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TransGrid Revenue Proposal 2023-28

REVIEW OF RIT-T PROJECT: MANAGING RISK ON LINE 86 (PUBLIC VERSION)

Report prepared for:

AUSTRALIAN ENERGY REGULATOR

August 2022

Preface

This report has been prepared to assist the Australian Energy Regulator (AER) with its determination of the appropriate revenues to be applied to the prescribed transmission services of TransGrid from 1st July 2023 to 30th June 2028. The AER's determination is conducted in accordance with its responsibilities under the National Electricity Rules (NER).

This report covers a particular and limited scope as defined by the AER and should not be read as a comprehensive assessment of proposed expenditure that has been conducted making use of all available assessment methods. This report relies on information provided to EMCa by Transgrid. EMCa disclaims liability for any errors or omissions, for the validity of information provided to EMCa by other parties, for the use of any information in this report by any party other than the AER and for the use of this report for any purpose other than the intended purpose. In particular, this report is not intended to be used to support business cases or business investment decisions nor is this report intended to be read as an interpretation of the application of the NER or other legal instruments.

EMCa's opinions in this report include considerations of materiality to the requirements of the AER and opinions stated or inferred in this report should be read in relation to this over-arching purpose.

Except where specifically noted, this report was prepared based on information provided by AER staff prior to 29 May 2022 and any information provided subsequent to this time have not been taken into account, except where specifically referenced. Some numbers in this report may differ from those shown in Transgrid's regulatory submission or other documents due to rounding.

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ABBREVIATIONS

Term	Definition
AAIT	Asset Analytics and Investment Tool
AER	Australian Energy Regulator
AEMC	Australian Energy market Commission
AEMO	Australian Energy Market Operator
ALARP	As Low As Reasonably Practicable
augex	Augmentation capital expenditure
BESS	Battery Energy Storage System
Capex	Capital expenditure
CBA	Cost Benefit Analysis
CPI	Consumer Price Index
CAPEX	Capital Expenditure
DF	Disproportionality Factor (or multiplier)
DNSP	Distribution Network Service Provider
ENA	Electricity Networks Association
EMCa	Energy Market Consulting associates
FCAS	Frequency Control Ancillary Service
IGF	Investment Governance Framework
ISP	Integrated System Plan
LoC	Likelihood of Consequence
NER	National Electricity Rules
NNS	Non-network solution / support
NOSA	Need and Opportunity Screening Assessment
NPC	Net Present Cost
NPV	Net Present Value
NSW	New South Wales
OFS	Option Feasibility Study
opex	Operating expenditure
PEC	Project Energy Connect
PACR	Project Assessment Conclusion Report
PADR	Project Assessment Draft Report
PSCR	Project Specification Consultation Report
PoE	Probability of Exceedance

Term	Definition
RCP	Regulatory Control Period
repex	Replacement (capital) expenditure
RIN	Regulatory Information Notice
RIT-T	Regulatory Investment Test
SME	Subject Matter Experts
SPS	Special Protection Scheme
STATCOM	Static Synchronous Compensator
VoSL	Value of Statistical Life
VCR	Value of Customer Reliability

EXECUTIVE SUMMARY

Scope and purpose of this report

1. The purpose of this report is to provide the AER with an expert review of Transgrid's RIT-T project to manage risk on Line 86.
2. Transgrid has not as yet included this project in its proposed capex allowance for the next RCP. In its Revenue Proposal (RP), it refers to this as a project currently undergoing a RIT-T and, in separate correspondence with the AER, Transgrid indicated that it intends for it to be considered as part of its Revised Revenue Proposal (RRP). The assessment contained in this report is therefore intended to assist the AER in its own analysis of the capex allowance as an input to a Decision on Transgrid's revenue requirements for the period 2023-28, in the event that Transgrid subsequently proposes it.
3. At the time of our engagement, our assessment was to be limited to published materials and which for this RIT-T project was the Project Specific Consultation Report (PSCR). By agreement with the AER, we agreed to consider updated materials provided to us prior to 29 May 2022.

Summary of the proposed RIT-T project

The need for action is indicated by the condition of the existing wood pole line

4. Transgrid has identified a potential need to replace wood poles on the 330 kV single-circuit transmission line, running between Tamworth and Armidale known as Line 86, due to declining wood pole condition on the line. Transgrid states that the deteriorating condition of the wood poles on Line 86 gives rise to increasing bushfire risk and also results in higher expected costs associated with reactive maintenance (which may need to be done under emergency conditions), and which justifies replacement of a proportion of the wood poles.
5. Transgrid has raised this project to address the asset condition issues identified on Line 86, while also claiming to provide the greatest overall net benefit to the market over the long-term through potentially increasing the transfer capacity between Armidale and Tamworth.

Transgrid initially proposed replacing the whole line

6. In its RP submitted to the AER in January 2022, Transgrid has included the project as a major project undergoing RIT-T, at a total cost of $331.1m (real 2022-23) based on estimates included for the establishment of a new transmission line. On the basis of the information in its RP, Transgrid would propose $331.1m (real 2022-23) to be included in the next RCP based on its preferred network option.
7. Transgrid's PSCR published in December 2021 included the network cost of the least cost option of wood pole replacement as $95.7m ($20/21) as Option 1, and its highest cost option of a double circuit line rebuild as $315.4m ($20/21) as Option 3.

In its PADR, Transgrid now proposes replacing only the worst-condition poles

8. Transgrid has substantially updated its PSCR in its draft Project Assessment Draft Report (PADR) provided to us in response to our request for information, and which we have considered in our review. Transgrid has now nominated its preferred option as Option 1C being the targeted replacement of the worst condition wood poles on Line 86 at a total network cost of $10.7m.
9. The new preferred option represents a significant reduction of the proposed network cost included in the PSCR of $95.7m, and earlier estimates exceeding $300m. The preferred Option 1C is presented as providing a weighted NPV of $20m.

Summary of our review findings

Transgrid revised proposal, to replace only worst-condition poles, is an appropriate solution

10. We consider that Transgrid's selection of Option 1C as the preferred option is appropriate based on the assumptions it has applied. However, we have concerns regarding the modelling approach and assumptions undertaken for this project, specifically the modelling of bushfire risk related costs, and which appears to be reflective of a systemic bias to overestimation of bushfire risk costs for replacement projects.
11. We have reviewed the drivers for this project, and when adjusting for this observed bias and accounting for good asset management practice to meet Transgrid's safety obligations including ALARP, we consider that the project nevertheless represents a prudent option.
12. Based on our assessment of related cost information, we consider that the cost estimate is higher than reasonable benchmarks, including when accounting for lack of economies of scale, and includes unsubstantiated scaling factors. The cost estimate is likely to be reduced as the project planning and approval is progressed to be more representative of an efficient level.

Implications for proposed expenditure

13. We consider that the proposed Option 1C for this project is prudent, however the cost is likely to be higher than an efficient level based on our assessment of reasonable benchmarks.
14. Since this project is now replacement-only and does not include any augmentation of capacity, Transgrid has indicated that the project expenditure is likely to be re-submitted as a part of its repex forecast in its RRP.

1 INTRODUCTION

1.1 Purpose and scope

1.1.1 Purpose of this report

15. The purpose of this report is to provide the AER with an expert review of Transgrid's RIT-T project to manage risk on Line 86.

1.1.2 Scope of requested work

16. The AER is seeking an expert review of capex forecasts proposed to be included in TransGrid's transmission revenue allowance for the next Regulatory Control Period (RCP), which was submitted to the AER in January 2022. Transgrid did not include this project in its proposed capex allowance for the next RCP. In its regulatory submission, it referred to this as a project currently undergoing a RIT-T and, in separate correspondence with the AER, Transgrid indicated that it intended for it to be considered as part of its RRP.

17. The scope of this review covers the prudency and efficiency of the proposed project and specifically to review:

- The need for the project –assessing the 'identified need' described by Transgrid;
- The options Transgrid has considered and whether its options analysis is robust;
- The timing of the proposed solution; and
- The reasonableness of the cost estimate for the proposed option, including by considering Transgrid's application of its cost estimation methodology.

18. At the time of our engagement, our assessment was to be limited to published materials, which for this RIT-T project was the PSCR. By agreement with the AER, we also consider updated materials provided to us prior to 29 May 2022, and which for this RIT-T project included a draft PADR. Transgrid has now finalised and published its PADR.

1.2 Approach and context

1.2.1 Our approach

19. In undertaking our review, we:

- completed a desktop review of the information provided to us by the AER followed by preparing requests for information to Transgrid;
- undertook a virtual review meeting with Transgrid, to ensure we suitably understood the methodology and assumptions being applied to the expenditure requirements and justification in accordance with the NER for RIT-T projects and the stage of development of this RIT-T project; and
- documented our findings in the current report.

1.2.2 Scope limitations

20. We have not been requested to undertake a compliance assessment of the RIT-T project to the AER RIT-T guideline or to consider all aspects of the NER and therefore in this report we do not explicitly consider all matters including those raised through public consultation.

21. To the extent that Transgrid's proposed justification for this project is based on electricity market modelling, we have reviewed the process and methodologies applied, as described

in documentation and models that Transgrid has provided. Our review does not encompass independent market modelling. While we have sought to identify the source of assumptions made by Transgrid and its consultants, our review should not be construed as an independent critique of all assumptions inherent in the modelling provided.

