Review of Victorian Distribution Network Service Provider's Initial Replacement Capex Proposals 2016-2020

Prepared for the

Australian Energy Regulator

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Executive Summary

On 30 April 2015, Jemena (JEM), United Energy Distribution (UED), AusNet Services (ANS), Citipower (CIT) and PowerCor (PCR) lodged their 2016-2020 Regulatory Proposals totalling $2.91 billion in replacement capital expenditure (repex) in undiscounted nominal terms[1].

The Australian Energy Regulator (AER) engaged Energeia Pty Ltd (Energeia) to undertake a top-down, qualitative review of the repex proposed in the Victorian Distribution Network Service Provider's (DNSPs) 2016-2020 against the capex objectives and criteria as required under the National Electricity Rules (NER).

Review Scope

Energeia's top-down review has covered DNSP's proposed repex for maintaining safety and reliability, and for asset categories included in the provided AER repex modelling reports. Energeia has at times focused its analysis on a sub-set of representative asset categories for manageability.

Out of scope asset categories included $463.8 million of repex categorised as 'other', which is in our view is a significant issue for the AER to examine in greater detail given its overall share of the total. Also out of scope was repex proposed for complying with the agreed Victorian Bushfire Royal Commission (VBRC) recommendations, replacement zone substations, secondary systems, and street lighting.

Review Approach

Energeia's overall approach to assessing whether the proposed repex complied with the NER capex objectives and criteria was to develop an appropriate technical assessment framework for whether it was in-scope, reflected a realistic forecast of future volumes and prices, and was reasonably efficient and prudent.

Energeia developed its technical assessment framework based on the following review methodology:

- Review DNSP modelling of future reliability, safety, power quality, and security performance gaps relative to requirements, including the model's key inputs, assumptions and estimates;
- Review DNSP modelling of investment inputs (repex) to outputs (i.e. Key Performance Indicators [KPIs]), including the model's key inputs, assumptions and estimates; and
- Identify any issues with DNSP repex objectives' target setting, volume or price forecasting or efficiency and undertake independent research and analysis where appropriate to inform our view.

Energeia's top-down assessment framework was refined over the course of the engagement based on the availability of data across the DNSPs, its ability to qualitatively identify risks and issues to the AER, and constructive feedback received from DNSPs and the AER regarding our approach.

Information Gathering and Validation Approach

Where DNSP's Regulatory Proposals did not appear to contain sufficient information for Energeia to apply our technical assessment framework, Energeia developed questions to address our information gaps.

Two rounds of questions were issued to DNSPs, with a request to respond within five business days due to tight project timeframes. The second RFI targeted more granular information and areas to make the data more comparable across the DNSPs.

Two meetings were held with the DNSPs to discuss the RFIs, our assessment framework and approach, and ultimately our findings and conclusions. The first meeting was held via a teleconference, while the second meeting was held in person at each DNSP's offices. The AER attended each meeting.

[1] All summed expenditure in this report will be in undiscounted nominal terms unless otherwise state.

Energeia acknowledges the pressure this process and the RFIs put on each DNSP, and would like to thank their regulatory managers in particular for their understanding, support and cooperation.

Review Findings and Conclusions

Overall, Energeia found the Victorian DNSPs to have proposed repex programs that were largely in keeping with current levels of volumes, prices and overall efficiency, which were on average more than 50% higher than the prudent and efficient levels approved by the AER, excluding bushfire expenditure.

There was one case identified where proposed expenditure may be better categorised as augex (UED's distribution automation project), and one case where a higher than maintain level of performance was being explicitly targeted (ANS 20% safety improvement). That being said, Energeia remains of the view that further efficiencies are possible, mainly in the optimisation of investment triggers and replacement mix and timing.

Table 1 presents our assessment of each DNSP's performance against our top-down technical assessment framework. The basis for our assessment is explained in section 4.3.

Table 1 – Summary of Qualitative Repex Review Findings and Conclusions

	UED	JEN	CIT	ANS	PCR
In-Scope Expenditure?	✓	✓	✓	✓	✓
Repex to KPI Data?	✓	✓	✓	✓	✓
Improves Performance?	Automation	✓	✓	Safety	✓
Realistic Forecast Volumes and Prices?	✓	✓	✓	✓	✓
Trending Gap at Existing Repex Level?	SAIFI	No Gap	No Gap	No Gap	No Gap
Industry Standard Volume Projection?	✓	✓	✓	?	✓
Period on Period Price Change?	✓	✓	✓	✓	✓
Reasonably Efficient?	✓	✓	✓	✓	✓
Efficient Repex KPIs?	SAIDI, Failures	✓	Leading	✓	Leading
Efficient Replacement Rates?	✓	✓	✓	?	✓
Efficient Replacement Prices?	✓	✓	✓	✓	✓
Efficient Replacement Mix?	?	?	?	?	?

