Decision

Expanding NSW-QLD transmission transfer capacity

Determination that the preferred option satisfies the regulatory investment test for transmission

March 2020

AUSTRALIAN ENERGY REGULATOR

Inquiries about this publication should be addressed to:

Australian Energy Regulator
GPO Box 520
Melbourne Vic 3001

Tel: (03) 9290 1444
Fax: (03) 9290 1457

Email: AERInquiry@aer.gov.au

AER reference: 65587

Contents

Executive summary

TransGrid and Powerlink are progressing a project to expand the transmission transfer capacity of the Queensland-New South Wales Interconnector (QNI) by 2022. TransGrid has sought regulatory approval of:

- the economic cost benefit analysis of the investment options conducted through the *Expanding NSW-QLD Transmission Transfer Capacity* Regulatory Investment Test for Transmission (RIT-T); and
- the incremental revenues required to recover the efficient costs of this project, through a contingent project application.

In this determination, the Australian Energy Regulator (AER) has examined the economic cost benefit analysis of the project undertaken by TransGrid and Powerlink through the RIT-T process.

We have determined, under clause 5.16.6 of the National Electricity Rules (NER), that the preferred option identified by TransGrid and Powerlink in the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T satisfies the requirements of the RIT-T.[1]

TransGrid and Powerlink considered a range of network and non-network options to address the need for this project, including the use of grid-connected batteries or non-network solutions. TransGrid and Powerlink ultimately excluded the battery options on the grounds that they were not technically feasible to meet the identified need in the required timeframe due to their untested nature at this scale in Australia. Given this, we consider that TransGrid and Powerlink have identified the credible option that maximises the present value of the net economic benefit to all those who produce, consume and transport electricity in the market (the preferred option).[2]

This determination is the first of two steps in the regulatory approval process for the QNI capacity expansion project (known as the QNI Minor Upgrade project). The next step in the regulatory approval process for the QNI Minor Upgrade project involves approval of the efficient costs of the project to be recovered from consumers. TransGrid has separately applied to the AER to amend its existing revenue determination to recover the efficient costs associated with delivering the proposed QNI capacity expansion.[3]

TransGrid submitted its contingent project application on 17 January 2020, one month after finalising the RIT-T for the QNI Minor Upgrade. We have therefore separated the timing of the contingent project decision from this RIT-T determination. We are currently reviewing TransGrid's application, and will make a separate determination on the efficient costs of the project in April 2020.

---

1 National Electricity Rules, clause 5.16.6(b).

2 National Electricity Rules, clause 5.16.1.

3 TransGrid, *QNI Minor Upgrade Project – Contingent Project Application*, 17 January 2020.

Expanding NSW-Qld Transmission Transfer Capacity RIT-T

In November 2018, TransGrid and Powerlink initiated a RIT-T process to explore options to increase the transfer capacity between Queensland and New South Wales in order to relieve existing and forecast congestion on the transmission network between the two states.

This followed the release of AEMO's inaugural Integrated System Plan (ISP) in July 2018, which identified that relieving transmission constraints between Queensland and New South Wales would provide substantial market benefits.[4]

Through the RIT-T process, TransGrid and Powerlink have considered a range of investment options to increase transfer capacity between Queensland and New South Wales in the near term. TransGrid and Powerlink's Project Assessment Conclusions Report (PACR) found that the preferred option to relieve power flow congestion between New South Wales and Queensland is to:[5]

- uprate the existing 330 kV Liddell to Tamworth lines; and
- install new dynamic reactive support at Tamworth and Dumaresq and shunt connected capacitor banks at Tamworth, Armidale and Dumaresq.

TransGrid and Powerlink found that this investment is expected to deliver $170 million in net benefits to consumers and producers of electricity and to support energy market transition through:[6]

- continuing to provide reliable supply at the lowest cost by deferring the need to build new generation and storage capacity in New South Wales ahead of the forecast retirement of Liddell Power Station in 2022 and 2023
- allowing for more efficient sharing of generation across the NEM and the adoption of new technologies (including higher quality renewable resources), thereby avoiding the use of higher cost generators and deferring, or avoiding, the construction of new, more expensive generation and/or storage capacity.

The initial capital cost of the project is estimated to be $230 million (nominal).[7] As the proposed works associated with the preferred investment option are in New South Wales, TransGrid is the proponent of the preferred option.

TransGrid expects that construction of the project could start in March 2020, with delivery in September 2021 and completion of inter-network testing expected by June 2022. TransGrid expects that the cumulative market benefits from its preferred option investment are expected to exceed the investment cost (in NPV terms) within seven years.[8]

---

4 AEMO, *Integrated System Plan*, July 2018, pp. 8-9

5 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 53.

6 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 53.

7 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 53.

8 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 53.

This RIT-T process has been shaped by a focus on options for increasing transfer capacity between New South Wales and Queensland in the near term to relieve transmission constraints and maximise net benefits in light of the forecast closure of the Liddell Power Station over 2022 and 2023. This is consistent with the 'QNI Minor' project in AEMO's draft 2020 ISP and all the scenario modelling undertaken for the ISP. If the Liddell Power Station was not expected to close in that timeframe, then it is likely that the net benefits of the project would be different and the need for the QNI Minor Upgrade in the near term would need to be reassessed.

TransGrid and Powerlink will undertake a separate RIT-T process in respect of the larger medium term expansion to QNI transfer capacity also included in AEMO's draft 2020 ISP as an actionable ISP project. The Project Assessment Draft Report (PADR) for the 'QNI Medium' RIT-T is scheduled to be published by 10 December 2021.

Consideration of 'virtual transmission lines'

This RIT-T uncovered a real potential for the use of 'virtual transmission line' grid-connected battery systems to provide network services. These options were included in the PADR but excluded by TransGrid and Powerlink from the PACR on the basis that they were not technically feasible. TransGrid and Powerlink also considered that the further modelling and analysis that would be required to fully assess their technical feasibility could not be completed within the timetable required for the project.

We consider that battery-based 'virtual transmission line' options are potentially credible options, but that further assessment of technical feasibility may be required. This has not been disputed by submissions, although there appears to be differences between the RIT-T proponents and the non-network proponents on the extent of the analysis required. Whether this work could have been done prior to or in conjunction with this RIT-T is arguable. However, in the context of the expedited timeframe and limited scope of this RIT-T process, TransGrid and Powerlink's approach in excluding these virtual transmission line options is consistent with requirements of the RIT-T.

We consider that the learnings in regard to these technologies and RIT-T processes by all parties will be valuable for future RIT-Ts. We expect all TNSPs to fully consider and explore credible options, including non-network options. This should include engaging with non-network service proponents, together with AEMO, sufficiently early in the process to acquire the necessary technical, commercial and operational information and experience required to robustly analyse these options in the context of future ISP and RIT-T processes. The assessment of technical feasibility should not be limited to experience and precedents in Australia but draw upon those in other systems as well.

Assessment approach

As foreshadowed in our Guidance Note and indicative timetable published in July 2019,[9] we have undertaken an expedited review process in order to make this

[9] AER, *Guidance Note – QNI Regulatory Investment Test*, July 2019.

determination in March 2020 and provide regulatory certainty to stakeholders given the need to expand QNI transmission capacity in the near term ahead of the forecast retirement of Liddell Power Station.

