EMCa
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Endeavour Energy Revenue Proposal 2019-24

Review of aspects of Endeavour Energy's forecast capital expenditure

Report to

Australian Energy Regulator

from

Energy Market Consulting associates

August 2018

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 distribution services of Endeavour Energy from 1st July 2019 to 30th June 2024. 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 capital expenditure that has been conducted making use of all available assessment methods.

This report relies on information provided to EMCa by Endeavour Energy. EMCa disclaims liability for any errors or omissions, for the validity of information provided to EMCa by other parties, for the use of any information in this report by any party other than the AER and for the use of this report for any purpose other than the intended purpose.

In particular, this report is not intended to be used to support business cases or business investment decisions nor is this report intended to be read as an interpretation of the application of the NER or other legal instruments. EMCa's opinions in this report include considerations of materiality to the requirements of the AER and opinions stated or inferred in this report should be read in relation to this over-arching purpose.

Except where specifically noted, this report was prepared based on information provided by AER staff prior to 29th June 2018 and any information provided subsequent to this time may not have been taken into account.

Energy Market Consulting associates
802 / 75 Miller St, North Sydney NSW 2060

and

Level 1, Suite 2 572 Hay St, Perth WA 6000
AUSTRALIA

Email: **contact@emca.com.au**
Web: **www.emca.com.au**

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 network management, access and regulatory arrangements. EMCa combines senior energy economic and regulatory management consulting experience with the experience of senior managers with engineering/technical backgrounds in the electricity and gas sectors.

Authorship

Prepared by:	Paul Sell, Gavin Forrest, Mark de Laeter, Scott Wallace, Steve Kelly, with input from Eddie Syadan and Anand Samuel
Quality approved by:	Paul Sell
Date saved:	10/10/2018 1:31 PM
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Executive Summary

Purpose of this report

1. This report provides our assessment and findings from our review of Endeavour's proposed repex and augex expenditure requirements for the next Regulatory Control Period (RCP) 2019 to 2024.

2. We have undertaken our review primarily based on Endeavour's Regulatory Proposal (RP) and the documents that Endeavour provided in support of its RP, and we have considered these documents to definitively provide its proposal and supporting rationale. To augment these sources, we sought and were provided with a range of additional documents[1], and we met with Endeavour for a two-day series of onsite meetings at which we provided Endeavour with the opportunity to provide clarifications and additional information on its proposed expenditure requirements and their basis.

Review approach

3. Our review approach comprises reviews of:

   - Endeavour's framework for expenditure governance and management of its expenditure, and in particular its governance and management framework for its RP forecast expenditure;
   - The forecasting methodologies that Endeavour states that it has employed in developing its repex and augex forecasts;
   - Its repex forecast, which we have reviewed at a category level consistent with the way in which Endeavour has presented it; and
   - Its augex forecast, for which we have reviewed its Greenfields and Brownfields expenditure forecasts.

[1] As at the current date of this report, Endeavour has provided a response to all Information Requests. However, some of our Information Requests were not fully answered, and Endeavour provided some responses after a cut-off for our assessment that was notified to Endeavour. We have sought to take account of all information provided, but we disclaim responsibility for full consideration or acknowledgment in this report, of information that was provided after the information cut-off for completion of our assessment.

4. We have assessed Endeavour's governance and management framework and its forecasting methodologies for the extent to which we consider that they would be likely to provide the means for Endeavour to forecast expenditure requirements that meet NER objectives and criteria. For Endeavour's repex and augex forecasts, we have assessed a significant sample of project and program-based information to identify any systemic issues that we consider have led Endeavour to over-estimate its forecast requirements.

Endeavour's proposal

5. Endeavour has proposed a forecast of $800.5m repex and $416.8m augex for the next RCP. Both these amounts represent significant increases on Endeavour's current RCP expenditure.

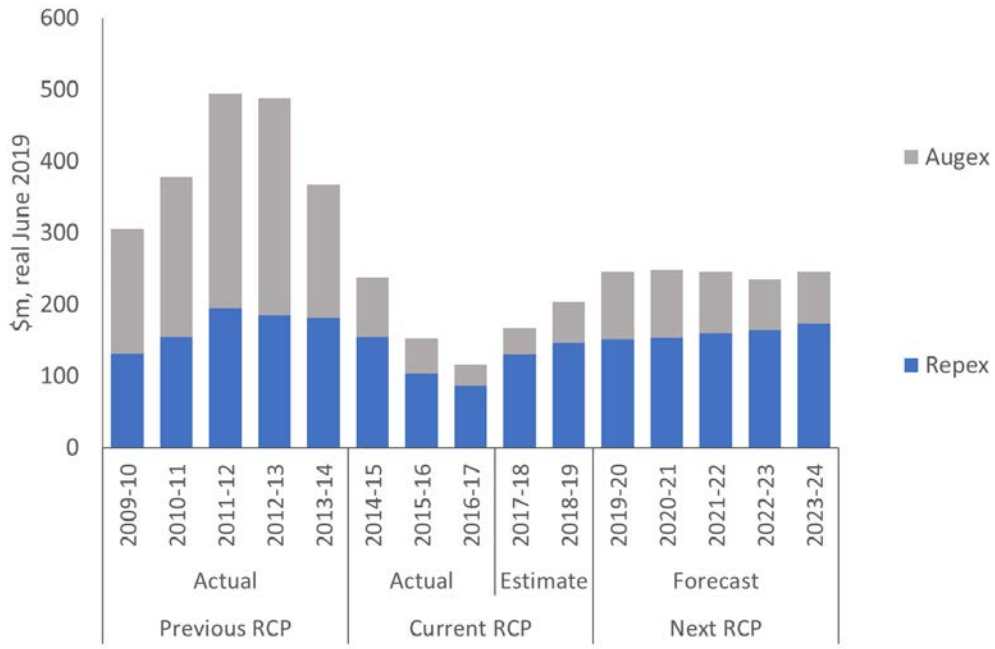
Table 1: Forecast repex and augex for the next RCP ($m, real June 2019)

$m, real June 2019	Next RCP					
	Forecast	Forecast	Forecast	Forecast	Forecast	Total
Category	2019-20	2020-21	2021-22	2022-23	2023-24	2020-24
Repex	151.0	153.0	159.7	164.0	172.7	800.5
Augex	93.5	94.7	85.4	70.9	72.2	416.8
Total	**244.6**	**247.7**	**245.1**	**234.9**	**245.0**	**1,217.2**

Source: Endeavour Reset RIN

6. As can be seen from the figure below, while Endeavour forecasts higher augex than in the current RCP, this is below the peak levels it incurred during the previous RCP. Endeavour's forecast repex shows a steady increase across the period, with a step up starting in 2017/18.

Figure 1: Actual, estimated and forecast repex and augex for the previous, current and next RCP ($m, real June 2019)



Source: Endeavour Reset RIN

Our assessment of Endeavour's expenditure governance and management framework

7. We consider that Endeavour's governance and management framework reflects a focus on expenditure control. However, we consider that the following aspects do not reflect current good industry practice amongst electricity networks:

   - At a portfolio-level, there is insufficient linkage between expenditure plans and their contribution to stated aggregate performance objectives;
   - Endeavour's portfolio-level risk assessment does not reflect Endeavour's stated risk framework and does not provide risk metrics (including linkages to a defined risk appetite) that would allow assessment of the appropriate level or mix of expenditure;
   - Differences in statements of objectives in different governance and management documents detract from the ability to plan to a common purpose;
   - The process by which Endeavour's Portfolio Investment Plan (PIP) is formed, and which underpins Endeavour's RP forecast, does not appear to account for future refinements and rationalisations that will occur as projects and programs progress through Gates 2 and 3; and
   - The incremental nature of Endeavour's rolling ten-year plans lends itself to a reduced a level of challenge which over time is likely to lead to an over-estimate of requirements.

Our assessment of Endeavour's expenditure forecasting methods

8. Contrary to claims in its RP of having used bottom-up and top-down forecasting methods, we find that Endeavour has established its overall repex requirement of $800m by a top-down process that was external to the forecasting methods adopted by its network managers. We find that:

   - this figure has not been justified against NER criteria or against Endeavour's stated corporate objectives;
   - within this overall figure, Endeavour has established category-level repex forecasts also using a top-down approach, that is essentially on an asset age basis;
   - Endeavour has not provided evidence of how it determined that the risk levels or asset health levels resulting from its proposed program are preferred over those that could have resulted from an alternative program;
   - Endeavour has not provided 'business cases' to support its proposed repex projects and programs nor has it validated its forecast by reference to 'asset class plans', which it appears are in development; and
   - at the project and program level, we observe only limited application of risk analysis and limited integration of repex plans with capacity planning. To the extent that Endeavour has developed bottom-up project and program plans, these appear to have been essentially 'fitted in' to the top-down forecasts.

9. Unlike repex, Endeavour's augex forecast results from the aggregation of a series of bottom-up planned projects. Whilst we note that Endeavour's forecast augex is less than the output of its application of the augex model, in our view

   - Endeavour has not demonstrated that it considered the potential impact of more rigorous planning on project scope and timing in its 'top-down challenge';

- we would also expect that with scope and scale of the regional development plans identified in its Area Plans, we would expect to see compelling evidence underpinning the decision to continue with widespread application of 11kV in greenfield areas; and
- at the project and program level, Endeavour's documentation shows inadequate options analysis and issues with the proposed project timing.

Our assessment of Endeavour's proposed repex requirements

10. Whilst we support the in-principle inclusion of the type of projects and programs that Endeavour has proposed, Endeavour has not provided sufficient analysis and justification for its RP repex forecast, for reasons including that Endeavour:
    - has not provided adequate justification for the composition of the forecast expenditure, which include material increases at the asset category level from the actual/estimated expenditure in the current RCP;
    - presents replacement volumes that are primarily derived from an age-based forecasting method, that is likely to overstate the actual requirements;
    - has not demonstrated that it has applied reliable asset condition and failure data, robust options, risk and cost-benefit analysis in support of the timing/volume of the activity; which is often described in business case documents or similar approval documents, and which have not been provided;
    - has derived the repex forecast, at multiple instanced, from its long-term modelling outcomes using the VDA tool as discussed in Section 4, and which is primarily based on asset age. To the extent that Endeavour's eventual investment decisions will take greater account of asset condition, there is considerable evidence in Endeavour's documentation that this will result in lower expenditure.
    - has included examples where 'nominal allocations' of expenditure have been provided that have not been adequately justified, such as by referring to asset condition or risk;
    - has not adequately considered the potential for prioritisation and optimisation of the portfolio which may indicate a lower level of expenditure is a reasonable forecast of such expenditure requirements; and
    - has not factored into its forecast the likely savings and investment deferrals that would be expected to be identified as individual projects are subjected to rigorous review and challenge through the IGF gate review process. There is significant evidence within Endeavour's documentation that, at these later stages in its decision process, it will find opportunities for more prudent and efficient options within the next RCP.

11. We have not been asked to specifically assess evidence of efficient costs employed by Endeavour in the development of its repex forecast. However, we have made observations within our review of the asset categories that suggests to us that further consideration of cost efficiency would likely reduce the forecast expenditure.

Our assessment of Endeavour's proposed augex requirements

12. Endeavour has identified sub-transmission and distribution works that are likely to be required at some time in the future to respond to load growth and technical compliance obligations. However, Endeavour has not provided sufficient analysis and justification for its RP augex forecast. We find the following issues:

- Inadequate justification for configuring the numerous new zone substations in greenfield areas based almost entirely on 11kV distribution voltage;
- Inadequate identification and consideration of alternative network options, particularly those which could defer zone substation establishment;
- Inadequate consideration of the potential impact of non-network solutions (when or if these are considered in more detail later in the project development life cycle);
- Potentially conflicting project timing – with the proposed project expenditure profiles and the results of 'probabilistic VCR model' studies appearing to materially differ; and
- For the Distribution Works Program,[2] lack of evidence to demonstrate that the volume of work proposed is prudent and efficient due primarily to the lack of detail about Endeavour's claimed 'risk-based approach'.

13. Endeavour has demonstrated that during the current RCP, it has delivered more efficient options to address demand growth and deferred other projects until a subsequent RCP. These options have been identified at Gates 2 and 3 of its IGF. We consider that Endeavour will find at least similar opportunities in the next RCP, and possibly increasing opportunities due to the rapid changes that are occurring in distributed supply and demand management solutions. Endeavour's aggregation of what are mostly Gate 1 projects has led it to propose a forecast that has not factored in the likelihood that some projects will be deferred from the next RCP into subsequent RCPs.

14. We consider that it is likely that Endeavour will find opportunities for more prudent and efficient options within the next RCP as it undertakes the detailed planning in preparation for the RIT-D process and also as a result of feedback from the process. These network and non-network options are likely to allow some of the forecast expenditure for proposed sub-transmission augex projects (both Greenfield and Brownfield) to be reduced in this RCP.

Implications for Endeavour's proposed expenditure

15. We consider that the weaknesses we have observed with Endeavour's expenditure governance and management process and its forecasting methodologies render it unlikely that its RP is a reasonable forecast of its prudent and efficient requirements.

16. From our assessment of the application of this framework and methodologies, we consider that the modelled and un-modelled components of Endeavour's proposed repex, and the Greenfields and Brownfields components of Endeavour's proposed augex are in aggregate significantly above a reasonable prudent and efficient level.

[2] Also referred to as 'HV Development works'

1 Introduction

1.1 Purpose and scope of requested work

1.1.1 Purpose

17. The purpose of this report is to provide the Australian Energy Regulator (AER) with our findings from a review of defined elements of Endeavour Energy's (Endeavour) proposed capital expenditure (capex) forecast for the 2019-24 Regulatory Control Period (next RCP). The assessment contained in this report is intended to assist the AER in its own analysis of the capex forecast as an input to its Draft Decision on Endeavour's revenue requirements.

1.1.2 Scope

18. The scope of this review covers Endeavour's proposed:

    (i) replacement capex (repex) forecast; and

    (ii) augmentation capex (augex) forecast.[3]

1.2 Our approach

19. In undertaking our review, we:

    - completed a desktop review of the information provided to us by the AER, which included Endeavour Regulatory Proposal (RP) and associated supporting documents;
    - prepared requests for specific additional information to be provided by Endeavour;

[3] As agreed with the AER by teleconference on 28 May 2018 and confirmed in subsequent emails on 29 May 2018.

- undertook onsite review meetings over two days with Endeavour[4] to ensure we correctly understood the methodology and assumptions being applied as the basis for its forecast expenditure requirements;
- undertook an assessment of Endeavour's expenditure forecast, which included reviewing Endeavour's expenditure governance, management and forecasting framework, Endeavour's top-down portfolio challenge process and Endeavour's application of its expenditure justification and forecasting approach on a sample of projects and programs; and
- documented our findings in the current report.

20. We also provided feedback to AER staff on our preliminary findings, while drafting the current report.

21. The limited nature of our review does not extend to advising on all options and alternatives that may be reasonably considered by Endeavour, or on all parts of the capex forecast.[5] We have included additional observations in some areas that we trust may assist the AER with its own assessment.

1.3 Structure of this report

22. Our main findings are summarised in the Executive Summary at the beginning of this report.

23. In Section 2, we present a context overview of the capex elements relevant to our review. This overview includes consideration of the expenditure trends and past forecasting performance of repex and augex.

24. In the subsequent four sections, we present the assessment that supports our findings as follows:

- In Section 3, we describe our assessment of the governance and management framework that Endeavour uses to plan and approve its repex and augex projects and programs, together with the implications of any identified issues on the forecast expenditure;
- In Section 4, we describe our assessment of the expenditure forecasting methodology and assumptions that Endeavour has used to determine its proposed repex and augex forecast, together with the implications of any identified issues on the forecast expenditure;
- In Section 5, we consider Endeavour's proposed repex forecast by asset category and describe any issues that we identified with the proposed expenditure, including Endeavour's application of its expenditure governance and management framework, and its expenditure forecasting methodology; and
- In Section 6, we consider Endeavour's proposed augex forecast and describe any issues that we identified with the proposed expenditure, including the application of its expenditure governance and management framework, and its expenditure forecasting methodology.

[4] The onsite review meetings took place on 13th and 14th June 2018.

[5] For example, our review does not include unit costs or supporting models, although we have included some observations where relevant.

1.4 Other

1.4.1 Information sources

25. We have examined relevant documents from Endeavour's RP, information supplied at the on-site meetings, and further documents provided in response to our information requests. These documents are referenced directly where they are relevant to our findings.

26. Our assessment is based on our observations from the onsite meetings, together with information supplied prior to, at, and following the onsite meeting pursuant to EMCa information requests. In our considering Endeavour's responses, and at the request of the AER, we have included additional information supporting our assessment of aspects of the capex forecast we have been asked to review.

27. To enable us to complete our draft report by the date requested by the AER, we agreed a cut-off date of 29th June 2018 for Endeavour to respond to information requests. However, Endeavour provided some information responses after our assessment cut-off and, while we have not been able to make full use of this delayed information, we have satisfied ourselves that it would not lead us to materially change our findings.

28. Please refer to Appendix A for a list of our information requests, and whether responses were received to these requests, and whether responses received were in time to be taken into account in our assessment.

29. For consistency, we have sourced data for our analysis from Endeavour's Reset RIN[6]. Any other data relied upon for analysis is referenced in our report.

1.4.2 Rounding of numbers and real conversion

30. Numerical totals in tables may not present as being equivalent to the sum of the individual numbers due to the effects of rounding. Also, some numbers in this report may differ from those shown in Endeavour's regulatory submission or other documents due to rounding.

31. This report refers to costs in real June 2019 dollars unless denoted otherwise.

[6] We have relied on the expenditure data provided in Endeavour Energy Reset RIN received 8th June 2018, as an updated version to that provided in the RP. All references to Endeavour Energy's Reset RIN are to the version received on 8th June 2018.

2 Background

2.1 Introduction

32. In this section, we provide background context to the assessments which follow.

33. We first provide an overview of Endeavour's total proposed capex for the next RCP, and we include observations of Endeavour's actual and forecast capex for the current RCP. We next outline the categories of capex that we have been asked to review, and for which our assessment has been based in the remainder of this report. Finally, we summarise the National Electricity Rules (NER) capital expenditure criteria and capital expenditure objectives that have guided our assessment.

2.2 Overview of proposed capex

2.2.1 Overview of total capex

34. Endeavour has forecast total capex for the next RCP of $2,158.1m. The table below sets out Endeavour's proposed capex for each capex category for each year of the next RCP.

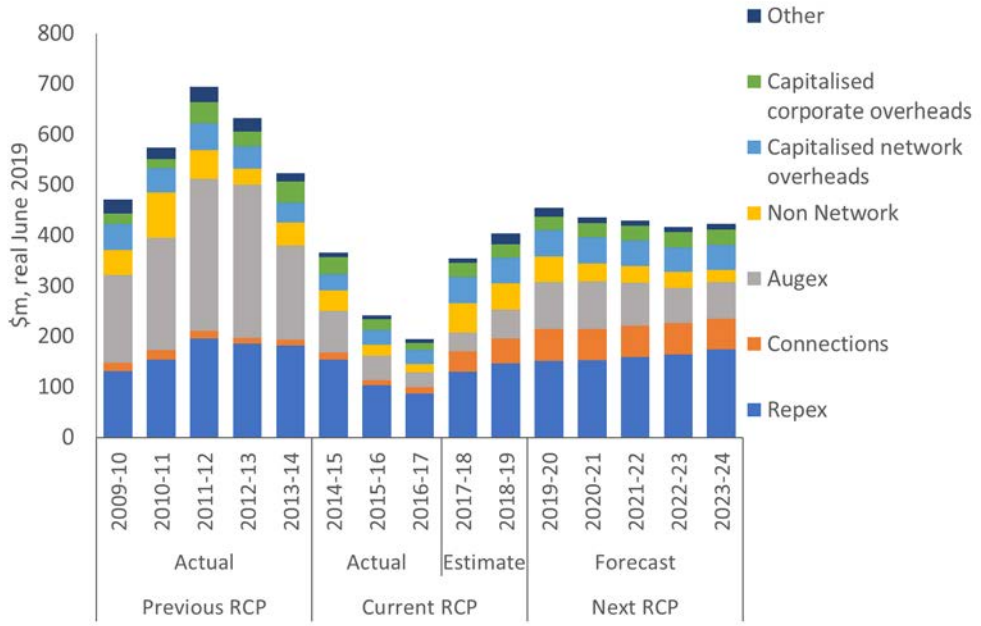
Table 2: Proposed capex for next RCP by capex category ($m, real June 2019)

$m, real June 2019	Next RCP Forecast					Total
Category	2019-20	2020-21	2021-22	2022-23	2023-24	2020-24
Repex	151.0	153.0	159.7	164.0	172.7	800.5
Connections	63.5	61.1	61.0	61.3	62.4	309.4
Augex	93.5	94.7	85.4	70.9	72.2	416.8
Non Network	49.7	35.1	31.7	30.0	23.6	170.1
Capitalised network overheads	51.7	51.2	51.0	49.5	49.1	252.4
Capitalised corporate overheads	27.7	28.5	29.5	30.5	31.5	147.6
Other	17.6	12.2	10.4	10.4	10.7	61.4
Total	**454.8**	**435.8**	**428.8**	**416.5**	**422.2**	**2,158.1**

Source: Endeavour Reset RIN

35. The figure below shows Endeavour's proposed capex for each capex category for each year of the 2009-14 RCP (previous RCP), 2014-19 RCP (current RCP), and the next RCP.

Figure 2: Capex for the previous, current, and next RCP by capex category ($m, real June 2019)



Source: Endeavour Reset RIN

36. Endeavour's total capex peaked in 2011/12 at $663.4m and then markedly declined up to 2016/17 where total capex was less than one third of its peak at $193.3m. Reduced augex is the largest contributing factor to the overall reduction in capex. Endeavour forecasts that its capex will increase to above $400m by the end of the current RCP and remain relatively stable over the next RCP.

2.2.2 EMCa observations on prior RCP trends and performance

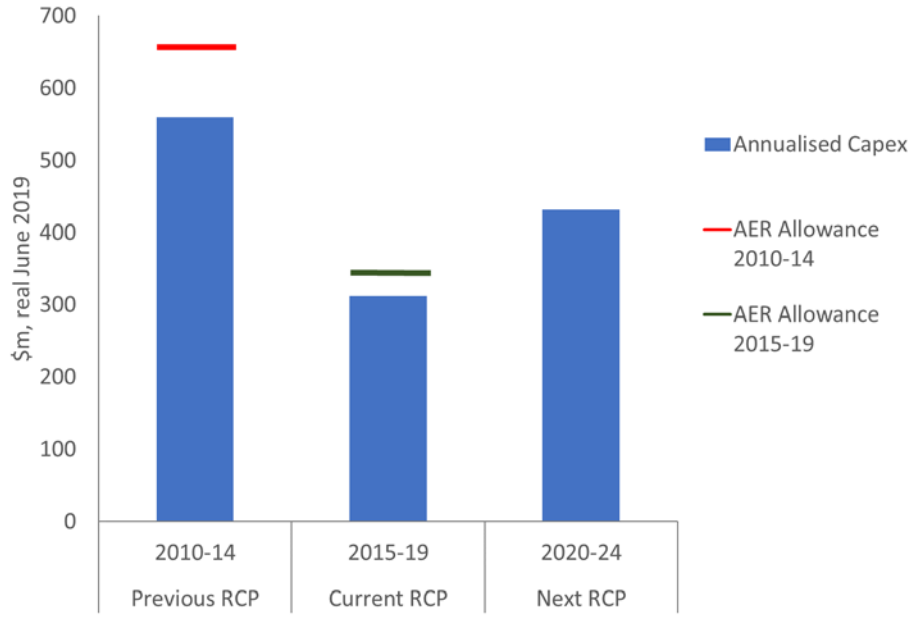
37. Endeavour is forecasting to spend $169.3m less than the capex allowance adopted by the AER in the current RCP, as shown in the table below. The figure below shows that Endeavour also spent less than the AER's capex allowance in the previous RCP.

Table 3: Actual & estimated capex versus allowance for current RCP ($m, real June 2019)

$m, real June 2019	Actual 2014-15	Actual 2015-16	Actual 2016-17	Estimate 2017-18	Estimate 2018-19	Total 2015-19
AER Allowance	455.0	368.5	311.4	302.4	288.9	1,726.2
Actual/ Estimated Capex	365.6	240.9	193.3	353.7	403.4	1,556.9
Variance	**-89.4**	**-127.6**	**-118.1**	**51.3**	**114.5**	**-169.3**

Source: Endeavour Reset RIN and RP

Figure 3: Actual, estimated and forecast capex for previous, current & next RCP, versus allowance for previous and current RCP ($m, real June 2019)



Source: Endeavour Reset RIN,RP and AER 2010-14 Determination for Endeavour

38. For the current RCP, the majority of the underspend relative to the AER's allowance occurred during the first three years. Endeavour explained at the onsite meeting that capex reduced during this period in response to its internal business transformation project, and also capex constraints during the lease transaction. Endeavour further explained that following finalisation of the lease transaction in 2017, its capex is forecast to increase in 2017/18 and 2018/19 to what it describes as a more sustainable level.

2.2.3 Aspects of capex relevant to our review

39. We have been requested to review Endeavour's forecast repex and augex for the next RCP.

40. Endeavour has forecast repex and augex for the next RCP of $800.5m and $416.8m respectively. The tables below set out Endeavour's actual and estimated repex and augex for each year in the current RCP, and also Endeavour's forecast repex and augex for each year in the next RCP.

Table 4: Actual & estimated repex and augex for current RCP ($m, real June 2019)

$m, real June 2019	Current RCP					
	Actual	Actual	Actual	Estimate	Estimate	Total
Category	2014-15	2015-16	2016-17	2017-18	2018-19	2015-19
Repex	153.9	103.5	85.9	129.6	146.0	619.0
Augex	83.7	48.6	29.3	37.1	57.5	256.2
Total	**237.6**	**152.1**	**115.2**	**166.8**	**203.5**	**875.2**

Source: Endeavour Reset RIN

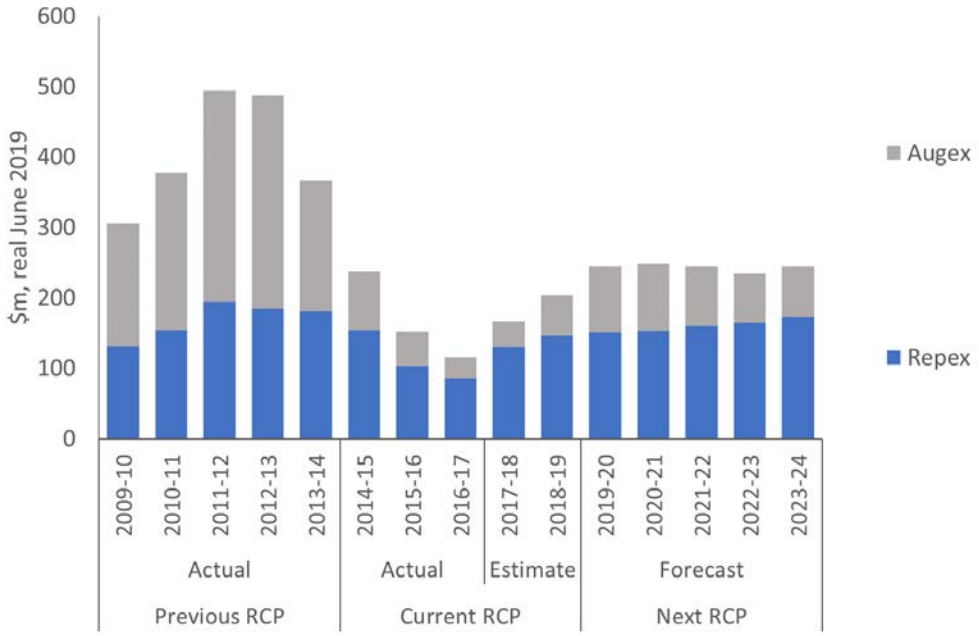
Table 5: Forecast repex and augex for next RCP ($m, real June 2019)

$m, real June 2019	Next RCP					
	Forecast	Forecast	Forecast	Forecast	Forecast	Total
Category	2019-20	2020-21	2021-22	2022-23	2023-24	2020-24
Repex	151.0	153.0	159.7	164.0	172.7	800.5
Augex	93.5	94.7	85.4	70.9	72.2	416.8
Total	**244.6**	**247.7**	**245.1**	**234.9**	**245.0**	**1,217.2**

Source: Endeavour Reset RIN

41. The figure below shows Endeavour's repex and augex for the previous, current and next RCPs.

Figure 4: Actual, estimated and forecast repex and augex for the previous, current and next RCP ($m, real June 2019)



Source: Endeavour Reset RIN

42. The expenditure profile for repex and augex is similar to Endeavour's total capex profile, and the comments relating to the total capex trend above are applicable to the repex and augex components. We discuss Endeavour's forecast repex and augex further in Section 5 and Section 6 respectively.