✓ = Limited or no risks/issues identified ✓ = Significant risks/issues identified ✓ = Substantial risks/issues identified

? = Unable to assess due to lack of information, high risk issue

Source: Energeia

In-scope Expenditure

Energeia's findings related to whether the proposed repex includes any out of scope[2] expenditure found the issues identified above with UED and ANS categorisation and targets, respectively, as well as issues with CIT/PCR's accounting for their repex in terms of the capex objectives. JEN, CIT and PCR's Asset Management System (AMS) reporting capability was found to be not as capable as ANS or UEDs, but we are of the view that these systems are able to relate repex to the capex objectives with additional effort and time.

Based on these findings, Energeia concluded that JEN and UED's proposal were the only ones without a substantial risk of including out-of-scope expenditure. In our view CIT/PCR's reporting gaps were likely due to the timeframes allowed, but the AER should follow-up this issue with CIT/PCR if possible to ensure all proposed expenditure is able to be accounted for in terms of the NER's capex objectives and the AER's repex definition. ANS has included repex to improve its safety performance above levels recommended by the VBRC, previously approved by the AER and/or funded by Victorian government.

[2] In or out of scope is with respect to the AER's definition of repex and the NER's capex objectives unless otherwise identified as with respect to the project.

Realistic Volume and Unit Pricing Forecast

Energeia's findings related to whether the proposed repex is based on realistic forecasts of future volumes and prices found that UED, JEN, CIT and PCR's forecast volumes were realistic due to their being validated against an industry standard projection model. We found that JEN, CIT and PCR's unit price forecasts were consistent with current expenditure trends and therefore realistic projections on average.[3]

Energeia found that UED and JEN both exhibited declining performance trends, which may merit a higher rate of baseline replacement, and/or more accurate replacement targeting.

The exceptions to the above findings was ANS volume forecast, which did not provide an industry standard quantitative model projecting its repex, and UED and ANS' unit price forecasts, which appear to be substantially and significantly higher than current prices, respectively. In the case of UED, Energeia investigated the basis of UED's forecasts and found them to be comparable to JEN's on average, their closest comparator distribution network, and therefore realistic (but not necessarily efficient or prudent).

Based on these findings, Energeia could not reach a conclusion regarding whether ANS's forecast volumes or unit prices were realistic, and recommends that the AER investigate both forecasts further. While we believe that UED's forecast prices are realistic on average based on our comparison of the pricing of key asset categories against their closest comparator network, JEN, this does not mean that they are necessarily prudent or efficient, which is assessed below.

Prudent and Efficient Expenditure

Energeia expects a prudent and efficient DNSP to be able to provide a ranked list of potential investments at the driver objective level (e.g. safety and reliability) each with an estimated impact to safety and reliability, and peer leading levels of sustainable asset replacement and unit prices.

Energeia's review of whether proposed repex was reasonably prudent and efficient found significant issues with the demonstrated efficiency and prudency of each DNSP. Importantly, none of the DNSPs appear capable of efficiently optimising their safety expenditure to maximise safety performance at least cost. There was also significant variation in unit prices for similar assets, suggesting differences in relative efficiency.

All DNSPs other than CIT/PCR included leading and lagging indicators, and considered the risks contributing to as well as stemming from, asset failures. UED's focus on SAIDI as its key reliability metric driving its repex left the door open to driving up the more direct repex KPI of SAIFI above the level necessary for compliance.

Our assessment of calibrated asset lifetimes via the replacement rate methodology found that the Victorian DNSP's proposed repex generally reflected a higher level of efficiency from an asset lifetime extension point of view than the accounting or expert estimates provided in their Regulatory Information Notices (RINs).

The key capability gap Energeia identified in our review of Victorian DNSP's repex efficiency was the lack of an awareness or ability to trade-off equivalent safety risks across assets to arrive at a lowest average cost for a given level or performance, or more desirably, a higher level of safety for the same cost.

Based on these findings, Energeia was unable to conclude that DNSP's proposed repex were prudent and efficient, due to the multiple efficiency issues and/or risks identified.

[3] Importantly, realistic volume and price forecasts do not imply prudent and efficient repex forecasts. If current repex is inefficient, and is the basis of the projection, then future volumes and prices will also be inefficient.

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1 Disclaimer

While all due care has been taken in the preparation of this report, in reaching its conclusions Energeia has relied upon guidance from the Australian Energy Regulator (AER) and information provided by the Distribution Network Service Providers (DNSPs), including third party consultants. To the extent these reliances have been made, Energeia does not guarantee nor warrant the accuracy of this report. Furthermore, neither Energeia nor its Directors or employees will accept liability for any losses related to this report arising from these reliances. While this report may be made available to the public, no third party should use or rely on the report for any purpose.

