Technical Advisor Report on the Transpower New Zealand Ltd IPP Proposal for RCP2

Report to

The Commerce Commission

Strata Energy Consulting Limited

and

Energy Market Consulting Associates

16 May 2014

This report has been prepared to assist the New Zealand Commerce Commission (the Commission) with its determination of an individual price-quality path (IPP) for Transpower New Zealand Limited (Transpower).

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About Strata

Strata Energy Consulting Limited specialises in providing services relating to the energy industry and energy utilisation. The Company, which was established in 2003, provides advice to clients through its own resources and through a network of Associate organisations. Strata Energy Consulting has completed work on a wide range of topics for clients in the energy sector both in New Zealand and overseas.

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1 Introduction

1.1 Purpose of this report

13 The purpose of this report is to provide advice to the Commerce Commission (Commission) on various technical aspects of Transpower NZ Limited's (Transpower's) Individual Price-quality Path (IPP) proposal for regulatory Control Period 2 (RCP2) for the five-year period 2014/15 to 2019/20. The report provides a summary of Strata Energy Consulting's (Strata's) findings and advice to the Commission on technical aspects of Transpower's proposed expenditures (capex and opex).

14 This report is structured in the form of headlines, key focus areas and a summary of proposed expenditure adjustments. The contents of this report have been developed based on our professional opinion from information provided by the Commission and Transpower throughout the course of this review. We have also relied on the Commission's analysis and modelling in forming our views.

1.2 Context

15 Expenditure forecasts submitted with Transpower's RCP2 IPP application are assessed against the Commission's criteria for evaluating base capex as set out in the Transpower Capital Expenditure Input Methodology Determination [2012] (the IM).

16 The IM states that the following criteria (the 'expenditure criteria') apply for the evaluation of base capex proposals, major capex proposals and applications made under clause 3.3.4 of the IM:

> a) *whether what is proposed is consistent with the input methodology in this determination and, where relevant, the Commerce Act (Transpower Input Methodologies) Determination 2010;*
>
> b) *the extent to which what is proposed will promote the purpose of Part 4 of the Act; and*
>
> c) *whether, the data, analysis, and assumptions underpinning what is proposed are fit for the purpose of the Commission exercising its powers under Part 4 of the Act, including consideration as to the accuracy and reliability of data and the reasonableness of assumptions and other matters of judgement.*[1]

17 Schedule A of the IM sets out how the Commission will evaluate a base capex proposal. In undertaking this review, we have evaluated Transpower's proposal against the expenditure criteria and also against good electricity industry practice (GEIP) standards. In assessing Transpower's proposed opex we applied an approach that was consistent with the approach taken for base capex.

18 Delivering electricity network services efficiently to consumers requires the use of sound asset management practices. Good asset management practice requires combined economic and technical evaluation of options to manage risk, cost and performance. For example, the deferment of capital expenditure for as long as possible may have economic benefits for consumers, provided that network performance and risk of failure can be managed within acceptable standards. Well-performing electricity network businesses utilise a range of asset management and network design approaches to avoid the need to spend money to replace assets unnecessarily.

19 Consistent with the above, Strata's approach to assessing Transpower's proposal was based on a top-down methodology that applied a critical review of the process through which Transpower developed the capex and opex forecasts and tested the validity and sensitivity of critical input assumptions. The approach is similar to a governance level review rather than a bottom-up replication of the network planning process.

20 On a number of occasions, Strata and Transpower management have met and discussed specific topics in order to gain a clear understanding of the RCP2 proposal. We provided reasons when additional information requests were made. Transpower has, at all times in the review, acted helpfully and professionally and provided responses within expected timeframes.

21 The Commission management and staff provided modelling and analysis of data, which we have relied on in parts of our review.

22 In this report, unless stated otherwise, currency values are expressed as constant 2012/13 dollars (as is generally used by Transpower in its RCP2 proposal).

1.3 Structure of this report

23 We initially provide a Headline section that sets out our recommended adjustments to RCP2 forecast expenditures and a section that provides a summary of our key observations and findings. Combined, these two sections give an overview of the main sections of the report and can be considered as an executive summary.

24 We then provide a brief overview of RCP1 performance to date and identify key implications from RCP1 performance for the RCP2 expenditure forecast review.

25 In the main sections we set out our understanding of the methods Transpower has used to determine its expenditure forecasts for:

(a) Grid base capex;

(b) IST base capex;

(c) Grid opex;

(d) IST opex; and

(e) Corporate opex.

26 We then set out our findings and recommendations for each of these expenditure categories.

27 Annex A provides our detailed review of each of the 15 Enhancement and Development (E&D) projects.

2 Headline summary of adjustment recommendations

2.1 Base capex

28 Please note that all base capex reductions are expressed as expenditure including interest during construction (real 2012/13 prices) and calculated from data sourced from Transpower's RT01 RCP2 Forecasts and Revenue Excel workbook – Tab 2 (Base capex).

2.1.1 Enhancement & Development base capex

29 Strata's recommended adjustments result in an overall reduction of $67.1m (pre-productivity adjustment) to base capex for RCP2.

30 In making the above recommendation, we consider that Transpower's proposed -7.5% productivity adjustment is not applied to the remaining balance of the E&D expenditure forecast. This means that the adjusted total is $57.8m less than Transpower's proposed E&D base capex less the 7.5% productivity adjustment.

2.1.2 Replacement & Refurbishment base capex

31 For Replacement & Refurbishment (R&R) Transmission Lines and AC Stations an adjustment of -5% is made to take account of expected project roll-outs from RCP2 to RCP3[2].

32 For Secondary Assets an adjustment of -$12.2m is made to account for the recommended reassessment of the substation management system (SMS) replacement system in the Secondary Assets category.

33 This will result in an adjustment of -$46.4m to base capex and is applied prior to the application of the -7.5% productivity adjustment.

34 It should be noted that, given the right conditions, the Commission could consider a proposal from Transpower of an asset health index performance measure that could be used as an alternative to the -5% roll-out adjustment for R&R Transmission Lines and AC Stations. We consider that such a measure would also provide an improved link between expenditure and service performance.

[2] The 5% adjustment applied to capex in each year is equal to a deferral of 25 % of the replacement and refurbishment work in the final year

2.1.3 IST base capex

35 An adjustment of -$15.1m relating to the Transmission Pricing Methodology project.

36 The application of an additional -2.5% (-$4.7m) capex efficiency/prudency adjustment in lieu of the limited benefits analysis for RCP2 projects and the uncertain embedment of RCP1 benefits in the RCP2 expenditure forecast. The -2.5% adjustment would be applied prior to the application of the -7.5% productivity adjustment.

37 The above adjustments will result in an overall reduction of $20.37m to IST base capex for RCP2.

2.2 Opex

38 Please note that opex reductions are expressed in 2012/13 (real) terms and calculated from data sourced from Transpower's RT01 RCP2 Forecasts and Revenue Excel workbook – Tab 3 (Opex).

2.2.1 Grid opex

39 No adjustment.

2.2.2 IST opex

40 A productivity adjustment of -2%.

41 This adjustment will result in an overall reduction of $4.82m to opex for RCP2.

2.2.3 Corporate opex

42 A productivity adjustment of -10% applied to corporate opex to reflect the identified reduction opportunities.

43 The above adjustment will result in an overall reduction of $57.64m to opex for RCP2.

Table 1 Summary of opex adjustments

	Proposal RCP2					Adjustment	Strata adjustments RCP2					Adjusted expenditure RCP2				
Opex Category	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**		**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
Grid	101.1	102.0	100.0	95.2	93.5	0.0%	-	-	-	-	-	101.1	102.0	100.0	95.2	93.5
IST	48.5	48.6	48.0	48.1	48.0	-2.0%	- 1	- 1	- 1	- 1	- 1	47.6	47.6	47.0	47.1	47.0
Corporate	113.3	113.3	117.0	117.4	115.4	-10.0%	- 11	- 11	- 12	- 12	- 12	102.0	101.9	105.3	105.6	103.9
Sub total	263.0	263.9	265.0	260.6	256.9		- 12.3	- 12.3	- 12.7	- 12.7	- 12.5	250.7	251.6	252.3	247.9	244.4
				RCP2 total	**1,309.3**					**RCP2 total**	**- 62.5**				**RCP2 total**	**1,246.9**

Table 2 Summary of capex adjustments

Capex Category		Proposal RCP2					Adjustment	Strata adjustments RCP2					Adjusted expenditure RCP2				
		2016-18	**2018-17**	**2017-18**	**2018-19**	**2018-20**		**2016-18**	**2018-17**	**2017-18**	**2018-19**	**2018-20**	**2016-18**	**2018-17**	**2017-18**	**2018-19**	**2018-20**
Grid R&R	Transmission Lines and AC Stations	144.4	141.7	137.5	129.9	129.9	-5%	- 7.2	- 7.1	- 6.9	- 6.5	- 6.5	137.1	134.6	130.7	123.4	123.4
Grid R&R	Secondary Assets	26.3	24.3	22.4	22.8	19.9	-$12.21	- 5.2	- 3.2	- 1.7	- 1.9	- 0.2	21.1	21.1	20.7	20.8	19.8
Grid R&R	HVDC	3.1	6.1	3.2	4.9	4.2	0%	-	-	-	-	-	3.1	6.1	3.2	4.9	4.2
Grid E&D	Grid E&D RCP2 <20mil	13.4	18.1	31.9	35.5	24.9	-$67.10	- 10.0	- 10.0	- 13.6	- 15.0	- 18.5	3.4	8.1	18.4	20.5	6.4
ICT	IT finance	5.8	0.7	0.4	7.3	7.9	-$15.10	- 3.0	- 3.0	- 3.0	- 3.0	- 3.0	2.8	-2.3	-2.6	4.3	4.9
ICT	less IT finance	48.3	42.6	30.2	37.4	30.2	-2.5%	- 1.2	- 1.1	- 0.8	- 0.9	- 0.8	47.1	41.5	29.4	36.5	29.4
Business Support		6.1	15.2	7.0	2.7	2.4	0%	-	-	-	-	-	6.1	15.2	7.0	2.7	2.4
	Sub total	247.3	248.6	232.8	240.5	219.4		- 26.6	- 24.4	- 26.0	- 27.4	- 28.9	220.7	224.2	206.8	213.1	190.5
					RCP2 total	**1,188.6**					**RCP2 total**	**- 133.3**				**RCP2 total**	**1,055.3**

Notes:

1. The above totals have not applied the 7.5% prudency adjustment proposed by Transpower. In the proposal Transpower applies these to the nominal total for Grid and IST base capex.

2. All amounts are real 2012/13 millions of dollars.

3 Summary of key points and findings

44 At the highest level our approach to the review has been to:

(a) understand and assess the method Transpower says it has used to develop its expenditure forecasts;

(b) identify and assess the key assumptions on which the forecasts are based; and

(c) establish if Transpower applies its strategies and processes in practice.

45 Throughout the review, we have considered and taken into account the Evaluation Criteria for Base Capex Proposals set out in Schedule A of the IM.

46 A summary of our key findings is provided in this section, with more detailed information provided in later sections of the report.

3.1 Grid base capex

3.1.1 What Transpower says it does

Enhancement and Development base capex

47 Transpower has set out its approach to forecasting E&D capex in section 3 of the document *AM03 Planning Lifecycle Strategy*. The process follows the generic approach applicable to all capital investment planning. This involves stages for:

(a) planning, including:

(i) needs identification; and

(ii) options analysis;

(b) integration, including:

(i) project integration; and

(ii) portfolio integration; and

(c) final approval.

48 For the purposes of developing an appropriate E&D expenditure forecast Transpower starts with the long list of potential projects identified in its Annual Planning Report (APR). An internal review subjects projects in the long list to assessment against the Grid Reliability Standards, economic

measures and expected customer requirements to select a smaller portfolio of projects to be included in the RCP2 expenditure forecast.

49 Project costs are established at the appropriate Business Case level (i.e. BC1, BC2, BC3) using the Transpower Enterprise Estimation System (TEEs) for cost estimates.

Replacement and refurbishment base capex

50 For R&R base capex Transpower uses asset lifecycle management practice to establish its R&R base capex programmes and projects. In attachments to the RCP2 proposal Transpower has provided information on its asset management framework in a range of documents and models. These include:

(a) policies;

(b) asset lifecycle management strategies;

(c) asset fleet strategies;

(d) use of asset health indices (AHIs) and criticality to establish the level of expenditure required and the prioritisation of work; and

(e) industry standard tools such as MAXIMO (an asset management information system) and TEEs (a cost estimation tool).

51 Transpower has also provided details of the process it has implemented to challenge the expenditure proposals made by the relevant business owners. The challenge levels include the RCP2 Advisory group, the Capital Governance Team including the CEO, and Board reviews.

3.1.2 Our findings on the asset management framework

52 Since Strata undertook earlier reviews of Transpower's expenditure in 2008, Transpower has made good progress in documenting its asset management framework. This is clearly demonstrated through its intention to seek, and progress toward, BSI PAS 55:2008 accreditation in 2015 and through the independent assessment reports it has received.

53 In recognising the progress that has been made, we have some concern at the time being taken to ensure asset health data is sufficiently accurate so that it can be relied upon. The Commission and Geoff Brown Associates raised these issues in the review of Transpower's RCP1 proposal three years ago.[3]

54 Asset lifecycle management is at the heart of Transpower's asset management practices and the documentation provided to support the RCP2 proposal sets out how Transpower relies on this when establishing

[3] Geoff Brown Associates: *Review of Transpower's forecast operating and capital expenditure for 2012 - 15* http://www.comcom.govt.nz/dmsdocument/1027

the activities, investments and related expenditure needed to maintain its network at the required performance levels.

55 From our review of Transpower's asset management framework documentation, including demonstrations of the systems and models in operation we have concluded that, if Transpower implements its asset lifecycle management planning and cost estimation framework as documented, the resulting expenditure forecasts are likely to meet the expenditure criteria.

3.2 Our findings on how Transpower applies its forecasting methodologies

3.2.1 Grid E&D base capex

56 For RCP2, E&D base capex is based on a $20m project upper threshold, which is a change from the $5m threshold that applied to RCP1. Even if the $20m threshold had applied in RCP1, the RCP2 forecast still represents a material step change increase in projects in this expenditure range.

57 The E&D projects mainly deal with regional capacity and security issues (e.g. interconnecting transformers).

58 Our initial review of two sample projects highlighted issues with Transpower's demand forecasts. In light of our initial findings, we decided to review each of the remaining 13 E&D projects. This review has uncovered a range of issues with several projects.

59 We have found that Transpower's internal challenges of the E&D forecast have been insufficiently robust, as they have failed to identify issues with a significant number of E&D projects. Transpower staff have acknowledged this shortcoming in our discussions with them.

60 Strata recommends that the following project adjustments should be made on the basis that the need for the projects has not been adequately demonstrated to meet the expenditure evaluation criteria.

Table 3 E&D forecast capex by year

POD reference	E&D Project	Total	Adjusted Total	Difference	
PD30	Otahuhu-Wiri Transmission Capacity	$ 18.5	$ 0.3	-$ 18.2	-98%
PD31	Relieve Generation Constraints	$ 16.7	$ 6.1	-$ 10.6	-63%
PD32	Upper North Island Reactive Support 2012 - 2020	$ 8.0	$ 8.0	$ -	0%
PD33	Bus Section Fault Reliability	$ 13.9	$ 6.4	-$ 7.5	-54%
PD34	Wellington Supply Security	$ 11.4	$ -	-$ 11.4	-100%
PD35	Otahuhu and Penrose Interconnection Capacity	$ 16.6	$ 10.9	-$ 5.7	-34%
PD36	Bunnythorpe Interconnection Capacity	$ 8.8	$ 8.8	$ -	0%
PD37	North Taranaki Transmission Capacity	$ 3.0	$ -	-$ 3.0	-100%
PD38	Timaru Interconnecting Transformers Capacity	$ 2.5	$ 2.5	$ -	0%
PD39	Southland Reactive Power Support	$ 6.0	$ 4.2	-$ 1.7	-29%
PD40	High Impact Low Probability Event Mitigation	$ 9.2	$ 9.2	$ -	0%
PD41	Hororata and Kimberley Voltage Quality	$ 3.4	$ -	-$ 3.4	-100%
PD42	Islington Spare Transformer Switchgear	$ 2.4	$ -	-$ 2.4	-100%
PD43	Haywards Local Service Third Incomer	$ 1.8	$ -	-$ 1.8	-100%
PD44	E&D Other	$ 1.7	$ 0.3	-$ 1.5	-85%
	Total	$ 123.8	$ 56.7	-$ 67.1	-54%

Amounts are $m

61 The above adjustments result in a recommended reduction of $67.1m to E&D base capex for RCP2.

62 In making this recommendation, we consider that Transpower's proposed 7.5% productivity adjustment is not applied to the remaining balance of the E&D expenditure forecast.

3.2.2 Grid R&R base capex

63 We have found that Transpower's RCP1 performance against forecast cannot be relied upon as a guide on the probable suitability of the RCP2 forecasts because:

(a) in RCP1 Transpower has implemented a grid capex programme that is materially different to that submitted to the Commission, which formed the basis for the Commission's RCP1 decision;

(b) Transpower's February 2014 updated forecast for 2013/14 year-end shows material differences to the forecast submitted with the RCP2 proposal in December 2013.

64 We have found that Transpower's asset lifecycle methodology, if applied in practice, should produce forecast expenditures that reflect what is needed to be spent on the replacement and refurbishment of transmission assets and meet the Evaluation Criteria. Drawing on our review of the asset management documentation, data and models and from the individual fleet reviews, we have identified three areas of concern with Transpower's application of the methodology:

(a) potential bias in the AHI models towards over estimation;

(b) engineering review is biased towards over estimation; and

(c) probable rollout of some asset replacements into RCP3 and the resulting non-delivery of the output asset health profiles[4].

65 Transpower places significant reliance on its asset lifecycle management approach when estimating required expenditure and managing its assets. This requires good quality asset information and data and the application of engineering judgement to interpret ant, if necessary make modifications. If the quality of data and/or models is poor the consequences can be significant in terms of increased whole of asset lifecycle costs and decreased network performance.

66 An alternative approach to the roll-out issue is through the use of AHI as a performance measure. Under this approach, we envisage that the expenditure could be allowed without a roll-over adjustment but that variations between proposed 2019/20 AHI and actual AHI would be used to identify roll-over deferrals. Any underspend from these deferrals would be excluded from any efficiency incentive that would otherwise be received by Transpower.

67 In the secondary assets category we have found that the significant step change for investment in the Substation Management System (SMS) is not adequately justified in the business case provided by Transpower. We consider that implementation of the SMS should be changed to allow a review of the business case and further quantification of the costs and benefits.

68 The inclusion of a challenge process when setting the expenditure forecasts is a significant improvement and we acknowledge the work that Transpower has undertaken in this area. The information provided by Transpower provides clear evidence that the various challenge stages have resulted in material changes as the forecasts have matured.

69 We consider, on balance, that the 7.5% productivity adjustment provides a reasonable expectation of the potential gains that will be realised during RCP2. However, we consider that insufficient account has been taken of the estimation bias and deliverability issues identified by the Transpower Board.

3.3 Cost accumulation and cost estimation methodologies

70 Transpower has produced its expenditure budgets for RCP2 using:

(a) a methodology for projects which is applied both to capex and opex projects; and

(b) a methodology for costing routine maintenance requirements.

[4] Work that was planned in one RCP but was not undertaken but is again planned to be undertaken in the subsequent RCP.

71 We have undertaken assessments of the methodologies used by Transpower to establish both volumetric and customised projects.

72 In both cases, the methodologies use a bottom-up building block approach to produce forecasts expressed in nominal dollar terms; that is, after applying a general inflation rate (CPI) as an escalator. The estimates used for the RCP2 forecasts are presented as 'P50' (most likely) estimates.

3.3.1 Our findings on cost estimation

73 While noting that we have not reviewed the cost accumulation models,[5] the cost accumulation processes and methodologies described by Transpower appear reasonable.

74 To the extent that information was made available to us, the cost estimation tools and processes appear to be on a path towards GEIP. However we are concerned by a lack of documentation of the tools and cost estimation processes and associated governance and this reduces our confidence in the cost estimations inherent in Transpower's proposed expenditure levels. Our assessment of cost estimation variances similarly leaves us with a reduced level of confidence.

75 Variances have been seen in the non-volumetric project unit cost information, which reduces our confidence in Transpower's application of the cost estimation process for these projects. Therefore it is difficult to accept that the cost estimation process adequately supports the proposed expenditures at this time.

76 Despite our concerns, we consider that the data for both volumetric and non-volumetric projects does not provide unequivocal evidence for a cost estimation bias that would lead us to recommend a specific cost estimation-based adjustment to these proposed expenditures.

3.4 IST base capex

77 We have found that the link between strategic objectives and expenditure is sound and that the strategy to switch to recognised commercial off the shelf (COTS) IST platforms and software follows a trend that is well established in utilities elsewhere.

78 We consider that Transpower's policy of staying within vendor support agreements is conservative but appropriate given the criticality of the relevant systems.

79 We have assessed the expenditure balance between investing in maintaining capability ($157.5m, 75%) rather than adding new capability ($52.5m, 25%) in RCP2 and consider that it is appropriate.

[5] Since this was undertaken by the Commission.

80 The IST capex cost estimation approach appears to be sound, when implemented in full. However, at the point of undertaking this review, only a relatively small proportion of the proposed expenditure in RCP2 has reached BC3 (P90) level of accuracy.

81 We agree with Transpower's assessment that the proposed RCP2 IST capex programme is deliverable.

82 We have found that Transpower has offered no tangible benefits assessment for its proposed RCP2 expenditure. Significant tangible benefits should accrue to support the $52.5m capex proposed to enhance capability. Given the lack of information on tangible benefits, it is difficult to assess what should be accounted for in the RCP2 expenditure forecasts.

83 Transpower has proposed that the productivity adjustment of 7.5% apply to its IST forecast in recognition of portfolio effects over its capex programme. However, the 7.5% adjustment was conceived at a high level with apparently little quantification and analysis which raises questions on its adequacy.

3.5 Opex

84 Transpower has proposed opex of $1.3 billion for RCP2. This represents a 2% increase in real terms above the immediately preceding five-year period. Whilst Transpower has significantly increased its asset base over RCP1 and has increased and improved is knowledge of asset condition, it would be expected that the impact of this would be seen over time. The increase of 2% can therefore be seen as being in line with expectation.

3.5.1 Grid opex

85 For maintenance projects and routine maintenance, we have observed that the forecasts are based on volumetric projections costed through the MACM and TEEs processes. From a process perspective, we consider that the volumes of work forecast are reasonable and that, subject to our concerns regarding cost estimation accuracy, will produce an expenditure forecast that reflects network needs.

86 Transpower initiated an external Maintenance Efficiency Study of its grid opex, which has identified potential efficiency gains. Transpower has taken the identified efficiency gains into account by adjusting its volumetric forecasts at an asset fleet level. We consider this is appropriate.

87 We consider the Grid opex forecast is likely to represent efficient costs that will be reasonably required to maintain the network assets.

88 Accordingly, we do not recommend any additional adjustment to the proposed Grid opex and, on this basis, we expect the grid opex forecast will meet the expenditure criteria.

3.5.2 IST opex

89 Transpower states that the increase in IST opex for RCP2 is:

> *… driven by the need to support more modular and flexible platforms, the management of new security risks, and increasing data volumes.*

90 The largest increases in opex have come from the telecommunications services and shared services categories.

91 In RCP2, the major changes proposed are the operational separation of critical systems from non-critical systems and the move by early in RCP2 to outsourced data centres.

92 We have not identified any efficiency improvement potential adjustments applied to the IST opex forecast. While the drivers for increased costs are clearly stated, Transpower has provided little evidence to indicate that operational efficiencies are aggressively being pursued. There are a number of opportunities in 2015 to contract for more competitive shared services through competitive tendering.

93 Accordingly, we consider that a productivity adjustment of 2% should be applied to IST opex.

3.5.3 Corporate opex

94 Transpower states an expectation that it will improve efficiency. However, unlike the 7.5% base capex productivity and grid opex efficiency adjustments, there has been no clarification on the expected efficiency gains from the investments completed in RCP1 or from the proposed investment in staff capability in RCP2.

95 We would expect to see that Transpower would hold a level of staff vacancies at around 5%, especially as the business will continue to transition from its former major projects focus. This does not appear to have been considered when setting the Departmental opex forecast.

96 We have found indications that Transpower may have too many staff involved in non-grid project or investigations work or it is not correctly booking time to capital projects.

97 To account for the proposed relocation from Transpower House, there is a 30% increase in accommodation costs from 2017/18 of $2m p.a.. This is in addition to an estimated $14.14m capex associated with the proposed move. A new business case has not yet been prepared for the 2017/18 relocation. We consider that an organisation focused on optimising its costs to minimise its price burden on consumers would require a high hurdle rate for an office relocation, as it is a discretionary expenditure.

Investigations

98 Transpower proposes $54.34m for investigations opex in RCP2. At $10.87m p.a. this is commensurate with the average expenditure in RCP1.

The original RCP1 forecast was exceeded by 14%. Transpower explains that in RCP2:

> *… fewer, larger investigations are expected to be replaced by a greater number of smaller investigations*
>
> and
>
> *… given that [Transpower's] work requirement during RCP2 will be stable and resource-levelled at a similar level throughout the period.*

99 We have found that it is difficult to reconcile this proposition when the characteristics of the two periods are so different. We would expect that investigation costs would reduce following the return to 'maintaining capability' mode. However, the investigations costs for the major projects undertaken in RCP1 would have been incurred prior to commencement of construction (i.e. prior to RCP1)

100 Our conclusion is that the information provided for investigations expenditure by Transpower, as evidenced by the above statement, is insufficient to meet the needs of the Commission when exercising its powers under Part 4 of the Act. Transpower should be required to provide improved detail and justification for these costs.

3.6 Service measures

Findings on service measures

101 We consider that Transpower's proposed service performance measures have been developed through a good consultation process with its customers and that the proposed targets are generally appropriate for the initial years of the scheme.

102 We consider that Transpower should be requested to establish a network health measure and incentive scheme based on delivery of the asset health levels that its forecast expenditures are expected to produce in 2020.

103 The proposed measure will need to:

(a) address how changes to asset condition data and models that will likely occur during the RCP would be accounted for;

(b) provide flexibility to make efficient adjustments within RCP2 (e.g. an efficient capex/opex trade-off allowing deferral of an asset replacement); and

(c) include a material financial incentive for Transpower to deliver the grid in the condition it has proposed its expenditures should deliver by the end of the RCP.

4 Expenditure overview

4.1 RCP1 progress and forecast outturn

4.1.1 Base capex

104 Transpower has forecast that base capex for RCP1 will be 6.8% below the regulatory allowance set for RCP1.[6] Transpower states that the variation reflects:

> *… reprioritisation of replacement projects and the movement of commissioning dates into RCP2.*

105 We consider this is what we refer to as inter-RCP 'roll-ins'. At the total base capex level, a -6.8% variation can be considered to be acceptable if the lack of accurate asset health and condition data at the time the RCP1 forecast was developed is taken into account. However, the variations at asset fleet and portfolio levels are more significant.

106 Variations between forecast capex (actual to 2012/13 and forecast for 2013/14 and 2014/15) and the allowance are provided by Transpower in section 4.3 of MP01 for the five main capex categories:

(a) AC Stations

(b) Transmission Lines

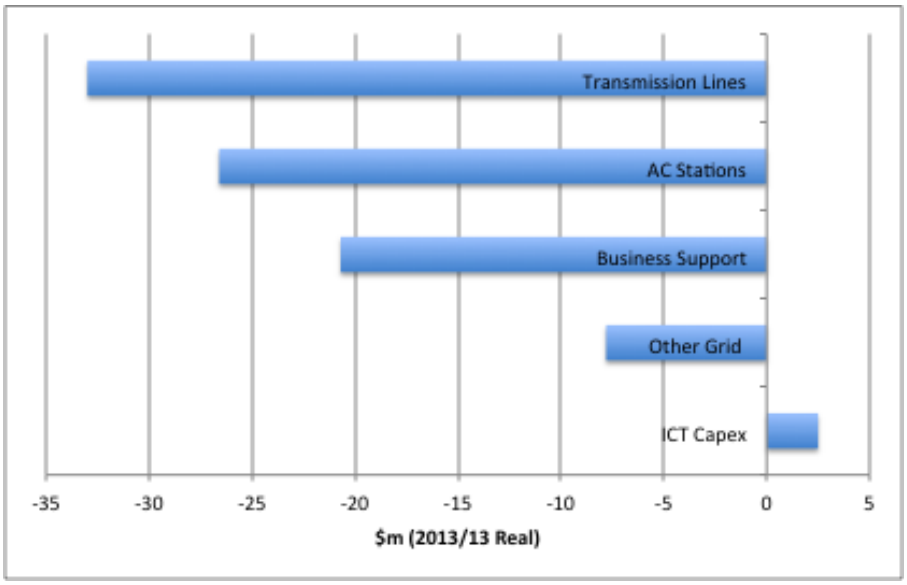
(c) Other Grid

(d) IST Capex

(e) Business Support.

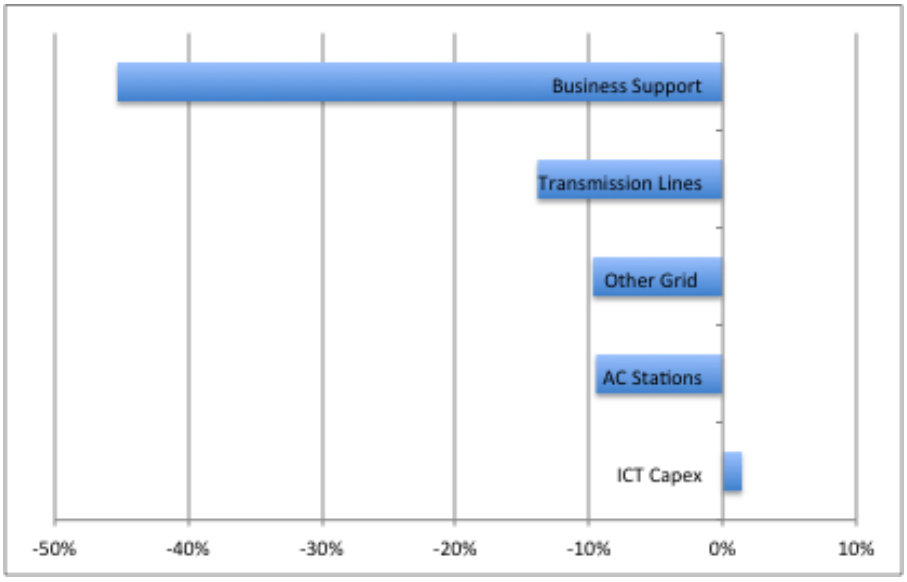
[6] MP01 – main proposal section 4.3.1

Figure 1 RCP1 Base capex spend vs allowance ($m)



Source: Transpower MP01 – Main proposal

Figure 2 RCP1 Base capex spend vs allowance (%)



Source: Transpower MP01 – Main proposal

107 Transpower provides reasons for the variations evident in these figures as follows:

AC Stations	The reduction is mainly due to fewer transformer replacements and rescheduled commissioning dates for a number of large projects. The drivers for substitution include the introduction of asset health, improved condition information and the use of criticality-based prioritisation.

Transmission Lines	The reduction is mainly due to a lower level of tower painting and deferral of conductor and grillage works. The largest forecast reduction by portfolio is in tower painting. The reduction is largely due to the constraints on the availability of suitable contractors in some regions.
Other Grid	The reduction is mainly due to reprioritisation of E & D projects and bus zone (BZ) protection projects. The largest forecast reduction by portfolio is in bus zone protection. A number of duplicate bus zone protection projects have been deferred as Transpower finalises a revised strategy.
Business Support	There are large variances in the Strategic Properties and Office & Facilities portfolios due to the deferral of the planned head office relocation to RCP2.
IST Capex	The forecast value of commissioned IST assets is $176m compared to an RCP1 allowance of $174m. Increased expenditure (such as on communications infrastructure) has been offset by efficiency savings in the Asset Management and Security portfolios and the deferral of some SCADA/RTS works to RCP2.

108 There is a broad range of reasons why there are variations between forecast and actual capex, which may include:

(a) cost estimation inaccuracy;

(b) excess in planning/forecasting;

(c) changes in key assumptions (e.g. asset condition);

(d) changes in policy and strategy (e.g. asset lives);

(e) changes in statutory obligations;

(f) productivity/efficiency gains;

(g) delivery issues (e.g. deferral due to resource constraints); and

(h) deferral due to productivity problems.

109 Variation, especially reduced spending, can be seen as positive so long as it is efficient and not detrimental in achieving network performance targets. For AC Stations, if deferral of transformer expenditure was driven by

improved asset information, this can be seen as a positive variation. The variation in Transmission Lines replacement appears to be mainly attributable to constraints on delivery (i.e. a limited pool of contract painting resources). In this case, the health of the assets is likely to be deteriorating below the ideal state.

110 In considering the reasons provided by Transpower, it appears that the RCP1 allowance, which was based on Transpower's forecast, was around 10% greater than what will be expected to be spent during RCP1.

111 Figure 3 shows the variance between the forecast 2013/14 base capex components in the December 2013 MP01 proposal and the reforecast provided in February 2014 in response to Commission question Q021. Several significant changes are evident in the components of the forecast. The overall difference is -3% (-$6.7m).

Figure 3 Reforecast movement in base capex ($m)

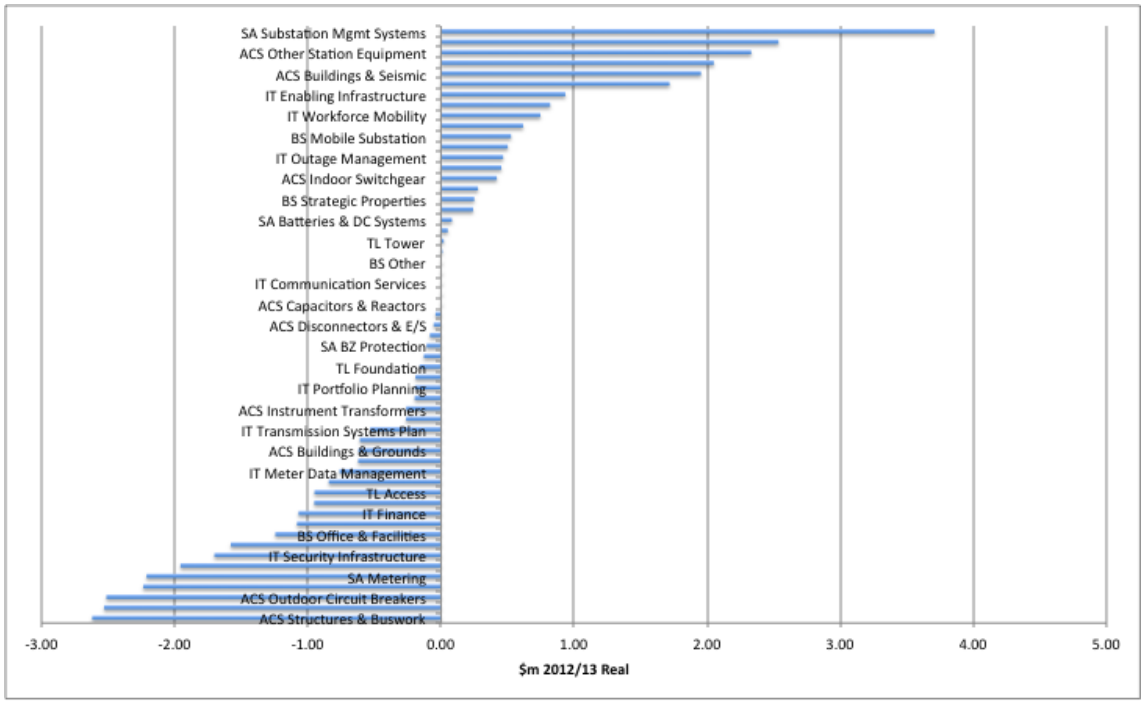
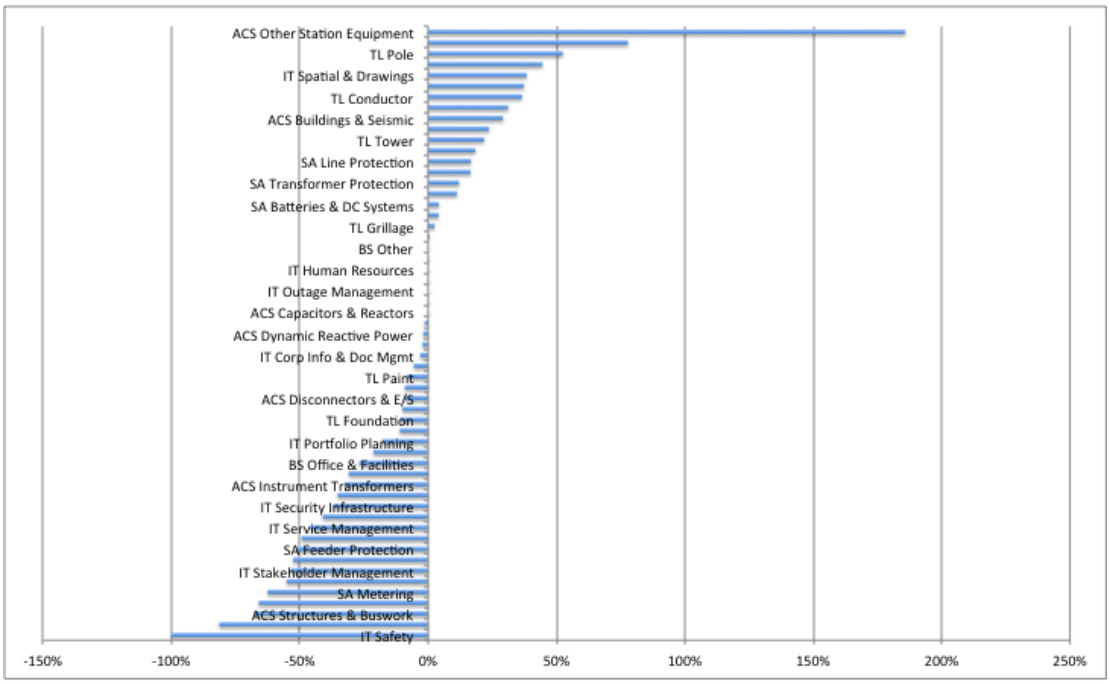


Figure 4 Reforecast movement in base capex (%)



112 We have observed that a relatively small variation of 3% overall change in the forecast for 2013/14 is based on a number of more significant movements in individual base capex components. Given that only a few months separated the submission of MP01 and the 2013/14 reforecast, such sizable movements are perhaps surprising.

113 We consider that Transpower's RCP1 performance against forecast can not be relied upon as a guide to the probable suitability of the RCP2 forecasts because:

(a) in RCP1 Transpower has implemented a grid capex programme that is materially different to that submitted to the Commission, which formed the basis for the Commission's RCP1 decision; and

(b) Transpower's February 2014 updated forecast for 2013/14 shows material differences to that submitted with the RCP2 proposal in December 2013.

114 While there are a number of possible reasons why this movement may have occurred, the level of variation seen in RCP1 (actual vs planned) does not provide evidence that the proposed RCP2 forecast can be taken as a reliable reflection of what Transpower will actually spend its money on in RCP2. However, it may also indicate that, at a component level, there are still issues remaining with Transpower's forecasting methods or project delivery.

115 Given the above findings, our assessment of the reliability of the RCP2 forecast will need to place more focus on how Transpower has developed the expenditure forecast and why it is an improvement on the RCP1 forecast.

4.1.2 Opex

116 Transpower has forecast that opex for RCP1 will be 2.2% below the regulatory allowance set for RCP1.[7] Transpower states that the variation reflects savings in routine maintenance and maintenance projects. At an aggregate level a -2.2% variation produced by savings can be considered to be a good outcome.

117 In section 4.4 of MP01 – Main Proposal, Transpower discusses RCP1 progress for the following five main opex categories:

(a) Maintenance projects

(b) Routine maintenance

(c) Other Grid opex

  (i) Training

  (ii) Operating

(d) IST opex

(e) Corporate

118 Variations between forecast opex (actual to 2012/13 and forecast for 2013/14 and 2014/15) and the RCP1 allowance, for the five opex categories, are shown in Figure 5 and Figure 6.

[7] MP01 – main proposal section 4.3.1

Figure 5 RCP1 Opex spend vs allowance ($m)

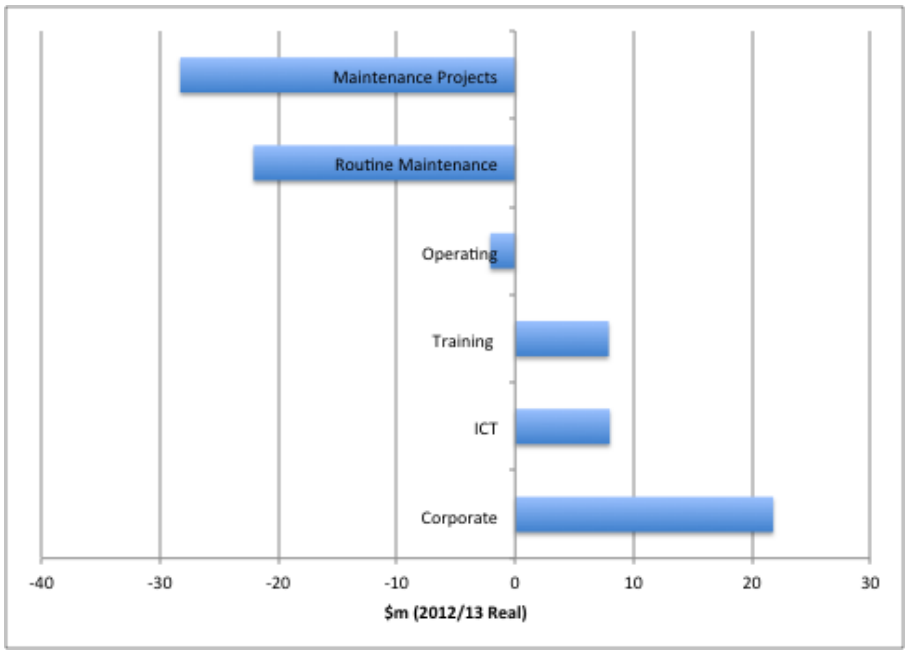
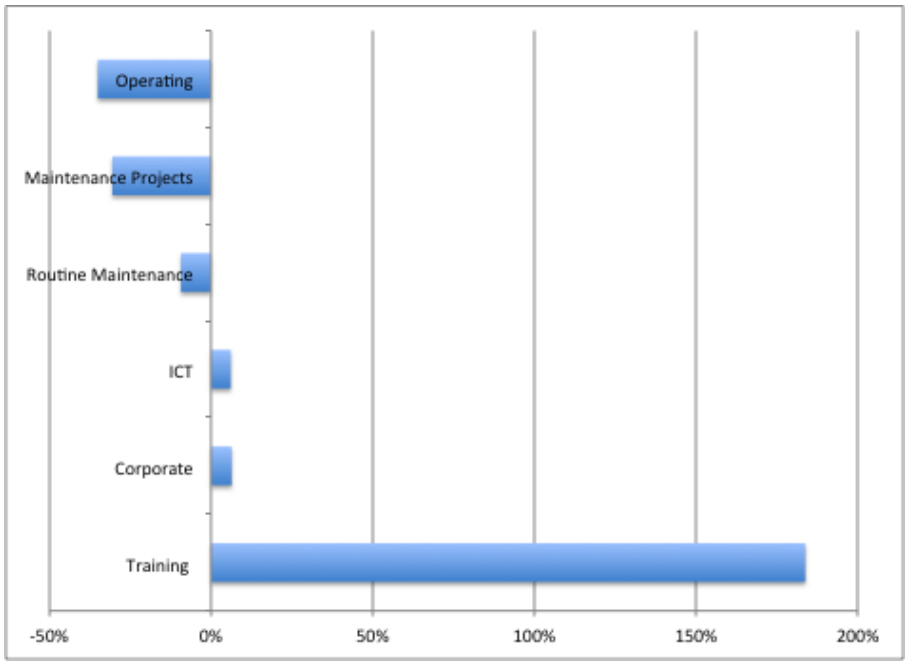


Figure 6 RCP1 Opex spend vs allowance (%)



119 An initial observation is that expenditure directly related to network assets is underspent against the RCP1 allowance while non-network expenditure is overspent.

120 Transpower provides reasons (but no supporting evidence) for these variations as follows:

Maintenance Projects	Forecast expenditure is $64.4m, compared with the allowance of $92.7m. A significant reduction attributed by Transpower to:

- deliverability constraints;
- the impact of asset divestments;
- deferrals based on improved condition information; and
- reprioritisation of resources towards capital projects.

Transpower states that the increased expenditure planned in 2014/15 is … *based on our use of asset health models informed by detailed asset assessments*[8]

Routine Maintenance	Forecast expenditure is $215.8m compared with the allowance of $237.9m. The majority of routine maintenance savings are in AC Stations and Transmission Lines and are stated to be due to: • *reduced corrective expenditure (particularly in buildings and grounds);* • *the on-going integration of standard maintenance procedures and the results of efficiency analysis;* • *improved vegetation management; and* • *the impact of our divestment programme.*
Other Grid Opex	Two portfolios: Training 184% increase above allowance largely due to Transpower forming the view that available technical training was insufficient and did not meet their requirements. Operations where the majority of operating functions were insourced during RCP1, with the costs captured under Corporate (Departmental) Opex. Operational saving attributed by Transpower to reduction in operating activities compared to forecast levels due to improvements in practices.

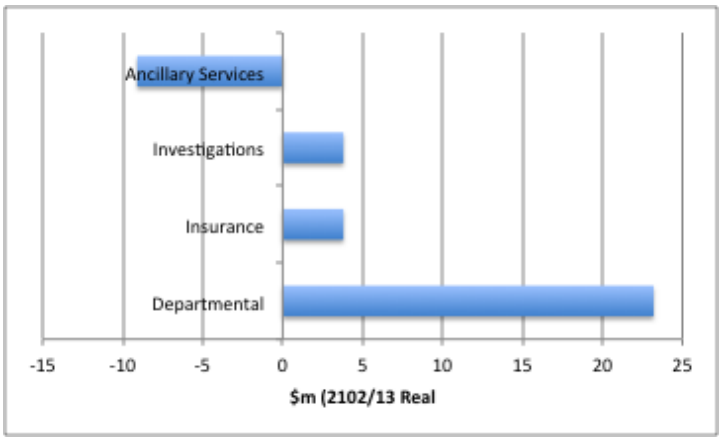
[8] MP01 section 4.4.2 page 31

IST

$8m (6%) overspend variance attributed to changes in support costs associated with new and updated systems and new approach to data centres.

Corporate

Corporate opex forecast to be $362.8m 6% above the allowance of $341m. The variance is seen across the following portfolios that make up Corporate opex.



Transpower attributes the large overspend in Departmental opex as being due to the combination of an overly optimistic RCP1 forecast and a large work programme that required supplementary resources.

121 The total variation between Transpower's original opex forecast submitted in MP01/RT01 and the reforecast provided in February 2014 is $1.3m (0.5%). In aggregate, the variation is negligible. However, as seen in capex, variation at the component level is greater. This can be seen in the following figures.

