**PRELIMINARY DECISION
Jemena distribution
determination
2016 to 2020**

**Attachment 6 – Capital
expenditure**

October 2015

AUSTRALIAN
ENERGY
REGULATOR

Note

This attachment forms part of the AER's preliminary decision on Jemena's revenue proposal 2016–20. It should be read with all other parts of the preliminary decision.

The preliminary decision includes the following documents:

Overview

Attachment 1 - Annual revenue requirement

Attachment 2 - Regulatory asset base

Attachment 3 - Rate of return

Attachment 4 - Value of imputation credits

Attachment 5 - Regulatory depreciation

Attachment 6 - Capital expenditure

Attachment 7 - Operating expenditure

Attachment 8 - Corporate income tax

Attachment 9 - Efficiency benefit sharing scheme

Attachment 10 - Capital expenditure sharing scheme

Attachment 11 - Service target performance incentive scheme

Attachment 12 - Demand management incentive scheme

Attachment 13 - Classification of services

Attachment 14 - Control mechanism

Attachment 15 - Pass through events

Attachment 16 - Alternative control services

Attachment 17 - Negotiated services framework and criteria

Attachment 18 - f-factor scheme

Contents

Shortened forms

Shortened form	Extended form
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
AMI	Advanced metering infrastructure
augex	augmentation expenditure
capex	capital expenditure
CCP	Consumer Challenge Panel
CESS	capital expenditure sharing scheme
CPI	consumer price index
DRP	debt risk premium
DMIA	demand management innovation allowance
DMIS	demand management incentive scheme
distributor	distribution network service provider
DUoS	distribution use of system
EBSS	efficiency benefit sharing scheme
ERP	equity risk premium
Expenditure Assessment Guideline	Expenditure Forecast Assessment Guideline for electricity distribution
F&A	framework and approach
MRP	market risk premium
NEL	national electricity law
NEM	national electricity market
NEO	national electricity objective
NER	national electricity rules
NSP	network service provider
opex	operating expenditure
PPI	partial performance indicators
PTRM	post-tax revenue model
RAB	regulatory asset base
RBA	Reserve Bank of Australia
repex	replacement expenditure

Shortened form	Extended form
RFM	roll forward model
RIN	regulatory information notice
RPP	revenue and pricing principles
SAIDI	system average interruption duration index
SAIFI	system average interruption frequency index
SLCAPM	Sharpe-Lintner capital asset pricing model
STPIS	service target performance incentive scheme
WACC	weighted average cost of capital

6 Capital expenditure

Capital expenditure (capex) refers to the investment made in the network to provide standard control services. This investment mostly relates to assets with long lives (30-50 years is typical) and these costs are recovered over several regulatory periods. On an annual basis, however, the financing cost and depreciation associated with these assets are recovered (return of and on capital) as part of the building blocks that form part of Jemena's total revenue requirement.[1]

This attachment sets out our preliminary decision on Jemena's total forecast capex. Further detailed analysis is in the following appendices:

- Appendix A - Assessment techniques
- Appendix B - Assessment of capex drivers
- Appendix C - Maximum demand forecasts
- Appendix D - Real cost escalation
- Appendix E - Predictive modelling approach and scenarios.

6.1 Preliminary decision

We are not satisfied Jemena's proposed total forecast capex of $708.6 million ($2015) reasonably reflects the capex criteria. This is 38 per cent greater than the AER's allowance for the 2011–15 regulatory control period ($515.1 million) and 10 per cent greater than actual capex for the 2011–15 period ($641.9 million). We substituted our estimate of Jemena's total forecast capex for the 2016–20 regulatory control period. We are satisfied that our substitute estimate of $670.7 million ($2015) reasonably reflects the capex criteria. Table 6.1 outlines our preliminary decision.

Table 6.1   Our preliminary decision on Jemena's total forecast capex ($2015, million)

	2016	2017	2018	2019	2020	Total
Jemena's proposal	131.8	158.1	149.8	141.9	127	708.6
AER preliminary decision	129.8	141.9	133.1	139	126.9	670.7
Difference	–2	–16.2	–16.7	–2.9	-0.1	–37.9
Percentage difference (%)	–1.5	–10.2	–11.1	–2.0	–0.1	–5.3

Source: AER analysis.
Note: Numbers may not add up due to rounding.

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[1]   NER, cl. 6.4.3(a).

Table 6.2 summarises our findings and the reasons for our preliminary decision.

These reasons include our responses to stakeholders' submissions on Jemena's regulatory proposal. In the table we present our reasons by 'capex driver' (for example, augmentation, replacement, and connections). This reflects the way in which we tested Jemena's total forecast capex. Our testing used techniques tailored to the different capex drivers, taking into account the best available evidence. Through our techniques, we found some aspects of Jemena's proposal, such as repex, were consistent with the NER. We found Jemena's proposal associate with other capex drivers were higher than an efficient level, inconsistent with the NER.[2] We are not satisfied that Jemena's proposed total forecast capex is consistent with the requirements of the NER.

Our findings on the capex drivers are part of our broader analysis and should not be considered in isolation. Our preliminary decision concerns Jemena's total forecast capex for the 2016–20 period. We do not approve an amount of forecast expenditure for each capex driver. However, we use our findings on the different capex drivers to arrive at an alternative estimate for total capex. We test this total estimate of capex against the requirements of the NER (see section 6.3 for a detailed discussion). We are satisfied that our estimate represents the total forecast capex that as a whole reasonably reflects the capex criteria.

Table 6.2   Summary of AER reasons and findings

Issue	Reasons and findings
Total capex forecast	Jemena's proposed a total capex forecast of $708.6 million ($2015) in its proposal. We are not satisfied this forecast reflects the capex criteria. We are satisfied our substitute estimate of $670.7 million ($2015) reasonably reflects the capex criteria. Our substitute estimate is 5.3 per cent lower than Jemena's proposal. The reasons for this decision are summarised in this table and detailed in the remainder of this attachment.
Forecasting methodology, key assumptions and past capex performance	We consider Jemena's key assumptions and forecasting methodology are generally reasonable. Where we identified specific areas of concern, we discuss these in the appendices to this capex attachment and section 6.4.2.
Augmentation capex	We do not accept Jemena's forecast augex of $140.6 million ($2015) as a reasonable estimate for this category. We consider that $92.5 ($2015) million is a reasonable estimate for Jemena to meet forecast demand growth and satisfy the capex criteria, including augex relating to the VBRC. In coming to this view we accept that Jemena's demand forecasts reflect a realistic expectation of demand. However we are not satisfied that Jemena's planning process always results in the most prudent and efficient option to address the need for augmentation investment.
Customer connections capex	We are satisfied Jemena's forecast is a reasonable estimate for this category. We have included an amount of $159.9 million ($2015) in our substitute capex estimate. In doing so, we have reclassified expenditure Jemena has forecast for the Melbourne Airport Expansion as augmentation capex.

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[2]   NER, cll. 6.5.7(c) and (d).

Issue	Reasons and findings
Asset replacement capex (repex)	We accept Jemena's forecast repex of $224 million ($2015) as a reasonable estimate for this category. We consider this forecast will allow Jemena to meet the capex objectives.
Non-network capex	We accept Jemena's forecast non-network capex of $137.2 million ($2015) as a reasonable estimate of the efficient costs a prudent operator would require for this category. However, we have reallocated a portion of Jemena's forecast ICT capex related to metering from standard control to alternative control services. We have therefore included forecast non-network capex for standard control services of $135.9 million ($2015) in our alternative estimate of total capex for the 2016–2020 regulatory control period. Jemena's forecast non-network capex is 1 per cent lower than actual non-network capex in the 2011–15 regulatory control period. We are satisfied that the forecast reduction in non-network capex reflects the underlying drivers of expenditure in this category.
Capitalised overheads	We do not accept Jemena's proposed capitalised overheads of $168.8 million ($2015). We have instead included in our substitute estimate of overall total capex an amount of $164.4 million ($2015) for capitalised overheads. Given that our assessment of Jemena's proposed direct capex demonstrates that a prudent and efficient distributor would not undertake the full range of direct expenditure contained in Jemena's proposal, it follows that we would expect some reduction in the size of Jemena's capitalised overheads. We reduced Jemena's capitalised overheads accordingly.
Real cost escalators	In respect of real material cost escalators (leading to cost increases above CPI), we are not satisfied that Jemena's proposed real material cost escalators, which form part of its total forecast capex, reasonably reflect a realistic expectation of the cost inputs required to achieve the capex objectives over the 2016–20 regulatory period. We consider that zero per cent real cost escalation is reasonably likely to reflect the capex criteria including that it is likely to reasonably reflect a realistic expectation of the cost inputs required to achieve the capex objectives over the 2016–20 regulatory period. Our approach to real materials cost escalation does not affect the proposed application of labour and construction cost escalators which apply to Jemena's forecast capex for standard control services. We are not satisfied Jemena's proposed real labour cost escalators which form part of its total forecast capex reasonably reflect a realistic expectation of the cost inputs required to achieve the capex objectives over the 2016–20 regulatory period. We discuss our assessment of forecast our labour price growth for Jemena in attachment 7. The difference between the impact of the real labour and materials cost escalations proposed by Jemena and those accepted by the AER in its capex decision is $2.6 million ($2015).

Source: AER analysis.

We consider that our overall capex forecast addresses the revenue and pricing principles. In particular, we consider our overall capex forecast provides Jemena a reasonable opportunity to recover at least the efficient costs it incurs in:

- providing direct control network services; and

- complying with its regulatory obligations and requirements.[3]

As set out in appendix B we are satisfied that our overall capex forecast is consistent with the national electricity objective (NEO). We consider our decision promotes efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity.

We also consider that overall our capex forecast addresses the capital expenditure objectives.[4] In making our preliminary decision, we specifically considered the impact our decision will have on the safety and reliability of Jemena's network. We consider this capex forecast should be sufficient for a prudent and efficient service provider in Jemena's circumstances to be able to maintain the safety, service quality, security and reliability of its network consistent with its current obligations.

6.2 Jemena's proposal

Jemena proposed total forecast capex of $708.6 million ($2015) for the 2016–20 regulatory period. This is $66.7 million ($2015) above Jemena's actual capex of $641.9 million ($2015) for the 2011–15 regulatory control period.

Figure 6.1 shows the increase between Jemena's proposal for the 2016–20 regulatory period and the actual capex that it spent during 2011–15. Jemena has stated that this forecast increase in capex is mainly attributable to a need to:[5]

- increase replacement of ageing assets to ensure that reliability, security and safety do not degrade over the 2016–20 regulatory period

- increase replacement of assets in areas where safety has deteriorated during the 2011–15 regulatory control period, to arrest this degradation and address concerns raised by the independent safety regulator (Energy Safe Victoria (ESV))

- increase connections expenditure in response to higher year on year growth in customer number forecasts

- sustain the IT asset functionality through upgrades, and replace systems that have come to the end of their useful or economic life and retire applications and technologies that have become redundant.

Only partially offsetting this is reduced investment in Jemena's non-network (other) category. This is driven by a reduction in property and buildings expenditure.

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[3] NEL, s. 7A.

[4] NER, cl. 6.5.7(a).

[5] Jemena, *Regulatory proposal 2016– 2020,* April 2015, pp. 71–78.

Figure 6.1   Jemena's total actual and forecast capex 2011–2020
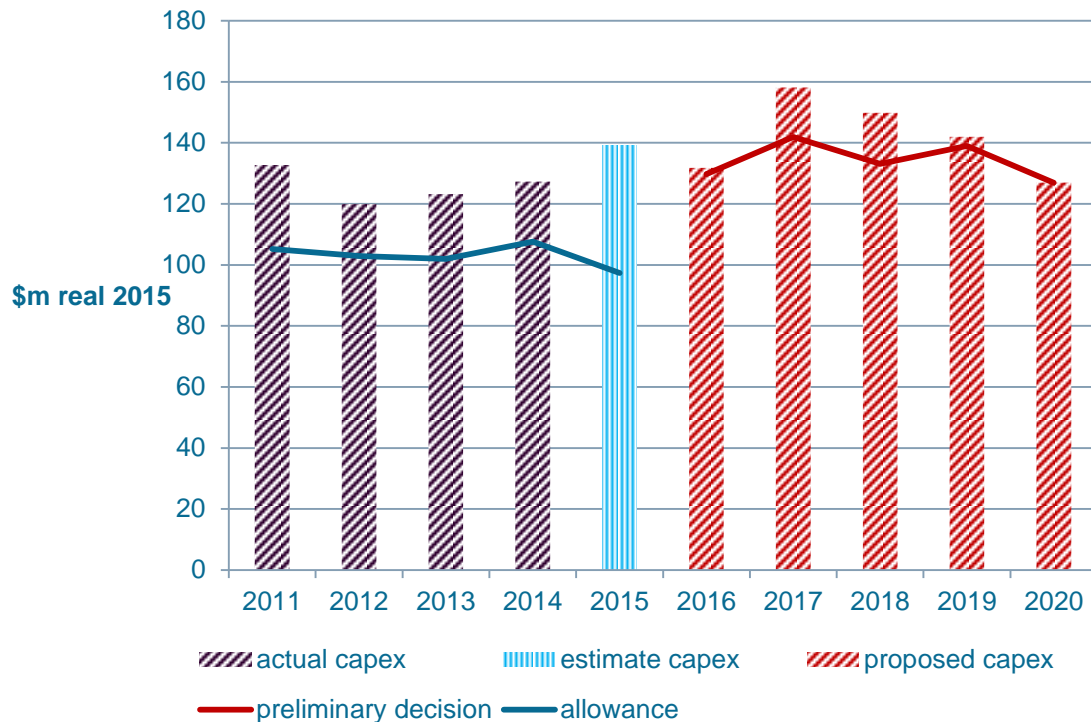
Source: AER analysis.

6.3 AER's assessment approach

This section outlines our approach to capex assessments. It sets out the relevant legislative and rule requirements, and outlines our assessment techniques. It also explains how we derive an alternative estimate of total forecast capex against which we compare the distributor's total forecast capex. The information Jemena provided in its regulatory proposal, including its response to our RIN, is a vital part of our assessment. We also took into account information that Jemena provided in response to our information requests, and submissions from other stakeholders.

Our assessment approach involves the following steps:

- our starting point for building an alternative estimate is the distributor's regulatory proposal.[6] We apply our various assessment techniques, both qualitative and quantitative, to assess the different elements of the distributor's proposal. This analysis informs our view on whether the distributor's proposal reasonably reflects the capex criteria in the NER at the total capex level.[7] It also provides us with an

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6   AER, *Better regulation: Explanatory statement: Expenditure forecast assessment guideline,* November 2013, p. 7; see also AEMC, *Final rule determination: National electricity amendment (Economic regulation of network service providers) Rule 2012,* 29 November 2012, pp. 111 and 112.

7   NER, cl. 6.5.7(c).

alternative forecast that we consider meets the criteria. In arriving at our alternative estimate, we weight the various techniques we used in our assessment. We give more weight to techniques we consider are more robust in the particular circumstances of the assessment.

- having established our alternative estimate of the total forecast capex, we can test the distributor's total forecast capex. This includes comparing our alternative estimate total with the distributor's total forecast capex and what the reasons for any differences are. If there is a difference between the two, we may need to exercise our judgement as to what is a reasonable margin of difference.

If we are satisfied the distributor's proposal reasonably reflects the capex criteria in meeting the capex objectives, we will accept it. The capital expenditure objectives (capex objectives) referred to in the capex criteria, are to:[8]

- meet or manage the expected demand for standard control services over the period

- comply with all regulatory obligations or requirements associated with the provision of standard control services

- to the extent that there are no such obligations or requirements, maintain service quality, reliability and security of supply of standard control services and maintain the reliability and security of the distribution system

- maintain the safety of the distribution system through the supply of standard control services.

If we are not satisfied, the NER requires us to put in place a substitute estimate that we are satisfied reasonably reflects the capex criteria.[9] Where we have done this, our substitute estimate is based on our alternative estimate.

The capex criteria are:[10]

- the efficient costs of achieving the capital expenditure objectives

- the costs that a prudent operator would require to achieve the capital expenditure objectives

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

The AEMC noted '[t]hese criteria broadly reflect the NEO [National Electricity Objective]'.[11]

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[8]   NER, cl. 6.5.7(a).
[9]   NER, cl. 6.12.1(3)(ii).
[10] NER, cl. 6.5.7(c).
[11] AEMC, *Final rule determination: National electricity amendment (Economic regulation of network service providers) Rule 2012,* 29 November 2012, p. 113.

Importantly, we approve a total capex forecast and not particular categories, projects or programs in the capex forecast. Our review of particular categories or projects informs our assessment of the total capex forecast. The AEMC stated:[12]

> It should be noted here that what the AER approves in this context is expenditure allowances, not projects.

In deciding whether we are satisfied that Jemena's proposed total forecast capex reasonably reflects the capex criteria, we have regard to the capex factors.[13] In taking the capex factors into account, the AEMC noted:[14]

> …this does not mean that every factor will be relevant to every aspect of every regulatory determination the AER makes. The AER may decide that certain factors are not relevant in certain cases once it has considered them.

Table 6.5 summarises how we took the capex factors into consideration.

More broadly, we note that in exercising our discretion, we take into account the revenue and pricing principles set out in the NEL.[15] In particular, we take into account whether our overall capex forecast provides Jemena a reasonable opportunity to recover at least the efficient costs it incurs in:

- providing direct control network services; and
- complying with its regulatory obligations and requirements.[16]

Expenditure Assessment Guideline

The rule changes the AEMC made in November 2012 required us to make and publish an Expenditure Forecast Assessment Guideline for electricity distribution (Guideline).[17] We released our Guideline in November 2013.[18] The Guideline sets out our proposed general approach to assessing capex (and opex) forecasts. The rule changes also require us to set out our approach to assessing capex in the relevant framework and approach paper. For Jemena, our framework and approach paper stated that we would apply the Guideline, including the assessment techniques outlined in it.[19] We may depart from our Guideline approach and if we do so, we need to provide reasons. In this determination, we have not departed from the approach set out in our Guideline.

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12 AEMC, *Final rule determination: National electricity amendment (Economic regulation of network service providers) Rule 2012,* 29 November 2012, p. vii.

13 NER, cl. 6.5.7(e).

14 AEMC, *Final rule determination: National electricity amendment (Economic regulation of network service providers) Rule 2012,* 29 November 2012, p. 115.

15 NEL, ss. 7A and 16(2).

16 NEL, s. 7A.

17 AEMC, *Final rule determination: National electricity amendment (Economic regulation of network service providers) Rule 2012,* 29 November 2012, p. 114.

18 AER, *Better regulation: Expenditure forecast assessment guideline for electricity distribution*, November 2013.

19 AER, *Final Framework and approach for the Victorian Electricity Distributors: Regulatory control period commencing 1 January 2016*, 24 October 2014, pp. 119–120.

We note that RIN data form part of a distributor's regulatory proposal.[20] In our Guideline we stated we would "require all the data that facilitate the application of our assessment approach and assessment techniques". We also stated that the RIN we issue in advance of a distributor lodging its regulatory proposal would specify the exact information we require.[21] Our Guideline made clear our intention to rely upon RIN data during distribution determinations.

6.3.1 Building an alternative estimate of total forecast capex

The following section sets out the approach we apply to arrive at an alternative estimate of total forecast capex.

Our starting point for building an alternative estimate is the distributor's proposal.[22] We review the proposed forecast methodology and the key assumptions that underlie the distributor's forecast. We also consider the distributor's performance in the previous regulatory control period to inform our alternative estimate.

We then apply our specific assessment techniques to develop an estimate and assess the economic justifications that the distributor puts forward. Many of our techniques encompass the capex factors that we are required to take into account. Appendix A and appendix B contain further details on each of these techniques.

Some of these techniques focus on total capex; others focus on high level, standardised sub-categories of capex. Importantly, while we may consider certain projects and programs in forming a view on the total capex forecast, we do not determine which projects or programs the distributor should or should not undertake. This is consistent with the regulatory framework and the AEMC's statement that the AER does not approve specific projects. Rather, we approve an overall revenue requirement that includes an assessment of what we find to be an efficient total capex forecast.[23]

We determine total revenue by reference to our analysis of the proposed capex and the various building blocks. Once we approve total revenue, the distributor is able to prioritise its capex program given its circumstances over the course of the regulatory control period. The distributor may need to undertake projects or programs it did not anticipate during the distribution determination. The distributor may also not require some of the projects or programs it proposed for the regulatory control period. We consider a prudent and efficient distributor would consider the changing environment throughout the regulatory control period in its decision-making.

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[20]   NER, cll. 6.8.2(c2) and (d).

[21]   AER, *Better regulation: Expenditure forecast assessment guideline for electricity distribution*, November 2013, p. 25.

[22]   AER, *Better regulation: Explanatory statement: Expenditure forecast assessment guideline,* November 2013, p. 7; AEMC, *Final rule determination: National electricity amendment (Economic regulation of network service providers) Rule 2012,* 29 November 2012, pp. 111 and 112.

[23]   AEMC, *Final rule determination: National electricity amendment (Economic regulation of network service providers) Rule 2012,* 29 November 2012, p. vii.

As we explained in our Guideline:[24]

> Our assessment techniques may complement each other in terms of the information they provide. This holistic approach gives us the ability to use all of these techniques, and refine them over time. The extent to which we use each technique will vary depending on the expenditure proposal we are assessing, but we intend to consider the inter-connections between our assessment techniques when determining total capex … forecasts. We typically would not infer the findings of an assessment technique in isolation from other techniques.

In arriving at our estimate, we weight the various techniques we used in our assessment. We weight these techniques on a case by case basis using our judgement. Broadly, we give more weight to techniques we consider are more robust in the particular circumstances of the assessment. By relying on a number of techniques, we ensure we consider a wide variety of information and can take a holistic approach to assessing the distributor's capex forecast.

Where our techniques involve the use of a consultant, we consider their reports as one of the inputs to arriving at our preliminary decision on overall capex. Our preliminary decision clearly sets out the extent to which we accept our consultants' findings. Where we apply our consultants' findings, we do so only after carefully reviewing their analysis and conclusions, and evaluating these against outcomes of our other techniques and our examination of Jemena's proposal.

We also take into account the various interrelationships between the total forecast capex and other components of a distributor's distribution determination. The other components that directly affect the total forecast capex include:

- forecast opex

- forecast demand

- the service target performance incentive scheme

- the capital expenditure sharing scheme

- real cost escalation

- contingent projects.

We discuss how these components impact the total forecast capex in Table 6.4.

Underlying our approach are two general assumptions:

- the capex criteria relating to a prudent operator and efficient costs are complementary. Prudent and efficient expenditure reflects the lowest long-term

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[24] AER, *Better regulation: Expenditure forecast assessment guideline for electricity distribution*, November 2013, p. 12.

cost to consumers for the most appropriate investment or activity required to achieve the expenditure objectives[25]

- past expenditure was sufficient for the distributor to manage and operate its network in past periods, in a manner that achieved the capex objectives.[26]

6.3.2 Comparing the distributor's proposal with our alternative estimate

Having established our estimate of the total forecast capex, we can test the distributor's proposed total forecast capex. This includes comparing our alternative estimate of forecast total capex with the distributor's proposal. The distributor's forecast methodology and its key assumptions may explain any differences between our alternative estimate and its proposal.

As the AEMC foreshadowed, we may need to exercise our judgement in determining whether any 'margin of difference' is reasonable:[27]

> The AER could be expected to approach the assessment of a NSP's expenditure (capex or opex) forecast by determining its own forecast of expenditure based on the material before it. Presumably this will never match exactly the amount proposed by the NSP. However there will be a certain margin of difference between the AER's forecast and that of the NSP within which the AER could say that the NSP's forecast is reasonable. What the margin is in a particular case, and therefore what the AER will accept as reasonable, is a matter for the AER exercising its regulatory judgment.

As noted above, we draw on a range of techniques, as well as our assessment of elements that impact upon capex such as demand and real cost escalators.

Our decision on the total forecast capex does not strictly limit a distributor's actual spending. A distributor might spend more on capex than the total forecast capex amount specified in our decision in response to unanticipated expenditure needs.

The regulatory framework has a number of mechanisms to deal with such circumstances. Importantly, a distributor does not bear the full cost where unexpected events lead to an overspend of the approved capex forecast. Rather, the distributor bears 30 per cent of this cost if the expenditure is subsequently found to be prudent

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[25] AER, *Better regulation: Expenditure forecast assessment guideline for electricity distribution*, November 2013 , pp. 8 and 9. The Australian Competition Tribunal has previously endorsed this approach: see : Application by Ergon Energy Corporation Limited (Non-system property capital expenditure) (No 4) [2010] ACompT 12; Application by EnergyAustralia and Others [2009] ACompT 8; Application by Ergon Energy Corporation Limited (Labour Cost Escalators) (No 3) [2010] ACompT 11; Application by DBNGP (WA) Transmission Pty Ltd (No 3) [2012] ACompT 14; Application by United Energy Distribution Pty Limited [2012] ACompT 1; Re: Application by ElectraNet Pty Limited (No 3) [2008] ACompT 3 ; Application by DBNGP (WA).

[26] AER, *Better regulation: Expenditure forecast assessment guideline for electricity distribution*, November 2013, p. 9.

[27] AEMC, *Final rule determination: National electricity amendment (Economic regulation of network service providers) Rule 2012,* 29 November 2012, p. 112.

and efficient. Further, the pass through provisions provide a means for a distributor to pass on significant unexpected capex to customers, where appropriate.[28] Similarly, a distributor may spend less than the capex forecast because they have been more efficient than expected. In this case the distributor will keep on average 30 per cent of this reduction over time.

We set our alternative estimate at the level where the distributor has a reasonable opportunity to recover efficient costs. The regulatory framework allows the distributor to respond to any unanticipated issues that arise during the regulatory control period. In the event that this leads to the approved total revenue underestimating the total capex required, the distributor should have sufficient flexibility to allow it to meet its safety and reliability obligations by reallocating its budget. Conversely, if there is an overestimation, the stronger incentives the AEMC put in place in 2012 should result in the distributor only spending what is efficient. As noted, the distributor and consumers share the benefits of the underspend and the costs of an overspend under the regulatory regime.

6.4 Reasons for preliminary decision

We applied the assessment approach set out in section 6.3 to Jemena. In this preliminary decision, we are not satisfied Jemena's total forecast capex reasonably reflects the capex criteria. We compared Jemena's capex forecast to the alternative capex forecast we constructed using the approach and techniques outlined in appendices A and B. Jemena's proposal is materially higher than ours. We are satisfied that our alternative estimate reasonably reflects the capex criteria.

Table 6.3 sets out the capex amounts by driver that we included in our alternative estimate of Jemena's total forecast capex for the 2016–20 period regulatory control period.

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[28]   NER, r. 6.6.

Table 6.3   Our assessment of required capex by capex driver 2016–20 ($2015, million)

Category	2016	2017	2018	2019	2020	Total
Augmentation	12.1	31.7	26.6	15.1	6.8	92.5
Connections	31.9	31.1	30.5	32.7	33.7	159.9
Replacement	36.4	40.9	39.3	53	54	223.5
Non-Network	38.5	27	26.4	24.4	19.7	135.9
Capitalised overheads	31.4	31.6	32.3	34	35.2	164.4
Labour and materials escalation adjustment	-0.1	-0.4	-0.4	-0.5	-1.2	-2.6
Gross Capex (includes capital contributions)	**150.2**	**161.8**	**154.7**	**158.7**	**148.1**	**773.6**
Capital Contributions	20.4	19.9	21.6	19.7	21.2	102.8
Net Capex (excluding capital contributions)	**129.8**	**141.9**	**133.1**	**139**	**126.9**	**670.7**

Source: AER analysis.

Note: Numbers may not add up due to rounding.

We discuss our assessment of Jemena's forecasting methodology, key assumptions and past capex performance in the sections below.

Our assessment of capex drivers are in appendices A and B. These set out the application of our assessment techniques to the capex drivers, and the weighting we gave to particular techniques. We used our reasoning in the appendices to form our alternative estimate.

6.4.1 Key assumptions

The NER require Jemena to include in its regulatory proposal the key assumptions that underlie its proposed forecast capex and a certification by its Directors that those key assumptions are reasonable.[29]

Jemena submitted that the assumptions which underpin its capex forecasts are provided in attachment 8–2 to its regulatory proposal.[30] This attachment relates to Jemena's opex forecasting method and base year efficiency. The AER sought further information from Jemena to confirm how this document related to its underlying assumptions for its forecast capex.

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[29]   NER, cll. S6.1.1(2), (4) and (5).

[30]   Jemena, *Regulatory proposal 2016–20,* April 2015, p. 66.

Jemena's response directed us to section 2 (key inputs and assumptions) of attachment 8–2. Jemena noted that this section is relevant to both operating and capital expenditure.[31] On review of this section the relevance to Jemena's underlying capex assumptions remains unclear. This is because section 2 discusses the basis of Jemena's specific opex forecasts, it does not set out broad assumptions across opex and capex.

Jemena also directed us to several other documents including its expenditure forecasting methodology submitted to us prior to submitting its regulatory proposal. This document provides a list of Jemena's key inputs and areas where assumptions have been made relating to its augex forecasts.[32] However the document does not include sufficient detail to determine what assumptions have actually been relied upon by Jemena in deriving its total capex forecast more generally.

6.4.2 Forecasting methodology

The NER require Jemena to inform us about the methodology it proposes to use to prepare its forecast capex allowance before it submits its regulatory proposal.[33] Jemena must include this information in its regulatory proposal.[34]

Jemena submitted that the following broad process was used to forecast expenditure for each capex category. Jemena:[35]

- considered the safety and service performance that its assets must deliver over the 2016–20 regulatory control period, taking into account its safety obligations and customers' service level preferences

- considered the anticipated changes in the energy market and other factors that influence the networks ability to deliver the required performance over the 2016–20 regulatory control period. For example, forecast changes in peak demand, new growth areas, changes in how customers use the network, and the condition of assets

- undertook engineering analysis of supply and demand side options for delivering the required performance

- determined its proposed capex program, balancing the service risks and costs involved and its ability to deliver the program. In relation to costs, Jemena took account of the forecast real escalation in its capital costs, as well as the interaction between capex and opex

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[31] Jemena, *JEN AER IR#009 response to AER questions,* 2 July 2015, p. 5.

[32] Jemena, *JEN AER IR#009 response to AER questions,* 2 July 2015, p. 5; Jemena, *Expenditure forecasting methodology for the 2016–2020 regulatory period,* May 2014, p. 10.

[33] NER, cll. 6.8.1A and 11.60.3(c).

[34] NER, cl. S6.1.1(2).

[35] Jemena, *Regulatory proposal 2016–20,* April 2015, p. 65.

- developed a detailed delivery strategy that demonstrates how it will deliver a greater volume of capital work over the 2016–20 regulatory control period than in the 2011–15 regulatory control period. It also described how the recommended resource mix will deliver the lowest sustainable cost to its customers and business.

We consider Jemena's forecasting methodology is generally reasonable. Where we identified specific areas of concern, we discuss these in the appendices to this capex attachment.

The Victorian Energy Consumer and Use Alliance (VECUA) considered the Victorian distributors overly relied on bottom up methodologies with insufficient regard to top down methods.[36] Origin Energy supported the application of both a top down and bottom up assessment:[37]

> to demonstrate that a level of overall restraint has been brought to bear. This dual exercise is necessary to ensure that forecast costs, including unit rates, have not been overstated and that inter-relationships and synergies between projects or areas of work which are more readily identified at a portfolio level are adequately accounted for.

As we noted in previous determinations, the drawback of deriving a capex forecast through a bottom-up assessment is it does not of itself provide sufficient evidence that the estimate is efficient. Bottom up approaches tend to overstate required allowances as they do not adequately account for inter-relationships and synergies between projects or areas of work. In contrast, reviewing aggregated areas of expenditure or the total expenditure, allows for an overall assessment of efficiency.[38]

6.4.3 Interaction with the STPIS

We consider that our approved capex forecast is consistent with the setting of targets under the STPIS. In particular, we consider that the capex allowance should not be set such that it would lead to Jemena systemically under or over performing against its STPIS targets. We consider our approved capex forecast is sufficient to allow a prudent and efficient Jemena to maintain performance at the targets set under the STPIS. As such, it is appropriate to apply the STPIS as set out in attachment 11.

In making our preliminary decision, we have specifically considered the impact our decision will have on the safety and reliability of Jemena's network.

In its submission, the CCP noted the following explanation from the AEMC:[39]

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[36] VECUA, *Submission: Victorian distribution networks' 2016–20 revenue proposals*, 13 July 2105, p. 19.

[37] Origin Energy, *Submission to Victorian electricity distributors regulatory proposals*, 13 July 2015, p. 8.

[38] For example, see AER, *Preliminary decision: Ergon Energy determination 2015−16 to 2019−20: Attachment 6 − Capital expenditure*, April 2015, pp. 22–23.

[39] CCP, *Advice to the AER: AER's Preliminary Decision for SA Power Networks for 2015-20 and SA Power Networks' revised regulatory proposal*, August 2015 p. 27.

…operating and capital expenditure allowances for NSPs should be no more than the level considered necessary to comply with the relevant regulatory obligation or requirement, where these have been set by the body allocated to that role. Expenditure by NSPs to achieve standards above these levels should be unnecessary, as they are only required to deliver to the standards set. It would also amount to the AER substituting a regulatory obligation or requirement with its own views on the appropriate level of reliability, which would undermine the role of the standard setting body, and create uncertainty and duplication of roles.

NSPs are still free to make incremental improvements over and above the regulatory requirements at their own discretion. Such additional expenditure will not generally be recoverable, through forecast capital and operating expenditure. However, DNSPs are also provided with annual financial incentives to improve reliability performance under the STPIS.

We consider our substitute estimate is sufficient for Jemena to maintain the safety, service quality and reliability of its network consistent with its obligations. Our provision of a total capex forecast does not constrain a distributors actual spending – either as a cap or as a requirement that the forecast be spent on specific projects or activities. It is conceivable that a distributor might wish to expend particular capex differently or in excess of the total capex forecast set out in our decision. However, such additional expenditure is not included in our assessment of expenditure forecasts as it is not required to meet the capex objectives. We consider the STPIS is the appropriate mechanism to provide distributors with the incentive to improve reliability performance where such improvements reflect value to the energy customer.

Under our analysis of specific capex drivers, we have explained how our analysis and certain assessment techniques factor in safety and reliability obligations and requirements.

6.4.4 Jemena's capex performance

We have looked at a number of historical metrics of Jemena's capex performance against that of other distributors in the NEM. We also compare Jemena's proposed forecast capex allowance against historical trends. These metrics are largely based on outputs of the annual benchmarking report and other analysis undertaken using data provided by the distributors for the annual benchmarking report. The report includes Jemena's relative partial and multilateral total factor productivity (MTFP) performance, capex per customer and maximum demand, and Jemena's historic capex trend.

We note that the NER set out that we must have regard to our annual benchmarking report.[40] This section shows how we have taken it into account. We consider this high level benchmarking at the overall capex level is suitable to gain an overall understanding of Jemena's proposal in a broader context. However, in our capex

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40 NER, cl. 6.5.7(e).

assessment we have not relied on our high level benchmarking metrics set out below other than to gain a high level insight into Jemena's proposal. We have not used this analysis deterministically in our capex assessment.

Partial factor productivity of capital and multilateral total factor productivity

Figure 6.2 shows a measure of partial factor productivity of capital taken from our benchmarking report. This measure incorporated the productivity of transformers, overhead lines and underground cables. Jemena performs relatively well on this measure, falling only behind CitiPower, and United Energy from 2006 to 2011. Jemena outperformed United Energy in 2012 and 2013.

Figure 6.2 Partial factor productivity of capital (transformers, overhead and underground lines)

Figure 6.3 shows Jemena ranks similarly on MTFP. MTFP measures how efficient a business is in terms of its inputs (costs) and outputs (energy delivered, customer numbers, ratcheted maximum demand, reliability and circuit line length). Jemena is the fourth highest performer on this metric, falling behind CitiPower, SA Power Networks, and United Energy.

Figure 6.3   Multilateral total factor productivity
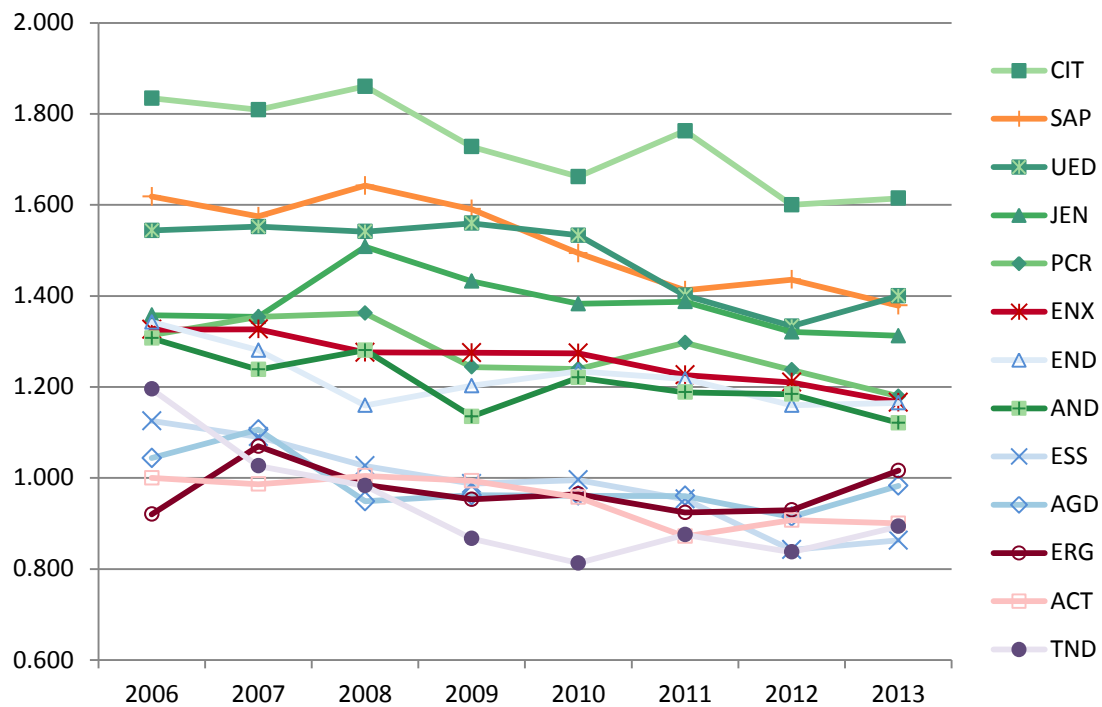
Source: AER, Electricity distribution network service providers: Annual benchmarking report, November 2014, p. 31.

6.4.4.1   Relative capex efficiency metrics

Figure 6.4 and Figure 6.5 show capex per customer and per maximum demand, against customer density. Unless otherwise indicated as a forecast, the figures represent the five year average of each distributor's capex for the years 2008–12. We have considered capex per customer as it reflects the amount consumers are charged for additional capital investments.

