EMCa
energy market consulting associates

Technical Review of Revenue Proposal

Review of Proposed Replacement Capex in TransGrid Revenue Proposal 2014 - 2019

Report to

Australian Energy Regulator

Energy Market Consulting associates

October 2014

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 2014 to 30th June 2019. 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.

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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 TransGrid prior to 6th September 2014 and any information provided subsequent to this time may not have been taken into account.

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About EMCa

Energy Market Consulting associates (EMCa) is a niche firm, established in 2002 and specialising in the policy, strategy, implementation and operation of energy markets and related access and regulatory arrangements. Its Managing Director, Paul Sell, is an energy economist and previous Partner in Ernst & Young and Vice President of Cap Gemini Ernst & Young (now Capgemini). Paul has advised on the establishment and operation of energy markets and on matters such as electricity network open access, pricing and regulation and forecasts for over 30 years.

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Executive Summary

Purpose of this report

1. The purpose of this report is to provide the AER with technical advice on the reasonableness of the main components of TransGrid's proposed replacement capital expenditure (repex), based on a review to identify any systemic issues in its governance, management and forecasting process and of a sample of projects and programs. The assessment contained in this report is intended to assist the AER in establishing an appropriate capital expenditure allowance as an input to its Draft Decision on TransGrid's allowable revenue.

2. Our assessment is based on a limited scope review,[1] which does not take into account all factors or all reasonable methods for determining a capital allowance in accordance with the National Electricity Rules (NER). We understand that the AER will establish a capital expenditure allowance for TransGrid based on assessments undertaken by its own staff and that other advisers are also contributing to this assessment.

Scope of work

3. The AER has appointed EMCa as the Technical consultant to provide advice regarding the prudence and efficiency of the specific capex projects and programs for replacement works as listed below. EMCa has been requested to review whether a prudent and efficient service provider would reasonably be expected to undertake the work as TransGrid has proposed, in meeting the capital expenditure objectives. We have also been requested to form a view (on the basis of the information available) as to whether the forecast cost is materially higher than would be incurred by an efficient service provider. To the extent TransGrid's forecast is considered to be materially higher, the AER requires EMCa to form a view on the efficient cost of these programs.

[1] The scope of our review considers specific capex projects and programs for replacement works, within the four project groupings identified in the terms of reference from the AER. This expenditure is a subset of the replacement capital expenditure within TransGrid's Revenue Proposal

4. The scope of our review comprises the following four project groupings:
    - Substation renewal;
    - Secondary system renewal;
    - Communications upgrade and replacement; and
    - Transmission line rebuilds.

5. 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, taking account of the focus issues advised by the AER. Where we found that forecast expenditure is not reasonable in terms of the NER, we have recommended adjustments to the proposed replacement capital expenditure to that required of a prudent and efficient service provider.

Findings

Governance and management

6. From our review of TransGrid's governance and management, we consider that a bias for over estimation of risk was evident. We found that:
    - development and application of TransGrid's Network Investment Risk Assessment (NIRA) Methodology is rudimentary and not a suitable basis for prudently assessing the need for, and prioritisation of, work programs;
    - management and governance of the assessment of replacement expenditure at a portfolio level, including prioritisation across project groupings, was not evident;
    - performance outcomes including asset health and risk levels, both as drivers of the need for expenditure and as impacted by the proposed expenditure levels, were not defined or well understood; and
    - there was no evidence provided of long term (>=10 years) strategic capital expenditure planning analysis, or management of a longer-term pipeline of asset replacement and refurbishment plans of which the proposed RCP expenditure should be considered an essential component.

Forecasting methods

7. From our review of TransGrid's forecasting methods, we consider that an over forecasting bias was evident. We found that:
    - comparisons of expenditure in previous RCPs identify a forecasting bias to advance projects;
    - the options generated for review at the needs analysis stage are biased towards major asset renewal projects and do not consider potentially viable sub-options; and
    - there is no assessment of the prudent timing for a project and the impact that delaying the project will have on the risk and costs.

Proposed expenditure

8. From our review of a sample of TransGrid's projects and programs, we found evidence that the risk and forecasting biases identified were reflected in the proposed expenditure. We consider these issues to be systemic in nature. We found that:

- there is insufficient analysis at a portfolio level to determine if the level of expenditure is prudent;
- there is insufficient evidence to suggest that all of the proposed work should, or will be, carried out in the forthcoming RCP - accordingly we consider that there is most likely scope to defer some of the work into the subsequent RCP and that (acting prudently) TransGrid is likely to do so;
- there are opportunities evident to us to reduce the scope of some works and to consider sub-options to address the major risks, at lower cost; and
- technology driven strategies to drive asset replacement in the secondary systems and communications areas are overly relied upon, leading TransGrid to propose an imprudently large program of work.

Implications for proposed expenditure

Systemic Issues leading to over-estimation

9. We consider that the systemic issues identified in our review are reflected in a number of biases that lead to an over-estimate of forecast expenditure. We found that the proposed increased level of replacement capex for the next RCP has:

- not been adequately linked to a prudent needs-driven strategic asset management program;
- not been sufficiently justified - there is insufficient evidence that the proposed increased level of expenditure reflects an efficient means of managing the identified risks;
- arisen, in many cases, from an over-estimation of the risk;
- resulted from a 'bottom-up' forecasting method - TransGrid has aggregated the expenditure proposed for individual projects and/or programs that it has identified without consideration of portfolio-level expenditure implications or overall business need; and
- not been adequately supported by cost-benefit analysis and appropriately-applied risk assessment.

Assessment of prudent and efficient level of expenditure

10. Based on our assessment of a sample of repex projects and programs, we have estimated the impact of these biases on forecast expenditure to be in the order of 20% to 30% of total proposed expenditure. In the absence of better information from TransGrid, we consider that expenditure in the four project groupings under review, proportionately reduced by this amount, could be taken as being broadly representative of a prudent and efficient expenditure level. The adjusted expenditure forecast is

considered to better reflect the expenditure that TransGrid would reasonably require in the period. There is no evidence that the adjusted expenditure would lead to increased risk.

11. We find that the issues identified in our review are systemic. Accordingly, and in the absence of specific review of other projects and programs, we consider that it would also be reasonable to assume that a further adjustment could be applied on a proportional basis to the "other" categories of replacement capital expenditure not reviewed.

1 Introduction

1.1 Purpose of this report

12. The Australian Energy Regulator (AER), in accordance with its responsibilities under the National Electricity Rules (NER), is required to conduct an assessment into the appropriate revenue to be obtained from provision of prescribed transmission services provided by TransGrid for the 2014/15 to 2018/19 regulatory control period (RCP). The process that the AER is required to follow is described in chapter 6A of the NER.

13. TransGrid provided its Revenue Proposal for the 2014/15 to 2018/19 regulatory control period to the AER on 2nd June 2014.

14. The AER engaged EMCa as a Technical Consultant to review and provide advice on the prudence and efficiency of specific capex projects and programs for replacement works proposed in TransGrid's Revenue Proposal. The purpose of this report is to provide the AER with our findings from this review.

1.2 Approach taken for the review

15. In this review, we first assess TransGrid's actual expenditures compared to planned expenditures for the prior RCP[2] and consider the reasons for any significant variances from the expectations and assumptions on which the revenue allowance was based. This assessment also takes into account material variations between historical expenditures (planned and actual) and forecast expenditures in the Revenue Proposal. This aspect of the review provides insights into TransGrid's forecasting performance and governance of its expenditure programs as circumstances change.

[2] 2009/10 to 2013/14

16. Our approach to the review of proposed replacement capital expenditure (repex) can be summarised as comprising the following components:

Asset governance and management structure and practices	Assessment of TransGrid's asset management framework as an integral part of the assessment of its capex forecast. Assessment of TransGrid's governance framework, investment planning process and risk assessment as tools and information to inform its decision-making.
Replacement capex forecast methodologies and assumptions	Description of the methodologies and assumptions used by TransGrid when determining the replacement capex forecast. Identification of TransGrid's use of innovation and efficiency management and reasonable incorporation of these assumptions into the capex forecast.
Replacement capex projects review	Review of a sample of projects that are included in the development of the prescribed transmission services capex forecast, including asset fleet strategies, use of condition information and trends.

17. The review included a one-day on-site review with TransGrid on Monday 25 August 2014.

1.3 Structure of this report

18. The structure of this report is, to the extent possible, aligned with the structure of the AER Scope of Work, on-site review and the review approach described above.

Section	Title	Content
1	Introduction	This section sets out the purpose and scope of our review.
2	Background	This section provides a summary of TransGrid's proposed replacement expenditure, overview of the AER focus issues, projects considered for review and assessment of prior RCP trends.

Section	Title	Content
3	Assessment of governance and management framework	This section provides an overview of TransGrid's governance and management framework for the capital works program, and the implications for the replacement capital expenditure program.
4	Assessment of forecasting methods	This section provides an overview of TransGrid's capital works forecasting methods, and the implications for the replacement capital expenditure program.
5	Assessment of proposed expenditure	This section provides a summary of the reviewed projects in each selected program and makes recommendations based on these reviews for adjustments to the overall replacement expenditure proposal.

2 Background

2.1 Introduction

19. TransGrid has proposed a significant increase to its replacement expenditure program from the prior RCP as a percentage of its total capex and in total.

2.2 Summary of TransGrid's proposed repex

20. Table 1 below provides a summary of TransGrid's proposed replacement capital expenditure for each of the four programs under review: (1) Substation renewal; (2) Secondary Systems renewal; (3) Communications upgrades; and (4) Transmission line rebuilds. Total proposed repex for the RCP is $1,093m, of which the four identified programs comprise $755m. The $338m balance is classified into a fifth category termed "Other".

