EMCa

energy market consulting associates

TransGrid 2023/24 to 2027/28 Regulatory Control Period

REVIEW OF ASPECTS OF TRANSGRID'S REVENUE PROPOSAL (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 may not have been taken into account. 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 Insights Tool
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AESCSF	Australian Energy Sector Cyber Security Framework
ALARP	As Low As Reasonably Practicable
augex	Augmentation (capital) expenditure
BAU	Business As Usual
BESS	Battery Energy Storage System
BSP	Bulk Supply Point
BST	Base Step Trend
Capex	Capital expenditure
CBA	Cost Benefit Analysis
CDN	Corporate Data Network
BCR	Benefit to Cost Ratio (We have defined BCR in this report as NPV/[PV(capex) + PV(opex)] Under this definition, therefore, a positive NPV also results in a BCR >0.
COTS	Commercial off the Shelf
CPI	Consumer Price Index
DF	Disproportionality Factor
DG	Decision Gate
DNSP	Distribution Network Service Provider
EMCa	Energy Market Consulting associates
ENA	Electricity Networks Association
EOL	End of Life
ESB	Energy Security Board
EUE	Expected Unserved Energy
FY	Financial Year
GDP	Gross Domestic Product
IaaS	Infrastructure as a Service
ICT	Information and Communications Technology
IFRS	International Financial Reporting Standards
IGF	Investment Governance Framework
ISP	Integrated System Plan

Term	Definition
IT	Information Technology
MIL	Maturity Indicator Level
MTWO	Transgrid's cost estimation database system
NCIPAP	Network Capability Incentive Parameter Action Plan
NEM	National Electricity Market
NER	National Electricity Rules
NNS	Non-network solution / support
NOSA	Need and Opportunity Screening Assessment
NPC	Net Present Cost
NPV	Net Present Value
NRAM	Network Risk Assessment methodology
NSP	Network Service Provider
NSW	New South Wales
OER	Option Evaluation Report
OFS	Option Feasibility Study
OIL	Optimised Investment List
opex	Operating expenditure
OT	Operational Technology
PEC	Project Energy Connect
PJCIS	Parliamentary Joint Committee on Intelligence and Security
PoE	Probability of Exceedance
PoF	Probability of Failure
PPM	Project and Portfolio Management
PSF	Powering Sydney's Future
RCP	Regulatory Control Period
RIN	Regulatory Information Notice
RIT-T	Regulatory Investment Test Transmission
RP	Revenue Proposal
RRP	Revised Revenue Proposal
REFCL	Rapid Earth Fault Current Limiter
repex	Replacement (capital) expenditure
REZ	Renewable Energy Zone
RIN	Regulatory Information Notice
SaaS	Software as a Service
SASE	Secure Access Service Edge

Term	Definition
SFAIRP	So Far As Is Reasonably Practicable
SLACIP	Security Legislation Amendment (Critical Infrastructure Protection)
SME	Subject Matter Experts
SoNS	Systems of National Significance
SP	Security Profile
SVC	Static Var Compensator
TAC	Transgrid Advisory Council
TNSP	Transmission Network Service Provider
totex	Total expenditure (capex and opex)
VCR	Value of Customer Reliability
VoSL	Value of Statistical Life
XaaS	Anything as a Service
ZTA	Zero Trust Authority

EXECUTIVE SUMMARY

Introduction

Background

1. On 31 January 2022 Transgrid submitted its 2023–28 revenue proposal (RP) to the Australian Energy Regulator (AER) for the period 1 July 2023 to 30 June 2028.

Scope and purpose of our review

2. The AER has requested that Energy Market Consulting associates (EMCa) provide an expert review of the governance, management and forecast methodology applied to the capex forecast, aspects of the proposed capex forecast and opex step change included in Transgrid's revenue proposal (RP) for the next regulatory control period (RCP). The scope of our review includes an assessment of Transgrid's:
   - Governance and management and forecasting methods applied to its capex forecast;
   - Augmentation capital (augex) forecast, excluding contingent projects and Network Capability Incentive Parameter Action Plan;
   - Information Communications Technology capex forecast; and
   - Proposed allowance for an opex step change for cyber security and physical security.
3. The assessment contained in this report is intended to assist the AER in its own analysis of the capex and opex allowance as an input to its Draft Decision on Transgrid's revenue requirements.

Our assessment

Governance and management framework and forecasting methods for capex

4. Whilst we consider that Transgrid has an effective governance and asset management system, we found evidence of some application issues associated with its portfolio optimisation, prioritisation, and risk framework.
5. For the most part, we consider that Transgrid's forecasting methods have led it to identify prudent projects with reasonable cost estimates based on its assumptions. However, the assumptions relied upon by Transgrid do not sufficiently account for likely changes in market conditions, and the corresponding risks to input costs and to the deliverability of its proposed capex program. Such changes are likely to lead to re-prioritisation of its proposed activities, which are likely to result in reductions to the prudent and efficient level of capex that it will incur.
6. Other areas of concern are with Transgrid's limited consideration of options (including non-network options, and the value of optionality) and assumptions regarding the continuation of benefits beyond the assessment period in its Augex projects.
7. Taken together, these issues are likely to have resulted in an overstatement of capex requirements.

Augmentation capex forecast

8. Non-network solutions, demand growth uncertainty, and delivery constraints may lead to a lower capex requirement than Transgrid has proposed. We have arrived at this finding based on our assessment that Transgrid has identified legitimate opportunities with potential

to generate net economic benefits by removing or mitigating network constraints to its network and that, to the extent that network solutions are indicated, Transgrid has likely selected the most appropriate such solution in each project presented. However, we consider that one or more non-network solutions, either on their own or in combination with other solutions, is likely to result in a reduction to the required augex for some projects in the next RCP.

9. Project timing is sensitive to actual spot load growth (for relevant projects) and also to Transgrid's delivery capability, which together may lead to re-prioritisation of the proposed augex against other works, as was undertaken in the current regulatory control period.

10. We consider that compliance projects with either economic timing or earliest possible commissioning dates at or near the end of the next regulatory control period are likely candidates for deferral. Similarly, we consider that economic benefits-driven projects are more likely to be deferred in deference to compliance projects with three of the economic benefits-driven projects having the lowest positive NPV being the most likely candidates.

11. Whilst the majority of Transgrid's forecast augex appears reasonable, the issues we have identified lead us to the view that its forecast augex for the next RCP represents an overestimate of its prudent and efficient requirement.

Information and Communications Technology capex forecast

12. Transgrid proposes a 128% increase in ICT capex in the next RCP despite its cloud migration strategy. A trend-based forecast for the next RCP indicates that ICT capex of about $72m (-17%) rather than the proposed $86.9m would be expected. This includes an allowance for Transgrid to meet its increased external cyber security obligations.

13. The expenditure profile and statements that Transgrid has made about 'deferring' work to the next RCP, strongly suggests that Transgrid is 'planning to the regulatory period' rather than investing based on need.

14. From our assessment of the eight packages underpinning the ICT capex forecast, we consider that in each case, Transgrid has identified compelling reasons for taking action in the next RCP. However, Transgrid has not adequately demonstrated that it has prioritised its work to ensure that only the work that is prudently and efficiently required in the next RCP is proposed.

15. We find that our 'bottom-up analysis' supports our top down 'trend analysis' that Transgrid is likely to have overstated the required ICT capex for the next regulatory control period. We consider that the non-network ICT risks and obligations it faces should have or can be managed through a combination of:

- Prudent spending continuing in the current RCP (reducing the capex required in the next RCP); and
- The adoption of alternative options during the next RCP which are likely to include some capex-opex trade-offs such that not all the identified needs will require a capex solution.

Cyber and physical security opex step changes

16. We consider that Transgrid should aim to achieve an AESCSF cyber security maturity level of SP-3 as soon as practicable. However, Transgrid has provided conflicting information about its progress with implementing the necessary activities to achieve SP-3.

17. For example, Transgrid provided information showing that it will take a further 2 years to go from [redacted] It claims to be progressing initiatives in the current RCP, yet also sought to justify delaying work on security enhancement into the next RCP based on what would be in effect 'just in time' compliance with anticipated legislative requirements. In doing so, Transgrid appears to have ignored the reality of the threat risks that are the drivers for those requirements. Whether Transgrid is, or should be, maintaining momentum in the current period, this should be factored into its requirements for the next RCP, which will be correspondingly less than Transgrid has proposed.

18. With regard to physical security Transgrid's proposed step change amount incorporates a significantly higher cost for external assurance-based activities than was contained in its internal business case, and which Transgrid did not adequately justify.

19. We consider that there is a degree of double counting inherent in Transgrid's 2022 Base Year opex, which already includes higher cyber security and physical security-related expenditure than the current period average from which Transgrid has estimated its 'additional requirement'.

20. We consider that Transgrid's estimate of the opex step change required in the next RCP is moderately over-stated and that the non-network ICT risks and obligations it faces should have or can be managed through a combination of:

    - For ICT cyber security, reducing the step change amount from $18.6m to $11.8m;
    - For OT cyber security, reducing the step change amount from $3.5m to $0.1m; and
    - For Physical security, reducing the step change amount from $2.8m to $0.6m.

1 INTRODUCTION

1.1 Purpose of this report

21. The purpose of this report is to provide the AER with an expert review of:
    i. The governance, management and forecast methodology that Transgrid claims to have applied in developing its capex forecast;
    ii. aspects of Transgrid's proposed capex forecast, as nominated by AER; and
    iii. a proposed security-related opex step change included in Transgrid's RP for the next RCP.
22. The assessment contained in this report is intended to assist the AER in its own analysis of the proposed capex and opex allowance as an input to its Draft Decision on Transgrid's revenue requirements for the next Regulatory Control Period (RCP).

1.2 Scope and approach

1.2.1 Scope of requested work

23. The AER is seeking an expert review of aspects of its capex and opex forecasts proposed to be included in Transgrid's transmission revenue allowance for the next Regulatory Control Period (RCP), and which was submitted to the AER in January 2022.[1]
24. The scope of this review will cover Transgrid's:
    - Governance, management and forecasting methods applied to its capex forecast;
    - Augmentation capital (augex) forecast excluding contingent and Network Capability Incentive Parameter Action Plan (NCIPAP);
    - Information Communications Technology (ICT) capex forecast; and
    - Proposed allowance for an opex step change for cyber and physical security.

1.2.2 Our approach

25. 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 an onsite review meeting with Transgrid, to ensure we correctly understood the methodology and assumptions being applied to the expenditure requirements; and
    - completed a top-down and bottom-up assessment of the expenditure forecast, including by reviewing a sample of projects to develop an overall opinion on the proposed capex categories within the scope of our review; and
    - documented our findings in a report.
26. We also provided feedback to AER staff on our preliminary findings in a teleconference, while drafting this report.
27. Our review considers the identification of systemic issues in the areas of governance and management and forecasting methodology. We assessed the implications of systemic issues identified to the proposed level of expenditure in accordance with the requirements of the National Electricity Rules (NER), specifically the capex criteria and capex objectives, and the AER's expenditure assessment guideline. In relation to our review of the proposed

[1] As described in the *RFQ_TransGridCapex2022* and subsequent advice received by email clarifying the scope of works

opex step change for cyber security we have assessed Transgrid's proposal against the opex criteria and opex objectives, and the AER's expenditure assessment guideline.

28. Where we found that forecast expenditure is not reasonable in terms of the NER, we have identified the extent to which the issues we have found have resulted in a higher level of expenditure that what would be required of a prudent and efficient service provider.

29. 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 NER

30. In undertaking our review, we have been cognisant of the relevant aspects of the NER under which the AER is required to make its determination.

Capex Objectives and Criteria

31. The most relevant aspects of the NER in this regard are the 'capital expenditure criteria' and the 'capital expenditure objectives.' Specifically, the AER must accept the Network Service Provider's (NSP's) capex proposal if it is satisfied that the capex proposal reasonably reflects the capital expenditure criteria, and these in turn reference the capital expenditure objectives.

32. We have taken particular note of the following aspects of the capex criteria and objectives:

- Drawing on the wording of the first and second capex criteria, our findings refer to efficient and prudent expenditure. We interpret this as encompassing the extent to which the need for a project or program has been prudently established and the extent to which the proposed solution can be considered to be an appropriately justified and efficient means for meeting that need;
- The capex criteria require that the forecast '*reasonably reflects'* the expenditure criteria and in the third criterion, we note the wording of a '*realistic expectation'* (emphasis added). In our review we have sought to allow for a margin as to what is considered reasonable and realistic, and we have formulated negative findings where we consider that a particular aspect is outside of those bounds;
- We note the wording '*meet or manage'* in the first capex objective (emphasis added), encompassing the need for the NSP to show that it has properly considered demand management and non-network options;
- We tend towards a strict interpretation of compliance (under the second capex objective), with the onus on the NSP to evidence specific compliance requirements rather than to infer them; and
- We note the word '*maintain'* in capex objectives 3 and 4 and, accordingly, we have sought evidence that the NSP has demonstrated that it has properly assessed the proposed expenditure as being required to reasonably maintain, as opposed to enhancing or diminishing, the aspects referred to in those objectives.

33. The NER's capex criteria and capex objectives are reproduced below.

Figure 1.1: NER capital expenditure criteria

NER capital expenditure criteria

(c) The AER must accept the forecast of required capital expenditure of a Transmission Network Service Provider that is included in a Revenue Proposal if the AER is satisfied that the total of the forecast capital expenditure for the regulatory control period reasonably reflects each of the following (capital expenditure criteria):

(1) subject to subparagraph (c)(2), accept the forecast of required capital expenditure of a Distribution Network Service Provider that is included in a building block proposal if the AER is satisfied that the total of the forecast capital expenditure for the regulatory control period reasonably reflects each of the following (the capital expenditure criteria):

(1) the efficient costs of achieving the capital expenditure objectives;

(2) the costs that a prudent operator would require to achieve the capital expenditure objectives; and

(3) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives.

Source: NER 6A.6.7(c) Forecast capital expenditure, v182

Figure 1.2: NER capital expenditure objectives

NER capital expenditure objectives

(a) A Revenue Proposal must include the total forecast capital expenditure for the relevant regulatory control period which the Transmission Network Service Provider considers is required in order to achieve each of the following (the capital expenditure objectives):

(1) meet or manage the expected demand for prescribed transmission services over that period;

(2) comply with all applicable regulatory obligations or requirements associated with the provision of prescribed transmission services;

(3) to the extent that there is no applicable regulatory obligation or requirement in relation to:

(i) the quality, reliability or security of supply of prescribed transmission services; or

(ii) the reliability or security of the transmission system through the supply of prescribed transmission services,

to the relevant extent:

(iii) maintain the quality, reliability and security of supply of prescribed transmission services; and

(iv) maintain the reliability and security of the transmission system through the supply of prescribed transmission services; and

(4) maintain the safety of the transmission system through the supply of prescribed transmission services.

Source: NER 6A.6.7(a) Forecast capital expenditure, v182

Opex Objectives and Criteria

34. The most relevant aspects of the NER in this regard are the 'operating expenditure criteria' and the 'operating expenditure objectives'. The NER's opex criteria and opex objectives are reproduced below.

Figure 1.3: NER operating expenditure criteria

> ***NER operating expenditure criteria***
>
> *(c) Subject to paragraph (c1), the AER must accept the forecast of required operating expenditure of a Transmission Network Service Provider that is included in a Revenue Proposal if the AER is satisfied that the total of the forecast operating expenditure for the regulatory control period reasonably reflects each of the following (the operating expenditure criteria):*
>
> *(1) the efficient costs of achieving the operating expenditure objectives;*
>
> *(2) the costs that a prudent operator would require to achieve the operating expenditure objectives; and*
>
> *(3) a realistic expectation of the demand forecast and cost inputs required to achieve the operating expenditure objectives.*

Source: NER 6A.6.6(c) Forecast operating expenditure, v182

Figure 1.4: NER operating expenditure objectives

> **NER operating expenditure objectives**
>
> *(a) A Revenue Proposal must include the total forecast operating expenditure for the relevant regulatory control period which the Transmission Network Service Provider considers is required in order to achieve each of the following (the operating expenditure objectives):*
>
> *(1) meet or manage the expected demand for prescribed transmission services over that period;*
>
> *(2) comply with all applicable regulatory obligations or requirements associated with the provision of prescribed transmission services;*
>
> *(3) to the extent that there is no applicable regulatory obligation or requirement in relation to:*
>
> *(i) the quality, reliability or security of supply of prescribed transmission services; or*
>
> *(ii) the reliability or security of the transmission system through the supply of prescribed transmission services,*
>
> *to the relevant extent:*
>
> *(iii) maintain the quality, reliability and security of supply of prescribed transmission services; and*
>
> *(iv) maintain the reliability and security of the transmission system through the supply of prescribed transmission services; and*
>
> *(4) maintain the safety of the transmission system through the supply of prescribed transmission services.*

Source: NER 6A.6.6(a) Forecast operating expenditure, v182

1.3 About this report

1.3.1 Report structure

35. Our main findings are summarised in the executive summary of this report.

36. The following sections of our report are structured as follows::

- In section 2, we present background information to provide context to our review;
- In section 3, we describe our assessment and findings on Transgrid's governance and management framework;
- In section 4, we describe our assessment and findings on Transgrid's expenditure forecasting methodology;
- In section 5, we describe our assessment of Transgrid's proposed augex allowance, and our findings on the prudency and efficiency of that allowance;
- In section 6, we describe our assessment of Transgrid's proposed ICT capex allowance, and our findings on the prudency and efficiency of that allowance; and
- In section 7, we describe our assessment of Transgrid's proposed allowance for an opex step change on the basis of additional cyber security and physical security obligations, and the reasonableness of including the proposed step change in Transgrid's opex allowance.

1.3.2 Information sources

37. We have examined relevant documents that Transgrid published and/or provided to AER in support of the areas of focus and projects that the AER has designated for review. Transgrid provided further information at virtual meetings and further documents in response to our information requests. These documents are referenced directly where they are relevant to our findings.

38. 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.

1.3.3 Presentation of expenditure amounts

39. Expenditure is presented in this report in $2023 real terms, to be consistent with Transgrid's RP unless stated otherwise. In some cases, we have converted to this basis from information provided by the business in other terms.[2]

40. While we have endeavoured to reconcile expenditure amounts presented in this report to source information, in some cases there may be discrepancies in source information provided to us and minor differences due to rounding. Any such discrepancies do not affect our findings.

[2] Where we have needed to convert cost information provided by the business from expenditure denominated in terms other than $2023, we have done so using a common index series that is what Transgrid has applied in its RIN.

2 BACKGROUND

2.1 Introduction

41. In this section, we provide an overview of Transgrid's capex forecast for the next RCP and we contrast this with an analysis of the corresponding expenditure in the current RCP for the elements of the expenditure forecast under review.

42. We provide a breakdown of the proposed capex for the categories of expenditure we have been asked to review, including for the proposed opex step changes included as part of our review in the remainder of our report.

2.2 Overview of proposed total capex

43. Transgrid has forecast total capex for the next RCP of $1,368.5m as shown in Table 2.1. As shown in the table, this figure excludes the pre-approved forecast capex for Project Energy Connect.

Table 2.1: Total capex for next RCP by year ($m real 2023)

Capex by category	2023-24	2024-25	2025-26	2026-27	2027-28	Total RCP
Repex	136.6	169.5	174.5	156.0	161.0	797.6
Augex	48.5	64.3	37.5	34.0	69.2	253.6
Non-network ICT	25.0	19.2	18.3	13.7	10.7	86.9
Non-network Other	15.8	15.7	13.5	14.0	12.6	109.7
Capitalised overheads	30.2	32.4	32.0	31.6	32.7	159.0
Sub-Total	**256.0**	**301.1**	**275.9**	**249.3**	**286.2**	**1,368.5**
Pre-approved Project Energy Connect	457.2	75.6	-	-	-	532.8
Total	**713.3**	**376.7**	**275.9**	**249.3**	**286.2**	**1,901.4**

Source: Transgrid 2023-28 Revenue Proposal, Table 8-2

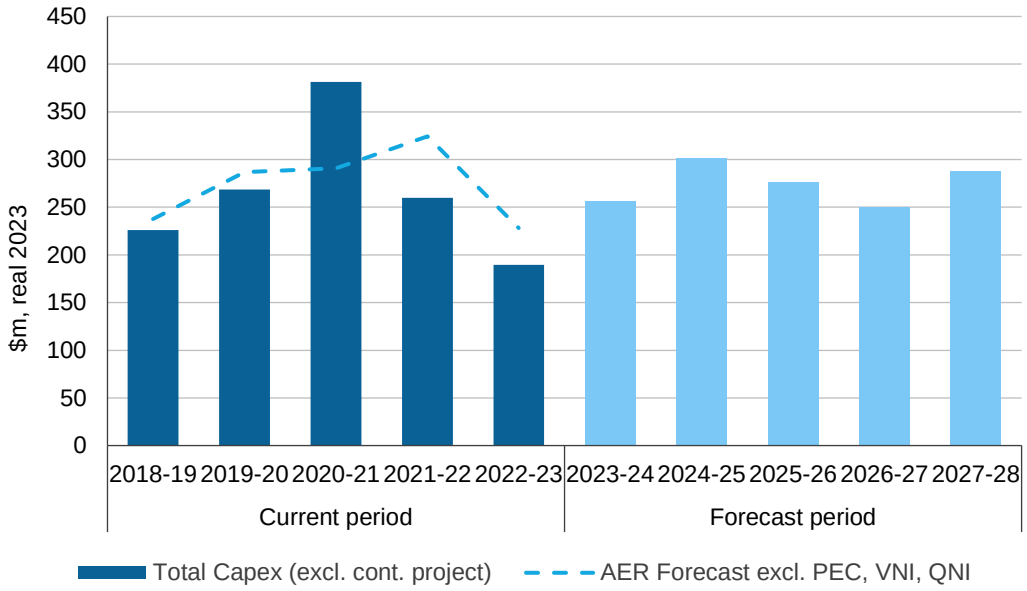
44. The forecast capex for the next RCP is $23.0m or 1.7 per cent higher than Transgrid has estimated it will incur in the current RCP (excluding expenditure on ISP Projects).

45. Transgrid states that the composition of its capex program is also changing in the next RCP, with 15 per cent of the forecast capex being to address localised maximum demand growth and 6 per cent to support 'energy transition'. This compares with only 1% and 0% in the current RCP, respectively.

2.3 EMCa observations on prior RCP trends and performance

46. In Figure 2.1, we show the comparison between Transgrid's actual/estimated capex for the current RCP and Transgrid's forecast capex for the next RCP. In this chart we have excluded the contingent projects of PEC, VNI and QNI. We observe that the forecast expenditure for the next RCP is in aggregate broadly similar to Transgrid's current RCP.

Figure 2.1: Total capex trend, as proposed excluding contingent projects ($m real 2023)



Source: AER

47. The capex expected to be incurred in the current RCP, including on ISP projects (VNI, QNI and Project Energy Connect), is $3,114.8m, representing an underspend of $564.0m against the allowance of $3,678.8m. Transgrid describes the reason for the underspend as a change in circumstances which has resulted in deferment of the scheduled project delivery date for Project Energy Connect to 2024–25 (i.e. the first year of the next RCP).

48. Transgrid has also advised that during the current RCP it has reprioritised its capex program and has implemented its capital efficiency program. We discuss the impact of these initiatives and the implications for forecast capex for the next RCP in subsequent sections of our report.

49. We note that Transgrid has claimed to have not included in its capex forecast:

- Costs associated with long-term impacts of the COVID-19 pandemic; nor
- Costs that it may incur to meet the 100 per cent renewables target by 2025.

50. Rather, Transgrid has indicated that it will propose either to include forecast costs, or a further cost pass through event, in its Revised Revenue Proposal associated with these costs.

51. Transgrid has identified potential costs for projects in accordance with AEMO's ISPs and the NSW Electricity Infrastructure Roadmap. Transgrid has not included costs of these projects in its expenditure forecasts, on the basis that:

- It will adhere to the NER automatic contingent project provisions for Actionable ISP projects and the EII Regulations for NSW Electricity Infrastructure Roadmap projects; and
- Due to the uncertainty associated with major augmentation projects, Transgrid has included many of its major transmission projects as contingent projects:[3]

  '...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.'

[3] Transgrid 2023-28 Revenue Proposal, page 163

2.4 Summary

52. Transgrid expects to incur a level of capex by the end of the current RCP consistent with its allowance, once adjustments are made to the timing of Project Energy Connect.

53. For the next RCP, the composition of the forecast capex has changed despite being similar in magnitude. However, when considered alongside ISP projects and NSW REZ projects, there is potential for $14billion of capital investment within the next 5 years in response to the energy transition. This is far in excess of the $1.9billion currently proposed in Transgrid's submission.

54. We have considered the impacts of the energy transition on Transgrid's forecast capex, and in particularly considerations of option value to ensure the right transmission investment projects proceed through the further regulatory and investment processes and are ultimately in the long-term interests of consumers. This helps to meet the regulatory objectives of ensuring that consumers do not end up paying the risk costs of transmission projects that are developed earlier than required or which become stranded or 'regretted' due to changes in the electricity market and the technologies deployed there.

3 REVIEW OF CAPEX GOVERNANCE AND MANAGEMENT FRAMEWORK

In this section, we provide an overview of the expenditure governance and management framework applied by Transgrid.

We consider that Transgrid has an effective governance and asset management system, that should when appropriately applied largely identify a reasonable capital forecast. However, we found evidence of some issues with the application of its governance framework associated with its portfolio optimisation, prioritisation and risk framework. Taken together, these are likely to have resulted in an overstatement of capex requirements.

More generally, an assessment of a prudent and efficient level of capex in accordance with the NER, is somewhat hindered by the lack of transparency of some of Transgrid's assumptions in its RP. This includes withholding some significant planned projects from its regulatory proposal for the draft determination, withholding inclusion of materials cost escalation for consideration in the draft determination and a lack of recognition of the likely impact of a number of 'mega projects' being considered outside of the current regulatory process, on Transgrid's ability to deliver the projects that it has included in its RP. Taken together, we consider that these factors are likely to result in Transgrid reassessing and reprioritizing some aspects of its proposed capex program.

The extent to which Transgrid's proposed expenditure allowances meet NER requirements is, in part, dependent on how its investment governance and management framework has been applied. For those expenditure forecasts that are within the scope of our review, we assess the extent to which they are likely to be prudent and efficient in subsequent sections of this report, by reference to the framework described in the current section.

3.1 Transgrid's capital expenditure governance

3.1.1 Investment governance framework

55. Transgrid describes its governance arrangements as being clear and accountable and refers to its Prescribed Network Capital Investment Process which sets out the process by which its investments are identified, evaluated and delivered. The process includes five steps to ensure a prudent and efficient investment portfolio that maintains the provision of prescribed network services.[4]

56. The five steps are:

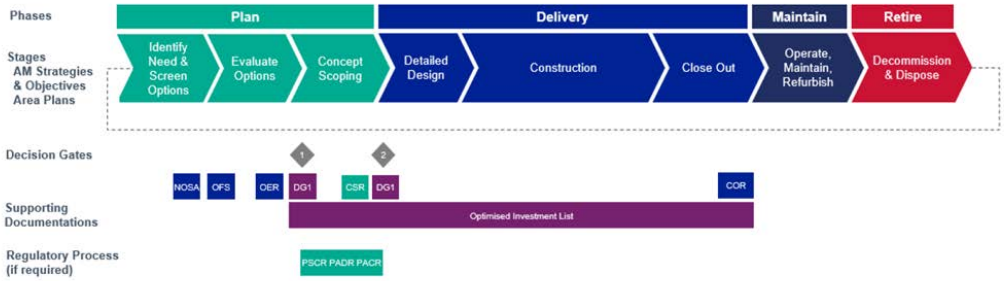
- Identify the need or opportunity.
- Evaluate options.
- Investment portfolio.
- Project approval and delivery.

[4] Transgrid, Expenditure forecasting methodology, page 5

- Project performance monitoring.

57. The framework includes documentation required to support each investment decision, and approval step in its process as outlined in Figure 3.1 below. Variations to the process are described that apply to contingent projects.

Figure 3.1: Asset lifecycle phases and stages



Source: Transgrid, Prescribed Network Capital Investment Process, Figure 1

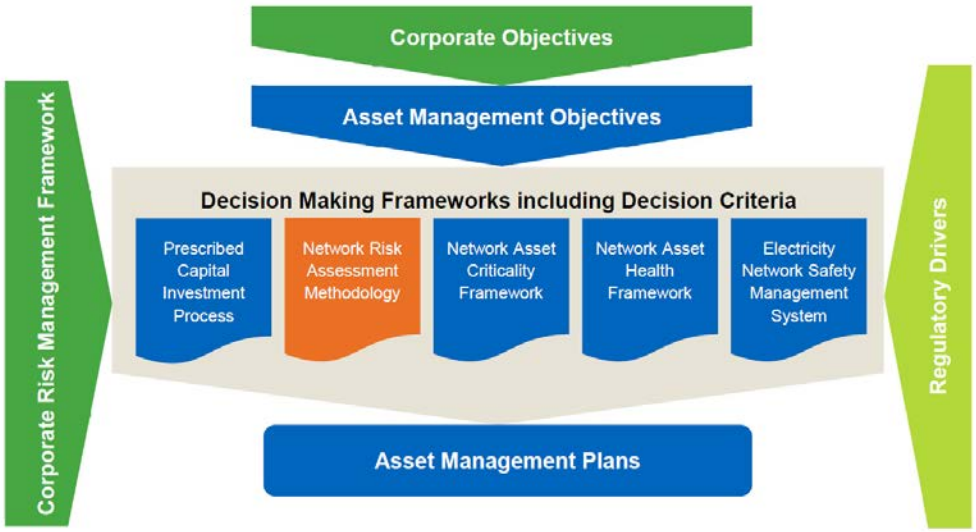
58. For ICT, Transgrid has an IT governance framework that requires investment decisions to pass through two internal decision gates to ensure delegated financial approval is applied and investment governance.

3.1.2 Risk assessment framework

59. Transgrid has a corporate risk framework that includes a risk appetite statement determined by the Board of Directors. It includes a threshold at which risk mitigating actions and plans must be put into place and requires risk registers to be developed and maintained on a regular cycle. The framework and approach are based on AS31000.

60. The framework includes a hierarchy of controls and governance arrangements for managing network risks includes the Network Risk Assessment methodology (NRAM) which Transgrid describes as forming the core of the network risk and investment analysis decision making framework. Further, that the analysis undertaken in accordance with the NRAM, is consistent with the requirements of its corporate Risk Management Framework and the international standard ISO 31000. This is shown in Figure 3.2 below.

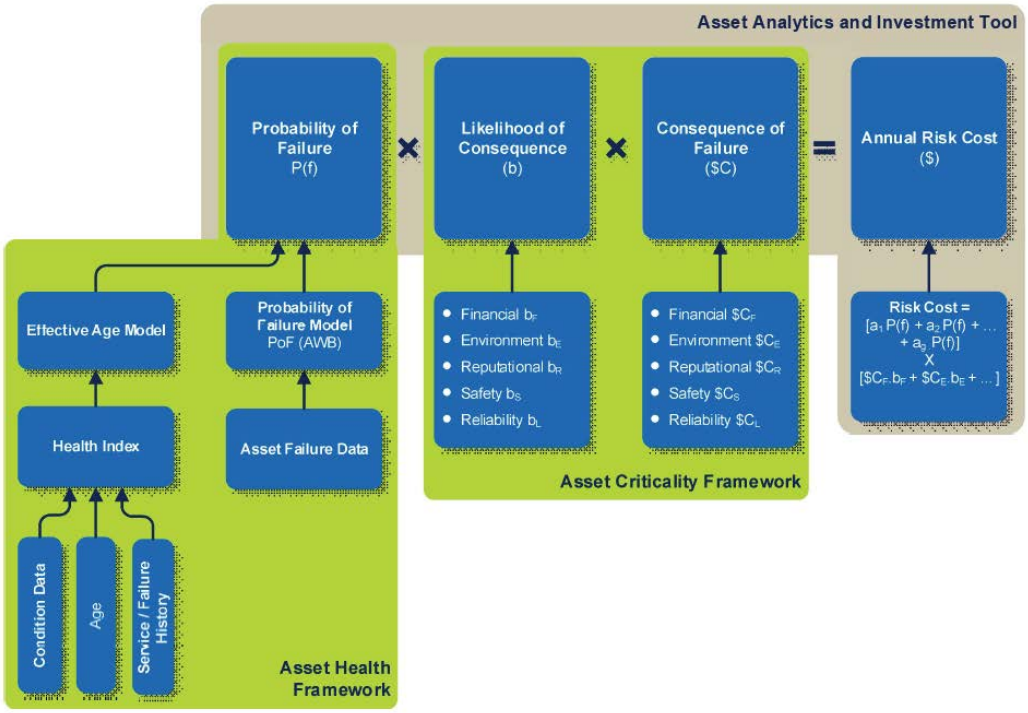
Figure 3.2: Decision framework and criteria



Source: Transgrid, Network Risk Assessment Methodology, Figure 1

61. A representation of the risk quantification methodology to determine its asset risk cost is provided in Figure 3.3 below. This includes the relationship to each of the framework documents which capture the relevant input assumptions.

Figure 3.3: Risk quantification methodology



Source: Transgrid, Network Risk Assessment Methodology, Figure 5

3.1.3 Asset management strategy

62. Transgrid has an overarching asset management strategy, and network vision for its transmission network that is informed by the risk management framework and Transgrid business plan. Transgrid states that its asset management strategy is consistent with ISO55001 and that it has achieved certification of its asset management system to this standard.

63. In its RP, Transgrid describes its key operational challenges as:[5]

- Safety, reliability and security – comprising response to ageing assets, addressing new obligations and climate driven extreme weather events;
- Rapid localised demand growth – comprising the regions of North West Slopes, central west NSW and western Sydney; and
- Energy transition – comprising response to more widespread network congestion, shortfalls in system strength and inertia, and decreasing minimum demand.

