EMCa
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Revised Revenue Proposal to AER 2018-2022

Review of Powerlink's replacement capital expenditure

Report to

Australian Energy Regulator

from

Energy Market Consulting associates

March 2017

This report has been prepared to assist the Australian Energy Regulator (AER) with its determination of the appropriate revenues to be applied to the prescribed transmission services of Powerlink from 1st July 2017 to 30th June 2022. The AER's determination is conducted in accordance with its responsibilities under the National Electricity Rules (NER). This report covers a particular and limited scope as defined by the AER and should not be read as a comprehensive assessment of proposed expenditure that has been conducted making use of all available assessment methods.

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Except where specifically noted, this report was prepared based on information provided by Powerlink prior to 9th February 2017 and any information provided subsequent to this time may not have been taken into account.

Some numbers in this report may differ from those shown in Powerlink's regulatory submission or other documents due to rounding.

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About EMCa

Energy Market Consulting associates (EMCa) is a niche firm, established in 2002 and specialising in the policy, strategy, implementation and operation of energy markets and related 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.

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Executive summary

Purpose of this report

1. The purpose of this report is to provide the Australian Energy Regulator (AER) with technical advice to assist the AER with determining a reasonable allowance for Powerlink's replacement capital expenditure (repex, which Powerlink sometimes refers to as reinvestment expenditure).

2. Our assessment is based on a limited scope review of certain aspects of Powerlink's repex forecast. It does not take into account all factors or all reasonable methods for determining a capital expenditure allowance in accordance with the National Electricity Rules (NER).

Scope of our report

3. Powerlink submitted its Revised Revenue Proposal (RRP) for the 2018-2022 Regulatory Control Period (RCP) to the AER in December 2016. The AER engaged Energy Market Consulting associates (EMCa) as a Technical Consultant to review and provide advice on the reasonableness of the revised replacement expenditure as proposed by Powerlink in its RRP, and its response to the AER's Draft Decision relating to:
   - The calibration of Powerlink's Repex Model and changes to its inputs;
   - The AER's mean replacement ages;
   - Reduction of approximately nine per cent from historical expenditure through adjustments to Powerlink's Repex Model inputs; and
   - The application of the 15 per cent offset allowance included in the AER's Draft Decision.

4. In relation to the specific areas of Powerlink's response that we have been requested to review, we have reviewed the new information provided by Powerlink in its RRP and its supporting information.

5. We have also reviewed the claims made by Powerlink and its consultant Nuttall Consulting regarding the methodology applied in our May 2016 report ('Initial report') and August 2016 report ('Addendum report'). We provide our responses to these claims in Appendix A of this report.

Calibration of the Repex Model and inputs

6. In its RRP Repex Model calibration, Powerlink made further reductions to its historical replacement quantities for assets identified as having no enduring need, or which were replaced in response to a non-condition driver. These adjustments are consistent with the approach that we considered to be appropriate in our Initial report.

7. In its Revenue Proposal (RP), Powerlink included additional replacement quantities associated with its 'average annual tower maintenance activities' in the historical calibration quantity for transmission tower assets. These quantities were unchanged in its RRP. Powerlink advised that to ensure there was no double counting of expenditure between opex and capex, it had removed an expenditure allowance associated with tower maintenance from its repex forecasts for the next RCP. However, we observe that its Repex Model includes a much higher expenditure forecast of $79m over the next RCP than is offset by removal of the tower maintenance allowance of $19m. Based on the information provided by Powerlink, we consider that the historical tower maintenance quantities should not be included in the Repex Model calibration quantities.[1]

8. For substation primary plant and for secondary systems and communications assets, Powerlink has made a number of adjustments to its historic quantities of replacement activity to those reported in its RP. We consider that Powerlink has now taken reasonable steps to correct its reported Regulatory Information Notice (RIN) quantities of replacement activity and, consequently, to correct this input to its repex modelling.

9. In its RRP, Powerlink has also made a number of adjustments to its asset age profiles in all three asset classes that we were asked to consider. The additional changes are likely to produce a reasonable asset age profile for the purposes of its repex modelling.

Adjustment to historic expenditure

10. In its RP and related documents, Powerlink had described what appeared to be a -9% adjustment to its historical replacement expenditure for the purposes of its repex modelling, to allow for historical non-condition driven asset replacements. We now understand that Powerlink has not made an additional adjustment of this amount to its repex modelling. Rather, this was the outworking of its calibration quantity adjustments to ensure only condition driven asset replacements are captured in its repex modelling, as described above.

Mean replacement lives

11. In its RRP, Powerlink has adjusted the historic transmission tower replacement quantities, resulting in an increase in the modelled mean replacement life for towers in corrosion zone DEF of 4.7 years (to 45 years). Our recommended removal of the 'averaged annual tower maintenance activities' from its calibration quantities would result in further increases to the mean tower replacement lives of approximately 6.8 years (to 78.2 years) in corrosion zone B, 3.2 years (to 61.1 years) in corrosion zone C, and by 0.8 years (to 45.8 years) in corrosion zone DEF. We consider that the resultant mean replacement lives, with these further changes applied, would be reasonable.

12. Powerlink's adjustments to historic quantities of replacement activity since its RP have resulted in increases in the modelled mean replacement lives for substation primary plant sub-categories by between 0.5 and 1.0 years, and for secondary systems and

[1] Review of these input quantities were not within the scope of our Initial and Addendum reports

communication assets by 0.4 years (to 20.6 years). We consider that the derived mean replacement lives in these two asset categories, after Powerlink's further calibration of the Repex Model, are reasonable.

Application of the 15 percent offset allowance

13. From the project reviews we conducted as part of our review of Powerlink's RP (and associated information), we formed a view that Powerlink may be foregoing prudent life extension opportunities. In its RRP, Powerlink has argued that its asset management strategies and practices already apply life extension strategies when it is economical to do so. On the basis of Powerlink's claim not to require such an offset, we consider that it is not necessary to apply an 'offset allowance' to repex reductions.

Concluding remarks

14. We have reviewed the new information provided by Powerlink in relation to its revised proposed replacement expenditure forecast. The specific issues that Powerlink has addressed are not identical to those that we raised in our earlier advice but, apart from transmission towers, the changes Powerlink has made indirectly address the concerns that we raised. With the exception of transmission towers, we consider that the adjustments made by Powerlink in its Repex Model are now reasonably likely to result in a prudent and efficient expenditure forecast.

1 Introduction

1.1 Purpose of this report

15. The purpose of this report is to provide the AER with an opinion on Powerlink's use of its Repex Model to assess the reasonableness of its proposed repex forecast and to address matters raised by Powerlnk in response to the AER's Draft Decision.

16. The assessment contained in this report is intended to assist the AER in its own analysis of Powerlink's capital expenditure allowance as an input to its Final Decision on Powerlink's revenue requirements.

17. The AER, in accordance with its responsibilities under the NER, is required to conduct an assessment of the revenue to be obtained from provision of prescribed transmission services provided by Powerlink for the 2018-2022 RCP. The process that the AER is required to follow is described in chapter 6A of the NER.

1.2 Scope and limitations of requested work

18. Powerlink provided its RP for the 2018-2022 RCP to the AER in January 2016. The AER engaged EMCa as a Technical Consultant to review and provide advice on the prudency and efficiency of the non-load driven capital expenditure proposed in Powerlink's RP.

19. In our Initial report on Powerlink's non-load driven expenditure forecast, we found that there were systemic biases that we considered were likely to have led to over-estimation of Powerlink's non-load driven capital expenditure requirement for the 2018-2022 RCP.

20. We further noted that Powerlink's use of the AER's Repex Model, whilst based on sound principles, is reliant on the validity of a large set of inputs, verification of which was outside the scope of our initial technical advice. In reviewing a sample of Powerlink's approved and proposed repex projects for the next period, we found evidence of risk and forecasting biases which we considered systemic in nature.

21. The AER subsequently sought particular advice regarding the prudency and efficiency of a sample of 18 of Powerlink's non-load driven projects and the implications for

Powerlink's proposed expenditure allowance. The projects have either been completed or were initiated within the 2011-2015 period. In our Addendum report, we reported the evidence we found of systemic issues that support the biases that we identified in our Initial report and confirmed that, in aggregate, the biases lead to an over-estimate of forecast expenditure.

22. Powerlink submitted its RRP for the 2018-2022 RCP to the AER in December 2016. The AER engaged EMCa as a Technical Consultant to review and provide advice on the reasonableness of the replacement expenditure as proposed by Powerlink in its RRP, and its response to the AER's Draft Decision relating to:

    - The calibration of the Repex Model – assess the nature and extent of adjustments made by Powerlink to calibrate the Repex Model and provide advice as to the reasonableness of Powerlink's approach (see Powerlink's RRP sections 4.6.3 and 4.7.2);
    - The AER's mean replacement ages – assess Powerlink's response to the AER's adjustment of the mean replacement ages, including Powerlink's advice from Nuttall Consulting, and advise on the reasonableness of EMCa's original recommendation to extend Powerlink's mean replacement lives by one standard deviation in light of Powerlink's response, and the basis of the actual replacement ages for substation primary plant and secondary systems it derived from the sample of projects reviewed in EMCa's Addendum report (see Powerlink's RRP section 4.7.3);
    - The 15% offset – provide further advice and justification for the 15% offset for life extension activities that EMCa recommended in its Addendum report (see Powerlink's RRP section 4.7.4);
    - Powerlink's changes to Repex Model inputs – consider the justification for Powerlink's revised mean asset replacement lives and advise whether the revised mean asset replacement lives are now reasonable (see Powerlink's RRP section 4.10.1); and
    - Whether Powerlink has explained sufficiently why it applied a reduction of approximately nine per cent from historical expenditure to adjust for historical augmentation of replaced assets in the calibration of its Repex Model inputs.