22. As stated above, Transgrid has not included this RIT-T project in its Revenue Proposal as a part of its augex forecast for revenue determination purposes. Transgrid states that it included this project as a 'contingent project' although to our knowledge Transgrid has not made a Contingent Project Application (CPA) for it. Transgrid also states that it intends to propose this project as part of its RRP. We have not been requested to consider the regulatory treatment of this RIT-T project, including whether it qualifies as a contingent project under the NER.

23. The limited nature of our review does not extend to advising on all options and alternatives that may be reasonably considered by Transgrid, or on all parts of the capex forecast. We have included additional observations in some areas that we trust may assist the AER with its own assessment.

1.2.3 Regulatory and planning context for this assessment

24. The NEM is currently in the midst of a significant transition towards increased renewable sources, with greater dispersion of generation. We have necessarily undertaken our assessment of the required project based on the current planning and regulatory framework, but cognisant of changes in this framework that are underway. Changes in this framework, and in the electricity market itself, may significantly and rapidly affect the technical and economic requirements for any transmission investment, including the assessment in the current report.

25. We provide further information on these contextual aspects in Appendix A.

1.3 This report

1.3.1 Structure of this report

26. The following sections of our report include the following:

- In section 2, we present background information summarising Transgrid's proposed project; and
- In section 3, we describe our assessment of this project.

27. In Appendix A, we provide a summary of the current planning and regulatory framework, current reviews underway in response to the energy transition and the impact of these on assessments of transmission projects in the NEM.

1.3.2 Information sources

28. We have examined relevant documents provided by Transgrid in support of the RIT-T project that the AER has designated for review. Transgrid provided further information at the on-site meetings and further documents in response to our information requests. These documents are referenced directly where they are relevant to our findings.

29. Except where specifically noted, this report was prepared based on information provided by AER staff prior to 29 May 2022 and any information provided subsequent to this time may not have been taken into account. We recognise that Transgrid's own assessment may continue beyond the time of our review, as it considers additional information and proceeds through the remainder of the RIT-T process, including consultation with stakeholders. Material changes that result from this process would require reassessment of our analysis and findings.

30. Since we undertook our primary assessment, and prior to finalisation of this report, Transgrid has published its PADR for this project. We have not identified material

differences in its final PADR from the information provided to us as the basis for our assessment, and which would result in a material change to the opinion contained in our report.

1.3.3 Presentation of expenditure amounts

31. Expenditure is presented in this report in $2021 real terms, unless stated otherwise.

2 BACKGROUND

2.1 Summary of Transgrid's RIT-T project

2.1.1 Expenditure summary

32. The project identified as "Managing the risk of Line 86" is listed in Transgrid's Revenue Proposal as a major project undergoing RIT-T as shown in Table 2.1.

Table 2.1: Major project summary included in Transgrid's RP ($m, real 2022-23)

Major project undergoing RIT-T	2023-28 estimated cost	Total estimated cost	Expected completion
Managing risk on Line 86 (Tamworth – Armidale)	$331.1	$331.1	2026-27

Source: Transgrid 2023-28 Revenue Proposal, Table 17-1

33. In its RP, Transgrid states that:

> *'..for the purpose of this Revenue Proposal we have also treated projects currently undergoing a RIT-T as contingent projects where we expect the outcome of the RIT-T to be identified prior to submitting our Revised Regulatory Proposal to the AER in November 2022.'*

34. In relation to the four major projects undergoing RIT-T named in the RP, Transgrid confirmed its intention to submit these projects as part of its RRP in correspondence with the AER in February 2022:[1]

> *'As noted in our Revenue Proposal, we did not include the indicative costs of major Augex projects undergoing RIT-Ts in our capex forecast in our Revenue Proposal given the current uncertainty and the potential size of these projects. We propose to include the costs of any network solutions arising from the RIT-T process in our Revised Revenue Proposal, which is due to the AER in November 2022.'*

35. We understand that Transgrid considers that it had insufficient information available to it at the then-current stage of the RIT-T process to reasonably cost any network solutions, should they be the preferred options.[2]

36. We note that in its Issues Paper, the AER stated:[3]

> *'While we appreciate that Transgrid's 2023–28 proposal may need to change due to circumstances outside of a business's control, the revised proposal should only include changes required by, or to address matters raised in, the draft decision. Furthermore, our expectation would be that consumers are properly consulted on any such changes.'*

37. While noting uncertainty regarding the regulatory status of this project, we have undertaken our assessment as if the project had been proposed for inclusion in a capital allowance and based on the information provided by Transgrid.

1 Transgrid letter to the AER, 10 February 2022

2 Transgrid letter to the AER, 10 February 2022

3 AER Issues Paper, 2023-2028 Revenue Proposal

2.1.2 Current stage of consultation

38. Transgrid is applying the Regulatory Investment Test for Transmission (RIT-T) to manage the risk of Line 86. In accordance with the transmission planning and investment framework, the current stage of consultation of this project is as follows:

- PACR expected to be released in July 2022.
- PADR released in June 2022.
- PSCR released in December 2021.

39. In the 'draft' of the PADR that has been provided to us, Transgrid has descoped this project to now cover only selected pole replacements. Its estimated cost for this descoped project has reduced to $10.7m, compared with the $331.1m referred to in Transgrid's RP.

40. We understand that the information provided in the draft PADR for the purposes of our review, and in accordance with the scope of review, reflects the forecasts, proposals and opinions adopted by Transgrid as at 29th May 2022 other than where otherwise specifically stated. Our assessment was completed prior to release of a final PADR, however we have since had the opportunity to review the final PADR and we consider that it does not result in any material change to the opinion contained in our report.

2.2 Transgrid's RIT-T projects in the context of its other planned projects

41. Our reading of Transgrid's RP is that due to the uncertainty associated with major augmentation projects, Transgrid has included many of its major transmission projects as contingent projects:[4]

> *'...so that customers only pay for them if and when they proceed. The costs of these contingent projects are not included in our capex forecast and are therefore not reflected in our forecast revenues or prices.'*

42. We understand Transgrid has included two categories of contingent projects:[5]

- Projects undergoing a RIT-T (comprising four projects that have an indicative cost in the 2023-28 regulatory period of $741.9 million and a total estimated cost of $792.2 million.)
- Standard contingent projects (eight projects that have an indicative cost in the 2023-28 regulatory period of $1,175.9 million and a total estimated cost of $2,142.3 million.)

43. In addition to the contingent projects, a number of additional actionable projects are nominated in the Integrated System Plan (ISP) published by AEMO. The ISP is principally an engineering-economic assessment that determines the least cost combination of network and supply side resources to meet forecast demand within the parameters of government policy. It is used to trigger transmission investment, whereas the market is relied upon to deliver generation investment. Importantly, the ISP identifies an investment need with potential market benefits, not a preferred solution.

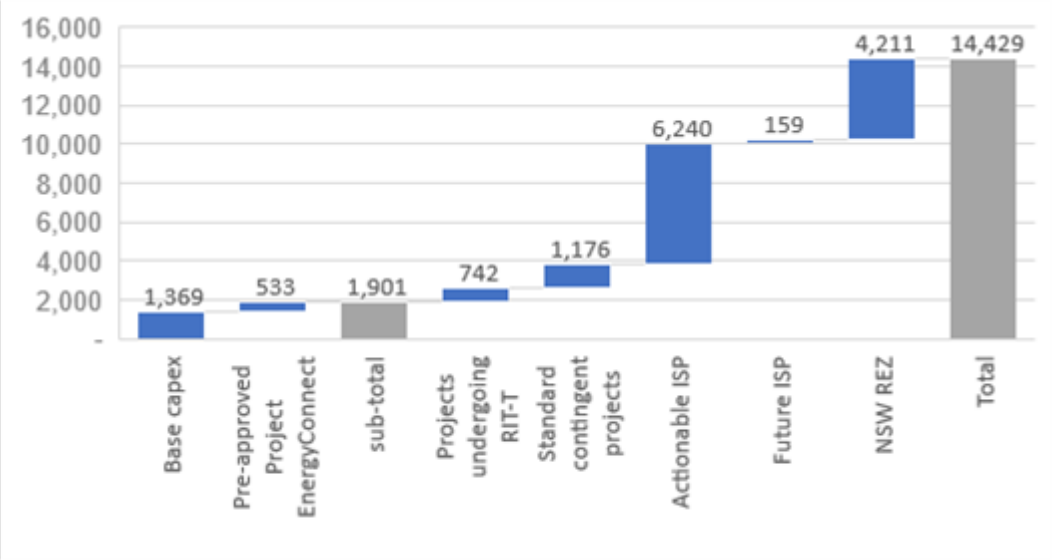
44. Transgrid has separately identified this tranche of additional projects in its Revenue Proposal. A further tranche of projects is also flagged associated with implementing Renewable Energy Zones in NSW.

45. As shown in Figure 2.1, collectively this has the potential for $14billion of capital investment within the next 5 years. This is far in excess of the $1.9billion currently proposed in Transgrid's submission.

4 Transgrid 2023-28 Revenue Proposal, page 163

5 Transgrid 2023-28 Revenue Proposal, page 163

Figure 2.1: Total planned capex, including contingent ISP and NSW REZ projects ($m, 2022-23)



46. The energy transition has been and is expected to be rapid. Whilst it is appropriate for TNSPs to be guided by the assumptions included in the ISP and other sources, and to plan and engage with local communities at a regional level, this does not insulate them from change. Accordingly, regular and ongoing review of market changes is required to build option value and minimise regret cost.

3 REVIEW OF PROJECT JUSTIFICATION

In this section we provide the findings from our review of the expenditure proposed for the RIT-T project for managing risk on Line 86. Our review is based on the published PSCR and a draft PADR provided by Transgrid.