Figure 6.4 and Figure 6.5 show the Victorian distributors generally perform well in these metrics compared to other distributors in the NEM. For completeness, we also included the other Victorian distributors' proposed capex for the 2016–20 regulatory control period in the figures. However, we do not use comparisons of Jemena's total forecast capex with the total forecast capex of the other Victorian distributors as inputs to our assessment. We consider it is appropriate to compare Jemena's forecast only with actual capex. This is because actual capex are 'revealed costs' and would have occurred under the incentives of the regulatory regime.

Figure 6.4 shows that Jemena performed well in the 2008–12 period in terms of capex per customer. However, Jemena's capex per customer will increase for the 2016–20 period based on its proposed forecast capex.

Figure 6.4   Capex per customer (000s, $2013–14), against customer density
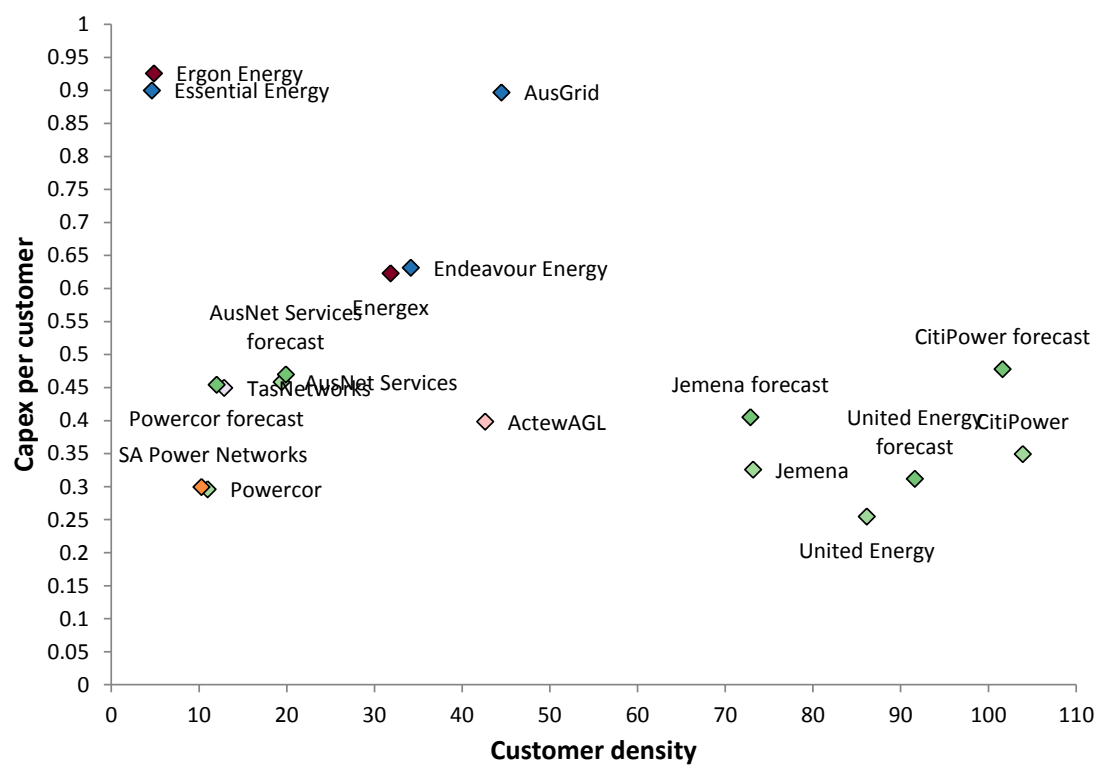
Source: AER analysis.

Figure 6.5 shows that Jemena performed well in 2008–12 in terms of capex per maximum demand. Again capex per maximum demand is forecast to increase for Jemena in the next period.

Figure 6.5 Capex per maximum demand (000s, $2013–14), against customer density
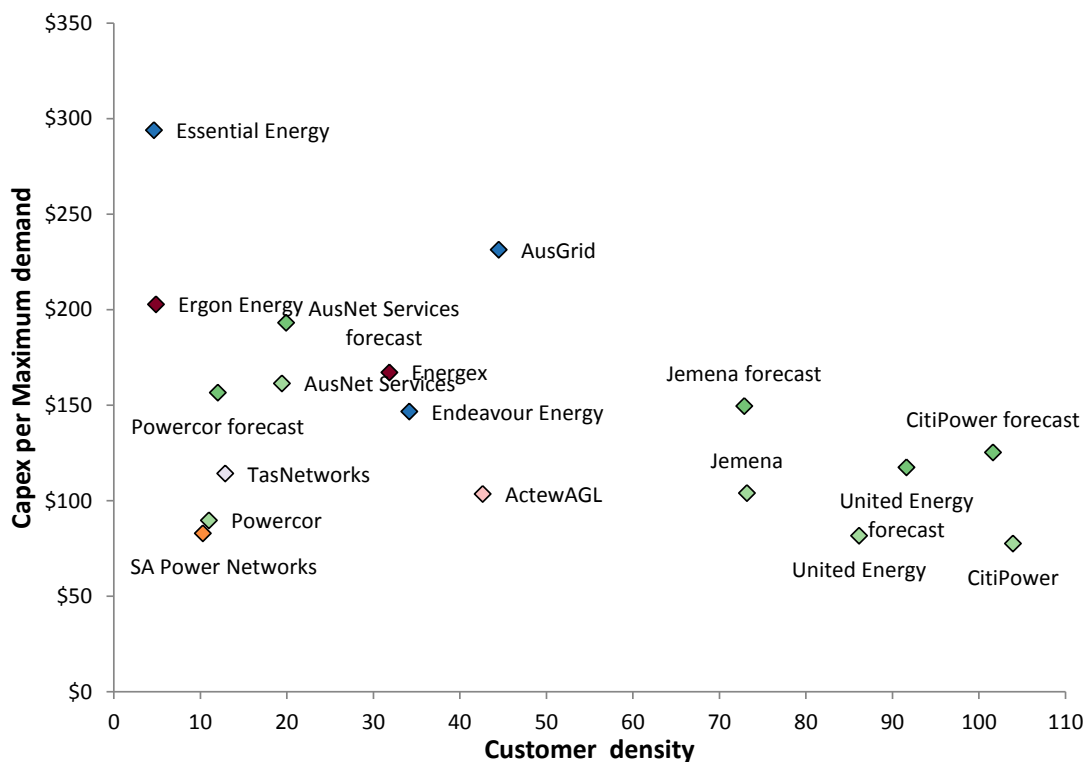
Source: AER analysis.

The Consumer Utilities Advocacy Centre (CUAC) expressed concern about the large increases in capex some Victorian distributors proposed and the decline in productivity in recent years.[41]

The Victorian Greenhouse Alliances (VGA) noted the increases in the capex forecast of the Victorian distributors. The VGA considered the increased capex forecasts were concerning given over-investment over recent regulatory periods has led to excess levels of network capacity and declining network utilisation. The VGA also expressed concern that the Victorian distributor proposed such high levels of capex at a time of:[42]

- declining capacity utilisation

- reduced average asset age for most asset categories

- static or falling demand and consumption

- reductions in the reliability standards.

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41   CUAC, *Submission: Victorian electricity distribution pricing review (EDPR) 2016 to 2020*, 13 July 2015, p. 2.

42   VGA, *Submission: Local Government response to the Victorian electricity distribution price review (EDPR) 2016–20*, July 2015, p. 33.

The Department of Economic Development, Jobs, Transport and Resources (DEDJTR) and the VECUA made similar points in their submissions.[43] We considered these factors in detail in our assessment of capex drivers (see appendix B). For example, we made reductions to the capex forecast as we do not consider Jemena's demand forecast is realistic (see appendix C).

Appendix B details our assessment of Jemena's capex categories. These assessments, along with the high level analysis in this section 6.4.4, were inputs into our preliminary decision on Jemena's total capex for the 2016–20 regulatory control period. We consider our assessment results in a total capex forecast that is largely consistent with the submissions received. Figure 6.1 shows our preliminary decision capex forecast is 4.5 per cent higher than Jemena's actual capex in the 2011–15 regulatory control period. By comparison, Jemena's proposed capex is 10.4 per cent higher than its actual capex for the 2011–15 regulatory control period.

To arrive at our preliminary decision, we considered the issues noted in these submissions, such as lower demand and declining utilisation in the network. For example, we consider Jemena's demand forecast does not reflect a realistic expectation of demand over 2016–20 and substituted a lower demand forecast. Our assessment of Jemena's augex forecast reflects this lower demand forecast (see appendix C). Importantly, our assessment considered many other factors such as asset age and condition. We discuss these, and other issues relevant to Jemena's capex proposal, in detail in appendix B.

Jemena's historic capex trends

We compared Jemena's capex proposal for the 2016–20 regulatory control period against the long term historical trend in capex levels.

Figure 6.6 shows actual historic capex and proposed capex between 2001 and 2020. This figure shows that Jemena's forecast is significantly higher than historical levels (actual spend), particularly for the first 3 years of the regulatory control period. We note that Jemena's capex falls towards the end of the regulatory control period.

The Consumer Challenge Panel (CCP) noted capex in the current period occurred under the 'old' National Electricity Rules, which the CCP considered overtly incentivised investment.[44] The CCP further noted the NER did not apply in Victoria prior to 2011. Despite the lower incentive prior to 2011, the CCP noted that reliability did not suffer.[45]

Our detailed assessment in appendix B examines whether the increase in capex is reasonably reflective of the capex criteria.

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[43] DEDJTR, *Submission to Victorian electricity distribution pricing review – 2016 to 2020*, 13 July 2015, p. 6; VECUA, *Submission: Victorian distribution networks' 2016–20 revenue proposals*, 13 July 2105, pp. 6 and 18.

[44] That is, prior the AEMC's changes to the NER in Nov ember 2012.

[45] CCP, *Submission: Response to proposals from Victorian electricity distribution network service providers for a revenue reset for the 2016–2020 regulatory period*, 5 August 2015, p. 41.

Figure 6.6 Jemena total capex – historical and forecast for 2001–2020
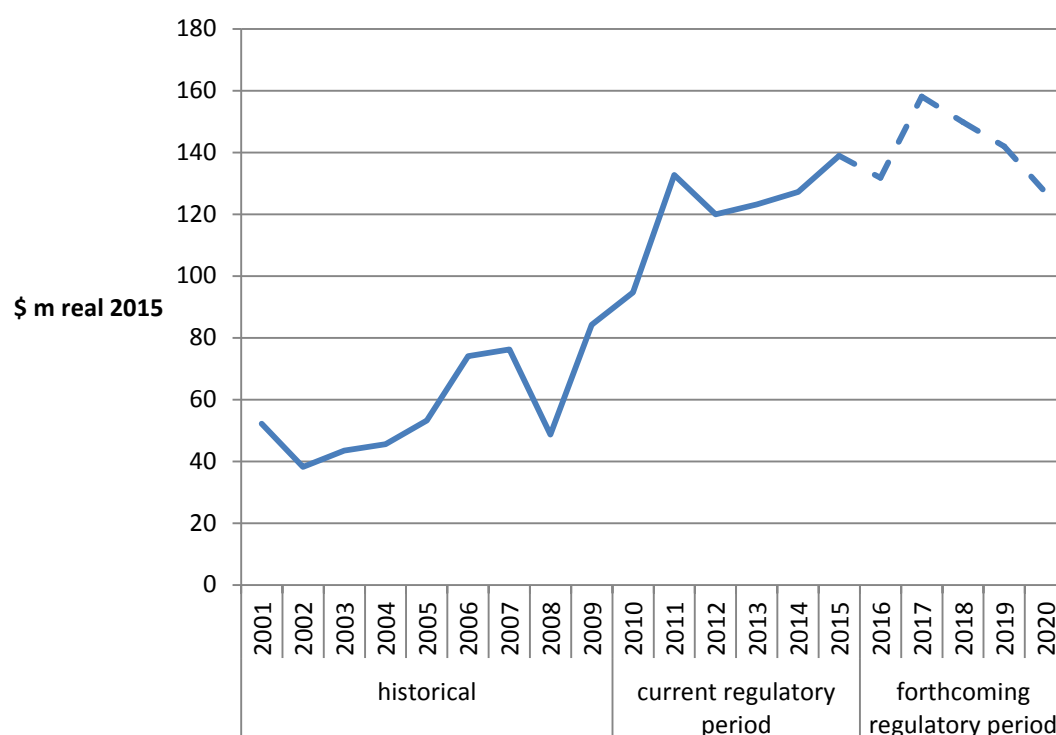
Source: AER analysis.

6.4.5 Interrelationships

There are a number of interrelationships between Jemena's total forecast capex for the 2016–20 regulatory control period and other components of its distribution determination (see Table 6.4). We considered these interrelationships in coming to our preliminary decision on total forecast capex.

Table 6.4   Interrelationships between total forecast capex and other components

Other component	Interrelationships with total forecast capex
Total forecast opex	There are elements of Jemena's total forecast opex that are specifically related to its total forecast capex. These include the forecast labour price growth that we included in our opex forecast in Attachment 7. This is because the price of labour affects both total forecast capex and total forecast opex. More generally, we note our total opex forecast will provide Jemena with sufficient opex to maintain the reliability of its network. Although we do not approve opex on specific categories of opex such as maintenance, the total opex we approve will in part influence the repex Jemena needs to spend during the 2016–20 regulatory control period.
Forecast demand	Forecast demand is related to Jemena's total forecast capex. Growth driven capex, which includes augex and customer connections capex, is typically triggered by a need to build or upgrade a network to address changes in demand or to comply with quality, reliability and security of supply requirements. Hence, the main driver of growth-related capex is maximum demand and its effect on network utilisation and reliability.
Capital Expenditure	The CESS is related to Jemena's total forecast capex. In particular, the effective application of

Other component	Interrelationships with total forecast capex
Sharing Scheme (CESS)	the CESS is contingent on the approved total forecast capex being efficient, and that it reasonably reflects the capex criteria. As we note in the capex criteria table below, this is because any efficiency gains or losses are measured against the approved total forecast capex. In addition, in future distribution determinations we will be required to undertake an ex post review of the efficiency and prudency of capex, with the option to exclude any inefficient capex in excess of the approved total forecast capex from Jemena's regulatory asset base. In particular, the CESS will ensure that Jemena bears at least 30 per cent of any overspend against the capex allowance. Similarly, if Jemena can fulfil their objectives without spending the full capex allowance, it will be able to retain 30 per cent of the benefit of this. In addition, if an overspend is found to be inefficient through the ex post review, Jemena risks having to bear the entire overspend.
Service Target Performance Incentive Scheme (STPIS)	The STPIS is interrelated to Jemena's total forecast capex, in so far as it is important that it does not include any expenditure for the purposes of improving supply reliability during the 2016–20 regulatory control period. This is because such expenditure should be offset by rewards provided through the application of the STPIS.

Further, the forecast capex should be sufficient to allow Jemena to maintain performance at the targets set under the STPIS. The capex allowance should not be set such that there is an expectation that it will lead to Jemena systematically under or over performing against its targets. |
| Contingent project | A contingent project is interrelated to Jemena's total forecast capex. This is because an amount of expenditure that should be included as a contingent project should not be included as part of Jemena's total forecast capex for the 2016–20 regulatory control period.

We did not identify any contingent projects for Jemena during the 2016–20 period. |

Source: AER analysis.

6.4.6 Consideration of the capex factors

As we discussed in section 6.3, we took the capex factors into consideration when assessing Jemena's total capex forecast.[46] Table 6.5 summarises how we have taken into account the capex factors.

Where relevant, we also had regard to the capex factors in assessing the forecast capex associated with its underlying capex drivers such as repex, augex and so on (see appendix B).

Table 6.5   AER consideration of the capex factors

Capex factor	AER consideration
The most recent annual benchmarking report and benchmarking capex that would be incurred by an efficient distributor over the relevant regulatory control period	We had regard to our most recent benchmarking report in assessing Jemena's proposed total forecast capex and in determining our alternative estimate for the 2016–20 regulatory control period. This can be seen in the metrics we used in our assessment of Jemena's capex performance.
The actual and expected capex of Jemena during any preceding regulatory control periods	We had regard to Jemena's actual and expected capex during the 2011–15 and preceding regulatory control periods in assessing its proposed total forecast.

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[46]   NER, cll. 6.5.7(c), (d) and (e).

Capex factor	AER consideration
	This can be seen in our assessment of Jemena's capex performance. It can also be seen in our assessment of the forecast capex associated with the capex drivers that underlie Jemena's total forecast capex. For some elements of non-network, augex and connections capex, we rely on trend analysis to arrive at an estimate that meets the capex criteria.
The extent to which the capex forecast includes expenditure to address concerns of electricity consumers as identified by Jemena in the course of its engagement with electricity consumers	We had regard to the extent to which Jemena's proposed total forecast capex includes expenditure to address consumer concerns that Jemena identified. Jemena has undertaken engagement with its customers and presented high level findings regarding its customer preferences in its regulatory proposal.
The relative prices of operating and capital inputs	We had regard to the relative prices of operating and capital inputs in assessing Jemena's proposed real cost escalation factors. In particular, we have not accepted Jemena's proposal to apply real cost escalation for labour and materials.
The substitution possibilities between operating and capital expenditure	We had regard to the substitution possibilities between opex and capex. We considered whether there are more efficient and prudent trade-offs in investing more or less in capital in place of ongoing operations. See our discussion about the interrelationships between Jemena's total forecast capex and total forecast opex in Table 6.4 above.
Whether the capex forecast is consistent with any incentive scheme or schemes that apply to Jemena	We had regard to whether Jemena's proposed total forecast capex is consistent with the CESS and the STPIS. See our discussion about the interrelationships between Jemena's total forecast capex and the application of the CESS and the STPIS in Table 6.4 above.
The extent to which the capex forecast is referable to arrangements with a person other than the distributor that do not reflect arm's length terms	We had regard to whether any part of Jemena's proposed total forecast capex or our alternative estimate is referable to arrangements with a person other than Jemena that do not reflect arm's length terms. We do not have any evidence to indicate that any of Jemena's arrangements do not reflect arm's length terms.
Whether the capex forecast includes an amount relating to a project that should more appropriately be included as a contingent project	We had regard to whether any amount of Jemena's proposed total forecast capex or our alternative estimate relates to a project that should more appropriately be included as a contingent project. We did not identify any such amounts that should more appropriately be included as a contingent project.
The extent to which Jemena has considered and made provision for efficient and prudent non-network alternatives	We had regard to the extent to which Jemena made provision for efficient and prudent non-network alternatives as part of our assessment. In particular, we considered this within our review of Jemena's augex proposal.
Any other factor the AER considers relevant and which the AER has notified Jemena in writing, prior to the submission of its revised regulatory proposal, is a capex factor	We did not identify any other capex factor that we consider relevant.

Source: AER analysis.

A   Assessment techniques

This appendix describes the assessment approaches we applied in assessing Jemena's proposed forecast capex. We used a variety of techniques to determine whether the Jemena total forecast capex reasonably reflects the capex criteria. Appendix B sets out in greater detail the extent to which we relied on each of the assessment techniques.

The assessment techniques that we apply in capex are necessarily different from those we apply in the assessment of opex. This is reflective of differences in the nature of the expenditure we are assessing. As such, we use some assessment techniques in our capex assessment that are not suitable for assessing opex and vice versa. We set this out in our expenditure assessment guideline, where we stated:[47]

> Past actual expenditure may not be an appropriate starting point for capex given it is largely non-recurrent or 'lumpy', and so past expenditures or work volumes may not be indicative of future volumes. For non-recurrent expenditure, we will attempt to normalise for work volumes and examine per unit costs (including through benchmarking across distributors) when forming a view on forecast unit costs.
>
> Other drivers of capex (such as replacement expenditure and connections works) may be recurrent. For such expenditure, we will attempt to identify trends in revealed volumes and costs as an indicator of forecast requirements.

Below we set out the assessment techniques we used to asses Jemena's capex.

A.1   Economic benchmarking

Economic benchmarking is one of the key outputs of our annual benchmarking report. The NER requires us to consider the annual benchmarking report as it is one of the capex factors.[48] Economic benchmarking applies economic theory to measure the efficiency of a distributor's use of inputs to produce outputs, having regard to environmental factors.[49] It allows us to compare the performance of a distributor against its own past performance, and the performance of other distributors. Economic benchmarking helps us to assess whether a distributor's capex forecast represents efficient costs.[50] As the AEMC stated, 'benchmarking is a critical exercise in assessing the efficiency of a NSP'.[51]

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[47]   AER, *Better regulation: Expenditure forecast assessment guideline for electricity distribution*, November 2013, p. 8.

[48]   NER, cl. 6.5.7(e)(4).

[49]   AER, *Better regulation: Explanatory statement: Expenditure forecasting assessment guidelines,* November 2013.

[50]   NER, cl. 6.5.7(c).

[51]   AEMC, *Final rule determination: National electricity amendment (Economic regulation of network service providers) Rule 2012,* 29 November 2012, p. 25.

A number of economic benchmarks from the annual benchmarking report are relevant to our assessment of capex. These include measures of total cost efficiency and overall capex efficiency. In general, these measures calculate a distributor's efficiency with consideration given to its inputs, outputs and its operating environment. We considered each distributor's operating environment in so far as there are factors outside of a distributor's control that affect its ability to convert inputs into outputs.[52] Once such exogenous factors are taken into account, we expect distributors to operate at similar levels of efficiency. One example of an exogenous factor we took into account is customer density. For more on how we derived these measures, see our annual benchmarking report.[53]

In addition to the measures in the annual benchmarking report, we considered how distributors performed on a number of overall capex metrics, including capex per customer, and capex per maximum demand. We calculated these economic benchmarks using actual data from the previous regulatory control period.

The results from economic benchmarking give an indication of the relative efficiency of each of the distributors, and how this has changed over time.

A.2 Trend analysis

We considered past trends in actual and forecast capex as this is one of the capex factors under the NER.[54]

Trend analysis involves comparing a distributor's forecast capex and work volumes against historical levels. Where forecast capex and volumes are materially different to historical levels, we seek to understand the reasons for these differences. In doing so, we consider the reasons the distributor provides in its proposal, as well as changes in the circumstances of the distributor.

In considering whether the total forecast capex reasonably reflects the capex criteria, we need to consider whether the forecast will allow the distributor to meet expected demand, and comply with relevant regulatory obligations.[55] Demand and regulatory obligations (specifically, service standards) are key drivers of capex. More onerous standards will increase capex, as will growth in maximum demand. Conversely, reduced service obligations or a decline in demand will likely cause a reduction in the amount of capex the distributor requires.

Maximum demand is a key driver of augmentation or demand driven expenditure. Augmentation often needs to occur prior to demand growth being realised. Hence, forecast rather than actual demand is relevant when a business is deciding the

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[52]   AEMC, *Final rule determination: National electricity amendment (Economic regulation of network service providers) Rule 2012,* 29 November 2012, p. 113. Exogenous factors could include geographic factors, customer factors, network factors and jurisdictional factors.

[53]   AER, *Electricity distribution network service providers: Annual benchmarking report*, November 2014.

[54]   NER, cl. 6.5.7(e)(5).

[55]   NER, cl. 6.5.7(a)(3).

augmentation projects it will require in an upcoming regulatory control period. To the extent actual demand differs from forecast, however, a business should reassess the need for the projects. Growth in a business' network will also drive connections related capex. For these reasons it is important to consider how trends in capex (in particular, augex and connections) compare with trends in demand (and customer numbers).

For service standards, there is generally a lag between when capex is undertaken (or not) and when the service improves (or declines). This is important when considering the expected impact of an increase or decrease in capex on service levels. It is also relevant to consider when service standards have changed and how this has affected the distributor's capex requirements.

We looked at trends in capex across a range of levels including at the total capex level, and the category level (such as growth related capex, and repex) as relevant. We also compared these with trends in demand and changes in service standards over time.

A.3   Category analysis

Expenditure category analysis allows us to compare expenditure across NSPs, and over time, for various levels of capex. The comparisons we perform include:

- overall costs within each category of capex
- unit costs, across a range of activities
- volumes, across a range of activities
- asset lives, across a range of asset classes which we use in assessing repex.

Using standardised reporting templates, we collected data on augex, repex, connections, non-network capex, overheads and demand forecasts for all distributors in the NEM. The use of standardised category data allows us to make direct comparisons across distributors. Standardised category data also allows us to identify and scrutinise different operating and environmental factors that affect the amount and cost of works performed by distributors, and how these factors may change over time.

A.4   Predictive modelling

Predictive modelling uses statistical analysis to determine the expected efficient costs over the regulatory control period associated with the demand for electricity services for different categories of works. We have two predictive models:

- the repex model
- the augex model (used in a qualitative sense)

The use of the repex and augex models is directly relevant to assessing whether a distributor's capex forecast reasonably reflects the capex criteria.[56] The models draw

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[56]   NER, cl. 6.5.7(c).

on actual capex the distributor incurred during the preceding regulatory control period. This past capex is a factor that we must take into account.[57]

The repex model is a high-level probability based model that forecasts asset replacement capex (repex) for various asset categories based on their condition (using age as a proxy), and unit costs. If we consider a distributor's proposed repex does not conform to the capex criteria, we use the repex model (in combination with other techniques where appropriate) to generate a substitute forecast.

The augex model compares utilisation thresholds with forecasts of maximum demand to identify the parts of a network segment that may require augmentation.[58] The model then uses capacity factors to calculate required augmentation, and unit costs to derive an augex forecast for the distributor over a given period.[59] In this way, the augex model accounts for the main internal drivers of augex that may differ between distributors, namely peak demand growth and its impact on asset utilisation. We can use the augex model to identify general trends in asset utilisation over time as well as to identify outliers in a distributor's augex forecast.[60]

For our preliminary decision we have relied on input data for the augex model to review forecast utilisation of individual zone substations to assess whether augmentation may be necessary to alleviate capacity constraints. We use this analysis both as a starting point for our further detailed evaluation, and as a cross-check on our overall augex estimate. We have not otherwise used the augex model in our assessment of Jemena's augex forecast.

A.5   Engineering review

We drew on engineering and other technical expertise within the AER to assist with our review of Jemena's capex proposal.[61] We also relied on the technical review of our consultant, Energeia, to assist with our review of distributors' capex proposals. These involved reviewing Jemena's processes, and specific projects and programs of work.

Appendix B discusses in detail our consideration of these reviews in our assessment of Jemena's capex forecast.

Origin Energy submitted the AER must continue to apply technical assessments in concert with its benchmarking techniques to ensure a prudent balance between asset risk and input costs.[62]

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[57]   NER, cl. 6.5.7(e)(5).

[58]   Asset utilisation is the proportion of the asset's capability under use during peak demand conditions.

[59]   For more information, see: AER, *Guidance document: AER augmentation model handbook,* November 2013.

[60]   AER, *'Meeting summary – distributor replacement and augmentation capex', Workshop 4: Category analysis work-stream – Replacement and demand driven augmentation (Distribution),* 8 March 2013, p. 1.

[61]   AER, *Better regulation: Explanatory statement: Expenditure forecast assessment guideline*, November 2013, p. 86.

[62]   Origin Energy, *Submission to Victorian electricity distributors regulatory proposals*, 13 July 2015, p. 1.

B   Assessment of capex drivers

We present our detailed analysis of the sub-categories of Jemena's forecast capex for the 2016–20 regulatory control period in this appendix. These sub-categories reflect the drivers of forecast capex over the 2016–20 period. These drivers are augmentation capex (augex), customer connections capex, replacement capex (repex), reliability improvement capex, capitalised overheads and non-network capex.

As we discuss in the capex attachment, we are not satisfied that Jemena's proposed total forecast capex reasonably reflects the capex criteria. In this appendix we set out further analysis in support of this view. This further analysis also explains the basis for our alternative estimate of Jemena's total forecast capex that we are satisfied reasonably reflects the capex criteria. In coming to our views and our alternative estimate we have applied the assessment techniques that we discuss in appendix A.

This appendix sets out our findings and views on each sub-category of capex. The structure of this appendix is:

- Section B.1 Alternative estimate

- Section B.2 Forecast augex

- Section B.3 Forecast customer connections capex, including capital contributions

- Section B.4 Forecast repex

- Section B.5 Victorian Bushfires Royal Commission

- Section B.6 Forecast capitalised overheads

- Section B.7 Forecast non-network capex.

In each of these sections, we examine sub-categories of capex which we include in our alternative estimate. For each such sub-category, we explain why we are satisfied the amount of capex that we include in our alternative estimate reasonably reflects the capex criteria.

B.1   Alternative estimate

Having examined Jemena's proposal, we formed a view on our alternative estimate of the capex required to reasonably reflect the capex criteria. Our alternative estimate is based on our assessment techniques, explained in section 6.3 and appendix A. Our weighting of each of these techniques, and our response to Jemena's submissions on the weighting that should be given to particular techniques, is set out under the capex drivers in appendix B.

We are satisfied that our alternative estimate reasonably reflects the capex criteria.

B.2   Forecast augex

Jemena proposed a forecast of $140.6 million ($2015) for augex, excluding overheads. This is a 23 per cent increase compared to actual augex incurred in the 2011–15 regulatory control period.

Augmentation is typically triggered by the need to build or upgrade the network to address changes in demand and network utilisation. However, it can also triggered by the need to upgrade the network to comply with quality, safety, reliability and security of supply requirements.

As set out in Table 6.6, Jemena's augex forecast is comprised of several identifiable major projects and programs, including new and upgraded zone substations and upgrading the Preston area network. We present these as either demand or non-demand driven projects.

Table 6.6   Jemena's proposed augex ($2015, million, excluding overheads)

Category	2016	2017	2018	2019	2020	Total
Demand augex	**10.3**	**30.3**	**26.7**	**13.7**	**7.4**	**88.4**
New Craigieburn zone substation	0.0	0.0	7.1	7.7	0.0	14.8
Flemington zone substation upgrade	2.3	5.8	0.0	0.0	0.0	8.2
Sunbury zone substation upgrade	0.0	5.5	8.6	0.0	0.0	14.1
HV feeders program	4.0	10.1	2.2	2.4	1.9	20.6
Distribution network program	3.8	3.5	3.5	3.5	3.6	17.8
Other small projects	0.2	5.4	5.3	0.1	1.9	12.9
Non-demand augex	**8.2**	**18.0**	**13.8**	**9.2**	**3.0**	**52.2**
Preston area conversion	5.9	6.6	9.8	5.2	0.0	27.5
VBRC	0.7	1.4	1.4	2.2	0.6	6.2
Other small projects	1.6	10.0	2.6	1.8	2.4	18.5
Total augex proposal	**34.7**	**32.3**	**37.8**	**36.9**	**24.9**	**140.6**

Source: Jemena regulatory proposal; Jemena response to AER Jemena 002.

Note: The annualised augex in this table differs from Jemena's reset RIN. The augex proposal in this table is based on the bottom-up build of the individual components of Jemena's forecast, based on costing information provided by Jemena in its regulatory proposal and in response to an information request. Numbers may not add up due to rounding.

Note that Jemena included capex within its connections capex forecast to build a new sub-transmission line to the Melbourne Airport. We consider that this project may represent augmentation capex rather than connections capex, and so we have considered this capex within our assessment of Jemena's augex requirements.

We include $92.4 million ($2015) in our alternative estimate of Jemena's augex requirements. While we accept that Jemena has demonstrated the need for augmentation in the areas identified, we are not satisfied that Jemena necessarily proposes the most prudent and efficient option to address the need for augmentation in each case. Our alternative estimate is 34.3 per cent less than Jemena's proposal.

We have formed this view by reviewing all of the material submitted by Jemena in its regulatory proposal, its responses to requests for further information and stakeholder submissions. Our review used a combination of top-down and bottom-up assessment techniques to estimate the efficient and prudent capex that Jemena will require to meet its obligations given expected demand growth and other augmentation drivers. This is consistent with the overall approach set out in our Expenditure Forecast Assessment Guideline.[63]

First, we consider Jemena's proposed demand-driven expenditure in the context of past expenditure, demand and current network utilisation.[64] We use our trend analysis as a starting point for our further project evaluation and as a cross-check on our overall augex estimate. As set out in section B.2.1, we found that:

- Jemena's forecasts of maximum demand likely reflect a realistic expectation of demand over the 2016–20 period, and

- some of Jemena's proposed augmentation projects may be required to alleviate forecast capacity constraints, and should be considered in further detail.

Second, we undertake a more detailed economic and technical review of Jemena's network planning methodology and criteria and its major augex projects and programs. This informs our top-down review by assessing whether Jemena used processes that would derive efficient design, costs and timing for each project such that Jemena's proposed augex reflects the efficient costs that a prudent operator would require to achieve the capex objectives.[65] In undertaking these technical reviews, we draw on engineering and other technical expertise within the AER.

Based on our technical project review, we form an alternative estimate of augex that reasonably reflects the capex criteria. This includes making necessary adjustments to individual projects or programs so that the project costs reflect efficient costs.[66] Our project reviews and detailed bottom-up estimates are set out in section B.2.2.

It is important to note that our overall capex decision does not approve or reject funding for individual projects. Rather, as set out in our Expenditure Forecast Assessment Guideline, we conduct technical project reviews to help us assess the efficient overall capex required for network augmentation, in conjunction with other

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[63] AER, *Explanatory Statement - Expenditure Forecast Assessment Guideline*, November 2013, p. 82.
[64] This is supported by the AER's augex model to generate trends in asset utilisation. We have not otherwise used the augex model to estimate forecast augex.
[65] AER, *Explanatory Statement - Expenditure Forecast Assessment Guideline*, November 2013, p. 128.
[66] AER, *Explanatory Statement - Expenditure Forecast Assessment Guideline*, November 2013, p. 128.

techniques such as trend analysis.[67] Within the overall capex and revenue allowance we provide in this preliminary decision, it is up to Jemena to allocate its capital and operating budget to meet its obligations (including as circumstances changes over time).

Table 6.7 sets out our overall alternative estimate of Jemena's augex forecast, including the difference from Jemena's proposal.

Table 6.7   AER's alternative estimate of augex ($2015, million)

	2016	2017	2018	2019	2020	Total
Jemena augex forecast	34.7	32.3	37.8	36.9	24.9	140.6
AER adjustment	-8.2	-17.3	-17.4	-5.2	0.0	-48.2
Alternative estimate	26.5	15.05	20.38	31.7	24.9	92.44
Difference	-23.6%	-53.4%	-46.1%	-14.1%	0.0%	-34.3%

Source: AER analysis.

Note: The annualised augex in this table is different from Jemena's reset RIN and our capex model for Jemena. Our alternative estimate, and the difference to Jemena's proposal, is based on the bottom-up build of the individual augex components. The alternative estimate in our capex model is based on applying the 34.3 per cent difference to each year of Jemena's augex forecast as contained in its reset RIN.

B.2.1   Trend analysis

The largest component of Jemena's augex forecast is $88.4 million ($2015) for demand-related augex (excluding overheads). Figure 6.7shows that Jemena's demand-driven augex is 5.6 per cent higher than its actual demand-driven augex in the 2011–15 regulatory control period.[68]

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[67]   AER, *Explanatory Statement - Expenditure Forecast Assessment Guideline*, November 2013, pp. 128–130.
[68]   AER analysis, Jemena's reset RIN, Jemena's response to AER Jemena 002.

Figure 6.7 Jemena's demand-driven augex historic actual and proposed for 2016–20 period ($2015, million, excluding overheads and one-off projects)
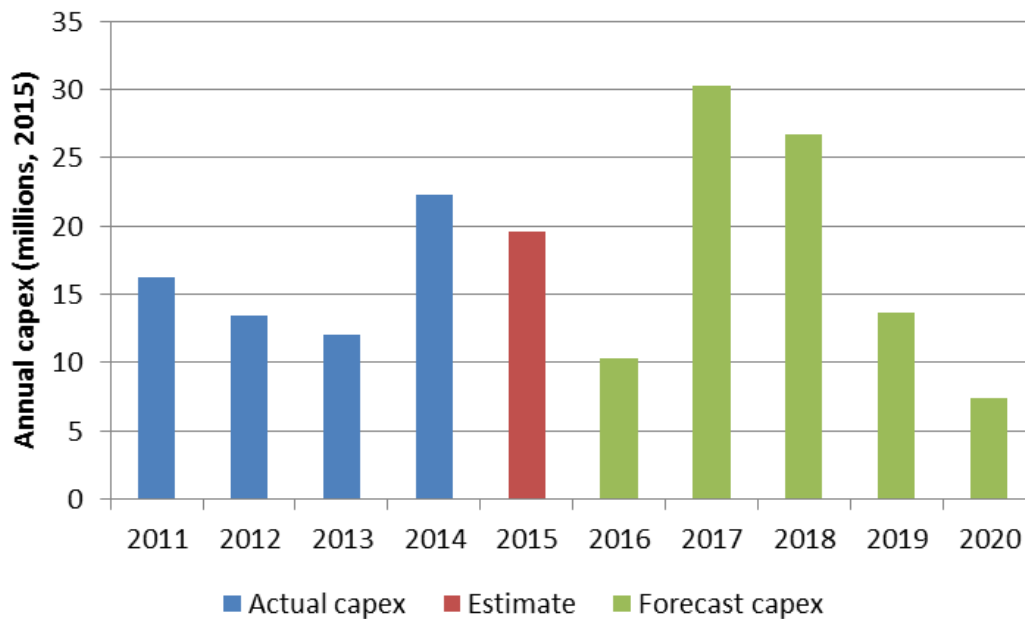
Source: AER analysis, Jemena's reset RIN Table 2.4.6, Jemena's response to AER Jemena 002.

The key driver of Jemena's demand-driven augex proposal is customer supply risk due to forecast maximum demand and network capacity constraints.[69] In particular, Jemena proposes capex to augment zone substations and feeders to address forecast demand in Craigieburn, Flemington, Sunbury and the surrounding areas.

To examine the impact of a maximum demand on the need for network augmentation, we look at network utilisation. Network utilisation is a measure of the installed network capacity that is in use (or is forecast to be). Where utilisation rates are shown to be declining over time, it is expected that total augex requirements would similarly fall to reflect a lower rate of growth of network capacity.

Figure 6.8 shows Jemena's zone substation utilisation between 2010 and 2014, and forecast utilisation in 2020 (at the end of the regulatory period). Between 2010 and 2014 Jemena undertook network augmentation, which is shown in a significant decrease in the number of substations operating above 80 per cent of their maximum capacity. The flattening of maximum demand between 2010 and 2014 also contributed to reduction in the utilisation of the network. As of 2014, there is only one substation operating above its maximum capacity (Sunbury).

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[69]   Jemena, *Regulatory proposal 2016–20:Attachment 7–3*, April 2015, pp. 66–67.

The forecast of zone substation utilisation in 2020 is based on Jemena's forecast demand at each substation and existing levels of capacity (without additional augmentation). This shows that Jemena expects that network utilization will increase overall by 2020, with more zone substations forecast to operate above 60 per cent capacity (shown in Figure 6.8 as a upwards shift in network utilisation forecast in 2020).

