TransGrid

Summary: Reinforcing the NSW Southern Shared Network to increase transfer capacity to demand centres (HumeLink)

Project Assessment Draft Report
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Summary

TransGrid is investigating options for reinforcing the New South Wales (NSW) Southern Shared Network to increase transfer capacity to the state's major load centres of Sydney, Newcastle and Wollongong.

The driver for reinforcing the Southern Shared Network is to deliver a net economic benefit to consumers and producers of electricity and support energy market transition through:

- increasing the transfer capacity and stability limits between the Snowy Mountains and major load centres of Sydney, Newcastle and Wollongong;
- enabling greater access to lower cost generation to meet demand in these major load centres; and
- facilitating the development of renewable generation in high quality renewable resource areas in southern NSW, which will further lower the overall investment and dispatch costs in meeting NSW demand whilst also ensuring that emissions targets are met at the lowest overall cost to consumers.

This analysis builds on the assessment in the 2018 Integrated System Plan (ISP) prepared by the Australian Energy Market Operator (AEMO) that transmission reinforcement provides net benefits, as well as the 2019 AEMO Electricity Statement of Opportunities (ESOO). Its findings are consistent with both of these studies as well as the draft 2020 ISP results recently released by AEMO.

Expanded transmission capacity from southern NSW to major demand centres was listed as a priority in the NSW Transmission Infrastructure Strategy, released in November 2018.[1]

We are applying the Regulatory Investment Test for Transmission (RIT-T)[2] to this identified need based on expected net market benefits, rather than a reliability corrective action. Reliability of supply has been considered as one class of market benefits in the overall benefits assessment. This Project Assessment Draft Report (PADR) has been prepared as the second formal step in the 'reinforcing the NSW Southern Shared Network to increase transfer capacity to demand centres' RIT-T process and follows the Project Specification Consultation Report (PSCR) released in June 2019.

Overview

This PADR assessment finds that the 500 kV options going between Maragle and Bannaby via Wagga Wagga (i.e., Option 2C and Option 3C[3]) provide the greatest net benefits of all options.

Option 3C is the preferred option as it provides additional unquantified benefits over Option 2C on account of its topology involving more opportunity for route diversity, which translates to a greater risk reduction in terms of 'high impact low probability' events (such as lightning strikes, bushfires or extreme wind events).

The analysis shows that the preferred option is expected to:

- deliver net benefits of approximately $1.1 billion over the assessment period to 2044/45 (in present value terms);
- lower the aggregate generator fuel costs required to meet demand in the National Electricity Market (NEM) going forward;
- reduce the need for new dispatchable generation investment to meet demand going forward;
- avoid capital costs that would otherwise be required associated with enabling greater integration of renewables in the NEM; and

[1] https://energy.nsw.gov.au/media/1431/download

[2] The Regulatory Investment Test for Transmission (RIT-T) is the economic cost benefit test that is overseen by the AER and applies to all major network investments in the NEM.

[3] Option 2C has two lines passing through Wagga Wagga, while Option 3C has one line passing through Wagga Wagga and one directly between Maragle and Bannaby.

- generate sufficient benefits to recover the project capital costs three years after the option is commissioned.

This RIT-T examines reinforcing the Southern Shared Network to increase transfer capacity to demand centres

TransGrid operates and maintains the transmission network in NSW. The shared transmission network between the Snowy Mountains and Bannaby carries power from all generation across southern NSW to the major load centres of Sydney, Newcastle and Wollongong. It also carries all electricity that is imported from Victoria (VIC) to the major load centres in NSW. The main transmission lines in this area are heavily congested at times of high demand and will become more congested as new generation connects in southern NSW.

In NSW, where the existing coal-fired generators are retiring progressively from 2022, there is a pressing need for new sources of supply to meet the community's growing energy demand.

Existing congestion at times of high demand limits access to the existing generation capacity of the Snowy Mountains Scheme at times of peak demand. Access to the additional 1,900 MW of new renewable generation and 2,000 MW capacity of Snowy 2.0 in southern NSW would be severely limited, without reinforcement to the Southern Shared Network.[4]

Snowy 2.0 will provide a new source of generation to meet future demand in the major load centres of NSW and 'firm' supply from new renewable generation which is anticipated in southern NSW. This includes renewables projects in construction or under development totalling 1,900 MW. Reinforcement of the Southern Shared Network will be required to allow the transfer of energy to demand centres.