23. The purpose of this report is to provide the AER with our findings from this review.

24. The assessment that we have undertaken and the advice we provide is based on a limited scope review in accordance with the terms of reference provided by the AER. It does not take into account all factors or all reasonable methods for determining an expenditure allowance in accordance with the NER. We understand that the AER will establish a capital expenditure allowance for Powerlink based on assessments undertaken by its own staff.

25. We have focussed our review on the repex categories of transmission towers, substation primary plant and secondary systems (including communications), being those categories that Powerlink outlined in its RRP, that do not align with the AER's Draft Decision.

26. We have not undertaken a review of the unit costs applied by Powerlink in its Repex Model.

1.3 Structure of this report

27. In section 2, we present background information to provide context to our review.

28. In section 3, we describe our assessment of the revised replacement expenditure proposed by Powerlink in its RRP for the major asset categories of transmission towers, substation primary plant and secondary systems.

29. In section 4, we describe our assessment of other factors of the revised replacement expenditure proposed by Powerlink in its RRP.

30. Appendix A responds to the claims made by Powerlink and its consultant Nuttall Consulting in relation to our original findings and the evidence we relied upon to determine these findings.

1.4 Information sources

31. We have examined relevant documents provided by Powerlink in support of its revised proposed repex that the AER has designated for review. Powerlink has also provided further information in response to our information requests. These documents are referenced directly where they are relevant to our findings.

2 Expenditure summary of Powerlink's revised proposed repex

2.1 Introduction

32. In this section, we consider Powerlink's RRP as it relates to the specific areas of Powerlink's repex included in our terms of reference from the AER.

2.2 Summary of AER's draft decision

33. The AER generally accepted the use of the hybrid forecasting approach by Powerlink in its RP. The AER did not accept the mean replacement lives proposed by Powerlink in its Repex Model, and made changes to its expenditure forecasts for a number of asset categories.

34. The AER included a capital offset amount of 15% of the capex forecast for those asset categories adjusted, to allow for additional preventative and corrective treatments. The combined effect of these adjustments reduced the repex forecast by 23%, as shown in Table 1.

2.3 Powerlink's revised proposed repex

35. Powerlink defines non-load driven capex as comprising of three expenditure sub-categories: reinvestment[2] (which we refer to as replacement and/or refurbishment),

[2] Powerlink defines reinvestment expenditure as *"primarily undertaken due to end of asset life, asset obsolescence, asset reliability or safety requirements and includes replacement with assets of an equivalent/ different type, configuration or capacity, refurbishment, or non-network alternatives"* (source: Powerlink, *Revenue Proposal 2018-2020*, Table 5.1)

security/compliance, and Other. In this review we consider Powerlink's replacement capex only, and specifically the components of replacement capex for transmission towers, substation primary plant, and secondary systems and communications (which we refer to as secondary systems, being inclusive of communications).

36. In its RRP, Powerlink has proposed a revised repex forecast of $728.1m for the 2018-2022 RCP. This is an 8% reduction from its RP. The changes in the repex forecast are shown in Table 1 below.

Table 1: Replacement capital expenditure (real $m, 2016/17)

	Total	Variance to RP
Powerlink RP	794.3	
AER Draft Decision	609.8	-23%
Powerlink RRP	728.1	-8%

Source: EMCa

2.4 Comparisons of Powerlink's repex proposals

37. In Table 2, we compare the total repex forecast in Powerlink's RRP to its RP in each year of the 2018-2022 RCP.

Table 2: Replacement capital expenditure (real $m, 2016/17)

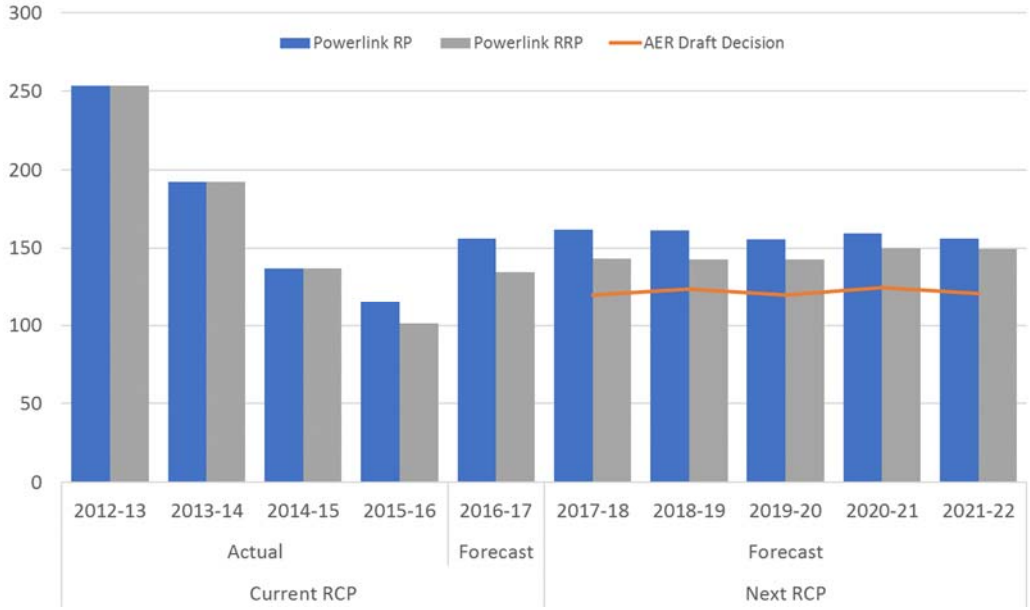
	Next RCP (RRP)						
	2017-18	2018-19	2019-20	2020-21	2021-22	Total	Variance to RP (%)
Powerlink RP	161.6	161.2	155.8	159.6	156.0	**794.2**	
AER Draft Decision	120.2	123.7	120.2	124.7	121.0	**609.8**	-23%
Powerlink RRP	143.2	142.7	142.5	150.1	149.6	**728.1**	-8%
Difference to RP	*-18.4*	*-18.5*	*-13.3*	*-9.5*	*-6.4*	*-66.1*	

Source: EMCa
Note: Totals may not add up due to rounding

38. Figure 1 below compares Powerlink's proposed and actual replacement expenditure for the current RCP with its proposed replacement expenditure in its RP and RRP. The results of the AER's Draft Decision are also shown.

39. Figure 1 illustrates the relatively flat expenditure profile forecast for the RRP, slightly below Powerlink's RP forecast, and the historical repex trend. Powerlink has updated its forecast for 2015/16 to an actual expenditure, indicating a $14.6m lower spend. Powerlink has also reduced its forecast for 2016/17 by $21.4m. The average annual repex for the RRP, at $146m, is a reduction from the current RCP of $164m and comparable to the 4-year period 2013-14 to 2016-17 of $141m.

Figure 1: *Replacement capital expenditure (real $m, 2016/17)*



Source: EMCa analysis of Powerlink's response (PQ0206) 9 February 2017 to our information request [3]

40. In Table 3, we show the components of the repex program for the next RCP. We have included the last two years of the current RCP, as Powerlink has updated the actual/forecasts for these years.

Table 3: Breakdown of replacement capital expenditure (real $m, 2016/17)

	Current RCP		Next RCP					
	Actual	Forecast	Forecast					
Replacement CAPEX	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	Total
Transmission Lines	22.8	29.3	38.4	37.3	45.5	51.3	57.6	230.1
Substation Primary Plant	27.9	35.1	41.9	44.6	37.7	34.0	31.6	189.8
Secondary Systems	47.2	63.9	46.2	45.3	43.9	45.3	47.6	228.3
Communications	3.2	6.2	12.1	10.7	10.2	10.3	11.0	54.3
Network Switching Centres	0.0	0.2	4.5	4.9	5.2	9.1	1.8	25.5
Total	101.1	134.7	143.1	142.8	142.5	150.0	149.6	728.0

Source: Powerlink's response (PQ0206) 9 February 2017 to our information request
Note: Totals may not add due to rounding. EMCa has reproduced the totals including escalation as applied by Powerlink.

41. In Table 4, we show the adjustments made by Powerlink in its RRP for each of its asset categories, when compared to its RP over the same period.

[3] We have used Powerlink's information, including escalation factors, in comparting the repex totals between its RP and RRP in Figure 1.

Table 4: Powerlink's RRP adjustments to replacement capital expenditure (real $m, 2016/17)

	Current RCP		Next RCP					
	Actual	Forecast	Forecast					
Replacement CAPEX	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	Total
Transmission Lines	4.2	-9.5	-13.9	-15.2	-10.3	-6.9	-4.0	-50.3
Substation Primary Plant	-7.4	-10.3	-3.0	-1.4	-1.2	-1.0	-0.7	-7.3
Secondary Systems	-4.4	9.3	-2.4	-1.8	-1.7	-1.7	-1.7	-9.3
Communications	-6.9	-8.8						0.0
Network Switching Centres		-2.1	0.8					0.8
Total	-14.5	-21.4	-18.5	-18.4	-13.2	-9.6	-6.4	-66.1

Source: Powerlink's response (PQ0206) 9 February 2017 to our information request
Note: Totals may not add due to rounding. EMCa has reproduced the totals including escalation as applied by Powerlink.

42. As shown in Table 4, Powerlink has reduced the repex forecast in its RRP by $66.1m. The majority of the reduction is associated with a reduction to its transmission tower forecast comprising $50.3m, with a further reduction of $16.6m to the combination of its substation primary pant and secondary systems asset categories. We note that Powerlink has also proposed to remove a further $35.9m from its program in the current RCP.

