the investment proceed as a priority. The 2020 ISP reconfirmed the proposed network upgrade as an actionable ISP project and labelled it a 'no regret' action.[33] The 2020 ISP assumes the upgrade is commissioned in 2022/23 under the five core scenarios and AEMO further states that it will deliver benefits to consumers if it can be delivered earlier than this timing.[34]

The assumed timing in the ISP for the VNI upgrade is consistent with that assumed in the RIT-T assessment completed by TransGrid and AEMO in February 2020. The RIT-T assessment shows that the VNI upgrade delivers substantial benefits from as soon as it can be put in place (2022/23).

TransGrid's portion of the VNI upgrade works are estimated to be completed in 2021/22, with the commissioning of the MPFC.

3.2.1 Our assessment

The expected completion date for the VNI minor upgrade coincides with closure of the Liddell power station in April 2023.

Our assessment, based on the RIT-T outcome for the VNI minor upgrade, is that the project is expected to provide a net benefit to the NEM based on the costs associated with delivering the project from 2022/23 onwards. Consequently, deferring this project would lower the total net benefits of the option.

AEMO's feedback loop will confirm whether this continues to be the case at the slightly higher costs included in TransGrid's contingent project application, which are based on firm contract costs to deliver the project on the proposed timing, and reflecting any changes to the cost estimate for the Victorian portion of the upgrade.

The feasibility of the proposed timing has also been market tested through the procurement process.

[32] AGL informed AEMO in August 2019 that the first unit at Liddell will close in April 2022 but that following an independent engineering assessment, the remaining three units will now close in April 2023.

[33] AEMO, *Final 2020 Integrated System Plan*, July 2020, p. 61.

[34] AEMO, *Final 2020 Integrated System Plan*, July 2020, pp. 61, 64 & 84.

4. Consistency of capex forecasts with NER requirements

In this section, we consider the consistency of TransGrid's capex forecasts for the NSW component of the VNI minor upgrade with the NER requirements.

TransGrid's component of the VNI upgrade comprises the installation of MPFC on the 330 kV Upper Tumut – Canberra and Upper Tumut – Yass lines, and associated works.

The MPFC at Stockdill and Yass are to be provided by Smart Wires.

The associated work which will be required to be undertaken by TransGrid relates to:

- substation works;
- transmission line works;
- the installation of secondary systems; and
- labour and indirect costs.

To inform our assessment, we have relied on:

- the Capex Forecasting Methodology report prepared by TransGrid, which covers both direct and indirect capex;
- the Labour and Indirect Costs Forecast report prepared by TransGrid;
- other documentation and models prepared by TransGrid, namely:
  - correspondence from VNI upgrade contractors;
  - the summary of the outcome of the tender process contained in the following spreadsheet: *VNI Capex forecast inputs – CONFIDENTIAL*; and
  - models setting out the capex forecast calculations.
- GHD's independent verification and assessment of TransGrid's capex forecast; and
- discussions with TransGrid staff to clarify and augment our understanding of matters covered in the TransGrid reports.

On the basis of the material above, we have assessed whether the capex forecast provided by TransGrid reflects the expected average costs of completing the project that would be forecast by a prudent and efficient business.

All costs in this section are expressed in 2017/18 dollars.

4.1 TransGrid's approach to deriving its capex forecast draws heavily on the outcomes of competitive procurement processes

The capex forecast for TransGrid's component of the VNI upgrade is $45.0 million ($2017/18). This comprises: [35]

- $21.3 million to cover the costs of the MPFC;

[35] Figures may not add up due to rounding.

- $13.2 million to cover substation works;
- $0.4 million to cover minor transmission line works;
- $2.6 million to cover secondary systems works;
- $7.2 million associated with TransGrid's direct labour and overheads costs; and
- $0.2 million to cover real labour cost escalation.

TransGrid's approach to deriving its capex forecast varies depending on the information that is available to inform the estimate for each key component of capex. However, $21.3 million (or 47 per cent) of the projected expenditure relates to the cost of the Smart Wires technology, which has been subject to review through the RIT-T process, and a further $16.2 million (or 35 per cent) is derived from competitive procurement processes. In total, this means that $37.5 million (or 83 per cent) of the capex forecast has been derived on the basis of costs determined through either submissions to the RIT-T or competitive procurement processes.

The circumstances of TransGrid's contingent project application, with many of the major procurement contracts for the VNI minor upgrade already having been concluded, is unusual compared to the circumstances in which the AER is typically evaluating the prudency and efficiency of capex forecasts at the time of a regulatory determination.

Specifically, the costs for the MPFC have been determined based on a contract that has been executed between TransGrid and Smart Wires. Given the proprietary nature of the Smart Wires technology, the identification of this technology as forming part of the preferred option under the RIT-T (which is an open process that allows all potential proponents of alternative solutions to participate) means that this cost has already been market tested and further testing through competitive procurement is not feasible.

In addition, TransGrid has already undertaken a competitive tendering process for key components of the VNI upgrade. TransGrid's general approach to procurement for the VNI upgrade is summarised in Box 1. The elements of the project that have been competitively tendered are the construction, design and equipment associated with the:

- substation works;
- transmission lines works; and
- secondary system replacements.