2.3 NER Capex Objectives and Criteria

43. In undertaking our review, we have been cognisant of the relevant aspects of the NER under which the AER is required to make its determination. The most relevant aspects of the NER in this regard are the 'capital expenditure criteria' and the

'capital expenditure objectives'. Specifically, the AER must accept Endeavour's capex proposal if it is satisfied that the capex proposal reasonably reflects the capital expenditure criteria, and these in turn reference the capital expenditure objectives.

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

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

45. The capex criteria and capex objectives are reproduced in the figures on the next page.

Figure 5: NER capital expenditure criteria

> *(c) The AER must:*
>
> *(1) subject to subparagraph (c)(2), accept the forecast of required capital expenditure of a Distribution Network Service Provider that is included in a building block proposal if the AER is satisfied that the total of the forecast capital expenditure for the regulatory control period reasonably reflects each of the following (the capital expenditure criteria):*
>
> *(i) the efficient costs of achieving the capital expenditure objectives;*
>
> *(ii) the costs that a prudent operator would require to achieve the capital expenditure objectives; and*
>
> *(iii) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives.*

Source: NER 6.5.7(c) Forecast capital expenditure, v111

Figure 6: NER capital expenditure objectives

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

Source: NER 6.5.7(a) Forecast capital expenditure, v111

3 Assessment of governance and management framework

3.1 Introduction

46. A premise of our review process is that application of a sound expenditure governance and management framework is necessary to support prudent and efficient expenditure and to support a reasonable forecast of such requirements.

47. In this section, we provide an overview of Endeavour's expenditure governance and management framework, and we assess the extent to which expenditure forecasts developed under this framework are likely to be prudent and efficient. The extent to which the Endeavour's forecast requirements meet NER requirements also depends on how the framework has been applied, and which we cover in subsequent sections.

3.2 Endeavour's capital expenditure governance framework

3.2.1 Investment Governance Framework overview

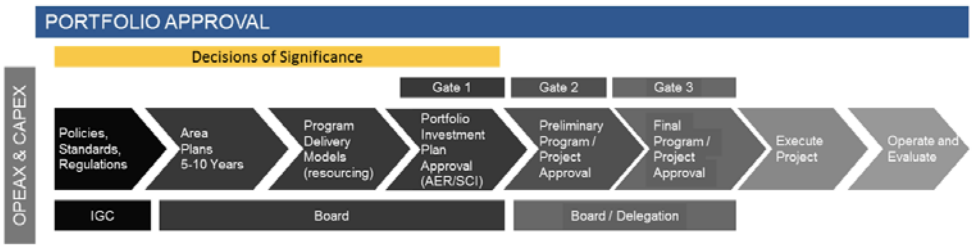
48. Endeavour maintains an Investment Governance Framework (IGF) to provide guidance and accountability in respect of the development, determination and approval of investments, both network (systems) and non-systems.[7] All major network projects and capital programs are required to comply with the procedures set out in the IGF.[8]

[7] RP Attachment 10.13 Company Policy 2.6 - Investment Governance Framework. April 2016. Section 1.

[8] RP Attachment 10.03 Capex Proposal (SAMP). March 2018. Section 2.1.

49. The IGF consists of a gated process with defined stages. The key stages in respect of system investments are shown in the figure below:

Figure 7: Endeavour's Systems investment governance process



Source: RP Attachment 10.13 Company Policy 2.6 - Investment Governance Framework. April 2016

50. Endeavour's investment gateway initial governance process defines accountabilities for policies and standards which impact on investment decisions.

51. Endeavour annually produces a ten-year Portfolio Investment Plan (PIP) which sets out the scope and timing requirements (and estimated delivery costs) of the rolling ten-year network capital investment requirements. This is submitted to the Board for review and initial approval (which is denoted as Gate 1). Endeavour's RP expenditure forecast is based on this PIP and has therefore been prepared at least under the Gate 1 governance arrangements described.[9]

52. Under its governance framework, Endeavour's projects and programs are subject to further testing of network need, consideration of options, delivery efficiency and more detailed planning at Gates 2 and 3.

53. Endeavour's claimed investment portfolio planning processes require that the entire network capital investment portfolio is optimised, integrated, and prioritised on the basis of the treatment of network risk.[10]

3.2.2 Asset Management framework

54. Endeavour has a Strategic Asset Management Plan (SAMP) that includes a suite of asset management plans, comprising the individual capital expenditure programs to address the asset and network need.[11] Endeavour describes a key function of the SAMP as being to '*prioritise the asset management projects and programs of expenditure and to discuss and document the trade-offs that are made in developing the year ahead and ten-year network expenditure forecasts*.'[12]

55. In its SAMP, Endeavour states that it requires assessment of the impact on network outcomes that each proposed project or work program will have, to achieve its strategic network outcomes.[13] Its review processes applied to growth, renewal and maintenance activities are shown in the figure below. Endeavour states that its integration process ranks growth, renewal and maintenance activities using risk to select the program of works to be implemented.

[9] Some projects in the RP forecast are at Gates 2 or 3 in this process.

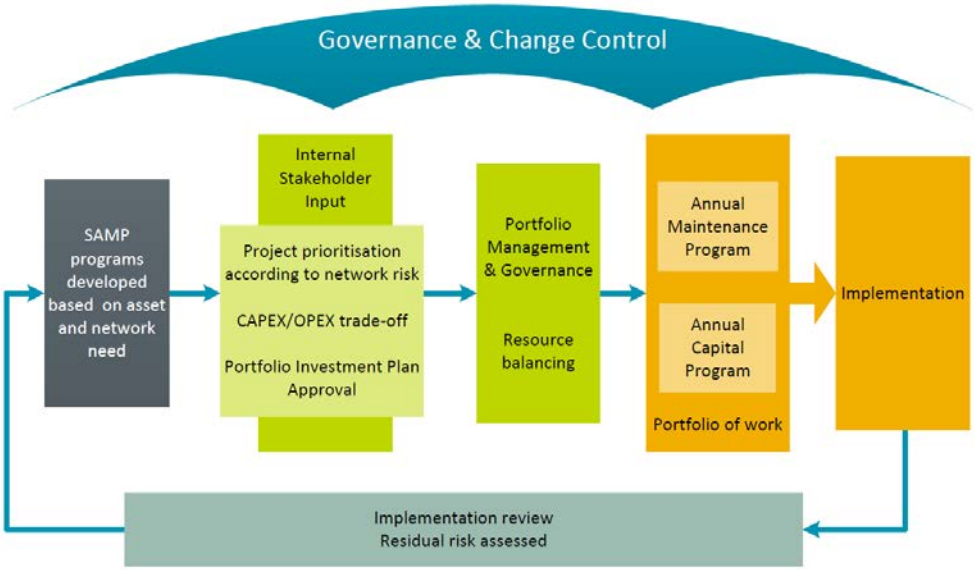
[10] See for example RP, page 109 and RP Attachment 10.03 Capex Proposal (SAMP). March 2018. Page 16.

[11] RP Attachment 10.03 Capex Proposal (SAMP). March 2018. Page 25.

[12] *Ibid*. Page.27.

[13] *Ibid*. Page.27.

Figure 8: Endeavour's high-level network asset management processes



Source: RP Attachment 10.03 Capex Proposal (SAMP). March 2018. Figure 13

56. Endeavour states that its prioritisation process is employed as part of its annual investment planning cycle and is supported by its Capital Allocation Selection Hierarchy (CASH) decision support tool and its Investment Priority Matrix (IPM).[14] Endeavour states that CASH is used to assist in selecting the projects for inclusion into the capital expenditure planning process each year which best meet Endeavour's business objectives based on addressing risk.

57. Through this process, Endeavour produces a prioritised list of programs and projects that forms a PIP that it submits to the Board for Gate 1 approval. It is a current version of this PIP, for the next regulatory period, that has been provided to support Endeavour's RP.

58. Endeavour states that it conducts an annual review to assess the degree to which each program has achieved its objectives. Endeavour states that it undertakes an assessment of the residual network risk, which provides an input into the process for the following year.[15]

3.2.3 Investment governance bodies and their roles

59. The peak investment governance body in Endeavour is the Investment Governance Committee (IGC), which is chaired by the CEO.[16] The IGC is responsible for confirming the selection and delivery of projects and programs consistent with corporate objectives; specific strategies; operational plans; and regulatory strategy.

60. The IGC is responsible for:

- endorsing annual capital and network operating expenditure budgets, reviewing long term capital and network operating plans and forecasts;

[14] RP Attachment 0.07 Expenditure Forecasting Methodology Statement. June 2017. Section 6.3.

[15] RP Attachment 10.03 Capex Proposal (SAMP). March 2018. Section 2.3.5.1.

[16] Endeavour's response to information request IR005, IGC Charter, extract from Charters of Company Committees, Amendment No. 92. December 2017. Page 17.

- endorsing individual capital or network operating expenditure projects and programs; and
- endorsing investment governance policies, procedures and processes.

61. The IGC reviews all investment proposals and variation requests where total estimated project or program value is above the following financial thresholds:[17]
    - network system - $2m; and
    - non-system - $0.5m.

62. The Investment Evaluation Unit (IEU) supports the IGC by focussing on the financial analysis, net present value and discounted cash flow analysis. The IEU tests the financial and economic assumptions underpinning the investment plans and checks whether they are consistent with financial policies and existing plans as per the most recent AER Revenue Determination and SCI program.[18]

63. Endeavour states that the General Manager Asset Management is responsible for developing the longer-term plans and strategies and submits them to the IGC and Board, however Endeavour states that these are submitted for information.[19]

64. Endorsement of the funding required to implement agreed plans and programs is provided by the IGC and then approved by the Board or the CEO under delegated authority.[20] Individual investment proposals require endorsement by the relevant Executive Leadership Team member.[21]

3.2.4 Strategic goals and objectives

65. Endeavour's stated strategic goals are:[22]
    (i) safety - deliver safe outcomes for our employees, contractors and the community;
    (ii) reliability - provide services on which customers can rely, that meet their long-term needs; and
    (iii) sustainability - build a thriving, adaptable business by growing long-term value for customers and shareholders.

66. Endeavour develops a Network Strategic Plan that is updated annually, which contains the asset management activities that it considers are required to achieve its strategic objectives.[23]

[17] *Ibid.*

[18] Endeavour's response to information request IR005, Branch Procedure BFN0019 Investment Evaluation Review. Section 5.0.

[19] Endeavour's response to information request IR001, Company Procedure GRM 0051 - Network Investment Governance. Section 5.2.

[20] RP Attachment 0.07 Expenditure Forecasting Methodology Statement. June 2017. Section 7.

[21] Endeavour's response to information request IR005, IGC Charter, extract from Charters of Company Committees, Amendment No. 92. December 2017. Page 17.

[22] RP Attachment 10.02 Asset Management Strategy. April 2018. Section 3.1.

[23] RP Attachment 0.07 Expenditure Forecasting Methodology Statement. June 2017. Section 6.1.

67. Endeavour defines its organisational strategic goal in relation for sustainability as being to '*ensure our business is sustainable by making it efficient, affordable and competitive so that it can meet future challenges*'.[24] It also claims that its investment objectives align with its strategic objectives.[25]

3.2.5 Endeavour's 2020 transformation program

68. Endeavour states that it has initiated the 'Endeavour 2020' transformation program to find efficiencies in all aspects of its operations.[26] The transformation program was designed to reduce the cost of building and maintaining the network over the next ten years whilst positioning Endeavour to efficiently deliver services to customers of the future by focussing on the following areas:

    (i) optimising asset management to safely and sustainably improve work on the network;

    (ii) improving the efficiency of works management on the network;

    (iii) improving the efficiency of the support teams and back office functions; and

    (iv) continued enhancement of procurement practices to drive ongoing savings.

69. In its Directions Paper, Endeavour claims that it will achieve $402m in cost savings over the period 2016 to 2019 and claims that its RP expenditure forecasts for the next RCP '*will fully reflect the projected cost savings of (this) program*.[27]'

3.2.6 Risk framework

70. Endeavour's risk framework is described in a Group Board Policy.[28] The framework is '*structured around ten business risk categories comprising safety, network, finance, compliance, reputation, environment, people, strategy, technology and lease obligations*.'[29] The framework prescribes that risks are to be assessed using the risk matrix shown in the figure below, which is accompanied by tables to assist with defining 'likelihood' and 'consequence'.

[24] RP Attachment 10.02 Asset Management Strategy. April 2018. Section 5.2.

[25] RP Attachment 10.06 2017 Distribution Annual Planning Report. December 2017. Section 2.3.

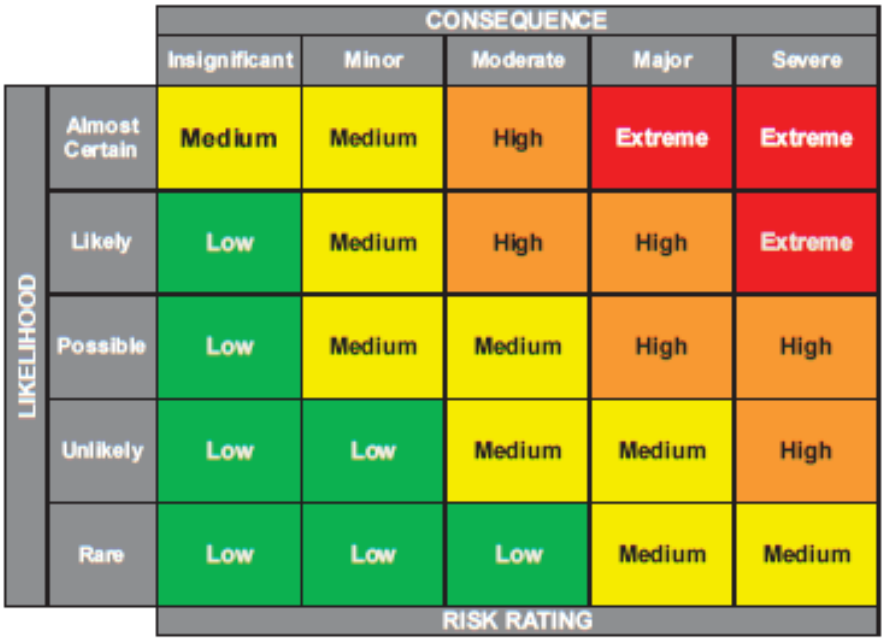
[26] Endeavour 2020 Directions Paper for consultation 2019-2024. Section 2.

[27] *Ibid*, page 12. We note, however, that Endeavour's figure does not distinguish opex and capex, and so it is unclear what proportion of this applies to capex

[28] Endeavour Group Board Policy No 2.0.5, Risk Management. Approved 31/08/2017.

[29] *Ibid*. Page 5.

Figure 9: Endeavour's risk matrix



Source: Endeavour Group Board Policy 2.0.5 – Risk Management. Appendix A

71. The risk appetite statement in Endeavour's Risk Management policy requires that it should not undertake any action or activity that has a residual risk rating of 'Extreme', or a residual risk rating of 'High' or 'Medium' that is not considered 'ALARP' or is subject to an ALARP-based treatment plan[30]. Endeavour states that management should take actions to '…*develop as a priority treatment action plans for all residual risks that are 'High" or "Medium" and not considered "ALARP", to move them to "ALARP"*.[31]

3.2.7 Endeavour's governance framework for its RP forecast

72. Endeavour describes its BAU governance and management framework as the framework under which it has developed its RP capex forecast. Specifically, the IGC was the peak governance body for its forecast and Endeavour states that the PIP presented for its RP has been developed using the same process as Endeavour uses to produce its rolling annual ten-year PIP.[32]

3.3 Our assessment

Governance bodies and their roles

73. Endeavour's governance bodies and their roles appear to be largely fit for purpose, with the peak body being the IGC. We note the importance of policies and

[30] ALARP means As Low as Reasonably Practicable, and represents the level of risk that cannot be reduced without expenditure that is disproportionate to the benefit gained or where the solution is impractical

[31] Endeavour Group Board Policy No 2.0.5, Risk Management. Approved 31/08/2017. Page 6.

[32] For example, see page 109 of Endeavour's RP which describes Endeavour's BAU Investment Governance Framework as having been applied in developing its RP capex forecast, and which refers to the prioritisation process in this framework as an annual (i.e. BAU) process; also page 23 of Endeavour's Capex Proposal which refers to its VDA model as reflecting its BAU approach to asset renewal.

standards, and their respective levels of approval, since these can drive the extent of investment that is considered to be necessary.

Investment portfolios do not appear to be tested against aggregate performance outcomes

74. Portfolio management involves constructing an appropriate mix of investments that in combination are intended to optimally achieve a set of portfolio level objectives, linked to the corporate strategy. For an electricity network, a strong element of this is managing a range of risks within defined risk parameters.

75. Endeavour's governance and management framework appears to be designed primarily as an expenditure control framework, through a standard gated decision process for individual projects and programs. There is considerable merit in Endeavour's process of annually developing ten-year plans (comprised of its SAMP, Strategic Asset Renewal Plan (SARP) and the projects contained in its PIP) and we note Endeavour's statements that its RP forecast has been developed through this same BAU process. However, for RP purposes, sufficient challenge discipline needs to be applied to the plan for it to reflect a reasonable forecast of prudent and efficient expenditure.

76. We observe steps in the governance and management framework that involve rationalising and prioritising individual projects and programs, in producing Endeavour's plan (PIP). However, Endeavour's capital planning process is missing top-down guidance that, at an aggregate portfolio level, would allow it to link its assessment of reasonable and prudent investment to service outcomes, aggregate risk levels and other factors that tie back to Endeavour's stated service objectives.

77. For example, while Endeavour claims that one of its objectives is to maintain reliability, it does not provide evidence that its proposed plan will do so, or that a different and perhaps more focused program of work, might also meet this objective, possibly at lower cost. Similar concerns arise in regards other objectives, such as safety or environmental risk management outcomes.

78. Without these linkages, the framework seems to be missing an element that would enable the Board to meaningfully interact with the portfolio investment plans presented at Gate 1 for approval each year, through understanding their aggregate impact on performance outcomes. Similarly, in its RP and supporting documentation, we do not observe justification of Endeavour's aggregate RP forecast by reference to the outcomes that Endeavour claims it is designed to achieve.

Endeavour's risk framework does not appear to be integrated into portfolio-level planning

79. As an integral part of its capex planning process, Endeavour states that it utilises the CASH model to prioritise projects, creating what it terms a risk-prioritised portfolio. For reasons that we describe in Section 4, we consider that the CASH model does not represent current good industry practice in electricity network risk assessment and risk management. The 'topics' considered in the CASH model do not align with the risk categories listed in Endeavour's risk framework, and there is also no clear link between CASH 'scores' and risk scores that would arise from the 5x5 matrix that is at the heart of Endeavour's risk management framework.

80. To the extent that Endeavour could truly assess the extent to which projects and programs in its portfolio would mitigate risk, in a way that meaningfully allows comparison of the different forms of risk (e.g. safety, reliability, environmental etc), then it would have a means of justifying a particular plan. This would include being able to show that the mix of projects and programs in the plan is optimised against a risk mitigation objective, and it would provide an important element of justification for the level of work required to maintain or manage defined risks by reference to a defined risk appetite.

81. Because of the lack of alignment with its risk framework and the lack of meaningful aggregate risk metrics, we consider that the claimed risk-based prioritisation process in Endeavour's governance and management framework does not demonstrate either that its planned portfolio reflects an appropriate level of work or that it provides 'optimal' risk mitigation for a given expenditure level. Given that this process appears to drive BAU prioritisation as well as longer term planning, this aspect would not assist Endeavour with ensuring that its capital expenditure decisions lead to prudent and efficient expenditure, or that its plans represent a reasonable forecast of such expenditure requirements.

Different framework documents contain multiple, unaligned statements of Endeavour's objectives and goals

82. While Endeavour's governance and management framework documents generally contain reference to 'safety, reliability and sustainability', the performance indicators in its RP replace 'sustainability' with 'affordability'. These are variously described as strategic goals, organisational objectives and performance indicators and there are differences in their definitions between different documents, as shown in the figure below.

83. We consider that these differences create an unnecessary challenge in providing a coherent definition of 'need' which can be used in developing and in assessing Endeavour's plans.

Figure 10: Comparison of defined objectives, performance indicators and goals in Endeavour's IGF documents

ATTACHMENTS	0.07	10.01	10.02	10.06
Regulatory Proposal 2019-24	**Expenditure Forecasting Methodology**	**Network Strategy**	**Asset Management Strategy**	**Distribution Annual Planning Report 2017**
Performance indicators: affordability, safety and reliability	Key strategic goals: safety, reliability and sustainability	Strategic goals: safety, reliability and sustainability	Strategic goals: safety, reliability and sustainability	Corporate objectives: safety, reliability and sustainability
Key strategic goals: safety, reliability and sustainability (cost)	Organisational objectives: safety, reliability and sustainability			Strategic goals: safety, reliability and sustainability
Primary objective is to manage assets efficiently and prudently Committed to improving the efficiency and productivity to drive cost savings	Strategic goals: • Safety - deliver safe outcomes for employees, contractors and the community; • Reliability - provide services on which customers can rely, that meet their long-term needs; and • Sustainability - build a thriving, adaptable business by growing long-term value for customers and shareholders.	Strategic goals: • Safety - deliver safe outcomes for employees, contractors and the community; • Reliability - provide services on which customers can rely, that meet their long-term needs; and • Sustainability - build a thriving, adaptable business by growing long-term value for customers and shareholders.	Strategic goals: • Safety - deliver best practice safety performance for employees, contractors and the community • Reliability - maintain the reliability, security and sustainability of the network • Sustainability - ensure the business is sustainable by making it efficient, affordable and competitive so that it can meet future challenges	Endeavour Energy is focused on: • Operating efficiently as any comparable distribution network business • Maximising the value of the company to shareholders • Balancing commercial, social, environmental and customer expectations

Source: RP Attachments, 0.07 Expenditure Forecasting Methodology, 10.01 Network Strategy, 10.02 Asset Management Strategy and 10.06 DAPR

Incremental nature of the planning process is likely to have led to over-estimation bias and a degree of inefficiency in actual spend

84. Endeavour's approach to portfolio management is to maintain a ranked list of programs/projects and, each year, to update this list.

85. We consider that a zero-based approach to this annual exercise (as opposed to the current incremental method) would result in stronger top-down challenge where the owners of each portfolio would need to justify all capex projects each year rather than allowing projects to persist in the plan. Endeavour's process is likely to have led to an over-estimate of project and program requirements. Further, there is a risk that each category manager may be prone to maintaining spending to the levels of funding implied by inclusion in a Gate 1 plan rather than dynamically reassessing what's needed as circumstances change or new information comes available.

Aspects of Endeavour expenditure governance suggest limited internal accountability

86. There are references in several key Endeavour documents provided to us following information requests,[33] [34] [35] [36] that indicate that Endeavour has relied on external processes such as the AER's regulatory determination allowances and the State budget process to determine its level of spending. A corporate governance and management framework should be capable of managing expenditure decision-making and determining planned requirements to meet clearly expressed corporate objectives and approved strategies.

87. The references in governance and management documents to managing to externally-imposed expenditure levels are suggestive of an internal lack of confidence in Endeavour's ability to determine and to demonstrate its requirements against such defined objectives.

Forecast does not appear to allow for future refinements or cost efficiencies

88. Endeavour's RP capex forecast is almost entirely comprised of projects at Gate 1 level. Endeavour describes how projects and programs are rationalised and refined at Gates 2 and 3. Whilst, at the individual project and program level, it is not possible to wind the clock forward and prejudge these refinements, it is possible to do this by considering the effect at an aggregate level that Gate 2 and Gate 3 processes are likely to have. On balance, it is likely that some projects may be subsequently rationalised, found not to be justified or displaced by alternative lower cost network or non-network options at Gates 2 or 3.

89. While Endeavour has claimed that material cost savings from its Endeavour 2020 transformation program have been incorporated in its forecast, we have not seen evidence of this in its capex forecast. For example, in its RP Endeavour refers to opex savings having been incorporated in its forecast,[37] but it does not refer in its RP or in its Capex Proposal[38] to having incorporated capex savings resulting from this transformation program.

[33] Endeavour's response to information request IR005, Company Procedure GAM0110 Gate 1 Portfolio Investment Plan Approval. Section 5.5.

[34] Endeavour's response to information request IR001, Company Procedure GRM 0051 - Network Investment Governance. Section 5.4.

[35] Endeavour's response to information request IR005, Company Procedure GRM 0052 - Non-system Investment Governance. Section 5.3.

[36] Endeavour's response to information request IR005, Branch Procedure BFN0019 Investment Evaluation Review. Section 5.0.

[37] RP. Page 23.

[38] RP Attachment 10.03 Capex Proposal (SAMP). March 2018.

3.4 Findings and Implications for proposed capex forecast

3.4.1 Findings

90. We consider that Endeavour's governance and management framework reflects a focus on expenditure control. However, we consider that the following aspects do not reflect current good industry practice amongst electricity networks:

- At a portfolio-level, there is insufficient linkage between expenditure plans and their contribution to stated aggregate performance objectives;
- Endeavour's portfolio-level risk assessment does not reflect Endeavour's stated risk framework and does not provide risk metrics (including linkages to a defined risk appetite) that would allow assessment of the appropriate level or mix of expenditure;
- Differences in statements of objectives in different governance and management documents detract from the ability to plan to a common purpose;
- The process by which the PIP is formed, and which underpins Endeavour's RP forecast, does not appear to account for future refinements and rationalisations that will occur as projects and programs progress through Gates 2 and 3; and
- The incremental nature of Endeavour's rolling ten-year plans lends itself to a reduced a level of challenge which over time is likely to lead to an over-estimate of requirements.

3.4.2 Implications

91. We consider that the weaknesses we have observed with Endeavour's expenditure governance and management process detract from its expenditure decision-making capacity and render it unlikely that its RP is a reasonable forecast of its prudent and efficient requirements.

4 Assessment of forecasting methods

4.1 Introduction

4.1.1 Content of this section

92. In this section, we describe and assess the methods by which Endeavour has developed its capex forecast. Whilst some aspects of its methods may apply across all components of its proposed capex, the focus of our assessment is on the methods that Endeavour has used to forecast the two expenditure categories that we have been asked to review – namely, its proposed repex and augex.

93. Because of its significance, we have described and assessed Endeavour's approach to forecasting its expenditure requirements at the aggregate portfolio level and at the individual project / program level in separate sub-sections. We also describe here certain tools that Endeavour states that it has used to develop or to verify its forecast and assess the conclusions that Endeavour has drawn from its use of these tools.

4.1.2 High-level summary of Endeavour's forecasting process

94. In summary, Endeavour states that it has developed needs-based plans that it has tested against top-down models, including the AER's Repex and Augex models and (in the case of repex) its own Value Development Algorithm (VDA) model.[39] It claims to have '*developed [*its capex proposal*] using a risk-based project prioritisation framework…supported by [*its*] Capital Allocation Selection Hierarchy (CASH) decision support tool*'.[40] Endeavour claims to have used the VDA model to

[39] RP. Page 110.

[40] RP. Page 109.

'*provide a useful reasonableness check…against the achievement of network outcomes.'*[41]

4.2 Repex forecasting - portfolio level justification

4.2.1 Endeavour's approach

Aggregate forecast repex requirement

95. Endeavour has not explained in its RP documentation how it established its proposed aggregate repex forecast of $800m[42] as being the appropriate level that it could justify as meeting its defined needs, consistent with NER objectives and criteria. At our onsite meetings, we were given to understand that it was determined through modelling of tariff outcomes which led to this aggregate repex figure being set from an affordability perspective.

96. In pre-submission material that Endeavour discussed with AER and with stakeholders, Endeavour had a draft forecast of $850m, but we understand that this was reduced to $800m in the course of deliberations by the IGC.

Category-level repex forecast

97. At our onsite meetings, Endeavour presented material that showed that its category-level repex forecast was determined directly from its VDA model. Endeavour provided information that its VDA model indicates a repex requirement of $1,410m in the next RCP if run in a mode in which the long-term Weighted Average Remaining Life (WARL) of its asset fleet remains constant, or $1,143m if run in a mode where expenditure is adjusted to account for asset condition.[43] Endeavour states that it reduced its aggregate repex forecast model output to $800m by adjusting input factors (relative to their default values of 100%), as follows:[44]

    - Renewal Asset Life - 120%; and
    - Growth planning parameters - 115%.

98. It appears that Endeavour's forecast category-level repex requirements are therefore determined from the outputs of its VDA model, having modified the input parameters to achieve the aggregate forecast repex of $800m that it has set as its target by other means.

[41] RP. Page 110 (We understand that this model is used for repex only).

[42] Rounded value from $800.5m included in its RP.

[43] It is unclear from Endeavour's documentation whether Endeavour is claiming that it has accounted for condition by increasing the 'renewal asset life' parameter, or whether it has a more granular means for adjusting the model for asset condition such as by asset type. If the former, then we consider this adjustment does not support Endeavour's claim that it has adjusted for asset condition. If the latter, then Endeavour has not provided evidence for its condition information and how it is used in its VDA model.

[44] Endeavour onsite meeting. Forecasting Q3 VDA v2 Presentation. 13 June 2018.