Figure 7 Reforecast movements in opex ($m)

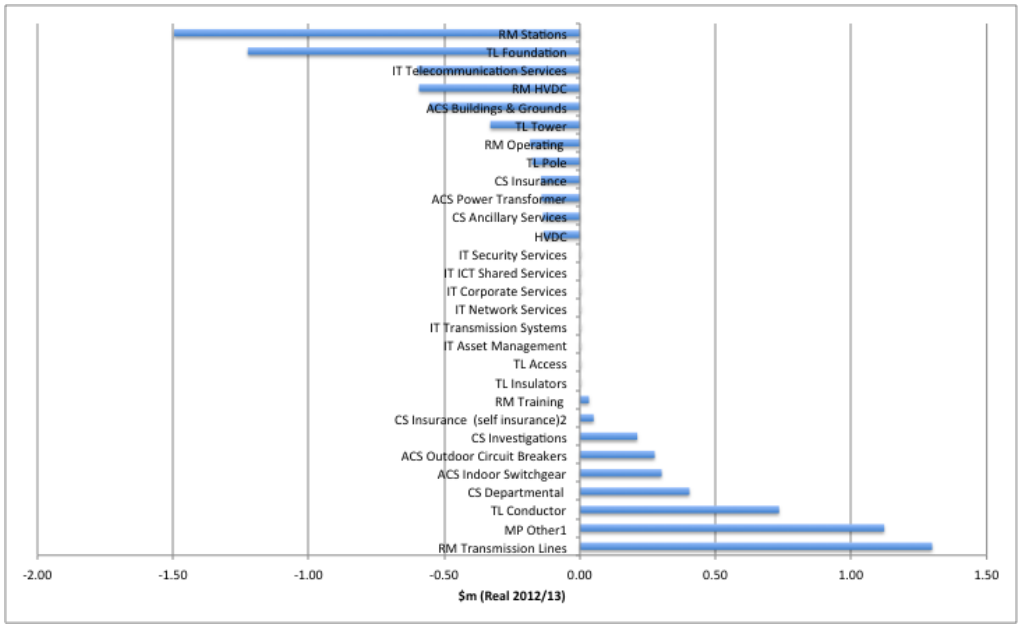
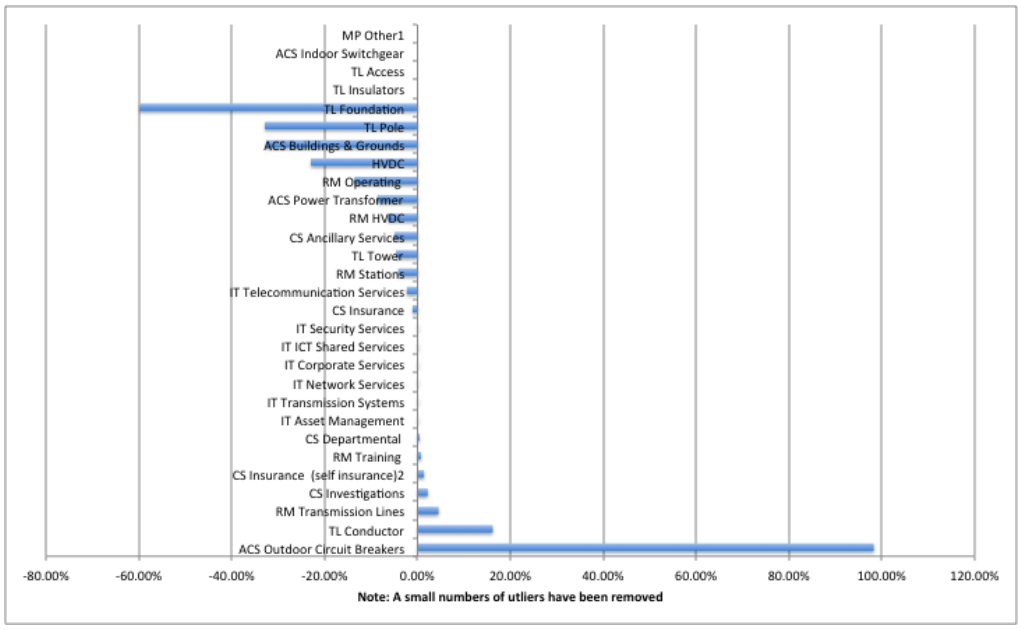


Figure 8 Reforecast movements in base opex (%)



122 As with capex, we note some relatively large variations between forecast outcomes for the current year. Again, the elapsed time between the two forecasts is only a few months.

123 The view presented by Transpower RCP1 progress in opex is one of savings being identified and realised in network management areas and increasing investment in non-network areas. Despite the variances seen at the fleet and portfolio levels, the overall variation of -2% should indicate reasonably accurate forecasting.

124 Variations at fleet and portfolio levels are not unexpected as an RCP progresses and Transpower reacts to changes and opportunities to work better. If we discount the large increase in training costs, we consider that Transpower's opex performance in RCP1 is good with overall cost reductions more than balancing component expenditure increases.

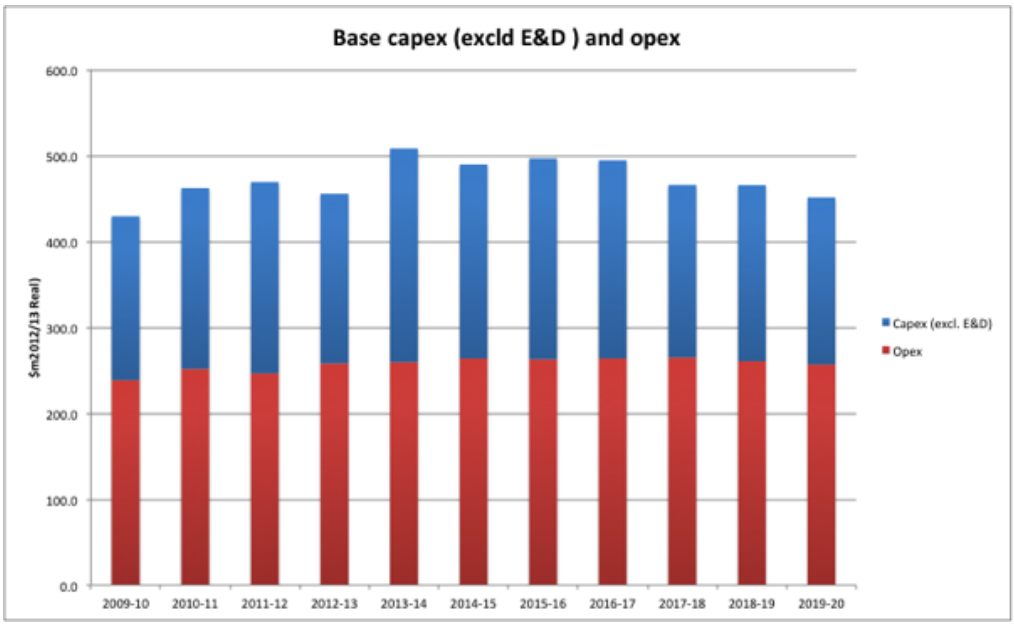
125 The RCP1 performance provides more confidence than we obtained for capex that the RCP2 forecast can be relied upon.

4.2 Proposed RCP2 expenditure compared with RCP1

126 In this section we set out a comparison between Transpower's proposed base capex and opex for RCP2 against the forecast outcome for RCP1. In this comparison (due to available timeframes) we have used the 2013/14 forecast from the MP01/RT01 main proposal rather then the updated forecast provided in February 2014.

127 Figure 9 below shows combined base capex and opex. For this comparison we have excluded the E&D projects, which were relatively minimal in RCP1 due to the $5m materiality threshold that applied to that period.

Figure 9 Expenditure excluding E&D and Major Capex projects



Source: Data sourced from RT01 base capex

128 Figure 10 shows the effect of bringing in the following major replacement capex projects:

(a) WDV-MGM-MST A reconductoring[9]

(b) BPE-HAY A & B reconductoring

(c) BRK-SFD B reconductoring

(d) BPE-WIL A reconductoring (WIL-JFD section)

(e) CPK-WIL B reconductoring

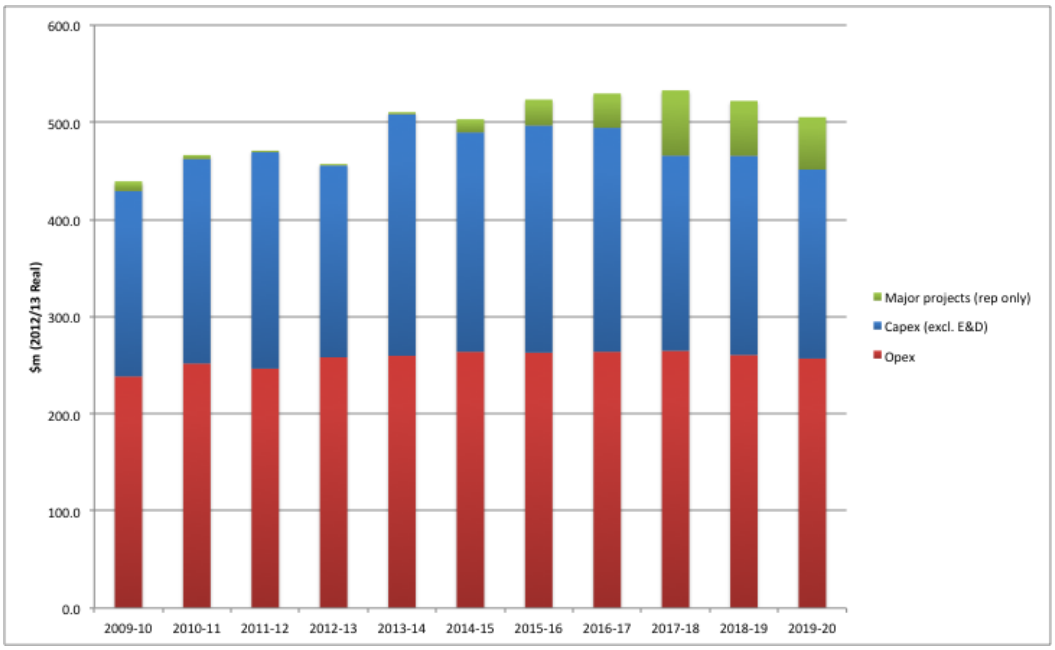
(f) OTB-HAY A reconductoring (Churton park section)

(g) BPE-WIL A reconductoring (BPE-JFD section)

(h) Unidentified reconductoring projects

[9] Reconductoring completed 2-3 years ago

Figure 10 Expenditure including major reconductoring



Source: Data sourced from RT01 base capex

129 It is evident that this profile shows a step-up in 2013/14, mainly driven by replacement capex. Opex has a relatively flat profile.

4.2.1 Base capex

130 Transpower has proposed $1,188.56m of base capex (including interest during construction (real 2012/13 prices)) for RCP2. Transpower's forecast is based on P50 cost estimates.[10]

131 Transpower identifies the following key assumptions used in developing the forecast expenditure:[11]

(a) exchange rates;

(b) interest during construction (IDC);

(c) inflation adjustments;

(d) commissioning; and

(e) cost allocation.

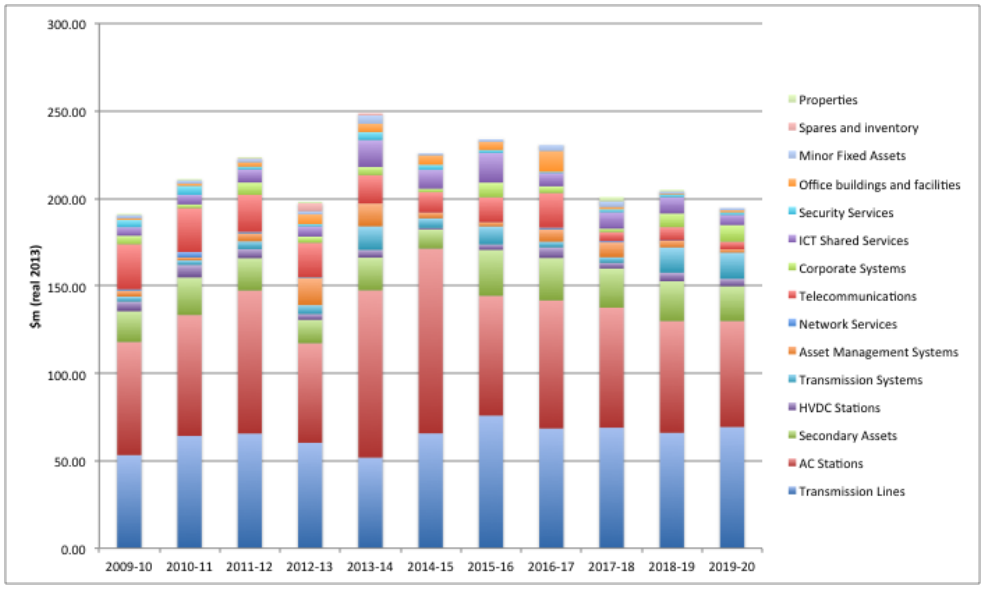
132 We consider that the assumptions listed above appear to be quite limited in scope. Demand forecast, asset health and criticality and resource constraints are important assumptions that Transpower would need to take into account when developing the forecasts. In this respect, we consider that the proposal does not meet the requirements of the IMs because,

[10] P50 probability of exceedance (i.e. where the likelihood of an estimate being exceeded is 50%).
[11] MP01 Section 5.4.2 page 44.

whilst Transpower clearly makes decisions based on these inputs and assumptions, it has not identified them in the 'Forecast Inputs and Assumptions' section of MP01.

133 Figure 11 shows the proposed base capex by expenditure category. Transmission Lines, AC Stations and Secondary Assets categories account for just over 75% of the total base capex (excluding E&D). Accordingly, the focus of our review has been on these categories.

Figure 11 Base capex (excluding E&D)



Source: Data sourced from RT01 base capex

134 The variations between the proposed RCP2 base capex categories and the previous five years (RCP1 plus 2010/11) are shown by value and percentage in the following tornado diagrams.

Figure 12 Base capex (excluding E&D) RCP2 vs 'RCP1 + 2010/11' ($m)

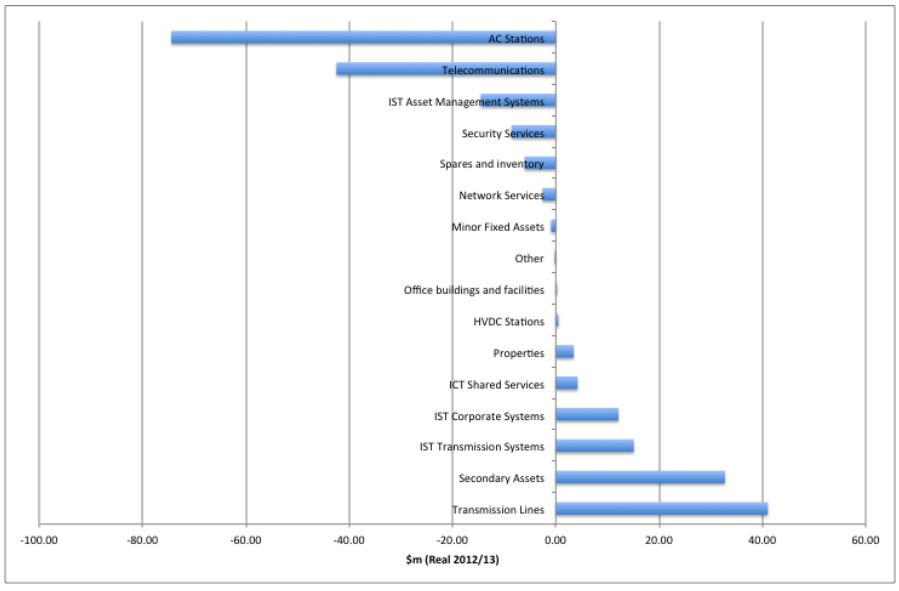
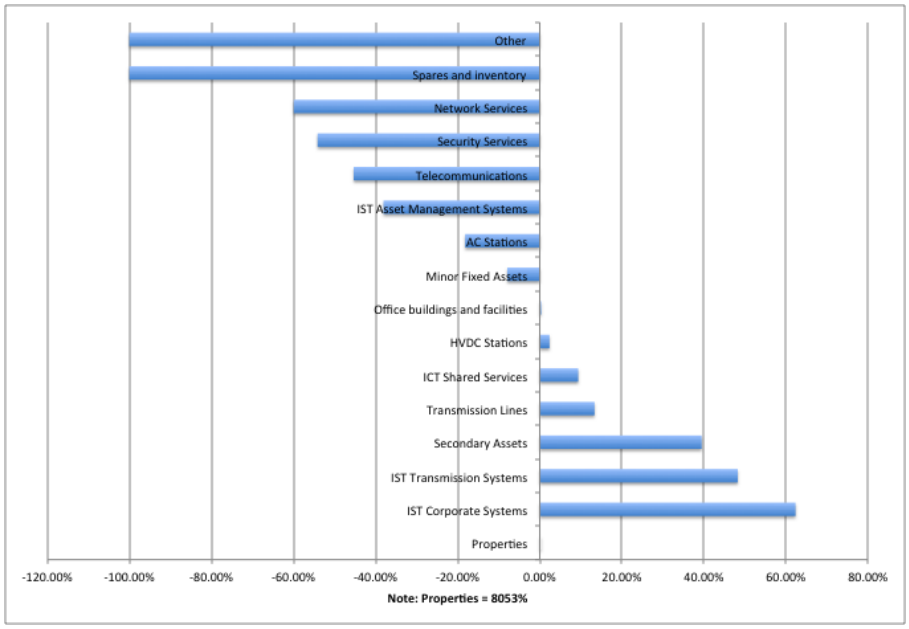


Figure 13 Base capex (excluding E&D) RCP2 vs 'RCP1 + 2010/11' (%)



Source: Data sources from RT01 base capex

135 These figures show that, in RCP2, activities are increasing for transmission lines, IST transmission systems and corporate systems and reducing for AC stations, telecommunications and IST asset management systems.

136 In the four grid R&R categories Transmission Lines, AC Stations, Secondary Assets and HVDC Stations there is negligible difference between the proposed RCP2 base capex and the RCP1+2010/11 base capex. However, as shown above, there are material differences at a fleet/portfolio level.

137 These movements are examined and discussed in the relevant sections of this report.

4.2.2 Opex

138 Transpower has proposed $1,309.3m for opex (real 2012/13 dollars) for RCP2. Transpower uses three categories for opex, Grid, IST and Corporate. These categories are broken down into the following sub-categories:

(a) AC Stations Buildings and Grounds

(b) Maintenance Projects - Transmission Lines

(c) Maintenance Projects - AC Stations

(d) Maintenance Projects - HVDC Stations

(e) Maintenance Projects - Other

(f) Routine Maintenance

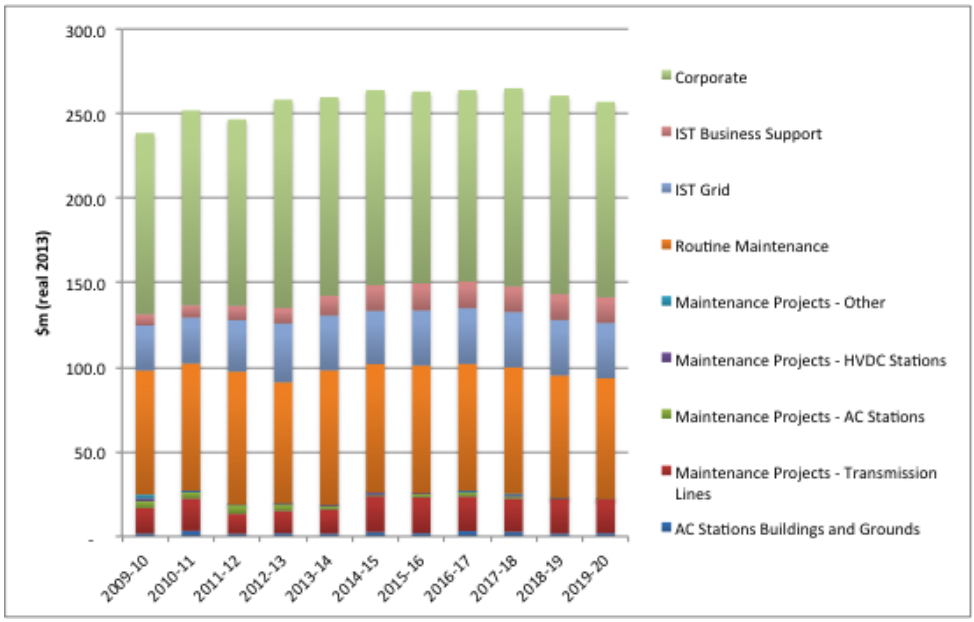
(g) IST Grid

(h) IST Business Support

(i) Corporate

139 The expenditure proposed for each subcategory and the relative movements over time are shown in Figure 14.

Figure 14 RCP2 opex proposal



Source: Data sourced from RT01 Opex

140 Variations between the proposed RCP2 opex categories and the previous five years (RCP1 + 2010/11) are shown by value and percentage in the following tornado diagrams.

Figure 15 Opex RCP2 vs RCP1+2010/11 ($m)

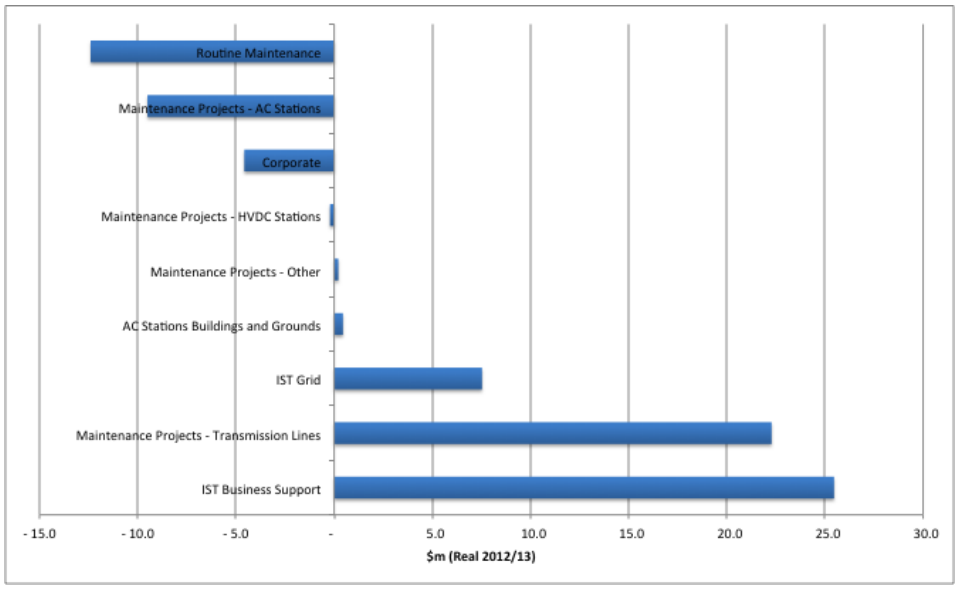
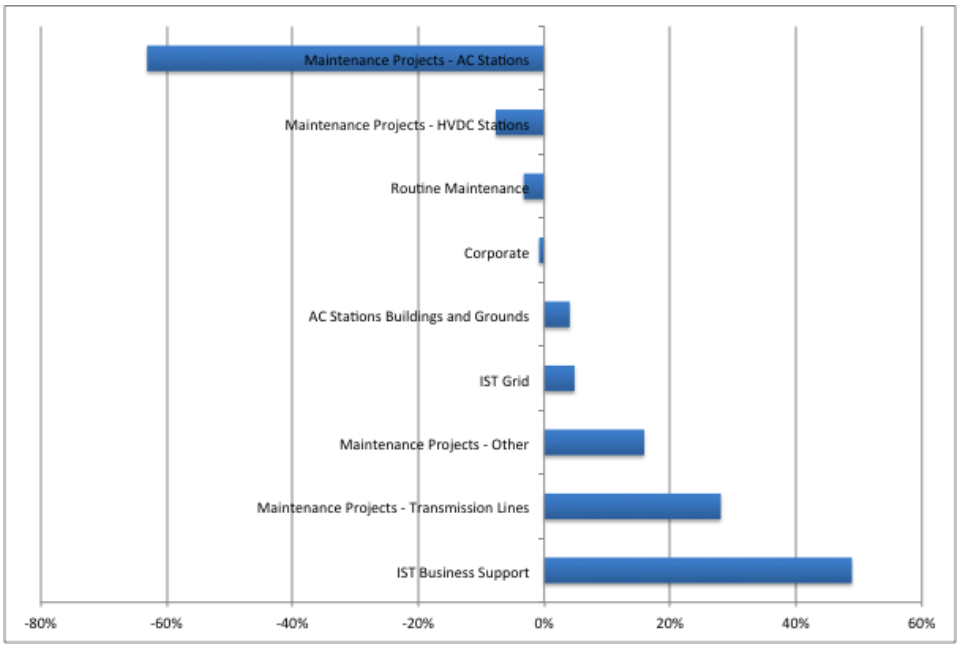


Figure 16 Opex RCP2 vs RCP1+2010/11 (%)



Source: Data sourced from RT01 Opex

141 These figures show that focus in opex is increasing in maintenance projects transmission lines and reducing in AC stations. There is a relatively large increase in IST business support. These observations are discussed further in section 8.

5 Transpower's planning & forecasting framework

5.1 Overview

142 At the highest level our approach to this review has the following three objectives:

(a) to understand and assess the method Transpower says it has used to develop its expenditure forecasts;

(b) to identify and assess the key assumptions on which the forecasts are based; and

(c) to establish if Transpower applies its strategies and processes in practice.

143 In this section, we set out our understanding of how Transpower has developed its expenditure forecasts. Essentially, our approach is to define what Transpower says it does when developing and implementing its expenditure forecasts. Once defined, this allows an assessment against the expenditure criteria to be undertaken and used as a reference when assessing how each component of expenditure has actually been forecast.

5.2 Transpower's asset management framework

5.2.1 Asset lifecycle management

144 Transpower describes how it uses asset lifecycle management practice to establish its grid base capex programmes and projects. In attachments to its RCP2 proposal, Transpower provided information regarding its asset management framework through a range of documents and models. These documents clearly set out how Transpower intends to apply its asset-related policies and strategies in practice. Documents on which we formed our views on Transpower's asset management frame work included:

(a) Policies

(b) Asset lifecycle management strategies

(c) Asset Fleet strategies

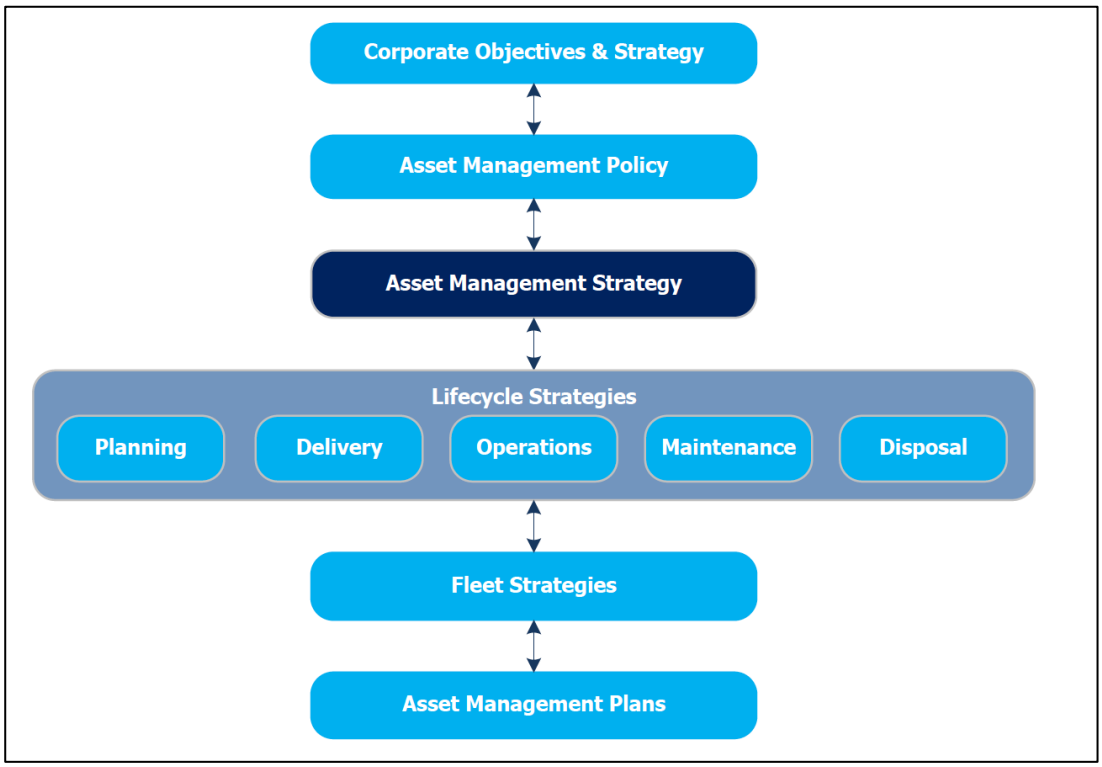
(d) Asset management plans

(e) Annual Planning Reports

(f) Industry standard tools such as MAXIMO and Success Enterprise

145 Figure 17, reproduced from Transpower's Asset Management Strategy, describes the hierarchy of policies and strategies that collectively sets out the framework through which asset management plans, which form the basis for the expenditure forecast, are developed.

Figure 17: Transpower's asset management framework



Source: Transpower AM02 Asset Management Strategy

146 We have reviewed the following documents related to Transpower's asset management framework:

(a) Asset management policies

(b) Asset strategies

(c) Asset management plans

(d) Asset lifecycle strategies (planning, operations, maintenance and delivery)

(e) Asset Fleet Strategies (14 in total)

(f) Portfolio Overview Documents (57 in total)

(g) IT Asset Portfolio plans (22 in total).

147 Transpower's well-documented asset management framework provides an accessible and usable reference for its management and engineers. The framework documentation very clearly sets out the process that should be

followed for developing asset management plans and for establishing performance-linked expenditure forecasts for Grid E&D, R&R and Secondary Assets.

148 Transpower describes its asset management vision statement and Asset Management Policy in the following way. Transpower's asset management vision is to:

> *… provide a Grid that safely delivers transmission services at a quality and cost that meets our customers' expectations.*

149 Transpower's asset management policy states that:

> *When managing our assets to ensure we meet consumer long-term Grid performance expectations we will:*
>
> - *embed a strong safety culture and capability, striving for zero harm to employees and members of the public*
> - *provide an enduring, reliable and efficient transmission network to meet New Zealand's present and future needs*
> - *maximise performance of our assets over their life, taking into account the trade-off required between cost and risk*
> - *make asset management decisions based on complete, accurate and timely information*
> - *ensure that the right mix of talented, competent and motivated people are developed and retained to improve our asset management capability*
> - *build effective relationships with all New Zealanders affected by our asset-related activities*
> - *comply with all applicable statutory and regulatory requirements.*[12]

5.2.2 Grid capex planning

150 Grid capex includes E&D and R&R expenditures.

151 E&D expenditure covers proposed capital investments that lead to new grid build to provide additional capacity and security. Base capex E&D projects include projects where the estimated project cost is less than $20m. Projects with a forecast cost in excess of $20m are classified as major capex projects and are subject to separate regulatory processes for approval outside of the IPP proposal.

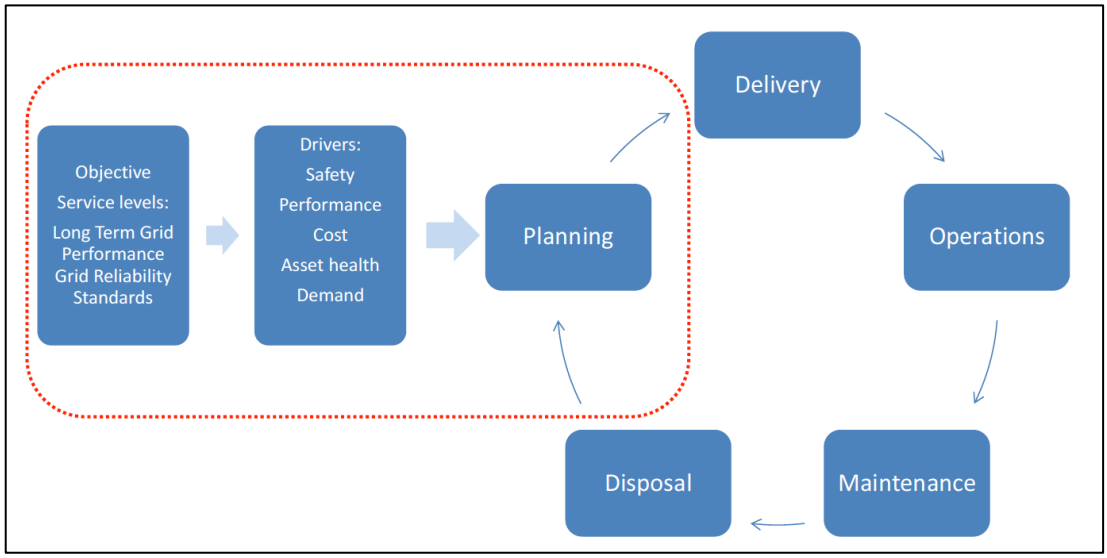
152 R&R expenditure covers projects to replace and refurbish assets such as those that make up transmission lines (e.g. conductors and towers) and substations (e.g. circuit breakers and transformers). Secondary assets (e.g.

[12] AM01 Asset Management Policy and AM02 Asset Management Strategy

protection and SCADA systems) and HVDC assets are also included in this category.

153 Transpower has provided the process it has used for developing its expenditure forecast in the RCP2 proposal in the document AM03 Planning Lifecycle Strategy. Our understanding from this documentation and through our on-site discussions with Transpower is that the planning and project identification is undertaken by following the process depicted in Figure 18.

Figure 18: Transpower's Planning Lifecycle

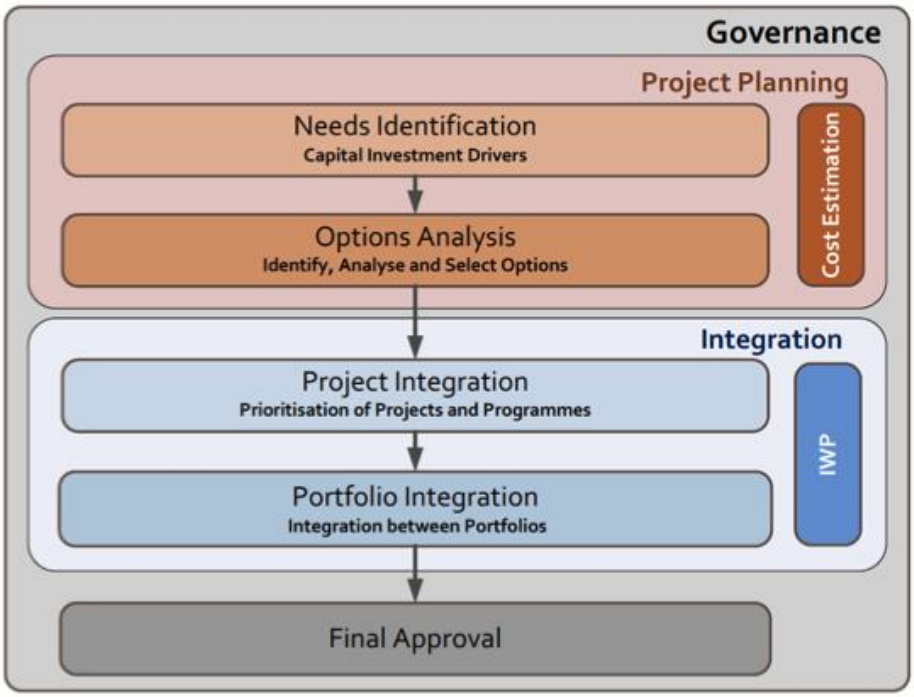


Source: Transpower AM03 Planning lifecycle strategy

154 Transpower's planning lifecycle is objective and takes into account the full asset lifecycle from planning through to construction, operation and maintenance to eventual end-of-life decommissioning and disposal. The use of total asset lifecycle planning provides an objective platform through which cost/benefit and engineering decisions such as options analysis (including capex/opex trade-offs) can be undertaken.

155 Transpower has provided the following diagram that sets out the various stages of its project planning process.

Figure 19: Transpower's project planning process



Source: Transpower AM03 Planning lifecycle strategy

156 Transpower identifies and discusses the project investment drivers under the following headings:

(a) Safety

(b) Service performance

(i) network performance measures

(ii) Grid Reliability Standards

(c) Demand for service

(d) Risk of asset failure

(i) asset health

(ii) asset criticality

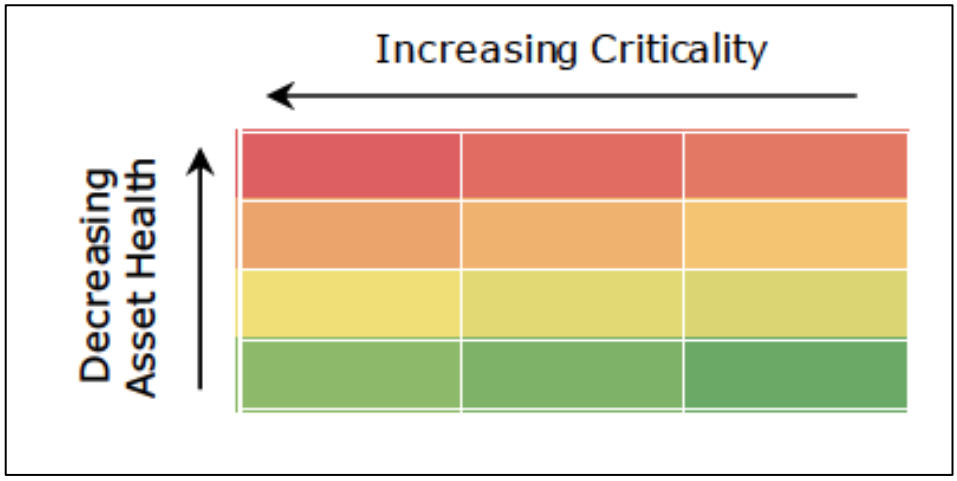
157 We consider that the project investment driver categories used by Transpower are appropriate and provide good direction for the development of a long list of potential projects.

158 Importantly, Transpower has proposed a set of service performance measures and targets for RCP2. Within the asset management framework, we would expect that Transpower's proposed performance measures and targets would be used as an input into the needs analysis under the service performance heading.

159 Under the risk of failure needs assessment heading Transpower's strategies place significant reliance on asset lifecycle management. We consider that asset lifecycle management is fundamentally important to Transpower's asset planning, operations and maintenance. We have noted that Transpower's approach to asset lifecycle management is emphasised throughout the documents we have reviewed.

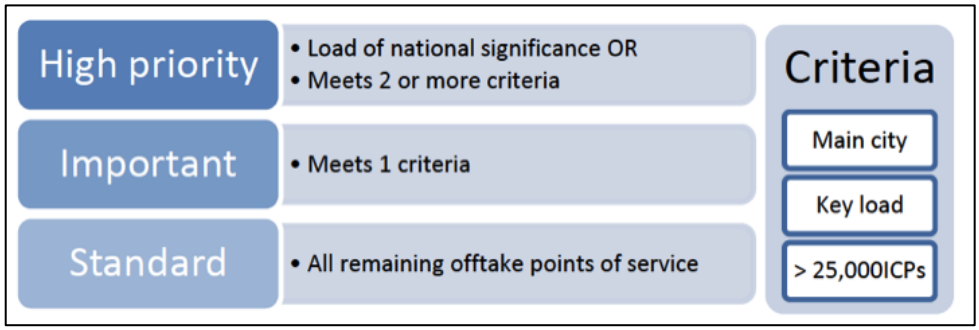
160 The Lifecycle Strategies and Fleet Strategies describe Transpower's method of developing expenditure forecasts based on a total asset lifecycle approach. Transpower's approach (confirmed at on-site sessions) is to use AHIs (measured as estimated remaining asset life in years) to identify assets scheduled for replacement (the long list). Transpower applies a criticality score to each asset, which sets the priority afforded to individual assets within the replacement programme.

Figure 20 Asset health framework



Source: Transpower BR02 Asset Health Framework

Figure 21 Asset criticality



Source: Transpower BR03 Criticality

161 Transpower's use of Asset Fleets provides a sound basis on which to develop asset lifecycle strategies for the primary items of network equipment. Adjusting the expected end-of-life date for an asset to reflect condition, mode type issues and failure rates derives the remaining life for each asset. This is a pragmatic and logical method for determining asset health indices that are informative and that allow an objective view of the overall status of an asset fleet, and of the whole network, to be gained.

Remaining asset life provides a combined capex/opex overview, which is useful when considering the interaction between maintenance, refurbishment and renewal activities.

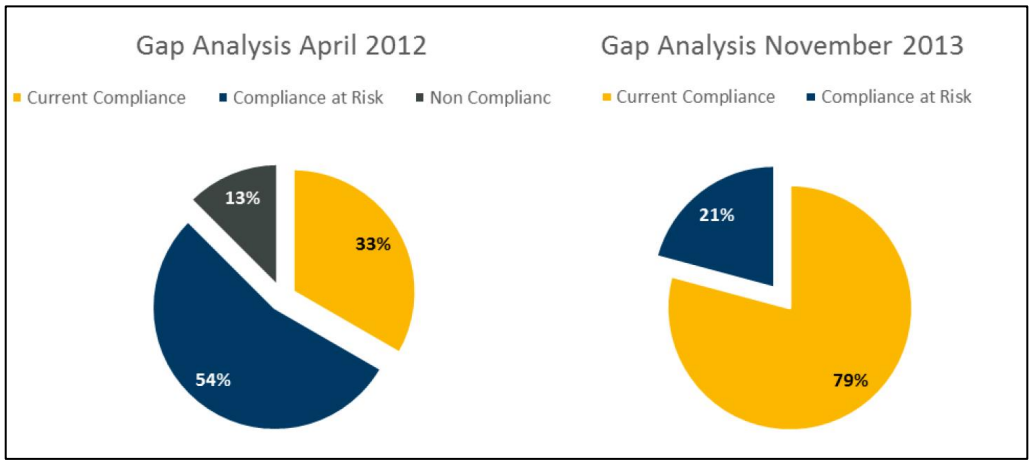
162 A relatively mechanical process such as Transpower's AHI model will produce outputs that subsequently require engineering and management judgements to be applied. These judgements will need to take into account broader risk factors than cannot be accommodated within standardised asset health ratings within a model. Such factors will include the constraints placed on projects and programmes due to access issues and resource constraints (e.g. limitations on the number of tower painters).

163 While we saw examples of where Transpower applied judgement and adjusted modelled outputs from the AHI models, we have not found any governance or procedural documentation that would provide a framework in which the impact of these judgement calls can be reviewed and assessed.

164 Notwithstanding this, we consider that the asset lifecycle methodology adopted by Transpower is appropriate and is consistent with the practices we have observed within other comparable transmission companies. The documents are generally well structured as would be expected as Transpower moves towards its PAS 55 accreditation target.

165 We have noted the progress that Transpower has made in establishing an asset management framework that will eventually align with PAS 55 standards, as recorded in the independent assessment undertaken by AMCL Pty Ltd in January 2014.[13]

Figure 22: Independent PAS 55 assessment of Transpower's progress



Source: Transpower response to Q005

166 While we consider overall progress is fair at this stage, we have concerns with the time being taken to establish some components of the framework and ensure that asset condition data is sufficiently accurate and reliable.

[13] *PAS 55 Gap Analysis Assessment Report*, AMCL Pty Ltd Version 1.1 January 2014.

We note that the Commission and Geoff Brown Associates raised these issues in the review of Transpower's RCP1 proposal three years ago.

167 As the lifecycle method relies heavily on sound asset age, failure history, degradation paths and condition data, it is extremely important that the data can be relied upon. Incorrect date would at best cause higher whole of asset life costs or worse lead to deterioration in network performance (e.g. lower reliability more outages).

168 In its proposal, Transpower states that it has developed AHI models for the following fleets:

(a) transmission lines;

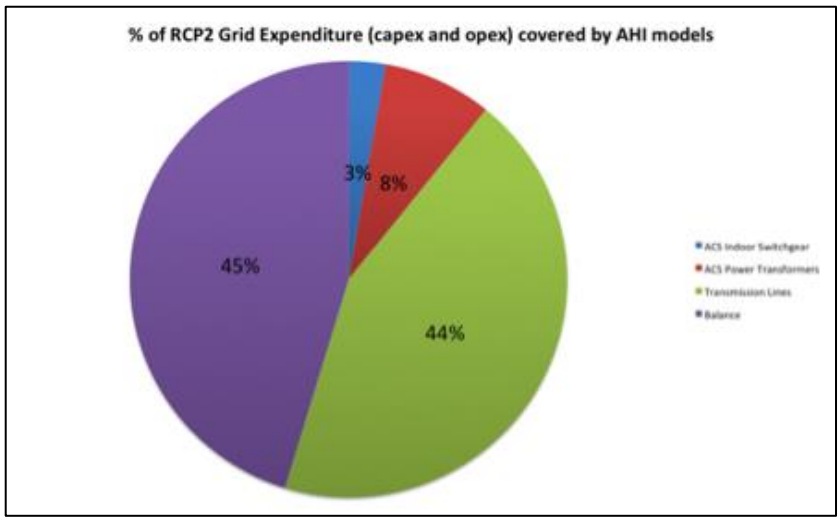
(b) power transformers; and

(c) outdoor circuit breakers.

Transpower advised that it is developing AHI models for additional fleets and we have seen evidence that this is occurring.

169 In aggregate, these asset fleets account for approximately 55% of capex and opex.

Figure 23: Grid expenditure with developed Asset Health Indices



Source: Data sourced from RT06 Integrated Transmission Plan

170 Accordingly, we would expect that Transpower would have applied its lifecycle methods for these fleets in developing its expenditure forecasts.

171 For other asset fleets, Transpower would have applied a less sophisticated planning process in developing its expenditure forecasts. The method that has been used to develop forecasts for these other (non-AHI) fleets is not well described in the proposal documentation.

172 Transpower's Planning Lifecycle Strategy describes how E&D projects are identified and assessed. Following this process, a long list of potential

projects (generally drawn from the Annual Planning Report) was reduced to form the short list of projects that is included in the RCP2 proposal.

173 In general, E&D projects will need to:

(a) address an identified need;

(b) be commercially and economically feasible or otherwise meet regulatory requirements (including a high-level cost-benefit assessment);

(c) meet GEIP and represent the best technically feasible option;

(d) have customer support;

(e) address safety and environmental issues and meet Resource Management Act requirements; and

(f) be able to be implemented in sufficient time to meet the identified need.

174 When assessing options that will meet the identified needs, Transpower requires the following to be considered:

(a) non-transmission solutions such as demand response or local generation;

(b) enhancements to existing assets;

(c) replacement or refurbishment of existing assets;

(d) creation of new assets;

(e) dismantling and divesting assets; and

(f) operational solutions such as special protection schemes.

175 The above requirements set out in the Asset Management Strategy provide very clear guidance to engineers and managers on the range of options that must be considered. The application of the strategy requirements will ensure that each project proposed as part of the RCP2 proposal is credible and represents the best option to meet the identified need.

176 Based on the asset management framework documentation, we would expect to find that Transpower has applied the above criteria and options assessment when developing its E&D capex forecast from a longer list of potential projects. We found little evidence in the project documentation provided that this had been done.

5.2.3 Assessment of the asset management framework

177 Since Strata undertook reviews in 2008, Transpower has made good progress in documenting its asset management framework. This is

demonstrated through its intention to seek PAS 55 accreditation in 2015 and through the independent assessment reports it has received.

178 While Transpower describes how it optimises between capex and opex in its lifecycle and fleet strategies, we have observed that, in practice, this assessment is not sufficiently transparent for us to reach conclusions. For example, for transmission lines and tower painting, we have not been able to observe clear examples of how capex/opex trade-offs are being considered by the planning engineers. We have not seen a clear consideration of the lifecycle implications of the continuing backlog in tower paintings (e.g. resulting in increased future costs).

179 We have noted well-documented graphical representations of how AHI and criticality ratings are being used to show the sensitivity of asset health to different expenditure forecasts. However, this seems to be limited to comparison of current, proposed and do-nothing scenarios.

180 We consider that forecasts would benefit from a broader range of sensitivity analysis and also from consideration of the aggregated fleet impacts. This would be especially useful if provided at the various challenge decision gates, where the impacts of changes in expenditure could be considered alongside the associated impact on asset health.

181 For AHI modelling to be a valuable tool, the quality of asset data is critical. We have observed that, for example in tower painting, Transpower frequently applies engineering judgement to override its modelled outputs. To some extent this is due to the continuing development of mature asset health data and systems but we consider that further refinement and calibration of the asset health models will be required for confidence to be gained in their outputs. Transpower has discussed its intentions to further develop its asset health data and systems during RCP2 and we fully support these.

182 In making the above observation, we note that the application of engineering judgement is an important component of GEIP asset management. However, good quality data and models must increasingly inform such judgements and provide decision transparency for governance and regulatory reviews.

183 We consider that output-based service criteria will drive a better understanding of the link between expenditure and performance and accordingly welcome Transpower's initiatives in developing service-based output measures. Over time, with appropriate systems and reporting in place, these should also enable the regulator to apply progressively higher-level assessments of Transpower's expenditure forecasts.

184 The quality of asset condition and health data remains an issue and is likely to be driving the on-going use of more qualitative engineering judgements, which frequently override modelled outputs (e.g. tower painting).

185 We have developed a concern that the substitutability of capex and the speculative nature of much of the E&D forecast may neutralise

Transpower's intended productivity adjustment. For example, deferral of a single large E&D project (e.g. of the order of $10 - $20m) would provide a large proportion of the targeted productivity gain.

5.2.4 Findings on the asset management framework

186 From our review of the asset management framework documentation and demonstrations of the systems and models in operation, we have reached the following conclusions:

(a) The framework used by Transpower for developing E&D projects is logical and is in line with practices seen in equivalent transmission companies.

(b) The use of asset lifecycle management for the development of R&R base capex projects and programmes is consistent with GEIP.

(c) With on-going development and refinement, Transpower's asset lifecycle management practices can provide a useful window through which the state of individual asset fleets and the whole network can be viewed, including the sensitivity of asset health to changes in expenditure over time.

(d) AHIs are currently limited to three asset fleets (representing 55% of R&R expenditure) with expansion to further fleets planned in RCP2. By subtraction, 45% of forecast R&R capex is not based on asset lifecycle management planning approaches. We have concluded that there is limited information available for assessing the appropriateness of the remaining 45% of R&R capex.

187 We have concluded that, if Transpower applies its asset management planning framework in practice, the resulting expenditure forecasts are likely to meet the requirements of the expenditure criteria.