64. Transgrid describes the specific drivers for each of its expenditure categories in Table 8-4 of its RP. Transgrid states that its forecast capex for the next RCP:[6]

> *'…has also been guided by our customers' priorities, in terms of supporting the energy transition, meeting load growth, maintaining a safe reliable and secure supply and promoting technology and innovation, while maintaining affordability.'*

5 Transgrid, 2023-28 Revenue Proposal page 41

6 Transgrid, 2023-28 Revenue Proposal page 97

65. For ICT, Transgrid has an ICT strategy that outlines the drivers for investing in and managing information, communication and security technologies.[7] Due to the pace of technological change, Transgrid states that the ICT Strategy does not recommend specific solutions, but instead provides principles to prioritise resources and funding.

3.1.4 Portfolio optimisation

66. Transgrid includes optimisation procedures in its Prescribed Network Capital Investment Process. Optimisation is described as occurring in one of two ways: (i) by changes at the project and program level ('bottom up'), or (ii) at the portfolio level ('top down'), where:[8]

> *'In both cases, the optimisation process involves assessing the impacts on the relevant change(s) to projects, programs, and portfolios (captured in relevant change management document).'*

67. The process includes a step described as "investment optimisation/ prioritisation using AAIT[9] based on risk and benefit" and which occurs immediately prior to assembling the Optimised Investment List (OIL). The OIL is then submitted for Decision Gate 1 (DG1) approval and annual budget setting. We understand this step consolidates the information contained in the respective project OER documents relating to its repex and augex needs.

3.2 Our assessment

3.2.1 Investment governance

Transgrid has applied a range of improvements since its submission for the current RCP

68. As part of its RP for 2018-2023, Transgrid made a number of statements pertaining to transformation of its investment framework and asset management strategies.[10] These statements referred to a number of improvements to the risk assessment, quantification, area planning and top-down assessment methods.

69. We observed similar statements in the RP for 2023-28. We looked for evidence of the outcomes of the improvements claimed by Transgrid, and the impact of the changes to the forecast capex.

70. Transgrid describes its efforts as part of:[11]

> *'...a multi-phased transformation program aimed at ensuring our increased capital work program maximises capital efficiency and improves the end-to-end capital delivery processes.'*

71. We asked Transgrid for evidence of the capital efficiency and operating model improvement initiatives it had referred to in the RP. [redacted][12]

7 Transgrid, ICT strategy

8 Transgrid, Prescribed Network Capital Investment Process, page 35

9 Asset Analytics and Insights Tool

10 Transgrid, Revenue Proposal 18/19 to 22/23 – January 2017, page 62

11 Transgrid, 2023-28 Revenue Proposal page 55

12 Transgrid response to information request IR022, Question 5

72. [redacted]

73. Transgrid has continued to make improvements to its capital governance framework and processes, including to address feedback from the AER, and it has realised capex efficiency savings from its efforts. We expect that Transgrid's cost estimates have captured these cost efficiencies because its cost estimation methodology is based on historical averages of contract and material costs.

74. We review the detail of the changes made to its governance framework and implications to the capex forecast in subsequent sections.

Investment decisions continue to be managed differently for network and non-network

75. Transgrid states that it applies its Prescribed Network Capital Investment Process:[14]

> *'…to determine our forecast capex for all categories of capex.'*

76. The Prescribed Network Capital Investment Process[15] clearly states that the process relates to network investments only, and accordingly a different process is applied for non-network investments including IT, property and fleet. For example, Transgrid applies its IT Governance Framework for IT investments.

77. We therefore looked for evidence of a robust governance process that applied to the non-network capex. We found that Transgrid has in place reasonable governance arrangements as described in its expenditure overview documents. We considered the effectiveness of these arrangements in our review of the non-network expenditure category we have been asked to review.

78. Whilst the governance process differs between network and non-network capex, Transgrid considers that it has been modelled on similar requirements. In our review, we observed a different level of rigour associated with investment justification and top-down review across network and non-network capex.

Expenditure trend suggests a bias to managing to regulatory period boundaries

79. Based on the observations included in section 2 of this report, it appears that Transgrid is managing to its capex allowance, within the RCP boundaries. We observe a material reduction in capex expected to be incurred during the latter years of the current RCP and proposed significant step-increases at the beginning of the next RCP for some categories. We consider that managing to RCP boundaries, rather than determining an optimal level and timing of expenditure, and/or managing to a capex allowance rather than to investment need, is not consistent with the NER capex objectives nor does it represent good industry practice.

3.2.2 Risk assessment

Changes introduced in response to feedback

80. In response to feedback provided as part of the determination of the current RCP, Transgrid has updated its decision-making frameworks with a view to preventing overstatement of the estimation of risks comprising:

- Network Risk Assessment Methodology;
- Network Asset Health Framework; and
- Network Asset Criticality Framework; and associated modelling changes.[16]

13 [redacted]

14 Transgrid, Expenditure forecasting methodology, page 13

15 Transgrid, Prescribed Network Capital Investment Process

16 Including references to changes made to its criticality modelling included in the Network Asset Strategy, page 42

81. The description of the enhancements is summarised in Table 3.1.

Table 3.1: Summary of enhancements to the network asset criticality modelling

Enhancement	Description of enhancement by Transgrid
Reliability and Market Constraints	Inclusion of DNSP restorative switching.
	Outlier removal of repair time, assigning capped nominal asset repair time.
	Applying Multiple Demand Scenarios, using a weighted average of the ten potential demand scenarios according to the respective probability of the demand.
	Simulating the Impact of Market Constraints, to reflect the market response where generation patterns and interconnector flows are adjusted to minimise the extent to which overloads and under-voltages occur.
Bushfire consequence	Development of a bushfire consequence model by University of Melbourne. Model is based on the IGNIS project works completed by the Bushfire and Natural Hazards CRC in conjunction with Energy Networks Australia. The fire propagation model was carried out using the Phoenix RapidFire simulator. Multiple improvements to risk estimation are discussed arising from this model.
Worker Safety consequence	Development of a Worker Safety consequence model. Multiple improvements to risk estimation are discussed arising from this model.
Public Safety consequence	Development of a Public Safety consequence model. Multiple improvements to risk estimation are discussed arising from this model.
VSL	Reduced the value of a statistical life from $10m to $5m in alignment with Australian Government Best Practice Regulation Guidance

Source: Response to information request IR015, Transgrid IR015 Transgrid response for capex 20220510 Confidential, question 6

82. In general, we consider the development of consequence models by working with academics and industry is a positive advancement of risk definition and assessment. Transgrid also stated that it has undertaken external reviews of its risk assessment methods and inputs, and we would expect these to provide further confidence in the robustness of the methods described.

83. We have sought evidence of these changes in our review of the governance related documents. We also looked for evidence of the application of these changes in the expenditure that we have been asked to review, and which is discussed in subsequent sections of this report.

Outputs of the bushfire consequence model requires further validation

84. The 2019-20 bushfire season was unprecedented in NSW and the impact on human life and property damage has been well documented.[17] This included damage to 999km of transmission line route length and 2,681 transmission line structures in bushfire impacted zones.[18]

85. We understand that Transgrid has developed safety, bushfire, and reliability consequence models as a part of its asset risk criticality framework. In our opinion, development of consequence models based on reputable sources of risk information and third-party analysis represents an improvement on its previous approach to estimating the cost of bushfire consequences for the purpose of assessing proposed network investments. We requested copies of the outcomes of these reviews to ascertain the robustness of the methods being proposed by Transgrid.

17 GHD, Bushfire Cost Pass Though Application – Independent Verification and Assessment for TransGrid, Nov 2000

18 Transgrid 2023-28 Revenue Proposal, page 62

86. Transgrid referred us to a technical assurance review of key proposal inputs, tools and processes underpinning the proposed repex forecast,[19] and a report on its bushfire consequence modelling.[20]

87. The reviews did not provide an adequate assessment of the outcome of the bushfire consequence model. For example, neither review included specific reference to having reviewed the model, or the outcomes arising from it either from a bottom-up perspective (e.g. review of reasonableness of results for specific bushfire risk locations) or from a top-down perspective (e.g. reasonableness of network-wide risk and consequence values, and relationship to historical bushfire related costs).

88. Notwithstanding the above, we have based our assessment of the capex governance and management framework and forecasting methods on the bushfire consequence modelling results provided by Transgrid. The model generates a risk cost expressed as dollar value consequence for each structure of a transmission line including:[21]

- Loss of life, as a function of house loss and the statistical value of life;[22]
- Loss of houses in the modelled burn area and the economic value of a house;
- Loss of agricultural (crops, vineyards) and plantation in the modelled burn area and associated economic value;
- [redacted]

89. [redacted]

90. We were not able to determine how sensitive the model is to each of the parameters, to ascertain the significance of the non-safety (non-loss of life) variables to the calculation of bushfire risk cost.

Risk assessment methods vary

91. Transgrid states that its NRAM is the guiding document for management of risk within the Asset Management System, and that:[24]

> *'This framework is applied to in-service assets and replacement evaluation but may be applied to other assets such as augmentation as deemed necessary'*

92. Much of the document is focussed on its application of asset replacement decisions. For augex, the risk assessment is primarily associated with determination of Energy at Risk, and which is valued at Value of Customer Reliability (VCR). We discuss the application of the methods for repex and augex further below.

---

19 Aurecon, 2023-28 Repex Proposal Technical Assurance Report, Jan 2022, Transgrid-IR022-Aurecon-Repex 2023-28 Proposal Technical Assurance Report-20220113-CONFIDENTIAL

20 University of Melbourne, draft final report on the project bushfire consequence modelling for TransGrid, December 2020, Transgrid-IR022-TG_BushfireConsequenceModellingforTransGrid_Report_Final-20220523-Confidential

21 Transgrid Network Asset Criticality Framework, page 35

22 Based on a value of $4.5m, and which is lower than the VoSL that has been stated in other sources of information. The report notes that this value can be changed in the model.

23 [redacted]

24 Transgrid, Network Asset Risk Assessment Methodology, page 5

93. For non-network ICT, the risk assessment utilises the Transgrid risk management framework. Transgrid states that risk modelling for its non-network ICT provides:[25]

> *'...moderated, expected risks which are then used in economic evaluation assessments to justify our ICT forecast.'*

94. Transgrid describes the proposed non-network IT forecast as aligning with its corporate policies, frameworks and management systems, supported by the (i) ICT strategy, (ii) IT and security frameworks, and (iii) Options Evaluation Reports (OERs).[26] However, we did not find a clear link between Transgrid's corporate risk management framework, ICT strategy, and risk modelling.

95. The expenditure profile evident in the current RCP, also highlights a further inconsistency with long term asset management of ICT assets.

Selection of VCR may lead to overstatement of the benefits

96. Whilst the VCR that Transgrid applies is based on the latest AER report,[27] it also states that it applies a weighted average VCR of the customers impacted.

97. In response to our request to describe the justification for the selection of VCR assumptions applied in the modelling of Augex and Repex, Transgrid states:[28]

> *'The NSW state-wide VCR value of $42.12/kwh (AER Final VCR report in Dec 2019) plus escalation is used in the Augex project economic assessments. The methods used to categorise the distribution load supplied by each BSP to the segments as defined in the AER VCR report are not accurately available from DNSPs. We believe the state-wide VCR value is the most suitable value for Augex projects. This is consistent with the approach used in market modelling for ISP projects which uses the state-wide VCR value.*
>
> *In modelling repex, the distribution connected VCR of $45.06/kWh is applied to assets whose failure interrupts distribution connected load, and the transmission connected VCR of $26.44/kWh to assets whose failure interrupts transmission connected load, in accordance with the AER VCR review 2019.'*

98. We also requested that Transgrid describes the approach(es) applied for allocating a weighted VCR in its analysis as referred to in the Network Asset Criticality Framework, and as recommended in the AER VCR review 2019. In its response Transgrid repeated the above response and did not confirm application of a load weighted VCR as nominated in its governance documents.

99. We looked for evidence of the application of VCR in the expenditure areas we have been asked to review. For augex, we observe a state-wide VCR value being applied, and we have assessed the appropriateness of this value and the sensitivity analysis applied in our assessment of proposed augex.

Application of VCR for demand driven augex

100. We also observed that Transgrid had applied an energy at risk calculation valued at VCR to determine the benefit of connecting new loads. In its Augex Overview Paper, Transgrid states:[29]

> *'The risk-costs and benefit associated with the unserved energy is valued at the VCR released in AER's VCR review in December 2019. This provides expected quantified*

25 Transgrid, Non-network ICT overview paper, page 32

26 Transgrid, Non-network ICT overview paper,

27 AER, Values of Customer Reliability: Final report on VCR values, 2019

28 Transgrid's response to information request AER IR015, question 14

29 Transgrid, Augex Overview Paper – 31 Jan 2022, page 60

risks which are then used in economic evaluation assessments to justify our Augex forecast.'

101. We acknowledge that Transgrid has an obligation under the NER to ensure that it complies with the performance standards nominated in the NER for the connection of new loads, however we consider this method of valuing the benefit is likely to grossly inflate the benefits. VCR was designed for determining the value of short-term interruptions, and not valuing the benefits to society of connecting new loads or industries, or the cost of failing to connect them. In these cases, determination of benefits using Gross Domestic Product (GDP) or similar may be a more appropriate measure of benefit.

102. Independent of the valuation method applied for the augex projects proposed, the benefits from connecting new loads are likely to be sufficiently positive, and to do so is a requirement under the Rules.

103. For growth projects Transgrid has used its Net Present Value (NPV) analysis, including the VCR of not supplying new loads, to compare options. With purported benefits of many billions of dollars (relative to a counterfactual of failing to supply the loads), Transgrid has taken the approach of artificially terminating the inclusion of such benefits after a few years so as not to swamp the NPV differences between the options. Where the options would materially provide the same level of reliability of supply of the new loads, we consider that a 'least net present cost' approach would achieve the same objective of identifying the preferred option and would provide more meaningful option selection information.

104. Where the application of VCR results in an overstatement of the benefits in the proposed expenditure by Transgrid, we comment on this in our augex assessment section. However, we make the general observation that it is not necessary to rely on the quantum of such benefits to justify growth projects, and therefore the apparent overstatement of benefits does not in itself render the project justification invalid.

General observations on Transgrid's application of an ALARP test

105. An important aspect of achieving a level of risk that is ALARP requires an assessment of the response to an unacceptable safety and health hazard that it is reasonably practicable to implement. The determination of what is reasonably practicable, being a narrower term than physically possible, is typically undertaken by applying an economic test. The level of expenditure to achieve ALARP is then determined as being justified up to the point that the expenditure would be 'grossly disproportionate' to the benefits, where the benefit is typically measured as the avoided risk. This is an objective test and requires substantiation using relevant good practice, industry practice and consumer and community preferences. The onus remains on the NSP to justify the application of ALARP, and the input assumptions it has relied upon in making its assessment.

106. Determining the level of expenditure that may be considered grossly disproportionate can be achieved by the application of disproportionality factors (or multipliers) to the assessment of health and safety risk. Disproportionality factors assist account for the higher value benefit attributed by the community to mitigating safety and health risks, and which in turn may justify higher levels of expenditure being incurred to achieve ALARP risk reductions.

107. In its NRAM, Transgrid states that its determination of ALARP, which it also refers to as the disproportionality test, forms part of its cost benefit analysis. Transgrid describes the components of its cost benefit analysis as: [30]

'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.'

[30] Transgrid, Network Asset Risk Assessment Methodology, page 18

108. It is appropriate for Transgrid to use the difference between the pre- and post-investment risk cost as the basis for the calculation of benefit for the purposes of the NPV analysis. However, as noted in our assessment below, Transgrid appears to apply its disproportionality multipliers to the total environmental consequence, and not limiting this to the safety and health related consequence.

109. We also observed evidence that Transgrid had separately applied an ALARP test by comparing the difference in pre- and post-risk costs (including the disproportionality multiplier) at the year following the optimal investment year and comparing with the annualised capex. Again, the application of the disproportionality multiplier to non-safety and health related benefits (associated with environmental risk) results in inflating the benefits for the purposes of the ALARP test for relevant projects.

Transgrid's application of disproportionality factors may lead to overstatement of the benefits

110. In its Final Decision for the 2018-23 RCP, the AER considered that Transgrid's application of disproportionality multipliers[31] to worst case consequence is likely to overstate risks. Further, AER considered that Transgrid's selection of disproportionality factors was not sufficiently supported. We therefore looked for evidence of how Transgrid had made adjustments to its methodology in response to this feedback, as a part of development of its repex forecast for the next RCP.

111. Transgrid summarises the disproportionality multipliers in its NRAM.[32] In relation to the bushfire related safety risks, Transgrid considers bushfire risk as a part of the environmental risk category and applies disproportionality multipliers as shown in Table 3.2.

Table 3.2: 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's 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 will have the risk outcomes halved in performing risk analysis.

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

112. We observe that Transgrid applies disproportionality multipliers to non-safety related consequences for environmental risk, 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 damage from bushfires) by assigning a disproportionality multiplier of 3.

31 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.

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

113. We consider that the use of disproportionality factors is intended to form part of an assessment of safety and health risk, and primarily to support investment in projects to mitigate safety and health risk that 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[33] on which the Australian Standards AS5577 was based, and previous AER guidance.[34]

114. Transgrid has defined network safety, being a term referred to in AS5577, as including property damage: [35]

> *'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.'*

115. Transgrid also claims that its selection of consequences included in its assessment, and specifically to include consideration of damage to property and the environment, align with the requirements of AS5577 where it states:[36]

> *'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).'*

116. 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.[37] 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 for applying disproportionality multipliers to property damage or to other environmental damage arising from bushfires.

117. We also observe a difference between Transgrid's approach and the requirements outlined in the 2019 AER industry practice note, which we consider requires that the application of disproportionality multipliers is to the safety consequence cost, which in turn is determined using the Value of Statistical Life (VoSL) as follows (emphasis added by EMCa):[38]

> *'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****.'*
>
> *'To demonstrate that the expenditure would be grossly disproportionate, it is common to apply disproportionality factors to the determination of risk cost to demonstrate that the requirements of ALARP have been met. These factors are intended to account for the inherent uncertainty in the variables involved in the risk analysis and represent the principle of prudent avoidance, while higher values of disproportionality factors seek to account for societal dread associated with more extreme events (e.g. multiple fatalities, or socially offensive outcomes).'*
>
> *'The selection of disproportionality factors and the method by which these are applied varies depending on the specific circumstances and nature of hazards being assessed.*

33 HSE website

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

35 Transgrid, Network Risk Assessment Methodology page 6

36 Transgrid, Network Risk Assessment Methodology page 18

37 AS 5577-2013 Electricity network safety management systems

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

***A simplified application of disproportionality may be achieved by applying the disproportionality factor to the calculation of the relevant consequence cost to essentially scale the expected value of statistical life within a simplified risk cost formula**. A further consideration is that **disproportionality factors may vary between workers and the general public**. This acknowledges differences that exist between trained staff engaged in a system of work compared with the general public.'*

118. 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):[39, 40]

'- 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 Royal Commission into National Disaster Arrangements.'

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

120. 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. Application of disproportionality multipliers in this way may result in inflating the benefits attributed to safety-driven investments where these investments also include non-safety-related benefits. A full review of the repex forecast would need to be undertaken, and detailed enquiry of these tests to ascertain whether Transgrid's wider application of disproportionality multipliers has led to an overestimate of a prudent and efficient level of such repex. This is beyond our scope of work.

121. We consider it incorrect that Transgrid and its consultant (in its Technical Assurance Report[41]) claim that Transgrid's approach is aligned with the AER industry practice note.

Transgrid's claim that application of DFs to risks other than safety was endorsed by EMCa is misleading

122. In its response to a request for information from the AER (per IR02) to explain the basis for the disproportionality factors that it has applied, Transgrid states:

'These factors for safety, bushfire and reliability have remained unchanged from the AERs 2018-2023 determination where EMCa found that Transgrid satisfactorily demonstrated that the disproportionality multipliers are appropriate for determining whether the cost of risk mitigation is disproportional to the benefit or not (refer paragraph 149 of EMCa – Review of aspects of Transgrid's forecast capital expenditure – June 2017).'

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39 Transgrid's response to information request, AER IR002 Question 4

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

123. In our 2017 report, we conclude that Transgrid's application of the SFAIRP/ALARP[42] test overstated the risk cost. We reproduced the disproportionality multipliers used by Transgrid, which at the time we had understood applied to the calculation of network safety risk and were based on the determination of a safety risk consequence to Transgrid staff and/or members of the public.

124. Transgrid excluded a key sentence from the assessment included in our report in its claim, and which we reproduce here in full:[43]

> *'TransGrid has provided its rationale for the use of the disproportionality multipliers, based primarily on work undertaken by the Health & Safety Executive (HSE) UK. We consider that TransGrid has satisfactorily demonstrated that the disproportionality multipliers are appropriate for determining whether the cost of risk mitigation is disproportional to the benefit or not. However, we have not seen sufficient evidence to conclude these multipliers are not already considered in its selection of the worst-case consequence costs it has used in its analysis, and therefore are likely to result in a bias to over-state the level of risk.'*

125. These statements confirm that the ALARP methodology and the type of disproportionality multipliers used by Transgrid are reasonable insofar as they relate to mitigation of safety risks. We arrived at this view after consideration of industry practice available at that time, and which pre-dated the AER's industry practice note. We also reviewed the basis for Transgrid's determination of the VoSL in determining its safety consequence, to which its disproportionality multipliers were applied.

126. Our review did not conclude that the application of the disproportionality factors to other risks was reasonable as Transgrid has claimed. Our conclusions can be summarised as being based on the following factors:

- We relied on information provided by Transgrid that the disproportionality multipliers were applied for the purpose of determining safety risk, where the safety risk consequence was determined using the VoSL and not to other non-health and safety related risks as now appears to be the case; and
- We noted the absence of sufficiently compelling information to determine that the consequence values assumed by Transgrid did not already include application of a disproportionality multiplier.

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

127. 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.'*

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

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42 So Far As Is Reasonably Practicable / As Low As Reasonably Practicable

43 EMCa, Review of aspects of Transgrid's forecast capital expenditure, June 2017, para 149

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

Assessment of the change in portfolio risk is limited by available information

129. As an alternative means to assess the change in portfolio risk, we requested that Transgrid provide a summary of the predicted pre- and post- investment risk levels included in the proposed capital program. Transgrid stated:[45]

> *'Network risk reduction primarily relates to repex investments. The pre- and post-investment risk levels for the repex portfolio, as assessed in the relevant year of optimal timing for each the projects, are $285.9 million and $24.3 million respectively.'*

130. We were not provided the source information or list of projects to review this information. As presented by Transgrid, the stated risk reduction (in the year of investment) corresponds to a proposed repex program of $797.6 million.[46] We are unable to ascertain the reasonableness of this capex program based on these figures, as the timing of the risk reduction and corresponding investment is critical. We suggest that an assessment of the assumed risk reduction by program and in aggregate is undertaken as a part of the review of Transgrid's proposed repex.

3.2.3 Asset management

Asset Management policy and asset management system are limited to network assets

131. Transgrid's asset management system and policy related to network assets only. The Asset Management Policy applies to all assets as described in the Asset Management System Description document. As a result, the series of committees it describes as providing strategic governance, asset management, change management, and continuous improvement through defect identification and rectification are similarly limited to application in relation to network assets, excluding property, facilities, fleet and IT.

132. For non-network assets, Transgrid has alternate governance arrangements to monitor and control key information technology capability decisions. The IT Portfolio is governed by the IT Portfolio Board, made up of senior managers across the various business units impacted by IT projects as well as IT senior management. This is captured in a separate IT governance framework document.[47]

Asset management strategy is reasonable

133. We consider that Transgrid has established an asset management strategy and supporting elements that are consistent with good industry practice for management of its network assets.

134. We consider the application of Transgrid's asset management strategy and framework to the capital forecast in our review of the expenditure categories we have been asked to review in subsequent sections of this report.

Asset management framework changes

135. In relation to the current period, Transgrid's Network Asset Strategy states that Transgrid's Asset Management System has:[48]

> *'...delivered improved capital management and operational cost efficiencies and improved network risk management.'*

136. We asked Transgrid to explain the efficiencies, which we understand are primarily associated with improving confidence in Transgrid's 2023-2028 forecast and its ability to meet service level objectives. Transgrid's outline of the changes is presented in Table 3.3.

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45 Transgrid's response to information request AER IR015, Question 12

46 Transgrid, 2023-28 Revenue Proposal, page 92

47 Transgrid, IT Governance Framework

48 Transgrid, Network Asset Strategy, page 14

Table 3.3: Summary of changes to capital management, operational cost efficiencies and improved network risk management as described by Transgrid

Transgrid's change	Transgrid's description
More granular risk assessments and lower underlying risk values	The more granular risk assessment leads to better targeted replacement programs ensuring the highest assets and components are addressed first.
Improved top down challenge through stronger deliverability, optimisation and trend review	The improved top down challenge has ensured that the interests of consumers and other stakeholders around (sic) are strongly integrated into the portfolio build up process.
Reviewed processes against the AER Planning Guidelines resulting in closing all gaps with respect to that methodology	Using optimal timing as the basis for our unconstrained program means that the deliverability review can use the most accurate needs date for each investment as a starting point.
Aligned NPV analysis and assumptions in our Options Evaluations Reports with all available RIT-T guidance	NPV methodology updated in line with recent decision and current parameters in better alignment with our published RIT-T and ensure consistency and transparency in our customer engagement.
Improvement in asset condition data collection feeding asset health calculations	Improvements in asset data give additional confidence to our failure modelling and the probabilities used to determine risk and optimal timing.
Reassessment of our asset strategies with respect to the changing environment	The re-assessment of our strategies gives us confidence that we renewing/replacing assets with the most appropriate solution to achieve sustainable outcomes.
Continued to trial new technologies as appropriate – for example high resolution and multi-spectrum aerial imagery for our transmission lines	This has ensured that all potential condition issues are accurately identified for further sampling and testing. This results in more accurate health and failure modelling.

Source: Response to information request IR015, Transgrid IR015 Transgrid response for capex 20220510 Confidential, question 5

137. In addition, Transgrid has made further enhancements as described in its Network Asset Strategy as part of its continuous improvement of the Asset Management System.[49] Transgrid describes the benefit of the associated initiatives as enhancing its understanding of risks and investments and improving confidence that the proposed capital expenditure addresses the identified needs. We have looked for evidence of these changes, and the claimed benefits in the areas we have reviewed.

Transgrid appears to have taken account of service outcome measures

138. Transgrid has developed and reports against a suite of outcome measures from its capex portfolio across the dimensions of network risk, safety and reliability. For network risk, Transgrid has introduced a measure of total network risk in the form of a 'risk index'. Transgrid describes the risk index as:[50]

> *'…a multi-dimensional measure for safety, environmental, bushfire and reliability risk. The risk index is the sum of the residual risk of each individual asset, which is then baselined, so that we can monitor relative changes in network risk over time.'*

139. The network risk index has been developed to track the change in risk in the major asset classes over time. It includes asset types where full portfolio risk modelling is available and relates to repex only.[51]

49 Transgrid's response to information request IR015, Question 8

50 Transgrid, 2023-28 Revenue Proposal, page 58

51 Transgrid's response to information request IR015, Question 9

140. The current performance indicates that Transgrid expects to maintain the network risk in line with the risk index at the start of the regulatory period. We were not provided with a forecast of the risk index for the next RCP to review against the proposed repex. We consider that assessment of the repex forecast should take account of the forecast changes to the risk index.

Area plans not provided for review

141. We asked Transgrid to explain how the proposed and related investments align with the strategic development plan for the areas, using project-specific details to aid in our understanding of the need in the context of the longer-term outlook and area strategy. We were directed to Transgrid's OER documents, and then to the OFS documents. We were not provided with area plans or strategies to understand the relationship between projects, selection of options and prioritisation of network projects relative to other related network projects.

142. On review of the Transgrid network planning framework, area plans are listed as part of Transgrid's mandatory documentation in horizon 1,[52] separate to the publication of Transgrid's TAPR, and which covers:[53]

- *'Current, committed, and proposed development to the whole NSW transmission network*
- *Input from generators, TNSPS, and load customers*
- *Input from asset management strategy and objectives'*

143. We are not aware of why these were not provided to us to assist with our review. However, we were able to ascertain sufficient information pertaining to related projects from our requests for information and assessment of project level documentation.

IT strategy and identified programs of work do not appear sufficiently linked

144. For its IT assets, Transgrid has a reasonable ICT strategy and provides a framework for managing its ICT portfolio. In response to our request for information, we were provided with the IT Renewal and Maintenance Strategy. The purpose of the strategy is to:[54]

> *'..define the renewal, disposal, and maintenance strategies for TransGrid's Information Technology assets and associated facilities. In doing this it applies the overarching IT Strategy and objectives, and relevant Lifecycle Strategies.'*

145. The strategy document outlines the drivers and focus of the strategy by comparing the activities at an IT sub-class level between the current RCP and next RCP, however detail of individual programs was not included nor the relationship with the changing emphasis of priority of the program.

146. We subsequently looked for evidence of the relationship between the strategies, drivers and the proposed scope and timing of the programs included for the next RCP and describe that in our assessment of the proposed ICT capex.

3.2.4 Portfolio optimisation

The importance of portfolio review and optimisation is recognised

147. In our experience, expenditure forecasts based on bottom-up aggregation of the activity at the project/program level without rigorous 'top-down challenge' overstates the actual expenditure required. Transgrid states that it has improved its portfolio optimisation, such that it has identified opportunities to optimise investments between repex and augex.

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52 Horizon 1 refers to the 0 – 7 year planning period

53 Transgrid Network planning framework, page16 provided in response to information request AER IR015

54 Transgrid, IT Renewal and Maintenance Strategy, page 3

Transgrid considers that its top-down assessment methods are more likely to result in a prudent level of expenditure.

148. In its expenditure forecasting methodology, Transgrid states that:[55]

> *'Once we establish the portfolio of network investments and the timing of these investments, which make up our proposed forecast, we review the portfolio for optimisation opportunities. This includes considering the deliverability of the portfolio, appropriate scheduling and bundling of works, and any overlap between Augex and Repex projects to ensure the portfolio represents an efficient forecast of our expenditure.*
>
> *We rank our investments based on their NPV, whether they address a compliance obligation, the network safety risk they mitigate and the consumer benefit (opportunity) they provide. We use this ranking to assess expenditure scenarios and the resultant impact on asset and network risk profiles. This portfolio optimisation process ensures that we maximise the benefit that we deliver to our customers.'*

149. At a total portfolio level, we reviewed the steps and the outcome of the review process described to us.

Optimisation occurs primarily within categories, and not across the portfolio

150. We found evidence of processes designed to allow Transgrid to optimise the portfolio of capex projects and also to defer projects where required. On closer review, the optimisation occurs primarily within categories of capex and across augex/repex and does not appear to be undertaken across the entire capex portfolio, including non-network capex.

151. A key output of the investment governance process is the Optimised Investment List (OIL). Transgrid describes this as comprising a list of projects and programs (including costs, risks, benefits, and timing). We requested a copy of the OIL to determine how it was used by Transgrid and its relevance to assist in reviewing the forecast capex for the next RCP. We determined that the OIL comprises augex, repex and NCIPAP projects only for FY22 and FY23, and constitutes DG1 approval for new projects and programs to commence design and development works.[56]

152. Transgrid also states that it has adjusted the forecast capex for individual needs / projects (as documented in its OER documents) through a combination of:[57] (i) changing the preferred option to include a lower cost option in the forecast; (ii) phasing of projects to meet deliverability requirements; (iii) deferral of lower priority replacement projects; and (iv) amending the scope to remove overlaps between augex and repex. We understand that the methods that Transgrid has applied as a part of its optimisation process, and which are reflected in adjustments to its forecast, relate primarily to its repex forecast.

153. Transgrid also describes a portfolio optimisation process for IT:[58]

> *'We take a whole-of-portfolio view of the information technology risk, ranking the projects in our forecast ICT program to optimise the portfolio to:*
>
> – *deliver technology solutions that support the optimisation of network investments*
> – *ensure consistency with historical investments, and*
> – *smooth the investment profile to consider deliverability and financial impacts*.'

154. In relation to each package of work, Transgrid states that:[59]

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55 Transgrid, Expenditure forecasting methodology, page 17

56 Transgrid's response to information request AER IR015, Transgrid-IR015-AMI - AAI - 2021-001 - FY22 and FY23 Optimised Investment List Final-20210805-CONFIDENTIAL

57 Transgrid's response to information request AER IR015, Question 9

58 Transgrid, Non-network ICT Overview paper - Confidential, page 29

59 Transgrid, Non-network ICT Overview paper - Confidential, page 30

'As part of our investment review and governance process, we assess each proposed investment against the backdrop of historical investment levels for the investment class and the portfolio as a whole. This ensures we do not overstate future investment requirements by implicitly applying a more stringent risk criteria for forecast investment than what we have proven that we can manage in the past.'

155. We observed that the IT program was formed primarily as a bottom-up forecast which included limited review as a portfolio of work, or included evidence of adequate application of top-down review processes to the forecast capex. For example, Transgrid states that it takes a whole-of-portfolio view of the information technology risk, ranking the projects in its forecast ICT program to optimise the portfolio, and making use of the Transgrid's Risk Management Framework to mitigate risk and to reconcile with its bottom-up build of risks.[60] However, we did not see evidence of this being undertaken.

156. We note that the capex forecast reflects the program prior to DG1, and which remains subject to investment approval. We consider that Transgrid may continue to modify its capex forecast. We therefore consider the review and challenge process that Transgrid has applied to determine a prudent and efficient level of capex in more detail below.