Figure 6.8   Jemena zone substation utilisation 2010 and 2014 actual, and 2020 forecast
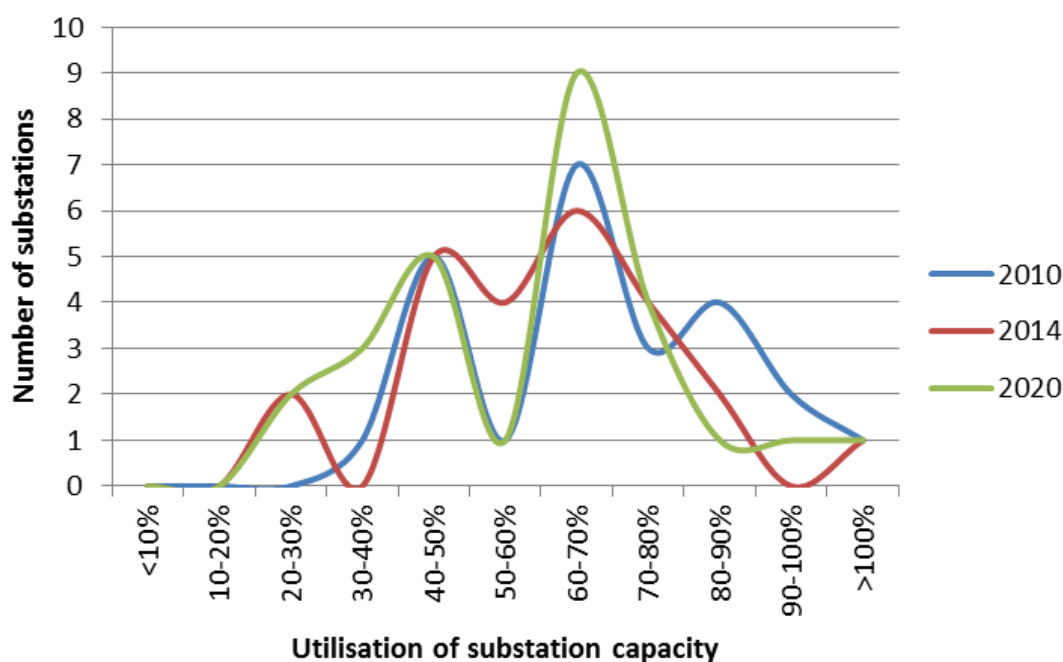
Source: AER analysis, Jemena's reset RIN.

Note: The utilisation rate is the ratio of maximum demand and the normal cyclic rating of each substation for the specified years.[70] Forecast utilisation in this figure is based on forecast weather corrected 50% POE maximum demand at each substation and existing capacity without additional augmentation over 2015-20.

The forecast of zone substation utilisation in 2020 is based on Jemena's forecast maximum demand at each zone substation and existing levels of capacity (without additional augmentation) by 2020. The small increase in the forecast network utilisation reflects Jemena's expectations of 1.4 per cent per annum demand growth between 2015 and 2020. As outlined in Appendix C, we accept that Jemena's demand forecasts reflect a realistic expectation of demand. However, we consider the forecasts in our decisions should reflect the most current expectations of the forecast period. Hence, we will consider updated demand forecasts and other information (such as AEMO's

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[70]   Normal cyclic rating is the maximum peak loading based on a given daily load cycle that a substation can supply each day of its life under normal conditions resulting in a normal rate of wear.

revised connection point forecasts) in the final decision to reflect the most up to date data.

Jemena identified the specific substations that it proposes to augment in the 2016–20 period. These include augmentation the Sunbury and Flemington zone substations and building a new zone substation in Craigieburn.[71] It also proposed the conversion and replacement of the Preston area network which will have impacts on utilisation in and around that area.

We have reviewed the forecast utilisation at these substations to assess whether augmentation is prudent based on alleviating capacity constraints. This is consistent with the submission from the VECUA which stated that:

> The AER needs to determine the distributors' augmentation capex needs utilising credible demand forecasts at the zone substation level and taking into account local system utilisation and excess capacity levels.[72]

Table 6.8 shows the forecast utilisation (without augmentation) for the Sunbury and Flemington zone substations, and the zone substations that are forecast to have their load reduced with the construction of zone substations at Craigieburn and Preston. These figures show that based on Jemena's demand forecasts, utilisation is expected to increase over the period at most substations.

Table 6.8   Utilisation of zone substations affected by augmentation

Zone substation	2015	2020
Sunbury	1.16	1.32
Flemington	0.70	0.73
Somerton	0.67	0.87
Coolaroo	0.62	0.69
East Preston switch yard	0.77	0.73
East Preston switch yard	0.49	0.48
Preston	0.26	0.26
Coburg North	0.68	0.62
Coburg South	0.80	0.93

Source: AER analysis, Jemena's Reset RIN.

Note: Load at the Somerton and Coolaroo zone substations is forecast to be reduced by the proposed Craigieburn substation. Load at the Coburg North and South zone substations is forecast to be reduced by the proposed Preston zone substation.

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[71] Jemena, *Regulatory proposal 2016–20: Attachment 7–3*, April 2015, pp. 71–74.

[72] Victorian Energy Consumer and User Alliance, *Submission to the AER Victorian Distribution Networks' 2016–20 Revenue Proposals*, 13 July 2015, p. 25.

On the basis of this analysis, we observe the following:

- The forecast utilisation of the Sunbury substation is over capacity and the load on the substation is expected to increase further. This indicates that augmentation should be required to ease expected load pressures.

- The forecast utilisation of the Somerton substation indicates that the new Craigieburn substation may be required to ease load pressures. However, the nearby Coolaroo zone substation is not forecast to be as highly utilised.

- The Preston conversion project will involve a new East Preston zone substation which will reduce load at the Coburg zone substations and existing East Preston zone substation. The relatively low forecast utilisation of East Preston and Coburg North suggests that alleviating capacity constraints would not be a primary driver for this project.[73]

We consider Jemena's proposal to augment these sub-stations in section B.2.2 below.

A number of submissions commented on network utilisation:

- The CCP submitted that Jemena's existing utilisation data and declining peak demand supports a view that there is little need for augmentation capex.[74] The CCP accepted that each Victorian distributor identifies that there are pockets of demand growth in its network that require augmentation. However, it also noted that there are also pockets of declining usage, meaning there is the potential to utilise assets no longer needed in some parts of the network and relocate them to where growth is being experienced.[75]

- The VECUA and the Victorian Greenhouse Alliances also submitted that there were significant investments in the Victorian networks over recent regulatory periods which have led to excess levels of network capacity and declining network utilisation.[76] Both submitted that we should consider this evidence closely in our capex assessment.

As noted by these stakeholders, we agree that current levels of network utilisation are important factors to consider in reviewing augmentation requirements over time. However, in terms of determining a level of augex for the 2016–20 period, it is also necessary to consider future demand and forecast network utilisation over this period. We consider this above.

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[73] The Coburg South zone substation is highly utilised because it currently receiving load transfers from the Preston zone substation (which also explains the low utilisation of the Preston substation).

[74] CCP Sub-panel 3, *Response to proposals from Victorian electricity distribution network service providers*, August 2015, p. 17.

[75] CCP Sub-panel 3, *Response to proposals from Victorian electricity distribution network service providers*, August 2015, p. 17.

[76] Victorian Energy Consumer and User Alliance, *Submission to the AER Victorian Distribution Networks' 2016–20 Revenue Proposals*, 13 July 2015, pp. 4 and 22–24; Victorian Greenhouse Alliances, *Local Government Response to the Victorian Electricity Distribution Price Review 2016–20* , 13 July 2015, pp. 33–34.

We note the comments of CCP in relation to the ability to relocate assets. Advice from our technical and engineering staff suggests that it is generally not technically or economically feasible to relocate distribution assets to other parts of the network to any significant degree. We understand that any ability to relocate assets would be limited and would not impact materially on the required expenditure for the 2016–20 period.

The remaining component of Jemena's augex forecast is $52.2 million ($2015) for non-demand related augex (excluding overheads). This is 74 per cent more than the actual non-demand augex that Jemena spent during the 2011−15 regulatory control period. This is primarily driven by the Preston area conversion project, which we discuss below.

B.2.2 Project reviews

We have examined Jemena's major augmentation projects and its network planning approach to assess whether its augex reflect the efficient costs that a prudent operator would require to achieve the capex objectives. In particular, we reviewed the Craigieburn, Sunbury and Flemington zone substation projects, the Melbourne Airport works, the Preston conversion project, and the distribution feeders and transformer upgrade programs. On the basis of our analysis, we then formed an alternative estimate of the prudent and efficient capex required for augmentation.

As part of our review, we first considered Jemena's governance and forecasting process to assess how it goes about making investment and operational decisions. As set out in our expenditure forecast assessment guideline, we considered:[77]

- the identified need for the project in terms of satisfying the capex objectives in the NER (in particular meeting a realistic expectation of demand forecasts)

- Jemena's network planning methodology and criteria to consider whether it reflects good industry practice to determine if the proposed costs are consistent with incurring efficient and prudent expenditure

- Jemena's cost-benefit analysis and options analysis, including considering non-network options to prudently defer major augex.

As set out previously, we draw upon engineering and other technical expertise within the AER to conduct these assessments.

On the basis of our review, we are satisfied that Jemena's network planning methodology and criteria reflects good industry practice. This is because Jemena applies cost-benefit and probabilistic network planning methods to its augmentation projects that take into account AEMO's value of customer reliability (VCR) (with the exception of the Preston conversion project), as is required by Jemena's Network Augmentation Planning Criteria. This is an economic approach to network planning in

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[77] AER, *Explanatory Statement - Expenditure Forecast Assessment Guideline*, November 2013, pp. 81–83, 84–86, 167–168.

which Jemena's compares the forecast cost to consumers from losing energy supply (e.g. when demand exceeds available capacity) against the proposed cost to augment capacity. The annual cost to consumers is calculated by multiplying the expected un-served energy (e.g. the expected energy not supplied based on probability of supply constraint occurring in a year) by VCR. This is then compared with the annualised augmentation solution cost.

We also accept that Jemena's demand forecasts at the system level (our reasons are set out in Appendix C). It follows that we also accept Jemena's more localised demand forecasts for the relevant augmentation projects. As noted in Appendix C and section B.2.1, we will consider updated demand forecasts and other information (such as AEMO's revised connection point forecasts) in the final decision to reflect the most up to date data.

However, we are not satisfied that in each case Jemena proposes the most prudent and efficient option to address the need for investment. In particular:

- For the Sunbury zone substation upgrade, we are not satisfied that Jemena's option to completely rebuild the sub-station is required to meet forecast demand or maintain the reliability of the substation in the 2016–20 period.

- For the Flemington zone substation upgrade, we are not satisfied that Jemena has selected the most prudent and efficient option to alleviate capacity constraints in this substation.

- Jemena generally dismisses non-network options to defer major augex. Non-network options such as embedded generation and demand management can be used to prudently defer major capex (although they may not fully resolve major capacity shortages in the longer term). Jemena has not consistently carried out probabilistic cost benefit analyses to investigate the benefit of these options over the 2016–20 period.

For Jemena's proposed Preston conversion project, Jemena did not engage in probabilistic planning as is required by Jemena's Network Augmentation Planning Criteria. While it provided a value of unserved energy at Coburg South zone substation that is relevant to this project, it did not evaluate the total customer benefit against the cost of proposed work. Instead its planning approach is largely deterministic and is based on the physical condition of the assets instead of their reliability performance. The absence of more probabilistic cost benefit assessment means that it is difficult for us to be satisfied that Jemena's options and timing for this project is necessary to maintain network reliability, safety or security.

On the basis of our analysis, we have formed an alternative estimate of the prudent and efficient capex for each of the augex projects and programs we reviewed. This analysis forms the basis for our alternative estimate of Jemena's total augex requirements for the 2016–20 period. This is shown in Table 6.9.

Table 6.9   AER alternative estimate of Jemena's major augex projects and programs ($2015, million, excluding overheads)

Category	2016	2017	2018	2019	2020	Total
New Craigieburn zone substation	0.0	0.0	7.1	7.7	0.0	14.8
Flemington zone substation upgrade	0.0	0.3	0.0	0.0	0.0	0.32
Sunbury zone substation upgrade	0.0	0.33	0.98	0.0	0.0	1.32
Melbourne Airport capacity upgrade	0.0	2.98	2.97	0.0	0.0	5.95
HV feeders program	4.0	10.1	2.2	2.4	1.9	20.6
Distribution network program	3.8	3.5	3.5	3.5	3.6	17.8
Preston area conversion	0.0	0.0	0.0	0.0	0.0	0.0
Reduction from Jemena's proposed augex	**8.2**	**17.3**	**17.4**	**5.2**	**0.0**	**48.2**

Source: AER analysis; Jemena regulatory proposal; Jemena response to AER Jemena 002 and 016.

Note: Numbers may not add up due to rounding.

Our assessment of each project and program and the reasons for our alternative estimate are set out below.

Craigieburn zone substation

Jemena proposed $14.8 million to build a new zone substation in Craigieburn, with associated feeders. This new zone substation is proposed to meet expected increases in demand in the Craigieburn and Greenvale areas within the 'northern growth corridor' of Jemena's network.[78]

We have included this capex in our alternative estimate because the capex reflects a prudent and efficient amount for Jemena to meet a realistic expectation of demand in the northern growth corridor of its network. However, we note that Jemena did not properly assess non-network alternatives that may allow it to prudently defer this capex (with the exception of demand management). Our reasons are provided below.

Jemena's northern growth corridor is currently served by the Somerton, Kalkallo and Coolaroo zone substations. The closest zone substation to the forecast growth areas is Somerton, which is forecast to be highly utilised by 2020 without any augmentation (using normal cyclic capacity). Jemena submitted that utilisation at the Somerton and Coolaroo substations will exceed their n-1 capacity before 2020. This suggests that some form of augmentation may be required to alleviate load pressure.

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[78]   Jemena, *Regulatory proposal 2016–20, Attachment 7–3*, p. 72.

Jemena submitted that demand growth in this area will be driven by expected increases in population and the establishment of two new suburbs. This is supported by the local Hume Council which forecasts a 14 per cent increase in population between 2015 and 2020.[79] As set out in Appendix C, we accept that Jemena's demand forecasts reflect a realistic expectation of demand over the 2016–20 period.

Given Jemena's demand forecasts, Jemena calculates that the cost to consumers from unmet demand and higher outages will be $25.3 million by 2020. This is based on the value of expected unserved energy, which is calculated by multiplying AEMO's latest Victorian VCR with forecast outages and expected unserved energy. On this basis, it is clear that Jemena's proposed $14.8 million cost to build the Craigieburn substation is outweighed by the benefit to consumers in terms of preventing outages and maintaining reliability in the northern growth area of the network.

Jemena considered five other investment options to building a new zone-substation, including building new sub-transmission lines or high voltage feeders to temporarily alleviate capacity constraints.[80] Of these options, Jemena's analysis shows that building the new zone-substation maximises net present value over a 10 year period.

Jemena considered and dismissed non-network options because it considered "that it will be unlikely to alleviate the underlying network issues due to the scale of the capacity requirement…"[81] Non-network options such as embedded generation and demand management can be used to prudently defer major capex (although they may not fully resolve major capacity shortages over time). Jemena's original analysis is qualitative and it has not carried out probabilistic cost benefit analysis to investigate the benefit that these options may offer to defer of major augex.

In response to an information request, Jemena provided analysis to show that utilising demand management for this project is estimated to cost $2.9 million per year.[82] This exceeds the proposed $1.3 million annualised cost of the Craigieburn substation. On this basis, we are satisfied that Jemena's decision to build a new substation over demand management is prudent in this case.

Sunbury zone substation

Jemena proposed $14.1 million to upgrade and redevelop the Sunbury zone substation. This project is proposed to meet expected demand growth in the Sunbury-Diggers Rest growth corridor in Jemena's network. The proposed capex includes:

- $1.3 million to increase capacity with a new transformer

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[79] We obtained population growth data from the Hume Council at http://forecast.id.com.au/hume on 1 September 2015.

[80] Jemena, *Northern Growth Corridor Network Development Strategy, ELE PL 0025*, 27 March 2015, pp. 17–22.

[81] Jemena, *Northern Growth Corridor Network Development Strategy, ELE PL 0025*, 27 March 2015, p. 22.

[82] Jemena, *Response to AER Information Request IR# 014*, 31 July 2015.

- $10.9 million to rebuild the Sunbury zone substation and replace existing assets, including establishing a new control building and replace the existing outdoor 22 kV switchyard with indoor 22 kV switching.[83]

We have included $1.3 million capex for a new transformer in our alternative estimate which reflects the prudent and efficient amount for Jemena to meet expected demand growth in the Sunbury-Diggers Rest area of Jemena's network. We have not included the remaining capex to rebuild the substation in our alternative augex estimate because it is primarily driven by age condition of some assets and reliability concerns. Based on our review of Jemena's supporting information, we are not satisfied that this capex is necessary to maintain network reliability, security or safety in accordance with the capex objectives of the NER.

We consider these in turn below.

Demand constraints

Jemena proposed $1.3 million to increase capacity in the Sunbury zone substation. This zone substation is currently over-utilised and demand is forecast to significantly exceed capacity by 2020 under normal transformer capacity. In relation to current and expected capacity constraints, Jemena submitted that:

> Since the summer of 2012, we've managed the overload risk under system normal conditions by conducting load transfers to the nearby Sydenham zone substation. Contingency transfer under system normal condition is only used as a temporary measure rather than a permanent solution, as this places additional risks on the adjacent Sydenham zone substation and its feeder where the transfer was made. From summer 2017-18 onwards, under system normal conditions, there will be insufficient capacity at Sunbury over the summer peak load period (including contingent load transfer to Sydenham) to supply the forecast customer demands.[84]

As set out in Appendix C, we accept that Jemena's demand forecasts reflect a realistic expectation of demand over the 2016–20 period. This is supported by population projections from the local Hume Council which forecasts a 14 per cent increase in population between 2015 and 2020.[85] Together with the existing capacity constraints at the Sunbury substation, this supports augmentation to alleviate forecast load pressure over the 2016–20 period.

Given Jemena's demand forecasts, Jemena calculated that the cost to of unmet demand and higher outages to consumers from increases in demand will be $3.6 million by 2018. On this basis, it is clear that Jemena's proposed $1.3 million cost to augment transformer capacity is outweighed by the benefit to consumers in terms of

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[83]   Jemena, *Response to AER Information Request IR# 016*, 19 August 2015

[84]   Jemena, *Regulatory proposal 2016–20: Attachment 7–3*, p. 73.

[85]   We obtained population growth data from the Hume Council at http://forecast.id.com.au/hume on 1 September 2015.

preventing outages and maintaining reliability in the northern growth area of the network.

Substation rebuild and replacement

Jemena also proposed $10.9 million to rebuild the Sunbury zone substation and replace existing assets, in addition to increasing transformer capacity. This includes establishing a new control building and replacing the existing outdoor 22 kV switchyard with indoor 22 kV switching.

Jemena supported this capex based on the age of some assets and reliability concerns. Jemena submitted that some of these assets are approaching the end of their useful life and need to be replaced. This includes the transformer that will be upgraded, the 66 kV circuit breakers, and the control room. However, other assets that Jemena proposed to replace are relatively new including the outdoor 22 kV circuit breakers (which were replaced in 2002).[86]

Jemena also submitted that the Sunbury zone substation is less reliable than other zone substations due the configuration of the substation. It submitted that there has been a loss of customer load from this zone substation eighteen times in the past twenty years.[87] Because of this, Jemena proposed to reconfigure the substation in line with the design of its more modern substations (which includes providing indoor switching) to improve reliability outcomes.

In our view, Jemena has not justified the need to rebuild the Sunbury zone substation in the 2016–20 period. This is because:

- Unlike its augmentation assessments, Jemena did not present details of the impact on customers from further outages in terms of the value of expected unserved energy. Rather, Jemena's analysis appears to be qualitative in nature and places no probability of the likelihood of further outages and the cost to consumers. This makes it difficult to determine whether the proposed cost to rebuild the substation is less than the cost to consumers from not proceeding.

- Similarly, while several of the assets may be aging, Jemena has not provided evidence that the assets need to be immediately replaced in the 2016–20 period (including in addition to the capex that is proposed within its repex forecast). This is because Jemena has not established that replacing these assets is necessary to maintain network reliability, security, safety or quality to satisfy the capex objectives.

- Most of the outdoor 22 kV circuit breakers that Jemena proposed to replace were replaced in 2000 and are not reaching the end of their life.

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[86]   Jemena, *Sunbury-Diggers Rest Growth Corridor Network Development Strategy*, p. 20.
[87]   Jemena, *Sunbury-Diggers Rest Growth Corridor Network Development Strategy*, p. 21.

For these reasons, we have not included Jemena's proposed $10.9 million to rebuild the Sunbury zone substation in our alternative estimate of augex.

In Appendix B.4, we assessed and provided an estimate of Jemena's likely asset replacement requirements in the next period, largely based on continuing asset replacement practices that it undertook to meet the capex objectives into the next period (business as usual repex). If Jemena is of the view that, given the condition of the assets, it requires more than business as usual repex to meet the capex objectives, then it should provide supporting information to this effect in its revised proposal (including updating any historical and forecast expenditure of this type in the form of an updated response to RIN template 2.2, and other supporting material such as business cases, options analysis and cost benefit analysis).

Flemington zone substation

Jemena proposed $8.2 million to upgrade the Flemington zone substation. This is primarily driven by proposed capacity on the zone substation 11kV feeders and circuit-breakers, and the age of some of its assets.

We have included $0.32 million in our alternative estimate which we consider reflects the prudent and efficient amount for Jemena to meet expected demand growth for the Flemington zone substation and maintain reliability and safety. This amount reflects the cost of replacing the 11 kV transformer cables which are the primary capacity constraint within the zone substation.

The Flemington zone substation is forecast to operate at 73 per cent capacity by 2020 under normal capacity conditions on its transformers. This does not suggest that immediate augmentation is required to alleviate load pressure. However, Jemena submitted that limited capacity on its 11kV transformers cables and circuit-breakers means that the transformers cannot be fully utilised.[88] This means that this zone substation currently operates above its n-1 emergency capacity.

Jemena has some limited ability to transfer load to adjacent substations with the completion of feeder upgrade works.[89] This will allow Jemena to partially reduce congestion in this substation by up to 6 MVA (which is approximately 40 per cent of the expected demand in excess of capacity by 2020). Based on our review of Jemena's supporting documents and modelling, it appears that Jemena has not taken this ability to transfer load into its calculation of the cost to consumers due to capacity constraints.

Jemena considered a number of options to address the capacity constraints in the Flemington zone substation. Its preferred option includes the installation of:

- a new indoor 11 kV switch room

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[88]   Jemena, *Flemington Development Strategy*, p. iii.

[89]   Analysis of forecast demand and capacity at the adjacent Essendon and North Essendon zone substation show that these substations will have up to 17MVA of spare capacity for emergency load transfer.

- three new 11 kV switchboards, two to replace the existing aged assets and one new 11 kV switchboard to allow for connection of new 11 kV feeders, and

- two new 11 kV transformer cables to the new switch-room.[90]

The primary constraint in the Flemington zone substation is the capacity of the 11kV transformer cables. Augmentation of existing cables alone would increase the emergency capacity of the substation from 23.9 MVA to 30.5MVA, which is sufficient to remove capacity constraints and allow the zone substation transformers to be nearly fully utilised. This would be a lower cost option and could potentially have less of an impact on supply security and reliability than more extensive augmentation and replacement work program.

In response to an AER information request, Jemena stated that:

> …replacing the transformer cables alone is not feasible or practical and it poses a significant and unacceptable health and safety risk to Jemena personnel and its contractors, and an unacceptable supply security and reliability risk to our customers during the construction works. In order to increase the station rating and facilitate the work to be done safely and securely, the 11 kV transformer cables replacement work needs to be undertaken together with other proposed primary and secondary works…[91]

Jemena's primary reason was that existing 11 kV transformer cables are currently installed in ducts within the concrete slab flooring of the Flemington zone substation 11 kV switch room. It states that "concrete flooring excavation works would be required to install new cables and switchboards, and these works would need to be done with the adjacent switchboards and transformer cables in service and alive to maintain supply to the Flemington area, which is unacceptable due to the safety risk."[92]

We accept that performing excavation and civil works in close vicinity to a live network poses safety and security risks. However, there a number of reasons to suggest that Jemena will be able to effectively and safely augment the existing transformer cables in this zone substation:

- The work to replace existing transformer cables with higher capacity cables is similar to replacing faulty transformer cables. This would involve removing the existing cables from the cable ducts and installing new cables through these same ducts. Because this fault replacement work would not require concrete flooring excavation and other potentially dangerous civil works, it is not clear why installing a new transformer cable would require such civil works.

- Similar transformer cable upgrades have been successfully performed by other distributors. In particular, ActewAGL installed two 11kV transformer cables in its

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[90]   Jemena, *Flemington Development Strategy*, p. iv.
[91]   Jemena, *Response to information request IR# 016.1*, 19 August 2015, p. 2.
[92]   Jemena, *Response to information request IR# 016.1*, 19 August 2015, p. 2.

Belconnen zone substation in 2013 which upgraded the emergency capacity in the substation.[93]

For these reasons we consider that replacing the 11kV transformer cables with higher capacity cables is a prudent option to alleviating existing and forecast capacity constraints in the Flemington zone substation. Jemena forecast that this will cost $0.32 million in capex. This will avoid the additional $7.9 million capex associated with building new switch rooms and switchboards.

Jemena also submitted that "due to its age and condition, many of the primary assets and the protection and control assets will require replacement over the next five to ten years to maintain current levels of supply reliability."[94] Jemena stated that replacement of the existing 11 kV switchboards with new assets is expected to reduce the probability of failure by approximately ten times, thereby reducing the expected unserved energy risk.[95]

While we recognise that the assets in this zone substation will reach the end of their life within the next ten years, it is not clear that replacement is necessary in the 2016-20 period to maintain network reliability, safety or security. If Jemena considers that these assets need to be replaced within the 2016–20 period, it should submit more detailed information about the existing reliability performance of these assets and quantify the costs to consumers from any expected reliability deterioration (or alternatively provide information about why this capex cannot be considered within our repex allowance if necessary).

Melbourne Airport

Jemena proposed $14.5 million ($2015) to augment capacity supplied to Melbourne Airport at Tullamarine. The primary driver of this expenditure is an expected significant increase in demand at Melbourne Airport over the next ten years.[96] This includes:

- $5.95 million to augment the existing 66kV sub-transmission loop to Melbourne Airport by constructing a double circuit to replace the existing single circuit

- $8.56 million to install a new 66kV sub-transmission line to the Melbourne Airport.[97]

We have included $5.95 million in our alternative estimate which we consider reflects the prudent and efficient amount for Jemena to meet expected demand growth at the Melbourne Airport. This amount reflects the cost of augmenting the existing 66kV sub-

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[93] ActewAGL, *Belconnen Transformer Augmentation*, 23 May 2014, p. 6.

[94] Jemena, *Regulatory proposal 2016–20: Attachment 07-03*, p. 73.

[95] Jemena, *Flemington Development Strategy*, p. iii.

[96] Jemena regulatory proposal, Attachment 07–03, p. 64

[97] Jemena categorised the capex for the new sub-transmission line as 'connections capex' because it is associated with a single customer connection (the Melbourne Airport). While we recognise that this capex has some elements of connections works, it likely represents augex because it relates to addressing existing and forecast network constraints on the shared network. We have therefore considered this capex within our assessment of Jemena's augex forecast

transmission loop. We have not included an amount for installing a new 66kV sub transmission line. Our reasons are as follows.[98]

Jemena submit that the existing sub-transmission lines to the Melbourne Airport are already highly utilised and are expected to exceed capacity beyond 2017–18.[99] Jemena has identified a range of expected demand scenarios based on discussions with the owners of the Melbourne Airport, and proposed different augmentation solutions depending on the expected demand. However, the required augmentation will ultimately depend on the amount of capacity that is requested and contracted by the Melbourne Airport.[100]

Jemena's preferred option to meet expected demand, based on its supporting analysis, is to augment capacity to the existing 66kV sub-transmission line. This is based on projections of required capacity to Melbourne Airport by 2023–24 and the lowest cost option to provide this capacity. On the basis of our technical review, we are satisfied that this option represents a prudent and efficient amount to meet expected demand at the Melbourne Airport.[101]

However, Jemena also proposed to install a new sub-transmission line in addition to augmenting the existing sub-transmission loop. This is based on Jemena's discussions with the owners of the Melbourne Airport in December 2014 (after Jemena's initial analysis was performed) that suggested that Melbourne Airport may request additional capacity by the end of 2018. If this additional capacity is contracted, Jemena proposed that this will likely require a new sub-transmission line in addition to augmenting existing capacity.

This option (to both augment existing capacity and install a new line) was not recommended or specifically modelled within Jemena's analysis. This means that we are unable to conclude whether the benefits of this option (in terms of meeting expected demand and preventing network outages) will outweigh the combined cost of the proposal. Furthermore, and importantly, the need for this augmentation will depend on whether the owners of Melbourne Airport actually contract the additional capacity. It is not clear from Jemena's information about the likelihood that Melbourne Airport will actually contract the additional capacity within the 2016–20 period.

For these reasons, our alternative estimate does not include Jemena's proposed additional $8.56 million to install a new 66kV sub-transmission line within our alternative estimate. We are open to Jemena providing updated information in its revised proposal about the status of Melbourne Airport's request for additional capacity

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[98]   Jemena has claimed confidentiality over the supporting documentation for this capex. This preliminary decision does not identify specific details within this documentation and we have presented our conclusions at a high level.

[99]   Jemena, *Regulatory proposal 2016–20: Attachment ELE_PL_0028*, p. 3.

[100]   Jemena, *Regulatory proposal 2016–20: Attachment ELE_PL_0028*, p. vi.

[101]   We reviewed Jemena's forecasts of the costs to consumers from unmet demand, its options analysis, and its network planning approach.

and more information about the combined cost-benefit of augmenting the existing sub-transmission loop and installing a new sub-transmission line.

Note that Jemena's proposed capex to upgrade the existing 66kV sub-transmission loop is included within its augex proposal (within the demand augex category 'other small projects' listed in Table 6.6), whereas the additional capex for a new sub-transmission line was included within its connection capex proposal. This means that our decision to only exclude the additional capex for the new sub-transmission line will not result in any change compared to Jemena's augex forecast.

Preston conversion

Jemena proposes $27.5 million ($2015) to convert the Preston area HV network from a voltage of 6.6kV to 22kV. This includes building a new Preston zone substation on the existing land of East Preston substation, which is proposed to be decommissioned.

This program was proposed to span four regulatory periods at a forecast cost of $83 million. Jemena submitted that in 2008 it developed a Preston area network development strategy which recommended converting the 6.6kV distribution assets to 22kV, rather than a like-for-like replacement of existing 6.6kV assets.[102] It stated that it had completed five of the fourteen stages of the conversion program by December 2014.

Jemena submitted that the primary drivers of this project are:

- The existing distribution assets in the Preston and East Preston areas and surrounding 6.6kV feeder network are approaching the end of life and require replacement.

- Poor asset condition of these assets (as indicated by Jemena's health indicators) means that there is an increased risk of outages.

- There is insufficient feeder capacity in the Preston and Preston East 6.6kV area for single contingencies (i.e. feeder load exceeding n-1 rating).

- Demand at the adjacent Coburg South zone substation exceeds n-1 emergency capacity rating. This zone substation is currently receiving load transfers from the Preston zone substation as Jemena has begun performing its conversion works.

We have not included the proposed capex for this project in our alternative estimate of Jemena's augex requirements. Based on Jemena's documentation, we are not satisfied that this project is justified by the need to expand the capacity or capability of the network. It is not clear that Jemena would have proposed this augmentation project if it were not for its assessment of the condition of the relevant assets. As Jemena has not appropriately justified the need for the expenditure on the basis of an augmentation driver, we have not included it within our alternative estimate of augex.

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[102]   Jemena *Regulatory proposal 2016–20: Attachment 07–03*, p. 71.

In Appendix B.4, we assessed and provided an estimate of Jemena's likely asset replacement requirements in the next period, largely based on continuing asset replacement practices that it undertook to meet the capex objectives into the next period (business as usual repex). If Jemena is of the view that, given the condition of the assets, it requires more than business as usual repex to meet the capex objectives, then it should provide supporting information to this effect in its revised proposal (including updating any historical and forecast expenditure of this type in the form of an updated response to RIN template 2.2, and other supporting material such as business cases, options analysis and cost benefit analysis).

To the extent that assets in the Preston and East Preston zones may be reaching the end of life, Jemena can prioritise its capex to carry out the replacement of assets on its network. If Jemena does not consider business as usual repex will allow it to meet the capex objectives in the next period, it should provide us with supporting information to this effect. Having said that, we consider Jemena has not demonstrated that the scope and timing of the project is necessary to maintain network reliability, safety or security over the 2016–20 period for the following reasons.

First, Jemena's planning approach for the Preston conversion was largely deterministic and was based on the physical condition of the assets instead of the reliability performance of the assets. This approach does not comply with Jemena's Augmentation Planning Criteria to use probabilistic planning method for zone substation and HV feeder augmentations. Jemena has not provided evidence that the reliability performance of the Preston zone substation and surrounding feeder network has been deteriorating over the recent period or that Jemena is unable to maintain reliability levels over the 2016–20 period without replacing assets.[103] This contrasts with Jemena's probabilistic planning for its other augmentation projects where it conducted cost benefit analysis and considered the cost of reliability to consumers (e.g. VCR).

Second, Jemena dismissed other potential credible options that will alleviate capacity concerns in 6.6kV feeders and ease pressure of aging assets. This included transferring load to the new East Preston zone substation (which has three new 22kV feeders that are available to pick up load), upgrading feeder sections where capacity constraints exist, building new feeder ties to improve load sharing among feeders, and adopting non-network options to address potential reliability and capacity shortages. Jemena appeared to largely dismiss these options because they do not address the proposed risk due to the condition of the assets. However, as we state above, Jemena has not demonstrated the expected consequences from asset condition in terms of reliability performance. These alternative options may be prudent lower cost options that address any expected performance degradation from capacity concerns of the 6.6kV feeders and aging assets and consistent with good industry practice.

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[103] Jemena's asset condition test data does not show a trend of material deterioration of conditions. For example, its dielectric dissipation factor (DDF) test on circuit breakers returned similar result in 2008 and 2013.

Distribution feeder and transformer augmentation

Jemena proposed $38.6 million to augment its distribution network. This included:

- $20.6 million to augment high voltage feeders

- $16.8 million to augment distribution transformers

- $1 million to augment low voltage feeders.

The primary driver of this augex is forecast capacity constraints on high and low voltage feeders and distribution transformers. Jemena submitted that 22 high voltage feeders and a significant number of distribution transformers are forecast to operate above capacity or maximum safe limits by 2020.[104]

As set out in Appendix C, we accept Jemena's demand forecasts for the 2016–20 period. Jemena's demand forecasts at the system level are slightly higher than the actual demand experienced in the 2011–15 period.

The forecast capex for these programs is generally comparable to the Jemena's actual capex for similar work over the 2011–15 period. The exception is a proposed increase in augex for high voltage feeder augex in 2017. Given that demand is forecast to be slightly higher over the 2016–20 period, Jemena's proposal to spend an equivalent amount of capex on augmenting distribution feeders and transformers as in the 2011–15 period should reflect a prudent and efficient amount for the 2016–20 period. On this basis, we include Jemena's proposed capex for these programs in our alternative estimate.

Rapid Earth Fault Current Limiter systems

Jemena proposes $6.2 million ($2015) to install Rapid Earth Fault Current Limiter (REFCL) systems within four of its zone substations.[105] This capex includes:

- $1.86 million to install a REFCL in the new Craigieburn zone substation

- $2.35 million to install a REFCL in the existing Coolaroo zone substation

- $1.97 million to install a REFCL in the existing Sunbury zone substation

- $0.21 million to install a REFCL in the existing Sydenham zone substation.

This capex is primarily related to bushfire mitigation and is related to the Victorian Bushfire Royal Commission recommendations. We have assessed this capex in appendix B.5. On the basis of the reasons set out in that appendix, we have included Jemena's proposed $6.4 million within our alternative estimate of augex.

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[104] Jemena, *Regulatory proposal 2016–20: Attachment 07–03*, p. 74.

[105] See Jemena, *JEN AER IR# 002,* 18 June 2015, p. 25, and Jemena, *Regulatory proposal 2016–20: Attachment ELE PL 0021*.

B.3 Forecast customer connections capex, including capital contributions

Connections capex is incurred by Jemena to connect new customers to its network and where necessary augment the shared network to ensure there is sufficient capacity to meet the new demand.

New connection works can be undertaken by Jemena or a third party. The new customer provides a contribution towards the cost of the new connection assets. This contribution can be monetary or in contributed assets. In calculating the customer contribution, Jemena is required to take into account the forecast revenue anticipated from the new connection.[106] These contributions are subtracted from total gross capex and as such decrease the revenue that is recoverable from all consumers. Customer contributions are sometimes referred to as capital contributions or capcons.

The mix between net capex and capcons is important as it determines from whom and when Jemena recovers revenue associated with the capex investment. For works involving a customer contribution, Jemena recovers revenue directly from the customer who initiates the work at the time the work is undertaken. This is different from net capex where Jemena recovers revenue for this expenditure through both the return on capital and return of capital building blocks that form part of the calculation of Jemena' annual revenue requirement.[107] That is, Jemena recovers net capex investment across the life of the asset through revenue received for the provision of standard control services. Jemena has forecast $68.2 million ($2015-16) of expenditure for connection works for the 2016–20 regulatory control period, net of customer contributions. Table 6.10 shows Jemena's proposed allowance for connections expenditure and customer connections.

Table 6.10   Jemena proposed connections capex ($2015/16, million, excluding overheads)

Category	2016	2017	2018	2019	2020	Total
Gross connections capex	32.8	34.6	37.2	32.7	33.7	171.0
Customer contributions	20.4	19.9	21.6	19.7	21.2	102.7
Net connections capex	12.4	14.7	15.6	13.0	12.6	68.2

Source: Jemena, Response to AER information request 013.

We accept both Jemena's net connections capex forecast and customer contributions forecast and have included these in our substitute estimate of net capex. Part of this expenditure related to a key customer project, the Melbourne airport expansion, we

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[106]   In Victoria, the Essential Services Commission's (ESCV) Guidelines 14 and Guideline 15 determine the customer connection charges.

[107]   For more information on the building blocks included in the determination of Jemena's annual revenue requirement see our attachments on the Regulatory Asset Base and Regulatory Depreciation.

consider is better characterised as augmentation capex and as such we have included this amount in our substitute capex forecast as augex. As such, we have included in our substitute capex forecast a connections component as shown in Table 6.11.

Table 6.11   AER adjusted connections capex ($2015/16, million, excluding overheads)

Category	2016	2017	2018	2019	2020	Total
Gross connections capex	31.9	31.1	30.5	32.7	33.7	159.9
Customer contributions	20.4	19.9	21.6	19.7	21.2	102.8
Net connections capex	11.5	11.2	8.9	13.0	12.5	57.1

Source: AER analysis.

In determining whether Jemena's forecasts meet the capex criteria, we considered:

- the trends in Jemena's connections capex across time, and
- Jemena's forecast methodology.

We note the stakeholders have raised some concerns with the classification of connection services.[108] Our assessment of service classification is discussed in the classification of services chapter 13 of this decision.