We have focussed our review on whether the project is justified, whether the preferred option identified by Transgrid is likely to be the option that maximises a positive net economic benefit and whether Transgrid's proposed cost represents an efficient estimate. We considered the reasonableness of the inputs, assumptions, and methodologies applied to identify the preferred option.

We consider that the de-scoped project represented in Transgrid's draft PADR (and which Transgrid refers to as Option 1C) is justified and that this preferred option is appropriate based on the assumptions it has applied.

We have identified concerns with the modelling approach and assumptions undertaken for this project, specifically the modelling of bushfire risk related costs. Nevertheless, following application of more reasonable assumptions, and accounting for Transgrid's own safety obligations, we consider that the project nevertheless represents a prudent option.

Based on our assessment of related cost information, we consider that the cost estimate is higher than reasonable benchmarks, including when accounting for lack of economies of scale. We consider that the cost estimate is likely to be reduced as the project planning and approval is progressed to be more representative of an efficient level.

3.1 Introduction

47. For our assessment, we considered:

- Transgrid's identification of a potential need;
- Transgrid's identification of the set of credible options to address that need, including the basis for excluding some options from the analysis presented in the draft PADR;
- the reasonableness of the input assumptions and scenarios applied to assess the net economic benefits of credible options;
- Transgrid's and its consultants' estimation of costs and benefits; and
- The reasonableness of the resulting assessment of net economic benefits, including sensitivity analysis, to test whether the identification of the preferred option is robust to changes in key parameters.

3.2 Identified potential need

3.2.1 Summary of Transgrid's PSCR

48. The network arrangement in northern NSW includes two 330kV lines between Tamworth and Armidale, referred to as Line 85 and Line 86, as shown in Figure 3.1 below. These lines form part of the primary flow path between Queensland and NSW, often referred to as

the Queensland NSW Interconnector (QNI). A system of 132kV lines connects into Tamworth and also at Armidale, and which Transgrid describes as providing supply to regional towns.

Figure 3.1: Overview of northern NSW transmission network[6]

Source: RIT-T PSCR, Managing risk on line 86, Figure 2-2

49. In its PSCR, Transgrid describes Line 86 as being:[7]

> *'…a critical transmission line in the evolving National Electricity Market (NEM) and there are expected to be material wholesale market benefits from expanding its transfer capacity in light of future wholesale market developments.'*

50. Line 86 is a 330 kV single-circuit line, running between Tamworth and Armidale (111 km), and was constructed in 1982 using mostly composite wood pole structures. Line 86 is the only 330 kV line in Transgrid's network that was not constructed using steel towers.

51. Transgrid describes the declining wood pole condition of the line, whereby wood rot beneath the composite pole joint sleeve is considered prevalent throughout the composite wooden poles that are utilised along the line. Transgrid supports its claims by having replaced 26 structures with concrete poles since 2011 due to condition-related issues, and which represents 6 per cent of the overall number of wood poles on Line 86.[8]

52. Transgrid states that the condition of these wood poles gives rise to bushfire risks. From the increasing rate of defect issues, including required pole replacements, and past experience with composite wood pole structures, Transgrid considers that it is likely that all the

6 Original image from Transgrid is of low resolution

7 Transgrid, RIT-T PSCR Managing risk on line 86

8 Transgrid, PSCR Managing risk on line 86

structures on Line 86 are exhibiting various forms of decay, which is expected to worsen over time.[9]

53. An example of the type of wood rot being experienced on a failed pole is shown in Figure 3.2.

Figure 3.2: Example of wood rot on Line 86

Source: RIT-T PSCR, Managing risk on line 86, Figure 2-1

54. Transgrid describes the identified need to:[10]

> *'… address the asset condition issues identified on Line 86, while also providing the greatest overall net benefit to the market over the long-term through potentially increasing the transfer capacity between Armidale and Tamworth.'*

55. Transgrid initially assessed there to be an opportunity both to address the existing asset condition issues on Line 86 and to augment the transfer capacity of that region of its network to provide wider wholesale market benefits to the NEM as it evolves. In its PSCR Transgrid stated that it considered this RIT-T project to be 'market benefits' driven.[11]

3.2.2 Summary of Transgrid's draft PADR

56. In its draft PADR, Transgrid elaborates on the wood pole condition:[12]

> *'The deteriorating condition of the wood poles gives rise to bushfire risk and also results in higher expected costs associated with reactive maintenance (which may need to be done under emergency conditions).'*

9 Transgrid, PSCR Managing risk on line 86, page 14

10 Transgrid, RIT-T PSCR Managing risk on line 86

11 Transgrid, RIT-T PSCR Managing risk on line 86

12 Transgrid, RIT-T draft PADR Managing risk on line 86, page 19

57. The identified need as described in the draft PADR is materially unchanged from that published in the PSCR. However, in the draft PADR Transgrid has now indicated that there is a cohort of 'highest risk' poles.

3.2.3 Our assessment

Highest risk poles determined by condition information

58. Transgrid describes its assessment of highest risk poles as follows:

> *'When we refer to 'highest risk' in this PADR, we are referring to the poles that have been determined to present the greatest risk (which is based on an assessment of both the condition of individual poles and the risk that they pose, e.g., taking into account the likelihood and consequence(s) of failure).'*

59. We consider that Transgrid's assessment of the combination of condition and risk is appropriate, taking account of the likelihood and consequence of failure.

Bushfire risk is a likely driver

60. Transgrid states that the condition of the wood poles on Line 86 was raised as part of the NSW Government's 2020 Bushfire Inquiry, and included a statement in its PSCR and draft PADR from the Inquiry final report that:[13]

> *'..the QNI is a vital asset and should be made more resilient through the replacement of the timber poles with suitable alternatives that are more fire resistant.'*

61. Transgrid concludes that this statement reinforced the need for this project.

62. We consider that this statement provides support for good asset management and risk management practices to be undertaken and supports the nature of the risk that Transgrid has identified, and therefore an investment need.

Investment need has been identified in related planning information

63. The condition of Line 86 is referenced in TransGrid's 2021 TAPR and Transmission line renewal and maintenance strategy submitted with the RP. As noted earlier in our report, the RIT-T process was commenced in December 2021 with publication of the PSCR.

64. Transgrid has identified this as a major project undergoing RIT-T in its 2023-28 Revenue Proposal.[14]

3.3 Credible options

3.3.1 Summary of options in Transgrid's PSCR

65. TransGrid has assessed three credible options as shown in Table 3.1.

[13] Final Report of the NSW Bushfire Inquiry, 31 July 2020, p. 327, viewed at https://www.dpc.nsw.gov.au/assets/dpc-nsw-gov-au/publications/NSW-Bushfire-Inquiry-1630/Final-Report-of-the-NSW-Bushfire-Inquiry.pdf.

[14] TransGrid 2023-28 Revenue Proposal, page ix

Table 3.1: Summary of the credible options (PSCR)

Option	Description	Estimated capital cost ($m, 2020/21)	Expected Delivery date
1	Replace Line 86 like for like in-situ utilising concrete or steel poles, keeping the existing twin lime conductor and single circuit configuration, while maintaining the overall design temperature at 100°C.	95.7	3 – 4 years
2	Rebuild Line 86 as double circuit, strung on one side initially with twin olive conductors and a 120°C design temperature along a new easement parallel to the original Line 86 (which is then removed). The other side to be strung at a later date as needed.	267.4 for the initial build. 60.2 for stringing the second side, when needed.	3– 4 years for the initial build. 1 year for stringing second side
3	Rebuild Line 86 as a double circuit with twin olive conductors and a 120°C design temperature along a new easement parallel to the original Line 86 (which is then removed).	315.4	3 – 4 years

Source: RIT-T PSCR Managing risk on Line 86, Table 3-1

66. A brief discussion on the options that Transgrid considered and did not progress was included in the PADR and is reproduced in Table 3.2.

Table 3.2: Summary of the options considered and not progressed by Transgrid (PSCR)

Option	Transgrid's description
Further uprating the existing line (e.g., by installing taller poles)	Not economically or technically feasible. Line 86 is constructed with a twin lime ACSR conductor with an original design temperature of 85°C. It has since been upgraded to a design temperature of 100°C. While the option to uprate the line to a design temperature of 120°C has been considered, it results in only a negligible contingency rating increase.
Staging the replacement works under Option 1.	Not technically feasible. Replacing Line 86 in stages would not avoid the line being unavailable for periods when unreplaced defective poles fail (and so would not address the risk or wider market impact components of the identified need).
Rebuild Line 86 as single circuit with twin mango conductors and a 120°C design temperature parallel to the original Line 86 (which is then removed) on a new easement.	Not commercially feasible. This option has been considered but not progressed since it costs significantly more than Option 1 ($192.7 million, compared to $95.7 million) and is expected to provide the same increase in transfer capacity (i.e., 280 MW increase compared to the base case). While this option would avoid an extended period of outage during construction, relative to Option 1, since the new line is built on a separate easement, this is not expected to be material to the assessment as all outages would be planned to have minimal impact on the market.

Source: RIT-T PSCR Managing risk on Line 86, Table 3-2

3.3.2 Summary of Transgrid's draft PADR

67. In the draft PADR, Transgrid has made several changes to the credible options it has considered, namely:

- Split option 1 into three sub-options:
  - New option 1A to replace all (367) poles on Line 86 in one-go (previously option 1 in PSCR);
  - New option 1B to replace all poles in-situ and providing greater capacity to this area of the network through coupling the existing line with a virtual transmission line (VTL) consisting of 2x 200MW batteries;

  - New option 1C to replace the highest risk (31) structures over 2025-26 to 2027-28 and a second tranche of 111 structures between 2042-43 and 2044-45 and the remaining structures (242) at a later time; and
- Removal of the previous option 2 from the PSCR as it was no longer considered commercially feasible – refer to Table 3.4, below.