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2 Background

The National Electricity Rules (NER) require the Australian Energy Regulator (AER) to make a draft 2016-2020 revenue determination regarding Victorian Distribution Network Service Providers' (DNSP's) Regulatory Proposals. As part of the NER specified process for making the determination, the AER is required to establish that the capex and opex forecasts provided by each distribution business comply with the requirements of the NER, particularly chapter 6.

The AER has outlined its planned approach to assessing the Victorian DNSP's capex and opex proposals against the NER in its capex and opex assessment guidelines[4] and framework and approach document[5]. As part of its assessment, the AER has stated that it will undertake top-down and bottom up assessments including methodology, governance and policy reviews, broad and category specific benchmarking, trend analysis, predictive modelling, cost benefit analysis and detailed project reviews, among other things.[6]

[4] AER, Expenditure Forecast Assessment Guideline for Electricity Distribution, November 2013: http://www.aer.gov.au/sites/default/files/Expenditure%20Forecast%20Assessment%20Guideline%20-%20Distribution%20-%20FINAL.pdf

[5] AER, Final Framework and Approach for the Victorian Electricity Distributors: Regulatory Control Period Commencing 1 January 2016, October 2014: http://www.aer.gov.au/sites/default/files/AER%20Victorian%20-%20final%20Framework%20and%20Approach_5.DOCX

[6] AER, Expenditure Forecast Assessment Guideline for Electricity Distribution, November 2013 , p.6-10 : http://www.aer.gov.au/sites/default/files/Expenditure%20Forecast%20Assessment%20Guideline%20-%20Distribution%20-%20FINAL.pdf

3 Overview

The AER engaged Energeia Pty Ltd (Energeia) to undertake a limited, six week review of Victorian DNSPs' replacement expenditure (repex) according to the following brief:

- Does the proposed replacement expenditure (repex) achieve or exceed the NER's capex objectives?
- How does the proposed repex and volumes meet the NER's capex objectives in regards to:
    - Maintaining the quality, reliability and security of supply
    - Maintaining the reliability and security of the distribution system
    - Maintaining the safety of the distribution system.
- To form the final advice, the AER advises the consultant examine:
    - Forecast repex and associated replacement volumes
    - Historical repex and associated replacement volumes
    - Any exogenous factors relevant to the forecast or historical repex
- Historical performance in relation to demand for Standard Control Services (SCS), quality, reliability and security of supply and the distribution system

In initial discussions with the AER they confirmed that Energeia's was not required to develop quantified estimates, rather a qualitative assessment was sought. The AER also clarified that assessing the expenditure against the NER's capex criteria was in-scope. Given the timeframe and budget constraints, a top down approach to the assessment focusing on the major repex categories of expenditure was agreed.

Energeia focused on applying the NER's capex objectives and criteria to a key set of proposed repex categories, working closely with the AER and DSNPs to resolve information gaps as they were identified. Energeia's review considered a number of spreadsheets and numerous key documents totalling thousands of pages provided by DNSPs in support of their proposals and responses to our two formal Requests for Information (RFIs) notifications and meetings.

This report documents the approach and outcomes of Energeia's review of DNSP 2016-2020 repex proposals against the AER's requirements.

4 Review Scope and Approach

Energeia's top-down review has covered DNSP's proposals to the degree their repex has been driven by safety and reliability, and for asset categories included in the provided AER repex modelling reports. Energeia focused its analysis on a sub-set of representative asset categories at times for manageability.