99. Endeavour claims in its SAMP to have used '*the AER's REPEX model…to inform [*it's*] views on future investment requirements'*[45] and that it has 'combined' the use of its VDA model and the AER's Repex model in developing its repex forecast.[46]

Prioritisation of projects and programs

100. Whilst Endeavour states that it uses the CASH model to prioritise projects as part of its annual planning cycle (as discussed in Section 3 of this report), the role that the CASH model played in determining Endeavour's RP capex forecast is unclear. There seem to be differences between statements made in the RP, which refers to risk-based prioritisation using this model, explanations provided at our onsite meeting, and other documentation we reviewed which does not refer to CASH being used in a manner that would align with statements in the RP.

101. Our understanding is that this model may have been used to prioritise projects or programs for inclusion in the proposed capex forecast, within category 'allowances' that Endeavour determined from its VDA model, as described above. We discuss this further under our assessment, where we also refer to information requests in which we sought to confirm if or how Endeavour has used this model in its RP forecasting process.

102. In its Expenditure Forecasting Methodology Statement, Endeavour also describes use of a newly-developed tool, which it describes as its Investment Priority Matrix. Endeavour describes this as a tool for *'…pre-testing projects for inclusion into the initial approved investment portfolio as a supplement to the CASH prioritisation process.*'[47]

4.2.2 Assessment

Aggregate repex requirement

103. Endeavour's RP, its SAMP and its Expenditure Forecasting Methodology describes a range of factors and processes that have the appearance of driving expenditure requirements. This includes references to Endeavour's purpose statement,[48] to the NER capex objectives and criteria,[49] to asset condition and to some form of risk prioritisation basis for its forecast. However, Endeavour has not demonstrated how, or even if, these have been used to develop or to justify its repex proposal of $800m for the next RCP.

104. We understand from discussions at our onsite meeting that the aggregate repex forecast was provided to asset managers by the IGC, and that it had been derived from a tariff modelling process. If this is the case, then it is not consistent with the NER expenditure objectives and criteria to determine a repex requirement based on an assumption of 'acceptable' tariff implications. Under the NER, regulated tariffs are the outcome of a process in which reasonable and justified expenditure forecasts, financial and other parameters are the inputs. Without justification in terms recognised by the NER, it is likely that a completely different level of repex

[45] RP Attachment 10.3 Capex Proposal (SAMP). March 2018. Page 20.

[46] *Ibid*. Page 21.

[47] RP Attachment 0.07 Expenditure Forecasting Methodology Statement. June 2017. Page 18.

[48] i.e. safety, reliability and sustainability objectives (as we describe in Section 3).

[49] For example, on pages 2 and 3 of RP Attachment 0.07 Expenditure Forecasting Methodology Statement.

may be the forecast required. It is possible that this could be lower than has been proposed which would lead to lower tariffs than those which Endeavour judges as acceptable.

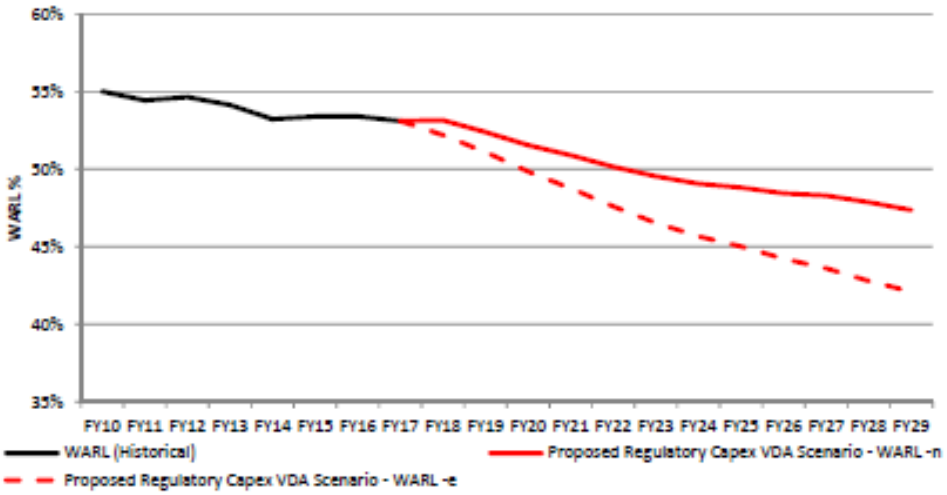
Category-level repex modelling – Endeavour's VDA model

105. While the VDA can provide a simple indication of reference expenditure requirements, Endeavour's apparent reliance on its VDA model to establish 'allowances' at the category level does not reflect good industry practice. This is primarily an age-based replacement model albeit with some capability to modify assumed remaining lives by reference to asset condition and other factors. Endeavour has claimed that this model provides a proxy for asset health[50] and we noted at our onsite meeting a tendency for Endeavour personnel to conflate the WARL of its asset fleet, with risk.

106. We have three significant concerns with this approach. Firstly, a repex program driven by WARL does not address risk in a systematic way, because different assets in the fleet have different failure modes, with different risk consequences that a model such as this does not account for. This model does not, and cannot, produce a forecast repex requirement that meets Endeavour's stated strategic objectives (which include addressing a range of specific risk categories) or which is justified in terms of the NER expenditure objectives and criteria.

107. Secondly, Endeavour's modelling shows that WARL will reduce under the proposed repex program. If this is correct (and it is unclear from information provided whether life extension strategies are fully and properly accounted for in its modelling), Endeavour has not provided a rationale as to why this particular fall in WARL indicates what it considers to be a justified level of expenditure.

Figure 11: Weighted average remaining life projections



Source: RP Attachment 10.03 Capex Proposal (SAMP). March 2018. Page 22

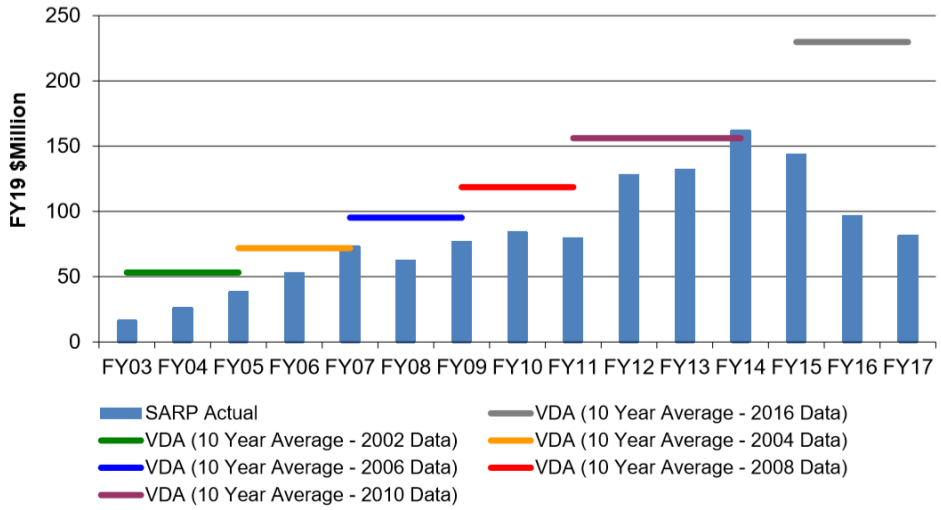
108. Our third area of concern is that Endeavour's VDA model appears to produce a significantly overstated forecast of its requirements. Endeavour included the following graph in its Repex Proposal,[51] showing the variance between forecast requirements as indicated by its VDA model, and its eventual repex spend. Endeavour's eventual spend results from application of its expenditure governance

[50] RP Attachment 0.07 Expenditure Forecasting Methodology Statement. June 2017. Page 20.

[51] RP Attachment 10.04 Repex Proposal (SARP). March 2018. Page 16

process, for which the current instance is described in Section 3. This process would have evolved over the period shown in this graph. However, it can be seen that once projects and programs are subjected to the processes that govern decision making on its actual works program, as opposed to its plans, less expenditure is required, whether by way of filtering projects out or from other rationalisations and efficiencies.

Figure 12: Historical SARP expenditure vs. VDA comparison



Source: RP Attachment 10.04 Repex Proposal (SARP). March 2018. Page 16

Repex modelling using AER's Repex model

109. Endeavour claims that its modelling using the AER's Repex model, supports its repex forecast.[52] Endeavour forms this conclusion by presenting a calibration of the AER's Repex model which produces a repex forecast of $789.0m (calibration S1), and which it compares with its own proposal of $582.0m for 'like' categories of repex.[53]

110. In its RP, Endeavour has noted the AER's apparent intention to '*calibrate the repex model using the most recent three years (rather than the typical five) and by calibrating unit costs and benchmarking asset lives*'.[54]

111. Assessment of AER Repex model scenarios and associated assumptions are not within EMCa's scope of review. However, we observe that the model outputs that Endeavour has presented as supporting its repex forecast are calculated according to its assumptions, rather than with the set of assumptions that it appears the AER discussed with Endeavour.[55]

112. The fact that Endeavour has proposed a repex forecast that is less than a particular scenario of the AER Repex model does not in our view support Endeavour's claim

[52] RP. Page 136.

[53] RP. Page 135. Table 10.8. Endeavour also adds $465m of 'unmodelled' repex to its AER Repex model output and adds $218.5m for equivalent categories from its own forecast.

[54] *Ibid*. Page 136.

[55] Endeavour does present a decrease of $50m in repex model results that it estimates to result from extending certain asset lives, which is one of the factors that appears to differentiate its model assumptions from those discussed with AER.

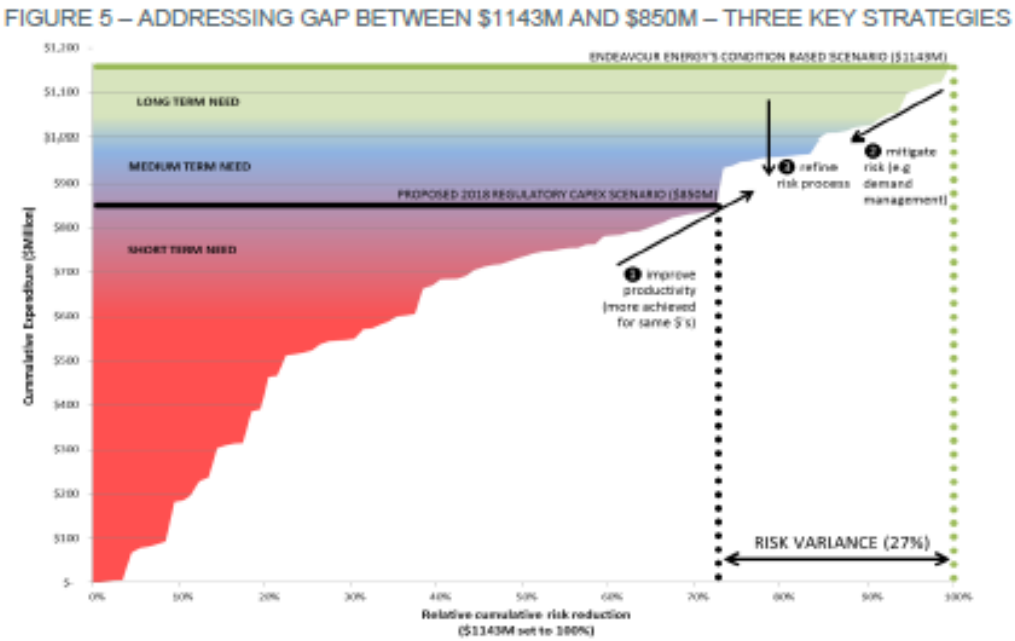
that its '*repex forecast represents an efficient estimate of [*its*] replacement needs and costs over the 2019-24 period*'.[56]

Endeavour's claimed risk-based prioritisation based on its CASH model

113. We are concerned by the claims throughout Endeavour's RP documentation[57] that its capex forecast is based on a risk-based prioritisation of required projects and programs. For example, Endeavour states in its SAMP that the proposed investment portfolio is *'optimised, integrated, and prioritised on the basis of network risk…*'.[58] Endeavour states that this process is 'supported by' its CASH tool.

114. In pre-submission material provided to the AER.[59] Endeavour included an illustration of output from this process, showing a stack of projects with cumulative 'risk reduction' scores plotted against cumulative expenditure. Endeavour illustrated its 'proposed regulatory capex scenario' on this graph (at that time, repex of $850m) and claimed a 'risk variance' of 27% between this and its 'condition-based' repex scenario which corresponds with a particular output from its VDA model, as described in the previous subsection.

Figure 13: Endeavour's illustration of risk-based prioritisation of its repex portfolio using its CASH model



Source: Endeavour Draft Repex Proposal FY20-FY24. February 2018. Page 22

115. Our first concern with this is that, despite the prominence that Endeavour gives to such a process, we have been unable to find evidence that a prioritisation process such as this has been used either in forecasting its required repex or in supporting a forecast derived by other means. The evidence we have been provided and the explanations provided at our onsite meetings with Endeavour are that its repex forecast was in aggregate determined externally to any of the forecasting

[56] *Ibid*. Page 136.

[57] Including in RP document, RP Attachment 10.03 Capex Proposal (SAMP), and in RP Attachment 0.07 Expenditure Forecasting Methodology Statement.

[58] RP Attachment 10.03 Capex Proposal (SAMP). March 2018. Page 16.

[59] Endeavour Draft Repex Proposal FY20-FY24. February 2018.

methodologies described and that the category-level forecast was determined from Endeavour's VDA model. Endeavour did not include an equivalent of the graphic above in its RP or associated documents and, as we describe in Section 4.4, we did not observe the use of the CASH model in justifying the category-level expenditure forecasts or for the inclusion of particular projects or programs in Endeavour's forecast.

116. In an information request,[60] we sought to confirm that Endeavour had used the CASH model in the manner claimed – specifically that it had risk-prioritised its portfolio such that projects with higher 'risk' (as measured by their CASH scores) had been included and those with lower risk had not.[61] Endeavour's response did not directly answer this question, nor did it provided the other information that we sought. Rather, Endeavour repeated the claim that '*[t]he Capital Allocation Selection Hierarchy (CASH) prioritisation process is used for prioritisation of projects and programs within the SARP'*[62] but provided no further information as to how this had been done. The remainder of Endeavour's response to the detailed and specific questions that we asked described three strategies by which Endeavour claimed it had reduced expenditure (relative to its 'unconstrained' VDA model outputs) '*without incurring an excessive increase in risk*'.[63] This claim was not justified by reference to the CASH model.

117. Our second concern is that, if Endeavour did use its CASH model in some way to establish its proposed portfolio, this is a poorly conceived tool for risk-based prioritisation.

118. Endeavour's CASH model is a tool which assigns scores to each project based on a user questionnaire. The questionnaire involves a range of 'topics' which include: asset condition; public safety, environment or regulatory impact; network-initiated fire; network reliability; community impact (reputation); employee WH&S; and network capacity. These topics are weighted equally (with a value of 10). Scores within each topic (and which are rated 1 to 10) are assigned based on a 'look up' depending on the user's answers to questions within these topic areas.

119. These answers are then further weighted according to whether the project is committed or considered a 'short term need', is considered 'medium-term' (and prior to project approval); or is considered 'long term' (including projects at planning stage). Projects are assigned overarching weightings of 15, 10 and 5 respectively according to these judgments.[64]

120. The project and program scores (which in some Endeavour documents are described as 'ranks') are the product of the factor results above.

121. Our chief concerns are that:

[60] Endeavour's response to information request IR014 EMCaEND052.

[61] Our information request was relatively detailed and involved a number of specific requests for information.

[62] Endeavour's response to information request IR014 EMCaEND052. We note also that this response seems to suggest that the CASH model is used for replacement projects only (SARP), whereas Governance and Management documentation referred to in Section 3 suggests that it is used to risk-rank across the whole network portfolio (ie repex and augex) as represented in the SAMP.

[63] *Ibid*.

[64] Endeavour onsite meeting. CASH Overview Presentation. 13 July 2018. Little of the information in this presentation was provided in Endeavour's CASH documentation provided with its RP.

- the CASH model 'topics' comprise a mix of service outcome-related risks, and an 'input' related issue (i.e. asset condition) that is not in itself a risk;
- there is considerable scope for overlap and double-up by a user providing input to the questionnaire – for example network-related fires, public safety and employee safety would all be considered to have a community reputational impact;
- whilst the model qualitatively considers various factors that in some cases are related to risk, it does not address the significant risk-related differences in consequence that result, for example, between a risk with potential for a fatality, compared with risk of a loss of supply, compared with property damage from a network-related fire;
- the resulting scores appear to represent some measure of the inadequacy presented by the current state of the relevant assets being considered; this may be quite different from the reduction in that inadequacy that results from a project which, depending on the option selected, may still leave a residual level of inadequacy, impairment or risk); and
- the user-assigned weightings as to whether a project is short-term, medium-term or long-term seem in themselves to require an overarching further judgment of 'risk' and which, given the three-times multiple between the lowest and highest such rating, would in all likelihood swamp the more granular 'topic' ratings.

122. Decision support tools such as CASH may improve decision-making beyond subjective judgment, and tools which have the ability to aggregate risk scores in a valid way across a full portfolio of projects are potentially useful in portfolio-level assessment and justification. However, this model falls a long way short of current good industry practice for the assessment of projects based on their risk mitigation outcomes. It has no clear or obvious links to Endeavour's stated risk framework,[65] it does not embody current industry good practice of defining risk-cost taking explicit and quantified account of consequences and their likelihood, and it does not have any clear or obvious reference back to Endeavour's risk appetite. Further, it does not appear to have been applied in a manner that would demonstrate efficiency through optimising the aggregate benefit for a given cost.

123. We consider that any use of this model in its current form would not support Endeavour's claim that its portfolio plan represents an 'optimal' risk-prioritised set of required projects and programs.

Deliverability

124. Endeavour's proposed repex is 29% higher than in the current period (allied with augex that is 63% higher). Given this increase, we would expect Endeavour to have provided evidence that it has the capability to deliver this volume of work. Endeavour's RP does not address deliverability, and neither does its SAMP[66] or its

[65] Endeavour's risk framework is based on a 5 x 5 matrix that is described in Company Policy 2.0.5 Risk Management.

[66] RP Attachment 10.03 Capex Proposal (SAMP). March 2018.

Expenditure Forecasting Methodology Statement[67]. Endeavour's SARP[68] refers to past limitations in delivery capability,[69] but provides no evidence of assessment of future capability to deliver the proposed plan.

4.3 Repex forecasting – individual project and program level justification

4.3.1 Endeavour's approach

Strategic Asset Management Plan

125. Endeavour states[70] that the individual plans within the SAMP are supported by detailed analysis that explicitly takes into account: (i) externally imposed obligations and requirements, (ii) information about the network system including condition of assets, (iii) forecast of demand growth by connection; and (iv) inputs obtained from stakeholder engagement. Endeavour further states that a key function of the SAMP is to '*prioritise individual asset management projects and programs of expenditure and to discuss and document trade-offs that are made in developing the year ahead and ten-year network expenditure forecasts*'.[71]

126. Endeavour also states that the SAMP uses a risk-based project prioritisation framework. We understand that the reference to a risk-based prioritisation framework is the CASH ranking methodology applied above and discussed in earlier sections of this report.

127. The SAMP[72] describes the general approach for asset renewal as based on specific condition and risk-driven requirements for each year's expenditure program, within the context of a long-term strategic expenditure plan. We sought additional information to understand how the expenditure forecast was developed for the 5-year RCP, and its relationship to the general approach described in its documentation. The SAMP describes the long-term expenditure settings as being '*developed and framed using modelling approaches, historically using the VDA model and in more recent times cross-referencing and challenging these against the AER's REPEX model*'.[73]

128. Further, Endeavour claims that asset specific condition assessments are used to establish the scope of assets that will be potential candidates for renewal and its '*modelling establishes efficient investment levels and informs the size of programs, thereby enabling a long [term] view about the appropriateness of the proposed expenditure program*'.[74]

[67] RP Attachment 0.07 Expenditure Forecasting Methodology Statement. June 2017.

[68] RP Attachment 10.04 Repex Proposal (SARP). March 2018.

[69] RP Attachment 10.04 Repex Proposal (SARP). March 2018. Page 15.

[70] RP Attachment 0.07 Expenditure Forecasting Methodology Statement. June 2017. Page 16.

[71] *Ibid*. Page 16.

[72] RP Attachment 10.03 Capex Proposal (SAMP). March 2018. Page 14.

[73] *Ibid*

[74] *Ibid*

Strategic Asset Renewal Plan

129. Endeavour also publishes a SARP. The SARP is developed annually and includes the following key stages:

- The identification of specific short-term renewal needs through asset condition and performance analysis (the 'bottom-up' approach);
- The formulation of a long-term position on renewal needs using predictive asset renewal expenditure modelling (the 'top-down' approach);
- The collation and integration of short-term and long-term renewal needs into the SARP;
- The prioritisation of renewal expenditure; and
- The integration with and prioritisation against, other expenditure in the SAMP.[75]

130. The SARP differentiates the forecasting approach of replacement costs for assets deemed to have high replacement values and/or perform a critical role in the network versus those of low value or high volume. For the former, Endeavour states that replacement plans are developed using replacement criteria contained in various asset maintenance and performance standards and through individual asset condition and performance assessment regimes on a bottom-up basis. Models such as the VDA are used to confirm that the expenditure is consistent with long-term trends.

131. For low value assets, the forecast is developed using a model-based approach for each asset class. Endeavour states that forecasts developed in this way are optimised by actual asset need through condition assessment, size of the asset base and other extraneous drivers.

132. A table provided by Endeavour is provided in the figure below to describe these methods.

[75] Endeavour's response to information request IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 5.

Figure 14: Overview of Endeavour's top-down and bottom-up forecasting methods

Forecasting method	Intended use	Comments
Top-down replacement analysis (VDA and REPEX)	Guide for renewal expenditure at a high level for the development of expenditure projections by asset category. Provide a renewal expenditure forecast for the next regulatory period based on VDA and Australian Energy Regulator (AER)'s predictive model (REPEX).	Complex analysis based on age profile, standard life, replacement cost, asset condition and condition adjustment. Further, it takes into account the risk limits, deferred asset spread, start of replacement year etc. with risk positions calibrated to current outcomes using WARL. The AER REPEX analysis includes a calibration process which takes into account the historical levels of expenditure and volumes to project the future expenditure and volumes. **Provides valuable insight into longer term renewal needs and trends**
Bottom-up replacement needs	SARP program development.	Actual short term replacement needs are based on field assessments (condition, reliability), operational requirements, industry experience, safety, environmental and regulatory requirements, maintenance issues, spares availability and age. Medium to long-term projections are based on the renewal plans developed for substations and specific asset categories. When such plans are not available, the medium to long term estimates are based on current replacement needs and anticipated replacement needs projected forward. **Identifies specific short to medium-term renewal requirements based on actual identified needs.**

Source: Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 15. Table 3

133. Endeavour also states that the proposed expenditure '*is validated against asset class renewal plans on an ongoing basis. These in turn are coordinated with proposed major network projects to ensure the expenditure programs are optimised and any potential double counting of investment requirements is eliminated*.'[76]

Project justification

134. We have only been provided a sample of business cases for the latter period of the current RCP. These business cases do not relate to expenditure that will be incurred in the next RCP. We understand from discussions with Endeavour that consistent with its application of the investment planning framework, it will not develop project and program business cases for the next RCP as part of its RP. We therefore looked for evidence of justification of the proposed expenditure, consistent with the normal requirements of a business case-like document, from the information we were provided.

135. We also reviewed the sample business cases to assess the nature of the information provided to support the expenditure decisions as part of Endeavour's normal governance process.

Integration with growth related investment

136. Endeavour claims a key aspect of its renewal planning approach is the integration of its asset renewal requirements with growth related investments. We therefore

[76] *Ibid*. Page 8.

also sought to understand how Endeavour undertook its optimisation decisions with respect to growth-driven and asset renewal planning.

4.3.2 Our assessment

Short-term delivery orientation

137. In the business case level information that we were provided, the expenditure forecast included for approval was for a period of 1-2 years only, and all within the current RCP. The expenditure generally aligned with the 10-year program documented in the SARP, as would be expected. The documentation generally included a description of the rationale for selection of the project/program, however many of the documents reflected a continuation of programs from previous years. We found that the justification documents generally did not include detailed options analysis, economic analysis or risk cost assessment.

138. Whilst there is a proportion of an asset renewal program that relates to low-value assets that are typically managed on a predominantly reactive basis, we would still expect to see a clear needs statement supported by asset condition, defect and failure analysis information, options analysis, economic analysis and risk analysis. We did not find this information in the documents we reviewed.

139. In the absence of this information, the basis for the justification documents appears to be weighted towards approval for delivery and resourcing than for any other purpose. In one example,[77] an approval document comprising four pages was provided for a collection of individual projects where individual value was less than $1 million for 2018/19. This comprised 35 individual programs ongoing in nature that in aggregate accounted for $18.7 million in 2018/19, and $93.3 million when extrapolated over 5 years. We would have expected a greater analysis to be presented for this level of expenditure, despite these being individually small programs.

Justification of volumes lacking

140. We understand from Endeavour that its forecast is based on a combination of top-down and bottom-up methods. Whilst we were able to determine the volume of replacements forecast for the year 2018/19 from the SARP, the rationale for the out-years including the next RCP was not clearly identified. In some cases, this was a flat profile, indicating a constant replacement rate, and in others an increasing profile. The interplay between volume and changing unit costs was also not evident.

141. From the supporting documents we reviewed, the forecast expenditure appears to be most likely determined from Endeavour's own expenditure modelling from its VDA tool for all expenditure categories, and not limited to the low-value assets. For example:

[77] Endeavour's response to information request IR005, GMAM Preliminary Program Approvals under 1M FY19.

- Power transformers: Endeavour states that '*annual replacement allowance increased to five – six transformers per year from 2021/22 onwards based on VDA analysis*';[78] and
- Substation renewal – Endeavour states that '*TS199 includes a funding allowance for the replacement of zone and transmission substations, when the VDA modelling based on the asset age profile indicates renewal investment is required by project individual needs have not yet been finalised through the bottom up asset condition assessment process*.'[79]

142. Further, it appears that in instances where the bottom-up estimates of programs were of a value less than the VDA model, the forecast expenditure was increased to align with the VDA model rather than relying on the bottom-up forecast in response to asset condition or risk as purported by Endeavour.

Validation of forecast

143. We have not seen evidence of validation of the forecast expenditure against asset class plans, including asset condition and risk as stated by Endeavour. During the onsite discussions, we sought clarification of the existence of asset class plans and were advised that these largely remained in development and were therefore unlikely to have a material impact on the development of the forecast expenditure for the next RCP.

144. In response to our requests for information, Endeavour has provided copies of asset class plans. Upon review, the framework for the asset class plans provides for the asset condition and risk information that we would typically expect to see to reflect good practice asset management and condition-based risk management decision making. However, in many instances the information provided was high level only and was not advanced to the level of providing compelling evidence for the program or the proposed volume of replacement.

Limited application of risk analysis

145. Endeavour's statements suggesting that '*detailed risk analysis and condition assessment is undertaken as part of the process of developing the capital asset renewal programs*'[80] appears incongruent with the modelling approach we observe as described above. We therefore sought evidence of its application of risk analysis, and specifically whether a quantitative assessment of risk had been undertaken and included in its economic analysis in our review of the proposed expenditure.

146. We observe that Endeavour had undertaken some quantitative risk analysis for two programs – DS011 Steel Mains[81] and TS700 11kV CB renewal.[82] Whilst we have not undertaken a detailed analysis of the input assumptions used in this modelling, we note that the parameters and approach to quantification of risk appear generally consistent with industry practice. The conclusions reached from this level of

[78] Endeavour's response to information request IR005, Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 103.

[79] *Ibid*. Page 167.

[80] RP Attachment 10.03 Capex Proposal (SAMP) FY19 – FY28. March 2018. Page 26.

[81] Endeavour's response to information request IR005, DS011 Steel Mains Modelling. June 2016.

[82] Endeavour's response to information request IR005, TS700 11kV Bulk Oil Circuit Breaker Renewal Plan.

analysis however are general in nature and do not appear to have been applied to any individual project or in determining optimal timing for replacement action. The relationship therefore between this level of analysis and the development of the expenditure forecast is not evident.

Limited integration with capacity planning

147. As discussed in Section 3, Endeavour applies a standard investment governance process to both replacement planning and growth planning requirements. The consideration of an integrated plan that considers both the proposed replacement planning need and growth planning needs however is relatively immature.

148. Recognition of alternative options to support the planning needs such as non-network options and Demand Management (DM) appear to be only applied to large projects that satisfy the RIT-D threshold.

4.4 Augex forecasting

4.4.1 Endeavour's approach

149. Endeavour's augex forecast for the next RCP responds to two drivers, including:

(i) forecast demand growth from existing and prospective new (infill) commercial, industrial, and residential loads; and

(ii) compliance with regulatory obligations and requirements.