68. With the exception of the new option 1C, the costs are retained in line with the PSCR as shown in Table 3.3.

Table 3.3: Summary of the credible options – comparison of PSCR and draft PADR

Option	PSCR Estimated capital cost	Draft PADR Estimated capital cost ($m 2020/21)	Draft PADR Expected Delivery date
1A	95.7	95.7	2027-28
1B	n/a	[redacted]	2023-24 (for the VTL) 2027-28 (for the line)
1C	n/a	10.7	2028-29 (initial tranche) 2045-46 (indicative second tranche)
3	315.4	315.4	2027-28

Source: RIT-T PSCR managing risk on Line 86, Table 3-1; draft RIT-T PADR Managing risk on Line 86, Table E-1 and Presentation to AER/EMCa 16 May 2022

69. A brief discussion on further options that Transgrid considered and did not progress was included in the PADR and is reproduced in Table 3.4.

Table 3.4: Summary of the options considered and not progressed by Transgrid (draft PADR)

Option	Transgrid's description
Rebuild Line 86 as a double circuit line (initially strung on one side only) – 'Option 2' from the PSCR	We no longer consider this option to be commercially feasible in light of the wholesale market modelling undertaken as part of this PADR. Specifically, this option was designed to be a 'flexible' option that rebuilt the line to be able to be operated as a double-circuit line but initially only strung on one side, i.e., effectively initially operating as Option 1A until being upgraded to Option 3. As outlined in this PADR, the wholesale market modelling finds that both Option 1A and Option 3 have significantly negative net market benefits due to the pattern of outages relative to the base case (for Option 1A) and the additional costs (for Option 3), meaning that Option 2 from the PADR is also expected to have significantly negative net market benefits and so has not been assessed further. Moreover, the market modelling results for Option 3 mean that Option 2 is now never expected to be upgraded from being strung on one side to being strung on both sides and so essentially represents a significantly more expensive version of Option 1A (with the same expected market benefits).
Coupling a VTL with Option 1C	We have not investigated coupling a VTL with Option 1C since the additional cost of the VTL is found to not be outweighed by the additional expected wholesale market benefits under the assessment of Option 1B (where the VTL is coupled with Option 1A). This will not change if the VTL is coupled with Option 1C and so this combination is not considered commercially feasible and has not been progressed.

Option	Transgrid's description
Use of an alternate conductor technology	In response to the PSCR, a party proposed the use of an alternate conductor technology for Option 2 and Option 3. The use of this technology has been assessed but not progressed as part of this PADR since these two network options are found to either not be commercially feasible (Option 2), or have costs that far outweigh the benefits (Option 3), and any cost reductions due to the alternate conductor technology are not expected to change these findings. Furthermore, the variants of Option 1 do not include replacement of the existing conductor in the analysis period, and therefore combining an Option 1 variant with replacement of the existing conductor with an alternate technology is not considered commercially feasible and has not been progressed.
Further uprating the existing line (e.g., by installing taller poles)	Not commercially feasible. Line 86 is constructed with a twin lime ACSR conductor with an original design temperature of 85°C. It has since been upgraded to a design temperature of 100°C. While the option to uprate the line to a design temperature of 120°C has been considered, it results in only a negligible contingency rating increase and is not expected to provide incremental benefits that are commensurate with the increase in cost associated with the uprating.
Rebuild Line 86 as single circuit with twin mango conductors and a 120°C design temperature parallel to the original Line 86 (which is then removed) on a new easement	Not commercially feasible. This option has been considered but not progressed since it costs significantly more than Option 1A ($192.7 million, compared to $95.7 million) and is expected to provide essentially the same benefits in terms of both avoided risk costs and through its increase in transfer capacity compared to the base case. While this option would avoid an extended period of outage during construction, relative to Option 1A, since the new line is built on a separate easement, the impact of this is not expected to be commensurate with the cost difference between these two options.

Source: RIT-T draft PADR Managing risk on Line 86, Table 4-5

3.3.3 Our assessment

Transgrid has reviewed a wider set of credible options

70. We note that in its PSCR, Transgrid dismissed the option to stage the replacement works under Option 1. We consider that staged replacement options often form a key part of the analysis for asset replacement projects.

71. The key change since the PSCR is inclusion of targeted replacement options in the draft PADR, as variants to Option 1. We consider it is appropriate and necessary to consider targeted replacement options in response to the identified need. Transgrid's new preferred option 1C is in effect similar to a staging option for replacement of the wood poles based on risk, with subsequent stages deferred beyond the next RCP (and beyond the assessment period).

72. In addition, Transgrid has also included reference to further options that it has considered and not progressed as a part of its assessment. We consider that Transgrid's dismissal of these options is reasonable.

Augmentation technical report

73. We note that Transgrid had intended to request an augmentation technical report from AEMO in relation to the options being considered in this RIT-T on the basis that Option 3 and Option 2 (once the second side is strung) considered in its PSCR may potentially increase fault levels at Bulli Creek and therefore have a '*material inter-network impact*' as defined in the NER.[15]

[15] Transgrid, RIT-T PSCR Managing risk on line 86 page 22

74. Given the change in emphasis identified in the draft PADR, and the conclusion that the market benefits are no longer material for the purpose of this assessment, we understand that Transgrid has not considered this further.

Consideration of non-network options

75. Transgrid has considered the potential role that non-network options may play in addressing a thermal limitation as part of its wider consideration of benefits to augment the capacity of Line 86, and which have subsequently been withdrawn.

76. We agree that non-network options are not able to directly address asset condition issues.

Credible options impacted by updated condition information

77. We consider that identification of a targeted replacement option should have been identified in the initial PSCR as a credible option. Nonetheless, Transgrid has included the targeted replacement option as part of the draft PADR. Transgrid explains the addition of Option 1C as:

> *'Option 1c has been included following additional asset condition assessment undertaken by Transgrid since the PSCR was released.'*

Highest risk poles determined by condition information

78. We understand that Transgrid has applied its general asset management approach for selection of the highest risk poles, to determine a quantity of 31 to replace. It states that:

> *'The 31 poles included in the first tranche replacement (and the later indicative 112 poles included in the second tranche replacement) have been identified through a process of reviewing the updated data on both the condition and risk of each of the 400 poles on Line 86 and comparing the expected risk reduction from replacing each pole with the associated cost. Specifically, this process has involved an assessment of both the condition of individual poles and the risk that they pose, e.g., taking into account the likelihood and consequence(s) of failure. We consider that replacing the 31 poles maximises the expected aggregate risk reduction relative to replacement cost in the immediate term.'*

79. We requested information from Transgrid to determine condition of poles, and to verify some of its claims concerning the condition of wood poles on Line 86. Transgrid provided:

- Inspection results of the pole / pole-raiser from 2021, for 212 suspension structures and various climbing inspections and underground inspection data (UGIs);
- Condition model applied to determine health score for poles; and
- Risk model that included effective age and annual probability of failure (PoF). However, these values were hard-coded and not able to be traced from source models.

80. In response to an information request from the AER, Transgrid has also provided a report of the analysis of Line 86 Defective Wood Poles[16] including a special focus on the 405 composite structures found on Line 86. Amongst other things, the report recommends

- The adoption of a Weibull 2-parameter model to be used for the prediction of structure replacement caused by a functional failure of a composite treated pole on Line 86. The parameter estimators of $\eta = 60.8$ and $\beta = 6$, suggests the assets are in a strong wear-out mode;[17]
- Observations surrounding decay modelling of composite poles used on Line 86 with respect to good wood and diameter measurements; and
- Improvements to the field inspection and record keeping for inspection data to improve alignment with Australia's best practice.

[16] ARMS, Transgrid Wood Transmission line structures, 2021 Reliability Improvement Study Report, May 2021

[17] These values are also included in Table 21 and Table 30 of the Network Asset Health Framework for composite poles

81. When the above information is considered alongside the Network risk assessment methodology, Network Criticality Framework, and Network Asset Health Framework we consider that Transgrid is more likely than not to have identified the highest risk poles for replacement. We have not been able to independently confirm the application of this method to identify the quantity of poles determined to be high risk, being 31 poles. However, we observe that the proposed quantity of poles to be replaced is broadly consistent with historical replacement volumes.

82. Whilst the poles will continue to be subject to inspection and condition assessment, we are surprised that Transgrid's modelling did not identify a second tranche of poles to be replaced prior to 2042, being in 20 years' time. Nor did Transgrid suggest that poles may be required to be replaced on functional failure during the intervening years. However this is not relevant to our consideration of Transgrid's current proposal, which relates only to expenditure requirements within the next RCP.

3.4 Input assumptions and scenarios

3.4.1 Summary of Transgrid's PSCR

83. Transgrid describes the base case as the (hypothetical) projected case if no action is taken. Transgrid reproduced the definition of base case from the RIT-T application guidelines, where it states:[18]

> *'The base case is where the RIT-T proponent does not implement a credible option to meet the identified need, but rather continues its 'BAU activities'. 'BAU activities' are ongoing, economically prudent activities that occur in absence of a credible option being implemented'*

84. Further Transgrid states that:

> *'..base case, where affected poles are not replaced, there is expected to be significant risk to our network and customers as outlined in section 2.3 above. In particular, we consider the base case to involve material risk costs and, in particular, bushfire, reliability, safety and financial risks.'*

85. An economic model or NPV analysis does not form a part of the PSCR. Transgrid stated its intention to model the market benefits of the credible options across different scenarios using its wholesale market modelling in its PADR.