3 Our assessment of the revised proposed repex

3.1 Introduction

43. In this section we provide our assessment of the new information (including adjustments made by Powerlink to its repex forecast[4]), address the specific matters raised by the AER, and advise whether this leads us to alter the findings set out in our earlier reports.

44. Powerlink's proposed repex has been largely forecast using the Repex Model, including Powerlink's 'enhancements' to the AER Repex Model guidelines. Powerlink has continued to apply its hybrid forecasting methodology as proposed in its RP. As part of its RRP, Powerlink has included a review of the AER's Draft Decision by its consultant, Nuttall Consulting.

45. Powerlink has not accepted the AER's Draft Decision for repex. Powerlink states that it "*considers the AER's assessment approach and conclusions result in mean replacement lives for assets that are unrealistic*."[5] Instead, it has proposed a number of further adjustments to the input data to its Repex Model as detailed in section 4.7 of its RRP. Powerlink's adjustments result in increases to the mean replacement lives for some asset classes in its Repex Model.

3.2 General observations

46. Under the propose/respond regulatory model in place in the NEM, the onus is on Powerlink to present clear, consistent and compelling information and evidence to the AER and its consultants in support of its RP. The regulatory review process also provides Powerlink (and other NSPs) with the opportunity to review and respond to the AER's Draft Decision and matters raised in reports provided to the AER, such as our

[4] Related to reinvestment capex for transmission towers, substation primary plant and secondary systems (including communications) in accordance with our scope of works

[5] Powerlink, *Revised Revenue Proposal 2018-22*, page 23

Initial report and Addendum report. To the extent that any such reports indicate that Powerlink did not provide sufficient information to support its RP, Powerlink has the further opportunity to provide such additional information as it deems necessary and/or appropriate through its RRP.

47. Powerlink has generally chosen not to provide information to directly address the issues identified in our Initial report and Addendum report regarding the quality of the justification for the scope and timing of proposed work in its replacement forecast. It has sourced input from its advisors that, similarly, does not directly address these issues.

48. Instead, Powerlink has focussed on describing the adjustments it has made to its Repex Model as its top-down forecasting methodology. Whilst we consider that a predictive model is a valid and useful aspect of a forecasting methodology, and the use of a Repex Model is consistent with the Better Regulation guidelines, we also consider that this should be complemented by the use of other techniques including bottom-up forecasting methods to help assure that systemic biases do not exist between regulatory periods.

49. We note that the AER advised Powerlink during the review of its Framework and Approach process of its expectation that Powerlink would supplement its use of the Repex Model with other techniques. It reinforced its view in its Draft Decision:

> *"In our final Framework and Approach for Powerlink, we noted that:*
>
> 1. *we continue to expect that the major technique used in forecasting capex will be a project based 'bottom-up' basis; and*
> 2. *Powerlink may make use of the repex model as a basis for forecasting but if we consider it is inappropriate for a particular expenditure, Powerlink would be at risk of that proposal being rejected or substantially amended."* [6]

50. In our Initial report and Addendum report, we commented on the reasonableness of the forecasting methodology adopted by Powerlink, where we considered that this was likely to reflect a bias from systemic issues identified in other aspects of our review. Our ability to assess Powerlink's forecasting methodology is impacted by Powerlink's ability to provide sufficient information and evidence to credibly demonstrate that its proposal meets the NER expenditure criteria. We are firmly of the view that the onus is on the NSP, and not the AER and/or its technical consultant(s), to provide sufficient information and evidence for this review.

3.3 Calibration of the Repex Model

3.3.1 Overview

51. Powerlink makes use of the historical quantity of replacements to calibrate its Repex Model. In determining the mean asset replacement life, Powerlink's approach assumes that level of replacements forecast by the Repex Model is a reasonable representation of the actual replacement profile over the calibration period. The Repex Model is therefore very sensitive to changes in the historical replacement quantities. Powerlink has made a number of adjustments to its actual replacement quantities for calibration purposes, and we consider the reasonableness of these adjustments below.

[6] AER, *Draft Decision – Powerlink Transmission determination – Attachment 6 – Capital expenditure – September 2016*, page 42

52. For most of the sample projects we studied for our Addendum report, we observed that the actual age of assets replaced by Powerlink was significantly longer than the comparable mean asset replacement life that Powerlink advised it used in its Repex Model. We also found that in some cases, Powerlink had replaced equipment that was well short of the end of its technical life. Whilst this does not, on its own, indicate that the mean asset replacement lives used by Powerlink are incorrect, it cast doubt over the robustness of the calibration process to derive reasonable mean asset replacement lives for use in its Repex Model.

53. The AER highlighted that the use of historical activity data to calibrate the Repex Model means that to the extent there is a lack of prudency or inefficiency in Powerlink's management of its asset replacement program in the five year period used to calibrate the model, this would be reflected in its repex forecast.

54. Following its own review, the AER states that:

> *"Where the timing of actual historical replacements has been driven by other factors, such as augmentation requirements, poor maintenance practices, or imprudent and inefficient asset replacement decisions, trending forward the observed asset replacement lives will perpetuate these issues into the repex forecast."* [7]

55. Powerlink's consultant, Nuttall Consulting acknowledged the importance of accurate historical data, stating that:

> *"In a broad sense, Powerlink's application of the model means it is clear and transparent what the replacement forecast volumes are attempting to represent: it is an intra-company benchmark (or business-as-usual forecast) that reflects the continuation of its recent historical asset management practices in the face of the ongoing aging of its network. Therefore, if it can be assumed that these practices are prudent and efficient then it follows that the forecast should represent prudent and efficient expenditure – without the need for proof from cost-benefit analysis (and associated risk assessments)."* [8]

56. Nuttall Consulting clarified that the model was reliant on a reasonable representation of the actual replacement profile, "*Therefore, the deduced mean life is sensitive to the volume of replacements it is calibrated to, but not the distribution of the ages of those replacements."* [9]

57. In its RRP, Powerlink has not provided a detailed response to the AER's concerns regarding the need or otherwise for further adjustment to the historical replacement volumes. It reiterated that it has adjusted its Repex Model for non-condition-based drivers and states that:[10]

> *"There is no evidence presented in the AER's Draft Decision or supporting EMCa reports to support the AER's view that the adjustments made by Powerlink are insufficient to provide a reasonable forecast."*

58. Nonetheless, Powerlink advises that it has "*made further adjustments to the Repex Model inputs to ensure it aligns with Powerlink's most recent asset management*

[7] AER, *Draft Decision – Powerlink Transmission determination – Attachment 6 – Capital expenditure – September 2016*, page 45

[8] Powerlink, *Appendix 5.04 Nuttall Consulting Forecasting Methodology Review*, 9 November 2015, page 25

[9] Powerlink, *Appendix 4.01 Nuttall Consulting Forecasting Methodology Review*, 9 November 2016, page 9

[10] Powerlink, *Revised Revenue Proposal 2018-22*, page 34

strategies and plans, while also having regard to aspects of the AER's Draft Decision…"[11]

3.3.2 Transmission towers

59. Powerlink's approach to calibrating the expected replacement life for transmission towers was to calibrate the actual replacement volumes in each of its defined corrosion zones separately.

60. We observe that Powerlink has applied the following process to adjust the replacement quantity provided in its RIN by voltage class and circuit type from a starting volume of 705 to a final volume of 683 over the period 2011-2015:

- Adjustments to the reported RIN quantities (-38):
  - Change of allocation of towers in Woree - Kamerunga as rebuild, instead of refit;
  - Addition of towers in Woree - Cairns refit previously excluded (+4); and
  - Remove duplication of projects for Woree - Kamerunga (-42);
- Removal of non-condition based replacements or refits (-76);[12] and
- Addition of towers with maintenance intervention due to corrosion (+92).

61. In Table 5, we show the adjustments by asset category from the original RIN. In Table 6 we show the adjustments made in Table 5 represented by corrosion zone, and the impact of the inclusion of maintenance intervention data to arrive at the final quantity/volumes used for calibration purposes in its Repex Model for the RRP.

Table 5: Adjustments to transmission towers replacements 2011-2015 (by asset category)

Asset category	Reported RIN quantities	Corrections to RIN quantities	Adjusted RIN quantities for condition driver only
Towers Rebuilt - 132 kV, Single Circuit	10	10	0
Towers Rebuilt - 132 kV, Multiple Circuit	96	54	36
Towers Rebuilt - 275 kV, Multiple Circuit	483	483	435
Towers Refurbished	116	120	120
Total	705	667	591

Source: EMCa analysis of Powerlink – Capex Calibration Quantity – 1 – Towers – December 2016

[11] *Ibid, page ii*

[12] Rather than a calculated number, this was directly input into the spreadsheet from an external source

Table 6: Maintenance adjustments to transmission tower replacements 2011-2015 (by corrosion zone)

Corrosion Zone	Reported RIN quantities	Corrections to RIN quantities	Adjusted RIN quantities for condition driver only	Repex Model calibration quantity	Difference to reported RIN quantities
B			0	2	
C			59	115	
DEF			532	566	
All Zones	705	667	591	683	-22

Source: EMCa analysis of Powerlink – Capex Calibration Quantity – 1 – Towers – December 2016[13]

62. We note that the adjustments made to the quantity of transmission towers differ from those reported in Table 4.1 of the RRP, in which the calibration volume for the Repex Model is listed as 591, rather than 683 as actually used in its Repex Model. Powerlink has not explained this difference in its RRP. From our review of the supporting information, the difference between the two figures is the inclusion of 92 transmission towers associated with maintenance intervention. We discuss the impact of this inclusion on the repex forecast in the following subsection.