5.3 Cost accumulation and cost estimation methodologies

5.3.1 Overview

188 Cost accumulation describes the process by which the expenditure budget estimates have been assembled. It includes cost estimation, which is usually conducted at a project or task level, together with the process of summing and adjusting those component cost estimates to produce a budget. For capex project costs, for example, the cost accumulation process typically includes the process of applying an allowance for interest during construction, cost escalators, S-curves to 'phase' the expenditure, allowances for overheads / support / design costs, and defined capitalisation rules (where the budget is on an 'as-commissioned' basis).

189 Transpower has produced its expenditure budgets for RCP2 using:

(a) a methodology for projects, which is applied both to capex and opex projects; and

(b) a methodology for costing routine maintenance requirements.

190 In both cases, the methodologies use a bottom-up building block approach which we overview below. The resulting forecasts are expressed in nominal dollar terms; that is, after applying a general inflation rate (CPI) as an escalator. The estimates used for the RCP2 forecasts are presented as P50 (most likely) estimates.

191 In July 2012, Transpower obtained external advice on its cost estimation processes and methodologies. At or around this time, Transpower introduced some improvements to its cost estimation process, notably:

(a) use of a blanket contingency was removed;

(b) 'volumetric' projects, comprising of high-volume repetitive works with a well-defined scope are costed using a specific costing approach. This applies particularly to generic R & R projects;

(c) a new cost estimation category (BC1+) was defined for larger or unique projects, and a cost estimation methodology involving more specific scope definition is now applied to such projects following Transpower's finding that a major cause of cost estimation uncertainty related to generalisations made in scoping the project; and

(d) risk allowances are applied to larger or unique projects, derived from project-specific risk modelling rather than applying generic risk allowances.

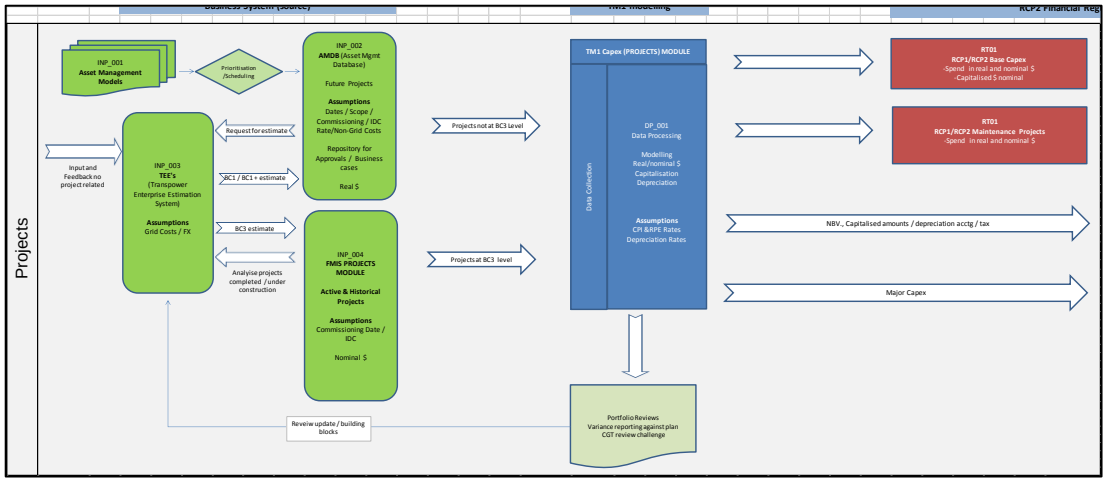
192 Around 2009/10 Transpower began the rollout of the US Cost Success Enterprise cost estimation system, which it named TEEs. Despite the long promised benefits, it appears that RCP2 is an early use of this system, and so little actual project cost information is available for projects that have been estimated using this system.

5.3.2 Capex and opex projects – cost accumulation

193 Transpower provided the following diagram to illustrate its cost accumulation process for capex and opex projects.[14]

[14] The diagram is not easily visible in this report, but it is included here to document the evidence that Transpower provided.

Figure 24: Project cost accumulation process (Transpower diagram)



194 In brief, the process is as follows:

(a) TEEs is used to provide both volumetric and one-off project cost estimates, based on assumptions about future projects that are held in the Asset Management Database (AMDB);

(b) TEEs can produce estimates based on different levels of scope definition, from 'level 1' general feasibility estimates to 'level 3' fully-scoped tender estimates;

(c) The AMDB holds cost estimates for unapproved projects, while an FMS Projects Module holds cost estimates and actual cost information for active, historical projects, and approved projects;

(d) Capex and opex project costs are then accumulated in the 'TM1' Projects Module, which converts any remaining real dollar-denominated project costs into nominal dollar terms, and applies capitalisation and depreciation rules. The main resulting outputs are:

(i) capex spend in real and nominal dollar terms, as capitalised, with IDC included; and

(ii) maintenance project costs in real and nominal dollar terms.

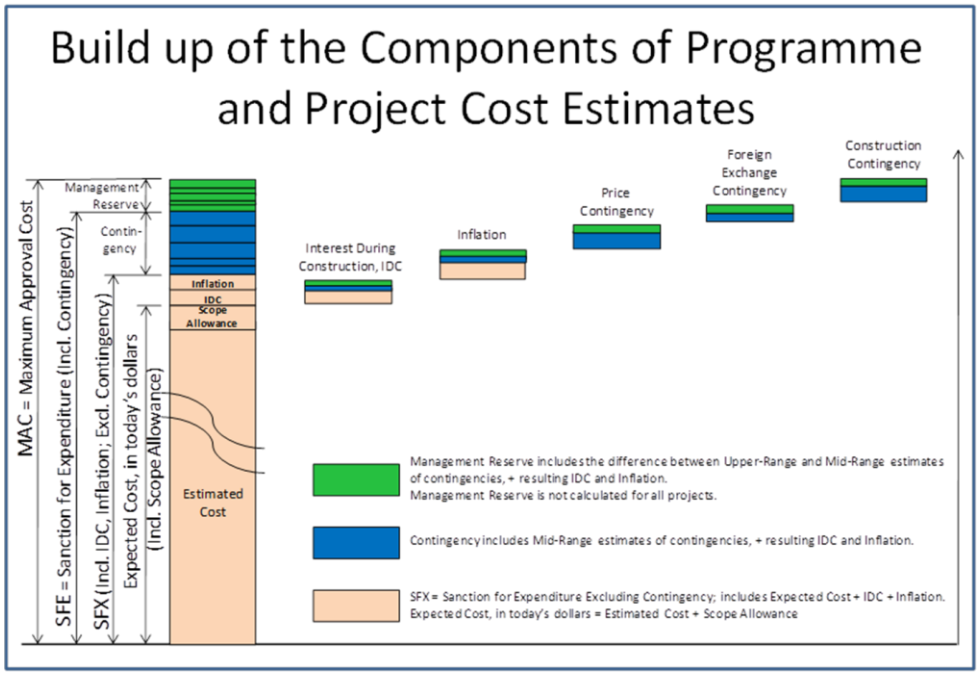
5.3.3 Capex and opex projects – cost estimation

195 Volumetric projects are costed using a suite of building blocks, based on the costs of historic equivalent works. Use of a large volume of such costs is intended to provide an appropriate average cost and to normalise for risks.

196 Customised project costs are developed using design layouts to produce detailed scopes of materials and labour. Unit costs are based on historical actual costs and supply contracts, with PERT-based risk allowances used to account for scope uncertainty. The build-up of costs for customised

estimates is shown in the following diagram.[15] Transpower has explained that the 'SFX' estimate, shown in light tan on this diagram, has been used for RCP2 budgeting purposes. This includes allowance for scope uncertainty, but excludes contingency and management reserves (which are used for project management and project governance purposes).

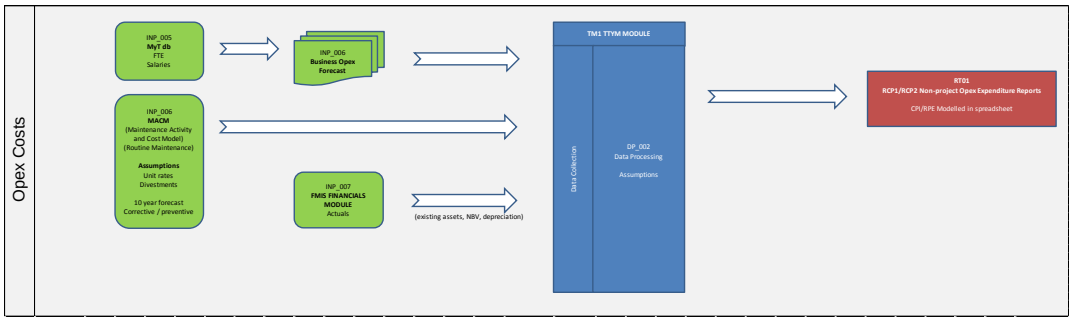
Figure 25: Build-up of components of programme and project cost estimates (Evans & Peck diagram representing Transpower cost estimation process)



Routine (non-project) opex – cost estimation and cost accumulation

197 Transpower's cost accumulation process for routine maintenance is shown in the diagram below.

Figure 26: Non-project (routine) opex cost accumulation process (Transpower diagram)



198 Separate processes are used to calculate routine (non-project) opex for each of corporate, IST and grid expenditures.

[15] From workshop material prepared by Evans & Peck, 17 – 20 July 2012.

199 The detail on the diagram above largely describes the process for accumulating routine grid maintenance expenditures. Maintenance costs are calculated using the Maintenance Activity and Cost Model (MACM). The main information used in this estimate is as follows:

(a) database of assets, by type (including projections for the asset fleet based on the assumed capex programme and the assumed divestment and decommissioning programme);

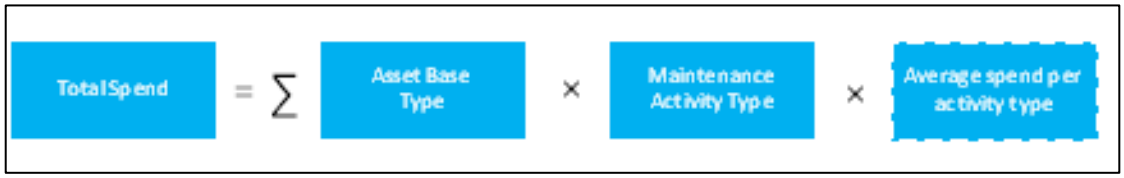
(b) maintenance activities for each asset type;

(c) the cycle or frequency of each maintenance activity for each asset type; and

(d) the cost of each maintenance activity.

200 Transpower has presented its total spend calculation for routine maintenance expenditure as a bottom-up build calculation, shown in Figure 27.

Figure 27: Non-projects (routine) opex cost accumulation process (Transpower diagram)



201 Corporate opex is subdivided into departmental opex, investigations, insurance and ancillary services. The cost accumulation for departmental opex is described as being based largely on headcount and salary assumptions. For investigations, the proposed expenditure is a top-down extrapolation from RCP1 expenditure, continuing the level that Transpower has forecast for the final year of RCP1 (2014/15). Transpower has separately estimated the costs of Ancillary Services and Insurance, and rolled them forward into its aggregate opex accumulation modelling.

202 Transpower has developed its proposed IST opex requirements as top-down projections to estimate cost trends by service category, based on extrapolation of historic cost trends.

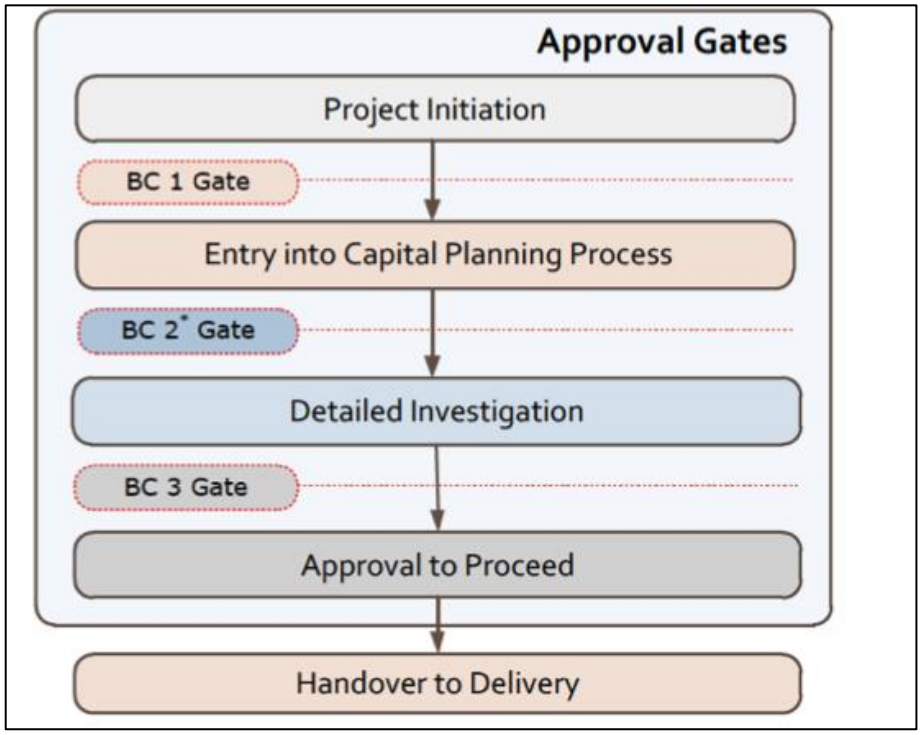
203 Corporate, IST and maintenance costs are accumulated in the 'TM1 TTYM Module'. This module applies CPI escalation as required, allocates IST costs to Business Service categories and applies the Avoided Cost Allocation Methodology (ACAM) to allocate joint costs to regulated services (where required).

204 The relevant outputs from this process are projected nominal routine opex costs, for regulated services.

5.4 Business case approval gates for projects

205 Transpower projects are progressed through the following approval gates, with the final gate (BC3) representing approval to proceed. The approval process is represented in Figure 28.

Figure 28: Transpower project approval stages (Transpower diagram)

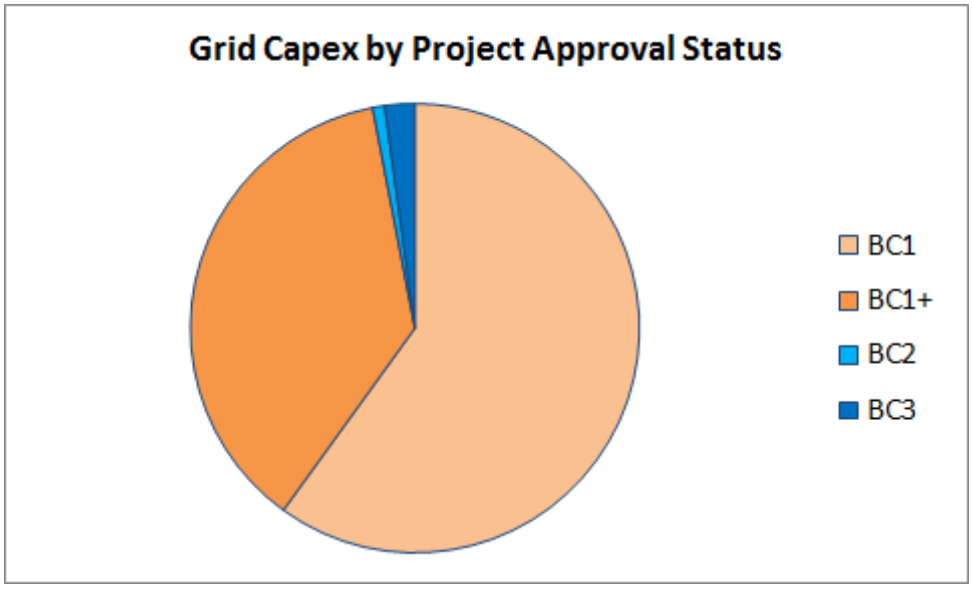


206 In on-site meetings, Transpower explained that it has introduced a more detailed scoping and cost estimation for large and unique projects, and which it has designated BC1+. This is not a separate approval gate, but is an enhanced cost estimation stage for these projects.

207 We sought information from Transpower on the value of projects by approval status. As shown in the diagram below, almost all of the value of projects proposed for RCP2 is at only the 'BC1' or 'BC1+' stage. These appear to be 'Level 1' estimates, which we would expect to have uncertainty in the order of ±35%.[16]

[16] This is consistent with Evans & Peck's 17-20 July 2012 Transpower workshop material, slide 11 (see response Q030-03)

Figure 29: Grid capex by approval status (Transpower diagram)



208 We would expect that the majority of projects within a two-year time horizon would have been approved, while (except for very large projects) the majority of expenditure beyond this timeframe will not have been approved. Given that the majority of projects beyond a two-year window are likely not to have been approved, it is as we would expect that almost all of the proposed projects for RCP2 are at only the BC1 or BC1+ stage.

5.4.1 Assessment of cost estimation and expenditure forecasting

Assessment of cost accumulation process

209 We have considered the process used to produce the expenditure forecasts, as follows.

210 We consider that the TEEs system, with associated scope risk analysis capabilities that Transpower has adopted, provides a reasonable basis for estimating expenditure requirements for grid capex and grid opex projects. This system is relatively recently introduced. We have not been able to review Transpower business / user documentation on this model or the governance process for its use or for updating of assumptions. Therefore our findings are based on representations made and overview descriptions of the cost estimation model and associated cost estimation business processes.

211 While no specific weaknesses are evident to us, Transpower's information on specification of input unit costs, and its governance of the process for updating these costs (with a feedback loop from actual purchases and actual completed projects), was not compelling and may be a source of greater uncertainty and possible bias. We consider that it would now be timely for Transpower to review its TEEs cost estimation tool and associated cost estimation processes and documentation in order to provide greater confidence in the use of this tool for project management

and approvals for internal financial budgeting and for regulatory expenditure budgeting.

212 We consider that the MACM system for costing routine maintenance projects is also, from the overview provided, a suitable tool for producing routine maintenance expenditure budgets. Since this system is based on a bottom-up activity-based costing, it is important to undertake top-down crosschecks and to ensure that unit costs for activities are valid and remain valid through a well-governed updating process. As with the TEEs system, we have been presented with overviews and descriptions of this system, but have not been able to view documentation around use of the system, or governance and verification of inputs to the system[17]. As with the TEEs system, we consider that activity unit cost inputs are likely to be the greatest source of uncertainty and possible bias.

213 Cost accumulation for other expenditure streams (such as IST and corporate expenditures) has been reviewed under those assessment headings.

214 In broad terms, Transpower has represented that its costs:

(a) are in nominal terms, using agreed CPI indices;

(b) for capex projections, are as-commissioned and include IDC; and

(c) for projects (capex and opex), are based on P50 estimates and do not include any contingency or other portfolio-level adjustments.

215 These expenditure forecasting bases are appropriate in concept and are as per the Commission's requirements.

216 We have not reviewed the calculations in the TEEs and MACM models, or the end-to-end calculations of the cost accumulation process for expenditure categories generally. We understand that the Commission has undertaken its own review of cost accumulation calculations in these models, tracing from the expenditure projections presented in the Expenditure Proposal back to source data and assumptions.

217 We therefore rely on Transpower's representations in its general descriptions of its models and processes, backed by the Commission's review, that the calculations to produce expenditure forecasts have been undertaken correctly. While there are aspects of these processes that we are uncertain of, we are not aware of any material error nor have we found any material misrepresentation in regards to these processes and methodologies, which therefore appear to be fit for purpose.

[17] Transpower subsequently provided information to the Commission after it was requested including the model architecture, the actual models, and the governance around developing the models

Assessment of portfolio-level cost estimation outcomes

218 To assist with our assessment of Transpower's cost estimation processes, we sought information on cost estimation outcomes compared with estimation allowances. Transpower provided its analysis of projects that had been estimated and completed during RCP1.[18] This comprised capex 50 projects for which customised cost estimates had been produced, and 778 'volumetric' projects. The total value of these projects was of the order of $357m.

219 We have had to make the working assumption that the data provided by Transpower was valid for comparison purposes. This would require that (inter alia) all projects had been completed, that the estimates and the outcomes related to what was materially the same project in each case (i.e. that projects had not been combined or split, or materially changed in scope) and that the cost estimates and cost outcomes are measured on the same basis (e.g. with respect to IDC, and/or any contingency allowances). Transpower presented the data in nominal terms, and without date information that would allow it to be adjusted into real terms. We consider this a weakness, in that the nominal cost could have been affected by delays in undertaking the project relative to the assumed timing when estimated and we consider that a better comparison would be on a real terms basis.

220 We also note that the customised estimate data was presented as 'BC1+' cost estimates. We had understood that Transpower introduced this cost estimation process in mid 2012; therefore it is difficult to reconcile this with the large set of projects presented.

221 Nevertheless, we assessed Transpower's data and in the first instance we simply determined the average portfolio variance, which is as shown in the following table.

Table 4 Portfolio cost variance for a set of projects completed during RCP1

Description	Number of Projects	Total Value	Average Variance
Volumetric Data	778	$147,936,370	1.7%
BC1+ Data	50	$210,785,523	13.8%
BC1+ Data excluding outliers*	40	$172,590,841	6.4%
*Between 10th and 90th percentiles			

222 The volumetric data shows a low variance, with an "overspend" (or under-estimate) of the order of 1.7%.

223 The BC1+ data showed a much bigger variance with a weighted average overspend of 13.8% relative to each project's cost estimate. We observed that a small number of projects had very large overspends with (for example) over 60 of the 778 volumetric projects, and two of the 50 BC1+ projects, having overspends greater than 100%, as is shown in the following two diagrams.

[18] Necessarily, this did not include all projects in RCP1 as not all projects are yet completed.

Figure 30: Individual project cost variance distribution for a set of volumetric projects completed during RCP1 (from Transpower analysis)

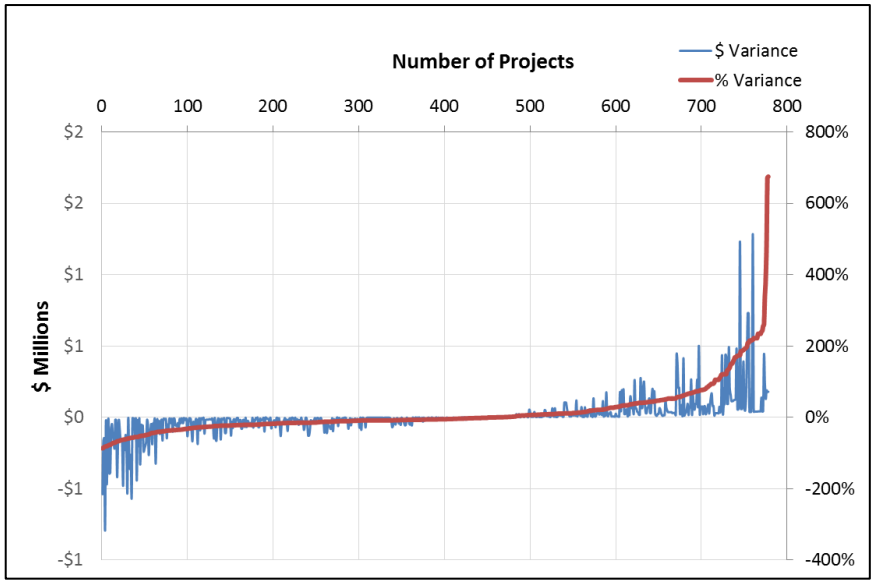
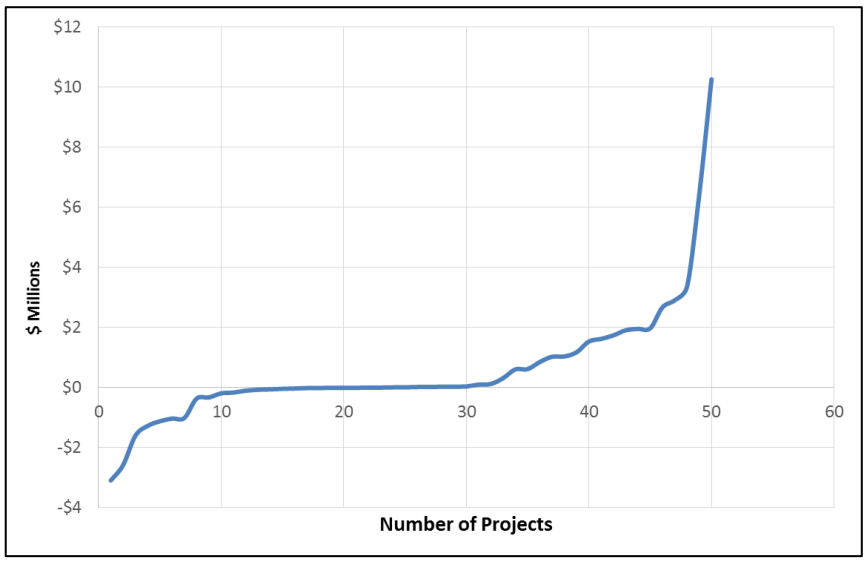


Figure 31: Individual project cost variance distribution for a set of BC1+ projects completed during RCP1



224 We considered that where very large variances are evident, they may result from the project data not being directly comparable, perhaps due to projects being combined or radically re-scoped. To test the impact of this, we removed outliers (which we defined as being above the 90th percentile and below the 10th percentile). This had minimal impact for the volumetric projects; however for the BC1+ projects, removing the outliers reduced the portfolio variance for the remaining projects to an over spend of 6.4%.

Assessment of unit costs for volumetric projects

225 To assist with assessment of the proposed expenditure for volumetric projects, we also sought information from Transpower on the total costs, quantities and (derived) unit costs for a range of volumetric project types. We asked for information on the RCP1 allowances for these projects and

actual costs for these projects, and we sought equivalent information for the proposed volumetric projects proposed for RCP2. This allowed us to determine the extent to which Transpower has delivered these projects during RCP1. The information potentially also allowed us to assess (at the level of specific volumetric project types):

(a) Transpower's cost estimation accuracy for these project types during RCP1 (i.e. unit cost accuracy), and

(b) the validity of the unit costs inherent in the RCP2 proposal, compared with actual unit costs.

226 Transpower did not have data that was used to put together the proposal readily available and was unable to provide the unit cost information for each of the volumetric project types, but the information was then given after one week and then a further three weeks. The information did not cover the full RCP1 period, and two of the three years were forecasts, with only one year being actual costs. It was also not clear in all instances whether data was expressed in real terms or nominal terms. Some data showed counter-intuitive relationships.[19]

227 We nevertheless took at face value that the data was comparable, as per our request to Transpower, and the results of our assessment are shown below. As can be seen, there were significant unit cost variances for each of the volumetric project types, with the exception of grillages where the cost per grillage project was within 2% of the estimated cost.

228 The analysis showed that, for each of the project types for which information was provided, except for 11 kV CB refurbishments, Transpower has assumed a lower unit cost for its RCP2 budget than its most recent actual/forecast unit costs for that type of project. Its assumed RCP2 unit costs are within 10% of the actual costs, except for two project types: 110 kV and 220 kV CB refurbishments, for which Transpower's assumed unit costs are 43% and 23% respectively below its most recent actual costs.

[19] Examples include similar projects at higher voltages having a lower unit cost than equivalent projects at lower voltages, and differences between data streams that did not exhibit an expected relationship, such as for inflation differences between real and nominal data.

Table 5 Assessment of RCP1 unit cost variances and RCP unit cost assumptions

Description	RCP1 Unit Cost variance				RCP2 Unit Cost comparison		
	Average allowance	Average actual	Average variance		Average proposed allowance	Difference RCP2 vs RCP1	
			$	%		$	%
Tower Painting Historic	$49,586	$73,635	$24,049	***48.5%***	$68,496	-$5,139	***-7.0%***
Grillages Historic	$27,326	$27,777	$452	***1.7%***	$25,251	-$2,526	***-9.1%***
SMS Historic* (nominal)	$181,179	$230,024	$48,845	***27.0%***			
SMS RCP2 Vs RCP1 (real)		$251,524			$242,717	-$8,807	***-3.5%***
11kV CB - Circuit Breaker (nominal)	$56,518	$100,428	$43,910	***77.7%***			
33kV CB - Circuit Breaker (nominal)	$176,087	$155,826	-$20,261	***-11.5%***			
66kV CB - Circuit Breaker (nominal)	$141,495	$129,106	-$12,389	***-8.8%***			
110kV CB - Circuit Breaker (nominal)	$191,221	$218,937	$27,716	***14.5%***			
220kV CB - Circuit Breaker (nominal)	$190,675	$203,691	$13,016	***6.8%***			
11kV CB - Circuit Breaker - RCP1 vs RCP2 (real)		$97,998			$106,241	$8,243	***8.4%***
33kV CB - Circuit Breaker - RCP1 vs RCP2 (real)		$136,188			$122,016	-$14,172	***-10.4%***
66kV CB - Circuit Breaker - RCP1 Vs RCP2 (real)		$118,785			$111,936	-$6,849	***-5.8%***
110kV CB - Circuit Breaker - RCP1 vs RCP2 (real)		$213,935			$121,194	-$92,741	***-43.4%***
220kV CB - Circuit Breaker - RCP1 vs RCP2 (real)		$193,883			$149,754	-$44,128	***-22.8%***
** Small & medium*							

Conclusions on cost estimation and expenditure forecasting

229 The time taken for Transpower to provide unit cost source data for volumetric projects and the high variances evident from this data for specific volumetric project types reduces our confidence in Transpower's proposed volumetric project expenditure. Countering this is the low portfolio-level RCP1 variance as shown in the subsection above and what appear to be lower unit cost assumptions for RCP2 than actual unit costs in RCP1.

230 Similarly, the significant variances that are evidenced in the non-volumetric project unit cost information that Transpower provided reduces our confidence in Transpower' cost estimation process for these projects. This may reflect a relative lack of maturity of currently used cost estimation tools and processes; nevertheless, from the evidence provided, it is difficult to accept that the cost estimation process adequately supports the proposed expenditures at this time.

231 We consider that the data both for volumetric and non-volumetric projects does not provide unequivocal evidence for a cost estimation bias that would lead us to recommend a specific cost estimation-based adjustment to these proposed expenditures. Nevertheless, our relatively low confidence in the cost estimate outcomes is a relevant factor that can be considered in conjunction with other factors in our assessment of the proposed project expenditure.

5.4.2 Findings on cost estimation and expenditure forecasting

232 While noting that we have not reviewed cost accumulation models,[20] the cost accumulation processes and methodologies described by Transpower appear reasonable.

233 To the extent that information was made available to us, the cost estimation tools and processes appear to be on a path towards good practice. However, we are concerned by a lack of documentation of the tools and cost estimation processes and associated governance and this reduces our confidence in the cost estimations inherent in Transpower's proposed expenditure levels. Our assessment of cost estimation variances similarly leaves us with a reduced level of confidence.

234 We do not recommend any adjustment to the proposed forecasts based solely on bias or inaccuracies in the cost estimation and cost accumulation processes, but diminished confidence in the cost estimations used for RCP2 is a relevant factor that can be considered in assessing the reasonableness of the proposed RCP2 expenditures.

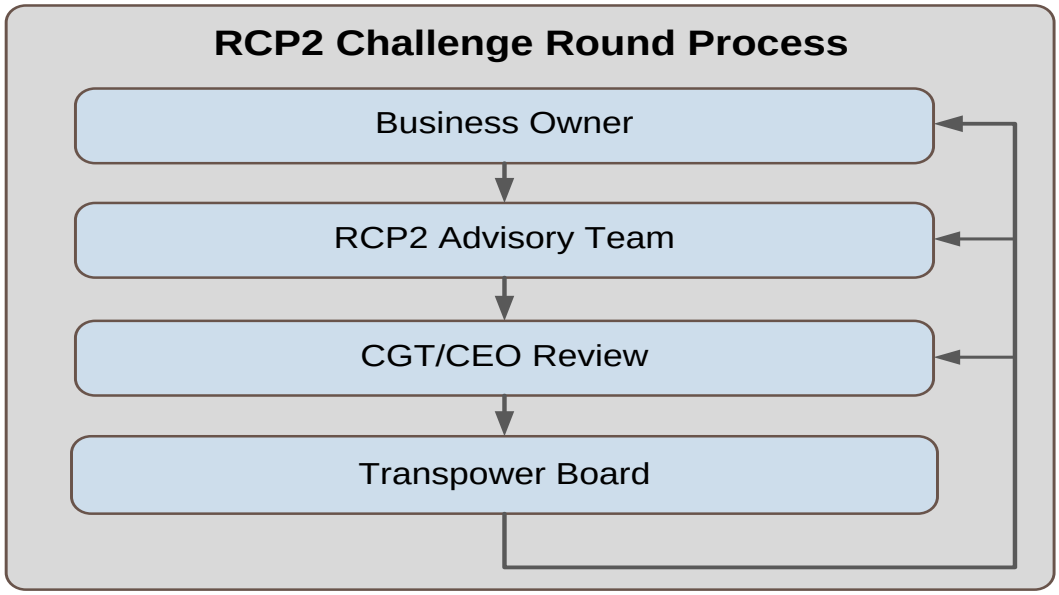
5.5 Challenge and review process

235 In previous reviews we have undertaken for the Commission and other regulators we have commented on the need for network businesses to undertake a robust and rigorous top-down review and challenge to expenditure forecasts that have been developed on a bottom-up basis. The top-down review is not only used to ensure that improvements are made in methodologies and processes but also that prudent decision making has been applied. The challenge will generally test the key input assumptions, the extent to which estimation basis has been accounted and the businesses' ability to deliver the proposed works and supporting activities.

236 Throughout its MP01 proposal, Transpower has described the multi level review and challenge process that it has implemented. In the following diagram, Transpower illustrates the review and challenge that the expenditure forecasts have been subjected to.

[20] Since this was undertaken by the Commission.

Figure 32 RCP2 Challenge round process



237 The review and challenge applied by Transpower has resulted in:

(a) a 7.5% productivity adjustment being applied to the aggregated nominal Grid and IST base capex forecast; and

(b) a range of efficiency adjustments on an asset fleet basis to corrective and preventive maintenance opex.

238 It is clear from the information provided in MP01 that Transpower has placed significant reliance on the review and challenge process when concluding that the expenditure forecasts are prudent.

5.5.1 Observations and findings

239 We have found that Transpower has applied internal reviews and challenges into its expenditure forecasting for RCP2. We have seen reviews applied at various stages of the process including at Business Owner, Advisory Team and Capital Governance Team (CGT) levels. We have observed that Transpower applies a top down challenge process at CEO and Board level as the expenditure forecasts progress to approval.

240 We have sought, received and reviewed additional documentation including presentation material, meeting notes, and minutes that document the changes and adjustments made to the expenditure forecasts during reviews and challenges. We are satisfied that Transpower has considered its expenditure forecasts through the top down reviews and challenges as set out in its proposal.

241 We have found the review and challenge process implemented by Transpower to be well structured and provides for the involvement of a broad range of inputs from the Board, executive, management and business owner. The introduction of the review and challenge rounds is, in our view, likely to produce more robust and reliable expenditure forecasts than would otherwise have been.

242 Notwithstanding the above observation, we have identified three key areas where the review and challenge could have been improved:

(a) the introduction of feedback loops that provide information on the implications and sensitivity of review decisions to changes in expenditure forecasts;

(b) the process through which productivity and deliverability considerations are made at the review and challenge levels; and

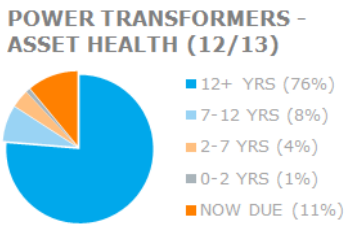
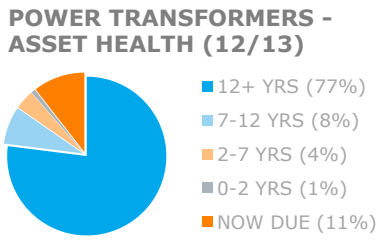
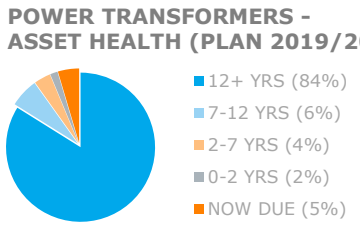
(c) cost management focus for non-network opex categories.

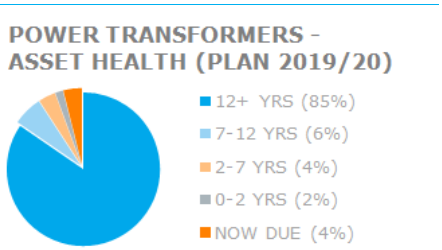
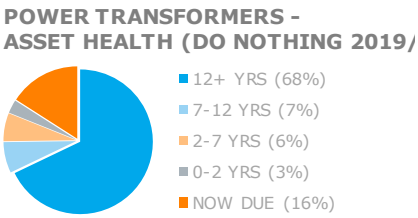
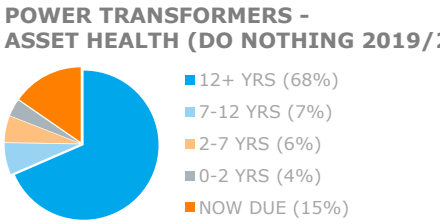
Introduction of feedback loops

243 Transpower has described, and we have observed, how asset lifecycle information and models are used to provide a link between forecast expenditure levels (capex and opex) and the forecast state of the network at the end of RCP2. Through asset lifecycle management and the models, Transpower has shown the ability to provide sensitivity assessment of the impact of changes in output performance measures and input expenditure on the state of the network. For example, if adjustments to expenditure are made, it is possible to view the resulting asset health profile for the asset fleets affected. This information should also provide the basis for a link through to performance measure targets.

244 Figure 33 provides an example for the changes in power transformer asset fleet that occurred between June and November 2013.

Figure 33: Power transformer AHI variations

Scenario	June 2013	November 2013
Current Remaining Life		
2020 Plan based on MD03		

2020 Plan based on Submission		
Do Nothing		

245 While the changes in the power transformer fleet profile are relatively minor, it is important that this is known to be the case. It is possible that more significant results will be seen for other asset fleets.

246 Our key concern in raising this issue is that, until Strata requested this information, Transpower had not produced it to inform its review and challenge process. Because of this, we cannot see how the impact of the decisions made through the later stages of review and challenge were taken into account.

247 Because the feedback loop was never undertaken, the AHI information provided in Transpower's proposal does not relate to the expenditure forecasts in the regulatory templates. If material differences are seen in the November profiles for other asset fleets this would need to be corrected.

248 At 14th April 2014 Transpower had not provided this information to us for other asset fleets.

Productivity and deliverability

249 Transpower has applied a 7.5% 'productivity adjustment' to Grid and IST base capex to account for improved productivity realised through a combination of the following factors:

(a) some identified needs met with alternative (lower cost) project solutions;[21]

(b) efficiency savings in procurement and delivery processes;

(c) improved asset management and innovation allowing service performance targets to be met at lower cost;

[21] Historically we have utilised alternative, more cost-effective solutions than initially envisaged (examples include the use of demand response and special protection schemes instead of large investments in primary plant). These have led to significant cost savings. This scope for solution 'diversity' (particularly for IST) is a key driver for the adjustment.

(d) increased levels of asset divestment;

(e) improvements to cost estimation and risk management processes reducing the potential for cost overruns; and

(f) integration with other capex works (including major projects) leading to reduced outage costs and increased resource utilisation.[22]

250 We have considered the proposed productivity adjustment and the additional information provided by Transpower on how it was conceived and quantified. Taking into account the investment and progress that Transpower has made in its asset management practices and information base, and for the focus on cost management that Transpower was to apply in IST during RCP1, we have found no reason to increase or decrease the proposed productivity adjustment. We agree with Transpower that the factors provided should lead to this level of productivity gain.

251 The June 2014 Transpower Board minutes noted that the Board required management to consider a 'diversity factor' to address inherent over estimation bias in bottom-up forecasting. Further discussion took place with the Board on 6 August 2013.

252 The following is an extract from management's paper to the Board:[23]

> *At the June Board meeting, Directors requested that the draft estimates for grid capital expenditure for RCP2 be further tested against our capability to deliver and to take account of "portfolio bias".*
>
> *After further consideration of the portfolio and challenge of specific projects, average grid replacement and refurbishment capital expenditure has been reduced to $177m per annum in RCP2 (at this stage). This includes a "top-down" reduction of 7.5% applied to account for our capability to deliver the proposed portfolio (deliverability factor)…*
>
> *The deliverability factor (-7.5%) will also [be] applied to grid enhancement and development and 1ST capex.*

253 The deliverability factor applied in discussion with the Board appears to have been set for quite different reasons to the productivity adjustment described in the RCP2 proposal which states: [24]

> *A further top-down review tested forecast Grid and IST Capex. This review took into account our output targets and our longer-term vision for the Grid. It assessed how various factors might impact our overall expenditure requirements. These included the following.*

[22] Transpower's response to Q003
[23] Transpower's response to Q004: RCP2 Proposal: Grid and Corporate Operating Expenditure
[24] MP01 page 46

- *Alternative Solutions: the potential for alternative project solutions (options) to address the identified needs. Historically there have been situations where more cost-effective solutions were developed following the completion of investigations or detailed design.*
- *Prioritisation: the potential for risk-based prioritisation to achieve larger improvements in performance and asset health relative to the associated expenditure.*
- *Asset divestment: which may increase beyond the levels assumed for RCP2.*
- *Efficiencies: potential improvements in our procurement and delivery processes.*

The expenditure chapters set out Base Capex based on our bottom-up view of the scope required to meet our RCP2 objectives. However, taking into account the above factors, we believe that it is reasonable for us to target meeting our RCP2 objectives with reduced expenditure. To account for anticipated productivity improvements we have applied a top-down reduction of 7.5% to our total Grid and IST Capex forecasts.

254 In the RCP2 proposal, Transpower provides the following view of deliverability:

Our RCP2 forecasts were challenged by our project delivery group to test the aggregate resource required. The review focused on critical resources (identified by our experience and service provider information), which included linesmen, tower painters, and substation construction and maintenance personnel.

The review concluded that our overall resource requirements are similar to what has been managed in the recent past. While there are specific areas where present capacity is insufficient (including tower painting), these are being addressed. In addition, we monitor and address emerging delivery risks through regular workshops as part of our risk management process. Accordingly, we are confident that the proposed levels of Base Capex and Opex can be delivered during RCP2.[25]

255 The documents we have viewed indicate that the Board considered that a 7.5% adjustment was appropriate for over estimation and deliverability correction whereas management considered that a 7.5% productivity adjustment was appropriate to account for the application of prudent decision-making. Both types of adjustment are relevant but Transpower has only applied a single 7.5% adjustment. Should the overall adjustment have been 15%?

[25] MP01 section 5.6 page 45

256 This question is considered further in section 6 when we discuss our findings on R&R capex for asset fleets. However, from a process perspective, there appear to be differences between the basis on which management had developed the productivity adjustment and discussions with the Board regarding a deliverability factor.

Opex cost management

257 For opex, Transpower initiated a Maintenance Efficiency Study[26] that resulted in several specific savings targets. In addition, Transpower took into account expected further improvements due to insourcing operational functions. Accordingly, Transpower has included efficiency adjustments to its opex forecasts for specific asset fleets. We consider that the efficiency adjustments have been well considered by Transpower and subjected to independent external review. The application of the efficiency adjustments is discussed in the network opex review in section 8 of this report.

258 We note that Transpower has not adopted a similar approach to applying an adjustment to non-network opex. When we questioned this Transpower informed us that:

> *… an overall reduction was not considered appropriate as we expect that achieving Capex productivity improvements will increase cost-pressure on Departmental and IST Opex (due to the interdependence between Capex and Opex and the additional analysis and oversight needed to drive productivity improvements).*[27]

259 While we accept that productivity and efficiency gains in other areas may have some related implications for non-network opex, we consider that the productivity and efficiency adjustments in base capex and network opex should be regarded as a net value rather than a gross value that does not take into account increased costs in other areas.

260 In particular, we consider that a culture of active cost management in Transpower is important as it will assure electricity consumers that services are being delivered as efficiently as possible. In our view, the RCP2 proposal does not provide adequate evidence that sufficient downward pressure is being applied to non-network costs. This issue is discussed further in section 8.4 covering non-network opex.

5.6 Summary of findings on planning & forecasting framework

261 Since Strata undertook earlier reviews of Transpower's expenditure in 2008, Transpower has made good progress in documenting its asset management framework. This is clearly demonstrated through its intention

[26] Provided in AP02 of Transpower's RCP2 proposal package
[27] Transpower's response to Q003

to seek, and progress toward, BSI PAS 55:2008 accreditation in 2015 and through the independent assessment reports it has received.

262 Though recognising the progress that has been made, we have some concern at the time that is being taken to ensure that asset health data is sufficiently accurate so that it can be relied upon. The Commission and Geoff Brown Associates raised these issues[28] in the review of Transpower's RCP1 proposal three years ago.

263 Asset lifecycle management is at the heart of Transpower's asset management practices and the documentation provided to support the RCP2 proposal sets out how Transpower relies on this when establishing the activities, investments and related expenditure needed to maintain its network at the required performance levels.

264 From our review of Transpower's asset management framework documentation, including demonstrations of the systems and models in operation, we have concluded the following points:

(a) The framework used by Transpower for developing E&D projects is logical and, if used as documented, should result in a forecast that represents a reasonable estimate of what will need to be spent over RCP2.

(b) The use of asset lifecycle management for the development of R&R base capex projects and programmes are consistent with GEIP and in line with practices seen in peer electricity transmission businesses.

(c) We have found that, provided the input data can be relied upon, Transpower's asset lifecycle management system can provide a useful window through which the state of the network can be viewed, including the sensitivity of asset health to changes in base capex and opex over time.

(d) AHIs are currently limited to three asset fleets (representing 55% of expenditure) with development to cover additional fleets expected to take place during RCP2. This means that for 45% of base capex, the forecast is not based on full asset lifecycle management planning practices. We note Transpower's intention to address this in RCP2 and recommend that progress towards this goal be reported at least annually.

(e) Cost estimation using the TEEs tool is an industry standard that should enable Transpower to produce more accurate cost estimates than seen in previous reviews. We note that its application is at an early stage of development (e.g. no feedback review has been completed on initial default S curves).

[28] Geoff Brown Associates *Review of Transpower's forecast operating and capital expenditure for 2012 - 15* http://www.comcom.govt.nz/dmsdocument/1027

(f) The Maintenance Activity and Cost Model (MACM) used by Transpower to establish its expenditure forecasts for routine maintenance is applying a sound methodology to establish volumes and apply unit costs.

265 We have concluded that, if Transpower applies its documented asset lifecycle management planning and cost estimation framework in practice, the resulting expenditure forecasts are likely to meet the requirements of the expenditure criteria.

6 Grid base capex

6.1 Content of this section

266 Transpower's proposed capex of $$1,188.56m includes $944.43m for grid base capex which covers E&D and R&R.

267 R&R includes:

(a) Transmission lines

(b) AC Stations

(c) Secondary assets

(d) HVDC Stations

268 This section of the report presents Strata's views on the grid base capex projects included in Transpower's RCP2 proposal.

269 While the proposed E&D and R&R expenditure makes up the grid base capex, Transpower has also indicated a number of major projects each of greater that $20m, for which it is likely to submit individual revenue approval applications during the course of RCP2. The total estimated cost of the major capex projects is $444m.[29]

6.2 Our review approach

270 At the highest level, the approach that we have adopted to the review of grid base capex is consistent with our overall top-down governance focused methodology. Our key activities are to:

(a) understand and assess the method Transpower says it has used to develop its expenditure forecasts;

(b) identify and assess the key assumptions on which the forecasts are based; and

(c) establish if Transpower applies its strategies and processes in practice.

271 Where we have found it to be necessary, we have supplemented the top-down review method with bottom-up assessments (e.g. detailed project/component reviews).

[29] RT06 Integrated Transmission Plan

272 In this section, we discuss our findings in relation to major expenditure components.

6.3 Findings on E&D capex

6.3.1 Introduction and comparison with RCP1

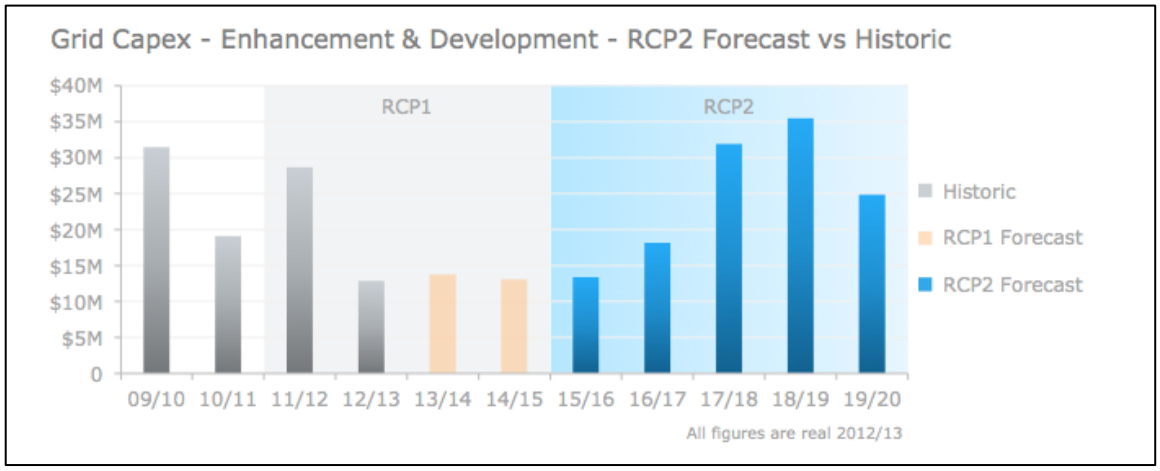
273 E&D capex for RCP2 comprises a programme of 15 growth-related projects that primarily address anticipated regional capacity and security issues. The primary drivers for E&D expenditure are demand growth and changes in generation patterns. E&D projects commonly provide for installation of new transformers, particularly interconnecting transformers, uprated transmission circuit capacities and installation of special protection schemes.