3.4.2 Summary of Transgrid's draft PADR

86. We did not identify any material changes to the definition of the base case in the draft PSCR.

87. In the draft PADR, Transgrid has undertaken its analysis across three scenarios, which differ in terms of the key drivers of the estimated net market benefits (including the expected impact on the wholesale market). The three scenarios are characterised as follows:

- A 'low net economic benefits' scenario, involving a number of assumptions that gives a lower bound and conservative estimate of net present value of net economic benefits;
- A 'central' scenario which consists of assumptions that reflect Transgrid's central set of variable estimates that provides the most likely scenario; and
- A 'high net economic benefits' scenario that reflects a set of assumptions which have been selected to investigate an upper bound of net economic benefits.

88. A summary of the assessment scenarios is shown in Table 3.5.

[18] AER, Regulatory Investment Test for Transmission Application Guidelines, August 2020, page 21

Table 3.5: Assessment scenarios

Variable	Central (S1)	Low net economic benefits (S2)	High net economic benefits (S3)
Network capital costs	Base estimate	Base estimate + 25%	Base estimate - 25%
Non-network costs	Base estimate	Base estimate + 25%	Base estimate - 25%
Estimated risk costs	Base estimate	Base estimate + 25%	Base estimate - 25%
Wholesale market benefits estimated	EY market modelling based on the step-change 2022 ISP scenario	EY market modelling based on the progressive change 2022 ISP scenario	EY market modelling based on the hydrogen superpower-change 2022 ISP scenario
Discount rate	5.50%	7.50%	1.96%

Source: RIT-T draft PADR, Managing risk on Line 86, Table E-2

89. In determining the weighted NPV, Transgrid has applied weightings as follows:

- 52 per cent to central scenario;
- 30 per cent to the low economic benefits scenario; and
- 18 per cent to the high economic benefits scenario.

3.4.3 Our assessment

Base case has not been materially changed in its draft PADR

90. In the PSCR, Transgrid nominates that the base case is to be updated for the PADR assessment, where Transgrid describes the base case as including:[19]

> *'…the cost of replacing the wood pole structures identified over the course of inspections in 2021 that require replacement due to the condition issues (since these assets have failed our inspection/serviceability tests and require reactive replacement).'*

91. We did not identify any material changes to the description of the base case included in the draft PADR. In its options assessment, Transgrid considers the impact of its proposed options relative to its base case. However, we infer that the only capex costs of pole replacement assumed to form part of the base case are those arising from its 2021 inspection program.

Market modelling was updated with the latest available information

92. The draft PADR was updated with market modelling based on the draft 2022 ISP incorporating the latest available AEMO scenarios and weightings.

Inclusion of varying discount rates in the weighted scenarios

93. A weighted scenario approach can be appropriate in assessing relative NPV outcomes where there are uncertain parameters. For this reason, the AER RIT-T guidelines refers to weighting of costs and benefits.[20]

94. The AER Guideline and the AEMO Inputs Assumptions and Scenarios report refer to considering different discount rates in project assessments.[21] AEMO refers to doing so as a sensitivity analysis, and which we consider to be appropriate. However, we do not consider it valid to weight together 'scenarios' that contain 'all low' and 'all high' exogenous cost and benefit parameters, with different discount rates applied to the low and high scenarios,

19 Transgrid, RIT-T PSCR Managing risk on line 86 page 19

20 AER, RIT-T guidelines, August 2020, paragraphs 6 and 7b.

21 AER, RIT-T guidelines, August 2020, paragraph 22(g)

noting that different discount rates differentially affect project options depending on the extent to which their costs and benefits are in the near term of further into the future.

Application of weighted scenarios

95. Whilst we support the use of scenario analysis and sensitivity analysis, it is problematic that scenarios with 'all low' and 'all high' parameter values have been weighted together with the 'base' parameter NPVs, with each of the low and high scenarios ascribed probabilities of 25%. Whilst Transgrid has not stated this directly, we would expect that each of the low and high parameters may have a probability of 25%, but the combined probability of 'all low' and 'all high' parameters is the product of the individual probabilities (assuming each is independent) and is therefore very small.

96. Because of the potential for an excessive weighting of a low probability outcome to bias the weighted average, we tend to pay attention to the central, low and high NPV outcomes in their own right, in forming conclusions drawn from the economic analysis.

3.5 Quantification of costs

3.5.1 Summary of Transgrid's PSCR

97. The PSCR included a total estimate for each of the options. No other information was provided that provided greater detail of the cost estimates.

98. Transgrid engaged Aurecon to provide a benchmark estimate for each of the options in the PSCR, and a comparison to Transgrid's internal cost estimates which were provided in response to our request.

3.5.2 Summary of Transgrid's draft PADR

99. The draft PADR included a total estimate and Transgrid provided a cost estimate breakdown for each of the options in response to our request. An updated verification report or independent estimate was not provided for the new options included in the draft PADR.

3.5.3 Our assessment

Transgrid's general approach to cost estimation is reasonable

100. Transgrid provided its CAPEX Estimating Database Administration Procedure which outlined how major project cost estimation is kept accurate and uses the most up to date information, including how it applies escalation.

101. TransGrid engaged Aurecon to provide a technical assurance report on key revenue proposal inputs, tools and processes, including cost estimates and found that the cost estimates benchmark closely with Aurecon's independently derived cost estimates for the same scopes.[22] No specific reference was made to the accuracy of the cost estimate for Line 86 in this high-level assurance report.

102. From our high-level review, the general TransGrid estimating approach[23] appears to be reasonable and supported by external review of the forecast costs. However, we note that in response to our request for further information on the development of the cost estimate, Transgrid stated that it did not include any escalation for materials and that this decision is being further reviewed ahead of submission of its RRP for capex that falls within the next RCP. At the current time, therefore, no escalation basis has been provided for review.

22 Aurecon Transgrid 2023-29 Repex Proposal Technical Assurance Report Page 1

23 TransGrid Expenditure Forecasting Methodology Page 16.

Cost estimate likely to be higher than an efficient level for this project

103. As part of its PADR assessment, Transgrid updated its Option Feasibility Study[24] in May 2022 in which it states that it:

> *'Updated Project Staging as Per AM's Requirement to Reflect Optimal Timing for the Works'*

104. The key change is inclusion of a staged delivery approach (option 1C) based on first tranche of pole replacement in the next RCP (corresponding with the highest risk poles), a second tranche of pole replacement towards the end of the assessment period in Option 1C (between 2042-43 and 2044-45), and consideration of remaining pole replacement beyond the assessment period, although no cost has been attributed to this final tranche. The total cost estimate totals $45.1m ($2020-21) with $10.7m attributed to the first tranche and therefore only this amount is now proposed within the next RCP.

105. The scope includes:

- Replacement of critical condition existing wood poles with concrete poles with associated Insulators, dampers and fittings also to be replaced along the existing easement alignment:
- S/C Suspension Concrete Pole Structures installations including associated insulators and fittings – 27 Structures: and
- S/C Tension Concrete Pole installations including associated insulators and fittings – 4 Structures.

An assessment of unit costs indicates that the cost estimate may be higher than an efficient level

106. We reviewed the proposed cost estimates provided by Transgrid in Table 3.6.

[redacted]

Source: EMCa analysis based on review of costs included in RIT-T draft PADR

107. In response to our request for information, Transgrid has also provided copies of independent cost estimates for the options considered in the PSCR by Aurecon and a summary report comparing Aurecon's estimates to those prepared by Transgrid. For Option 1A, Aurecon's estimate was 10% lower than Transgrid's final estimate, and 38% lower than Transgrid's initial estimate of $139m. The reason for the difference was noted as a variation in construction allowances.[25]

108. To our knowledge, Aurecon has not prepared a cost estimate for Option 1C. We consider that the scale efficiencies associated with delivery of Option 1A will not be present for the Stage 1 or Stage 2 options, and so some uplift in per-unit cost is likely to be present. Nevertheless, we would expect that the comparison of unit costs between Stage 1 and Stage 2 to be closer, based on the assumption of a single 3-month outage window for both options.

[24] Transgrid OFS rev 2, 10 May 2022

[25] Transgrid summary report 2021-08-20 – Line 86.xls

109. We note that Transgrid's assumed delivery model will result in higher costs:[26]

> *'Assumption of outage works to be completed with 3 crews concurrently to minimise outage duration as per Asset Management's direction in order to minimise market impact on Line 86. Additional mobilisation cost (x 2) has been allowed for in the BoE to cater for this delivery approach. This will need to be confirmed and validated as part of the project development process.'*

110. A higher cost of delivery may be necessary to mitigate other risks, however we would expect to see a commensurate reduction in the associated risk costs, which we did not see.

Assembly costs include unjustified scaling factors

111. We also reviewed the cost build-up models provided by Transgrid and identified scaling factors that were not adequately justified, in its explanation of variances from its standard assembly costs used in its costing model. In Table 3.7 we show the materials assemblies for a suspension and tension structure.