150. Endeavour categorises the Brownfield augex projects and programs of work in terms of work at: (i) the sub-transmission level; and (ii) the distribution level. Greenfield projects relate primarily to sub-transmission zone substation development.

Sub-transmission augmentation

151. Endeavour's ten-year spatial demand forecasts are developed at the substation level. The weather-corrected historical demand is the starting point for the spatial forecast. Endeavour adds 'spot' load forecasts (i.e. discrete commercial and industrial loads), connections forecasts (i.e. infill residential developments), and permanent load transfers between substations (if any). The spot load forecasts are derived from a combination of developers' demand forecasts and Endeavour's view of the likelihood of the developers' forecasts eventuating. The connections forecast is based on NSW Department of Planning data to which Endeavour applies an average ADMD to generate a corresponding demand forecast. Endeavour then applies post-model adjustments to account for factors such as energy efficiency trends, distributed generation penetration, and government energy policy.

152. Endeavour develops area plans for areas of the network that are expected to require significant investment. Endeavour states that the area plans:[83]

- '*Identify anticipated network constraints;*

[83] RP Attachment 10.09 Growth Strategy. February 2018. Page 9.

- *Identify prudent network infrastructure investments need [sic] and potential opportunities for non-network options;*
- *Ensure that investments are made in an orderly manner, timed and linked to the staging of the development being serviced, or the expected reaching of capacity limits in existing infrastructure;*
- *Ensure that network augmentation and expansion along a pathway that sustainably leads to the ultimate long-term network configuration as outlined;*
- *ensure that overall objectives of the network strategy are satisfied; and*
- *minimises the risk of rework investment and the potential stranding of assets'*

153. Endeavour further advises that the '*Area Plans would typically cover development of the network for 30 years or more'*[84] and that its planning process '*results in development of:*

- *Annual capital investment plans aligned to long term plans and the network strategy;*
- *The 10-year capital investment portfolio, which is revised and updated annually; [*and*]*
- *Integration of the investment portfolio with other business requirements'*.[85]

154. Sub-transmission constraints are identified by comparing the capacity of the substation to supply the P50 peak demand forecast. If a constraint is identified, Endeavour undertakes a form of probabilistic assessment of the net economic benefit of removing the constraint. Endeavour typically assesses two network augmentation options (i.e. the preferred option and one alternative), selecting the network option with the highest 'net economic benefit'. Endeavour states that it '*considers demand management and non-network options to avoid or defer the need for capital intensive network augmentation…regularly through investment options analysis and as part of the RIT-D requirements and incorporated into individual business cases.'*[86]

Distribution works

155. Endeavour responds to its interpretation of NER and NSW jurisdictional requirements for the distribution network by developing policies and standards which specify planning and operational criteria. Endeavour identifies extant and potential constraints and non-compliances and selects programs of work based on a 'risk-based approach'.[87] Network constraints present reliability and safety risks. The compliance risks are primarily associated with safety and quality of supply. For the next RCP, Endeavour states that it used four approaches to identify network risks, as follows:

- Network load flow and fault analysis for each zone substation, identifying voltage regulation issues, conductor overloads, and excessive fault levels;

[84] *Ibid.* Page 14.

[85] *Ibid,* Page 16.

[86] RP Attachment 0.07 Expenditure Forecasting Methodology Statement. June 2017. Page 36.

[87] RP Attachment 10.05 Distribution Works Program. April 2018. Sections 3 and 4.

- Cable overload risk is identified by studying the most onerous cable installations (projected cable operating temperatures vs maximum operating temperature);
- Identifying non-compliance of existing network elements with current standards, typically triggered by changes to the existing network configuration; and
- Identifying potential non-compliance with environmental and vegetation management requirements.

4.4.2 Our assessment

Lack of evidence of a comprehensive top-down challenge of the forecast

156. Endeavour's augex forecast for the next RCP appears to be based primarily on a bottom-up assessment of the network augmentation required to respond to growth and compliance drivers. Endeavour advises that it tested the reasonableness of its augex forecast against the AER's Augex model '*as a top down challenge*'[88] and it illustrates various Brownfield augex investment levels in its SAMP.[89] Endeavour considers that its augex forecast is reasonable as it is only 67 percent of the forecast output of its Augex model.[90] Given (i) the 63% increase in forecast augex expenditure from the current RCP, and (ii) the very preliminary nature of the project-level planning (i.e. all pre-Gate 2), we would expect to see further evidence of critical top-down analysis – for example the likely impact of demand management and/or lower demand growth.

Demand forecasting methodology

157. Endeavour's augex forecast is heavily dependent on demand forecasts, which for Greenfield areas and, to a lesser extent, Brownfield areas are driven by new residential and commercial connections. The scope of our review does not include review of Endeavour's demand forecasts, however through our assessments we make the following observations.

Forecast ADMD may be too high

158. Endeavour has reduced the After Diversity Maximum Demand (ADMD) it uses for area wide studies from 5.2kVA/lot to 4kVA/lot and has further reduced the ADMD for zone substation planning by 20% to 3.2kVA/lot, to apply from 2019/20-2023/24. Endeavour provides demand readings from four zone substations that generally align with a 4kVA/lot ADMD.[91] However, the sample is small, the effects of diversity are not explicitly obvious, and it is not clear that the selected substations are representative of the identified Greenfield and Brownfield development areas. Furthermore, extrapolation of the long-term trend of declining ADMD[92] indicates a

[88] RP. Page 44.

[89] RP Attachment 10.03 Capex Proposal (SAMP). March 2018. Figure 11.

[90] RP. Page 126.

[91] Endeavour's response to information request IR011 EMCaEND019, graphs on Page 4.

[92] *Ibid,* graph on Page 3.

reduction to 2kVA/lot by 2024 may reasonably be assumed. This would result in an average ADMD for the next RCP of approximately 2.5kVA/lot. This would have the effect of reducing the 'base case' forecast demand for residential development in the subject areas by approximately 20%. Finally, we note that Endeavour does not apply the post-model adjustments developed by NIEIR to new connections.[93]

New connections forecasts may be optimistic

159. Endeavour's actual new connections for 2017/18 appear to be considerably lower than the forecast for 2017/18 included in the RP, even when the abnormally low number of connections in January and February 2018 are accounted for. This suggests that the Department of Planning connection forecasts, and relied upon by Endeavour, may be optimistic and that their validity should be further tested.[94]

Sub-transmission forecasting methodology

160. At a high level, Endeavour follows steps common to the industry to identify potential network constraints and investment requirements arising from forecast demand growth.[95] Endeavour's area plans outline the basis for its development plans for the region covered, considering government-led and developer-led growth strategies and forecasts as well as organic growth from existing customers. The plans identify the scope, timing, and cost of sub-transmission augmentation projects relevant to the next RCP. Endeavour's approach to selecting the solution to address the supply constraint at particular zone substations is essentially a three-step process: (1) identify potential network-based options; (2) select the option with the highest 'Net Market Benefit' (which is included in its SAMP); and then, (3) if the project approval process is required to follow the RIT-D process, invite the market to propose non-network solutions as part of that process[96] – the responses (if any) are then compared with network solutions.[97]

Lack of evidence to support ongoing widespread use of 11kV in greenfield augmentation

161. No analysis is provided (or referenced) to support the very important decision to continue use of 11kV as the distribution voltage in the four area plans we considered.[98] Given (i) the scale of the proposed greenfield developments and large forecast 'horizon' loads, and (ii) the relatively sparse existing rural and semi-rural developments in three of the four area plans, we expect Endeavour to have robustly examined whether alternative distribution voltages are more cost effective. We would expect that as a minimum, Endeavour has undertaken a detailed engineering

[93] Endeavour Energy's response to information request IR014 EMCaEND059.

[94] Endeavour's response to information request IR014 EMCaEND043.

[95] Our scope does not include assessment of Endeavour's demand forecasting methodology (including its post-modelling adjustments). Our comments are therefore confined to our assessment of the application of its spatial demand forecasts.

[96] Via a Non-Network Options Report.

[97] We note that Endeavour refers to a 'DM screening test' in some of its business cases, but we are not clear about the role of this test from the documentation provided by Endeavour (for example, it does not feature in its Demand Management & Non-network options strategy (at least in those terms).

[98] Western Sydney, South West, North West, West Lake area plans; for example: Endeavour Energy, Area Plan – Western Sydney Priority Growth Area, page 11, noting that 22kV is applied in the Box Hill area.

and cost-benefit analysis comparing 11kV development with alternatives such as wider use of 22kV distribution.

Inadequate identification and analysis of network-based options

162. Based on our review of a sample of augex projects (as discussed in Section 6), we consider that some potentially credible options that could be used to prudently defer the establishment of the proposed new substations are either not included in the project documentation or, as presented, were inadequately analysed.

163. We also have concerns with Endeavour's probabilistic risk-based approach. Endeavour advises that it determines the 'Net Market Benefit' of each option using a probabilistic risk-based approach (referred to as the 'Probabilistic VCR Template' or the 'NPV probabilistic planning model' – we refer to it herein as 'the probabilistic VCR model') in which it:[99]

- determines the annualised cost of the augmentation option;[100]
- estimates the annual avoided energy at risk (EAR)[101,102] by comparing: (i) the base case (no augmentation); and (ii) the EAR after the proposed augmentation (i.e. to remove or mitigate the constraint); and
- determines the Net Market Benefit from the difference between the present value of the augmentation capital cost and the mean present value of the avoided cost of energy at risk,[103] which Endeavour calls the 'congestion cost'.[104]

164. The probabilistic VCR model applies Monte Carlo simulations using a normal distribution around the 50PoE and varying assumptions of: VCR (±30%);[105] the discount rate;[106] and capital cost (±25%). The impacts of transformer outages and underground cable outages on reliability are considered.[107] Endeavour selects the option with the highest Net Market Benefit,

165. Our chief concerns are that:

- it is not clear from the information provided to us how Endeavour establishes the economically optimum timing of the proposed expenditure. In the projects we have reviewed, Endeavour's conclusion is that capacity augmentation is

[99] Endeavour's response to information request IR005, Guideline on NPV Probabilistic Spreadsheet using Monte Carlo, June 2018.

[100] In the case of staged augmentation, the capital cost of each stage is included in the analysis.

[101] Including the energy not served if the forecast demand exceeds the installed capacity of the substation.

[102] In the sample projects we reviewed, Endeavour used a constant transformer failure rate of 0.01 pa (i.e. 1 failure per 100 transformers per year) and only considered the cost of unserved energy.

[103] The energy at risk is valued at the NSW VCR of $38,350/MWh.

[104] The output identifies a distribution of NPV results from the Monte Carlo (random), including whether there is a risk of the NPV being negative under 'worst case' scenarios (e.g. lower than actual forecast, lower VCR, higher than forecast capital cost).

[105] For demand above the firm capacity of the substation.

[106] WACC, WACC+2%, and WACC+4%.

[107] The transformer outage rate (0.01 p.a.) and the underground cable outage rate (0.009 per km) are both held constant as are the assumed outage probabilities; Endeavour does not include the safety consequences or repair cost consequences in its model.

required '*within the 2018/19-2023/24 regulatory period*'.[108] However, in five of the 13 spreadsheets for the preferred options that Endeavour provided, the indicated economic timing is beyond the next RCP;[109]

- input parameters are applied which draw on Victorian information, such as outage probabilities, and restoration times,[110] which (i) appear conservative, (ii) are not compared or calibrated in any way with Endeavour's own data, and (iii) are not adequately referenced;
- application of a capped VCR amount to define the value of Energy Definitely Not Supplied (EDNS) when the forecast peak demand exceeds the installed substation capacity. We consider that this approach is invalid regardless of Endeavour's 'cap' (because VCR is a value ascribed to temporary outages to existing customers, not to customers that have not yet been connected) and will distort the options analysis;
- the spreadsheets we were provided for review include entered values, including EAR and EDNS which are critical to the analysis, which we are unable to validate; and
- use of uniform distributions in the Monte Carlo analysis where we would not expect to see them.[111]

166. We consider this further in Section 6 where we assess the proposed augex expenditure.

Non-network options not adequately accounted for

167. The zone substation projects selected to commence in the next RCP have been determined without adequate consideration of the potential impact of non-network solutions. This is primarily because, in accordance with Endeavour's planning process, the projects have not yet been subject to the RIT-D process. Consequently, there is insufficient evidence to show that Endeavour abides by its claim that its capital expenditure forecasts incorporate expectations about the impact of demand management.[112] Endeavour advises that it has had success with implementing non-network solutions to reduce peak demand, particularly in areas where there is significant commercial and industrial load, but that the impact in residential brownfields areas is likely to be lower than in the past.[113] It also reports recent limited or nil response to open tenders for provision of non-network options

[108] This appears to be a standard phrase in the Conclusion section of Endeavour's Business Cases; we assume the reference to 2018/19 is an error (i.e. it should be 2019/20).

[109] That is, the point at which the annual 'congestion (VCR) costs exceeds the annualised cost of investment is beyond 2023/24.

[110] Endeavour's response to information request IR005, Guideline on NPV Probabilistic Spreadsheet using Monte Carlo, June 2018. Page 3.

[111] For example, we would expect an estimate of capital investment cost to be normally distributed around an 'expected' value – but Endeavour model it as a uniform distribution between what is described as maximum and minimum values

[112] RP Attachment 0.07 Expenditure Forecasting Methodology Statement. June 2017. Page 36.

[113] Due to lower rooftop areas per dwelling and lower space for energy storage in high density residential infill – see RP, 10.12 Demand Management & Non-network Options Strategy - February 2018 – Public. Page 9.

for substation deferral and that since 2012 no demand management projects have been implemented.[114]

168. Endeavour has advised that it is trialling a suite of demand management solutions that may further enhance the prospects of accessing significant demand side responses from new and existing residential customers in Brownfield developments.[115]

169. We also note that there are broader industry developments that will improve opportunities for non-network solutions, including:

- AEMO and ARENA's Demand Response Trial, which sourced 143MW of demand response for the 2017/18 Summer. Incorporating network benefits would further strengthen the business cases for these demand response providers;
- the 2017 Rule change allowing any load to be approved by AEMC as an ancillary service load. This will improve the business case for loads to offer themselves for active management;
- possible outcomes from the AEMC's Technology Work Program; and
- improving economics of battery storage – numerous announcements of battery installs for market reasons – adding revenue for network benefits would further improve the economics of batteries.

170. On this basis, we consider that it is reasonable to assume that non-network solutions will increasingly provide a technically and economically prudent means of deferring traditional network capex solutions for projects proposed in the next RCP and should be factored into its augex forecast.

171. We further observe that Endeavour's approach to engaging with the market during the RIT-D process may not provide sufficient time for the best non-network solutions to be identified and implemented efficiently and effectively. For example, early engagement with developers may result in initiatives 'designed-in' to developments which have the effect of reducing peak demand (at all times, or 'as required' in response to supply-side capacity constraints).

Distribution Works forecasting approach

172. Endeavour's approach to identifying potential non-compliance and constraints on its distribution network is based on common methodologies applied across the industry. It has provided evidence to support its claim that it filters the study results and addresses less than 10% of constraints per year.[116] A similar risk-based approach is applied to limit the volume of non-compliance work each year.

Determination of volumes of distribution work is unclear

173. However, in the information provided, it is not clear how Endeavour assesses what is an acceptable or non-tolerable risk in determining the volumes of assets to be

[114] E.g. for South Marsden Park, per North West Priority Growth Area Plan 2018, page 16, and RP attachment 10.12 Demand Management & Non-network Options Strategy. February 2018. Page 4.

[115] RP Attachment 10.12 Demand Management & Non-network Options Strategy. February 2018. Pages 2-5.

[116] E.g. RP Attachment 10.05 Distribution Works Program, April 2018. Diagrams 1 and 2.

treated. Endeavour does not undertake quantitative risk-cost analysis for this category of expenditure.

4.5 Findings and Implications for proposed capex forecast

4.5.1 Findings

Repex

174. Contrary to claims in its RP of having used bottom-up and top-down forecasting methods, we find that Endeavour has established its overall repex requirement of $800m by a top-down process that was external to the forecasting methods adopted by its network managers. We find that:

- this figure has not been justified against NER criteria or against Endeavour's stated corporate objectives;
- within this overall figure, Endeavour has established category-level repex forecasts also using a top-down approach, that is essentially on an asset age basis;
- Endeavour has not provided evidence of how it determined that the risk levels or asset health levels resulting from its proposed program are preferred over those that could have resulted from an alternative program;
- Endeavour has not provided 'business cases' to support its proposed repex projects and programs nor has it validated its forecast by reference to 'asset class plans', which it appears are in development; and
- at the project and program level, we observe only limited application of risk analysis and limited integration of repex plans with capacity planning. To the extent that Endeavour has developed bottom-up project and program plans, these appear to have been essentially 'fitted in' to the top-down forecasts.

Augex

175. Unlike repex, Endeavour's augex forecast results from the aggregation of a series of bottom-up planned projects. Whilst we note that Endeavour's forecast augex is less than the output of its application of the augex model, in our view

- Endeavour has not demonstrated that it considered the potential impact of more rigorous planning on project scope and timing in its 'top-down challenge';
- we would also expect that with scope and scale of the regional development plans identified in its Area Plans, we would expect to see compelling evidence underpinning the decision to continue with widespread application of 11kV in greenfield areas; and
- at the project and program level, Endeavour's documentation shows inadequate options analysis and issues with the proposed project timing.

4.5.2 Implications

176. We consider that there are aspects of the forecasting methodologies that Endeavour has used that are likely to have led Endeavour to over-estimate its

required repex and augex. This includes methodologies that Endeavour claims to have used, but which it appears not to have used or (if so) to have used only to a limited extent.

177. In the subsequent sections, we present the results of our review of the application of these methodologies to Endeavour's repex and augex forecasts.

5 Assessment of proposed repex

5.1 Introduction

178. In this section we provide our assessment of Endeavour's repex forecast. We first summarise Endeavour's proposed repex, before providing our review of Endeavour's forecast for each repex category. Finally, we present the findings from our assessment, and we indicate the implications that these findings have for determining a reasonable forecast of Ausgrid's prudent and efficient expenditure requirements.

5.2 Summary of proposed expenditure

5.2.1 Overview

179. Endeavour has proposed a repex forecast of $800.5m for the next RCP compared to the actual/estimated expenditure in the current RCP of $619.0m as shown in the tables below, representing an increase of 29% ($181.5m).

Table 6: Forecast repex by asset category for next RCP ($m, real June 2019)

$m, real June 2019	Next RCP					
Category	Forecast 2019-20	Forecast 2020-21	Forecast 2021-22	Forecast 2022-23	Forecast 2023-24	Total 2020-24
Poles	28.7	29.1	32.3	33.7	35.6	159.5
Pole Top Structures	0.0	0.0	0.0	0.0	0.0	0.0
Overhead Conductors	16.0	18.1	18.6	19.5	17.3	89.5
Underground Cables	9.3	12.7	14.1	14.9	14.5	65.6
Service Lines	9.2	9.3	9.3	9.5	9.8	47.1
Transformers	19.5	20.0	20.3	22.7	24.3	106.7
Switchgear	20.4	21.2	23.0	24.3	24.8	113.6
SCADA, Network Control & Protection System	10.0	10.0	9.0	9.0	10.0	47.9
Other	38.0	32.6	33.1	30.5	36.5	170.8
Total	**151.0**	**153.0**	**159.7**	**164.0**	**172.7**	**800.5**

Source: Endeavour Reset RIN

Table 7: Actual/Estimated repex by asset category for current RCP ($m, real June 2019)

$m, real June 2019	Current RCP					
Category	Actual 2014-15	Actual 2015-16	Actual 2016-17	Estimate 2017-18	Estimate 2018-19	Total 2015-19
Poles	16.8	14.1	14.8	19.3	25.5	90.5
Pole Top Structures	0.0	0.0	0.0	0.0	0.0	0.0
Overhead Conductors	24.4	25.3	19.3	14.7	18.3	101.9
Underground Cables	9.4	8.9	4.6	15.1	7.6	45.5
Service Lines	12.2	11.5	15.1	15.4	9.2	63.4
Transformers	11.1	3.1	2.4	6.9	15.0	38.6
Switchgear	10.7	10.2	5.7	17.0	30.0	73.7
SCADA, Network Control & Protection System	24.7	10.0	4.9	6.4	4.2	50.2
Other	44.5	20.4	19.1	35.0	36.2	155.2
Total	**153.9**	**103.5**	**85.9**	**129.6**	**146.0**	**619.0**

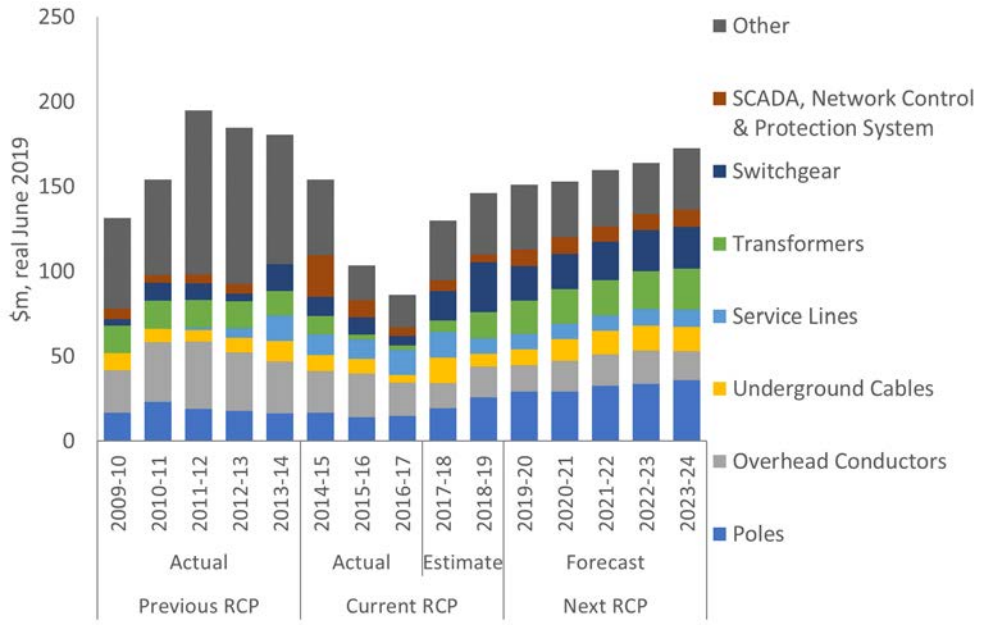
Source: Endeavour Reset RIN[117]

180. Forecast expenditure is higher than current RCP expenditure in most asset categories, with the largest increases being associated with the Poles ($68.9m) and Transformers ($68.1m) asset categories. These increases are partly offset by reductions in the Service lines ($16.3m) and Overhead conductor ($12.5m) asset categories.

181. In the figure below, the profile of repex over the previous, current and next RCP is shown. It can be observed that the actual/estimated repex increases at the end of the current period, and that Endeavour proposes that this elevated level of repex needs to continue into the start of the next RCP, with further increases throughout the RCP. We review the trends within each asset category in the subsequent sections.

[117] The Total 2015-19 figure for Poles of $90.5m in Table 7 (sourced from the Reset RIN) is different to the equivalent figure in Table 8 of $88.3m (sourced from the RP). Endeavour has not provided a reconciliation between the two sources of data.

Figure 15: Repex by asset category – previous, current and next RCP ($m, real June 2019)



Source: Endeavour Reset RIN

5.2.2 Modelled versus unmodelled repex

182. Endeavour has compared its proposed repex forecast against the Repex model projections under four different calibration scenarios, as applied by Endeavour. From this comparison, Endeavour concludes that '*there is a sound correlation between the AER's Repex model using historical scenarios as adopted in previous determinations and Endeavour Energy's VDA model projections, especially at the total level and over the long-term.*'[118]

183. On the basis of the above analysis, Endeavour states that it is satisfied that a continuation of the current level of repex is reasonable. We show the comparison of the proposed repex by asset category for modelled and unmodelled in the table below[119], for the current and next RCP. The unmodelled repex total of $218.5m for the next RCP is the sum of the 'Other' repex ($170.8m) and SCADA, network control and protection systems ($47.9m) asset categories provided by Endeavour.

[118] Endeavour's response to information request IR005, Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 23.

[119] We understand that Endeavour has advised the AER of alternate expenditure classification that may modify the modelled and unmodelled repex from the figures provided in its RP.

Table 8: Forecast modelled and unmodelled repex for current and next RCP ($m, real June 2019)

$m, real June 2019	2014-19 Current RCP	2020-24 Next RCP
Modelled repex		
Poles	88.3	159.0
Overhead conductors	101.7	89.0
Underground cables	45.4	66.0
Service lines	63.2	47.0
Transformers	38.5	107.0
Switchgear	73.6	114.0
Total Modelled repex	**410.7**	**582.0**
Unmodelled repex	**206.2**	**218.5**
Total repex	**617.0**	**800.5**

Source: RP. Page 135. Table 10.8[120]

184. Endeavour has included $44.0m of expenditure related to the Pole-top structure asset category in the Poles asset category. We note that the AER has typically excluded expenditure for Pole-top structures from its assessment of the modelled repex in the AER's Repex model. Excluding this from the comparison of modelled repex, would have the effect of reducing the forecast modelled repex to $538.0m, and increasing the unmodelled repex to $262.5m.

185. We also note that the expenditure profile as described in Section 2 for the current RCP, having been influenced by a number of extraneous events beyond the reasonable control of Endeavour, is likely to impact the calibration of the Repex model outcomes. While assessment of repex modelling is not within our scope, we observe that further calibration and/or adjustment of the model would be required to compare the Repex model outcomes with Endeavour's proposed repex forecast.

186. EMCa has not been asked to review Endeavour's application of the AER's Repex model, nor to review Endeavour's input assumptions. We also note that the AER may elect to classify asset category expenditure differently to that proposed by Endeavour in its repex modelling. We have not commented on the asset category classification. We have, however, included discussion of the Repex model outputs and classification of expenditure against the asset categories in the Repex model as proposed by Endeavour to assist with the review of the proposed forecast expenditure.

5.3 Our assessment of proposed expenditure by asset categories

187. Our review has focussed on the major drivers of expenditure included in Endeavour's repex forecast. We note that:

- two asset categories, Poles and Other, comprise approximately 41% of the total repex forecast;

[120] The values provided differ slightly from those provided in the Reset RIN and reproduced in Table 6, which appear to be due to rounding in Table 8

- the AER has provided a summary of its preliminary modelling results using the AER's Repex model to EMCa,[121] and which identifies variances between AER's modelling and Endeavour's repex forecast, with the largest variances being for the Transformers, Poles and Switchgear categories; and
- the AER has also raised concerns with extent of unmodelled repex.

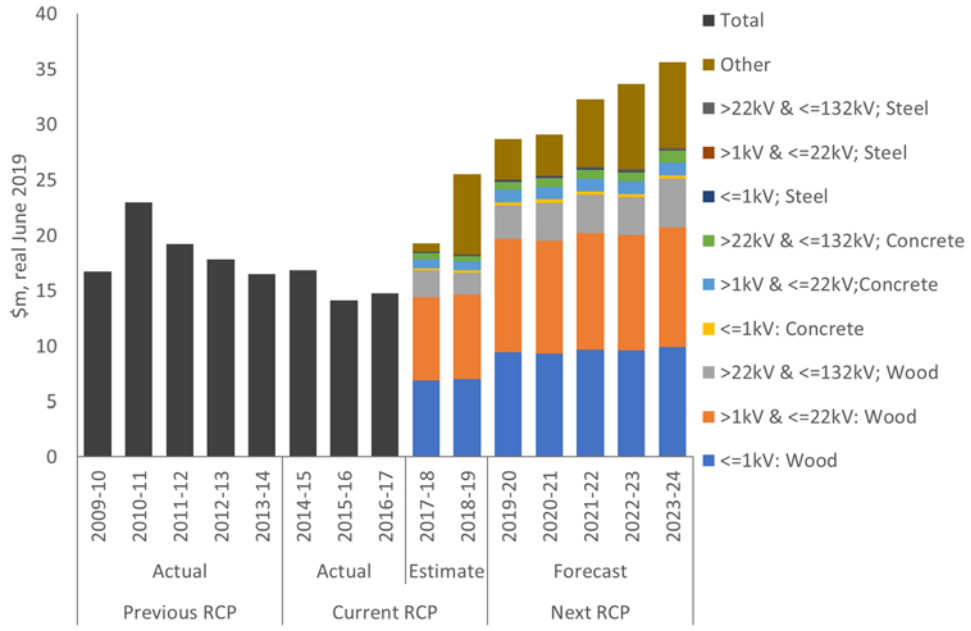
188. Through our review of the programs and projects proposed by Endeavour, we have sought to establish the strategic basis for, and the reasonableness of, the proposed repex for each of the identified asset categories. This is particularly the case where Endeavour proposes that significant increases are required. We have undertaken this by reviewing a sample of projects and programs to ascertain the extent to which the issues identified in the preceding sections are evident at the activity level, and that the forecast expenditure reflects the requirements of the NER.