To assist in our review, we utilised our internal technical and engineering expertise to review the findings and conclusions presented in the *Expanding NSW-QLD Transmission Transfer Capacity* PACR. We considered:

- the process – whether TransGrid and Powerlink followed the RIT-T process in accordance with the requirements of the NER and the RIT-T application guidelines. This included a review of whether TransGrid and Powerlink addressed issues raised by stakeholder submissions.
- the outcome – whether the preferred option identified in the PACR is likely to be the option that maximises the net economic benefit, in present value terms, for the market. In making this assessment, we considered the reasonableness of the inputs, assumptions and methodologies applied to identify the preferred option.

Our assessment is based on the findings and material set out in the PACR.[10] We also sought further information from TransGrid and Powerlink as required, particularly in relation to the range of credible options considered for the project.[11] We reviewed the analysis and modelling undertaken in the RIT-T which underpins the identification of the preferred option. We did not separately undertake our own market modelling or cost benefit analysis of the potential investment options.

If there are no material errors in the calculation of net benefits, the modelling methodologies are sound, and the inputs and assumptions that affect the ranking of options are reasonable, then we consider that the credible option identified as the preferred option satisfies the RIT-T.

Based on our assessment of the process and analysis undertaken by TransGrid and Powerlink, we are satisfied that this is the case for the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T.

[10] NER, cl. 5.16.6(b)(2).

[11] NER, cl. 5.16.6(b)(3).

1 Introduction

TransGrid and Powerlink have undertaken a cost benefit analysis of options to expand QNI transmission capacity in the near term through the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T.

On 20 December 2019, TransGrid submitted a written request to the AER for a determination on whether the preferred option identified in the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T satisfies the RIT-T.[12]

This section sets out background information relevant to our determination of whether the preferred option satisfies the RIT-T.

1.1 Who we are and our role in this process

The Australian Energy Regulator (AER) is the economic regulator for electricity transmission and distribution services in the NEM. Our electricity related powers and functions are set out in the National Electricity Law (NEL) and the NER.

We are responsible for developing, publishing and maintaining the RIT-T and accompanying RIT-T application guidelines.[13] The RIT-T is an economic cost benefit analysis that is used by transmission businesses to assess and rank different investment options. The RIT-T application guidelines provide guidance on the operation and application of the RIT-T.

Following the finalisation of a RIT-T through the publication of a PACR, a RIT-T proponent may make a written request to the AER to make a determination on whether the preferred option satisfies the RIT-T.[14] Our determination may then constitute a trigger for a contingent project application, whereby the transmission business can seek to recover efficient costs associated with delivering the project in the current regulatory control period. For the QNI Minor Upgrade project, the NER allow for our RIT-T review and contingent project assessment processes to proceed in parallel.[15]

We note that the Energy Security Board is working on changes to the rules related to the transmission planning framework, in particular the ISP and the role of RIT-Ts in future.[16] However, the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T is not impacted by these prospective framework changes, as the RIT-T process was undertaken prior to the new framework coming into place.

---

12 TransGrid and Powerlink's proposal is available on the AER's website.

13 The RIT-T and RIT-T application guidelines are available on the AER's website.

14 NER, cl. 5.16.6(a).

15 NER, cl. 11.114.3

16 ESB, *Converting the Integrated System Plan into action, Consultation on draft ISP Rules*, November 2019.

1.2 Who are TransGrid and Powerlink?

TransGrid is a transmission business which owns and operates the electricity transmission network in NSW and the ACT. Powerlink is a transmission business which owns and operates the electricity transmission network in Queensland.

TransGrid and Powerlink's transmission revenues are regulated through five year transmission determinations. TransGrid's current transmission determination commenced on 1 July 2018 and will finish on 30 June 2023. Powerlink's current transmission determination commenced on 1 July 2017 and will finish on 30 June 2022.

TransGrid was predominately responsible for conducting the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T consultation process and assessment. The preferred option identified by the RIT-T process for expanding QNI transfer capacity involves investment in TransGrid's NSW transmission network only.

1.3 The Expanding NSW-QLD Transmission Transfer Capacity RIT-T

RIT-T Process

The inaugural ISP, released by AEMO in July 2018, recommended two key transmission investments in relation to transfer capacity between New South Wales and Queensland necessary to support the long-term interests of consumers for safe, secure, reliable electricity, at the least cost, across a range of plausible futures. AEMO differentiated between these two investments as being needed over the near-term (by around 2020) and over the medium-term (by the mid-2020s).[17]

This RIT-T focusses on options for increasing transfer capacity between NSW and Queensland in the near term, consistent with the assessment of the 'Group 1' QNI expansion in the 2018 ISP and the 'QNI minor' upgrade in the draft 2020 ISP, as well as guidance from us.[18]

The focus on near term expansion options ensures that the consideration of medium-term options (i.e., 'Group 2' QNI expansion in the 2018 ISP and 'QNI Medium' in the draft 2020 ISP) does not delay the consideration of near-term options required to increase transmission transfer capacity, particularly in light of the forecast closure of Liddell Power Station over 2022 and 2023. The medium-term options will be assessed as part of a separate RIT-T, with the Project Assessment Draft Report (PADR) for that process expected to be published by 10 December 2021 at the latest, in-line with the draft 2020 ISP recommendations.[19]

---

17 AEMO, *Integrated System Plan*, July 2018, pp. 8-9

18 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 3.

19 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 3.

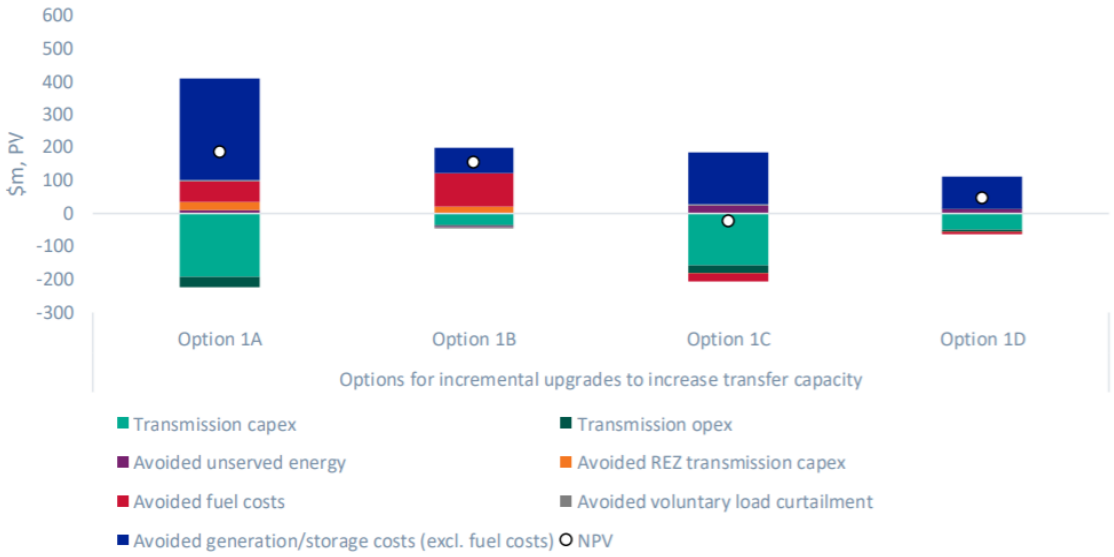
Market benefits

The preferred option[20] identified in the PACR is a network investment of $230 million ($nominal) to uprate the Liddell to Tamworth lines and install new dynamic reactive support at Tamworth and Dumaresq and shunt capacitor banks. According to the PACR, this option delivers the greatest expected net benefits of all options considered. TransGrid and Powerlink's analysis shows that the preferred option is expected to:[21]

- deliver approximately $170 million in net benefits over the assessment period, which includes significant wholesale market cost savings that will put downward pressure on electricity prices with flow-on benefits to customers
- reduce the need for new generation and large-scale storage in New South Wales to meet demand following Liddell Power Station's forecast retirement over 2022 and 2023
- lower the aggregate generator fuel costs required to meet demand going forward
- avoid capital costs associated with enabling greater integration of renewables in the NEM; and
- generate sufficient benefits to recover the project capital costs seven years after the option is commissioned.