274 E&D projects valued at less than $20m are included in Transpower's RCP2 proposal. Above this threshold, larger projects are submitted to the Commission for approval under a separate process as needs arise.

275 Transpower states that E&D capex is forecast to be higher in RCP2 compared with RCP1 because the base capex threshold has increased from $5m to $20m.[30] This means that a number of projects that would previously have required separate approval as major capex are now included in RCP2 under base capex.

276 A view of comparable E&D historic and forecast expenditure over an 11-year period including RCP2 is shown in Figure 34. To enable a fair comparison on an equivalent basis, RCP1 and historic expenditure has been included for projects up to $20m.

Figure 34 Total E&D base capex vs historic spend



Source: Transpower MP01, Figure 29

277 It is apparent that E&D capex is relatively 'lumpy' over time, which is to be expected for large one-off projects. However, while lumpy, forecast

[30] Document MP01 - Transpower Expenditure Proposal RPC2, page 66.

expenditure during RCP2 shows a step increase commencing in 2016/17 from the relatively flat profile of around $13m per annum from 2012/13 through to 2015/16.

6.3.2 Transpower's approach to forecasting E&D capex

278 Transpower has set out its approach to forecasting E&D capex in section 3 of document *AM03 Planning Lifecycle Strategy*. The process follows the generic approach applicable to all capital investment planning. This involves stages for:

(a) planning, including:

(i) needs identification; and

(ii) options analysis;

(b) integration, including:

(i) project integration; and

(ii) portfolio integration; and

(c) final approval.

Needs identification (AM03 section 3.2)

279 Needs (or drivers) relevant to E&D capex typically relate to compliance with the grid reliability standards[31] and the impact of demand growth. The grid reliability standards consist of:

(a) an economic standard for the whole grid and the associated assessment of costs and benefits of investment for reliability; and

(b) a safety net minimum reliability standard of N-1 for contingencies on the core grid.

280 Transpower includes updated long-term demand and generation forecasts and identifies possible investments that may be required to address identified capacity constraints in its Annual Planning Report (APR).

Options analysis (AM03 section 3.3)

281 For E&D projects, the approach to identifying and analysing options is commensurate with the size and complexity of the project. In general, a long list of options is identified and reduced to a credible options list using a range of assessment criteria.

282 A high level scope and an estimate of costs and benefits are derived for each of the short list options. Transpower states that it undertakes a whole-

[31] See Electricity Industry Participation Code, Schedule 12.2, available at http://www.ea.govt.nz/act-code-regs/code-regs/the-code/

of-life approach to assessing costs and benefits, which avoids decisions being made on initial capital costs alone.

283 Following options analysis, including any customer consultation that may be relevant, a preferred option is identified.

Cost estimation (AM03 section 3.7)

284 Projects with a value greater than $1m have customised estimates prepared at the approval gates BC1, BC2 and BC3. Key design requirements are estimated from a desktop review of relevant site documentation and standard costing estimates are applied. Scope and cost escalation risks are factored into estimates.

285 The RCP2 E&D forecast project costs in PD30 – 44 are predominantly based on BC1-level project cost estimates of the preferred option.

Integration and optimisation (AM03, sections 3.4 and 3.5)

286 E&D projects are continually prioritised and integrated with Transpower's broader works programme, including opex, replacement and refurbishment base capex and major project capex. The timing of end-of-life replacements has clearly triggered some E&D projects that provide capacity upgrades of the replaced equipment.

287 Constraints related to resource forecasting, deliverability, site integration and outage availability are taken into account in determining the final integrated transmission work plan.

Approvals (AM03 section 3.6)

288 Confirmation of individual E&D projects follows a staged approvals process. The stages are:

(a) project initiation followed by a BC1 gate decision;

(b) entry into the capital planning process followed by a BC2 gate decision;

(c) detailed investigation followed by a BC3 gate decision; and

(d) approval to proceed and handover to the delivery group.

289 Successive stage gate processes provide escalating levels of challenge from portfolio owner, capital governance team and Board respectively. Relevant delegated financial authorities apply to all expenditure decisions.

6.3.3 E&D projects resulting from the planning process

290 For the purposes of RCP2 E&D base capex, Transpower has included the subset of the projects from the April 2013 APR it considers is likely to proceed within RCP2. Each possible project is summarised in a project overview document (POD) and these are listed in Table 6 along with the forecast expenditure for each project by RCP2 year.

Table 6 E&D forecast capex by year

POD reference	E&D Project	2015/16	2016/17	2017/18	2018/19	2019/20	Total
PD30	Otahuhu-Wiri Transmission Capacity	$ 2.8	$ 9.0	$ 6.7	$ -	$ -	$ 18.5
PD31	Relieve Generation Constraints	$ -	$ -	$ 2.6	$ 8.5	$ 5.5	$ 16.7
PD32	Upper North Island Reactive Support 2012 - 2020	$ -	$ -	$ 3.9	$ 4.1	$ 0.0	$ 8.0
PD33	Bus Section Fault Reliability	$ -	$ -	$ 2.2	$ 7.0	$ 4.6	$ 13.9
PD34	Wellington Supply Security	$ -	$ -	$ 3.8	$ 3.8	$ 3.8	$ 11.4
PD35	Otahuhu and Penrose Interconnection Capacity	$ -	$ -	$ 1.9	$ 10.7	$ 3.9	$ 16.6
PD36	Bunnythorpe Interconnection Capacity	$ 0.1	$ 3.1	$ 5.6	$ -	$ -	$ 8.8
PD37	North Taranaki Transmission Capacity	$ -	$ -	$ -	$ -	$ 3.0	$ 3.0
PD38	Timaru Interconnecting Transformers Capacity	$ -	$ -	$ -	$ -	$ 2.5	$ 2.5
PD39	Southland Reactive Power Support	$ -	$ 2.1	$ 3.8	$ -	$ -	$ 6.0
PD40	High Impact Low Probability Event Mitigation	$ 2.8	$ 2.9	$ 1.5	$ 1.0	$ 1.0	$ 9.2
PD41	Hororata and Kimberley Voltage Quality	$ 3.4	$ -	$ -	$ -	$ -	$ 3.4
PD42	Islington Spare Transformer Switchgear	$ 2.3	$ 0.1	$ -	$ -	$ -	$ 2.4
PD43	Haywards Local Service Third Incomer	$ 1.8	$ -	$ -	$ -	$ -	$ 1.8
PD44	E&D Other	$ 0.2	$ 0.9	$ 0.1	$ 0.2	$ 0.4	$ 1.7
	Total	$ 13.4	$ 18.1	$ 31.9	$ 35.5	$ 24.9	$ 123.8

6.3.4 Strata's approach to reviewing the E&D projects

291 We commenced our review by examining the key planning assumptions that drive this forecast – for E&D projects these primarily relate to growth in peak demand within and across regions.

292 We then reviewed a sample of the E&D projects to determine the extent to which Transpower has followed the processes set out in its Planning Lifecycle Strategy in developing the E&D base capex forecast. In this review, we were looking for evidence of appropriate levels of needs identification, options analysis, project cost estimation, portfolio integration and approvals.

293 Our initial top-down review of sampled E&D projects involved a review of the documentation submitted in support of the projects to establish, to the benchmark of an experienced network planner, whether:

(a) needs are clearly established;

(b) planning data and assumptions are stated so as to support the case for the project;

(c) a range of likely options are identified;

(d) the rationale for eliminating options is credible; and

(e) the preferred option is supported by a business case.

294 Review of an initial sample was expected to confirm conformance with established processes and provide confidence that the whole portfolio had been rigorously developed from a sound basis.

6.3.5 Findings from our top-down review

295 Our review has raised a number of issues in respect of:

(a) demand forecasting;

(b) needs identification; and

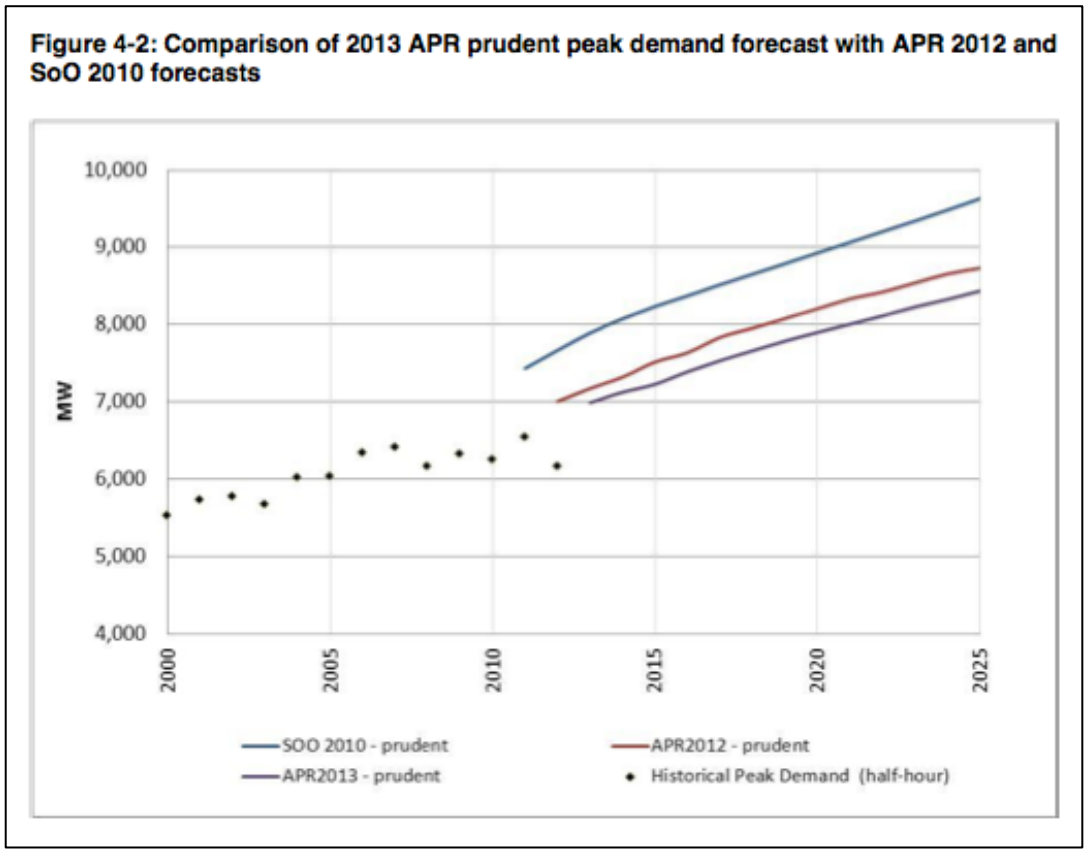
(c) options analysis.

Demand Forecasting

296 Our primary initial concern with Transpower's demand forecasts was that they were based on forecasts prepared for the 2013 APR, which was published in March 2013. This prudent forecast would have been developed in the period following the winter of 2012. At that stage, a trend of flat demand was clearly established from as far back as 2008 – Transpower has acknowledged this trend as being triggered by the global economic recession.

297 The pattern of recent demand forecasts is shown in Figure 35, which is reproduced from the 2013 APR.

Figure 35 APR demand forecasts in recent years



Source: Transpower 2013 APR, page 34

298 The record peak in 2011 was due to the unusual polar weather event in mid-August that affected the whole country, bringing snow to urban areas (such as Wellington) that would not normally experience such severe conditions. Transpower noted that this weather event served to mask the underlying flattened demand growth, established from 2008 on.

299 In section 4.5 of the APR, Transpower foreshadowed a need to review its demand forecasting methodology, citing two areas of concern:

(a) the adequacy of its shorter-term (i.e. 1 – 5 years) forecasts, illustrated in Figure 35 where successive prudent demand forecast curves are pushed materially outwards in time; and

(b) the relationship between demand and real GDP growth, since GDP has recently been growing at a faster rate than electricity peak demand, possibly due to different sectoral growth trends impacting energy intensive industries.

300 Transpower subsequently reviewed and updated its approach to demand forecasting in mid-2013, adding a fourth method to its ensemble forecasting approach that reflects the impact of shorter-term historical growth trends.[32] At the same time, Transpower updated its regional demand forecasts.

301 Having considered this latest information relating to demand forecasting, we have noted that:

(a) the national peak demand growth forecast continues to flatten;

(b) most regional peak demand growth forecasts are increasing at a decreasing rate year-on-year;

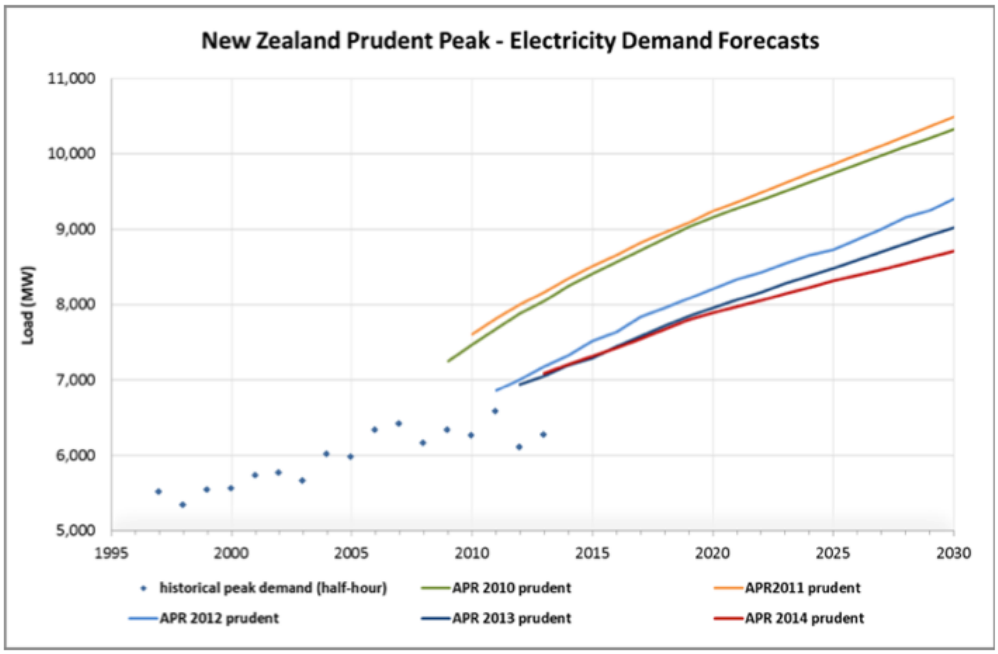
(c) the apparent disconnect between peak demand growth and GDP growth, identified in the 2013 APR, remains unexplained, yet an econometric forecast is retained within the ensemble forecast approach; and

(d) the 2014 prudent forecast is essentially the same as the 2013 prudent forecast.

[32] See *Summary of Transpower's peak forecast process*, Transpower, June 2013 available at: https://www.transpower.co.nz/sites/default/files/plain-page/attachments/Summary%20of%20Transpower%20demand%20forecastFINAL.pdf.

Figure 36 Most recent (2014 APR draft) peak demand forecast

Figure 4-2: Comparison of 2014 APR prudent peak demand forecast with previous APR forecasts



302 From visual inspection of Figure 36, the largest year-on-year peak demand increase (which appears to be 2003 to 2004, within a relatively high-growth period) is around 50% of the gap between the 2013 actual and P90 peak demands. This leads to an overall impression of on-going conservatism underpinning Transpower's P90 prudent forecast, which is probably an artefact of the ensemble approach to peak demand forecasting that Transpower favours. The national forecast is related to the regional forecasts that drive the timing of much of the E&D base capex forecast.

303 In response to a question put to Transpower by the Commission (Q051), and having considered the impacts of its 2014 prudent peak demand forecast, Transpower has provided updated analysis of the timing of peak demand growth-driven projects within the E&D base capex portfolio. In general, there is no change from the timings submitted in the RCP2 proposal documentation, other than:

(a) a *possible* delay into RCP3 of one of the two static capacitor banks that were included in PD32; and

(b) revised timings for two minor transformer secondary system upgrades that were included in PD44.

304 We have not adjusted our recommendations in respect of this new information at this stage but would appreciate confirmation of the status of these, and any other, E&D projects from Transpower in its submission on the Commission's draft decision.

Needs identification and options analysis

305 For E&D projects, needs are established on a case-by-case basis. Each potential project is selected from amongst a long list of projects documented initially in Transpower's 2013 APR. The 15 short listed projects are included as part of the RCP2 documentation suite in a series of PODs, specifically PD30 – PD44.

306 Our initial review focused on two projects, selected as representing two relatively large and complex projects that we would expect to require careful development through all of the planning process stages:

(a) PD30 – Otahuhu – Wiri Transmission Capacity; and

(b) PD34 – Wellington Supply Security.

307 Our review of these two projects has raised a number of concerns, as follows:

(a) PD30 – Otahuhu – Wiri Transmission Capacity:

(i) the need identification is unclear and not substantiated by the support information provided;

(ii) there is conflicting information in respect of the expected project timing;

(iii) the options analysis is weak (at least it is weakly documented) in respect of a project that might require $18.5m of base capex;

(iv) there is no information provided relating to customer consultation; and

(v) the preferred option appears to self-select as the highest cost option that fits within the upper base capex limit of $20m.

(b) PD34 – Wellington Supply Security:

(i) the needs identification summary raises some significant questions around the project drivers;

(ii) project timing is inadequately described; and

(iii) the options analysis is weak (at least it is weakly documented) in respect of a project that might require $11.4m of base capex.

308 We have provided a summary of our reviews for each of the E&D projects in Annex A.

309 Our review of these two projects has concluded that:

(a) most of the expenditure included in PD30 is unlikely to be justified for inclusion within RCP2, resulting is a reduction of $18.2m (98% of forecast) from the E&D forecast; and

(b) none of the expenditure included in PD34 is likely to be justified for inclusion in RCP2, resulting in a reduction of $11.4m from the E&D forecast.

310 Transpower presented a summary of these two projects at the onsite Q&A session and we discussed some aspects with a view to clarifying our understanding, prior to our forming our views on these projects. It is unlikely, though possible, that there are further explanations that would satisfy the doubts we hold at this stage in respect of these matters.

311 In respect of the two E&D projects, we appreciate that these are at an early stage of investigation (i.e. BC1), nevertheless we would have expected a significantly higher level of substantiation for expenditures totalling around $30m.

312 Additionally, in respect of demand forecasting, the significant issues foreshadowed by Transpower in the 2013 APR should have been comprehensively investigated and resolved prior to submitting the RPC2 proposal, as Transpower intended.

313 Consequently, we elected to extend our sampling approach within the E&D base capex category to consider the documented case for each project. The following sections set out the findings of our review of each of the remaining E&D projects.

6.3.6 Our review of E&D base capex on a case-by-case basis

Approach

314 In line with our review of PD30 and PD34 (discussed above), we have:

(a) considered the extent to which Transpower has followed the planning processes set out in its Planning Lifecycle Strategy document AM03; and

(b) applied our experience in transmission network planning to undertake a high-level review of submitted documentation and determine the extent to which a clear justification is made for expenditure proposed for each project.

315 Where appropriate, we have recommended adjustments to the RCP2 forecast base capex and provided supporting rationale.

316 Our detailed findings are included in Annex A.

6.3.7 Recommendations on E&D capex

Forecast expenditure adjustments

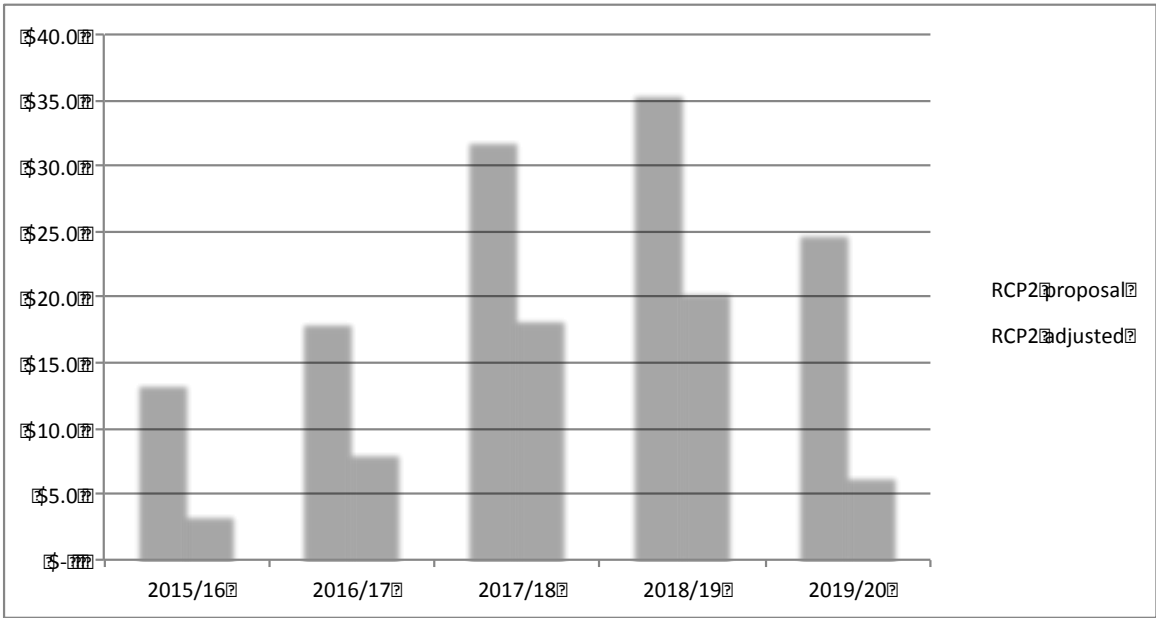
317 Applying the recommendations for PD30-44 to the RCP2 forecast (set out in Table 6) results in the adjusted forecast shown below in Table 7.

Table 7 RCP2 adjusted E&D forecast

POD reference	E&D Project	2015/16	2016/17	2017/18	2018/19	2019/20	Adjusted Total	Difference	
PD30	Otahuhu-Wiri Transmission Capacity	$ 0.3	$ -	$ -	$ -	$ -	$ 0.3	-$ 18.2	-98%
PD31	Relieve Generation Constraints	$ -	$ -	$ 1.5	$ 3.7	$ 0.8	$ 6.1	-$ 10.6	-63%
PD32	Upper North Island Reactive Support 2012 - 2020	$ -	$ -	$ 3.9	$ 4.1	$ 0.0	$ 8.0	$ -	0%
PD33	Bus Section Fault Reliability	$ -	$ -	$ 1.9	$ 4.5	$ -	$ 6.4	-$ 7.5	-54%
PD34	Wellington Supply Security	$ -	$ -	$ -	$ -	$ -	$ -	-$ 11.4	-100%
PD35	Otahuhu and Penrose Interconnection Capacity	$ -	$ -	$ 1.9	$ 7.1	$ 2.0	$ 10.9	-$ 5.7	-34%
PD36	Bunnythorpe Interconnection Capacity	$ 0.1	$ 3.1	$ 5.6	$ -	$ -	$ 8.8	$ -	0%
PD37	North Taranaki Transmission Capacity	$ -	$ -	$ -	$ -	$ -	$ -	-$ 3.0	-100%
PD38	Timaru Interconnecting Transformers Capacity	$ -	$ -	$ -	$ -	$ 2.5	$ 2.5	$ -	0%
PD39	Southland Reactive Power Support	$ -	$ 2.1	$ 2.1	$ -	$ -	$ 4.2	-$ 1.7	-29%
PD40	High Impact Low Probability Event Mitigation	$ 2.8	$ 2.9	$ 1.5	$ 1.0	$ 1.0	$ 9.2	$ -	0%
PD41	Hororata and Kimberley Voltage Quality	$ -	$ -	$ -	$ -	$ -	$ -	-$ 3.4	-100%
PD42	Islington Spare Transformer Switchgear	$ -	$ -	$ -	$ -	$ -	$ -	-$ 2.4	-100%
PD43	Haywards Local Service Third Incomer	$ -	$ -	$ -	$ -	$ -	$ -	-$ 1.8	-100%
PD44	E&D Other	$ 0.2	$ 0.1	$ -	$ -	$ -	$ 0.3	-$ 1.5	-85%
	Total	$ 3.4	$ 8.1	$ 18.3	$ 20.4	$ 6.4	$ 56.7	-$ 67.1	-54%

318 The proposed and adjusted forecasts are represented graphically in Figure 37.

Figure 37 RCP2 E&D forecast proposed and adjusted ($m)



319 It is evident from Figure 37 that the first two years of RCP2 show a significant drop in expenditure when compared with the immediately preceding years in RCP1 and the final three years of RCP2. This appears to reflect a 'pipeline' issue caused by very few E&D base capex projects being undertaken in the latter years of RCP1 and the larger project expenditures forecast to occur in the latter years of RCP2.

320 It is possible that in-progress RCP1 projects could 'roll-in' to RCP2, increasing expenditure in 2015/16 and 2016/17, but we cannot see

significant potential for this. Unforeseen demand- or generation-driven needs could bring forward E&D capex into the early years of RCP2, potentially flattening the E&D expenditure profile over RCP2.

321 In aggregate, the recommended adjusted E&D forecast represents an average expenditure of $11.3m annually over 5 years and we consider this is a prudent amount to allow for the documented, genuinely high value needs within this expenditure category, particularly considering that:

(a) major project risk is mitigated for contingent unforeseen needs in excess of $20m that may arise;

(b) some of the adjusted projects could be re-scoped to fit within a major project with little difficulty;[33] and

(c) there remains within this expenditure category considerable scope for project substitution between lower and higher value competing needs – in other words, we consider opportunities will arise to efficiently delay some of the unadjusted projects within this category.

Productivity adjustment

322 Transpower has proposed that a 7.5% productivity adjustment should be applied to a number of expenditure categories to reflect expected improvements over RCP2. The E&D projects discussed in this section would be covered by the productivity adjustment.

323 We consider the adjustments we have recommended to E&D base capex would be duplicated if a further adjustment were to apply. Consequently, we further recommend that the E&D base capex category is not included within any additional productivity adjustment, if the Commission retains such an adjustment in respect of a range of expenditure categories.

6.4 R&R Asset Portfolios and Fleets

324 The R&R expenditure category is formed by the following asset fleets and portfolios:

Transmission lines	TL Tower
	TL Pole
	TL Paint
	TL Foundation
	TL Grillage

[33] The Kawerau interconnecting transformer upgrade in PD31 is a potential candidate for such treatment, for example.

	TL Conductor
	TL Insulators
	TL Access
AC Stations	ACS Outdoor to Indoor Conversions
	ACS Outdoor Circuit Breakers
	ACS Indoor Switchgear
	ACS Power Transformers
	ACS Buildings & Grounds
	ACS Buildings & Seismic
	ACS Dynamic Reactive Power
	ACS Capacitors & Reactors
	ACS Power Cables
	ACS Structures & Buswork
	ACS Instrument Transformers
	ACS Disconnectors & E/S
	ACS Other Station Equipment
Secondary assets	SA Substation Management Systems
	SA Metering
	SA BZ Protection
	SA Line Protection
	SA Transformer Protection
	SA Batteries & DC Systems
	SA Feeder Protection
HVDC Stations	HVDC

350 For the R&R assessment we undertook a top-down review of each of the asset fleets and portfolios. This involved reviewing documentation including

Asset Fleet Strategies and Portfolio Overview Documents. For each, we formed a view on the extent to which the documentation demonstrated that Transpower had applied its asset management framework in practice when developing the expenditure forecasts for each fleet/portfolio.

351 We undertook on-site review sessions where Transpower presented further detail and the Strata team raised questions and issues for discussion and clarification. We made subsequent requests for further information required to complete the top-down assessment and form our views.

352 In addition, we undertook detailed reviews of four specific asset fleets. The primary objective of the fleet studies was to assess the extent to which Transpower, in practice, applies its asset framework. The four fleets studied represent 51.5% of total proposed R&R capex for RCP2.

353 The four specific fleets were chosen for different reasons:

Tower painting	Tower painting was chosen because at $187m, the fleet represented almost 54% of the tower lines category and 23% of the total R&R forecast. The proposed RCP2 expenditure represented a significant step change above historical levels. Actual expenditure had consistently fallen below forecast levels.
Power transformers	The Power transformers fleet was chosen because at $106m it represents almost 32% of the AC Stations category and 13% of the total R&R forecast. Transpower had advised that asset lifecycle management was most advanced and mature for power transformers. This asset fleet provided a good example of how Transpower was taking lifecycle management into account when establishing its expenditure forecast.
Outdoor to indoor conversions	This was chosen because it makes up 24% of the AC Stations category and 10% of total R&R expenditure. During the final two years of RCP1, the expenditure for this fleet was forecast to ramp up significantly and then reduce over RCP2.
Substation management	While SMS accounts for only 5.75% of the

systems	total R&R forecast, it makes up 41% of the secondary assets category. The proposed SMS expenditure during RCP2 represented a significant step change of 288% above levels seen for the five years RCP1+2012/11.

354 In undertaking these studies, we considered both capex and opex, which has informed our conclusions relating to how Transpower applies asset lifecycle methods when making trade-off decisions to achieve optimal asset lifecycle outcomes.

6.5 Tower painting

6.5.1 Transpower's approach to forecasting TL capex

355 Transpower describes its management of transmission lines in AM02 Asset Management Strategy, BR02 Asset Risk Strategy, AP01 Asset Management Plans, AM03 Lifecycle Planning Strategy, AM06 Lifecycle Strategy Maintenance and, for transmission towers, the FS01 Fleet Strategy Towers and Poles.

356 As discussed in section 5.2, Transpower has provided clear, consistent statements in its documents and in discussions that it establishes the R&R expenditure forecast for tower painting on the basis of asset lifecycle practices. Transpower states that the greatest asset management challenge for its ageing fleet of towers is steel corrosion. Transpower describes its approach to this challenge as follows:

> *Assessing asset health is particularly important, as it is used to understand the deterioration profile of asset fleets and to forecast and prioritise replacement and refurbishment activities. Asset health information and asset criticality data are used to assign an overall priority to each asset that then is used to optimise the level of investment in the fleet.*[34]
>
> *The first step in the planning phase is identifying the asset investment required to meet our asset management objectives and policy. The process is mainly driven by asset condition and development plans such as those contained in our Annual Planning Report.*

357 In its TL Towers and Poles Asset Fleet Strategy, Transpower describes how it uses condition assessments (CA) against expected degradation curves for six corrosion zones, to determine the forecast remaining life of the asset.

[34] FS01 Asset Fleet Strategy - Towers and Poles page 20

358 Based on this information, we would expect to see the development of the tower painting forecast to have included the following:

(a) AHI (including condition assessment (CA) rating) established for all towers based on a representative sample of towers;

(b) an assessment of the criticality of each tower or group of towers;

(c) a model output schedule of tower painting based on AHI and criticality;

(d) cost estimates for the replacement schedule produced through TEEs and/or the FS01 painting cost schedule;

(e) engineering assessment giving consideration to prioritisation, sequencing and deliverability of the schedule;

(f) the revised schedule being subject to review, challenge and approval with any changes or adjustments resulting in further revised schedules;

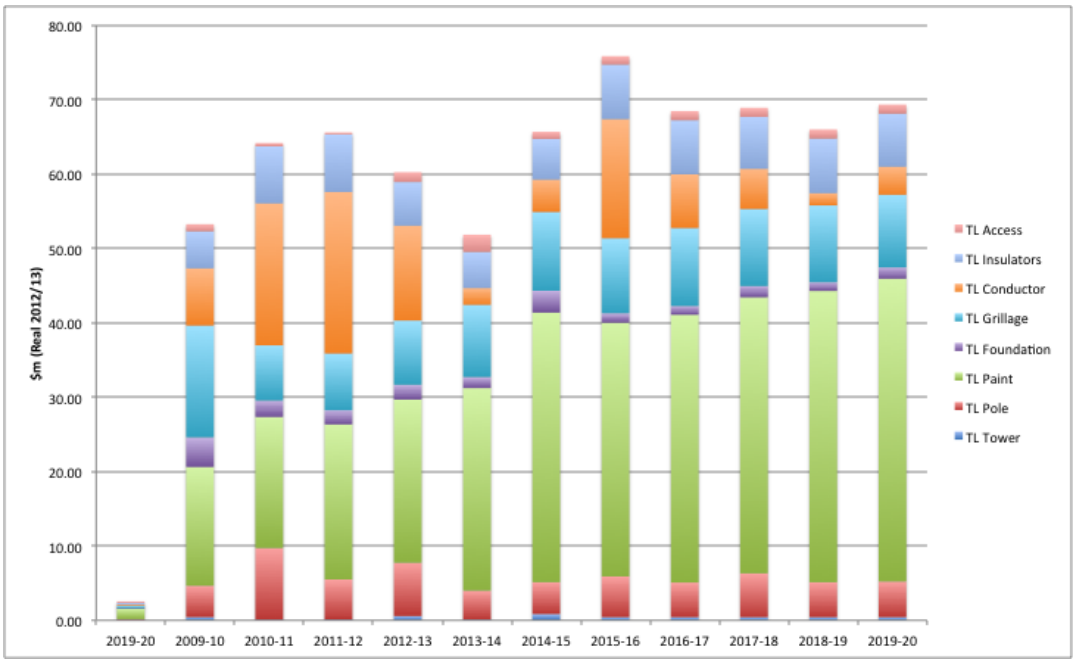
(g) revised AHI information being produced to inform Transpower decision makers of the sensitivity of the revisions to the various revisions and adjustments; and

(h) the resulting final revised schedule and expenditure forecasts being used as a component of the Regulatory Template RT01 RCP2 Forecast and Revenue and the associated AHI profiles being submitted with the RCP2 Proposal.

6.5.2 Expenditure on tower painting

359 Tower painting capex of $187.2m accounts for 53.7% of the total Transmission Lines capex. This contrasts with $124m for the preceding 5 years. The contribution to capex by each asset fleet is shown in Figure 38.

Figure 38 R&R Transmission Line Capex



360 It is evident that Transpower plans to significantly ramp up its tower painting programme and that this is the primary driver for the step change increase seen in transmission lines capex.

361 The variations in value and percentage terms for the TL asset fleets between RCP2 and the preceding five years (RCP1 + 2019/10) are shown in Figure 39 and Figure 40.

Figure 39 TL capex RCP2 vs RCP1+2010/11 (%)

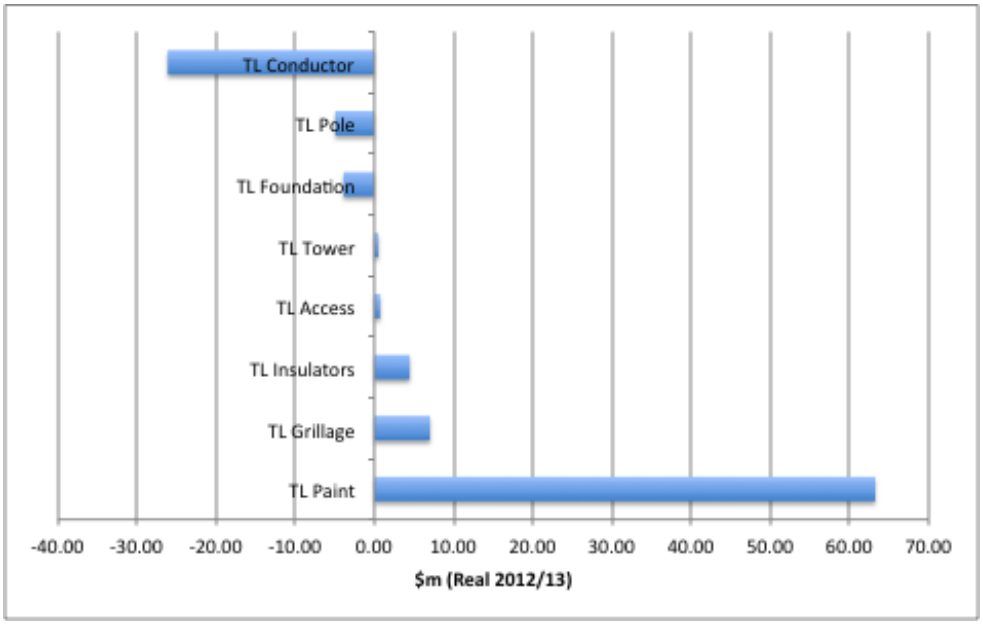
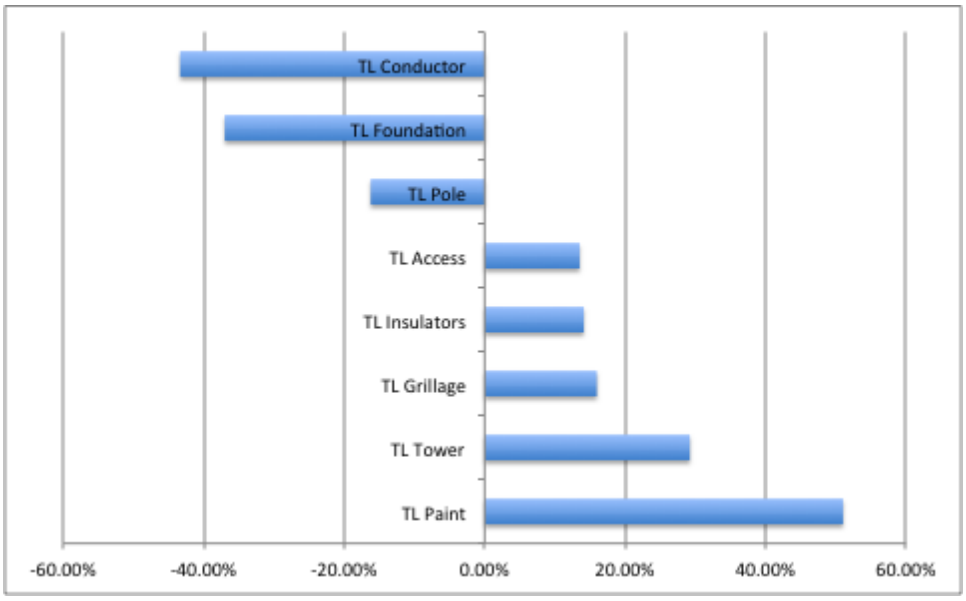


Figure 40 TL capex RCP2 vs RCP1+2010/11 (%)



362 Transpower's forecast spend of $187.2m on tower painting during RCP2 is based on the assumption that an average of 530 towers will be painted each year.

6.5.3 Findings on tower painting

363 We have reviewed how Transpower applies asset lifecycle strategies when developing its tower painting capex forecasts. In paragraph 358 we set out our expectations on the process steps that we expected Transpower to have worked through when developing the capex forecast. Our findings for each of these steps are provided in the table below:

AHI Model	Transpower has demonstrated and provided its AHI model for tower painting. The model is consistent with Transpower's documented asset lifecycle approach and asset management strategies and with its fleet strategy for towers and poles.
Criticality	The tower painting AHI model takes into account the criticality factors relating to each asset. This is consistent with Transpower's asset lifecycle documentation.
Cost estimation	We have confirmed that the AHI and criticality factors are combined and the result entered as a project into AMDB. The TEES cost is then calculated and used as the estimate against the Project in AMDB, which is then used in the R&R capex forecast. The Commission is assessing Transpower's application of the cost estimation process when establishing the expenditure forecast. We have, therefore, not undertaken this assessment.
Engineering	During on site discussions, Transpower engineers told us

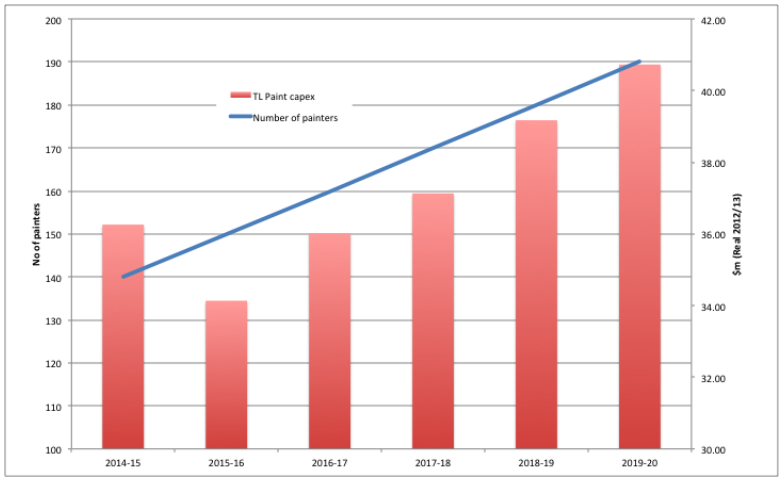
assessment

that they considered the AHI model to have a bias towards over estimation of tower painting requirements. However, the model had not been adjusted to correct this effect.

For the RCP2 forecast, the AHI model estimation bias can be considered to be irrelevant as the painting schedule is constrained by the number of available painters. This critically constrains the actual number of towers that can be painted. In December 2014, Transpower had access to 110 painters and has stated an intention to increase this number to 140 painters by 2015 and 190 by 2020.

Transpower's current capability to undertake the painting work is significantly below the forecast long-term requirements (780 towers per year)[35]. The RCP2 tower painting capex forecast is based on Transpower achieving an average of 530 towers per year. However, the capex forecast appears to assume a linear growth in painters over RCP2, see the chart below.

Figure 41 Tower painters and capex



Transpower recognises that failure to achieve the required increase in skilled painters would have a significant impact on future costs, as towers need to be replaced if they degrade beyond an established condition.

Accordingly, the engineering assessment produced a 'constrained' painting schedule.

Challenge Review

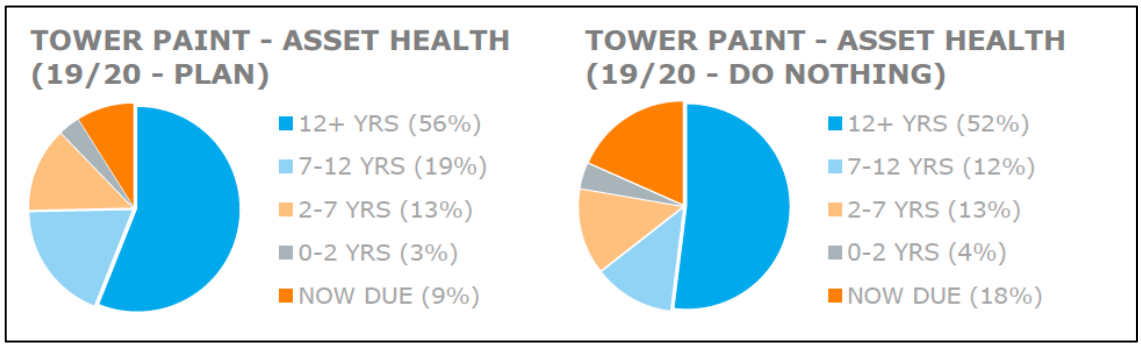
Transpower provided discussion on and evidence that the overall R&R capex forecast had been subjected to a challenge and approval review. This resulted in the application of the overall 7.5% productivity adjustment

[35] POD3 TL Paint

	applied to Grid and IST base capex. As discussed in Section 5.5 we have not seen any adjustment to reflect the potential for a proportion of the work to be deferred beyond RCP2 due to deliverability issues.
Sensitivity analysis	Transpower has discussed and provided documentation that sets out sensitivity to 'do nothing' and 'constrained' AHI modelled outcomes. Sensitivity assessments for a broader range of capex levels do not appear to have been undertaken.
Capex aligned with AHI	As a minimum, we would have expected to see revised AHI model outputs based on the final MP01 R&R capex forecast. We have requested this information for tower painting and Transpower has yet to provide it.

365 In FS01 Asset Fleet Strategy - Towers and Poles, Transpower provides the asset health profile for tower painting for the 'constrained' painting schedule and the 'do nothing' alternative. These are reproduced below.

Figure 42 Tower Paint asset health outcomes



366 The above charts indicate that, while some improvement will be seen, the proposed tower painting capex will be insufficient to clear the backlog of now due towers by 2020. Therefore the proposed programme will not deliver optimal asset lifecycle outcomes.

367 This position indicates that more capex than Transpower is forecasting should be applied to tower painting. However, the constraint due to availability of painters places constraints on the programme.

368 Taking into consideration Transpower's previous initiatives to secure increased painting resources, and taking into account the efforts and initiatives that Transpower is undertaking, we consider that the target of 190 painters is optimistic.

369 Our conclusion is that while it would be in the best interests of Transpower's customers and consumers for tower painting to be at least at the proposed levels, there is a reasonable probability that a deferral of some of the programme into RCP3 will occur. Accordingly, we consider that Transpower will be likely to spend less than it has forecast.

6.6 Power Transformers

6.6.1 Transpower's approach to forecasting ACS capex

370 Transpower describes its management of the components of ACS including the power transformer fleet in AM02 Asset Management Strategy, BR02 Asset Risk Strategy, AP01 Asset Management Plans, AM03 Lifecycle Planning Strategy, AM06 Lifecycle Strategy Maintenance and, for power transformers, the FS07 Fleet Strategy ACS Power Transformers.

371 As discussed in section 5 Transpower has provided clear, consistent statements in its documents and in discussions that it establishes the R&R expenditure forecast for ACS Power Transformers on the basis of asset lifecycle practices. In summary, based on this information, we would expect to see the development of the ACS Power Transformer forecast to have included the following:

(a) AHI established for all power transformer assets in an AHI Model;

(b) an assessment of the criticality for each transformer;

(c) an output schedule of transformer replacements based on AHI and criticality;

(d) cost estimates for the replacement schedule produced through TEEs;

(e) engineering assessment giving consideration to prioritisation, sequencing and deliverability of the schedule;

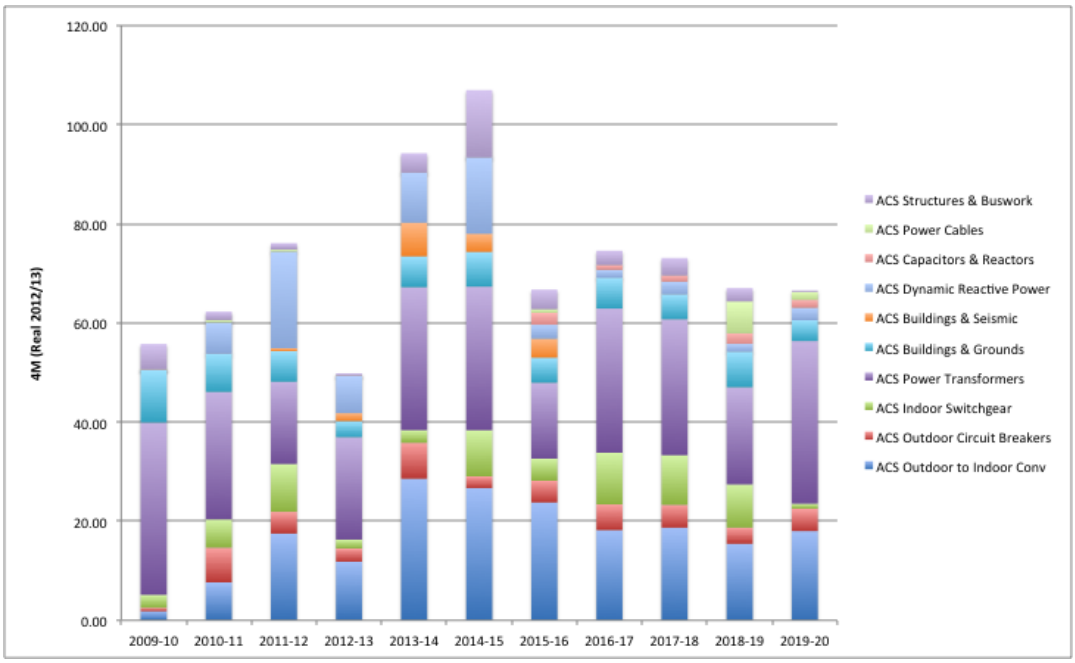
(f) the revised schedule being subject to review, challenge and approval with any changes or adjustments resulting in further revised schedules;

(g) revised AHI information being produced to inform Transpower decision makers of the sensitivity of the revisions to the various revisions and adjustments; and

(h) the resulting final revised schedule and expenditure forecasts being used as a component of the Regulatory Template RT01 RCP2 Forecast and Revenue and the associated AHI profiles being submitted with the RCP2 Proposal.

372 Power transformer capex of $106.2m accounts for 31.8% of the total ACS capex. The contribution to ACS capex by each asset fleet is shown in Figure 43.