Top-down methods have led to a lower capex forecast, primarily from re-categorisation

157. As part of its optimisation process, Transgrid describes having applied a number of top-down review methods to elements of its capex forecast:

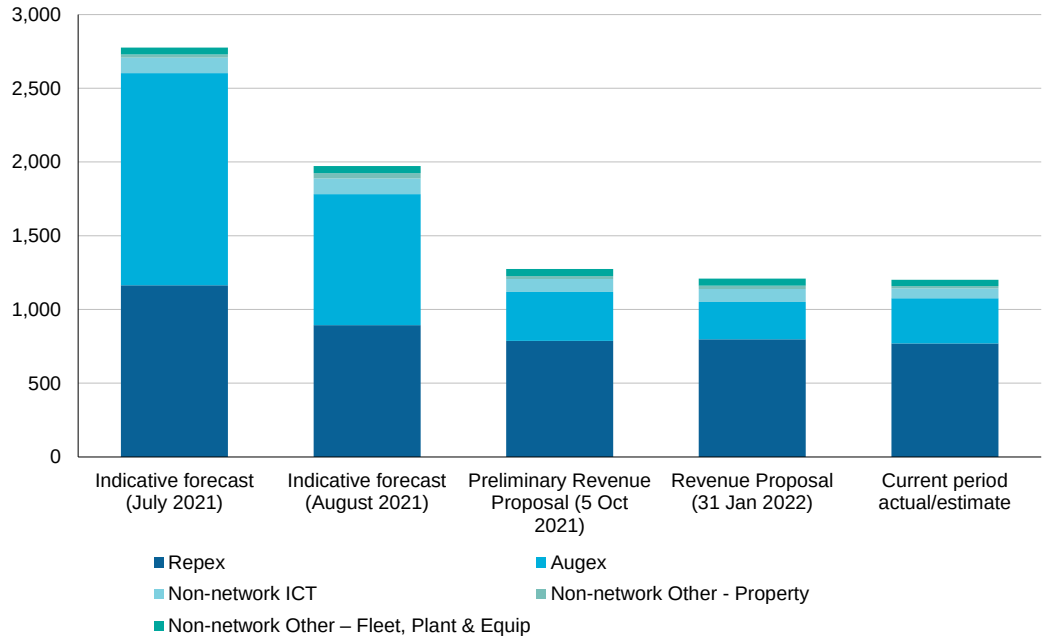
- Top down Repex model review;
- Historical expenditure trending for repex;
- Independent Augex assurance reviews;
- Board and executive review of the capex portfolio; and
- Sensitivity analysis:
  - For repex needs, sensitivity of the economic benefit evaluation is reviewed by developing suitable statistical distributions of key inputs both in relation to risks and costs. Monte Carlo simulations were undertaken to test portfolio stability against input parameters; and
  - For repex and augex, sensitivity to inputs was considered through the range of high, central and low scenarios within our economic assessment methodology. The weighted NPV ensures that the outcome is robust to changes in the key input parameters.

158. Following Transgrid's portfolio optimisation review, individual need expenditure was adjusted through a combination of typical methods. The results are shown in Figure 3.4 below.[61]

60 Transgrid, Non-Network ICT Overview paper, page 29

61 The totals provided in Transgrid's response and this chart do not reconcile due to the inclusion of overheads for the Preliminary RP and RP in Transgrid's response.

Figure 3.4: Movement in proposed capex excluding PEC, excluding overheads $m real 2022-23



Source: EMCa analysis of Transgrid's response to AER IR022

159. The key changes to each of the capex categories are summarised in Table 3.4.

Table 3.4: Summary of changes arising from Executive and Board challenge sessions, $m 2022-23

Capex category	Indicative forecast	Revenue Proposal	Summary of changes provided by Transgrid
Repex	1,163	798	Reduction of $376m from the indicative forecast to the preliminary RP to balance risk and cost, including: • Removing RIT project: Line 86 (approx. $140m) • Applying additional prioritisation to the forecast repex • Adopting lower cost options, e.g. across a number of secondary system replacement projects • Phasing projects to match network outage availability, deferring some into the following period • Allowing some level of deferral of projects into the following period • Removing scope overlaps with augex projects, e.g. asset replacements included in 'manage increased fault levels in southern NSW' augex contingent project.
Augex	1,439	254	Reduction of $1,106m from the Indicative forecast to the preliminary RP by removing projects that were uncertain and including these as contingent projects, including: • RIT-T projects: Supply to northwest slopes (approx. $166.3m) and Supply to Bathurst, Orange and Parkes (approx. $630.3m) • Property acquisitions: easement for supply to Sydney (approx. $252.5m), [redacted] • Removing six augex projects Further reduction from the preliminary RP of $79m by • Removing 'Improve fault levels in Southern NSW' – indicative cost of $51.1 million given the uncertainty of

Capex category	Indicative forecast	Revenue Proposal	Summary of changes provided by Transgrid
			the project and to address our customers' highest priority of affordability • Removing three augex projects following external assurance review
Non-network IT and other	174	158	Reduction of approximately $33m from the indicative forecast to the preliminary RP by: • Reducing the scope and forecast to two non-network ICT capex programs • Removing three projects from Non-network other capex
Total	2,776	1,210	Total excludes capitalised overheads

Source: EMCa analysis of information response provided by Transgrid, IR022. The project values above will not reconcile to the total change in our capex forecast due to other changes within the forecasts such as inflation assumptions and refinement of project cost estimates. We have included an estimate of the capitalised overheads.

160. As is evident in Table 3.4, the large reductions resulted largely from moving some projects out of the base proposal, to be presented separately as 'contingent projects' and 'major projects undergoing a RIT-T', plus some prudency and prioritisation of capex projects in the base proposal.

161. This movement of capex between classifications understates the level of capex that Transgrid is proposing to recover as part of its regulated activities. The RIT-T projects alone comprised $741m of Transgrid's forecast capex (at the time of Transgrid's Regulatory Proposal) that were removed from the augex forecast submitted for revenue determination purposes.

Transgrid has excluded major augmentation projects from its RP

162. Transgrid has elected to exclude major sources of augmentation expenditure from the capex forecast included in its RP:[62]

> *'...our 2023–28 forecast capex excludes pre-approved capex for Project EnergyConnect and it also excludes capex for projects identified in AEMO's ISP (including HumeLink and VNI West) and the NSW Electricity Infrastructure Roadmap.'*

163. We understand that the NER places the onus on the NSP, and not the AER, to present the justification of a prudent and efficient level of capital expenditure for the regulatory control period in its RP. Furthermore, the NER requires that the RRP should include updated information, including to address matters raised in the AER's draft decision. Our reading is that this does not extend to withholding projects or withholding factors from the RP, with a view to introducing them in the RRP.

164. In relation to the four major projects undergoing RIT-T named in the RP, Transgrid set out its plans to submit these projects as part of its RRP in correspondence with the AER in February 2022[63]

> *'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.'*

62 Transgrid 2023-28 Revenue Proposal page 94

63 Transgrid's letter to the AER, 10 February 2022

165. We understand that Transgrid considered that it had insufficient information available to it at the current stage of the RIT-T process to reasonably cost any network solutions, should they be the preferred options.[64]

166. Transgrid also stated that:[65]

> *'Our forecast capex does not include costs that we may incur if we are required to ready our network for 100 per cent renewables by 2025. We are currently examining the nature and scope of these costs and will work closely with AEMO and our industry peers to understand and quantify the investment required to facilitate an orderly transition towards this future state.'*

167. We note that in the AER's Issues Paper for the RP, the AER stated:[66]

> *'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.'*

168. Regardless of the regulatory status, we have undertaken our assessment based on the information and justification included in the RP, and in response to our requests for information and workshop discussions as a part of our review of the aspects of expenditure we have been asked to review. We have not, in the current report, assessed projects not proposed or factors not included in Transgrid's RP.

Risk of project deferrals when impact of contingent projects is included

169. If contingent projects are included in consideration of Transgrid's capacity to deliver its capex program, the pressure on delivery of the capex program will be increased by an order of magnitude compared to what is currently presented (i.e. Major Projects, Strategic Property, and Base Augex). This may require re-prioritisation of the portfolio and result in some projects or programs being deferred beyond the end of the next RCP.

170. During the current RCP we note that Transgrid has deferred a total of $74m of augex projects. The reason provided by Transgrid for deferring projects is:[67]

> *'Project had lower benefits compared to other projects and hence was prioritised due to market benefit'*

171. As shown in Table 3.5, 36% of the augex deferred from the current RCP has been included in the capex forecast for the next RCP. We are of the view that a proportion of the proposed capex may similarly be deferred from the next RCP if Transgrid again faces delivery challenges and, again, the obvious candidates from Transgrid's perspective would be the proposed 'market benefit' projects since it could defer these without risk of breaching compliance obligations. We discuss this further in our review of the proposed augex forecast.

172. Transgrid describes the deferral of projects from the current RCP as listed in Table 3.5.

64 Transgrid's letter to the AER, 10 February 2022

65 Transgrid, 2023-28 Revenue Proposal, page 93

66 AER Issues Paper, Transgrid 2023-28 Revenue Proposal

67 Transgrid's response to information request AER IR015

Table 3.5: Transgrid's description of the deferral of projects in current RCP

Need ID	Project name	Augex saving ($m 2023)	Reason for deferral
1698	Strengthening Far West NSW Network	6.4	Timing of project has materially changed due to revised customer demand forecast.
1316	Beryl Area Constraint	3.4	Timing of project has materially changed due to revised demand forecasts.
1687	Western Sydney Development	7.0	Scope and timing of the project has materially changed due to revised demand forecasts. This requires establishment of a 330/132kV supply point which was not part of the original proposal, with early supplies to the area being managed through the Endeavour Energy network.
1491	Sydney Nth West 330 kV Smart Grid Controls	2.6	Project had lower benefits compared to other projects and hence was prioritised due to market benefit. Included into the 2023-2028 regulatory period to ensure security of supply to Sydney, especially due to the continued closure of coal-fired generation, and the high importance of the possible loss of these important supplies to Sydney.
1522	31-32 Bayswater 330 kV Smart Grid Controls	2.4	Project had lower benefits compared to other projects and hence was prioritised due to market benefit. Included into the 2023-2028 regulatory period to ensure security of supply to Sydney, especially due to the continued closure of coal-fired generation, and the high importance of the possible loss of these important supplies to Sydney.
1473	North West 330 kV Smart Grid Controls	3.0	Project had lower benefits compared to other projects and hence was prioritised due to market benefit. Included into the 2023-2028 regulatory period to ensure security of supply to northern NSW, especially due to the continued closure of coal-fired generation, and the high importance of the possible loss of these important supplies to Sydney.
1440	Beaconsfield 132kV Cable Replace	0.1	Deferred in response to DNSP timing.
1443	Canberra Sub – Installation 132kV Switchbay – Line Single CB	1.8	Deferred in response to DNSP timing and demand forecast.
Sub-Total of projects proposed for 2023-28		**26.6**	**n/a**
Sub-Total projects not proposed for 2023-28		47.8	Various reasons
TOTAL deferred projects in current RCP		**74.4**	

Source: Transgrid's response to information request, AER IR015

173. The components of work that have been rolled-out from the current RCP to the next RCP are indicative of Transgrid constraining expenditure unnecessarily within RCP time periods.

3.3 Summary and implications for the aspects of expenditure we have been asked to review

3.3.1 Summary

174. Transgrid has an effective governance and asset management system that should largely identify a reasonable capital forecast, to the extent that it is appropriately applied. We found some application issues associated with portfolio optimisation, prioritisation and risk framework that are likely to have resulted in an overstatement of requirements in some cases due to:

- Application of parameters such as VCR and disproportionality multipliers that may lead to an overstatement of benefits used in its cost benefit analysis;
- Focus on delivering to its capex allowance within RCP boundaries;
- Likelihood that a proportion of projects will be deferred in the next RCP as priorities change, and demands on project delivery increase; and
- Whilst Transgrid has improved aspects of its portfolio optimisation, there is a lack of sufficient top-down review of non-network IT capex.

175. Assessment of a prudent and efficient level of capex is hindered by the lack of transparency of Transgrid's assumptions in its Revenue Proposal, specifically related to:

- Scale of significant 'planned' investments not proposed for determination in the current RP, and their impact on Transgrid's ability to deliver the capex portfolio that it has proposed;
- Consideration of prioritisation of investment, should this be required, and where this will impact on investments delivered; and
- Consideration of inflationary and other cost impacts.

176. In considering the macro level forces that may act on Transgrid as discussed in section 2, the current regulatory framework review processes (e.g. on congestion management and transmission investment planning framework review) are also likely to affect priorities during the period. These reviews recognize that the current framework is leading to inefficient siting decisions for new generation, currently requiring inefficient over-investment in transmission.

177. Importantly, our assessment is based on the information and justification included in Transgrid's RP, and in response to our requests for information and workshop discussions as a part of our review of the aspects of expenditure we have been asked to review. We have not, in the current report, assessed projects not yet proposed or factors not included in Transgrid's RP, while noting that Transgrid has indicated that it intends to include some such projects and factors in its RRP.

3.3.2 Implications for forecast capex

178. We have identified issues with Transgrid's selection of some parameters, that may result in an overstatement of the benefits of the proposed investment and lead to an overstatement of expenditure requirements. In subsequent sections of this report, we have reviewed evidence of the application of its framework, and specifically the issues identified in its governance and management framework, to the areas of expenditure that we have been asked to review.

179. In relation to portfolio management, we observe that the steps undertaken by Transgrid have contributed to a lack of transparency to consumers of the magnitude of capex that is proposed to be undertaken in the next period, and how that will be managed during the RCP. Further, absence of sufficient review or challenge of parts of the capex forecast, specifically IT, has contributed to an overstatement of a prudent and efficient level of expenditure.

4 REVIEW OF CAPEX-RELATED FORECASTING METHODS

In this section, we present our assessment of the forecasting methods that Transgrid has applied to forecasting its capex requirements. We consider the methodologies used to:

- forecast capex in each of the nominated expenditure categories;
- estimate the costs of those activities;
- ensure the work is delivered efficiently; and
- challenge its bottom-up activity forecast.

We find that the assumptions relied upon by Transgrid do not sufficiently account for reasonable changes in market conditions, and the corresponding risks that this poses to the costs that Transgrid will incur. Specifically, this applies where delivery of a program may materially differ from the program that Transgrid has proposed.

We discuss our concerns with Transgrid's consideration of options, quantification and assessment of benefits and application of its economic analysis more broadly.

We consider that a combination of these factors is likely to have resulted in over-estimation of its requirements.

4.1 Transgrid's expenditure forecasting

4.1.1 Capital expenditure forecasting methods

180. Transgrid has determined its capital forecast by aggregating expenditure forecasts developed for sub-categories of capex, and which it has referred to as a bottom-up forecasting method.

181. Transgrid describes the application of top-down validation techniques to each of the sub-categories of forecast capex as a means to determine the prudent and efficient level of capex that meets the NER requirements.[68] Each of the bottom-up and top-down forecasting methods is outlined in Table 4 of its expenditure forecasting methodology, by sub-category.

182. Transgrid's Network asset strategy[69] describes a number of enhancements to its forecasting models since its previous regulatory submission.

4.1.2 Expenditure assessment and justification

183. Transgrid has introduced a common cost benefit analysis model, included as a part of the OER stage of its investment governance process (pre-DG1). Transgrid describes this model as aligning its economic assessment methodologies with the AER's regulatory investment test application guidelines, the AER's *Industry practice application note - Asset replacement planning 2019* and claimed industry best practice.[70]

68 Transgrid Expenditure Forecasting Methodology, June 2021, page 12

69 Transgrid, Network Asset Strategy, page 42

70 Transgrid's response to information request, AER IR015

184. Transgrid has utilised a generic Cost Benefit Analysis (CBA) model developed for it by consultants, in seeking to demonstrate that proposed projects are economically viable, and (in some cases) to demonstrate optimal timing and its preferred option (where more than one option is considered). The analysis typically compares the incremental costs and incremental benefits of the proposed option with a Business as Usual (BAU) counterfactual.

185. For augex projects, benefits are typically derived from assumed reduced Expected Unserved Energy (EUE), reduced generation development costs (by improving access to existing generation) and avoided fuel costs (associated with reduced running of thermal generation out of merit order).

186. Transgrid has primarily relied on a 'weighted NPV'. In each case this results from weighting low, base, and high scenarios, using weightings of 25%, 50% and 25% respectively. The three scenarios result from adopting all 'low' or all 'high' parameters (in terms of their impact on NPV) together. The varied parameters include discount rate, capital and operating costs and benefit-related relative costs and avoided costs (being the VCR and generation fuel savings).

187. We have reviewed the models for a sample of projects for each of the capex categories we have been asked to review.

4.1.3 Activity level forecasting

Replacement expenditure

188. Transgrid refers to repex as the investment required to meet and maintain asset safety compliance obligations and performance levels through replacement of assets, triggered by assets that are approaching technical end of life.[71]

189. Repex comprises expenditure related to: (i) network asset replacement, (ii) physical security of network assets, and (iii) network asset compliance.

Augmentation expenditure

190. Transgrid refers to augex as the investment required to meet and maintain power system compliance obligations and performance levels through augmentation of the network, triggered by changes in electricity demand, fault levels, or power flows (for example).[72]

191. Augex comprises expenditure related to: (i) Base Augmentation (compliance, demand, economic benefits), (ii) Major Projects, (iii) Strategic Property, (iv) Connections, and (v) NCIPAP.

192. Contingent projects are identified separately to its augex forecast, as investments required to augment the network when triggered by market or other needs. Contingent projects are separated into (i) Major projects undergoing a RIT-T and (ii) Standard contingent projects. Transgrid states that it has:[73]

> *'.. not include the costs of these projects in our ex-ante expenditure forecasts given the uncertainty around timing and costs of these projects.'*

193. In its augex forecast, Transgrid has not included projects associated with development of the NSW Renewable Energy Zones (REZs) as contingent projects on the basis that they will be regulated under the NSW regulatory framework.[74] Neither has Transgrid included actionable and future ISP projects:[75]

71 Transgrid Expenditure Forecasting Methodology, Table 3 – Capex categories

72 Transgrid Expenditure Forecasting Methodology, Table 3 – Capex categories

73 Transgrid Expenditure Forecasting Methodology, Table 3 – Capex categories

74 Transgrid 2023-28 Revenue Proposal, page 163

75 Transgrid 2023-28 Revenue Proposal, page 166

'We have not included these projects as contingent projects because these projects are, or will be, 'automatic' contingent projects under the new NER automatic contingent project provisions for Actionable ISP projects.'

Non-network capex

194. Transgrid refers to non-network capex as investment required to support the business in providing its prescribed transmission services including IT systems, fleet, tools, depots and office buildings.[76]

4.1.4 Cost estimation

195. Transgrid forecasts the costs required to develop and implement its network capex projects and programs using its MTWO estimating database. The MTWO cost estimating database reflects actual outturn costs built up over more than 10 years from:[77]

- Period order agreement rates and market pricing for plant and materials;
- Labour quantities from recently completed project; and
- Construction tender and contract rates from recent projects.

196. For non-network ICT capex, Transgrid describes the forecast as being based on contract rates, service agreements and independent estimates. For its ICT forecast, this comprises a combination of standardised unit rates based on recent costs and individually costed projects, where the costs inputs are similar to those of recently implemented projects of similar scope. Capex is estimated using a detailed cost model in an Excel spreadsheet.

4.1.5 Delivery strategy and risk

197. Transgrid describes a deliverability assessment as being a part of its Prescribed Network Capital Investment Process, specifically to identify optimisation opportunities by considering the deliverability of the portfolio, appropriate scheduling and bundling of works. [78]

198. Deliverability is also discussed in each of the expenditure overview papers in providing an overview of the capex by category.

4.2 Our assessment of Transgrid's expenditure forecasting

4.2.1 Expenditure forecasting

Improvements made to expenditure forecasting appear reasonable

199. Transgrid has introduced a number of top-down forecasting methods that it claims to apply to network investment, including in direct response to concerns raised previously by the AER. Transgrid describes the focus of these improvement initiatives as being to increase consistency of approach, to enhance Transgrid's understanding of risks and investments, improving confidence that the proposed capital expenditure addresses the identified needs and maintain network safety, security and reliability. [79] The improvements include:

- Methodology improvements to consequence modelling;
- Improvements to economic assessment methodologies;

[76] Transgrid Expenditure Forecasting Methodology, Table 3 – Capex categories

[77] Transgrid Revenue Proposal, page 101

[78] Transgrid Revenue Proposal, page 100

[79] Transgrid's response to information request AER IR015 Question 7

- Improvements to risk models, including greater modelling consistency through the use of global variables for VCR, Value of Statistical Life (VoSL) etc. across the asset classes;
- Optimising portfolio prioritisation through review of deliverability and broadening top down challenge techniques;
- Applying the latest estimate inputs in forecasts from its cost database; and
- Updating the Network Prescribed Capital Investment Process to streamline the documentation effort.

200. We have reviewed evidence of the application of its forecasting methodologies, including the claimed improvements, to the areas of expenditure that we have been asked to review in the subsequent sections of this report

4.2.2 Expenditure assessment and justification

Options analysis is biased to supporting the preferred option for some categories of capex

201. In its Final Decision for the 2018-23 RCP, the AER found a lack of consideration of options for extending the programs (or some portion of them) beyond the end of the regulatory control period.[80] Also, it found that Transgrid's options analysis was likely to bias the analysis towards its preferred replacement option, such that Transgrid's ICT forecast was likely to overstate prudent and efficient costs.[81]

202. In the Expenditure methodology included with its RP, Transgrid states that:[82]

> *'Other than for non-network other, we evaluate each need by considering the expected benefits to our customers (e.g. risk reduction of a need or benefits of an opportunity) and costs for each feasible option by preparing an economic cost benefit analysis business case compared against the base case. The preferred option is typically the one that offers the highest positive benefits in net present value (NPV) terms. We also consider the sensitivity of the business case outcome by varying key parameters, apply weighted scenarios and check the optimal timing of the investment to ensure we have a robust business case before proceeding to add the investment to our forecast expenditure.'*

203. We looked for evidence that Transgrid has improved its options analysis in the expenditure areas that we were asked to review, specifically the extent to which Transgrid has considered and made provision for efficient and prudent options in its assessment. For augex, this extends to consideration of non-network alternatives.

204. As discussed in section 5, for augex there is limited consideration of non-network solutions in projects included in the base augex forecast, with reliance instead often placed on the upcoming RIT-T process to confirm or otherwise whether a non-network solution is superior to or supplements the preferred network solution. Given the likelihood that non-network solutions will eventuate for at least some projects, it is likely that this will have resulted in some overestimation bias in Transgrid's current augex forecast.

Treatment of benefits / recognising uncertainty and option value

205. Transgrid claims to have adopted industry practice for its economic analysis and aligned the application of its economic analysis across its capex portfolio. However, its approach has the effect of (i) inflating some benefits, (ii) deflating capital costs, and (ii) understating option value. Factoring explicit consideration of option value into assessments can assist with making prudent investment decisions where there is material uncertainty of key investment parameters (such as load growth, technology changes or changes in the market).

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80 AER, Attachment 6 – Capital expenditure | TransGrid transmission final determination 2018–23 page 6-56

81 AER, Attachment 6 – Capital expenditure | TransGrid transmission final determination 2018–23 page 6-106

82 Transgrid, Expenditure forecasting methodology, page 16

Inclusion of varying discount rates in the weighted scenarios is not appropriate

206. 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.

207. The AER Guideline and the AEMO Inputs Assumptions and Scenarios report refer to considering different discount rates in project assessments. AEMO refers to doing so as a sensitivity analysis. However, in its augex analyses Transgrid has typically weighted together 'scenarios' that contain 'all low' and 'all high' exogenous cost and benefit parameters, with different discount rates applied to the low, base and high scenarios.

208. Unlike cost and benefit forecasts, the discount rate is not a 'project-related' uncertainty. While sensitivity analysis involving different discount rates represents good practice, we consider that varying the discount rate along with varying costs and benefits and then weighting the outcome introduces a distortionary impact that effectively masks the impact on economic analysis outcomes of genuine project uncertainties. Noting that different discount rates differentially affect project options depending on the extent to which their costs and benefits are in the near term or further into the future, this particularly affects comparisons between long-term capital-intensive network solutions and short-term 'operational' solutions.

Inappropriate use of terminal value

209. Transgrid's CBA analyses include a 'terminal value' that ascribes an unamortised value to the original capital cost in the final year of the analysis period. We observe that these values can be substantial – for example with a 20-year analysis period and a 40-year asset life, but with the project being commissioned only in year 8 of the analysis period, the model ascribes a terminal value that reflects the remaining 28 years of asset life that is assumed to exist at year 20. That is, the assumed terminal value is 28/40 of the original assumed capital cost.

210. This value, which is assessed as a benefit in Transgrid's CBA modelling, effectively assumes that the investment will continue to provide a benefit over the remaining years from the end of the modelled assessment period to the end of the assumed economic life of the relevant assets, that at least exceeds that terminal value. However, inspection of the benefit profile is required to form a view as to whether this is realistic, also 'option value' consideration is needed for scenarios in which change both within and beyond the analysis period may render the value of an investment redundant beyond a certain time. This includes where:

- The need may be superseded by other investments made in the network at some stage over the 40 years' assumed technical life; or
- The need dissipates, for example, due to technical advances (such as improvements in the controllability of loads and the level of transmission or distribution flows).

211. Use of a terminal value in CBA where the benefits can reasonably be expected to continue beyond the period of assessment, reflects good practice. However, it is important to be able to substantiate reasonable expectation of such future benefits. In a number of instances in models presented (and which we refer to in later sections of this report) we found that the benefits towards the end of the modelled period were negligible or at least insufficient to justify the modelled terminal value, even if it was reasonable to assume that these benefits would continue. We also found instances where the full original capital cost of land was assumed as a terminal value 'benefit', despite the ongoing need for the land on which the transmission assets had by then been built, beyond the analysis period.

212. Within the NPV models, we observe that the terminal value is also sometimes presented as a 'negative cost' in the 'capital cost' row of the model. The NPV of the capital cost that is presented is effectively then net of the terminal value, and in our view is therefore misleading in under-reporting the PV of the actual capital cost of the proposed project. This then also distorts assessment of the 'payback' profile and also, where the 'annuitised capital cost' is net of the terminal value, distorts optimum timing analysis.

Reliance on weighted scenarios is not always appropriate

213. 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.

214. Further, there is a risk that a high scenario, which may potentially be driven by one outlier parameter, may unreasonably bias up the weighted average.

215. As an alternate approach, we applied Monte Carlo analysis on a test basis to some of Transgrid's proposed augex projects, using similar ranges of cost and benefit parameters as Transgrid. In this analysis, we selected a 20-year analysis period. We did not vary the discount rate, but we did allow the economic life to vary (using a distribution function for this parameter), as well as the cost and benefit parameters.

216. In Table 4.1, we show the results of such an alternate analysis for one such project. While this is only intended to illustrate the use of this alternate methodology, the results differ from Transgrid's 'weighted average NPV' approach, and also provide greater insights into the project risk, than are obtained by focusing justification primarily on the weighted average result.

Table 4.1: Comparison of Transgrid weighted average NPV approach with Monte Carlo approach (for project N2584)

Transgrid analysis	**Low NPV**	**Central NPV**	**High NPV**	**Weighted Average NPV**
	-$5.09m	*$2.57m*	*$14.25m*	**$3.58m**
Indicative Monte Carlo simulation	**Mean NPV**	**90% confidence interval**	**Probability of negative NPV**	**25th and 75th percentiles**
	$1.03m	*+/- $0.9m*	*38%*	*-$2.75m; +$4.75m*

217. While we do not suggest that Monte Carlo simulation necessarily must be universally applied in Transgrid's NPV analyses, we consider that Transgrid's reliance on weighted average outcomes ignores the richness of information that is potentially available on project uncertainty and risk ranges. This effectively builds on information that is obtainable through the modelling of low, central and high scenario parameters that is already incorporated in the models.

4.2.3 Cost estimation

Development of cost estimates follows a reasonable process

218. We have not observed any material issues in the information we reviewed regarding Transgrid's cost estimating methodology for network or non-network cost estimates.

219. We understand that Transgrid's network cost data is updated annually to ensure costs are current and that its estimation methodology follows a similar process applied during the current period and is supported by a robust database and governance procedure. Transgrid describes its update of costs as being based on:[83]

- A detailed review of tender pricing schedules from the past year.

[83] Transgrid's response to information request AER IR015, Question 11

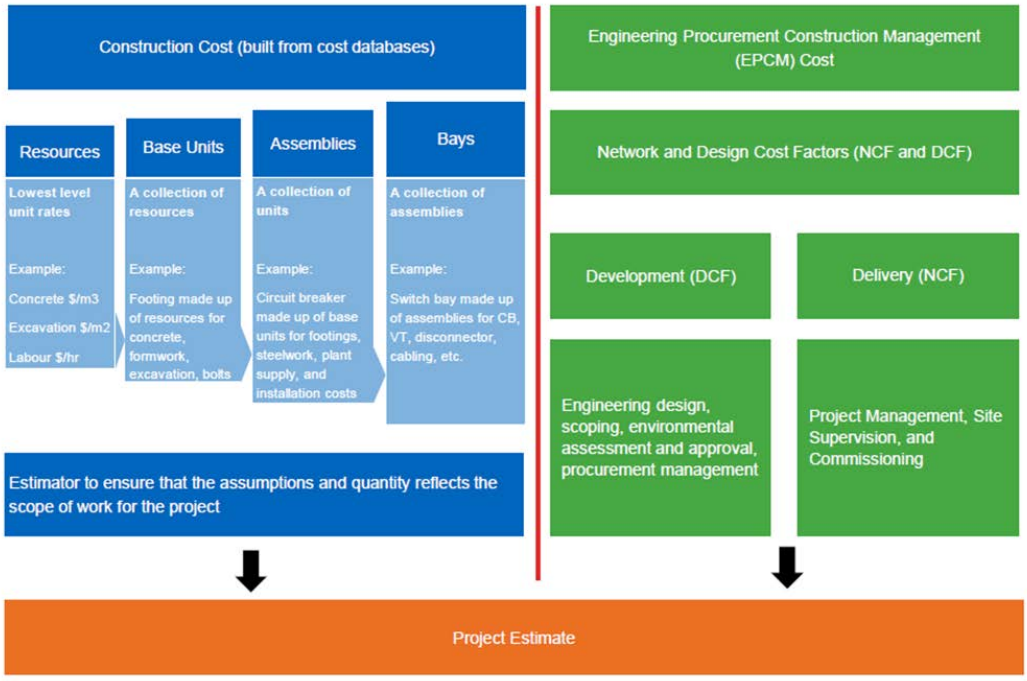
- Transgrid labour costs (in accordance with Enterprise Bargaining Agreement increases).
- Period order plant and equipment pricing.
- Transgrid Ellipse system for stocklined (i.e. commonly bought) items.
- Rawlinson's Australian Construction Handbook or similar industry publications.

220. The cost estimation database (used for development of its network costs) is benchmarked annually, with Transgrid engaging third party firms to prepare independent estimates for packages of works. The independent estimates are compared to estimates produced from the database to identify issues and areas of improvement. For the next RCP, Transgrid commissioned an independent review[84] of key proposal inputs, tools and processes underpinning Transgrid's repex forecast. This concluded that Transgrid's estimation system was aligned with industry best practice as per AACE 96R-18 and specifically that:

> *'Cost estimates benchmark closely with Aurecon's independently derived cost estimates for the same scopes.'*

221. An overview of the cost estimation method and assumptions is reproduced in Figure 4.1 below.

Figure 4.1: Network cost estimation methodology (applied to projects)



Source: Presentation to AER/EMCa

222. For its ICT forecast, a cost model for each package of work was developed, based on known software licenses and hardware costs, application support costs, project resources including internal labour, consultants and vendors, and previous costs to implement a similar solution. Costs are developed from a bottom-up perspective using a combination of historical costs (unitised costs) and tailored cost estimates (non-unitised costs).

223. Transgrid describes several measures to avoid additional risk-costs being added to its cost estimates, including:[85]

84 Transgrid's response to information request AER IR015, Transgrid-IR015-Aurecon-Repex 2023-28 Regulatory Proposal Technical Assurance Report-20220113-PUBLIC

85 Transgrid - Non-network ICT overview paper, page 36

- use of industry standard technology asset lifecycles for determining prudent timeframes for investment;
- benchmarking market rates with 3rd party advisors;
- 3rd party advice on market trends and risks;
- clear visibility of forecasts containing higher degrees of uncertainty and risk mitigation plan that's been applied to minimise the uncertainty in forecast; and
- reuse of previous project actuals for comparison and estimates for cyclical initiatives.

Inadequate consideration of cost escalation

224. We noted that Transgrid's cost estimates are assessed by it to be at +/-25% accuracy, which is consistent with its capital governance framework requirements. Based on our understanding of current global supply-related costs and associated inflationary affects being experienced in the construction market and impacting infrastructure delivery, we asked Transgrid to describe its understanding of the macro trends affecting the delivered cost of Transgrid's work program (e.g. labour costs, material costs).

225. Transgrid stated that whilst real labour cost escalation had been included, no provisions were included for material cost increases:[86]

> *'We are experiencing materials cost increases and expect that this will continue into the 2023-28 period due to global events impacting supply chains and increases in material demand. We are analysing these trends and its expected impact on our 2023-28 forecasts, ahead of our revised revenue proposal.'*

226. In its RP, Transgrid also states that it:[87]

> *'...has not at this stage included*
>
> *– a real increase in materials costs in our expenditure forecasts although, like AEMO, we forecast that the cost of materials will increase at a rate faster than CPI. In our Revised Revenue Proposal, we will revisit this matter in consultation with our customers and other stakeholders, and*
>
> *– any cost impacts associated with the long-term effects of the COVID-19 pandemic given that the economic effects are still highly uncertain.'*

227. Within the RP Transgrid refers to updating its forecasts at a later stage of its review process. This message is repeated in supporting information. Transgrid suggests that these updates, taking account of inflationary impacts and other cost impacts, will be presented as a part of the RRP.

228. There is considerable generation and transmission development in Australia, and also significant investment in government and private sector infrastructure projects underway and planned. The impact of this demand for labour/skilled resources, materials, plant and equipment is already being experienced in some industry sectors in Australia.

229. We remain concerned that Transgrid has not taken sufficient regard to the current market conditions in preparing its cost forecast, and that it is reasonable to expect that its projects will be subject to material increases in costs and to deliverability constraints, which may impact option selection, timing and the viability of some projects. It is standard practice to allow for assumed 'real cost escalation', where applicable, in providing a regulatory submission. This allows the regulator to consider the basis for such escalation and to provide a response in its Draft Determination. Transgrid appears to recognise the likelihood of real cost escalation leading to higher costs than it has proposed but has not provided the opportunity in its RP for these to be assessed.