The breakdown of benefits provided by the four options considered in the PACR is shown in Figure 1. The preferred option is Option 1A.

Figure 1: Breakdown of benefits for the RIT-T options (neutral scenario)



Source: TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 40.

[20] The preferred option is defined as the option that maximises net market benefits under the RIT-T framework.

[21] TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, pp. 3-4.

1.4 Why did TransGrid and Powerlink request that the AER make this determination?

We included a QNI upgrade project as a contingent project in TransGrid's revenue determination for the 2018–23 regulatory control period, and Powerlink's revenue determination for the 2017–22 regulatory control period. An AER determination that the preferred option identified in the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T satisfies the RIT-T is a trigger event for the QNI upgrade contingent project in both TransGrid and Powerlink's current revenue determinations.[22]

Generally, contingent projects are significant network augmentation projects that may be required in order to meet the capex objectives in the NER during a regulatory control period. However, unlike other proposed capex projects, the need for the project (and therefore the associated costs) is not sufficiently certain at the time of the revenue determination to be included in the allowed forecast of total capex. Contingent projects are linked to unique investment drivers and are subject to a set of 'trigger events'.[23]

The preferred option identified by the RIT-T process involves investment in TransGrid's NSW transmission network only. There is therefore no need to amend Powerlink's revenue determination to account for the QNI Minor Upgrade project.

In relation to TransGrid, our final decision on TransGrid's 2018–23 revenue determination approved the QNI upgrade project as a contingent project with the following trigger events:[24]

1. Either:
    i. Committed retirement of more than 1100 MW of generation in the Hunter or Central Coast area; and/or
    ii. AEMO classification of generation developments as being at the 'committed' stage of development on the 'Generator Information' webpage, exceeding 1100 MW at any current or future connection point(s) north of Armidale; and/or
    iii. AEMO classification of generation developments as being at the 'committed' stage of development on the 'Generator Information' webpage, exceeding 350 MW at any current or future connection point(s) south of Liddell and Bayswater.
2. Successful completion of the RIT-T demonstrating a network investment by TransGrid that maximises the positive net economic benefits from increasing the

---

22 AER, *Final Decision TransGrid transmission determination 2018 to 2023, Attachment 6 – Capital expenditure*, May 2018, p. 138; and AER, Final Decision, *Powerlink transmission determination 2017−22, Attachment 6 – Capital expenditure*, April 2017, p. 43.

23 NER, clauses 6A.8.1(b)(4) and 6A.8.1(c)(5).

24 AER, *Final Decision TransGrid transmission determination 2018 to 2023, Attachment 6 – Capital expenditure*, May 2018, p. 138.

capacity of the network between Bulli Creek and Liddell at 132/330kV or other voltages.

3. Determination by the AER that the proposed investment satisfies the RIT-T.
4. TransGrid Board commitment to proceed with the project subject to the AER amending the revenue determination pursuant to the Rules.
5. Clauses 2 and 3 do not apply if a change in the law occurs that allows the inclusion of the proposed investment in TransGrid's maximum allowed revenue under this revenue determination even if a RIT-T is not carried out.

This determination satisfies the third element of the trigger event.

The AEMC's rule change of April 2019 allowed the AER to commence the contingent project process of the QNI Minor Upgrade project concurrently with the 5.16.6 review to expedite the regulatory approval process.[25] TransGrid submitted a contingent project application to us in relation to the QNI upgrade project on 17 January 2020.[26]

1.5 Structure of this document

This document sets out our determination on whether the preferred option identified by the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T satisfies the RIT-T, and our reasons for the determination.

This decision is structured as follows:

- section two sets out our assessment approach, as well as the details of our assessment of the application of the RIT-T by TransGrid and Powerlink. This includes the reasons for our determination that the preferred option identified by TransGrid and Powerlink satisfies the RIT-T
- section three sets out our determination.

This section outlines our assessment of whether the preferred option satisfies the RIT-T. Where our assessment identified a concern with any aspect of the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T, we have considered whether this materially affects the selection of the preferred option. The structure of this section broadly follows the steps involved in applying the RIT-T, as set out in section 2 above and in the RIT-T application guidelines.

[25] NER, cl.11.114.3.

[26] TransGrid, *QNI Minor Upgrade Project Contingent Project Application*, 17 January 2020.

2 AER assessment of RIT-T application Our RIT-T assessment approach

Upon request by the RIT-T proponent, we are required to make a determination as to whether the preferred option satisfies the RIT-T. We must make and publish a determination, including reasons for the determination, within 120 business days.[27] This time is automatically extended if the AER seeks further information requests and the time taken by the RIT-T proponent to respond.

Accordingly, we were required to make and publish this RIT-T determination by June 2020. This includes the time taken for TransGrid to respond to our request for additional information. However, as foreshadowed in our Guidance Note and indicative timetable published in July 2019,[28] we have undertaken an expedited review process in order to make this determination in March 2020 and provide regulatory certainty to stakeholders given the need to expand QNI transmission capacity in the near term.

In making this determination, we

- must use the findings and recommendations in the PACR
- may request further information from the RIT-T proponent; and
- may have regard to any other matter that we consider to be relevant.[29]

In order to make a determination that the preferred option identified satisfies the RIT-T, we must be satisfied that the identified preferred option is the credible option which maximises the present value of net economic benefits to all those who produce, consume and transport electricity in the NEM.

In making our determination we assessed:

- the process – whether TransGrid and Powerlink have followed the RIT-T process in accordance with the requirements of the NER and the RIT-T application guidelines. This includes a review of whether the PACR has addressed issues raised by stakeholder submissions.
- the outcome – whether the preferred option identified in the PACR is likely to be the option that maximises the net economic benefit, in present value terms, for the market. In making this assessment, we consider the reasonableness of the inputs, assumptions and methodologies applied to identify the preferred option.

We have not sought to undertake our own modelling of costs and benefits or replicate the work undertaken by TransGrid and Powerlink through the RIT-T process.

---

27 NER, cl. 5.16.6(b)(1).

28 AER, *Guidance Note – QNI Regulatory Investment Test*, July 2019.

29 NER, cl. 5.16.6(b)(2)-(4).

As set out in the RIT-T application guidelines, the broad steps involved in applying the RIT-T are:[30]

- Identify the need for investment. The identified need may be for reliability corrective action or to increase the sum of consumer and producer surplus in the NEM.
- Identify the base case and a set of credible options to address the identified need.
- Identify a set of reasonable scenarios that are appropriate to the credible options under consideration. A reasonable scenario is a set of variables or parameters that are not expected to change across each of the credible options or base case.[31]
- Quantify the expected costs of each credible option.
- Quantify the expected market benefits of each credible option.
- Quantify the expected net economic benefit of each credible option and identify the preferred option as the option with the highest expected net economic benefit.

We have assessed whether the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T satisfies the requirements of each of the above steps, and whether there have been any material errors made or unreasonable inputs, assumptions or approaches applied by TransGrid and Powerlink in undertaking the RIT-T.