63. In Powerlink's response to our information request,[14] Powerlink has confirmed that it has not made any changes to the Repex Model calibration quantities for transmission towers from its RP to its RRP.

3.3.3 Inclusion of maintenance intervention data for Transmission towers

64. As shown in Table 7, the final adjustment to the reported RIN tower replacement quantities for use as the calibration quantity in the Repex Model is associated with the addition of the maintenance intervention data of 92 towers. This adjustment has the impact of approximately doubling the historical replacement quantity for towers in corrosion zone C, from 59 to 115, thereby approximately doubling the average annual replacement quantity used for calibration purposes in the Repex Model from 11.8 to 23.

Table 7: Changes to annual replacement quantity 2011-2015 (by corrosion zone)

Corrosion Zone	Adjusted RIN quantities for condition driver only	Average annual quantity	Repex Model calibration quantity	Average annual quantity	Difference to adjusted RIN for condition
B	0	0.0	2	0.4	2
C	59	11.8	115	23.0	56
DEF	532	106.4	566	113.2	34
All Zones	591	118.2	683	136.6	92

Source: EMCa analysis of Powerlink – Capex Calibration Quantity – 1 – Towers – December 2016

65. Powerlink has derived an 'Allocation of Towers maintained under opex (per year)' of 18.4, being the average of the maintenance intervention volume of 92 over the 5 year period. Powerlink then calculates an annual expenditure amount using a unit cost for maintenance multiplied by this factor of 18.4. The calculated annual expenditure of $3.811m remains constant for each year of the forecast period representing the 'average

[13] The breakdown of Reported RIN quantities and Corrections to RIN quantities by corrosion zone were not provided by Powerlink

[14] Powerlink, *Response to Information Request – PQ0203*, 2 February 2017, Table 1

corrosion treatment rate' in its Repex Model.[15] Powerlink states that this average corrosion treatment rate was removed from the replacement capital expenditure forecast by applying an associated adjustment.

66. Powerlink explain the rationale of including the maintenance driven interventions as:

> *"For corrosion zones B and C Powerlink has to date had very few instances of capital expenditure for replacement or refit of structures based on their condition. Steel lattice transmission towers are somewhat unique in the context of repex modelling in that the maintenance activities that address the earliest stages of their degradation towards ultimate end-of-life are the same activities that are performed under capital reinvestment when they are further along their degradation path – replacement of corroded components. For Powerlink, the difference is that addressing the corrosion on the first few structures in a built section asset is operating expenditure. It is only when a substantial proportion of the entire built section is requiring intervention that it is undertaken as a capital project. While it is the same type of intervention, for the same reasons, under both operating and capital expenditure, it is only the quantities addressed under capital expenditure that were captured in the annual RIN data as transmission tower refurbishment."* [16]

67. Powerlink also states that:

> *"While it is appropriate that these additional quantities, based on maintenance work, were included for the purposes of deriving a mean replacement life, it is important to recognise that these quantities of interventions on structures will continue to be addressed under maintenance and not form part of the capital expenditure forecast. To ensure there was no double counting, the appropriate costs for this ongoing maintenance work were removed from the resulting Repex Model forecast."*[17]

68. We understand that Powerlink has sought to use its Repex Model to derive a mean replacement life for the population of transmission towers, recognising that interventions on individual structures will continue as maintenance and not part of the capital expenditure forecast. In Powerlink's response to our information request,[18] Powerlink advises that it has made an adjustment in its Repex Model expenditure forecast totalling $3.81 million each year for maintenance intervention (i.e. $19.06 million over the RCP) to ensure there was no double counting. The operating expenditure associated with tower maintenance is subject to a different forecasting methodology,[19] and it is not appropriate to include the activity in the Repex Model.

69. We estimate that the inclusion of the maintenance intervention activity into the calibration volume, as previously described, results in a mean replacement life that when used to

[15] Our review has focussed on Powerlink's use of its Repex Model, and therefore we have not reviewed, nor were we asked to review, other factors or adjustments made by Powerlink in preparing its consolidated capital expenditure forecast in its RRP

[16] Powerlink, *Appendix 5.05 Non-load Driven Network Capital Expenditure Forecasting Methodology*, page 23

[17] Powerlink, *Appendix 5.05 Non-load Driven Network Capital Expenditure Forecasting Methodology*, page 23

[18] Powerlink, *Response to Information Request – PQ0208*, 8 February 2017

[19] We have not undertaken, nor have we been requested to undertake, a review of Powerlink's capitalisation policy, its forecasting methodology for operating expenditure or maintenance criteria fas applied to its transmission tower maintenance operating expenditure.

forecast capital expenditure, increases the expenditure forecast in the Repex Model by $72.91m over the RCP.[20, 21]

70. On the basis that the maintenance work would likely continue, and is estimated separately by Powerlink as operating expenditure, inclusion in the Repex Model appears to be conservative and results in an inflated historical replacement quantity and, when applied to its Repex Model, an over-estimate of forecast expenditure due to:

- Including maintenance activity that is occurring at a different mean asset life to the mean replacement life associated with tower built section refits, and therefore biasing the tower population to a younger mean replacement life;
- Applying the derived mean replacement life to both the the tower built section rebuild and refit activities in the Repex Model;
- Applying a flat rate of maintenance activity of 18.4 towers per year, and corresponding flat maintenance adjustment amount of $19.06m, whereas the forecast replacement quantity and repex forecast is increasing with time, resulting in an over-estimate of $53.85m over the next RCP; and
- Not differentiating the volume of maintenance activity across corrosion zones within the Repex Model.

71. We also note that Powerlink has applied what appears to be a relatively high unit cost[22] of $207.1 thousand to the maintenance activities associated with replacement of corroded components of a tower, whereas such maintenance activities when compared with full tower refit activities, on average, would be expected to be much lower cost per unit.

3.3.4 Substation primary plant[23]

72. We observe that Powerlink has applied the following process to adjust the replacement quantity of substation primary plant provided in its RIN, by voltage class and circuit type, reducing the replacement quantity by 458 over the 2011-2015 period:
    - Adjustments to the reported RIN quantities (-49). The major changes include:
        - RIN adjustments for Belmont 110kV substation replacement including split of RIN data into additional voltage level 11kV (-109); and
        - Adjustment for procurement versus equipment records for Gladstone Switchyard rebuild (+29) and Ingham/Yabulu Sth 275/132kV Line Replacement (+14)

[20] This includes the expenditure forecast in the Repex Model for Tower rebuild and Tower refit over the period 2018-2022, but not the maintenance adjustment or towers replaced due to substation rebuild.

[21] We estimate that the forecast replacement quantities in Powerlink's, *Replacement capex (repex) Model – Forecast Model – 2015 Profile – CONFID*, increase from 748 (based on a cal bration volume of 591) to 1,102 over the next RCP (based on a calibration volume of 683).

[22] In Powerlink, *Replacement capex (repex) Model – Forecast Model – 2015 Profile – CONFID*, transmission tower refit unit costs vary between [redacted] We have not undertaken a detailed review of the unit costs in the Repex Model, nor have we been requested to. However we include this observation as it forms part of the bias that exists by including the maintenance activity volumes into the Repex Model.

[23] The terms substation primary plant and substation switchgear are used interchangeably. We have standardised on the use of substation primary plant to include circuit breakers, isolators/earth switches, voltage transformers and current transformers.

- Removal of equipment type exclusions (-16);
- Addition of CTs corresponding to dead bank CBs replacements (+207); and
- Removal of projects with drivers not completely asset condition (-600). The major changes include:
  - Swanbank A and B power station rebuild (-239);
  - Gladstone power station switchyard rebuild (-106); and
  - Loganlea 110kV substation rebuild (-63) and secondary systems replacement[24] (-8) for fault level.

73. In Powerlink's response to our information request,[25] Powerlink has confirmed that the only changes it made from its RP to its RRP in this asset category is the removal of the Swanbank power station switchyard site, Gladstone Power Station site and the primary plant components of the Loganlea 110kV substation secondary systems replacement, removing 353 asset replacements.

74. In Table 8, we show the adjustments by asset category from the original reported RIN quantities.

Table 8: Adjustments to substation primary plant replacements 2011-2015

Asset category	Reported RIN quantities	Corrections to RIN quantities	Adjusted RIN quantities for condition driver only	Repex Model calibration quantity	Difference to reported RIN quantities
CB - All Voltages	160	162	110	110	-50
IsolES - All Voltages	649	605	368	368	-281
VT - All Voltages	358	326	204	204	-154
CT - All Voltages	257	473	284	284	27
Total	1424	1566	966	966	-458

Source: EMCa analysis of Powerlink – Capex Calibration Quantity – 2 – Switchgear – December 2016

75. We note that the actual adjustments to substation primary plant in Powerlink's Repex Model are larger than that reported in the RRP, Table 4.1 for all asset sub-categories. We consider that Powerlink has applied a reasonable process for adjusting the historic quantities of replacement activity for substation primary plant assets.

3.3.5 Secondary systems

76. We observe that Powerlink has applied the following process to adjust the replacement quantity of secondary systems and communications provided in its RIN, increasing the replacement quantity by 45 for the 2011-2015 period:
    - Adjustments to the reported RIN quantities (-11);
    - Removal of secondary system assets at power station sites (-32); and
    - Addition of communications assets capitalised after commissioning primary assets (+87) and secondary systems (+1).