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86 Transgrid's response to information request AER IR015, Question 11

87 Transgrid 2023-28 Revenue Proposal, page 2

The full impact of global demand may not be reflected in delivery timeframes and associated costs

230. Supply-related risks are well documented, as are the potential inflationary effects on transmission investments. In a submission to AEMO for the Draft 2022 ISP,[88] Transgrid refers to two sources of research to support its position, and which describe:

- Inflationary effects rising to 5-6% per annum over the next few years;[89] and
- Competition for skills and materials including steel and concrete will likely exceed available capacity.[90]

231. Whilst the delivery-related risks of major augex projects are likely to differ from those associated with base levels of capex, there are overlaps in skill types and materials provision that impact all transmission-related projects. Whilst the accuracy of the forecast capex affords some level of uncertainty, the absence of specific consideration of delivery risks at a portfolio level potentially understates the impacts of supply issues.

4.2.4 Delivery strategy and risk

Growing uncertainty associated with the energy transition

232. 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:[91]

> *'...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.'*

233. We understand Transgrid has included two categories of contingent projects:[92]

- Projects undergoing a RIT-T (comprising 4 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 (8 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.)

234. 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.

235. Transgrid has separately identified this tranche of additional projects in its Revenue Proposal. A further tranche of projects is also flagged associated with implementing REZs in NSW.

236. As shown in Figure 4.2 below, 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 regulatory submission.

88 Transgrid, Submission to AEMO draft 2022 Integrated System Plan, February 2022

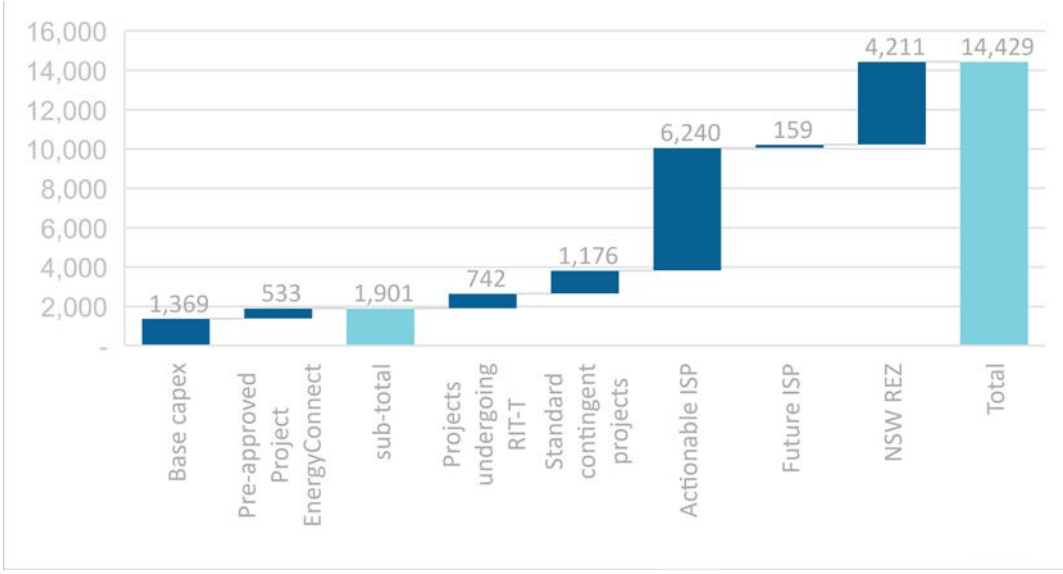
89 Arcadis analysis, https://www.arcadis.com/en-gb/news/europe/united-kingdom/2021/12/high-construction-price-inflation-set-to-continue-into-2022

90 Infrastructure Australia, Infrastructure Market Capacity, October 2021

91 Transgrid 2023-28 Revenue Proposal, page 163

92 Transgrid 2023-28 Revenue Proposal, page 163

Figure 4.2: Total planned capex, including contingent ISP and NSW REZ projects, $m 2022-23



Source: EMCa analysis of Transgrid 2023-28 Revenue Proposal and supporting documents

237. 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 changes that may rapidly and materially affect the need, viability and/or preferred options for certain projects. Accordingly, regular and ongoing review of market changes is required to build option value wherever possible and to minimise potential regret cost.

238. It remains critical that TNSPs continue analysis to ensure the appropriate transmission investment projects proceed through the further regulatory and investment processes and are ultimately in the long-term interests of consumers. This is premised on full transparency to ensure that risk is not unreasonably transferred to consumers.

Deliverability assessment is not adequately demonstrated

239. We consider that demonstration of the deliverability of the proposed capex program is an important aspect of a prudent and efficient forecast. Whilst the underlying or 'base' level of capex proposed by Transgrid is similar to the level delivered in the current RCP, this is against a backdrop of significant increase in demands for infrastructure and energy related skills and materials. At the same time, Transgrid is proposing significant increases in capital projects in response to the NSW REZ developments, ISP projects, and contingent projects to a level previously unseen in the industry, as shown in the figure above.

240. We asked Transgrid to describe what steps it had undertaken to review the deliverability of the total capital investment program, noting the addition of the proposed contingent and RIT-T projects to the capex forecast commencing in the next period. Transgrid stated that it had undertaken a review of the deliverability of the proposed capex as a part of its portfolio optimisation process, based on the potential scope and timing of activities at the time the forecasts were compiled:[93]

> *'Upon identification of all individual Repex / Augex needs (including RIT-T and contingent projects) and evaluation of the preferred option, the portfolio of network capital investment proposed for the 2023-28 regulatory period was assembled for review of deliverability and optimisation through consideration of the following key factors:*
>
> *- Key outage clashes which restrict particular works from either being progressed in parallel or impeding critical needs date to be met for large AUGEX projects.*

[93] Transgrid's response to information request AER IR015, Question 16

- Inter-relations and dependencies of the needs across the portfolio, ensuring scope interactions between Augex/Repex programs are addressed

- Expenditure / resource levelling across the program where flexible works program such as asset replacements is utilised to ensure the expenditure trend is steady

- Phasing of projects requiring major plant with long lead time (e.g. transformers / capacitors) to minimise market impact

Through this portfolio optimisation process, Transgrid minimises the deliverability risks of its forecast program.'

241. For example, in the summarising its augex forecast Transgrid states that:[94]

'The process [augex forecasting method] is repeated for each investment need, selecting those projects that deliver the highest value to ultimately form an augmentation program that maintains current levels of network risk. We adjust scope or timing of projects to incorporate potential overlap with other capital expenditures and constraints from business planning processes to ensure deliverability and optimised outcomes at the portfolio level.'

242. We infer from comments by Transgrid that it considers that the deliverability risks of its forecast program have been effectively minimised through this portfolio optimisation process.[95]

243. We were not provided with evidence of the specific deliverability assessment including the results of any delivery-related risks identified by Transgrid, or corresponding impact to the efficient timing of the proposed program. We consider that as delivery risks emerge for individual projects, there may be a material change to the selection of preferred options and timing and which may result in a corresponding reduction in the level of capex that will be incurred by Transgrid for its proposed program. This is evidenced in the current RCP through the deferral of work, and in particular work justified based on 'market benefits' (as discussed in section 3). We consider these specific risks in our assessment of the proposed capex in the remainder of our report.

4.3 Transgrid's demand forecasting

244. Transgrid describes the method of preparing its 2021 NSW load forecast as taking into account outputs from the following components:[96]

- Econometric modelling of the impacts of population, price, economic growth, weather and other drivers of underlying consumer behaviour – undertaken with help from GHD;
- Weather correction of historical electricity maximum demands and the calculation of probability of exceedance levels – undertaken with help from GHD;
- Regional demographic and economic forecast scenarios – provided by BIS Oxford Economics;
- Projections of future energy price paths – undertaken by Jacobs;
- Assessment of recent energy efficiency policies and standards, and quantification of the energy savings impacts – undertaken by Energy Efficient Strategies;
- Modelling of rooftop Photovoltaic (PV) installation and generation, and distributed battery storage – undertaken by Jacobs; and

94 Transgrid - Augex overview paper, page 58

95 Transgrid's response to information request AER IR015

96 Transgrid - Augex overview paper, page 54

- Projections of the take-up of externally charging electric vehicles – undertaken by Energeia.

245. Together with other econometric data, Transgrid develops projections of summer and winter maximum demand based on historical POE10, POE50 and POE90 underlying maximum demands, including estimated above-trend energy efficiency.

246. Transgrid also reconciles the NSW regional maximum demand forecast with the regional forecasts prepared by AEMO, and against the aggregated Bulk Supply Point (BSP) maximum demand forecasts provided to it by the Distribution Network Service Providers (DNSPs).

247. Transgrid describes the following demand and system related drivers:[97]

- Summer (and to a lesser extent, winter) maximum demand growth is a key driver of augmentation capital expenditure and been steady over the last 10 years
- Minimum demand is extremely sensitive to forecast growth in distributed PV and forecast minimum operation demand is declining rapidly.
- There are pockets of strong maximum demand growth (and some minimum demand issues) that will drive augmentation expenditure in the next regulatory control period.
- Voltage stability, system strength and inertia requirements are also driving augmentation expenditure into the next period, triggered by the renewable energy transition, reducing the numbers of in-service synchronous generators and changing power flows.

4.4 Our assessment of Transgrid's demand forecasting

Transgrid appears to reasonably challenge its bottom-up demand forecast

248. We consider that Transgrid has applied a reasonable level of rigour to development of its demand forecast. We have arrived at this view by interrogating Transgrid's own review process, and which includes:

- High level (consistency and clarity) checks on the DNSPs' BSP forecasts, including by:
  - Comparing BSP forecasts (or aggregations of BSP forecasts) with historical actual or weather corrected maximum demands;
  - Comparing current year BSP forecasts with equivalent forecasts from last year. If there are significant differences for any BSP, then these are taken up with the relevant DNSP for further checks;
- Accepting the DNSP spot load confidence assessments only after a thorough due diligence procedure, as detailed above; and
- Transgrid also engaged an independent review[98] to critically review demand forecasts for key network locations at which major network augmentation (augex) projects are planned. This review, included with its revenue proposal, went through the assumptions behind the included spot loads and the independent advice on the suitability of spot loads in the DNSP forecasts.

249. We consider that these checks are both necessary and reflective of a reasonable approach.

Uncertainty remains for the connection of large spot loads

250. Notwithstanding the review process undertaken by Transgrid described above, there remains a level uncertainty as to the timing and magnitude in particular for certain large spot loads being proposed for connection to Transgrid's network. In the current RCP a number of

97 Transgrid, Augex overview paper, page 71

98 GHD, Demand driven augex, Forecast review, 2021

projects were deferred or cancelled in direct response to changed assumptions surrounding the connection of new loads.

251. We note that GHD in its review acknowledged the continued uncertainty of spot loads and suggests alternative scenarios:[99]

> *'It is always possible that some future spot loads that have been included in TransGrid's forecasts (i.e., after substantial discounting) may still be postponed due to economic circumstances or even cancelled. That Is not to say that the most reliable forecast has not been put forward, only those forecasts inherently include an element of uncertainty.*
>
> *Based on the evidence considered, the general approach taken by each DNSP, the level of careful application of that approach and the level of detailed local understanding demonstrated suggest that each of TransGrid's connection point demand forecasts generally represent a realistic expectation of future demand.*
>
> *The most likely demand forecasts for planned electricity consumer projects are likely to be those that DNSPs have included after detailed assessment and discounting. However, network planning at locations where the demand forecast includes a relatively large growth component made up of planned electricity consumer projects may consider alternative scenarios for with and without the projects.'*

252. Whilst the expenditure forecasting process recognises that the composition of projects will change within the RCP, including some level of roll-ins and roll-outs, the allowance should reflect those projects where there is a high level of certainty of expenditure to be incurred during the next RCP to minimise costs associated with the risk of deferment being transferred to consumers.

253. We asked Transgrid to describe the steps it had undertaken to consider alternative demand growth scenarios, and how these scenarios have been applied in its economic analysis for projects included in the capital investment plan. In its response, Transgrid stated that it considered a range of demand scenarios and weighted those scenarios in its economic assessment. A weighting of 50% was given the central forecast (corresponding with the POE50 demand), being the most likely and 25% to the remainder.

254. We have reviewed the reasonableness of the demand forecasts, scenarios and weightings assigned to each of the economic assessments provided as a part of our assessment of augex projects in the subsequent section of this report.

4.5 Summary of findings and implications for Transgrid's proposed capex forecast

4.5.1 Summary

255. For the most part, we consider that Transgrid's forecasting methods have led it to identify prudent projects with reasonable cost estimates based on its assumptions. However, the assumptions relied upon by Transgrid do not sufficiently account for likely changes in market conditions, and the corresponding risks that such uncertainty poses to the costs that Transgrid will incur, to deliverability of its proposed capex program and to any re-prioritisation that it may undertake (and that may result in changes to the prudent and efficient level of capex that it will likely incur).

256. Other areas of concern are with Transgrid's limited consideration of non-network options, the value of optionality, and assumptions regarding the continuation of benefits beyond the assessment period in its augex projects.

[99] GHD, Demand driven augex, Forecast review, 2021, page 30

4.5.2 Implications for forecast capex

257. We have identified issues with aspects of Transgrid's expenditure forecasting methods that are likely to have led to an overstatement of expenditure requirements. In the subsequent sections, we have reviewed evidence of the application of Transgrid's forecasting methodology to the areas of expenditure that we have been asked to review.

5 REVIEW OF PROPOSED AUGEX

We reviewed the information provided by Transgrid to support its proposed augex forecast, including its business cases and relevant supporting information. Our focus is to assess the extent to which the forecast expenditure is likely to meet the NER criteria, and whether there was evidence of the issues identified in sections 3 and 4 affecting the reasonableness of the forecast. We also applied sensitivity analysis to examine the robustness of the proposed options and the timing of activity to variances in the demand forecast and other input assumptions.

We consider that Transgrid has identified NER compliance issues that are likely to require resolution within the next decade and legitimate opportunities to generate net economic benefits by mitigating network constraints. To the extent that network solutions are required, we consider also that Transgrid has generally selected the most appropriate such solution in each project presented as a part of its proposed augex forecast for the next RCP. However, we consider that an NNS, either as standalone solutions or in combination with other solutions, may result in a reduction to the required augex for some projects in the next RCP.

Furthermore, for some projects, project timing is sensitive to spot load growth and also to Transgrid's delivery capability, which may lead to re-prioritisation of the proposed augex against other works such as occurred in the current RCP.

Our assessment suggests that Transgrid's proposed expenditure represents an overstatement of its prudent and efficient requirement.

5.1 Summary of Transgrid's augex forecast

5.1.1 Overview

258. Transgrid has proposed $253.6m for augex for the next RCP, representing an average annual expenditure of $50.7m. In Table 5.1, we show Transgrid's proposed augex, not including capitalised overheads. Whilst Connections expenditure is shown in the table for completeness, it is not within our scope of review.

Table 5.1: Transgrid proposed Augex by category ($m, real 2022-23)

Augex	Total 2018-23	2023-24	2024-25	2025-26	2026-27	2027-28	Total 2023-28	2023-28 % of total
Major Projects	**275.9**	[redacted]						
Strategic property	**-**	[redacted]						
Base Augex	**14.8**	31.3	63.6	33.9	20.4	12.5	**161.6**	63.7%
Compliance	***2.7***	*4.8*	*11.6*	*18.2*	*0.5*	*1.8*	***36.9***	*14.5%*
Demand	***8.0***	*22.9*	*33.4*	*7.6*	*13.9*	*7.3*	***85.2***	*33.6%*
Economic benefits	***4.2***	*3.6*	*18.6*	*8.1*	*60*	*3.3*	***39.6***	*15.6%*
Connection	**14.7**	-	-	-	0.6	2.3	**2.9**	1.1%
Total Augex (excl. PEC and NCIPAP	**305.4**	**48.5**	**64.3**	**37.5**	**34.0**	**69.2**	**253.6**	**100%**

Source: Transgrid 2023-28 Revenue proposal Table 8-6, page 110

259. The majority of Transgrid's actual/estimated augex of $305.4m[100] in the current RCP is for Major Projects. These comprise:[101]

- Powering Sydney's Future ($235.2m, 77%); and
- Stockdill Drive Switching Station ($40.7m, 13%).

260. Only $14.8m (5%) was directed to 'Base Augex' which comprises six projects, with the balance of $14.7m for connections capex. This contrasts with the capex forecast for the next RCP, for which Base Augex comprises 65% of the total $253.6m augex forecast in the RP. However, Transgrid is also planning several major projects in the next RCP including HumeLink, several projects currently undergoing 'RIT-T' assessments and other projects driven by NSW REZ policies. As we indicate in section 3, these major projects are likely to dominate Transgrid's augex over this period, however Transgrid has chosen not to include them in its regulatory submission.

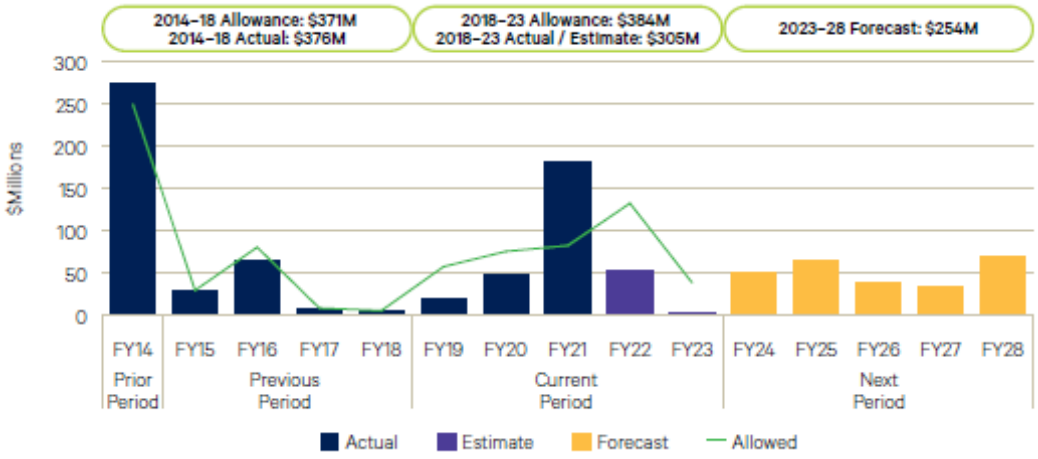
261. Transgrid has proposed six 'demand driven' projects, four 'compliance-driven' projects and six 'economics benefits driven' projects as a part of its base augex forecast in its RP. We assess the proposed project-level expenditure for base augex in sections 5.2 to 5.5.

5.1.2 Augex capex trend

Overview

262. Figure 5.1 below compares Transgrid's historical actual and estimated augex and forecast augex (excluding ISP and the NSW Electricity Infrastructure Roadmap projects).

Figure 5.1: Transgrid Augex historical and forecast - $m, real 2022-23



Source: Transgrid 2023-28 Revenue Proposal Figure 8-10

EMCa's observations

263. Transgrid expects to incur $305.4m in the current RCP, which is $78.8m (20.5%) less than the AER's allowance.[102] Transgrid explains that the underspend is due to: (i) a $19m underspend of the Powering Sydney's Future project; and (ii) reprioritisation of other expenditure:[103]

> *'We have needed to re-prioritise projects across our capex portfolio during the current regulatory period to respond to emerging issues and remain within the AER's capex*

100 Including connections capex of $14.7m

101 Transgrid – Augex Overview Paper – 31 Jan 2022 – PUBLIC, p16

102 Transgrid – Augex Overview Paper – 31 Jan 2022 – PUBLIC, Table 3-1, including connections and excluding ISP projects

103 Transgrid – Augex Overview Paper – 31 Jan 2022 – PUBLIC, pages 21-22

allowance. For Augex, this means that we have focused on the delivery of key projects driven by our compliance obligations…

As a consequence, we have not pursued projects which could be cancelled without affecting network reliability (which are typically market benefit projects) and we have also sought to defer projects that can be efficiently deferred into the next period.'

264. We discuss the movements in the current RCP further in section 3.2.4 and Table 3.5. In summary:

- It is common practice for NSPs to reprioritise their programs of work within a RCP in response to changing assumptions, and which may include prudently deferring or cancelling projects, as Transgrid has done in the current RCP.
- However, we are concerned that the new timing of projects was influenced, in part, by Transgrid's strategy not to proceed with some projects in order to '*remain within the AER's capex allowance'*, and which we consider to be inconsistent with the NER capex objectives and with good industry practice.

265. For the reasons discussed in section 4.2.4, we consider that one or more projects designated for the next RCP may similarly be deferred due to Transgrid's constrained future delivery capacity. This would lead to a reduced overall capex requirement. If this risk materialises, we again expect that Transgrid would prioritise deferment of one or more market economics-benefit driven projects. It is also possible that delivery constraints may lead to one of more of the other ten Augex projects being deferred, particularly those that are scheduled to be completed late in the next RCP or in the subsequent RCP. We discuss this concern further in our assessment of individual projects in the sections below.

266. Load growth uncertainty, specifically the timing and magnitude of expected new spot loads, may again result in a net reduction in capex requirements. We also consider the sensitivity of Transgrid's forecast augex to load growth uncertainty in the sections below.

5.2 Our assessment of major projects augex

5.2.1 Introduction

267. In this section we assess Transgrid's proposed capex for the Major Project included in the augex forecast and the land purchase which enables it:

- Supply to Western Sydney Priority Growth Area; and
- Strategic property.

5.2.2 Supply to Western Sydney Priority Growth Area – project 1687

Overview

268. Transgrid proposes establishing a new Kemps Creek Bulk Supply Point (BSP) with 2 x 375 MVA 330/132kV transformers and adding a 330/132kV transformer at the existing Macarthur BSP.[104] The project is designed to provide sufficient extra capacity to meet expected demand growth. Transgrid refers to its preferred option as Option A, with [redacted] capex required in the next RCP, the bulk of which is expected to be incurred in FY28.

269. Transgrid's OER describes the driver of demand growth as:[105]

'… development of the Aerotropolis precinct comprising:

[104] Endeavour Energy is separately progressing approvals to rebuild the existing 66kV line 85L into a 132kV line; upgrade line 9L1 and 9L29 to match the transformer rating of 375 MVA, and achieve higher ratings for new cables/lines between Kemps Creek BSP and South Erskine Park (or install a series reactor) to manage the 132 kV line/cable loading

[105] Transgrid - OER-1687 Rev 4 Supply to WSyd Priority Growth Area - 24 Dec 2021 – CONFIDENTIAL, page 4

- Western Sydney International (Nancy Bird Walton) Airport;

- The Sydney Metro-Western Sydney Airport line;

- Road infrastructure (including the M12 motorway); and

- New industries including agribusiness, transport and logistics, defence, aerospace, education and advanced manufacturing.'

270. The project is planned to be completed in FY29 at a total cost to Transgrid of [redacted] (real $2021, including capitalised overheads and the property acquisition discussed in section 5.2.3). The cost to Endeavour Energy for its complementary works is estimated to be $87.8m (real $2021).[106]

Assessment

271. The information provided by Transgrid and in response to our questions confirms that (i) there is a high likelihood of rapid and sustained load growth in the subject area, and (ii) in the absence of remedial measures, the increase in demand will result in power flows exceeding the capacity of elements in the network from 2026/27, even under system normal conditions. We consider it reasonable to assume that remedial action is required to avoid non-compliance with the NER.

272. Transgrid describes its Base Case as requiring no new augmentation to relieve the loading on Macarthur 132kV BSP transmission network. Transgrid reasonably deems the Base Case to be technically and commercially unacceptable.

273. Transgrid's NPV analysis compares its options (Option A and Option B[107]) with its Base Case.[108] Option B is estimated to cost 50% more than Option A and has a marginally lower NPV. Option A's NPV is estimated by Transgrid to be $10.5 billion.[109]

274. Transgrid also identified two other network options, referred to as Option C and Option D. The estimated cost of Option C[110] is significantly higher than Option A and it offers no technical or other advantages. Transgrid reasonably deems Option D[111] to be technically unfeasible. Transgrid also identified a Non-Network Solution (NNS) as Option E, but it does not identify what form(s) of NNS may contribute to a solution to the forecast overload, relying instead on the upcoming RIT-T process. This leaves some uncertainty regarding the optimal solution or combination of solutions until the RIT-T process is completed.

275. Transgrid identifies the 'Supply to Sydney West Area' (project N2371, discussed in section 5.4.2) as a related project but does not discuss it further in the OER, although Sydney West BSP is mentioned in Options C and D. We did not understand how the two projects were related and particularly whether project 1687 was required if project N2371 proceeded. From our discussions with Transgrid, we now understand that project N2371 provides an initial source of additional supply capacity into the West Sydney area (it is planned to be completed by FY25) and project 1687 is required in addition to project N2371 to meet the forecast demand growth. This addresses our concern.

276. We have described our concerns with Transgrid's approach to its economic analysis (refer to section 4.2.2). For this project, we consider that:

106 Transgrid - OER-1687 Rev 4 Supply to WSyd Priority Growth Area - 24 Dec 2021 – CONFIDENTIAL, Table 1

107 Develop a new BSP supplied from a cut-in to line 39 near the southern transition station of Western Sydney Airport underground cable

108 In the Base Case, Endeavour projects may still proceed, but '*will not reduce the risk or extent of load curtailment required at Macarthur'* OER-1687, page 6

109 As we have described in section 3, this exceedingly high NPV results from Transgrid treating unconnected load as 'non-supply' valued at VCR. We consider this to be a significant over-estimate of the benefits of the option, however it is the load itself rather than the assessed 'economic benefit' that is the over-riding justification of need.

110 Upgrade existing Sydney West and Macarthur BSP

111 Upgrade existing Sydney West and Macarthur BSP with open point within Endeavour Energy distribution network

- Whilst Transgrid's NPV analysis leads to an overstatement of the benefits, we consider that it is likely to lead to the appropriate discrimination between options (i.e. for the purpose of option selection); and
- Option A is the logical network-based option from those considered.

277. The timing of the project is determined by Transgrid's assessment of the earliest practical commissioning of the works, and not the NPV:[112]

> *'[T]he earliest practical commissioning year based on the project program in OFS-1687A and the estimated duration of approval process through the RIT-T is 2028/29. The final commissioning year will be determined through joint planning with Endeavour Energy and will subject to the implementation of Endeavour Energy's supply network development plan.'*

278. We note Transgrid's advice that FY28/29 is the earliest practicable completion year. Given that (i) 74% ($55.0m) of the Option A cost is scheduled to occur in the final year of the next RCP, and (ii) our concerns regarding the deliverability of Transgrid's proposed network capex program, we consider that the completion date is more likely than not to slip due to any number of external factors. If so, this would result in a greater proportion of capex incurred in the subsequent RCP.

Summary

279. A solution is required to address the identified need. The proposed Option A is likely to be the prudent network solution and a new BSP is likely to be required within the foreseeable future. There remains uncertainty regarding the required capex in the next RCP due to:

- Lack of consideration of non-network solutions (which may for example lead to deferment of the BSP establishment); and
- The likelihood of program slippage due to delivery constraints (or other factors, given that Transgrid deems FY29 to be the 'earliest practicable commissioning year' for this project).

5.2.3 Strategic Property

Overview

280. Transgrid has included the purchase of land for the establishment of the proposed new Kemps Creek BSP (discussed above) at an estimated total cost of [redacted] (real $2020-21). A total of [redacted] is proposed to be incurred in the next RCP. [redacted][113]

281. Transgrid's project OER states that:[114]

> *'Land south of Kemps Creek 500/330 kV Substation has been identified as a suitable site with access to the 330 kV and 500 kV network, and close-proximity to the load centre…[i]n the absence of strategic land acquisition in the near future, it likely that when this infrastructure is needed, the land south of Kemps Creek 500/330 kV Substation will be either: no longer available for purchase; or significantly more expensive, in present value terms, than it is now.'*

112 Transgrid - OER-1687 Rev 4 Supply to WSyd Priority Growth Area - 24 Dec 2021 – CONFIDENTIAL, page 12

113 Transgrid - OER-2137 Rev 2 Strategic prop acq WSyd Priority Growth Area – 23 Dec 2021 - CONFIDENTIAL, page 2

114 Transgrid - OER-2137 Rev 2 Strategic prop acq WSyd Priority Growth Area – 23 Dec 2021 - CONFIDENTIAL, page 2

Assessment

282. Transgrid presents a Base Case (defer purchase until the next RCP) and its preferred Option A. No other options were presented, but we assume that the site selected for Option A followed consideration of other possible sites.

283. The estimated costs for the Base Case and Option A were derived from an initial land valuation from the NSW Department of Planning. Transgrid also refers to a land valuation by Knight Frank and to an overall estimate accuracy of ±25%, which appears to be a reasonable approach for the business case, though this variance seems inconsistent with [redacted]. If the RP is an estimate and not the actual purchase price, we assume the latter will be included in the RRP given the advice that the purchase contract was scheduled to be entered into in FY22.

284. Transgrid's economic analysis is simply based on comparing the estimated purchase cost for Option A with the estimated purchase cost for the Base Case (which is derived from external advice).[115] This results in a Base Case cost approximately three times higher than Option A, with a net present cost (NPC) 170% higher than for Option A. We are satisfied that Option A is preferrable to the Base Case.

Summary

285. It is prudent for Transgrid to secure a property for the proposed new Kemps Creek BSP.

5.3 Our assessment of compliance driven augex

5.3.1 Introduction

286. In this section we assess the proposed $36.9m expenditure on the four projects that Transgrid categorises as 'compliance driven' augex:

- Improve voltage control in Southern NSW;
- Maintain voltage in Greater Sydney Area;
- Voltage control under light load conditions; and
- Maintain voltage in Alpine Area.

287. Three of the four projects are intended to provide solutions to the impacts of a common issue ('System Low'), so we have assessed these three projects together in section 5.3.2.

5.3.2 Projects to address System Low impacts – projects 2145, 2584 and 2649

Overview

288. In this section we consider Transgrid's proposed investments to address the impacts of forecast minimum demand (or 'system low') events via the following projects:

- Improve voltage control in Southern NSW – OER 2145, in which Transgrid proposes installing shunt reactors at Kangaroo Valley (1 x 50MVAr, 330kV), Darlington Point (2 x 20MVAr, 132kV) and Balranald (1 x 20MVAr, 220kV) by FY27, which Transgrid considers to be the earliest practical completion date;
- Maintain voltage in Greater Sydney Area – OER N2584, in which Transgrid proposes installing a 100MVAr shunt reactor at Beaconsfield 132kV by FY26, which Transgrid identifies as the economically optimum timing; and

[115] Transgrid - OER-2137 Rev 2 Strategic prop acq WSyd Priority Growth Area – 23 Dec 2021 - CONFIDENTIAL, page 4

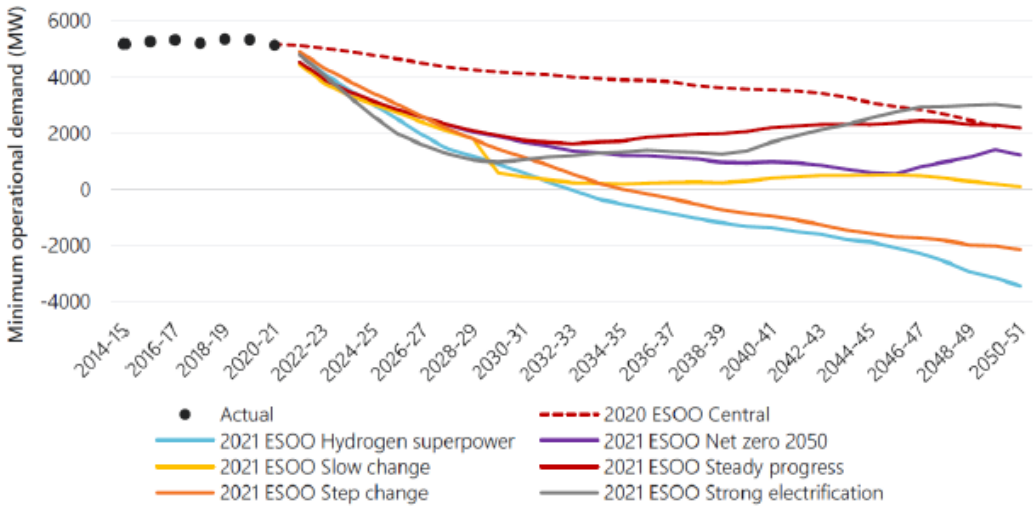
- Voltage control under light load conditions – OER N2649, in which Transgrid proposes installing a 25MVAr reactor at Inverell 132kV in FY25, which Transgrid identifies as the economically optimum timing.

Assessment

289. Transgrid notes that AEMO's ESOO 2021 report indicates that minimum demand in NSW will decline over the next 3 - 5 years (to FY26). This is due primarily to the increasing penetration of DER and, in some cases, load reduction from industrial plant shutdowns.[116] The impact is described as over-voltages in excess of the technically prescribed limit or plant maximum voltage rating.[117]

290. Each of the OER documents reports non-compliance issues for certain single contingency events with the expectation that following progressively lower system low events, voltage non-compliance will manifest during normal system operation within the next few years. This trend is depicted in Figure 5.2.

Figure 5.2: AEMO minimum demand forecast for NSW



Source: ESOO 2021

291. Each OER considers multiple options, including one or more of the following:

- Base Case – no intervention in the next RCP;
- Different combinations of shunt reactors installed by Transgrid;
- The relevant DNSP installing reactive support – this is recognised as a possibility in each OER but discounted because optimisation between the DNSP and Transgrid has not been finalised;
- Dynamic voltage control (SVCs, synchronous condensers) – not pursued by Transgrid primarily because it is cost-prohibitive compared to installing reactors, which we consider to be a reasonable conclusion;
- Replacing transformers – reasonably assessed by Transgrid to be cost-prohibitive compared to the preferred option;
- NNS – OER N2584 identifies installation of a BESS to provide reactive support and reduce the voltage level in the Ausgrid network as a possible solution but questions the commercial viability and leaves the full exploration to the RIT-T process; and

116 Transgrid - OER-2145 Rev 4 Southern NSW Improve voltage control - 23 Dec 2021 – PUBLIC, p2

117 Voltage levels must be maintained within connection point voltage regulation requirements under NER S5.1.4; NER 4.2.6 requires NSPs to operate the transmission network in a secure operating state, which requires voltages to be maintained within 10% of normal voltage during normal operation and following any credible contingency event

- Operational measures[118] – Transgrid classifies these as acceptable only as a short-term solution (i.e. in the interim to a longer term solution), which is a reasonable position.