To assist in our review, we utilised our internal technical and engineering expertise to review the findings and conclusions presented in the *Expanding NSW-QLD Transmission Transfer Capacity* PACR. In particular, we considered:

- the identification of the set of credible options to address the identified need, including the basis for excluding 'virtual transmission line' options from the analysis presented in the PACR
- the reasonableness of the inputs and methodology applied to assess the net economic benefits of credible options; and
- sensitivity analysis, to test whether the identification of the preferred option is robust to changes in key parameters.

2.2 Identified need

The identified need is the objective which the RIT-T proponent seeks to achieve by investing in its transmission network.[32] The identified need may consist of meeting reliability standards or an increase in the sum of consumer and producer surplus.[33]

---

30 AER, *Final - Regulatory investment test for transmission application guidelines*, 29 June 2010, p. 7.

31 AER, *RIT-T*, June 2010, paragraph 15.

32 National Electricity Rules, chapter 10.

33 This means that the investment option must increase the welfare of all who produce, consume and transport electricity in the NEM as a whole and not merely transfer wealth from one class in the NEM (i.e. consumers) to another (i.e. producers).

The identified need in the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T is to increase overall net market benefits in the NEM through relieving existing and forecast congestion on the transmission network between New South Wales and Queensland.[34] This need has been shaped through this RIT-T by a focus on near term options to relieve transmission constraints and maximise net benefits in light of the forecast closure of the Liddell Power Station over 2022 and 2023.

AER's assessment and conclusion

An identified need is the achievement of a desired end or objective, and not simply the means to achieve a desired objective or end.[35]

We consider the identified need in the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T, which includes achieving positive net market benefits and relieving power flow congestion, is consistent with the requirements of the RIT-T.

The identified need statement as set out at the Project Specification Consultation Report (PSCR) stage of the RIT-T does not include a timeframe for when the need is to be met. However, the identified need addressed through this RIT-T has been shaped by a focus on near term options to relieve transmission constraints in light of the forecast closure of the Liddell Power Station over 2022 and 2023.

The PACR focusses on options for increasing QNI transfer capacity in the near term, consistent with the 'Group 1' QNI expansion in AEMO's 2018 ISP and the 'QNI Minor' project in the draft 2020 ISP. This is also consistent with our expectation that TransGrid and Powerlink would proceed with the RIT-T analysis and consultation focussed on the QNI near term upgrade in order to address the immediacy of the Liddell Power Station closure.[36] The range of reasonable scenarios and credible options considered by TransGrid and Powerlink for this RIT-T reflects this focus.

2.3 Identification of credible options

When applying the RIT-T, proponents must consider all options that could reasonably be considered as credible options. A credible option is an option that addresses the identified need, is commercially and technically feasible, and can be implemented in sufficient time to address the identified need.[37]

The *Expanding NSW-QLD Transmission Transfer Capacity* PACR assessed four credible options, covering a range of different network upgrades.[38] All options are expected to be delivered and inter-network testing completed by June 2022.[39] Table 1 below summarises the credible options considered by TransGrid and Powerlink.

---

34 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 17.

35 RIT-T application guidelines, p. 7.

36 AER, *Guidance Note – QNI Regulatory Investment Test*, July 2019.

37 NER, clause 5.15.2.

38 TransGrid and Powerlink, *Expanding NSW-QLD transmission transfer capacity PACR*, December 2019, pp. 27-37.

39 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 53.

Table 1: Summary of credible options considered in the PACR

Option	Capex	Description of credible option
Option 1A	$230 million	Option 1A involves uprating the Liddell to Tamworth lines and installing new dynamic reactive support at Tamworth and Dumaresq and shunt capacitor banks. This option involves incremental investments to the existing network to increase transfer capacity in the near term and is the same option recommended in the 2018 ISP for Group 1 projects (near-term construction to maximise economic use of existing resources). The indicative total transfer capacity is 690 MW northward and 1,120 MW southward. Capital costs for this option are estimated to be in the order of $230 million. This option has additional operating costs associated with refurbishing elements of the static VAR compensator (SVC) in the future (these costs sum to approximately $8.5 million in total over the assessment period).
Option 1B	$43 million	Option 1B involves uprating the Liddell to Tamworth lines only. Option 1B has been included as an alternative to Option 1A and explicitly investigates the expected net benefits of only undertaking the line uprating component. The indicative total transfer capacity is 570 MW northward and 1,070 MW southward. Capital costs are approximately $43 million.
Option 1C	$187 million	Option 1C involves only the second component of Option 1A, i.e. installing new dynamic reactive support at Tamworth and Dumaresq and shunt capacitor banks. As with Option 1B, Option 1C has been included as an alternative to Option 1A and explicitly investigates the expected net benefits of only undertaking the new dynamic reactive support at Tamworth and Dumaresq and the shunt capacitor banks. The indicative total transfer capacity is 480 MW northward and 1,120 MW southward. Capital costs for this option are estimated to be in the order of $187 million. As with Option 1A, this option also has additional operating costs associated with refurbishing elements of the SVC in the future (these costs sum to approximately $8.5 million in total over the assessment period).
Option 1D	$59 million	Option 1D involves cutting line 8C (Armidale – Dumaresq 330 kV) into the existing Sapphire substation and establishing a new mid-point switching station between Dumaresq and Bulli Creek 330 kV by cutting into 8M and 8L. Option 1D targets only southerly QNI stability limitations and has been included as a potentially cheaper alternative to installing new dynamic reactive support at Tamworth and Dumaresq and shunt capacitor banks (i.e., the second component included in Option 1A and Option 1C). The indicative total transfer capacity is 480 MW northward and 1,110 MW southward. Capital costs for this option are estimated to be in the order of $59 million.

Source: TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, pp. 27-35.

In addition to the four credible options considered in the PACR, TransGrid and Powerlink also considered but did not progress a number of 'virtual transmission line' options, either as network or non-network solutions, because they were not considered to be technically feasible. TransGrid and Powerlink concluded that a 'virtual transmission line' comprised of grid-connected battery systems and/or braking resistors of the magnitude proposed by proponents would be the first in Australia of this scale and that substantial additional network modelling and testing would be required in order to comprehensively determine technical feasibility. TransGrid and Powerlink considered that determining whether these solutions are likely to be technically feasible would require around twelve months of additional work and consultation with proponents.[40]

[40] TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 36.

TransGrid and Powerlink noted that 'virtual transmission lines' may form a potential credible option considered as part of the medium term QNI upgrade recommended in the draft 2020 ISP, for which a PADR is required by 10 December 2021. TransGrid and Powerlink consider such a timeframe allows for a comprehensive assessment of the technical feasibility of these options.[41]

AER's assessment and conclusion

Overall, we are satisfied that TransGrid and Powerlink considered all options that could reasonably be classified as credible options to address the identified need in the context of this RIT-T, and that the options assessed meet the definitional requirements of a credible option under the NER.[42]

As discussed above in the context of the identified need, the range of credible options considered for this RIT-T was limited to options that could deliver an increase in transmission transfer capacity in the near term.

At the PSCR stage of the RIT-T, TransGrid and Powerlink identified four credible near term options, including the 'Group 1' QNI upgrade project identified in the 2018 ISP. These four network options were further developed and assessed at the PADR stage, along with two additional near term 'virtual transmission line' options based on consultation with proponents of these options in response to the PSCR. The two 'virtual transmission line' options consisted of:[43]

- a 'modest' 2 x 40MW/20MWh battery energy storage system (BESS), and
- a refinement of the original, larger, BESS option proposed in the PSCR (assumed to be a 2 x 200MW/100MWh system).

For the PACR, TransGrid and Powerlink assessed the same four credible options for near term incremental upgrades to the existing network as assessed in the PADR.