Table 1: TransGrid proposed replacement expenditure, highlighting programs within requested scope

$m, real 2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	Total
Substation renewal	85.7	56.7	59.3	66.9	54.9	323.5
Secondary Systems renewal	40.5	45.3	27.8	35	42.6	191.2
Communication upgrades	6.8	35.8	25.5	29.5	27.4	124.9
Transmission line rebuilds	15.7	36.5	10.6	42.5	10.3	115.6
Other	81	84.8	91.3	48.3	32.2	337.5
Total Replacement capex	**229.7**	**259.1**	**214.3**	**222.1**	**167.5**	**1,092.70**

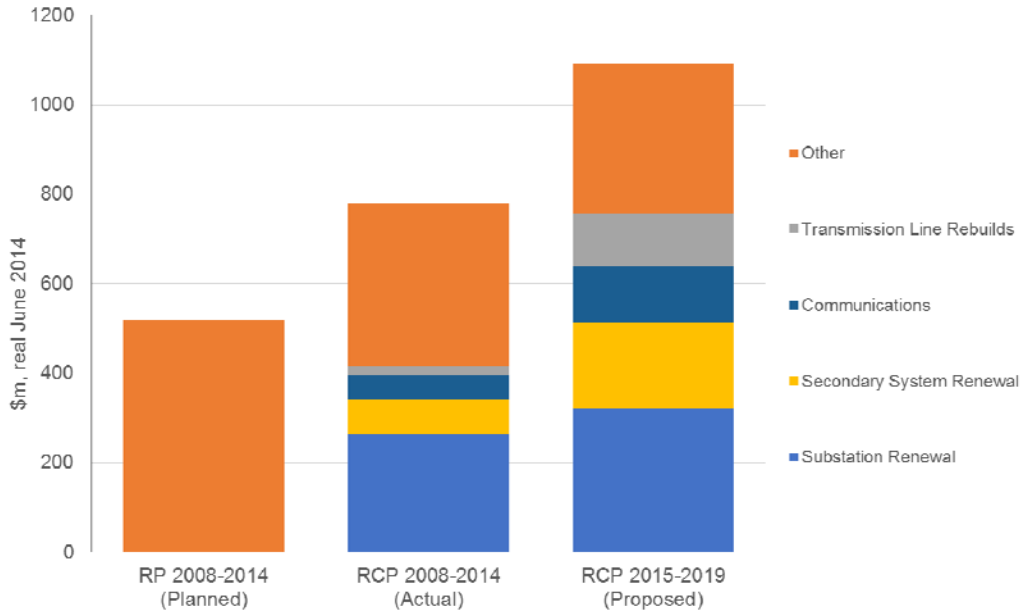
Source TransGrid Capital Accumulation Model

21. Figure 1 below provides a comparison of TransGrid's replacement capital expenditure between the prior and forthcoming RCP. Actual repex in the prior RCP of $779m was $260m (50%) higher than planned repex of $519m. Proposed repex of $1,093m for the forthcoming RCP is $314m (40%) higher than actual repex and $574m (110%) higher than planned repex for the prior period. This doubling of proposed expenditure since the last revenue proposal raises critical questions in regards to: (1) explanation for, and

justification of, the expenditure variance in the prior period; and (2) changes in any fundamental drivers that might explain the large step-change increase that is proposed.

22. We sought[3] a disaggregation of the prior RCP planned expenditure from TransGrid into the project groupings that it used to propose expenditure for the forthcoming RCP (as shown in Table 1). At the time of drafting, this information had not been provided in a form that is readily adaptable to the project groupings under review. However, from the information that was supplied, it appears that actual expenditure exceeded both the AER allowance and planned levels of expenditure in each category.[4]

Figure 1: Capital expenditure for repex review programs 2008-2019



Source TransGrid Capital Accumulation Model

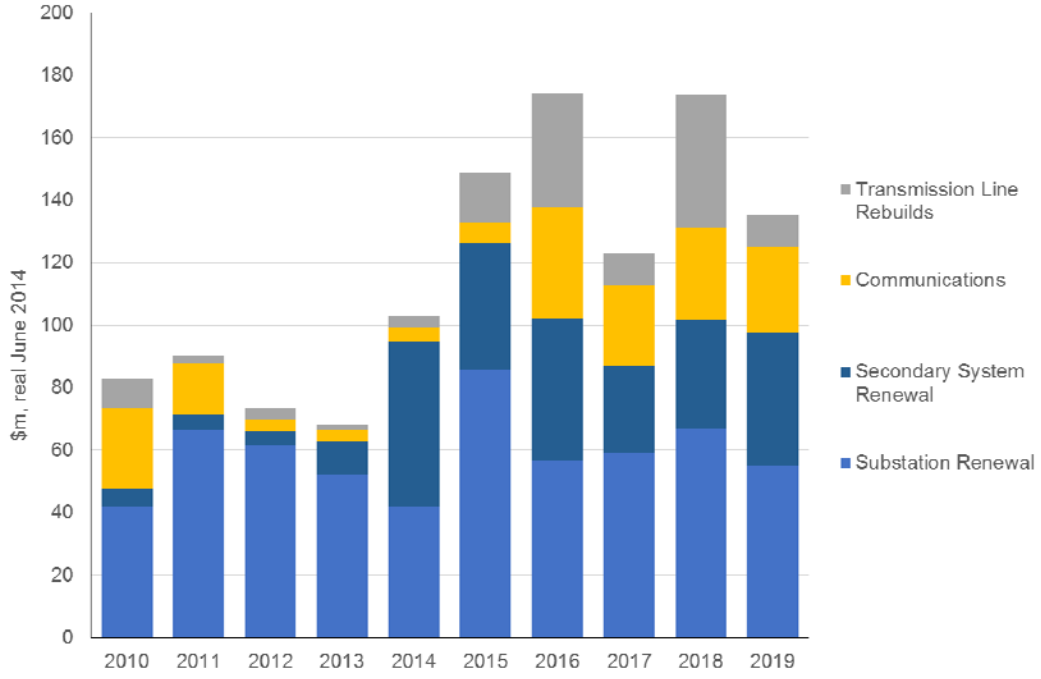
23. The proposed allowance would represent a substantial increase in the four project groupings under review and an overall increase of 40% compared to actual repex from the prior RCP. As noted previously, actual expenditure in the prior RCP was 50% higher than the allowance for that period.

24. Figure 2 provides a profile of TransGrid's actual and proposed replacement capital expenditure over the period 2010 to 2019 for the four project groupings under review. TransGrid advised that a number of potential replacement projects have been deferred to the subsequent RCP (i.e., 2019/20 – 2023/24). Notwithstanding these deferrals, the repex growth trend indicates substantial increases in other projects. As noted previously, TransGrid proposes total expenditure of $755.2m in the four project groupings that we have been asked to review. This reflects a significant ($337.2m) increase on actual expenditure of $418.0m for the portfolio compared to the prior RCP.

[3] We requested repex and total capex on a common basis (i.e., real $2013/14), including breakdown into project groupings / categories under review for the AER Allowance 2009-14 (planned), Capital Expenditure 2009-14 (actual) and Forecast CAPEX 2015-19

[4] 2014-08-29 EMCa information 2

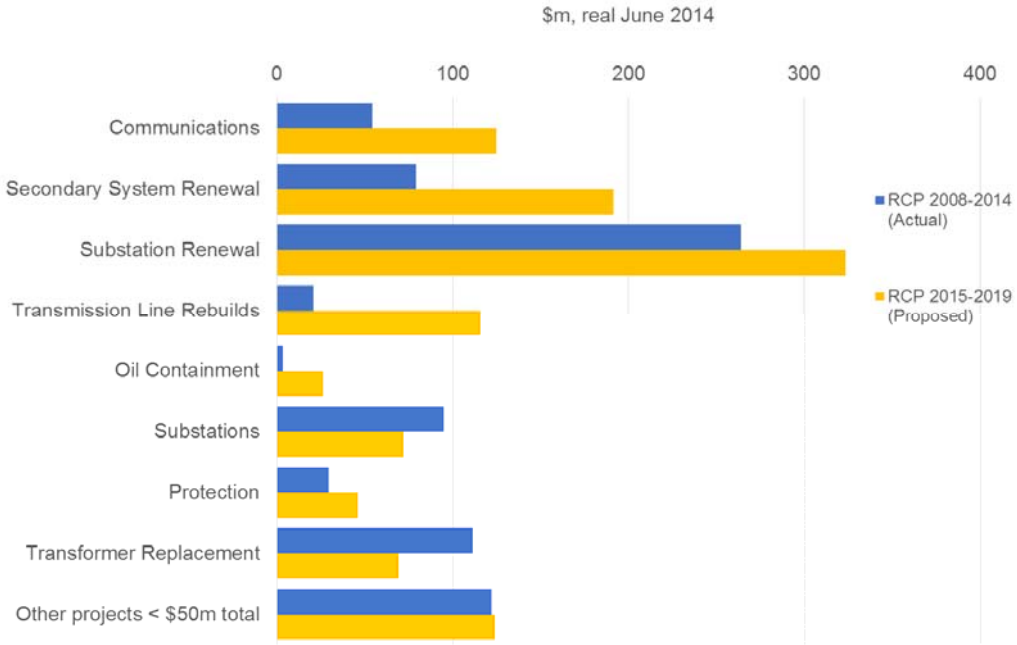
Figure 2: Movement of repex across project groupings over RCPs



Source TransGrid Capital Accumulation Model

25. Figure 3 compares proposed expenditure for the forthcoming period with actual expenditure for the prior period across the four project groupings we were asked to review, together with expenditure detail for the "other" expenditure categories which make up the remainder of total proposed repex. "Other" can be seen to include: (i) Oil Containment; (ii) Substations; (iii) Protection; (iv) Transformer Replacement; and (v) Other projects < $50m total.