B.3.1   Trend analysis

As we note in section A.2, when assessing Jemena's connections capex we have considered the trends in actual and forecast capex.[109] We have used this analysis to provide context to Jemena's proposal, in particular trend analysis has allowed us to:

- gauge the degree to which Jemena's proposal is consistent with past connections capex, and
- understand variations between Jemena's capex allowances for connections and that incurred in the 2011-15 regulatory control period .

Actual and forecast customer connections

Figure 6.9 shows the trend in Jemena's actual and forecast gross connections capex by both net connections capex and customer contributions.

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[108]   Consumer Challenge Panel 3 – Victorian DNSPs revenue reset comments on DNSPs proposal, pp. 54–56.
Vector, *Submission on the AER's Issues Paper on Victorian Electricity Distribution Pricing Review for 2016–2020*, 13 July 2015, pp. 4–5.

[109]   This is one of the capex factors to which we are required to have regard to under the NER (NER, cl. 6.5.7(a)(5)).

Figure 6.9   Jemena connections and capital contributions - historic actual and proposed for 2016–20 regulatory control period ($2015/16, million)
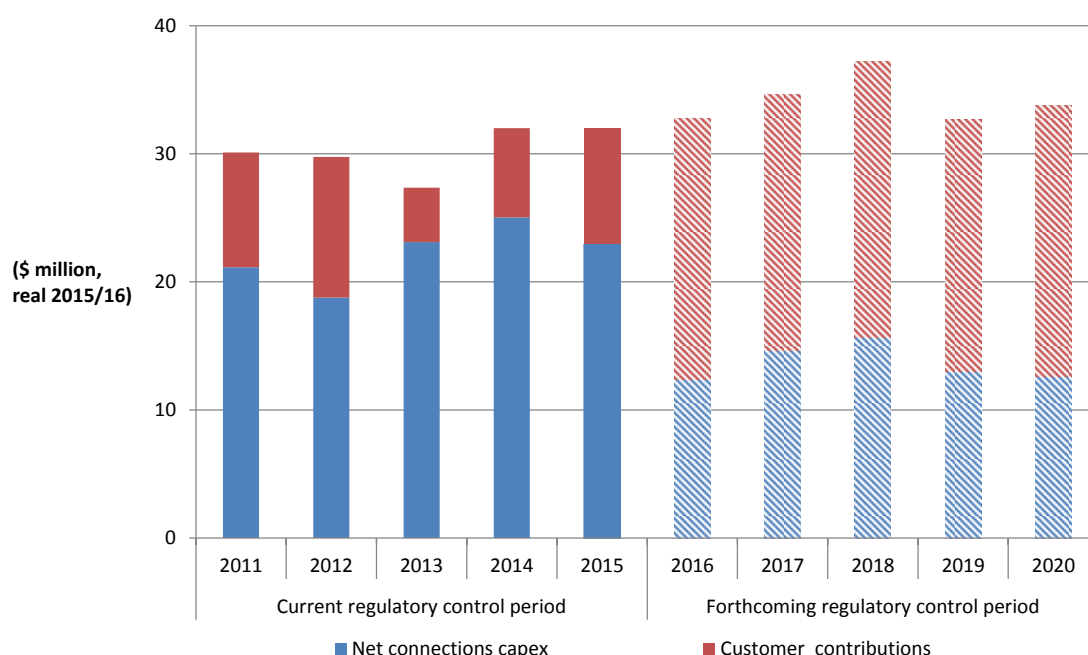
Source: Jemena, Response to AER information request 013.

Figure 6.9 shows that between 2011 and 2014, gross connections capex was relatively stable. With respect to gross capex, there has been a relatively small decline in capital contributions, leading to increases in the prominence of net capex.

We note there is a timing mismatch whereby Jemena submits its regulatory proposal before the calendar year 2015 is complete.[110] This means the expenditure and volumes that Jemena has reported for 2015 are estimates. With this in mind, we have not used the 2015 data for the purposes of comparing actual expenditure observed in the last regulatory control period with the expenditure forecast by Jemena for the next period.

Historic spend

In determining whether we are satisfied that Jemena's forecast connections capex meets the criteria in the rules we must have regard to Jemena's actual and expected capex during any preceding regulatory periods.[111] We note that Jemena is forecasting

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[110]   Jemena submitted its regulatory proposal to the AER on 30 April 2015, in advance of the actuals for calendar year 2015 being finalised.

[111]   NER 6.5.7(e)(5)

to underspend its regulatory allowance in the 2011-15 period by $48 million ($2015/16).[112]

Figure 6.10 compares Jemena's connections capex spend in the 2011-15 regulatory control period with the allowance included in the capex determination.[113]

Figure 6.10 Jemena 2011-15 regulatory control period connections capex actual and allowed ($2015/16, million)
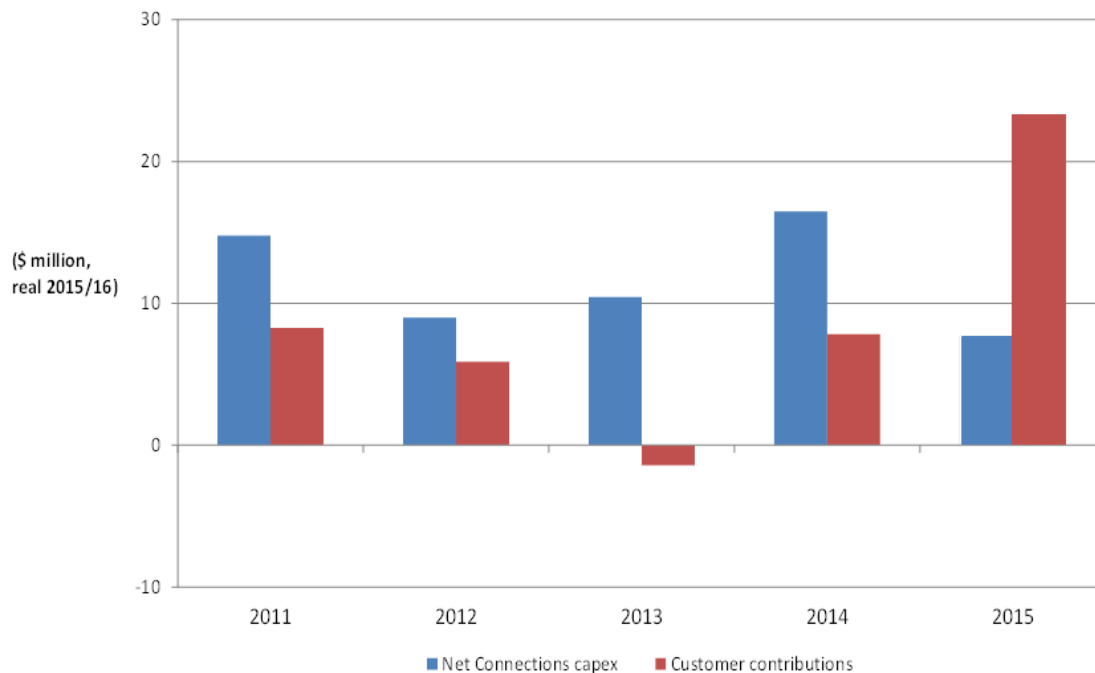
Source: AER analysis.

Jemena notes that it expects its expenditure on connections in the current period to exceed the forecast.[114] Jemena considers:

> This was due to higher levels of activity in business supply, residential sectors (medium density housing, dual and multiple occupancy) and special capital works, specifically underground cable works. Unit costs were also higher than those used to forecast gross demand connections in our revised proposal. Jemena expects gross demand connections capex will continue to exceed the allowance for the

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[112] Jemena, *Regulatory proposal 2016–20: Attachment 07-01 Historical capital expenditure report for the 2011 regulatory period* Table 2–6

[113] 2011-15 allowance: AER Victorian Distribution Determinations 2011-15 - Final Decisions - Table 8.24 (adjusted for inflation)

2011-15 actual: Jemena Annual RINs

[114] Jemena, *Regulatory proposal 2016–20: Attachment 07-01 Historical capital expenditure report for the 2011 regulatory period, April 2015,* p. 10.

remainder of the regulatory period, as reflected in the estimated 2015 capex.[115]

Figure 6.10 shows that compared with its allowance in the 2011-15 period, Jemena overspent on net connections capex and received less customer contributions than forecast (with the exception of 2013). We note that a major feature of the regulatory framework is the incentives Jemena has to achieve efficiency gains whereby actual expenditure is lower than the allowance. Differences between actual and allowed connections capex could be the result of efficiency gains, forecasting errors or some combination of the two.

We have been mindful of the above trends when assessing Jemena's forecast methodology for the 2016–20 regulatory control period.

B.3.2 Jemena's forecasting methodology

Jemena's forecast consists of a series of activity based connection type forecasts. These activity forecasts correspond to each standard control customer connection service as classified in the final framework and approach.[116]

Jemena adopts a phased approach to produce these forecasts by:[117]

- deriving a "base volume" and "base unit rate" for each activity from historical expenditure and volumes

- the base unit rates are then escalated to be in current year dollars. Similarly, volume growth rates are applied to each base volume, and

- the forecast capex is then calculated as the product of the forecast volumes and escalated unit rates. At this stage any horizon' projects are then included in the forecast.

In determining whether we are satisfied Jemena's forecast meets the capex criteria, we have assessed each phase of the forecast as set out below.

Volume forecasts

Jemena has derived volume growth rates from forecasts of economic activity by ACIL Allen for the residential sector and the Construction Forecasting Council (CFC) for the construction and industrial sectors.[118]

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[115] Jemena, *Regulatory proposal 2016–20: Attachment 07-01 Historical capital expenditure report for the 2011 regulatory period,* April 2015, p. 12.

[116] AER, *Final Framework and approach for the Victorian Electricity Distributors Regulatory control period commencing 1 January 2016*, 24 October 2014.

[117] Jemena, *Customer Connections Capital Forecast Methodology*, p. 8.

[118] Jemena, *Customer Connections Capital Forecast Methodology*, p. 8.

Residential sector volume growth rates

We are satisfied that the growth rates of residential connections underlying Jemena's forecast represent a realistic expectation of the volume residential connection activity Jemena will be required to undertake over the 2016–20 regulatory control period. In determining this we have compared this growth rate to other available data on the rate of residential construction and found they follow a similar trend.

Figure 6.11 below shows the historical and forecast of residential customer growth rates Jemena relied on which we have compared to the actual and forecast new dwelling data for Victoria published by the Housing Institute of Australia (HIA).[119]

Figure 6.11   ACIL Allen Jemena residential connection growth and HIA Victorian dwelling growth – actual and forecast
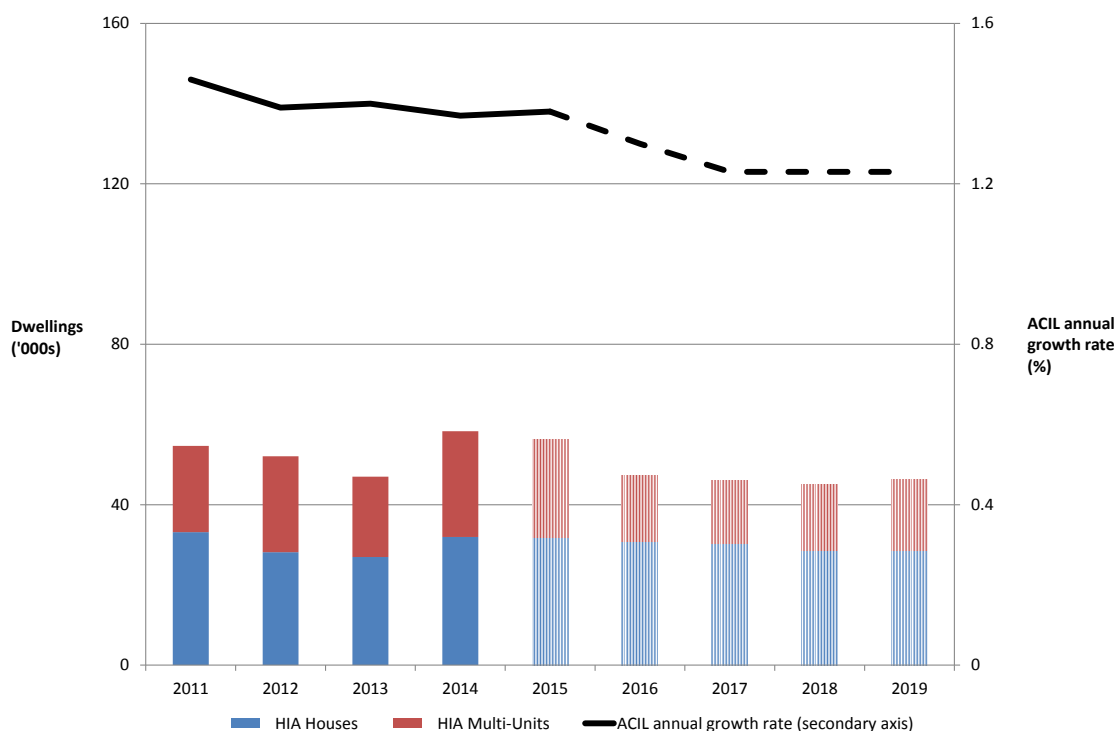
Source: Jemena, Public Attachment 07-03 Forecast capital expenditure report for 2016 regulatory period, Table 3-19 HIA Housing Forecasts, May 2015.

We note the forecast growth of both series follow the same rates of initial decline in growth before plateauing later in the forecast period. On this basis, we are satisfied that the volume growth rates relied on by Jemena for residential connections represent an unbiased forecast.

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[119]   HIA Housing Forecasts, May 2015.

Commercial/industrial sector volume growth rates

Similar to the growth rates of residential connections, we are satisfied that the commercial/industrial activity forecasts underlying Jemena's forecast represent a realistic expectation of the volume this type of connection activity Jemena will be required to undertake over the 2016–20 regulatory control period. Further, we have sought to validate the historical data relied on for the projected volume growth rate by comparing the underlying non-residential construction expenditure with other available data.

Figure 6.12 compares the historical construction expenditure underlying the forecast volume growth Jemena relied on against data published by the ABS for historical total non-residential construction expenditure in Victoria.

Figure 6.12   Comparison of growth in non-residential expenditure – CFC and ABS
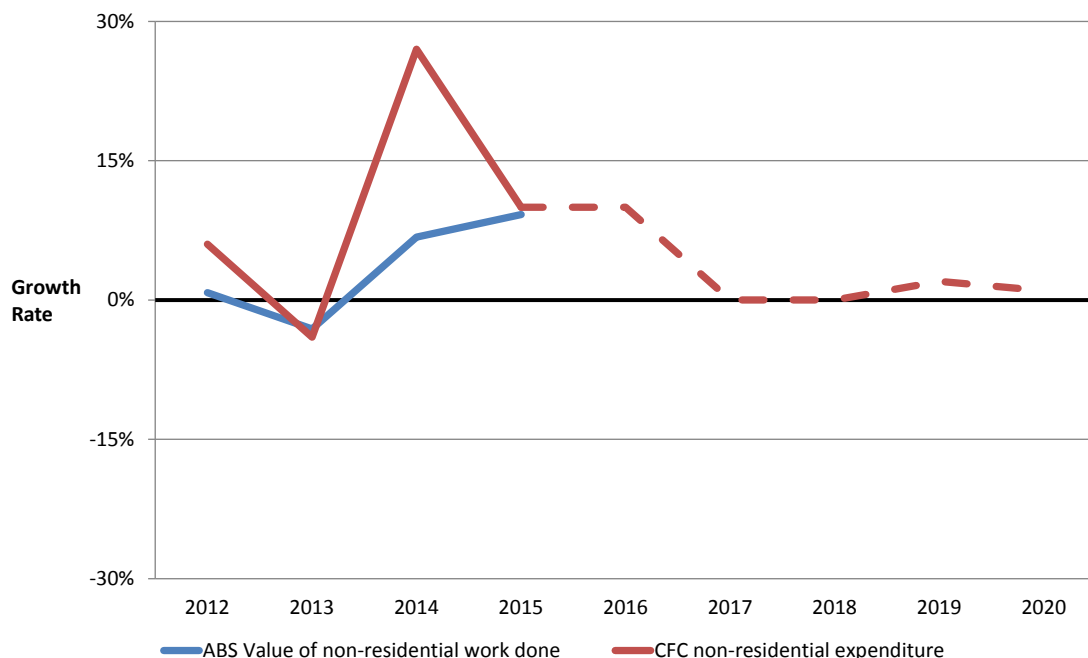
Source: Jemena, Public Attachment 07-03 Forecast capital expenditure report for 2016 regulatory period, Table 3-20.

ABS Series 8755.0 - Construction Work Done – Victoria – Total non-residential.

We note, with the exception of 2014, the two series track at a similar rate of growth in non-residential construction expenditure.

We sought feedback from Jemena on the reason for significant increases in capex for its "Business supply >10kVA" connection activity in 2014 and 2015. We noted that these increases appear to be generated by the CFC input data. Historical expenditure ratios of CFC data are used to forecast the commercial/industrial volume growth rates.

Given this, we asked Jemena to provide evidence or argument that supports the increases in these years and why they are reasonable given the historical trend.[120] In its response, Jemena stated:

> Whilst the output of the model shows significant increases for activity 'Business Supply > 10kVA' in Australian FY2014/15 and 2015/16, of 25% and 12% per annum respectively, JEN considers this forecast reasonable viewed in the context of the historical trend which shows large variations as high as 57% increase in FY2012/13 and 23% decrease in FY2013/14.

> Furthermore, when the connections capex is presented by calendar year, as shown in Table 6-3, the capex forecast for activity 'Business Supply > 10kVA' shows a 2% reduction in 2014 and an increase of 18% in the following year. This compares with historical increases of 12%, 5% and 16% per annum in recent years, 2011, 2012 and 2013 respectively. The cumulative effect of historical compared to forecast is conservative, which

> further supports the view that JEN's connections capex forecast for activity 'Business Supply > 10kVA' is reasonable.[121]

With this in mind, we are satisfied that on balance the projected volume growth rates represent an unbiased forecast given the historical data underlying strongly resembles rate of construction expenditure growth observed by the ABS.

We note the data underlying the growth rate is a reasonably well accepted industry standard indicator of commercial and industrial connection activity. HIA is a private-sector industry association comprising mainly house construction contractors. HIA forecasts have been used by the industry since 1984.[122]

Unit rates

In determining their forecast, Jemena relies on a series of internally derived unit costs. These unit costs are broken down by connection activities based on the characteristics of the type of customer served and the capacity of the connection.[123]

Jemena derives a unit rate for each connection activity based on historical data which Jemena then escalates into current year dollars by applying a CPI escalation. We are satisfied that Jemena's unit rates are reasonable given they are based on verifiable historical data. We further note that the use of historical expenditure works in step with the regulatory framework to reveal efficient cost over time. Further we are satisfied that applying the CPI escalation is appropriate to enable a forecast to be made on the basis of the current year dollars.

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[120] AER, *Information Request JEN - IR#013*, 24 July 2015.

[121] Jemena, *Response to AER Information Request IR#013*, 31 July 2015.

[122] Mills, Anthony and Harris, David and Skitmore, Martin R, *The Accuracy of Housing Forecasting in Australia*, Engineering Construction and Architectural, Management 10(4), 2003, pp. 245-253. Accessed from: http://eprints.qut.edu.au/archive/00004441/.

[123] Jemena, *Customer Connections Capital Forecast Methodology,* p. 7.

Jemena then multiplies these escalated unit rates by the volume forecasts produced by applying the volume growth rates discussed above to produce the gross connections capex for the 2016–20 regulatory control period. Jemena then includes key gross connection projects or horizon projects it has identified.

Key gross connections projects

Jemena notes that the above approach results in a forecast of gross customer connections capex that is on trend with its historical expenditure, except for incremental expenditure associated with significant development at Melbourne Airport.[124]

As set out in section B.2.2, we consider the Melbourne Airport project is better characterised as augmentation, as it is primarily driven by a need to expand the capacity or capability of the network ensuring security of supply.

Customer Contributions

We have analysed Jemena's forecast for customer contributions by:

- assessing the extent that the forecast was prepared in accordance with the relevant connection charge guideline

- comparing the forecast to the trends in actual customer contributions, and

- assessing the reasonableness of Jemena's forecasting methodology.

Connection Charge Guideline

In Victoria, the Essential Services Commission's (ESCV) Guidelines 14 and 15 determine the customer connection charges. This applies a slightly different framework than is included in the National Energy Customer Framework (NECF), where participating jurisdictions apply the connection charge guidelines determined by the AER.

For the current regulatory control period, Guideline 14 requires Jemena to use the price path approved by the AER.[125] For the price path beyond the last year of the current regulatory period, Guideline 14 requires Jemena to assume ongoing annual real price changes equal to the last X-factor of the current regulatory control period.[126]

We requested Jemena provide further detail on how it generated its forecast of customer contributions.[127] In its response Jemena noted that:

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[124] Jemena, Jemena, Regulatory proposal 2016–20, Capital Expenditure: p. 63
[125] Essential Services Commission, *Electricity Industry Guideline No.14, Provision of Services by Electricity Distributors.*
[126] Essential Services Commission, *Electricity Industry Guideline No.14, Provision of Services by Electricity Distributors.*
[127] Jemena, *Response to AER Information Request IR#013*, 31 July 2015.

JEN's methodology for calculating the uplift is compliant with both Guideline 14 and the AER connection charge guideline. AER connection charge guideline clause 5.3.5 requires JEN to use the price path until the end of the determination (2016–20) and a flat price path after the end of the determination. Guideline 14 requires JEN to use the last year's X-factor after the end of the determination. As JEN proposes zero price increase in the final year of the determination, the proposed methodology is compliant with the requirements of both Guidelines.[128]

We are satisfied that Jemena has demonstrated that its forecast has been prepared in accordance with Guideline 14.

Actual and forecast customer contributions

Figure 6.13 shows the trend in Jemena's actual and forecast customer contributions.

Figure 6.13   Jemena's customer contributions – historic actual and proposed for 2016–20 regulatory control period ($2015/16, million)
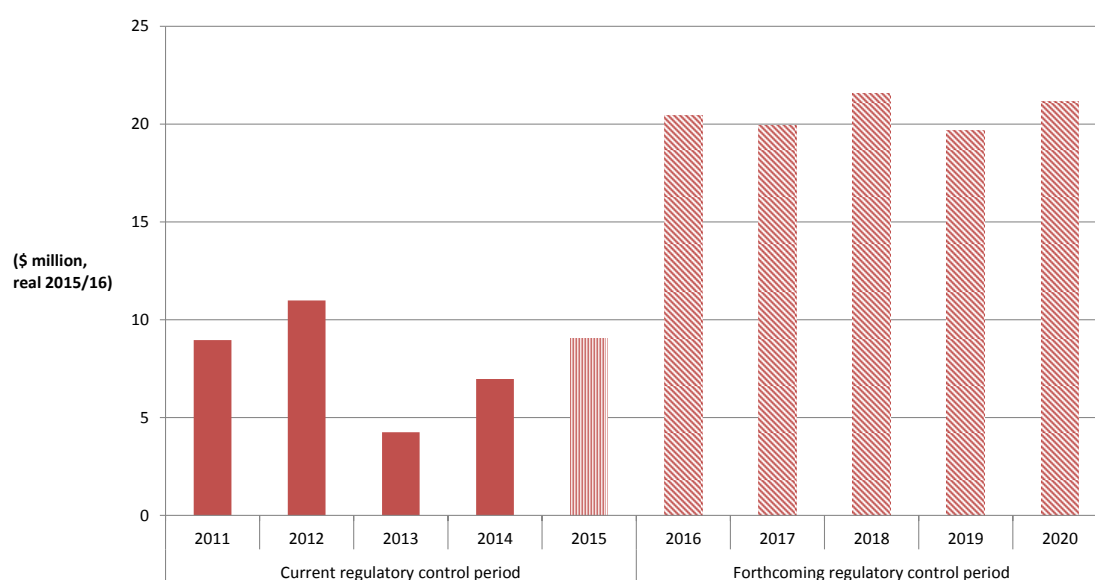
Source: Jemena, Response to AER information request 013.

We compared customer contributions for the 2011-14 period with Jemena's forecast for the 2016–20 regulatory control period.[129] To determine whether we are satisfied this forecast meets the capex criteria, we have assessed the methodology Jemena has relied on to produce this forecast.

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[128]   Jemena, *Response to AER Information Request IR#013, 31 July 2015.*

[129]   When comparing the 2011-14 annual average with the annual average being forecast for the 2016–20 regulatory control period.

Jemena forecast methodology

As we note above, we sought more detail on how Jemena generated its forecast of customer contributions.[130] In its response Jemena stated:

> JEN's customer capital contributions forecast method applies a percentage rate of customer capital contributions to forecast capital expenditure for the regulatory period. The percentage rate of customer capital contribution is determined based on the average historical percentage for the current regulatory period and adjusted for the x-factors based on the proposed price path. Historical percentages are determined based on the total actual customer capital contributions revenue received vs total actual capex expenditure. The percentages are determined for each individual project category.

> The historical percentages are determined based on 2012-2014 actual data. JEN used 2012-2014 data as, due to financial system limitations, these are the only years in the existing regulatory period where JEN has the full year of data for customer capital contributions and capital expenditure in a format that breaks down the data by current project categories. This covers 3 of the 4 completed regulatory years in the current regulatory period.[131]

We are satisfied that Jemena's use of historical percentage rates is derived from a sufficiently large sample of projects. Further, we note that in combination with the trending approach applied to generate its gross connections forecast, we are satisfied that it has demonstrated that the sample used is reflective of the projects included in its forecast.

We note that given the relatively stable forecast in gross connections capex, Jemena's approach yields a significant increase in the proportion of the gross forecast capex being recovered through customer contributions than was the case in the 2011-15 regulatory control period. We have sought to identify what is driving this by understanding the forecast inputs to the Guideline 14 capital contribution formula.[132]

Jemena in its response to request for more detailed information stated:

> In May 2014 JEN began including income tax on customer capital contributions as a component of the incremental costs used in the calculation. JEN does not consider this to be a change of policy or guidelines, but rather the correction of an oversight in implementing the existing policy and guidelines on customer capital contributions. The concept of incremental cost is fundamental to calculating customer capital contributions, and tax on customer capital contributions is an incremental cost incurred by JEN. This change of practice

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130   Jemena, *Response to AER Information Request IR#013, 31 July 2015.*
131   Jemena, *Response to AER Information Request IR#013, 31 July 2015.*
132   That is, Capital contribution = Incremental costs – incremental revenue.

resulted in a small increase to capital contributions for 2014 and will also affect all years thereafter.[133]

We also note that Jemena has highlighted in its 2014 Distribution Annual Planning Report a large number of areas with stable or declining demand.[134] We have cross checked this against independent load forecasts produced by AEMO which predict that whilst peak demand is maintained, average customer load is forecast to decline compared to the 2011-15 regulatory control period.[135] In simple terms, the customer contribution is determined by deducting the incremental revenue that Jemena will receive from the new customer over a set period, from the incremental cost of the connection.[136] Therefore, where the incremental revenue from the customer is expected to decline, the 'gap' between incremental cost and revenue widens. This has the effect of increasing the contribution required from the new customer.

In total, we are satisfied that the customer contributions forecast by Jemena are consistent with the requirements set out in Guidelines 14 and 15 and reasonably reflect the contributions Jemena is likely to receive in the 2015-20 regulatory control period.

B.4   Forecast repex

Repex is driven by the inability of network assets to meet the needs of consumers and the overall network. The decision to replace can be based on cost, quality, safety, reliability, security, or a combination of these factors. In the long run, a service provider's assets will no longer meet the requirements of consumers or the network and will need to be replaced, refurbished or removed.[137] Replacement is commonly driven when the condition of the asset means that it is no longer economic or safe to be maintained. It may also occur due to jurisdictional safety regulations, or because the risk of using the asset exceeds the benefit of continuing to operate it on the network. Technological change may also advance the timing of the replacement decision and the type of asset that is selected as the replacement.

Electricity network assets are typically long-life assets and the majority will remain in use for far longer than a single five year regulatory period. Many of these assets have economic lives of 50 years or more. As a consequence, a service provider will only replace a portion of its network assets in each regulatory control period. The majority of network assets will remain in commission well beyond the end of any single regulatory control period.

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[133]   Jemena, *Response to AER Information Request IR#013, 31 July 2015.*

[134]   Jemena, *Electricity Networks 2014 Distribution Annual Planning Report*, pp. iii–iv.

[135]   AEMO, National Electricity Forecasting Report (NEFR) 2015, Detailed summary of 2015 electricity forecasts, p. 68.

[136]   The period is set in Guideline 14 and forecasts of incremental revenue and costs are made over 15 years for a business customer and 30 years for a residential customer.

[137]   Assets may also be replaced due to network augmentation. In these cases the primary reason for the asset expenditure is not the replacement of an asset that has reached the end of its economic life, but the need to deploy new assets to augment the network, predominantly in response to changing demand.

Our assessment of repex seeks to establish the portion of Jemena's assets that will likely require replacement over the 2016–20 regulatory control period, and the associated expenditure. Jemena's forecast of repex includes estimates of the capex it considers necessary to comply with safety obligations implemented in response to the 2009 Victorian Bushfire Royal Commission (VBRC). Jemena also included estimates in its augex forecast for VBRC. Our analysis of Jemena's repex and augex forecast for VBRC is included together at appendix B.5, as the expenditure driver is related. The repex aspects are then included in the total repex forecast, while the augex aspects are included in the augex forecast at appendix B.2.

B.4.1 Position

We accept Jemena's proposed repex of $224 million and have included this amount in our alternative estimate of overall total capex for repex, excluding overheads. We are satisfied that this amount reasonably reflects the capex criteria.

B.4.2 Jemena's proposal

Jemena's proposed forecast repex is $224 million. Jemena submitted that this expenditure is driven by:[138]

- an ageing asset profile which places Jemena in the initial phase of a replacement cycle for many assets

- need to address a number of areas where they say safety has deteriorated during the 2011–15 regulatory control period.

We address Jemena's submission as part of our assessment below.

B.4.3 AER approach

We have applied several assessment techniques to assess Jemena's forecast of repex against the capex criteria. These techniques were:

- analysis of Jemena's long term total repex trends

- predictive modelling of repex based on Jemena's assets in commission

- technical review of Jemena's approach to forecasting, costs, work practices and risk management

- consideration of various asset health indicators and comparative performance metrics.

We primarily use our predictive modelling to assess approximately 51 per cent of Jemena's proposed repex in combination with the findings of Energeia's technical review. For the remaining categories of expenditure, we do not use our predictive

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[138] Jemena, *Regulatory Proposal 2016–2020*, April 2015, p. 74.

modelling but rely instead on the analysis of historical expenditure for those categories as supported by the findings of Energeia technical review. We explain the reasons for this approach in the "other repex categories" section below.

We note that the assessment of long term trends, the consideration of asset health indicators and comparative metrics are also considered as part of our assessment process. Our findings from these assessment techniques are consistent with our overall conclusion.

In its report on the Victorian distributor's the CCP considered that the suite of approaches we use in our assessment or repex provides a much better top down approach to identifying the upper bounds for efficient capex proposals than appears to be the view of the distributors'.[139]

Trend analysis

We recognise the limitations of expenditure trends, especially in circumstances where replacement needs may change over time (e.g. a distributor may have a lumpy asset age profile or legislative obligations may change over time). In recognising these limitations, we have used this analysis to draw general observations in relation to the modelled categories of repex. We have also relied on trend analysis to assist our assessment of the unmodelled categories of repex.

Predictive modelling

Our predictive model, known as the repex model, can be used to predict a reasonable amount of repex Jemena would require if it maintains its current risk profile for condition-based replacement into the next regulatory period. Using what we refer to as calibrated replacement lives in the repex model gives an estimate that reflects Jemena's 'business as usual' asset replacement practices. We explain the calibrated replacement life scenario, along with other input scenarios, below.

As part of the 'Better Regulation' process we undertook extensive consultation with service providers on the repex model and its inputs. The repex model we developed through this consultation process is well-established and was successfully implemented it in a number of revenue determination processes including the recent NSW/ACT decisions. It builds on repex modelling we undertook in previous Victorian and Tasmanian distribution pricing determinations.[140] The CCP countered the view of the distributors that there are significant shortcomings in our repex modelling

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[139]   Consumer Challenge Panel Sub Panel 3, *Response to proposals from Victorian electricity distribution network service providers for a revenue reset for the 2016–2020 regulatory period*, August 2015, pp. 38.

[140]   We first used the predictive model to inform our assessment of the Victorian distributors' repex proposals in 2010. We undertook extensive consultation on this technique in developing the Expenditure Forecasting Assessment Guideline. We have since used the repex model to inform our assessment of repex proposals for Tasmanian, NSW, ACT, QLD and SA distributors.

approach. The CCP recognised that predictive modelling is part of our overall approach which also uses other techniques such as trend analysis.[141]

The repex model has the advantage of providing both a bottom up assessment, as it is based on detailed sub-categories of assets using data provided by the service providers, and once aggregated it provides a well-founded high level assessment of that data. The model can also be calibrated using data on Jemena's entire stock of network assets, along with Jemena's recent actual replacement practices, to estimate the repex required to maintain its current risk profile.

Notably, we can use the calibrated repex model to capture a number of the drivers put forward by Jemena's in its submission. This includes replacement drivers related to the deterioration in asset condition; environmental conditions; fleet problems; asset failure risk; risk of collateral asset damage; safety risk to public and field personnel, environmental damage from asset failure; technical obsolescence; and third party damage. This is because the calibrated repex model captures the replacement practices from the last period, which include each of these drivers listed above.

We recognise that predictive modelling cannot perfectly predict Jemena's necessary replacement volumes and expenditure over the next regulatory period, in the same way that no prediction of future needs will be absolutely precise. However, we consider the repex model is suitable for providing a reasonable statistical estimate of replacement volumes and expenditure for certain types of assets, where we are satisfied we have the necessary data. We note that the service providers (including Jemena) rely on similar predictive modelling to support their forecast amount for repex.

We use predictive modelling to estimate a value of 'business as usual' repex for the modelled categories to assist in our assessment. However, predictive modelling is not the only assessment technique we have relied on in assessing Jemena's proposal. Our other techniques, which are qualitative in nature, allow us to form a view on whether or not 'business as usual' expenditure appropriately reflects the capex criteria.

Any material difference from the 'business as usual' estimate could be explained by evidence of a non-age related increase in asset risk in the network (such as a change in jurisdictional safety or environmental legislation) or evidence of significant asset degradation that could not be explained by asset age. Jemena faces a number of new safety obligations arising from the recommendations of the VBRC. These are assessed at appendix B.5 of this preliminary decision.

Technical review

We engaged Energeia to perform a technical review of Jemena's proposed repex. Energeia assessed Jemena's approach to forecasting, in particular, whether Jemena's forecast repex in order to maintain its safety and reliability, or whether it was seeking to

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[141] Consumer Challenge Panel Sub Panel 3, *Response to proposals from Victorian electricity distribution network service providers for a revenue reset for the 2016–2020 regulatory period*, August 2015, p. 38.

improve these outcomes. In doing so, Energeia took account of indicators of safety and reliability, forecast expenditure, and qualitative information from Jemena on the matters it has regard to when forecasting repex. Energeia's review was limited to the six asset categories included in the repex model.

As set out above, we considered Energeia's findings in assessing whether Jemena's forecast will allow it to prudently and efficiently maintain the safety and reliability of its network. All Victorian network businesses have used predictive modelling as part of their initial proposal. This allows us to have confidence that the use of the repex model is suitable in either accepting a network business's proposal, or in arriving at our alternative estimate.

Asset health indicators and comparative performance metrics

We have used a number of asset health indicators with a view to observing asset health. While providing some context for our decision, we have not relied on these indicators to any extent to inform our alternative estimate, they have provided context for our decision and the findings are consistent with our overall conclusion.

Similar to trend analysis, our use of these high level benchmarks has been to inform the relative efficiency of Jemena's previous repex. However, we have not used this analysis in rejecting Jemena's proposal and in developing our alternative estimate. We used this analysis as a cross-check with the findings of other techniques.

B.4.4   AER repex findings

We have conducted a trend analysis of repex. The NER requires that we consider the actual and expected capital expenditure during any preceding regulatory control period.[142] Our use of trend analysis is to gauge how Jemena's historical actual repex compares to its expected repex for the 2016–20 regulatory control period.

Figure 6.14 shows Jemena's repex spend has been variable across time, and is forecast to increase above historical levels for the 2016–20 regulatory control period. .

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[142]   NER, cl. 6.5.7(e)(5).

Figure 6.14   Jemena- Actual and forecast repex ($ million, 2015)
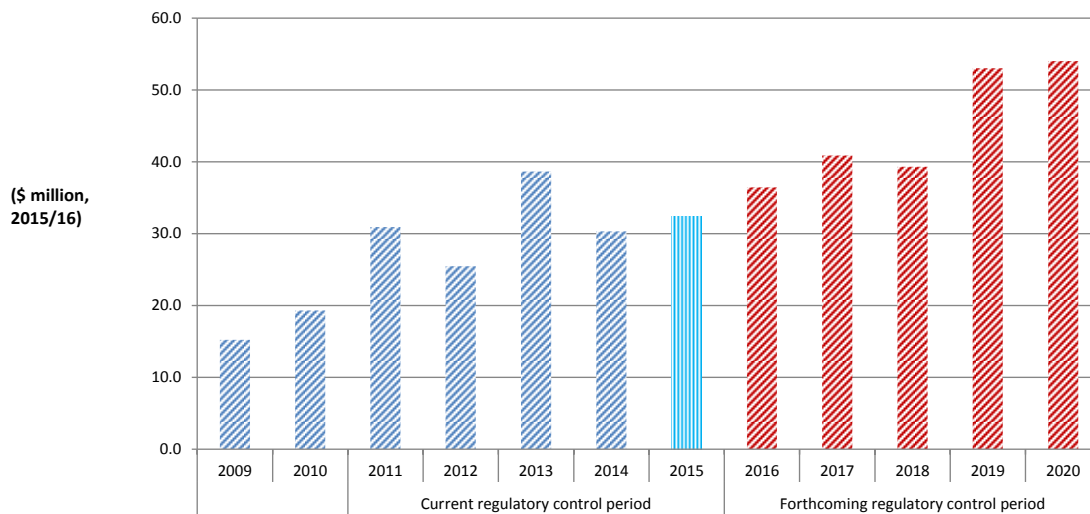
Source: Category analysis and Reset RINs

When considering the above trend we acknowledge there are limitations in long term year on year comparisons of replacement expenditure. In particular we are mindful that during the 2011-2015 regulatory control period, Jemena says that it overspent its regulatory allowance for reliability and quality maintained capex which it associates as primarily related asset replacement capex.[143] We note that a major feature of the regulatory framework is the incentives Jemena has to achieve efficiency gains whereby actual expenditure is lower than the allowance. Differences between actual and allowed repex could be the result of efficiency gains, forecasting errors or some combination of the two. Jemena notes that this overspend was a result of higher unit costs than was provided in its allowance for the following projects and programs:

- non-preferred service replacement

- pole reinforcement

- pole replacement.