5.3.1 Poles

Endeavour's forecast

189. Endeavour has proposed $159.5m for the Poles asset category in its repex forecast for the next RCP. The expenditure profile for the previous, current and next RCP for Poles is shown in the figure below.

Figure 16: Repex for the Poles asset category for the previous, current and next RCP ($m, real June 2019)



Source: Endeavour Reset RIN

190. There is a 76% increase in expenditure proposed for the Poles asset category for the next RCP (an average increase of $13.8m per year) compared with the actual and estimated expenditure for the current RCP. The expenditure trend appears to be driven by increases in the categories of replacement of un-staked LV, 11kV and 66kV poles and an increase in Other.[122]

[121] EMCa has not been asked to review the AER Repex model as applied by Endeavour or the AER; or consider the reasonableness or otherwise of the forecast produced by the AER Repex model.

[122] Sub-transmission tower below-ground and earthing refurbishment (TM803 and TM809).

191. The major components of expenditure include:

- DS005 Distribution pole replacement ($64.4m);
- DS418 Pole top structure / hardware refurbishment ($44.0m);
- TM012 Sub-transmission pole replacement ($19.8m);
- TM015 Sub-transmission tower replacement ($18.4m); and
- TM803 Steel tower below ground rectification work ($10.5m).

Our assessment

Distribution pole replacement

192. The DS005 *Distribution pole replacement program* is the largest component of the expenditure forecast. Timber poles comprise 91% of the 278,263 distribution poles in Endeavour's network, of which 3% are older than the 55 years 'nominal life expectancy' that Endeavour attributes to timber poles.[123]

193. Endeavour advises that '[o]*n average 1,500 timber poles (0.5% of the population) at end-of-life are addressed each year… and the average nominal life of 55 years suggests that 1.8% should be being addressed annually. This indicates a substantial increase in volumes will be required in the future as part of the distribution pole replacement program DS005.*'[124] Endeavour goes on to state that its remaining life analysis '*supports the strategy of 1.8% [*of poles*] being addressed annually.*' [125] Our understanding is that: (i) Endeavour's condemned poles are 'addressed' (or treated) by either replacement or reinstatement (nailing); and (ii) its strategy is to address 5,400 (1.8%) poles per year.

194. The activity forecast provided by Endeavour is primarily based on a bottom-up, age-based assessment, in which timber poles that will be 55 years old or more in the next RCP are earmarked for replacement or reinforcement.[126] Endeavour estimates that 2,178 poles per year require treatment over the next RCP (i.e. 10,891 poles over the next RCP).[127] Endeavour has made downward adjustments to its forecast replacement volume for DS005 for (i) poles replaced by other activities (15%), and of those, (ii) poles no longer required to be replaced due to re-instatement (27%).[128] Endeavour then includes an average of 311 reinstated poles per year approaching end of life that require replacement.[129] Endeavour has based its forecast

[123] Endeavour's response to information request IR013 Distribution Mains Asset Class Plan. June 2018. Pages 5, 8, and 12.

[124] *Ibid*. Page 13. Noting that we have interpreted this as being the average number of timber poles addressed each year from all Endeavour's activities (i.e. not just DS005).

[125] *Ibid.*

[126] Endeavour's response to information request IR013 DS005 Distribution Pole Replacement. June 2008. Forecast Summary.

[127] *Ibid.*

[128] Number of replacements deferred from Standard Age Replacement Profile due to re-instatement.

[129] Endeavour's response to information request IR013 DS005 Distribution Pole Replacement. June 2008. Forecast Summary.

expenditure for program DS005 on treating an average of 2,163 poles per year over the next RCP.[130]

195. The forecast replacement volume is a material increase from the average of 1,500 timber poles at 'end-of-life' that Endeavour currently addresses each year based on condition, but is materially lower than indicated by replacement once a poles reaches its nominal life expectancy.

196. In our experience, bottom-up, age-based forecasts are biased towards overestimating the actual expenditure requirements. This is consistent with Endeavour's age-based treatment plan versus its actual historical condition-based pole condemnation rate. In our view, a program of this magnitude should be based on a risk-based cost-benefit analysis (CBA) which examines various options (e.g. higher reinforcement rates) to demonstrate that the volume of activity selected is justifiable. We also consider that the volume of pole replacements/reinforcements in the 'base case' in the CBA should be derived from the actual number of poles treated from condition assessment, rather than age. We would also expect to see a quantified assessment of the risk presented from the pole population before and after the proposed expenditure, including any scenarios considered. We have not observed analysis commensurate with this approach undertaken by Endeavour.

Pole top structure and hardware refurbishment

197. The DS418 Pole top structure and hardware refurbishment forecast activity is also derived from an age-based forecast.[131] It has included two adjustments: (i) completing a backlog of actual defects from the current RCP; and (ii) forecast pole cap reinstatements.[132]

198. The proposed 2019/20 expenditure of $10.0m is double the $5.0m forecast for 2018/19. It is also higher than the average annual proposed expenditure of $8.5m over the balance of the RCP due to the introduction of an allowance for addressing the defect backlog. The 2018/19 forecast is based on '*pole inspections and high resolution pole top photographs'*[133] (i.e. it is a condition-based estimate). It would appear from the information provided by Endeavour that the age-based forecasting approach results in a much higher volume of renewal expenditure than the condition-based approach.

199. Endeavour has not demonstrated that: (i) the age-based forecast (which underpins the forecast increased expenditure) is superior to a condition-based forecast; (ii) the benefit of the program outweighs the cost; (iii) it will successfully address the carryover defects from the current RCP; and (iv) it will not continue to accumulate a backlog of defects over the next RCP.

[130] Total of replacements and reinstatements. Endeavour's response to information request IR013 DS005 Distribution Pole Replacement. June 2008. Forecast Summary

[131] Endeavour assumes that pole top hardware on individual poles will be replaced in the period 26-30 years and 51-55 year pole life. Endeavour's response to information request IR014 DS418 Pole Top Hardware. June 2018.

[132] The 2020 forecast expenditure is increased $2.1m for rectifying 2,680 outstanding actual pole top defects, and the 2021 forecast expenditure is increased by $1.1m for rectifying 4,292 outstanding pole cap defects.

[133] Endeavour's response to information request IR005 DS005.19 Project Scope Distribution Pole Replacement. March 2018. Page 4.

Other pole and tower programs

200. Endeavour has not provided sufficient information to enable us to assess the reasonableness of the expenditure forecasts for the remaining pole and tower sub-categories. For example, the $19.8m *Sub-transmission pole replacement program* (TM012) is based on age rather than condition.[134] We have not observed the basis of the analysis that leads to the increased pole treatment forecast. As for our comments on distribution poles, our concern is that an age-based expenditure forecast is likely to overstate the actual requirements. The expenditure forecast for program TM015 is increasing from $1.6m in 2019/20 to $5.6m by 2023/24, based on replacing towers with excessive corrosion with poles rather than repainting them. We have not observed the analysis underpinning the change in strategy nor the expenditure forecast.

201. The $10.5m *Steel tower below ground rectification program* is based on refurbishing corroded 'grillage' type foundations, which is a common industry issue. Endeavour applies typical rectification practices and proposes a continuation of the staged refurbishment of grillage foundations from the current RCP for (at least) another 10 years. It has an expert consultant's review which recommends that further remedial work should be done.[135] The basis for the annual average rectification of 14 towers in the next RCP is not clear, however the annual expenditure is less than the forecast for 2018/19.

5.3.2 Overhead conductors

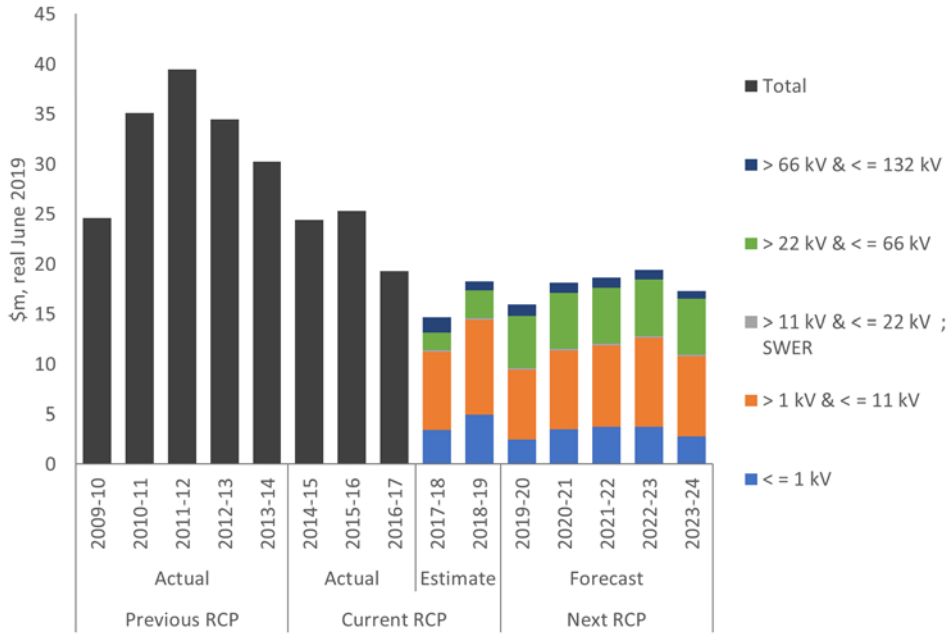
Endeavour's forecast

202. Endeavour has proposed $89.5m for the Overhead conductors asset category in its repex forecast for the next RCP. The expenditure profile for the previous, current and next RCP for Overhead conductors is shown in the figure below.

[134] The average recent condemnation rate is 200 poles p.a. and based on age, 250 poles p.a. are expected to require treatment in 2019/20 - 2022/23 and then 300 poles p.a. thereafter per Endeavour's response to information request IR005 SARP 2018-19. April 2018. Page183.

[135] Endeavour's response to information request IR005 SARP 2018-19, April 2018, Page 209.

Figure 17: Repex for the Overhead conductors asset category for the previous, current and next RCP ($m, real June 2019)



Source: Endeavour Reset RIN

203. There is a 12% decrease in expenditure proposed for the Overhead conductors asset category for the next RCP (an average decrease of $2.5 million per year) compared with the actual and estimated expenditure for the current RCP.

204. The major program components of the forecast expenditure for the overhead conductor asset category are:

- DS011 HV distribution steel mains replacement ($25.6m);
- DS414 Copper distribution mains replacement ($11.0m);
- TM030 Feeder 7028 replacement ($10.5m); and
- DS413 Low mains remediation ($8.1m).

Our assessment

Distribution steel mains replacement

205. Endeavour has included two specific programs for replacement of aging, deteriorating distribution conductors, being DS011 for steel mains and DS414 for copper mains. The Endeavour Board approved a strategy in 2010 to replace at risk steel conductors in response to the recommendations of the Victorian Bushfire Royal Commission (VBRC). This was followed by a Statement of Asset Need in 2014, and introduction of program DS011. In 2014/15 Endeavour adopted an expanded strategic replacement program to 2029/30 at a nominal replacement rate of 60km per year. Endeavour makes reference to this strategy as the basis of the ongoing replacement program in subsequent business cases for programs undertaking in the current RCP.

206. In its SARP, Endeavour states that the forecast replacement volume increases from approximately 32km per year in 2018/19 to approximately 60km per year across the next RCP. The business case for 2018-20 includes replacement of 98km, with

approximately 60km planned for 2019/20. Endeavour claims to be progressively addressing replacement of conductor sections at highest risk of failure.

207. By the end of the next RCP, assuming a replacement rate of 60km is maintained, Endeavour will be replacing steel conductor that is currently assessed as corrosion category 2 (light surface corrosion). Endeavour has not demonstrated that this condition level poses a similar safety risk, or that a proportion is likely to continue to degrade in condition over the next RCP and should be included in the replacement program.

208. In its earlier business case, Endeavour limits its consideration of options to replacement of the conductor with underground cable, or a new line. We would have expected a broader range of options that take into account the future uncertainty associated with electricity networks, and introduction of distributed generation solutions especially for regional supply areas where it may not be economic to rebuild the electricity networks.

209. Endeavour has provided a copy of its modelling for *DS011 HV distribution steel mains replacement*.[136] It not clear to us what, if any, impact the results of its modelling have had on the scope or scale of the proposed program, other than to reinforce the need to prioritise any expenditure to replace steel mains. We have not been asked to review the model in detail and note that whilst the parameters included by Endeavour are generally aligned with what we would expect to see in this type of analysis, the input assumptions appear very conservative. As a part of its analysis, Endeavour indicates that it is uneconomic to replace a large proportion of the population of steel mains and acknowledges the need to continue to validate the inputs used in its model.[137] We consider this further reinforces the need for a more holistic review of options for replacing all steel mains as a broad strategy.

210. The program for replacement of Copper conductors is in response to a high risk to public and worker safety following conductor failure. Endeavour appears to have assigned a nominal allocation or allowance as the basis of the expenditure forecast. The target length of conductor to be replaced and the assumed unit cost are not clearly identified so an assessment of the reasonableness of the forecast is not possible.

211. In both replacement programs, Endeavour has not provided sufficient evidence to demonstrate that it has adequately assessed the risks associated with conductor failure, presented target risk levels aligned with the organisations risk appetite, or looked at scenarios that assess the forecast change in risk levels arising from the proposed level of expenditure.

LV mains

212. Programs DS409, DS413 and DS415 target identified issues with the LV mains. DS413 *Low mains remediation* has the largest expenditure. Endeavour has placed renewed focus on this program following a fatality, moving from condition-based maintenance and various capital programs, to a targeted condition-based capital program due to a reassessment of the risk posed by low mains. The extent of the risk posed by Endeavour's network is not explained, nor is the targeted risk

[136] Endeavour response to information request IR005 DS011 Steel Mains Modelling. June 2016.

[137] *Ibid*. Page 9.

reduction sought from the expenditure, nor the risk treatment options considered to address the identified risk.

Feeder 7028 replacement

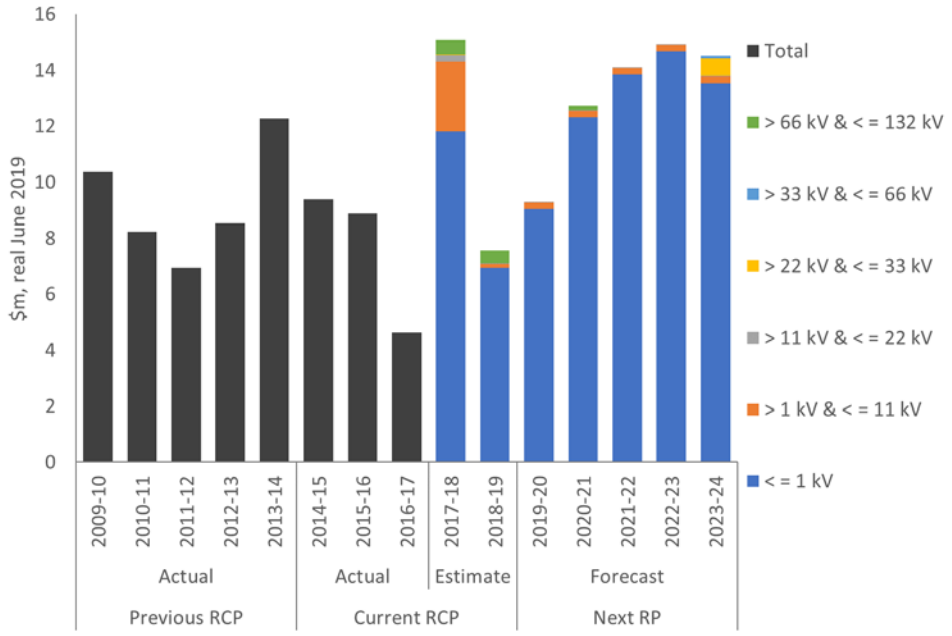
213. The information provided to support inclusion of project TM030 *Feeder 7028 replacement* in the SARP suggests that the line may be a candidate for retirement. However, Endeavour's analysis is insufficient to demonstrate that full line replacement is the prudent and efficient option, as there is inadequate consideration of the available options including whether this line has an enduring need. Endeavour states that the project '*is subject to an assessment of the most efficient method of ensuring ongoing reliability of the 33kV supply to the northern end of the Illawarra region*',[138] suggesting that such a review has not yet occurred, and when undertaken, may result in this project no longer being required.

5.3.3 Underground cables

Endeavour's forecast

214. Endeavour has proposed $65.6m for the Underground cables asset category in its repex forecast for the next RCP. The expenditure profile for the previous, current and next RCP for Underground cables is shown in the figure below.

Figure 18: Repex for the Underground cables asset category for the previous, current and next RCP ($m, real June 2019)



Source: Endeavour Reset RIN

215. There is a 44% increase in expenditure proposed for the Underground cables asset category for the next RCP (an average increase of $4.0m per year) compared with the actual and estimated expenditure for the current RCP. The expenditure trend appears to be driven primarily by an increase in LV cable replacement.

[138] Endeavour's response to information request IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 190.

216. The major program components of the forecast expenditure for the Underground cables asset category are:

- DS006 LV CONSAC cable replacement ($46.5m);
- DS014 LV cable network renewal ($8.6m);
- DS415 LV mains replacement ($4.8m of $5.5m total); and
- DS409 Misc mains renewal expenditure ($4.8m of $5.8m total).

Our assessment

LV CONSAC cable

217. Endeavour considers that[139] LV CONSAC cable has the most significant failure risk in its network. Endeavour has had a CONSAC replacement program in place for several years, which was based on replacement of all cable sections. It has installed neutral integrity (NI) monitoring capability to identify cable sections in poor condition, and to assist with prioritising replacement of cable sections. From these devices Endeavour has identified that only 18%[140] (or 79km) of the remaining CONSAC in the distribution network has failed or is beginning to fail the neutral integrity testing and is required to be addressed.

218. Endeavour claims that it has historically been undertaking replacement of approximately 7km of CONSAC cable that had reached end of life. It has determined that this volume is inadequate to avoid '*an unmanageable escalation of risk in the future*'.[141] It has therefore proposed a replacement volume of 18km per year for DS006, to address the 79km[142] of CONSAC cable that has been identified as 'potentially failed/failing' by the end of the next RCP. Endeavour has not provided information supporting its confidence around this volume, or evidence of the increasing risk of electric shock, reliability impact and damage from CONSAC cable used to justify the change in proposed expenditure forecast.

219. At the stated unit rate of $750,000 per km,[143] the proposed replacement volume is more likely closer to 9km per year and not 18km. The SARP suggests that a lower replacement volume of 4km is estimated for replacement in 2018/19[144]. Neither the increase in replacement volume or expenditure are explained by Endeavour. Furthermore, Endeavour has provided a lower figure of 48.65km of CONSAC cable identified as being in poor condition[145]. The variance between this figure and the asset class plan is not provided. In the absence of better information, it would appear that a lower replacement volume is more likely representative of the level of replacement that Endeavour will undertake.

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[139] Endeavours response to information request, IR013 Asset Class Plan, Distribution. June 2018. Page 16.

[140] *Ibid*. Page 16.

[141] Endeavour's response to information request IR013 Asset Class Plan, Distribution. June 2018. Page 17.

[142] *Ibid*. Table 8. Page 16

[143] Endeavour's response to information request IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 234.

[144] *Ibid.* Page 234.

[145] Endeavour's response to information request IR005 DS005 Master list. November 2017 Worksheet 'Cluster Analysis'.

Other LV cable programs

220. The remaining programs are shown with an increasing expenditure trend over the next RCP, namely:

- *DS014 LV cable network renewal* is a new program for replacement of components of the underground cable system. Endeavour describes the initial focus of this program as being in the areas of Lapstone and Mt Riverview and that this will continue as an ongoing program for other areas;
- *DS415 LV mains replacement* is an ongoing program for the replacement of LV mains in commercial areas, due to identified safety risks; and
- *DS409 Miscellaneous mains renewal* is an on-going program for the refurbishment of LV mains, that falls outside of the other renewal programs.

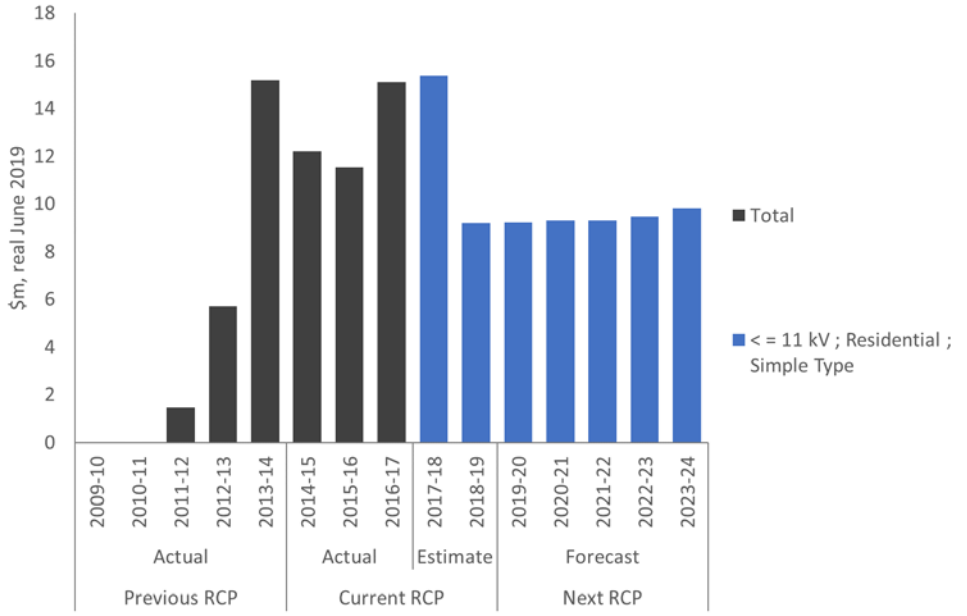
221. Endeavour has not demonstrated that the proposed expenditure, when considered as a collection of programs, reflects a prudent and efficient level of expenditure or that an increase is required to address an increased level of risk. We would have expected to see evidence of asset condition information across the asset population, assessment of risk, options analysis including works packaging from which a prudent level of expenditure may be determined. Instead we observed examples where Endeavour has provided 'nominal allocations' of expenditure.

5.3.4 Service lines

Endeavour's forecast

222. Endeavour has proposed $47.1m for the Service lines asset category in its repex forecast for the next RCP. The expenditure profile for the previous, current and next RCP for Service lines is shown in the figure below.

Figure 19: Repex for the Service lines asset category for the previous, current and next RCP ($m, real June 2019)



Source: Endeavour Reset RIN

223. There is a 26% reduction in expenditure proposed for the Service lines asset category for the next RCP (an average reduction of $3.3m per year) compared with the actual and estimated expenditure for the current RCP. The step reduction is observed from 2018/19 and maintained into the next RCP.

224. There is a single program comprising the forecast expenditure for Service lines, being DS007 *Service wire replacement program* ($47.1m).

Our assessment

225. Endeavour states that a significant proportion of its overhead service lines are approaching end of life and are likely to be in poor condition due to degradation of the insulation which poses electrical safety hazards to workers and the public.

226. Endeavour describes the basis of its forecast for its *Service wire replacement program* as being '*scoped on the basis of the total population of 540,000 services to be replaced over 30 years*[146] which equates to 18,000 services to be replaced per year. Endeavour plans to replace all services in a given geographic area, regardless of condition.

227. We note that the planned replacement program commenced in 2014 and since that time, Endeavour has increased the replacement volumes to a peak replacement volume of 18,000 services during 2016.[147] For the next RCP, the replacement volume has been maintained and the expenditure reduced based on absorbing its reactive replacements into its planned program, and through cost efficiencies realised in its new delivery model totalling $30m over the next RCP.[148]

228. By the end of the next RCP, Endeavour would have replaced a total of 180,000 service lines. This represents a large replacement program. It is not clear to us how Endeavour is prioritising this program to manage the associated safety risk, how it has detemined that the proposed volume of replacements has been optimised, or whether further efficiences can be realised due to economies of scale. With the constant rate of replacement that Endeavour has assumed, the basis for an increasing real-terms expenditure trend is also not explained.

5.3.5 Switchgear

Endeavour's forecast

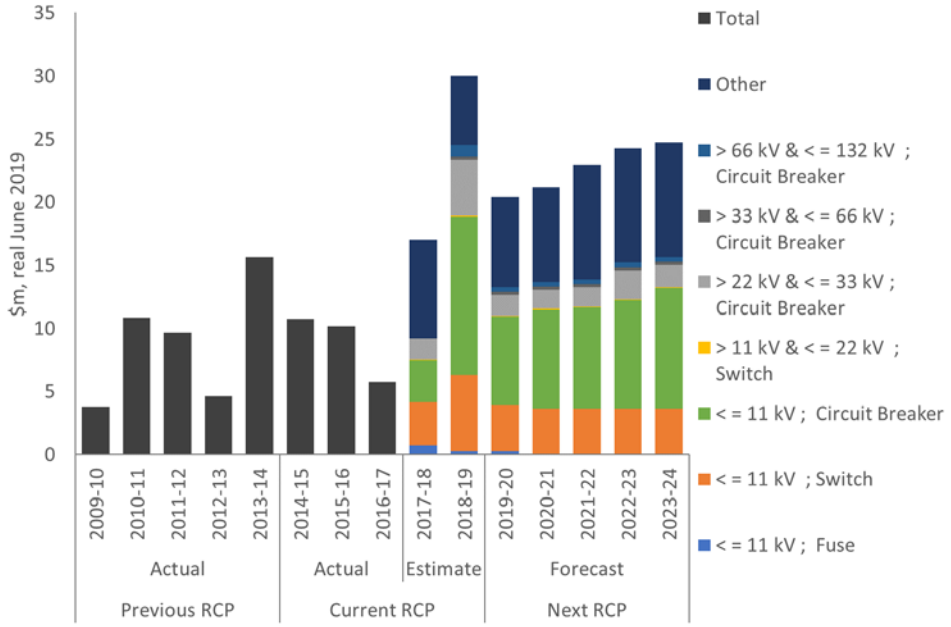
229. Endeavour has proposed $113.6m for its Switchgear asset category in its repex forecast for the next RCP. The expenditure profile for the previous, current and next RCP for Switchgear is shown in the figure below.

[146] Endeavours response to information request IR005 Strategic Asset Renewal Plan FY19 – FY29. April 2018. Page 67.

[147] Endeavour's response to information request IR013 Asset Class Plan, Distribution. June 2018. Page 15.

[148] Endeavour's response to information request, IR005 Strategic Asset Renewal Plan FY19 – FY29. April 2018. Page 26.

Figure 20: Repex for the Switchgear asset category for the previous, current and next RCP ($m, real June 2019)



Source: Endeavour Reset RIN

230. There is a 54% increase in expenditure proposed for the Switchgear asset category for the next RCP (an average increase of $8.0m per year) compared with the actual and estimated expenditure for the current RCP. The expenditure trend appears driven by 11kV circuit breaker replacement, with a step increase occurring in 2017/18, with further increases in the forecast period. Endeavour has not explained the basis for the anomalous expenditure in 2018/19.

231. The major program components of the forecast expenditure for the Switchgear asset category are:

- DS307 Holec MD4 epoxy switchgear replacement ($35.9m);
- TS700 11kV zone substation switchboard replacement ($35.0m);
- DS405 Air break switch replacement ($14.5m); and
- TS005 33kV circuit breaker replacement ($4.3m).

Our assessment

232. The major driver of the proposed increase in 11kV circuit breaker replacement appears to be Endeavour's reassessment of the safety risk resulting from premature failure of the switchgear. For example, the documentation supporting program DS307 *Holec MD4 11kV ground mount switchgear* describes an increased volume of replacement from 10 to 170 units per year, with a further increase in replacements to 225 units per year during the next RCP.

233. Endeavour states that a review was conducted in 2017 of the inspection and partial discharge testing process due to an observed increase in the failure rate.[149]

[149] Endeavour's response to information request IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 59.

However, in other documentation[150] Endeavour states that '*the risk of failure has been persistent*' and refers to a chart that shows a flat trend, with an average of 2 catastrophic asset failures[151] per quarter over the period Q4 2013 - Q1 2017. The risk, including any increase in risk determined by Endeavour, is not supported in the provided documentation to justify the proposed increase of replacements and corresponding increase in expenditure.

234. As a further example, Endeavour describes[152] program DS312 *Miscellaneous substation renewal* expenditure as an ongoing refurbishment program where projects are assessed for completion in conjunction with other works. The increase from a historical expenditure of $0.75m to $3.5m per year in the next RCP is not adequately explained and is likely to be higher than is required.

235. In its SARP, Endeavour describes six programs, comprising four switchgear replacement programs for voltages of 11kV (TS007), 33kV (TS005), 66kV (TS055), 132kV (TS004); a 11kV switchboard truck replacement program (TS173);[153] and a 11kV zone substation switchboard replacement program (TS700). In total this accounts for over $43m of its proposed expenditure, with an emphasis on 11kV due primarily to risk of failure of oil-filled switchgear.