Figure 3: Comparison of repex project groupings across RCPs



Source TransGrid Capital Accumulation Model

26. The proposed increase in protection expenditure also needs to be considered in the context of the substantial increases in secondary system and substation renewal programs, as these also contain protection work. Similarly, although it is a smaller program, the oil containment program is forecast to be significantly increased; elements of this work is also included in many of the substation renewal projects. TransGrid's proposed transformer replacement and other substations programs are also significant, although the proposed allowance is lower than actual expenditure during the prior RCP.

2.3 AER's identification of focus issues and hypotheses

27. The AER identified a list of focus issues that reflected a hypothesis of possible forecasting bias and risk aversion. This review was commissioned to identify any systemic issues that may be resulting in forecasting biases in TransGrid's replacement capex forecasts, specifically whether TransGrid's processes, systems, behaviours and/or cultures are leading to any biases in the replacement capex forecasts and to identify whether these biases mean that the capex forecast does not meet the capex criteria. The AER informed us that it sought an opinion as to whether TransGrid's proposed expenditure allowance is a reasonable and unbiased forecast, and to pay particular attention to its risk management practices and their application in preparing its forecast.

28. The AER stated the focus issues as being the:

- Increase in substation renewal replacement capex.
- Increase in secondary system renewal replacement capex.
- Increase in communications upgrade and replacement capex.
- Apparent revision /development of new strategies for transmission line life extension: replacement versus rebuilds versus renewals; and increase in related expenditure.

2.4 Identification of projects for review

29. Part of our review included specific project and program reviews.

30. A sample of projects and programs, as shown in Table 2 below, were identified for review. When considered collectively, these programs were deemed to satisfy the following criteria:

- Projects and programs identified as future;
- Projects and programs identified as committed;
- Combination of programs future and committed;
- Large and complex;

- Projects and programs with expenditure in the RCP; and
- Projects and programs completed and traversing the RCP.

Table 2: Projects identified for review with project status

Program Name	Status
Substation renewal	
Canberra Substation Renewal	Future Project
Vales Point Substation Renewal	Future Project
Wagga 132 Substation Renewal	Future Project
Tamworth 132 Substation Renewal	Committed Project
Cooma Substation Renewal	Committed Project
Secondary systems renewal	
ANM Secondary System Replacement	Future Project
Beryl Secondary System Replacement	Future Project
Liddell Secondary System Replacement	Committed Project
Sydney West Secondary System Renewal	Committed Project
Communications	
Communications Between Parkes and Cowra	Future Project
Communications Between Port Macquarie and Stroud	Future Project
Dumaresq Protection & Communication Replacement	Committed Project
Spur Microwave System Replacement	Future Project
Transmission lines	
22 Line Vales Point to Structure 136 Life Extension	Committed Project
Line 99F Uranquinty to Yanco Pole Replacements	Future Project
Line 96H Coffs Harbour To Koolkhan Wood Pole Replacement	Future Project
99J Yanco to Griffith 132kV Line Partial Rebuild	Committed Project

Source: EMCa analysis

2.5 EMCa assessment of prior RCP trends and performance

31. The replacement expenditure trends shown in Figure 2 and Figure 3 clearly identify a significant increase in replacement capital expenditure. Investigation of the rationale and justification of this significant increase has been the focus of our review.

32. TransGrid advised[5] that they reallocated capital from augmentation to replacement. They explained that, provided the total capital expenditure was less than the AER allowance, this was a satisfactory management approach. However, this approach fails to recognise that augmentation capex is required to increase services whereas replacement capital is required to maintain existing services. To reallocate funding between the two categories reflects a substantial change in asset management strategy from that proposed by TransGrid at the time of its prior RCP determination. While it is prudent to reduce augmentation expenditure in response to declining demand growth (or, more so, declining demand), it is only prudent to increase repex above what was previously planned to the extent that there is an unanticipated increase in some program driver or a realisation of additional unanticipated asset risk.

[5] AER/EMCa/TransGrid Meeting, 25 August 2014.

33. During our onsite meeting, we requested TransGrid to explain its decisions and approval processes for the significant changes in replacement expenditure incurred over the prior RCP.[6] TransGrid advised during the onsite that the increase in replacement capex was primarily due to replacement works that would ordinarily have been achieved during a higher level of augmentation capex. TransGrid considered that it was able to spend more on replacement capex because of the lower augmentation capex requirements within the total capital allowance. No cogent explanation of changes to repex drivers that might have justified such a change was provided either at the on-site meeting or subsequently. This raises serious concerns about TransGrid's governance of its replacement expenditure programs. We sought further evidence to inform our initial assessment.

[6] We requested TransGrid to provide records of decisions / approvals relating to decision to increase in repex above planned levels in 2009-14 i.e., Minutes of meetings or actions from Asset Management Committee, Executive and/or Board meetings

3 Assessment of governance and management framework

3.1 Findings

34. TransGrid's asset management system comprises documented network and asset related policies and strategies that guide the procedures used by the business to develop its capex program. TransGrid advised that they sought pre-certification against the PAS55 asset management framework, as part of seeking full certification in later 2014. TransGrid also advised that they have established an investment planning framework for the development of projects that supports the asset management system.

35. We found exceptions that indicate TransGrid's application of the asset management framework for the purpose of including repex projects in the Revenue Proposal was not sufficiently rigorous. This has led to the inclusion of some items of expenditure that lack sufficient justification. We consider also that TransGrid has focussed overly at the individual project and program level and has paid less attention to the strategic scope, timing and risk / benefit of the aggregate portfolio of projects and programs that it has proposed. Given TransGrid's considerable increase in replacement capital expenditure during the last RCP, and substantial further increase proposed for the next RCP, we consider this to be a significant weakness in the proposed submission which has led to over-forecasting expenditure needs for the next RCP.

36. We find that key elements of the replacement capex proposed by TransGrid are not reasonable in terms of the NER requirements and result from an overestimation of risk, as evidenced by:

    - development and application of the Network Investment Risk Assessment (NIRA) Methodology was rudimentary and immature. We did not find evidence of individual project based pre- and post-investment risk assessments being used to assist the review of risk at an asset class or corporate level by the responsible governance bodies;

- management of the replacement expenditure at a portfolio level and governance of prioritisation across project groupings was not evident;
- performance outcomes including asset health and risk, both as drivers of the need for expenditure and as impacted by the proposed expenditure levels were not defined or well understood; and
- there was no evidence of long term (>=10 years) strategic capital expenditure planning analysis, or management of a pipeline of asset replacement and refurbishment plans based on risk.

3.2 Assessment

3.2.1 General observations

37. The processes relating to the management of projects following assessment of project need, were considered to be good industry practice. Some examples of good industry practice include:
    - Asset Management Committee structure;
    - use of a Project Management Office;
    - use of four decision gates in the investment process;[7]
    - early identification of project risks;
    - structured approach to documentation;
    - commitment to review asset replacement strategies annually; and
    - regular asset condition assessments and reports.
38. TransGrid advised in our onsite meeting that processes were recently updated and subsequently referred to a review of investment plans and supporting document by GHD.[8] We note that the included analysis showed the average quality score at stage 1 of the review was around 40% and at stage 2 this had increased to just under 70% following changes from TransGrid.
39. Our review identified substantial gaps in the analysis of the need for a project including the identification and assessment of option, risks, costs and benefits. We did not find sufficient evidence of review and analysis of the overall portfolio to ensure an efficient level of expenditure. Further, we found that investment decisions can be based more on an overarching technology-driven strategy and implementation goals rather than a disciplined investment decision.
40. Investment decision documentation was found to contain considerable duplication. Further, in many cases, only very broad, high level options and analysis was presented. We found that consideration of broad options resulted in a very high level risk assessment for the investment, and which was often dominated by a single risk. It is our view that the determination of a prospective treatment for a dominant risk might

[7] Network Investment Process Decision Gates, TransGrid Revenue Proposal 2014-2019, page 60 Table 4.3.

[8] Review of Network Investment Plans and Supporting Documents, GHD, 27 March 2014

prudently include additional options and risk analysis. We found that these factors were either not considered or not adequately represented in the options analysis.

3.2.2 Network Investment Risk Assessment Methodology

Risk management framework

41. TransGrid has a risk assessment process linked to its corporate risk management framework[9] for undertaking risk assessments and managing the identified risks. The risk tolerances are quantified by the Board in the "Overarching statement of TransGrid's risk tolerance". The risk assessment process includes an assessment of inherent risk, and review of effectiveness of management strategies and/or controls to establish the residual risk. TransGrid's risk monitoring and reporting matrix shows that 'Extreme' risks must be reported to the Executive and Board on an immediate basis and "High' risks must be reported on a quarterly basis.

42. The corporate risk framework requires risks assessed as 'High' to have contingency plans in place within three months and 'Extreme' within one month. The contingency plan is to manage the identified risk to an acceptable level of 'Low' or 'Medium' depending on a cost-benefit assessment.

43. The network "observable failure risk" is reported at the corporate level and has been assessed as 'Medium' with a stable trend.[10] Whilst this risk is not identified as a driver of expenditure by TransGrid, we would have expected to see a greater correlation between asset class risks and project level risks to this corporate risk. We also note that the network performance metrics of system minutes, line outages, transformer outages and reactive plant outages have been relatively stable or improving since 2009. The risk and performance trends do not independently signal the need for a major change in asset management focus.