Further Jemena overspent on capex projects related to the Yarraville zone substation decommissioning. This was a result of higher than forecast urban infill meaning it was prudent to rebuild the existing substation rather than shift load onto surrounding substations as was provided for in the current regulatory period allowance.

In terms of overall capex, Jemena notes in its proposal that:

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[143]   Jemena, *Regulatory Proposal 2016–20: Attachment 07-01 Historical capital expenditure report for the 2011 regulatory period*, April, 2015, p. 5.

> We also experienced slightly lower peak demand relative to our forecast, which contributed to our decision to defer some demand-driven projects, and also meant we could replace a greater volume of the failure-prone and oldest assets in our network in the 2011 regulatory period.[144]

We have been mindful of the above trends and the reasons Jemena has provided in assessing the repex allowance required for the 2016–20 regulatory control period.

An increasing or decreasing trend does not, in and of itself, indicate that a service provider has proposed repex that is likely to reflect or not reflect the capex criteria. In the case of Jemena, which has proposed an increase in repex from the last regulatory period, we must consider whether it has sufficiently justified that this increase is required to reflect the capex criteria. We use our predictive modelling, the advice of our consultants, the views of stakeholders, the material put forward by Jemena's in support of its forecast, and our consideration of any repex required to meet the new safety obligations arising from the recommendations of the VBRC, to help us form a view on whether Jemena has sufficiently justified its increase in repex from the last period.

Predictive modelling

We use predictive modelling to estimate how much repex Jemena is expected to need in future, given how old its current assets are, and based on when it is likely to replace the assets. We modelled six asset groups using the repex model. These were poles, overhead conductors, underground cables, service lines, transformers and switchgear. To ensure comparability across different service providers, these asset groups have also been split into various asset sub categories.

We have sufficient replacement volume, cost and asset age data for these modelled categories at a granular level. This gives us the ability to assess the outcomes of benchmark data across all distributors in the NEM. For other categories, we do not necessarily have sufficient data to allow such comparison, for example, repex without an associated age profile. In this instance, we rely more heavily on other assessment techniques such as business cases and high level justifications put forward by the service providers. However, where we have age and historical volumes, we may still choose to use the repex model to test both the service provider's proposal and our own findings. Our predictive modelling process is described further at appendix E. In total, the assets in these six categories represent 51 per cent of Jemena's proposed repex.

Jemena provided suitable asset age data for SCADA and the specialised categories of capex it defined that were not classified under the six asset groups above (referred to as "other" asset categories). Given the availability of data for Jemena, and the significant increase in expenditure proposed in the next regulatory period, we have considered the outcome of predictive modelling, along with a qualitative review of Jemena's proposal on these expenditure items and comparison with historical trends. By comparison, pole top structures were not modelled. To date we have not

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[144] Jemena, *Regulatory Proposal 2016–20*, April 2015, p. 70.

considered pole top structures as suitable to include in the repex model because of their relationship to pole replacement. That is, when a pole is replaced, it usually includes the structure, such that it is difficult to predict the number of structures that will be replaced independent of the pole category. Where we are unable to directly use predictive modelling for pole top structures we have placed more weight on analysis of historical repex, trends, and information provided by the service provider.

We consider the best estimate of business as usual repex for Jemena is provided by using calibrated asset replacement lives and unit costs derived from Jemena's recent forecast expenditure. This estimate uses Jemena's own forecast unit costs, but it effectively 'calibrates' the proposed forecast replacement volumes to reflect a volume of replacement that is consistent with Jemena's recent observed replacement practices, rather than relying on a purely aged based indicator. We have assessed this finding in the context of our technical review before forming a view as to the appropriate repex component of capex for Jemena. We set out below our views on their suitability for use in our assessment.

In total for all six modelled categories we have accepted the amount of $114 million ($2015) in our alternative estimate of total forecast capex, which reflects Jemena's forecast for the modelled categories.

While Jemena have provided evidence of policies and procedures for trading-off on the basis of risk adjusted costs, they have not evidenced that this process is followed by providing a ranking of potential safety repex options by category. Their rate of asset replacement is among the best for the categories we have reviewed except for one category. Their unit rates were significantly higher than United Energy's in all but one category, indicating they are not proposing least cost outcomes. Based on the foregoing findings, Energeia cannot conclude that JEN's proposed repex is prudent and efficient due to the number and degree of significant risks and/or issues identified.

Our technical consultant, Energeia, assessed Jemena's approach to forecasting, In particular, whether Jemena's forecast repex was necessary in order to maintain its safety and reliability, or whether it was seeking to improve these outcomes. Energeia found that while Jemena have provided evidence of policies and procedures for trading-off on the basis of risk adjusted costs, they have not evidenced that this process is followed by providing a ranking of potential safety repex options by category. Energeia considered Jemena's rate of asset replacement is among the best for the categories it reviewed except for one category. However, Energeia couldn't conclude that JEN's proposed repex is prudent and efficient due to the number and degree of significant risks and/or issues identified.[145]

Our modelling estimates future repex by allowing Jemena's the opportunity to continue its current replacement practices in the next period. This is the approach that Jemena has undertaken to maintain the safety and reliability of its network and meet the capex

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[145]   Energeia, *Review of Victorian Distribution Network Service Provider's Initial Replacement Capex Proposals 2016–2020*, September 2015, pp. 32–33.

objectives. In our modelling, we found that Jemena's forecast for the modelled categories was consistent with our estimate of business as usual repex, and have accepted Jemena's forecast for these repex categories. We explain in the section on business as usual repex why we consider trending forward Jemena's current practices results in an estimate which reflects the capex criteria.

Model inputs

The repex model uses the following inputs:

- The asset age profile input is the number of assets in commission and when each one was installed.

- The replacement life input is a mean replacement life and standard deviation (i.e. on average, how old assets are when they are replaced).

- The unit cost input is the unit cost of replacement (i.e. on average, how much each asset costs to replace).

In appendix E, we describe using the repex model to create three scenarios. In each of the three modelling scenarios (base case scenario, calibrated scenario and benchmark scenario) we combined different data for the final two inputs.

Under all scenarios, the first input is Jemena's asset age profile (how old Jemena's existing assets are). This is a fixed input in all three scenarios.

The second and third inputs can be varied by using different input assumptions about:

- how long we expect an asset to last before it needs replacing; and

- how much it costs to replace it.

The repex model takes the replacement life input for each asset category and applies it to the actual age of the assets in each asset category, on an asset category basis. In doing this it calculates when and how many assets in the asset category will need replacement in the near future.[146] The model then applies the unit cost input to calculate how much expenditure is needed for that amount of replacement in each asset category. This is aggregated to a total repex forecast for each of the next 20 years.

In the remaining part of this section, we outline the replacement lives and unit cost inputs we tested in the repex model to assess Jemena's proposed repex. As part of our assessment, we compared the outcomes of using Jemena's estimated replacement lives and its unit costs, both forecast and historical, with the replacement lives and unit costs achieved by other NEM distributors. We also used the repex model to determine calibrated replacement lives that are based on Jemena's past five years of actual replacement data. These reflect Jemena's immediate past approach to

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[146]   The repex model predicts replacement volumes for the next 20 years.

replacement.[147] We calculated historic unit costs by dividing historic expenditure by historic volumes and forecast unit costs by dividing forecast expenditure by forecast volumes. Detail on how we prepared the model inputs is at appendix E of this preliminary decision.[148]

Our repex modelling assessment is exclusive of expenditure required for VBRC repex, which Jemena has identified in its 'other' repex category.

'Business as usual' repex

The calibrated asset life scenario gives an estimate based on Jemena's current risk profile, as evidenced by its own replacement practices. Our estimate brings forward the current replacement practices that Jemena has used to meet the capex objectives in the past. Calibrated replacement lives use Jemena's recent asset replacement practices to estimate a replacement life for each asset type. These replacement lives are calculated by using Jemena's past five years of replacement volumes, and its current asset age profile (which reveals how many, and how old, Jemena's assets are), to find the age at which, on average, Jemena's replaces its assets.

The calibrated replacement life may be different to the "nameplate" or nominal replacement age of the asset (which we considered under the "base case" scenario). Jemena reports these expected asset lives as part of its RIN response. However these reflect expectations of lives from engineering and manufacturing information, rather than observations of the economic lives achieved on the network. Using the lives provided in the RIN response in the repex model provides estimates of repex that greatly exceed Jemena's own expectation of its replacement needs over the next period. From this, we observe that, in general, these technical estimates of asset life tend to understate the actual lives achieved on the network, and are a conservative estimate of the observable economic life of the assets, when compared to the calibrated replacement life.

The calibrated asset life scenario has been our preferred modelling scenario in recent reviews of other service providers.[149] This is because we considered the calibrated replacement lives formed the basis of a business as usual estimate of repex, as they are derived from the service provider's actual replacement practice observed over the past five years and the observable (or revealed) economic replacement lives of the assets.

A service provider decides to replace each asset at a certain time by taking into account the age and condition of the asset, its operating environment, and its

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[147] For discussion on how we prepared each of the inputs see AER, *Preliminary decision, Energex distribution determination Attachment 6: Capital expenditure*, *Appendix E :Predictive modelling approach and scenarios*, May 2015.

[148] AER, *Preliminary decision, Energex distribution determination, Attachment 6: Capital expenditure, appendix E*, May 2015.

[149] See final decisions for NSW, Queensland and South Australian distributors.

regulatory obligations. If the service provider is currently meeting its network reliability, quality and safety requirements by replacing assets when they reach a certain age, then by adopting the same approach to replacement in future they are likely to continue to meet its obligations. Consequently, the estimates derived from the model reflect the replacement practices that Jemena has used in the past to meet the capex objective of maintaining the safety and reliability of the network.

If underlying circumstances are different in the next regulatory control period, then this approach to replacement may no longer allow a service provider to meet its obligations. We consider a change in underlying circumstances to be a genuine change in the underlying risk of operating an asset, genuine and justifiable evidence that there has been a change in the expected non-age related condition of assets from the last regulatory control period, or a change in relevant regulatory obligations (e.g. obligations governing safety and reliability).

If we are satisfied that there is evidence of a change in a service provider's underlying circumstances, we will accept that future asset replacement should not be based on a business as usual approach. This means that where there is evidence that a service provider's obligations have changed then it may be necessary to provide a forecast of repex different to the business as usual estimate. This alternative forecast would be required in order to satisfy us that the amount reasonably reflects the capex criteria.

Where there are new obligations (or fewer obligations) we can use the service provider's past practices as a first step before estimating the impact of the change. The new safety obligations arising from the VBRC recommendations represent a change in circumstances from the 'business as usual' practices of the last period. The impact of these are set out in appendix B.5 and, as noted above, are included within our consideration of total repex. We do not consider that Jemena has identified other new obligations for the next regulatory period that cannot be captured by adopting the 'business as usual' forecast of repex. Consequently, we have relied on our estimate from the calibrated repex model, in combination with our findings in relation to the new safety obligations, in assessing whether Jemena proposed repex reasonably reflects the capex criteria.

Submissions raised issues regarding the total level of repex proposed by the Victorian distributors:

- The CCP stated that it is consumer experience that should be the core drive of repex levels, concluding that consumers are satisfied with current levels of repex and therefore they see no need for a step increase in repex. It considered that the distributors' proposed increase to the overall level of repex is not justified as current reliability levels do not suggest there is a need to increase repex. The CCP was of the view that the residual ages of the distributors' assets have maintained or

improved over time, opex spending has been increasing, and condition based assessments appear subjective and likely conservative.[150]

- The CCP questioned the Victorian distributor's arguments that condition based monitoring has identified more assets at risk than occurred in the past, necessitating more repex. It considered that unless there are exogenous reasons causing faster deterioration of assets than what occurred in the past, the only reason for significant increases in repex would be:

  o a more conservative approach is being used to establish asset condition

  o distributors are applying less care in their maintenance practices.

- Since the Victorian distributors' have not had an overall reduction in network performance the CCP considers that the first cause above is more likely. This leads the CCP to conclude that greater conservatism is being applied to condition assessments than was applied in the past.[151]

- The CCP was also concerned with the approach of the service providers to assessing asset health, considering that the bulk of assessments are being made on a subjective qualitative basis. For example, visual inspections which will vary between individuals, and that the context for an inspection may produce greater conservatism like performing an assessment following bushfires. The CCP also questioned the assertion that increased failure rates have driven the increased proposed repex.[152]

- The Victorian Greenhouse Alliance was concerned with the significant increases to repex the Victorian distributors are proposing. It considered this was concerning given that over-investment in the networks over recent regulatory periods has led to excess levels of network capacity and declining network utilisation. It is also found it concerning that high revenue proposals were being put forward at a time of declining capacity utilisation, a reduced average asset age for most asset categories, static or falling demand and consumption, and reductions in the excessive reliability standards.[153] The Victorian Greenhouse Alliance also noted there was little information in the proposals on asset condition. It considered this makes it difficult to assess the validity of the distributors' claims, and that the distributors should provide greater transparency on asset age trends and asset condition data.[154]

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[150] Consumer Challenge Panel Sub Panel 3, *Response to proposals from Victorian electricity distribution network service providers for a revenue reset for the 2016–2020 regulatory period*, August 2015, p. 47.

[151] Consumer Challenge Panel Sub Panel 3, *Response to proposals from Victorian electricity distribution network service providers for a revenue reset for the 2016–2020 regulatory period*, August 2015, p. 52.

[152] Consumer Challenge Panel Sub Panel 3, *Response to proposals from Victorian electricity distribution network service providers for a revenue reset for the 2016–2020 regulatory period*, August 2015, p. 47.

[153] Victorian greenhouse alliance, *Local Government Response to the Victorian Electricity Distribution Price Review (EDPR) 2016–20*, July 2015, p. 7.

[154] Victorian greenhouse alliance, *Local Government Response to the Victorian Electricity Distribution Price Review (EDPR) 2016–20*, July 2015, p. 34.

As noted above, we are satisfied that with the exception of additional funding to address the impact of new safety obligations a business as usual approach to repex will provide Jemena with sufficient capex to manage the replacement of its assets and meet the capex objectives of maintaining safety, reliability and security of the distribution system.

That said, we have also considered whether the service provider's replacement practices from the last regulatory control period did more than maintain safety, reliability and security of the distribution system, such that applying the business as usual approach for asset replacement may result in replacement practices that provide for expenditure over and above what is necessary to satisfy the capex objectives. In considering the efficiency of recent replacement practices, we place some weight on the ex-ante capex incentive framework under which the service providers' operate.

There are incentives embedded in the regulatory regime that encourage a service provider to spend capex efficiently (which may involve spending all of the allowance, less or more, in order to meet the capex objectives). A service provider is only funded in the regulatory control period to meet the capex allowance. The service provider keeps the funding cost obtained over the regulatory control period of any unspent capex for that period, and, conversely, bears the funding cost of any capital expenditure that exceeds the allowance. In this way, the service provider has an incentive to spend efficient capex, or close to the allowance set by the regulator, as it is essentially rewarded (penalised) for any underspend (overspend). This provides some assurance that a service provider reacting to these incentives will undertake efficient capex to meet the capex objectives. This means that to some extent we can rely on the ex-ante capex framework to encourage the service providers to engage in efficient and prudent replacement practices.

Going forward, this incentive will be supplemented by a Capital Expenditure Sharing Scheme, which will provide a constant incentive to spend efficient capex over the regulatory control period, as well as the ability to exclude capex overspends from the RAB as part of an ex-post review. These additional arrangements will provide us with greater confidence that the service provider's past replacement practices are likely to reflect efficient and prudent costs, such that business as usual asset replacement approach is likely to be consistent capex objectives.

Possible future rule changes may also extend the regulatory investment test for distribution (RIT-D) to repex. Such a change would make it incumbent upon the service provider to develop credible options for asset replacement, including considering whether the asset life could be extended or whether the asset could be retired rather than replaced.

Finally, the collection of a longer period of data on changes in the asset base as part of our category analysis RIN will provide us with further information into the service providers' asset replacement practices over a longer period of time. This will further inform our understanding of business as usual replacement practice to estimate repex. More time series data would also strengthen our ability to use benchmarked information (e.g. asset life inputs) in the repex model in the future, which is intended to drive further efficiency in replacement expenditure.

Calibrated scenario outcomes

The calibrated repex model scenario, which was described in the last section, provides an estimate of replacement volumes for the next period. In order to estimate how much repex is required to replace this estimated volume of assets, we must multiply the volume by the cost of replacing a single asset (unit cost). We tested two unit cost assumptions, based on data provided by Jemena:

We modelled the calibrated lives using two unit cost assumptions:

- Jemena's own historical unit costs from the current regulatory period. These reflect the unit costs Jemena has incurred over the last five years.

- Jemena's own forecast unit costs for the next regulatory period. These reflect the unit costs Jemena expects to incur over the next five years.

Applied to the forecast volumes predicted from calibrated replacement lives, the repex model estimates $169 million of repex when using Jemena's historical unit costs, and $184 million using forecast unit costs. Both of these outcomes are above Jemena's forecast of $114 million for the six modelled asset categories. This suggests that Jemena's forecast is likely to be a reasonable estimate of business as usual repex for these categories and we have included this amount in our alternative estimate of total forecast capex.

Other repex categories

Repex categorised as supervisory control and data acquisition (SCADA), network control and protection (which we collectively refer to as SCADA); pole top structures; and "other" in Jemena's RIN response were not included in the repex model. However, Jemena provided suitable age and expenditure data to allow the SCADA and "other" categories to be modelled. Given the availability of data for Jemena and the significant increase in expenditure proposed in the next regulatory period, we have considered the outcome of predictive modelling, along with a qualitative review of Jemena's proposal on these expenditure items and comparison with historical trends. Together, these categories of repex account for $109 million (49 per cent) of Jemena's proposed repex.

As noted in appendix E, we did not consider pole top structures were suitable for inclusion in the model because of their relationship to pole replacement. That is, when a pole is replaced, it usually includes the structure, such that it is difficult to predict the number of structures that will be replaced independent of the pole category. Where we are unable to directly use predictive modelling for pole top structures we have placed more weight on an analysis of historical repex, trends, and information provided by Jemena in relation to these categories. Our analysis of these is included below.

We consider that the replacement of network assets is likely to be relatively recurrent between periods. We recognise there will be period-on-period changes to repex requirements that reflect the lumpiness of the installation of assets in the past. Using predictive tools such as the repex model allows us to take this lumpiness into account in our assessment. For repex categories we cannot model, historical expenditure is our

best high level indicator of the prudency and efficiency of the proposed expenditure. Where past expenditure was sufficient to meet the capex criteria it can be a good indicator of whether forecast repex reasonably reflects the capex criteria. This is due to the predictable and recurrent nature of repex.[155]

For unmodelled asset categories we consider that if the forecast expenditure for the next period is similar or lower than the expenditure in the last period, the distributor's forecast is likely to satisfy the capex criteria. If forecast repex exceeds historical expenditure, we would expect the distributor to sufficiently justify the increase.

We have accepted Jemena's proposed repex for pole top structures of $35 million, proposed repex for SCADA of $35 million and or "other" repex categories of $40 million. We consider these amounts are sufficient to meet business as usual requirements, and reasonably reflect the capex criteria.

Pole top structures

Jemena has forecast $35 million of repex on pole top structures over the 2016–20 regulatory control period. This represents a one per cent increase over the 2011–15 regulatory control period.

As noted above, we consider repex is likely to be relatively recurrent between periods, and that historical repex can be used as a good guide when assessing Jemena's forecast. Jemena's expenditure on pole top structures increased at a relatively low rate over the 2010–15 regulatory control period. Jemena's proposed repex has a similar low overall rate of increase over the 2016–20 regulatory control period for this category. We consider Jemena's forecast repex for pole top structures of $35 million is likely to reflect the capex criteria and have included this amount in our alternative estimate of total forecast capex.

SCADA, network control and protection

Jemena's proposal includes $38 million for replacement of SCADA, network control and protection (collectively referred to as SCADA). This is a material increase from the amount Jemena spent in the 2010–15 regulatory control period of $25 million. This proposed repex is comprised of:[156]

- condition based replacement of protection and control schemes

- upgrade or replacement of SCADA systems used to support Jemena's real time network management and operation

- ageing protection and control relays.

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[155]   AER, *Expenditure Forecast Assessment Guideline for Electricity Distribution*, November 2013, pp. 7–9.

[156]   Jemena, *Regulatory Proposal 2016–20: Attachment 07-03 Forecast capex*, April 2015, p. 41.

Jemena submits its proposed SCADA repex is driven by an aging asset population.[157] There was sufficient data for the field devices category to test this proposed expenditure in the repex model. Jemena's field devices repex in the 2010–15 period was $10 million, and its proposed forecast for the 2016–20 period is $20 million. The age-based driver of this step increase ($10 million) is supported by repex modelling for this category. The remainder of the increase appears to be explained in Jemena's supporting business cases for relay replacements. We are of the view these contain sufficient detail and options analysis to justify the remainder of the proposed step increase. Overall we are satisfied that Jemena's proposed SCADA repex of $38 million is likely to reflect the capex criteria and have included this amount in our alternative estimate of total forecast capex.

Other repex

Jemena categorised a number of assets under an "Other" asset group in its RIN response. Jemena forecast $40 million of repex for these assets for the 2016–20 regulatory control period. This is a material increase from the amount Jemena spent in the 2010–15 regulatory control period of $26 million. The assets categories Jemena has proposed in this forecast are:

- Capacitor Banks

- Earths

- ZSS Property

- Surge Diverters

- CT / VT

- NER

- DC Batteries and Banks

- PQ Meters

- Special Capital Works

- Animal Proofing

- HV Insulators > 11kV & <= 22kV

- ST Insulators > 22kV & <= 66kV

- LV Spreaders

- Overhead Service Disconnect Device

- Indirect Capital

- Other - External related cost

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[157] Jemena, *Regulatory Proposal 2016–20: Attachment 07-03 Forecast capex*, April 2015, p. 19.

- Vibration Dampers Armour Rods

- Connectors.

The driver of the increase in forecast expenditure can be entirely attributed to the category Special Capital Works. The step increase is because Jemena reclassified this service from an alternative control service to a standard control service. This is non-age based replacement for capital works where the asset is replaced as requested by a customer with an associated capital contribution. The amount of forecast repex for the category aligns with the average of the last five years expenditure, and is supported by Jemena's consultant.[158] After excluding the Special Capital Works category, Jemena's forecast repex for the remainder of the other asset group is the same as its historic spend with no proposed increase in expenditure for the forthcoming period. So we are satisfied that Jemena's forecast repex for other assets of $40 million is likely to reflect the capex criteria and have included this amount in our alternative estimate of total forecast capex.

Network health indicators

As noted above, we have looked at network health indicators and benchmarks to form high level observations about whether Jemena' past replacement practices have allowed it to meet the capex objectives. While this has not been used directly either to reject Jemena' repex proposal, or in arriving at an alternative estimate, the findings are consistent with our overall findings on repex. In summary we observed that:

- the measures of reliability and asset failures show that outages on Jemena' network have been stable across time with the exception of a sharp decrease in SAIFI in 2010 (see Trends in reliability and asset failure).

- measures of Jemena' network assets residual service lives and age show that the overall age of the network is being maintained. Using age as a high level proxy for condition, this suggests that historical replacement expenditures have been sufficient to maintain the condition of the network (see Trends in the remaining service life and age of network assets).

- asset utilisation has reduced in recent years which means assets are more lightly loaded, this is likely to have a positive impact on overall asset condition (see Asset utilisation discussion below).

Further, the value of customer reliability has recently fallen. Other things being equal, this fall should result in the deferral of repex as the value customers place on reliability for replacement projects has fallen.

The above indicators generally suggest that replacement expenditure in the past period has been sufficient to allow Jemena to meet the capex objectives. This is

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[158] Jemena, *Regulatory Proposal 2016–20:: Attachment 7.3 – forecast capital expenditure by category*, April 2015, p. 65.

consistent with our overall findings on repex from our other assessment techniques. The asset health indicators are discussed in more detail below.

Trends in reliability and asset failure

Asset failure is a significant contributor to the volume of sustained interruptions on Jemena' network. Table 6.12 shows that, over the 2009–14 period 72.6 per cent of total interruptions on Jemena's network were caused by the failure of assets.[159]

Table 6.12   Jemena - contribution of asset failures to non-excluded sustained interruptions (per cent)

	2009	2010	2011	2012	2013	2014
Sustained interruptions caused by asset failures	55.6%	57.9%	58.0%	58.0%	57.3%	60.9%

Source: Jemena- CA RIN – 6.3 Sustained Interruptions.

Figure 6.15 compares sustained interruptions caused by asset failure with the System Average Interruption Frequency Index (SAIFI), which is an aggregate measure of the frequency of sustained interruptions on the network.[160]

Figure 6.15 Relationship between system wide SAIFI and non-excluded interruptions caused by asset failures
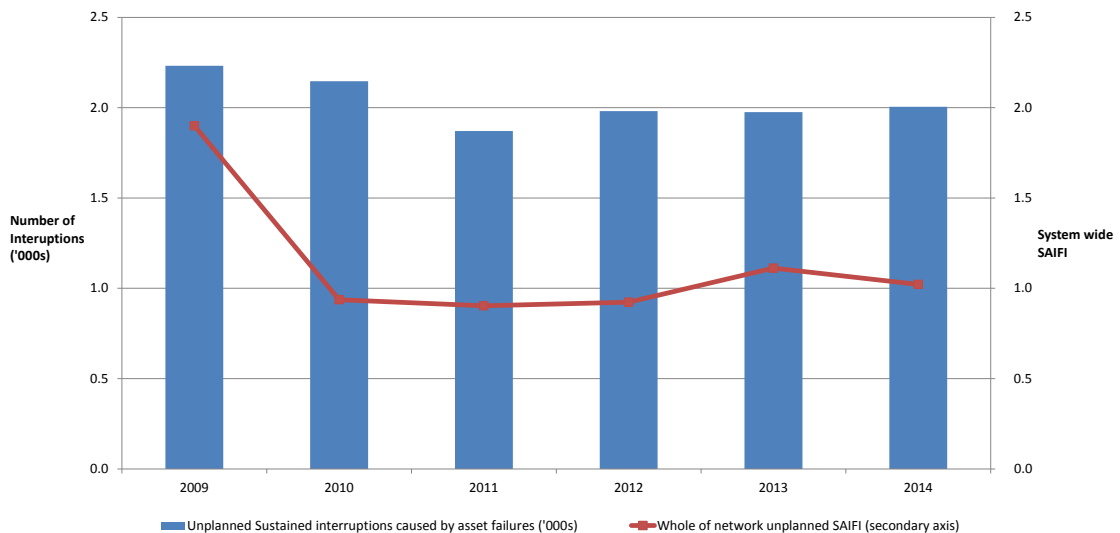
Source: Jemena- CA RIN – 6.3 Sustained Interruptions and EBT RIN - Whole of network unplanned SAIFI.

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[159]   These measures do not include planned outages, momentary outages, major event days and excluded events.

[160]   SAIFI: The total number of unplanned sustained customer interruptions divided by the total number of distribution customers. Unplanned SAIFI excludes momentary interruptions (one minute or less). SAIFI is expressed per 0.01 interruptions.

Figure 6.15 shows Jemena' both outages due to asset failures and SAIFI have generally been flat across time, with the exception of a significant decrease in SAIFI in 2010. The overall stability in both of these measures indicates that the replacement practices from the last period have been sufficient to meet the capex objectives.

Trends in the remaining service life and age of network assets

Another factor which we have considered when assessing Jemena' repex requirements for the 2016–20 period is the trend in Jemena' residual asset life across time. We are satisfied that residual service life is a reasonable high-level proxy for asset condition. Asset condition is a key driver of replacement expenditure.

Figure 6.16 shows that Jemena' residual asset lives have generally been flat over the period 2006-2014. This means that, on average, Jemena' network assets are staying the same age.

Figure 6.16   Jemena estimated residual service life network assets
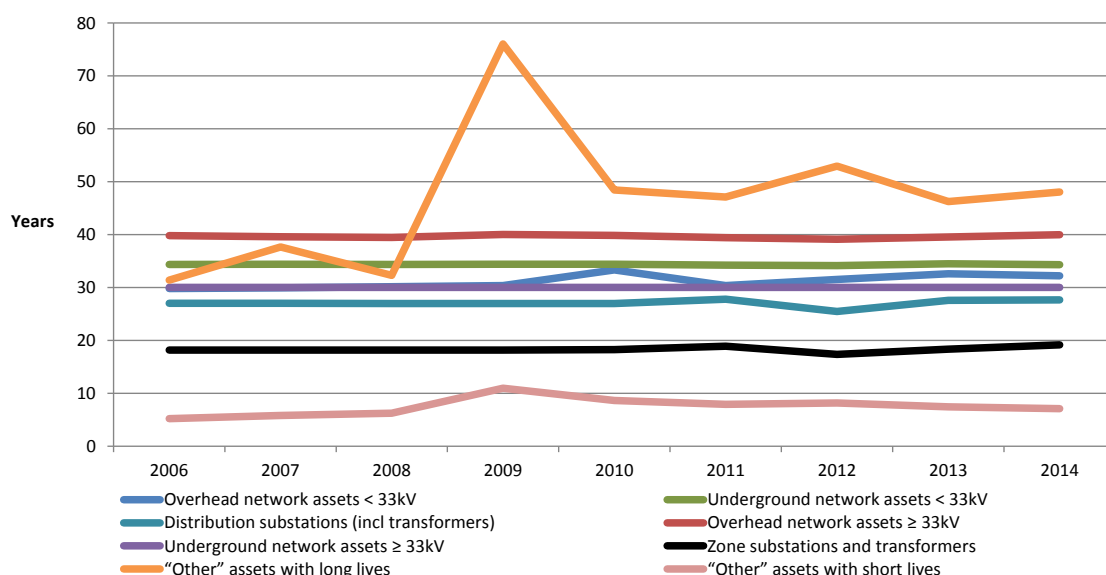
Source: Jemena EBT RIN - 4. Assets (RAB) - Table 4.4.2 Asset Lives – estimated residual service life (Standard control services).

We acknowledge limitations exist when using estimated residual service life to indicate the trend in the underlying condition of network assets. Large volumes of network augmentation and connections can result in a large stock of new assets being installed in the network, which may bring down the network's average age. In this way, the residual service life of the assets may increase without necessarily addressing any underlying asset condition deterioration.

Noting the above, the flat trend in residual lives (where age is a proxy for asset condition) suggests that the health of Jemena' asset base has been maintained.

Asset utilisation

We consider the degree of asset utilisation can impact asset condition for certain network assets. As set out in the augex section B.2, we note Jemena has experienced a steady decrease in utilisation levels at its zone substations between 2010 and 2014. Jemena undertook zone substation augmentation projects between 2010 and 2014 that led to a decrease in the number of substations operating above 80 per cent of their maximum capacity. We note that the flattening of demand between 2010 and 2014 may have contributed to a reduction in the utilisation of the network. As of 2014, there are no substations operating above their maximum capacity.

We are satisfied this demonstrates that Jemena' network has spare capacity in its network based on past investments. All things being equal, we expect a positive correlation between asset condition and lower network utilisation exists for certain asset classes.

However we recognise that:

- The relationship between asset utilisation and condition is not uniform between asset types. For example; poles and fuses.

- The relationship is not necessarily linear (e.g. condition may not be materially impacted until a threshold point is reached).

- The condition of the asset may be difficult to determine (e.g. overhead conductor). As such early-life asset failures may be due to utilisation or, more commonly, a combination of factors (e.g. utilisation and vibration).

While noting these issues, we consider that Jemena' asset utilisation has not been high, and we do not expect any material deterioration of Jemena' network assets is likely to have occurred in recent years due to high utilisation of the assets.

B.5   Victorian Bushfires Royal Commission

Jemena proposes a forecast of $6.237 million ($2015) for capex related to the Victorian Bushfires Royal Commission (excluding overheads). This is driven by a bushfire safety mitigation program for the 2016–20 period.

We accept Jemena's proposed $6.237 million ($2015) forecast and have included this amount in our alternative estimate of augex.

In coming to this view, we have assessed the Jemena bushfire safety capex proposals. Based on our assessment, we find that the proposed capex for the bushfire safety programs reasonably reflect the capex criteria and therefore we have included the proposed capex in our estimate of Jemena's capex requirements.

Our assessment of this program is contained in the section below.

This proposed capex amount for the program is incremental to Jemena's business as usual capex related to bushfire risk management. Table 6.13 sets out the proposed components of the program.

Table 6.13 Jemena's proposed capex for a bushfire mitigation program ($2015, million, excluding overheads & escalation)

Strategy	Proposed capex
Sydenham sub-station - REFCL	0.202
Sunbury sub-station - REFCL	1.927
Coolaroo sub-station - REFCL	2.294
Craigieburn sub-station - REFCL	1.813
Total	**6.237**

Source: Jemena, *Regulatory proposal 2016–20: Attachment 07.04 - JEN Capex Forecast Model*, Worksheet: Input | Project costs, Projects P081, P082, P083, P084.

AER assessment approach

For bushfire safety related capex there are three potential bases for consideration of a funding requirement. These are:

1. Business As Usual (BAU): Capex which we assess along with other capex in attachment 6. We use the tools outlined in attachment 6 to assess the efficiency of the forecast. These capex projects relate to maintaining the quality, reliability or security of supply of standard control services or the reliability or security of the distribution system through the supply of standard control services or the safety of the distribution system through the supply of standard control services.[161]

2. Approved projects are set out in the companies' Electrical Safety Management Scheme (ESMS) or Bushfire Mitigation Plan (BMP). We rely on Energy Safe Victoria to establish need. We then assess the efficiency of the forecast cost. These projects are assessed in accordance with the capital expenditure objectives to determine if they are necessary to comply with applicable regulatory obligations or requirements associated with the provision of standard control services.[162]

3. Pending regulations from the Victorian Government which will implement aspects of recommendation 27 of the Victorian Bushfires Royal Commission (VBRC). The timing and scope of the regulations are not yet known. We want to provide the distributor with a mechanism to recover the prudent costs associated with any new obligations while ensuring that consumers pay no more than necessary for the implementation of these.

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[161]   NER, cll. 6.5.7(a)(3) & (4).
[162]   NER, cl. 6.5.7(a)(2).

Our first order of assessment is to consider whether a proposed expenditure fits into one of these broad categories. This helps us to determine which are the most appropriate tools to assess whether a proposal satisfies the capital expenditure objectives.[163] We also consider if the amount sought is compliant with the capital expenditure criteria, particularly if the cost is prudent and efficient.[164]

Assessment of Jemena proposal

Based on the evidence submitted by Jemena and other information before us, we are satisfied that Jemena's BMP is required to comply with applicable regulatory obligations or requirements and to maintain the reliability and safety of the network and would be a prudent and efficient investment in the network.

In summary, we consider that:

- Jemena's proposed capex is required to maintain the reliability and safety of its network and to comply with applicable regulatory obligations or requirements.

- Jemena has provided evidence of a mandatory obligation to address bushfire risk from ignition by power lines through the installation of four Rapid Earth Fault Current Limiting (REFCL) devices.

- Jemena proposed costs which are consistent with the AER's expected costs for these installations.

- Jemena has undertaken a cost benefit analysis of their proposed installations at Sydenham, Sunbury, Coolaroo and Craigieburn. Jemena's business case and other supporting material has provided properly evaluated the costs versus the benefits of the program.

- Jemena's proposed capex is a prudent and efficient investment.

- The Jemena VBRC proposal does not include any BAU capex.

- Jemena has not proposed a mechanism to fund future obligations associated with potential regulations to implement recommendation 27 of the VBRC. Jemena has addressed the likely impact of future regulations through its BMP.

For these reasons, we accept Jemena's' proposed capex for the bushfire mitigation program satisfies the capex criteria. Each of these reasons is discussed further below.

Regulatory obligation

Victorian electrical safety framework

In Victoria, the safety obligations of major electricity companies are contained in the Electricity Safety Act 1998 (Vic). Section 99 of this Act mandates that major electricity companies must submit an approved Electricity Safety Management Scheme (ESMS)

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163 NER, cl. 6.5.7(a).
164 NER, cll. 6.5.7(c)(1) & (2).

to Energy Safe Victoria for acceptance.[165] These schemes are approved and regulated by Energy Safe Victoria. Each of the five Victorian distributors is classed as a 'major electricity company' under this Act.

It is compulsory for Jemena to comply with the accepted ESMS for its network.[166] Further, the Act requires that each major electricity company must submit a Bushfire Mitigation Plan for its network to Energy Safe Victoria and must comply with that plan.[167] The Bushfire Mitigation Plan forms part of an accepted ESMS.[168] This legislated requirement applies to the whole of the Jemena network including urban areas of the network.

Two mechanisms exist for a major electricity company to address a safety concern of when it arises. The first is to voluntarily propose to address the safety hazard by including a proposal in their ESMS or the Bushfire Mitigation Plan to undertake a specific activity to address the hazard. If a proposed change to their ESMS is accepted by the safety regulator, the activity becomes an obligation which must be carried out. Jemena has adopted this path.

The second mechanism is the creation of a new regulatory obligation by the Government or an action by a Government agency under existing legislation. The issuance of a direction by Energy Safe Victoria falls into this category.

Jemena's mandatory safety obligations relate to the installation of REFCL technology.

Rapid Earth Fault Current Limiting (REFCL) Technology

The Victorian Government is currently investigating technology solutions which have the potential to reduce the cost of minimising the risk of a powerline fault igniting a fire. The REFCL is a relatively new technology which may have cost advantages. Its potential for bushfire mitigation is promising. It is an extension of resonant earth system technology, which is commonly used in Europe and elsewhere. The REFCL device is capable of detecting when a power line has fallen to the ground and can almost instantaneously shut of power on the fallen line.

Jemena's proposal

Jemena's bushfire related obligations are contained in the Bushfire Mitigation Strategy Plan which applies to Jemena's network.[169] Jemena's BMP states that: [170]

> …JEN have developed a targeted program to deliver the greatest bushfire mitigation benefits at least cost in zone substations supplying JEN's HBRA. This includes base level REFCL technology to be deployed to Sydenham

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[165] *Electricity Safety Act 1998* (Vic), s. 99.
[166] *Electricity Safety Act 1998* (Vic), s. 106.
[167] See, *Electricity Safety Act 1998 (Vic)*, ss. 113A, 113B and 113C.
[168] *Electricity Safety Act 1998* (Vic), s. 113D.
[169] Jemena, *Bushfire Mitigation Plan 2016–2020 [PUBLIC]*, Doc No. ELE PL 0100, September 2015.
[170] Jemena, *Bushfire Mitigation Plan 2016–2020 [PUBLIC]*, Doc No. ELE PL 0100, September 2015, p. 90.

(SHM) in 2015-16, Sunbury (SBY) in 2018, Craigieburn (CBN) is 2019, and Coolaroo (COO) in 2020.

Jemena has four zone substations which serve High Bushfire Risk Areas of the State. These are Sydenham, Sunbury, Coolaroo and Craigieburn. This program focusses on those four substations. These statements in the BMP constitute a firm commitment to install four REFCL devices at specific locations on safety grounds. We consider that Jemena has demonstrated it has a regulatory obligation to undertake this work in the next regulatory control period.