77. In Powerlink's response to our information request,[26] Powerlink has confirmed that the only change from its RP to its RRP in this asset category is the the removal of the

[24] In Powerlink, *Capex Calibration Quantity – 2 – Switchgear – December 2016*, project CP.01127 Loganlea 110kV Secondary Systems Replacement includes adjustmetns of 1 off CB, 4 off Isolator/earth switches, and 3 off CTs

[25] Powerlink, *Response to Information Request – PQ0203*, 2 February 2017, Table 1 items 3 and 4

[26] Powerlink's response PQ0203 (2 February 2017) to our information request, Table 1 items 3 and 4

Swanbank power station switchyard site and Gladstone Power Station site, removing 32[27] asset replacements.

78. In Table 9, we show the adjustments by asset category from the original RIN.

Table 9: Adjustments to secondary systems switchgear replacements 2011-2015

Asset category	Reported RIN quantities	Corrections to RIN quantities	Adjusted RIN quantities for condition driver only	Repex Model calibration quantity	Difference to reported RIN quantities
Secondary Systems (Bay & Non-bay)	322	280	280	280	-42
Communications Assets	966	1053	1053	1053	87
Total	1288	1333	1333	1333	45

Source: EMCa analysis of Powerlink – Capex Calibration Quantity – 3 – Secondary Systems Telecommunications – December 2016

79. We note that the actual adjustments to secondary systems in Powerlink's Repex Model are larger than that reported in the RRP, Table 4.1. We consider that Powerlink has applied a reasonable process for adjusting the historic quantities of replacement activity for secondary systems assets (including communications).

3.3.6 Implications to the repex forecast

80. Powerlink has used a reasonable process to calibrate replacement quantities and adjust its reported RIN quantities of replacements to account for assets with no enduring need, no future capex requirement or with non-condition drivers.

81. As shown in Table 10, Powerlink has reduced the calibration quantities used in its RRP for substation primary plant and secondary systems. We have discussesd the basis for these changes in the preceeding sections.

Table 10: Comparison of calibration quantities between RP and RRP

Asset category	RP Calibration Quantity	RRP Calibration Quantity	Difference to RP
Transmission towers	683	683	0
Substation primary plant	1319	966	-353
Secondary systems	1365	1333	-32

Source: EMCa analysis of Powerlink's calibration quantities[28]

82. We do not agree with Powerlink's approach to inclusion of its maintenance volumes into the transmission tower replacement quantity, thereby increasing the historic replacement quantity from 591 (as reported in Table 4.1 of its RRP) to 683. This has the impact of increasing the average annual replacement quantity in the Repex Model for calibration purposes, and therefore the forecast replacement volumes. We estimate that by removing the maintenance volumes, and applying the revised annual calibration quantities shown in Table 11, the mean replacement life derived from Powerlink's calibration model[29] increases for corrosion zone B and corrosion zone C by

[27] This relates to secondary systems assets categorised as bay and non-bay only, and excludes metering and SVC assets.

[28] The RP calibration quantity was derived by adjusting the RRP calibration quantity by the figures provided in Powerlink, *Response to Information Request – PQ0203,* 2 February 2017, Table 1 with the addition of row 16 in the *Calibration Quantity – 2 – Switchgear / Reporting 4 – project Diffs*

[29] We have applied the revised annual calibration quantities to Powerlink, *Replacement (repex) Model - Calibration Model – 2010 Profile – December 2016*. To model an annual cal bration quantity of 0.0 for zone B, we accepted

approximately 6.8 years (to 78.2 years) and 3.2 years (to 61.1 years) respectively, and by less than one year (to 45.8 years) in corrosion zone DEF.

Table 11: Comparison of tower calibration quantities between RP and RRP

Corrosion zone	RRP annual calibration quantity	Annual calibation quantity with maintenance removed	RRP Calibrated asset replacement life (years)	Calibrated asset replacement life with maintenance removed (years)	Difference to RRP
Zone B	0.4	0.0	71.4	78.2	6.8
Zone C	23.0	11.8	57.9	61.1	3.2
Zone DEF	113.2	106.4	45.0	45.8	0.8

Source: EMCa analysis of Powerlink – Replacement capex (repex) model – Calibration Model – 2010 Profile – December 2016

83. Where the maintenance volumes are removed from the calibration quantity, and thereby from the derivation of mean replacement lives and capital expenditure forecast, the corresponding maintenance adjustment proposed by Powerlink should also be removed.

3.4 Changes to the asset age profiles

3.4.1 Overview

84. As distinct from the historical replacement volumes used for calibration, Powerlink also uses the age profile of the asset population in its calibration process for determining the mean asset replacement lives. Importantly, the asset profile needs to be consistent with, and relate to the calibration quantities determined by Powerlink over the same period. That is, if the asset profile is not representative of the asset population when the asset replacements were undertaken, then the calibrated mean replacement lives are likely to be more conservative. Similarly, the age profile used for the forecast must reflect the asset profile that is being managed by Powerlink and to which the replacement capital expenditure is to be applied.

85. Powerlink has made a number of adjustments to its age profile reported in the original RIN which "*better reflects Powerlink's actual asset management practices and is able to produce a credible and reasonable forecast.*"[30] We consider the reasonableness of these adjustments below.

3.4.2 Transmission towers

86. We have reviewed the changes proposed by Powerlink to its age profile as described in its RRP and supporting documents. The RRP states that a total of 2,725 transmission towers have been identified for future retirement and therefore removed have been from the RIN.[31] This aligns with the summation of adjustments for the 2015 age profile in the supporting information, however the reasons provided for these adjustments in the supporting information also include other factors. We have relied on the information provided in Powerlink's Repex Model and supporting spreadsheets in our analysis.

a derived forecast quantity and asset replacement age to an accuracy of 1 decimal place in the model. That is, for the purpose of comparison and in the absence of better information, we applied an annual replacement quantity of 0.049, which when rounded, is equivalent to 0.0.

[30] Powerlink, *Appendix 5.05 Non-load Driven Network Capital Expenditure Forecasting Methodology*, page 24

[31] Powerlink, *Appendix 5.05 Non-load Driven Network Capital Expenditure Forecasting Methodology*, Table 4, page 20

87. In Powerlink's response to our information request,[32] it advised that a number of adjustments were applied to the age profiles used in its RRP, adding a further 256 towers since its RP:

- Inclusion of additional transmission line in the 2010 age profile (+256); and
- Change of corrosion zone DEF to corrosion zone C of one line installed in 1973 in the 2015 age profile.

3.4.3 Substation primary plant

88. We have reviewed the changes proposed by Powerlink to its age profile as described in its RRP and supporting documents. We note that:

- The Capex Age Profile for Switchgear[33] shows that a total of 161 items of substation primary plant have been removed from the age profile for 2015, with the majority (151) identified as having no future enduring need;
- A further 672 CTs were added over the period 2012-2015 associated with the descriptor "*..recent generation of dead tank CBs*", and 132 CTs over the period 1975-1984 with the descriptor "*..older generation of dead tank CBs*"; and
- Powerlink describe the modelling changes for CTs associated with dead tank CBs, and specifically that whilst they are included in the forecast model:

  "These CT units were not included in the 2010 age profile for the calibration model as they would only be replaced in conjunction with their host circuit breaker. The result of this approach to calibration is that the calibrated mean replacement life for CTs is not influenced by any replacement of CTs on dead tank circuit breakers which are driven by the condition of the circuit breaker, not the included CT. Nevertheless they should be included in the 2015 age profile for the forecast model as there will be a future need to replace these CTs."[34]

89. In Powerlink's response to our information request,[35] it advised that it had removed the substation primary plant associated with Swanbank power station switchyard from the 2010 asset age profile.

3.4.4 Secondary systems

90. We have reviewed the changes proposed by Powerlink to its age profile as described in its RRP and supporting documents. We note that:

- The Capex Age Profile for Secondary Systems[36] shows that a total of 84 items of secondary systems plant have been removed from the age profile for 2015, with only 10 associated with no enduring need.
- Two main changes were made, being:
  - Adjustments to correct for default age associated with the capitalisation date of 1 July 1996, which resulted in a reallocation of 178 items of equipment; and

[32] Powerlink, *Response to Information Request – PQ0203*, 2 February 2017, Table 1 items 1 and 2

[33] Powerlink, *Capex Age Profile – 2 – Switchgear – December 2016*

[34] Powerlink, *Appendix 5.05 Non-load Driven Network Capital Expenditure Forecasting Methodology*, page 27

[35] Powerlink, *Response to Information Request – PQ0203,* 2 February 2017, Table 1, item 3

[36] Powerlink, *Capex Age Profile – 3 – Secondary Systems – December 2016*

  - Adjustments to "*account for secondary systems – basis of preparation from RIN to adjusted age profile*", being removal of 83 communications items and addition of 34 secondary systems item; and

- Powerlink states that the adjustments allow it to more accurately model a single mean replacement life by limiting its "*consideration to the major protection and control equipment such as protection relays and Remote Terminal Units (RTUs)"* and not the ancillary equipment.

91. In Powerlink's response to our information request,[37] it advised that it had removed the secondary systems associated with Swanbank power station switchyard from the 2010 asset age profile.

3.4.5 Implications to the repex forecast

92. Powerlink has shown how the adjustments in its spreadsheet have been made to its asset age profile for use in its Repex Model, including addressing issues identified in the report by its consultant Nuttall Consulting relating to the consistency of the 2010 age profile and calibration volume for transmission towers. The implications of these adjustments to the calibration of the mean replacement age of towers in its RRP are discussed in subsequent sections.