Benefits from reinforcing the Southern Shared Network compared to the status quo

The RIT-T must demonstrate that there is an overall net market benefit to the NEM from increasing the transfer capacity of the transmission network – the Southern Shared Network between southern NSW and the major demand centres of Sydney, Newcastle and Wollongong.

Increasing access to generation capacity in southern NSW has the potential to benefit the market and consumers through lowering the overall dispatch and investment costs required to meet the demand from households and businesses in NSW for reliable and safe electricity, as existing generators in NSW are expected to progressively retire.

The investments to be considered in this RIT-T have the potential to:

- open up additional capacity for new generation (primarily renewable generation) in areas of southern NSW, which have recognised high-quality wind and solar resources;
- increase the transfer capacity between VIC and NSW, which would provide NSW with access to additional generation from VIC; and
- allow the additional transfer capacity between South Australia (SA) and NSW provided by the proposed SA–NSW interconnector, Project EnergyConnect, to flow to Sydney.

In the absence of investment under this RIT-T, alternative investment by market participants in peaking plant and other generation technologies in NSW would be needed to continue to meet the State's demand and system stability requirements, as existing dispatchable generation in NSW retires.

[4] New generators will connect to the transmission network at various locations. The connection works are funded by the respective generator and are outside the scope of this RIT-T, which examines reinforcing the shared network.

The RIT-T tests whether the net cost to the market, (and therefore ultimately to consumers), would be higher under the 'do nothing' path, than if investment under this RIT-T proceeds.

The PADR analysis has benefited from extensive stakeholder consultation

TransGrid published the PSCR for this RIT-T in June 2019, along with an accompanying input and methodology consultation paper and assumptions workbook. The input and methodology documents provided additional detail on the proposed economic and wholesale market modelling to be undertaken, as well as further information on the specification of the credible options assessed.

In September 2019, TransGrid held its Transmission Annual Planning Report (TAPR) public forum and, as part of this, ran a consultation session on this RIT-T.

Formal submissions from six parties were subsequently received, all of which have been published on our website. While formal submissions and points raised in the consultation session covered a range of topics, there were three broad topics that were most commented on, namely:

- the modelling approach, assumptions, scenarios and sensitivities;
- options considered and the proposal of alternative options; and
- the provision of information to support the PADR and modelling that has been undertaken.

In addition, prior to, as well as after, receiving submissions, we held bilateral meetings with interested parties in order to further discuss the RIT-T assessment. These have played a pivotal role in being able to define and undertake the assessment in this PADR.

We have taken all feedback raised in submissions and stakeholder feedback sessions into account in undertaking our PADR analysis, as explained throughout this document (together with an appendix providing a comprehensive list of key points raised through stakeholder engagement and responses to each).

Twelve options have been developed and assessed in this PADR

This PADR assesses twelve different network options to provide additional transfer capacity on the NSW Southern Shared Network between the Snowy Mountains and the major load centres. These are the same options as presented in the PSCR.

The network options considered reflect four alternative topologies for greenfield developments, reflecting:

1. a 'direct' path between Maragle[5] and Bannaby ('route 1');
2. a path between Maragle and Bannaby via Wagga Wagga that would open up additional capacity for new renewable generation in southern NSW ('route 2');
3. a wider footprint via Wagga Wagga, that would open up both direct and additional capacity for new renewable generation in southern NSW ('route 3'); and
4. a wider Maragle-Wagga Wagga-Bannaby footprint plus additional capacity between Bannaby and Sydney, to further relieve constraints on that portion of the network ('route 4').

Each topology has been modelled using three different operating capacities:

> construction and operation at 330 kV with high capacity conductor (referred to as the 'fixed 330 kV' options);
> construction to 500 kV and initial operation at 330 kV, with the optionality to augment substation equipment in the future to operate to 500 kV (referred to as the 'flexible 500 kV' options); and
> construction and operation at 500 kV (referred to as the 'fixed 500 kV' options).

[5] Maragle is approximately 85 km south of Tumut, in the Snowy Mountains. This is the connection point to the shared network for Snowy 2.0.

These network options are summarised in Table E-1, which shows the additional network capacity that each provides between southern NSW and the major load centres of Sydney, Newcastle and Wollongong. We have also considered a staged variant of Option 3C as a standalone sensitivity in response to submissions.