The outcomes of the tendering process, including the contracts that have been executed with the preferred tenderers, have been used as the basis for the associated elements of the capex forecast. As a consequence, these costs have been validated by the market. Moreover, all the suppliers participating in the tenders are unconnected with TransGrid, and so represent suppliers who are operating on independent terms.[36]

Given the above, there is a high degree of certainty and confidence associated with these elements of TransGrid's capex forecasts.

[36] NER 6A.6.7(e)(9).

Box 1 – Overview of procurement approach

TransGrid's general approach to procuring services from external suppliers for the VNI upgrade project can be broken into three separate processes:

- A single, competitive early contract involvement (ECI) tender process to procure all construction works (ie, all substation work, transmission line work and secondary systems work):
  - This involved two suppliers from TransGrid's existing provider panel (Construction Services Panel) who were selected based on a range of factors, including an early filtering process to determine capability both to undertake the works generally as well as within the reasonably short time required.
  - Tenders were based on concept designs prepared by TransGrid, supported by TransGrid's Standard Design Manual and Standard Construction Manual.
  - TransGrid developed a Tender Evaluation Plan to ensure that all tenders were evaluated fairly.
  - The tender process involved an initial Request for Proposal (RFP) in April 2020, a number of workshops with each party's commercial and technical teams, and a subsequent Request for Tender (RFT) process to obtain Best and Final Offers from each supplier.
  - The preferred supplier, Zinfra, ranked highest on both the technical and commercial assessments and represents the lowest cost supplier overall.
- A single, competitive ECI tender process to procure all design works:
  - this involved three members of the existing Engineering Services Panel (BECA, Aurecon and AECOM) plus the reserve panellist (APD).
  - Tenders were based on concept designs prepared by TransGrid, supported by TransGrid's Standard Design Manual and Standard Construction.
  - The RFT process was run in April 2020. The preferred supplier, BECA, ranked highest on both the technical and commercial assessments and represents the lowest cost supplier. Further, BECA provided a 7.5 per cent discount on their existing panel rates (which had also previously been established using a competitive process).
- The use of existing period agreements with suppliers for plant and equipment:
  - There are multiple potential providers for each of these components, and TransGrid uses a competitive process to establish its period agreements.
  - TransGrid identified, through its existing period agreements, the lowest cost supplier for the provision of each of these components.
  - All equipment is being provided to Zinfra as 'free issue' items in its capacity as the supplier undertaking the associated construction works.

4.2 Summary of our assessment of TransGrid's capex estimate

This section presents a summary of our overall assessment of TransGrid's capex forecast for the NSW components of the VNI upgrade. Our consideration of each element is then presented in more detail in the following sections.

We have assessed each element of TransGrid's capex forecast based on a consideration of the basis on which each element has been procured. In other words, we have considered whether TransGrid's approach

to procurement is likely to lead to efficient and prudent costs in each case. We have also had regard to the findings of GHD's independent review of the proposed capex costs and GHD's comparative estimates, particularly for those elements where costs have not been based on an external procurement process, and where as a consequence the forecasts have been estimated by TransGrid internally.

Table 4.1 below summarises our assessment.

Table 4.1: Assessment of capex categories – summary (all costs $2017-18)

Cost category	Estimated cost and basis for estimate	GHD comparative estimate and assessment	Our observations
MPFC	$21.3 million via a negotiation with Smart Wires.	GHD's comparative estimate of $20.4 million is within a reasonable range of TransGrid's estimate of $21.3 million. GHD concludes that TransGrid's estimate is reasonable	The RIT-T process identified the adoption of Smart Wires MPFC as the preferred option. The Smart Wires MPFC represents a proprietary technology and so cannot be subject to further competitive procurement. Further, the negotiated price included in the CPA is marginally below the costs used in the RIT-T and GHD's verification provides confidence that the forecast is prudent and efficient.
Substation	$12.7 million based on outcomes from a competitive tender process $0.2 million based on existing pricing schedules provided by suppliers on TransGrid's panel $0.3 million based on TransGrid's internal estimates	GHD concludes TransGrid's estimate is reasonable	Competitive procurement, panel pricing and GHD verification provide confidence that the forecast is prudent and efficient.
Secondary systems	$2.1 million based on outcomes from competitive tender process $0.5 million based on existing pricing schedules provided by suppliers on TransGrid's panel	GHD concludes TransGrid's estimate is reasonable	Competitive procurement, panel pricing and GHD verification provide confidence that forecast is prudent and efficient.
Transmission lines	$0.4 million based on outcomes from competitive tender process	GHD concludes TransGrid's estimate is reasonable	Competitive procurement, panel pricing and GHD verification provide confidence that forecast is prudent and efficient.
Corporate and overheads costs	$7.2 million (or 16.1 per cent of total capex) based on historical transaction records and a bottom up costing approach.	GHD concludes TransGrid's estimate is reasonable. GHD's comparative estimate indicates that 15.2 per cent of total capex is a reasonable allowance for the indirect capex for VNI. This is very close to the 16.1 per cent proposed by TransGrid.	GHD's verification provides confidence that forecast is prudent and efficient.

4.3 Assessment of TransGrid's capex forecast for tendered/procured costs

This section provides our assessment of TransGrid's capex forecast for tendered/procured costs.