292. Transgrid includes the Base Case and one or two options involving additional shunt reactors in its economic analyses. In each case, Transgrid has selected the lowest cost technically acceptable transmission network option.

293. In our view, whilst Transgrid appears to have selected the appropriate network solution in each case, the three OERs do not adequately account for the possibility of viable alternative solutions or part-solutions which may reduce the augex required by Transgrid in the next RCP, including:

- Staging of the planned installations in N2145 to provide option value;
- Optimisation of investment between the relevant DNSP (Ausgrid) and Transgrid; and
- The impact of technical standards and technology providing viable non-network solutions, including temporary PV curtailment and load shifting.

294. Transgrid acknowledges that the latter two options will be developed through the RIT-T process, which applies to each proposed project.

Summary

295. Transgrid has likely selected the appropriate transmission network solution to avoid voltage non-compliance in localised parts of its network under system low conditions, assuming that a network solution is required. Whilst it has deferred full consideration of alternative solutions to the RIT-T process, the existing non-compliances identified under specific single contingencies and the reasonable expectation of voltage non-compliance during normal system conditions within the next 3-5 years means that it is prudent to propose augex for the installation of the majority of the proposed reactors.

5.3.3 Maintain voltage in Alpine Area – project N2645

Overview

296. Transgrid proposes the installation of a +75/-40 MVAr Static Var Compensator (SVC) at Williamsdale by FY30 at a total cost of $22.4m (of which $2.1m is forecast for the next RCP). Transgrid refers to the preferred option as Option A in its analysis.

297. Transgrid describes the need for this project to ensure that loads are reliably supplied from Munyang and Cooma whilst maintaining satisfactory voltage levels in the area as the winter peak demand grows due to a number of spot loads associated with skiing.

298. Under N-1 outage conditions Transgrid has identified that there will be voltage limitations reached and/or breached at Cooma and Munyang. If the spot loads eventuate, Transgrid advises that:[119]

> *'… [u]nder-voltage conditions (< 0.9pu) are expected to occur at Munyang 132 kV and 33 kV busbars, Cooma 132 kV and 66 kV busbars and Williamsdale 132 kV busbar under N-1 outage conditions….'*

Assessment

299. We consider that Transgrid has demonstrated a prima facie need for investment to address the identified issues.

300. Transgrid considered five options in addition to the Base Case ('do nothing') with the preferred option and Option D to install a 40MW/80MWh Battery Energy Storage System (BESS) included in the economic analysis.

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118 Such as switching out lines at times of voltage control problems

119 Transgrid - OER-N2645 Rev 2 Maintain voltage in Alpine area - 24 Dec 2021 – PUBLIC, page 2

301. In our opinion, the options not progressed[120] were reasonably assessed by Transgrid as not being technically feasible. However, we queried the sizing of the SVC given the relatively modest peak winter demand growth above the voltage limit. Transgrid's response[121] satisfactorily explained the basis for the SVC rating.

302. Transgrid's economic analysis of Option A identified a Benefit to Cost Ratio (BCR)[122] of 2.1 for the Central scenario. As discussed in section 4.2, there are likely to be unfavourable variances to Transgrid's input assumptions which would bring the Central scenario closer to Transgrid's lower bound scenario, which has a Net BCR of 0.4, which whilst still positive may lead to a different economically optimum timing for the project.[123] Given the reliance of Transgrid's analysis on the steady growth in spot loads in the Thredbo/Perisher area,[124] only a minor reduction in actual growth would likely defer the economic timing by 12 months or more, reducing the required capex in the next RCP by approximately $1.8m (-8%).

303. Transgrid also identified procurement of demand management services and voluntary load curtailment as a potential NNS (Option F), but deferred exploration of these to the RIT-T process. This is a common and deliberate limitation of Transgrid's OER analysis.

Summary

304. Transgrid has likely selected the appropriate transmission network solution to address potential voltage control issues in the Alpine area, if a network solution is required. However, there is material uncertainty regarding the need for the majority of the proposed capex in the next RCP due to the possibility of a combination of higher costs and lower than forecast load growth and/or delay to the capital investment due to adoption of an NNS.

5.3.4 Summary of our assessment of compliance driven augex

Transgrid has established a reasonable basis for the proposed projects

305. Transgrid has identified three compliance-driven projects that warrant consideration for investment in the next RCP to mitigate the impacts of system low events. In each case, we consider that Transgrid's recommended solution is likely to be the best option from those considered. We note that the RIT-T process will provide a more thorough examination of the viability of NNS to maximise the net economic benefit.

One project is a candidate for deferral

306. Project N2645 is a candidate for deferral due to the possibility of a combination of higher costs; lower than forecast load growth; and/or adoption of an NNS arising from the RIT-T process.

5.4 Our assessment of demand driven augex

5.4.1 Introduction

307. In this section we assess the proposed $85.2m expenditure on the four projects that Transgrid categorises as 'demand driven' augex:

- Supply to Sydney West Area;
- Maintain voltage in the Vineyard Area;

120 Option B – capacitor banks, Option C – capacitor banks, Option E – operational measure

121 Transgrid's response to information request AER IR022, Transgrid-IR022-Transgrid response for Capex EMCa onsite-20220523-CONFIDENTIAL, question 12

122 BCR is equal to the NPV divided by the PV of cost. We apply this definition throughout the report

123 Transgrid - OER-N2645 Rev 2 Maintain voltage in Alpine area - 24 Dec 2021 – PUBLIC, Table 8

124 5MW pa FY22-FY26, 9MW pa from FY27-FY29, and 11MW p.a. in FY30-FY31

- Maintain voltage in the Beryl area; and
- Supply to Far West NSW Network.

5.4.2 Supply to Sydney West Area – project N2371

Overview

308. Transgrid proposes installing a new 330/132 kV transformer at Sydney West BSP by FY25 at a cost of $17.4m.[125] Transgrid refers to this as Option A in its analysis.

309. Transgrid reports that the latest Endeavour demand forecast shows rapid load growth in the Sydney West area due to the connection of new data centres and ongoing development of commercial and residential lands and associated infrastructure in the area. The gap between the forecast demand and firm capacity at Sydney West BSP is expected to increase from 62 MVA in FY24 to 731 MVA in FY30. Absent any remedial investment, load growth at this level would result in load shedding under single or multiple transformer outages.

Assessment

310. On the basis of the demand growth information provided, we consider that a need for investment has been reasonably established. We note that there is an interdependency between this project and Project 1687 Supply to Western Sydney Growth Area with similar descriptions of the demand growth and spot load increases. Our understanding is that this project precedes Project 1687 (scheduled for completion in FY29 at the earliest) and both projects (including the complementary work by Endeavour) are required to provide sufficient firm capacity.[126]

311. Transgrid identifies three options in its OER in addition to the Base Case ('do nothing') and its preferred option, Option A, noting that the Base case is expected to require load shedding from FY25:

- Option A increases the firm capacity at Sydney West BSP by 375 MVA by installing a new 330/132 kV transformer;
- Option B is to establish a new 330/132kV BSP at Mt Druitt and to convert the existing 132kV line to 330kV. This is significantly more expensive than Option A;
- Option C is an unspecified NNS, with Transgrid deferring consideration of possible NNS to the RIT-T process; and

312. Two load transfer options were also identified but were reasonably rejected by Transgrid because they are not technically feasible.

313. The NPV for Option A is significantly higher than for Option B under all scenarios. The BCR for the central scenario is 10.7 and it is 2.7 for the Lower bound scenario, both of which indicate a robust economic result. The optimal timing for Option A is sensitive to input assumptions and may be a year or two later than the FY25 commissioning year nominated by Transgrid but is still more likely than not to require commissioning within the next RCP.

Summary

314. Unless the RIT-T process identifies an NNS that can economically defer the proposed Option A (and which we consider unlikely), the new transformer is likely to be required within the next RCP.

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125 The scope includes work at the BSP to accommodate the new circuit in addition to the transformer itself

126 Transgrid - OER-N2371 Rev 2 Supply to Sydney West BSP - 20 Dec 2021 – PUBLIC; The new Kemps Creek BSP is '*mainly to provide the electricity supply to the area surrounding [the] new Western Sydney airport. It can partially offload the Sydney West 132kV load once it is completed by 2028/29 but it won't provide adequate supply for the load growth at Sydney West BSP*'

5.4.3 Maintain Voltage in the Vineyard Area – project N2360

Overview

315. Transgrid proposes looping-in line 26 to Vineyard 330kV substation at a cost of $38.4m by the summer of FY25. This is referred to as Option A in Transgrid's analysis.

316. The voltage stability requirement (NER S5.1.8) is that the reactive margin must not be less than 1% of the maximum fault level at the connection point. Load shedding will be required if the reactive margin is breached.

317. The Vineyard Precinct is in the North West Priority Growth Area. Rapid load growth is occurring in the area supplied by the Vineyard BSP, which is expected to result in a breach of the reactive margin at the Vineyard 330 kV and 132 kV busbars in FY25 for an outage of 330 kV line 29 (which supplies the Vineyard BSP from Sydney West BSP).

Assessment

318. We consider that Transgrid has demonstrated a need for action. Transgrid identifies three options in its OER in addition to the Base Case ('do nothing') and the preferred Option A:

- The Base Case is expected to require load curtailment from FY25 for the specific single contingency.
- Option A addresses the voltage stability (reactive margin) driven supply limit for the 25 year assessment period.
- Option B is a staged installation of shunt capacitors at the Vineyard BSP 330kV and 132kV busbars. This option is estimated to cost approximately the same as Option A, but Transgrid's analysis identifies Option A as providing a longer-term solution to managing the load curtailment risk.
- Option C is an unspecified NNS, with Transgrid deferring consideration of possible solutions to the RIT-T process.

319. A load transfer option and an option locating new shunt capacitors in the Endeavour distribution network are also discussed briefly in the OER. The load transfer option is reasonably assessed by Transgrid to be technically infeasible and more costly than Option A. The shunt capacitor option is reasonably assessed by Transgrid as not providing a commercially superior alternative to Option A.

320. The NPV for Option A is strongly positive under all sensitivity scenarios and is slightly higher than Option B. Although the NPV results are distorted by Transgrid's input assumptions, they support Transgrid's option selection. Nonetheless, the optimal timing for Option A is sensitive to input assumptions and may be a year or two later than the FY25 identified by Transgrid if, for example, demand growth is somewhat slower than forecast. On balance, however, we consider that Option A is still more likely than not to require commissioning within the next RCP.

Summary

321. Unless the RIT-T process identifies a NNS that can economically defer the proposed Option A, the new transformer is likely to be required within the next RCP.

5.4.4 Maintain Voltage in the Beryl Area – project 1316

Overview

322. Transgrid proposes installing a 30MVA synchronous condenser at the Beryl BSP 132kV busbar at a cost of $20.9m[127] by FY27 to avoid voltage and reactive margin non-compliance in the Beryl area. Transgrid refers to this as Option A in its analysis.

[127] The scope includes extending the substation and relay room, a new 30MVA 132kV/11kV transformer and an auxiliary transformer

323. Loads supplied from Beryl BSP are forecast to steadily increase to 90 MW (summer peak). Transgrid has identified under-voltage constraints and reactive margin shortfalls in the Beryl area for a contingent outage of a 132 kV.[128, 129] The amount of unserved energy is calculated as pre-contingent load shedding including the output of renewable generation in the area and is forecast to increase approximately eight-fold from 2021 to 2030.[130]

Assessment

324. Based on the information provided by Transgrid on the growth of expected unserved energy, there is a prima facie case for corrective action to avoid compliance breaches/voltage collapse in the local 132kV network.

325. Transgrid identifies six options in addition to the Base Case and the preferred Option A:

- The Base Case ('do nothing') assumes that load is involuntarily curtailed in case of a contingent outage of 132kV line 94B from Wellington BSP to Beryl BSP, which is exacerbated when renewable generation in the area is not dispatched.
- Option A provides dynamic reactive power support to alleviate the undervoltage constraints.
- Option B is a new Beryl 330/132kV substation. It is technically feasible and would also improve system strength in the Beryl area. However at an estimated capex of $50.1m it has a materially lower NPV than Option A.
- Option C is installation of a 18MW/36MWh BESS at Beryl Substation at an estimated cost of $52.0m. Again, because it is significantly more expensive that Option A, it has an inferior NPV.
- Option D is duplication of line 94B, which at an estimated capital cost of $74.0m and is considered prohibitively expensive.
- Option E is installation of a new 132kV +30MVAr/-5MVAr STATCOM at Beryl 132/66kV substation at an estimated cost of $20.0m, which provides similar technical benefits to Option A at a slightly lower cost. However, Transgrid favours the synchronous condenser over the STATCOM because it is likely to be able to be delivered a year earlier. This is a reasonable position for the purposes of the augex forecast and pending the RIT-T process.
- Option F is an unspecified NNS, with Transgrid advising that it has not identified any technically or commercially viable options and has deferred further consideration to the RIT-T process.

326. A final identified option is the installation of capacitor banks at Beryl 132/66kV substation, but Transgrid reasonably concludes that this is not technically feasible.

327. The Option A BCR is 3.0 for the Central scenario, which is relatively strong and supports Transgrid's analysis of FY27 as the optimal year for completion. However, the NPV result (and therefore the economic timing) is sensitive to demand growth. As discussed in section 4.2, there are likely to be unfavourable variances to Transgrid's input assumptions which would bring the Central scenario closer to Transgrid's Lower bound scenario, which has a BCR of -0.5 (and which is therefore indicative of an uneconomic project).

Summary

328. It is possible that this project may be prudently delayed by a year or two if load growth is lower than expected or if an acceptable NNS is identified. This would lead to a reduced capex requirement in the next RCP.

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128 NER cS5.1a.4 requires TNSPs to plan and design equipment for voltage control of its network to maintain voltage levels within 10 per cent of nominal voltage.

129 NER cS5.1.8 requires reactive power margin at any connection point to be not less than 1% of the maximum fault level (in MVA) at the connection point.

130 Transgrid - OER-1316 Rev 6 Maintain voltage in Beryl area - 24 Dec 2021 – PUBLIC, p3

5.4.5 Supply to Far West NSW Network – project 1698

Overview

329. Transgrid proposes installing 2 x 30MVA 220kV capacitor banks at Broken Hill substation at a cost of $8.4m[131] by FY29. The majority of the proposed augex ($7.3m) is scheduled to be incurred in FY28. Transgrid refers to this as Option C in its analysis.

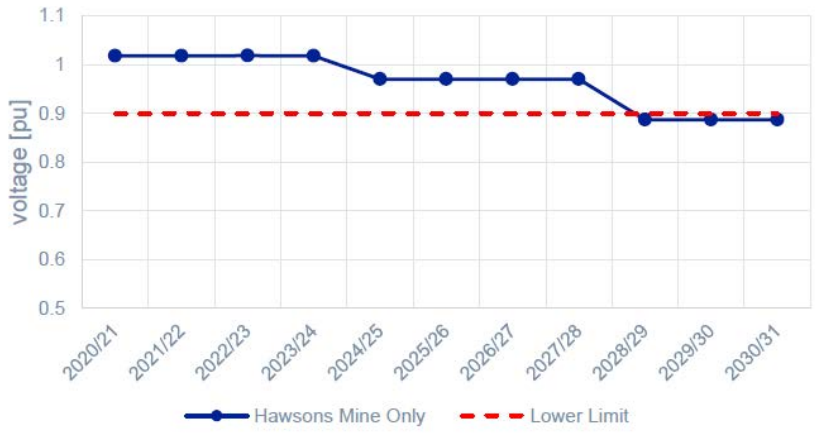
330. Forecast load is expected to increase by [redacted] in the Broken Hill area as a result of proposed new mining loads. Transgrid's planning studies show that connecting the new mines will result in (i) under-voltage and voltage step change breaching NER specified limits,[132] and (ii) overloading of the 220 kV Line X2 during N-1 conditions.

Assessment

331. Based on the information provided by Transgrid on the growth of expected unserved energy, there is a prima facie case for taking corrective action to avoid likely non-compliance with the relevant NER requirement[133] if the proposed mining loads proceed.

332. The Base Case shows the post contingent voltage at Broken Hill 220kV busbar (refer to Figure 5.3 below), indicating that the non-compliance could occur in FY29.

Figure 5.3: Broken Hill 220kV busbar voltage – post contingent



Source: Transgrid - OER-1698 Rev 2 Supply to Far West NSW Network - 27 Sep 2021 – CONFIDENTIAL, p8

333. The busbar voltage lower limit is exceeded by a relatively small amount for the Central scenario and therefore is sensitive to the planning assumptions applied in deriving Figure 5.3. [134] A delay of the second stage expansion of the proposed Hawsons Mine and of the proposed Cobalt Blue Mine (or any other new mines) would likely result in the voltage not exceeding the lower limit. Accordingly, if this was to occur, most or all of the proposed capex to address the 'compliance breach' would be deferred into the next RCP or beyond.[135]

131 The total cost is $15.4m (real, 2020-21), with $7.0m (real, 2020-21) to be incurred in FY29. The scope of work includes property acquisition, switchyard extension, and other work at Broken Hill substation to accommodate the proposed new capacitor banks

132 Undervoltage of less than 0.9 pu and voltage step change of >10% at Broken Hill 220kV and 22kV busbars and at the mine connection points

133 NER 4.2.2 Satisfactory Operating State

134 Transgrid's Central scenario assumes only Hawsons Mine proceeds with 100% of planned load take up of [redacted]; the High scenario assumes both the Hawsons mine and the Cobalt Blue mine [redacted] proceed

135 Not taking into account the possibility of a NNS also resulting in deferral of some capex

334. Transgrid advises that project planning has taken into account the benefit from augmentation work associated with Project EnergyConnect.

335. Transgrid identifies six options in addition to the base Case ('do nothing') :

- Option B includes installation of a third SVC at Broken Hill and is technically feasible but commercially inferior to Transgrid's preferred Option C. Option B has double the capital cost of Option C and has lower NPV for the three sensitivity scenarios than for Option C.
- The preferred Option C has a BCR of 1.4 for the Central scenario, which is a modest result. However, as discussed above, the result is very sensitive to the spot load timing and, as discussed in section 4.2, there are likely to be unfavourable variances to Transgrid's input assumptions which would bring the Central scenario closer to Transgrid's Lower bound scenario, which has a BCR of -1.1 (which is indicative of an uneconomic project).
- Options A, D and E - Option A is to upgrade the existing No. 1 and No. 2 SVCs at Broken Hill, Option D is to install a 100MW/200MWh BESS at Broken Hill, and Option E is to establish a second 220kV single circuit between Buronga and Broken Hill. These were all rejected by Transgrid on what we consider to be reasonable grounds. However, Transgrid states that it will consider these again as part of the RIT-T process.
- Option F to provide a NNS considers potential solutions, including support from embedded generation or energy storage:[136]
  - *'procurement of demand management services in the Broken Hill area during the times of peak demand and/or outage conditions to alleviate the network constraints;*
  - *procurement of reactive power support from renewable generation in the area (i.e. Broken Hill Solar Farm);*
  - *support from embedded generation or energy storage; and*
  - *voluntary under voltage load shedding schemes associated with industrial loads in the area.'*

336. Transgrid's OER refers to project 1754 Broken Hill Supply Reinforcement as a related project undergoing the RIT-T assessment process. Importantly the OER states that:

> *'[i]f similar reactive support is installed to address Need 1754 and associated projects, it could provide a solution to this Need, i.e. the requirement for reactive support to facilitate the safe and reliable connection and supply for the mine loads (Hawsons and Cobalt Blue). In this event the requirement for this need is to be reviewed.'*

337. We asked Transgrid for an update on progress with this project but no new information was provided.[137] However, Transgrid has since published its PACR for a new back up supply[138] and identifies a NNS as the preferred approach – a 200MW/1,500MWh compressed air storage facility. This indicates to us that Project 1698 may not be required for the foreseeable future. The result also demonstrates that in some cases, NNSs are potentially viable alternatives to address transmission constraints.

Summary

338. Project 1698 may not be required in the next RCP due to a likely NNS solution to the related project 1754.

136 Transgrid - OER-1698 Rev 2 Supply to Far West NSW Network - 27 Sep 2021, page 11

137 Transgrid's response to information request AER IR015, Transgrid-IR015-Transgrid response for capex-20220510-CONFIDENTIAL, page 28

138 Viewed at https://www.transgrid.com.au/projects-innovation/broken-hill-supply

5.4.6 Summary of our assessment of demand driven augex

Non-network solutions may be identified for some demand-driven projects

339. We consider that Transgrid has identified legitimate compliance risks in its network in each of the four projects proposed. However:

- Transgrid has focused its planning effort on consideration of network solutions, deferring assessment of NNSs to the RIT-T process; and
- The recent result of the RIT-T process for project 1754 demonstrates that a NNS, either as a standalone solution or in combination with another solution, may reduce the required augex in the next RCP for some projects.

Projects are sensitive to timing of spot loads

340. The project timing is sensitive to actual spot load growth and to Transgrid's delivery capability. In at least one of the four projects considered in this section, the project timing and most of the proposed augex is at risk of deferral to the next RCP for even a one-year delay to one or more new spot loads.

5.5 Our assessment of economics benefit driven augex

5.5.1 Introduction

341. NER cS5.1.8 requires NSPs to consider the effects of non-credible contingencies which could potentially endanger the stability of the power system and give rise to cascading failures. Transgrid has identified six projects designed to provide a net economic benefit from avoiding or mitigating the cost associated with non-credible contingencies (i.e. multiple coincident outages).

342. In this section we assess Transgrid's proposed $39.6m expenditure on the six projects that Transgrid categorises as 'economics benefit driven' augex:

- Increase capacity for generation in Wagga North Area ($10.3m);
- Manage multiple contingencies in Sydney Northwest Area ($10.1m);
- Increase capacity for generation in the Molong to Parkes Area ($6.6m);
- Increase capacity of 132kV busbars at Wagga Substation ($5.2m);
- Manage multiple contingencies in the Bayswater to Sydney Area ($4.7m); and
- Manage multiple contingencies in the North West NSW Area ($2.7m).

5.5.2 Increase capacity for generation in Wagga North Area – project N2205

Overview

343. Transgrid proposes restringing 132kV lines 9R5 and 9R6 supplying Wagga North 132/66kV substation with a modern equivalent conductor to lift the thermal capacity of the lines to 160MW. Transgrid states that this will unlock the expected renewable energy and deliver market benefits for the foreseeable future.[139] The estimated capital cost is $10.3m and the proposed completion date is FY25. Transgrid refers to this as Option A in its analysis.

344. Transgrid reports that there have been recent renewable generation developments in the Wagga North area, with a number of generators planning to connect in this area in the near

[139] Transgrid - OER-N2205 Rev 1 Network Access via Wagga North SS - 18 Oct 2021 – PUBLIC, page 3

future.[140] Transgrid's planning studies identify increasing risk that lines 9R6 or 9R5 could be loaded beyond their thermal ratings under system normal network conditions with the current level of in-service and committed generation dispatched to their maximum capacities. Transgrid concludes that in all credible scenarios it expects significant economic benefits to the NEM from increasing the generation transfer capacity in the area.

Assessment

345. In addition to the preferred Option A and the Base Case ('do nothing'), Transgrid identified four other options. In the Base Case, Transgrid values the energy expected to be constrained-off to avoid thermal overload as the expected additional cost to the NEM from the equivalent amount of thermal based generation. The economic benefits for the options considered are determined relative to the Base Case. We consider this approach to be reasonable up to a point - in our view the duration of the benefit (i.e. avoided additional generating cost) may not persist for as long as Transgrid has assumed.

346. The remaining options assessed by Transgrid include:

- Option B to restring 9R5 and 9R6 with a high-temperature conductor is estimated to cost 20% more than the similar Option A, which is based on a standard temperature conductor. Option B would give more thermal 'headroom' than the preferred option, however Transgrid's economic analysis derives a higher NPV for Option A.
- Option C to construct a new double circuit transmission line from Wagga 330 to near Wagga North and reroute Line 991 and Option D to construct a new single circuit 132kV transmission line between Wagga North 132/66 kV. These are both four to five times more expensive than Option A and have materially inferior NPVs as a result.
- Option E to install a 120MW/240MWh BESS at Wagga North 132 kV Substation. This was estimated by Transgrid to cost 12 times more than Option A and was reasonably deemed by Transgrid to be commercially infeasible.

347. The Option A BCR is 3.5 for the Central scenario and 1.2 for the Lower bound scenario. It is a little lower in each case for Option B. This indicates that even correcting for issues we encountered with Transgrid's modelling (discussed in section 4.2) and with unfavourable variances in Transgrid's assumed input parameters, a positive NPV is likely for this project,

Summary

348. The proposed Option A is likely to be the best approach, and the economic timing is likely to be within the next RCP.

5.5.3 Manage multiple contingencies in Sydney Northwest Area – project 1491

Overview

349. Transgrid proposes a new control scheme using a SCADA/Protection-based Hybrid Special Protection System (SPS) for the Sydney North West 330 kV area to prevent or minimise the effect of widespread interruptions and a partial or full system collapse in the event of critical non-credible multiple contingencies. The estimated cost is $10.1m and the proposed commissioning year is FY28.[141] Transgrid refers to this as Option A in its analysis.

Assessment

350. Transgrid has identified that outages of any two (or more) of [redacted]

[140] The Bomen Solar Farm (100MW) is operating; Wagga North Solar Farm (49MW) is at commissioning stage; another 320MW of generation is at the committed stage and under development (planned to commence generation in 2-9 months). Transgrid - OER-N2205 Rev 1 Network Access via Wagga North SS - 18 Oct 2021 – PUBLIC, page 3

[141] Transgrid - OER-1491 Rev 4 Sydney North West area Protection System - 14 Jan 2022 - CONFIDENTIAL

[redacted] could lead to voltage collapse in the Greater Sydney load area. Refer to Figure 5.4.

Figure 5.4: Sydney metropolitan and target cut-set

[redacted]

351. This is Transgrid's Base Case as if nothing is done to mitigate the probability of occurrence or the consequences of the multiple contingency event, the expected maximum load shed is 1,500MW. Transgrid bases the probability of occurrence on:

- Application of a load moderating factor of 0.7 to account for the likelihood of the demand not being at the peak at the time of the double contingency;
- An outage duration of 8 hours, but with a load restoration factor of 0.5 to account for the time to restore 50% of the interrupted load;
- Transmission line failure rates from IPART's Electricity Transmission Reliability Standards (2015); and
- A cut-set moderating factor of 1.0 to account for the proportion of time that the load through the cut-set[142] is expected to exceed about 1200 MW.[143]

142 The Sydney North cut-set is shown in Figure 1 of the OER and comprises the flows across the [redacted]

143 *'If this cut-set flow is greater than 1200 MW, trip of any two of the parallel 330kV paths can trip the remaining parallel path and results in severe undervoltage conditions leading to widespread interruptions.'* Transgrid - OER-1491 Rev 4 Sydney North West area Protection System, page 6

352. We consider that each of these assumptions results in reasonable estimates with the exception of the cut-set moderating factor. We asked Transgrid for clarification of its derivation, but we remain unconvinced by the response that the load across the cut-set will exceed 1,200MW from year one of the study period at all times.[144] We therefore paid particular attention to the sensitivity of Transgrid's economic analysis outcomes to this moderating factor.

353. We consider that Transgrid's derivation of the transmission line probability of failure is reasonable.

354. We then reviewed Transgrid's method for estimating the probability for tripping of two lines (i.e. the combination of multiple contingency line outages), which among other things, assumes that the multiple contingency is triggered by intense bushfire events. We consider that Transgrid's overall failure rate of 1.0468% is a reasonable estimate.

355. Transgrid determined the risk cost of unserved energy for a multiple contingency event from the following formulas:[145]

$$Unserved\ Energy = (Load\ Moderating\ Factor * Maximum\ MW\ at\ risk) * (Load\ Restoration\ Factor * failure\ duration) * (Overall\ failure\ rate * Cutset\ Flow\ Moderating\ Factor)$$

$$Risk\ cost\ of\ energy = Unserved\ energy * VCR$$

356. Transgrid derived the VCR from the AER's *Value of Customer Reliability - Final Report on VCR Values*. Transgrid has used $43,032/MWh in its Central scenario. Due to the importance of this assumption in the economic analyses, we paid particular attention to the sensitivity of Transgrid's economic analysis outcomes to this factor.

357. Transgrid identified two options in addition to the Base Case ('do nothing') and the preferred Option A:

- Building at least two new transmission lines between Eraring / Vales Point and Sydney load centre via separate routes; or
- Undergrounding at least two transmission lines of the cut-set, for a length of about 86 km) to prevent impact from extreme weather conditions.

358. Transgrid reasonably determined that neither option was likely to be commercially viable due to the significantly higher cost and lack of commensurate benefits for the additional costs involved.[146] We consider it unlikely that a NNS will provide a technically acceptable, commercially viable solution to the multiple contingency scenario described, although this will be tested in the RIT-T process.

359. The Option A BCR is only 1.0 for the Central scenario and the NPV (and therefore the economic timing) is particularly sensitive to demand growth. As discussed in section 4.2, there are likely to be unfavourable variances to Transgrid's input assumptions, which would bring the Central scenario closer to Transgrid's Lower bound scenario with a BCR of -0.1, which would then indicate deferral as the preferred option.

Summary

360. Whilst we consider that the proposed investment is likely to be the prudent approach, it is a candidate for deferral if there are material unfavourable variances to Transgrid's assumed input parameters.

144 Transgrid's response to information request AER IR022, Transgrid-IR022-Transgrid response for Capex EMCa onsite-20220523-CONFIDENTIAL, question 14

145 Transgrid - OER-1491 Rev 4 Sydney North West area Protection System - 14 Jan 2022 – CONFIDENTIAL, page 6

146 Transgrid - OER-1491 Rev 4 Sydney North West area Protection System - 14 Jan 2022 – CONFIDENTIAL, page 7

5.5.4 Increase capacity for generation in the Molong to Parkes Area – project 2162

Overview

361. Transgrid proposes re-stringing 132kV line 94T (Moolong – Orange North) with a higher capacity conductor to achieve a summer day rating of at least 150 MVA. This is expected to avoid approximately 92% of forecast loss of market benefits due to removing the network constraint (i.e. the current line 94T thermal rating). The estimated capital cost of the project is $6.6m and the proposed completion date is FY25. Transgrid refers to this as Option B in its analysis.

Assessment

362. Line 94T is one of four 132 kV transmission lines which supply Orange North switching station, which supplies Orange City, Cadia Mine and surrounding areas. There is 340MW of in-service solar generation in the area, with a further 320MW of new generation scheduled to be operational in 2022.

363. Transgrid states that its network modelling, used as its Base case, shows that[147]

> *'…with the current level of in-service and committed generation dispatched to their maximum capacities, thermal overloading of Line 94T is expected under system normal network conditions. If the thermal capacity of Line 94T remains unchanged, regular limitations on the output of generators will be required… and… a substantial quantity of low-cost renewable energy from these generators will be curtailed/constrained throughout the course of a year.'*

364. Transgrid considered nine alternative options in the OER in addition to the preferred Option B:

- Option A: Increase transmission line design temperature to 125 MVA normal operation;
- Option A3: Increase conductor rating to 138MVA for contingency only;
- Option C: Rebuild line 94T as a single circuit line;
- Option D: Rebuild line 94T as a double circuit line;
- Option E: New dedicated circuit parallel to the existing line 94T;
- Option F: Demand management in Orange area;
- Option G: Battery storage at Molong Substation;
- Option H: Open circuit line 94T during daytime hours; and
- Option I: Smart Wires Line impedance control.

365. In our view, Transgrid has reasonably concluded that these nine options are likely to be either technically non-feasible (Options A3, H) or commercially non-feasible. Option A has a lower estimated capital cost than the preferred Option B, however Transgrid's analysis shows that the improvement in thermal capacity of line 94T from 112MVA to 125MVA is '*insufficient to address forecast market benefits.'*[148] Transgrid states that NNSs will be considered further in the RIT-T process.

366. Transgrid's Central scenario modelling result for Option B is strongly NPV positive with a BCR of 6.2. The Lower bound scenario NPV is 2.5. These results indicate that, despite our concerns with Transgrid's economic modelling and the likelihood of unfavourable variances of some key parameters (discussed in section 4.2), the market benefit is likely to be robust enough to justify the proposed investment in the next RCP.

147 Transgrid - OER-2162 Rev 3 Increase cap for gen in MOL to PKS area - 23 Dec 2021 – PUBLIC, page 3

148 Transgrid - OER-2162 Rev 3 Increase cap for gen in MOL to PKS area - 23 Dec 2021 – PUBLIC, page 4

Summary

367. The proposed Option B is likely to be the best approach, and the economic timing is likely to be within the next RCP.

5.5.5 Increase capacity of 132kV busbars at Wagga Substation – project 2208

Overview

368. Transgrid proposes uprating 132kV busbar sections at Wagga 132/66kV substation. Transgrid describes the source of market benefits as reduction of constraints on renewable generation in the Temora region under normal operating conditions. The estimated capital cost is $5.2m, with the project scheduled to be completed in FY27.[149] Transgrid refers to this as Option A1 in its analysis.

Assessment

369. Transgrid's modelling of its Base Case ('doing nothing') suggests that for approximately 118 days of the year it will be necessary to constrain at least 50 MW of renewable generation[150] to prevent overloading of the Wagga 132kV busbar. Transgrid also identifies constraints on the Wagga 66kV bus and Yanco 132kV bus, all caused by the rating of in-situ galvanised steel pipe busbars, which is much lower than for the current standard aluminium tube.

370. Transgrid modelled the economic benefit of replacing the under-rated busbar sections at the three busbars, with only the replacement of the Wagga 132kV busbar sections deemed likely to provide a positive NPV. Transgrid also considered two other options being Option B for replacement with adjacent busbars, and Option C as alternative engineering solutions. Based on the information provided, these were reasonably rejected by Transgrid. It is unlikely that a NNS will be identified that is superior to the preferred option, however this will be tested if the project is subject to the RIT-T process.