Application of risk cost

44. TransGrid has developed the Network Investment Risk Assessment Methodology[11] for undertaking risk assessment for network investment decisions. One of the objectives is for the implementation of a risk valuation system that '*can be used as part of the option evaluation process to compare different projects*'. Further, the process is described at step 5 to '*determine the investment in dollars to the dollar value of risk reduction and rank the investments accordingly*' and at step 6 to '*engage in debate with the appropriate stakeholders about the value for money of the investments that are directly targeted at risk reduction*'.

45. We requested a copy of the decision approval for the selection of risk cost, being the unit of risk in dollars per year. TransGrid provided a copy of the approval for the Corporate Risk Management framework and a document that had been generated to show how network events are aligned to financial risk levels. However, no documentation was provided to describe how this risk is to be assessed at a project level or evidence of the calculations used to determine the consequence cost level.

[9] Risk Management Framework, Management System Document

[10] Observable Asset Failure Risk report March 2014, supplied by TransGrid in EMCa Information Response 2

[11] Network Investment Risk Assessment Methodology, Management System Document

46. TransGrid advised that they have migrated from using a total risk score to a total risk cost in their project assessments, such that the risk score was no longer used. We were also advised that the unit of risk cost had been approved internally and was subject to ongoing review. In the absence of the requested information, we were not able to draw meaningful conclusions on the implied cost of risk selected by TransGrid.

Assessment of project options

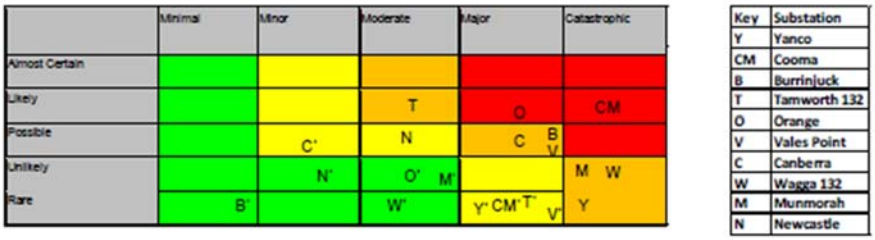
47. Our review of the project definition reports, known as Needs Statements, indicates that the selection of the recommended project option has been undertaken on a cost basis only. It is not clear how, if at all, the risk cost calculated as a part of the Needs Statement is used in the assessment and prioritisation of projects. TransGrid advised that the project risk-cost may be used where a timing conflict occurs in project scheduling and delivery. However, for the projects reviewed, there was no assessment of the prudent timing for the project based on the risk assessment.

Reporting of high and extreme risks

48. TransGrid staff advised[12] that where the overall asset risk has been assessed as 'High' or 'Extreme' a project has been included to reduce the risk in accordance with the corporate risk framework.

49. TransGrid has assessed the organisational risk at a number of substations as either 'High' or 'Extreme'. Figure 4[13] below shows the assessed risk for the substation renewal projects and the forecast residual risk (shown with an *) after the selected option has been implemented.

Figure 4: Risk assessment for substation renewal projects before and after treatment. (Risk Categories: Red = Extreme; Orange = High; Yellow = Medium; Green = Low)



Source: TransGrid onsite presentation

50. We requested a copy of a similar representation of project risks for other asset classes. However, it became evident that this information was prepared in response to our request only. We believe this further reinforces our view that such representations of risk at an asset class level are not currently used within TransGrid to understand current and forecast risk levels.

51. During our onsite meeting we requested a copy of any corporate reporting for 'Extreme' risks for substations (such as Cooma) as identified in Figure 4 and as required by TransGrid's reporting process. We were provided with a copy of a Board level risk report

[12] TransGrid meeting of 25th August 2014

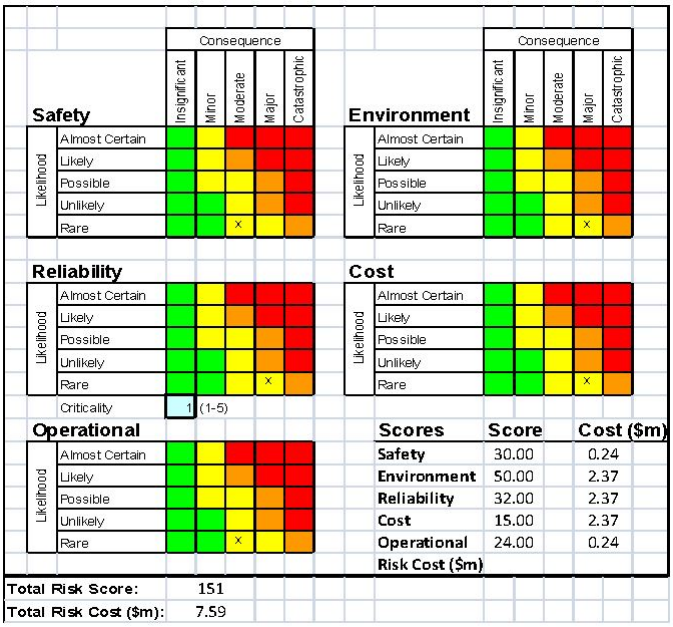
[13] AER EMCa Session 2 Presentation

for '5 - Observable Asset Failure'. However, there was no reference to Cooma substation in this report.

Project risk assessment

52. Figure 5 below shows the risk assessment from the Needs Statement of the Yanco substation renewal project. While this risk template has been used in all of the reviewed substation renewal projects, there is no mention in the Network Investment Risk Assessment Methodology documentation for how a risk is mapped from this risk assessment template to the single risk rating shown in Figure 4.

Figure 5: Yanco 132kV Needs Statement Risk Assessment



53. Figure 5 shows that the highest assessed risk for all risk categories (shown by an 'x') is Medium (yellow). Yet, when aggregated to the single risk rating as shown in Figure 4, we found that the risk was elevated from Medium to High. We selected a further example to determine if this was an isolated case. The Needs Statement risk assessment for the Orange substation renewal project was similarly found to have increased from High to Extreme when aggregated.

Evaluation of cost effectiveness

54. We understand the Total Risk Cost ($m) referred to in Figure 5 for project risk assessments corresponds with the calculated annual risk cost by TransGrid.

55. TransGrid advised that '*a cost of risk (in dollars) enables the evaluation of cost effectiveness of control measures*'.[14] The Network Investment Risk Assessment procedure also states that '*the cost savings (per annum) from remediation can be compared with the one-off cost of remediation*'. However, while the risk cost was included in many of the substation projects there was no cost effectiveness evaluation or discussion in the options analysis. Also the project justification documentation for

[14] TransGrid presentation – AER EMC[a] Session 2

Tamworth substation renewal[15] provided to the Executive and Board did not contain a reference to the risk assessment and risk cost.

56. No evidence was provided on its use in evaluating projects in project justification documentation. Also, the Network Investment Risk Assessment Methodology documentation was first approved on 21st May 2014, so it is unclear the extent to which this assessment was used to determine the projects included in TransGrid's revenue submission in June 2014.

Summary

57. The application of the risk assessment tools by TransGrid exhibits a strong bias to over-estimation of the risk. Our review identified that the:

- summation of five risk costs disproportionally represents the cost of the risk. Our review of available literature on this topic supports the selection of the single largest risk and corresponding risk cost, or the aggregation on a logarithmic scale to avoid the disproportionate effect. The risk cost values for projects proposed in the RCP existed in a very wide range from $4.13 to $399.61 million per year for individual sites. The corresponding risk-cost to project-cost ratio ranged from 19% to 3,000%, where values of around 10% were expected.

- assessment was undertaken at too high a level to identify meaningful risk mitigation actions, which resulted in unnecessarily large investment projects. In the extreme case, the OPGW strategy, which is the collection of 9 projects at a proposed expenditure of $112.5m, has a single risk assessment applied. We observe that the review of network investment plans by GHD commissioned by TransGrid notes that "*Following the workshop* [between GHD and TransGrid] *TransGrid revised the investment planning documentation for the 10 projects* [under review]." *The revisions included "… expand the OER where appropriate to include a staged risk based option for asset replacement projects".*[16] We consider that this and other revisions relating to improving the justification for the need and proposed timing should have been addressed.

- existence and effectiveness of current risk mitigation controls and management measures was not included in the risk assessment. In our meeting with TransGrid, a risk was identified in the secondary systems cabling of older substations whereby the 415V supply cable was allocated with the other protection and control cabling. In the event of the failure of the 415V cable, and subsequent fire in the cable pit, the secondary system cabling would be disabled which would cause loss of control of that station. TransGrid advised that this risk was mitigated through use of fire retardant coating on the cable pit. Our review has identified that the risk assessment of a number of the secondary systems renewal projects appear to be based on the un-mitigated (inherent risk), without consideration of the current controls (residual risk). Where other risks and/or mitigation measures were also present at the site, these were not detailed in the risk assessment.

[15] Tamworth 132/66kV Substation Rebuild Decision Gate 2, EGM/Network Planning and Performance, May 2013 and Tamworth 132kV Substation Condition Planning Funds Approval (DG0) request to EGM/Network Planning and Performance in July 2013.

[16] Appendix K Review of Network investment plans and supporting documents, 41/27095, p14

58. TransGrid stated that they have recently updated their investment planning process[17] and capital project documentation,[18] including options analysis. We nevertheless found insufficient examples of sub-option investigation, feasibility or development to mitigate identified risks. Rather, we found that the selected options were very broad in nature and sought to lower the identified risk to "green" rather than to an acceptable level with consideration of the economic cost as required by the TransGrid risk management framework. Figure 4 shows the residual risk after the completion of the projects with 50% being Low and 50% at the Medium level. However, in the project documentation provided for substation renewal projects, we found no assessments of the residual risk costs in the options. It is not clear how or when these residual risks were determined.