We have categorised TransGrid's capex forecast to align with how they have been estimated and procured. More specifically, we have grouped TransGrid's tendered/procured capex into the following categories:

- MPFC costs;
- construction costs, which covers costs related to substation, transmission lines, and secondary system construction works;
- design costs, which covers costs related to substation, transmission lines, and secondary system design works; and
- plant and equipment costs, which covers costs of procuring plant and equipment required

This section also provides some observations on cyber security costs (section 4.3.5), noting that these are not based on tender or procurement outcomes. TransGrid's capex forecast for direct labour and overhead costs is considered in section 4.5.

4.3.1 Modular power flow controllers

TransGrid's forecasting approach

Two MPFC are required for the VNI minor upgrade, to control power flows on the 330 kV Upper Tumut to Canberra and 330 kV Upper Tumut to Yass lines. The MPFC can be used to effectively increase or decrease the reactance of a given circuit through lagging or leading constant voltage injection.

Smart Wires proposed the modular power flow equipment to improve the transfer capability of the Snowy to Canberra/Yass transmission corridor as a solution as part of the VNI upgrade RIT-T process.[37] The RIT-T concluded that the procurement of the Smart Wires' MPFC resulted in the highest net benefits of all the credible options considered. The cost of the Smart Wires technology reflected in the capex forecast in TransGrid's contingent project application is marginally below that assumed in the PACR ($21.4 million compared to $21.3 million).

The scope of works to be carried out by Smart Wires includes the following six separable tasks: [38]

- **Portion 1a:** design of the full MPFC installation – including support insulators – at Stockdill substation;
- **Portion 1b:** MPFC testing of contractor products to be installed at Stockdill substation:
  - 1b1: Stockdill mandatory testing;
  - 1b2: Stockdill preferential testing;
- **Portion 2:** procurement and construction of the MPFC works to be carried out for/at Stockdill substation;
  - 2a: Stockdill equipment long lead time items;
  - 2b: Stockdill equipment supply and commissioning;
- **Portion 3**: design of the full MPFC installation at Yass substation and RTDS protection studies;
- **Portion 4:** procurement and commissioning of the design of the full MPFC works to be carried out for/at Yass substation; and
- **Portion 5:** development of a spares strategy and associated procurement for both Yass and Stockdill substations

On 28 February 2020, TransGrid signed a letter with Smart Wires that agreed that, in order to keep the VNI Project on track, the Smart Wires components would be completed under an overarching set of agreed terms and conditions ('Master Services Agreement') with work on each respective separable portion to commence following the issuing of a respective 'work order'.

Following the issuance of the letter, Smart Wires received a direction from TransGrid to proceed with separable portion 1a and separable portion 3 on 28 February 2020, with a total combined sum of $368,260.87, by way of an issued work order.

Another direction was subsequently provided by TransGrid on 24 July 2020 to proceed with separable portion 1b1 with the authority to spend $750,000 and the balance of the work order to be payable upon final contract consolidation.

[37] AEMO, *Victoria to New South Wales Interconnector Upgrade – Project Assessment Draft Report*, August 2019, p 31.

[38] TransGrid, *Capex Forecasting Methodology for VNI Minor Upgrade Project*, Contingent Project Application for VNI Minor Upgrade Project, 30 October 2020, section 5.2.

On 4 August 2020, TransGrid executed a final contract with Smart Wires, which replaced the Master Services Agreement signed in February 2020. The contract involves a total cost of $21,586,983.27 ($2019-20) and includes all separable portions outlined above (including 1a, 3 and 1b1).

The final executed contractual cost has been included in the capex forecast in the contingent project application and is marginally lower than the $21.4 million ($2017-18) used in the RIT-T PACR analysis.

Our assessment

We conclude that TransGrid's capex forecast for MPFC is reasonable because:

- the option that included Smart Wires' MPFC technology ('Option 2') was identified in the RIT-T process undertaken by AEMO and TransGrid as providing the greatest net benefits;
- the identification of MPFC as part of the preferred option under the RIT-T (which is an open process that allows all potential proponents of alternative solutions to participate) means that this cost has already been market tested and further testing through competitive procurement is not feasible;
- the costs included in the CPA for the MPFC are marginally lower than the costs estimated in the RIT-T, which indicated that the inclusion of $21.3 million for these services would result in the greatest net benefits compared to all other credible options;
- a contract with Smart Wires has been executed – the capex forecast reflects the lump sum payment (rather than a cap on total costs) for the agreed scope, and so reflects the expected costs TransGrid will incur for the expected scope; and
- we understand that TransGrid intends to manage any variations through efficiencies in other areas if required.

Furthermore, GHD notes that the sole source approach is typical for project involving technology available from one supplier. [39] In addition, GHD notes that: [40]

> … TransGrid has achieved an outcome in the negotiations with Smart Wires that is well positioned to manage the risks and at reasonable costs given the sole source negotiation process required.

4.3.2 Construction works for substation, transmission lines and secondary systems

TransGrid's approach

TransGrid has procured construction works associated with the VNI upgrade through a competitive tender with external suppliers. This tender process covered:

- major substation works at Stockdill to facilitate the installation of a MPFC;
- minor substation works at Yass, including installation of six additional SmartValves unit and other works; and
- secondary system construction works, including protection replacement works, subsequent testing and commissioning support.