236. Endeavour states that *'[a]ssessment of risk and cost confirmed that for most zone substations, replacement of the oil circuit breaker trucks with vacuum trucks allows the life of the switchboards to be extended while reducing the safety risks presented by the existing oil switchgear at a lower cost than wholesale replacement of the switchboard*'.[154]

237. Endeavour also states that '*the decision on whether truck replacement or full switchboard replacement is appropriate will be determined on a cost justification basis per substation based on site specific conditions, overall switchboard health and future requirements*'[155]. We consider that in the absence of information pertaining to the candidate projects for refurbishment and replacement, risk-ranked with estimated costs, the approach adopted by Endeavour to allocate expenditure in aggregate is likely to ignore opportunities for more efficient options, inflating Endeavour's forecast for the required expenditure.

11kV switchboard replacement program

238. In response to a request for information pertaining to its 11kV switchboard replacement program, Endeavour has provided a copy of a risk assessment worksheet.[156] Whilst this risk assessment appears to consider the type of input

[150] Endeavour's response to information request, IR013 Ground Based Distribution Substation Asset Class Plan. Pages 15-16.

[151] Catastrophic asset failures are when the asset is required to be replaced.

[152] Endeavour's response to information request IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 224.

[153] No expenditure has been allocated to program TS173.

[154] Endeavour's response to information request, IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 26.

[155] Endeavour's response to information request, IR013 Asset Class Plan, Circuit Breakers. June 2018. Page 28.

[156] Endeavour's response to request for information, IR013 11kV Switchboard risk assessment. June 2018.

assumptions we would expect to see, as described in Section 4 of this report, we have not seen evidence of how this risk assessment has been developed by Endeavour,[157] or applied to the development of the proposed expenditure forecast.

11kV zone substation switchboard replacement

239. We note that a list of projects included in the worksheet aligns with projects re-produced in the SARP, separated into truck replacement and switchboard replacements. However, Endeavour has presented the expenditure forecast in a single program, TS700 *11kV zone substation switchboard replacement*. For a large number of the included projects, the worksheet recommends a 'do nothing' option, however this is then overwritten with an option to replace the switchboard or replace trucks. Endeavour has not adequately explained the justification for this change.

Other replacement programs

240. Other parts of the program, including DS405 and TS005 are presented as being ongoing replacement programs and appear to reflect reduced levels of replacement activity. We note that from a review of its strategy for ABS replacement, Endeavour expects to remove 20-30% of the total number of switches currently in operation which otherwise would require replacement.[158] Also, further savings are included based on replacement of existing switches with an ABS or manual LBS rather than a SCADA operated switch.

5.3.6 Transformers

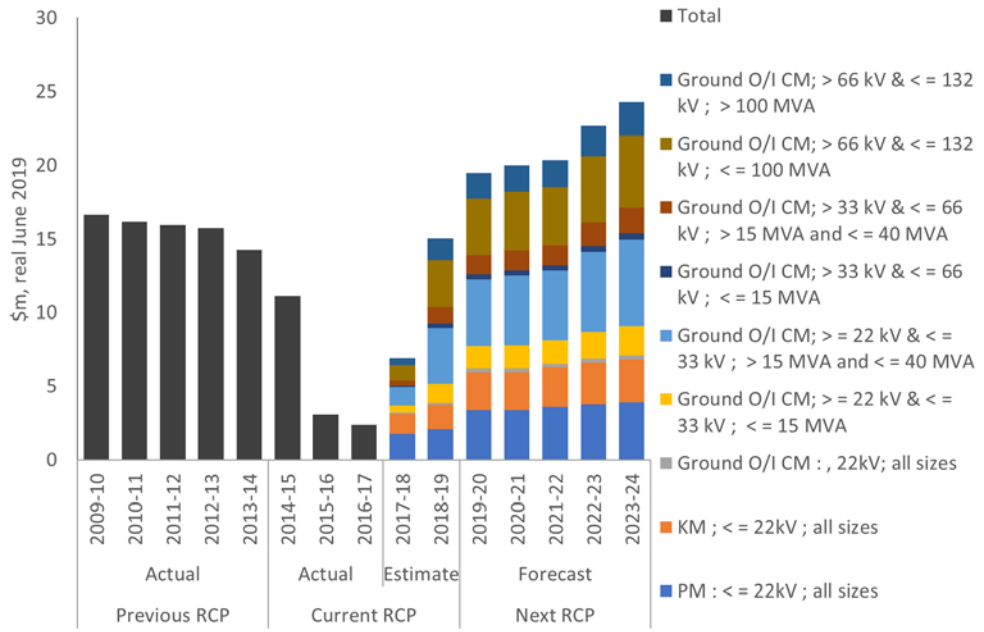
Endeavour's forecast

241. Endeavour has proposed $106.7m for the Transformers asset category in its repex forecast for the next RCP. The expenditure profile for the previous, current and next RCP for Transformers is shown in the figure below.

[157] Including a methodology document that describes the alignment of the risk assessment approach to the risk management framework, input assumptions applied in the development of its quantified risk cost, and validation of the outputs of its risk cost model.

[158] Endeavour's response to information request, IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 26.

Figure 21: Repex for the Transformers asset category for the previous, current and next RCP ($m, real June 2019)[159]



Source: Endeavour Reset RIN

242. There is a 177% increase in expenditure proposed for the Transformers asset category for the next RCP (an average increase of $13.6m per year) compared with the actual and estimated expenditure for the current RCP. The increases appear across most categories of Transformers, with a step-change in 2017/18, again in 2018/19 and in 2019/20 primarily due to increasing expenditure for power transformer replacements.

243. The major program components of the forecast expenditure for the Transformers asset category are:

- TS600 Power transformer replacement ($62.0m);
- DS312 Miscellaneous substation renewal expenditure ($17.5m); and
- DS302 Distribution transformer replacement program ($6.4m).

Our assessment

244. Endeavour has advised that the relatively low expenditure on transformer replacement and refurbishment in 2015/16-2017/18 was due to a deliberate pause in activity during the lease transaction process.[160] The driver of the expenditure profile in the next RCP is the risk posed by power transformers assessed to be approaching the end-of-technical life (which Endeavour establishes from condition assessment).[161]

[159] Where PM refers to Pole-mounted, KM refers to Kiosk-mounted, Ground O/I refers to Ground-mounted Outdoor/Indoor enclosure.

[160] Verbal advice received from Endeavour during the on-site meeting.

[161] Endeavour's response to information request IR013 Power Transformers Asset Class Plan. June 2018. Pages 2-15.

Power transformer replacement program

245. Endeavour advised at our on-site meeting that the TS600 *Power transformer replacement program* for the next RCP is based on a combination of condition assessment and network criticality, and that it has selected 25 transformers to be replaced over the next RCP.[162]

246. We have several concerns with the planned power transformer repex forecast:

- The SARP states that *'…power transformers are replaced when they are assessed as being at the end of their effective life based on their condition and performance*'. [163] In its asset condition report, Endeavour identifies 33 power transformers 'nearing end of life' or 'EOL2' category[164] based on condition, of which '*17 will be considered for replacement in the next SARP for upcoming financial years….*'[165] This is significantly less than the 25 transformers that appear to comprise the $62.0m expenditure forecast;
- In its renewal program, 16 of the 25 transformers designated for replacement by 2024 are rated as medium priority, at an estimated cost of $41.0m. There are no high priority replacements, and the remaining nine transformers allocated for replacement are rated as low priority.[166] It is not clear why nine low priority transformers are now included in the replacement program;
- Endeavour[167] refers to the need to proactively allocate replacement or retirement of 120MVA and 60MVA transformers in 'upcoming investment profiles' due primarily to the age of the two transformer fleets. The asset condition report identifies five 120MVA and three 60MVA units for replacement and four 120MVA and two 60MVA units for major repair or refurbishment.[168] However, the SARP and the table presented at the onsite meeting include nine 120MVA and five 60MVA units for replacement in the next RCP. We can find no explanation for Endeavour's decision to replace rather than refurbish/repair the four 120MVA units and two 60MVA units; and
- Endeavour has not provided business cases for any transformer replacements nominated in its various lists to allow us to fully understand the basis for replacement, the options analysis (including cost-benefit analysis), and the economic timing of the replacement.[169]

[162] Endeavour onsite meeting. Repex TS600, PS008, unmodelled pres - r1. 13 July 2018. Slide 7.

[163] Endeavour's response to information request IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 102.

[164] ELO2 = health index (HI) score of 70-220 or operational age >50 years.

[165] Endeavour's response to information request IR005 TS600 Asset Class Condition Power Transformers. June 2017. Page 22.

[166] Endeavour's response to information request IR013 PX renewal program master. June 2018. Priority Matrix.

[167] Endeavour's response to information request IR013 Power transformer Asset Class Plan and Endeavour's response to information request IR013 Asset Class Condition Report Transformers.

[168] Endeavour's response to information request IR013 Asset Class Condition Report Transformers. Pages 24-26.

[169] Endeavour has supplied two business cases for TS619 and TS620. These relate to projects in the current RCP for reactive replacement of failed units, not proactive transformer replacement.

Miscellaneous substation renewal

247. The second highest project expenditure is DS312, which '*covers approved refurbishment expenditure associated with distribution substations that falls outside of the current distribution substation renewal programs or cuts across multiple distribution substation renewal programs*'.[170] Whilst the SARP outlines the criteria for selection of the projects under this category, little justification is given for the $17.5m forecast, particularly given that the annual provision of a constant $3.5m, is much higher than the $0.75m forecast for 2018/19.[171]

Distribution transformers

248. Endeavour has assumed that 100 distribution transformers per year will need to be replaced under project DS302 due to their condition.[172] This is consistent with the amount estimated for 2018/19 and given the size of the distribution transformer population and the assumed unit cost, the forecast expenditure seems reasonable.

Other transformer programs

249. There are a further eight programs in the transformers category totalling $15.8m which, in the main are based on extrapolations of current work volumes. In some programs adjustments are made on the basis of the age profile or specific condition-related issues. For the relatively small continuation programs, the approach and forward estimates appear to be reasonable.

5.3.7 SCADA, Network Control and Protection System

Endeavour's forecast

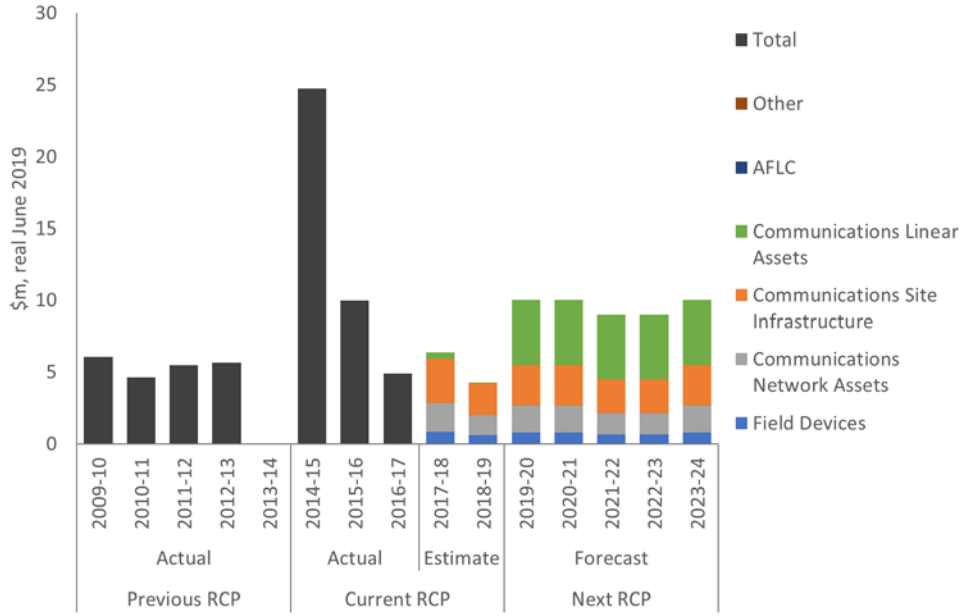
250. Endeavour has proposed $47.9m for the SCADA, network control and protection system asset category in its repex forecast for the next RCP. The expenditure profile for the previous, current and next RCP for SCADA is shown in the figure below.

[170] Endeavour's response to information request IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 224.

[171] *Ibid*. Page 224.

[172] *Ibid*. Page 217.

Figure 22: Repex for the SCADA, network control and protection system asset category for the previous, current and next RCP ($m, real June 2019)



Source: Endeavour Reset RIN

251. There is a 5% reduction in expenditure proposed for the SCADA, network control and protection system asset category for the next RCP (an average reduction of $0.5m per year) compared with the actual and estimated expenditure for the current RCP. However, we note that the current period average is dominated by large expenditure in 2014/15. For the next RCP, the largest expenditure is associated with communications infrastructure.

252. The major program components of the forecast expenditure for the SCADA, network control and protection system asset category are:

- AU004 Substation SCADA RTU replacement ($9.2m);
- TM134 Wollongong – Port Kembla pilot cable replacement ($8.1m);
- AU013 SCADA master station development software ($8.0m); and
- TM137 Optical fibre protection and communication upgrades in the Macarthur area ($6.4m).

Our assessment

Substation SCADA RTU replacement

253. Endeavour describes a change in strategy from maintain and repair to a combined strategy of planned replacement and managing spares through salvaged units, that came into effect in 2014/15 for program AU004.[173] The change in strategy is described as being in response to falling inventory and an increasing failure rate of installed units.

254. We have not seen evidence of these trends that supports the change in strategy. However, the age profile provided by Endeavour suggests to us that a large number

[173] Endeavour's response to information request IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 71.

of assets are at end of life, and where spares are depleted, an increase in replacement volumes is likely to be required.

255. Endeavour also attributes a proportion of the RTU replacements as '*being driven by the technological requirements of the protection relay programs, PS008 - Substation protection relay refurbishment and PS012 - Distribution feeder safety improvement*.'[174] Where the replacements are not associated with end of life, we would expect to see the benefits associated with the new protection devices reflected in a business case including analysis of benefits from bringing forward the associated RTU replacements. This analysis has not been provided.

SCADA master station development software

256. Endeavour has described the proposed forecast expenditure for AU013 *SCADA master station development software* as an on-going requirement for increased data and additional functionality required of the SCADA system. We have not seen quantification of this requirement in terms of a forecast of required data points and services as part of the forecast period, or assessment of the limitations of the current software that quantifies this level of expenditure.

Communication upgrade projects

257. A number of communication upgrade projects are included in the forecast, namely TM134, TM135 and TM137. These projects relate to upgrades of the existing communication infrastructure to fibre optic on the basis of increased safety and reliability at the nominated sites. We have not seen sufficient information pertaining to the risks that these projects are seeking to address, consideration of options in the context of a strategic asset plan for the communications infrastructure, or analysis of economic benefit for these projects. The proposed expenditure is included in the SARP at near constant expenditure levels for 10 years, which requires further explanation.

Asset class strategy

258. A comprehensive strategy that seeks to optimise the expenditure for this asset category is not evident. The absence of such a strategy, or evidence of optimisation, suggests that the proposed expenditure is likely to be overstated.

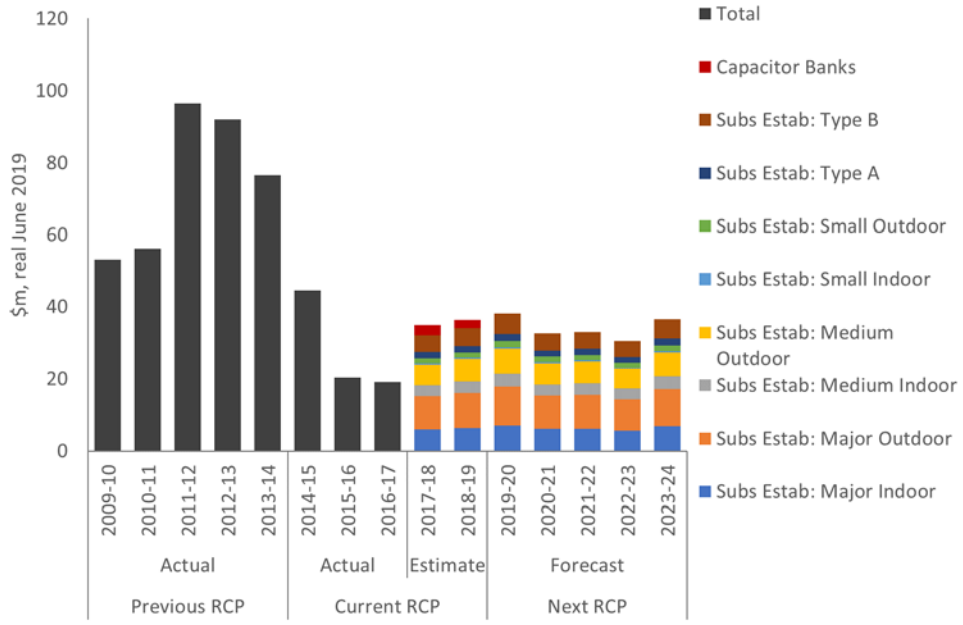
5.3.8 Other

Endeavour's forecast

259. Endeavour has proposed $170.8m for the Other asset category in its repex forecast for the next RCP. The expenditure profile for the previous, current and next RCP for Other is shown in the figure below.

[174] *Ibid*. Page 71.

Figure 23: Repex for the Other asset category for the previous, current and next RCP ($m, real June 2019)



Source: Endeavour Reset RIN

260. There is a 10% increase in expenditure proposed for the Other asset category for the next RCP (an average increase of $3.1m per year) compared with the actual and estimated expenditure for the current RCP.

261. The major program components of the forecast expenditure for the Other asset category are:

- TS199 Future sub-transmission substation renewal program ($34.0m);
- PS008 Substation protection relay refurbishment ($21.1m);
- TS167 Carlingford Transmission Substation control building replacement ($13.5m); and
- TS163 Unanderra Zone Substation renewal ($12.2m of total $15.0m).

Our assessment

262. The sub-categories provided in the RIN analysis do not provide an understanding of the drivers of the proposed increase.

Major substation renewal projects

263. Endeavour has included six major substation renewal projects: Carlingford, Unanderra, West Wollongong, Sussex Inlet, Marrayong and Greystanes totalling $62.1m in the repex forecast. Endeavour has mapped a total of $50.0m of these costs to the Other asset category of repex.[175]

264. We have reviewed the information provided to justify the inclusion of the proposed substation renewal projects into the repex forecast. For a number of these projects we found evidence of:

[175] The balance has been mapped to transformer ($2.8 million) and switchgear ($9.3 million) RIN asset category.

- limited options analysis, including lack of cost / benefit analysis;
- limited risk assessment – inadequate consideration of risk-cost;
- lack of timing consideration of the expenditure forecast, and therefore justification of the required volume of replacement activity; and
- inadequate consideration of the interaction with other parts of the capital program, including opportunities to defer the expenditure and consideration of non-network solutions.

265. In its SARP, Endeavour describes three key strategies[176] to identify areas where expenditure reductions can be made. A number of program reductions are summarised in Table 7 of the SARP that include deferral of TS165 *Greystanes zone substation renewal* beyond 2023/24. However, project TS165 is included in the expenditure forecast.[177]

266. Furthermore, Endeavour provides examples of lower cost solutions employed for the substation renewal projects and refers to having applied these lower cost solutions for Carlingford, and Dundas zone substations in its forecast. It is therefore foreseeable that these types of lower cost solutions, including opportunities for project deferral are likely to exist in other parts of the expenditure forecast for this asset category, and in the absence of better information is likely to lead to a lower level of required expenditure.

Future sub-transmission substation renewal program

267. In addition to the six major substation renewal projects, Endeavour has also included project TS199 *Future sub-transmission substation renewal program* at $34.0m. In its SARP, Endeavour describes this project as providing an allowance for the future redevelopment of zone and transmission substations that reach the end of their lives in the longer-term renewal programs, until such time as the renewal strategy for individual substations has been finalised and individual renewal projects established.

268. Endeavour states that it develops a partial or complete replacement project 'when a confluence of end of life asset condition issues points to complete or partial replacement being a more efficient and effective solution than continued like-for-like replacement of individual component assets'.[178] Whilst the strategy appears to reflect a broader efficiency objective, Endeavour has not demonstrated that it has optimised its portfolio, or that the forecast expenditure represents a prudent and efficient level.

Protection relay replacement programs

269. Endeavour has also included five protection relay replacement programs[179] totalling $30.4m over the next RCP, with the largest being PS008 *Substation protection*

[176] Endeavour's response to information request IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 24.

[177] $6.975m in 2023/24.

[178] Endeavour's response to information request IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018.

[179] Seven programs are included in Endeavour Energy – IR013 Protection Asset Class Plan – June 2018, page 10, however only five have been included in the repex forecast.

relay refurbishment at $21.1m. PS008 is described as an ongoing program for the replacement of protection relays and associated panel equipment as it reaches the end of life.

270. In the Protection Asset Class Plan, Endeavour describes its strategy '*where high consequence relays, relays without redundancy and low quantity relays are retired based on age at mid-EOL age. For other relays, failure rate data will be used as the retirement driver, with retirement at late-EOL age if not retired earlier*'.[180]

271. We have been provided with modelling outcomes that support greater emphasis on replacement of relays in areas associated with failures of higher consequence. Whilst we have not reviewed the input assumptions in detail, we consider that this provides a basis for differentiated replacement options across its portfolio of protection relays based on consequence, and a prioritisation framework to address highest risk relays within PS008. Whilst this approach is more likely to be consistent with a prudent and efficient level of expenditure, Endeavour has relied on high level modelling outcomes for its forecast.

272. Furthermore, statements in the SARP such as '*missed opportunities to take advantage of the benefits of modern technology*'[181] as drivers of expenditure, where relevant, would need to be subject to economic analysis and which Endeavour has not provided.

Civil and building related programs

273. Endeavour has included a portfolio of 10 programs for civil work totalling $24.0m over the next RCP. During our onsite review meeting, Endeavour described the increase in costs associated with civil and buildings related works as the result of elevated rates for contract civil costs across NSW over the last few years. Endeavour has not provided evidence of these increases or for continued increases in such costs.

Ancillary substation programs

274. An additional 12 programs are included for ancillary substation assets totalling $32.2m over the RCP. This includes battery replacements, essential spares, auxiliary switchgear, earthing etc. In many cases these appear to be based on an allowance-based approach (allocation of a nominal expenditure amount) as described earlier.

Category optimisation

275. Endeavour has not demonstrated that it has exploited opportunities for optimisation of its portfolio of expenditure relating to substation sites, or packaged opportunities to deliver works in a targeted and prioritised manner. Furthermore, where expenditure drivers include realising the benefits of modern infrastructure, we would expect to see, and have not seen evidence of, these benefits reflected in the economic analysis supporting the inclusion of the expenditure into the repex forecast.

[180] Endeavour's response to information request IR013 Protection Asset Class Plan. June 2018.

[181] Endeavour's response to information request IR005 Strategic Asset Renewal Plan FY19 – FY28. April 2018. Page 268.

5.4 Findings and Implications for proposed repex forecast

5.4.1 Findings

276. Whilst we support the in-principle inclusion of the type of projects and programs that Endeavour has proposed, Endeavour has not provided sufficient analysis and justification for its RP repex forecast, for reasons including that Endeavour:

- has not provided adequate justification for the composition of the forecast expenditure, which include material increases at the asset category level from the actual/estimated expenditure in the current RCP;
- presents replacement volumes that are primarily derived from an age-based forecasting method, that is likely to overstate the actual requirements;
- has not demonstrated that it has applied reliable asset condition and failure data, robust options, risk and cost-benefit analysis in support of the timing/volume of the activity; which is often described in business case documents or similar approval documents, and which have not been provided;
- has derived the repex forecast, at multiple instanced, from its long-term modelling outcomes using the VDA tool as discussed in Section 4, and which is primarily based on asset age. To the extent that Endeavour's eventual investment decisions will take greater account of asset condition, there is considerable evidence in Endeavour's documentation that this will result in lower expenditure.
- has included examples where 'nominal allocations' of expenditure have been provided that have not been adequately justified, such as by referring to asset condition or risk;
- has not adequately considered the potential for prioritisation and optimisation of the portfolio which may indicate a lower level of expenditure is a reasonable forecast of such expenditure requirements; and
- has not factored into its forecast the likely savings and investment deferrals that would be expected to be identified as individual projects are subjected to rigorous review and challenge through the IGF gate review process. There is significant evidence within Endeavour's documentation that, at these later stages in its decision process, it will find opportunities for more prudent and efficient options within the next RCP.

277. We have not been asked to specifically assess evidence of efficient costs employed by Endeavour in the development of its repex forecast. However, we have made observations within our review of the asset categories that suggests to us that further consideration of cost efficiency would likely reduce the forecast expenditure.

5.4.2 Implications

278. Based on the projects and programs we reviewed, we consider that both the modelled and un-modelled components of Endeavour's proposed repex are significantly above a reasonable prudent and efficient level. This view is unchanged when adjustments are made to the composition of the modelled and un-modelled repex forecast, to recognise that pole-top structures form part of the un-modelled expenditure.

279. In the table below, we present an assessment (by asset category) of the potential overstatement of Endeavour's RP repex forecast that is indicated by the nature of the issues we identified in our review.

Table 9: Summary implications for proposed repex forecast

Asset category	Forecast $m	Expenditure trend	Potential overstatement
Poles	159.5	Increasing	Moderate
Pole top structures	-		
Overhead conductor	89.5	Decreasing	Low
Underground cables	65.6	Increasing	High
Service wires	47.1	Decreasing	None
Transformers	106.7	Increasing	High
Switchgear	113.6	Increasing	High
SCADA	47.9	Increasing	Low
Other	170.8	Increasing	High

Source: EMCa analysis

6 Assessment of proposed augex

6.1 Introduction

280. In this section we provide our assessment of Endeavour's augex forecast. We first summarise Endeavour's proposed augex, before providing our assessment of Endeavour's forecast for each of 'Greenfields' and 'Brownfields' augex. Finally, we present the findings from our assessment, and we indicate the implications that these findings have for determining a reasonable forecast of Endeavour's prudent and efficient expenditure requirements.

6.2 Summary of proposed expenditure

281. Endeavour has proposed an augex forecast of $416.8m for the next RCP compared to the actual/estimated expenditure in the current RCP of $256.2m as shown in the table below, representing an increase of 63% (or $160.6m). Endeavour estimates it will underspend its augex allowance[182] for the current RCP by 18%.

[182] The allowance for augex is determined by Endeavour in its RP based on the AER's final decision for the 2014-19 RCP.

Table 10: Actual and forecast augex by category for the current and next RCP ($m, real June 2019)

$m, real June 2019 Asset type	Allowance 2014-19	Actual/ Estimate 2014-19	Forecast 2020-24
Brownfield	118.8	97.7	115.7
Greenfield	192.4	158.2	301.1
Total	**311.2**	**255.9**	**416.8**

Source: RP. Table 10.6

282. Endeavour is proposing higher expenditure for both Brownfield and Greenfield augex, with proposed Greenfield augex nearly doubling to $301.1m[183] from the current RCP to meet Endeavour's forecast growth in Greenfield land releases.

283. Endeavour advised that it expects to spend less than AER's allowance for augex in the current RCP[184], primarily due to the adoption of probabilistic planning and the increased use of staged solutions.[185]

284. Consistent with Endeavour's RP, we have separately assessed the augex categories of Greenfields and Brownfields. Endeavour's actual and forecast Greenfield and Brownfield augex by each of the asset types reported in the RIN for the current and next RCP is provided in the table below.

Table 11: Forecast augex by asset type for next RCP ($m, real June 2019)

$m, real June 2019	Next RCP					
Asset type	Forecast 2019-20	Forecast 2020-21	Forecast 2021-22	Forecast 2022-23	Forecast 2023-24	Total 2020-24
Subtransmission Substations, Switching Stations, Zone Substations	45.1	52.6	52.4	47.9	44.1	242.1
Subtransmission Lines	24.7	30.7	22.8	8.6	11.7	98.4
HV Feeders	8.2	4.8	4.2	4.6	4.5	26.3
HV Feeders - Land Purchases & Easements	0.0	0.0	0.0	0.0	0.0	0.0
Distribution Substations	0.6	0.6	0.6	0.6	0.6	3.2
Distribution Substations - Land Purchases & Easements	0.0	0.0	0.0	0.0	0.0	0.1
LV Feeders	1.0	1.0	1.0	1.0	1.0	4.9
LV Feeders - Land Purchases & Easements	0.0	0.0	0.0	0.0	0.0	0.0
Other Assets	13.9	4.9	4.5	8.1	10.3	41.8
Total	**93.5**	**94.7**	**85.4**	**70.9**	**72.2**	**416.8**

Source: Endeavour Reset RIN

[183] Note this figure, reported from Table 10, is different to the equivalent figure from Table 13 due to rounding errors.

[184] Based on its assessment of the AER's allowance for augex for the current RCP.

[185] Endeavour onsite meeting. Augex Overview Presentation. Slide 3.