Table 3.7: Comparison of assembly cost assumptions for supply of structures

Assembly	Item	Cost assumption
Suspension structure	Provision for two-piece concrete poles (supply only)	• No. of poles multiplied by factor of 2 • 2-piece pole rate scaled by 1.25 times for the increased cost of 3-piece poles, with the use of 3-piece poles as per Project Developer clarification
Tension structure	Provision for two-piece concrete poles (supply only)	• No. of poles multiplied by factor of 3 • 2-piece pole rate scaled by 1.25 times for the increased cost of 3-piece poles, with the use of 3-piece poles as per Project Developer clarification

Source: EMCa analysis of Transgrid cost estimates

112. No further explanation by Transgrid was provided for the scaling factors applied to these assemblies. In the resource adjustments, we observed that for Option 1C this adjustment was increased from 1.25 times to 1.375 times, relative to Option 1A. No explanation was provided.

113. A total of 45 adjustments were made to the resource estimates from the 2021C cost library, being the same cost library relied upon for the Option 1A cost estimate, the majority of which resulted in cost increases.

114. In absence of better information, the increases and scaling factors applied by Transgrid indicate to us that the costs assumed by Transgrid are conservative and may be higher than an efficient level.

Costs of second tranche to be removed

115. Transgrid states in the draft PADR that:[27]

> *'We intend to further assess the indicative second set of pole replacements included in the PADR assessment further as part of the PACR and expect that they will be removed from the analysis given how far into the future they are expected to be required. An indicative assessment undertaken as part of preparing the PADR finds that they are not expected to be material to the conclusion and, if removed, would slightly reduce the net*

[26] Transgrid OFS1555 NOSA Rev 2 86 Tamworth – Armidale WP Line Rebuild, page 4

[27] Transgrid, RIT-T draft PADR Managing risk on line 86, page 32

market benefits of Option 1C (although by not enough to change the conclusion that it is the preferred option).'

116. We consider this to be a reasonable approach and have removed the second tranche in our analysis given the uncertainty of the cost and timing for this work.

3.6 Quantification of benefits

3.6.1 Summary of Transgrid's PSCR

117. Transgrid provided a high-level estimate of the benefits only. Transgrid has identified sources of benefits as arising from market benefits or avoided risks costs where:[28]

'While the aggregate risk cost is currently estimated at around $0.6 million/year, it is expected to increase rapidly going forward if action is not taken and the poles are left to deteriorate further (reaching approximately $13.5 million/year by 2044/45).'

118. Market modelling or risk costs modelling was not provided with the PSCR.

3.6.2 Summary of Transgrid's draft PADR

119. In response to our request for information, Transgrid has provided a copy of its market modelling report, and the results of each of the modelled benefit streams captured in the NPV model for each option and scenario considered.

120. Transgrid also provided a copy of its risk cost model for the calculation of the avoided risk costs as benefits in its modelling.

3.6.3 Our assessment

Market benefits are no longer considered material

121. In its PSCR, Transgrid considered that the location of Line 86, specifically that it forms part of the QNI, meant that investment in augmenting the transfer capacity would also provide wider wholesale market benefits.

122. We were not convinced that augmenting this line would result in material market benefits, on the basis that:

- Adjacent projects have been identified and are at varying stages of completion to augment capacity of the QNI and did not raise a material concern with the capacity of Line 86 (e.g. QNI Minor);
- The adjacent New England REZ, shown in light blue in Figure 2-2, is to be developed in the area surrounding Armidale as part of the NSW Government's Electricity Strategy and Electricity Infrastructure Roadmap; and
- Future related ISP projects have been proposed for the region (e.g. QNI Connect) and which do not include Line 86.

123. In the draft PADR, Transgrid has subsequently concluded that the wholesale market benefits are not as material as it had previously assumed, and cause a negative wholesale market benefit for options resulting in increased capacity of Line 86:[29]

'The wholesale market modelling undertaken as part of this PADR has found that rebuilding Line 86 as a higher capacity line actually results in significant negative

[28] Transgrid, RIT-T PSCR Managing risk on line 86

[29] Transgrid, RIT-T draft PADR Managing risk on line 86

wholesale market benefits (i.e., a cost relative to the base case). This was not expected…'

124. We consider it appropriate that Transgrid is no longer proposing an option to increase line capacity.

Major sources of benefits are associated with avoided safety and bushfire risk cost

125. In a response to our request for information, Transgrid stated that:[30]

'The avoided risk cost such as bushfire, reliability, safety, financial, reputational risks is based on the Network risk assessment methodology, Network Criticality Framework, and Network Asset Health Framework submitted with our revenue proposal. The calculation is an input to the PADR which is currently being prepared.'

126. From the risk model, the primary benefits are related to the avoidance of safety and bushfire risk cost as shown in Table 3.8.

Table 3.8: Proportion of benefit reduction (to 1 decimal place), no multiplier

Risk cost	Proportion of benefits, 2029	Components of consequence cost
Public safety	Negligible	Weighted average VoSL multiplied by LoC fatality multiplier multiplied by public safety consequence model LoC applied to each structure / component
Reliability	1%	Reliability impact expressed as $/hour for the location of Line 86 and duration of outage applied to each structure / component
Environmental	26%	Bushfire consequence model, emergency response factor and environment multiplier of 0.231 applied to each structure / component
Financial	66%	Annualised structure / component replacement cost, plus Financial costs,[31] plus Cost of major legislative breach, major litigation and large investigation multiplied by environment multiplier of 0.231 applied to each structure / component, plus Cost of major legislative breach, major litigation and large investigation multiplied by public safety consequence model LoC applied to each structure / component
Reputational	7%	Major media event multiplied by public safety consequence model LoC applied to each structure / component, plus Extreme media event multiplied by env multiplier of 0.231 applied to each structure / component

Source: Transgrid's response to information request AER IR018, 1555 Risk Model Option 1Cline86 Stage1

127. Any failure will result in a major financial risk.

Determination of Disproportionality Factors may lead to overstatement of the benefits

128. In its Final Decision for the 2018-23 RCP, the AER considered that TransGrid's application of the disproportionality multipliers[32] to worst case consequence was likely to overstate risks. Further, that its selection of disproportionality factors was not sufficiently supported.

30 Transgrid's response to information request, AER IR018 question 9

31 Referred to in the model as soc_finanical and was empty and did not contribute to the consequence cost

32 The terms disproportionality factor (DF) and disproportionality multiplier are used interchangeably by Transgrid and are assumed to have the same meaning for the purpose of our assessment.

We therefore looked for evidence of how Transgrid had adjusted its methodology in response to this feedback as a part of development of its repex forecast for the next RCP.

129. Disproportionality multipliers are typically used to determine whether costs are disproportional to the benefits as part of an assessment that an investment option is 'reasonably practicable'.

130. Transgrid summarises the disproportionality multipliers it uses in its Network Asset Risk Assessment Methodology.[33] In relation to the bushfire related safety risks, Transgrid considers bushfire risk as a part of the environmental risk category and applies the disproportionality multipliers as shown in Table 3.9.

Table 3.9: Summary of environment-related disproportionality multipliers

Risk	Consequence severity	Disproportionality multiplier	Additional notes
Bushfire (B)	Potential for multiple fatalities (Transgrid staff and public) and extensive property damage.	6	None
Environment (E) (Excluding Bushfire)	Potential for serious, long term, widespread environmental damage. (SF6 loss or oil spills)	3	Transgrid states that the Asset Analytics and Investment Tool (AAIT) includes Bushfire (B) and Environmental (E) risk in the one category Environmental and so only applies one disproportionality multiplier. To account for the different multipliers non bushfire risk including SF6 leakage and oil leaks Transgrid halve the risk outcomes in performing risk analysis.

Source: Transgrid, Network Asset Risk Assessment Methodology, Table 3 – Determination of network safety risk reduction benefit

131. We observe that Transgrid has applied disproportionality multipliers to non-safety related environment risk consequences, specifically:

- By inclusion of extensive property damage under the bushfire risk and assigning a disproportionality multiplier of 6; and
- For serious long term, widespread environmental damage (excluding bushfire) assigning a disproportionality multiplier of 3.

132. We consider that disproportionality factors are intended to form part of an assessment of safety & health risk and are primarily to support investment in projects to mitigate safety & health risk, where the costs are not disproportionate to the benefits. They are not intended for application to non-safety and health related risks such as property damage. This is supported by advice published by the HSE[34] to which the Australian Standards AS5577 was based, and previous AER guidance.[35]

133. Transgrid has defined network safety, being a term referred to in AS5577, as including property damage: [36]

33 Transgrid, Network Asset Risk Assessment Methodology, Table 3 – Determination of network safety risk reduction benefit

34 HSE website

35 AER, Industry practice application note Asset replacement planning January 2019

36 Transgrid, Network Risk Assessment Methodology page 6

'The safety aspects of risk arising from the network associated with designing, building, operating, maintaining and disposing network assets that pose a risk to workers, the public, the environment (including Bushfire) and property.'

134. Transgrid also claims that its selection of consequences included in its assessment, and specifically including consideration of damage to property and the environment, aligns with the requirements of AS5577 where it states[37]

'It should also be noted that AS 5577 requires that an option that provides the greatest safety and bushfire risk reduction benefit should be progressed irrespective of cost, until an acceptable level of residual risk is achieved (where Reasonably Practicable to do so).'

135. We understand that AS5577 is a standard that provides nationally consistent requirements for the development of an Electricity Network Safety Management System (ENSMS) by an Electricity Network Operator. The standard is principally focussed on how the Network Operator manages the safe design, construction, commissioning, operation, maintenance and decommissioning of its electricity network.[38] The standard does not nominate disproportionality factors or multipliers, or explicitly outline their application to property or environmental damage. Accordingly, we consider that Transgrid has not sufficiently justified the basis of applying a disproportionality multiplier to property damage or other environmental damage arising from bushfires.