TransGrid has used a competitive early contract involvement (ECI) tender process utilising its existing provider panel to procure all construction works for the VNI upgrade project. A single competitive tender was used to procure all three construction works listed above, to avoid raising interface risks and incurring additional costs.

[39] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, executive summary.

[40] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, 10.6.

While TransGrid's panel has several suppliers on it, we understand that the decision was made in March 2020 to limit the ECI process to two tenderers – Zinfra and Downer. We understand that this decision was based on:[41]

- an early filtering process based on data from TransGrid's internal monthly panel scoring system for contractors, which factored in:
  - past performance delivering projects for TransGrid; and
  - general capability and capacity in delivering the works required,
- the other suppliers on the Construction Services Panel currently facing resourcing constraints due to the number of projects currently being undertaken in the sector;
- TransGrid's desire to minimise the risk associated with timing impacts on other projects that will be occurring over the same period (2021/22 and 2022/23); and
- the ability to have a deeper engagement with two suppliers compared to three or four suppliers, allowing a more prudent and efficient outcome and greater confidence in the subsequent delivery of the VNI upgrade project.

A request for quote (RFQ) for the VNI substation works was sent to Zinfra and Downer. Responses to the RFQ were received from these suppliers on the 30 April 2020. TransGrid undertook an evaluation process to determine the preferred supplier. This involved:

- a technical assessment for non-compliance; and
- a commercial assessment for any commercial departures.

The preferred supplier (Zinfra) ranked highest on both the technical and commercial assessments and also represented the lowest cost supplier for construction works.

TransGrid's capex forecasts for construction works are based on the executed contract signed with the preferred supplier, Zinfra. The contract signed is a lump sum fixed price contract of $14.5 million.

Our assessment

We conclude that TransGrid's capex forecast for construction works is reasonable because:

- a competitive tendering process was undertaken to procure all construction works (major substation works, minor substation works and secondary system works) – the preferred bidder was assessed to have a higher score for technical and commercial outcomes for all capex works as well as the lowest cost supplier:
- a contract with Zinfra has been executed – the capex forecast reflects the lump sum payment (rather than a cap on total costs) for the agreed scope, and so reflects the expected costs TransGrid will incur for the expected scope;
- we understand that TransGrid intends to manage any variations through efficiencies in other areas if required; and
- GHD notes that the procurement sourced from existing panel arrangements follows industry practice processes. [42]

[41] TransGrid, *Capex Forecasting Methodology for VNI Minor Upgrade Project*, Contingent Project Application for VNI Minor Upgrade Project, 30 October 2020, section 5.2.2.

[42] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, executive summary.

4.3.3 Design works for substation, transmission lines and secondary systems

TransGrid's approach

TransGrid procured design works associated with the VNI upgrade through a competitive tender with external suppliers. This tender process covered:

- substation design work, including design works for the Stockdill substation;
- transmission design work, including initial scoping, concept design, standard development and detailed design; and
- secondary system design work, including relay notification forms, relay test instructions, automation design and bill of materials.

TransGrid used a competitive ECI tender process to procure all design works for the VNI upgrade project. A single competitive tender was used to procure the design works across all three components listed above to avoid raising interface risks and increasing overall costs.

We understand that TransGrid used its existing panel to identify potential suppliers. TransGrid approached all three members of the existing panel (BECA, Aurecon and AECOM) plus the reserve panellist (APD). Following this: [43]

- an RFT was issued based on concept designs prepared by TransGrid, which were supported by TransGrid's Standard Design Manual and Standard Construction Manual. Suppliers were asked to provide detailed designs to achieve technical compliance; and
- suppliers were required to provide their bids subject to the standard terms and conditions of the panel (ie, as opposed to developing new, bespoke, terms and conditions).

TransGrid issued its RFT for design works on 14 April 2020 and received responses from all four suppliers on 16 April 2020. TransGrid evaluated each tender based on:

- a technical assessment for non-compliance, and
- a commercial assessment for any commercial departures.

We understand that the preferred supplier, BECA, ranked highest on both the technical and commercial assessments and also represents the lowest cost tender. In addition, we understand that BECA offered a 7.5 discount on their existing panel rates, which had previously been established using a competitive process.

On 5 May 2020, TransGrid executed a contract with BECA for the provision of design works related to the VNI upgrade. TransGrid's capex forecasts for design works are therefore based on the executed contract signed with the BECA. The contract is a fixed price contract of $0.7 million.

Our assessment

We conclude that TransGrid's capex forecast for design works is reasonable because:

- a competitive tendering process was undertaken – the preferred bidder was assessed to have a higher score for technical and commercial outcomes and was also the lowest cost provider:
- a contract has been executed – the capex forecast reflects a lump sum payment (rather than a cap on total costs) for the agreed scope, and so reflects the expected costs TransGrid will incur for the expected scope;

[43] TransGrid, *Capex Forecasting Methodology for VNI Minor Upgrade Project*, Contingent Project Application for VNI Minor Upgrade Project, 30 October 2020, section 5.2.2.