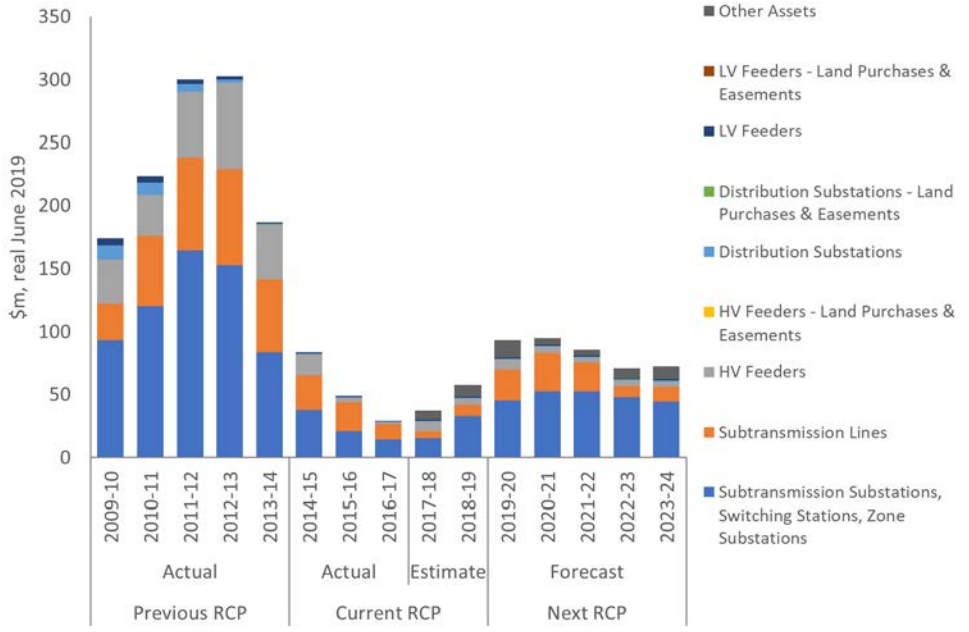
Table 12: Actual/Estimated augex by asset type for current RCP ($m, real June 2019)

$m, real June 2019	Current RCP					
Asset type	Actual 2014-15	Actual 2015-16	Actual 2016-17	Estimate 2017-18	Estimate 2018-19	Total 2015-19
Subtransmission Substations, Switching Stations, Zone Substations	37.5	21.3	14.6	15.4	32.9	121.7
Subtransmission Lines	27.5	22.2	12.1	5.8	8.8	76.4
HV Feeders	17.1	3.9	1.4	7.4	5.1	34.8
HV Feeders - Land Purchases & Easements	0.0	0.0	0.0	0.0	0.0	0.0
Distribution Substations	0.6	0.4	0.4	0.6	0.6	2.7
Distribution Substations - Land Purchases & Easements	0.0	0.0	0.0	0.0	0.0	0.1
LV Feeders	1.0	0.8	0.7	1.2	1.0	4.7
LV Feeders - Land Purchases & Easements	0.0	0.0	0.0	0.0	0.0	0.0
Other Assets	0.0	0.0	0.0	6.7	9.2	15.8
Total	**83.7**	**48.6**	**29.3**	**37.1**	**57.5**	**256.2**

Source: Endeavour Reset RIN

285. In the figure below, the profile of augex over the previous, current and next RCP is shown. From a most-recent low actual expenditure in 2016/17, Endeavour estimates that augex will increase markedly over the last two years of the current RCP and it forecasts expenditure to climb further at the start of the next RCP to an elevated level of augex, that is forecast to continue throughout the next RCP. A similar ratio of Brownfields to Greenfields augex is maintained throughout the next RCP.

Figure 24: Augex by asset type – previous, current and next RCP ($m, real June 2019)



Source: Endeavour Reset RIN

6.3 Greenfield augex

6.3.1 Endeavour's forecast

286. Endeavour explained at the onsite meeting that the increase in Greenfield augex (+90%) for the next RCP is due to:

- a forecast increase in new Greenfield land release areas; and

- a reduction in available zone substation capacity 'headroom' in the current RCP.

287. Endeavour's proposal includes: (i) three new zone substations in industrial precincts; (ii) 13 new zone substations in residential precincts; (iii) the deployment of 3 mobile substations; and (iv) site purchases for future zone substations.

288. Endeavour included a list of Greenfield projects in its Growth Servicing Plan, as shown in the table below.[186,187]

Table 13: Summary of Greenfield Projects for the next RCP ($m, real June 2019)

$m, real June 2019		Current RCP	Next RCP					
		Estimate	Forecast	Forecast	Forecast	Forecast	Forecast	Total
ID	Description	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2020-24
PR110	Edmondson Park ZS establishment	2.2	1.9	0.0				1.9
PR248	Penrith Lakes ZS site acquisition					1.0		1.0
PR249	Establish Penrith Lakes 33/11kV Zone Substation						3.6	3.6
PR258	Menangle Park 66/11kV ZS establishment	3.8	3.5					3.5
PR292	South Marsden Park (industrial) 132/11kV ZS establishment	14.5	9.6					9.6
PR423	Maryland ZS establishment			4.2	8.3	8.3		20.8
PR425	Austral ZS establishment (interim initially)			2.4				2.4
PR427	Leppington North ZS establishment	10.0	2.9	0.3				3.2
PR430	North Rossmore ZS site purchase					3.0		3.0
PR432	Rossmore ZS site purchase						3.0	3.0
PR438	North Bringelly ZS site purchase						3.5	3.5
PR499	Southpipe (Oakdale Estate) ZS 132/11kV establishment		5.5	12.9	8.9			27.3
PR602	Riverstone West site purchase							0.0
PR620	West Dapto ZS establishment				2.5	4.9	4.9	12.3
PR656	Leppington South ZS establishment (permanent)	10.9	12.2	1.9				14.1
PR657	Calderwood ZS establishment (interim initially)	0.2	7.9	7.9				15.7
PR659	Avondale (South West Dapto) 132/11kV Zone Substation							0.0
PR698	Marsden Park (residential) 132/11kV ZS - stage 2		3.5	5.5				8.9
PR703	Riverstone East site purchase		6.0					6.0
PR713	Box Hill 132/22kV ZS establishment		5.0	15.9	13.9			34.8
PR717	Acquire improved site for West Dapto ZS		2.0					2.0
PR722	Camellia TS connection works for Ausgrid	0.2	0.0	0.1				0.1
PR723	Supply to Luddenham Science Park		6.1	18.2	16.2			40.5
PR724	Establish Mt Gilead ZS				3.9	7.7	7.7	19.3
PR727	Luddenham ZS site purchase		1.0					1.0
PR728	Western Sydney Employment Lands ZS				4.7	9.4	9.4	23.5
PR739	South Gilead (South Campbelltown)						3.9	3.9
PR742	North Bomaderry ZS establishment				3.7	7.4	7.4	18.5
PR744	Termeil ZS establishment					4.0	4.0	7.9
PR748	Establish permanent Catherine Park ZS				1.9	3.8	3.8	9.6
	Total Augex Greenfield (Excl contingent projects)	41.8	66.9	69.2	64.0	49.6	51.2	300.8

Source: RP Attachment 10.10, Growth Servicing Plan 2018. March 2018. Page 14

289. Endeavour is forecasting strong growth in Greenfield release areas. Endeavour's forecasts are based on connection forecasts developed by the NSW Department of Planning for residential precincts, and information provided by developers for commercial precincts. This information is sense-checked against Housing Industry Association data and Endeavour's own data on new connections.

[186] RP Attachment 10.10, Growth Servicing Plan 2018. March 2018

[187] Total Greenfield augex reported in this figure differs from the figure provided in Endeavour's RP. We consider the difference to be immaterial and does not impact our assessment based on RIN data.

290. We have not been asked to review demand and connection forecasts, however we have provided observations on Endeavour's application of the demand forecasts in Section 4 as they are the primary determinant of Greenfield augex.

6.3.2 Our assessment

Identifying improved network-based options

291. Endeavour explained that it undertakes a 'staged approach' to providing additional capacity that enables lower cost solutions to meet capacity requirements in the near term. These utilise spare capacity at existing zone substations, thus allowing large investments such as establishing new zone substations to be deferred as long as possible.

292. We reviewed a number of business cases including Box Hill, West Dapto, and Mt Gilead zone substation establishment projects. These projects provide evidence of Endeavour's application of a staged approach to provide additional capacity in the current RCP in response to Greenfield growth - primarily by using feeder augmentations utilising spare capacity at existing substations. In the case of West Dapto, Endeavour proposes trialling a 1MW battery to meet peak demand in the short term.[188]

293. Many of the projects in the next RCP, including the projects in the paragraph above, have not been subjected to review and challenge at Gates 2 and 3 of Endeavour's IGF. The business cases for these projects include assessment of a single alternate network option to the preferred solution (e.g. the Mount Gilead Zone substation business case only includes assessment of the option to establish distribution feeders to defer the establishment of the new zone substation). The one alternative to the preferred option is only described at a high level. Both network options are compared using Endeavour's model. The option with the highest NPV is selected as the preferred option.

294. Endeavour explained at the onsite meeting that it engages a more thorough review and challenge process at Gates 2 and 3 when design options are fully scoped and all feasible options are considered (including through the RIT-D process at Gate 2) and before investment is approved.[189]

295. Endeavour explained that it is forecasting to underspend its augex allowance in the current RCP by $50m and cited two examples where it has deferred zone substation investment through alternative network solutions. For Box Hill, Endeavour invested $7m[190] on two additional 22kV feeders. Endeavour described the alternative network solution to zone substation as follows: '*This investment included a project to convert the existing rural standard 11kV network to 22kV. The 22kV conversion works allowed previous plans for two zone substations in the area (Box Hill and Box Hill North) to be combined into a single future zone substation project due to the additional reach of the 22kV feeders. These 22kV feeders were commissioned in March 2017 and allowed a deferral of the proposed Box Hill Zone*

[188] We understand from onsite discussions that this battery has been installed.

[189] Endeavour onsite meeting, Governance Framework Presentation, 13 June 2018, Slide 9.

[190] Endeavour onsite meeting, Augex Overview Presentation. 14 June 2018. Slide 3.

Substation.'[191] Endeavour also invested $5m in 11kV feeders to defer the Catherine Park zone substation.[192]

296. Endeavour has not provided evidence to demonstrate that its Greenfield augex forecast allows for the likelihood that some projects, particularly in the later years of the next RCP, will be deferred by implementing network alternatives identified through Endeavour's Gates 2 and 3 review and challenge process.

Identification of Non-network solutions

297. Endeavour considers non-network alternatives at Gate 2 through the RIT-D process. The NER requires[193] the RIT-D process to include a Screening Test Report to explore the feasibility of non-network solutions, a Non-Network Options Report that summarises credible options, and a Project Assessment Report detailing the preferred option.

298. Endeavour has not included allowance for non-network alternatives in its Greenfield augex forecast. Most of the projects included in Endeavour's Greenfield augex forecast are at Gate 1, which is pre-RIT-D. For the projects for which non-network investigations are underway (South Marsden Park, South Leppington & Menangle)[194], we understand these are still at the stage of assessing non-network solutions and Endeavour's Greenfield augex forecast does not allow for the likelihood that any of these projects could be deferred by non-network solutions.

299. Endeavour advised at the onsite meeting that in the past it has had only limited success in acquiring non-network solutions through the RIT-D's non-network options investigations. In its *Demand Management and Non-network Supply Strategy*, Endeavour states that: '*Demand Management programs are ineffective in limiting this growth in infrastructure, which is required simply for the number of customer connections required irrespective of the loading presented by each customer*.'[195]

300. We accept there is a need to build infrastructure in greenfield areas, however we consider there is a role for non-network solutions to enable deferral of major investment. For example, the Box Hill business case states:[196] *'[a]vailable capacity from Mungerie Park ZS will also approach its firm capacity of 90 MVA in 2023'* and *'this operating condition means that any further 22kV feeders from Mungerie Park ZS to Box Hill will exceed firm capacity at Mungerie Park ZS and start to introduce additional expected unserved energy. A business case to support the establishment of Box Hill ZS will allow the bulk transfer of 18 MVA from Mungerie Park to Box Hill ZS as well as supporting the new residential subdivisions of Box Hill.'* In scenarios such as this,[197] it might be possible to use non-network solutions

[191] RP Attachment 10.23, Box Hill Zone Substation Business Case. Page 4.

[192] Endeavour onsite meeting, Augex Overview Presentation. 14 June 2018. Slide 3.

[193] NER 5.17.4.

[194] Endeavour onsite meeting. Augex Overview Presentation. 14 June 2018. Slide 20.

[195] RP Attachment 10.12 Demand Management & Non-network Options Strategy. February 2018. Page 8.

[196] Endeavour, Business Case – Box Hill. Page 6.

[197] Note this scenario has been selected to help illustrate the point only and we are not necessarily suggesting that a non-network solution will enable this particular investment to be deferred.

from existing customers supplied by the Mungerie zone substation to defer the need for the Box Hill zone substation.

301. The electricity industry is undergoing technological transformation and customers' needs from the grid are changing, as also recognised by Endeavour in its *Demand Management and Non-Network Options Strategy*.[198] It is reasonable to expect that the improving economics of distributed energy resources, supported by the non-network pilots and trials Endeavour has and is undertaking[199], will reduce customer demand for supply from the grid over the next 5 years. Given the uncertainty of the demand outlook beyond even the next two years, it would be prudent for Endeavour to defer major investments for as long as possible.

302. Endeavour has not provided sufficient evidence to demonstrate that its Greenfield augex forecast allows for the reasonable likelihood that some projects may be prudently deferred by implementing non-network alternatives identified through proactively applying relevant RIT-D processes at approval Gate 2.

6.4 Brownfield augex

6.4.1 Endeavour's forecast

303. The majority of the Brownfield augex forecast is directed towards sub-transmission augmentation ($81.1m) with the balance for HV and LV distribution augmentation ($34.9m).[200]

304. Endeavour has included six sub-transmission projects in its expenditure forecast for the next RCP totalling $81.1m[201] as shown in the table below.

[198] RP Attachment 10.12 Demand Management & Non-network Options Strategy. February 2018. Page 4.

[199] Endeavour onsite meeting. Augex Overview Presentation. 14 June 2018. Slide 22.

[200] Totals differ from RP which may be due to rounding

[201] RP Attachment 10.10 Growth Servicing Plan. March 2018. Figure 8.2.

Table 14: Summary of sub-transmission brownfield projects for the next RCP ($m, real June 2019)

$m, real June 2019		Current RCP	Next RCP					
		Estimate	Forecast	Forecast	Forecast	Forecast	Forecast	Total
ID	Description	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2020-24
PR113	Augment feeder 308 Nepean to Douglas Park	0.5	6.1					6.1
PR677	South Penrith Zone Substation		4.6	13.2	10.2			28.1
PR700	Riverstone east ZS establishment				4.1	8.3	8.3	20.6
PR732	Feeder 214/215 contraints		4.7	4.7				9.5
PR751	Parklea ZS to Bella Vista ZS load transfer		4.0					4.0
PR754	Augment Westmead Zone substation					6.4	6.4	12.8
	Total Augex Brownfield (Excl contingent projects)	**0.5**	**19.4**	**18.0**	**14.4**	**14.7**	**14.7**	**81.1**

Source: RP Attachment 10.10 Growth Servicing Plan. March 2018

305. Endeavour has included three distribution projects in the next RCP totalling $34.9m[202] as shown in the table below.

Table 15: Summary of distribution brownfield projects for the next RCP ($m, real June 2019)

$m, real June 2019		Current RCP	Next RCP					
		Estimate	Forecast	Forecast	Forecast	Forecast	Forecast	Total
ID	Description	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2020-24
HVW	HV development works	7.1	6.8	7.1	6.6	6.3	5.9	32.8
AG	Automation - operational/capacity risk	0.3	0.3	0.3	0.3	0.3	0.3	1.5
LV001	Overloaded distribution sub uprates	0.1	0.1	0.1	0.1	0.1	0.1	0.6
	Total Augex Brownfield (Excl contingent projects)	**7.5**	**7.2**	**7.5**	**7.1**	**6.7**	**6.4**	**34.9**

Source: RP Attachment 10.10 Growth Servicing Plan. March 2010

6.4.2 Our assessment

Subtransmission expenditure requirement is likely to be overstated

306. We considered a sample of proposed projects and found in most cases that, taking the load growth projections as a given,[203] there are network constraints that are likely to require some form of intervention within the next ten years to mitigate the risk of significant loss of supply to customers and/or to avoid non-compliant outcomes.[204]

307. However, we have found that the alternative(s) to building a new substation considered in the business cases typically omit(s) robust consideration of one or more potentially credible alternatives,[205] including non-network solutions. Given the

[202] *Ibid*. Page 15.

[203] As per the scope of our engagement

[204] In some cases, there is insufficient information provided in the documentation we have reviewed to enable a reasonable view to be reached about the extent of the risk posed by some network constraints.

[205] For example – increasing distribution transfer capacity, use of temporary or mobile substations; installing a 3rd transformer at an existing substation.

strong forecast load growth in each case, we expect that zone substations will generally be required eventually, but it is likely that a combination of network and non-network solutions will enable prudent deferral. Opportunities may arise through load growth not occurring at the forecast rate, or differences in the geographic nature of that growth, or through refining the means of providing for that load growth, such that some planned substations may not be needed. For example:

- Endeavour's South Penrith zone substation business case states that *'[g]iven previous interest in non-network proposals and the diverse nature of the load supplied currently, Endeavour Energy considers that non-network options may be feasible in this area to defer the network build option and/or manage the risks of unserviced load thus allowing further connections to be made'*;[206] and
- Endeavour's Westmead zone substation business case does not consider a non-network solution at all (neither does it include any network alternative options). In our view, given the substation is currently not scheduled to be commissioned until 2023/24[207], there is ample time to work with the hospital, developers, and existing customers to investigate non-network (and network) options.

308. In the 'probabilistic VCR' models for the two Brownfield projects that we have reviewed,[208] we observe that the economic timing of the proposed new zone substations appears to be beyond 2024.[209] Specifically, an output of the probabilistic VCR model is the calculated congestion cost (energy not served valued at VCR[210]), which increases with the forecast load, which in every case is assumed to grow. It is compared to the annualised cost of the investment. Whilst not referenced in the 'Guideline' on its probabilistic model, we interpret the point at which the avoided congestion cost (i.e. the benefit) exceeds the annualised cost of the proposed investment to realise that benefit, to be the economically optimum time at which to complete the investment. This indicates that completion of the two projects should be deferred to the RCP commencing in 2024/25, noting that some expenditure may still be required in the next RCP given the typical project development time of 3-5 years.

309. We also noted in its modelling that:

[206] Endeavour 's response to information request IR005 PR677 South Penrith ZS. March 2018. Page 7.

[207] RP Attachment 10.10 Growth Servicing Plan. March 2018. Figure 8.2.

[208] For projects PR700 (3 x economic models) and PR677 (2 x economic models), and associated business cases.

[209] As indicated by the 'congestion cost vs the annualised option cost for the preferred option (i.e. zone substation establishment) in the Probabilistic VCR spreadsheets for Riverstone and South Penrith ZS projects.

[210] VCR appears to be based on AEMO's guidelines, and are applied for Expected Unserved Energy, which is energy at risk if an N-1 outage occurs. Endeavour applies the term 'Energy Definitely Not Served' for situations where the forecast demand on a zone substation exceeds the firm capacity, and assume the cost of energy above installed capacity is valued at VCR '*only up to a fraction above installed capacity';* beyond this value it values the energy at $500/MWh on the assumption that it would have implemented a solution well before installed capacity is exhausted. Endeavour's response to information request IR005 *Guideline on NPV Probabilistic Spreadsheet using Monte Carlo.* Pages 3-4 and *Endeavour's response to information request EMCaEND069,*

- Endeavour's assumed plant failure rates are set at constant values and are not based on its own data.[211] Constant failure rates will tend to understate the probability of failure over time for the network elements modelled. It is not clear why Endeavour has not sought to calibrate the assumed failure rates against its own data;
- Endeavour does not appear to include distribution transfer capacity in its calculation of the restoration time in the event of transformer failure, which we consider to be an overly conservative omission; and
- a transformer MTTR of 2.6 months is assumed, which we consider to be very conservative.[212]

310. These observations cast further doubt on the usefulness of the VCR model beyond limited options comparison.

311. In summary, we do not consider that Endeavour has satisfactorily demonstrated that all of the proposed Brownfields augex expenditure is likely to be required in the next RCP.

Distribution works program is not adequately justified

312. The Distribution Works Program dominates the distribution Brownfield augex at $32.8m. Endeavour has advised that it expects to underspend its estimate in the current RCP by $24m as a result of a mix of scope reductions and delivery efficiencies. We understand that the proposed expenditure of $32.8m for the next RCP is broadly based on the same 'risk-based' approach it used in the current RCP and more efficient unit costs.

313. Within the program there are 11 sub-programs, three of which represent the majority of the proposed expenditure: (i) conductor fault level exceedance ($9.1m); (ii) distribution networks standards ($6.9m); and (iii) auto reclose backup ($6.5m).

314. Endeavour advises that it has used a 'risk-based' approach for each of these sub-programs to prioritise the work, with the result that only a fraction of the constraints or non-compliances identified through its load flow and other analyses are planned to be addressed each year.[213] However, in the sub-programs we found that:

- the definition of risk is typically not well explained in the context of what is included in the program and what is not;[214]
- it is not clear what work is being done;[215] and

[211] Endeavour's response to information request IR005 *Guideline on NPV Probabilistic Spreadsheet using Monte Carlo*, Page 1-4.

[212] We consider an MTTR of 14 -30 days to be more reflective of the time to replace a failed transformer if the alternative is load shedding and assuming competent contingency planning (including a compatible spare transformer, circuit breaker, etc).

[213] E.g. 'less than 10% of feeder constraints require investment per year' – Endeavour onsite meeting. Augex Overview Presentation. Slide 38.

[214] With the exception of de-rated feeder cables, which represents less than 2% of the proposed Distribution Works expenditure category, it is not clear from Attachment 10.05 (Distribution Works Program), what risk criteria are used and how they are applied to derive the proposed expenditure.

[215] For example, the driver of the new auto reclose program is said to be NER S5.1.9 '*regarding protection systems and fault clearance times…[and] backup protection issues associated with the failure of auto reclosers'* and *'…investigation into the back up protection requirements is underway.'* [per Endeavour

- the basis for the volume of work is not clearly established.[216]

315. On this basis, we do not consider that Endeavour has provided sufficiently compelling justification for its Distribution Works Program. We consider that some lower amount than the $32.8m forecast is likely to represent a prudent and efficient expenditure level.

6.5 Findings and Implications for proposed augex forecast

6.5.1 Findings

316. Endeavour has identified sub-transmission and distribution works that may be required at some time in the future to respond to load growth[217] and technical compliance obligations. However, Endeavour has not provided sufficient analysis and justification for its RP augex forecast. We found the following issues:

- inadequate justification for configuring the numerous new zone substations in greenfield areas based almost entirely on 11kV distribution voltage;
- inadequate identification and consideration of network options, particularly those which could defer zone substation establishment;
- inadequate consideration of the potential impact of non-network solutions (when or if these are considered in more detail later in the project development life cycle);
- potentially conflicting project timing – with the proposed project expenditure profiles and the results of 'probabilistic VCR model' studies appearing to materially differ for some projects; and
- for the Distribution Works Program,[218] lack of sufficient evidence to demonstrate that the volume of work proposed is prudent and efficient due primarily to the lack of detail about the 'risk-based approach'.

317. Whilst we have not been asked to specifically assess Endeavour's demand forecast, demand growth is the primary driver for augmentation expenditure. A small reduction in Endeavour's demand growth projections at the substations or catchment areas in question could lead to potentially significant deferral of some augex projects. Deferral by just one year for projects with proposed expenditure only in the final year of the next RCP would lead to a material reduction to Endeavour's augex forecast for the next RCP.

Energy - 10.05 Distribution Works Program - April 2018 – Public, section 5.3.1] It is not clear what these 'issues' are, what is being done, what options were considered, and why 'fixing' 143 auto-reclosers in the next RCP is reasonably justified given that 'investigations are still underway'.

[216] For example, 31 conductor fault level exceedances are planned to be rectified in 2019/20 and about another 24 p.a. in the remainder of the RCP, and yet only nine 'exceedances' were rectified in in 2017/18 (the latest available historical information) [per RP Attachment 10.05 Distribution Works Program. April 2018. Diagram 2].

[217] Consideration of demand forecasts was not within scope for our review.

[218] Also referred to as 'HV Development works'

318. Endeavour has demonstrated that during the current RCP, it has delivered more efficient options to address demand growth and deferred other projects until a subsequent RCP. These options have been identified at Gates 2 and 3 of its IGF. We consider that Endeavour will find at least similar opportunities in the next RCP, and possibly increasing opportunities due to the rapid changes that are occurring in distributed supply and demand management solutions. Endeavour's aggregation of what are mostly Gate 1 projects has led it to propose a forecast that has not factored in the likelihood that some projects will be deferred from the next RCP into subsequent RCPs.

319. We consider that it is likely that Endeavour will find opportunities for more prudent and efficient options within the next RCP as it undertakes the detailed planning in preparation for the RIT-D process and also as a result of feedback from the process. These network and non-network options are likely to allow some of the forecast expenditure for proposed sub-transmission augex projects (both Greenfield and Brownfield) to be reduced in the current RCP.

6.5.2 Implications

320. We consider that a moderately reduced level of augex (Greenfield and Brownfield) than has been proposed by Endeavour is more likely to reflect a prudent and efficient level of expenditure.