371. Transgrid's Central scenario modelling result for Option A1 is strongly NPV positive with a BCR of 30.6. The Lower bound scenario NPV is also strongly positive at 15.1. These results indicate that, despite our concerns with Transgrid's economic modelling and the likelihood of unfavourable variances of some key parameters (discussed in section 4.2), the market benefit is likely to be robust enough to justify the proposed investment in the next RCP.

Summary

372. The proposed Option A1 is likely to be the best approach, and the economic timing is likely to be within the next RCP.

5.5.6 Manage multiple contingencies in the Bayswater to Sydney Area (project 1522) and Manage multiple contingencies in the North West NSW Area (project 1473)

Overview

373. The two projects to manage multiple contingencies are considered together here as the proposed solution is common to both projects, and the solution responds to the same form of non-credible contingency (N-2 contingency of 330kV lines) which can lead to voltage instability, voltage collapse, and involuntary load shedding.

374. The proposed solution in each case is to install a hybrid SPS control system:

- Project 1522: the estimated capital cost is $4.7m, to be commissioned by FY27; and
- Project 1473: the estimated capital cost is $2.7m, to be commissioned by FY26.

149 Transgrid - OER-N2208 Rev 2 Incr busbar capacity at Wagga Sub - 24 Dec 2021 - PUBLIC

150 Transgrid - OER-N2208 Rev 2 Incr busbar capacity at Wagga Sub - 24 Dec 2021 - PUBLIC, page 5

Assessment

375. The market benefit in each project is derived from the avoided cost of EUE, with the EUE increasing with increased demand, increased power transfer via the Queensland and NSW interconnector, and new renewable generators in Northern NSW. The expected involuntary load shedding could reach a maximum of 1,500 MW in the case of Project 1522 and 1,000MW for the line outage combinations considered in Project 1473.

376. The risk cost associated with the Base Case is derived by Transgrid applying the same methodology discussed above for Project 1491. In the case of projects 1522 and 1473, the cut-set moderating factor is 0.8. As with Project 1491, we are satisfied with Transgrid's methodology to derive the risk cost.

377. Transgrid identifies alternative options in both OERs, and we consider that the proposed SPS schemes are likely to represent the best approach.

378. Transgrid's economic benefit modelling results in modestly positive NPVs for both projects for the central scenario:

- For Project 1522, the BCR is 1.8; and
- For Project 1473, the BCR is 1.5.

379. The NPVs (and therefore the economic timing) are particularly sensitive to demand growth. As discussed in section 4.2, there are likely to be unfavourable variances to Transgrid's input assumptions which would bring the Central scenario closer to Transgrid's Lower bound scenario, with BCRs of 0.2 and 0.4 for the two projects. This may lead to project deferral.

Summary

380. Whilst we consider that the proposed investments are likely to be the prudent approaches in each case, we consider them to be candidates for deferral if there are material unfavourable variances to Transgrid's assumed input parameters, as identified in our assessment of each of the proposed projects.

5.5.7 Summary of our assessment of economics driven augex

Transgrid has established a reasonable basis and benefit for the proposed projects

381. Transgrid has identified six economic benefit-driven projects that warrant consideration for investment in the next RCP due to the avoidance of sufficient EUE to derive a net economic benefit. In each case, we consider that Transgrid's recommended solution is likely to be the best option from those considered. We note that the RIT-T process will provide a more thorough examination of the viability of NNS to maximise the net economic benefit.

Three of these projects are likely candidates for deferral into subsequent RCP

382. The NPV outcomes are relatively strong for three of the six proposed projects, indicating that under most scenarios, there is likely to be sufficient justification for the investment within the next RCP. The net benefit of the other three projects is particularly susceptible to unfavourable movements in the input assumptions (such as demand and generation growth). This leads us to conclude that if Transgrid were to prioritise any of the investments for deferral due to the factors as discussed in section 3, one or more of Projects 1491, 1473, and 1522 are likely candidates.

5.6 Summary of findings and implications for Transgrid's proposed augex forecast

5.6.1 Summary of findings

383. We conclude that Transgrid has identified NER compliance issues that are likely to require resolution within the next decade. Transgrid also has identified legitimate opportunities with potential to generate net economic benefits by removing or mitigating network constraints in six locations in the NSW network.

384. If a network solution is required, then we consider that Transgrid has likely selected the most appropriate such solution. However, we consider that an NNS, either as standalone solutions or in combination with other solutions, may result in a reduction to the required augex for some projects in the next RCP. We have arrived at this view, after considering the potential for NNS to be applied and noting in particular Transgrid's recent experience with an NNS solution likely to form part of the solution for Project 1754.

385. Correcting for the issues identified in section 3 concerning economic modelling and section 4 concerning selection and treatment of input assumptions, is likely to lead to lower NPV results in all projects. In projects with relatively strong NPVs and BCRs, this is not likely to change the preferred option or defer the economic timing materially. However, in projects with relatively low NPV results, the economic timing of the proposed option may be deferred.

386. Furthermore, project timing for some projects is sensitive to specific spot load growth assumptions and also to Transgrid's delivery capability. This may lead to re-prioritisation of some proposed augex against other works, as was undertaken in the current RCP and as discussed in section 4 of this report. For example, we consider that:

- Compliance projects with either economic timing or earliest possible commissioning dates at or near the end of the next RCP may be likely candidates for deferral; and
- Economic benefits-driven projects are more likely to be deferred in deference to compliance projects with three of the economic benefits-driven projects having the lowest positive NPV being the most likely candidates.

5.6.2 Implications for forecast augex

387. Whilst the majority of Transgrid's forecast augex appears reasonable, the issues we have identified lead us to the view that its forecast augex for the next RCP represents an overestimate of its prudent and efficient requirement.

6 REVIEW OF PROPOSED ICT CAPEX

We reviewed the information provided by Transgrid to support its proposed ICT capex forecast, including its business cases and relevant supporting information. Our focus is to assess the extent to which the forecast expenditure meets the NER criteria, and whether there is evidence of the systemic issues identified in sections 3 and 4 compromising Transgrid's proposed allowance.

In considering the ICT expenditure trends, we have reviewed ICT totex, being the sum of opex and capex, because of recent movements resulting from opex/capex trade-offs and material changes to accounting treatment.

After allowing for increased obligations (e.g. for cyber security) and replacement cycles, Transgrid's totex increases do not seem consistent with efficiencies that should have resulted from its transition to the cloud. The profile of expenditure and our bottom-up assessment of Transgrid's proposed packages of work indicate that at least a portion of the proposed ICT expenditure is 'allowance-driven', in which Transgrid has 'waited for the next RCP', rather than managing its ICT program based on identified need.

From our assessment of the eight packages of work underpinning the ICT capex forecast, we consider that in each case, Transgrid has identified adequate needs for taking action, either due to asset management issues, external obligations, or for business strategic alignment. However, we consider that in aggregate, once it undertakes more detailed options analysis, Transgrid will find that it requires less capex to meet those needs because in some cases it will find better alternatives than are apparent at this stage and some of these alternatives are likely to be cloud-based, 'opex' solutions.

Overall, our assessment suggests that Transgrid has moderately overstated its ICT capex expenditure requirements for the next RCP.

6.1 Summary of Transgrid's ICT capex forecast

6.1.1 Overview

388. Transgrid has proposed $86.9m for ICT capex for the next RCP, in eight ICT 'packages' with an average annual expenditure of $17.4m. In Table 6.1, we show Transgrid's proposed ICT capex, including real cost escalation but excluding capitalised overheads.

Table 6.1: Transgrid's actual/estimated ICT capex for the current RCP and proposed ICT capex for the next RCP, by package ($m, real 2022-23)

ICT capex packages	Current RCP[151]	Next RCP
Application maintenance	39.7	18.3
Infrastructure and network	11.9	17.8
Bespoke applications	0.4	17.5
Employee enablement	1.7	12.2
Data and decisioning	1.2	6.3
Operational evolution	0.3	1.9
Customer safety and support	0.0	1.0
Cyber security	9.6	11.9
Total	**64.7**	**86.9**

Source: Transgrid's response to information request AER IR010, Transgrid – IR010-Updated tables and charts-20220321-PUBLIC

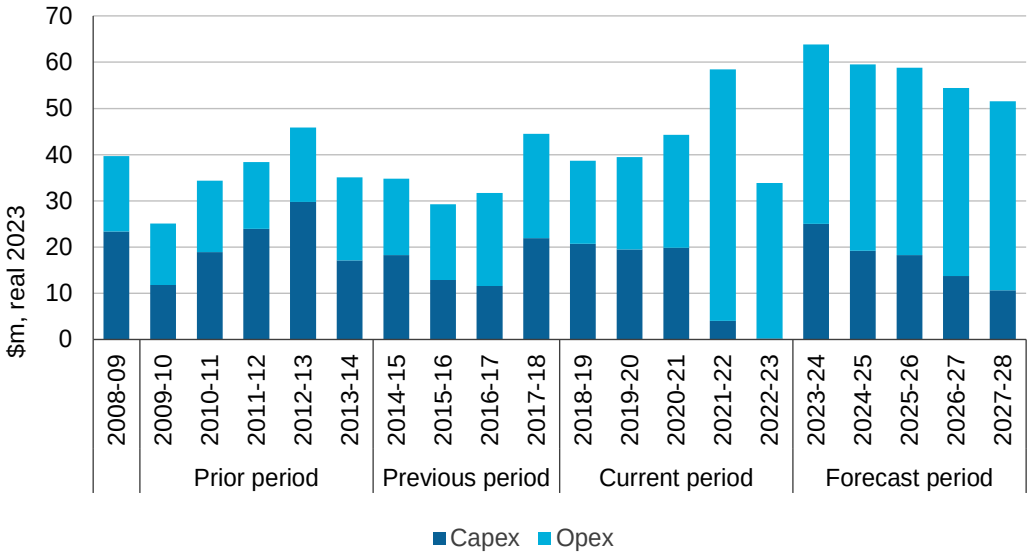
6.2 ICT trend analysis

6.2.1 ICT total expenditure

Overview

389. Figure 6.1 shows Transgrid's actual/estimated and forecast ICT total expenditure (i.e. capex plus opex). It shows a significant uplift in total ICT expenditure proposed by Transgrid in the next RCP compared to the current RCP.

Figure 6.1: Transgrid annual ICT Totex (capex plus opex) – historical and forecast ($m, real 2022-23)

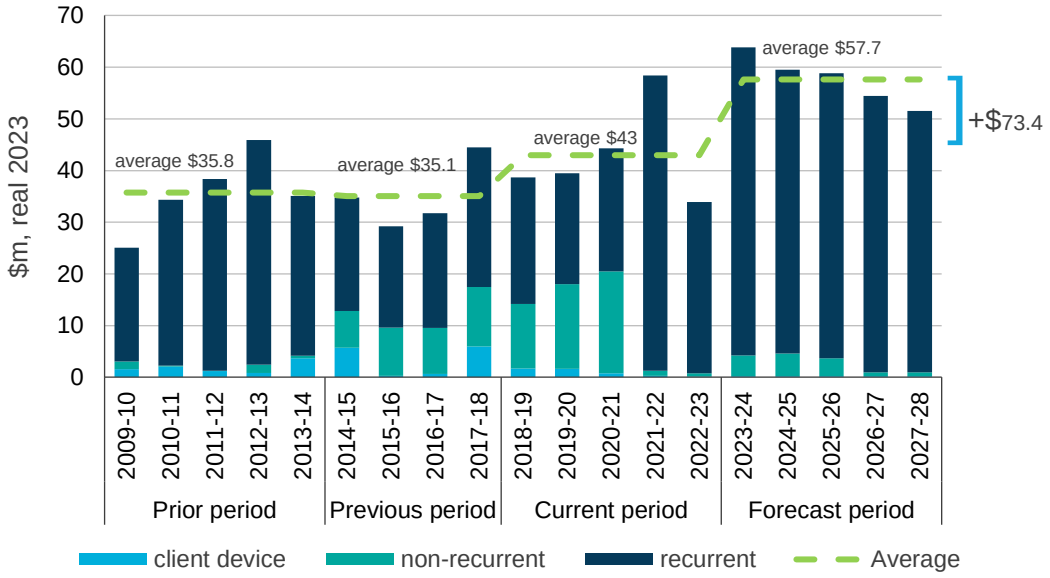


Source: AER RIN data

390. Figure 6.2 shows a similar perspective, with the annual average expenditure over a five-year period. This trend is disaggregated into three RIN sub-categories, namely: client devices, non-recurrent, and recurrent expenditure.

151 The actual/estimated capex for the current RCP is less than identified in the RP, having been updated following Transgrid's response to information request AER IR010

Figure 6.2: Transgrid ICT total expenditure historical and forecast, shown annual average ($m, real 2022-23)



Source: AER RIN data

391. We consider that taking a 'totex view' assists with discerning trend expenditure, given the shift from capex to opex as Transgrid has progressively adopted, cloud-computing services (i.e. XaaS[152]) either by choice or by necessity. Adopting cloud computing services is effectively a form of capex to opex trade-off, in which the opex is incurred to pay for licences and subscription services, instead of incurring capex for the procurement of on-premise hardware, software, platforms, etc.

Observations

The actual and proposed increases in totex in the current RCP and the next RCP from the previous period are not indicative of efficient capex-opex tradeoffs

392. Transgrid commenced its transition to the cloud 'in earnest' in the current RCP as more cloud-based options became viable. Transgrid attributes the $7.9m p.a. average increase (or approximately $40m over 5 years) from the previous RCP to the current RCP to:[153]

- Meeting externally-driven cyber security obligations;
- Mitigating outage risk due to aged systems; and
- Implementing large non-recurrent capex projects (e.g. replacement of Ellipse).

393. Compared with the current RCP, Transgrid proposes a further increase in totex of $73.4m in the next RCP of which:

- $34.0m is explicitly attributed to new externally imposed security obligations,[154] which we discuss in sections 6.3.10 (Cyber security capex) and section 7 (Opex step change);
  - As we discuss in section 6.3.7 (Data and decisioning), a portion of the project cost of $6.3m may reasonably be attributed to the same new external obligation;
- Approximately [redacted] increase in opex from transitioning from Ellipse to 'Digital Core';[155]

152 XaaS is 'Anything as a Service', including Infrastructure as a Service (IaaS), Device as a Service (DaaS), Software as a Service, (SaaS), and Platform as a Service (PaaS)

153 Transgrid - Non-network ICT Overview Paper - 31 Jan 2022 – CONFIDENTIAL, page 11

154 Transgrid proposes $22.1m ICT-related opex step change

155 Transgrid's response to information request AER IR005 Question1b; the Digital Core comprises a number of cloud-based systems including [redacted]

- Of the balance of approximately $30m, the ICT capex component increase is explained by Transgrid as being required to '*provide our staff with the necessary ICT support to perform their roles*', to '*refresh our legacy data platform and extending our access to business insights'* and '*providing a modern project management solution*…'[156]

394. The shift to the cloud from on-premise ICT in the current and next RCPs has not resulted in lower totex. As described in section 6.3, Transgrid was obligated to transition from on-premise ICT infrastructure and software in some cases due to vendors withdrawing support for on-premise variants. Transgrid offers a further explanation of the increase in ICT totex as follows:[157]

> *'Our organisation has announced major network programs leading into the next regulatory period and ICT will play an important role in supporting the network business achieve the benefits for consumers and industry. We expect that the overall IT spend will need to increase to support these initiatives but will decline as an overall percentage of total expenditure due to the size and volume of the planned network changes.'*

395. We explore this statement from a 'bottom-up' perspective by considering the justification for the expenditure attributed to the eight ICT capex packages listed in Table 6.1.

396. We note that the totex increase in Figure 6.2 would be even higher if Transgrid was not committed to self-funding [redacted] of ICT opex impacts from its proposed 2024-28 ICT capex program (refer to the discussion in section 7).[158]

6.2.2 ICT benchmarking

Overview

397. Transgrid presented a number of benchmark graphs in its RP, including (i) ICT totex as a percentage of total transmission capex, (ii) the ICT share of corporate capex, and (iii) recurrent ICT and client device capex per employee.[159]

Observations

Transgrid benchmarks reasonably well

398. We have developed a benchmark comprising ICT totex per user from available RIN data, as shown in Figure 6.3. Overall, Transgrid benchmarks well against its peers – particularly against AusNet (Transmission) and ElectraNet – despite Transgrid's totex per user trending up over the current RCP and at an increasing rate during the next RCP.

399. While benchmarking can provide insights, we consider that differences between NSPs in ICT maturity and replacement cycles, differences in accounting treatment and categorisation, differences in ICT delivery models and the appropriateness of different 'normalising factors', combine to indicate a need for caution in drawing definitive conclusions for ICT from single-factor benchmarking alone.

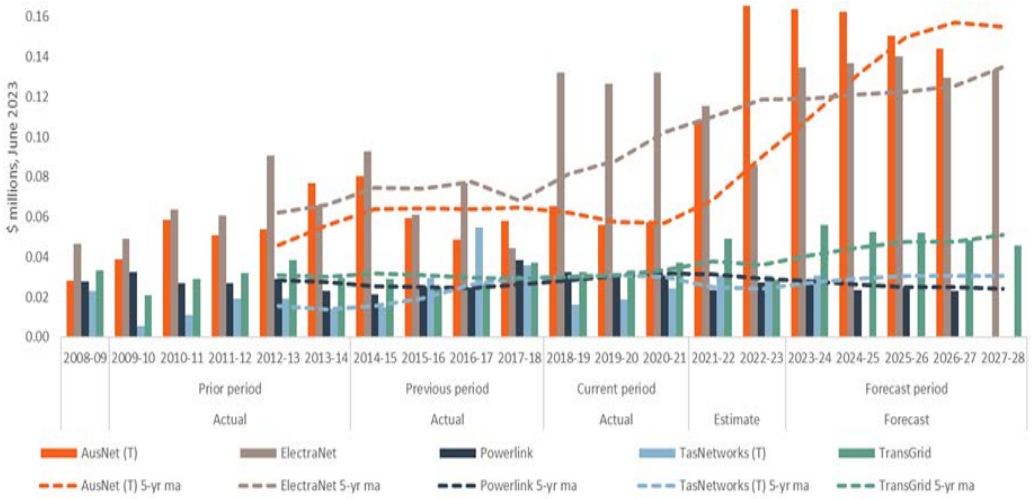
156 Transgrid - Non-network ICT Overview Paper - 31 Jan 2022 – CONFIDENTIAL, page 19

157 Transgrid - Non-network ICT Overview Paper - 31 Jan 2022 – CONFIDENTIAL, page 13

158 Transgrid - Opex Step Change Overview Paper - 31 Jan 2022 – CONFIDENTIAL, pages 5-6

159 Transgrid - Opex Step Change Overview Paper - 31 Jan 2022 – CONFIDENTIAL, section 3.4

Figure 6.3: ICT totex per user



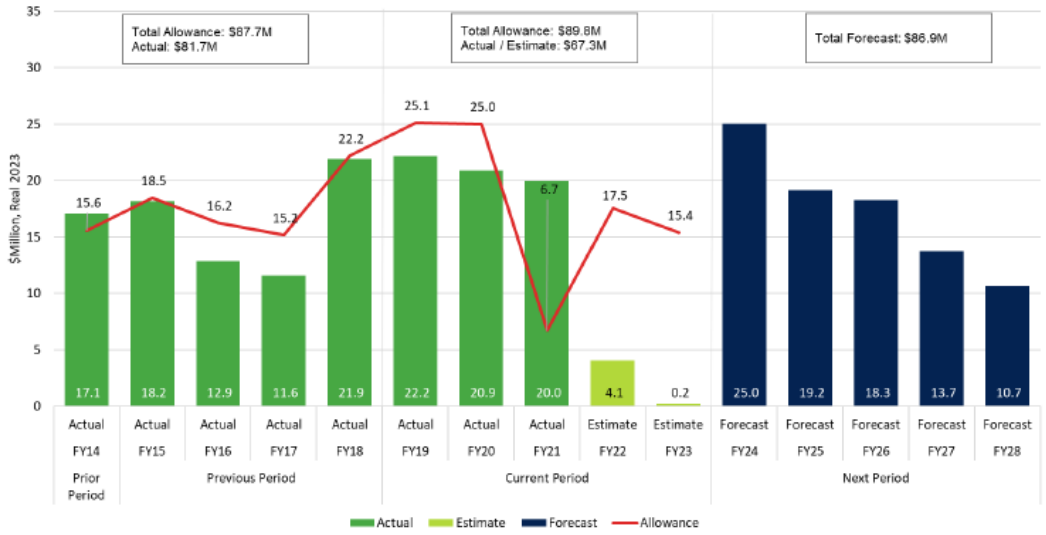
Source: EMCa analysis of AER RIN data

6.2.3 ICT capex trend

Overview

400. In Figure 6.4, we show Transgrid's ICT capex trend since FY2014. The ICT capex profile for the current RCP excludes $25.0m ICT capex incurred in FY22 and FY23 that was reclassified by Transgrid as SaaS opex due to application of the ruling from the International Financial Reporting Standards (IFRS) Foundation. This has reduced Transgrid's expected ICT capex in the current RCP to $67.3m (and which was subsequently revised by Transgrid to $64.7m),[160] compared to the AER allowance of $89.9m.

Figure 6.4: Actual and estimated ICT capex compared to the AER's allowance ($m real 2022-23)



Source: Transgrid - Non-network ICT Overview Paper - 31 Jan 2022 – CONFIDENTIAL, Figure 3-1, page 9

160 Transgrid's response to information request AER IR010, Transgrid – IR010-Updated tables and charts-20220321-PUBLIC

Observations

Transgrid's capex for the current period would have been similar to the AER allowance if not for the IFRS ruling

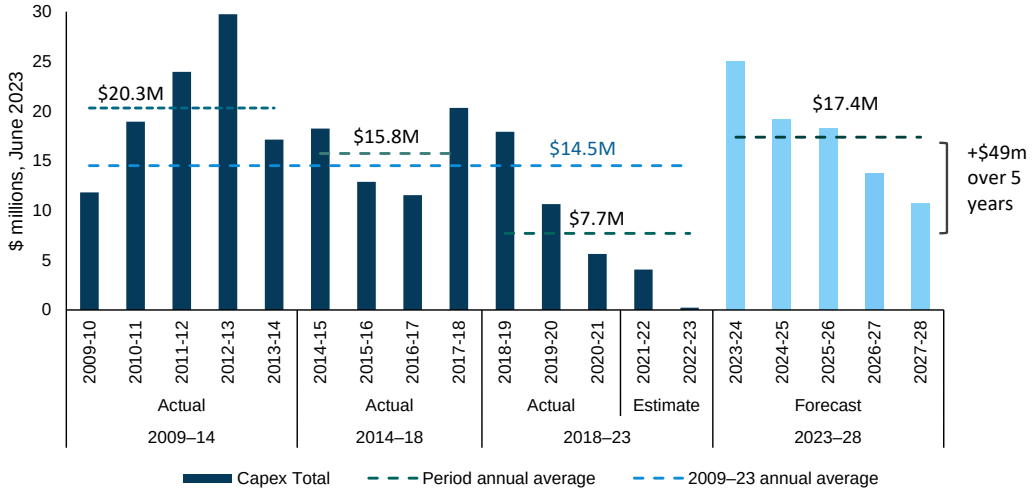
401. Transgrid's total estimated ICT expenditure for the current RCP (inclusive of capex and SaaS opex) is estimated to be $92.3m (or $89.7m with Transgrid's adjustment), which is similar to its ICT capex allowance. So, whilst the IFRS driven reclassification of capex has significantly reduced the capex profile of ICT, it has not reduced the total expenditure Transgrid expects to spend on ICT services.

Transgrid proposes a 128% increase in ICT capex in the next RCP despite cloud migration

402. Transgrid proposes a 128% ($49m) increase in ICT capex from the current RCP, after excluding SaaS opex. Transgrid proposes a material step increase in the expenditure profile in the first two years of the next RCP, despite its strategy of adopting cloud computing, where feasible.

403. The biggest increases are in the Bespoke Applications and Employee Enablement packages, both of which comprise on-premises investments.

Figure 6.5: Transgrid's ICT capex excluding SaaS-related expenditure ($m, real 2022-23)



Source: AER

404. As shown in Figure 6.5, the average annual capex over the current and previous regulatory periods is $11.7m, which if used as a basis for the next RCP, would provide an indicative ICT capex forecast of $58.3m. Allowing approximately $14m for Transgrid to meet its new externally-driven cyber security obligations,[161] would indicate a trend-based forecast of approximately $72.3m, which is similar to the long-term average shown in Figure 6.5. However, this is $14.6m (-17%) lower than Transgrid's forecast.

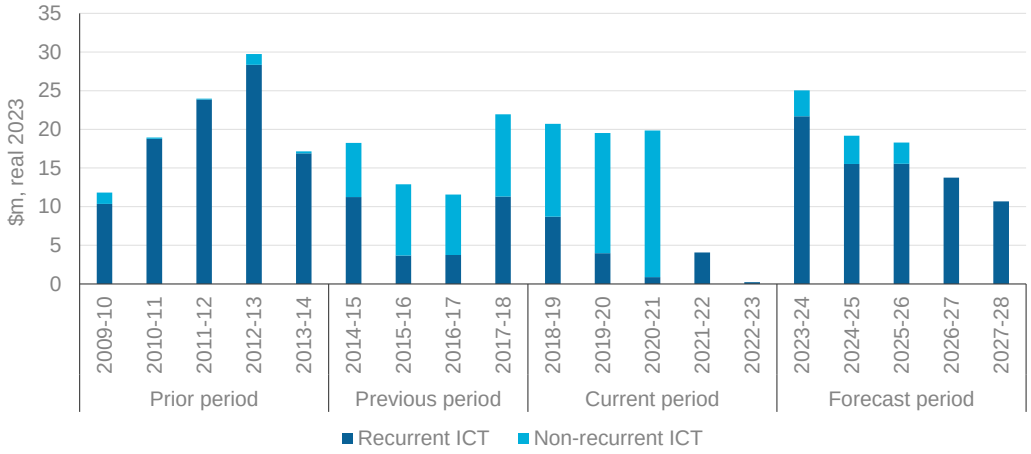
405. We examine the bottom-up build of Transgrid's ICT capex forecast in section 6.3.

The majority of ICT capex in the next RCP is recurrent

406. The trend of ICT capex by recurrent / non-recurrent expenditure classification is shown in Figure 6.6. It incorporates the IFRS SaaS reclassification for FY22 and FY23. It shows that the majority of proposed ICT capex in the next RCP is recurrent expenditure and is an order of magnitude higher than the recurrent capex in the current RCP. This is consistent with Transgrid's own observation that it has focussed on replacing legacy systems in the current RCP, which satisfies the AER definition of non-recurrent capex.

[161] Derived from Transgrid's ICT cyber security proposed capex of $11.9m (discussed in section 6.3.10) and a portion of its Data and Decisioning package (discussed in section 6.3.7)

Figure 6.6: ICT capex profile categorised as recurrent or non-recurrent expenditure ($m, real 2022-23)



Source: EMCa analysis of AER RIN data

The expenditure profile suggests that Transgrid is 'planning to the regulatory period' rather than investing as required

407. As discussed in our assessment in section 6.3 of the prudency of the ICT capex packages underlying the expenditure profile shown in Figure 6.5, the low amount of recurrent capex in the current RCP followed by the proposed immediate ramp-up in recurrent expenditure in the next RCP is indicative of aligning expenditure with the regulatory period rather than investing for need. For example, for Transgrid's Employee Enablement package, which covers the recurrent replacement of user devices such as desktops, laptops, tablets, and mobile phones:

- Only $1.7m was spent in the current RCP, all in the first two years of the period;
- However, the recurrent spend on user devices is proposed to increase to $12.2m in the next RCP.

408. This is counterintuitive given the relatively short lifecycles of 2-3 years for many of the user devices – we would expect a relatively flat expenditure profile for this 'package'.

There is limited evidence of prioritisation of the ICT portfolio

409. As discussed in section 3.2.4, there is limited evidence from Transgrid of portfolio prioritisation, including by assessing its capability to deliver the materially higher project activity in the next RCP.

Summary

410. The extent of the increase in ICT capex, particularly in the first two years, of the next RCP and the apparent lack of prioritisation of expenditure collectively undermine confidence in the prudency of the proposed portfolio of ICT capex.

6.2.4 Benefits Realisation

No evidence of 'cashable' benefits from the current RCP ICT investments

411. The principle underpinning the AER's approach to assessing NSPs' non-network ICT capex proposals[162] provides guidance to our assessment of Transgrid's incorporation of cost-savings benefits into its expenditure forecast, namely:

> *'We expect that businesses will be able to clearly identify and evidence that any financial cost saving benefits achieved from a non-recurrent expenditure have been incorporated*

[162] AER, Non-network ICT capex assessment approach, November 2019, page 12

into its overall expenditure forecast. Similarly, where any investments affect reliability, this needs to be considered in the STIPS target.

If we do not consider that these interrelationships have been clearly identified, we will not accept the proposed expenditure. In the cases where ICT expenditure is proposed to deliver cost savings but it has not been evidenced that these savings have been identified in the expenditure forecast, we will apply the self-funding approach.'

412. Given that the preponderance of ICT capex (or SaaS services adopted) in the current RCP was for non-recurrent expenditure, we expected to be provided with evidence of benefits management – specifically the expected realisation of cashable[163] benefits from the non-recurrent investments of these investments in terms of the capex and opex required in the next RCP. However, Transgrid did not provide evidence of capex to opex transfers providing any short-medium term cashable benefits.

Transgrid is self-funding some opex step-changes in the next RCP

413. Nonetheless, Transgrid states that:[164]

'We expect increases to both ICT capex and opex over the same period for some of our ICT work packages, which means that we cannot demonstrate the capex to opex trade-offs in order for the AER to approve the increases in opex as step-changes. We therefore propose to self-fund these opex increases.'

414. We infer from the [redacted] total increase in ICT opex that Transgrid is self-funding, that Transgrid expects to realise at least that quantum of net benefits from its ICT capex investments and/or cloud transition. However, we are unable to confirm whether this is a reasonable offset.

Summary

415. In the absence of sufficient evidence to the contrary, the increasing totex profile indicates that Transgrid may not be appropriately accounting for cashable benefits from its ICT capex investments or from voluntary decisions to transition to the cloud.

6.3 Our assessment of ICT Capex Packages

6.3.1 Introduction

416. In this section we consider the justification for the expenditure proposed by Transgrid for the next RCP in each of the eight ICT capex 'packages.'

6.3.2 Overview

417. Table 6.2 shows the proposed ICT capex expenditure profile for the eight ICT packages for the next RCP.

163 Meaning it can be realised in terms of costs saved / revenue earned

164 Transgrid - Opex Step Change Overview Paper - 31 Jan 2022 – CONFIDENTIAL, p5

Table 6.2: Transgrid's proposed ICT capex for the next RCP by package ($m, real 2022-23)

ICT package	FY24	FY25	FY26	FY27	FY28	Average annual	Total
Application maintenance	6.0	4.1	3.1	0.9	4.2	3.7	18.3
Infrastructure and network	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	17.8
Bespoke applications	4.0	4.3	5.5	2.8	0.9	3.5	17.5
Employee enablement	5.0	1.6	2.5	1.6	1.6	2.4	12.2
Data and decisioning	2.8	2.4	1.2	0.0	0.0	1.3	6.3
Operational evolution	0.8	0.3	0.2	0.6	0.0	0.4	1.9
Customer Safety and Support	0.7	0.3	0.0	0.0	0.0	0.2	1.0
Subtotal	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	75.0
Cyber security	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	11.9
Total	**25.0**	**19.2**	**18.3**	**13.7**	**10.7**	**17.4**	**86.9**

Source: Transgrid - Non-network ICT Overview Paper - 31 Jan 2022 – CONFIDENTIAL, page 20

6.3.3 Applications Maintenance

Overview

418. Transgrid advises that maintaining and refreshing its applications is critical to avoid compliance and security vulnerabilities, business outages, and unnecessary costs. The package covers the maintenance and refresh of 93 Commercial off the Shelf (COTS) and cloud applications.[165]

419. In the current RCP, approximately 60% ($39.7m) of Transgrid's actual/estimated ICT capex is for applications maintenance to *'refresh and modernise legacy systems such as Ellipse and other upgrades.'*[166]

420. In the next RCP, Transgrid proposes $18.3m on applications maintenance. It refers to its preferred option as the Base Case which is described as a '*maintain refresh approach':*

- *Support and maintain current applications including those being established as part of Digital Core program;*
- *Refresh COTS applications and one dependent bespoke application based on 5-year EOL average;*
- *Minor enhancements only for Bespoke applications*
- *Continue migration of integration platform.'*[167]

Assessment

Transgrid only considers the 'Base Case'

421. Transgrid states that '*Given our existing approach to application maintenance is consistent with industry good practice, we are recommending staying with this base case and have not put forward alternative options.'*[168] Transgrid did not provide a cost-benefit analysis, despite it typically deriving benefits from the avoided cost of (system/application) failure under the 'do nothing' counterfactual. As this is recurrent expenditure, and Transgrid has selected

165 This package excludes bespoke applications and applications requiring enhanced capabilities, which are covered in other 'packages'

166 Transgrid - Non-network ICT Overview Paper - 31 Jan 2022 – CONFIDENTIAL, page 16

167 Transgrid - OER-Application Maintenance - 15 Nov 2021 – CONFIDENTIAL, page 11

168 Transgrid - OER-Application Maintenance - 15 Nov 2021 – CONFIDENTIAL, page 2

what is effectively a business-as-usual approach for the next RCP, a cost-benefit analysis is strictly not necessary.

For established cloud service contracts, Transgrid no longer has control of the application maintenance cycle

422. Transgrid's OER refers to 41 cloud applications which are maintained by the cloud provider as-a-service. For these applications, the maintenance/refresh cycle is determined by the service provider for which Transgrid pays a recurrent (opex) service fee, which includes the cost of refreshes/upgrades. Transgrid therefore (i) has little to no discretion over the maintenance cycle for these applications, and (ii) requires no capex for the maintenance of these applications. The proposed expenditure is therefore for the non-cloud-based applications.