If a regulatory obligation exists in an ESMS or BMP it follows that the activity is also required to maintain the reliability and safety of the network. On this basis we consider that the proposed investment in Rapid Earth Fault Current Limiting (REFCL) technology is required to maintain network reliability and safety and to comply with applicable regulatory obligations or requirements.

In reaching our conclusion, we have also taken into account the interrelationship between this proposed expenditure and other expenditure proposed by Jemena. We are satisfied this is a discrete program of work that does not fall within Jemena's business as usual level of capex and opex to manage asset fire safety.

We next assess whether the proposed allowance satisfies the capex criteria.[171]

In deciding to adopt the REFCL technology Jemena has participated in trials (as an observer), reviewed published information supporting the use of the technology in this role and is cognisant of impending action by the Victorian Government to develop standards for the use of the technology. Based on the acceptance by Energy Safe Victoria of Jemena's amendment to its ESMS to include installation of four REFCLs, we consider Jemena's adoption of the technology to be prudent. Our review of Jemena's total capital expenditure allowance takes account of expenditure related to Jemena's bushfire risk management, based on their approved Electrical Safety Management Scheme.

Jemena commenced the installation of a Ground Fault Neutraliser at the Sydenham sub-station in 2015. The Ground Fault Neutralizer is a specific form of REFCL technology. This project was approved in the current regulatory determination. It is to be completed in 2016. The justification for this installation is the fire safety and reliability benefits that flow from the installation of a REFCL device. It is included in the BMP.

As this installation is underway its completion will allow Jemena to get direct experience of the technology, which is likely to assume increasing prominence in future years. We consider the cost to complete the Sydenham installation is reasonable. The total project cost is significantly lower than the reported cost of earlier installations by

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[171] NER, cll. 6.5.7(c)(1) & (2).

other Victorian distributors. For these reasons we think completing this installation will be prudent and efficient.

Jemena also proposes to rebuild or reconfigure three substations in the next regulatory control period. They will install REFCLs at: Sunbury, Craigieburn and Coolaroo. Feeders leaving these substations service areas of high (or hazardous) bushfire risk when assessed against criteria generally used by the Victorian Government emergency services agencies. The selection by Jemena of these three substations as sites for REFCLs is based on these criteria. These selections have been approved by Energy Safe Victoria.

Jemena has performed a separate cost-benefit analysis to demonstrate that the safety and reliability benefits of these three installations warrant funding.[172] We accept that analysis demonstrates a net reliability and safety benefit. The project cost is significantly lower than the reported cost of earlier installations by other Victorian distributors. Jemena has had the opportunity to study the first trial installations and has adapted its approach to these installations to achieve cost efficiencies in their installations.

We have reviewed the project cost estimates and the methodology used by Jemena to derive its estimates. Jemena has undertaken a desktop study of the need for asset hardening which has produced modest requirements for hardening works. This need can only be fully determined by undertaking a detailed survey of each affected line to determine specific needs for hardening. As such, we have not adjusted our estimates as the possibility that additional hardening may be required may not arise.

Based on our review of the Jemena estimate of installation costs and the methodology that Jemena applied to derive those costs, we accept the estimates of costs that have been proposed are reasonable and efficient.

We accept Jemena's capex proposal to spend $6.237 million ($2015, excluding overheads and escalation) on the accepted BMP applying to its network.

Accordingly, the resultant cost estimates are a reasonable estimate of the prudent and efficient cost necessary to reasonably reflect the capex criteria.

Future regulatory obligations

Following the Victorian Bushfires Royal Commission (VBRC) 67 recommendations were made, of which eight relate directly to the safety of electrical distribution networks in Victoria. One of these relevant recommendations is recommendation 27:

> The State amend the Regulations under Victoria's Electricity Safety Act 1998 and otherwise take such steps as may be required to give effect to the following:

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[172] Jemena, *Adopting Fault Current Limiter Technology to Reduce the Risk of Bushfire Ignition in JEN*, Strategic Planning Paper, ELE PL 0021, Confidential, 3 April 2015.

- the progressive replacement of all SWER (single-wire earth return) power lines in Victoria with aerial bundled cable, underground cabling or other technology that delivers greatly reduced bushfire risk. The replacement program should be completed in the areas of highest bushfire risk within 10 years and should continue in areas of lower bushfire risk as the lines reach the end of their engineering lives

- the progressive replacement of all 22-kilovolt distribution feeders with aerial bundled cable, underground cabling or other technology that delivers greatly reduced bushfire risk as the feeders reach the end of their engineering lives. Priority should be given to distribution feeders in the areas of highest bushfire risk.

The Victorian Government is developing a regulatory requirement to give effect to recommendation 27. In particular, work is being undertaken by the Victorian Government to develop suitable regulatory standards for the use of new technologies such as Rapid Earth Fault Current Limiting (REFCL) devices and a new type of insulated line as major tools to reduce the risk of powerline faults igniting bushfires. We have included a brief description of the new REFCL technology in a later section.

These regulations are expected to apply in High Bushfire Risk Areas (HBRA) of the State and will involve a mandatory program of installing REFCLs and a change to the design standards that apply to new line construction and the reconstruction of assets in certain areas (Codified Areas). However, this Victorian Government program is not yet in place. The timing and scope of the regulations are not currently known.

Jemena has not addressed this impending development in their regulatory proposal. AusNet Services proposed to apply a regulatory change pass through event to any regulatory change or changes that apply in the next regulatory control period.[173] However, we note that Powercor has proposed that the pending regulatory changes be dealt with as contingent projects.[174] We have therefore, considered whether either approach is preferable (contingent project or pass through event) and the trigger event which should apply to a contingent project.

Having considered the respective proposals of AusNet Services and Powercor, we consider a contingent project approach is preferable. Our preference is to apply a common regulatory approach to all affected service providers. We prefer to deal with the costs of the Victorian government regulations consistently across distributors. This ensures that the cost of the regulation is recovered from customers in the same manner. It also allows us to compare the costs and impacts on customers more transparently so that we can ensure that consumers pay no more than necessary for the implementation of the regulation. This is particularly important because the cost and timing of the regulation are not yet known.

Until the Victorian Government regulations are developed and promulgated it will remain unclear whether there is likely to be an impact on Jemena. If, in their substitute

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[173] AusNet Services, *Regulatory proposal 2016–20*, April 2015, p. 260.
[174] Powercor, *Regulatory proposal 2016 – 20*, April 2015, p. 143.

determination regulatory proposal Jemena applies for one or more contingent projects in response to these impending regulations, our intention is to apply a common regulatory approach to that proposal, including the applicable trigger event.

B.6   Forecast capitalised overheads

Capitalised overheads are costs associated with capital works that have been capitalised in accordance with Jemena's capitalisation policy. They are generally costs shared across different assets and cost centres.

B.6.1   Position

We do not accept Jemena's proposed capitalised overheads. We instead included in our alternative estimate of overall total capex an amount of $164.4 million ($2015) for capitalised overheads. This is 2.6 per cent lower than Jemena's proposal of $168.8 million ($2015). We are satisfied that this amount reasonably reflects the capex criteria.

B.6.2   Our assessment

We consider that reductions in Jemena's forecast expenditure should see some reduction in the size of its total overheads. Our assessment of Jemena's proposed direct capex demonstrates that a prudent and efficient DNSP would not undertake the full range of direct expenditure contained in Jemena's regulatory proposal. It follows that we would expect some reduction in the size of Jemena's capitalised overheads. We do accept that some of these costs are relatively fixed in the short term and so are not correlated to the size of the expenditure program. However, we maintain that a portion of the overheads should vary in relation to the size of the expenditure.

Our assessment in the Queensland distribution determinations found Energex's overheads comprised 75 per cent fixed and 25 per cent variable components. We consider this split of fixed and variable overheads components is also reasonable for Jemena. If Jemena does not consider this split is reasonable for its circumstance, it may provide a more appropriate split, with evidence, in its revised regulatory proposal.

We have also considered the relationship between opex and capex, specifically whether it is necessary to account for the way the CAM allocates overheads between capex and opex in making this decision. We considered this was not necessary in order to satisfy the capex criteria. This is because our opex assessment sets the efficient level of opex inclusive of overheads. It has accounted for the efficient level of overheads required to deliver the opex program by applying techniques which utilise the best available data and information for opex.

The starting point of our capitalised overheads assessment is Jemena's proposal, which is based on their CAM. As such, Jemena's forecast application of the CAM underlies our estimate. We have only reduced the capitalised overheads to account for the reduced scale of Jemena's approved capex based on assessment techniques best suited to each of the capex drivers. In doing so we have accounted for there being a fixed proportion of capitalised overheads.

As a result of a $59.2 million ($2015) reduction in Jemena's direct capex that attract overheads, we consider a reduction of $4.4 million ($2015) reasonably reflects the capex criteria.

B.7   Forecast non-network capex

The non-network capex category for Jemena includes expenditure on information and communications technology (ICT), buildings and property, motor vehicles, and tools and equipment. Jemena proposed $137.2 million ($2015) for non-network capex, compared to actual expenditure of $138.5 million for the 2011–15 regulatory control period.[175] It proposed $101.9 million for ICT capex, compared to $75.5 million in the previous period. It has also proposed $35.3 million for the other non-network capex categories, compared to $63.1 million in the previous period.

B.7.1   Position

We accept that Jemena's forecast of non-network capex is a reasonable estimate of the efficient costs that a prudent operator would require for this capex category. However, as discussed in attachment 16 of this preliminary decision, we have reallocated a portion of Jemena's forecast ICT capex related to metering from standard control to alternative control services. We consider forecast non-network capex for standard control services of $135.9 million reasonably reflects the capex criteria. We have included it in our estimate of total capex for the 2016–20 regulatory control period.

In modelling Jemena's required revenue for the 2016–20 regulatory control period, we have also accounted for forecast disposals of property assets which Jemena omitted from its regulatory proposal.
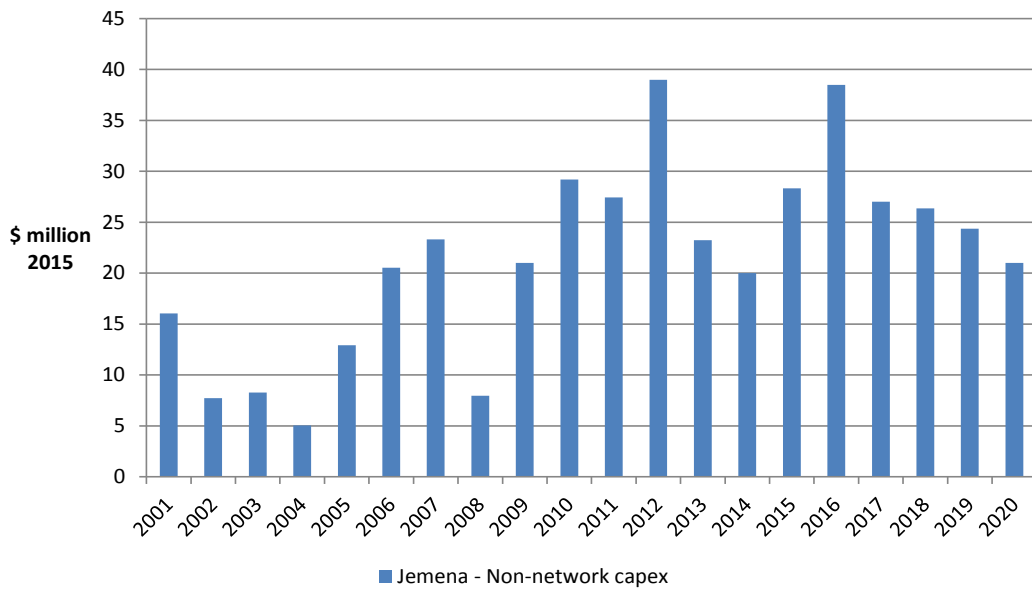
B.7.2   Jemena's proposal

Figure 6.17 shows Jemena's actual and expected non-network capex for the period from 2001 to 2015, and forecast capex for the 2016–20 regulatory control period.

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[175]   Jemena, *Regulatory proposal 2016–20*, April 2015, p. 68.

Figure 6.17 Jemena's non-network capex 2001 to 2020 ($million, 2015)

Source: Jemena, *Regulatory information notice*, template 2.6; Jemena, *Category Analysis RIN 2014*, template 2.6; Jemena, *RIN response for 2010-2015 regulatory control period, template 2.1.1*; AER analysis.

Jemena's forecast non-network capex for the 2016–20 regulatory control period is 1 per cent lower than actual and expected capex in the 2011–15 regulatory control period.[176]

Our analysis of longer term trends in non-network capex suggests that Jemena has forecast capex for this category declining to levels which are generally consistent with historical expenditure in this category, with the exception of the 2016 year. Non-network capex from 2017–2020 is forecast to be 11 per cent lower, on average, than capex in the 2011–15 regulatory control period and in line with expenditure in most years of the earlier 2006–2010 regulatory control period. In our view, this suggests that Jemena's forecast of non-network capex requirements in the 2016–20 period is likely to be reasonable having regard to past expenditure[177], with the possible exception of the 2016 year.

We have also assessed forecast expenditure in each category of non-network capex. Analysis at this level has been used to inform our view of whether forecast capex is reasonable relative to historical rates of expenditure in each category, and to identify trends in the different category forecasts which may warrant further review.[178] Figure 6.18 shows Jemena's actual and forecast non-network capex by sub-category for the period from 2009 to 2020.
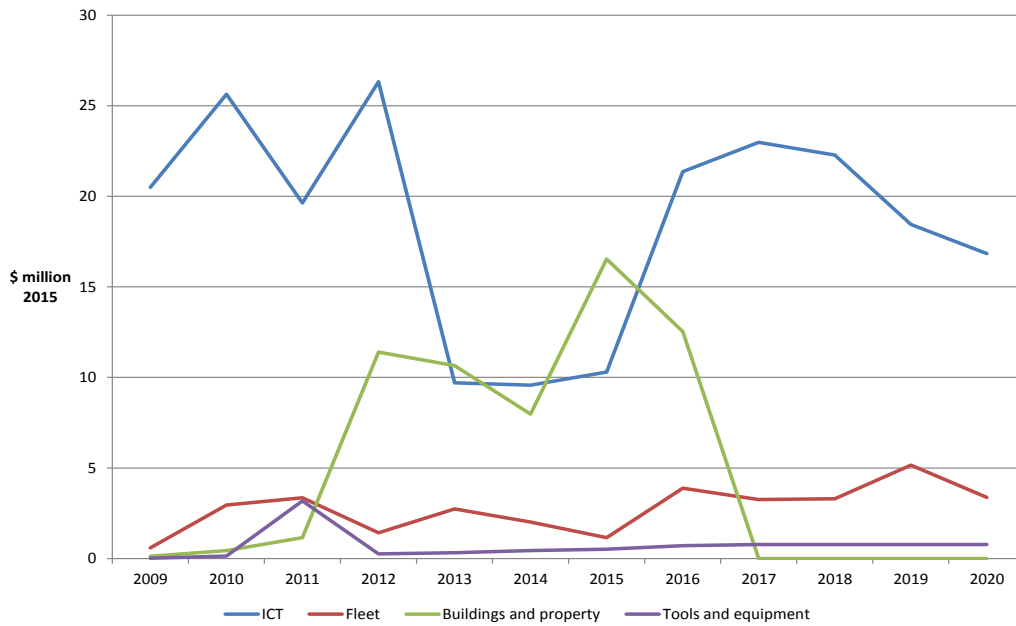
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[176]   Jemena, *Regulatory information notice*, template 2.6; Jemena, *Category Analysis RIN 2014*, template 2.6; AER analysis.

[177]   NER, cl. 6.5.7(e)(5).

[178]   NER, cl. 6.5.7(e)(5).

Figure 6.18 Jemena's non-network capex by category ($million, 2015)

Source: Jemena, *Regulatory information notice*, template 2.6; Jemena, *Category Analysis RIN 2014*, template 2.6; AER analysis.

Jemena has forecast increases in the ICT and motor vehicles categories of non-network capex. However, these increases are more than offset by reductions in the buildings and property and plant and equipment categories. We examined the high level drivers of expenditure in these categories to identify areas for further specific review at the project or program level.

In relation to ICT capex, the CCP noted that Jemena had forecast 'a bit more' than actual capex in the 2011–15 regulatory control period, but otherwise made no specific comment on Jemena's proposed ICT capex.[179] Jemena's forecast ICT capex is predominately recurrent in nature, allowing for the lifecycle replacement of some existing systems such as the outage management and distribution management systems.[180] Jemena submitted that the increase from the 2011–15 regulatory control period reflected the re-categorisation of some Advanced Metering Infrastructure (AMI) costs previously regulated under the AMI Cost Recovery Order in Council (CROIC), and increasing software and hardware licencing costs.[181]

Figure 6.18 shows a trough in ICT capex in the period from 2013–2015, followed by a significant increase in forecast capex in the 2016 year. This pattern reflects the front loading of expenditure in the 2011–15 regulatory control period, with 61 per cent of ICT

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[179]   CCP Sub-panel 3, *Response to proposals from Victorian electricity distribution network service providers, August 2015*, p. 57.

[180]   Jemena, *Regulatory proposal 2016–20*, April 2015, p. 78.

[181]   Jemena, *Response to Information Request IR# 015*, 7 August 2015, p. 2.

capex undertaken in the first two years of that period. This expenditure profile is consistent with our allowance for Jemena's ICT capex in the 2011–15 regulatory control period.[182] The forecast increase in total ICT capex from the 2011–15 regulatory control period to the 2016–20 regulatory control period is in fact less than one third of the annual increase from 2015 to 2016 shown in Figure 6.18. Overall, forecast ICT capex is broadly in line with historical expenditure in the five years from 2009–2013, and is trending down from 2009. On this basis, we are satisfied that forecast capex for this category is likely to reflect the high level drivers of expenditure, and as such reflect a reasonable estimate of efficient costs. However, as discussed in attachment 16, we have reallocated a portion of forecast capex for the network management system upgrade project from standard control to alternative control services. Our estimate of standard control services ICT capex is therefore $100.6 million.

The forecast increase in motor vehicles capex reflects necessary changes in the technical specifications for some vehicles, and the replacement of a number of currently leased commercial vehicles with owned vehicles.[183] The increase in motor vehicles capex is therefore driven, in part, by the substitution of capex for opex.[184] Again, we are satisfied that forecast capex for this category is likely to reflect the high level drivers of expenditure, and represents a reasonable estimate of efficient costs.

Our analysis suggests that the high level of capex in the 2016 year relative to other years of the forecast period shown in Figure 6.18 is in fact caused by buildings and property expenditure of $12.5 million in that year. Buildings and property capex falls to zero for all subsequent years of the 2016–20 regulatory control period. We therefore sought further information from Jemena in relation to its forecast buildings and property capex to confirm the need and timing of the forecast capex for this category.

B.7.3   Buildings and property capex

Jemena forecast capex of $12.5 million for buildings and property (excluding tools and equipment), which predominately relates to the redevelopment of the Broadmeadows depot facility.[185]

The Broadmeadows depot was Jemena's main field service depot until 2014 when the new Tullamarine depot became operational. The site consists of three office buildings constructed in the 1960s and 1970s on two separate land titles. Jemena submitted that the Broadmeadows project will involve the demolition of one of the existing buildings, construction of a new operational and administration facility on one land title, and sale of the second land title. This project will allow Jemena to address age and condition

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[182]   Jemena, *Regulatory Proposal, 2016–20: Attachment 7-1 Historical capital expenditure report for the 2011 regulatory period*, 29 April 2015, p. 14.

[183]   Jemena, *Regulatory Proposal, 2016–20: Attachment ELE PL 0035 Fleet Replacement and Rebuild Strategic Planning Paper*, 3 April 2015, p. 4 and section 2.2.4.

[184]   NER, cl. 6.5.7(e)(7).

[185]   Jemena, *Regulatory Proposal, 2016–20: Attachment 7–3 Forecast capital expenditure report for the 2016 regulatory period*, 30 April 2015, p. 92.

related issues at the site, resulting in a smaller facility which better meets business requirements and facilitates a more efficient operating environment.[186]

We reviewed the business case and other documentation submitted by Jemena in support of the Broadmeadows redevelopment project. In general, we found that Jemena had provided appropriate evidence to support the preferred Broadmeadows redevelopment option, including:

- a detailed description of the need for investment, with supporting evidence as to the nature of asset obsolescence and other specific site condition and compliance issues

- evidence that a range of alternative options has been considered

- evidence of a formal risk assessment or analysis performed as part of the need identification or options analysis process

- a comparison of costs and benefits for each option considered

- evidence that the lowest cost option had been selected such that the preferred option is economically justified.

However, the Broadmeadows project business case did not specifically assess the costs and benefits of a 'do nothing' option in line with how the compliance and safety issues at the site have been managed to date. We therefore sought further information from Jemena to confirm that the proposed redevelopment option was justified with regard to a 'do nothing' option and was therefore likely to reflect prudent and efficient expenditure.[187]

Jemena submitted a range of additional documentation in support of the proposed Broadmeadows redevelopment.[188] Jemena explained that its consideration of options for redeveloping the Broadmeadows site dates back to 2010, when external consultants conducted an investigation of the existing site. This investigation considered a 'do nothing' option, along with various development options involving single or multiple sites, and was supported by a detailed analysis of forecast lifecycle costs. Jemena provided the report summarising this investigation, and related financial analysis subsequently considered by Jemena management.[189] Ultimately, this formed the basis of Jemena's chosen strategy to develop the new Tullamarine depot and subsequently redevelop the Broadmeadows site. Jemena determined that the 'do nothing' option' did not meet the need to provide a safe environment for employees, contractors and visitors.[190]

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[186] Jemena, *Regulatory Proposal, 2016–20: Attachment 7–3 Forecast capital expenditure report for the 2016 regulatory period*, 30 April 2015, p. 92.

[187] AER, *Information request JEN IR# 015*, 27 July 2015.

[188] Jemena, *Response to Information Request JEN IR# 015*, 7 August 2015.

[189] Woodhead, *JEN Broadmeadows depot replacement project - Feasibility Report*, 19 July 2010; *JEN Depot Summary Matrix - August 2011 - CONFIDENTIAL*; and *JEN Depot Strategy (Board Buy Option 3) - August 2011 - CONFIDENTIAL*.

[190] Jemena, *Response to Information Request JEN IR# 015*, 7 August 2015, p. 6.

Having reviewed the additional information submitted by Jemena, we are satisfied that the proposed Broadmeadows depot redevelopment capex reasonably reflects the efficient costs of a prudent operator. This conclusion reflects the context of the Broadmeadows project as part of Jemena's multi-depot strategy. In our view, the information submitted by Jemena demonstrates that the financial case supporting this strategy is sound, and supports the need for further investment to redevelop the Broadmeadows site following completion of the new Tullamarine depot in 2014. On this basis, we have included the forecast costs associated with this project in our estimate of forecast capex which reasonably reflects the capex criteria.

B.7.4 Buildings and property disposals

Jemena's business case for the depot redevelopment project at Broadmeadows accounts for the disposal of one of the existing two land titles at the site following completion of the redevelopment project.[191] However, in modelling its forecast revenues for the 2016–20 regulatory control period, Jemena has not accounted for any property disposals in this period.

We sought confirmation from Jemena of its forecast property disposals in the 2016–20 regulatory control period. Jemena advised that it expected the sale of land at Broadmeadows would occur in 2016. However, Jemena advised that it did not include any forecast land disposals in its submitted post tax revenue model due to the uncertainty of the disposal amount exposing Jemena to avoidable forecasting error. Jemena advised that it would include the forecast disposal in its revised post tax revenue model should further information come to light on the amount to include prior to submitting its revised regulatory proposal.[192]

In our view, where a disposal of land is expected to occur in a regulatory control period, estimated sale proceeds should be accounted for in the post-tax revenue model. Not accounting for the disposal is likely to lead to greater forecasting error than any uncertainty in the disposal amount. As discussed above, we will make allowance for the Broadmeadows redevelopment project in our estimate of forecast capex for the 2016–20 regulatory control period. We have therefore also accounted for the property disposal related to this project, based on the estimate of $3.5 million ($2014) included in the Broadmeadows project business case.[193]

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[191]   Jemena, *Broadmeadows site redevelopment 2016 business case PUBLIC*, 14 April 2015, p. 13.
[192]   Jemena, *Response to Information Request JEN 015*, 7 August 2015, p. 8.
[193]   Jemena, *Broadmeadows site redevelopment 2016 business case PUBLIC*, 14 April 2015, p. 13.

C Maximum demand forecasts

Maximum demand forecasts are fundamental to a distributor's forecast capex and opex, and to our assessment of that forecast expenditure.[194] This is because we must determine whether the capex and opex forecasts reasonably reflect a realistic expectation of demand forecasts. Hence accurate, or at least unbiased, demand forecasts are important inputs to ensuring efficient levels of investment in the network.

This attachment sets out our decision on Jemena's forecast network maximum demand for the 2016–20 regulatory control period. We consider Jemena's demand forecasts at the system level and the more local level.

System demand represents total demand in the Jemena distribution network. System demand trends give a high level indication of the need for expenditure on the network to meet changes in demand. Forecasts of increasing system demand generally signal an increased network utilisation which may, once any spare capacity in the network is used up, lead to a requirement for growth capex. Conversely forecasts of stagnant or falling system demand will generally signal falling network utilisation, a more limited requirement for growth capex, and the potential for the network to be rationalised in some locations.

Localised demand growth (spatial demand) drives the requirement for specific growth projects or programs. Spatial demand growth is not uniform across the entire network: for example, future demand trends would differ between established suburbs and new residential developments.

In our consideration of Jemena's demand forecasts, we have had regard to:

- Jemena's proposal

- AEMO's independent forecasts[195]

- a report by our internal economic consultant, Dr Darryl Biggar, on the forecasting methodologies underlying each Victorian electricity distributor's demand forecasts for 2016–20 (this report will be published alongside this preliminary decision)[196]

- long-term demand trends and changes in the electricity market, and

- stakeholder submissions in response to Jemena's proposal (as well as submissions made in relation to the Victorian electricity distribution determinations more generally).[197]

These are set out in more detail in the remainder of this appendix.

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[194] NER, cll. 6.5.6(c)(3) and 6.5.7(c)(3).
[195] AEMO, *National electricity forecasting report for the National Electricity Market*, June 2014, p. 4-4.
[196] Biggar, *2015 Victorian Electricity Distribution Pricing review: An Assessment of the Vic DNSP's Demand Forecasting Methodology*, August 2015.
[197] See AER, http://www.aer.gov.au/node/24446.

C.1   AER determination

We accept that Jemena's demand forecasts reflect a realistic expectation of demand over the 2016–20 regulatory control period. In determining a realistic expectation of demand over the 2016–20 period, we have had regard to the following factors:

- Structural changes observed in the electricity market and the way energy is consumed in recent years (e.g. strong uptake of solar PV, changing customer behaviours and energy efficiency measures) suggests that the strong positive demand growth seen in Jemena's network prior to 2009 is unlikely to return in the short to medium term. This is discussed in section C.3.

- Independent forecasts from the Australian Energy Market Operator (AEMO) best explain the actual demand pattern seen on all distributors' networks. Jemena adopts a similar methodology as AEMO. This is also discussed in section C.4.

- While Jemena proposes some small growth in maximum demand over 2016–20, it is significantly less than the growth in demand previously experienced prior to 2010. Furthermore, Jemena's forecasts at the 50 PoE level are broadly in line with average actual demand experienced over the 2011–15 period, and its

We understand that Jemena (and the Victorian electricity businesses) are in the process of updating their demand forecasts as part of the 2015 distribution annual planning report (DAPR). We also note AEMO will publish updated connection point demand forecasts for Victoria. These forecasts will into account actual 2015 summer demand data and some revisions to its forecasting methodology. For our final determination, we anticipate Jemena will submit an updated demand forecast that includes the most recent demand data and takes into account AEMO's most recent forecasts.

We consider the forecasts in our decisions should reflect the most current expectations of the forecast period. Hence, we will also consider updated demand forecasts and other information (such as AEMO's revised connection point forecasts) in the final decision to reflect the most up to date data.

We have also received a number of consumer submissions that raise concerns with Jemena's and the other Victorian distributors maximum demand forecasts. The CCP submitted that we should pay particular attention to the distributors' maximum demand forecasts and whether they have been over estimated, given the following considerations:

- forecasts of maximum demand are key drivers of revenue requirements

- distributors forecasts exceed and contrast with AEMO's forecasts, and

- distributors have consistently over forecast maximum demands in the past.[198]

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[198]   CCP Sub-panel 3, *Response to proposals from Victorian electricity distribution network service providers*, August 2015, pp. 32–37.

The Ethnic Communities Council of Victoria (ECCV) also supported us further examining the Victorian distributors forecasts that exceed forecasts by AEMO.[199]

The VECUA also submitted that the Victorian distributors have consistently over estimated their peak demand and energy delivered projections. VECUA put forward that network distributors are insulated from volume risk through revenue cap regulation, which allows them to pass that risk on to customers. Therefore if the actual energy delivered is lower than forecast by networks' then networks will increase their prices to recover their guaranteed revenues. VECUA also considered it important to note:[200]

> …that the Victoria distributors were rewarded with windfall profits for their forecasting errors, as their revenue allowances included returns and depreciation on load-driven capex which they did not incur.

As set out in this appendix, we have closely examined Jemena's maximum demand forecasts and drawn similar observations to these submissions. A key part of our work has been to analyse Jemena (and the other Victorian distributors) demand forecasts with reference to AEMO's independent maximum demand forecasts. However, the VECUA submitted that AEMO has consistently over estimated its energy forecasts in recent years and has not fully considered the influence of future factors in reducing demand (such as energy efficiency schemes, automotive closures, cost reflective price structures and battery storage technology).[201] We do not agree with the VECUA and consider that AEMO's explanation of its forecasting methodology reveals that it has considered a wide variety of information in its forecast, including predictions for energy efficiency and automotive closures in Victoria and this represents an enhancement and improvement to its previous forecast approach.[202]

Further, the CCP and VECUA referred to AusNet Services demand forecasts as the only Victorian distributor to forecast lower energy consumption in the future compared to the past.[203] VECUA has submitted that AusNet Services demand forecasting methodology incorporates actual interval metering data, which it considers may account for the differences between AusNet Services forecast growth and other Victorian distributors.[204] The CCP considered that the AusNet Services approach to

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[199] Ethnic Community Council of Victoria, *Submission to the Australian Energy Regulator Victoria Electricity Pricing Review*, 15 July 2015, p. 4.

[200] Victorian Energy Consumer and User Alliance, *Submission to the AER Victorian Distribution Networks' 2016–20 Revenue Proposals*, 13 July 2015, pp. 14–16.

[201] Victorian Energy Consumer and User Alliance, *Submission to the AER Victorian Distribution Networks' 2016–20 Revenue Proposals*, 13 July 2015, p. 17.

[202] AEMO, *Detailed summary of 2015 electricity forecasts, 2015 National Electricity Forecasting Report*, June 2015, p. 11.

[203] CCP Sub-panel 3, *Response to proposals from Victorian electricity distribution network service providers*, August 2015, pp. 35–37; Victorian Energy Consumer and User Alliance, *Submission to the AER Victorian Distribution Networks' 2016–20 Revenue Proposals*, 13 July 2015, pp. 15–16.

[204] Victorian Energy Consumer and User Alliance, *Submission to the AER Victorian Distribution Networks' 2016–20 Revenue Proposals*, 13 July 2015, p. 16.

developing its forecast demand is a significant enhancement in forecasting future demand and is a direct outcome from the decision to mandate the roll out of the AMI program in Victoria.[205] We consider there is merit to these views (and will be useful as distributors' develop their information capacity). However we have not directly taken this into account for our assessment of Jemena's maximum demand forecasts.

C.2 Jemena's proposal

Jemena provided historical and forecast demand figures in their proposal and in the reset Regulatory Information Notice (RIN).[206] Jemena proposed approximately 1.46 per cent annual growth in maximum demand across the 2016–20 period. In its proposal, Jemena forecast an increase in peak demand in specific areas of its network to be driven by:[207]

- new developments associated with urban sprawl towards the edge of the urban growth boundary.

- amendments to planning schemes to allow high density living in inner urban areas, such as Coburg (Moreland City Council) and Preston (City of Darebin).

- expansion of community facilities and services, including the Footscray Central Activities District, Essendon Airport and Melbourne International Airport.

Jemena submitted that its forecast of peak demand growth is based on public information from the Victorian Government, as well as, local information sources such as local councils.[208]

Jemena engaged the ACIL Allen to develop its demand forecasts.[209] Jemena's proposal also included a summary of ACIL Allen's demand forecasting method, including approaches to:

- demand drivers

- accounting for economic conditions such as incomes and electricity prices, and

- post model-adjustments for block loads and embedded generation.[210]

Jemena's forecasting methodology is described in detail in Dr Biggar's report.[211]

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[205] CCP Sub-panel 3, *Response to proposals from Victorian electricity distribution network service providers*, August 2015, pp. 35-37 and p. 44.

[206] Jemena reset RIN; Jemena, *Regulatory Proposal 2016–20, Demand summary report*, April 2015, p. 13.

[207] Jemena, *Regulatory Proposal 2016–20, Demand summary report*, April 2015, pp. 13–17.

[208] Jemena, *Regulatory Proposal 2016–20, Demand summary report*, April 2015, p. 19.

[209] Jemena, *Regulatory Proposal 2016–20, Demand summary report*, April 2015, pp. 18-20; ACIL Allen, *A report to Jemena Electricity Networks: Electricity demand forecast report*, November 2014.

[210] ACIL Allen, *A report to Jemena Electricity Networks: Electricity demand forecast report*, November 2014, p. 43.

[211] Biggar, *2015 Victorian Electricity Distribution Pricing review: An Assessment of the Vic DNSP's Demand Forecasting Methodology*, August 2015, pp. 16–19.

C.3   Demand trends

Our first step in examining Jemena's forecast of maximum demand is to look at whether the forecast is consistent with, or explained by, long-term demand trends and changes in the electricity markets.

Figure 6.19 shows that over the last few years, the path of electricity demand seems to be changing. From 2006 to 2009, actual maximum demand on Jemena's network was growing steadily. Then from 2009 to 2012, demand flattened and declined. The decline in 2009 from historical demand growth has also been recorded for Victoria and for the NEM. While there was some growth in demand between 2013 and 2014, this does not necessarily indicate a return to longer-term growth in demand.

As shown further in Figure 6.19, Jemena's demand forecasts for the 2015–20 period are slightly higher than the actual demand observed for its network during 2006–14. Jemena forecasts continued demand growth on the network. This contrasts with AEMO's Connection Point Forecasts, published in September 2014, which forecasts little or no growth in connection point demand on Jemena's network for the same period.[212]

Figure 6.19   Comparison of peak demand forecasts of Jemena and AEMO (MW, non-coincident, summated connection point forecasts)

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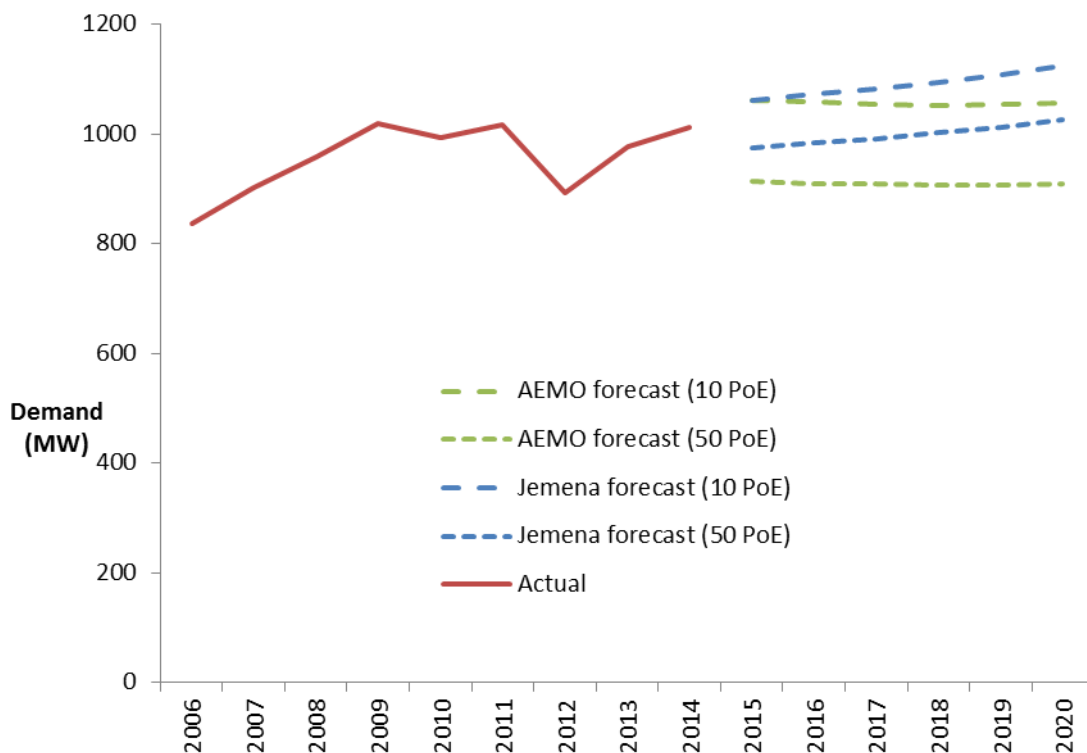
[212]   AEMO, *Transmission Connection Point Forecasting Report for Victoria*, September 2014, pp. 12–13.

Figure 6.20 shows AEMO's forecasts of maximum demand across Victoria. In its 2015 national electricity forecasting report, AEMO forecast a flattening of maximum demand for Victoria for 2015–2020. However, AEMO has forecast some growth in maximum demand over the next twenty years, which is a change from its 2014 national electricity forecasting report.

Figure 6.20 AEMO's maximum demand forecasts for Victoria
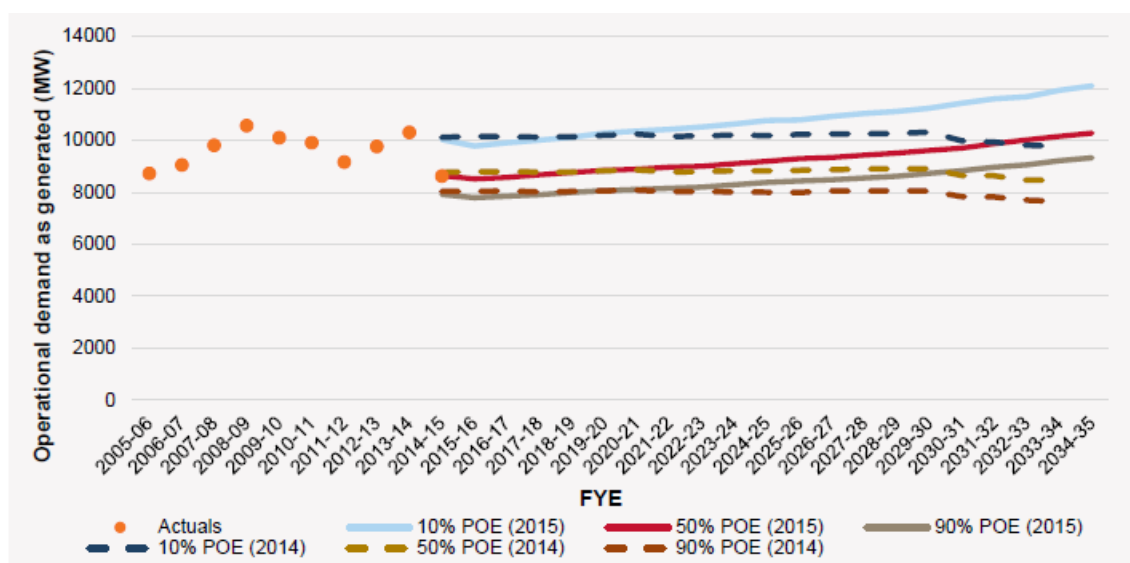
We see a similar change in peak demand patterns across the National Electricity Market (NEM). Figure 6.21 compares NEM peak demand together with the forecast peak demand two years ahead and total generation capacity, since the NEM began. It shows actual demand has been declining generally since 2008–09 across the NEM.