Figure 43 AC Stations R&R capex

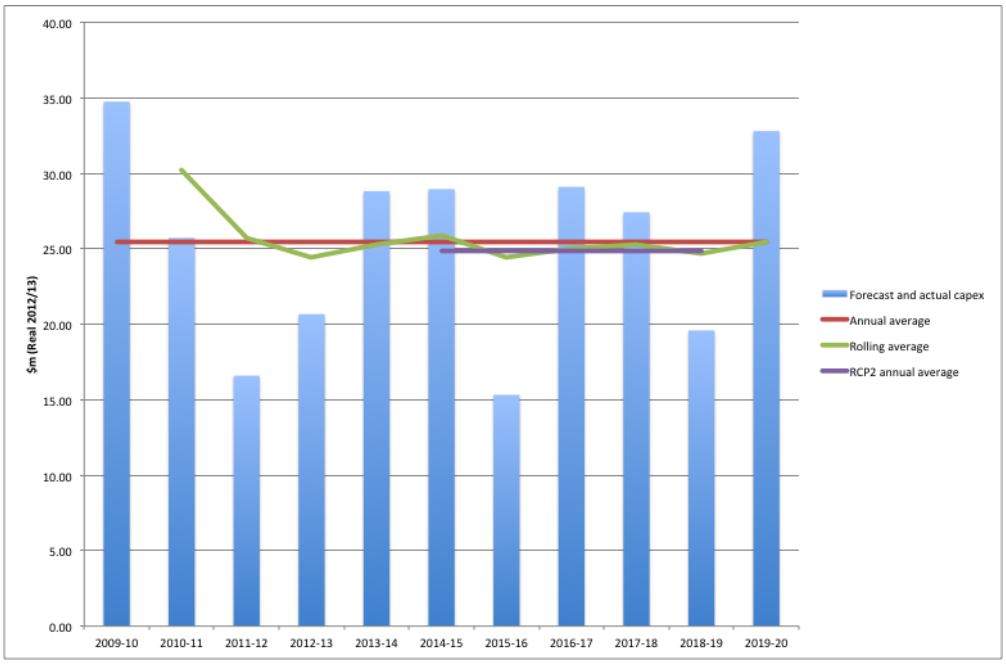


373 The major contributor to the peak in ACS R&R capex is due to the indoor/outdoor conversion programme that commenced in 2010 and continues through RCP2 and beyond.

6.6.2 Expenditure on power transformers

374 Forecast expenditure in RCP2 on R&R capex for the power transformer fleet is $106.2m. This contrasts with $120m for the preceding 5 years. Figure 44 provides a profile of actual and forecast capex.

Figure 44 RCP2 Power Transformer R&R capex ($m)

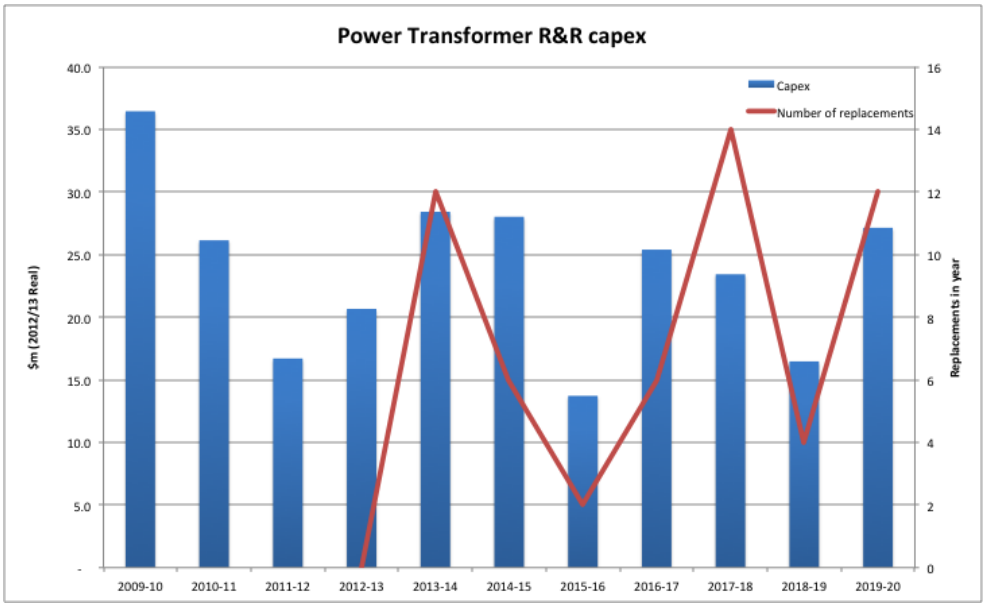


375 The average power transformer R&R capex for RCP2 is tracking slightly below the annual average for the eleven-year period and in line with the rolling average.

376 In the February 2014 reforecast, Transpower informs us that overall, AC stations is expected to be 4% below that given in the MP01 proposal and power transformer expenditure is expected to be 2% below. This is in addition to the 9.6% underspend that Transpower forecasts in MP01 for RCP1 AC stations R&R capex against the RCP1 allowance which has been largely attributed to fewer transformer replacements.

377 Figure 45 shows power transformer capex against the numbers of replacements that are proposed. The general alignment of the proposed replacement volumes and capex is apparent.

Figure 45 Power transformer capex and replacement volumes



6.6.3 Findings on power transformers

378 We have reviewed how Transpower applies asset lifecycle strategies when developing its expenditure forecasts and managing its power transformer asset fleet. In paragraph 371 we set out our expectations on the process steps that we expected Transpower to have worked through when developing the power transformer forecast capex. Our findings for each of these steps are provided in the table below.

AHI Model	Transpower has provided its AHI model for power transformers. The model is consistent with Transpower's documented asset lifecycle approach and asset management strategies. In reviewing the AHI model, we have found that it is likely to have a bias towards over estimation. This is because the remaining asset lives are adjusted by the sum of the asset health factors. For example, a transformer base life can be

reduced by 25 years (-10 for mechanically ganged tap changer plus -10 for poor internal condition plus -5 for poor external condition). In our view, it is more appropriate to use the maximum factor value instead of summing all factors because the factors are independent of each other.

Also, we have not seen evidence of cost benefit analysis needed to support the life reduction factors.

Criticality	The power transformer AHI model takes into account the criticality factors relating to each asset. This is consistent with Transpower's asset lifecycle documentation.
Cost estimation	We have confirmed that the AHI and criticality factors are combined and the result entered as a project into AMDB. The TEES cost is then calculated and used as the estimate against the Project in AMDB, which is then used in the R&R capex forecast.
Engineering assessment	Transpower has described and provided information on how engineering reviews are undertaken on the initial R&R schedule and cost estimation. We have been provided with documented evidence that the Advisory Team and the Capital Governance Team considered and reviewed the proposed power transformer capex. In its response Q041B, Transpower provided a summary of the reasons for additions to the AHI model outputs that were made by the subsequent reviews. We have reviewed the list of power transformers that have more than seven years remaining life and yet are being replaced in RCP2.[36] These replacements total $43.8m (41%) of the proposed power transformer R&R capex. Out of the above, we consider that three replacements totalling $13.8m are not supported by the justifications provided by Transpower. These replacements are: CPK T3 & T4 – This has a customer-driven E&D component, which suggests that this replacement is being brought forward as a load-driven upgrade. The total project should therefore be progressed on a customer contract basis (see comments in E&D section). HAY T11 & T12 - Transpower's preferred option is to replace both units in a single project to reduce expenditure and outages. This benefit has not been demonstrated and,

[36] The Commission has reviewed the Kinleith substation asset replacement component as Strata has previously provided advice to Carter Holt Harvey on related transmission issues.

given that each replacement is over $4m, the net benefit would need to be clearly demonstrated.

WEL T1 & T2 – Transpower intends to replace the WEL units as part of a single project to reduce the overall cost and the level of required outages. The benefit has not been demonstrated and given that the advancement of the replacement is over $3m, the net benefit would need to be clearly demonstrated.

We note that the reviews resulted in additions and not reductions to the AHI model schedules. It is not apparent that the reviews considered opportunities for deferment of any replacements in the AHI model schedule.

Challenge Review	Transpower provided discussion and evidence that the overall R&R capex forecast had been subjected to a challenge and approval review. This resulted in the application of the overall 7.5% productivity adjustment applied to Grid and IST base capex. As discussed in Section 5.5 we have not seen any adjustment to reflect the potential for a proportion of the work to be deferred beyond RCP2 due to deliverability issues.
Sensitivity analysis	Transpower has discussed and provided documentation that sets out sensitivity to 'do nothing' and 'as proposed' AHI modelled outcomes. Sensitivity assessments for a broader range of capex levels do not appear to have been undertaken.
Capex aligned with AHI	At a minimum, we would expect to see revised AHI model outputs based on the final MP01 R&R capex forecast. We have requested this information and Transpower has provided it for Power Transformers but not for other asset fleets. In its response to Q41A Transpower stated that: *We can confirm that assets identified for replacement during RCP2 in the Asset Management Models (MD01-MD11) have been subjected to subsequent review and challenge as part of the RCP2 challenge round process. In some instances this resulted in differences between the projects identified by the AHI model and those included in RT01 Base Capex.* We take from this, that the proposed expenditure would result in an alternative AHI profile for each asset fleet. The executive and Board, prior to approval and submission of

the MP01 proposal, appears not to have seen not seen this information. If correct, this reflects a serious process issue.

Notwithstanding this observation, for power transformers, we consider the difference between the initial and post adjustment AHI model outputs is not material.

379 In addition, we have assessed the impact of the proposed asset divestment programme. Figure 46 shows the resulting average remaining life for the power transformer fleet at the start and at the end of RCP2 with and without the proposed divestments.

Figure 46 Power transformer average remaining lives

380 Figure 46 shows that the proposed asset divestment programme has a relatively low impact on remaining life in 2019/20 under Transpower's proposed transformer replacement capex. The average remaining life will improve from 31 years to 38 years if the replacement and divestment programmes are completed as planned. However, if the divestment programme is not implemented, the average remaining life in 2019/20 will be 35 years.

381 The average expected life for the total transformer fleet in 2012/13 was 63.8 years and the average remaining asset life at this time was 31 years.[37] It can therefore be assumed that, on average, the transformer fleet is at mid-life at approximately 30 years. This average is consistent with average remaining lives we have seen adopted by other transmission companies and we consider this is reasonable.

[37] Transpower assigns a 60-year life to transformers manufactured before 1992 and a 70-year expected life to those manufactured after 1992.

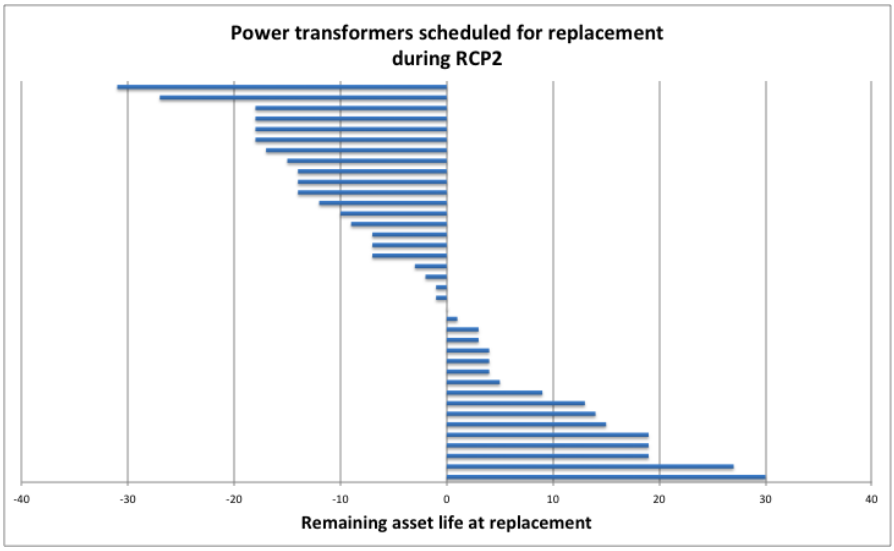
382 Assuming the asset health data reasonably represents the fleet's condition, the current state of the transformer fleet does not raise concerns. We would expect the transformer strategy to target maintenance of the current position.

383 However, the proposed replacement schedule and resulting capex forecast represents a significant improvement in the average remaining life of the power transformer fleet. The average remaining life of 38 years gives an average asset life of 26.2 years (63.8 minus 38 RL years). With no divestments, the average asset life would be 28.4 years.

384 This suggests that if the divestments proceed, there would be scope for deferring some replacements while retaining the current average asset life at a reasonable level. If the divestment programme is completely unsuccessful, scope for deferrals will be reduced but flexibility would remain.

385 This view is supported by the profile of transformers scheduled for replacement, shown in Figure 47.

Figure 47 AHI model scheduled power transformer replacement



386 The number of transformers currently scheduled for replacement in RCP2 based on asset health and criticality with several years remaining life suggests that there is scope for some deferrals.

387 The use of average life, average remaining life and asset health and criticality factors should not be relied upon as the sole indicator of the need for replacement. However, our assessment of each of these factors and our review of a number of individual replacements provides a reasonable indication that the proposed capex can be reduced.

388 Our analysis of the scope for deferral and our judgement suggests that the scope for deferral is in the order of 5 to 12% of the proposed power transformer R&R capex.

6.7 Outdoor to indoor conversions

6.7.1 Background

389 Transpower commenced a programme of 33 kV switchgear conversions in 2009 that aims to convert many existing outdoor 33 kV switchyards to indoor installations using modern indoor switchgear. The background and rationale for this strategy is described in the fleet strategy document FS04 ACS Outdoor 33 kV Switchyards Fleet Strategy Transpower.FS.01.01.

390 Switchyards are identified for conversion using a number of criteria, including the level of risk present, asset condition and whether the switchyard is a candidate for asset divestment. Transpower's analysis supports conversion of 28 of its 61 33 kV switchyards and Transpower has an objective to complete the remaining conversions by 2026.

391 33 kV switchyard conversions are significant projects involving customer agreement and coordination, new switchroom design and construction and often complex commissioning logistics. Each conversion project can take up to three years from start to finish and cost in the order of $5m.[38]

392 Transpower's planning includes location prioritisation, which seeks to replace higher risk switchyards earlier in the programme. The criteria used for prioritising includes structure type (which is a safety consideration), location criticality, number of circuit breakers and asset health ratings.

6.7.2 Progress

393 Transpower has completed nine conversions since 2009 and is currently progressing a further seven, which are at various stages of completion.

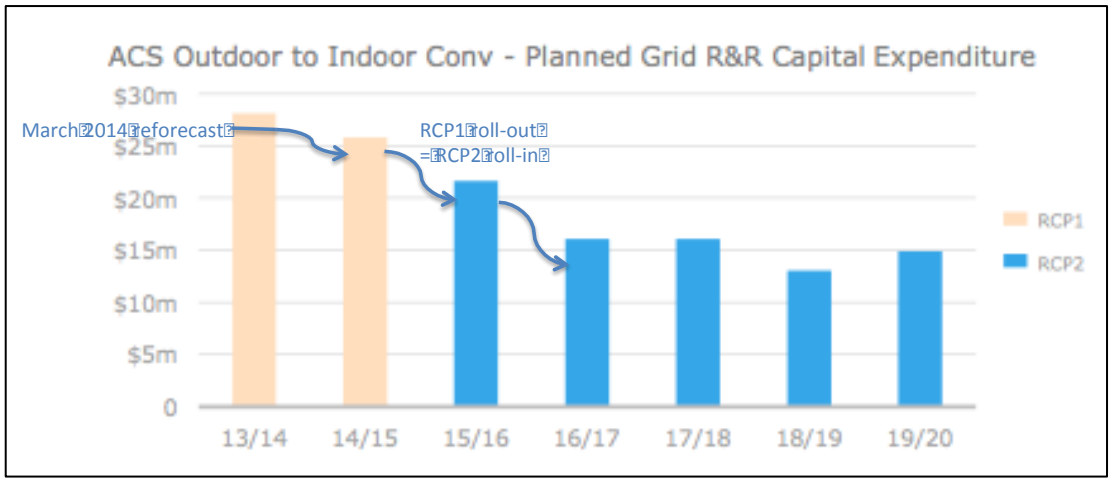
Deliverability

394 In response to Commission question Q021, Transpower provided a reforecast of current year expenditure. This shows that the 2013/14 forecast (included in the RCP2 proposal) of $28.2m has reduced to $26.6m, a decrease of 5.7%.

395 This decrease likely represents an under-delivery against plan (as opposed to a productivity gain by commissioning more conversions at lower than planned cost), which will have the effect of delaying planned expenditure into succeeding years, as shown in Figure 48.

[38] However, the largest conversions can cost considerably more than this – e.g. the estimate for Penrose is $15m.

Figure 48 Effect of delayed expenditure – Outdoor to indoor 33 kV switchgear conversions



Data source: Transpower AP01 and March 2014 reforecast (Q021)

396 This current under performance against plan, in conjunction with comments we have noted from the 33 kV Outdoor to Indoor Prioritisation model provided in support of planning and prioritisation of the conversion programme,[39] leads us to conclude that deliverability will be a key issue at least over the next few years of the programme.[40]

Cost estimation

397 Also evident from a review of the prioritisation model are some significant cost estimate increases in respect of current projects. For example, the Penrose conversion, included in RCP1 at a forecast $7.5m, is now shown as an estimated $15m. We sought comment on this from Transpower during the on-site sessions and were informed that the estimates in the prioritisation model should not be relied upon.

398 Nevertheless, it is evident that some of the earlier cost estimates were compiled using simple volumetric assessments and that more recent project-specific, design-based estimates have significantly increased many of the expected project costs, particularly those planned for the larger Auckland-based substations.

399 We are generally comfortable that project-specific, design-based estimates should reflect realistic expenditure forecasts.

[39] For example, in the Status field are comments such as *"Complex site, unlikely to achieve in RCP1 if we started now" and "On hold – Cable $$ and approach"*.

[40] A further compounding factor related to deliverability is that the near-term work programme for this portfolio includes most of the larger, more complex sites, many of which are located in Auckland and rated as high-criticality supply points.

6.7.3 Recommendations on Indoor Outdoor Conversions capex

400 While acknowledging an on-going concern relating to deliverability, we consider that the forecast of $81.9m for this portfolio is reasonable, subject to the global 7.5% productivity adjustment continuing to apply to the portfolio.

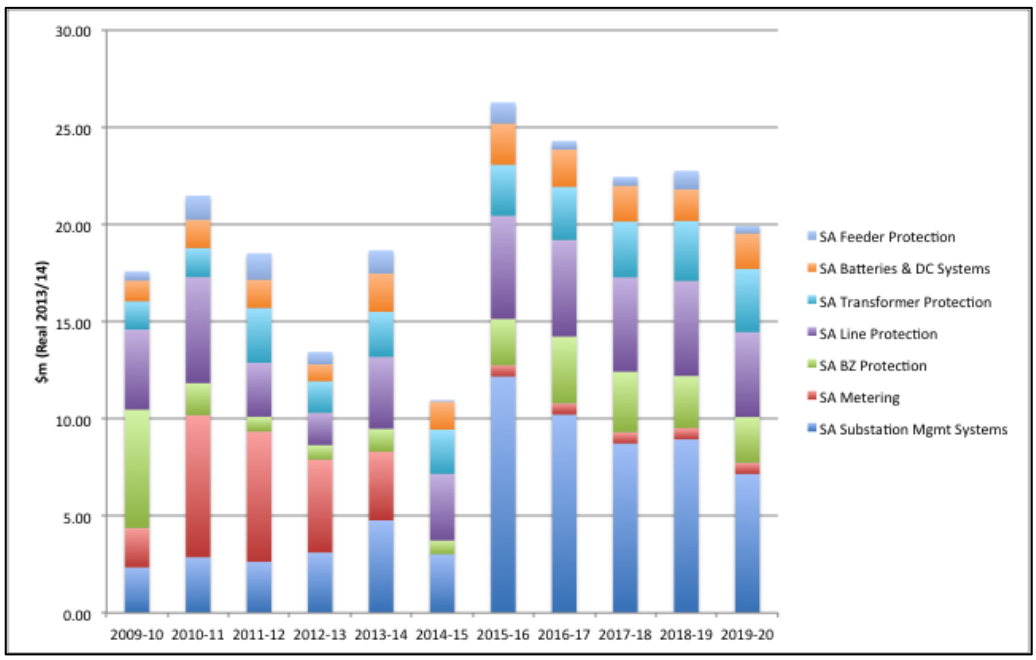
401 We anticipate that, short of a significant near-term direction of resources to the portfolio, some of the projects in this portfolio planned for completion in late RCP1, or early in RCP2, will roll further into RCP2 than currently planned. Unless delivery of projects is improved, this will likely have an on-going impact, potentially resulting in roll-outs from RCP2 to RCP3. This issue is further considered later in this section.

6.8 Secondary Assets - SMS

6.8.1 Expenditure on secondary assets

402 Forecast expenditure in RCP2 on secondary assets R&R capex is $115.7m. This compares with $83m for the preceding five years. Thus, Transpower is proposing a 39.4% increase in secondary assets expenditure for RCP2 above the level achieved and forecast in the preceding five years. Figure 49 provides a profile of the components of secondary assets capex and the relative changes between 2009 and 2020.

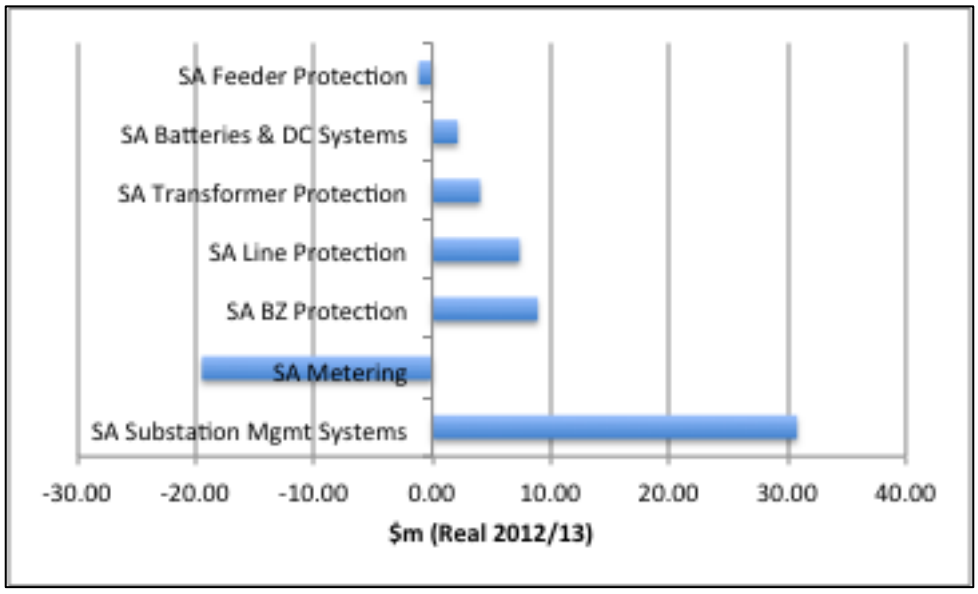
Figure 49 Secondary assets R&R capex



403 Figure 49 shows that investment in replacement metering was the dominant feature of RCP1 and that this programme has now finished. Replacement substation management systems (SMSs) are driving the significant step change in secondary assets capex in RCP2.

404 Figure 50 shows the differences between secondary assets components for RCP1 plus 2009/10 and RCP2.

Figure 50 Secondary assets changes RCP1 plus 209/10 and RCP2



6.8.2 Expenditure on SMSs

405 Forecast expenditure in RCP2 on SMSs R&R capex is $47.2m. This is an increase of $30.8m, representing a 188% increase in expenditure in this category above the preceding five years.

406 SMSs are telemetry systems that enable the remote control and monitoring of substations providing visibility and control of critical substation assets. The existing SMS relies on remote terminal units (RTUs) to gather and provide data and also remotely control some substation equipment. The number and age of RTUs is provided in the table below.

Table 8 Size and age of the RTU fleet

Type	Age	Units in Service	Comments
GE Harris D200	< 6 years	21	Current model
GE Harris D20VME	< 6 years	79	Current model
GE Harris D20ME	6 to 8 years	15	No Ethernet
GE Harris D20M++	8 to 12 years	78	No longer supported; no Ethernet; sometimes referred to as legacy units
Foxboro C50	> 11 years	111	Current model; sometimes referred to as a legacy unit
Total		**304**	

Source: Transpower FS12

407 Transpower has identified the need to replace the RTU fleet as being:

(a) significant diversity within the RTU fleet (note that there are five RTU models in the fleet);

(b) age of the RTU fleet;

(c) depleting spares and the difficulty securing replacements;

(d) RTU failures (safety, control and reliability issues);

(e) increased loading on RTUs; and

(f) the reliability of RTUs is forecast to decline.

408 Transpower considers that replacement of the RTUs with a state-of-the-art SMS will deliver a transmission grid with advanced operating capabilities and enhanced communications and data management functions at substations. To achieve these outcomes, Transpower has set the following strategic direction:

> *to continue the progressive deployment of SMS as replacements for the existing RTUs, with a staged approach to be completed by 2025.*[41]

409 Transpower is prioritising sites for replacement based on condition and functional capability of the existing RTU and the specific benefits at the site that can be obtained through an SMS.[42]

410 During RCP2, Transpower plans to replace RTUs with a new SMS at 70 sites.

6.8.3 Findings on secondary assets

411 We accept Transpower's assessment of the need for the RTU fleet to be replaced by at least modern equivalent equipment. However, Transpower's proposed expenditure provides for a rapid installation and full deployment of a state-of-the-art SMS with considerably greater features than simple replacement with modern equivalent RTUs.

412 Transpower prefers the SMS option because:

(a) it is being increasingly used by electricity transmission utilities internationally; and

(b) its capacity, ease of use and standardised connectivity provides many benefits.

413 Transpower has identified the key benefits as improved reliability, lower maintenance costs and increased capacity.

414 We are comfortable that Transpower should be replacing old RTU technology but our assessment has raised questions over the significant

[41] FS12
[42] FS12

step change that occurs at the start of the RCP2 reset and the robustness of the business case that has been presented for the proposed capex.

How Transpower reached the step change decision

415 Transpower states that it will complete a staged replacement of RTUs with modern SMS by 2025. In reaching this decision Transpower has considered two options:

(a) **Option 1** Replacement with modern equivalent units in line with the current approach where RTUs that are no longer supported by their manufacturers are replaced with modern equivalent units.

(b) **Option 2** Staged approach involving conversion, prioritised by condition, obsolescence, criticality and *other factors that affect the level of benefits.*

416 Transpower undertook a cost benefit analysis of both options and concluded that:

> *… in light of the closeness of the NPV of the options, and in consideration of the expected unquantified benefits that SMS will deliver, option 2 'SMS rollout' is preferred over option 1 'RTU replacement'.*

417 Transpower's quantitative analysis of the options is reproduced in the table below.

Table 9 RTU replacement / SMS rollout options analysis

Option	Description	Net Present Capital Costs ($m) [A]	Net Present Benefits ($m) [B]	Net Present Value ($m) [B] – [A]	Relative to Reference Case ($m)
Option 1	RTU replacement	44.5	5.2	-39.3	0.0
Option 2	SMS rollout	58.3	14.2	-44.1	-4.8

418 On the basis of unquantified benefits, Transpower is proposing to implement a substantial $58.3m conversion of its RTU fleet over the next two RCPs. This is a major strategic investment that will significantly change the way in which substations are monitored and managed.

419 The extent of this change is demonstrated in the following charts that represent the change in RTU/SMS component population over RCP2 and RCP3.

Figure 51 RTU/SMS population charts

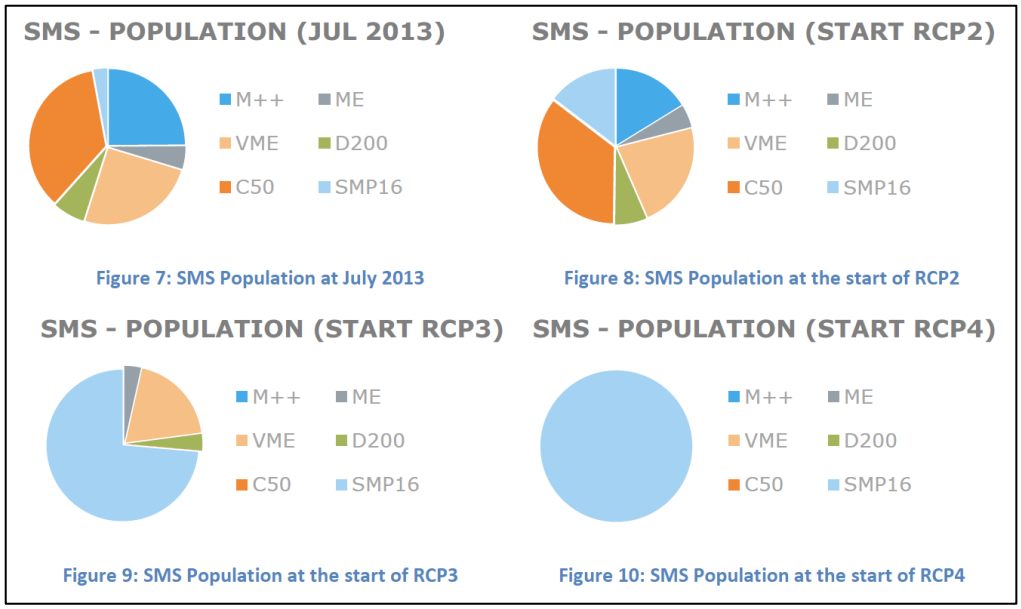


Figure 7: SMS Population at July 2013

Figure 8: SMS Population at the start of RCP2

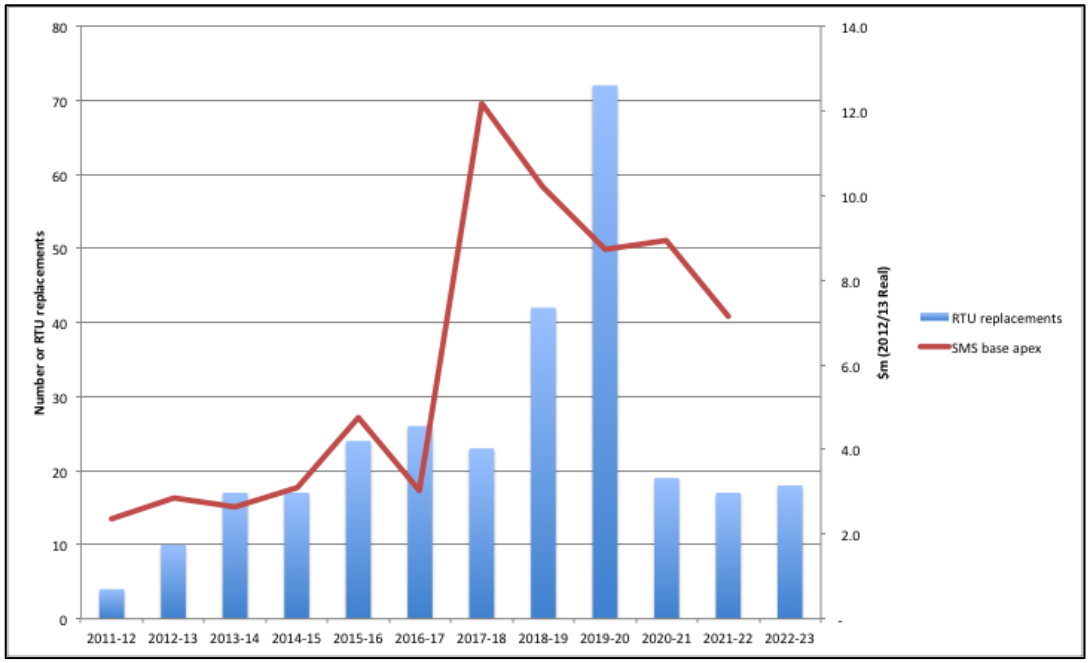
Figure 9: SMS Population at the start of RCP3

Figure 10: SMS Population at the start of RCP4

Source: Transpower - FS12 SA Substation management (Telemetry systems) fleet strategy

420 The above charts highlight the rapid conversion during RCP2. The speed of the proposed conversion programme can also be seen in the proposed SMS capex profile for RCP2.

Figure 52 SMS rollout proposed capex



Our assessment of Transpower's SMS business case

421 As we stated earlier in this section, we agree that the RTU asset fleet is in need of replacement. Further, we agree with Transpower that a 'do nothing' option is not credible due to the safety and reliability risks that this option would create. We agree with Transpower that the two options identified are appropriate.

422 Notwithstanding this, we have three concerns with the business case and Transpower's decision to proceed with the rapid SMS option rollout . These are:

(a) the accuracy of the cost estimate;

(b) the reliance on unquantified benefits; and

(c) the speed of the rollout.

423 Each concern is discussed in the following paragraphs.

424 Strata's review team has experience with SMS systems and we have also discussed the cost estimates with the Commission's technical staff. All have expressed the view that the $58m cost estimate is highly likely to increase, possibly by a substantial amount if Transpower is to realise the full benefits claimed.

425 It may be possible to rollout a basic SMS for the proposed expenditure but to achieve the unquantified benefits claimed, Transpower would require further substantial investment in additional system capabilities. These features are normally packaged as 'add-ons' to the basic system. The colloquial term used for this effect is 'feeding the monster'.

426 Accordingly, we consider that the costs of the SMS rollout may be significantly understated relative to Transpower's expectation of the benefits that will be delivered.

427 The reliance on unquantified benefits is problematic for such a substantial technical investment. In the SMS fleet strategy, Transpower lists the expected benefits as including:

- *Remote Engineering Access*
- *Better asset condition information*
- *Reduction in telemetry installation and configuration costs*
- *IEC 61850 intra-substation communications, and centralised configuration management*
- *Reduced maintenance costs*
- *Reduced SCADA system loading*

428 We consider that most or all of the listed benefits can be quantified to support the SMS rollout. At a minimum, an attempt should be made to make these factors transparent within the decision making process. Other potential benefits such as smart grid support, asset health data, self-healing network technologies etc. should also be capable of being quantified to some degree.

6.8.4 Recommendations on SMS capex

429 We consider that the business case presented is inadequate to support the proposed SMS rollout investment.

430 As shown in Figure 53 (the blue line), the SMS rollout is rapid. Given that a third of the RTUs are current models less than six years old and that spares for older models may be released as units are replaced, we consider that a SMS slowed rollout option should be considered.

431 Rather than rejecting the proposed SMS capex completely, we recommend that the expenditure profile is adjusted to reflect a slower rollout. This will allow Transpower to:

(a) undertake a critical review of the cost estimates;

(b) quantify the benefits that the comprehensively costed system will deliver; and

(c) rework the business case options assessment.

432 Figure 53 and Table 10 show our recommended SMS capex profile.

Figure 53 Revised SMS rollout capex

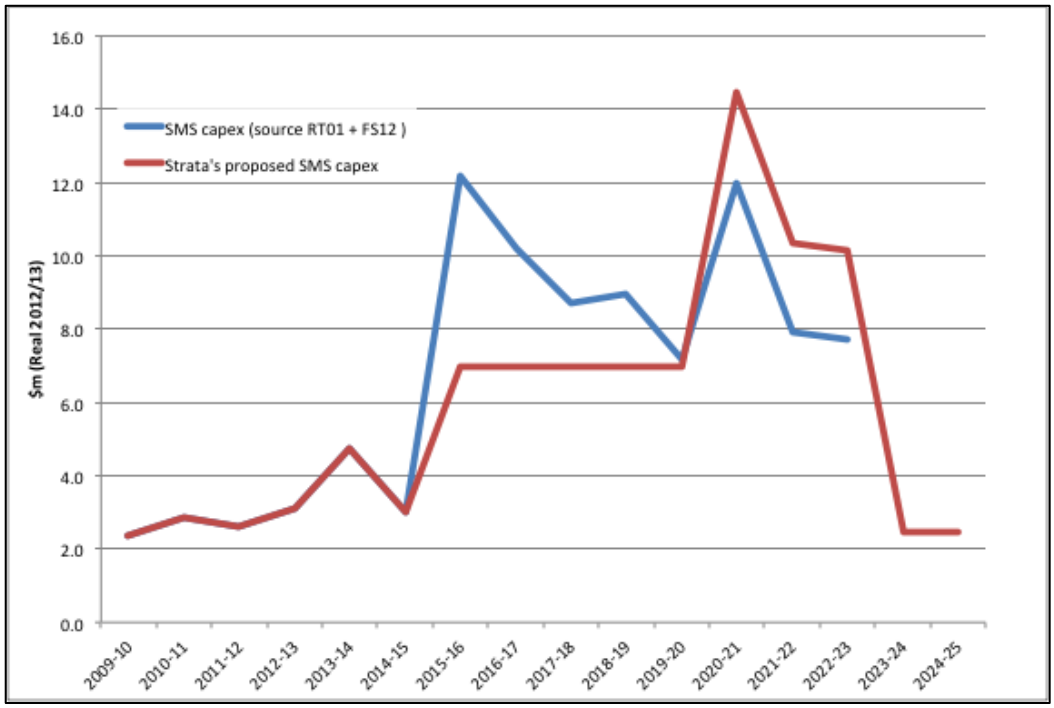


Table 10 Revised SMS rollout capex

RCP2 Expenditure including interest during construction $m (Real 2012/13 prices)					
	2015-16	**2016-17**	**2017-18**	**2018-19**	**2019-20**
SMS capex (source RT01 + FS12)	$12.2	$10.2	$8.7	$8.9	$7.2
Strata's proposed SMS capex	$7.0	$7.0	$7.0	$7.0	$7.0
Reduction	$5.2	$3.2	$1.7	$1.9	$0.2

433 The application of our recommendation of a slower SMS rollout results in a $12m decrease in AC Stations capex for RCP2.

6.9 Summary of findings on grid R&R base capex

434 We have found that Transpower's RCP1 performance against forecast cannot be relied upon as a guide on the probable suitability and accuracy of the RCP2 forecasts.

435 While there are several reasons why this may have occurred, the level of variation seen in RCP1 (actual vs planned) does not provide confidence that the proposed RCP2 forecast reflects what Transpower will actually deliver in RCP2.

436 Accordingly, we have placed greater reliance on a deeper assessment of the basis on which the RCP2 forecasts were developed.

437 As discussed in section 5, we have found that Transpower's asset lifecycle methodology, if applied in practice, should produce forecast expenditures that reflect what is needed to be spent on the replacement and refurbishment of transmission assets and meet the evaluation criteria.

438 Drawing on our review of the asset management documentation, data and models and from the individual fleet reviews, we have identified three areas of concern with Transpower's application of the methodology:

(a) potential bias in the AHI models towards over estimation;

(b) the engineering review is biased towards over estimation; and

(c) the probable roll-out of some asset replacements into RCP3 and the resulting non-delivery of the output asset health profiles.

439 Reviews of AHI models have indicated a likelihood of roll-outs (i.e. non-completion within the RCP) of projects from RCP2 to RCP3 due to reasons other than productivity gains. The indication from the asset fleet reviews is that this level is likely to be in the order of 5 – 10%.

440 The inclusion of a challenge process when setting the expenditure forecasts is a significant improvement and we acknowledge the work that Transpower has undertaken in this area. The information made available by Transpower provides clear evidence that the various challenge stages have resulted in material changes as the forecasts have matured.

441 Transpower's Board acknowledged the inherent bias towards over-estimating in bottom-up forecasts and considered that an adjustment for this should be made. The 7.5% productivity adjustment applied by Transpower accounts for expectations that the proposed programmes would be delivered for less cost. This is quite different to the cost estimation bias and deliverability issue noted by the Board.

442 It could be concluded that the management proposed a 7.5% adjustment for productivity gains, and the Board determined that a 7.5% adjustment for estimation bias and deliverability should be applied. However, based on our assessment of the desired health of the network at the end of RCP2, we recommend that the lower bound adjustment of 5% be used to take account of cost estimation bias and project rollouts.

443 In the secondary assets category, we have found that the significant step change for investment in SMSs is not adequately justified in the business case provided by Transpower. We consider that implementation of a new SMS should be changed to allow a review of the business case and further quantification of the costs and benefits.

6.9.1 Recommendations on R&R grid base capex

444 On R&R Transmission Lines and AC Stations, an adjustment of -5% is made to take account of over estimation bias and the probability of project roll-outs from RCP2 to RCP3.

445 On R&R Secondary Assets, an adjustment of -$12.2m is made to account for the recommended reassessment of the substation management system replacement system in the Secondary Assets category. This will result in an adjustment of -$46.4m to base capex and would be applied prior to the application of the -7.5% productivity adjustment.

446 It should be noted that, given the right conditions, the Commission could consider a proposal from Transpower of an asset health index performance measure that could be used as an alternative to the -5% roll-out adjustment for R&R Transmission Lines and AC Stations. It is expected that such a measure would also provide an improved link between expenditure and service performance. More discussion on this option is provided in section 9.

7 IST capex

7.1 Introduction

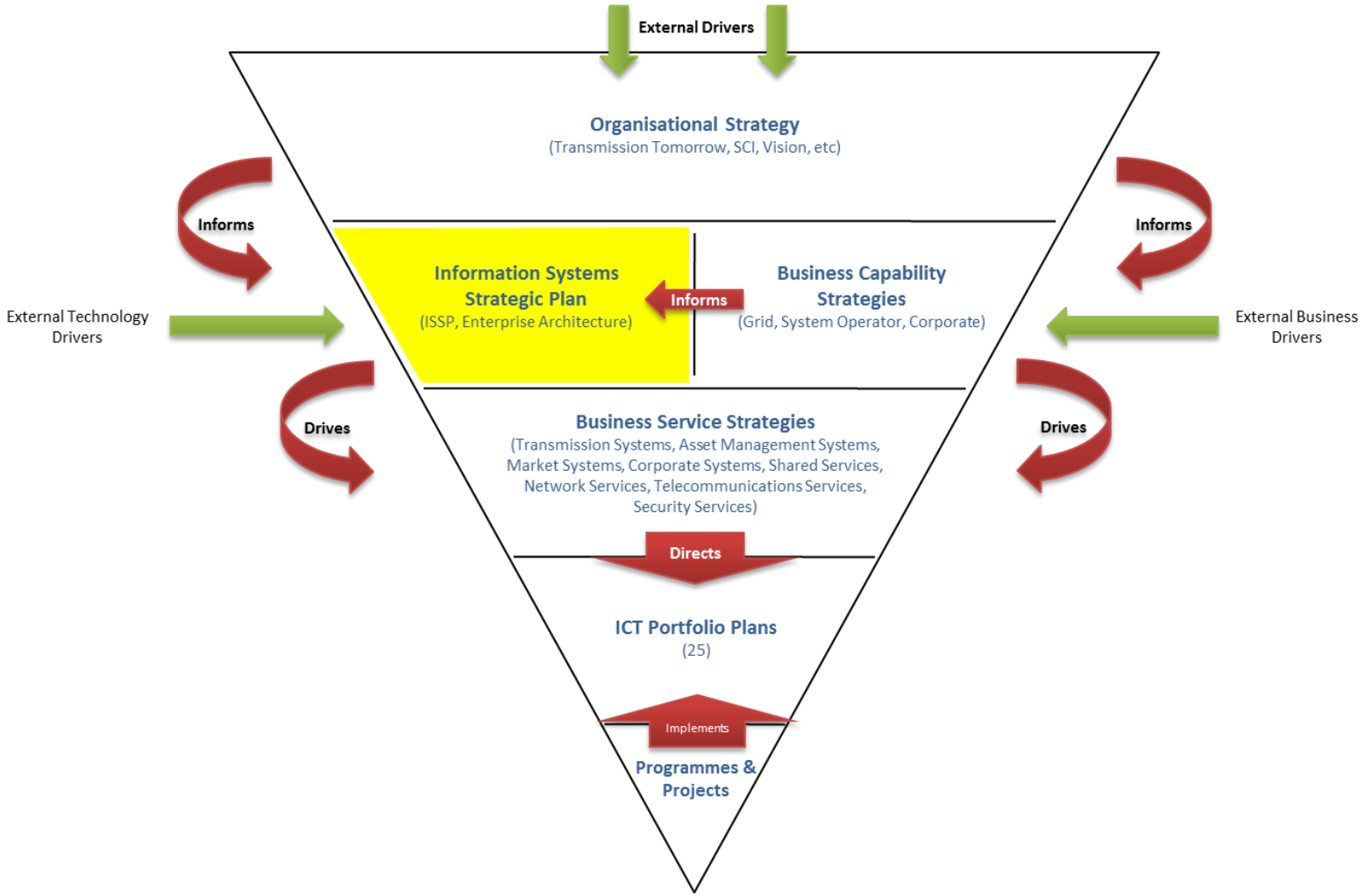
447 In this section we examine Transpower's historic and proposed IST expenditure to confirm that Transpower is proposing efficient costs for achieving prudent IST capex and opex objectives.

448 Note that Transpower uses IT, IST and ICT in various parts of the proposal. In this report we have used Information Systems Technology (IST) to cover the range of the proposed information technology expenditure.

7.2 IST Objectives and Strategy

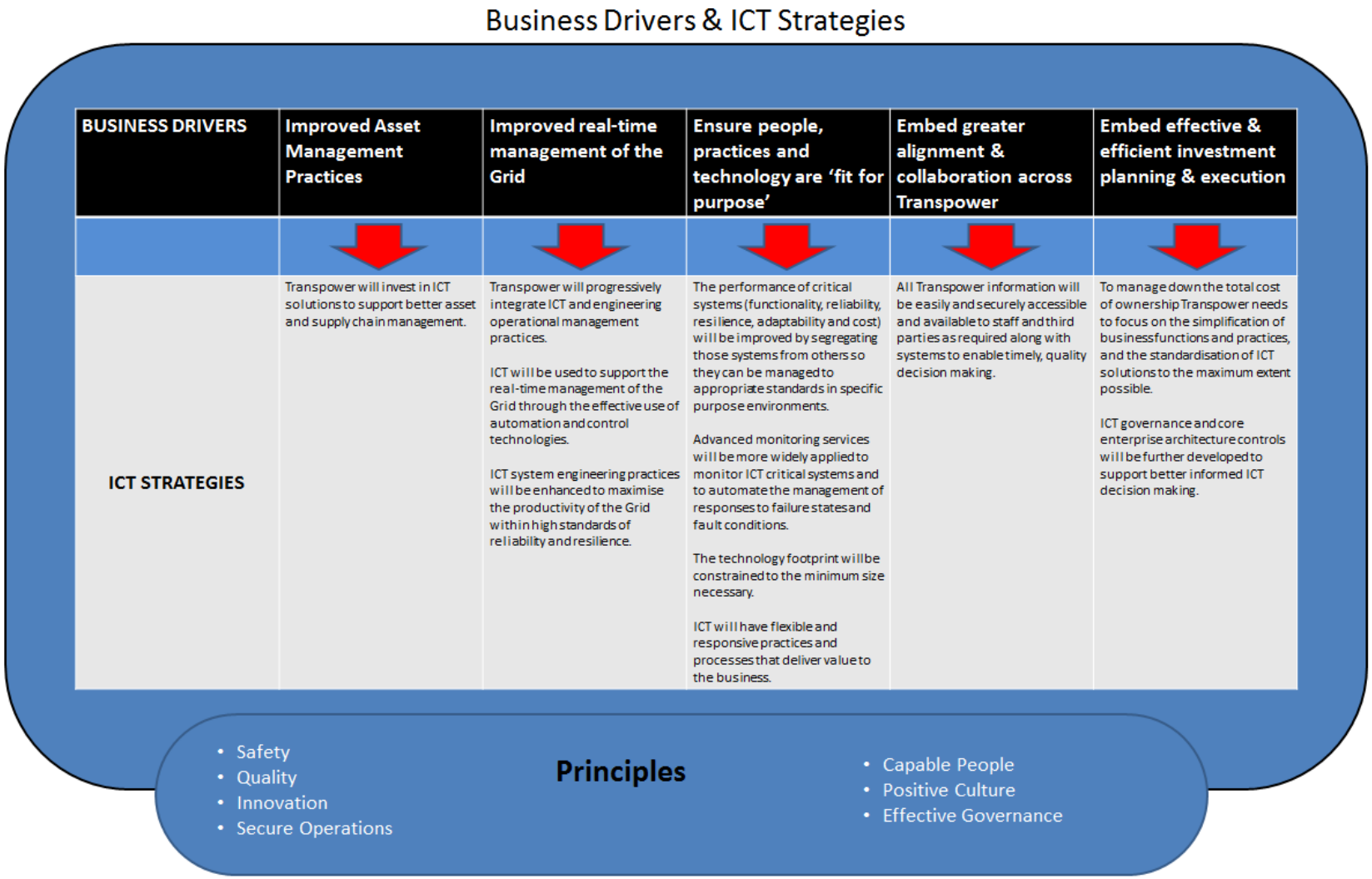
449 Transpower's Information Services Strategic Plan 2013 (ISSP) identifies the linkages between the organisational strategy, the business' capability, external business drivers and external technology drivers (Figure 54).

Figure 54 Transpower's IST Framework



Source: Transpower, Information Services Strategic Plan 2013, p4

Figure 55 Business drivers and IST strategies



Source: Transpower, Information Services Strategic Plan 2013, p9

450 The rationale for each IST strategy is explained in the ISSP, as are the objectives of each strategy. Transpower's IST objectives are linked to feedback from its customers and from the Commission (and other key stakeholders) in addition to current and emerging technical challenges.[43]

451 Transpower's strategies for IST investment can be summarised as supporting better decision-making and better operational execution by integrating IST and engineering practices and leveraging IST systems.