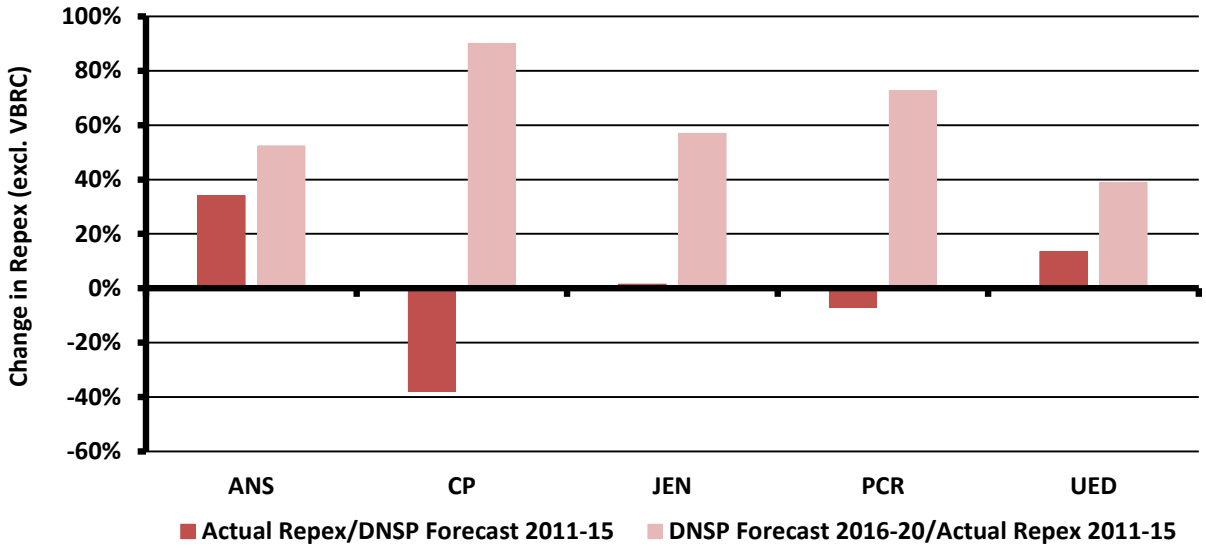
Out of scope asset categories included $463.8 million of repex categorised as 'other', which is in our view is a significant issue for the AER to examine in greater detail given its overall share of the total.[7] Also out of scope was repex proposed for complying with the agreed Victorian Bushfire Royal Commission (VBRC) recommendations, replacement zone substations, secondary systems, and street lighting.

The following sections detail our in-scope expenditure asset categories and sub-categories, regulatory framework and key interpretations, and our technical assessment framework.

4.1 Expenditure Categories

The AER is seeking to understand whether DNSP's proposed repex is going to maintain existing safety, reliability, security and power quality service levels or potentially exceed them. As shown in Figure 1, DNSPs are on average asking for around 58% more repex to meet targets that have not changed, giving rise to the AER's question of whether current spending levels are failing to maintain performance levels, requiring an increase, and/or whether the key drivers of repex are reasonably expected to increase by this amount.

Figure 1 – Period on Period Growth in Replacement Expenditure



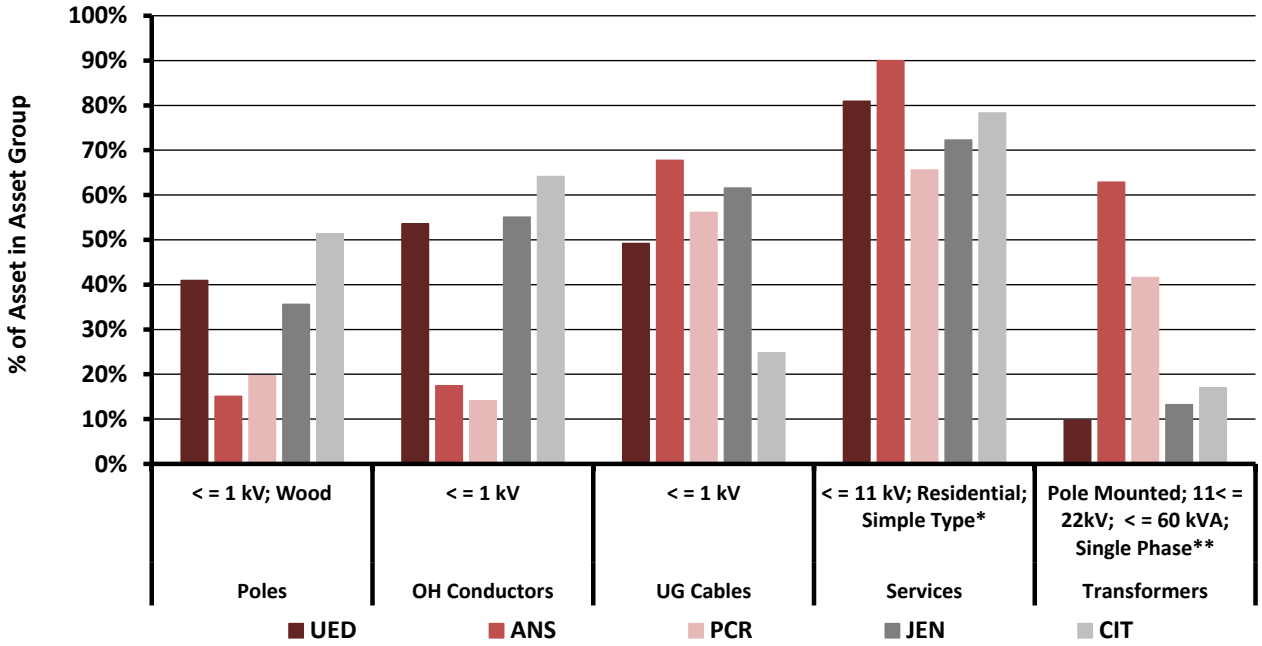
Source: DNSP Regulatory Proposals

In order to answer these questions given the limited timeframe and budget, Energeia developed an efficient top-down, risk based review approach that focused on the most representative sub-classes of asset categories, representing 66-80% of their respective class. Figure 2 displays the representativeness of the selected asset sub-categories as measured by their share of total asset numbers in the category.[8]

[7] In or out of scope is with respect to the AER's definition of repex and the capex objectives unless otherwise identified as with respect to the project.