The COTS applications maintenance spend is based on refreshing at EOL but alternatives requiring less capex are likely to be prudent for some applications

423. For its 52 (non-cloud) COTS applications, Transgrid states that its capex forecast is based on refreshing the applications when they reach their end of life (EOL). It also states that this approach is based on the recommendations of the ISO16350 framework, '*which suggests taking a risk-based approach for determining an application's life cycle*.'[169] Finally, it concludes that its maintenance approach is consistent with industry standards and vendor recommendations.

424. However, elsewhere in the OER Transgrid reasonably states in relation to its risk assessment that '*it will bring forward expenditure on some applications, while extending the life of others where it has been acceptable to do so from a risk perspective.'*[170]

425. Transgrid considered but did not progress one option in addition to the preferred option (which it refers to as the Base Case):

- Do nothing – was reasonably rejected by Transgrid because of the escalation of risk and cost; and
- 'Other alternatives' – Transgrid noted that during the next RCP, alternatives to COTS would be considered and that *'[t]here may be options in the future that provide greater value for individual applications… however*, *application roadmaps and solutions are not currently available at the time of this submission.'*[171]

426. In our view, Transgrid could have considered the 'other alternatives' options more rigorously in deciding its required expenditure for this package. It could have taken the likelihood of other alternatives being preferrable to the proposed capex-based approaches into account probabilistically, even at this relatively early stage of the program development for the next RCP.

427. Whilst we are cognisant of the risks, including the potential for economic inefficiency, in extending the lives of applications to the extent where an excessive level of technology debt can arise, we consider that:

- It is more likely in practice that Transgrid's risk assessment will lead it to a modest bias (1-2 years at most) to deferment of applications maintenance, noting that:
  - it may be prudent in some cases for Transgrid to defer an on-premises upgrade if an off-premise (cloud) solution is imminent;
  - the Application Maintenance package has a relatively low impact on other OERs;[172]
  - Transgrid states in several other OERs[173] that it typically is able to prudently extend the replacement/refresh of applications and platforms beyond EOL – Transgrid has

169 Transgrid - OER-Application Maintenance - 15 Nov 2021 – CONFIDENTIAL, pages 2

170 Transgrid - OER-Application Maintenance - 15 Nov 2021 – CONFIDENTIAL, pages 4

171 Transgrid - OER-Application Maintenance - 15 Nov 2021 – CONFIDENTIAL, pages 9-10

172 Transgrid - OER-Application Maintenance - 15 Nov 2021 – CONFIDENTIAL, page 4

173 For example, Infrastructure and Network, Employee Enablement

not presented sufficiently compelling information that it will not choose to do this in the next RCP;

  - from the information provided, we are not aware of any instances where Transgrid has advanced the replacement of applications; and

- During the five years of the next RCP we consider it likely that Transgrid will be able to transition more of its on-premise applications to cloud services, reducing the need for capex.

Summary

428. Transgrid is likely to require less capex than it has forecast for Applications Maintenance in the next RCP.

6.3.4 Infrastructure and Network

Overview

429. This ICT package covers expenditure to maintain Transgrid's corporate data network (CDN), which includes routers, servers and data storage devices, enabling staff to access corporate information, Transgrid's intranet, the internet, internal files, and tools such as Microsoft Office.

430. In the current RCP, Transgrid's actual/estimated capex on its CDN assets and infrastructure is $11.9m. Transgrid states that:[174]

> *'The period 2018 to 2023 saw minimal investment in CDN assets and infrastructure as ICT expenditure was directed towards more critical areas. The resulting increased risk of business outages needs to be remediated in the next regulatory period.'*

431. Transgrid proposes spending $17.8m in the next RCP, a 50% increase from the current RCP because:[175]

> *'Currently, our infrastructure and CDN assets are operating beyond their useful asset life, with unsupported hardware and software. Maintaining this aging technology is expensive and runs the increasing risk of security threats, non-compliance and hardware failure.'*

432. Transgrid's preferred option is its Base Case which is based on refreshing infrastructure and CDN assets using a risk-based approach, which in turn assumes it will extend asset lives beyond those recommended by vendors without a material increase in outage risk.

Assessment

Transgrid considered four options but the assumptions underpinning the selected option may be overly conservative

433. Transgrid's preferred option is the Base Case, described above. Transgrid's NPV analysis results in a positive NPV, which is derived from a probabilistic risk-cost analysis, where the benefit is the avoided costs of infrastructure failure. Transgrid also considered and rejected the following alternatives:

- Do nothing – Transgrid concludes that this option is no longer viable after deferring maintenance from the current period to the point where '*these assets are well beyond end of life support and the risks associated with the approach are high, including the risk of device failure, security vulnerabilities being exploited…resulting in disruption to the business';*[176]

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174 Transgrid - Non-network ICT Overview Paper - 31 Jan 2022 - CONFIDENTIAL page 21

175 Transgrid - Non-network ICT Overview Paper - 31 Jan 2022 - CONFIDENTIAL, page 21

176 Transgrid - OER-Infrastructure and Network - 15 Nov 2021 – CONFIDENTIAL, pages 10-11

- Option 1 - Replace infrastructure and CDN assets according to vendors' asset life cycle: Transgrid concludes that this option does not provide additional benefits to the business for the additional cost, resulting in a negative NPV; and
- Option 2 - Maintain only the critical existing infrastructure and CDN assets: Transgrid provides a qualitative assessment of the reasons for not pursuing this option, which include: (i) may be more costly in the long term, (ii) more than the core infrastructure is well past its used by date now, and (iii) the underlying infrastructure is interconnected and partial replacement may not mitigate the risk of critical component outages.[177]

434. Whilst we have some reservations about assumptions underpinning Transgrid's cost forecast for its preferred approach (discussed below), we consider that its risk-based approach (i.e. its Base Case) is likely to be superior to the other approaches/options considered.

The forecast capex allows for a relatively small cloud migration component in the next RCP

435. Transgrid's OER recognises the benefits of moving critical services to the cloud and recognises that '*to take advantage of these benefits, CDN infrastructure and assets will need to adapt to a hybrid landscape so we can operate the combined on-premise and cloud-based assets in the most efficient and secure manner.*'

436. Therefore, it is appropriate that Transgrid's approach is based on introducing a hybrid environment that combines on-premise and cloud-based platforms, providing *a scalable modern network that can meet critical business needs such as work-from-anywhere and future energy transition requirements.'*[178]

437. Yet Transgrid's cost estimate allows for migration of only ten applications to cloud-based platforms, with an opex cost of $0.7m over five years.[179] This appears to be a relatively conservative assumption which is apparently inconsistent with:

- The benefits of transitioning infrastructure to the cloud that Transgrid recognises in the OER; and
- The likelihood that more opportunities for cloud migration will occur throughout the next RCP, with the net benefits to Transgrid in doing so helping to fund the transition.

Summary

438. Transgrid has based its proposed capex on a risk-based approach to upgrading its CDN assets and infrastructure, which we consider to be appropriate. However, in our view the required capex is likely to be lower than estimated because of the likelihood that over the five-year regulatory period significantly more than ten opportunities for cloud-migration will be available to Transgrid.

6.3.5 Bespoke Applications

Overview

439. Transgrid's bespoke applications have been developed over the last 15 years and '*enable key business activities, such as the planning and tracking of outages to High Voltage equipment, supporting our protection relays, maintaining metering equipment and customer billing, and identifying safety risks pertaining to work tasks'*[180] not available as COTS products.

440. Transgrid spent only $0.4m in the current RCP on bespoke applications and proposes $17.5m capex in the next RCP to replace 17 obsolete bespoke applications. The cost

177 We note that in section 2 of the OER Transgrid assesses that the proposed package has a high functional relationship to six other ICT packages

178 Transgrid - OER-Infrastructure and Network - 15 Nov 2021 – CONFIDENTIAL, pages 2, 3, 5

179 Transgrid - Opex Step Change Overview Paper - 31 Jan 2022 – CONFIDENTIAL, page 5

180 Transgrid - Opex Step Change Overview Paper - 31 Jan 2022 – CONFIDENTIAL, page 21

estimate is based on (i) refreshing the applications with a modern code base, and (ii) implementing a secure development environment for all applications. Transgrid refers to Option 1 as its preferred option in its analysis.

Assessment

Transgrid has extended the life of the 17 applications to 7-10 years, reducing capex in the current RCP

441. Transgrid advises that it can no longer extend the life of the 17 applications subject to the OER and that the proposed 'refresh, re-platform, and modernisation' of the applications will bring them back to supportable levels. Transgrid further advises that the applications were developed in code no longer commonly used by developers and that its current development platforms are 'inadequate.'

442. In the OER, Transgrid provides a description of the issues with the 17 bespoke applications and why they each require upgrades within the next RCP. Transgrid makes a reasonable case for replacing each application, with (i) being 'out of support', (ii) 'non-compliance' with security obligations, and (iii) performance issues being the dominant themes. We note that Transgrid has '…*other Bespoke applications that are not included in this OER…because either they do not require remediation or they are scheduled for decommissioning*.'[181] This last point adds credibility to the proposed activities under this project, but we still consider that it is not credible that Transgrid determined there was insufficient justification for it to undertake any work in the current period. The reality is that it has chosen not to. Moreover, it is also not credible that for all such applications, the need now arises only when the next regulatory period commences.

Transgrid considered four options and has likely selected the appropriate option

443. Transgrid's preferred option is Option 1, described above. Transgrid's NPV analysis results in a positive NPV, which is derived from a probabilistic risk-cost analysis, where the benefit is the avoided costs of infrastructure failure. Transgrid also considered and rejected the following alternatives:

- Do nothing – Transgrid concludes that this option is no longer viable after deferring replacement from the last two regulatory periods to the point where further deferral '*introduces a high level of risks in terms of security, safety and regulatory issues. These applications perform most of our critical functions…;*'[182]
- Base Case – Implement a secure environment and upgrade software retaining code base: Transgrid concludes that this option provides only half the benefits of the Base Case and results in a negative NPV; and
- Others – Transgrid advises that (i) there may be cheaper commercial alternatives that become available in the next RCP but these are not able to be identified at the time of developing its OER, and (ii) it considered refreshing only certain critical bespoke applications but that 'this still left security vulnerabilities that would need to be addressed in the remainder of the applications and the level of risks associated with this approach have been considered too high to move forward with.[183]

444. Despite our reservations about the deferment of all refresh activity into the next RCP, we consider that of the options considered, Transgrid's preferred Base Case approach is the prudent choice (based on available information).

181 Transgrid - OER-Bespoke Application Refresh - 5 Nov 2021 – CONFIDENTIAL, page 16

182 Transgrid - OER-Bespoke Application Refresh - 5 Nov 2021 – CONFIDENTIAL, pages 11

183 Transgrid - OER-Bespoke Application Refresh - 5 Nov 2021 – CONFIDENTIAL, pages 11-12

The applications have low interdependency with other ICT programs

445. Transgrid's OER identifies a relatively low interdependency with (or importance to) other ICT programs/OERs, which indicates that the timing of the proposed bespoke applications work is not influenced by the timing of other projects.

Summary

446. Transgrid is undertaking minimal ICT capex of any sort in the final two years of the current regulatory period, which we find to be implausible from a prudency perspective. However, taking the current state as a given, it is reasonable to conclude that:

- It will be prudent for Transgrid to 'refresh, re-platform, and modernise' and in some cases rewrite the 17 identified applications in the next RCP; and
- Implementing a secure development environment is likely to be a prudent initiative.

447. With the exception of our concerns regarding the lack of visibility of Transgrid's capacity to deliver all the work in the next RCP, we consider that it is likely it will require the proposed ICT capex for Bespoke Applications in the next RCP.

6.3.6 Employee Enablement

Overview

448. Transgrid spent only $1.7m in the current RCP on employee enablement, noting that this package involves the replacement and maintenance of user devices (e.g. laptops, iPads), together with MS Office, Exchange, and Sharepoint software, and telephony services.

449. Transgrid's forecast for the next RCP is $12.2m capex on employee enablement and which it describes as follows:[184]

- *'Maintain current approach of purchasing and refreshing hardware assets*
- *Migrate to Microsoft 365 (a SaaS model).*
- Move to Microsoft *Exchange Online and SharePoint Online under the Microsoft 365 licence.*
- *Move from soon to be decommissioned ISDN solution to SIP [Session Internet Protocol] solution.'*

450. Transgrid refers to this preferred option as Option 1 in its analysis.

Assessment

Transgrid considered three options and has likely selected the appropriate option

451. Transgrid's preferred Option 1 is described above. Its cost-benefit analysis is based on a simple probabilistic risk-cost analysis in which the benefit is derived from the avoided cost of lost access to Office 365, resulting in a positive NPV of $7.8m.[185] Transgrid also considered the following options:

- Base Case: continuing the existing approach to procuring and providing employee enablement services to its staff while on-premise versions of software remain available.
  - Transgrid's analysis provides a compelling basis for not selecting this option, based primarily on the EOL/obsolescence of both devices, ISDN and the current on-premise version of Office and Sharepoint; the estimated cost was approximately $2m higher than for the preferred option. Transgrid's estimated NPV for this option is $7.1m, or $0.7m less than the preferred Option 1.
- Do nothing: Transgrid reasonably concludes that this is not a viable option.

184 Transgrid - OER-Employee Enablement - 15 Nov 2021 – CONFIDENTIAL, pages 2-3

185 Transgrid-IR010-ICT Employee Enablement NPV-20211115-CONFIDENTIAL

- Other alternatives: Transgrid discussed the merits and shortcomings of the BYOD[186] model and moving to Device as a Service (DaaS), which '*will need to be looked at further down the line as a possible option*.'[187] We agree that BYOD is unlikely to be a suitable approach for Transgrid given security issues, but DaaS appears to be a promising alternative. Transgrid provided no cost-benefit analysis of DaaS as an alternative to the on-premise device model.

452. Whilst we consider the avoided cost in Transgrid's cost-benefit analysis to be somewhat exaggerated, and therefore the NPV of $7.8m is likely to be over-stated, Transgrid has applied the same benefit assumptions to its Base Case analysis (i.e. only the assumed costs differ). Based on the available information, and cognisant of concerns expressed below, we consider that Option 1 is superior to the other options considered.

Transgrid has not explained the zero expenditure on the employee enablement sub-category in FY20 to FY23

453. Transgrid's number of user devices has been relatively stable[188] but expenditure on them was very low in the current RCP at $1.7m across the first two years and no capex at all in the three subsequent years.

454. Transgrid's device technical life ranges from 3-5 years,[189] noting that Transgrid advises that *'[g]enerally we depreciate assets over three years and then sweat the hardware for an extra one or two years above the recommended hardware manufacturers refresh timeline.*'[190] Even with the extra one-two years of service, it is likely that a prudent operator would replace on average 20-25% of Transgrid's each year at an average cost of about $1.6m p.a.[191]

455. It appears that Transgrid has assumed in its RP estimate for the balance of the current RCP that it will defer capex on device replacement to the start of the next RCP, rather than investing prudently in the current RCP. This is not consistent with the actions of a prudent operator and has the effect of increasing the capex forecast in at least the first year of the next RCP to $5.0m, which is well above the annual average for the balance of the RCP of $1.8m, as shown in Table 6.2.

456. The average assumed number of user devices across the next RCP is 4% higher than for the current RCP, with the device/user ratio relatively constant at 1.5 according to Transgrid's RIN data. The RIN information also shows that the average number of devices ramped up by about 30% during the last two years of the current RCP but the assumed number of devices declines in the next RCP. The ramp up in device numbers in FY22 and FY23 is not explained in Transgrid's OER and, again, nor is the apparent absence of ICT capex on the procurement of these 'extra' devices in the last two years of the current RCP.

Summary

The transition to MS 365, Exchange Online and Sharepoint Online and to SIP is likely to be prudent

457. Transgrid's analysis for these initiatives is sufficient to justify the transitions proposed as part of the preferred Option 1.

User device expenditure in the next RCP is unnecessarily high

458. Whilst there is a need to replace devices which in some cases Transgrid states are now 10 years old, Transgrid appears to have deferred expenditure that should have been

186 Bring Your Own Device

187 Transgrid - OER-Employee Enablement - 15 Nov 2021 – CONFIDENTIAL, page 13

188 Based on our analysis of AER RIN data

189 For example, 3 years for phones and laptops and longer for other devices such as printers, and displays

190 Transgrid - OER-Employee Enablement - 15 Nov 2021 – CONFIDENTIAL, page 5

191 Based on the $1.6m capex in FY25, FY27, and FY28 in the next RCP which we assume to be largely for device refresh

reasonably invested on user device replacement during the current RCP. This creates a 'bow wave' of forecast device replacement capex of $5.0m in the first year of the next RCP, which is well above the annual average expenditure for the remainder of the next RCP.

459. In the absence of an explanation regarding the apparent extension of the average life of devices well beyond the 3 - 5 year average, we consider it more likely than not that a prudent operator would invest in at least some replacement of devices in the remainder of the current RCP. This would have the effect of reducing the requirement in the next RCP by up to $3.2m, which is the difference between Transgrid's average annual capex in FY25-FY28 and its proposed FY24 capex.[192]

6.3.7 Data and Decisioning

Overview

460. Transgrid's actual/estimated capex in the current RCP is $1.2m. Transgrid proposes spending $6.3m capex in the next RCP on (i) replacing its [redacted], and (ii) implementing a governance framework *supporting adherence to regulatory requirements, including with the [draft] CI Bill*.'[193] Transgrid refers to this as the Base Case in its analysis.

Assessment

Transgrid considered four options and has likely selected the appropriate approach

461. For its preferred Base Case, investments are triggered by Transgrid's transition away from its Ellipse ERP to its Digital Core and will also enable Transgrid to meet its obligations under the Critical Infrastructure Bill 2020 (CI Bill). This is the least cost, technically viable option and is reasonably selected by Transgrid to address the 'technical obsolescence' and regulatory requirements. Transgrid provided a probabilistic risk-cost analysis in which the benefit is derived from the avoided costs of application/systems outages. However no quantifiable benefits are claimed in the OER for the Base Case or Option 1 (discussed below).

462. Transgrid considered three alternatives the preferred Base Case:

- Do nothing – Transgrid reasonably concludes that this option is not technically feasible because, among other things, [redacted] will not work with the Digital Core SaaS applications and [redacted] are no longer integrated with many of its applications;
- Option 1 - This builds on the Base Case, onboarding a much larger set of data to provide greater visibility of assets, leading to improved maintenance scheduling, compliance and organisational efficiency, etc however the cost outweighs the benefits;[194] and
- Option 2 - Restoration of [redacted]: this option involves restoring the previous existing functionality to integrate them with the Digital Core. However, Transgrid reasonably concludes that the option is not preferrable to the Base Case because the cost of doing so is prohibitive.

463. Despite the opaqueness of Transgrid's cost-benefit analysis, we consider that Transgrid's preferred Base Case is likely to be superior to the other approaches/options considered.

192 Refer to Table 6.2

193 Security Legislation Amendment(Critical Infrastructure) Bill 2020, Transgrid - OER-Data and Decisioning - 15 Nov 2021 – CONFIDENTIAL, page 2

194 In the NPV analysis provided, the benefit is the same as for the Base Case, however the assumed costs are significantly higher (per Transgrid-IR010-ICT Data and Decisioning NPV-20211115-CONFIDENTIAL); however in the OER, no benefits are claimed

This OER and the Cyber security OER appear to be complementary rather than duplicative

464. Transgrid states that the additional obligations in the CI Bill '*require a new approach to data governance, security, access and use…'*[195] and that *'[a]chieving the requirements in the draft CI Bill will require us to introduce automated tools that can check and correct for vulnerabilities, such as checking if confidential data has accidentally been categorised as non-sensitive data.*'[196] We were concerned that this implied duplication between the functionality in this OER and the cyber security OER (discussed in section 6.3.10).

465. In the Data and Decisioning OER, Transgrid identifies a high[197] functional relationship with the Cyber security OER in that the enterprise data model[198] that will be built as part of the former OER will (i) allow it to define data and set security classifications against the cyber security requirements, and (ii) inform both the Business Continuity Plan and Disaster Recovery plan, '*increasing our resilience and ability to respond to potential cyber events, particularly in relation to our obligations in light of the CI Bill.'*[199]

466. Our understanding therefore is that the replacement of [redacted] remain complementary to the activities required to achieve AESCSF SP-2/SP-3 discussed in section 6.3.10.

This OER is of medium importance to five other OERs

467. Transgrid also identifies that the Data and Decisioning investment is '*required to fully realise the benefits of*' five of the other six OERs or would result in a change in scope if it were not to proceed.[200]

Summary

The main driver for the project is lack of integration of CARD and ORA with the Digital Core

468. Transgrid identifies that it could not meet the requirements of the CI Bill without replacement of [redacted]. However, the trigger for the replacement of the legacy systems appears to be much wider than this given that the Digital Core means that [redacted] are no longer integrated with many of Transgrid's applications.

Transgrid has likely selected the prudent option

469. Transgrid has selected the least-cost technically viable option. Whilst we have reservations about the quantified benefits presented in its cost-benefit analysis, the non-quantified benefits described in the OER appear to be sufficient to support the investment. Both components of work (i.e. replacing legacy systems and implementing the data and governance framework) are likely to be required in the next RCP.

6.3.8 Operational Evolution

Overview

470. Transgrid proposes:

i. replacing its existing MS Project and Portfolio Management (PPM) system with an integrated hybrid cloud solution that incorporates the industry standard systems [redacted] and

195 Transgrid - OER-Data and Decisioning - 15 Nov 2021 – CONFIDENTIAL, page 4

196 Transgrid - OER-Data and Decisioning - 15 Nov 2021 – CONFIDENTIAL, pages 4-5

197 'High' means this OER is essential from a functional or compliance perspective to another OER

198 Defines how data is produced and consumed across the business; gives an overarching view of the data available and the connections between data sets (Transgrid - OER-Data and Decisioning - 15 Nov 2021 – CONFIDENTIAL, page 7)

199 NPV of -$6.7m, Transgrid - OER-Data and Decisioning - 15 Nov 2021 – CONFIDENTIAL, page 6

200 Transgrid - OER-Data and Decisioning - 15 Nov 2021 – CONFIDENTIAL, page 6

ii. expanding its Digital Core capabilities to allow it to better optimise inventory, asset and workforce management. This is referred to as Option 2 in Transgrid's analysis. The estimated capital cost is $1.9m in the next RCP with the total project cost estimated to be $16.4m (2020-21), with the balance to be incurred as opex over the next RCP.

Assessment

471. Transgrid proposes replacing PPM because (i) it has not been supported by the vendor since September 2021, and (ii) it does not provide the functionalities of the industry standard software, which Transgrid claims will limit its management of the complex major and mega projects planned to be undertaken in the next RCP. Transgrid proposes investing in a replacement inventory management system as an opportunity to reduce operating costs.

Transgrid considered four options and has likely selected the appropriate approach

472. Transgrid's preferred Option 2 is described as being 'Option 1 plus expanded Digital Core capabilities.' That is, in addition to the features of Option 1, this option includes implementing [redacted]. It has the highest capital cost of the options considered, with the highest NPV at +$11.3m. Transgrid considered three alternatives in addition to its preferred Option 2:

- Do nothing: Transgrid reasonably concurs that this is not a technically or commercially viable alternative given the risk to its business of retaining its existing PPM;
- Base case: Maintain current systems and perform essential Digital Core maintenance – Transgrid reasonably concludes that this option does not address the identified risks and is not commercially superior to the preferred option; and
- Option 1: Replace PPM and perform essential Digital Core maintenance – in addition to replacing PPM, this introduces an '*updated and modern core system to run HR, risk management, procurement, works maintenance, assets management and finance functions*' with a NPV of +$4.2m.

473. On the basis of this analysis, Transgrid's selection of Option 2 appears to be the prudent choice.

The net benefit of Transgrid's preferred option is likely to be positive under most scenarios

474. Transgrid estimates that maintaining the current PPM system will cost [redacted] based on:

- Its 200 project managers spending 2 to 4 days each per month processing monthly forecasts and reports in addition to the 3-5 days project managers currently take to 'close the month'; and
- With the proposed replacement of PPM, it would take only one day per project manager to 'close the month'.

475. Avoiding the cost inefficiencies attributed to the Base Case is classified as a benefit for Options 1 and 2. At a workshop with Transgrid we asked clarifying questions regarding the above assumptions. Transgrid reaffirmed its current state position and its assumptions regarding the extra 'close of month' time required. Nonetheless, we remain concerned that the assumptions are likely to represent an overestimate of the cost of maintaining the current system.

476. Transgrid also estimates that Options 1 and 2 will reduce cost overruns, and given the $4.9b stated forward work program, Transgrid states that '*even a very small (0.25%) reduction in overruns would justify our investment in a new project management system*.'[201] It does not include this benefit in its analysis.

477. For Option 2 only, Transgrid estimates that introducing [redacted] will deliver benefits of $6m to $13m over three years from optimising inventory levels based on industry

201 Transgrid - OER-Operational Evolution - 15 Nov 2021 – CONFIDENTIAL, page 13

'averages.' Transgrid includes the lower bound number in the economic analysis in FY24 and with the benefit progressively reducing to a stable $2.6m p.a. from FY29 to the end of the study period. It then applies a probability weighting of 51%.[202]

478. Transgrid also provides a qualitative 'case study' in managing its inventory, assets, and workforce. Transgrid provided no supplementary information in support of its benefit assumptions regarding [redacted], despite our request for it to do so.[203] Nonetheless, based on the qualitative information provided, and our own experience, we expect that the benefits are likely to offset the incremental cost of [redacted] of [redacted] ($2020-21).

Summary

The selected option is likely to be the prudent approach

479. Based on the information provided, we consider that Option 2 is likely to be the prudent choice.

The whole project should be self-funding

480. We consider that the benefits described by Transgrid that it will garner from this investment should self-fund the initiative, including the proposed capex of $1.9m.

6.3.9 Customer and Safety Support

Overview

481. Transgrid proposes non-recurrent capex of $1.0m to consolidate its current customer relationship management (CRM) systems into [redacted], a cloud-based solution, and to extend the functionality of its web site. The total cost over the next RCP is $3.7m, with the balance being opex. Transgrid refers to this investment as Option 2 in its analysis.

Assessment

482. Transgrid concludes that its current CRM is not fit for purpose because it has limited functionality and '*requires complex and inefficient manual processes that prevent effective customer engagement and hamper the efficient delivery of projects and maintenance work.'*[204] Furthermore it proposes to invest to leverage its new web site functionality to improve customer engagement via self-service options, chat bots, and other 'engaging digital features.'

Transgrid considered three options and it has likely not chosen the appropriate approach

483. Transgrid did not include a 'do nothing' option in its OER. Its current CRM was implemented in 2014 and according to the information provided by Transgrid in the OER,[205] we consider that it is reasonable to conclude that retaining the [redacted] without enhancement through to at least FY29 is unlikely to be the prudent or efficient decision.

484. Transgrid considered a Base Case and another alternative to its preferred Option 2:

- Base case: maintain the current CRM but increase access for the field work force – this will extend its use to more than 100 field-based workers at a total estimated recurrent cost of $0.3m.

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202 Transgrid's response to information request AER IR010, Transgrid-IR010-ICT Operational Evolution NPV-20211115-CONFIDENTIAL; 51% is the lower bound value corresponding to a 'likely' occurrence (which is described as 'will probably happen, but not a persistent issue')

203 Transgrid's response to information request AER IR010, question 2 – for example the basis for the benefits Table 11 of its OER, page 15

204 Transgrid - OER-Customer Safety and Support - 15 Nov 2021 – CONFIDENTIAL, page 4

205 Transgrid - OER-Customer Safety and Support - 15 Nov 2021 – CONFIDENTIAL, pages 5-6

- Option 1: Consolidate and integrate, optimise processes - this option will '*consolidate our current CRM systems into the superior* [redacted] *and integrate its information with TSS to optimise processes and support information visibility.'* [206] The total capital cost is estimated to be [redacted] to be incurred in FY24 and is estimated to generate $6.8m benefits in the next RCP, resulting in an NPV of $2.6m.[207]
- Option 2: Enhance customer interactions – this includes the scope of work under Option 1 plus a [redacted] investment to extend the functionality of Transgrid's web site to improve the customer experience for totex of [redacted]. The total IFRS-adjusted capex is [redacted], with the balance being SaaS subscription solutions. Option 2 is estimated to generate $6.9m benefits in the next RCP, resulting in an NPV of +$1.3m.

Transgrid's economic benefits analysis is not compelling

485. The major benefit attributed by Transgrid is common to Options 1 and 2 and is derived from avoided cost of project delays due to disagreements with landowners from having more information in the hands of the relevant field staff. It has based its analysis on its experience with Project EnergyConnect, applying a saving of $1.2m p.a.[208]

486. We do not consider this benefits estimation approach to be sufficiently well justified to demonstrate a positive NPV for Options 1 or 2.

Summary

487. We are satisfied that the current CRM, which is currently eight years old, is approaching technical and commercial obsolescence and that the prudent approach is likely to be replacing it with a contemporary cloud-based solution in the next RCP.

488. Transgrid has selected Option 2 despite it generating a lower NPV than Option 1, based on the intangible benefits afforded by Option 2. We consider that the additional [redacted] for customer engagement improvements has not been adequately justified by Transgrid.

489. Whilst we therefore endorse Option 1, we expect that this will have the same or similar [redacted] as Option 2.

6.3.10 Cyber Security

Overview

490. Transgrid proposes ICT capex of $11.9m across the next RCP to achieve AESCSF[209] security profile of SP-3. The package is responding to a new legislative and likely regulatory obligations to achieve a prescribed and measurable level of cyber security maturity within the next RCP. The total cost is estimated at $30.5m including the opex impost across the next RCP (discussed in section 7). Transgrid proposes $11.9m cyber security capex in the next RCP.

Assessment

Transgrid is [redacted] and its proposed AESCSF maturity target of SP-3 is appropriate

491. The proposed cyber security expenditure (i.e. capex and opex) is to meet the increased security and resilience requirements in the Security Legislation Amendment (Critical Infrastructure) Bill 2021 (SLACI 2021) [redacted] which

206 TSS is Transgrid Spatial System, OER-Customer Safety and Support - 15 Nov 2021 – CONFIDENTIAL, page 10

207 Transgrid's response to information request AER IR010, Transgrid-IR010-ICT Customer Safety NPV-20211115-CONFIDENTIAL

208 Based on 1% of the total potential cost of 2 days delay across 200 properties, at $300k per day delay cost

209 Australian Energy Sector Cyber Security Framework

commenced on 2 December 2021.[210] There is also a draft Security Legislation Amendment (Critical Infrastructure Protection) Bill 2022 (SLACIP 2022), which was passed by federal parliament on 31 March 2022. Draft sector-specific rules for SLACI 2021 and SLACIP 2022 were published on 31 March 2022.

492. Transgrid expects that the rules will commence from January 2023 and advises that it will reflect any changes to its assumptions in its revised submission to the AER.[211, 212] The requirements for [redacted].

493. Transgrid states that:[213]

> *'As a critical infrastructure provider, we need to prepare to comply with the enhanced regulatory framework proposed by the CI Bill, which builds on the Australian Energy Sector Cyber Security Framework (AESCSF).'*
>
> *'… to comply with the proposed CI Bill, we expect to have to gain and maintain an AESCSF Security Profile (SP) rating of 3 (or its equivalent), requiring achieving MIL-3 ratings across all relevant domains. To reach this mandated increase in security, we will need to refresh or improve our current controls and implement new controls.'*

494. In addition to the CI Bills, Transgrid notes that it also needs to comply with other new legislative requirements, including:

- Energy Legislation Amendment Bill 2021 (NSW) ('NSW Bill');[214] and
- Ransomware Payments Bill 2021.

495. Transgrid has provided a compelling analysis of the Federal and State legislation changes and timing to support its position that:[215]

- [redacted]; and
- It is appropriate for it to achieve an AESCSF maturity indication level of SP-3 based on the combination of legislation, appropriate risk management, and the urgent request of the Australian Cyber Security Centre (ACSC) to adopt an enhanced cyber security posture.

Transgrid is not planning to achieve SP-2 in the current RCP

496. Transgrid is now working to achievement of SP-1 in FY23 (i.e. 12 months after the assumed commencement date of the rules, SP-2 in FY25 (i.e. within 24 months of the assumed commencement of rule change), and SP-3 in FY28 (i.e. within 60 months of the assumed commencement of the rule change).[216] The proposed timeframes are based on the expected legislative requirements to achieve the three security profiles within 12 months, 24 months and 60 months from the expected regulatory rule change date (i.e. enacted under the CI Bill). Transgrid's plan is to achieve these requirements 'just in time' to comply and effectively allows no margin for slippage.

497. Transgrid proposes only one option in its OER – achieving SP1, SP-2, and SP-3 by the assumed final compliance deadlines arising from the CI Bill.

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210 This is referred to as Part 1 of the Federal amendments; viewed at https://www.aph.gov.au/Parliamentary_Business/Bills_Legislation/Bills_Search_Results/Result?bId=r6657

211 Transgrid – Opex Step Change Overview Paper – 31 Jan 2022 – CONFIDENTIAL, page 11

212 Transgrid's response to information request AER IR031 received on 14 June 2022, Transgrid-IR031-Transgrid response for cyber security step change-20220614-CONFIDENTIAL, question 2

213 Transgrid - Opex Step Change Overview Paper - 31 Jan 2022 – CONFIDENTIAL, page 11

214 This gained assent on 29 November 2021, viewed at https://www.parliament.nsw.gov.au/bills/Pages/bill-details.aspx?pk=3889

215 Transgrid's response to information request AER IR006, Transgrid-IR006-Transgrid response for Cyber and security step change-20220406-CONFIDENTIAL, question 1(a)-(c)

216 Transgrid's response to information request AER IR016, Transgrid-IR016-Transgrid response for cyber-20220502, question 2

498. As shown in Figure 6.7, Transgrid self-assessed its 'current maturity' in early 2021[217] as [redacted] practices and anti-patterns fully implemented.