452 IST investment in RCP1 was characterised by major investments in system replacements and also by taking the opportunity to build capability (e.g. MAXIMO and TransGO), with several projects dominating expenditure, as discussed in more detail below. This IST expenditure path is similar to many electricity utilities in Australia, where:

(a) bespoke IST systems are being replaced by COTS products to reduce costs, to increase functionality, and to reduce long-term technical support risks;

(b) in moving to supported vendor-based critical platforms and systems, utilities accept the tie to the product upgrade and support cycles of the chosen platform/system suppliers to reduce performance risk;

(c) existing business processes are being changed to allow COTS products and services to be integrated into the business at least cost;

(d) IST systems are being designed to support better decision making (strategic and operational);

(e) incentives to deliver highly reliable and secure power supply in turn require highly secure and reliable IST performance;

(f) security of critical IST systems is rising in importance; and

(g) the expectation of owners/shareholders and the Board is that there will be significant tangible benefits from IST investment, in addition to multiple intangible benefits.

453 Transpower advocates the need for highly performing[44] critical systems to support grid operation and performance.[45] What is lacking is a concise set of measurable objectives by which the success of the ISS Plan can be measured. This makes it difficult to understand and track the specific benefit.

[43] Sources of feedback per Transmission Tomorrow, p01
[44] With respect to functionality, reliability, resilience, adaptability and cost
[45] IST BSS 2015-20 Overview, section 3, p7

7.2.1 IST capex

454 In this section we test whether Transpower's IST capex expenditure is aligned with the corporate objectives and whether the expenditure is prudent and efficient.

455 Transpower's significant investment in IST capability in RCP1 has led to RCP2 IST capex being characterised as:

> *… moving from a period of major investment in new capability to one of maintaining capability established by past investment.*[46]

456 This gives rise to expectations of:

(a) reduced capex expenditure in RCP2;

(b) stringent benefits analysis and objectives from RCP2 IST capex on building new capability;

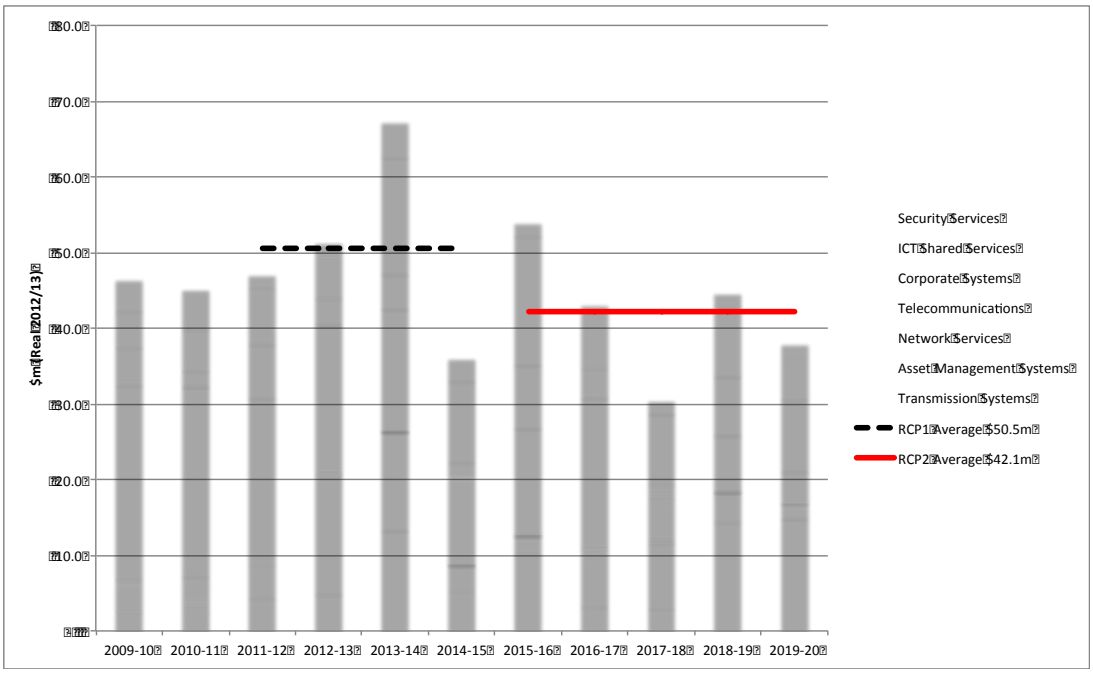
(c) careful consideration of capex/opex trade-offs; and

(d) demonstrated realisation of tangible and intangible benefits flowing from RCP1 expenditure.

457 Figure 56 shows the RCP2 forecast vs historic IST capex. At $42.1m, the annual average capex in RCP2 is reduced from RCP1 ($50.5m) by 16.6%, with investment in maintaining capability of 75% ($158m) of total expenditure and in upgrading capability at 25% of $52.7m. Transpower overspent its IST capex allocation in RCP1 by just $2m (1%), however, as discussed below, there were significant cost variances at the portfolio and project level.

[46] Transpower RP, section 3.1, p87

Figure 56 IST capex- RCP2 forecast vs historic (real 2012/13 $m)



Source: RCP2 forecast and revenue workbook.xlsx

458 The categories of expenditure in RCP1 and RCP2 are shown in Table 11. As identified by Transpower, it is clear that the emphasis is moving from providing new engineering systems to Shared Services (replacing core IT infrastructure) and Corporate Systems (replacing the financial management system).

Table 11 Categories of IST Capex Expenditure – RCP1 and RCP2

Category	RCP1 11/12 – 14/15 ($m, 2012/13)	RCP2 15/16 – 19/20 ($m, 2012/13)
Transmission systems	28.6	46.3
Asset management systems[47]	36.6	23.6
Corporate systems	17.3	31.6
IST shared services	39.5	49.1
Telecommunications and network[48]	69.7	52.9
Security	10.6	7.3
Total	**202.2**	**210.7**

Source: Transpower RT01 - RCP2 Forecasts and Revenue.xlsx

459 At a portfolio level, there is evidence that Transpower's RCP2 governance process has resulted in a lower proposed IST capex expenditure than was originally proposed on a 'bottom-up' basis:

(a) in September 2013, the proposed IST capex was $253m, an average of $50m p.a.;[49]

(b) a top down productivity adjustment of 7.5% to the nominal IST forecast; and

(c) in November 2013, following further challenge rounds, the proposed IST capex was set at $205m, at an average of $41m pa, noting that the final landing was slightly higher at $210.7m.[50]

460 The largest source of the reduction in proposed expenditure was achieved by bringing the establishment of the second data centre into RCP1 (reducing RCP2 expenditure by $31.5m).

461 Interestingly, the governance review incorporated analysis by independent consultants (Butler & Lewis), which supported Transpower's proposed IST

[47] In RCP1 it includes $5.5m in the outage management category
[48] This is the RCP1 category
[49] Board paper, *RCP2 Proposal: Grid opex, corporate opex and IST capex and opex, 12* September 2013
[50] IST BSS 2015-20 Overview

capex at an even higher level of $260m, based on a simple prudency review.[51] This raises questions as to the rigour of the review.

462 Nonetheless, the Butler & Lewis review is worthy of further examination. The key findings, quoted here form the report, were that:

(a) the IST capital stock which exists to support the 'smooth running of the transmission grid capital stock and the end users' has largely mirrored the increase in the net book value of Transpower's capital base, which is reasonable;[52]

(b) programmed refresh of existing platforms and applications comprises 75% of proposed RCP1 IST capex, compared to 25% on 'new' projects, with the expenditure dominated by a small number of high value projects, with a 'long tail' of minor projects;[53]

(c) the maintenance projects follow a conservative strategy of reducing overall costs and staying within vendor support agreements, which is appropriate as Transpower operates an essential 'nation asset' and to reduce over cost;[54] and

(d) there may be some opportunity to defer projects in the latter part of RCP2 into RCP3, but there is the risk that this will result in underinvestment that compromises RCP3 or that Transpower's delivery capability would be exceeded in RCP3.[55]

463 Butler & Lewis also found that Transpower's IST Strategic Plan for RCP2 is:

> *… well documented with clear linkages drawn from business requirements through to individual IST portfolio plans.*[56]

IST Technology Refresh Policy

464 Butler & Lewis deemed the Technology Refresh Policy[57] as 'appropriate'. It is a particularly important document as it underpins over $150m of IST capex in RCP2. Transpower advises that it:

> *… has been informed by reviewing industry accepted standards and ensuring lifecycle management achieves the lowest economic cost through the life of the asset.*

465 Our examination of the principles underpinning this policy leads to our conclusion that it is conservative, but provided that the analysis underpinning the various asset classes is, in each case, based on

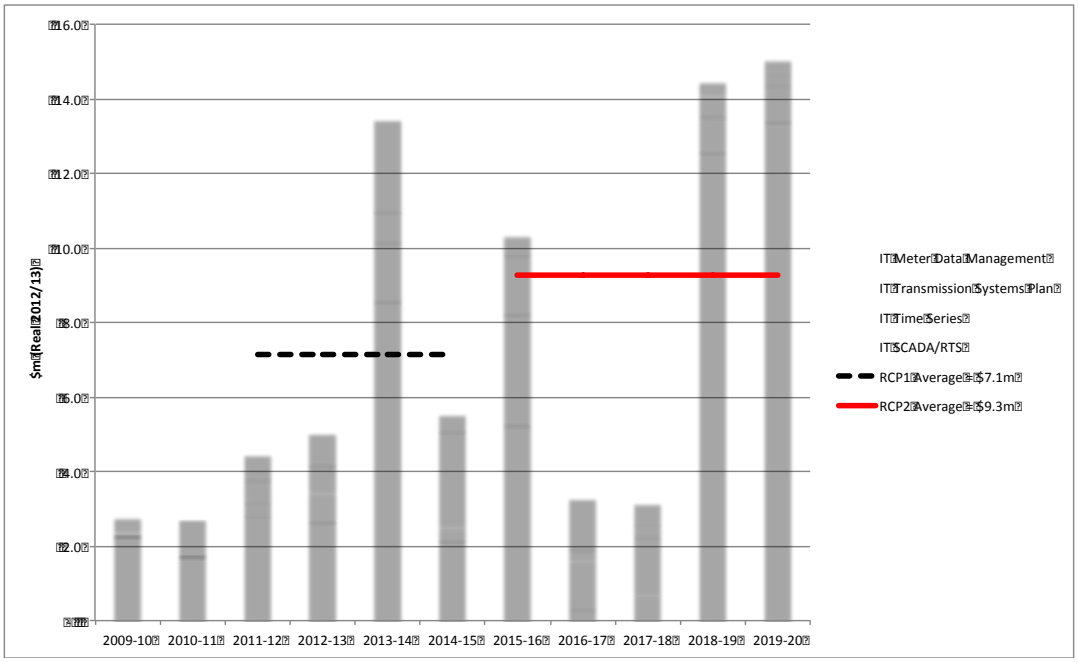
[51] R Lewis and M Butler, *Independent Review of RPC2 IST Expenditure for Transpower*, October 2013, p2
[52] *Ibid,* p6
[53] *Ibid,* p7
[54] *Ibid,* p2, 3
[55] *Ibid,* p7
[56] *Ibid,* p2
[57] Transpower, Technology Refresh Policy, February 2011

achieving the lowest economic cost (while maintaining acceptable functionality), then it is appropriate.

IST Transmission System capex

466 Figure 57 shows the historical and forecast capex in the transmission systems category. It shows the increased average annual expenditure between RCP1 and RCP2. The emphasis (60%) in RCP2 is on maintaining capability, with the replacement of the SCADA ($32.4m) and Real-Time Systems ($7.8m) being the largest proposed portfolios.

Figure 57 IT Transmission systems capex ($m, real 2012/13)



467 Most of the IT SCADA/RTS capex proposed for RCP2 is to renew existing systems and IT infrastructure to ensure that it is supported by vendors (to avoid the higher lifecycle costs of running obsolete, out of support IT equipment and systems). The refresh/upgrade timing is driven largely by the vendor product lifecycle of 5 to 7 years. Some of this work was deferred from RCP1.[58]

468 In RCP1, the average annual capex for the Time Series portfolio was $0.8 m. This increases to an annual average cost of $1.6 m for RCP2. This is driven by the lifecycle refresh on the Pi Historian system, to improve the resilience of operationally critical systems that feed data to Pi, and to ensure that storage and communications links meet the data volume and throughput requirements of time series data.[59]

469 As the two largest projects are predominantly maintaining existing capability and are based on compelling arguments, major productivity gains are not expected. However, 40% of the category expenditure ($18.5M) is

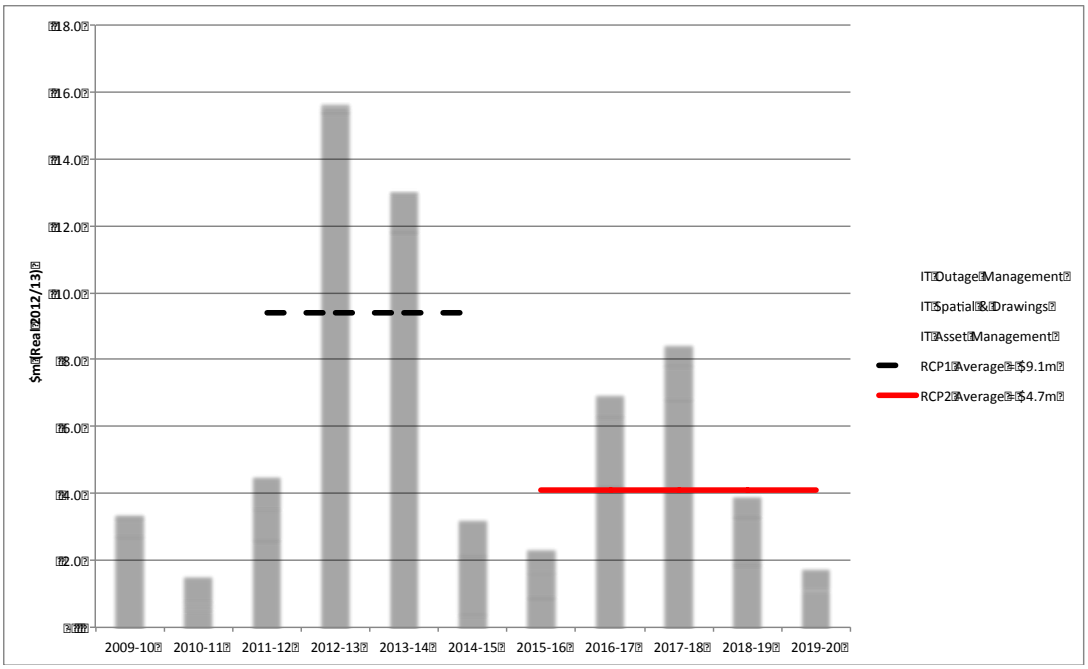
[58] Transpower Expenditure Proposal, *Section 4.3,* p28
[59] IP02 – IT Portfolio Plan - IT Time series

directed at upgrading capability, but there is no evidence of tangible benefits being ascribed to this investment or that it is being driven by a regulatory obligation.

ICT Asset Management Systems capex

470 Figure 58 shows the historic and forecast expenditure on asset management systems, with the forecast RCP2 expenditure of $4.7M pa is 48% less than in RCP1. However, over 70% of Asset management systems capex of $23.6M is allocated to building capability in RCP2[60]. The investment includes nine projects to enhance job and workforce planning and a lifecycle upgrade to the AMIS[61].

Figure 58 IT asset management systems capex ($m, real 2012/13)



471 The enhancements are designed to build on the RCP1 investment in MAXIMO:

(a) It leverages the investment in MAXIMO, which was part of the phased approach Transpower has to 'turning on' MAXIMO's capability. This should enable the release of significant benefits in operational efficiency. This approach is typically used to progressively release the functionality and therefore the benefits of the initial capex investment in major system replacements/upgrades.

[60] IP05 IT Portfolio Plan – IT Asset management systems
[61] Asset Management Information System

(b) ACML's assessment of Transpower's asset management maturity[62] recognises that Transpower needs to continue to develop its asset management systems and to apply the knowledge to better investment decision-making.

472 In its business case for MAXIMO, Transpower estimated annual net benefits of $9.3m,[63] but IP05 is vague about the additional benefits that may be ascribed to the RCP2 work. While we are generally supportive of the strategy of leveraging the investment from RCP1, there are two provisos:

(a) As $16.5m is directed towards building new capability, the tangible savings of the investment should be identified.

(b) The timing of the projects should maximise the realisation of benefits. A potential concern is that the business may not be able to absorb so much systems change while 'managing the business'. In this case, capability-building investments should be deferred to allow productive business-as-usual (BAU) operation as the transition is made to productive use of the new capability. The high-level analysis by Butler & Lewis confirmed that there is limited scope for prudent deferral of significant expenditure into RCP3 and provides a degree of confidence that Transpower has considered this aspect adequately.

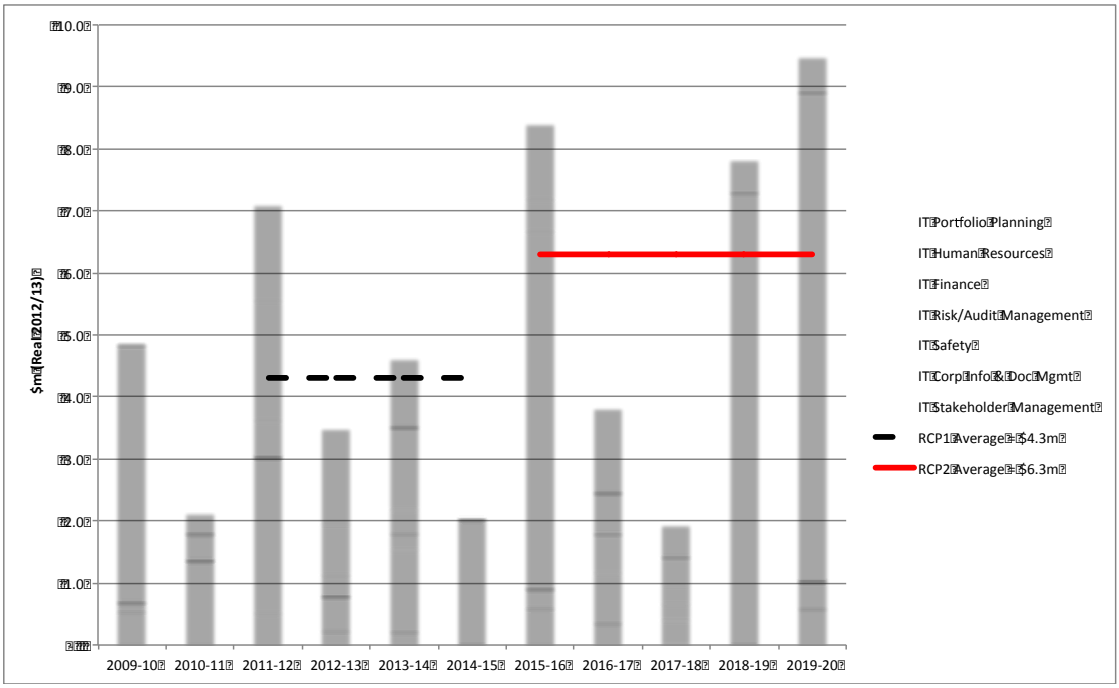
IST Corporate Systems capex

473 There are seven expenditure portfolios in this category, with the dominant projects being finance ($22.1m, 67%), $15.1m for implementation of transmission pricing methodology (TPM) and upgrading and replacing finance and supply chain tools ($7.0m).

474 Overall expenditure from RCP1 to RCP2 is increasing, from an average annual expenditure of $4.3m to $6.3m (+42%). Transpower identifies 82% ($25.9m) of the RCP2 capex being directed to maintaining capability.

[62] ACML Pty Ltd, *PAS 55 Gap Analysis Assessment Report,* 2013, p43-46
[63] Transpower, *Core Asset Management Information System, Business Case v2.0,* 7 June 2012, p36

Figure 59 IT corporate systems capex ($m, real 2012/13)



475 A major revision of the TPM is planned for 2018 and 2019, with Transpower identifying that a delay would leave it unable to implement changes to TPM as required by the regulator.[64] However, although the upgrade *may* eventually be necessary, the timing and scope of the required changes are not certain at this time.

476 The driver for the FMIS[65] expenditure ($6.2m) is a lifecycle upgrade linked to the vendor's support roadmap, which results in a four-year obsolescence cycle[66] – which seems particularly short. Nonetheless, acknowledging the critical nature of the FMIS, whether it is undertaken in 2015 or 2016 (or even later), the upgrade in RCP2 is warranted.

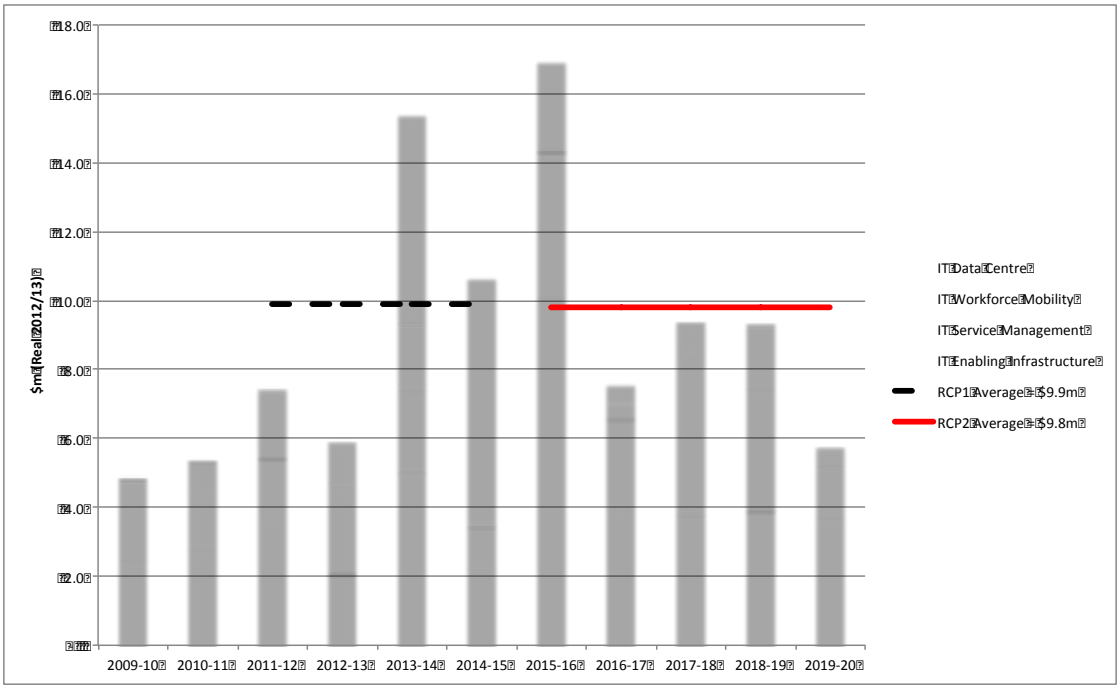
477 As with other IST capex expenditure categories, there is no evidence of tangible benefits attributed to the $5.7m of investment in new capability or a link to a new regulatory obligation.

IST Shared Services capex

478 The shared services category covers four portfolios, with the largest proposed capex in enabling infrastructure ($25.8m) and service management ($16.5m). The average annual capex is relatively consistent on an annual basis, but with significant year-on-year variances. Approximately 70% ($34.4m) is proposed to maintain capability and the balance ($14.7m) is directed to building capability.

[64] Transpower Expenditure Proposal, *Section 8.5.3,* p97
[65] Financial Management Information System
[66] IP15 - IT Portfolio Plan – IT Finance, p4

Figure 60 IST shared service capex ($m)



479 The enabling infrastructure portfolio comprises 13 projects, with all of the projects driven either by the timing of other projects requiring new or enhanced IST capabilities, or by the need to replace, refresh or upgrade systems. Transpower claims that delays to these projects may cause delays in other dependent projects, or lead to increased operational costs and risks of IST system outages.[67] However, these claims are not explicitly quantified.

480 The IT services management portfolio projects during RCP2 are either to extend the use of, or update and maintain, the existing Service Management tools to ensure that the vendor support remains available.[68]

481 As with other IST capex categories, there is no evidence of tangible benefits attributed to the $15.5m of investment in new capability or a link to a new regulatory obligation.

IST Network Services capex

482 The total network services capex proposed in RCP2 is $1.7m, with 100% directed towards maintaining capability to refresh telephony and video conferencing systems in accordance with lifecycles.

IST Telecommunications Services capex

483 The proposed telecommunications category comprises two portfolios – shared communications infrastructure ($43.6m) and substation

[67] IP18 – IT Portfolio Plan – IT enabling infrastructure, p3
[68] IP19 – IT Portfolio Plan – service management, p2-3

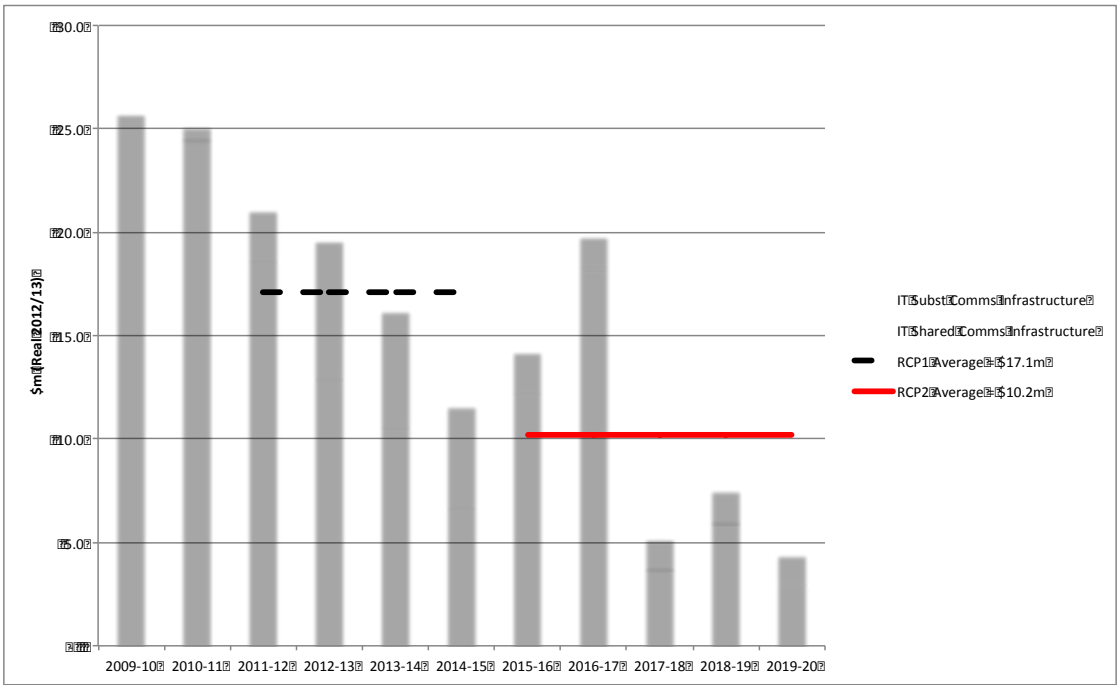
communications infrastructure ($7.6m). The average annual expenditure in RCP2 is 40% lower than RCP1 at $9.8m, reflecting that the RCP1 focus on building the TransGO network is virtually complete.

484 The focus in RCP2 is on upgrading and replacing components of the TransGO network to ensure they remain reliable and supportable. Transpower has committed to the in-house provision of all IST components in the shared communications portfolio.

485 The majority of Transpower's historical leased circuits have been retired, and leasing will not generally be considered as a sourcing option for this portfolio. This has resulted in a trade-off in reduced opex for leased circuits, against increased capex for Transpower-owned and operated circuits.[69]

486 The ownership path is one adopted by a number of Australian utilities to help manage costs and, crucially, to ensure control over critical network infrastructure. This appears to be a sound strategy for Transpower, as there is a relatively thin market in NZ for access to the secure, high performance networks that Transpower requires. Based on the information available, Transpower's competitive tender approach to procuring what external services it does need should lead (or have led) to a reasonable price being paid for the infrastructure.

Figure 61 IST telecommunications service capex ($m, Real 2013)



487 The shared communications infrastructure comprises 22 projects, ranging from $0.1m to $8.3m, with $31.4m (72%) for lifecycle upgrades or replacement. The $10.4m extension of the network to Northland and the

[69] IP09 – IT Portfolio Plan – IT shared communications infrastructure, p3

West Coast of the South Island is to provide route diversity, enhancing capability.[70] There is no attribution of a tangible net benefit to this investment at this stage of the project lifecycle.

488 The projects in the IT Substation Communications portfolio are exclusively for replacing existing batteries and refreshing UPS equipment. This is therefore directed 100% to maintain existing capability and is justified on whole-of-life cost minimisation benefits (at the targeted level of reliability).

IST Security Services capex

489 The shared services category covers one portfolio – security infrastructure ($7.3m in total), of which 70% ($5.2m) is to maintain capability. Because of the business criticality of the systems associated with this portfolio, Transpower pursues in-house provision of all of the IST components.

490 The system upgrade component ($2.1m) is to enhance security at substations.[71] As with Transpower's strategy of controlling its telecommunications infrastructure directly, transmission companies in Australia commonly operate in-house security services.

491 Transpower does not demonstrate how its investment in increased capability is linked to new regulatory requirements or tangible benefits.

7.2.2 Transpower's methodology for establishing the IST capex forecast

492 Transpower's expenditure forecasting approach for IST-related projects is described in the IST BSS Overview.[72] The estimating process comprises three stages:

(a) considering the cost of historic investments, original implementation costs and current market pricing;

(b) scoping workshops and industry analysis to refine the estimate, drawing on internal subject matter experts (SMEs), consultants, and industry analysts; and

(c) further refinement through the SDLC.[73]

493 In the on-site sessions, Transpower also described its use of the Agile[74] approach to IST project development and implementation. This is congruent with Transpower's phasing of the implementation of large projects and its acceptance by its Board of the principle of considering

[70] *Ibid,* p3-4
[71] IP09 IT Portfolio Plan – IT Shared Communications Infrastructure
[72] BSS, *Section 4*, p8
[73] Service Delivery Life Cycle (plan, deliver, manage, and maintain IST services and solutions)
[74] Agile is a software development method based on iterative and incremental development. The principles can be applied to other forms of project development.

emerging, cost effective technologies as close as possible to starting the work.

494 The incremental approach means that there is a significant degree of uncertainty about the cost estimates used for major IST projects that start in more than 12 months' time. As Transpower says:

> *… we cannot predict with certainty what technologies we will be commissioning in 3-5 years' time or the exact techniques that we will use to deliver them.*[75]

495 Typically, it is more difficult to estimate transformation IST programmes than system upgrades or replacements because of the uncertainty of the integration cost. Projects in which the major cost component is material (i.e. the system/software) rather than labour (particularly for integration) are more straightforward to estimate and deliver on schedule and budget. For more complex projects requiring significant integration and change management effort, estimates are often exceeded due to:

(a) the use of more expensive IST contractors to undertake work that was allocated to staff; and

(b) a longer (and more expensive) change management process.

496 Benefits realisation can also be jeopardised.

497 In the on-site sessions, Transpower management acknowledged its success in line management fulfilling its commitment to make SMEs available to the IST projects as a key success factor. In RCP1, Transpower successfully implemented (or substantially delivered) several transformational IST projects and was within 2% of its overall IST allocation.

498 RCP2 includes another suite of large projects, but with the emphasis now on maintaining existing capability, rather than embarking on further transformational change.

499 However, approximately $30m of the forecast IST RCP1 capex (2014/15) is for a data centre project brought forward from RCP2.

500 Table 12 shows the comparison of allocated IST capex in RCP1 and the actual expenditure. At the portfolio level the variances were significant. Transpower explains these variances as:[76]

(a) expanded scope: +$2.1m

(b) licencing and project delivery efficiencies: -$8.7m

(c) reduced scope (deferral to RCP2): -$10.6m

[75] Ibid, p8
[76] Transpower Expenditure Proposal, *Section 4.3.3, p*27-28

(d) unforeseen costs: +$2.3m.

501 While the clarification does not explain all the variances, Transpower appears to have earned the appropriate value from its IST investment by ensuring to a significant extent that the high priority programmes were delivered.

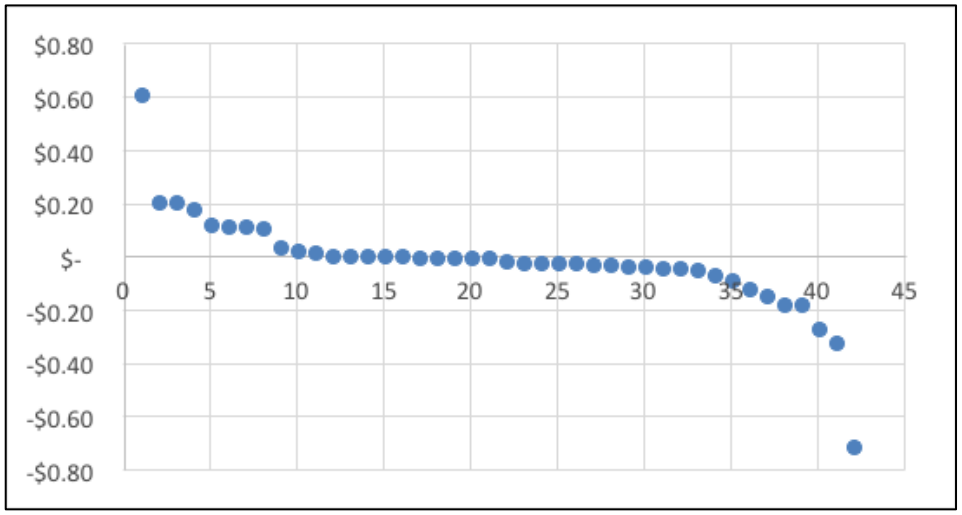
Table 12 Sources of IST RCP1 capex variance

Portfolio	Allowance ($m)	Forecast ($m)	Variance	
			$m	%
SCADA/RTS	19.9	11.3	-8.6	-43%
Security infrastructure	12.9	9.7	-3.2	-25%
Asset management	36.3	30.8	-5.5	-15%
Enabling infrastructure	12.0	10.3	-1.6	-13%
Substation comms infrastructure	13.1	13.3	0.2	2%
Workforce mobility	1.3	3.4	2.1	162%
Spatial & drawings	1.1	2.4	1.3	118%
Service management	3.6	7.3	3.7	103%
Other	32.3	40.7	8.4	26%
Shared comms infrastructure	41.3	47.2	5.9	14%
TOTAL	**173.9**	**176.4**	**2.5**	**1%**

Source: Transpower Expenditure Proposal, Table 6, p27

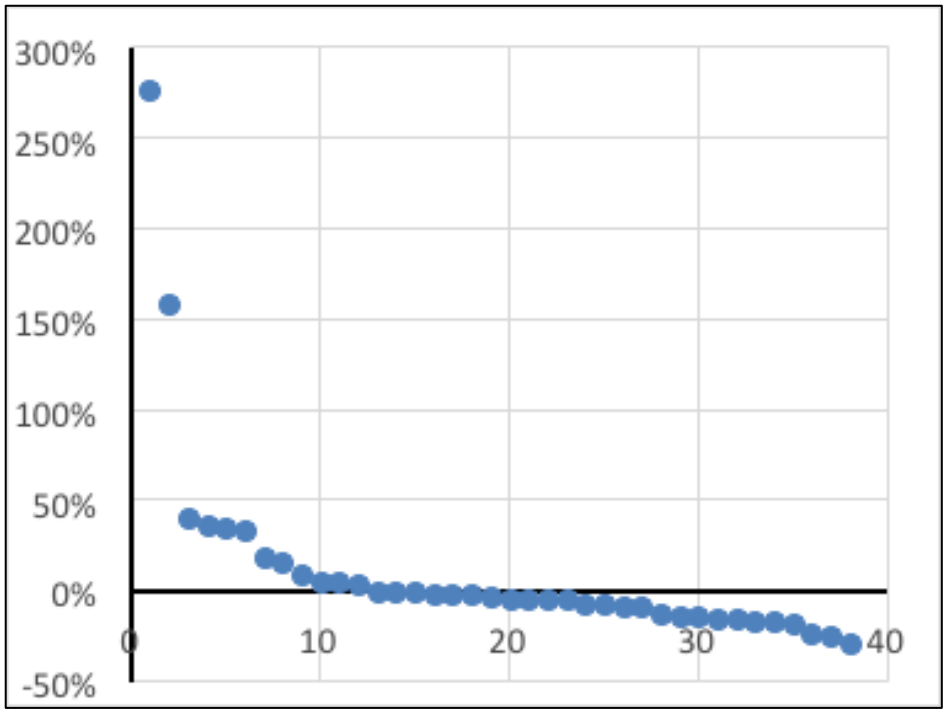
502 To test the cost variance in more detail, we examined the individual project cost variance in RCP1. Figure 62 shows the cost variance distribution in value terms and Figure 63 shows the cost variance in percentage terms for all the projects in the IST portfolio in RCP1 with a close-out report.

Figure 62 IST project cost variance by year in RCP1 ($m)



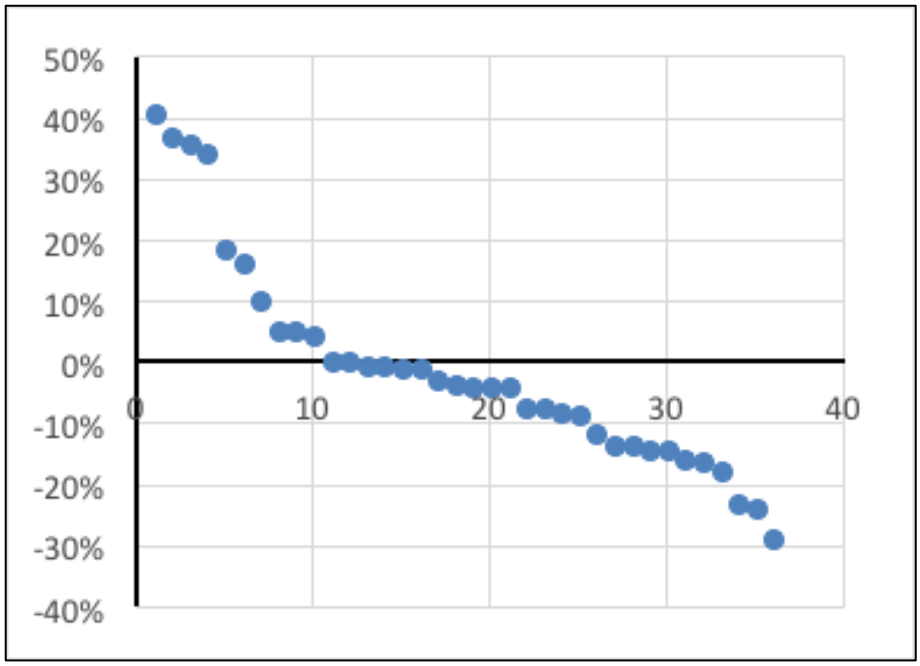
Source: Transpower response to Q024b – Close-out reports

Figure 63 IST project cost variance by year in RCP1 (%)



Source: Transpower response to Q024b – Close-out reports

Figure 64 IST project cost variance by year in RCP1 (%) - with two outliers removed



Source: Transpower response to Q024b – Close-out reports

503 These figures indicate:

(a) a surprising degree of symmetry about the estimate in dollar terms and, with the two outliers removed, in percentage terms as well.

This symmetry has led to the remarkably close total portfolio actual against forecast expenditure;

(b) the degree of spread in dollar terms is not particularly large, with even the two outliers not indicating massive cost over-runs or under-runs. This is probably because the close-out reports have been provided for projects that are only up to $4m and with only four projects exceeding $1m estimated cost; and

(c) with the exception of the degree of symmetry about nil variance, the scatter of variance about the initial estimate is typical for a portfolio of IST projects.

504 Transpower may have managed its portfolio to result in expenditure matching budget by a combination of re-scoping and rescheduling IST projects. This then raises unresolved questions about the true value earned against the initial project, which leads to the question of what benefit the expenditure will release. This has proved to be an elusive issue, but our concerns are offset to a large degree by Transpower's self-determination of a 7.5% prudency/productivity reduction on RCP2 IST capex (on nominal expenditure).

7.2.3 Benefits assessment

Benefits from RCP1 IST capex

505 As discussed above, the IST emphasis in RCP1 was to build new capability. With the exception of the Core AMIS project, which promises base direct benefits of $22m (NPV) [77] – and a high case benefit of $52.6m – the other business cases and Board papers provided do not nominate any (or significant) direct benefits.[78]

Benefits from RCP2 IST capex

506 Transpower has offered no tangible benefits assessment for its proposed RCP2 expenditure. Significant tangible benefits should accrue to support the $52.5m capex proposed to enhance capability. Transpower provides the following commentary in the IT Portfolio Plans to explain the absence of benefits associated with the proposed projects:

> *Cost-benefit analyses will be conducted as appropriate for individual projects as part of the business case process. For IST projects the dynamic nature of technology development and evolution means that it is generally not prudent to carry out detailed design and costing in excess of 18 months before the commencement of the project, and therefore valid cost-benefit analysis of the projects is not possible on longer time horizons.*

[77] Core AIMS Business Case – June 2012 – Q031-18
[78] Transpower's response to question Q031

Typically formal business analysis and final signoff activity occurs between 12 and 18 months before the commencement of the project. This allows us to retain a degree of flexibility when specifying the final implementation. However, the proposed [Insert title] programme has been reviewed and agreed by the relevant business owners and General Managers.

507 This approach makes it impossible to assess the tangible benefits that should be built into the RCP2 and RCP3 budgets. However, Transpower has proposed a top-down productivity adjustment of 7.5% to its IST budget.

7.2.4 Capex-opex trade-offs

508 Transpower refers to two deliberate decisions that result in capex-opex trade-offs:

(a) Telecommunication services (IST leases). It is not practical or economic (based on 20 year TCO) to build Transpower-owned infrastructure as part of the TransGO programme. The strategy of owning and operating has resulted in a trade-off in reduced opex for leased circuits, against increased capex for Transpower-owned and operated circuits.

(b) IST shared services. Transpower has decided to move to hosted data centres. The choice was based on the lowest lifetime cost with the required level of support.[79] This is forecast to increase IST Shared Services opex by about $3.4m p.a. ($17m), but offset the need for $26m capex for Transpower to build dedicated facilities.

509 Transpower has not provided any other information about IST-based opex-capex trade-offs at a material level.

7.2.5 Assessment of IST capex

510 The link between strategic objectives and expenditure is sound.

511 Transpower's strategy to switch to recognised COTS IST platforms and software follows a trend well established in utilities elsewhere.

512 Transpower's policy of staying within vendor support agreements is conservative but appropriate given the criticality of the relevant systems provided that the analysis underpinning the various asset classes is, in each case, based on achieving the lowest economic cost (while maintaining acceptable functionality).

513 The bias towards investing in maintaining capability ($151m, 75%) rather than adding new capability ($50m, 25%) in RCP2 is appropriate, giving Transpower the opportunity to consolidate (i.e. to leverage off the

[79] IST BSS 2015-20, *Section 5.4.4,* p27

investments made in RCP1 rather than have SMEs focused on the next transformational project).

514 The portfolio challenge approach has resulted in a reduction in proposed RCP IST capex from an initial $260m to $210.7m, which is significant although primarily a result of bringing forward call centre expenditure into RCP1 and deducting a 7.5% productivity adjustment.

515 The IST capex programme delivery performance in RCP1 combined with (i) the lower annual capex in RCP2, (ii) the reduced complexity of the capex projects, and (iii) the maturing practice of internal ex-post reviews provide confidence that the proposed RCP2 IST capex programme is deliverable.

516 The IST capex cost estimation approach appears to be sound, *when implemented in full*. It results in cost and schedule variation that is typical for large and complex IST programmes. However, only a relatively small proportion of the proposed expenditure in RCP2 has reached a BC3 level of accuracy (i.e. with P90 estimates).

517 Typically, it is difficult to ascribe recurrent tangible benefits to projects that primarily maintain capability, however, for the $50m capex proposed to build capability in RCP2, the tangible benefits should be identified and steps taken by Transpower to deliver the benefits.

518 There is insufficient benefits (or risk) analysis due to the lack of detailed business cases. It is therefore difficult to be sufficiently certain about what return customers will see from the investment in terms of either operational savings for the same or higher service levels.

519 The comprehensive business case for the Core Asset Management System is a good example of the benefits analysis required for all major IST investments. The business case's acknowledgement that the estimated cost reductions are conservative provides strong indication that higher benefits could be secured with good project management.

520 Overall, based on the information provided, Transpower's project documentation (including project close-out reports) and presentations to the Board do not have strong emphasis on direct or bankable bottom-line benefits realisation for its customers – particularly from projects that promise improved productivity and efficiency (as most do).

521 On the other hand, there is a strong level of identification of technical benefits and intangible benefits for both 'maintain' and 'build capability' projects.

522 Transpower proposes a 7.5% efficiency adjustment for RCP2 to account for portfolio level efficiencies and adjustments. However, this may not be sufficient to recognise the recurrent tangible benefits from IST capex in RCP1.

7.2.6 Recommendations on IST capex

523 We conclude with the following recommendations on IST capex:

(a) disallow the capex allocation of $15.1m for the TPM project; and

(b) apply an additional 2.5% capex efficiency/prudency adjustment on top of the 7.5% offered in lieu of the limited benefits analysis for RCP2 projects and the uncertain embedment of RCP1 benefits in the RCP2 expenditure forecast.

8 Review of RCP2 opex

8.1 Content of this section

524 This section sets out our views on opex included in Transpower's RCP2 proposal. The opex categories we have reviewed are:

(a) Grid

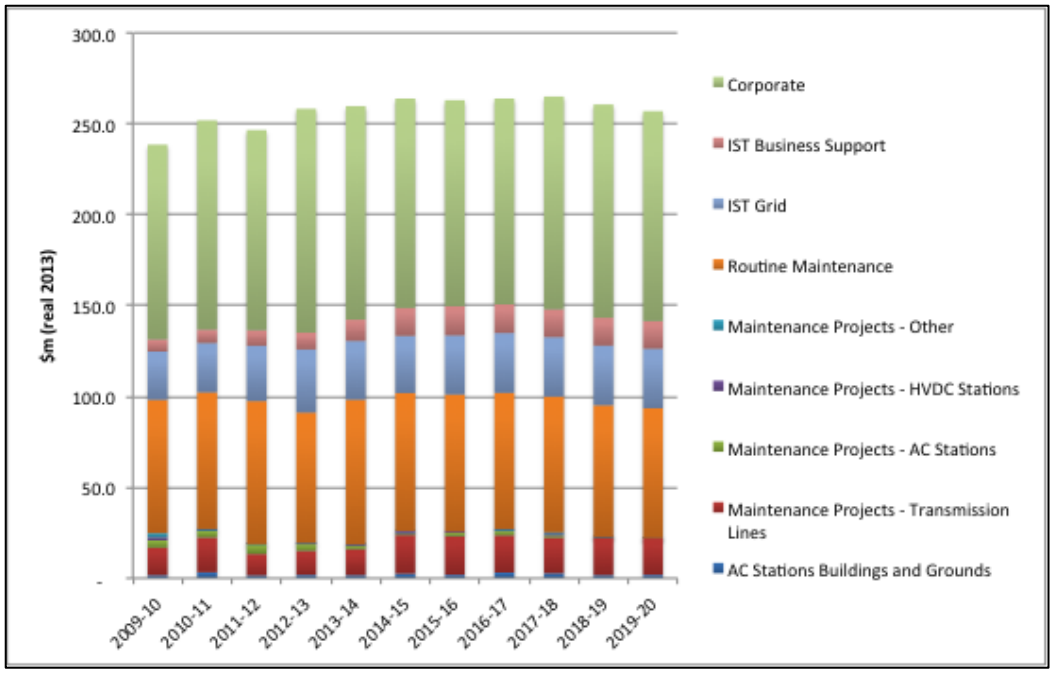
(b) Non Grid opex (IST and Corporate)

8.2 Transpower's proposed opex

525 Transpower has proposed opex of $1.3 billion for RCP2. This represents a 2.3% increase in real terms above the previous five-year period (RCP1 + 2019/10). Given that Transpower has significantly increased its asset base over RCP1 and has increased and improved is knowledge of asset condition, the increase can be viewed as being possibly lower than would have been expected.

526 Figure 65 shows that while opex has been increasing in real terms since 2012, it has subsequently remained level and is forecast by Transpower to show some minor reductions after 2018. The largest opex items are Corporate (which includes most staff costs), routine maintenance projects and IST. We have focused on these three categories in our review.

Figure 65 Opex by category



527 While overall opex is increasing by 2.3%, some reasonably large movements are evident between opex categories. These are shown in Figure 66 and Figure 67.