[8] Not all sub-categories were the largest for each DNSP, but they were found to be the largest on average across all DNSPs.

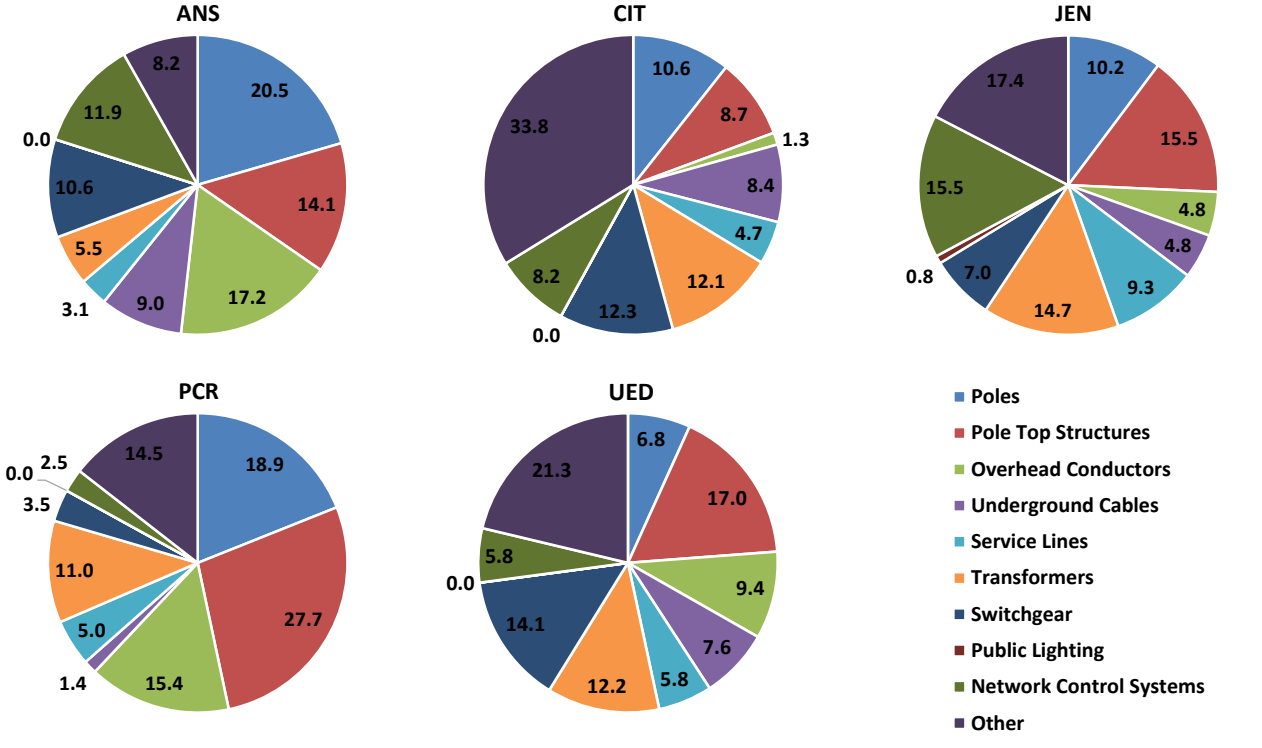
Figure 2 – Representativeness of Asset Sub-Categories Examined



Notes: *LV OH Service Cable for PCR and CIT for 2011-13; **Pole Mounted; < = 22kV; > 60 kVA; < = 600 kVA; Multiple Phase for CIT and POLE MOUNTED; > 11kV and < = 22kV; < = 60 kVA; Single Phase for UED. Source: DNSP 2009-13 RIN Category Analysis

DNSP proposed repex is displayed by asset category in Figure 3. This figure shows that the asset categories examined by Energeia as part of its review represent between 54%-80% of all proposed repex. The main categories of repex not included are other and secondary systems. Public lighting is also excluded from our analysis, however it represents only a tiny fraction of JEN and PCR's proposals.