Option 1A (the preferred option) is consistent with the 2018 ISP recommended 'Group 1' investment and draft 2020 ISP recommended 'QNI minor' investment.[44] The other network options were developed based on additional studies and consultation undertaken since the 2018 ISP and the publication of the PSCR. These options reflect alternate, lower cost options targeting different transfer limits, providing different market benefits.[45] Option 1B (line uprating) and option 1C (new dynamic reactive support at Tamworth and Dumaresq and shunt capacitor banks) are the two individual components of option 1A.

The procurement and contracting process for Option 1A that TransGrid progressed in parallel to the PACR resulted in an increase in the estimated capital costs of this

---

41 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 36.

42 As defined in clause 5.15.2 of the NER.

43 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PADR*, September 2019, p. 17.

44 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 28.

45 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 28.

option. Compared to the PADR, the estimated capex cost of this option increased from $175 million to $230 million ($nominal), an increase of 31 per cent. For consistency, the PACR modelling applied proportionate increases to the cost of the other incremental network upgrade options.

Virtual transmission line options

The two 'virtual transmission line' options considered in the PADR were not included as credible options in the PACR. TransGrid and Powerlink stated that:[46]

- consultation with proponents of 'virtual transmission line' options since the PADR resulted in the costs of these technologies falling, meaning they were more likely to be considered 'economically feasible'.
- credible options under the RIT-T are also required to be 'technically feasible'.
- the PADR adopted a proportionate approach to assessing the technical feasibility of the 'virtual transmission line' options, which effectively assumed these options were technically feasible. This approach was taken in order to compare all options on their expected net market benefits (i.e. putting aside technical feasibility).
- this approach was not taken as part of the PACR since the assessment was required to identify the preferred credible option.
- a 'virtual transmission line' comprised of grid-connected battery systems and/or braking resistors of this magnitude would be the first in Australia of this scale and substantial additional network modelling and testing is required in order to determine technical feasibility. Determining whether these solutions are likely to be technically feasible will require around twelve months of additional work and consultation with proponents.
- as a consequence, these 'virtual transmission lines' were not credible options for the purpose of this RIT-T assessment.

TransGrid and Powerlink concluded that 'virtual transmission lines' may form a potential credible option considered as part of the medium term QNI upgrade recommended in the draft 2020 ISP, for which a PADR is required by 10 December 2021. TransGrid and Powerlink considered that this timeframe would allow for a comprehensive assessment of the technical feasibility of these options.[47]

Assessment and conclusion

As part of our review, we considered whether TransGrid and Powerlink had considered all options that could reasonably be classified as credible options – that is, technically and commercially feasible options that can be implemented in sufficient time to address the identified need. A key question is whether it was reasonable for TransGrid

---

[46] TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 36.

[47] TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 36.

and Powerlink to conclude that the virtual transmission line options are not currently technically feasible, and therefore not credible options in the context of this RIT-T.

In undertaking this assessment, we reviewed the information presented in the PACR, including Appendix D which provided additional detail on the assessment required to determine the technical feasibility of virtual transmission line solutions.

We also sought further information from TransGrid and Powerlink regarding their assessment of the virtual transmission line options, and the nature and extent of engagement with and information provided by proponents of these solutions through the RIT-T consultation process.[48]

We reviewed the engagement between TransGrid and Powerlink and the virtual transmission line option proponents, including requests for modelling and other technical information. This helped us to understand the information available to TransGrid and Powerlink in assessing the technical and commercial feasibility of potential solutions, and whether these options were likely to provide sufficiently proven technological solutions for expanding the QNI transmission capacity in the necessary timeframe. We were also interested in understanding the technical and commercial risks associated with the virtual transmission line options and how these compare to the preferred network option.

TransGrid and Powerlink's response to our information request provided:[49]

- a summary of their engagement with proponents related to understanding whether the virtual transmission line options were sufficiently proven technology suitable for the QNI Minor Upgrade project, including clarifications and requests for modelling and other technical information
- an explanation of how TransGrid and Powerlink took into account the submissions to the PADR and other information from proponents in concluding that the virtual transmission line options were not technically feasible; and
- an explanation of some of the key technical and commercial risks of the virtual transmission line options, and how these compared to the preferred network option.

Based on the information set out in the PACR and provided in response to our information request, we consider that TransGrid and Powerlink's approach in excluding virtual transmission line options from assessment as credible options in the context of the *Expanding NSW-QLD Transmission Transfer Capacity* RIT-T was reasonable. This is because:

- the 'virtual transmission line' options represent a relatively new concept and have not yet been implemented in Australia or this scale for such an application. Note, however, there are other battery projects that exist in Australia and that have a

[48] AER, *Information request to TransGrid*, 19 February 2020.

[49] TransGrid and Powerlink, *Response to AER Information Request*, 25 February 2020.

proven record in delivering sophisticated network services, with resulting benefits to consumers.

- TransGrid and Powerlink undertook preliminary analysis of the implications of adopting these solutions for the network, in order to identify the areas of uncertainty which would require further investigation.
- this preliminary analysis indicated that a comprehensive assessment of the technical feasibility of these virtual transmission line options would be required before they could be recommended as part of the preferred option for this RIT-T. This will require joint efforts between proponents, suppliers, consultants, TransGrid, Powerlink and AEMO through a rigorous program of analysis.
- this further work is expected to take approximately 12 months. Therefore, such an assessment could not be completed within the timeframes required for this RIT-T.
- TransGrid and Powerlink demonstrated that its approach was informed by engagement with proponents, including to clarify points raised in submissions and gather information required to perform analysis of these options.

We also note AEMO's assessment in the draft 2020 ISP, in which it stated that it had tested a number of virtual transmission concepts and concluded that these are not yet, but may in future be, a viable alternative to traditional transmission infrastructure.[50]

In contrast, the use of static VAR compensators and capacitor banks (the preferred network option) to enhance transient and voltage stability is a well proven and readily applied technology. Both TransGrid and Powerlink have significant experience in designing and operating this plant. Detailed power system analysis, including thermal capability and stability assessments, have been completed for the preferred option.[51]

For these reasons, we consider that TransGrid and Powerlink have sufficiently considered credible options for meeting the identified need and satisfied this requirement of the RIT-T. The four network options considered address the identified short term need in the 2018 ISP to meet demand following the scheduled retirement of the Liddell Power Station in 2022, and can be implemented within the sufficient time to meet this need (a proposed in-service date of September 2021). The preferred option has the highest net benefit amongst all four network options.

The battery-based virtual transmission line options, while potentially credible options, may not be able to be implemented within the sufficient time. This is due to the time required to confirm their technical feasibility, design and operating parameters.

However, we consider that the use of grid-connected batteries, or a combination of traditional network investments and network or non-network battery solutions, are likely to be credible options or components of credible options for the medium term QNI upgrade project recommended in the draft 2020 ISP. The timeframe for the QNI

---

50 AEMO, *Draft 2020 Integrated System Plan Appendices*, 12 December 2019, p. 298.

51 TransGrid and Powerlink, *Response to AER Information Request*, 25 February 2020, p. 5.

medium project, with a need date of 2026-27 to 2028-29, allows for a comprehensive assessment of the technical and commercial feasibility of these options. TransGrid and Powerlink consider that these options have potential, and that undertaking this assessment is therefore worthwhile.[52]

TransGrid and Powerlink should fully consider and explore all credible options, including virtual transmission line options and non-network options, in the context of the timeframes for the QNI medium project. This should include engaging with virtual transmission line and non-network service proponents, together with AEMO, to acquire the necessary technical, commercial and operational information and experience required to robustly analyse these options in the context of future ISP and RIT-T processes. The assessment of technical feasibility should not be limited to the whether similar projects have been implemented in Australia but also consider whether similar projects have been implemented in other countries and the non-network proponents' experience both in Australia and overseas.