Figure 6.21 Comparison of historical generation capacity and peak demand across the NEM

Source: AER, accessed on 18 August 2015 at: https://www.aer.gov.au/node/9772.

Note: The step up in maximum demand in 2004-05 is as a result of Tasmania's entry to the NEM.

Jemena forecasts moderate demand growth for 2015–20, whereas other independent forecasts from AEMO predict low or no growth over this period. While actual connection point demand increased on Jemena's network in 2013 and 2014 (see Figure 6.21), the observed changes in demand patterns within the span of nine years raises the question of whether the recent flattening of demand is an aberration (and demand will return to growth) or a realistic expectation of demand over the 2016–20 period.

There have been some fundamental developments in the Australian and Victorian electricity markets over recent years that have influenced energy consumption and maximum demand patterns.

First, across the NEM, growth in rooftop solar generation (PV) and energy efficiency (through the uptake of energy efficient appliances and building efficiency) has reduced electricity drawn from the grid. Rooftop PV generation has had the long-term effect of reducing maximum demand and shifting the daily peak to later in the evening. Energy efficiency reduced overall energy consumption and has a downward impact on maximum demand.

In Victoria, AEMO reported that in the five years to 2014–15, consumption in the residential and commercial sector decreased due to rising prices and the uptake of rooftop PV.[213] AEMO forecasts that there will be continued uptake of rooftop PV in the residential and commercial sectors.

To demonstrate, Figure 6.22 below, drawn AEMO's 2015 national electricity forecasting report for Victoria, shows the projected capacity of solar PV systems across Victoria. From this figure we observe a projected substantial increase in the volume of installed rooftop solar PV capacity can be observed from 2010 to 2015, with capacity expected to continue to grow strongly to 2020 and beyond.[214]

Figure 6.22 Projected capacity of solar PV systems in Victoria
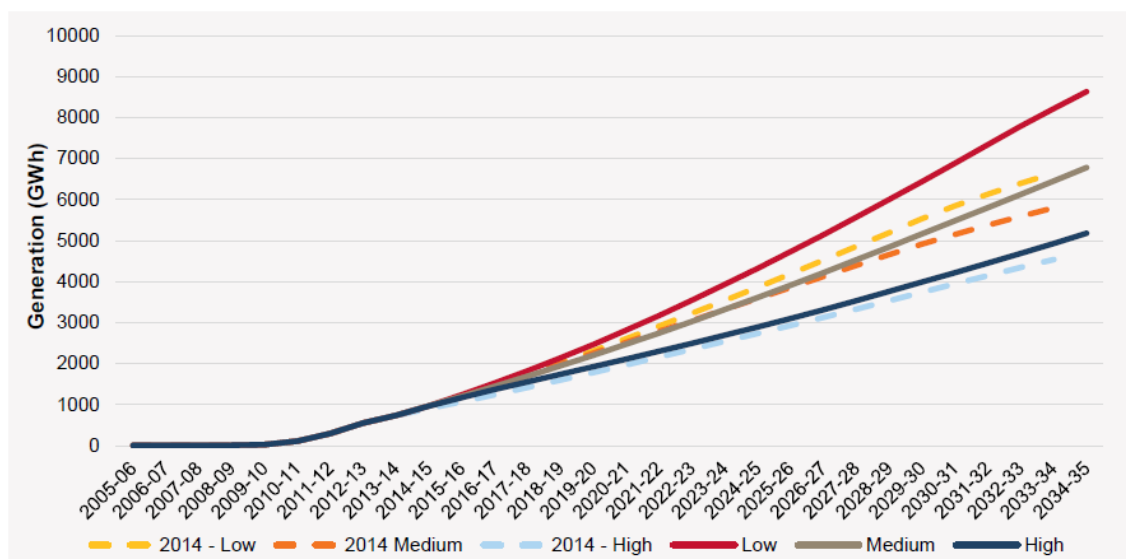
Source: AEMO 2015 National Electricity Forecasting Report, June 2015.

However, we note that the impact of rooftop PV will likely have diminishing impacts on maximum demand over the longer-term as peak daily demand shifts to the evening. This is recognised in AEMO's forecasting report.[215] We note that electricity storage (e.g. batteries) has the potential to significantly enhance the impact of solar generation on maximum demand on the distribution network. However, wide-spread uptake of battery storage will probably not be significant over the 2016–20 period.

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[213]   AEMO, *Detailed summary of 2015 electricity forecasts, 2015 National Electricity Forecasting Report,* June 2015, p. 68.
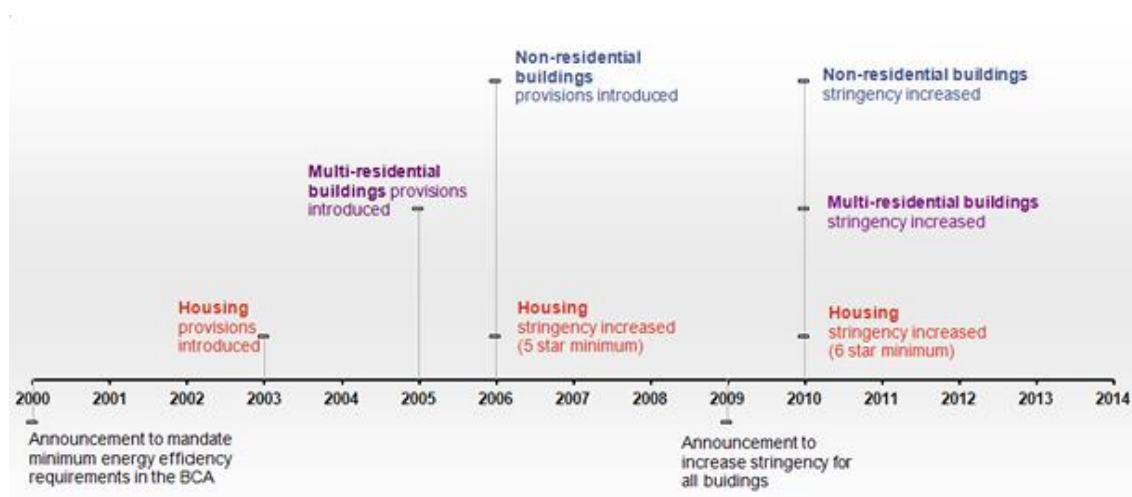
[214]   AEMO, *Detailed summary of 2015 electricity forecasts, 2015 National Electricity Forecasting Report,* June 2015, p. 73.

[215]   AEMO, *Detailed summary of 2015 electricity forecasts, 2015 National Electricity Forecasting Report*, June 2015, p. 77.

Second, energy efficiency also contributed to decreased consumption and AEMO forecasts that energy efficiency measures will continue.[216] Ongoing energy efficiency measures such as, mandatory energy efficiency building requirements[217] and other government incentives[218] have created an accumulative effect in slowing down demand growth over time. In addition, greater customer awareness of energy usage, improving appliance efficiencies and replacement of aging appliances   will likely continue to put downwards pressure on consumption and maximum demand.[219]

Figure 6.23 gives an overview of government energy efficiency requirements in building provisions. From this timeline it can be inferred that the increasing energy efficiency requirements in building regulation are likely to have a cumulative effect on demand in the future.

Figure 6.23 Timeline of Energy Efficiency Requirements in Building Regulation

Source: Australian Building Codes Board (ABCB), accessed on 27 August 2015 at: http://www.abcb.gov.au/en/work-program/energy-efficiency.aspx.

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[216]   AEMO, *Detailed summary of 2015 electricity forecasts, 2015 National Electricity Forecasting Report*, June 2015, p. 67.

[217]   Australian Building Codes Board (ABCB), *National Construction Code energy efficiency requirements*, http://www.abcb.gov.au/en/work-program/energy-efficiency.aspx , accessed on 27 August 2015.

[218]   Department of Industry and Science, *Your energy savings: Rebates*, http://yourenergysavings.gov.au/rebates?live_in%5B%5D=64&interested%5B%5D=82&=Search, accessed on 27 August 2015.

[219]   AEMO, *2015 National Electricity Forecasting Report: Overview*, June 2015, pp. 8–11.

Finally, AEMO also forecast that Victoria is not expected to recover to its historical high level of operational consumption (in 2008-09) until 2030–31, when population is projected to be 1.7 million higher than in 2014–15.[220]

We consider that the combination of these factors support forecast reductions or softening of maximum demand even in the presence of economic and population growth. In particular, based on our assessment of independent forecasts from AEMO, we consider the continuing presence of energy efficiency measures, improving appliance efficiencies and continued growth in rooftop PV will likely put downward pressure on demand, which may counteract any demand growth due to economic and population growth. Solar PV and energy efficiency are not transient or temporary phenomena, but rather fundamental changes in the way electricity is consumed.

As set out in section C.4 below, we consider that Jemena's forecasting methodology reflects a reasonable expectation of demand over the 2016–20 period. While Jemena proposes some small growth in maximum demand over the 2016–20 period, it adopts a methodology that is clear and transparent and has the capacity to respond to recent apparent changes in demand drivers. We consider that once recent demand data has been included, Jemena's demand forecasts should sufficiently capture the changes we are observing for the electricity market in Victoria and recent declines in demand.

We note this is consistent with international trends. Figure 6.24 highlights the fact that growth in electricity demand is currently low or zero in the USA and UK despite the existence of continued population growth and economic growth. In other words, this chart suggests that the impact of economic growth and population growth on electricity demand is being offset by other factors (such as improving energy efficiency). On this basis, it is reasonable to argue that high growth is unlikely to return over 2016–20.[221]

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[220] AEMO, *Detailed summary of 2015 electricity forecasts, 2015 National Electricity Forecasting Report*, June 2015, p. 67.

[221] Biggar, *2015 Victorian Electricity Distribution Pricing review: An Assessment of the Vic DNSP's Demand Forecasting Methodology*, August 2015, p. 11.

Figure 6.24   Long-term trends in electricity growth rates
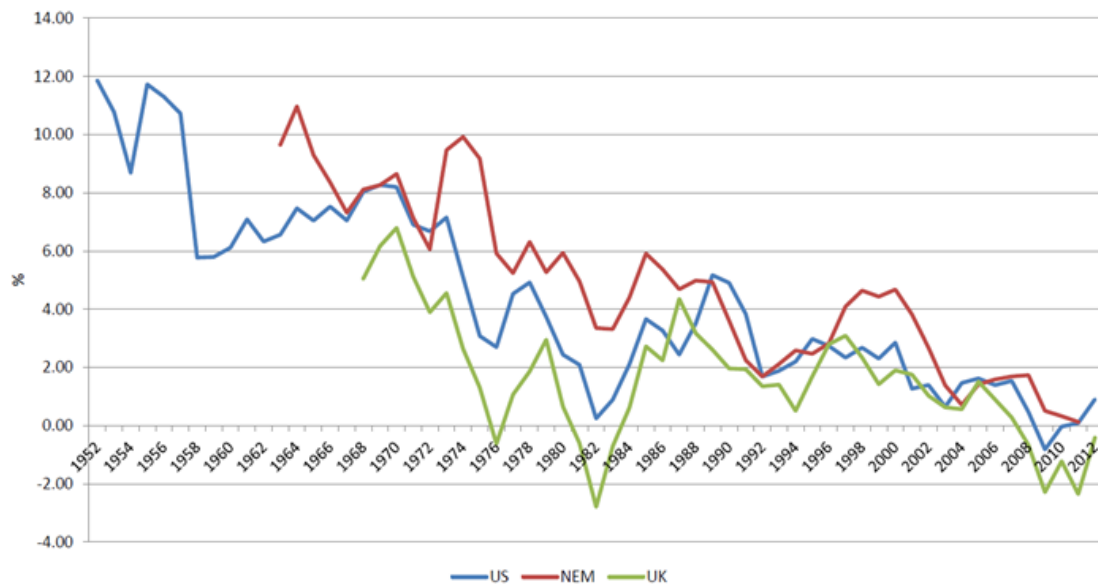
Source: Energy Supply Association of Australia (ESAA).[222]

C.4   Jemena's forecasting methodology and assumptions

Our next step in examining Jemena's forecasts of maximum demand is to look at Jemena's methodology and whether it is likely to result in a demand forecast that reflects a realistic expectation of demand.

Jemena's forecasting methodology (from ACIL Allen), is based on the methodology recommended by ACIL Allen for AEMO. ACIL Allen has prepared Jemena's peak demand forecasts for both the system wide and connection point level. These forecasts are then reconciled. ACIL Allen's methodology allows for a separate relationship between temperature and demand to be estimated in each year of the sample. A key advantage of this approach is that it does not impose a fixed and unchanging relationship between temperature and demand.

Some of the problems with imposing a fixed and unchanging relationship between temperature and demand are shown in Dr Biggar's 2015 report on the Victorian electricity distributors' demand forecasting methodologies.[223] Dr Biggar's analysis, replicated in Figure 6.25, provides a simple illustration which shows what can happen when the assumed drivers of demand do not capture a fixed and unchanging

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[222]   Economic and Social Outlook Conference 2014, ESAA, 3 July 2014, p. 7, accessed on 18 August 2015 at: http://www.melbourneinstitute.com/downloads/conferences/Outlook2014/Outlook2014_slides/6_Warren,%20Matthew.pdf.

[223]   Biggar, *2015 Victorian Electricity Distribution Pricing review: An Assessment of the Vic DNSP's Demand Forecasting Methodology*, August 2015, p. 8.

relationship between demand and the key drivers. In this example it is assumed that the primary driver of demand is time (a simple time trend). But as Figure 6.25 shows, there appears to be no fixed relationship between peak demand and time. In the first half of the last decade, peak demand growth was increasing rapidly. Since around 2009 it appears that peak demand has been declining. This illustrates that a model, which assumes a simple fixed relationship between peak demand and time would likely give unreliable forecasts of future peak demand.

Figure 6.25   Illustration of future forecasts of POE10 levels based on the most recent five years of data
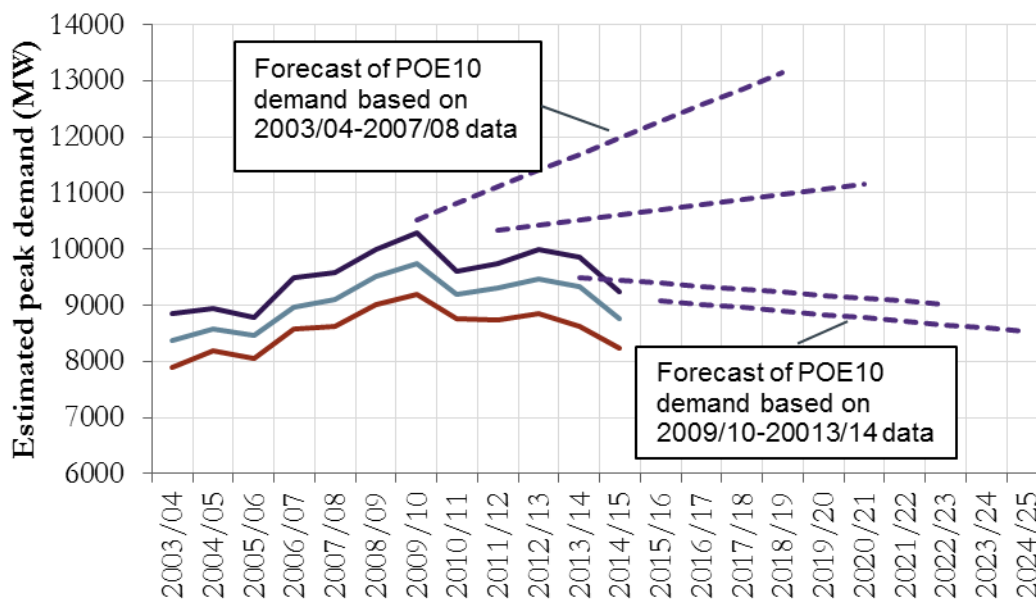
Source: Biggar, *2015 Victorian Electricity Distribution Pricing review: An Assessment of the Vic DNSP's Demand Forecasting Methodology*, August 2015, p. 10.

Dr Biggar stated that ACIL Allen's model treats the recent downturn in demand as due to an increase in electricity prices or a decrease in Gross State Product (GSP). Dr Biggar's 2015 report noted that this approach is acceptable provided that the model has accurately and fully captured all of the key drivers of peak demand. However, after examining the drivers used by ACIL Allen, Dr Biggar expressed concern that these drivers may not be able to adequately capture the recent apparent change in demand drivers noted above (such as investment in solar PV and increasing energy efficiency) in an appropriate manner.[224]

We have had regard to Dr Biggar's concerns and, on balance, we consider that Jemena's methodology is reasonably likely to reflect a realistic expectation of demand

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[224]   Biggar, *2015 Victorian Electricity Distribution Pricing review: An Assessment of the Vic DNSP's Demand Forecasting Methodology*, August 2015, pp. 16–19.

over the 2016–20, in particular as more up-to-date information is adopted. This is because:

- Jemena adopts the same methodology as AEMO, which is likely to result in more realistic forecasts when compared to other models we have assessed.

- Jemena's forecast is similar to AEMO's in the beginning of the 2016–20 regulatory control period (which we have used as an independent comparison), in particular at the 10 PoE level

- Jemena forecasts for 50 PoE level are broadly in line with average actual demand experienced over the 2011-15 period. While Jemena proposes moderate growth in demand, it is significantly less than the growth in demand previously experienced prior to 2010.

As noted, we have used AEMO's connection point demand forecasts as an independent comparison to Jemena's forecasts. In September 2014, AEMO published its report on connection point demand forecasts for each of the Victorian electricity distributors for the 2014–2023 period. As noted previously, AEMO forecasts low or zero demand growth over the 2016–20 period.

AEMO's connection point demand forecasts are based on a methodology developed by ACIL Allen, which was developed after consultation during 2012–13 with all distribution businesses.[225] This methodology does not assume a particular long term structural relationship for demand over time. AEMO has decided to adopt a 'cubic' relationship with historical demand and adopts an "off the point approach" (which means that the demand forecast begins at the most recent point of actual demand).[226]

ACIL Allen's "off-the-point" approach is not without its criticisms. In particular, it relies on industry knowledge and judgement to adopt an alternative to a historical linear trend and to start the forecast at the most recent point, which can be arbitrary if not based on first principles or underlying economic phenomena.[227] This approach was also used in ACIL Allen's demand forecasts for Jemena. In using the "off-the-point" approach ACIL Allen extrapolates the relationship between demand and the long term underlying drivers based on the most recent actual demand value. Because of this, we consider that ACIL Allen's forecasts are likely to reflect a realistic expectation of demand over the 2016–20 period.

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[225] In December 2012, the Council of Australian Governments (COAG) released its energy market reform implementation plan. In this plan, AEMO will develop independent demand forecasts in 2013–14 to inform the AER's assessment of infrastructure investment plans submitted by Network Service Providers. Further detail is provided at http://www.aemo.com.au/Electricity/Planning/Forecasting/AEMO-Transmission-Connection-Point-Forecasting.

[226] Biggar, *2015 Victorian Electricity Distribution Pricing review: An Assessment of the Vic DNSP's Demand Forecasting Methodology*, August 2015, pp. 55–56.

[227] This was a source of criticism in Frontier Economics' peer review of AEMO's demand forecasts. See Frontier Economics, *"High level review of transmission connection point forecasts: Victoria", A report prepared for the Australian Energy Market Operator*, September 2014.

Jemena submitted that its demand forecasting methodology is consistent with AEMO's.[228] We consider this to be a reasonable assessment, however, a number of the key input assumptions were different. This led to different results. Some of the differences observed by Jemena are:[229]

- Jemena produced maximum demand econometric models for each terminal station and at the total network level, whereas AEMO only undertook economic modelling at the state level.

- Jemena did not observe any integration of maximum demand and energy forecast models, whereas AEMO's forecasts had energy growing faster than maximum demand.

- Jemena disagrees with AEMO's post modelling adjustments for:
    o Contribution of solar PV to maximum demand
    o Assumptions and application of forecast energy efficiency.

- Difference in observation for Probability of Exceedance (PoE) weather normalisation and terminal station forecasts starting point.

We took these into account. On balance, we are of the view that Jemena's demand forecast represents a reasonable expectation of future demand. In forming our view, we have recognised that each approach has strengths and limitations. These are highlighted in our analysis above and Dr Biggar's report.[230] As stated previously, we understand that Jemena is in the process of updating its demand forecasts as part of the 2015 DAPR. We will take the updated demand forecasts and AEMO's updated connection point forecasts into consideration in our final determination.

[228] Jemena, *Regulatory Proposal 2016–20, Demand summary report*, April 2015, p. 5.

[229] Jemena, *Regulatory Proposal 2016–20, Demand summary report*, April 2015, pp. 21–23.

[230] Biggar, *2015 Victorian Electricity Distribution Pricing review: An Assessment of the Vic DNSP's Demand Forecasting Methodology*, August 2015, pp. 16–19.

D   Real cost escalation

Real material cost escalation is a method for accounting for expected changes in the costs of key material inputs to forecast capex. The capital expenditure forecast model submitted by Jemena includes forecasts for changes in the prices of commodities such as copper, aluminium, steel and crude oil, rather than the prices of physical inputs themselves (e.g., poles, cables, transformers) which are the inputs directly sourced by Jemena in the provision of its network services. Jemena has also escalated construction related costs in its cost of materials forecast.

D.1   Position

We are not satisfied that Jemena's proposed real material cost escalators (leading to cost increases above CPI) which form part of its total forecast capex reasonably reflect a realistic expectation of the cost inputs required to achieve the capex objectives over the 2016–20 period.[231] Instead we consider that zero per cent real cost escalation is reasonably likely to reflect the capex criteria and is likely to reasonably reflect a realistic expectation of the cost inputs required to achieve the capex objectives over the 2016–20 period. We have arrived at this conclusion on the basis that:

- zero per cent real cost escalation is likely to provide a more reliable estimation of the price of input materials, given the potential inaccuracy of commodities forecasting

- there is little evidence to support how accurately Jemena's capex forecast model forecasts reasonably reflects changes in prices it paid for physical assets in the past. Without this supporting evidence, it is difficult to assess the accuracy and reliability of Jemena's material input cost escalators model as a predictor of the prices of the assets used to provide network services, and

- Jemena has not provided any supporting evidence to show that it has considered whether there may be some material exogenous factors that impact on the cost of physical inputs that are not captured by the capex forecast model.

Our approach to real materials cost escalation discussed above does not affect the proposed application of labour and construction related cost escalators which apply to Jemena standard control services capital expenditure. We consider that labour and construction related cost escalation as proposed by Jemena is likely to more reasonably reflect a realistic expectation of the cost inputs required to achieve the capex criteria, given these are direct inputs into the cost of providing network services.[232]

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[231]   NER, clause 6.5.7(a).
[232]   NER, clause 6.5.7(c)(3).

D.2   Jemena's proposal

Jemena engaged independent market experts to forecast the real escalation in its capital costs, and then applied this escalation to its capital program for the 2016–20 regulatory control period.[233] Real cost escalation indices for the following material cost drivers were calculated for Jemena by BIS Schrapnel:[234]

- aluminium

- copper

- steel

- oil

- wood; and

- concrete.

Table 6.14 outlines Jemena's real materials cost escalation forecasts.

Table 6.14   Jemena's real materials cost escalation forecast—inputs (per cent)

	2016	2017	2018	2019	2020
Aluminium	8.0	8.2	5.1	-7.0	-5.2
Copper	3.5	7.7	2.1	-10.0	-6.1
Steel	4.7	3.0	2.7	-11.0	-3.4
Oil	-1.1	4.3	2.5	-7.7	-5.0
Wood	2.2	1.7	0.9	2.2	3.9
Concrete	-1.0	-2.0	-4.9	-3.2	1.3

Source: Jemena, Revenue proposal, Attachment 8-8, BIS Schrapnel, Real Labour and Material Cost Escalation Forecasts to 2020 - Australia and Victoria, November 2014, p. iii.

On the basis of these individual material (and labour) cost escalators, Jemena through its consultant Jacobs, calculated escalation indices specific to various asset classes common to Jemena's asset base.[235] These escalation factors were determined by applying a percentage contribution, or weighting, by which each of the underlying cost

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[233]   Jemena, *Regulatory Proposal 2016–20, April 2015*, p. 65.

[234]   Jemena, *Regulatory Proposal 2016–-20: Attachment 8-8 BIS Schrapnel, Real Labour and Material Cost Escalation Forecasts to 2020 - Australia and Victoria*, November 2014.

[235]   Jemena, *Regulatory Proposal 2016–20:Attachment 07-13 Jacobs - Cost Escalation Indices Forecast*, November 2014.

drivers were considered to influence the total price of each asset.[236] Table 6.15 outlines Jemena's real cost escalation indices by asset class.

Table 6.15   Jemena real materials and labour cost escalation forecast (indices)

	2016	2017	2018	2019	2020
Asset classes					
Wooden Pole	1.013	1.014	1.014	1.015	1.018
Concrete Pole	1.004	1.006	1.008	1.011	1.013
Steel Pole	1.014	1.016	1.017	0.999	1.008
Steel Cross Arms (incl. Insulators)	1.006	1.009	1.010	1.008	1.009
Wood Cross Arms (incl. Insulators)	1.007	1.010	1.011	1.015	1.014
Bare Conductors (Al)	1.023	1.023	1.020	0.999	1.003
Insulated Conductors - LV	1.022	1.028	1.021	0.982	0.991
Bare conductors (steel)	1.014	1.014	1.016	1.008	1.013
Underground Cables and Cablehead - HV, XLPE	1.012	1.018	1.014	1.003	1.008
Underground Cables and Cablehead - LV, XLPE	1.013	1.016	1.015	1.011	1.013
Supervisory Cable - Fibre Optic	1.014	1.016	1.015	1.016	1.019
Capacitor Banks	1.014	1.016	1.016	1.006	1.011
Power Transformers -	1.016	1.018	1.015	0.993	1.003

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[236]   Jemena, *Regulatory Proposal 2016–20: Attachment 07-13 Jacobs - Cost Escalation Indices Forecast*, November 2014, p. 1.

	2016	2017	2018	2019	2020
Zone Substation					
Power Transformers - Distribution	1.016	1.018	1.015	0.990	1.000
Circuit Breakers - Indoor	1.007	1.007	1.007	1.010	1.010
Circuit Breakers - Outdoor	1.007	1.007	1.008	1.012	1.011
Outdoor Buses	1.003	1.005	1.008	1.011	1.012
CT's and VT's - Zone Substation	1.008	1.008	1.008	1.012	1.012
Neutral Earthing Resistor	1.012	1.014	1.017	1.015	1.014
Earth Grid Conductors	1.016	1.023	1.016	0.998	1.005
Zone Substation Batteries	1.007	1.008	1.008	0.999	1.005
Zone Substation Battery Chargers	1.007	1.008	1.008	0.999	1.005
HV Disconnectors / Isolators	1.006	1.006	1.006	1.011	1.010
LV Disconnectors / Isolators	1.005	1.005	1.006	1.010	1.009
Reclosers / Gas Switches	1.005	1.004	1.004	1.008	1.008
Surge Diverters	1.001	0.998	0.996	1.001	1.002
Fault Indicators	1.006	1.006	1.006	1.011	1.010
Pillars / Pits	1.009	1.011	1.013	1.016	1.016
Public lighting luminaries	1.011	1.012	1.012	1.013	1.015
Relays - Digital / Microprocessor	1.006	1.007	1.008	1.016	1.013
SCADA - RTU	1.009	1.011	1.012	1.015	1.014
Fence	1.006	1.008	1.009	1.011	1.014
Ring Main Unit	1.001	0.998	0.996	1.001	1.001

D.3   Assessment approach

We assessed Jemena's proposed real material cost escalators as part of our assessment of total capex under the National Electricity Rules (NER) requirements. Under the NER, we must accept Jemena's capex forecast if we are satisfied it reasonably reflects the capex criteria.[237] Relevantly, we must be satisfied those forecasts reasonably reflect a realistic expectation of cost inputs required to achieve the capex objectives.[238]

We have applied our approach as set out in our Expenditure Forecast Assessment Guideline (Expenditure Guideline) to assessing the input price modelling approach to forecast materials cost.[239] In the Expenditure Guideline we stated that we had seen limited evidence to demonstrate that the commodity input weightings used by service providers to generate a forecast of the cost of material inputs have produced unbiased forecasts of the costs the service providers paid for manufactured materials.[240] We considered it important that such evidence be provided because the changes in the prices of manufactured materials are not solely influenced by the changes in the raw materials that are used.[241] As a result, the price of manufactured network materials may not be well correlated with raw material input costs. We expect service providers to demonstrate that their proposed approach to forecast manufactured material cost changes is likely to reasonably reflect changes in raw material input costs.

In our assessment of Jemena's proposed material cost escalation, we:

- reviewed the BIS Schrapnel and Jacobs reports commissioned by Jemena[242]

- reviewed the capex forecast model used by Jemena; and

- reviewed the approach to forecasting manufactured material costs in the context of electricity service providers mitigating such costs and producing unbiased forecasts.

We received no stakeholder submissions on this issue.

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237   NER, cl. 6.5.7(c).

238   NER, cl. 6.5.7(c)(3).

239   AER, *Better Regulation - Explanatory Statement Expenditure Forecast Assessment Guideline,* November 2013, pp. 50–51.

240   AER, *Better Regulation - Explanatory Statement Expenditure Forecast Assessment Guideline*, November 2013, p. 50.

241   AER, *Better Regulation - Explanatory Statement Expenditure Forecast Assessment Guideline*, November 2013, p. 50.

242   Jemena, Revenue proposal *Attachment 8-8 BIS Schrapnel, Real Labour and Material Cost Escalation Forecasts to 2020 - Australia and Victoria*, November 2014 and *Attachment 07-13 Jacobs - Real Cost Escalation Indices Forecast*, November 2014.

D.4   Reasons

We must be satisfied that a forecast is based on a sound and robust methodology in order to accept that Jemena's proposed total capex reasonably reflects the capex criteria.[243] This criteria includes that the total forecast capex reasonably reflects a realistic expectation of cost inputs required to achieve the capex objectives.[244] In making our assessment, we do recognise that predicting future materials costs for electricity service providers involves a degree of uncertainty. However, for the reasons set out below, we are not satisfied that the materials forecasts provided by Jemena satisfy the requirements of the NER. Accordingly, we have not accepted it as part of our substitute estimate in our preliminary decision on total forecast capex. We are satisfied that zero per cent real cost escalation is reasonably likely to reflect the capex criteria and this has been taken into account into our substitute estimate.

Capital expenditure forecast model

Jemena's capex forecast model does not demonstrate how and to what extent material inputs have affected the cost of inputs such as cables and transformers. In particular, there is no supporting evidence to substantiate how accurately Jemena's materials escalation forecasts reasonably reflected changes in prices they paid for assets in the past to assess the reliability of forecast materials prices.

In our Expenditure Guideline, we requested service providers should demonstrate that their proposed approach to forecast materials cost changes reasonably reflected the change in prices they paid for physical inputs in the past. Jemena's proposal does not include supporting data or information which demonstrates movements or interlinkages between changes in the input prices of commodities and the prices Jemena paid for physical inputs. Jemena's capex forecast model assumes a weighting for total material inputs for each asset class, but does not provide information which explains the basis for the weightings, or that the weightings applied have produced unbiased forecasts of the costs of Jemena's assets. For these reasons, there is no basis on which we can conclude that the forecasts are reliable. In summary, Jemena has not demonstrated that their proposed approach to forecast materials cost changes reasonably reflects the change in prices they paid for assets in the past.

Materials input cost model forecasting

Jemena has used its consultants' reports to estimate cost escalation factors in order to assist in forecasting future operating and capital expenditure. These cost escalation factors include commodity inputs in the case of capital expenditure. The consultants have adopted a high level approach, hypothesising a relationship between these commodity inputs and the physical assets it purchased. Neither the consultants' reports nor Jemena have successfully attempted to explain or quantify this relationship,

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[243]   NER, cl. 6.5.7(c).

[244]   NER, cl. 6.5.7(c)(3).

particularly in respect to movements in the prices between the commodity inputs and the physical assets and the derivation of commodity input weightings for each asset class.

We recognise that active trading or futures markets to forecast prices of assets such as transformers are not available and that in order to forecast the prices of these assets a proxy forecasting method needs to be adopted. Nonetheless, that forecasting method must be reasonably reliable to estimate the prices of inputs used by service providers to provide network services. Jemena has not provided any supporting information that indicates whether the forecasts have taken into account any material exogenous factors which may impact on the reliability of material input costs. Such factors may include changes in technologies which affect the weighting of commodity inputs, suppliers of the physical assets changing their sourcing for the commodity inputs, and the general volatility of exchange rates.

Materials input cost mitigation

We consider that there is potential for Jemena to mitigate the magnitude of any overall input cost increases. This could be achieved by:

- potential commodity input substitution by the electricity service provider and the supplier of the inputs. An increase in the price of one commodity input may result in input substitution to an appropriate level providing there are no technically fixed proportions between the inputs. Although there will likely be an increase in the cost of production for a given output level, the overall cost increase will be less than the weighted sum of the input cost increase using the initial input share weights due to substitution of the now relatively cheaper input for this relatively expensive input.

   We are aware of input substitution occurring in the electricity industry during the late 1960's when copper prices increased, potentially impacting significantly on the cost of copper cables. Electricity service provider's cable costs were mitigated as relatively cheaper aluminium cables could be substituted for copper cables. We do however recognise that the principle of input substitutability cannot be applied to all inputs, at least in the short term, because there are technologies with which some inputs are not substitutable. However, even in the short term there may be substitution possibilities between operating and capital expenditure, thereby potentially reducing the total expenditure requirements of an electricity service provider[245]

- the substitution potential between opex and capex when the relative prices of operating and capital inputs change.[246] For example, Jemena has not demonstrated whether there are any opportunities to increase the level of opex (e.g. maintenance costs) for any of its asset classes in an environment of increasing material input costs

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[245] NER, cl. 6.5.7(e)(7).
[246] NER, cl. 6.5.7(e)(6).

- the scale of any operation change to the electricity service provider's business that may impact on its capex requirements, including an increase in capex efficiency, and

- increases in productivity that have not been taken into account by Jemena in forecasting its capex requirements.

By discounting the possibility of commodity input substitution throughout the 2016–20 period, we consider that there is potential for an upward bias in estimating material input cost escalation by maintaining the base year cost commodity share weights.

Forecasting uncertainty

The NER requires that an electricity service provider's forecast capital expenditure reasonably reflects a realistic expectation of cost inputs required to achieve the capex objectives.[247] We consider that there is likely to be significant uncertainty in forecasting commodity input price movements. The following factors have assisted us in forming this view:

- recent studies which show that forecasts of crude oil spot prices based on futures prices do not provide a significant improvement compared to a 'no-change' forecast for most forecast horizons, and sometimes perform worse[248]

- evidence in the economic literature on the usefulness of commodities futures prices in forecasting spot prices is somewhat mixed. Only for some commodities and for some forecast horizons do futures prices perform better than 'no change' forecasts;[249] and

- the difficulty in forecasting nominal exchange rates (used to convert most materials which are priced in $US to $AUS). A review of the economic literature of exchange rate forecast models suggests a "no change" forecasting approach may be preferable to the forward exchange rate produced by these forecasting models.[250]

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[247] NER, cl. 6.5.7(c)(3).

[248] R. Alquist, L. Kilian, R. Vigfusson, *Forecasting the Price of Oil*, Board of Governors of the Federal Reserve System, International Finance Discussion Papers, Number 1022, July 2011 (also published as Alquist, Ron, Lutz Kilian, and Robert J. Vigfusson, 2013, *Forecasting the Price of Oil*, in Handbook of Economic Forecasting, Vol. 2, ed. by Graham Elliott and Allan Timmermann (Amsterdam: North Holland), pp. 68–69 and pp. 427–508) and International Monetary Fund, *World Economic Outlook — Recovery Strengthens, Remains Uneven*, Washington, April 2014, pp. 25–31.

[249] International Monetary Fund, *World Economic Outlook — Recovery Strengthens, Remains Uneven*, Washington, April 2014, p. 27, Chinn, Menzie D., and Olivier Coibion, *The Predictive Content of Commodity Futures*, Journal of Futures Markets, 2014, Volume 34, Issue 7, p. 19 and pp. 607–636 and T. Reeve, R. Vigfusson, *Evaluating the Forecasting Performance of Commodity Futures Prices*, Board of Governors of the Federal Reserve System, International Finance Discussion Papers, Number 1025, August 2011, pp. 1 and 10.

[250] R. Meese, K. Rogoff, (1983), *Empirical exchange rate models of the seventies: do they fit out of sample?*, Journal of International Economics, 14, B. Rossi, (2013), *Exchange rate predictability*, Journal of Economic Literature, 51(4), E. Fama, (1984), *Forward and spot exchange rates*, Journal of Monetary Economics, 14, K. Froot and R. Thaler, (1990), Anomalies: Foreign exchange, the Journal of Economic Perspectives, Vol. 4, No. 3, CEG,

Strategic contracts with suppliers

We consider that electricity service providers can mitigate the risks associated with changes in material input costs by including hedging strategies or price escalation provisions in their contracts with suppliers of inputs (e.g. by including fixed prices in long term contracts). We also consider there is the potential for double counting where contract prices reflect this allocation of risk from the electricity service provider to the supplier, where a real escalation is then factored into forecast capex. In considering the substitution possibilities between operating and capital expenditure,[251] we note that it is open to an electricity service provider to mitigate the potential impact of escalating contract prices by transferring this risk, where possible, to its operating expenditure.

Cost based price increases

Accepting the pass through of material input costs to input asset prices is reflective of a cost based pricing approach. We consider this cost based approach reduces the incentives for electricity service providers to manage their capex efficiently, and may instead incentivise electricity service providers to over forecast their capex. In taking into account the revenue and pricing principles, we note that this approach would be less likely to promote efficient investment.[252] It also would not result in a capex forecast that was consistent with the nature of the incentives applied under the CESS and the STPIS to Jemena as part of this decision.[253]

Selection of commodity inputs

The limited number of material inputs included in Jemena's capex forecast model may not be representative of the full set of inputs or input choices impacting on changes in the prices of assets purchased by Jemena. Jemena's capex forecast model may also be biased to the extent that it may include a selective subset of commodities that are forecast to increase in price during the 2016–20 period.