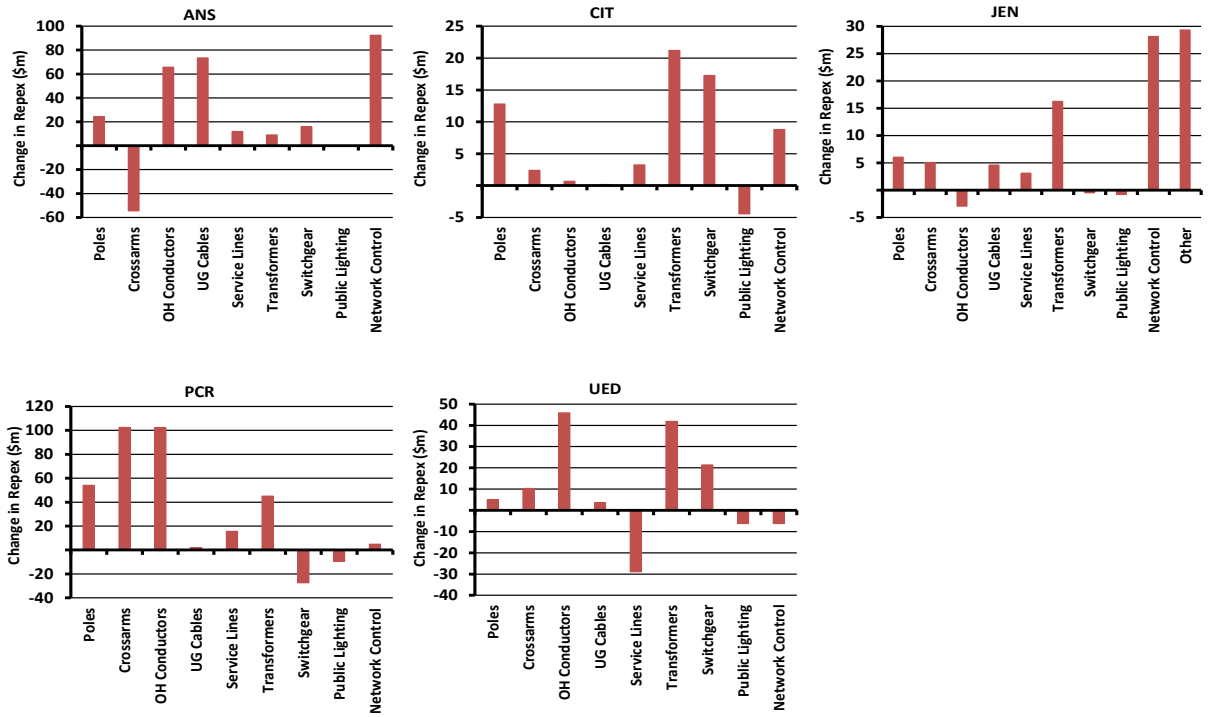
Figure 3 – Proposed Share of Replacement Expenditure by Asset Category



Source: DNSP Regulatory Proposals

Importantly, Figure 4 demonstrates that these asset categories also include the majority of the period on period increase in spending. Most of the additional expenditure being proposed by the Victorian DNSPs is to replace poles, pole top structures, overhead conductors and transformers. There is also significant period on period growth in the other category, which is the largest category for CIT and UED.

Figure 4 – Rate of Period on Period Growth by Asset Category



Source: DNSP Regulatory Proposals

The exception to the general rule is ANS's and JEN's significant increase in their period on period expenditure on their network control systems, which the AER should take a closer look at given their proportionality of expenditure relative to the other DNSPs.

4.2 Regulatory Requirements

The AER's questions to Energeia were designed to inform their decision making regarding whether the proposed repex met the NER requirements. Energeia's approach to developing our response has therefore taken the key regulatory requirements that must be met under the NER for the AER to approve the proposed repex into account. The AER clarified this included the Capex Criteria during the project.[9]

The following sections outline the scope of key regulatory requirements that Energeia's approach addressed, and Energeia's interpretation of them where potential issues were identified.

[9] Telephone call between Energeia and AER on 29/7/15, 10:00am AEST.

4.2.1 The National Electricity Rules

The National Electricity Rules (the NER) govern how the Australian Energy Regulator (AER) makes a revenue determination for electricity distribution networks.[10] The Rules were last updated in August 2015.

The main rules governing the AER's assessment of repex are found in sections 6.5.7(a) and 6.5.7(c) of Chapter 6 of the NER and referred to as the Capex Objectives and Capex Criteria, respectively.[11]