Figure 66 Opex movement RCP2 vs RCP1 + 2019/10 ($m)

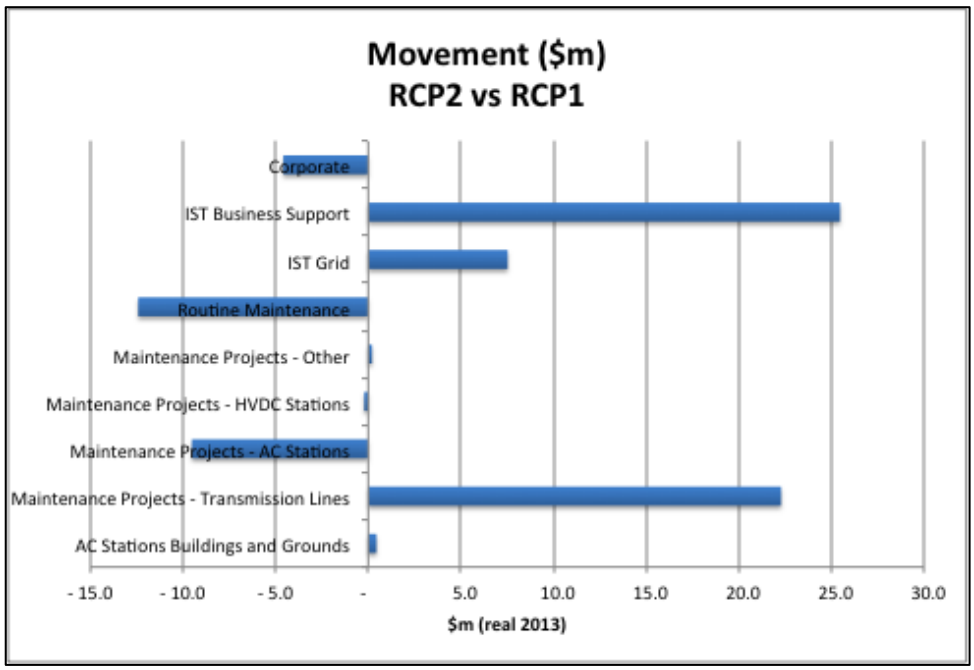
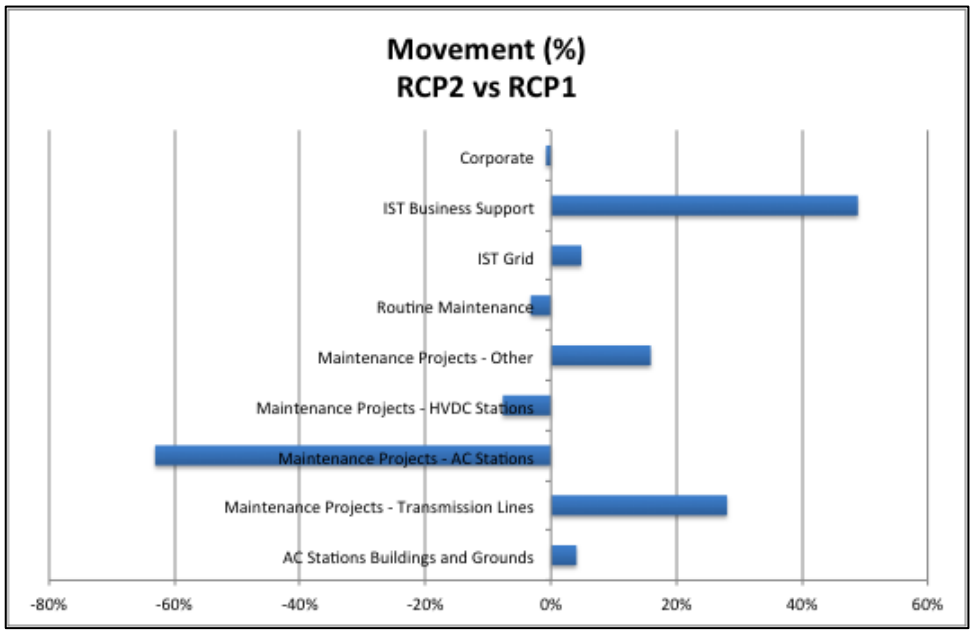


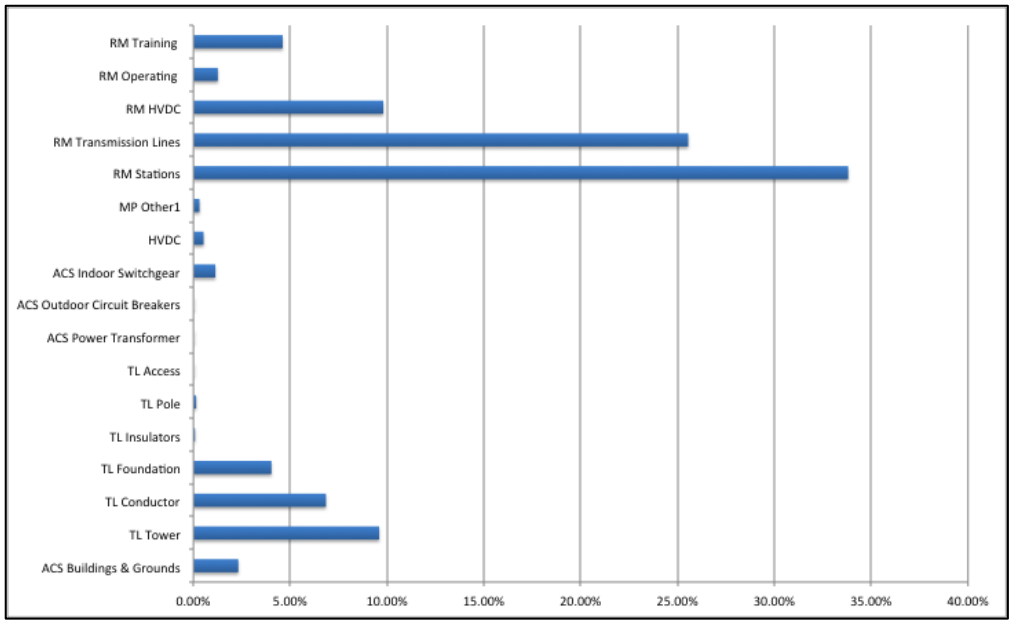
Figure 67 Opex movement RCP2 vs RCP1 + 2019/10 (%)



528 The change of focus for maintenance projects from AC Stations to Transmission Lines is clearly evident.

529 Figure 68 shows the relative sizes of the components of Grid opex as a percentage of total Grid opex.

Figure 68 Components of Grid opex

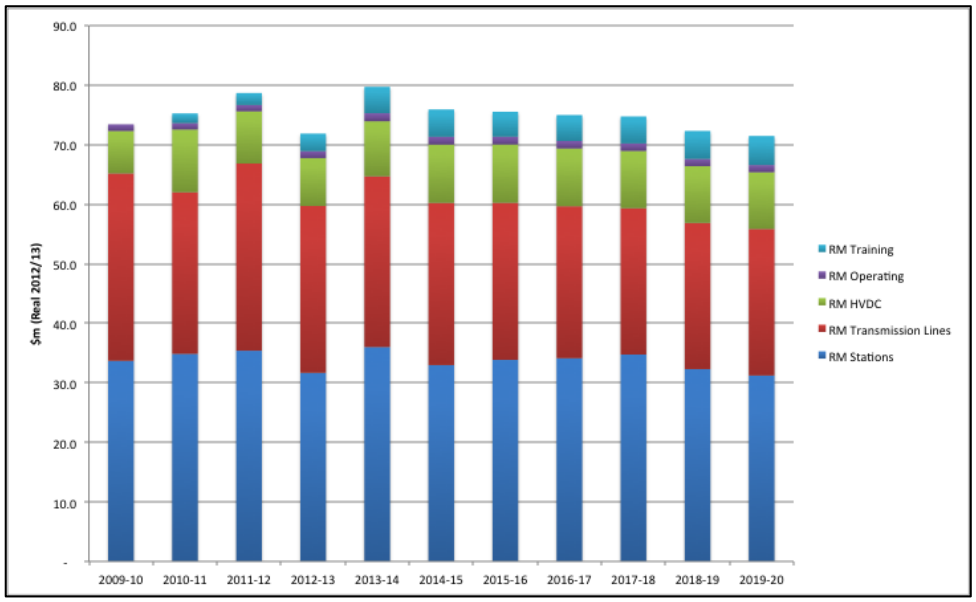


530 Routine maintenance for transmission lines, stations and HVDC are the largest contributors to Grid opex with transmission lines making up the bulk of the maintenance project expenditure.

8.2.1 Findings on routine maintenance

531 Routine maintenance opex accounts for 75% of total Grid opex and 79% of routine maintenance opex is allocated to the preventive and corrective maintenance of transmission lines ($126m) and AC Stations ($166m). The components of the routine maintenance opex forecast are shown in Figure 69.

Figure 69 Routine maintenance opex



532 Transpower's routine maintenance forecast was developed using the MACM forecasting model. We have reviewed how this was undertaken in

practice and as a result consider that Transpower has applied the process as described in its RCP2 proposal.[80]

533 Transpower considers that the use of MACM:

(a) allows improved optimisation between capex and opex;

(b) accounts for asset base changes including divestments;

(c) improves transparency and accuracy;

(d) captures the outputs of work history analysis and similar initiatives; and

(e) can incorporate on-going improvements to Transpower's maintenance regime.

534 We also observed Transpower's application of its work history and asset database base capex forecast when developing the routine maintenance forecast. We observed that Transpower had taken account of the planned asset divestments in its opex forecasts.

535 Transpower initiated an external Maintenance Efficiency Study of its grid opex, which identified potential efficiency gains. Transpower has taken the identified efficiency gains into account by adjusting its volumetric forecasts at an asset fleet level.

536 An example of Transpower's application of the efficiency gain can be seen in routine maintenance where Transpower has targeted a 7% adjustment in preventive and corrective maintenance for RCP2.[81]

537 During our onsite sessions, we observed how Transpower had applied the target efficient gains to the fleet components of the grid opex forecast.

538 We note that the routine maintenance forecasts are based on volumetric projections costed through the MACM and TEEs processes. From a process perspective, we consider the volumes of work forecast are reasonable and, subject to our concerns regarding cost estimation accuracy, will produce a prudent expenditure forecast.

539 We note that Transpower has applied the recommendations of the efficiency study through an efficiency adjustment to corrective maintenance. During the on-site sessions, Transpower described how it had also accounted for potential efficiency gains when setting the preventive component of the routine maintenance budget.

[80] MP01 section7.2.3
[81] See Section 7.3.1 of the RCP2 proposal, page 76

540 We consider that the proposed routine maintenance forecast has been developed in accordance with Transpower's documented policy and asset fleet strategies and RCP2 Maintenance Forecast.

541 Notwithstanding our concerns regarding cost estimation, we consider that the routine maintenance forecast is robust and, with the application of the proposed efficiency factors, reflects prudent expenditure for network maintenance activities.

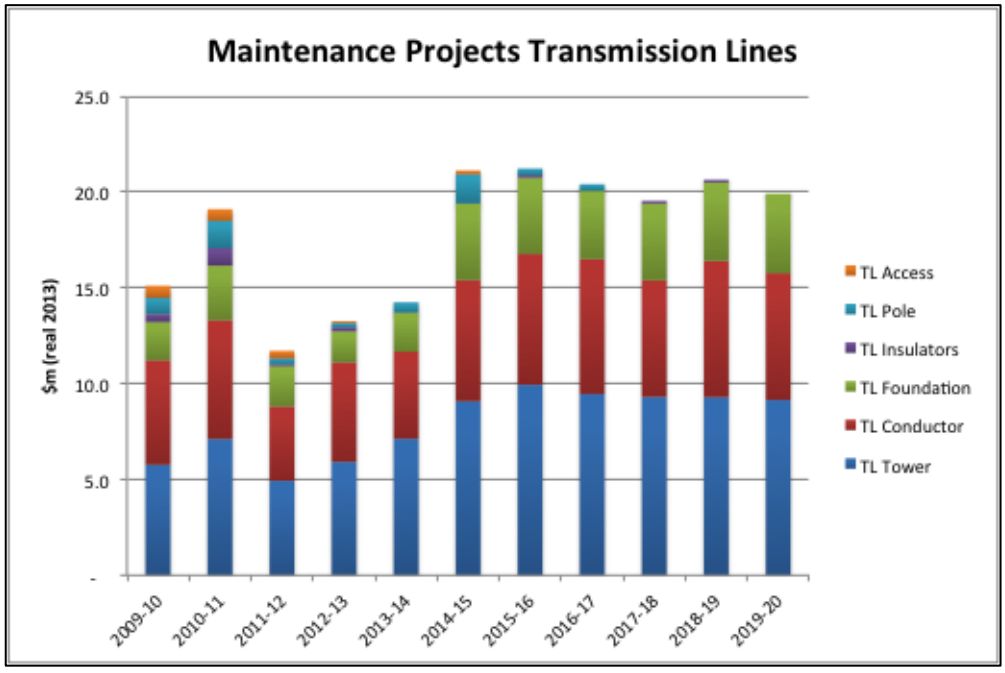
8.2.2 Findings on TL Lines maintenance projects

542 Transpower describes its individual asset fleet maintenance projects, the asset fleet strategies and portfolio overview documents. Costing of maintenance projects is generally undertaken on a volumetric basis with project approval subject to business case assessment similar to capital projects.

543 Transpower identifies necessary work through application of its asset health models taking into account the criticality assessment of the particular assets involved. This is in line with Transpower's asset lifecycle strategies.

544 For maintenance project opex, transmission lines forecast expenditure accounts for 4.5% of total Grid opex. Tower and conductor maintenance projects account for 79.5% of transmission lines opex forecast.

Figure 70 Routine maintenance projects transmission lines



545 Transpower explains the reason for the dip in transmission lines opex during RCP1 as being due to:

> *… deliverability constraints and reprioritisation of resources towards capital projects.*[82]

546 This seems a reasonable conclusion as Transpower delivered a number of major capital works during this period.

547 Based on the likely deterioration in asset health due to the suboptimal deferral of maintenance projects in RCP1, it is understandable that an increase is forecast. RCP2 maintenance project opex therefore represents a return to historical levels and includes a catch-up of RCP1 deferrals.

548 Following review of the proposed transmission lines maintenance projects, we conclude that it would not be desirable to reduce expenditure levels for RCP2 as this would likely lead to suboptimal lifecycle management and ultimately, higher costs to consumers.

8.3 Summary of findings on Grid opex

549 On Grid opex we consider that:

(a) Transpower's management systems are delivering appropriate work programmes;

(b) efficiency adjustments on preventive and corrective maintenance are appropriate and are supported by an independent expert review; and

(c) cost estimation accuracy cannot be relied upon given our concerns with the information and data we have viewed.

550 However, given the:

(a) low portfolio-level RCP1 variance;

(b) apparent use of lower unit cost assumptions for RCP2 than actual unit costs in RCP1; and

(c) application of the efficiency study targeted reductions,

we consider that Transpower's proposed Grid opex forecast is likely to represent efficient costs that will reasonably be required to maintain the network in an appropriate condition.

8.3.1 Recommendations on Grid opex

551 We consider that in developing the proposed Grid opex forecast, Transpower has used its asset management framework and incorporated asset lifecycle practices that, in our view, are consistent with the intentions of the IM.

[82] MP01 Section 7.4.1

552 We recommend that the Commission require that Transpower addresses the concerns and issues identified regarding cost estimation accuracy. It should be signalled to Transpower that recurring issues in this area will not be tolerated when reviewing the RCP3 proposal.

553 Accordingly, we do not recommend any additional adjustment to the proposed Grid opex.

8.4 Non-network opex

8.4.1 Overview of Non-Network Opex

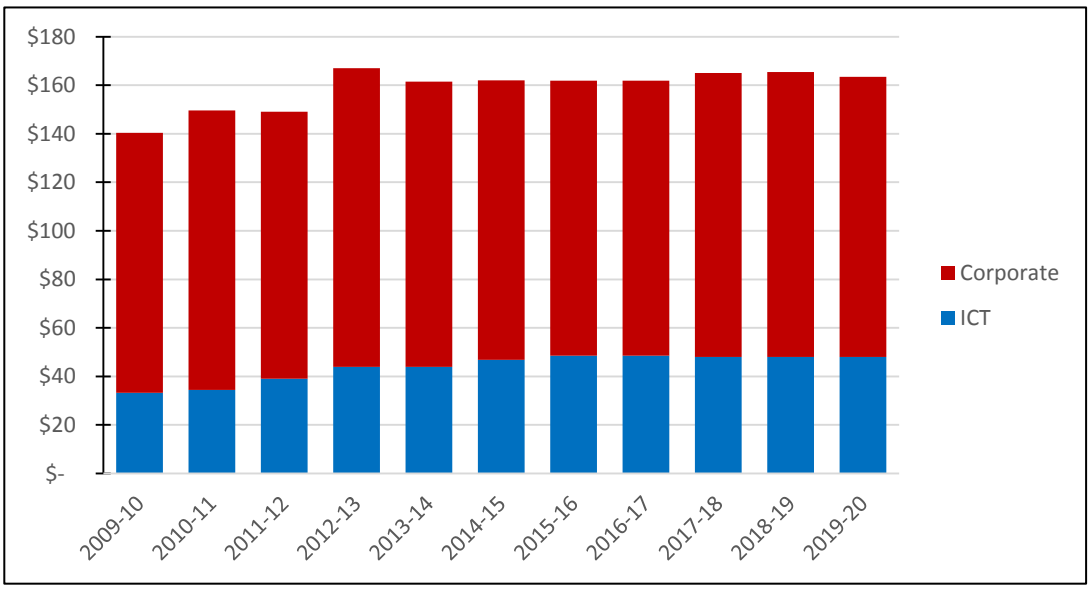
554 Non-network opex comprises the Corporate and IST categories of expenditure. Corporate opex comprises all other opex that is not within the Grid or IST categories – in RCP2 it includes Departmental, Investigations, Insurance and Ancillary Services portfolios.

555 Figure 71 shows the RCP2 forecast and historic expenditure in the two categories. Transpower forecast of Corporate and IST opex is relatively flat during RCP2.

556 Given that the RCP2 theme for Transpower is 'consolidation' (as opposed to the 'growth of capability' theme applicable to RCP1), the proposed levelling of Non-network opex is a reasonable outcome.

557 However, as we have touched on elsewhere in the report, in respect of the price pressures experienced by electricity consumers, we would expect Transpower to be aggressively seeking to reduce costs in all areas of its business, but particularly in the non-network category (to prioritise opex for the network).

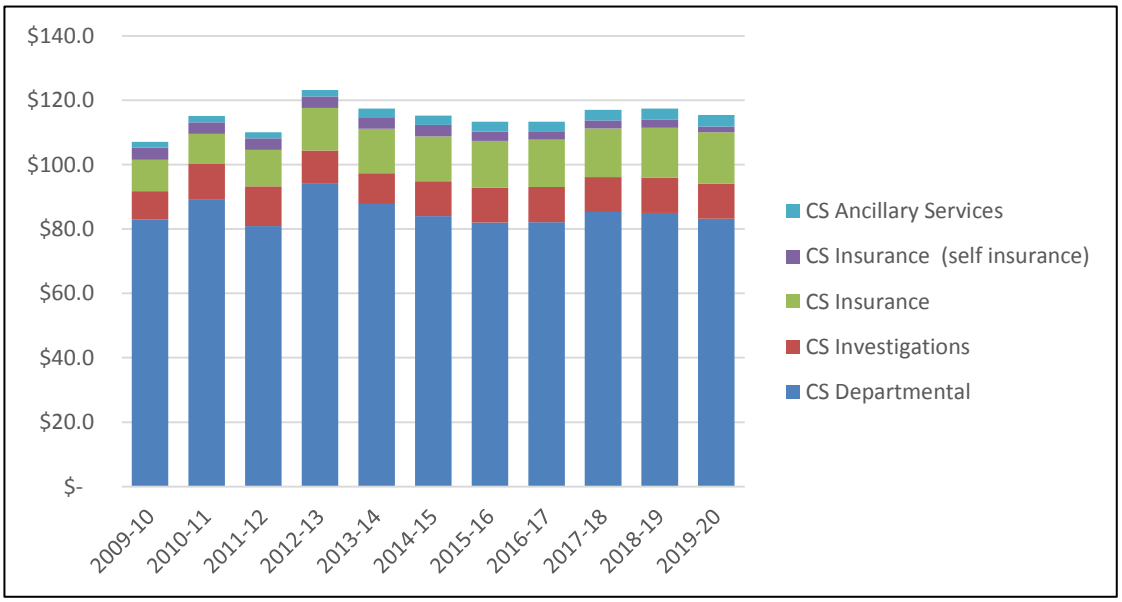
Figure 71 Historic and forecast Non-network opex ($m, real 2012/13)



8.4.2 Corporate Opex

558 Figure 72 shows the breakdown of Corporate opex into its portfolio components. All portfolios are forecast to have a relatively flat expenditure profile in RCP2.

Figure 72 Historic and forecast Corporate opex ($m)



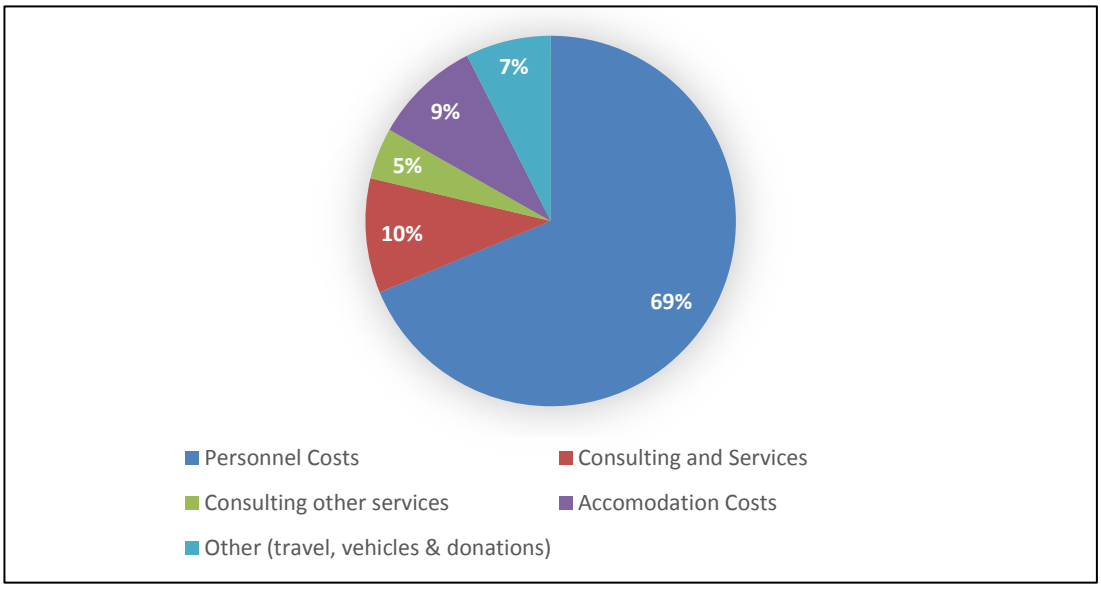
Departmental opex

559 Almost 70% of the Departmental opex RCP forecast of $414.7m is personnel costs, as shown in Figure 73. This includes all staff-related costs.

560 These costs increased in the 2012/13 and 2013/14 years to support the implementation of major projects and other business improvement initiatives and are forecast to largely reverse by 2014/15 as the initiatives/projects end or are transitioned into BAU.[83]

[83] RCP1 projects, compilation of RCP2 proposal, restructuring costs, and improvements to asset management (Transpower RP, *Section 9.3.1*, p114)

Figure 73 Proportions of RCP2 Departmental opex ($m, real 2012/13)



561 The RCP1 Departmental opex outturn is forecast to exceed the RCP1 allowance by $31m (+11%). Transpower has anticipated that additional requirements would be offset by efficiencies and/or cost reductions.

562 However, the combination of the RCP business improvement initiatives, RCP2 preparation and the relatively short period remaining in RCP1 has caused an excessive demand on internal SMEs. This in turn has led to increased use of external contractor and consultant resources, increasing personnel expenditure, which peaked in 2012/13.

563 Transpower assumes that the additional 42 FTEs in 2013/14 (see Figure 74) will be achieved by filling vacancies with staff redeployed from the major capital projects.[84]

564 The RCP2 forecast is derived from the 2014/15 'Base Year', noting that this year reflects the forecast reduction from the 2013/14 peak due to the completion of the major change initiatives.

565 As shown in Figure 74, Transpower assumes a relatively flat headcount for the duration of RCP2. The rationale for this is two-fold:

> *…while we have an ongoing focus on improving our efficiency and are confident that improvement will be made, we also recognise that there will also be additional (unpredictable) demands and requirements that will offset these savings. As an example, we anticipate that resources required to support regulatory and policy changes …will continue to increase.*[85]

[84] RCP2 Corporate Opex & Business Support Capex, GM and CEO Review, 28 June 2013
[85] RCP1 projects, compilation of RCP2 proposal, restructuring costs, and improvements to asset management (Transpower RP, *Section 9.3.1*, p115)

> *A continuing requirement to continue to develop our in-house capabilities, especially in key technical areas…The effective resourcing and management of our divisions will depend on retaining and developing our people and skills during RCP2.*[86]

566 Transpower's expectation that it will improve efficiency is noted, however, unlike the 7.5% capex efficiency 'dividend', we have seen no information provided on the expected efficiency gains from the investment in RCP1 or from the proposed investment in staff capability in RCP2.

567 To offset indeterminate opex efficiencies (from the hundreds of millions of dollars invested in asset management, communications, and other capabilities in RCP1 and RCP2) with the speculative requirement for additional opex in response to the uncertainty of new regulatory requirements is not a compelling argument.

568 Organisations focused on reducing overall expenditure for the benefit of their customers would re-prioritise their work (including stopping or deferring some activities) and find more efficient approaches to undertaking essential tasks. Transpower has adopted the latter approach by investing heavily in a number of improvement initiatives (with more proposed).

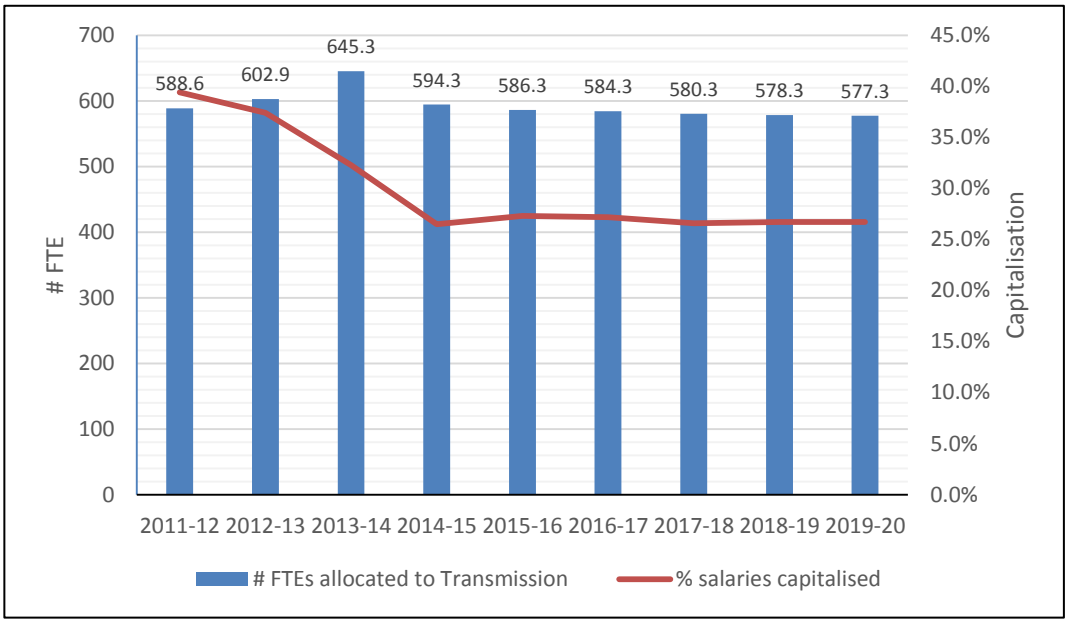
569 Figure 74 shows a 9% reduction in FTEs from the 2013/14 peak through to the first year of RCP2 and a small decline thereafter. For the duration of RCP2, with two exceptions, the nine divisions forecast exactly the same FTE level over the five-year duration of RCP2.[87]

570 The impact of the reduction from the peak is minor as it is offset by a reduced capitalisation rate as staff reduce booking of their costs to major projects (as the projects are progressively completed). Given that Transpower staff book investigation expenditure to a separate regulatory opex category, at an average of about 26%, the capitalisation rate appears to be low.

571 Our conclusion is that Transpower has too many staff involved in non-grid project (or investigations work) or it is not correctly booking time to capital projects.

[86] *Ibid,* p5
[87] RCP2 Corporate Opex & Business Support Capex, GM and CEO Review, 28 June 2013

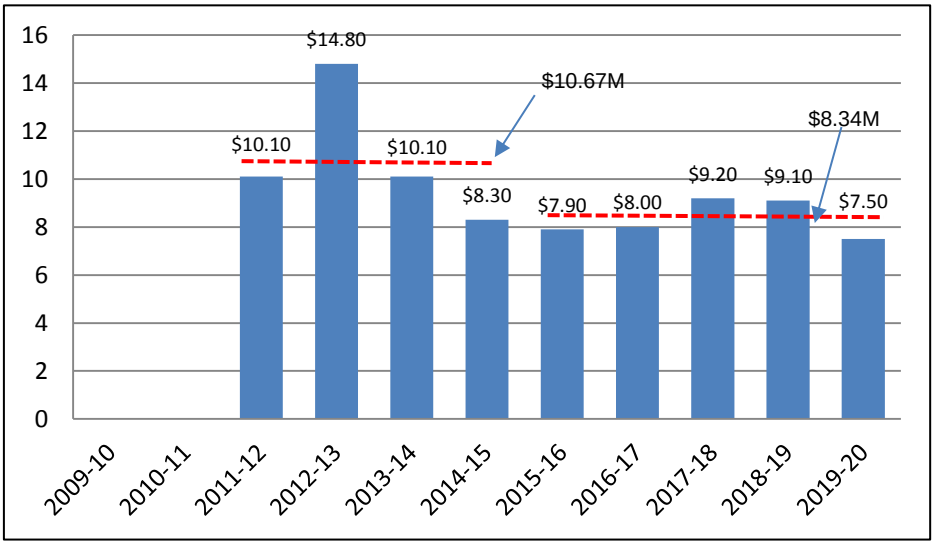
Figure 74 Historic and forecast Departmental FTEs and Capitalisation ($m, real 2012/13)



572 Figure 75 shows the forecast decline in contractor and consultancy expenditure through to the preparation of the RCP3 proposal as the demand on the SME cohort declines to normal levels and technical staff are redeployed from major projects into vacant positions.

573 This is an appropriate trend for contractor and consultancy expenditure, but still represents 10% of the workforce (or around 60 FTEs).

Figure 75 Historic & forecast contractor and consultancy expenditure ($m, real 2012/13)



574 In terms of other cost drivers, Transpower forecasts:

(a) An additional 'cost to meet our contractual obligations' as 'a process of cultural change will see an element of generational

change as some very experienced staff will leave the organisation.'[88] The additional cost has not been identified.

(b) Travel costs ($2.6m p.a.) and the average salary ($120,300 p.a.) are stable over the duration of RCP2, with the latter down from a peak of $124,380 in 2012/13. Transpower seeks to maintain a competitive labour market position and is not at risk of unplanned turnover due to uncompetitive pay.[89] Given the relatively high turnover Transpower experienced up to a few years ago, the focus on retention is appropriate and the strategy of offering median level salaries (with discretion to go higher) is also appropriate. This is a common strategy within the industry.

(c) A 30% increase in accommodation costs from 2017/18 (Figure 76) of $2m p.a. to account for the proposed relocation from Transpower House. This is in addition to an estimated $14.14m capex associated with the proposed move. The drivers for the relocation include:

(i) consolidation of staff currently in three buildings in Wellington, to increase productivity; and

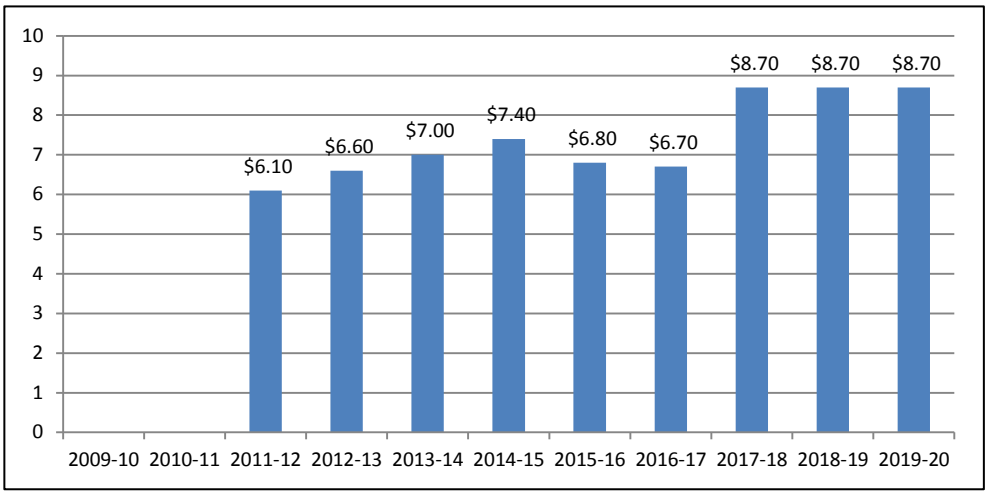
(ii) reduction in the loss of productivity during 12-18 months of refurbishment of the existing building (façade and lifts).

575 Transpower advised that the Board rejected a previous business case supporting the office relocation on the grounds that the cost was prohibitive.[90] A new business case has not yet been prepared for the forecast 2017/18 relocation.

576 We consider that an organisation focused on cost restraint so as to minimise its cost burden on consumers would require a high hurdle rate for an office relocation, as it is a discretionary expenditure.

[88] RCP2 POD, *CS Departmental*, p5
[89] PCS, *Labour market relativity,* p27
[90] On site meeting, Feb10—11 2014

Figure 76 Historic and forecast Accommodation costs ($m, real 2012/13)



577 Given that the Departmental costs are linked to Transpower's People Capability Strategy (PCS), it is also important to test the objectives of the strategy.

578 The PCS identifies that the vision of the PCS is '[t]o recruit, develop and retain the capability required for Transmission Tomorrow'. The three limbs of the strategy comprise generic sub-strategies.

579 The various approaches to achieve this vision between 2013 and 2020 are made clear, but there appears to be no assessment of the cost of the initiatives. A number of objective targets for 2020 are nominated:

(a) Turnover: <9.5% for all roles; 8%-9% for strategic roles

(b) Engagement: >65% ('high performance/ best employer range')

(c) Diversity: gender ratio = 40%

(d) Internal recruitment: >30% pa; 10% staff promoted annually.

580 The benefits of achieving these targets are described generally as helping to achieve the vision (i.e. enabling the Transmission Tomorrow objectives). While there are several references to productivity benefits from the various initiatives, the cost of these initiatives is not apparent in the PCS and there does not appear to be a cost-benefit analysis of the initiatives nor the options analysis (e.g. doing more, or doing less, in RCP2).

Investigations

581 The Investigations category captures any cost incurred in the investigation of potential improvements to the grid, IST or business processes. A sound governance process is applied to the expenditure. Transpower's Accounting Guidance Notes for Revenue and Capital Expenditure provide a guide to the correct application of the relevant Accounting Standard.

582 Transpower proposes $54.34m investigations opex in RCP2. At $10.87m p.a., this is commensurate with the average expenditure in RCP1. As

shown in Figure 77, the original RCP1 forecast was exceeded (by 14%). There was larger than expected expenditure in 2011/12 and 2012/13:

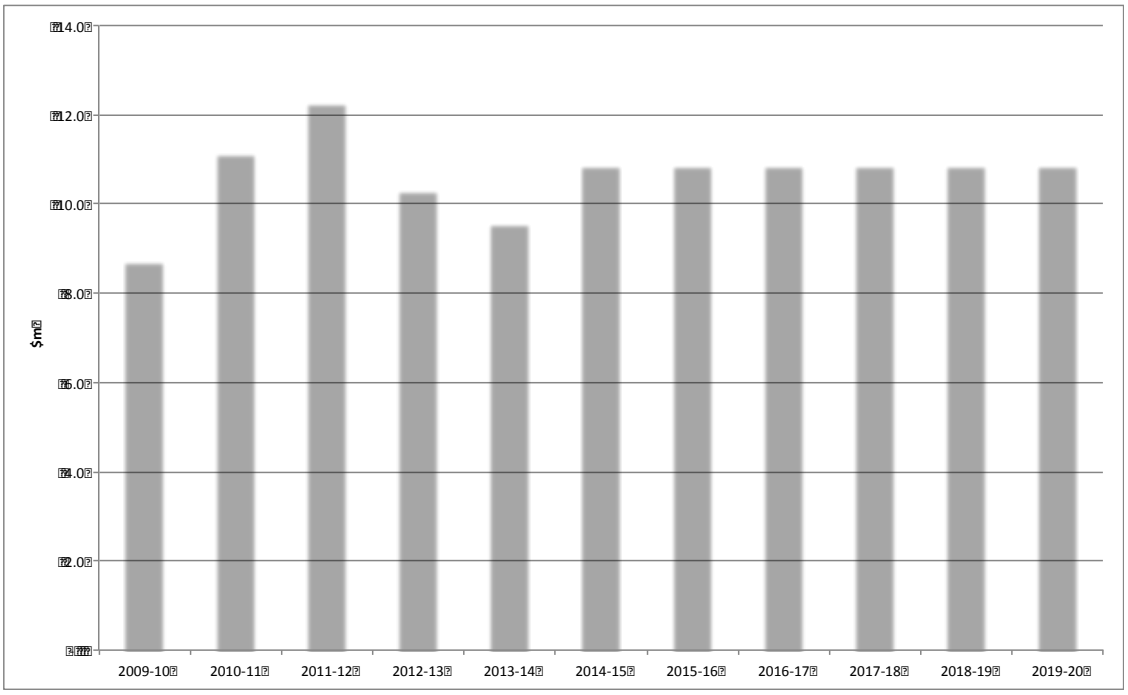
> *… reflecting the requirement for investigations dictated by the optimal timing and sequencing of major capital work*[91]

583 Transpower proposes RCP2 expenditure similar to the actual RCP1 average of $10.75m p.a. on the basis that in RCP2:

> *… fewer, larger investigations are expected to be replaced by a greater number of smaller investigations*
>
> *and*
>
> *… given that [Transpower's] work requirement during RCP2 will be stable and resourced at a similar level throughout the period.*[92]

584 It is, however, difficult to reconcile this proposition when the characteristics of the two periods are so different. RCP1 was characterised by major projects and intensive business improvement work. RCP2 is characterised as one of maintaining capability or consolidation, albeit with on-going business improvement work and investigations.

Figure 77 Historic and forecast Investigations opex ($m)



[91] POD55, *CS Investigations*, p4
[92] *Ibid,* p3

Ancillary Services

585 The System Operator is obliged by the Electricity Industry Participation Code 2010 (the Code) to procure ancillary services to support power system operation. Under the Code, Transpower and other parties are required to pay for three components of ancillary services - Black start (BS), Over-frequency reserves (OFR), and Instantaneous reserves (IR). Each service comprises two charge components: availability and event. Event charges are triggered by significant under- or over-frequency events.

586 Transpower forecasts net opex of $16.45m over RCP2 for ancillary services payments. It has undertaken an options analysis to determine the most prudent and efficient way of managing the requisite availability and event charges for each service.

587 With the exception of event triggers for OFR and IR events, there is little opportunity for Transpower to mitigate its payment obligations.[93] Following the recent commissioning of HVDC Pole 3, Transpower's only viable event charge mitigation strategy is to prudently operate and maintain the HVDC link.

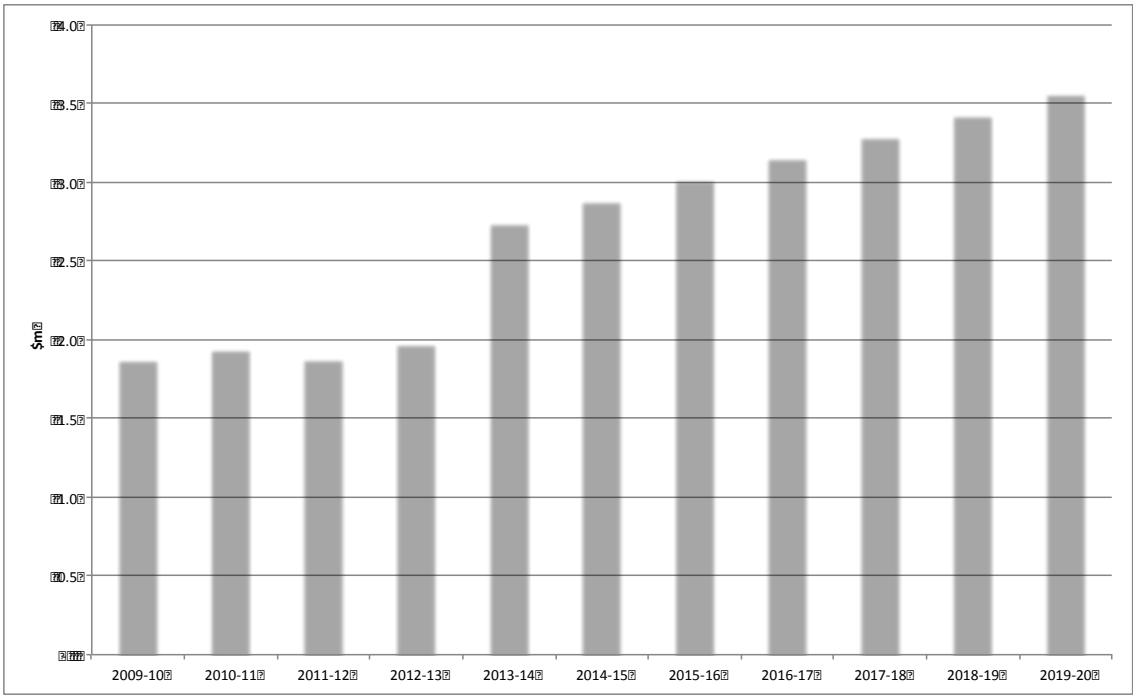
588 Figure 78 shows the actual and forecast Ancillary Services opex, including the RCP1 average annual allowance.[94] The real cost of the BS availability has increased linearly since 2005, with Transpower expecting 6% linear real increases during RCP2.

589 IR availability costs are recoverable, except if an asset is out-of-service for more than 14 days. The Pole 2 and Pole 3 configuration now in place means the average annual impact of such a scenario is very small. The combined event charges are only $0.4k p.a.

590 The much higher than actual RCP1 allowance was a function of the predicted impact of IR availability and event charges that were much larger than were actually incurred. Assuming that the System Operator is adopting a prudent approach to procuring Ancillary Services, we consider Transpower's forecasting methodology is reasonable.

[93] Considering the construct of the Code (per BS and OFR) and the thin hedge market for IR events.
[94] RCP2 Corporate Opex & Business Support Capex, GM and CEO Review, 28 June 2013, p24 and POD57, *CS Ancillary Services*, p1

Figure 78 Historic and forecast Ancillary Services opex ($m)



Assessment of Non-grid opex

591 Corporate opex appears to be excessive due to:

(a) insufficient cost-reduction focus on Departmental opex – particularly given the mooted but largely unquantified productivity benefits from its RCP1 investment and proposed RCP2 investment in the context of a period of business consolidation (i.e. following the period of major project and business improvement activity that characterised RCP1);

(b) including a step change of $2m p.a. for a new Wellington head office that has not been justified by a rigorous cost-benefit analysis; and

(c) the Investigations budget is proposed at the same level as required for RCP1 (on average) yet there is insufficient evidence to support the contention that the same amount of investigative work will be required in RCP2.

Findings on Non-Grid opex

592 A productivity adjustment of -10% should be applied to non-grid opex to reflect the reduction in opex that should be available from:

(a) extracting the full benefits of business improvement initiatives and investment in staff capability, retention and recruitment undertaken in RCP1;

(b) extracting benefits from proposed business improvement initiatives and investment in staff capability, retention and recruitment proposed to be undertaken in RCP2;

(c) a more rigorous focus on the proportion of activity spent on augmenting and improving the performance of the existing asset base compared with non-grid activities; and

(d) eliminating the average vacancy rate from the Departmental cost assumption on the basis that there will always be a 3 – 5% active vacancy level.

593 Disallow the proposed $6m opex step change ($2m p.a.) for the proposed relocation of the Wellington Head Office relocation and consolidation, as it is not supported by a business case.

594 Reduce CS Investigations allocation by 20% to $43.5m.

8.4.3 IST opex

595 In this section we test whether Transpower's IST opex expenditure is aligned with the corporate objectives and whether the expenditure is prudent and efficient.

Overview of proposed RCP2 opex

596 Transpower identifies a 7% annual average increase in IST opex during RCP2 compared to RCP1 (2012/13 – 2014/15), however, from 2011/12, the average annual expenditure in RCP1 was $43.4m and in RCP2 it is forecast to be $48.2m, an increase of 11% in real terms. Furthermore, Figure 79 illustrates the 46% increase in IST opex from 2009/10 to 2015/16.

597 Transpower states that the increase is:

> *… driven by the need to support more modular and flexible platforms, the management of new security risks, and increasing data volumes.*[95]

598 From Figure 79 and Figure 80 we see that the biggest increases in opex have come from the telecommunications services and shared services categories.

599 This growth has led to a forecast overspend of 6% ($8m) in RCP1 (2012/13 – 2014/15), with variances:

> *… largely due to changes in support costs associated with new and updated systems and the new approach to data centres.*[96]

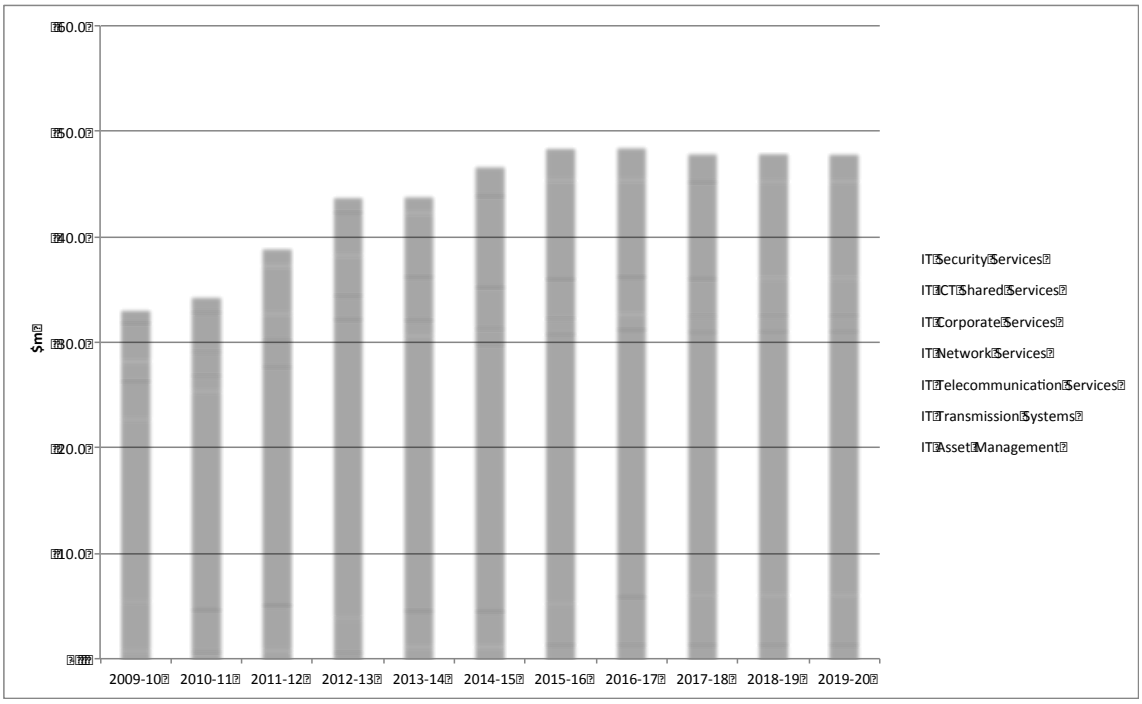
[95] Transpower Expenditure Proposal RCP2, p vii
[96] *Ibid*, p33

600 Only two of the 22 IT Portfolio Plans refer to meeting regulatory obligations as a driver for expenditure.[97] Even in those Portfolio Plans, no clear link is made to the actual expenditure incurred as a result of the obligation.

601 In RCP2, the major changes proposed are the operational separation of critical systems from non-critical systems and the move by early in RCP2 to outsourced data centres. Transpower maintains that its approach to licensing management and prudent use of emerging technology will constrain IST opex during RCP2.[98] The inference is that without this strategy being implemented, IST opex would rise. However, compelling evidence of this claim is not provided.

602 IST opex is divided into two categories: Grid and Business Support, which collectively comprise seven portfolios of expenditure. We examined the portfolios that contribute the majority of RCP2 expenditure to help understand the justification for the proposed overall 11% opex increase.