Commodities boom

The relevance of material input cost escalation post the 2009 commodities boom experienced in Australia when material input cost escalators were included in determining the approved capex allowance for electricity service providers. We consider that the impact of the commodities boom has subsided and as a consequence the justification for incorporating material cost escalation in determining forecast capex has also diminished.

Escalation factors affecting expenditure forecasts, December 2013, and BIS Shrapnel, *Real labour and material cost escalation forecasts to 2019/20, Australia and New South Wales*, Final report, April 2014.

[251]   NER, cl. 6.5.7(e)(7).

[252]   NEL, s. 7.

[253]   NER, cl. 6.5.7(e)(8).

D.5 Review of independent expert's reports

We have reviewed the BIS Schrapnel report commissioned by Jemena. We consider that this review, along with our review of two other reports detailed below, provides further support for our position to not accept Jemena's proposed materials cost escalation.

BIS Schrapnel report

BIS Schrapnel acknowledge that as well as individual supply and demand drivers impacting on the forecast price of commodities, movements in the exchange rate also impact on the price of commodities. BIS Schrapnel stated that movements in the Australian dollar against the US dollar can have significant effects on the domestic price of minerals and metals.[254] BIS Shrapnel are forecasting the Australian dollar to fall to US$0.77 in 2018.[255] This is significantly lower than the exchange rate forecasts by Sinclair Knight Mertz (SKM, now Jacobs SKM) of between US$0.91 to US$0.85 from 2014-15 to 2018-19 submitted as part of our recent review of TransGrid's transmission determination for the 2015–18 regulatory period.[256] In its report submitted in respect to our review of Jemena Gas Networks access arrangement for the 2016–20 access arrangement period, BIS Schrapnel stated that exchange rate forecasts are not authoritative over the long term.[257]

> We consider the forecasting of foreign exchange movements during the next regulatory control period to be another example of the potential inaccuracy of modelling for material input cost escalation.

BIS Schrapnel stated that for a range of items used in most businesses the average price increase would be similar to consumer price inflation and that an appropriate cost escalator for general materials would be the Consumer Price Index (CPI).[258] In its forecast for general materials such as stationary, office furniture, electricity, water, fuel and rent for Jemena Gas Networks, BIS Shrapnel assumed that across the range of these items, the average price increase would be similar to consumer price inflation and that the appropriate cost escalator for general materials is the CPI.[259]

> This treatment of general business inputs supports our view that where we cannot be satisfied that a forecast of real cost escalation for a specific material

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[254] Jemena, *Regulatory Proposal 2016–20: Attachment 8-8 BIS Schrapnel, Real Labour and Material Cost Escalation Forecasts to 2020 - Australia and Victoria*, November 2014, p. 37.

[255] Jemena, *Regulatory Proposal 2016–20: Attachment 8-8 BIS Schrapnel, Real Labour and Material Cost Escalation Forecasts to 2020 - Australia and Victoria*, November 2014, p. 4.

[256] SKM, *TransGrid Commodity Price Escalation Forecast 2013/14 - 2018/19*, 9 December 2013, p. 10.

[257] BIS Shrapnel, *Real Labour and Material Cost Escalation Forecasts to 2019/20 - Australia and New South Wales*, April 2014, p. A-7.

[258] Jemena, *Regulatory Proposal 2016–20: Attachment 8-8 BIS Schrapnel, Real Labour and Material Cost Escalation Forecasts to 2020 - Australia and Victoria*, November 2014, p. 43.

[259] BIS Shrapnel, *Real Labour and Material Cost Escalation Forecasts to 2019/20 - Australia and New South Wales*, April 2014, p. 48.

input is robust, and cannot determine a robust alternative forecast, zero per cent real cost escalation is reasonably likely to reflect the capex criteria and under the PTRM the electricity service provider's broad range of inputs are escalated annually by the CPI.

In addition to our review of the BIS Shrapnel Report, we have also received submissions from electricity service providers on other recent resets. We have considered the relevance of those submissions to the issues raised by Jemena in order to arrive at a position that takes into account all available information. Our views on these reports are set out below. Overall, both these reports lend further support to our position to not accept Jemena's proposed materials cost escalation.

Competition Economists Group report

A number of electricity service providers commissioned the Competition Economists Group (CEG) to provide real material cost escalation indices in respect to revenue resets for these businesses recently undertaken by us. These businesses included ActewAGL, Ausgrid, Endeavour Energy, Essential Energy and TasNetworks (Transend).

CEG acknowledged that forecasts of general cost movements (e.g. consumer price index or producer price index) can be used to derive changes in the cost of other inputs used by electricity service providers or their suppliers separate from material inputs (e.g. energy costs and equipment leases etc.).[260] This is consistent with the Post-tax Revenue Model (PTRM) which reflects at least in part movements in an electricity service provider's intermediary input costs.

CEG acknowledged that futures prices will be very unlikely to exactly predict future spot prices given that all manner of unexpected events can occur.[261] This is consistent with our view that there are likely to be a significant number of material exogenous factors that impact on the price of assets that are not captured by the material input cost models used by Jemena.

CEG provide the following quote from the International Monetary Fund (IMF) in respect of futures markets:[262]

> While futures prices are not accurate predictors of future spot prices, they nevertheless reflect current beliefs of market participants about forthcoming price developments.

This supports our view that there is a reasonable degree of uncertainty in the modelling of material input cost escalators to reliably and accurately estimate the prices of assets used by electricity service providers to provide network services. Whilst the IMF may conclude that commodity futures prices reflect market beliefs on future prices, there is

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[260] CEG, *Escalation factors affecting expenditure forecasts*, December 2013, p. 3.

[261] CEG, *Escalation factors affecting expenditure forecasts*, December 2013, pp. 4–5.

[262] CEG, *Escalation factors affecting expenditure forecasts*, December 2013, p. 5.

no support from the IMF that futures prices provide an accurate predictor of future commodity prices.

Figures 1 and 2 of CEG's report respectively show the variance between aluminium and copper prices predicted by the London Metals Exchange (LME) 3 month, 15 month and 27 month futures less actual prices between July 1993 and December 2013.[263] Analysis of this data shows that the longer the futures projection period, the less accurate are LME futures in predicting actual commodity prices. Given the next regulatory control period covers a time span of 60 months we consider it reasonable to question the degree of accuracy of forecast futures commodity prices towards the end of this period.

Figures 1 and 2 also show that futures forecasts have a greater tendency towards over-estimating of actual aluminium and copper prices over the 20 year period (particularly for aluminium). The greatest forecast over-estimate variance was about 100 per cent for aluminium and 130 per cent for copper. In contrast, the greatest forecast under-estimate variance was about 44 per cent for aluminium and 70 per cent for copper.

In respect of forecasting electricity service providers future costs, CEG stated that:[264]

> There is always a high degree of uncertainty associated with predicting the future. Although we consider that we have obtained the best possible estimates of the NSPs' future costs at the present time, the actual magnitude of these costs at the time that they are incurred may well be considerably higher or lower than we have estimated in this report. This is a reflection of the fact that while futures prices and forecasts today may well be a very precise estimate of current expectations of the future, they are at best an imprecise estimate of future values.

This statement again is consistent with our view about the degree of the precision and accuracy of futures prices in respect of predicting electricity service providers future input costs. CEG also highlights the (poor) predictive value of LME futures for actual aluminium prices.[265]

CEG also acknowledge that its escalation of aluminium prices are not necessarily the prices paid for aluminium equipment by manufacturers. As an example, CEG referred to producers of electrical cable who purchase fabricated aluminium which has gone through further stages of production than the refined aluminium that is traded on the LME. CEG also stated that aluminium prices can be expected to be influenced by refined aluminium prices but these prices cannot be expected to move together in a 'one-for-one' relationship.[266]

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[263]   CEG, *Escalation factors affecting expenditure forecasts*, December 2013, pp. 5–6.

[264]   CEG, *Escalation factors affecting expenditure forecasts*, December 2013, p. 13.

[265]   CEG, *Escalation factors affecting expenditure forecasts*, December 2013, p. 5.

[266]   CEG, *Escalation factors affecting expenditure forecasts*, December 2013, p. 19.

CEG provided similar views for copper and steel futures. For copper, CEG stated that the prices quoted for copper are prices traded on the LME that meet the specifications of the LME but that there is not necessarily a 'one-for-one' relationship between these prices and the price paid for copper equipment by manufacturers.[267] For steel futures, CEG stated that the steel used by electricity service providers has been fabricated, and as such, embodies labour, capital and other inputs (e.g. energy) and acknowledges that there is not necessarily a 'one-for one' relationship between the mill gate steel and the steel used by electricity service providers.[268]

These statements by CEG support our view that the capex forecast model used by Jemena has not demonstrated how and to what extent material inputs have affected the cost of intermediate outputs. We note, as emphasised by CEG, there is likely to be significant value adding and processing of the raw material before the physical asset is purchased by Jemena.

CEG has provided data on historical indexed aluminium, copper, steel and crude oil actual (real) prices from July 2005 to December 2013 as well as forecast real prices from January 2014 to January 2021 which were used to determine its forecast escalation factors.[269] For all four commodities, the CEG forecast indexed real prices showed a trend of higher prices compared to the historical trend. Aluminium and crude oil exhibited the greatest trend variance. Copper and steel prices were forecast to remain relatively stable whist aluminium and crude oil prices were forecast to rise significantly compared to the historical trend.

Sinclair Knights Mertz report

Sinclair Knights Mertz (SKM, now Jacobs SKM) were commissioned by TransGrid to provide real material cost escalation indices in respect to the revenue reset for TransGrid recently undertaken by us.

SKM cautioned that there are a variety of factors that could cause business conditions and results to differ materially from what is contained in its forward looking statements.[270] This is consistent with our view that there are likely to be a significant number of material exogenous factors that impact on the cost of assets that are not captured by Jemena's capex forecast model.

SKM stated it used the Australian CPI to account for those materials or cost items for equipment whose price trend cannot be rationally or conclusively explained by the movement of commodities prices.[271]

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[267] CEG, *Escalation factors affecting expenditure forecasts*, December 2013, p. 19.

[268] CEG, *Escalation factors affecting expenditure forecasts*, December 2013, p. 23.

[269] CEG, *Escalation factors affecting expenditure forecasts*, December 2013, Figures 3, 4 and 5, pp. 23, 25 and 28.

[270] SKM, *TransGrid Commodity Price Escalation Forecast 2013/14 - 2018/19*, 9 December 2013, p. 4.

[271] SKM, *TransGrid Commodity Price Escalation Forecast 2013/14 - 2018/19*, 9 December 2013, p. 8.

In its modelling of the exchange rate, SKM has in part adopted the longer term historical average of $0.80 USD/AUD as the long term forecast going forward.[272] This is consistent with our view that longer term historical commodity prices should be considered when reviewing and forecasting future prices. In general, we consider that long term historical data has a greater number of observations and as a consequence is a more reliable predictor of future prices than a data time series of fewer observations.

SKM stated that the future price position from the LME futures contracts for copper and aluminium are only available for three years out to December 2016 and that in order to estimate prices beyond this data point, it is necessary to revert to economic forecasts as the most robust source of future price expectations.[273] SKM also stated that LME steel futures are still not yet sufficiently liquid to provide a robust price outlook.[274]

SKM stated that in respect to the reliability of oil future contracts as a predictor of actual oil prices, futures markets solely are not a reliable predictor or robust foundation for future price forecasts. SKM also stated that future oil contracts tend to follow the current spot price up and down, with a curve upwards or downwards reflecting current (short term) market sentiment.[275] SKM selected Consensus Economics forecasts as the best currently available outlook for oil prices throughout the duration of the next regulatory control period.[276] The decision by SKM to adopt an economic forecast for oil rather than using futures highlights the uncertainty surrounding the forecasting of commodity prices.

Comparison of independent expert's cost escalation factors

To illustrate the potential uncertainty in forecasting real material input costs, we have compared the material cost escalation forecasts derived by BIS Schrapnel and CEG as shown in Table 6.16 SKM did not provide its real materials escalation forecasts in calendar years so were excluded from this comparison.

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[272] SKM, *TransGrid Commodity Price Escalation Forecast 2013/14 - 2018/19*, 9 December 2013, p. 9.

[273] SKM, *TransGrid Commodity Price Escalation Forecast 2013/14 - 2018/19*, 9 December 2013, p. 12.

[274] SKM, *TransGrid Commodity Price Escalation Forecast 2013/14 - 2018/19*, 9 December 2013, p. 16.

[275] SKM, *TransGrid Commodity Price Escalation Forecast 2013/14 - 2018/19*, 9 December 2013, p. 18.

[276] SKM, *TransGrid Commodity Price Escalation Forecast 2013/14 - 2018/19*, 9 December 2013, p. 20.

Table 6.16   Real material input cost escalation forecasts (per cent)

	2015 (%)	2016 (%)	2017 (%)	2018 (%)	2019 (%)
Aluminium					
CEG	8.3	0.9	1.8	2.9	2.8
BIS Shrapnel	9.5	8.0	8.2	5.1	-7.0
Difference (%)	-12.6%	-88.8%	-78.0%	-43.1%	-140.0%
Copper					
CEG	-1.4	-1.5	-0.4	1.2	1.1
BIS Shrapnel	0.4	3.5	7.7	2.1	-10.0
Difference (%)	-450.0%	-142.9%	-105.2%	-42.9%	-111.0%
Steel					
CEG	-4.2	1.8	0.9	1.0	1.0
BIS Shrapnel1	4.8	4.7	3.0	2.7	-11.0
Difference (%)	-187.5%	-61.7%	-70.0%	-63.0%	-109.1%
Oil					
CEG	-9.0	1.2	1.0	0.9	1.0
BIS Shrapnel	-1.9	-1.1	4.3	2.5	-7.7
Difference (%)	373.7%	-209.1%	-76.7%	-64.0%	-113.0%

Source: CEG, Updated cost escalation factors, December 2014, pp. 6, 7, 9 and 10 and BIS Shrapnel, Real Labour and Material Cost Escalation Forecasts to 2019/20 - Australia and New South Wales, April 2014, p. iii. and BIS Shrapnel, Real Labour and Material Cost Escalation Forecasts to 2019/20 - Australia and New South Wales, April 2014, p. iii.

As shown, there is considerable variation between the two consultant's commodities escalation forecasts. The greatest margin of variation is 12.0 percentage points for steel in 2019, where CEG has forecast a real price increase of 1.0 per cent and BIS Shrapnel a real price decrease of 11.0 per cent. These forecast divergences between consultants further demonstrate the uncertainty in the modelling of material input cost escalators to reliably and accurately estimate the prices of intermediate outputs used by service providers to provide network services. This supports our view that Jemena's forecast real material cost escalators do not reasonably reflect a realistic expectation of the cost inputs required to achieve the capex objectives over the 2016–20 regulatory control period.[277]

D.6   Conclusions on materials cost escalation

We are not satisfied that Jemena has demonstrated that the weightings applied to the intermediate inputs have produced unbiased forecasts of the movement in the prices it expects to pay for its physical assets. In particular, Jemena has not provided sufficient

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[277]   NER, cl. 6.5.7(a).

evidence to show that the changes in the prices of the assets they purchase are highly correlated to changes in raw material inputs.

CEG, in its report to electricity distribution service providers, identified a number of factors which are consistent with our view that Jemena's capex forecast model has not demonstrated how and to what extent material inputs are likely to affect the cost of assets. BIS Schrapnel and CEG acknowledged that forecasts of general cost movements (e.g. CPI or producer price index) can be used to derive changes in the cost of other inputs used by electricity service providers or their suppliers separate from material inputs.[278] CEG stated that futures prices are unlikely to exactly predict future spot prices given that all manner of unexpected events can occur.[279] CEG also stated that while futures prices and forecasts today may well be a very precise estimate of current expectations of the future, they are at best an imprecise estimate of future values.[280]

Recent reviews of commodity price movements show mixed results for commodity price forecasts based on futures prices. Further, nominal exchange rates are in general extremely difficult to forecast and based on the economic literature of a review of exchange rate forecast models, a "no change" forecasting approach may be preferable.

It is our view that where we are not satisfied that a forecast of real cost escalation for materials is robust, and we cannot determine a robust alternative forecast, then real cost escalation should not be applied in determining a service provider's required capital expenditure. We accept that there is uncertainty in estimating real cost changes but we consider the degree of the potential inaccuracy of commodities forecasts is such that there should be no escalation for the price of input materials used by Jemena to provide network services.

In previous AER decisions, including our recent decisions for the New South Wales and ACT distribution networks as well as our decisions for Envestra's Queensland and South Australian gas networks, we took a similar approach. This was on the basis that as all of the New South Wales and ACT distribution businesses and Envestra's real costs are escalated annually by CPI under the PTRM and tariff variation mechanism respectively, CPI must inform the AER's underlying assumptions about energy service provider's overall input costs. Consistent with this, we applied zero real cost escalation and by default the New South Wales and ACT distribution businesses and Envestra's input costs were escalated by CPI in the absence of a viable and robust alternative. Likewise, for Jemena, we consider that in the absence of a well-founded materials cost escalation forecast, escalating real costs annually by the CPI is the better alternative that will contribute to a total forecast capex that reasonably reflects the capex criteria.

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278   Jemena, *Regulatory Proposal 2016—20: Attachment 8-8 BIS Schrapnel, Real Labour and Material Cost Escalation Forecasts to 2020 - Australia and Victoria*, November 2014, p. 43 and CEG, *Escalation factors affecting expenditure forecasts*, December 2013, p. 3.

279   CEG, *Escalation factors affecting expenditure forecasts*, December 2013, pp. 4–5.

280   CEG, *Escalation factors affecting expenditure forecasts*, December 2013, p. 13.

The CPI can be used to account for the cost items for equipment whose price trend cannot be conclusively explained by the movement of commodities prices. This approach is consistent with the revenue and pricing principles of the NEL which provide that a regulated network service provider should be provided with a reasonable opportunity to recover at least the efficient costs it incurs in providing direct control network services.[281]

D.7   Labour and construction escalators

Our approach to real materials cost escalation does not affect the application of labour and construction related cost escalators, which will continue to apply to standard control services capital and operating expenditure.

We consider that labour and construction related cost escalation reasonably reflects a realistic expectation of the cost inputs required to achieve the opex and capex objectives.[282] We consider that real labour and construction related cost escalators can be more reliably and robustly forecast than material input cost escalators, in part because these are not intermediate inputs and for labour escalators, productivity improvements have been factored into the analysis (refer to the opex attachment).

Further details on our consideration of labour cost escalators are discussed in Attachment 7.

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[281]   NEL, s. 7(2).
[282]   NER, cll. 6.5.6(c)(3) and 6.5.7(c)(3).

E   Predictive modelling approach and scenarios

This section provides a guide to our repex modelling process. It sets out:

- the background to the repex modelling techniques

- discussion of the data required to apply the repex model

- detail on how this data was specified

- description of how this data was collected and refined for inclusion in the repex model

- the outcomes of the repex model under various input scenarios

This supports the detailed and multifaceted reasoning outlined in appendix A.

E.1   Predictive modelling techniques

In late 2012 the AEMC published changes to the National Electricity and National Gas Rules.[283] In light of these rule changes the AER undertook a "Better Regulation" work program, which included publishing a series of guidelines setting out our approach to regulation under the new rules.[284]

The expenditure forecast assessment Guideline (Guideline) describes our approach, assessment techniques and information requirements for setting efficient expenditure allowances for distributors.[285] It lists predictive modelling as one of the assessment techniques we may employ when assessing a distributor's repex. We first developed and used our repex model in our 2009–10 review of the Victorian electricity DNSPs' 2011–15 regulatory proposals and have also used it subsequently.[286]

The technical underpinnings of the repex model are discussed in detail in the Replacement expenditure model handbook.[287] At a basic level, the model predicts the volume of a distributor's assets that may need to be replaced over each of the next 20 years. This prediction is made by looking at the age of assets already in commission, and the time at which, on average, these assets would be expected to be replaced. The unit cost of replacing the assets is used to provide an estimate of replacement expenditure. The data used in the model is derived from the distributor's regulatory information notice (RIN) responses and from the outcomes of the unit cost and

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[283]   AEMC, *Rule Determination, National Electricity Amendment (Economic Regulation of Network Service Providers) Rule 2012*, 29 November 2012.

[284]   See AER *Better regulation reform program* web page at http://www.aer.gov.au/Better-regulation-reform-program.

[285]   AER, *Expenditure Forecast Assessment Guideline for Electricity Distribution*, November 2013; AER, *Expenditure Forecast Assessment Guideline for Electricity Transmission*, November 2013.

[286]   AER Determinations for 2011–15 for CitiPower, Jemena, Powercor, SP AusNet, and United Energy.

[287]   AER, *Electricity network service providers: Replacement expenditure model handbook*, November 2013.

replacement life benchmarking across all distribution businesses in the NEM. These processes are described below.

E.2   Data specification process

Our repex model requires the following input data on a distributor's network assets:

- the age profile of network assets currently in commission

- expenditure and replacement volume data of network assets

- the mean and standard deviation of each asset's replacement life (replacement life).

Given our intention to apply unit cost and replacement life benchmarking techniques, we defined the model's input data around a series of prescribed network asset categories. We collected this information by issuing two types of RINs:

1. "Reset RINs" which we issued to distributors requiring them to submit this information with their upcoming regulatory proposal

2. "Category analysis RINs" which we issued to all distributors in the NEM.

The two types of RIN requested the same historical asset data for use in our repex modelling. The Reset RIN also collected data corresponding to the distributors proposed forecast repex over the 2016–20 regulatory control period. In both RINs, the templates relevant to repex are sheets 2.2 and 5.2.

For background, we note that in past determinations, our RINs did not specify standardised network asset subcategories for distributors to report against. Instead, we required the distributors to provide us data that adhered to broad network asset groups (e.g. poles, overhead conductors etc.). This allowed the distributor discretion as to how its assets were subcategorised within these groups. The limited prescription over asset types meant that drawing meaningful comparisons of unit costs and replacement lives across distributors was difficult.[288]

Our changed approach of adopting a standardised approach to network asset categories provides us with a dataset suitable for comparative analysis, and better equips us to assess the relative prices of capital inputs as required by the capex criteria.[289]

When we were formulating the standardised network assets, we aimed to differentiate the asset categorisations where material differences in unit cost and replacement life existed. Development of these asset subcategories involved extensive consultation

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[288]   The repex model has been applied in the Victorian 2011–15 and Aurora Energy 2012–17 distribution determinations; AER, *Electricity network service providers: Replacement expenditure model handbook*, November 2013.

[289]   NER, cl. 6.5.7(e)(6).

with stakeholders, including a series of workshops, bilateral meetings and submissions on data templates and draft RINs.[290]

E.3 Data collection and refinement

The new RINs represent a shift in the data reporting obligations on distributors. Given this is the first period in which the distributors have had to respond to the new RINs, we undertook regular consultation with the distributors. This consultation involved collaborative and iterative efforts to refine the datasets to better align the data with what we require to deploy our assessment techniques. We consider that the data refinement and consultation undertaken after the RINs were received, along with the extensive consultation carried out during the Better Regulation process, provide us with reasonable assurance of the data's quality for use in this part of our analysis.

To aid distributors, an extensive list of detailed definitions was included as an appendix to the RINs. Where possible, these definitions included examples to assist distributors in deciding whether costs or activities should be included or excluded from particular categories. We acknowledge that, regardless of how extensive and exhaustive these definitions are, they cannot cater for all possible circumstances. To some extent, distributors needed to apply discretion in providing data. In these instances, distributors were required to clearly document their interpretations and assumptions in a "basis of preparation" statement accompanying the RIN submission.

Following the initial submissions, we assessed the basis of preparation statements that accompanied the RINs to determine whether the data submitted complied with the RINs. We took into account the shift in data reporting obligations under the new RINs when assessing the submissions. Overall, we considered that the repex data provided by all distributors was compliant. We did find a number of instances where the distributors' interpretations did not accord with the requirements of the RIN but for the purpose of proceeding with our assessment of the proposals, these inconsistencies were not substantial enough for a finding of non-compliance with the NEL or NER requirements.[291]

Nonetheless, in order that our data was the most up to date and accurate, we did inform distributors, in detailed documentation, where the data they had provided was not entirely consistent with the RINs, and invited them to provide updated data. Refining the repex data was an iterative process, where distributors returned amended consolidated RIN templates until such time that the data submitted was fit for purpose.

E.4 Benchmarking repex asset data

As outlined above, we required the following data on distributors' assets for our repex modelling:

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[290] See AER *Expenditure forecast assessment guideline—Regulatory information notices for category analysis* webpage at http://www.aer.gov.au/node/21843.

[291] NER, cl. 6.9.1.

- age profile of network assets currently in commission

- expenditure, replacement volumes and failure data of network assets

- the mean and standard deviation of each asset's replacement life.

All NEM distributors provided this data in the Reset RINs and Category analysis RINs under standardised network asset categories.

To inform our expenditure assessment for the distributors currently undergoing revenue determinations,[292] we compared their data to the data from all NEM distributors. We did this by using the reported expenditure and replacement volume data to derive benchmark unit costs for the standardised network asset categories. We also derived benchmark replacement lives (the mean and standard deviation of each asset's replacement life) for the standardised network asset categories.

In this section we explain the data sets we constructed using all NEM distributors' data, and the benchmark unit costs and replacement lives we derived for the standardised network asset categories.

E.4.1 Benchmark data for each asset category

For each standardised network asset category where distributors provided data we constructed three sets of data from which we derived the following three sets of benchmarks:[293]

- benchmark unit costs

- benchmark means and standard deviations of each asset's replacement life (referred to as "uncalibrated replacement lives" to distinguish these from the next category)

- benchmark calibrated means and standard deviations of each asset's replacement life.

Our process for arriving at each of the benchmarks was as follows. We calculated a unit cost for each NEM distributor in each asset category in which it reported replacement expenditure and replacement volumes. To do this:

- We determined a unit cost for each distributor, in each year, for each category it reported under. To do this we divided the reported replacement expenditure by the reported replacement volume.

- Then we determined a single unit cost for each distributor for each category it reported under. We first inflated the unit costs in each year using the CPI index.[294]

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[292] Vic, SA and QLD distribution network service providers—AusNet Services, United Energy, Jemena, Powercor, CitiPower, SA Power Networks, Energex and Ergon Energy.

[293] We did not derive benchmark data for some standardised asset categories where no values were reported by any distributors, or for categories distributors created outside the standardised asset categories.

[294] We took into account whether the distributor reported on calendar or financial year basis.

We then calculated a single unit cost. We did this by first weighting the unit cost from each year by the replacement volume in that year. We then divided the total of these expenditures by the total replacement volume number.

We formulated two sets of replacement life data for each NEM distributor:

- The replacement life data all NEM distributors reported in their RINs.

- The replacement life data we derived using the repex model for each NEM distributor. These are also called calibrated replacement lives. The repex model derives the replacement lives that are implied by the observed replacement practices of a distributor. That is, the lives are based on the data a distributor reported in the RIN on its replacement expenditure and volumes over the most recent five years, and the age profile of its network assets currently in commission. In this way, they can be said to derive from the distributors observed replacement practices. The calibrated lives the repex model derives can differ from the replacement lives a distributor reports.

We derived the benchmarks for an asset category using each of the three data sets above. That is, we derived a set of benchmark unit costs, benchmark replacement lives, and benchmark calibrated replacement lives for an asset category. To differentiate the two sets of benchmarked replacement lives, we refer to the benchmarks based on the calibration process as 'benchmarked calibrated replacement lives' and those based on replacement lives reported by the NEM distributors as 'benchmarked uncalibrated replacement lives'. We applied the method outlined below to each of the three data sets.

We first excluded Ausgrid's data, since it reported replacement expenditure values as direct costs and overheads. Therefore these expenditures were not comparable to all other NEM distributors which reported replacement expenditure as direct costs only. We then excluded outliers by:[295]

- calculating the average of all values for an asset category

- determining the standard deviation of all values for an asset category

- excluding values that were outside plus or minus one standard deviation from the average.

Using the data set excluding outliers we then determined the:

- Average value:

  o benchmark average unit cost

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[295] For the benchmarked calibrated replacement lives we performed two additional steps on the data prior to this. We excluded any means where the distributor did not report corresponding replacement expenditure. This was because zero volumes led to the repex model deriving a large calibrated mean which may not reflect industry practice and may distort the benchmark observation. We also excluded any calibrated mean replacement lives above 90 years. Although the repex model can generate these large lives, observations of more than 90 years exceed the number of years reportable in the asset age profile.

- o benchmark average mean and standard deviation replacement life
- o benchmark average calibrated mean and standard deviation replacement life.

- One quartile better than the average value:
  - o benchmark first quartile unit cost (below the mean)
  - o benchmark third quartile uncalibrated mean replacement life (above the mean)
  - o benchmark third quartile calibrated mean replacement life (above the mean).

- 'Best' value:
  - o benchmark best (lowest) unit cost
  - o benchmark best (highest) uncalibrated mean replacement life
  - o benchmark best (highest) calibrated mean replacement life.[296]

E.5   Repex model scenarios

As noted above, our repex model uses an asset age profile, expected replacement life information and the unit cost of replacing assets to develop an estimate of replacement volume and expenditure over a 20 year period.

The asset age profile data provided by the distributors is a fixed piece of data. That is, it is set, and not open to interpretation or subject to scenario testing.[297] However, we have multiple data sources for replacement lives and unit costs, being the data provided by the distributors, data that can be derived from their performance over the last five years, and benchmark data from all distributors across the NEM. The range of different inputs allows us to run the model under a number of different scenarios, and develop a range of outcomes to assist in our decision making.

We have categorised three broad input scenarios under which the repex model may be run. These are explained in greater detail within our Replacement expenditure model handbook.[298] They are:

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[296] We did not determine quartile or best values for the uncalibrated standard deviation and calibrated standard deviation replacement lives. This is because we used the benchmark average replacement lives (mean and standard derivation) for comparative analysis between the distributors. However, the benchmark quartile and best replacement life data was for use in the repex model sensitivity analysis. The repex model only requires the mean component of an asset's replacement life as an input. The repex model then assumes the standard deviation replacement life of an asset is the square root of the mean replacement life. The use of a square root for the standard deviation is explained in more detail in our Replacement expenditure model handbook; AER, *Electricity network service providers: Replacement expenditure model handbook*, November 2013.

[297] It has been necessary for some distributors to make assumptions on the asset age profile to remove double counting. This is detailed at the end of this appendix.

[298] AER, *Electricity network service providers: Replacement expenditure model handbook*, November 2013.

(1) The Base scenario – the base scenario uses inputs provided by the distributor in their RIN response. Each distributor provided average replacement life data as part of this response. As the distributors did not explicitly provide an estimate of their unit cost, we have used the observed historical unit cost from the last five years and the forecast unit cost from the upcoming regulatory control period in the base scenario.

(2) The Calibrated scenario – the process of "calibrating" the expected replacement lives in the repex model is described in the AER's replacement expenditure handbook.[299] The calibration involves deriving a replacement life and standard deviation that matches the distributor's recent historical replacement practices (in this case, the five years from 2011 to 2015). The calibrated scenario benchmarks the business to its own observed historical replacement practices.

(3) The Benchmarked scenarios – the benchmarked scenarios use unit cost and replacement life inputs from the category analysis benchmarks. These represent the observed costs and replacement behaviour from distributors across the NEM. As noted above, we have made observations for an "average", "first or third quartile" and "best performer" for each repex category, so there is no single "benchmarked" scenario, but a series of scenarios giving a range of different outputs.

The model can also take into account different wooden pole staking/stobie pole plating rate assumptions (see section E.3 for more information on this process). For the Victorian distributors, who exhibit high wooden pole staking rates relative to the rest of the NEM, we have not chosen to test different staking scenarios. A full list of the scenario outcomes is provided in Table 6.17and Table 6.18 below.

Table 6.17 Repex model outputs – replacement lives

Replacement lives	
Base case (RIN)	$1.83 billion
Calibrated lives	$184 million
Benchmarked calibrated average	$257 million
Benchmarked calibrated third quartile	$169 million
Benchmarked calibrated best	$110 million

Source: AER analysis, using historic unit costs.

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[299] AER, *Electricity network service providers: Replacement expenditure model handbook*, November 2013, pp. 20–21.

Table 6.18   Repex model outputs − unit costs

Unit cost	
Benchmarked average	$193 million
Benchmarked first quartile	$99 million
Benchmarked best	$79 million

Source: AER analysis, using calibrated replacement lives.

Data assumptions

Certain data points were not available for use in the model. For unit costs, this arose either because the distributor did not incur any expenditure on an asset category in the 2011–15 regulatory control period (used to derive historical unit costs) or had not proposed any expenditure in the 2016–20 regulatory control period (used to derive forecast unit costs). If both these inputs were not available, we used the benchmarked average unit cost as a substitute input.

In addition, we did not use a calibrated asset replacement life where the distributor did not replace any assets during the 2011−15 regulatory control period. This is because the calibration process relies on replacement volumes over the five year period to derive a mean and standard deviation, and using a value of zero may not be appropriate for this purpose. In the first instance, we substituted these values with the average calibrated replacement life of the broad asset group to which the asset subcategory belonged. Where this was not available, we used the benchmarked calibrated replacement life or the base case replacement life from the distributor.

While the majority of the data was provided in a form suitable for modelling, limited adjustments needed to be made for some of the data. For Jemena we converted their historic replacement volumes for underground cables and overhead conductors from metres to kilometres to match its forecast reporting.

Un-modelled repex

As detailed in the AER's repex handbook, the repex model is most suitable for asset categories and groups with a moderate to large asset population of relatively homogenous assets. It is less suitable for assets with small populations or those that are relatively heterogeneous. For this reason, we chose to exclude certain data (or asset categories) from the modelling process, and did not use predictive modelling to directly assess these categories. However, where suitable data was available, we used predictive modelling to test our other findings on these categories. We decided to exclude SCADA repex from the model for this reason. Expenditure on pole top structures was also excluded, as it is related to expenditure on overall pole

replacement and modelling may result in double counting of replacement volumes. Other excluded categories are detailed in appendix E.3 of this preliminary decision.[300]

E.6 The treatment of staked wooden poles

The staking of a wooden pole is the practice of attaching a metal support structure (a stake or bracket) to reinforce an aged wooden pole.[301] The practice has been adopted by distributors as a low-cost option to extend the life of a wooden pole. These assets require special consideration in the repex model because, unlike most other asset types, they are not installed or replaced on a like for like basis. To understand why this requires special treatment, we have described below the normal like-for-like assumption used in the repex model, why staked poles do not fit well within this assumption, and how we adapt the model inputs to take account of this.

E.6.1 Like-for-like repex modelling

Replacement expenditure is normally considered to be on a like-for-like basis. When an asset is identified for replacement, it is assumed that the asset will be replaced with its modern equivalent, and not a different asset. For example, conductor rated to carry low voltage will be replaced with conductor of the same rating, not conductor rated for high voltage purposes.

The repex model predicts the volume of old assets that need to be replaced, not the volume of new assets that need to be installed. This is simple to deal with when an asset is replaced on a like-for-like basis – the old asset is simply replaced by a new asset of the same kind. It follows that the volume of assets that needs to be replaced where like-for-like replacement is appropriate match the volume of new assets to be installed. The cost of replacing the volume of retired assets is the unit cost of the new asset multiplied by the volume of assets that need to be replaced.

E.6.2 Non-like-for-like replacement

Where old assets are commonly replaced with a different asset, we cannot simply assume the cost of the new asset will match the cost of the old asset's modern equivalent. As the repex model predicts the number of old assets that need to be replaced, it is necessary to make allowances for the cost of a different asset in determining the replacement cost. In running the repex model, the only category where this was significant was wooden poles.

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[300] For AusNet Services, we ran a limited set of modelling scenarios on SCADA and other repex, as suitable data was available. This was used to test the findings from our other techniques. For Powercor, we ran limited scenarios on pole top structures to test the findings from our other techniques. For each of these, we relied more on other assessment techniques, as detailed in Appendix A.

[301] The equivalent practice for stobie poles is known as "plating", which similarly provides a low cost life extension. SA Power Networks carries out this process. We applied the same process for modelling SA Power Networks' stobie pole plating data as we have for staked wooden poles. However, for simplicity, this section only refers to the staking process.

Staked and unstaked wooden poles

The life of a wooden pole may be extended by installing a metal stake to reinforce its base. Staked wooden poles are treated as a different asset in the repex model to unstaked poles. This is because staked and unstaked poles have different expected lives and different costs of replacement.

When a wooden pole needs to be replaced, it will either be staked or replaced with a new pole. The decision on which replacement type will be carried out is made by determining whether the stake will be effective in extending the pole's life, and is usually based on the condition of the pole base. If the wood at the base has deteriorated too far, staking will not be effective, and the pole will need to be replaced. If there is enough sound wood to hold the stake, the life of the pole can be extended, and a stake can be installed. Consequently, there are two possible asset replacements (and two associated unit costs) that may be made by the distributor – a new pole to replace the old one or nailing a stake to the old pole.

The other non-like-for-like scenario related to staking is where an in-commission staked pole needs to be replaced. Staking is a one-off process. When a staked pole needs to be replaced, a new pole must be installed in its place. The cost of replacing an in-commission staked pole is the cost of a new pole.

Unit cost blending

We use a process of unit cost blending to account for the non-like-for-like asset categories.

For unstaked wooden poles that need to be replaced, there are two appropriate unit costs: the cost of a new pole; and the cost of staking an old pole. We have used a weighted average between the unit cost of staking and the unit cost of pole replacement to arrive at a blended unit cost.[302] We ran the model under a variety of different weightings – including the observed staking rate of the business and observed best practice from the distributors in the NEM.

For the Victorian distributors, we adopted their own observed staking ratio.

For staked wooden poles being replaced, in the first instance, we used historical data from the distributors on the proportion of different voltage staked wooden poles being replaced to approximate the volume of each new asset going forward.[303] The unit cost of replacing a staked wooden pole is a weighted average based on the historical proportion of pole types replaced. Where historical data was not available, we used the

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[302]   For example, if a distributor replaces a pole with a new pole 50 per cent of the time, and stakes the pole the other 50 per cent of the time, the blended unit cost would be a straight average of the two unit costs. If the mix was 60:40, the unit cost would be weighted accordingly.

[303]   Poles with different maximum voltages have different unit costs. An assumption needs to be made to determine, for example, how many new ">1kv poles" and how many new "1kv-11kv" need to be installed to replace the staked wooden poles.

asset age data to determine what proportion of the network each pole category represented, and used this information to weight the unit costs.

E.7   Calibrating staked wooden poles

Special consideration also has to be given to staked wooden poles when determining calibrated replacement lives. This is because historical volumes of replacements are used in calibration. The RIN responses provide us with information on the volume of new assets installed over the last five years. However, the model predicts the volume of old assets being replaced. Since the replacement of staked poles is not on a like-for-like basis, we make an adjustment for the calibration process to function correctly. That is, we need to know the number of staked poles that reach the end of their economic life so we can calibrate the model for when these assets are replaced. The category analysis RIN currently only provides us with information on how many new stakings have taken place, rather than how many were actually replaced. We sought, and were provided with this information directly from the distributors.