- we understand that TransGrid intends to manage any variations through efficiencies in other areas if required; and
- GHD notes that the procurement sourced from existing panel arrangements follows industry practice processes. [44]

4.3.4 Major plant and equipment for substation, transmission lines and secondary systems

TransGrid's approach

TransGrid intends to provide certain plant and equipment as free issue items to its supplier for construction works (Zinfra). This includes the procurement of:

- high voltage major plant, equipment and materials for the Stockdill substation related works;
- minor transmission line materials, such as insulators and conductors; and
- secondary system equipment, including supply of protection relays and associated equipment.

TransGrid has procured the items above through its existing period agreements with equipment suppliers. We understand that TransGrid has multiple agreements in place and there are generally multiple potential providers for each of the required components. TransGrid identified the lowest cost provider from its existing agreements for each component and has ordered the required components from the lowest cost provider. [45]

We also understand that it is a routine process for TransGrid to select companies to enter into a period agreement with for the supply of equipment, and that this is a competitive process.

We understand that all the required plant and equipment have now been ordered from suppliers, noting that they have not yet all been delivered. TransGrid's capex forecast of $0.7 million for plant and equipment is based on the number of units of equipment/plant/material TransGrid has ordered and the expected price for each unit.

Our assessment

We conclude that TransGrid's capex forecast for plant and equipment is reasonable because:

- TransGrid has existing period agreements with several suppliers and the lowest cost provider for each equipment type was selected;
- the process of entering into period agreements is itself a competitive process and companies put forward their proposed costs, conscious that this will influence whether they receive work from TransGrid;
- the capex forecast reflects the expected costs TransGrid will incur – the capex forecast reflects the pricing schedules put forward by its existing providers and the equipment TransGrid has already ordered;
- we understand that TransGrid intends to manage any variations through efficiencies in other areas if required; and
- GHD notes that the procurement sourced from existing panel arrangements follows industry practice processes. [46]

4.3.5 Cyber security

TransGrid's approach

We understand that TransGrid has a comprehensive Cyber Security Framework covering a number of Information Technology and Operational Technology systems. Since the Smart Wires i3600 unit is new

[44] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, executive summary.

[45] TransGrid, *Capex Forecasting Methodology for VNI Minor Upgrade Project*, Contingent Project Application for VNI Minor Upgrade Project, 30 October 2020, section 5.2.2.

[46] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, executive summary.

innovative technology, TransGrid is undertaking an assessment of the cyber security risk associated with the connection of this unit to its transmission network.

This assessment involves working closely with the equipment supplier, Smart Wires, internal staff, external consultants and possible third party testing of equipment to verify compliance with TransGrid's Cyber Security Framework.

TransGrid's capex forecast for cyber security is $0.3 million, based on its own bottom-up estimate of the costs this will involve. [47]

Our assessment

We do not have the relevant expertise to independently validate the reasonableness of TransGrid's bottom up approach to calculating cyber security costs. However, we note that the proposed solution for the VNI upgrade is new innovative technology, and so it would appear prudent and reasonable for there to be an allowance within the cost forecast to update cyber security arrangements.

GHD has not undertaken an individual assessment of this cost category. However, GHD has concluded that TransGrid's capex forecast for the VNI upgrade as a whole is reasonable and reflects an efficient outcome.

4.4 GHD's assessment of TransGrid's direct capex provides confidence that it is reasonable

4.4.1 GHD's assessment approach

TransGrid engaged GHD to undertake an independent verification and assessment of TransGrid's capex forecast. To assess the reasonableness of TransGrid's capex forecast, GHD developed comparative estimates, or estimated costs using historical project costs and publicly available data where possible.[48]

To ensure that GHD's comparative estimate is like for like with TransGrid's capex, GHD has made adjustments to TransGrid's allocation of costs between different works components. Specifically, GHD states that: [49]

> TransGrid allocated the design and project management, general and ancillary services for Stockdill substations works to civil and electrical works and a very small component to the direct transmission line costs. To provide a like for like comparison to GHD's estimates we adjusted the allocations which mainly resulted in transferring some mobilisation, project management and plant costs to transmission lines. This results in a lower cost for the substation costs in total and respectively to the sub categories under substations

In other words, GHD has readjusted TransGrid's capex forecast so that it is comparable with its comparative estimate. By way of example, TransGrid's capex forecast for transmission line works in its contingent project application is $0.4 million but is readjusted to $1.1 million in GHD's assessment so that it is like for like with GHD's comparative estimate.

The innovative nature of MPFC means historical project costs are not readily available. Given this, GHD developed a comparative estimate based on available unit cost data from Smart Wires and unit costs of different Flexible AC Technology Systems (FACTS) technology.

[47] TransGrid, *Capex Forecasting Methodology for VNI Minor Upgrade Project*, Contingent Project Application for VNI Minor Upgrade Project, 30 October 2020, section 5.2.2.

[48] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, section 5.2.

[49] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, section 5.6.3.

GHD considered TransGrid's capex forecast to be reasonable if it was within ± 20 per cent of its comparative estimate. For forecast capex categories that were not within ± 20 per cent, GHD then undertook a further review to explore if there were any know project specific reasons that resulted in this variation.

GHD's independent review provides further support for the consistency of TransGrid's forecast capex with that which would be incurred by a prudent and efficient business.