136. We also observe a difference between Transgrid's approach and the requirements outlined in the AER industry practice note. As stated in the AER practice note:[39]

'The overarching principle is that extreme and high risks should be proactively reduced until the cost of doing so becomes grossly disproportionate to the benefits. Within an economic context, this test requires monetisation of safety risk, with an event causing a fatality being a typical test case. Good industry practice is to apply the value of statistical life (VSL) to monetise the risk associated with a fatality.'

137. We consider it incorrect that Transgrid and its consultant (in its Technical Assurance Report[40]) claim that its approach is aligned with the AER industry practice note.

138. In response to a request for information from the AER, Transgrid describes its approach for application of disproportionality multipliers to bushfire consequence costs on the basis that (emphasis added by EMCa):[41, 42]

- *'AS 5577 requires all hazards within the scope of the safety management system objectives to be eliminated or if not managed to ALARP.*
- *Community attitudes to the impact of bushfire events meet the test of "societal dread associated with extreme outcomes" and hence the* ***use of disproportionality factors is appropriate for all aspects of the bushfire risk****.*
- *Overall bushfire risk to the community includes a number of impacts which cannot be estimated in our bushfire model as noted in the 202 (sic) Royal Commission into National Disaster Arrangements.'*

139. Transgrid then concludes that:

'These uncertainties mean that the application of disproportionality to the quantified impacts from the Transgrid bushfire model (which is limited to directly attributable

37 Transgrid, Network Risk Assessment Methodology page 18

38 AS 5577-2013 Electricity network safety management systems

39 AER, Industry practice application note Asset replacement planning January 2019, page 60

40 Aurecon, Technical Assurance Report

41 Transgrid's response to information request, AER IR002 Question 4. We understand the reference to Royal Commission into National Disaster Arrangements was the report tabled in Parliament in October 2020.

42 Reference to the safety management system objectives related to clause 6 of the Electricity Supply (Safety and Network Management) Regulation 2014.

economic costs) is reasonable and meets the principles of the AER replacement planning guideline.'

140. We consider that the use of disproportionality multipliers for risks and consequences other than health and safety is inconsistent with the intent of the AER industry practice note and AS5577 for application of disproportionality multipliers and will result in inflating the benefits for safety-driven investments.

Application of ALARP test

141. In its Network Asset Risk Assessment Methodology, Transgrid states that its ALARP test, which it refers to as the disproportionality test, forms part of its cost benefit analysis. Transgrid describes the components of its cost benefit analysis as: [43]

'The cost benefit analysis should consider the cost of each feasible option and the associated network safety risk reduction benefit (pre-investment risk minus post-investment risk). The difference in pre and post-investment risk is multiplied by the appropriate disproportionality multiplier, taking into consideration the type of risk and severity of the consequence of the risk. If the cost benefit analysis returns a positive result, the option is considered for implementation.'

142. It is appropriate to consider the difference between the pre- and post-investment risk cost as being the basis for the calculation of benefit for the purposes of the NPV analysis. However, as noted above, Transgrid appears to apply its disproportionality multipliers to the total environmental risk consequence, not limiting this to the safety and health related risk consequence (within the environmental risk). The application of the disproportionality multiplier to non-safety and health related benefits results in inflating the benefits for the purposes of the ALARP test for relevant projects.

Inclusion of reputational risk not aligned with the AER industry practice note

143. Transgrid has also included reputational risk in its calculation of consequence cost. We acknowledge that this is a cost that Transgrid must consider in operation of its business, however inclusion of reputational risk was specifically excluded from the AER industry practice note:[44]

'This [reputational risk] has not been included in the Application Note as there is no recognition of the value of reputation within the determination of the regulatory asset base, within determination of the WACC, or within the capital expenditure objectives. While there may be costs in managing stakeholders that arise from adverse outcomes from asset related incidents (as opposed to operational), there is nothing within the Application Note that precludes such costs being included in the analysis where they can be appropriately justified. Given the NER requirements, the inclusion of reputational risk when considering asset replacement investments would likely require consideration of how such a risk fits within the NER requirements as well as robust demonstration of the value of any reputational risk proposed.'

144. Accordingly, the reputational risk should be removed from the calculation of asset risk cost.

43 Transgrid, Network Asset Risk Assessment Methodology, page 18

44 AER, Industry practice application note Asset replacement planning January 2019, page 89

3.7 Economic analysis (including sensitivity analysis and timing)

3.7.1 Summary of Transgrid's PSCR

145. Transgrid did not provide an economic model or NPV analysis with the PSCR.

3.7.2 Summary of Transgrid's draft PADR

146. Transgrid has utilised a CBA model developed for it by its consultants in seeking to demonstrate that the proposed project is economically viable, to demonstrate optimal timing, and to justify its preferred option. The analysis compares the incremental costs and incremental benefits of the proposed option with a base case (or business as usual) counterfactual.

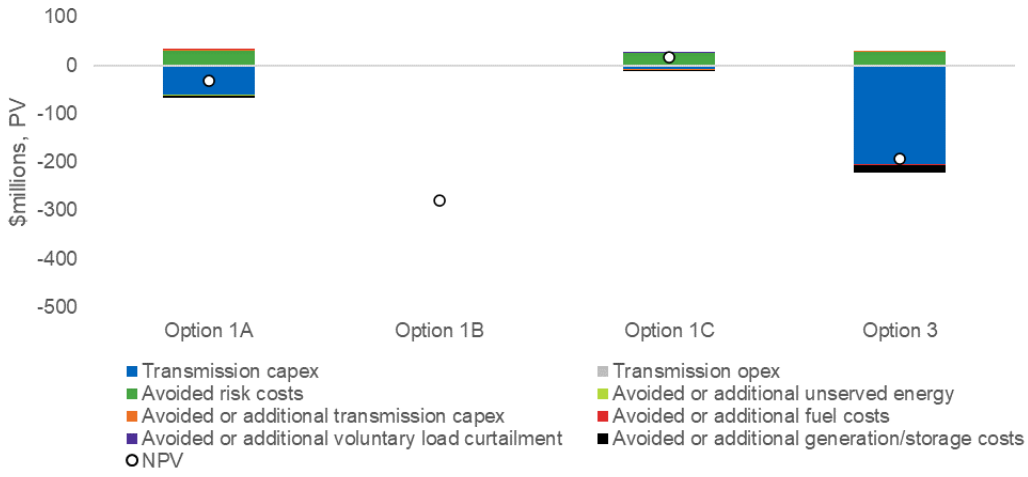
147. Transgrid has provided a copy of its NPV model which presents the NPV analysis for each of the options and scenarios.

148. Transgrid also undertook sensitivity testing in addition to the scenario analysis in the draft PADR. The range of factors tested as part of the sensitivity analysis in the draft PADR are: (i) assumed level of risk costs; (ii) higher and lower network capital costs; (iii) higher and lower non-network capital costs; and (iv) alternate commercial discount rate assumptions.

149. The results of the draft PADR assessment identify Option 1C as the preferred option to deliver approximately $17 million in net benefits for the central scenario, and $20m for the weighted NPV. This is the only option with a positive NPV.

150. A summary of the NPV analysis for the central scenario is provided in Figure 3.3 below.

Figure 3.3: Summary of NPV analysis for selected options



Source: Transgrid, draft PADR Managing risk on line 86

3.7.3 Our assessment

Adjustments for quantification of benefits

151. As discussed in earlier sections of this report, we found issues with the application of disproportionality factor to all of bushfire risk costs and inclusion of reputational risk costs.

152. Upon further enquiry, we also observed that the risk costs included for Option 1C in the NPV model did not align with the risk model we were provided and appeared to be interposed with the risk costs included for option 3. We have relied on the risk costs as provided in the risk model.

153. When we make adjustment for these factors, the benefits attributable to this project cause the NPV to go marginally negative. However, when a further adjustment is made to remove the costs of stage 2, noting the uncertainty around cost and timing of this stage (and that there is no need to commit this stage now), the NPV returns to a positive value in the order of $2m.

Testing for other benefits

154. We further tested the sensitivity to other benefit assumptions and observed that the market benefits for option 1C are negative and not considered to be a determining factor.

Application of ALARP

155. We were not able to readily account for the over-estimate of safety related bushfire costs to reasonably apply the appropriate disproportionality factor, due to the bushfire consequence cost being a single hard-coded figure. We recognise that the safety related costs form a proportion of these costs, however we were not able to assign a proportion of these costs with a reasonable level of confidence.

Timing at end of the RCP

156. Transgrid included an assessment of the optimal timing of this investment as a part of its NPV model. The benefits used for this analysis were hard-coded and did not align with the input assumptions used in the NPV analysis, and we expect included the same issues identified elsewhere in this report.

157. The timing is very sensitive to the input assumptions including probability of failure and cost of consequence. We consider the timing to be an approximate guide so as to determine whether the replacement program is likely to be undertaken within the next RCP or not. However, intuitively we expect that when a more reasonable estimate of the benefits is undertaken, the optimal timing will occur within the next RCP because the risk 'already exists' and therefore it is better to address this now rather than to incur continuing risk costs.

3.8 Summary of our finding

158. Whilst there are elements of Transgrid's NPV analysis that we consider overstate the benefits, we consider that Transgrid's now de-scoped project for replacement of worst-condition poles, is justified on the basis of risk-cost. We note that Transgrid no longer views this project as market benefit driven.

159. Transgrid's costing appears to be an over-estimate, with several loading factors applied without satisfactory justification. However, the project is now a 'repex' project and, assuming that Transgrid proposes it in its RRP, we expect that the cost allowance will be re-considered as part of Transgrid's overall repex allowance.