2.4 Reasonable scenarios considered

The RIT-T requires a proponent to model reasonable scenarios to assess the market benefits of the credible options under consideration.[53] A reasonable scenario is a set of variables or parameters of relevant market supply and demand characteristics and conditions which is not expected to change across each of the credible options or the base case.[54] The number and choice of reasonable scenarios must be appropriate to the credible options under consideration.[55] Therefore, the choice of reasonable scenarios must reflect any variables or parameters that are likely to affect the ranking of credible options or the sign of the net economic benefits of any of the credible options.[56]

A weighting to each reasonable scenario must be assigned that reflects the probability of the reasonable scenario occurring.[57]

For the PADR, TransGrid and Powerlink engaged Ernst & Young (EY) to undertake market modelling of system costs and benefits of the various network upgrade options to provide additional transfer capacity between NSW and Queensland assessed through the RIT-T.[58] EY computed the least-cost generation dispatch and development plan for the NEM associated with the QNI augmentation options across a range of scenarios and sensitivities. Market benefits were forecast for the credible options across four scenarios covering a broad range of reasonable possible futures for the NEM. The scenarios were:

---

52 TransGrid and Powerlink, *Response to AER Information Request*, 25 February 2020, p. 5.

53 AER, *RIT-T*, June 2010, paragraph 4.

54 AER, *RIT-T*, June 2010, paragraph 15.

55 AER, *RIT-T*, June 2010, paragraph 16.

56 AER, *RIT-T*, June 2010, paragraph 16.

57 AER, *RIT-T*, June 2010, paragraph 4(a)(ii).

58 EY, *Expanding NSW-Qld Transmission Transfer Capacity PADR market modelling report,* 9 October 2019.

- neutral
- neutral + lower emissions
- slow change
- fast change.

The same four scenarios were applied for the PACR.[59] These scenarios are generally aligned with AEMO's draft 2020 ISP 'slow change', 'neutral' and 'fast change' scenarios. In all scenarios, QNI predominantly flows to the south due to load growth in NSW coupled with large coal fired generator retirements.[60]

A summary of the four scenarios to determine the market benefits for the credible options is outlined in Table 2.

Table 2: Summary of reasonable scenarios considered

	Description of scenario
Neutral scenario	Reflects the best estimate of the evolution of the market going forward, selected by TransGrid and Powerlink as a central view after public consultation following publication of the PSCR. It includes AEMO's 'neutral' demand forecasts, new generator/storage capital and fuel costs, as well as a national emissions reduction of around 28 per cent below 2005 levels by 2030. Under this scenario, the NEM gradually shifts towards increasing capacity of wind, solar, gas generation and storage, both pumped hydro storage and large scale battery storage.
Neutral + low emissions scenario	Applies all the same assumptions as the neutral scenario with the exception of a stronger emissions reduction target and assumed earlier retirement of coal generators as a result. Under this scenario, earlier coal generator retirements are replaced by wind and solar generation, with some pumped hydro storage and large scale battery storage. This scenario is intended to test the robustness of the RIT-T assessment to future emissions policy changes.
Slow change scenario	Applies a set of assumptions reflecting a future world of lower demand forecasts, lower fuel costs and later coal plant retirements relative to the neutral scenario. The slow change scenario also excludes the Victoria to NSW interconnector upgrade (VNI) as well as the planned Snowy 2.0 generation, HumeLink and VNI West developments. The slow change scenario is intended to represent the lower end of the potential range of realistic net market benefits associated with the various options. Overall, less capacity is installed in this scenario due to lower demand growth.
Fast change scenario	Applies a set of assumptions reflecting a future world of high demand forecasts, gas costs, a more stringent national emissions reduction target of around 52 per cent below 2005 levels by 2030 and earlier coal plant retirements compared to the neutral scenario. This scenario also assumes that the MarinusLink and Battery of the Nation are commissioned. The fast change scenario represents the upper end of the potential range of realistic net market benefits associated with the various options. Overall, there is more capacity in this scenario due to higher demand growth. There is also less gas capacity installed in later years due to the stronger emissions constraint applied.

Source: Ernst & Young, *Expanding NSW-Qld Transmission Transfer Capacity PADR market modelling report*, 9 October 2019, pp. 2-5.

[59] TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, pp. 39-48.

[60] EY, *Expanding NSW-Qld Transmission Transfer Capacity PADR market modelling report,* 9 October 2019, pp. 2-3.

In lieu of evidence for an alternate weighting, TransGrid and Powerlink's NPV modelling of the estimated net benefits for each of the credible options weighted each scenario equally.[61] In effect this gives many of the assumptions in the AEMO 'neutral' scenario a higher weighting than in the 'slow change' or 'fast change' scenarios (since there are two variants of the neutral scenario). TransGrid and Powerlink considered this appropriate because the low and high scenarios represent a less likely combination of assumptions occurring simultaneously across a range of variables.[62]

Under the neutral scenario, considered to represent the best estimate of the evolution of the market going forward, option 1A is estimated to deliver approximately $190 million in net benefits. This is approximately 22 per cent more net benefit than the second ranked option (option 1B). The estimated benefits include significant wholesale market cost savings that will put downward pressure on wholesale electricity prices with flow-on benefits to customers. The cumulative market benefits are expected to exceed the investment cost within seven years.

With all scenarios equally weighted, Option 1A is expected to deliver approximately $170 million of net benefits. This is only slightly higher than option 1 B. However, TransGrid and Powerlink also investigated the minimum weighting the neutral scenario would need to be given in order for Option 1A to generate at least five per cent greater net benefits than Option 1B. This threshold test finds that the neutral scenario would need a weighting of at least 36 per cent (with the other three scenarios weighted equally) for Option 1A to deliver at least five per cent greater net benefits than Option 1B on a weighted basis. TransGrid and Powerlink consider this a relatively low percentage, which adds to the conclusion that Option 1A is the preferred option overall.[63]

The PACR also modelled a number of additional sensitivities, including:[64]

- the forced outage rates assumed in the market modelling (in response to submissions to the PADR)
- higher and lower network capital costs of the credible options (+/- 25 per cent); and
- alternate commercial discount rate assumptions.

A range of other sensitivity analyses were also presented in the PADR to test the robustness of the modelling outcomes. In particular, the PADR investigated sensitivities involving:[65]

- deferring the retirement of three of Liddell Power Station's units from 2022 to 2023 (as announced by AGL earlier in 2019)

---

61 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 48.

62 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 23.

63 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, pp.48-49.

64 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 50.

65 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity Project Assessment Draft Report*, December 2019, p. 59.

- the impact of assuming Wood Mackenzie's 'fast' coal prices, which have been developed for AEMO as part of the 2020 ISP assumptions, and
- the impact of outages during the line uprating work (as raised in submissions to the PSCR).

TransGrid and Powerlink submitted that none of these sensitivities were found to be material and so were not investigated again for the PACR.[66]

AER's assessment and conclusion

We consider that the number, choice and weighting of the reasonable scenarios modelled by TransGrid and Powerlink satisfies the requirements of the RIT-T.