93. We have not, nor were we requested to, undertaken an audit of the age profile or Powerlink's asset systems to confirm the accuracy of the movement of individual assets or the business rules applied by Powerlink in each case.

94. We support the addition of an independent audit opinion to provide assurance of the accuracy of the large number of adjustments to the RIN as proposed by Powerlink's advisor, Nuttall Consulting. We reviewed the audit opinion provided in Powerlink's RRP, and consider this does little to assure that the age profile data used in the Repex Model is accurate, rather it appears to be a statement that the procedures provided by Powerlink were performed by the auditor, and that a determination of accuracy remains a function of Powerlink (rather than the auditor):

    "The procedures were performed to solely assist you in determining the accuracy of the adjustments made to the asset age profile at 30 June 2015 and 30 June 2010." [38]

95. In our Initial report we stated that on review of Powerlink's advice as to how it has addressed each of the issues raised by Nuttall Consulting, which resulted in some of the adjustments to the asset age, we consider it had addressed them adequately. On balance, we do not consider that there is sufficient cause to change our opinion on this matter.

96. Powerlink has made further changes to its asset age profile, and we consider that with the addition of these changes it is more likely to produce a reasonable asset age profile for the purposes of its repex modelling.

[37] Powerlink, *Response to Information Request – PQ0203,* 2 February 2017, Table 1, item 3

[38] Powerlink, *KPMG Agreed upon procedures - Repex Model - Adjustment to asset age profiles – January 2016*

3.5 Application of mean replacement lives

97. In its Draft Decision, the AER increased Powerlink's calibrated mean replacement lives for transmission towers, substation primary plant and secondary systems by one standard deviation.[39, 40]

98. The AER (and EMCa) observed that the actual replacement lives at replacement were, on average, significantly longer than the replacement lives in the Powerlink Repex Model.[41] The AER and EMCa identified and reported several other issues with Powerlink's forecasting methodology, key assumptions and past capex performance that collectively indicated that the Powerlink's forecast repex was unlikely to be at a prudent and efficient level.[42, 43]

99. Powerlink states that it "*considers the AER's assessment approach and conclusions result in mean replacement lives for assets that are unrealistic*."[44] It further states that the "*AER and EMCa have erred in their assessment of the calibrated mean replacement lives used in the Repex Model by assuming an observed replacement age for an existing asset is reflective of the mean replacement age of the entire population of new assets. This ignores the conditional probability analysis that is necessary when there is an existing population of similar assets, but all of different ages, and which is a fundamental basis of the proper application of the Repex Model*."[45]

100. In the following sub-sections, we have taken into account new and/or updated information from Powerlink and have addressed Powerlink's expressed concerns with the AER's adjustment approach in the context of the asset categories for which the AER adjusted the mean replacement life.

3.5.1 Transmission towers

101. Table 12 shows the changes to the mean replacement lives for Transmission towers for each of the three corrosion zones as presented by Powerlink in its RRP. Powerlink's further adjustments since its RP has resulted in a mean replacement life for towers in corrosion zones DEF that is commensurate with the AER's adjustment. It has made no changes that result in revised mean replacement lives for towers in corrosion zones B or C in its RRP and these remain materially different to the AER's values.

[39] AER, *Draft Decision, Attachment 6 – Capital Expenditure*, page 6-48

[40] Powerlink derived standard deviation from the square root of the mean replacement life (i.e. assuming the distribution of lives around the mean is random)

[41] As derived from EMCa's review of a sample of Powerlink projects and noting that in each case, one standard deviation was less than the difference between the estimated actual mean replacement lives (derived from the sample projects) and the mean replacement lives reported in Powerlink's RP

[42] AER, *Draft Decision, Attachment 6 – Capital Expenditure*, pages 6-10 to 6-11, and 6-37 to 6-51

[43] It was not within EMCa's scope of work to undertake a detailed review of the actual input data to the model

[44] Powerlink, *Revised Revenue Proposal 2018-22*, page 23

[45] Powerlink, *Revised Revenue Proposal 2018-22*, page 26

Table 12: Mean replacement lives – Transmission towers (years)

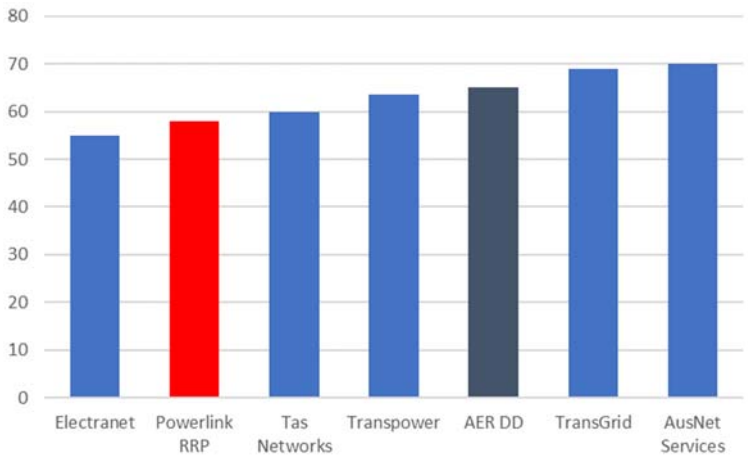
Calibration Of Standard Lives	Powerlink RP	AER Draft Decision	Powerlink RRP	Difference to RP
Towers in Corrosion Zone B	71.4	79.9	71.4	-
Towers in Corrosion Zone C	57.9	65.5	57.9	-
Towers in Corrosion Zone DEF	40.3	46.6	45.0	4.7

Source: EMCa analysis of Powerlink - Replacement capex (repex) model - calibration model - 2010 profile - December 2016 and AER Draft Decision Attachment 6, Table 6.8

102. As discussed in an earlier section of this report, we consider that Powerlink has not justified the inclusion of maintenance interventions for its calibrated replacement quantities relating to all three corrosion zones. As shown in Table 11, the removal of the maintenance intervention quantities results in mean replacement lives for each of the three corrosion zones that are more similar to the mean replacement lives proposed by the AER, as shown in Table 12.

103. Figure 2 shows a comparison of weighted mean replacement lives for a selection of peer utilities.[46] This graph indicates that the AER's adjusted results are not 'unrealistic' compared to Powerlink's peer utilities (as claimed by Powerlink) and that Powerlink's RRP mean tower replacement life is the second lowest of its peer group. In compiling this information, Powerlink reference TransGrid's Network Management Plan 2013-2018 to explain that its mean tower replacement life is only likely to be achieved following a life extension activity.[47]

Figure 2: *Weighted mean tower replacement lives – peer comparison (years)*



Source: Powerlink Information Request response PQ0203, Transpower Towers and Poles Fleet Strategy, Nov 2013, page 12

3.5.2 Substation primary plant

104. Powerlink has made further adjustments to its Repex Model which have had the effect of increasing the mean replacement lives for substation primary plant. Table 13 shows the changes to the mean replacement lives as presented by Powerlink in its RRP for substation primary plant.

[46] The values for the Australian utilities were derived by Powerlink from assessment of RIN data; the Transpower result was derived by EMCa

[47] Powerlink, *Response to Information Request – PQ0203*, 2 February 2017, page 8

Table 13: Mean replacement lives – Substation primary plant (years)

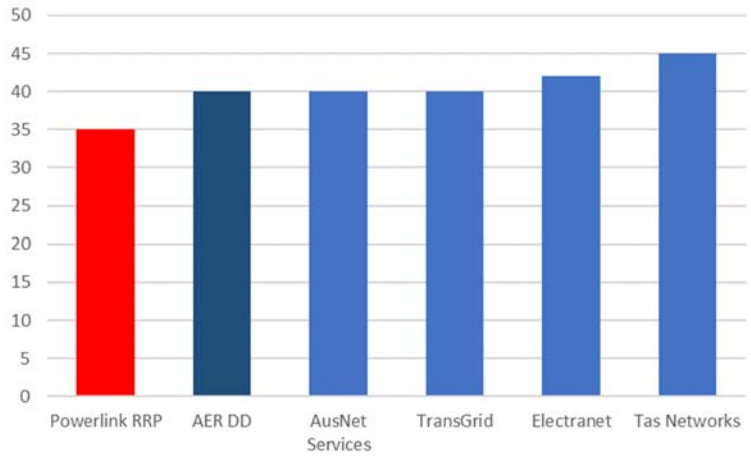
Calibration Of Standard Lives	Powerlink RP	AER Draft Decision	Powerlink RRP	Difference to RP
CB - All Voltages	34.2	40.2	35.2	1.0
Isolator / ES - All Voltages	39.8	45.8	40.6	0.8
VT - All Voltages	34.6	40.6	35.1	0.5
CT - All Voltages	33.2	39.2	34.2	1.0

Source: EMCa analysis of Powerlink - Replacement capex (repex) model - calibration model - 2010 profile - December 2016 and AER Draft Decision Attachment 6, Table 6.8

105. Figure 3 shows the mean circuit breaker (CB) replacement lives from other transmission utilities, the AER's Draft Decision, and Powerlink's RRP.[48] This indicates that the AER adjusted results are not 'unrealistic' compared to peer utilities (as claimed by Powerlink), and that Powerlink's RRP mean CB replacement life is the lowest of its peer group.

106. Powerlink reported that its assessment of the actual replacement lives from the sample project documentation reviewed by EMCa resulted in a lower variance with Powerlink's calibrated mean replacement lives.[49] We have reviewed our analysis and consider that the difference is likely to be a result of the approximations and assumptions that were used in determining the mean replacement life from the sample projects. The AER's adjustment of +6 years to Powerlink's RP values is less than EMCa's derived average age at replacement from the sample projects (as reported in our Addendum report). The margin between the AER's values and Powerlink's revised values is now on average five years.