Table E-1 Summary of the twelve credible options assessed in this PADR

Topology	A. Fixed 330 kV	B. Flexible 500 kV	C. Fixed 500 kV
Route 1 Two new transmission lines between Maragle and Bannaby (and power flow control between Bannaby and Sydney where needed to provide 2,000 MW capacity)	Option 1A Two new 330 kV high capacity transmission lines, switchgear and phase shifting transformer Additional firm capacity 2,050 MW Indicative capex $790m	Option 1B Two new 500 kV transmission lines operated at 330 kV, switchgear and phase shifting transformer Additional firm capacity 2,170 MW initially 2,570 MW if upgraded to 500 kV Indicative capex $950m initially Plus $117m for upgrade to 500 kV	Option 1C Two new 500 kV transmission lines, tie transformers and switchgear Additional firm capacity 2,510 MW Indicative capex $1,060m
Route 2 New transmission lines between Maragle, Wagga Wagga and Bannaby (and power flow control between Bannaby and Sydney where needed to provide 2,000 MW capacity)	Option 2A Four new 330 kV high capacity transmission lines, switchgear and phase shifting transformers Additional firm capacity 2,000 MW Indicative capex $1,240m	Option 2B Four new 500 kV transmission lines operated at 330 kV, switchgear and phase shifting transformers Additional firm capacity 2,000 MW initially 2,500 MW if upgraded to 500 kV Indicative capex $1,420m initially Plus $208m for upgrade to 500 kV	Option 2C Four new 500 kV transmission lines, tie transformers and switchgear Additional firm capacity 2,500 MW Indicative capex $1,380m
Route 3 New transmission lines in a 'loop' between Maragle, Bannaby and Wagga Wagga (and power flow control between Bannaby and Sydney where needed to provide 2,000 MW capacity)	Option 3A Three new 330 kV high capacity transmission lines, switchgear and phase shifting transformer Additional firm capacity 2,000 MW Indicative capex $1,010m	Option 3B Three new 500 kV transmission lines operated at 330 kV, switchgear and phase shifting transformer Additional firm capacity 2,030 MW initially 2,570 MW if upgraded to 500 kV Indicative capex $1,220m initially Plus $166m for upgrade to 500 kV	Option 3C Three new 500 kV transmission lines, tie transformers and switchgear Additional firm capacity 2,570 MW Indicative capex $1,350m
Route 4 New transmission lines in a 'loop' between Maragle, Bannaby and Wagga Wagga and direct between Bannaby and Sydney	Option 4A Four new 330 kV high capacity transmission lines and switchgear Additional firm capacity 2,000 MW Indicative capex $1,330m	Option 4B Four new 500 kV transmission lines operated at 330 kV and switchgear Additional firm capacity 2,030 MW initially 3,100 MW if upgraded to 500 kV Indicative capex $1,570m initially Plus $343m for upgrade to 500 kV	Option 4C Four new 500 kV transmission lines, tie transformers and switchgear Additional firm capacity 3,100 MW Indicative capex $1,890m

Note: While the indicative additional firm capacities in this table assume an average level of import from VIC to NSW of 200 MW and average wind generation in southern NSW of 265 MW and zero SA-NSW imports, the market modelling dynamically models both of these key sources of supply for NSW.

The costs provided here must not be interpreted as a cap or maximum cost but rather as the midpoint of a range of possible cost outcomes. The costs have been prepared through desktop studies, utilising preliminary plant and material cost data available at the date of preparation for inter-option comparison. An extensive range of factors will affect the final project cost including (but not limited to) environmental factors affecting line route, land acquisition or easement requirements and cost, construction cost implications arising from route dynamics, currency fluctuations and construction contractor costs during the proposed construction period. As such, the costs specified are indicative only and will be further refined during the PACR stage of the project.

Construction for all options is expected to take 3-4 years, with commissioning in 2024-25, subject to obtaining necessary environmental and development approvals. The exception to this is Options 4A, 4B and 4C, in which the Bannaby to Sydney link is expected to take 4-5 years to construct (with commissioning expected in 2025-26). The future upgrades associated with the flexible 500 kV options are expected to take two years and the timing differs by scenario.

The 500 kV options going between Maragle and Bannaby via Wagga Wagga provide the greatest net benefits across all scenarios

Uncertainty is captured under the RIT-T framework through the use of scenarios, which reflect different assumptions about future market development, and other factors that are expected to affect the relative market benefits of the options being considered.