The number of reasonable scenarios was appropriate to the credible options considered by TransGrid and Powerlink. We also consider that the weighting assigned to the scenarios reasonably reflects the probability of each relevant scenario occurring. The four scenarios have been equally weighted, though most assumptions of the 'neutral' scenario have to an extent been weighted more heavily (through the use of two variants of this scenario). We consider this to be reasonable. The 'slow change' and 'fast change' scenarios each represent a less likely combination of assumptions occurring simultaneously across a range of variables. The high and low scenarios are equally weighted as there is no evidence to weight one as more likely than the other.

The set of assumptions reflecting demand forecasts, generator fuel prices, new generation/storage, coal plant retirements, emissions targets and generator and storage capital costs in the scenarios selected sufficiently reflected those which were likely to affect the ranking of the credible option or the sign of the net economic benefit of any of the credible options. These assumptions, as outlined in Table 2, capture within the market modelling the likely key drivers impacting on the options for expanding transfer capacity between NSW and Queensland and the benefits of addressing the identified need.

In preparing the PACR, TransGrid and Powerlink applied the same market modelling results presented in the PADR but updated to the NPV analysis to reflect changes in capital costs. We consider this to be a reasonable approach given the timing of the release of the PADR on 30 September 2019 and the release of the PACR on 20 December 2019. We do not expect that there would have been significant changes to the market model inputs between the release of the PADR and PACR. The inputs and assumptions applied align in all material respects with the planning and forecasting assumptions consulted on by AEMO in the context of the 2020 ISP.[67]

We note that all scenarios and sensitivities modelled for this RIT-T assume the forecast closure of the Liddell Power Station over 2022 and 2023. This is consistent

---

66 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 50.

67 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PADR*, December 2019, p. 27.

with the scenario modelling undertaken by AEMO for the draft 2020 ISP, and the stated intention of the plant's owner AGL. If the Liddell Power Station was not expected to close in this timeframe, then it is likely that the benefits of a near term investment to expand the capacity of QNI would be substantially reduced or deferred. In those circumstances, the need for and timing of this investment should be further assessed to confirm the investment continued to provide a net benefit to the market.

2.5 Quantification of costs

The RIT-T requires the proponent to quantify, for each credible option, the costs and all material classes of market benefit.[68] Costs are defined as the present value of the direct costs of the credible option and include classes such as the costs incurred in constructing or providing the credible option.[69]

The forecast capital costs for the preferred option 1A increased significantly between the PADR and PACR, from $175 million to $230 million ($nominal).[70] This is because the procurement and contracting process for Option 1A that TransGrid progressed in parallel to the PACR resulted in the capital costs of this option being revised from the estimate included in the PADR. TransGrid and Powerlink stated that the cost of the preferred option is now known with a high degree of certainty as a result of contracts being entered into with suppliers and contractors.[71]

The proportionate increases in the cost of option 1A's key components have also been applied to the other credible options involving incremental upgrades to the existing network to increase transmission transfer capacity, for consistency. TransGrid and Powerlink considered that the factors that have driven the higher costs would apply equally to these options.

All options are assumed to have annual operating costs equal to approximately one per cent of their capital costs.[72]

The PACR assessed the sensitivity of the credible options to capital cost estimates of +/- 25 per cent. The PACR extended this sensitivity testing and found that Option 1A's capital costs would need to be at least 89 per cent higher than the central estimates for it to no longer have positive estimated net benefits (on a weighted-basis).[73]

Table 3 below outlines the total capital cost of each credible option.

---

68 AER, *RIT-T*, June 2010, paragraph 1.

69 AER, *RIT-T*, June 2010, paragraph 2(a).

70 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity Project Assessment Draft Report*, 30 September 2019, p. 5 and TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, 20 December 2019, p. 28.

71 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 50.

72 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 28.

73 TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 51.

Table 3: Total capital cost of the credible options

Option	Estimated capex costs ($nominal)
Option 1A – Uprate Liddell to Tamworth lines and install new dynamic reactive support at Tamworth and Dumaresq and shunt capacitor banks	$230 million
Option 1B – Uprate Liddell to Tamworth lines only	$43 million
Option 1C – Install new dynamic reactive support at Tamworth and Dumaresq and shunt capacitor banks	$187 million
Option 1D – Sapphire substation cut into line 8C and a midpoint switching station between Dumaresq and Bulli Creek	$59 million

Source: TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity PACR*, December 2019, p. 5.

AER's assessment and conclusion

We consider that the costs of the credible options have been appropriately quantified by TransGrid for the purposes of the RIT-T process. We consider TransGrid's estimate of the capital costs of each credible option to be reasonable, given cost estimates are informed by the market testing of delivery costs through a procurement process for the preferred investment option 1A.

TransGrid refined its estimated capital costs in the PACR from those assumed in the PADR, resulting in a 31 per cent increase in the estimated capital cost of the preferred option (and proportionate increases in the cost of other credible options). We consider this has resulted in a more realistic estimate of likely capital costs for the credible options, informed by market pricing. TransGrid's procurement process, run in parallel to the finalisation of the PACR, developed detailed cost estimates for each component of Option 1A which have been used in the economic cost benefit analysis presented in the PACR. We consider it reasonable that the costs of the other incremental network upgrade options assessed in the PACR have also been updated based on TransGrid's experience from this procurement process.

TransGrid investigated the impact of changes in capital costs for all options relative to Option 1A through the sensitivity analysis in the PACR. TransGrid's sensitivity analysis found that Option 1A's capital costs would need to be at least 89 per cent higher than the central estimates for it to no longer have positive estimated net benefits. Option 1A remained the preferred option in the low capital cost sensitivity, though we note that option 1B becomes preferred in the high capital cost sensitivity. We have not placed significant weight on this sensitivity, given the capital cost of the preferred option is now known with a relatively high degree of certainty.

It is important to note that we have not assessed TransGrid's estimated capex or opex costs for each credible option in detail at this stage. We will undertake this task in our assessment of TransGrid's contingent project application to recover the efficient costs associated with delivering this project. This will include a detailed assessment of whether the forecast costs reasonably reflect the capex and opex criteria under the rule 6A.8.2 of the NER.

2.6 Quantification of market benefits

The RIT-T proponent is required to quantify, for each credible option, all classes of market benefit that are material. A market benefit is material if it is likely to affect the outcome of the assessment of the credible options under the RIT-T.[74] A market benefit may not be quantified if the estimated cost of undertaking the analysis to quantify the market benefit is likely to be disproportionate to the scale, size and potential benefits of each credible option assessed.[75]

The market benefits of each credible option are calculated by comparing for each reasonable scenario the state of the world with the credible option in place to the state of the world in the base case where no option is implemented, and weighting the benefits derived by the probability of each reasonable scenario occurring.[76] A market benefit must be a benefit to those who consume, produce and transport electricity in the NEM and not include a transfer of surplus between consumers and producers.[77]

TransGrid and Powerlink engaged EY to evaluate the potential market benefits of expanding the transfer capacity between NSW and Queensland in the near term.[78] EY applied a cost-benefit analysis based on the change in least-cost generation dispatch and capacity development plan for each credible option. To determine the least-cost solution, the model makes decisions for each hourly trading interval in relation to:[79]

- the generation dispatch level for each power plant along with the charging and discharging of storage. Power stations are assumed to bid at their short-run marginal cost, which is derived from their variable operation and maintenance and fuel costs. The generation for each trading interval is subject to the modelled availability of power stations in each hour, network limitations and energy limits.
- commissioning new entrant capacity for wind, solar PV Single Axis Tracking, Closed-Cycle Gas Turbine, Open-Cycle Gas Turbine, large-scale storage and pumped hydro storage.