3.2.3 Investment planning and portfolio governance

Portfolio management

59. The revised investment planning process noted earlier includes clear guidance for decision gates, required procedures and allocated accountabilities across TransGrid. The framework includes establishment of the Network Investment Committee to review the progress of delivery of TransGrid's capital portfolio. TransGrid was requested to provide copies of the reporting to the Executive and Board of the capital portfolio which occurs on a monthly and quarterly basis. The only information received was a chart showing the total capital expenditure against budget and the AER allowance. The expenditure is not split into augmentation and renewal categories and therefore, with the evidence provided, the capital portfolio is managed at an aggregated level and the need to justify transferring funds into either expenditure category does not appear to have occurred.

60. As noted earlier, the absence of an aggregate view of the project risk assessments hinders the ability to make properly informed decisions relating to the priority areas within the portfolio.

Portfolio management office

61. A Portfolio Management Office (PMO) has been created with responsibility across all projects from decision gate DG0, and a working project list maintained, referred to as the program of work. TransGrid states that the PMO undertakes a high level review of the risk assessment, however, we have not been provided with the outcome of this process.

Application of decision gates

62. Our review has identified a strong orientation to project control, project risk identification, scope management and project delivery. The management and governance of the capital portfolio supports the project beyond decision gate DG0.

63. The management and governance of the need for expenditure, prior to decision gate DG0, is vested primarily with the role of EGM/Network Planning & Performance who in turn advises the Network Investment Committee.

[17] Network Investment Process Rev 4, Management System Document

[18] Corporate Governance Framework for Expenditure on Major Capital Works Projects Rev 4, Management System Document

Summary

64. We have reviewed a sample of needs statements, governance documents, committee terms of reference and meeting minutes to form a view of the investment governance and consider that:

- The capital portfolio is developed from an aggregation of needs statements (with corresponding expenditure forecasts) and once approved by TransGrid, remain unchallenged. The identified projects are required to be addressed within the RCP. Our review did not find evidence of a prioritisation process or framework that considered all business needs and ranked or prioritised these needs based on risk, cost or other criteria, and which may have also considered deferring projects into a subsequent RCP. TransGrid advised that the portfolio was prioritised. However this prioritisation was largely based on delivery date determined by the project feasibility and scoping stages.

- There is no objective criteria used to identify the economic cut-off for the portfolio of work, or where the prudent risk outcome is achieved for a level of expenditure.

- The capital portfolio has had limited review at a whole of portfolio level or across project groupings to satisfy the requirement of prudence and efficiency. We requested records of the decision approval process undertaken over this period to ascertain the management of the pipeline of works into the capital portfolio. We conclude that the process was largely reactionary to the availability of additional resources through declining demand and associated reductions in augmentation expenditure.

3.2.4 Performance drivers and outcomes

Project and performance outcomes

65. The asset management documents that we reviewed include asset fleet strategies and Renewal and Maintenance Strategies for each asset fleet. These documents include discussion of asset attributes, asset health, obsolescence and compliance requirements. They also identify decisions where the Asset Manager has identified the need for action and refer to development of Needs Statements.

66. We find that the link of proposed replacement expenditure to the business performance outcomes including asset health and risk are not well defined in the reviewed project documentation.

Project delivery

67. The correlation between the identified required-by date in the needs statement and the anticipated project delivery date is inconsistent, especially where project delivery dates have been extended. In these cases, it is unclear if the level of risk is increasing and, if so, what management procedures or additional controls have been enacted by TransGrid. We did not find a clear assessment of the prudent delivery of projects other than for smoothing within the portfolio and a base assumption that current needs must be addressed in the RCP.

Benefits management

68. TransGrid identified benefits associated with some investments, ranging from reductions in inspection and maintenance expenditure for wood poles, to new functionality and capacity related to replacement of the microwave bearers. The quantification of benefits for projects is limited and, in most of the reviewed projects, the reduction in the risk cost was the only quantified assessment of benefits.

Use of condition assessments

69. The individual needs statements were derived from the condition assessment information provided, rather than in response to a business performance target. However, the condition information in most cases was more representative of an aggregate health and condition for the asset group, rather than at an individual asset level. The resulting condition improvement, and corresponding improvement to business outcomes was not evident at a project or portfolio level. For example:

- for Line 22 – Sydney North to Vales Point, the structure condition assessment included a range of conditions along the line and formed conclusions for the best option for treatment of tension towers only without justifying the difference in condition within the supplied documentation;
- similarly for Line 99F Uranquinty to Yanco, the replacement of wood poles appeared to be based primarily on a structural defect rate higher than the TransGrid average and supposition of declining wood pole condition and increasing failure rate, where individual pole data was not provided as a basis for analysis; and
- at a portfolio level, the impact of the delay of substation rebuilds and transmission lines from the previous RCP was not readily identifiable which further challenges the link to performance outcomes and bias to over-forecasting.

3.2.5 Long term capital expenditure planning

Options assessment

70. The TransGrid investment planning process described earlier promotes the identification of the lowest cost option through a process of needs identification, options analysis and evaluation. Options considered for replacement and renewal consider variations of rebuilding the asset or replacement of the asset, often where there may have been some form of asset replacement undertaken previously.

Value of past investments

71. We understand that the scope of the partial replacement option includes those assets identified from the asset condition reports for replacement, whereas the rebuild option replaces all associated assets. The value of past investments, however, does not appear to have been included in the analysis where the rebuild options is applied. This indicates to us that improvements may be required to the management of full life cycle analysis. TransGrid advised that assets considered to have residual life were considered for return to its stores.

Long term planning

72. Our review identified references to long term capital expenditure plans of at least 10 years. However, no long-term capital expenditure plans was made available to us for this review. Further, no explanation was provided as to whether (or if so, how) the proposed allowance for the forthcoming RCP fits into this long term capital plan. The management of expenditure over the life of the asset requires a long term outlook of capital expenditure requirements as part of the life cycle analysis. The absence of an available long term capital expenditure plan suggests that capital requirements of the asset are not optimised over the life of the asset.

Portfolio management

73. We acknowledge the actions taken by TransGrid to defer projects and recommend options that prudently reflect the lowest cost for a required outcome. However, we are not persuaded that those actions reflect sufficient demonstration of prudent portfolio management, in terms of need, timing and expenditure.

3.3 Implications for proposed repex

74. The level of proposed replacement capital expenditure across the four project groupings under review has increased by approximately $337 million (110%) compared to the prior RCP. Further, the allocation across the programs has changed considerably.

75. The increased level of replacement capex has not been adequately linked to a prudent and efficient portfolio of capital expenditure to meet the needs of TransGrid's assets in the long term. TransGrid advised that the proposed increase corresponds with maintaining the current risk level. However, they have neither advised the method used to assess the current level of risk, nor shown evidence of increasing risk or the desired level of risk in order to measure the effectiveness of the proposed program.

76. Justification for the programs that have increased significantly has not been adequately supported. There is insufficient evidence that the increased level of expenditure reflects an efficient means of managing the identified risks.

77. In many cases, the identified risks are: (i) described only at a high level, without supporting detail; and (ii) significantly over-estimated, the effect of which is to elevate projects into the 'High' or 'Extreme' risk level where TransGrid has determined that a plan must be put in place to reduce the risk. This risk over-estimation bias contributes to an increase in the number of projects included in the RCP.

78. The lack of a longer term view of the risk or performance outcomes does not enable the proposed level of expenditure to be put in context with the longer term requirements of the network. As such, we do not consider that the proposed program is prudent.

4 Assessment of forecasting methods

4.1 Findings

79. TransGrid's asset management system includes review of asset conditions by the asset manager to determine the course of action, including 'no action', 'monitor' and 'develop' options. The needs statement represents the start of the investment planning process to identify the basis for expenditure; it provides initial justification, cost estimate and options identification. Once approved, the needs statement establishes a project that is managed within the Project Management Office.

80. We find that key elements of the replacement capex proposed by TransGrid are not reasonable in terms of the NER requirements and are the result of an over-forecasting bias, as evidenced by:

- comparisons of expenditure in previous RCP identify a forecasting bias to advance projects;
- options generated for review at the needs analysis stage are biased towards major asset renewal projects and do not consider sub-options. There was also no evidence of sub-options being generated during the option detailed study phase; and
- there was no evidence of assessment of the prudent timing for a project and the prospective impacts that delaying the project may have on the risk and costs.

4.2 Assessment

4.2.1 General observations

81. TransGrid uses a bottom up process that utilises asset age, condition and performance data to develop its expenditure forecast. During the onsite sessions, TransGrid

demonstrated the application of its method and how this was used to establish the asset related expenditure forecasts

82. The economic evaluation used by TransGrid takes into account the cost of options with some consideration of future capital expenditure. In some cases, the evaluation also considers operating expenditure. However, in many of the examples we reviewed, the operating expenditure requirements were unchanged between options.

83. The estimating and costing procedure is regularly reviewed by TransGrid including obtaining advice from the market, and benchmarking costs. TransGrid demonstrated a strong understanding of its costs and forecasts.

84. TransGrid provided examples of projects deferred, but these were largely augmentation projects in response to changes in demand. There has been deferral of some secondary systems replacement work in order to align this work with the replacement of the primary assets (which provides efficiency gains). However, the main deferrals of work are due to external factors such as delays in gaining a site for a rebuild. Whilst prudent in their own right, the examples TransGrid provided do not demonstrate the consistent application of prudent deferral of replacement projects based on risk-based prioritisation, as claimed by TransGrid.