APPENDIX A – CONTEXTUAL INFORMATION ON NEM PLANNING AND REGULATORY FRAMEWORK

A.1 Current regulatory arrangements

A.1.1 Overview of planning and investment framework

160. The current regulatory arrangements provide for TNSPs to invest in the transmission network to promote the long-term interest of consumers. This is achieved by an independent regulator, the AER regulating revenues and prices.

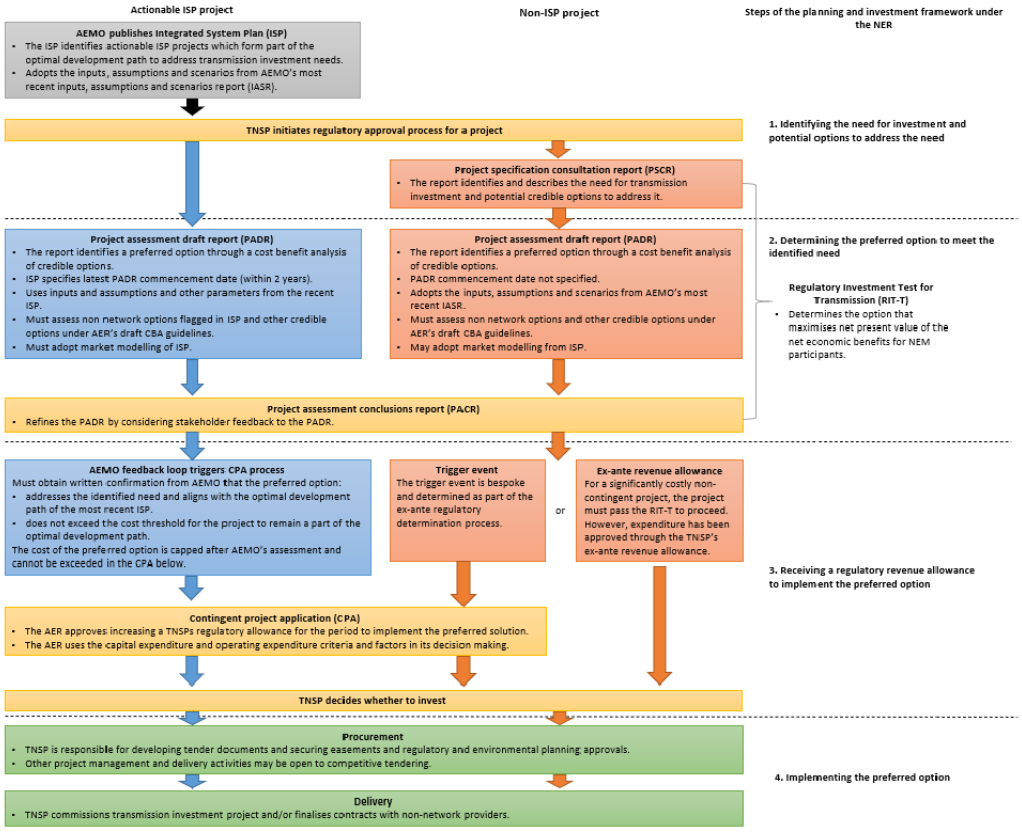
161. TNSPs are regulated on an ex-ante basis, with the governing National Electricity Rules (NER) requiring the determination of a revenue cap, being the result of a building block assessment. The components of the building block model include providing for a return on and return of capital, and which requires the AER to determine a prudent and efficient level of capital expenditure (referred to as the capital expenditure allowance) for each regulatory control period.

162. TNSPs are also subject to efficiency schemes to encourage efficient investment in capital expenditure, the benefits of which are shared with consumers.

163. In addition to the determination of a capital expenditure allowance as part of the regulatory determination cycle for each Regulatory Control Period (RCP), TNSPs are provided with a 'contingent project' mechanism. Contingent projects are significant network augmentation projects that may arise during a regulatory control period, but the need, timing and/or cost of the project is uncertain. As such, project costs are not provided for in expenditure forecasts for a regulatory control period. Rather, contingent projects are linked to specific investment drivers, which are defined by a 'trigger event'. When a trigger event occurs, the proponent is able to submit a CPA to seek an increase to the revenue allowance to fund the project.

164. An overview of the planning framework is provided in Figure A.1 below.

Figure A.1: Overview of key steps in the transmission planning and investment framework



Source: AEMC, Consultation paper transmission planning and investment review

165. The NER requires also that transmission projects that have a capital expenditure above a pre-determined cost threshold are also subject to the requirements of the Regulatory Investment Test for Transmission (RIT-T). The cost threshold is currently $6 million.

A.1.2 RIT-T assessment

Purpose of the RIT-T

166. The RIT–T aims to promote efficient transmission investment in the national electricity market (the NEM) by promoting greater consistency, transparency and predictability in transmission investment decision making.

167. RIT–T proponents must apply the RIT–T in accordance with the procedures under NER clause 5.16.4 to assess the economic efficiency of proposed investment options.

168. NER clause 5.15A.1(c) states that the purpose of the RIT–T is to:

> *'… identify the credible option that maximises the present value of net economic benefit to all those who produce, consume and transport electricity in the market (the preferred option). For the avoidance of doubt, a preferred option may, in the relevant circumstances, have a negative net economic benefit (that is a net economic cost) to the extent the identified need is for reliability corrective action or the provision of inertia network services required under clause 5.20B.4 or the provision of system strength services required under clause 5.20C.3.'*

RIT-T guidelines

169. The NER requires that the AER publish guidelines for application of a RIT-T. As set out in the RIT-T application guidelines, the broad steps involved in applying the RIT-T are:

- 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.
- 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.

A.1.3 Current reviews will provide additional guidance

170. There are two key reviews currently underway that will provide important guidance to the market and regulatory bodies and which seek to address some immediate issues facing the industry transition.

AEMC review of Transmission planning and investment

171. The AEMC has initiated a review of the transmission planning and investment framework to (i) identify issues with the existing regulatory frameworks in relation to the timely and efficient delivery of major transmission projects, (ii) explore options for reform of or improvements to the existing regulatory frameworks, and (iii) recommend possible changes to the National Electricity Rules (NER) and other regulatory instruments (if required) to support frameworks that are fit-for-purpose and promote the timely and efficient delivery of transmission services. [45]

172. The AEMC describes the objective of the review as:[46]

> *'..to ensure that the regulatory frameworks strike an appropriate balance between requiring rigorous assessment, to mitigate the risk of inefficient transmission investment, and the need to facilitate timely investments that deliver beneficial outcomes. Consumers will be paying for these projects for decades into the future and it is therefore important that they are in the long term interest of consumers. As such, it is imperative that the regulatory framework for assessing and approving them remains fit-for-purpose. '*

173. Amongst the reasons for this review given in the consultation paper, the AEMC states:[47]

> *'The magnitude of anticipated investment brings into focus the need for the regulatory framework to accommodate the substantial investment and effectively manage the uncertainty of the transition, as such major discrete projects have a greater degree of uncertainty than business-as-usual (BAU) transmission investment. For the purposes of this consultation paper, the Commission considers major transmission projects to be projects of a significant size, scale and scope such that they are associated with greater uncertainty relative to BAU investments. These can be ISP or non-ISP projects.'*

ESB review of congestion management

174. National Cabinet has instructed the ESB to progress detailed design work on transmission access reform and to propose a rule change to Energy Ministers by December 2022.[48]

175. The ESB initiated a project to:[49] (i) address the problems that prompted National Cabinet to ask the ESB to conduct the review, namely, the problems associated with the current

45 AEMC Consultation paper, TPI Review, 19 August 2021, page 1

46 AEMC Consultation paper, TPI Review, 19 August 2021, page 2

47 AEMC Consultation paper, TPI Review, 19 August 2021, page 2

48 ESB consultation paper Transmission access reform Consultation paper, page 8

49 ESB consultation paper Transmission access reform Consultation paper, page 8

access regime; (ii) work with stakeholders to understand their concerns and respond to them where appropriate, including by considering alternative mechanisms proposed by stakeholders, and (iii) ensure sufficient flexibility for jurisdictional differences.

176. The latest deliverable from this project is a consultation paper to seek feedback on four model options to guide the design of solutions for congestion management.

177. The ESB describes the current arrangements for provision of transmission access as follows:[50]

> *'The NEM has a transmission access regime whereby parties may connect to the grid at any point (subject to meeting technical requirements) and fund only the cost of the assets required to connect to the shared grid. Generators are not required to contribute towards the cost of the shared transmission network, and they receive no assurance that the transmission network will be capable of transporting their output to load centres.'*

178. Amongst the reasons provided in the consultation paper for this project, the ESB states:[51]

> *'The energy transition can be delivered more cheaply and quickly if new generators and storage connect in places that facilitate the full benefit of all these resources coming into the national power system.*
>
> *In some cases, generators are connecting in locations where, a lot of the time, they are not adding new renewable energy to the power system. Instead, they are displacing the existing renewable generators. If we don't change the access regime, we are likely to end up with a larger generation and storage fleet and transmission network than necessary to achieve the same decarbonisation and reliability outcomes (see Figure 1).*
>
> *These issues are being recognised by some State governments who have sought to progress reforms to implement renewable energy zones (REZ) within their regions. The work of the Energy Security Board (ESB) aims to support and dovetail with these initiatives.'*

50 ESB consultation paper Transmission access reform Consultation paper, page 15

51 ESB consultation paper Transmission access reform Consultation paper, page 5