Figure 79 Historic and forecast IST opex ($m)



[97] The exceptions are IP05, IP07 which refer to IR26 (System enablement for the provision of data and information to industry participants to meet Grid Owner obligations) and Business Requirement BR076 (Provide required information to the System Operator as per the System Operator Business Capability Plan).
[98] *Ibid,* p90

Figure 80 Change in IST opex by category from 2009/10 to 2015/16

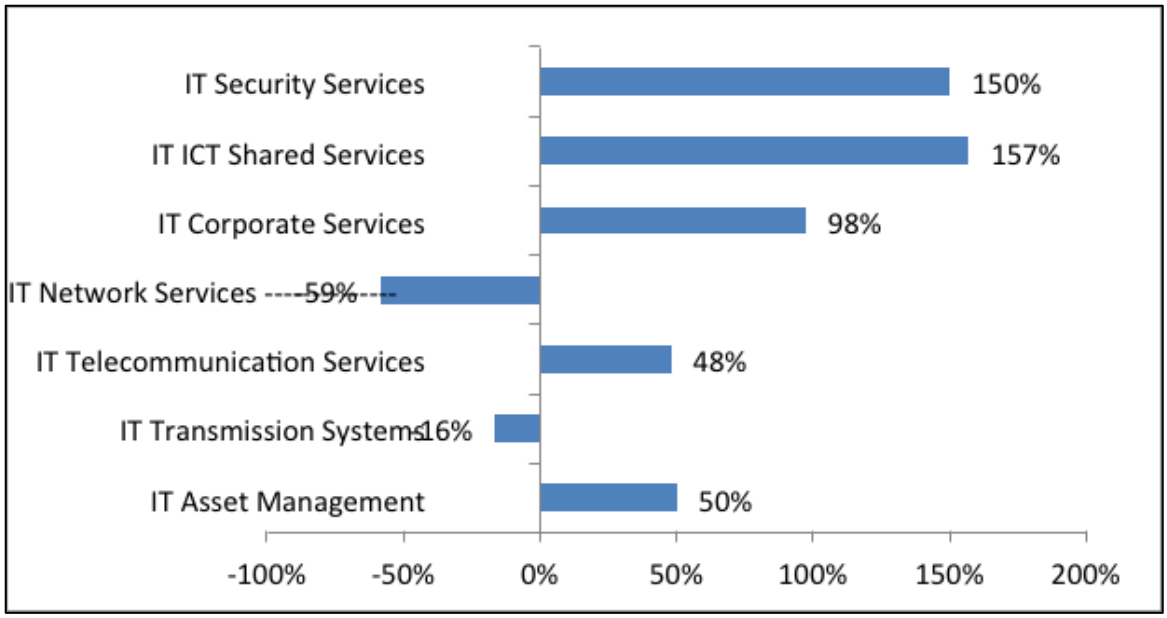
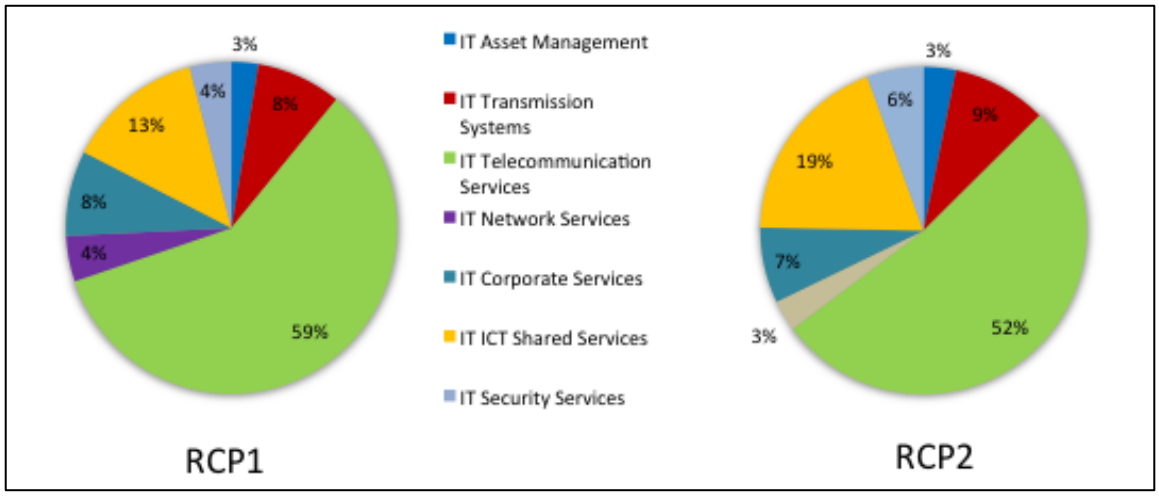


Figure 81 Relative capex in IST opex categories



603 Figure 80 illustrates the dramatic increases in five of the seven portfolios from 2009/10 to 2015/16 (year 1 of RCP2). Figure 81 shows that in percentage terms, the Telecommunication Services portfolio continues to dominate overall IST opex at 52% of total IST capex.

604 The increase in proposed Shared Services opex is also evident. While at a total expenditure level the growth in net book value of IST capital stock since 2009/10 (70%) may be reasonable in the context of the growth of Transpower's total capital stock,[99] growth in Security Services, Shared Services and even IT Corporate Services significantly exceed this growth rate and require detailed examination.

[99] Lewis & Butler. P5

Forecasting methodology

605 Transpower has adopted the 2012/13 opex as the baseline for the RCP forecast, extrapolating the base for each business service category taking into account the particular requirements and impacts (e.g. changes to the operating environment, existing and new service agreements, IST capex, emerging tools and practices).[100]

IST Grid opex

606 Grid opex comprises four portfolios, as shown in Figure 82, which compares historic and forecast Grid opex. According to Transpower, the high level of Grid opex is designed to assure instantaneous communications with 24/7 availability and instantaneous restoration in cases of faults.

607 Figure 83 shows the flat expenditure profile for the five components over RCP2. The assumed expenditure is all associated with payments to external parties (via lease agreements, third party support contracts, outsource services, licences, and contractor payments for communications and control).

608 There are a number of issues to examine to determine if Transpower has secured a prudent and efficient prices for its telecommunications services:

(a) Is outsourcing the correct strategy?

(b) What are the performance objectives?

(c) What are the terms and risks associated with the contract (incentive mechanism)?

(d) What was the tendering process (least cost?)

[100] IST Business Services Strategies 2015-2020 Overview

Figure 82 Historic and forecast IST grid opex ($m)

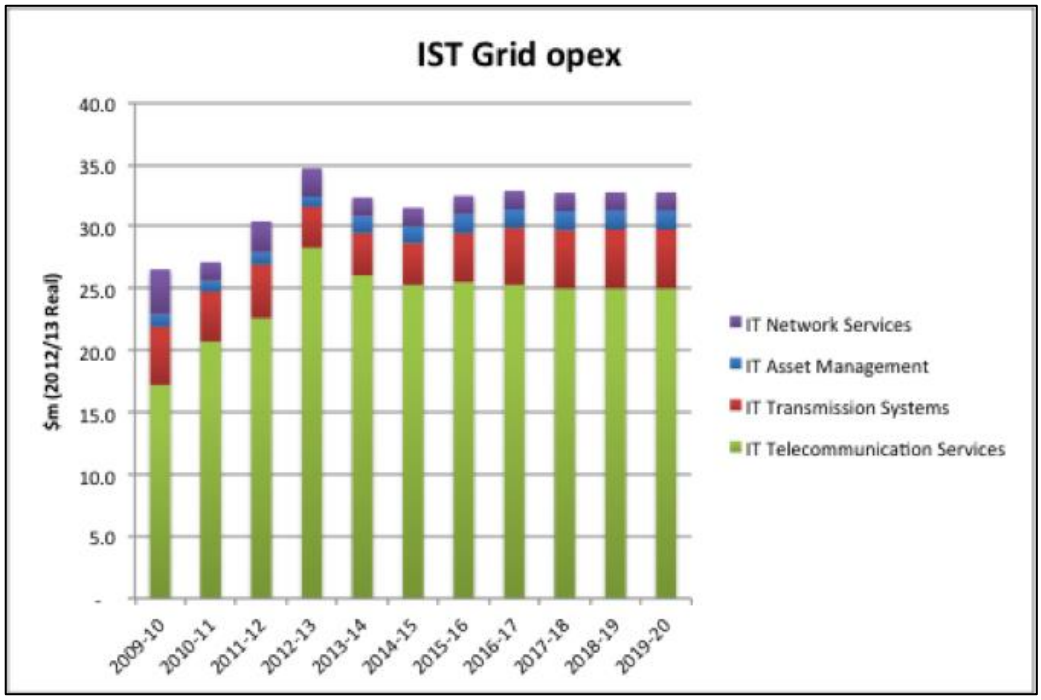
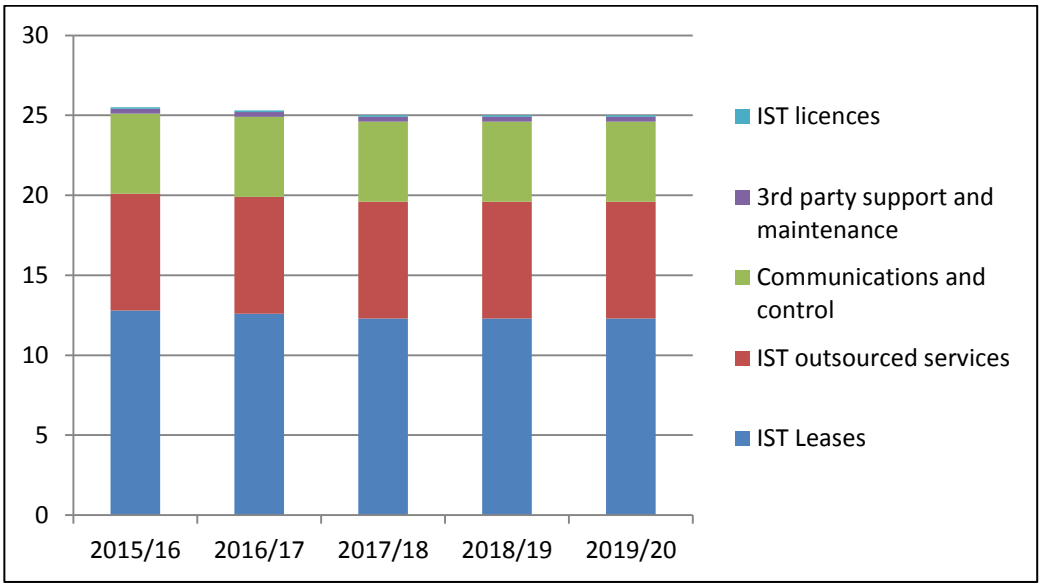


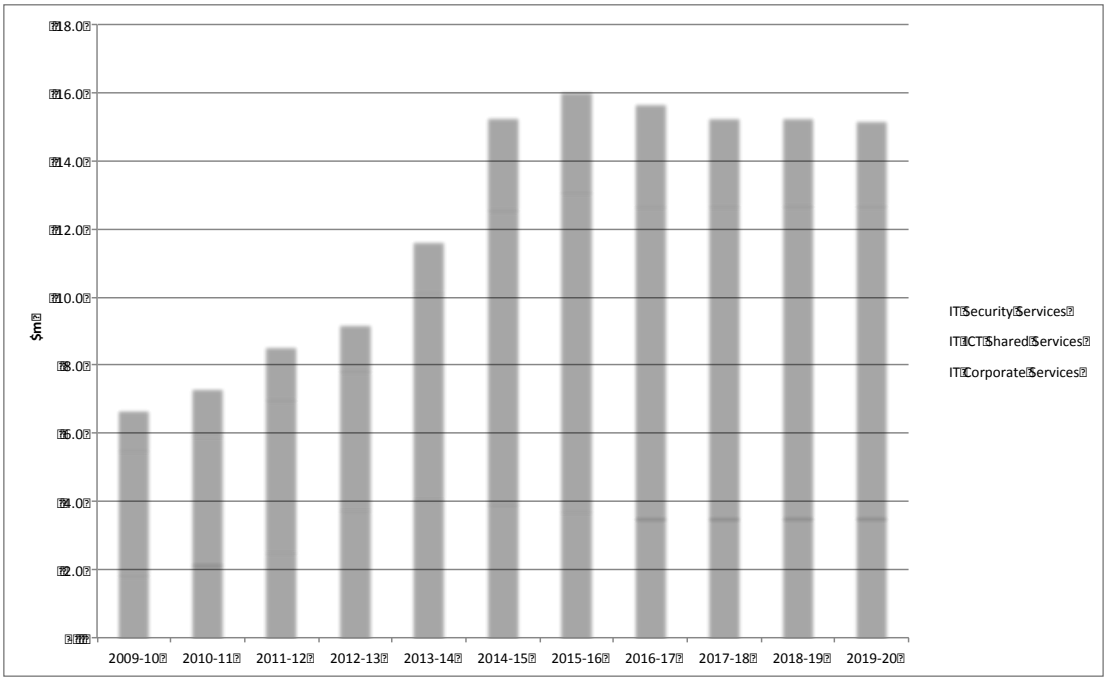
Figure 83 IST Telecommunications Services opex forecast ($m)



IST Business support opex

609 Figure 84 shows the dramatic increase in Shared Services opex that underpins the 140% increase in business support opex since 2009/10, with a total proposed RCP2 expenditure of $46.1m. IT Security Services have increased more than 2.5 times and Corporate Services have almost doubled.

Figure 84 Historic and actual IST business support opex ($m)



610 The increase in security services to an average of $2.7m pa is attributed to:[101]

(a) enhancements Transpower expects will be required over the remainder of the RCP1 period;

(b) implementation of more firewalls and security infrastructure in the early years of RCP2; and

(c) increased support and maintenance costs for the increasing amount of infrastructure.

611 The major expenditure item is Third Party Support and Maintenance – it has a declining cost profile and the supplier was selected from a competitive tender. However, Transpower has not provided compelling reasons for the extent of the increase in security services opex.

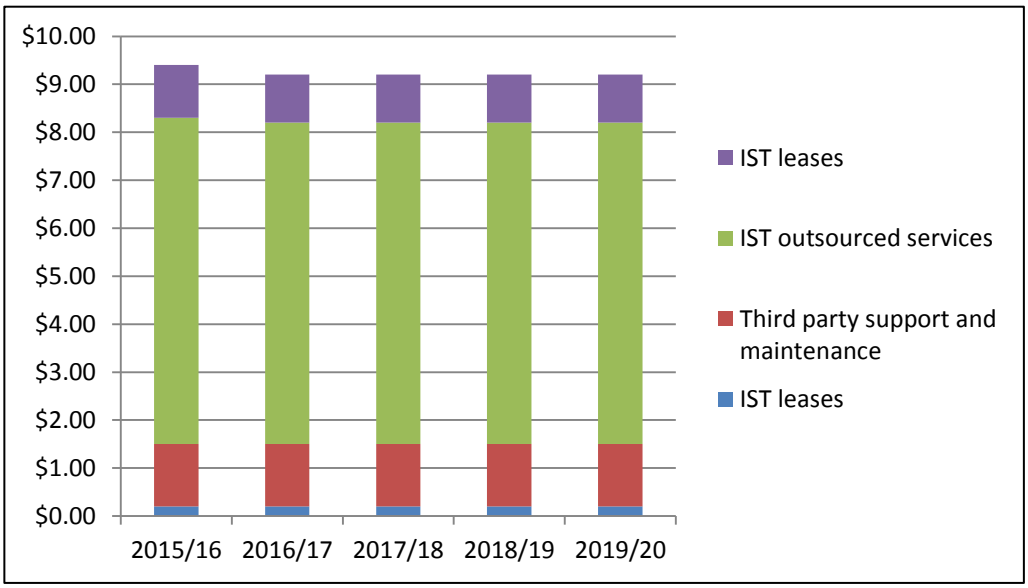
612 Figure 85 shows the composition of the proposed $46.2m Shared Services RCP2 opex. Three outsourcing contracts underpin the expenditure estimates, all of which expire in 2015. Competitive tender established the existing contracts.

613 The increase from 2012/13 to 2014/15 and beyond is to cater for the increased opex when Transpower completes its move to hosted data centres. As discussed above, Transpower concludes that incurring the increased opex (~$3.4m pa or $17m over five years) is more economical

[101] IST BSS 2015-2020 Overview, *Section 5.7.4*, p35

than Transpower investing $26m capex to build its own data centres.[102] Based on the information provided, we consider that this is a sound business decision.

Figure 85 IST Shared Services RCP2 opex forecast ($m, real 2012/13)



Benchmarking

614 The Butler & Lewis report provides extensive benchmarking information on Transpower's opex relative to other NZ businesses. It concludes that Transpower's position in the bottom of the third quartile relative to all government agencies is appropriate.[103]

615 However, we consider that comparison with Australian electricity transmission utilities would have provided greater insight into Transpower's opex trends and proposals.

Assessment of IST opex

616 Transpower's opex expenditure trend is characterised by a sharp increase in total opex over the period 2009/10 – 2014/15, driven by the costs associated with the need to support progressively modular and flexible platforms, new security risks, and increasing data volumes.

617 While RCP2 presents as a period of relative consolidation, real costs are forecast to increase by 7% over RCP2 compared to RCP1.

618 We consider the capex-opex trade-off in moving to hosted data centres, increasing opex by $17m over five years in real terms, is prudent.

[102] *Ibid*, *Section 5.4.4,* p27
[103] Butler & Lewis, *Independent Review,* p2

619 While the drivers for increased costs are clearly stated, Transpower has provided little evidence to indicate that operational efficiencies are aggressively being pursued. There are a number of opportunities in 2015 to contract for more competitive Shared Services through competitive tendering.

8.5 Recommendations on opex

620 We recommend that a productivity factor of -2% is applied to IST opex.

9 Service Performance Measures

9.1 Content of this section

621 In this section, we provide a description of what we consider is an important additional service measure – a network health measure.

9.2 Network health measure

622 We consider that a measure relating to asset health and asset capability would provide a valuable link between management of the network and the ultimate performance experienced by customers and consumers. Such measures will assist in what we consider to be the important criteria for achieving a balanced set of leading and lagging measures. This concept is discussed further in the following subsection.

623 Delivering electricity network services efficiently to consumers requires the use of sound asset management practices. Good asset management practice requires combined economic and technical evaluation of options to manage risk, cost and performance. For example, the deferment of capex for as long as possible may have economic benefits for consumers, provided that network performance and risk of failure can be managed within acceptable standards. Well-performing electricity network businesses utilise a range of asset management and network design approaches to avoid the need to spend money to replace assets unnecessarily.

624 These considerations raise the question of how service performance (as an output) can be linked to varying levels of expenditure (as the input). Transpower has proposed a number of service performance measures and targets, with an underlying assumption that the forecast expenditure proposed for RCP2 will deliver these performance outcomes.

625 We have been unable to identify an explicit process or model that could be used by Transpower to quantify this link, or test sensitivity to varying inputs in any of the RCP2 documentation we have reviewed or in our discussions with Transpower.

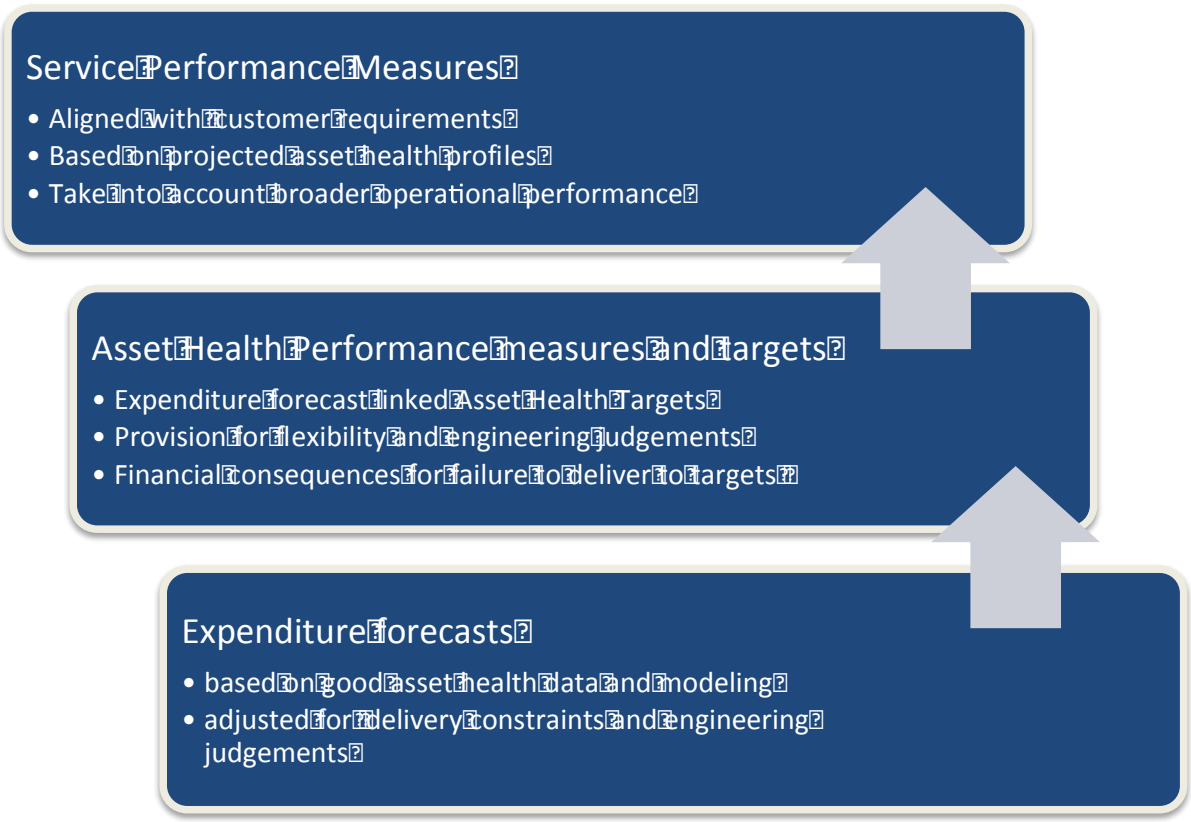
626 In addition to the service measures and targets in its proposal, Transpower has included what it refers to as Asset Health Improvement targets.[104] However, these measures and targets are proposed for the purpose of planning to clear off outstanding work backlogs (e.g. in tower painting); they are not proposed as asset fleet health indices.

[104] RCP2 proposal section 5.1.3 Asset Health Improvements

627 Because the Asset Health Improvement measure proposed by Transpower is not part of the service performance measures there are no financial consequences for Transpower if the targets are not met. However, there is a clear link between inefficient deferment of expenditure and longer-term risks of performance issues for consumers.

628 A key issue in linking expenditure to performance is the latency that exists between an expenditure decision and the consequential impact on performance. We consider that the use of asset health performance measures provides a greatly improved link between expenditure and longer-term service performance, as shown in Figure 86.

Figure 86 Hierarchy linking expenditure to performance



629 The diagram can be considered to demonstrate how expenditure supports the health of the network, which in turn delivers the performance experienced by customers and consumers. The link between performance and expenditure must take into account the current and forecast network health.

630 While Transpower's asset lifecycle approach is not yet fully mature, we consider that asset health is now capable of being used as a performance measurement tool, linking expenditure (and hence cost to consumers) to a tangible set of asset health deliverables.

631 We consider Transpower's Asset Health Improvement measure is not sufficient in its current form and should be extended to include the delivery of forecast RCP2-end asset health profiles, with performance linked to appropriate financial consequences.

Recommendation on a network health measure

632 We consider that Transpower should be requested to establish an asset health performance measure and incentive scheme based on delivery of the asset health levels its forecast expenditures are expected to produce in 2020.

633 The proposed measure will need to:

(a) address how changes to asset condition data and models occurring during the RCP will be accounted for;

(b) provide flexibility to make efficient adjustments within RCP2 (for example, an efficient capex/opex trade-off allowing deferral of an asset replacement); and

(c) include a material financial incentive for Transpower to deliver the grid in the condition it has proposed its expenditures should deliver by the end of the RCP.

634 An AHI based performance measure could be considered as an alternative to the application of an estimation bias and deliverability adjustment, as we have proposed for R&R capex. Under such an approach, we envisage that the expenditure could be allowed without adjustment but that variations between proposed 2019/20 AHI and actual AHI would be used to identify rollover deferrals. Any underspend from these deferrals would be excluded from any efficiency incentive that would otherwise be received by Transpower.

10 Concluding comments

635 Strata and EMCa thank Transpower for the cooperative manner in which it has engaged with us on this review. We understand the burden that expenditure reviews place on a business and have generally found Transpower to be responsive to our questions and requests for further information.

636 We also thank the Commission for the assistance provided to us by its management and staff.

637 We also thank Partna Consulting Group Limited for its valuable comments and assistance in this review.

Annex A E&D base capex review summaries

A.1 PD30 – Otahuhu – Wiri Transmission Capacity

Concern: The need identification is unclear and not substantiated by the support information provided

638 PD30 references four separate items from the 2103 APR but the primary driver stated in PD30 is that the N-1 capacity of the Wiri supply transformers will be exceeded from summer 2013/14. Supply transformer capacity is a customer-specific investment issue (indeed, the preferred solution anticipates that a customer investment contract for $5m would be sought). The information provided in section 8.8.13 of the 2013 APR conflicts with the information provided in PD30. The APR states that Wiri transformer capacity will be adequate until 2021 if a low cost protection upgrade is undertaken in 2019.

639 Contrary to the stated need, the actual need for this project appears to relate to 110 kV transmission capacity concerns between Bombay and Otahuhu, in respect of which it is necessary to reference information provided in the 2013 APR. The relevant APR sections are written in a very preliminary form. The APR highlights a need that requires a complex interaction of circuit outages and specific generation and loading patterns, without providing more detailed information that would be necessary to develop even a high-level understanding of the issue.

Concern: Conflicting information is provided in respect of the expected project timing

640 PD30 states "… a moderate to high level of confidence that the project will be required during RCP2."[105] This appears to be based on the project driver being the need to provide N-1 supply transformer capacity (which is unrelated to BOB-OTA transmission capacity). Against this, the benefits ascribed to two possible (but not preferred for unstated reasons) options, being the SPS (option 5) and Demand-side response (option 6) options, include that these options "… can be applied in the short to medium term to enable deferral of capex."[106] This open-ended uncertainty casts significant top-down doubt in respect of a project that might require $18.5m of base capex.

Concern: The options analysis is weak (at least it is weakly documented) in respect of a project that might require $18.5m of base capex

[105] 2013 APR, final sentence on page 1.
[106] 2013 APR, bullet point alongside Option 5 – SPS, page 5 and a similar point for Option 6.

641 Even considering that the investigation is stated to be at BC1 stage, the preferred option is significantly unsubstantiated. There is no evidence provided that the stated need would justify a business case involving $18.5m of cost (even a very high level preliminary cost benefit analysis, which should be feasible at this stage). Less expensive options appear to have been discounted for weak reasons (e.g. it is not clear why reconductoring of the BOB-OTA circuits would require double circuit outages with the consequence that Transpower "… would be unable to supply Wiri during these periods."[107] Reconductoring in two stages – i.e. the sections respectively north and south of the Wiri tee – ought to be feasible without loss of supply.)

Concern: There is no information provided relating to customer consultation

642 Vector's future demand profile at Wiri is a critical factor in this investigation, yet no information is provided relating to possible load shifting or other demand-side options.

Concern: The preferred option appears to self-select as the highest cost option that fits within the upper base capex limit of $20m

643 From a top-down perspective, an $18.5m project is a very significant level of expenditure to remedy a need that requires the alignment of three concurrent operating conditions (i.e. a circuit outage, a specific generation pattern and a specific loading condition) in order to trigger. Our experience applied to the information provided in support of PD30 would indicate that a low cost deferral option would be a much more likely RCP2 outcome than the preferred option included in the base capex forecast.

Recommendation

644 Delete the forecast expenditure associated with installation of a new interconnecting transformer at Bombay.

645 Substitute with the stated cost for option 5 – SPS of $300k in 2015. Demand-side options, which may form part of the solution, have not been provided for, as they are unlikely to require capex.

A.2 PD31 – Relieve Generation Constraints

646 PD31 includes base capex in respect of four smaller projects:

(a) Kawerau interconnecting transformer upgrade ($10.0m)

(b) Wairakei Ring HV equipment upgrade ($3.6m)

(c) Bunnythorpe – Mataroa series reactor ($1.6m)

(d) Install two special protection schemes ($0.6m)

[107] PD30, bullet point alongside Option 3, page 6.

647 We have reviewed and are in general comfortable with the expenditures for three of these projects – these are (b), (c) and (d) in the above list. These three projects represent relatively low-cost enhancements to remove generation constraints as and when they might occur and a combined total of $5.8m across RCP2 is not an unreasonable provision for such needs.

648 We are, however, concerned with the rationale provided in support of replacement and upgrade of Kawerau T13. We understand that T12 is currently being upgraded to a new 250 MVA unit and that the Commission approved this as a major capex project. Given the upgrade of only one of the two interconnecting transformers was able to pass the Grid Investment Test, it is in retrospect unfortunate that the healthier of the two transformers was chosen for replacement.

649 With new information now available regarding the actual health of T13, it is not automatic that upgrading T13 within RCP2 is the best option available. A proposed expenditure on the order of $10m (which formerly would have required approval by the Commission as major capex) would justify significantly more supporting information than has been provided. Relevant factors in consideration of this include:

(a) that the internal condition of T13 is apparently not of sufficient concern to warrant its immediate removal from service,[108] hence there is time available to undertake further need identification and analysis of options;

(b) that other alternatives likely exist, such as:

(i) not replacing T13 until the capacity of T12 is inadequate to export current and committed Kawerau generation – instead, simply remove T13 from service (or put it on hot standby) in the meantime;

(ii) replacing T13 with the decommissioned (younger/healthier) T12 unit, which would have the additional benefit of providing an additional 40 MW of export capacity from Kawerau 110 kV. Upgrade this transformer when export capacity issues justify this;[109]

[108] This conclusion is supported by information provided in Transpower's transformer asset health model (Q006 - Attachment - MD03 - Model - Power Transformers - 2 Dec 2013 - Q#006-04.XLSM), which indicates an assessed (modelled?) end-of-life date of 2019/20 for T13.

[109] This conclusion is supported by information provided in Transpower's major capex proposal to the Commission (see Kawerau Generation Export Enhancement Investment Proposal, December 2011, available on the Commission's website). Section 5 concludes there was effectively no difference between the options of replacing (i) T12 or (ii) T13 with 150 or 250 MVA, 10% impedance units. With the benefit of hindsight and in light of new information relating to the actual health of T13, electing to replace the significantly younger (and healthier) T12 in 2013/14, thus leaving a transformer (T13) in service in a configuration that afforded 40 MW less export capacity, affords a material difference to the two options that was not considered in the analysis. The export capacity calculations of the various options are set out in Table 2 of Attachment B to this report.

(iii) reinstating (or not removing) the 110 kV circuit bypass at Kawerau that provides additional export capacity, possibly in conjunction with either of options (i) or (ii) above.

(c) that the next increment of export capacity that would justify installation of a second new 250 MVA unit would run up against 220 kV export concerns,[110] rendering the entire issue beyond the expenditure limit for base capex and necessitating a major capex proposal at the appropriate time.

Recommendation

650 Delete the expenditure associated with part (a) – Kawerau interconnecting transformer upgrade ($10.0m).

651 Accept the expenditure associated with parts (b), (c) and (d), totalling $5.8m. We note that the four project cost components set out on page 4 of PD31 do not add to the total forecast summarised on page 1. At this stage we have included the lesser of the two options

652 As the proposed expenditure relating to each of the four projects in PD31 is not broken down by year, we have made a corresponding assumption in how the adjustment is applied across the three relevant forecast years.

A.3 PD32 – Upper North Island Reactive Support

653 PD32 provides for additional reactive power support in the Upper North Island region to support increasing regional loads. The need for and type of incremental reactive power support is primarily driven by demand and an on-going lack of in-region generation.

654 We have minor concerns relating to the justification of this project, as follows:

(a) There is an inconsistency between the rationale for additional reactive power support provided in PD32 and the relevant sections of the 2013 APR. The APR forecasted a need within RCP2 that included local voltage support investment at points in Northland north of Marsden,[111] whereas PD32 proposes 2 x 100 MVAr static capacitor banks, which would indicate connection to electrically stronger Auckland-based busses. The status of the Northland issue is not clear.[112]

(b) We are concerned with the relative lack of specificity in considering options that could delay the relatively significant capex associated with installation of capacitor banks. SPS and DSR are noted as options and are, in fact, included in the preferred option as options

[110] See Kawerau Generation Export Enhancement Investment Proposal, Attachment B (Technical, Options and Cost Report) December 2011, section 1.4, page 8, available on the Commission's website.
[111] See 2013 APR, page 49, detail within the section headed "Resolving projects".
[112] See 2013 APR, section 7.8.7.

that might delay the need for capacitors.[113] However, the lack of a provisional base capex amount for implementing either of these options provides the impression that neither is considered to provide a pragmatic option. In contrast, a P50 costing for the capacitor bank option is provided for $8.01m with commissioning in 2019/20. Would SPS and/or DSR delay this timing or does the timing already include the impact of SPS and/or DSR?

(c) As discussed in section 6.3.5 (Demand Forecasting), demand growth is remaining flat. PD32 recognises the impact of this on the timing of this project (by indicating that the latest review includes a one year delay from the previous review of voltage support needs) but it is very possible that further delay will eventuate.

Recommendation

655 Notwithstanding the concerns discussed above, we accept that the project has been sufficiently developed in accordance with Transpower's Planning Lifecycle Strategy, with a good likelihood of necessity within RCP2, even if it were to be delayed by a further year beyond the currently forecast need date.

656 Accordingly, we support retention of this project in the RCP2 base capex forecast as proposed.

A.4 PD33 – Bus Section Fault Reliability

657 PD33 provides for solutions to three identified bus section security deficiencies at Haywards, Bunnythorpe and Mt Roskill.

658 The Haywards project provides for additional security by ensuring that each 220/110 kV interconnecting transformer connects to a separate 110 kV bus section. The project is supported with additional information in the 2013 APR.[114] We have no concerns with the needs identification or option selection for this project.

659 The Bunnythorpe project provides for additional security by rearranging 220 kV circuit terminations on the Bunnythorpe bus. The project is supported with additional information in the 2013 APR.[115] We have no concerns with the needs identification or option selection for this project.

660 The Mt Roskill project provides for additional security by creating three 110 kV bus sections. Our concern with this project is that the 2013 APR notes that Vector had not (at least at the date of publication) requested additional security beyond that provided by the current arrangement and that further investment would be customer driven.[116]

[113] PD32, page 5.
[114] 2013 APR, page 250.
[115] 2013 APR, pages 197 – 199.
[116] 2013 APR, page 126.

661 PD33 provides no information relating to updated customer needs at Mt Roskill. Assuming the customer now wants upgraded security, it is not clear how a three bus section arrangement has been arrived at as providing the optimal solution over other possible arrangements. Without additional supporting information, including confirmation of customer commitment, we cannot support inclusion of this project in the PD33 forecast.

Recommendation

662 Accept the expenditure associated with the Haywards and Bunnythorpe projects

663 Delete the expenditure associated with the Mt Roskill project.

A.5 PD34 – Wellington Supply Security

Concern: The need identification summary raises some significant questions around the project drivers

664 Firstly, the need is described as a concern about the tripping of a second circuit with another circuit out of service for maintenance. This is a second order (N-2) contingency, not normally provided for under the grid reliability standards, that would only give rise to a risk during periods of high load. We are unsure why Transpower would schedule maintenance during high load periods if alternative outage windows were available.

665 Secondly, the need is linked to a project to reconductor circuits on the CPK-WIL B line. It is stated that up to two months of double circuit outages will be required to undertake the reconductoring work. At our Q&A session with Transpower, it was further explained that the need for double circuit outages was related to the small number of triple circuit tower spans adjacent to Central Park substation. If this is in fact the case, it raises further questions about how the work on these spans can be undertaken with the third circuit still live and why work on these few (~4?) spans would take two months of continuous outage to complete. If it relates to reconductoring work on the double circuit section of the line, we are not clear as to why one circuit cannot be reconductored with the other circuit live.

666 Thirdly, the need is associated with the need to provide uprated transformer capacity at Central Park. Why would Vector be required to enter into a customer investment contract for upgraded supply transformer capacity at Wiri (see (a) above – note these transformers are also stated to be replacing lower capacity transformers near the end of their serviceable life) while Wellington Electricity would have two 180 MVA transformers provided under base capex? It is possible that a customer investment contract is envisaged in this project (perhaps related to the incremental capacity to be provided) but this is not discussed.

Concern: Project timing is inadequately described

667 The statement that the inability of existing supply transformers to provide N-1 capacity from 2016 provides a moderate level of confidence that the

expenditure will be required during RCP2 ignores the stated driver for the majority of the expenditure in this project.

Concern: The options analysis is weak (at least it is weakly documented) in respect of a project that might require $11.4m of base capex

668 Combining two separate issues into a single project has significantly complicated the need identification and options analysis. Considered on its own, the need for and timing of a supply transformer upgrade is a relatively straightforward prospect and appears to coincide with an end-of-life decision that, following adequate customer consultation (particularly in respect of Wellington Electricity's sub-transmission development plans and demand forecasts) would lead to a routine customer investment contract driven upgrade, outside of base capex.

669 The question of the system security provided by a three transformer-ended feeder arrangement is also relatively straightforward. With long-term transformer capacity having been settled through consultation with the customer (the circuit capacities not providing any practical constraint), system security on an N-1 basis should be automatic (and any enhanced system security requirements beyond N-1 would be a matter for customer specific investment). The major concern we have with PD34 is that we can see no valid rationale for construction of a 110 kV bus at Central Park. As discussed in (i) above, we significantly question the need for lengthy double circuit outages for reconductoring of CPK-WIL B and this appears to be the primary rationale for a 110 kV bus at Central Park at a cost of $8.7m.[117]

Recommendation

670 Delete the forecast expenditure associated with installation of a 110 kV bus at Central Park.

671 Delete the forecast expenditure associated with upgrading T3 and T4 to 180 MVA. The choice of transformer capacity should be a customer specific investment, outside of base capex (c.f. Wiri supply transformer capacity upgrade).

A.6 PD35 – Otahuhu and Penrose Interconnecting Capacity

672 This project provides for the upgrade of interconnecting transformers at Otahuhu and Penrose, driven by the need to replace Otahuhu T2 and Penrose T10 at end-of-life within RCP2. We accept that these replacements appear to be justified within RCP2 and that upgrading to 250 MVA capacity is appropriate.

673 The case for also replacing Otahuhu T4, which would have 18 years remaining life at the end of RCP2, is made on the basis that it would not

[117] Being calculated as the difference between the option 1 and option 2 costs on pages 3 and 4 of PD34.

share with the three other parallel transformers, making it "the limiting factor on the interconnection capacity at Penrose and Otahuhu."[118]

674 Our concern is that the extent and impact of the limitation that would be caused by delaying replacement and upgrade of T4 is not provided. It is thus unclear as to whether there is a case to advance replacement of T4, particularly as a significant amount of load that was historically supplied from Penrose 110 kV is now, or soon will be, transferred to the 220 kV network via Hobson St.

675 We would have expected that alternative options would have been included as options for analysis, such as:

(a) delay replacement of T4 for up to 18 years; or

(b) delay replacement of T4 for up to 18 years and install a series reactor if/when necessary to ensure parallel load sharing.

Recommendation

676 Accept the expenditure associated with replacement and upgrade of Otahuhu T2 and Penrose T10 within RCP2.

677 Delete the expenditure associated with replacement and upgrade of Otahuhu T4.[119]

A.7 PD36 – Bunnythorpe Interconnecting Capacity

678 This project provides for the upgrade of three interconnecting transformers at Bunnythorpe, driven by the need to replace Bunnythorpe T1, T2 and T3 at end-of-life within RCP2.

679 We accept that these replacements appear to be justified within RCP2 and that upgrading to 2 x 150 MVA capacity transformers appears to represent the optimal replacement and upgrade option.

Recommendation

680 Accept the expenditure associated with replacement and upgrade of Bunnythorpe interconnecting transformers within RCP2.

A.8 PD37 – North Taranaki Transmission Capacity

681 This project provides for an early upgrade option associated with end-of-life replacements of the Stratford and New Plymouth interconnecting transformers forecast for RCP3.

[118] PD35, page 1.
[119] The individual transformer upgrade costs have not been broken out in PD35, so we have assumed one third of the total for each transformer.

682 The forecast expenditure for PD37 spans across RCP2 and RCP3, with $3.03m forecast for RCP2. The preferred option is to install a new 200 MVA transformer at Stratford to operate, initially at least, alongside the existing 100 MVA transformer.

683 We note that the needs identification for this project cites as key drivers overloading of the Carrington Street – Stratford circuit and low 33 kV voltage at Huirangi, if New Plymouth T8 is out of service. However, the preferred option (providing additional interconnection capacity at Stratford) does not appear to address either of these problems (which would appear to require additional 110 kV circuit capacity north of Stratford).

684 We also note a contradiction in the preferred solution for this project (requiring a new 200 MVA 220/110 kV transformer) with supporting information provided in PD35, which rejects the option of installing new 200 MVA 220/110 kV transformers in Auckland on the grounds that 200 MVA is a non-standard capacity.[120]

685 In line with our earlier views regarding demand forecasts, we consider there is a very good chance that the commencement date for this project will slip into RCP3 and, for the reasons outlined above, consider that this project requires further options development and analysis.

Recommendation

686 Delete the forecast expenditure associated with commencing a project to upgrade the Stratford interconnecting transformer capacity within RCP2.

A.9 PD38 – Timaru Interconnecting Transformers Capacity

687 This project provides for increased interconnecting transformer capacity at Timaru. The need arises following resolution of major capex decisions relating to alternative means of addressing the 110 kV capacity issue.

688 Transpower considers that the need year is 2018, based on the 2013 APR demand forecast. While it is possible that this date could be delayed, we consider it likely that one of the more costly options will be justified to commence within RCP2, and are comfortable with the forecast provision included in PD38.

689 At this stage, we are not convinced that the preferred option represents the best alternative. For example, further work in identifying demand-side management resource (including contingency triggered sheddable load) may delay the need for investment in major primary network equipment. Nevertheless, the forecast expenditure of $2.52m in 2019/20 is a reasonable provision.

[120] See PD35, footnote 2.

Recommendation

690 Accept the forecast expenditure associated with commencing an option to upgrade of Timaru 110 kV capacity within RCP2.

A.10 PD39 – Southland Reactive Power Support

691 This project provides for increased reactive power support in the Southland region to provide additional post-contingency system security following anticipated demand growth. There are currently 2 x 50 MVAr static capacitor banks installed at North Makarewa.

692 The preferred option has two components:

(a) install an additional 70 MVAr bank at North Makarewa; and

(b) replace the 2 x 50 MVAr banks with 2 x 70 MVAr banks at the same time as (a).

693 This option would increase the installed reactive power support from 100 MVAr to 210 MVAr in 2017/18. It would be achieved by bringing forward replacement of the two existing banks, which PD39 states would not be required until RCP3. The justification provided for early replacement is that there would be (unquantified) project efficiencies from this option.[121]

694 We are not convinced that the early replacement of the existing banks is justified on a cost benefit basis. The two project components would appear to be independent asset management decisions. It may be that ultimate replacement of the two existing banks can be further delayed on an asset health basis – this possibility is not considered. It should not pose any near-term issues to achieve 170 MVAr in 2017/18, rather than the 210 MVAr proposed.

Recommendation

695 As the project component costs have not been broken down, we have made the simple assumption that one third of the forecast capex is justified. Accordingly, we recommend deleting two thirds of the forecast capex in PD39.

A.11 PD40 – High Impact Low Probability Event Mitigation

696 This project aims to improve system security by investigating and deploying a number of relatively low cost, high value initiatives that would reduce the extent of, and increase responsiveness to, high impact, low probability events at key grid substations.

697 The portfolio of smaller projects is supported by a completed investigation that appears to justify expenditure of $4m at Islington for two separate

[121] We also note here that there is no additional supporting information provided in the 2103 APR for this upgrade and early replacement project.

initiatives. The proposal includes an estimate of a further $5.2m across the balance of RCP2 for similar initiatives at other key grid substations.

698 We consider these types of expenditure generally represent good value for relatively little money and support the additional (but yet to be substantiated) provision of $5.2m within RCP2.

Recommendation

699 Accept the forecast expenditure of $9.2m within RCP2.

A.12 PD41 – Hororata and Kimberley Voltage Quality

700 This project provides for new reactive power support in the 66 kV network between Islington and Hororata. The preferred option is to install 3 x 9 MVAr static capacitor banks at Hororata in 2015/16.

701 The investment is justified on the basis of a net market benefit test, which is yet to be undertaken. PD41 acknowledges that the justification of this project is marginal – it requires confirmation of costs – and may not be proceeded with. It also relies on increased peak demand at Hororata and Kimberley.

702 Peak demand at Hororata and Kimberley totals 58 MW in 2013 and 63 MW in 2020.[122] This represents a marginal level of demand growth, unlikely on its own to trigger an investment need. Less costly options appear to be feasible but are not preferred.

703 We would be happy to reconsider this project in light of completed (or even indicative, which should be achievable given the straightforward nature of the proposed solution) net market benefit test results but at this stage, the expenditure forecast for this project is unsubstantiated.

Recommendation

704 Delete the expenditure proposed for PD41.

A.13 PD42 – Islington Spare Transformer Switchgear

705 This project provides for installation of the new spare 220/66 kV interconnecting transformer at Islington, by providing switchgear, protection and a neutral earthing transformer and operating the transformer on hot standby.

706 Our main concern with this proposal is that it appears to be an afterthought on top of an earlier project that presumably justified purchase of the spare transformer in the first place. The additional $2.4m required to install and energise the transformer at Islington should have been included in the original business case.

[122] See 2013 APR, pages 288 – 289. Note, peak demand diversity across the three supply busses is ignored.

707 We note that the investment on an incremental projects basis (i.e. in addition to the earlier purchase of the transformer itself) has not yet been economically justified. It also represents an enhanced N-2 level of security with no indication that the affected customers have requested this.

708 We would be happy to reconsider this project in light of a completed (or even indicative, which should be achievable given the straightforward nature of the proposed solution) cost benefit analysis but at this stage, the expenditure forecast for this project is unsubstantiated.

Recommendation

709 Delete the expenditure proposed for PD42.

A.14 PD43 – Haywards Local Service Third Incomer

710 This project provides for installation of a third 11 kV local service incomer, supplying the synchronous condenser auxiliaries at Haywards. The proposed arrangement would increase 11 kV supply bus security to an N-2 level.

711 The concern is that the synchronous condensers would suddenly trip if 11 kV local service was lost. This might cause island-wide automatic under-frequency load shedding if the HVDC transfer pre-contingency were high enough.

712 A net present cost of $10 – 70k is estimated for this contingency (the return period for the cause is estimated at 1 in 2,700 years) and it is difficult to see a capex of $1.8m being justified against the benefit of avoiding a $70k NPV cost. There are also likely to be other less costly options that would provide a more economic solution. For example, it is not clear why the synchronous condensers would need to be instantaneously tripped following the loss of 11 kV supply. Loss of cooling system power is cited as the primary driver but this is unlikely to pose an instantaneous over-temperature condition.

Recommendation

713 Delete the expenditure proposed for PD43.

A.15 PD44 – E&D Other

714 PD44 provides for five miscellaneous projects.

715 A. Christchurch reactive power controller (RPC)
This project anticipates replacement of the Bromley interconnecting transformers in RCP2 and provides for incorporation of the on-load tap changers (OLTC) with the RPC and the training simulator. However, the stated benefits do not appear to relate to OLTC, rather to capacitors at Bromley, citing a wider range of benefits that do not fit the project need statement. The basis for undertaking this project is thus unclear.

716 B. North of Huapai transmission security
This project provides a solution to a possible contingency in which the bus

section breaker at Huapai fails to trip for a fault on the Albany or Henderson circuits. The proposed solution is to install surge arrestors and motorised disconnectors and split the Huapai bus when the network is under normal configuration. Unless we have misunderstood the intent, this would appear to revert the operating configuration of the circuits north of Albany and Henderson to the state that existed prior to commissioning of Huapai. Further information is required to fully explain the proposal and to quantify (at least at a high level) net benefits.

717 C. De-rate Bombay capacitor

The Bombay capacitor appears to be overrated against the strength of the network it is connected to and is consequently underutilised. The project is intended to de-rate the capacitor bank. Without further information, our view is that this appears to be a project that would remedy a former design mistake. If this is in fact a mistake that could have been foreseen, we do not support inclusion of further capex to remedy this situation now, particularly considering the original investment would have cost more than was necessary at that time. The project is also connected with PD30 and we agree it should be more appropriately considered within that scope.

718 D. Real Time Digital Simulator (RTDS) upgrade

This project provides for the upgrade of processing capacity for a power system modelling tool. While we are unsure why this would be provisioned under E&D grid capex – and not under IST capex – we are comfortable with the need.

719 E. Supply transformer minor enhancement project

This project provides for the upgrade of three supply transformers by removing secondary equipment constraints. We consider this solution cost-effectively unlocks additional capacity.

Recommendation

720 Delete the expenditure associated with projects A, B and C.

721 Accept the expenditure associated with projects D and E.