4.2.2 Needs analysis

Review of Needs statements

85. Our review of the needs statements is that they appear to be based on review of a prima facie need to address a risk, and are then moved through to project feasibility. TransGrid's asset management strategies and plans identified needs for expenditure based on a number of drivers including asset condition. However, the identification of needs appeared to be generally constrained by the RCP, plus a few outer years. We were advised by TransGrid that this was typically in the order of a period of 8 years. Where project option analysis required expenditure beyond the RCP, this appeared based on an assessment of age as a predictor of asset health.

Limited options analysis

86. Options analysis was limited to large discrete options. TransGrid has, in some instances, included assessment of additional options through the investment planning process of a discrete project. However, options are often rejected without sufficient analysis within the Options Evaluation Report. For example:

- Wagga 132kV substation upgrade - an option presented is to defer the major rebuild project by replacing one transformer that can later be used as system spare, and a few circuit breakers;
- Cooma rebuild - a deferral option is the replacement of one of the regulators and disconnector refurbishments; and
- Communications OPGW work - the delayed installation of the OPGW over two RCP periods instead was not evaluated.

Treatment of pre-planning expenditure

87. We observe that expenditure incurred during the "identify needs" phase is expected by TransGrid to be operating expenditure and included in the operating budget approval

process. Review of the nature of this expenditure and treatment was not within our review, however, we note that pre-planning expenditure is more typically capitalised against projects or programs within the capital expenditure portfolio.

4.2.3 Cost estimating

Capital project delivery

88. TransGrid advised that its capital program makes use of a competitive process for 96% of the capital program. TransGrid retain core skills in design and construction to complement contract management.

89. TransGrid later advised that, for the replacement capital works, activities that are undertaken internally include project development and approval, design, project management, field supervision, testing and commissioning. Depending on the nature of the works, construction may be undertaken internally (e.g., in-situ secondary systems replacement) or the design, testing and commissioning may be outsourced. Across the total capital works portfolio, the internal costs amount to approximately 20% of the estimated costs. For each of the four programs under review, the forecast percentage of internal costs are as follows:

- Substation renewal – 17%;
- Transmission Line Renewal – 12%;
- Secondary System Renewal – 37%;
- Communications – 11%.

Use of cost estimates

90. TransGrid advised that the project cost estimates are based on the same costs for internal and external resources, except where the construction of a project is to be performed by internal resources (such as the in-situ secondary systems renewal works).

91. TransGrid advised that it uses an industry standard platform for cost estimating and the estimating database costs have been based on the cost of competitively sourced work and validated through capital project cost benchmarking undertaken with UMS, SKM, PB and Aurecon.

92. On the basis of the information provided, we have not separately reviewed the cost estimating accuracy or use of unit rates applied to the proposed replacement expenditure.

Approach to brownfields cost estimates

93. TransGrid apply an escalating factor to estimates produced on a greenfields basis for application to brownfields asset renewal and replacement projects. In addition, TransGrid identify the project risks that can have a material impact on the project cost and delivery timeline, assign a likely range of costs and select a reasonable midpoint that forms part of a risk cost allowance in the project as a part of their "P50"[19] estimate. TransGrid also apply a project contingency allowance to the cost estimate, which we understood from the onsite meeting as being used as part of their project governance

[19] A P50 estimate refers to the most likely cost of delivery where the actual cost of delivery is expected to fall equally higher and lower than the estimate.

for budget management and did not form part of the forecasts of the Revenue Proposal. TransGrid has not proposed the use of a portfolio level cost estimating risk factor in its RP.[20]

Summary

94. Based on the information provided, we do not consider TransGrid's cost estimates to be uncompetitive. However, we do believe there may be an opportunity to reduce costs further by outsourcing more of the design, site supervision and secondary construction work.

4.2.4 Options analysis

Base case

95. The evaluation of the options identified in the Needs Statement occurs in an Options Evaluation Report. This report discusses each option, but in all cases the 'Do Nothing' option is dismissed as non-viable. Accordingly, there is no base case evaluation to judge the value gained by the investment options. The assessment of the base case is done using the risk score or risk cost in the Needs Statement.

Evaluation of risk cost

96. The options evaluation does not include an assessment of how the annual risk cost or maintenance costs vary over time, except in some cases where maintenance costs were assumed to be constant in all options. The evaluation refers to an NPV for each project option, but is only an assessment of the present value of the capital costs for each option.

Piecemeal approach

97. The "piecemeal" option included is where the assets to be replaced are assigned a target replacement year and the replacement costs are included in the year they fall due. However, this assessment method can over-estimate the cost as, in practice, efficient projects would be formed to replace assets over time and this would reduce the capital costs.

Delivery timing

98. Since there is no assessment of how risks or operating costs vary over time, it is not possible to determine the prudent delivery timing for a project. Instead, TransGrid has deemed all projects to be required if the risk score is high. Prioritisation is then based on risk. Subsequently, the time required for engineering, procurement and construction, along with available resources to undertake the work, determines the completion date.

4.3 Implications for proposed repex

99. The identification of needs, and framework for selection and prioritisation of expenditure, is a central tenet of effective expenditure forecasting.

[20] TransGrid Revenue Proposal, pg 87, Forecasting Methodology pg 17

100. TransGrid stated that it has applied only a bottom-up forecasting method, in which it has aggregated the expenditure implied by the projects and programs that it has identified. We found that the identification of these projects and programs has not been adequately supported. There is insufficient evidence that the increased level of expenditure reflects an efficient and effective means of managing the identified risk.

101. Our review identified issues that are consistent with a review[21] commissioned by TransGrid in 2004 (prior to the last revenue reset), specifically:

- insufficient correlation between projects, strategies and future capital needs; and
- the cost-benefit analyses are brief and largely qualitative, and the risk assessment is descriptive.

102. In addition, the existence of such issues is of concern to the reasonableness of the proposed expenditure in the RCP and indicate an over-forecasting bias due to:

- inadequate assessment of prudent timing of projects;
- focus on adherence to large replacement options, and insufficient options analysis; and
- inadequate consideration of risk mitigation options associated with the 'do nothing' option, reflective of the issues discussed in section 3.

[21] GHD, TransGrid Regulatory Review, Final Report (April 2004)

5 Assessment of proposed expenditure

5.1 Findings

103. From the information provided by TransGrid, we did not observe assessment of the trends in asset risk, health or failures rates, or other relevant performance measures to determine if the current levels are appropriate and if the proposed expenditure will result in a stable, improving or declining trend. Whilst the high level performance information suggests a stable trend in risk, and stable and improving for other measures, there is insufficient correlation to the expenditure levels to draw any meaningful conclusions.

104. We also did not observe assessment at the asset class or network level of the outcomes of the proposed replacements, only quantities of assets that will be replaced.

105. From our examination of a sample of projects, we consider that the issues identified in sections 3 and 4 relating to the over-estimation of risk and over-forecasting bias are evident in the proposed forecast expenditures. This is evidenced by:

- risk assessments that in many cases are at an aggregated level and do not enable the assessment of sub-options that may address the major risks at a much lower cost and will reduce the risk to an acceptable level;
- excessive scope - where we believe it is possible to defer some of the work from this RCP without changing the selected option or by undertaking interim measures to achieve an acceptable level of risk until the major renewal takes place. In some projects, we have identified opportunities that should have been considered to reduce the scope of work;
- replacement of relatively new assets as part of the major substation and secondary renewal projects - there has been insufficient consideration of reusing these assets either in-situ or to extend the life of other assets; and

- an over-reliance on technology driven strategies to drive asset replacement in the secondary systems and communications areas where the benefits of the use of new technology is not recognised in the economic analysis, not justified and/or where other lower-cost options may be adequate to address the identified risk.

5.2 Assessment

5.2.1 Substation Renewal

Expenditure summary

106. The proposed expenditure for the Substation renewal project grouping is shown in Table 3 below.

Table 3: TransGrid Substation renewal forecast repex

$m, real 2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	Total
Substation renewal	85.7	56.7	59.3	66.9	54.9	323.5

Source TransGrid Capital Accumulation Model

107. TransGrid advised that many substation assets are at the end of their technical life and that it needs to increase the level of asset renewal from eight to ten projects (+25%) based on asset condition and risk assessments. The proposed expenditure of $323.5m reflects a 23% increase over the $263.9m of actual expenditure in the 2009-14 period.

108. Compared to the prior RCP, the number of projects requiring at least $8m of expenditure has increased from four to eleven. On this basis, the number of projects with substantial expenditure has considerably increased. Also, in the 2009-14 RCP, the expenditure was predominately (approximately 50%) due to the Beaconsfield West substation renewal project. Accordingly, both the level of expenditure and number of projects in the proposal has substantially increased compared to the prior period.

Deliverability

109. We consider that it is highly likely that some projects will "slip" from the forthcoming period, which would result in a reduction to the proposed expenditure. For example, if the projects at the end of the RCP being Wagga, Mummorah and Newcastle were deferred by only one year, the proposed substation renewal expenditure would be reduced by $39.5m. Considering the increase in the number of substation renewal projects, combined with the lack of an assessment of how the risk might change due to deferral, it is reasonable to assume that this could occur.

Review of risk

110. We reviewed a number of risk assessments and found evidence of expenditure linked to what we consider to reflect a systemic over-estimation of risk. For example, the risk assessment for the Newcastle substation renewal project as shown in Figure 4 is 'Medium'. According to TransGrid's corporate risk framework, a 'Medium' risk only requires treatment based on a cost-benefit assessment. This assessment has not been adequately demonstrated to us. We consider that, in this example, the project could be deferred.