Figure 3: *Mean CB replacement lives - peer comparison (years)*



Source: Powerlink Information Request response PQ0203

3.5.3 Secondary systems

107. Powerlink has made further adjustments to its Repex Model which have had the effect of slightly increasing the mean replacement lives for Secondary systems, with no change to the Communciations asset mean replacement life. Powerlink's value for Secondary systems therefore remains materially different from the AER's adjusted values. Table 14 shows the changes to the mean Secondary systems replacement lives as presented by Powerlink in its RRP.

[48] These results were derived by Powerlink

[49] Powerlink, *Revised Revenue Proposal 2018-22*, page 34

Table 14: Changes in mean replacement lives – Secondary systems (years)

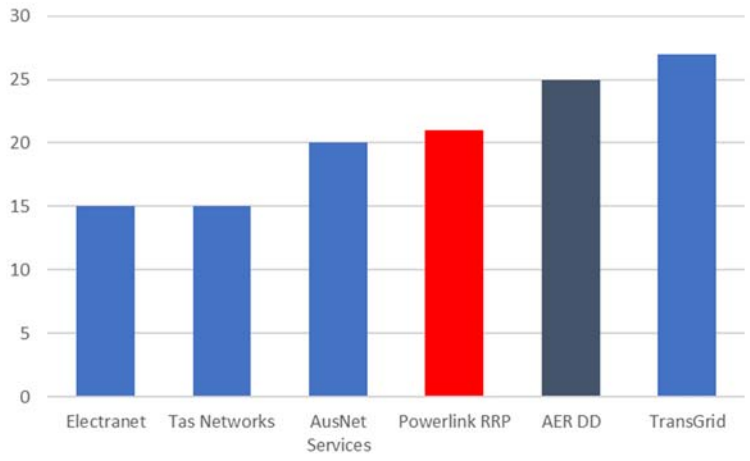
Calibration Of Standard Lives	Powerlink RP	AER Draft Decision	Powerlink RRP	Difference to RP
Secondary Systems - Bay or Non-bay	20.2	24.7	20.6	0.4
Communications Assets	10.7	10.7	10.7	-

Source: EMCa analysis of Powerlink - Replacement capex (repex) model - calibration model - 2010 profile - December 2016 and AER Draft Decision Attachment 6, Table 6.8

108. Figure 4 shows the mean secondary systems replacement lives from other transmission utilities, the AER's Draft Decision, and Powerlink's RRP. This indicates that the AER's adjusted results are not 'unrealistic' compared to peer utilities (as claimed by Powerlink) and that Powerlink's RRP mean secondary systems replacement life is higher than three NSPs in its peer group. In compiling this information, Powerlink reference TransGrid's Network Management Plan 2013-2018 to explain that Transgrid estimates that the expected life of new relays is between 15 and 20 years. Powerlink observes that this is likely to infer that the mean replacement life indicated in Figure 4 includes electro-mechanical relays.[50]

109. Powerlink reported that its assessment of the actual replacement lives from the sample project documentation reviewed by EMCa resulted in negligible variance with the Repex Model mean replacement lives.[51] We have reviewed our analysis and consider that our derived value is reasonable based on the information available. We note that the AER's Draft Decision value for secondary systems is less than EMCa's derived average age at replacement from the sample projects.

Figure 4: *Mean secondary systems replacement lives – comparison (years)*



Source: Powerlink Information Request response PQ0203

3.6 Governance and management considerations

110. In its Draft Decision, the AER was concerned that "*Powerlink's historical asset replacement policies and practices, particularly in the early years of the calibration period, are likely to distort the repex model calibration and result in average asset*

[50] Powerlink, *Response to Information Request – PQ0203*, 2 February 2017, page 8

[51] Powerlink, *Revised Revenue Proposal 2018-22*, page 34

replacement lives which are shorter than Powerlink is actually likely to achieve in the 2017-22 regulatory control period."[52]

111. The AER stated that its determination was cognisant of Powerlink's adjustment of the historical volume of work to remove assets from consideration that: (i) are deemed by Powerlink to have no enduring need; and (ii) were replaced for reasons other than asset condition.[53]

112. In our Initial and Addendum reports, we undertook a review of Powerlink's governance and management frameworks and associated management practices. Through this review, we observed the following systemic issues leading to a bias towards over estimation of its repex forecast:

- Inclusion of replacement work that was initiated by non-condition drivers;
- Bundling assets that did not require replacement due to condition and/or obsolescence with assets that did require replacement; and
- Inadequate justification of the scope and timing of work in project documentation - with the lack of comprehensive options analysis and cost-benefit assessment to confirm the prudent scope and timing of work.

113. The extent of asset write-offs reported in business cases that we reviewed and the mismatch between the actual asset lives at replacement compared with those used in the Powerlink Repex Model were further indicators that the replacement quantities being used for calibration of Repex Model were likely to be inflated.

114. In its RRP, Powerlink has:

- *"[M]ade further adjustments to the Repex Model inputs to ensure it aligns with Powerlink's most recent asset management strategies and plans, while also having regard to aspects of the AER's Draft Decision…"*[54]. Specifically, it has made a series of adjustments to its replacement quantities and age profiles, that as inputs to its Repex Model, have had the combined affect of reducing its repex forecast for the 2018-2022 RCP;
- Responded to concerns raised with respect to its nominated mean replacement lives; and
- Presented information relating to the application of life extension strategies (discussed in section 4).

115. Powerlink has not responded directly to the issues identified in our Initial or Addendum reports relating to the justification of project scope and volume, and implications to its repex forecast.

116. For transmission towers, we consider that the combination of adjustments that Powerlink has made since its RP are directionally consistent with our previous findings. We remain concerned that the replacement quantities are likely to be higher than a prudent and efficient level. The exclusion of the maintenance intervention to the calibration quantity, and corresponding maintenance offset to the repex forecast are more likely to reflect a

[52] AER, *Draft Decision, Powerlink transmission determination 2017-18 to 2021-22, Attachment 6 – Capital expenditure, Sep 2016,* page 6-11

[53] *Ibid, page 6-48*

[54] *Ibid, page ii*

prudent and efficient level and address the concerns with project justification expressed in our Initial report and Addendum reports.

117. For substation primary plant and secondary systems, the adjustments to the Repex Model inputs that Powerlink has made since the RP are again directionally consistent with our previous findings and are more likely to to reflect a prudent and efficient level. Powerlink's adjustments since its RP indirectly address the concerns with project justification expressed in our Initial report and Addentum report.

3.7 Adjustment to historic expenditure

118. Powerlink has claimed that we, alongside the AER, misunderstood information provided in Powerlink's response to an information request[55] relating to the treatment of historical expenditure.

119. To clarify our understanding, we requested additional information from Powerlink to explain the modelling referred to by Powerlink as part of its RP:

> *"Powerlink's modelling indicates these adjustments equate to a reduction of approximately 9% compared to historic reinvestment expenditure."*[56]

120. In its RRP, Powerlink advised that its reference to a 9% reduction compared to historical expenditure was based on the following calculation for each type of asset:[57]

> *(calibration model replacement quantity – actual replacement quantity) * unit rate*

121. In Table 15 we show the results of this calculation as provided in Powerlink's reponse to our information request.

Table 15: Derivation of 9% difference to historical expenditure ($m) for Powerlink's RP

Asset category	Repex based on actual historical replacements	Repex based on RP adjusted quantities
Transmission towers	$239	$207
Substation primary plant	$182	$155
Secondary Systems	$292	$288
Buildings and site infrastructure	$41	$40
Total	$754	$690
Difference between RP and historical repex		-9%

Source: EMCa analysis of Calibration quantities with Unit Rates spreadsheet provided with Powerlink's response PQ0203 (2 February 2017) to information request

122. In Table 16 we show the replacement quantities used by Powerlink for the modelling in Table 15, and compare these with the replacement quantity assumptions provided by Powerlink to explain adjustments for inclusion in its Repex Model for its RRP. The quantities used in its RP, and relied upon for this analysis, align with those reported in its RRP, as shown in Table 10, with the exception of (i) the quantities for towers (as previously discussed); and (ii) the secondary systems. For secondary systems, the quantities of metering and SVC secondary system assets need to be removed, as denoted in Table 16 as 'Secondary Systems (Corrected)'. We consider that a direct

[55] Powerlink, *Response to Information Request – PQ0178*, 5 August 2016

[56] *Ibid*

[57] Powerlink, *Revised Revenue Proposal 2018-22*, page 29

comparison cannot be made to the values provided in Table 15 with those of the RRP without similar corrections being applied.

Table 16: Comparison of replacement quantities

Asset category	Revenue Proposal		Revised Revenue Proposal	
	Actual historical replacements	Calibration quantities	Actual historical replacements	Calibration quantities
Transmission towers	667	591	667	683
Substation primary plant	1582	1319	1424	966
Secondary Systems	1406	1404	1288	1333
Secondary Systems (Corrected)	1365	1365	1288	1333
Buildings and Infrastructure	54	46	54	46

Source: EMCa analysis of Calibration quantities with Unit Rates spreadsheet provided with Powerlink's response PQ0203 (2 February 2017) to information request

123. In summary, Powerlink has not made an additional adjustment of -9% to its repex modelling in its RP. Rather, this was the outworking of its calibration quantity adjustments to ensure only condition driven asset replacements are captured in its repex modelling, as described above.

4 Assessment of repex offset for preventative replacement

4.1 Introduction

124. In this section, we assess other factors relevant to the determination of the replacement expenditure, other than those directly related to the Repex Model as discussed in section 3.