> ***6.5.7 Forecast capital expenditure***
>
> *(a) A building block proposal must include the total forecast capital expenditure for the relevant regulatory control period which the Distribution Network Service Provider considers is required in order to achieve each of the following (the capital expenditure objectives):*
>
> *(1) meet or manage the expected demand for standard control services over that period;*
>
> *(2) comply with all applicable regulatory obligations or requirements associated with the provision of standard control services;*
>
> *(3) to the extent that there is no applicable regulatory obligation or requirement in relation to:*
>
> *(i) the quality, reliability or security of supply of standard control services; or*
>
> *(ii) the reliability or security of the distribution system through the supply of standard control services, to the relevant extent:*
>
> *(iii) maintain the quality, reliability and security of supply of standard control services; and*
>
> *(iv) maintain the reliability and security of the distribution system through the supply of standard control services; and*
>
> *(4) maintain the safety of the distribution system through the supply of standard control services.*
>
> *(c) The AER must accept the forecast of required capital expenditure of a Distribution Network Service Provider that is included in a building block proposal if the AER is satisfied that the total of the forecast capital expenditure for the regulatory control period reasonably reflects each of the following (the capital expenditure criteria):*
>
> *(1) the efficient costs of achieving the capital expenditure objectives;*
>
> *(2) the costs that a prudent operator would require to achieve the capital expenditure objectives; and*
>
> *(3) a realistic expectation of the demand forecast and cost inputs required to achieve the capital expenditure objectives.*

[10] Australian Energy Market Commission, National Electricity Rules v 73, August 2015: http://www.aemc.gov.au/energy-rules/national-electricity-rules/current-rules

[11] AEMC, National Electricity Rule Version 73, August 2015, p.669-670: http://www.aemc.gov.au/getattachment/ff018221-b609-4eb8-a67d-68bb07655e6e/National-Electricity-Rules-Version-73.aspx

The NER's Capex Objectives and Capex Criteria point to the Victorian Distribution Code and Electricity Safety (Management) regulations (see Section 4.2.2), which in turn points to the Service Target Performance Incentive Scheme (STPIS) rules set out in Section 3.2.1 for reliability target setting: [12]

> ***3.2.1 Performance targets***
>
> *(a) The performance targets must be based on average performance over the past five financial years or other measurement period as described in clause 2.4(a) as appropriate, modified by the following:*
>
> > *(1) any reliability improvements completed or planned where the planned reliability improvements are:*
> >
> > > *(i) included in the expenditure program proposed by the DNSP in its regulatory proposal, or*
> > >
> > > *(ii) proposed by the DNSP, and the cost of the improvements is allowed by the relevant regulator, in the DNSP's previous regulatory proposal or regulatory submission, and*
> > >
> > > *(iii) expected to result in a material improvement in supply reliability.*
> >
> > *(1A) an adjustment to correct for the revenue at risk, that is the sum of the s-factors for all parameters, to the extent it does not lie between the upper limit and the lower limit in accordance with clause 2.5(a).*
> >
> > *(2) any other factors that are expected to materially affect network reliability performance.*
>
> *(b) Where a DNSP proposes a performance target modified in accordance with clause 3.2.1(a), the DNSP must provide in writing an explanation of how the modified performance target has been calculated.*
>
> *(c) Where five financial years of data is not available the AER may approve a performance target based on an alternative methodology or benchmark where the AER is satisfied that the performance target meets the objectives set out in clause 1.5.*

The VBRC recommendations led to the establishment of the AER's fire incentive framework (F-factor), which is being applied over the 2012-2015 period. Like the STPIS framework, the F-factor effectively sets the KPIs and targets for fire safety for the Victorian DNSPs as being the level funded by the price determination. [13]

Table 2 displays the F-factor scheme targets applying over the current period.

Table 2 – AER F-Factor Scheme Final Determination Targets 2012-15

	CIT	JEN	PCR	ANS	UED
Fire Starts Target	30.4	56.8	401.8	256.8	124.2

Source: AER

[12] AER, Electricity Distribution Network Service Providers Service Target Performance Incentive Scheme, May 2009: https://www.aer.gov.au/sites/default/files/Appendix%20C%20-%20Amended%20distribution%20STPIS%20-%2015%20May%202009.pdf

[13] AER, Final Determinations and Explanatory Statement: F-Factor Scheme Determinations 2012-2015 for Victorian Electricity Distribution Network Service Providers, December 2011 http://www.aer.gov.au/sites/default/files/Final%20decision%20-%20F-factor%20scheme%20determinations.pdf

4.2.2 Victorian Distribution Code

The Victorian Electricity Distribution Code (the Code) covers requirements for DNSP's asset management plans, along with the standards for quality of supply, reliability of supply and other areas such as guaranteed service levels that a VIC DNSP must adhere to. The Code is regulated by the Essential Services Commission (ESC), Victoria's Independent Economic Regulator of Essential Services, and was last updated in 2012.[14]

The key sections of the Victorian Distribution Code with respect to Energeia's review of DNSP's proposed repex include 3.1, 5.1.1 and 5.2, which are set out below:[15]