Review of scope and timing

111. The Canberra 330kV ($57.8m), Wagga 132kV ($51.6m), Tamworth 132kV ($43.0m), Vales Point 330kV ($44.1m) and Cooma 132kV ($39.9m) substation renewal projects were reviewed to ascertain any substantial issues with the work and if any issues identified are systemic. Within the period, proposed expenditure for these projects is approximately $202m or 63% of total proposed repex.

112. There were a number of options considered in the assessment for each project and the selected options include: (i) piecemeal replacement; (ii) rebuild in-situ; and (iii) develop on a new site.

113. Of the five projects reviewed, we consider that, on a reasonable interpretation of the documentation provided, prudent executive management and/or Board consideration of reasonable alternatives would result in deferral of the Wagga and Tamworth projects (in spite of Tamworth being a committed project). For example:

- Wagga may be deferred if some temporary works are undertaken and a less expensive option implemented at a later date if further use is made of the assets already replaced. For example, all the 132kV circuit breakers are relatively new.
- The Tamworth project did not consider the option of undertaking temporary works and purchasing a spare transformer in order to defer the station renewal; this alternative may be more economical, especially if the spare is purchased so that it can be used at a number of sites.

Relationship to other works

114. In the reviewed projects there was also significant work in secondary replacements and civil works. For example:

- Approximately $35m or 60% of the expenditure for the Canberra project is secondary equipment and control cable replacement. The Vales Point project proposes to replace all 330kV and 220kV secondary systems, yet there is not a compelling reason to undertake the 132kV replacements at the same time. The Wagga project also proposes to replace all 330kV and 132kV secondary systems and cables. There should be opportunities to reduce the scope of this secondary work.
- In all of the substation renewal projects, there is considerable expenditure for replacement or augmentation work in areas such as fencing, drainage, oil containment, auxiliary services and other general civil works. From the documentation provided, no compelling reasons were provided to explain why some of this work could not reasonably be deferred.

Cooma substation

115. The Cooma substation is listed with the most extreme risk, with a risk cost of $246.5m per annum. Yet, the major risks are associated with the condition of the 11kV regulators and an assumption that it will take up to a year to replace a failed unit if a transformer fails. It is unlikely that this situation would be allowed to occur. (We note that the station also has existing redundancy.) Based on an assessment of extreme risk, we consider that a new regulator should have been installed and the removed regulator kept as a

spare. Also, a spare transformer should be available to cover Cooma and other substations.

116. Many of the substation circuit breakers at Cooma have previously been replaced, resulting in 65% of the fleet being less than 20 years old. Many of the projects are now being driven by the replacement of other equipment at the substations such as disconnectors, instrument transformers, power transformers and secondary systems. However, there is a concern that relatively new circuit breakers will be replaced as part of a substation renewal project; this issue was observed in some of the project documents reviewed. For example, the Wagga project includes the complete demolition and rebuild of the 132kV switch bays despite nine of the ten existing circuit breakers being relatively new SF6 units. There was no mention of the option to reuse these in situ.

Implications for proposed expenditure allowance

117. From the review of a sample of projects we found evidence of inadequate risk assessment, forecasting and scope bias, including:

- excessive assessment of risk costs;
- areas of excessive scope;
- insufficient consideration of the option to defer the major renewals by undertaking interim work and the use of spares; and
- insufficient consideration of the retained use of relatively new assets.

118. By examining this sample of expenditure, it is evident that the biases described above have consistently led to an over-estimate of the proposed expenditure. We consider that these biases reflect a systemic issue and are likely to reasonably exist in the remainder of this expenditure category.

119. Based on our analysis of this sample, and the impact of systemic issues found, we consider that the level of expenditure during the last RCP is a better indicator of a prudent level of expenditure. We remain unconvinced of the need for an increase.

120. It is our view that the over-estimation of required expenditure is in the order of 10% to 20% within this project category. We consider that a corresponding adjustment to the replacement capital expenditure that TransGrid has proposed for this project category would more reasonably reflect a prudent and efficient level of expenditure.

121. We consider that increased focus on the prudency of the expenditure and enhanced analysis methods will determine the most efficient scope of works and the timing of projects.

5.2.2 Secondary Systems Renewal

Expenditure summary

122. The proposed expenditure for the Secondary Systems Renewal project grouping is shown in Table 4 below.

Table 4: TransGrid Secondary Systems Renewal forecast repex

$real 2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	Total
Secondary Systems Renewal	40.5	45.3	27.8	35	42.6	191.2

Source TransGrid Capital Accumulation Model

123. Total expenditure in the current period is forecast to be $79m and is forecast to increase by 240% to $191.2m. There were six projects over $1m in the last RCP, whereas this has increased to 17 projects in the 2015-19 period. This is a substantial increase. We expect that TransGrid will encounter significant challenges to implement all of these projects in the period, while also undertaking the secondary system renewal component of works included in the substation renewal projects.

124. The secondary system renewal work is being driven by the strategies adopted in the Network Renewal, Maintenance & Disposal Strategy and Objectives – Substation Automation Systems issued on 20 May 2014, specifically:

- Protection – to have the majority of electromagnetic relays replaced by 2030 and the discrete component and early microprocessor protection by 2025;
- Control systems - replace all discrete component control assemblies as a matter of urgency and all early microprocessor type control systems by 2024; and
- Meters - replacement of the remaining electromechanical, solid state and early microprocessor meters by the end of the RCP.

125. This results in forecast replacement targets as shown in Table 5 below.

Table 5: Secondary system scheme replacement asset strategy targets

Secondary System Scheme	Replacements 20015-19	Replacements 2020-25
Protection schemes	1,943	2,412
Control schemes	229	0
Metering schemes	239	0
TOTAL	**2,411**	**2,412**

Source TransGrid Capital Accumulation Model

126. This strategy results in an aggressive technology driven replacement program. The strategy does not take into account the specific risks associated with each site and instead focusses on target replacement quantities.

Delivery strategy

127. The delivery strategy used to achieve the scheme replacements depends on the control cables and the number of secondary schemes to be replaced at the substation, specifically:

- where a substation has reached the end of its serviceable life then a complete rebuild will be selected, including the secondary systems;
- if the majority of secondary systems are due to be replaced and the secondary cables are past their serviceable life, a complete rebuild of the secondary

systems, control cables and cables trenches and LV switchyard equipment is undertaken;

- where the control cables are still in a serviceable condition, but the majority of the secondary systems have reached their end of life, the systems are replaced and the existing control cables reused where possible; and
- if the majority of secondary systems and cables are in good condition, then a limited project is put in place to upgrade specific schemes.

Secondary System Buildings

128. TransGrid has developed a transportable Secondary System Building (SSB) that can be fitted off-site with the required protection, control and metering schemes and then connected to the existing equipment with old or new secondary cables at site. This is being used to facilitate the complete replacement of secondary equipment at a site and may be a factor in the increased scope of the secondary systems renewal program. TransGrid state, however, that SSB installations will only be used where such an installation has been deemed the most economically viable.[22]

Higher level of replacements

129. The substation and secondary renewal programs will result in the replacement of some of the more modern systems at the site. Therefore, the number of scheme replacements will be more than those shown in Table 5. For example, in the substation renewal project secondary assessments there may be 75% of schemes that are targeted for replacement, thus the actual number retired will be 25% higher. The extent of the renewals programs will also potentially generate many spares.

Review of project drivers

130. In order to assess if there are any systemic issues with the secondary systems renewal projects, we reviewed the following projects: ANN 132kV ($5m); Beryl 132kV ($5.7m); Liddell 330kV ($22m); and Sydney West 330kV ($39.6m).

131. Project-specific documentation to describe asset condition, options and any options evaluation was sparse. There were no details of specific performance issues associated with the secondary equipment at each site. The assessed number of secondary assets to be replaced at each site was based on TransGrid's technology replacement strategies.

ANN 132kV substation

132. The ANN 132kV substation was commissioned in 1981. The control cables are in good condition and the secondary systems condition assessment report states that approximately half the protection relays are targeted for replacement. However, the only option considered is a full secondary system replacement. The two options considered only relate to the delivery method. Other options should have been considered, including: (i) interim works to enable the deferral of the project; and (ii) an option for more targeted replacements. The age of this station should not warrant a complete secondary systems replacement as proposed. We consider that, on a reasonable interpretation of the documentation provided, prudent executive management or Board

[22] Asset Manager – Secondary Systems Requirements, pg 6

review would seriously consider implementation of alternate options or deferral of this work.

Beryl 132kV substation

133. The Beryl 132kV substation was commissioned in 1976. It is similar to ANN as the secondary cables are satisfactory. In this case, 74% of the protection relays and 30% of the metering relays and the control system are targeted for replacement. However, only the complete replacement option was considered.

Liddell 330kV substation

134. The Liddell 330kV substation was commissioned in 1970. The secondary cables are in good condition and the condition assessment reported that approximately 75% of the secondary systems are targeted for replacement. Again, only the complete replacement option was considered. The Options Evaluation Report stated that the project can be delayed by two years (i.e., defer to 2020) provided a maintenance cycle is carried out. However, in TransGrid's proposal, the project was only delayed by one year to 2019.

Sydney West 330kV substation

135. The Sydney West 330kV substation was commissioned in 1965. It is a major hub in the network. The condition assessment stated that 70% of the secondary systems at the site are targeted for replacement. The site inspection report states that the secondary cables can last for one more secondary system cycle. However, the options chosen assume complete replacement of the cables. This is not in keeping with the TransGrid secondary systems strategy and cables of this age should be in reasonable condition. The complete secondary systems replacement was the only option considered and there is no risk assessment. Considering the age and technology of some of the secondary systems, coupled with the criticality of the station, some replacements are appropriate. However, the evaluations are insufficient to justify the total work scope and cost.