4.4.2 GHD's assessment of the Smart Wires work package

Given the innovative nature of technology used in the Smart Wires work package, GHD was not able to develop a comparative estimate using historical costs. Instead, GHD developed a comparative estimate using two approaches:

1. Unit base pricing provided by Smart Wires on its website, adjusted for the size of the proposed VNI upgrade investment and calibrated using pricing data provided by Smart Wires; and
2. Comparable power electronic devices, such as STATCOMs, SVCs and other FACTS technology.

Table 4.2 shows GHD's comparative estimate against TransGrid's capex forecast by activity. Overall, TransGrid's total capex forecast for the Smart Wire work package is within a reasonable range of GHD's comparative estimate (GHD's estimate is five per cent lower than TransGrid's capex forecast). GHD also found that TransGrid's capex forecast and GHD's comparative estimate was within a reasonable range by activity type. Given this, GHD concludes that TransGrid's forecast costs for the Smart Wires work package reflects an 'efficient outcome'.

Table 4.2: GHD's comparative estimate for the Smart Wires work package (m, $2017-18)[50]

Activity	TransGrid's CPA forecast	GHD's comparative estimate	Variance
Supply, design and testing at Stockdill Substation	19.47	18.54	-5%
Supply, design and testing at Yass Substation	1.61	1.61	0%
Spares	0.24	0.24	0%
Total	**21.32**	**20.40**	-5%

In addition, GHD has considered whether the use of MPFC represents the most appropriate option for the VNI upgrade. To this end, GHD considered the merits of different FACTS technologies and conventional solutions, such as Phase Shifting Transformers. GHD found that alternative technologies would cost more than the proposed solution of using MPFC but also noted that MPFC would carry some risk, which could result in higher project and asset management costs. Notwithstanding this, GHD concluded that the use of MPFC is the more prudent and efficient solution to meeting the project investment scope.

4.4.3 GHD's assessment of the substation augmentation work package

The substation works involve augmentation, civil and secondary works at Stockdill and Yass substations.

Table 4.3 shows GHD's comparative estimate against TransGrid's capex forecast by activity. Overall, TransGrid's total capex forecast for the substation augmentation work package is within a ±20 per cent reasonable range of GHD's comparative estimate (GHD's estimate is 15 per cent lower than TransGrid's capex forecast).

[50] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, section 5.6.2.

On an activity basis, GHD found that its comparative estimates was within a ±20 per cent reasonable range of TransGrid's estimate for two of the three activities it considered (ie, civil works and major plant, equipment and materials).

For electrical and secondary works, TransGrid's estimate was 22 per cent higher than GHD's comparative estimate. Upon further analysis, GHD was not able to identify the exact reasons for this difference but considered it could be because of additional costs for light voltage cabling and communications that it has not fully appreciated. That said, GHD considered the difference of $0.6 million to be 'small', or around one per cent of total proposed capex for the VNI upgrade.

Given the above, GHD considers TransGrid's capex forecast for substation augmentation works to be reasonable and reflect an efficient outcome.

Table 4.3: GHD's comparative estimate for the substation augmentation work package (m, $2017-18) [51]

Activity	TransGrid's CPA forecast	GHD's comparative estimate	Variance
Civil works	8.10	7.12	-14%
Electrical & secondary system works	3.36	2.76	-22%
Major plant, equipment & materials	1.06	1.02	-4%
Total	**12.52**	**10.90**	**-15%**

4.4.4 GHD's assessment of the substation secondary work package

The substation secondary work package is required to help mitigate the risks of incorrect operation of distance protection relays. It includes the upgrade of 26 protection relays at Stockdill and Yass substations.

Table 4.4 shows GHD's comparative estimate against TransGrid's capex forecast by activity. Overall, GHD considers that TransGrid's capex forecast is reasonable as:

- TransGrid's capex forecast for the package is well within a ±20 reasonable range of GHD's comparative estimate (GHD's estimate is four per cent lower than TransGrid's capex forecast); and
- the difference in secondary system relay costs of $0.1 million is immaterial.

Table 4.4: GHD's comparative estimate for the substation secondary work package (m, $2017-18) [52]

Activity	TransGrid's CPA forecast	GHD's comparative estimate	Variance
Secondary system material & equipment	1.60	1.59	-1%
Secondary system plant (relays)	0.50	0.4	-25%
Commissioning and modifications	0.49	0.5	-1%
Total	**2.60**	**2.49**	**-4%**

[51] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, section 5.6.3.

[52] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, section 5.6.4.

4.4.5 GHD's assessment of the transmission line work package

The transmission line work package comprises the replacement of two existing structures – TL 01 Structure 282A and TL3C Structure 16B – with new concrete poles, together with a notional 100 m of Twin Olive ACSR conductors, one OPGW, one Grape ACSR OHEW and standard fittings and insulators.

Table 4.5 shows GHD's comparative estimate against TransGrid's capex forecast for Transmission lines. GHD's comparative estimate is 25 per cent higher than TransGrid's capex forecast. However, GHD considered the difference of $0.36 million to be relatively small (less than one per cent of total capex) and the difference could be explained by contractor overheads. In addition, GHD notes that TransGrid's capex forecast is based on market pricing, and so will be more accurate than GHD's estimate.

Based on the above, GHD is satisfied that TransGrid's forecast capex for transmission line works is reasonable when considered together with substation costs.