These hourly decisions take into account operational constraints that include:

- supply must equal demand in each region for all trading intervals plus a reserve margin, with unserved energy costed at the value of customer reliability
- minimum loads for generators
- transmission interconnector flow limits (between regions)
- intra-regional flow limits (between zones in NSW and the central/south zone for Queensland)

---

74 AER, *RIT-T*, June 2010, paragraph 8(a).
75 AER, *RIT-T*, June 2010, paragraph 8(b).
76 AER, *RIT-T*, June 2010, paragraph 4.
77 AER, *RIT-T*, June 2010, paragraph 6.
78 EY, *Expanding NSW-Qld Transmission Transfer Capacity PADR market modelling report,* 9 October 2019.
79 EY, *Expanding NSW-Qld Transmission Transfer Capacity PADR market modelling report,* 9 October 2019, p. 1-2.

- maximum and minimum storage reservoir limits and cyclic efficiency
- new entrant capacity build limits for wind and solar for each Renewable Energy Zone (REZ) where applicable, and pumped hydro storage in each region
- emission constraints in applicable scenarios; and
- renewable energy targets where applicable by region or NEM-wide in applicable scenarios.

From the hourly time-sequential modelling EY computed the following costs:[80]

- capital costs of new generation capacity installed
- total fixed operation and maintenance costs of all generation capacity
- total variable operating and maintenance costs of all generation capacity
- total fuel costs of all generation capacity
- total cost of voluntary (demand-side participation) and involuntary load curtailment
- transmission expansion costs associated with REZ development.

For each credible option simulation and in a matched existing QNI base case, EY calculated the difference between the sum of these components. The changes in costs are the gross market benefits due to the QNI augmentation for each credible option.[81]

EY forecast the market benefits for the credible options across four scenarios covering a broad range of reasonable possible futures for the NEM. In all scenarios, QNI flows to the south due to load growth in NSW coupled with large scale coal-fired generator retirements. EY performed a range of sensitivity analyses to test the robustness of the modelling outcomes.[82]

Table 4 shows the forecast gross market benefits associated with the change in the least cost development plan with each augmentation option over the modelled 25 year horizon for each credible option assessed in the PACR.

Table 4: Summary of gross market benefits ($ real millions, June 2019)

Option	Slow change	Neutral	Neutral and low emissions	Fast change
1A	240	379	382	451
1B	71	179	230	284
1C	159	146	94	112
1D	115	95	59	67

Source: EY, *Expanding NSW-Qld transmission transfer capacity PADR market modelling report*, 9 October 2019, p. 6.

[80] EY, *Expanding NSW-Qld Transmission Transfer Capacity PADR market modelling report,* 9 October 2019, p. 2.
[81] EY, *Expanding NSW-Qld Transmission Transfer Capacity PADR market modelling report,* 9 October 2019, p. 2.
[82] EY, *Expanding NSW-Qld Transmission Transfer Capacity PADR market modelling report,* 9 October 2019, pp. 2-3.

The market benefits of all options are primarily derived from the avoided or deferred costs associated with generation and storage – this benefit arises since the expanded transfer capacity between New South Wales and Queensland under each option allows existing and new Queensland generation to export to NSW, reducing the need for new investment in NSW.

The timing of the generation capital cost benefit accrual is associated with NSW coal retirements, starting with Liddell in 2022-23. This outcome holds across all modelled scenarios, although the technology deferred varies with each scenario. EY noted that although the cost of option 1A is equivalent to options 1B plus 1C, there are synergies in gross market benefits by combining the two work components of option 1A.[83]

AER's assessment and conclusions

We reviewed the market benefits modelling methodology, inputs and assumptions used in the *Expanding NSW-Qld Transmission Transfer Capacity* RIT-T.

We consider the approach taken by EY to quantify wholesale market benefits, involving least cost electricity market modelling is consistent with the requirements of the RIT-T.

We have not sought to undertake our own modelling of market benefits. Instead, we utilised our internal technical and engineering expertise to review EY's electricity market modelling and focused on identifying material concerns or errors in the approach, inputs and assumptions. As part of this, we participated in a market modelling workshop with EY and engaged regularly with Transgrid and Powerlink throughout the RIT-T process.

We did not identify material concerns with EY's electricity market modelling approach or with the inputs and assumptions applied in the context of this RIT-T.

The methodology reflects a standard approach to undertaking long-term modelling of investment and dispatch outcomes in the NEM.

We also consider that the input assumptions relied upon in the modelling generally come from credible sources and are reasonable. The inputs and assumptions applied align in all material respects with the planning and forecasting assumptions consulted on by AEMO in the context of the 2020 ISP, and were the latest available at the time of the RIT-T modelling.

The primary source of identified market benefits are generator capex savings associated with deferred or avoided build of new generation capacity and large-scale storage in NSW to meet demand following Liddell Power Station's forecast retirement over 2022 and 2023. We also consider that the EY modelling appropriately captures market benefits in relation to lower aggregate generator fuel costs to meet demand as

[83] EY, *Expanding NSW-Qld Transmission Transfer Capacity PADR market modelling report,* 9 October 2019, p. 7.

well as avoiding capital costs associated with enabling greater integration of renewables in the NEM.

We therefore consider that the selection of material market benefits and the quantification of those material market benefits is reasonable and satisfies the requirements of the RIT-T.

2.7 Identification of the preferred option

The final step in the RIT-T assessment is the identification of the preferred option. The preferred option is the credible option which maximises the net economic benefit compared to all other credible options. The net economic benefit of a credible option is the market benefit minus the cost.

The *Expanding NSW-Qld Transmission Transfer Capacity* RIT-T identified Option 1A as the preferred option. Table 5 shows the net economic benefit of each credible option.

Table 5: Net economic benefit of credible options assessed - Neutral Scenario ($ present value)

Option	Costs (Capex and Opex)	Market Benefit	Net economic benefit
1A	-$222,975,260	$401,287,853	$188,344,789
1B	-$40,266,983	$194,173,104	$153,906,121
1C	-$182,708,277	$158,916,118	-$23,792,159
1D	-$56,992,449	$103,195,991	$46,203,542

Source: TransGrid and Powerlink, *Expanding NSW-QLD Transmission Transfer Capacity Project Assessment Conclusions Report – HoustonKemp NPV Model*, December 2019.

The preferred option identified through the RIT-T process did not change between the PADR and the PACR. The preferred option identified in the PACR, Option 1A, is the preferred option identified under this RIT-T. Option 1A is also the near term investment option for expanding QNI transmission transfer capacity assessed and recommended by AEMO in both the 2018 ISP and the draft 2020 ISP.

AER's assessment and conclusions

We are satisfied that TransGrid and Powerlink have correctly identified Option 1A in the PACR as the preferred option. Option 1A is the credible option that maximises the net economic benefit compared to all other credible options.

The analysis presented in the PACR demonstrates that Option 1A is the preferred option, and provides positive net economic benefits, across a range of reasonable scenarios and sensitivities.

3 AER determination

In accordance with clause 5.16.6(b) of the National Electricity Rules, our determination is that the preferred option identified in the Expanding NSW-Qld Transmission Transfer Capacity RIT-T satisfies the RIT-T. We consider that:

- the identified need is consistent with the requirements of the RIT-T.
- the credible options assessed meet the definition of a credible option, and the number and range of credible options assessed is appropriate.
- the number, choice and weighting of the reasonable scenarios modelled by TransGrid and Powerlink satisfies the requirements of the RIT-T.
- the costs of the credible options have been appropriately quantified.
- the selection of material market benefits and the quantification of those material market benefits satisfies the requirements of the RIT-T.
- Option 1A was correctly identified as the preferred option.