Consideration of alternatives

136. For all of the above major projects, there was no consideration of alternatives to complete replacement - or options to delay the delivery timing. For example, there will be many opportunities to use some of the assets being replaced as spares in order to extend the life of schemes at other stations. There was no mention of reusing spares, or of a life extension option, in any of the strategy documents reviewed.

137. We find that the substantial increase in the complete replacement of secondary systems is not well justified. The proposed repex allowance should be reduced in order to encourage the efficient consideration of partial replacements at some sites and the selection of life extension options through the reuse of replaced equipment.

Implications for proposed expenditure allowance

138. From the review of the project information, we found evidence of systemic forecasting and scope bias, including:

- projects that could be reasonably deferred; and
- projects that could reasonably be reduced in scope.

139. By examining this sample of expenditure, it is evident that the biases in terms of scope and risk have led to an overestimate of the proposed expenditure. We consider that these biases reflect systemic issues and are likely to reasonably exist in the remainder of this replacement capital expenditure category.

140. Based on our analysis of this sample and the impact of systemic issues that we found, we consider that a reduced level of expenditure is a more reasonable indicator of a prudent level of expenditure. We do however find that there is sufficient basis for increasing the level of total expenditure from the level of the last RCP.

141. It is our view that the over-estimation of required expenditure is in the order of 20% to 30% within this project category. We consider that a corresponding adjustment to the replacement capital expenditure that TransGrid has proposed for this project category would more reasonably reflect a prudent and efficient level of expenditure.

142. We consider that TransGrid can make reasonable use of life extension strategies and consideration of alternatives to the complete renewal of all secondary systems at the sites.

5.2.3 Communications upgrades

Expenditure summary

143. The proposed expenditure for the Communications upgrades project grouping is shown in Table 6 below.

Table 6: TransGrid Communications upgrade forecast repex

$m, real 2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	Total
Communication upgrades	6.8	35.8	25.4	29.5	27.4	124.9

Source TransGrid Capital Accumulation Model

144. TransGrid proposes to undertake targeted asset replacement works in response to asset condition and replacement of obsolescent components for critical sites, and in addition to modernise existing assets and provide capacity for the future.

OPGW strategy

145. The largest component of this expenditure category is for TransGrid's OPGW strategy. The OPGW strategy comprises a total of nine projects with combined expenditure of $112.5m for replacing the existing microwave trunk bearer with OPGW in three regions. We acknowledge the strategic benefits of such a program to TransGrid. However, the case for the proposed expenditure and timing within the RCP are not proven.

146. TransGrid stated an operational need to supersede microwave radio as a medium for providing trunk telecommunications services. Replacement of the microwave trunk services throughout TransGrid's telecommunications network is proposed to deploy existing Operation Technology and Information Technology (OT/IT) services further around TransGrid's network and enable the future rollout of services currently in development.

147. Our review of the strategy documentation has revealed identification of future benefits to TransGrid for this program, however, these benefits do not appear to have been included in the financial analysis of the options provided. Our review also revealed the

existence of a so called “mandate” from the TransGrid Board of the need for OPGW to be strung as part of line rebuild projects. However, this corporate justification was not provided in support of the proposed projects.

148. We consider that the proposed work has been aggregated at too high a level with a single risk assessment and options analysis, rather than considering the justification of individual projects and associated expenditure. The risks specific to supply reliability as a result of congestion and capacity constraints of the existing microwave bearer are not detailed for each project. A single option to implement the OPGW strategy is presented. Benefits and significance of timing of the expenditure were not adequately justified.

149. We consider that options to defer some of this work into subsequent regulatory periods were not adequately considered. We found insufficient evidence to support the justification of an increase in proposed expenditure for OPGW projects.

Component asset replacement

150. TransGrid proposes to modernise some further communications components to improve performance and to replace obsolete components. Included in the communications forecast is the replacement of a number of components that are reaching the end of expected life and upgrades of communication operation and management systems to mitigate capacity constraints for critical sites.

151. We reviewed the items included in this expenditure category and consider that the proposed work to be undertaken is appropriate.

Implications for proposed expenditure allowance

152. By examining this sample of expenditure, we found that there are biases evident in terms of scope and risk that have led to an over-estimate of expenditure. We consider that these biases reflect a systemic issue and are likely to reasonably exist in the remainder of this expenditure category.

153. Based on our analysis of this sample, and the impact of systemic issues found, we consider that the level of expenditure during the last RCP is a better indicator of a prudent level of expenditure. We remain unconvinced of the need for an increase.

154. It is our view that the over-estimation of required expenditure in the forthcoming RCP is in the order of 50% to 60% within this project category. We consider that a corresponding adjustment to the replacement capital expenditure that TransGrid has proposed for this project category would more reasonably reflect a prudent and efficient level of expenditure.

155. We consider that TransGrid can manage risk through improved and more granular analysis of the benefits, prioritisation and timing of the OPGW projects.

5.2.4 Transmission line rebuilds

Expenditure summary

156. The proposed expenditure for the Transmission line rebuild project grouping is shown in Table 7 below.

Table 7: Proposed Transmission line rebuild expenditure

$m, real 2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	Total
Transmission line rebuilds	15.7	36.5	10.6	42.5	10.3	115.6

Source TransGrid Capital Accumulation Model

157. The proposed expenditure for Transmission line rebuilds is largely comprised of Transmission line life extension projects ($43.4m), Transmission line wood pole replacement ($58.6m) and Transmission line renewal ($13.6m). The identification of assets to be treated and/or replaced is established through condition assessment and consideration of asset age. TransGrid identified an underlying poor condition of some transmission line towers and wood poles requiring treatment and possible replacement. Corrosion of steel tower members and line hardware of lines in the coastal corridor and deterioration of wood poles of 132kV inland pole lines was evident in the asset condition reports.

158. The information provided indicated that TransGrid spent less than half of its previously proposed expenditure on lines and lines related projects in the previous RCP.

Steel tower refurbishment

159. We find that the need for proposed refurbishment of the steel tower lines is prudent. However, we consider that aspects of the scope of a sample of the projects have been engineered conservatively at this initial scoping stage and that the risk assessments should be expanded to include:

- consideration of specific tower conditions;
- improved justification of the approach to only treat tension towers and prioritisation across the nominated lines; and
- consideration of a risk based approach to tower treatment across the network.

Transmission wood pole replacement

160. Whilst we support the need for transmission line wood pole replacement projects, we consider that:

- the case to rebuild entire lines is not compelling and leads to a high estimate where this is proposed. We consider that greater consideration of targeted replacement of individual poles or poles within line sections of the line may lead to a more efficient estimate;
- the information provided was insufficient to conclude that there was a reasonable expectation of increasing levels of pole defects and an increased risk to reliability of supply, as stated by TransGrid. This is further evidenced by TransGrid's view that, for some projects, the defect rate is manageable;
- other risk mitigation options - such as pole reinforcement (or nailing) - could be considered for application to some lines and line sections as undertaken by other TNSPs at 132kV; and

- whilst it may be efficient to package requirements together within a single project, components to address a low span / clearance requirement and opportunities to install OPGW should be, where included, justified separately.

Implications for proposed expenditure allowance

161. By examining this sample of expenditure, it is evident that the biases in terms of scope and risk have led to an overestimate of expenditure. We consider that these biases reflect a systemic issue and are likely to reasonably exist in the remainder of this expenditure category.

162. Based on our analysis of this sample and the impact of systemic issues that we found, we consider that a reduced level of expenditure is a more reasonable indicator of a prudent level of expenditure. We do, however, find that there is sufficient basis for increasing the level of expenditure from the level of the last RCP.

163. It is our view that the over-estimation of required expenditure in the forthcoming RCP is in the order of 10% to 20% within this project category. We consider that a corresponding adjustment to the replacement capital expenditure that TransGrid has proposed for this project category would more reasonably reflect a prudent and efficient level of expenditure.

164. We consider that TransGrid can manage this lower level of expenditure through prioritisation of projects and can also explore projects and treatments targeted at addressing the identified risks. We believe that this level of adjustment reflects a prudent and efficient level and should be readily achievable.

5.2.5 Other repex

165. We consider that the significant issues identified within TransGrid's governance and management and; forecasting methodology and evidenced within the proposed expenditure under review indicate a number of systemic issues that arise from forecasting, scope and risk biases. The systemic nature of these issues cast reasonable doubt over the prudence of the remainder of the proposed replacement capital expenditure.

166. Based on our review of a sample of expenditure from the four major project groupings proposed, we consider that the remainder of the proposed replacement capital expenditure is likely to be subject to the same issues and bias that has led to an over estimate of proposed expenditure.

167. Accordingly, to reflect a prudent level of expenditure, we consider that it would be reasonable to make a pro rata adjustment to the 'other' replacement expenditure category. Any such adjustment should be applied at an aggregate level without change to any specific project or program.

5.3 Implications for proposed repex

168. Our review of the four samples of expenditure has identified evidence of issues and biases that contribute to an overestimate of expenditure within each of the four expenditure categories reviewed. Although we assessed each of the four project categories separately, we consider that the biases evident in the sample of projects

reviewed reflect systemic issues. As such, it is reasonable to conclude that similar issues and biases are likely to exist in the remainder of the proposed replacement capital expenditure.

169. We estimate that these biases result in an over-estimate of the proposed level of expenditure, in aggregate across the four project expenditure categories reviewed. It is our view that this over-estimation, when considered in aggregate across the forecast replacement capital expenditure, is in the order of 20% to 30%. We consider that a corresponding adjustment to the replacement capital expenditure that TransGrid has proposed would more reasonably reflect a prudent and efficient level of expenditure.