Table 4.5: GHD's comparative estimate for the transmission line work package (m, $2017-18) [53]

Activity	TransGrid's CPA forecast	GHD's comparative estimate	Variance
Civils, access roads, footings & concrete structures	1.10	1.47	25%
Total	**1.10**	**1.47**	**25%**

4.4.6 GHD's assessment supports our conclusions that TransGrid's capex forecast is reasonable

By way of summary, GHD concludes that the tendered/procured capex forecast is reasonable. In particular, GHD finds that:

- the variation of Smart Wires system costs to GHD's comparative estimate is negative five per cent, and so is considered to be a reasonable and an efficient outcome;
- the variation of procured and tendered costs to GHD's comparative estimate is negative six percent, and so is considered to be a reasonable and efficient outcome; and
- the exception is transmission line costs, where the GHD's comparative estimate was higher than TransGrid's capex forecast – however, the value of this variance is small and represents less than one per cent of the total VNI upgrade capex forecast.

Further, GHD also noted that TransGrid's capex forecast is likely to be more accurate as it is based on market pricing outcomes whereas GHD's comparative estimate is a class 4 estimate with an accuracy of ±30%.

4.5 Direct labour, corporate and network overhead capex (indirect capex)

4.5.1 TransGrid's capex forecast

Overview of costs categories considered by TransGrid

TransGrid will incur corporate and network overhead capex in the delivery of the NSW portion of the VNI upgrade project, ie, indirect capex. Indirect capex can be grouped into the following key categories:

- historical capex, or costs that TransGrid has already incurred; and
- forecast capex, to cover:

[53] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, section 5.6.6.

- works delivery;
- project development;
- land and environment;
- stakeholder and community engagement; and
- insurance.

TransGrid's forecast for corporate and network overhead capex is $7.4 million in total, or $7.2 million if real labour cost escalation is excluded.

Historical capex

Historical capex relates to expenditure that TransGrid has incurred to progress the VNI upgrade from 1 July 2018 to 30 September 2020. TransGrid's enterprise resource planning system (Ellipse) records transactions and staff time that TransGrid has incurred. TransGrid has followed its cost allocation methodology and capitalisation policy when allocating and attributing costs to the VNI upgrade as capex. TransGrid estimates that its historical indirect capex is $3.0 million for the VNI upgrade.

Forecast indirect capex – works delivery

TransGrid forecasts that it will need to hire additional staff to undertake work delivery activities, eg, undertake project and contract management and inspect work completed by suppliers and contractors.

TransGrid has identified the need for an additional 13 FTE, with the actual number of FTEs varying across the different project phases. Work delivery costs have been calculated based on the estimate of an additional 13 FTEs, TransGrid's standard rates and costs for these FTEs, and TransGrid's estimate of the likely duration required for each role. The forecast cost of works delivery capex is $3.4 million.

The method TransGrid has applied for allocating indirect capex for the VNI upgrade is consistent with the methodology adopted in the minor Queensland New South Wales Interconnector (QNI) upgrade and Project Energy Connect (PEC).

Forecast indirect capex – project development

The forecast cost of project development is $0.8 million.

Labour related costs

TransGrid is scheduled to construct several major capex projects over the coming years. For example, in addition to the VNI upgrade, TransGrid will also be constructing the QNI minor upgrade, HumeLink and the NSW portion of Project EnergyConnect (PEC).

To help coordinate these projects and integrate these upgrades into the existing network, TransGrid has established a major projects division.

Some of these FTEs will be working specifically on the VNI upgrade, whereas some will be working across the different major projects. TransGrid estimated that the costs that are attributed to the VNI upgrade are around $0.7 million for labour and labour related costs. This cost has been estimated based on the expectation that:

- there will be 17 roles dedicated specifically to the VNI upgrade – these costs have been allocated to the VNI upgrade based on scheduled hours dedicated to the project; and
- there will be 24 roles that are not specific to an individual major project, and so are common costs across all major projects – these costs have been allocated to the VNI upgrade based on the expected proportion of capex for the VNI upgrade compared to the total capex for all major projects.

Non-labour related costs

TransGrid estimates that it will incur around $0.1 million of non-labour project development capex to cover:

- drafting assistance and specialist knowledge and skills for specific tasks; and
- independent verification of project costing.

These estimates have been based on historical costs of undertaking similar projects or estimates from potential suppliers.

Forecast indirect capex – Land and environment

TransGrid will need to manage any environmental impact that may arise from the project. While there is a larger Land and Environment team allocating time to the VNI upgrade project, this has been resourced using existing internal resources apportioning less than 25 per cent of their time during the project. TransGrid has therefore not allocated specific land and environment costs to the VNI upgrade, as per its cost allocation methodology.

Forecast indirect capex – stakeholder and community engagement

TransGrid's capex forecast for stakeholder and community engagement for the VNI upgrade is $6,000, to cover a small proportion of a media and communications manager's time on the project. TransGrid intends to leverage its existing community and stakeholder engagement team to undertake all other stakeholder activities.