[redacted]

499. Despite Transgrid self-assessing that it had achieved [redacted] in early 2021, [redacted][218]

500. Given the elevated and increasing cyber threat landscape, we asked Transgrid why it had apparently ceased progress towards SP-2 in the current RCP. Transgrid responded as follows:

> *'The issuing of the Acts and their associated regulations is now later than the timing assumed in our Revenue Proposal…[t]his means our anticipated cyber security activities and associate expenditure in the 2018-2023 regulatory period may now be delayed to the 2023-2028 regulatory period.'*[219]
>
> *'We have aligned our compliance timing to reflect our capacity to implement changes and our risk appetite as per the cyber security OER.'* [220]
>
> *'As of May 2022, there are 19 initiatives/projects in flight that have contributed to progressing cyber security capabilities…it would not be efficient and prudent to seek to accelerate progress toward achieving SP2 in the remainder of this RCP due to the program of works currently underway, impacts to the business and the market for security resources.'*[221]

501. We consider that Transgrid's response is inconsistent with its gap analysis. If the 19 initiatives referred to above are indeed progressing its cyber security program, then the gap to SP-3 will be decreasingly small and the required expenditure should be less than proposed.

502. Conversely, if Transgrid is not improving its cyber security maturity, then its actions and intent are not consistent with the actions of a prudent TNSP operator. By justifying delaying its work on security enhancement based on its anticipation of the timing of legislative

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217 We infer this from the fact that KPMG's gap analysis report for Transgrid (Transgrid-IR006-KPMG-Critical Infrastructure Security Costing Final-20210624-CONFIDENTIAL), which was finalised in June 2021, was based on the self-assessment in this diagram according to Transgrid's response to IR016, question 1

218 In response to question 2(c) of IR016, Transgrid advised its target for achieving SP-1 was FY23 which was revised from previous advice that its target was FY24

219 Transgrid's response to information request AER IR016, Transgrid-IR016-Transgrid response for cyber-20220502-CONFIDENTIAL, question 2(a)

220 Transgrid's response to information request AER IR0006, Transgrid-IR006-Transgrid response for Cyber and security step change-20220406-CONFIDENTIAL, question 2(a)

221 Transgrid's response to information request AER IR022, Transgrid-IR022-Transgrid response for Capex EMCa onsite-20220523-CONFIDENTIAL, question 15

requirements, Transgrid appears to have ignored the reality of the threat risks that are the drivers for those requirements.

503. We consider that Transgrid should have undertaken the necessary activities in the current RCP to achieve SP-2, with the assistance of external resources as necessary, as it plans to do in any case starting in the next RCP. In forming this view we took into account the following:

- The cyber security threat landscape, which is evolving and complex.
- Admonitions to act to improve cyber security maturity from the likes of the Parliamentary Joint Committee on Intelligence and Security (PJCIS) and the Australian Cyber Security Centre:

> *'Ultimately, despite reservations regarding cost, the Committee is conscious of the benefits, both immediate and longer-term, of the security uplift that will result from the full suite of SOCI measures. Such uplift does come with a cost and ultimately the Committee agrees with the Department that the potential cost to the economy of catastrophic critical infrastructure failure from not doing anything far outweighs the cost of complying with the measures proposed'*[222]
>
> *'It is strongly recommended that responsible entities for critical infrastructure assets commence voluntarily implementing the obligations proposed in the draft risk management program rules under the Security Legislation Amendment (Critical Infrastructure Protection) Bill 2022 that is currently before the Parliament.'*[223]

- Transgrid has been aware since at least early 2021 that it was not at SP-2 maturity level and it was likely that TNSPs would need to achieve at least that level:
  - it was self-assessed at [redacted] implemented;
  - the work to fill the practice and anti-pattern gaps to achieve SP-2 (or close to it) with concerted effort in the ensuing 19 months through to the end of the current RCP should be achievable; and
  - the work required to achieve SP-2 was identified in a report by KPMG[224] which Transgrid commissioned, was finalised in June 2021 and which, among other things, details the activities and costs for 16 initiatives to respond to the CI Bills.

504. On this basis we consider that Transgrid should have commenced what is identified as a five-year program of work in the current RCP. Allowing time to secure internal approval and to secure the requisite resources, our view is that Transgrid could have commenced the initiatives at least from July 2022. This would reduce the required capex in the next RCP by at least the equivalent capex to the FY24 amount ($0.4m) identified by Transgrid in its RP.[225]

The initiatives and activities described within them appear to be appropriate to achieve the respective security level requirements, starting from the base level in 2021

505. Transgrid provided supporting information (primarily via the KPMG report, supplemented by responses to Information Requests) that:

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222 Transgrid's response to information request AER IR006, Transgrid-IR006-Transgrid response for Cyber and security step change-20220406-CONFIDENTIAL, page 4 which refers to Advisory report of the Security Legislation Amendment (Critical Infrastructure Protection) Bill 2022, page 68, paragraph 3.54

223 Transgrid's response to information request AER IR006, Transgrid-IR006-Transgrid response for Cyber and security step change-20220406-CONFIDENTIAL, page 3 which refers to https://www.cisc.gov.au/help-and-support-subsite/Files/action-alert-risk-management-implementation-uplift.pdf

224 Transgrid's response to information request AER IR006, Transgrid-IR006-KPMG-Critical Infrastructure Security Costing Final-20210624-CONFIDENTIAL

225 Transgrid - Non-network ICT Overview Paper - 31 Jan 2022 – CONFIDENTIAL, Table 5-1

- Describes the purpose of each initiative;
- Links the initiatives to the 11 AESCSF domains;
- Shows how the activities within each initiative build upon current cyber security activities; and
- Provides a breakdown of the assumed external services, internal resources, hardware, and licences, which collectively provides some insight into the initiatives costs, both capex and opex).

506. After reviewing the descriptions of each initiative and the activities within them, we consider they are individually and collectively likely to represent a prudent approach to closing the gap between Transgrid's (then current) cyber security maturity (per Figure 6.7) and SP-3.

Transgrid's initiative development principles and strategy are appropriate

507. We asked Transgrid to demonstrate that the cost estimate for each initiative was likely to represent an efficient level, cognisant of the stated accuracy of the estimate at ±25% overall. Transgrid provided a list of seven 'principles',[226] which include the following four which we consider to be the key principles:

- Use of SaaS and other forms of cloud services for operational efficiency and scalability where possible;
- Focus on solutions as part of overall ecosystems rather than best-of-breed solutions to reduce the number of vendors and to leverage licence economies of scale;
- Automation of manual tasks to reduce recurrent labour cost; and
- Weighting of junior and senior resources towards junior resources, where possible.

508. Transgrid also described its strategy for the allocation of accountabilities to internal vs external service providers, which it states was applied in developing and costing the sixteen initiatives.

509. We consider the principles and strategy collectively provide a reasonable framework for structuring and costing the cyber security improvement initiatives (capex and opex).

The cost estimates appear to be high for some elements of the program, but not unreasonably so in aggregate within the proposed accuracy range

510. The KPMG report provides the cost breakdown for each initiative, showing the bottom-up build of the external and internal labour, hardware, and XaaS cost estimates for each initiative. KPMG's report also provides a good explanation of the method it uses to both allocate and price resources for each initiative. The reference salary prices (including on-costs), resource allocation factors, and resource allocations all appear to be reasonable.

511. There is also evidence in the KPMG report and the accompanying spreadsheet of refinement of the costs through one iteration for capex (and up to two iterations for opex), resulting in the proposed totex being less than the initial totex estimate.

512. Based on our experience, we consider that the estimated capex for two initiatives is overstated.[227] However, given our concurrence with the initiative development principles and strategy described and our assumption that these were applied appropriately to each initiative, we conclude the total estimated capex cost of $11.9m is likely to be within the ±25% stated accuracy range but with an element of bias on the high side.

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226 Transgrid's response to information request AER IR006, Transgrid-IR006-Transgrid response for Cyber and security step change-20220406-CONFIDENTIAL, page 13

227 Enhanced IGA and Performing cyber security exercises

Summary

Transgrid has identified appropriate activities for achieving SP-3 but the cost of doing so may be slightly overstated

513. We are satisfied that it is prudent for Transgrid to seek to achieve SP-3 in the next RCP based on external obligations and the appropriate link to the AESCSF. We are also satisfied that the 16 initiatives proposed are appropriate for closing the gap between its current maturity level and SP-3.

514. We consider that the estimated capex requirement is slightly overstated but consistent with the inherent accuracy of the cost estimate at this stage of the project development lifecycle.

Transgrid appears to be waiting until the next RCP to invest significantly in improving its cyber security maturity, despite the current threat landscape

515. We consider that Transgrid's deferral of work to the next RCP and its plan to achieve compliance 'just in time' to meet legislated obligations maintains an unnecessary risk and does not represent the approach of a prudent network operator of the NSW transmission system. We consider it more likely that a network operator acting prudently from the 'current state' that it assessed in 2021, would seek to at least achieve SP-2 maturity in the current RCP, and this would reduce the capex (and opex) required in the next RCP.

6.4 Summary of findings and implications for Transgrid's proposed ICT capex forecast

6.4.1 Summary of findings

Findings from our analysis of ICT totex and ICT capex trends

516. Transgrid's capex for the current period would have been similar to the AER allowance if not for the IFRS ruling. Transgrid proposes a 128% increase in ICT capex in the next RCP despite its cloud migration strategy. The actual and proposed increases in totex in the current RCP and the next RCP from the previous period are not indicative of efficient capex-opex tradeoffs, despite Transgrid stating that it is self-funding some of the opex-related increases from its proposed ICT capex packages.

517. A trend-based forecast for the next RCP indicates that ICT capex of about $72.3m rather than $86.9m would be expected. This estimate includes an allowance for Transgrid to meet its increased external cyber security obligations. Thus, a top-down trend-based sense check suggests that Transgrid may have overstated its capex requirement by approximately $15m (or 17%).

518. The expenditure profile in which Transgrid has almost entirely paused ICT capex in the final years of the current RCP, only to ramp up immediately from commencement of the next RCP, taken together with statements that Transgrid has made about 'deferring' work to the next RCP, strongly suggests that Transgrid is 'planning to the regulatory period' rather than investing based on prudent assessments of need.

Findings from our analysis of the eight proposed packages of work

519. From our assessment of the eight packages underpinning the ICT capex forecast, we consider that in each case, Transgrid has identified adequate needs for taking action, either due to asset management issues (such as assets at end-of-life), external obligations, or for business strategic alignment (e.g. operational evolution). However, we consider that Transgrid has not adequately demonstrated that it has prioritised its work to ensure that only the work that is prudently and efficiently required in the next RCP is proposed.

520. Similarly, in our view a prudent TNSP operator that has identified a justified need, as Transgrid has, would continue making investments to meet those justified needs in the current RCP rather than wait for the commencement of the next RCP as Transgrid appears to have done in several aspects of its ICT portfolio.

521. In some cases, Transgrid has not adequately considered alternative options, including the likely increased availability and feasibility of cloud-computing options. Also, we consider that a small proportion of ICT capex is not required under AER guidelines because it should be self-funding or where the selected (more expensive) option is not adequately justified.

6.4.2 Implications for forecast ICT capex

522. Transgrid has not demonstrated that the ICT portfolio of work that it has proposed is prudent and efficient.

523. We consider that Transgrid's estimate of the capex required in the next RCP is moderately over-stated and that the non-network ICT risks and obligations it faces should have or can be managed through a combination of:

- Prudent spending continuing in the current RCP (reducing the capex required in the next RCP); and
- The adoption of alternative options during the next RCP which are likely to include some capex-opex trade-offs such that not all the identified needs will require a capex solution.

7 REVIEW OF PROPOSED OPEX STEP CHANGE

We consider that Transgrid has not presented a reasonable case for the full amount of the opex step change that it has proposed for cyber security and physical security, to be included in its opex allowance.

We consider that in the case of ICT cyber security, whilst Transgrid's five-year program of work to achieve AESCSF SP-3 maturity level and the commensurate (estimated) additional opex amount is reasonable, it should have or will have completed the first year of its proposed program in the current RCP.

In the case of the proposed Physical security opex step change, Transgrid's cost estimate for enhanced assurance-based activities is significantly higher than in its internal business case documentation, for reasons that we consider Transgrid has not adequately justified. Accordingly, we consider that a lesser amount is likely to be required.

In regard to all three components, the additional expenditure that Transgrid requires on average in the next RCP is to some extent already allowed for in its Base Year opex, which is already higher than its average expenditure in the current RCP. Therefore, in addition to the adjustments indicated above, the proposed step change should be commensurately reduced to avoid an element of double counting.

7.1 Introduction

7.1.1 Scope

524. In its RP, Transgrid has proposed step changes to its opex forecast that it describes as responding to new external obligations.

525. In this section, we consider Transgrid's proposed Information and Communications Technology (ICT), Operational Technology (OT) and Physical security opex step changes for the next RCP. We first consider the proposed additional expenditure requirements, before then considering the extent to which these require a step change.

7.1.2 The proposed step changes are independent of other incremental ICT opex that Transgrid will self-fund

526. We note that Transgrid is self-funding ICT opex impacts from five of its ICT capex packages of work, totalling [redacted], from business opex savings that it expects to result from these investments. The self-funded opex does not include the proposed opex step change associated with its ICT cyber security capex package.

7.2 Our assessment of ICT cyber security opex

7.2.1 Overview

527. Transgrid has identified an $18.6m ICT cyber security opex step change that it claims is required to meet additional external obligations over the next RCP, with the annual expenditure profile shown in Table 7.1.

Table 7.1: Transgrid proposed ICT Cyber security opex step change ($m, real 2022-23)

Opex step change	2023/24	2024/25	2025/26	2026/27	2027/28	Total
ICT Cyber Security	3.7	3.7	3.7	3.7	3.7	18.6

Source: Transgrid-Opex Step Change Overview Paper – 31 Jan 2022 – CONFIDENTIAL, Table 4-7. The difference of $0.1m between the sum of the annual expenditure and the total of $18.6m is assumed to be due to rounding.

528. Based on our analysis of Transgrid's cyber security initiatives spreadsheet, the actual ICT opex profile is as shown in Table 7.2. This represents a yearly aggregation of the expenditure that Transgrid has planned for each initiative, based on a five-year workplan prepared for Transgrid by KPMG in June 2021. The aggregate amount is the same, but we note that the expenditure profile differs from Transgrid's RP.

Table 7.2: Cyber security opex step change derived from Initiatives Workbook ($m, real 2022-23)

Opex step change	2023/24	2024/25	2025/26	2026/27	2027/28	Total
ICT Cyber Security	2.5	4.1	4.1	4.0	4.0	18.6

Source: EMCa analysis of Transgrid-IR006-Initiatives Workbook OER Packages spreadsheet-20211112-CONFIDENTIAL.

7.2.2 Proposed initiatives to achieve SP-3

529. KPMG's June 2021 report to Transgrid includes a bottom-up analysis of the activities and cost required for the three options:

- Option 1 - Maintaining Current Maturity: $3.3m capex + $3.7m opex uplift (real 2021);
- Option 2 - Complying with [then current view of] proposed [CI Bills] requirements: $5.0m capex and $9.6m opex uplift (real 2021); and
- Option 3 - Maturing to AESCSF MIL3:[228] $11.2m capex + $17.8m opex (real 2021).

530. Transgrid selected Option 3 for reasons discussed in section 6.3.10. Transgrid has adopted the 16 initiatives as defined and costed within the KPMG report as achieving SP-3. We discuss the proposed initiatives and costing in section 6.3.10 (ICT cyber security capex). Our findings are that:

- The initiatives and activities described within them are likely to be appropriate;
- Transgrid's initiative development principles and strategy are appropriate; and
- The cost estimates appear to be high for two capex components, but not unreasonably so within the proposed accuracy range. In the case of the opex-related cost estimates, and based on our experience, the estimated costs for four initiatives appear to be high.[229]

531. Given our concurrence with the initiative development principles described and our assumption that these were applied appropriately to each initiative, we conclude the total estimated additional ICT opex cost of $18.7m in the next RCP is likely to be within the ±25%

228 AEMO's AESCSF Maturity Level 3

229 Enhanced IGA, Secure by Design, Enhanced Network and Firewall Assurance, Performing Cyber Security Exercises

stated accuracy range but is likely to be on the high side. External obligation driving the cyber security investment

532. We have considered the external obligation driving the Cyber security opex step change in section 6.3.10. In summary, we consider that Transgrid has provided a compelling case for it to target achievement of the AESCSF SP-3 maturity level. However, as also discussed in section 6.3.10, Transgrid has provided no business-related reason for having slowed its security enhancement program in the remainder of the current RCP, deferring it from this period and planning to ramp it again from the beginning of the next RCP.[230] We conclude that Transgrid should have continued its program throughout the current RCP at a rate sufficient to achieve SP-2 by June 2023, or possibly sooner.

533. Specifically, we consider that Transgrid should have been able to complete the first year of its proposed five-year cyber security program in the current RCP, and which corresponds with its forecast expenditure for FY24, thereby reducing the amount required in the next RCP by $2.5m ($2023). However, for reasons discussed in section 7.5, this amount over-states the step change required to achieve this additional expenditure allowance in the period.

534. Alternatively, as we have expressed in our assessment of proposed ICT cyber security capex, if Transgrid is actually progressing its cyber security maturity to SP-2 in the current RCP, then it should require a commensurately smaller ICT opex amount in the next RCP than it has proposed.[231]

7.3 Our assessment of Operational Technology cyber security opex

7.3.1 Overview

535. Transgrid has identified a $3.5m OT cyber security opex step change to meet additional external obligations over the next RCP. Table 7.3 shows the proposed expenditure profile for the next RCP.

Table 7.3: Transgrid proposed OT Cyber security opex step change ($m, real 2022-23)

Opex step change	2023/24	2024/25	2025/26	2026/27	2027/28	Total
OT Cyber Security	0.7	0.7	0.7	0.7	0.7	3.5

Source: Transgrid-Opex Step Change Overview Paper – 31 Jan 2022 – CONFIDENTIAL, Table 4-7

7.3.2 External obligation driving the cyber security investment

536. In its Critical Infrastructure Security Cost OER (encompassing OT cyber security and Physical security opex requirements), Transgrid nominates the same set of legislative and regulatory drivers for its investment in ICT cybersecurity in the next RCP as driving the requirement to uplift its OT cybersecurity maturity. Transgrid also refers to the need for it to demonstrate '*regard to the requirements of IEC-62443…*'[232, 233]

230 The lack of proposed investment in progressing ICT cyber security maturity in FY23 is evidenced by the immaterial increase in forecast opex between FY22 and FY23 in Transgrid's response to information request AER IR032, received on 30 June 2022.

231 We note that Transgrid's Opex Step Change Overview Paper (Table 4.4) shows that Transgrid expects to incur $0.5m ICT cyber security opex in FY22. It also expects to spend $2.4m in FY23 (per its response to Information Request AER IR031, received on 14 June 2022) which does indicate that progress is being made in the current RCP, but perhaps at a lower level.

232 Transgrid - Critical Infrastructure Security Costs - 14 Jul 2021 – PUBLIC, pages 4 and 6

233 IEC 62443 is an international series of standards that address cybersecurity for operational technology in automation and control systems

537. We have considered the external obligation driving the Cyber security step change in section 6.3.10. Together with the identified requirements of IEC-62443, we consider that Transgrid has provided a compelling case for it to target achievement of the AESCSF SP-3 maturity level.

538. Transgrid has provided information that indicates that it intends to progress its OT cyber security maturity in FY23 (which is not the case for ICT cyber security). Specifically, Transgrid proposes to increase its OT cyber security opex by $0.7m from its Base Year level of $2.0m.

7.3.3 Proposed initiatives to achieve SP-3

539. Transgrid's OER report to Transgrid includes a bottom-up analysis of the activities and cost required for three options:[234]

- Option 1 - Maintaining Current Maturity: there is no incremental opex over the next RCP from this option;
- Option 2 - Complying with the current Bill requirements: $1.3m incremental ($2021); and
- Option 3 - Maturing to AESCSF MIL3: $3.1m opex ($2021).

540. Transgrid selected Option 3 (and the alternative Security Profile-3) for reasons discussed in section 6.3.10. Transgrid proposes OT cyber security activities in nine of the 16 initiatives that KPMG included in its report/costing for ICT cyber security. Transgrid has provided descriptions which in some cases identify the OT-specific impacts, but which in others appear to be common to ICT.[235] For example:

- [redacted] – *'Increase TransGrid's OT capability to identify compromises within the environment. This is achieved by [redacted]'; and*
- [redacted]

541. Whilst Transgrid has not explicitly stated that it applied the same initiative development principles and strategy to its OT-specific costings, there is sufficient evidence from the similarities of approach (including the salary price point assumptions) to assume that they also apply to the derivation of the OT activities and costs. A point of difference is that Transgrid has only included resource costs in its OT opex uplift, with the cost per initiative derived from allocation factors (% of FTE required) ranging from 10% to 100%.[236]

542. Similar to our findings regarding the ICT cyber security opex step change, we consider that the OT cyber security improvement initiatives and activities within them are likely to be prudent and the total estimated opex cost of $3.5m is likely to be within the ±25% stated accuracy range but is likely to be on the high side. For reasons discussed in section 7.5, however, this amount over-states the step change required to achieve this additional expenditure allowance in the period.

7.4 Our assessment of Physical Security opex

7.4.1 Overview

543. Transgrid has identified a $2.8m physical security opex step change to meet external obligations over the next RCP. Table 7.4 shows the proposed expenditure profile for the next RCP.

234 Transgrid - Critical Infrastructure Security Costs - 14 Jul 2021 – PUBLIC, pages4 and 5

235 Transgrid - Critical Infrastructure Security Costs - 14 Jul 2021 – PUBLIC, Table 1

236 Transgrid - Critical Infrastructure Security Costs - 14 Jul 2021 – PUBLIC, Appendix A and Appendix B

Table 7.4: Transgrid proposed Physical security opex step change ($m, real 2022-23)

Opex step change	2023/24	2024/25	2025/26	2026/27	2027/28	Total
Physical security	0.8	0.3	0.8	0.3	0.8	2.8

Source: Transgrid-Opex Step Change Overview Paper – 31 Jan 2022 – CONFIDENTIAL, Table 4-7

7.4.2 External obligation driving the physical security investment

544. In its Critical Infrastructure Security Cost OER, Transgrid nominates '*work by the Department of Home Affairs, AEMO, and industry to date,'* in relation to the Security Legislation Amendment (Critical Infrastructure Protection) Bill 2022 as leading it to anticipate that the infrastructure security obligations shown in Figure 7.1 below will apply.

Figure 7.1: Transgrid's assumptions regarding new physical security obligations

> Within 12 months of rule commencement, ensure that our risk management program sets out how we:
>
> a) detect and deter unauthorised persons accessing secure areas, and respond to incidents where unauthorised access occurs;
>
> b) restrict, control and monitor access by unauthorised persons; and
>
> c) control authorised access, including restricting access to only those persons with the appropriate approval who have an operational need to access.
>
> > Within 12 months of rule commencement, demonstrate in our risk management program how we conduct tests, as appropriate, to ensure active security measures are effective and appropriate to detect, deter, respond to and recover from breaches of security at self-assessed critical sites.
>
> a) These tests may be conducted in conjunction with other safety, security or emergency management exercises or procedures.
>
> > Within 12 months of rule commencement, ensure that our risk management program sets out how we have regard to ENA Doc 015 2006 "National guidelines for prevention of unauthorised access to electricity infrastructure".

Source: Transgrid - Critical Infrastructure Security Costs - 14 Jul 2021 – PUBLIC, p10

545. In response to our request for information,[237] Transgrid has confirmed that the timeframes nominated in Figure 7.1 have been reduced to six months.[238] Also that Transgrid proposes to increase its OT cyber security opex by 7% in FY23 from its Base Year level of $1.7m.

546. The key aspect of the assumed obligations required to underpin additional activities (and therefore expenditure) is to consider the current risks associated with Transgrid's physical assets and the adequacy of the current risk controls. Only if the current risk controls are assessed as being inadequate would additional activities be warranted. In this context, we assess Transgrid's proposed additional activities below.

7.4.3 Transgrid's proposed physical security initiatives

547. Transgrid considered three options in its OER:[239]

- Option PS1 – Maintaining Current Maturity, involving no incremental opex over the next RCP;
- Option PS2 – Compliance driven assurance (critical sites only), estimated to cost $1.7m ($2021) over the next RCP; and
- Option PS3 – Complete network assurance (all sites[240]), estimated to cost $2.4m ($2021) over the next RCP.

237 Transgrid's response to information request AER IR031, received 14 June 2022

238 Department of Home Affairs and Cyber and Infrastructure Security Centre, Protecting Critical Infrastructure and Systems of National Significance, Industry Town Hall, 25 November 2021

239 Transgrid - Critical Infrastructure Security Costs - 14 Jul 2021 – PUBLIC, page 5

240 17 Tier 1 sites; 100 Tier 2 sites, 90 communications sites, giving a total of 207 sites

548. Transgrid concluded in its OER and in its RP that Option PS1 would not meet the physical security obligations, Option PS3 was not justified, but that Option PS2:[241]

> *'...ensures our compliance obligation as a utility of national significance are fully met under the Bill. Under this Option we will achieve compliance at the lowest incremental opex whilst still assuring our physical security risks are appropriately managed as mandated under the Bill requirements.'*

549. While Transgrid concluded in favour of Option 2, it proposed a $2.8m (or $2.7m in $2021) step change in its RP. This compared with the $1.7m ($2021) additional expenditure requirement that it identified in its OER. We asked for an explanation of the linkage between these two amounts, and in its response Transgrid provided the following:

- A physical security gap analysis;[242] and
- An Expenditure Map which provides the initiative-to-cost mapping, reproduced in Table 7.5.

Table 7.5: Transgrid's physical security initiatives and costing for opex step change 2023-28 ($k, 2021)

Initiative description	5 year FTE cost	5-year non-FTE cost	Total 5 year cost	Less Base Year cost	Proposed step change
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Source: Transgrid's response to information request AER IR006, Transgrid-IR006-Expenditure Map-CONFIDENTIAL

550. As shown, Transgrid derived its step change opex by deducting its estimated Base Year opex (physical security) from the sum of its five-year FTE and non-FTE additional costs. However, this information also revealed that Transgrid had increased its estimate for [redacted]. No adequate justification was provided for this very significant increase.

551. In the step change costing information it provided, we find that Transgrid has also assumed extending [redacted] We have considered Transgrid's cost estimate and the suggested approach in ENA guideline 015-2022, which recommends a risk analysis.[243] However, the physical security gap analysis that Transgrid provided did not contain risk-based analysis.

552. We consider that Transgrid's OER estimate of $1.7m ($2021, or $1.8m $2023) additional opex requirement in the next RCP is likely to be sufficient to meet the increased security

241 Transgrid - Critical Infrastructure Security Costs - 14 Jul 2021 – PUBLIC, page 11

242 Transgrid's response to information request AER IR022, Transgrid-IR022-SLACIP Physical Security Gap Analysis-20220509-CONFIDENTIAL, which was produced in May 2021

243 Specifically section 3.5 and Table 9

obligations. For reasons discussed in section 7.5, however, this amount over-states the step change required.

7.5 Consideration of base year in step change allowances

553. Having considered the incremental opex requirements that are reasonably required in the next RCP to meet enhanced obligations, we then considered the extent (if any) to which these may be accounted for within the BST methodology.

554. For ICT cyber security opex, Transgrid has presented its incremental requirements by comparing its current period expenditure with its estimated requirement in the next RCP. For example, its report from KPMG on its ICT requirements explicitly shows the 'current budget' (being for FY18 – FY23) and its 'proposed budget' (which is labelled for FY23 – FY28). However, Transgrid presents the required additional period-to-period opex from KPMG's advice, as its required additional opex.

555. We asked Transgrid for information on its security-related opex in the current period, and which it provided in its response to Information Request AER IR032.[244] This showed that Transgrid had higher-than-average expenditure on all three elements of security (ICT, OT and physical) in 2022, which is its Base Year for BST opex forecasting purposes, compared with its average expenditure in the RCP.

556. We then examined Transgrid's opex forecast model to identify whether any Base Year adjustment had been made to account for the higher level of security-related expenditure in the Base Year, in order to ensure that the step change would not double-count the required increment. For ICT cyber security opex, an adjustment of $70k appears to have been made, resulting in a step change of $18.6m (or $17.7m in $2021).[245] Transgrid also provided confirmation (in its AER IR032 response) that a security-related adjustment was not implicit in the 'non-recurrent SaaS costs' adjustment that Transgrid had made. For OT cyber security opex and Physical security opex, Transgrid separately advised that it deducted estimated Base Year opex amounts to arrive at its step-change amounts.[246]

557. Transgrid's approach to deriving the step change amounts for OT cyber security and Physical security is flawed, as deducting the Base Year opex from the five-year forecast for the next RCP does not result in the required step change over those five years. This is because any base year amount is effectively multiplied by five in determining the resulting five-year aggregate amount.

558. We instead used the information provided in response to Information Request AER IR032 to calculate the difference between Transgrid's current RCP average security-related opex, which formed the baseline from which it estimated its additional expenditure requirements for the next RCP, and the increment already accounted for through adoption of 2022 as the Base Year.

559. We first converted Transgrid's response to $2023 real terms, then we calculated the annual average expenditure in the current RCP and calculated the difference between that amount and the 2022 Base Year amount. We then multiplied this difference by 5, to determine the five-year value of the incremental amount for the next RCP already allowed for in the Base Year amount. We consider that these amounts should be deducted from the proposed step changes, in order to avoid double counting Transgrid's additional requirements. These corrections to the step change calculation are in addition to any adjustments to the period-to-period additional expenditure requirements described in the previous subsections.

244 Transgrid's response to information request AER IR032 was received on 30 June 2022

245 Transgrid-IR006-Initiatives Workbook OER Packages spreadsheet-20211112-CONFIDENTIAL

246 Transgrid's response to information request AER IR006, Transgrid-IR006-Expenditure Map-CONFIDENTIAL

Table 7.6: Incremental security-related expenditure accounted for within 2022 base year ($m, 2023)

Category	Annual average for current period	FY22 amount included in Base Year	Incremental amount already accounted for within 2022 Base Year	5-year value of increment already accounted for in Base Year
ICT	2.97	3.83	0.87	4.34
OT	1.27	1.95	0.69	3.44
Physical	1.44	1.69	0.25	1.24
TOTAL	**5.67**	**7.47**	**1.80**	**9.01**

Source: EMCa calculations from Transgrid's response to information request AER IR032

7.6 Summary of findings and implications for Transgrid's proposed opex step change

7.6.1 Summary of findings

Findings regarding proposed ICT and OT cyber security opex step change

560. For many of the same reasons discussed in our assessment of Transgrid's proposed increase in ICT cyber security capex, we consider that Transgrid should aim to achieve a AESCSF maturity level of SP-1, SP-2, and, ultimately, SP-3 as soon as practicable. We find that Transgrid's 'gap analysis' (and corresponding opex step change estimate) is between its self-assessed maturity level in early 2021 and SP-3, that its initiative development principles and strategy and the activities are likely to be appropriate, and that its cost estimates appear to be high but not unreasonably so.

561. We find that Transgrid appears to have slowed-down its progress towards achieving SP-2 (and therefore SP-3) and we consider that Transgrid has sufficient time since its last AESCSF self-assessment to implement the activities necessary to achieve SP-2 by the end of the current RCP.

562. We have received conflicting information from Transgrid about its progress with implementing the necessary activities to achieve SP-1 and SP-2 (i.e. as precursors to achieving SP-3 maturity level) in the current RCP. Our conclusion is that Transgrid will require a smaller opex step in the next RCP than it has proposed for achieving SP-3 ICT and OT cyber security.

Findings regarding Physical security opex step change

563. In its OER, Transgrid has selected the appropriate option based on addressing the gaps between its current practices and the Positive Security Obligations arising from the SLACIP Bill 2022. The option appropriately focusses on critical sites.

564. However, Transgrid's RP proposed $2.8m opex step change includes unjustifiably increased cost estimates for [redacted], compared with those in its OER. Accordingly, we consider that the additional opex requirement should be $1.8m which is equivalent to Transgrid's cost estimate for Option PS2 in its OER.

Findings regarding step change accounting

565. We consider that there is a degree of double counting inherent in Transgrid's 2022 Base Year opex, which includes security-related expenditure that is already higher than the average current RCP baseline against which Transgrid has sought to justify its increased requirement for the next RCP. Transgrid has not adequately adjusted the Base Year amount for this increment, and we consider that the step changes should be reduced accordingly.

7.6.2 Implications for proposed opex step change

566. We consider that Transgrid's estimate of the opex step change required in the next RCP is moderately over-stated. and that the non-network ICT risks and obligations it faces should have or can be managed through a combination of the following:[247]

- For ICT cyber security, prudent spending continuing in the current RCP, reducing the proposed aggregate additional opex of $18.7m required in the next RCP by $2.5m and by a further $4.3m to net off the Base Year increment already accounted for; that is, a reduction of $6.8m to a resulting step change of $11.8m;
- For OT cyber security, prudent spending continuing in the current RCP, with the aggregate additional opex required in the next RCP of $4.0m as Transgrid has proposed. However, the step change requirement to achieve this is partly covered by the $3.4m Base Year increment already accounted for in the Base Year, reducing the step change requirement to $0.6m; and
- For Physical security, spending an additional amount of $1.8m in aggregate over the RCP, rather than the $4.0m proposed, being a reduction of $2.2m, and a further reduction of $1.2m to net off the Base Year increment already accounted for; that is, a step change of $0.6m.[248]

567. The EMCa proposed adjustments and step change amounts are summarised in the table below.

Table 7.7: Summary of EMCa adjusted step changes for the next RCP ($m, 2023)[249]

Category	TG proposed additional expenditure	less Transgrid allowance for base year	TG proposed step change	EMCa adjusted step change	EMCa adjustment
ICT	18.7	-0.1	18.6	11.8	-6.8
OT	4.0	-0.5	3.5	0.6	-2.9
Physical	4.0	-1.2	2.8	0.6	-2.2
Total	**26.7**	**-1.8**	**24.9**	**13.0**	**-11.9**

Source: EMCa analysis

247 Numbers in the following paragraphs are converted to $2023

248 Rounding errors lead to a slight difference to the amount shown in Table 7.7

249 The amounts and the adjustments in this table have been converted where required from $2021 to $2023 using Transgrid's inflation assumptions