Appendix A – Record of Information Request Responses & RP Supporting Documents

Documents which EMCa has assessed to support its findings

Endeavour Regulatory proposal and Supporting documents

Filename
• Appendix F - TS146 Noise Report - 6260-1.1R draft 2.pdf
• Appendix G - TS146 Marayong ZS cost and risk assessment, r9.pdf
• Endeavour Energy - 7.02 - NIEIR - Post Modelling Adjustments for Demand Forecasts - June 2016 - Public.pdf
• Endeavour Energy - 7.03 - NIEIR - Economic Scenarios for the Endeavour Region 2017-2029 - September 2017 - Public.pdf
• Endeavour Energy - 7.04 - Cutler Merz - Review of Demand Forecasts and Basis for Spot Load Growth for 2019-2024 - April 2018 - Public.pdf
• Endeavour Energy - 0.01 Regulatory Proposal - April 2018 - Public.pdf
• Endeavour Energy - RIN0.01 Final RIN Workbook 1 Reset (Consolidated) - 30 April 2018 - Confidential.xlsm
• Endeavour Energy - 10.19 Capex for previous, current and forecast period - April 2018 - Public.xlsx
• Endeavour Energy - 10.16 Capex Listing (PIP) - April 2018 - Public.xlsm
• Endeavour Energy - RIN0.05 Basis of Preparation - 30 April 2018 - Public.pdf
• Endeavour Energy - 10.03 Capex Proposal (SAMP) - March 2018 - Public.pdf
• Endeavour Energy - 0.07 Expenditure Forecasting Methodology Statement - June 2017 - Public.pdf
• Endeavour Energy - 10.02 Asset Management Strategy - April 2018 - Public.pdf
• Endeavour Energy - 10.01 Network Strategy - April 2018 - Public.pdf
• Endeavour Energy - 10.04 Repex Proposal (SARP) - March 2018 - Public.pdf
• Endeavour Energy - 10.09 Growth Strategy - February 2018 - Public.pdf
• Endeavour Energy - 10.10 Growth Servicing Plan 2018 - March 2018 - Public.pdf

Filename
• Endeavour Energy - 10.12 Demand Management & Non-network Options Strategy - February 2018 - Public.pdf
• Endeavour Energy - 10.27 ICT Investment Plan - February 2018 - Confidential.pdf
• Endeavour Energy - 10.28 KPMG - ICT Benchmarking Report - November 2017 - Confidential.pdf
• Endeavour Energy - 10.29 Fleet Capex Plan - March 2018 - Confidential.pdf
• Endeavour Energy - 10.30 Buildings, Property and other Non-network Capex Plan - March 2018 - Public.pdf
• Endeavour Energy - Nuttall - 10.25 Assessing the Endeavour Energy Augex Forecast - February 2018 - Public.pdf
• Endeavour Energy - 10.22 Augex Area Plans - April 2018 - Public.zip
• Endeavour Energy - 10.07 STPIS - March 2018 - Public.pdf
• Endeavour Energy - 10.15 Company Policy 6.9 - Capital Expenditure Overhead Calculation - September 2014 - Public.pdf
• Endeavour Energy - 0.08 Board Certified Key Assumptions - April 2018 - Public.pdf
• Endeavour Energy - 0.09 Connection Policy - January 2018 - Public.pdf
• Endeavour Energy - Minister for Resources, Energy and Utilities - 10.08 Licence Conditions - June 2017 - Public.pdf
• Endeavour Energy - Nuttall - 10.21 Assessing Endeavour Energy's Replacement Forecast - February 2018 - Public.pdf
• Endeavour 10.16 Capex Listing (PIP) Reconciliation.xlsm
• Endeavour Energy - 10.06 2017 Distribution Annual Planning Report - December 2017 - Public.pdf
• Endeavour Energy - 10.08 - Minister for Resources, Energy and Utilities - Licence Conditions - June 2017 - Public.pdf
• Endeavour Energy - 10.11 Transmission Network Planning Review 2017-2026 - October 2017 – Public.pdf
• Endeavour Energy - 7.01 2018-2027 Summer Demand Forecast - August 2017 - Public.pdf
• Endeavour Energy - 10.32 Western Sydney Airport Growth Area - Contingent Project Business Case - April 2018 - Public.pdf
• RIT-D Final Project Assessment Catherine Park PR437 Final.pdf
• RIT-D Final Project Assessment North Leppington PR427 published.pdf
• NIO PR674 Draft Marsden Park Industrial Capacity limitation_final.pdf
• RIT-D Final Project Assessment Box Hill PR184.pdf
• Business Case - Austral Zone Substation FINAL.pdf
• Business Case - Box Hill FINAL.pdf
• Business Case - Calderwood.pdf
• Business Case - Catherine Park FINAL.pdf

Filename
• Business Case - Maryland and Lowes Creek FINAL.pdf
• Business Case - Mt Gilead FINAL.pdf
• Business Case - North_Bomaderry_FINAL.pdf
• Business Case - Riverstone East FINAL.pdf
• Business Case - Science Park FINAL.pdf
• Business Case - Westmead FINAL.pdf
• NIO Report PR656 - Supply for the East Leppington & Leppington Precincts.pdf
• Non-Network Options Report - South Marsden Park ZS.pdf
• PR258 Menangle Park - Advanced copy of Non Network Options Report.pdf
• RIT-D Project Assessment South Marsden Park Stage 2 PR292.pdf
• Screening for Non Network Options-South Leppington ZS (Stage 2).pdf
• Area Plan - Western Sydney Priority Growth Area.pdf
• West Lake Illawarra Plan (Final).pdf
• Final South West Sector Area Plan.pdf
• North West Priority Growth Area Plan 2018 V3 FINAL.pdf
• Endeavour Energy - 10.21 - Nuttall - Assessing Endeavour Energy's Replacement Forecast - February 2018 - Public.pdf
• DS307.19 MD4 switchgear replacement.pdf
• TS617 Prospect ZS transformer replacement 2017-18.pdf
• PS012 Distribution Feeder Safety Improvement - 2018-19.pdf
• TS177 Substation Battery Duplication - FY18.pdf
• PS008 Substation Protection Relay Refurb -17-18 Stage 2.pdf
• PS008 Substation Protection Relay Refurb -17-18.pdf
• TS700 11kV Switchboard Replacement - 2017-18.pdf
• DS006.19 CONSAC replacement.pdf
• TS155 Sussex Inlet ZS.pdf
• DS011.18 Steel mains - 2017-18.pdf
• TM171 Replacement of corroded earth wires - FY18.pdf

Filename
• Appendix A - SNN - Marayong ZS TS146 (r1).pdf
• Appendix E - Marayong ZS Condition Assessment.pdf
• TS146 - Marayong ZS NIO (r3.1).pdf
• Endeavour Energy - 10.17 AER Repex Model - April 2018 - Public.zip

Endeavour documents received before/on assessment cut-off date (29th June)

AER Ref#	EMCa Ref#	Date received	File Name
IR005	EMCaEND001	8/06/2018	• Endeavour Energy - IR005 Branch Procedure BFN0019 Investment Evaluation Review - January 2017 - Public.pdf
IR005	EMCaEND002	8/06/2018	• Endeavour Energy - IR005 Company Procedure GRM0052 Non-system Investment Governance - June 2016 - Public.pdf
IR005	EMCaEND003	8/06/2018	• Endeavour Energy - IR005 Company Policy 9.0 Network Asset Management - August 2017 - Public.pdf
IR005	EMCaEND004	8/06/2018	• Endeavour Energy - IR005 2017-18 Demand Management Plan - November 2017 - Public.pdf
IR005	EMCaEND005	8/06/2018	• Endeavour Energy - IR005 Network Maintenance Implementation Plan - March 2018 - Public.pdf
IR005	EMCaEND006	8/06/2018	• Endeavour Energy - IR005 Reliability Work Program FY18 - September 2017 - Public.pdf • Endeavour Energy - IR005 Reliability Work Program FY19 - June 2018 - Public.pdf
IR005	EMCaEND007	8/06/2018	• Endeavour Energy - 10.31 Future Network Strategy - March 2018 - Public.pdf
IR005	EMCaEND008	8/06/2018	• Endeavour Energy - IR005 Workforce Strategy - January 2017 - Confidential.pdf
IR005	EMCaEND009	8/06/2018	• Endeavour Energy - IR005 ENAMC Charter - August 2017 - Public.pdf
IR005	EMCaEND010	8/06/2018	• Endeavour Energy - IR005 IGC Charter - December 2017 - Public.pdf
IR005	EMCaEND011	8/06/2018	• Endeavour answered EMCa questions. No attachment

AER Ref#	EMCa Ref#	Date received	File Name
IR005	EMCaEND012	8/06/2018	• Endeavour Energy - IR005 Board Policy 2.0.5 Risk Management - August 2017 - Public.pdf • Endeavour Energy - IR005 Company Procedure GAM0110 Gate 1 Portfolio Investment Plan Approval - August 2016 - Public.pdf • Endeavour Energy - IR005 Company Procedure GRM0051 Network Investment Governance - November 2016 - Public.pdf • Endeavour Energy - IR005 Division Procedure GNV1119 Quantitative Risk Measures - May 2016 - Public.pdf • Endeavour Energy - 10.13 Company Policy 2.6 - Investment Governance Framework - April 2016 - Public.pdf • Endeavour Energy - 10.14 Company Policy 9.2.1 Network Planning - May 2016 - Public.pdf
IR005	EMCaEND013	18/06/2018	• Endeavour Energy - IR005 Company Policy 9.0 Network Asset Management -
IR005	EMCaEND014	8/06/2018	• Endeavour answered EMCa questions. No attachment
IR005	EMCaEND015	8/06/2018	• Endeavour answered EMCa questions. No attachment
IR005	EMCaEND016	8/06/2018	• Endeavour answered EMCa questions. No attachment
IR005	EMCaEND017	08/06/2018	• Endeavour Energy - IR005 AU013 Asset Class Plan - March 2018 - Public.pdf • Endeavour Energy - IR005 AU013.19 Project Scope SCADA Master Station Development Software FY19 - March 2018 - Public.pdf • Endeavour Energy - IR005 Division WPI WNV1070 Neutral Integrity Investigation on CONSAC - February 2018 - Public.pdf • Endeavour Energy - IR005 DS005 Preliminary Program Approval - February 2018 - Confidential.pdf • Endeavour Energy - IR005 DS005.19 Project Scope Distribution Pole Replacement - March 2018 - Public.pdf • Endeavour Energy - IR005 DS006 MASTER LIST - November 2017 - Public.xlsx • Endeavour Energy - IR005 DS006.19 PS CONSAC Replacement - November 2017 - Public.pdf • Endeavour Energy - IR005 DS007 Service Mains Replacement BC - November 2013 - Public.pdf • Endeavour Energy - IR005 DS011 Steel Mains Master List - March 2018 - Public.xlsx • Endeavour Energy - IR005 DS011 Steel Mains Modelling - June 2016 - Public.pdf • Endeavour Energy - IR005 DS011.19 BC HV Distribution Steel Mains Renewal FY19 to FY20 - March 2018 - Public.pdf • Endeavour Energy - IR005 DS307 Master List - March 2018 - Public.xlsx • Endeavour Energy - IR005 DS307 SAN 12kV Holec MD4 Swgr - June 2017 - Public.pdf • Endeavour Energy - IR005 DS307 TB 0236 Inspection and Testing - May 2017 - Public.pdf • Endeavour Energy - IR005 DS307 TB 0236 Inspection and Testing - May 2017....pdf

AER Ref#	EMCa Ref#	Date received	File Name
			• Endeavour Energy - IR005 DS307.19 Project Scope MD4 Switchgear Replacement - November 2017 - Public.pdf • Endeavour Energy - IR005 DS312.19 PS Miscellaneous Substation Renewal Expenditure - April 2018 - Public.pdf • Endeavour Energy - IR005 DS405 ABS RCM Impact Assessment - March 2014 - Public.pdf • Endeavour Energy - IR005 DS405 ABS Replacement Process Improvement - August 2016 - Public.pdf • Endeavour Energy - IR005 DS405 Master List for ABS Replacement Scoping Lockout - June 2018 - Public.xlsx • Endeavour Energy - IR005 DS405.19 Project Scope Air-Break Switch Replacement - November 2017 - Public.pdf • Endeavour Energy - IR005 DS414 Copper Distribution Mains Replacement BC 2018-19 - November 2017 - Public.pdf • Endeavour Energy - IR005 DS418 Full List of Pole Top Hardware Defects COGNOS - June 2018 - Public.xlsx • Endeavour Energy - IR005 DS418 LV Pole Top Structure Hardware Refurbishment Approval - April 2018 - Confidential.pdf • Endeavour Energy - IR005 DS418.19 Project Scope LV Pole Top Structure Hardware Refurbishment - April 2018 - Public.pdf • Endeavour Energy - IR005 DS421 HV Pole Top Structure Hardware Refurbishment Approval - April 2018 - Confidential.pdf • Endeavour Energy - IR005 GMAM Preliminary Program Approvals under 1M FY19 - March 2018 - Confidential.pdf • Endeavour Energy - IR005 MDI 0026 Location of isolation points on the high voltage distribution network - November 2015 - Public.pdf • Endeavour Energy - IR005 MMI 0001 Pole and line inspection and treatment procedures - November 2016 - Public.pdf • Endeavour Energy - IR005 PS008 Substation Protection Relay Refurbishment BC 2017-18 - April 2017 - Public.pdf • Endeavour Energy - IR005 SARP 2018-19 - April 2018 - Public.pdf • Endeavour Energy - IR005 TM012 Preliminary Program Approval - February 2018 - Confidential.pdf • Endeavour Energy - IR005 TM012.19 Project Scope Transmission Pole Replacement FY19 - March 2018 - Public.pdf • Endeavour Energy - IR005 TM015 Steel Tower Painting BC and PD (TM801) - January 2016 - Public.pdf

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			• Endeavour Energy - IR005 TM015 Tower Condition Assessment - April 2018 - Public.xlsx • Endeavour Energy - IR005 TS148 West Wollongong ZS SNN - June 2013 - Public.pdf • Endeavour Energy - IR005 TS163 Unanderra ZS SNN - July 2013 - Public.pdf • Endeavour Energy - IR005 TS199 Substation Renewal Plan 2018-19 - June 2018 - Public.xlsx • Endeavour Energy - IR005 TS600 - TS616 Camellia TS Transformer Replacement & 33kV Busbar Rearrangement - July 2017 - Confidential.pdf • Endeavour Energy - IR005 TS600 Asset Class Condition Power Transformers - June 2017 - Public.pdf • Endeavour Energy - IR005 TS700 11kV Bulk Oil Circuit Breaker Renewal Plan - February 2018 - Public.pdf • Endeavour Energy - IR005 TS700 11kV Switchboard Risk Assessment - February 2018 - Public.xlsm
IR005	EMCaEND018	8/06/2018	• Endeavour Energy - IR005 Guideline on NPV Probabilistic Spreadsheet using Monte Carlo - June 2018 - Public.pdf • Endeavour Energy - IR005 PR423 Probabilistic VCR Template v3 - Marylands ZS Option 1 Dist Fdrs Then ZS - February 2018 - Public.xlsm • Endeavour Energy - IR005 PR423 Probabilistic VCR Template v3 - Marylands ZS Option 2 ZS Up front - February 2018 - Public.xlsm • Endeavour Energy - IR005 PR499 Probabilistic VCR Template v4 Mamre Fdrs + Southpipe ZS Build - February 2018 - Public.xlsm • Endeavour Energy - IR005 PR499 Probabilistic VCR Template v4 Southpipe ZS Build - February 2018 - Public.xlsm • Endeavour Energy - IR005 PR499 Southpipe (Oakdale West) - February 2018 - Public.pdf • Endeavour Energy - IR005 PR620 Probabilistic VCR Template v4 West Dapto ZS - February 2018 - Public.xlsm • Endeavour Energy - IR005 PR620 West Dapto ZS - February 2018 - Public.pdf • Endeavour Energy - IR005 PR677 Probabilistic VCR Template v4 South Penrith 132kV ZS - March 2018 - Public.xlsm • Endeavour Energy - IR005 PR677 Probabilistic VCR Template v4 South Penrith 33kV ZS - March 2018 - Public.xlsm • Endeavour Energy - IR005 PR677 South Penrith ZS - March 2018 - Public.pdf • Endeavour Energy - IR005 PR698 Marsden Park Stage 2 - February 2018 - Public.pdf • Endeavour Energy - IR005 PR698 Probabilistic VCR Template v4 Marsden Park Extend Fdrs frm Sth Marsden Park - February 2018 - Public.xlsm • Endeavour Energy - IR005 PR698 Probabilistic VCR Template v4 Marsden Park Stage 2 - February 2018 - Public.xlsm

AER Ref#	EMCa Ref#	Date received	File Name
			• Endeavour Energy - IR005 PR700 Probabilistic VCR Template v3 Riverstone Augment plus Fdrs - February 2018 - Public.xlsm • Endeavour Energy - IR005 PR700 Probabilistic VCR Template v3 Riverstone New Riverstone East ZS Option - February 2018 - Public.xlsm • Endeavour Energy - IR005 PR700 Probabilistic VCR Template v3 Schofields Augment plus Fdrs - February 2018 - Public.xlsm • Endeavour Energy - IR005 PR713 Probabilistic VCR Template v4 - Box Hill Full ZS Option - March 2018 - Public.xlsm • Endeavour Energy - IR005 PR723 Probabilistic VCR Template v3 - Science Park ZS Option - September 2017 - Public.xlsm • Endeavour Energy - IR005 PR724 Probabilistic VCR Template v3 Mt Gilead - ZS + Feeders Option - February 2018 - Public.xlsm • Endeavour Energy - IR005 PR724 Probabilistic VCR Template v3 Mt Gilead - ZS Upfront Option - February 2018 - Public.xlsm • Endeavour Energy - IR005 PR728 Western Sydney Employment Lands - March 2018 - Public.pdf • Endeavour Energy - IR005 PR742 Probabilistic VCR Template v4 North Bomaderry ZS Construction - February 2018 - Public.xlsm • Endeavour Energy - 10.05 Distribution Works Program - April 2018 - Public.pdf
IR011	EMCaEND019	15/06/2018	• Endeavour answered EMCa questions. No attachment
IR011	EMCaEND020	15/06/2018	• Endeavour answered EMCa questions. No attachment
IR013	EMCaEND021	28/06/2018	• Endeavour Energy - IR013 Company Policy 9.2.6 Network Asset Renewal - November 2015 - Public.pdf
IR013	EMCaEND022	28/06/2018	• Endeavour Energy - IR013 Company Policy 9.9.1 Network Asset Maintenance - June 2017 - Public.pdf

AER Ref#	EMCa Ref#	Date received	File Name
IR013	EMCaEND023	28/06/2018	• Endeavour Energy - IR013 Asset Class Plans Overview and Framework - June 2018 - Confidential.pdf • Endeavour Energy - IR013 Communications Systems Asset Class Plan - June 2018 - Confidential.pdf • Endeavour Energy - IR013 Earthing Systems Asset Class Plan - June 2018 - Confidential.pdf • Endeavour Energy - IR013 Ground Based Distribution Substations Asset Class Plan - June 2018 - Confidential.pdf • Endeavour Energy - IR013 OT Systems Asset Class Plan - June 2018 - Confidential.pdf • Endeavour Energy - IR013 Pole Substations and HV Overhead Switches Asset Class Plan - June 2018 - Confidential.pdf • Endeavour Energy - IR013 Power Transformers Asset Class Plan - June 2018 - Confidential.pdf • Endeavour Energy - IR013 Protection Asset Class Plan - June 2018 - Confidential.pdf • Endeavour Energy - IR013 Public Lighting Asset Class Plan - June 2018 - Confidential.pdf • Endeavour Energy - IR013 Substation Asset Class Plan - June 2018 - Confidential.pdf • Endeavour Energy - IR013 Transmission Feeder Asset Class Plan - June 2018 - Confidential.pdf
IR013	EMCaEND024	28/06/2018	• Endeavour Energy - IR013 Asset Class Condition Report 33-132kV Circuit Breakers - June 2017 - Confidential.pdf • Endeavour Energy - IR013 Asset Class Condition Report Instrument Transformers June 2017 - Confidential.pdf • Endeavour Energy - IR013 Asset Class Condition Report Power Transformers June 2017 - Confidential.pdf • Endeavour Energy - IR013 Asset Class Condition Report Shunt Capacitors June 2017 - Confidential.pdf
IR013	EMCaEND025	28/06/2018	• Endeavour Energy - IR013 PS012 Business Case 2015-16 July 2015 - Public.pdf • Endeavour Energy - IR013 PS012 Statement of asset need - May 2015 - Public.pdf
IR013	EMCaEND026	28/06/2018	• Endeavour Energy - IR013 Mains Maintenance Instruction MMI 0034 PSBI November 2016 - Public.pdf
IR013	EMCaEND027	28/06/2018	• Endeavour Energy - IR013 DS005 Distribution Pole Replacement - June 2018 - Public.xlsx
IR013	EMCaEND028	28/06/2018	• Endeavour Energy - IR013 Forecast Expenditure DS418 Pole Top Structure and Hardware Refurbishment - June 2018 - Public.xlsx
IR013	EMCaEND030	28/06/2018	• Endeavour Energy - IR013 11kV Switchboard risk assessment - June 2018 - Public.xlsm

AER Ref#	EMCa Ref#	Date received	File Name
IR013	EMCaEND031	28/06/2018	• Endeavour Energy - IR013 Gate 2 Project Approval TS173-11kV switchboard circuit breaker truck replacement - May 2015 - Confidential.pdf • Endeavour Energy - IR013 TS173 11kV truck replacement Business Case 2015-16 - March 2015 - Public.pdf
IR013	EMCaEND032	28/06/2018	• Endeavour Energy - IR013 Circuit Breakers Asset Class Plan - June 2018 - Confidential.pdf
IR013	EMCaEND033	28/06/2018	• Endeavour Energy - IR013 PX renewal program master - June 2018 - Public.xlsm
IR013	EMCaEND035	28/06/2018	• Endeavour Energy - IR013 Probabilistic VCR Template v4 Dundas Trf Replacement 35MVA - May 2018 - Public.xlsm • Endeavour Energy - IR013 Probabilistic VCR Template v4 Minto Trf 1 Replacement 35MVA May 2018 - Public.xlsm • Endeavour Energy - IR013 TS619 Dundas ZS transformer replacement Business Case - May 2018 - Public.pdf • Endeavour Energy - IR013 TS620 Minto ZS transformer replacement Business Case - June 2018 - Public.pdf
IR013	EMCaEND036	28/06/2018	• Endeavour Energy - IR013 PS008 SAN 2017-18 increased funds - August 2016 - Public.pdf • Endeavour Energy - IR013 PS008 SAN 2017-19 relay details - March 2017 - Public.pdf • Endeavour Energy - IR013 PS008 SAN 2017-2029 forecast - July 2017 - Public.pdf
IR013	EMCaEND037	28/06/2018	• Endeavour Energy - IR013 Quantitative risk analysis for PS008 - June 2018 - Public.xlsx
IR013	EMCaEND038	28/06/2018	• Endeavour Energy - IR013 2.2.1 Strengthen Causal Controls to Mitigate Network Bushfire Risk - October 2010 - Confidential.pdf • Endeavour Energy - IR013 Board Decisions - 2013-14 Business Case - June 2013 - Confidential.jpg • Endeavour Energy - IR013 Board Decisions - May 2015 - Confidential.pdf • Endeavour Energy - IR013 Distribution Mains Asset Class Plan - June 2018 - Confidential.pdf • Endeavour Energy - IR013 DS011 Steel Mains Business Case 2013-14 - May 2013 - Public.pdf • Endeavour Energy - IR013 DS011 Steel Mains Business Case 2015-16 - April 2015 - Public.pdf • Endeavour Energy - IR013 Endorsement for DS011 BC 2013-14 - May 2013 - Confidential.pdf • Endeavour Energy - IR013 VBRC Summary - July 2010 - Public.pdf
IR013	EMCaEND041	29/06/2018	• Endeavour answered EMCa questions. No attachment • Endeavour Energy - IR013 PR728 Probabilistic VCR Template Western Sydney Employment Lands - June 2018 - Public.xlsm • Endeavour Energy - IR013 Probabilistic VCR Template Rebuild Feeder 308 - June 2018 - Public.xlsm

AER Ref#	EMCa Ref#	Date received	File Name
IR013	EMCaEND042	28/06/2018	• Endeavour Energy - IR013 Probabilistic VCR Template Catherine Park Full ZS - June 2018 - Public.xlsm • Endeavour Energy - IR013 Probabilistic VCR Template Catherine Park Interim ZS - June 2018 - Public.xlsm
IR013	EMCaEND043	28/06/2018	• Endeavour answered EMCa questions. No attachment
IR001		25/05/2018	• Endeavour Energy - IR001 Collaborative Framework Agreement - Haslin Constructions and UEA Electrical - December 2017 - Confidential.pdf
IR001		25/05/2018	• Endeavour Energy - IR001 Collaborative Framework Agreement - Zinfra and Project Co-Ordination - December 2017 - Confidential.pdf
IR001		25/05/2018	• Endeavour Energy - IR001 Company Policy 9.2.1 - Network Planning - May 2016 - Public.pdf
IR001		25/05/2018	• Endeavour Energy - IR001 Company Procedure GAM 0110 - Gate 1 Portfolio Investment Plan Approval - August 2016 - Public.pdf
IR001		25/05/2018	• Endeavour Energy - IR001 Company Procedure GRM 0051 - Network Investment Governance - November 2016 - Public.pdf
IR001		25/05/2018	• Endeavour Energy - IR001 Division Procedure GNV 1119 Quantitative Determination of Reasonably Practicable Risk Control Measures - May 2016 - Public.pdf
IR001		25/05/2018	• Endeavour Energy - IR001 Group Board Policy 2.0.5 - Risk Management - August 2017 - Public.pdf
IR001		25/05/2018	• Endeavour Energy - IR001 Information Request Response - May 2018.pdf
IR001		25/05/2018	• Endeavour Energy - IR001 List of Major Projects spanning RCPs - May 2018 - Confidential.xlsx
IR001		25/05/2018	• Endeavour Energy - IR001 List of Major Projects spanning RCPs - May 2018 - Public.xlsx
IR001		25/05/2018	• Endeavour Energy - IR001 UGL O&M Alliance Agreement - May 2018 - Confidential.pdf
IR005		8/06/2018	• Endeavour answered EMCa questions. No attachment
IR005		7/06/2018	• Endeavour Energy - IR005 Company Procedure GAM0111 Gate 2 Preliminary Program and Project Approval - August 2016 - Public.pdf
IR005		7/06/2018	• Endeavour Energy - IR005 Division Procedure GNV1120 CONSAC Condition Reporting - February 2018 - Public.pdf
IR005		7/06/2018	• Endeavour Energy - IR005 PS008 2017-18 SAN - Protection Scheme Renewal Need - July 2016 - Public.pdf
IR005		8/06/2018	• Endeavour answered EMCa questions. No attachment
IR006		14/06/2018	• Endeavour Energy - IR006 Information Request Response - June 2018.docx
IR006		14/06/2018	• Endeavour Energy - IR006 Other repex item history - June 2018 - PUBLIC.xlsx

AER Ref#	EMCa Ref#	Date received	File Name
IR006		14/06/2018	• FW_ Endeavour - IR#006 - Capex and data related issues - 31 May 2018 - Public _DLM_For-Official-Use-Only_.msg
IR013		28/06/2018	• Endeavour Energy - IR013 Remote Terminal Unit Asset Class Plan - June 2018 - Confidential.pdf
		8/06/2018	• Endeavour Historical RIN data - for EMCa (updated 08062018)
		31/05/2018	• Board Policy 2.05 - Risk management.pdf
		31/05/2018	• Cash Extract.xlsx
		31/05/2018	• Introduction to Endeavour Energy's CASH Model.docx
		31/05/2018	• Q 1. VDA Reg Capex scenario inputs and outputs.xlsx
		31/05/2018	• Q 2. Investment Program Analysis VDA Modelling.pdf
		31/05/2018	• Q 3. VDA Timeline.docx

Documents that did not form part of assessment

Endeavour documents received after assessment cut-off date (29th June 2018)

AER Ref#	EMCa Ref#	Date Received	File Name
IR014	EMCaEND044	4/07/2018	• Endeavour Energy - IR014 Company Procedure GAM 0077 Network Portfolio Investment Plan Change Control - July 2017 – Public • Endeavour Energy - IR014 Company Procedure GAM 0116 Gate 3 Final Project Program Funding And Variation Approvals For Network Investments -September 2017 – Public
IR014	EMCaEND045	4/07/2018	• Endeavour answered EMCa questions. No attachment
IR014	EMCaEND046	4/07/2018	• Endeavour answered EMCa questions. No attachment
IR014	EMCaEND047	4/07/2018	• Endeavour answered EMCa questions. No attachment
IR014	EMCaEND048	4/07/2018	• Endeavour answered EMCa questions. No attachment
IR014	EMCaEND049	4/07/2018	• Endeavour answered EMCa questions. No attachment
IR014	EMCaEND050	4/07/2018	• Endeavour Energy - IR014 Gate Approval Status - June 2018 - Public
IR014	EMCaEND051	4/07/2018	• Endeavour answered EMCa questions. No attachment
IR014	EMCaEND052	4/07/2018	• Endeavour Energy - IR014 Expenditure Reduction FY20-FY24 - June 2018 – Public
IR014	EMCaEND053	4/07/2018	• Endeavour answered EMCa questions. No attachment
IR014	EMCaEND054	4/07/2018	• Endeavour Energy - IR014 Project and Program Status - June 2018 - Public
IR014	EMCaEND055	4/07/2018	• Endeavour Energy - IR014 PIP Submission FINAL - March 2018 - Public
IR014	EMCaEND056	4/07/2018	• Endeavour Energy - IR014 Forecast Documentation - June 2018 – Public
IR014	EMCaEND057	4/07/2018	• Endeavour Energy - IR014 DS418 Pole Top Hardware - June 2018 - Public
IR014	EMCaEND058	4/07/2018	• Endeavour answered EMCa questions. With attachment • Endeavour Energy - IR014 Sanity Checks - June 2018 - Confidential
IR014	EMCaEND059	4/07/2018	• Endeavour Energy - IR014 Peak Demand Forecast Method 50POE 10POE - June 2018 – Public
IR014	EMCaEND060	4/07/2018	• Endeavour Energy - IR014 Comparison of actual versus forecast at zone substation level - June 2018 – Public

AER Ref#	EMCa Ref#	Date Received	File Name
IR014	EMCaEND061	4/07/2018	• Endeavour Energy - IR014 Oakdale Industrial Forecast revised BC - June 2018 - Confidential • Endeavour Energy - IR014 West Dapto Forecast - June 2018 - Public • Endeavour Energy - IR014 Marsden Park Forecast - June 2018 - Public • Endeavour Energy - IR014 Business Case WSA Precinct Load Calculation - June 2018 – Public • Endeavour Energy - IR014 Maryland Lowes Creek ZS Catchment Indicative Forecast - June 2018 - Public • Endeavour Energy - IR014 Box Hill and Box Hill North Precinct Indicative Forecast - June 2018 – Public • Endeavour Energy - IR014 Science Park Indicative Forecast - June 2018 - Confidential • Endeavour Energy - IR014 Mt Gilead Forecast - June 2018 - Confidential • Endeavour Energy - IR014 North Bomaderry Forecast - June 2018 - Public • Endeavour Energy - IR014 Riverstone East Catchment Indicative Forecast - June 2018 - Public • Endeavour Energy - IR014 Westmead Forecast - June 2018 - Public • Endeavour Energy - IR014 Penrith 11kV Forecast - June 2018 - Public
IR014	EMCaEND062	4/07/2018	• Endeavour answered EMCa questions. No attachment
IR014	EMCaEND063	4/07/2018	• Endeavour answered EMCa questions. No attachment
IR014	EMCaEND064	4/07/2018	• Endeavour Energy - IR014 NW and SW PGA dwelling forecast review of dept of planning - June 2018 - Public
IR014	EMCaEND065	4/07/2018	• Endeavour answered EMCa questions. No attachment
IR014	EMCaEND066	4/07/2018	• Endeavour Energy - IR014 Customer Numbers - June 2018 – Public
IR014	EMCaEND067	4/07/2018	• Endeavour answered EMCa questions. No attachment
IR014	EMCaEND068	4/07/2018	• Endeavour Energy - IR014 PeakMVA_ZS2018S - June 2018 - Public
IR014	EMCaEND069	4/07/2018	• Endeavour answered EMCa questions. No attachment