Forecast indirect capex – insurance costs

[redacted]

4.5.2 GHD's assessment of indirect capex forecasts

GHD noted that TransGrid's indirect capex of $7.2 million (excluding real labour cost escalation) represents 16.1 per cent of total forecast capex for VNI. GHD further noted that in general, the larger the project, the smaller the project development and management owner costs will be as a percentage of total costs. In other words, the fixed overhead costs will be spread across a larger cost base, and so total overhead costs will represent a smaller proportion of total costs for larger projects.

To assess whether TransGrid's indirect capex is reasonable, GHD has undertaken an assessment of how the project overhead is expected to change for transmission projects. GHD's assessment indicates that project overheads for transmission projects can range from 5 per cent of total project costs for a $2 billion project to around 23 per cent of total project costs for a $25 million project.

For a $50 million transmission project, GHD estimated that it is reasonable for indirect capex to represent 15.2 per cent of total capex, which is very close to TransGrid's capex forecast for indirect capex, representing 16.1 per cent of total capex.

Given this, GHD concludes that TransGrid's indirect capex forecast is reasonable given the size of the NSW works for the VNI upgrade.

4.5.3 Our assessment

We do not have the relevant expertise to independently validate the reasonableness of TransGrid's bottom up approach to calculating corporate and overhead costs. However, we consider TransGrid's capex forecast for corporate and network overheads to be prudent and efficient on the basis of GHD's assessment.

4.6 Overall assessment of TransGrid's capex forecast compared with GHD's comparative estimates

4.6.1 Overall conclusions from GHD's report

GHD has developed a comparative estimate for different components of the project and compared it against TransGrid's capex forecast. Overall, GHD concludes that: [54]

> The CPA capex forecast of $45.0 million is supported by tender results and the overall forecast totals are within the nominal ±20% range of GHD's comparative estimate, and therefore we consider the overall CPA forecast to be reasonable and an efficient outcome.

Further, GHD notes that: [55]

> … generally the TransGrid CPA forecasts are slightly higher than the GHD comparative estimates on a work package basis, and the total CPA forecast overall 6% higher (which is well within the GHD range of ±20% variance for reasonableness).

That said, GHD states that: [56]

> TransGrid's substations, secondary systems and transmission line costs are based on market tested pricing and will be more accurate, as GHD's comparative estimate is a Class 4 estimate with an accuracy of ±30%.

4.6.2 Our overall assessment

We have considered whether TransGrid's capex forecast for procured and tendered works is reasonable. Procured and tendered works represent 83 per cent of capex for VNI. In our view, TransGrid's capex forecast for tendered and procured works is reasonable because:

- it has been market tested, either via the RIT-T process or competitive tender processes;
- TransGrid has selected the lowest cost provider where possible; and
- it reflects the expected costs TransGrid will incurred.

GHD's findings support that TransGrid's capex forecast for tendered and procured capex is reasonable. In addition, it also provides confidence that TransGrid's total capex forecast for VNI and capex forecast for other costs are also reasonable.

[54] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, executive summary.
[55] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, executive summary.
[56] GHD, *VNI - Independent Verification and Assessment*, 27 October 2020, executive summary.

5. Conclusions on the consistency of TransGrid's proposed capex for the VNI upgrade with the NER

We have considering the following:

- consistency of the VNI upgrade with the capital and operating expenditure objectives;
- whether the proposed capex amounts proposed by TransGrid as part of the contingent project application reasonably reflects (both in total, and on an annual basis):
  - the efficient costs of achieving the expenditure objectives;
  - the costs that a prudent operator would require to achieve the expenditure objectives; and
  - a realistic expectation of the demand forecast and cost inputs required to achieve the expenditure objectives.

Our conclusions are summarised in the following table.

Table 5.1: Consistency of TransGrid's proposed expenditure on the VNI upgrade with the NER

Assessment criteria	Assessment
How does the project meet the capital and operating expenditure objectives?	The overall VNI upgrade project has been subject to a RIT-T and has been identified as the preferred option which is expected to deliver benefits that exceed costs. The cost for the NSW portion of the project has increased slightly since the RIT-T (within the bounds of the RIT-T sensitivity tests). TransGrid has requested that AEMO provide 'feedback loop' confirmation of the continuing alignment of the project with the optimal development path, which will reaffirm the need for the project on the cost estimate presented in the CPA. On the basis of the RIT-T outcome and subject to a positive feedback loop confirmation from AEMO, the project therefore meets the capital and operating expenditure objectives.
Does the proposed expenditure reflect the efficient and prudent costs of achieving the expenditure objectives?	The competitive procurement process (which has resulted in a fixed price), competitive panel pricing and GHD's verification provides confidence that the forecast is prudent and efficient
Does the proposed expenditure reflect a realistic expectation of the demand forecasts and cost inputs to achieve the capital expenditure objectives?	The RIT-T has considered multiple demand and cost scenarios and has identified that the VNI upgrade as the preferred option across all of these scenarios.
Is the amount of capital required each remaining regulatory year reasonable?	We understand that the amount of capital required each year aligns with the expected costs TransGrid will incur. Given this, we consider the amount of capex TransGrid has put forward for each year to be reasonable.
Is the likely commencement and completion dates reasonable?	The likely commencement and completion dates are reasonable and have been market tested through the procurement process. The RIT-T has confirmed that the project will provide net market benefits from 2022/23, on the basis of the costs set out in this contingent project application.

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