Four core scenarios have been considered as part of this PADR, which are intended to cover a wide range of possible futures and are generally aligned with the AEMO proposed 2020 ISP 'central', 'slow-change', 'fast-change' and 'step-change' scenarios. The four scenarios differ in relation to key variables expected to affect the market benefits of the options considered, including demand outlook, DER uptake, assumed generator fuel prices, assumed emissions targets, retirement profiles for coal-fired power stations, and generator and storage capital costs.

The results of the PADR assessment find that the 500 kV options going between Maragle and Bannaby via Wagga Wagga (i.e., Option 2C and Option 3C) are found to provide the greatest net benefits of all credible options across all four scenarios. The net benefits for these two options range from around $370 million to $1.4 billion across the four scenarios.

Figure E.1 – Estimated net benefits for each scenario

Note: The top-ranked option under each scenario (and any other options within 5 per cent of the top-ranked option) are shown in green above.

Under the central and step-change scenarios, the benefits are primarily driven by avoided generator fuel costs, with avoided or deferred costs associated with generation and storage providing the second largest source of benefit. Under the fast-change scenario, the benefits are driven equally by both avoided generator fuel costs and avoided or deferred costs associated with generation and storage. Under the slow-change scenario, market benefits are almost completely driven by avoided or deferred costs associated with generation and storage.

On a weighted-basis, Option 2C and Option 3C are expected to deliver approximately $1.1 billion of net benefits and are ranked equal-first (Option 3C has approximately 2 per cent greater net benefits than Option 2C), which is around 7 per cent greater net benefits than the third-ranked option (Option 3B).

The 500 kV 'loop' reinforcement is the preferred option due to the additional risk reduction benefits it provides

While Option 2C and Option 3C are effectively ranked equal-first, the new circuits under Option 3C have lower capital cost than Option 2C due to shorter circuit length, and marginally higher net benefits. They have more route diverse paths than for Option 2C due to their topology. In particular, the new lines under Option 3C provide greater route diversity opportunity (forming a 'loop') while the new lines under Option 2C run in parallel for the length of the line.

Option 3C is therefore expected to provide a greater risk reduction than Option 2C in terms of avoiding 'high impact low probability' events (such as lightning strikes, bushfires or extreme wind events) affecting multiple lines simultaneously. While recognising the low probability of two lines going down simultaneously under both options, TransGrid has undertaken indicative power system studies that estimate the value of load at risk to be

approximately $450 million (in present value terms). Option 3C is consequently the preferred option identified as part of this PADR as it provides the lowest chance of this occurring due to its multiple route diversity solutions.

For the purposes of the options assessed in this PADR, route diversity consideration may not apply to the entire route lengths. Final decisions regarding route diversity will be based on assessment of network risks and mitigation strategies having regard to the relative cost of diversity options.

We have tested the robustness of the assessment to a range of sensitivities including the retirement of existing plant based on economic viability, Snowy 2.0 not proceeding, higher DER uptake, QNI Stage 2, VNI West timing, staged development of the preferred option and 50 per cent POE demand forecasts. All tests confirm the conclusion that Option 3C is the optimal investment.

We have also assessed the ability of demand response to provide net benefits prior to Option 3C being commissioned. Specifically, modelling has shown that if demand response is enabled to respond within 5 minutes of loss of a transmission line between the Snowy Mountains and Sydney, the use of 5-minute transmission line ratings can provide approximately $2.4 million in gross market benefits (in present value terms).

Although no submissions to the PSCR offered demand response, we encourage parties who consider they can assist with providing this service to contact us, so a more fulsome assessment of whether this is likely to be efficient can be undertaken in the PACR.

Submissions and next steps

TransGrid welcomes written submissions on this PADR. Submissions are due on or before 24 February 2020.

Submissions should be emailed to regulatory.consultation@transgrid.com.au

Submissions will be published on the TransGrid website. If you do not wish for your submission to be made publicly available, please clearly specify this at the time of lodgement.

The next formal stage of this RIT-T is the Project Assessment Conclusions Report (PACR). The PACR will address PADR consultation responses and determine the final preferred option and is expected to be published in the first half of 2020.

A copy of the Project Assessment Draft Report can be obtained from TransGrid's website or by emailing regulatory.consultation@transgrid.com.au