4.2 Our assessment

4.2.1 Summary of Initial and Addendum reports

125. In our Initial report, and in the absence of Powerlink providing other forecasting techniques to supplement the use of its Repex Model, we raised concerns that we did not observe sufficient evidence that Powerlink took the opportunity to apply life extension strategies earlier in the life of its transmission tower assets. Specifically, we did not see a similar level of survival curve analysis, as evident in Transpower New Zealand Limited (Transpower), for its transmission towers which we considered would likely increase the prudency and efficiency of its forecast and enhance the robustness of its Repex Model.[58]

126. In our Addendum report, we recommended that the AER allows for a prudent increase in Powerlink's preventative and corrective replacement expenditure for asset life extension. We provided the example of earlier painting of transmission towers by Transpower, as illustrative of the type of preventative replacement expenditure to achieve life extension.

127. We considered that the potential life extension to key asset categories will likely reduce the expenditure requirements indicated by Powerlink's Repex Model. However, as a partial offset to this reduction, we recommended that the AER allows for a prudent

[58] EMCa, *Review of Powerlink's forecast non-load riven capital expenditure – July 2016*, pages 33-35

increase in Powerlink's preventative and corrective replacement expenditure on asset life extension, including earlier painting of transmission towers.

128. We calculated the prudent increase based upon an estimated forecast tower painting volume from Powerlink's Repex Model and assumed an average tower painting unit cost from Transpower's regulatory disclosures.

4.2.2 AER's Draft Decision

129. The AER included an allowance of 15% of the initial repex forecast in its Draft Decision to support the increased activity associated with life extension.

4.2.3 Powerlink's RRP response

130. In its RRP, Powerlink has stated that it already undertakes life extension activities, and considers that this provides further evidence that the proposed reductions to its repex forecasts by the AER are not justified.

131. Powerlink has included examples from TransGrid and Transpower to illustrate that the approach taken by Powerlink is comparable to other TNSPs.

132. Powerlink also indicated that it was not clear what activities the 15% offset could be usefully directed towards that would make any meaningful difference to those assets already approaching their end-of-life within the next regulatory period.

4.2.4 Our assessment

133. We note that Powerlink includes references to preventative techniques such as tower painting for its transmission towers in its asset management strategies:

- *"Early Life Tower Painting in highly corrosive environments or environmentally sensitive areas is an accepted refurbishment activity and occurs on a needs basis, where economic"*[59]*; and*
- *"Trigger for tower painting is Deterioration of zinc layers on steel to Grade 2 in areas of high corrosion or environmentally sensitive areas, where economic"*[60]

134. However, it is not evident in our project reviews or in the information provided to us, the extent to which Powerlink applies these strategies in practice, and where Powerlink has applied this practice outside of a refit project, what benefit can be realised for the replacement program. Powerlink does present the option of undertaking a refit program, including tower painting, at a time 5 years prior to the tower end of life.

> *"Powerlink considers that its expected timing for the first life extension works on transmission towers (selected bolt and member replacement together with painting with a zinc coating) is consistent with that adopted by other TNSPs in similar operating environments."*[61]

135. In the absence of the inclusion of survival curve analysis as undertaken by Transpower, it is likely that further life extension may be possible to asset lives.

[59] Powerlink, *Transmission line asset methodology framework*, page 23

[60] Powerlink, *Transmission line asset methodology framework*, page 26

[61] Powerlink, *Revised Revenue Proposal 2018-22*, page 41

136. Whilst we acknowledge that Powerlink does consider early tower painting in its 'Transmission line asset methodology framework' documentation, we did not see evidence of its application in our review of Powerlink's practices. Moreover, our review of a sample of projects suggested that the observed condition of several lines suggested very little maintenance had occurred, rather than the reported maintenance practices described in its documentation.

137. We consider that the examples provided by Powerlink in its RRP aimed at demonstrating its practices are comparable with other TNSPs do not, on their own, address the concerns raised in our Initial and Addendum reports nor address the opportunity for Powerlink to undertake additional early preventative/corrective maintenance measures with the objective of life extension.

4.3 Implications to the repex forecast

138. In its Draft Decision, the AER included an offsetting allowance in Powerlink's repex to assist with additional asset life extension strategies. We had suggested that Powerlink consider the inclusion of earlier painting of transmission towers, and remained silent on other methods and techniques of life extension that could be reasonably considered by Powerlink across the asset categories of transmission towers, substation primary plant and secondary systems.

139. The allowance provided a partial offset to the reduction in expenditure arising from adopting longer mean asset replacement life assumptions in its Repex Model. As discussed in section 3, Powerlink has made further adjustments to its Repex Model that result in mean asset replacement life assumptions that are directionally consistent with our earlier advice. Further, Powerlink has not demonstrated that it would reasonably apply the allowance to achieve the NER and capital objectives to the nominated asset categories.

140. In its RRP, Powerlink states that it:

> *".. is not satisfied that there are other, additional, capital expenditure options to achieve the extended replacement lives put forward by the AER"*[62]

141. In the absence of compelling information from Powerlink to retain the allowance, and in the absence of a more complete review of the application of Powerlink's maintenance strategies and programs, we consider that the allowance should be removed from the forecast.

142. Notwithstanding the advice received from Powerlink that life extension strategies, and early intervention programs already form part of its asset management planning, we consider that additional economically prudent life extension opportunities are likely to exist.

[62] Powerlink, *Revised Revenue Proposal 2018-2022*, page 36

Appendix A: Our observations on Powerlink's claims

Overview

143. Powerlink has detailed its response to the AER's Draft Decision on the replacement capital expenditure forecast, including application of its Repex Model, in Section 4 of the RRP and in appendices and additional supporting information. In this Appendix A, we consider Powerlink's specific claims and those of its consultant (Nuttall Consulting) and provide our response.

144. In its RRP, Powerlink outlines that EMCa provided two reports for the AER, and states that:

> *"Powerlink has identified several issues and concerns with these two reports and their consequent influence on the AER's Draft Decision. These are:*
>
> - *Significant inconsistencies in EMCa's assessment of the mean replacement lives between the first report and the addendum report;*
> - *Over-reliance on historical expenditure trends as a basis for concluding the inputs to the Repex Model do not represent efficient replacement; and*
> - *Lack of consideration given to the adjustments made from actual historical reinvestment quantities as input to the Repex Model."*[63]

145. Powerlink has provided the review undertaken by its consultant, Nuttall Consulting as Appendix 4.01 in its submission. We have reviewed this submission and provide our response in the sections that follow.

Reference to inconsistencies between our two reports to the AER

146. Powerlink claims that statements made in our Initial report in regards to replacement age of transmission towers and substation primary plant led to 'clear' conclusions that were subsequently amended in our Addendum report.

147. Our statements that the replacement ages for transmission towers and substation circuit breakers (being a subset of substation primary plant) were either within a broad range of those we had observed, or consistent with what we have seen in other TNSPs were consistent with the governance review we had undertaken.

148. This alone is not sufficient for Powerlink to claim that the replacement ages are reasonable, or that when applied to the Repex Model are likely to result in a prudent and efficient level of expenditure. From the sample of projects provided to us for our Initial report, we did not have sufficient information to make a direct link to asset replacement ages and at the AER's request undertook a review of a further sample of projects.

149. As noted in our Initial report, we observed systemic biases that we consider likely to have led Powerlink to over-forecast its non-load driven capital expenditure requirements for the 2018-2022 RCP.

[63] Powerlink, *Revised Revenue Proposal 2018-2022*, page 27

150. In our Addendum report, we considered that the systemic issues identified support the biases that we identified in our Initial report and that in aggregate the biases lead to an over-estimate of forecast expenditure. Specifically we found a similar bias towards replacing assets that were not justified on the basis of their condition, and that the calculated asset replacement lives for the purpose of the Repex Model may be too short.

Over-reliance on historical expenditure trends

151. Powerlink claims that statements made in our Addendum report relating to how the inputs to the Repex Model have been derived from historical projects have not been fully understood, specifically the treatment of non-condition driven expenditure. We have addressed this in the body of this report.

Lack of consideration to the adjustments made to the Repex Model

152. Powerlink claims that EMCa (and the AER) have not given due consideration to the adjustments that Powerlink made to the inputs to its version of the Repex Model. In a number of places in our Initial and Addendum reports[64] we acknowledged the adjustments Powerlink had made. We have reviewed and given due consideration to relevant material that Powerlink has provided.

153. As noted in our Initial report and Addendum report, Powerlink did not provide sufficient evidence to support selection of its mean asset replacement life. The AER has since requested that we provide an opinion on the Repex Model inputs. We have covered this in the body of this report.

Use of actual replacement lives

154. Nuttall Consulting states that it is not appropriate to use only actual ages, as it claims the AER and EMCa have, to estimate the mean life of the asset population.

155. Powerlink did not provide compelling information to support its selection of asset replacement ages, or other techniques to supplement its use of the Repex Model and which may have assisted with reconciling the difference between the observed replacement lives from the project reviews and asset replacement lives used for modelling. In the absence of better information, the observations from the project reviews were relied upon to help with the reconciliation. Whilst the use of actual replacement lives alone are likely to introduce a bias, the use of the actual lives illustrates that there is a disconnect between the modelling and the project outcomes. This issue has not been adequately addressed in Powerlink's RRP.

[64] EMCa, *Review of Powerlink's forecast non-load riven capital expenditure – July 2016*, pages 27, 28, 29 and EMCa, *Review of Powerlink's forecast non-load riven capital expenditure – Addendum report – September 2016*, pages 3, 5, 13