> ***3.1 Good asset management***
>
> *A distributor must use best endeavours to:*
>
> *(a) assess and record the nature, location, condition and performance of its distribution system assets;*
>
> *(b) develop and implement plans for the acquisition, creation, maintenance, operation, refurbishment, repair and disposal of its distribution system assets and plans for the establishment and augmentation of transmission connections:*
>
> - *to comply with the laws and other performance obligations which apply to the provision of distribution services including those contained in this Code;*
> - *to minimise the risks associated with the failure or reduced performance of assets; and*
> - *in a way which minimises costs to customers taking into account distribution losses; and*
>
> *(c) develop, test or simulate and implement contingency plans (including where relevant plans to strengthen the security of supply) to deal with events which have a low probability of occurring, but are realistic and would have a substantial impact on customers.[16]*

In discussions with DNSPs it became clear that there was some confusion as to whether the Code required the minimisation of risks leading to asset failure, or the risks stemming from asset failure, e.g. loss of supply, shocks or fires. All DNSPs bar CIT/PCR confirmed verbally in our meetings with them that they viewed the section as requiring the minimisation of risks stemming from and contributing to asset failures. CIT/PCR's view was that the section in the Code focused on the risks contributing to asset failure, e.g. asset defects.

Energeia's view is that the Code is referring to the risks stemming from asset failure, and that the risks contributing to asset failure are relevant and appropriate only to the degree that they are useful in minimising the latter at least costs to customers.

[14] Essential Services Commission, Electricity Distribution Code, May 2012 v7: http://www.esc.vic.gov.au/getattachment/c2697e4e-d485-4b6d-a5a5-11149fa3b3df/Electricity-Distribution-Code-May-2012.pdf

[15] Essential Services Commission, Electricity Distribution Code, May 2012 v7: http://www.esc.vic.gov.au/getattachment/c2697e4e-d485-4b6d-a5a5-11149fa3b3df/Electricity-Distribution-Code-May-2012.pdf

[16] Essential Services Commission, Electricity Distribution Code, May 2012 v7: http://www.esc.vic.gov.au/getattachment/c2697e4e-d485-4b6d-a5a5-11149fa3b3df/Electricity-Distribution-Code-May-2012.pdf

5.1 Distributor's targets

5.1.1 Before 31 December each year, a distributor must publish on its website, and in a newspaper circulating in the area in which its distribution system is located, its targets for reliability of supply for the following year.

5.1.2 As a minimum, these targets must include:

(a) for customers supplied from CBD feeders, urban feeders, short rural feeders and long rural feeders:

- *average minutes off supply per customer (SAIDI) due to planned interruptions;*
- *average minutes off supply per customer (SAIDI) due to unplanned interruptions;*
- *average number of unplanned interruptions per customer (SAIFI), excluding momentary interruptions;*
- *average number of momentary interruptions per customer (MAIFI); and*
- *average duration of unplanned interruptions (CAIDI);*

5.2 Reliability of supply

A distributor must use best endeavours to meet targets required by the Price Determination and targets published under clause 5.1 and otherwise meet reasonable customer expectations of reliability of supply.[17]

Several of the DNSPs referred to their obligation to use best endeavours as justification for their repex. ANS identified legal precedent that appeared to constrain best endeavours within available means.[18] This interpretation is consistent with Energeia's view, which is that best endeavours is not a justification for spending more than their allowance (i.e. available means), rather the inclusion of best endeavours is to ensure that lower cost methods are implemented to improve performance at the same cost.

Several DNSPs seemed to interpret 'reasonable customer expectations' as allowing for higher targets at higher cost[19]. Energeia's view is that a reasonable customer would not expect higher levels of reliability without a business case based on the Value of Customer Reliability (VCR), which is the basis of the STIPIS. We therefore consider additional expenditure beyond the STPIS scheme to be outside the scope of the NER's capex objectives by going beyond the levels specified.

Energeia notes that the relevant Price Determination for the purpose of Sections 5.2 is the 2016-2020 Revenue Determination by the AER.[20]

4.2.3 Victorian Electrical Safety Regulations

The key sections of Victorian electrical safety regulations with respect to Energeia's review of DNSP's proposed repex include the Electrical Safety (Management) Regulations 2009, the Electrical Safety (Bushfire Management) Regulations 2013 and the Electrical Safety Reporting Guidelines, which are set out below.

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[17] Essential Services Commission, Electricity Distribution Code, May 2012 v7: http://www.esc.vic.gov.au/getattachment/c2697e4e-d485-4b6d-a5a5-11149fa3b3df/Electricity-Distribution-Code-May-2012.pdf

[18] AusNet Services, Additional information following discussion at the Capex Review Briefing at AusNet Services on 1 September 2015, provided to Energeia on 2nd September

[19] Essential Services Commission, Electricity Distribution Code, May 2012 v7: http://www.esc.vic.gov.au/getattachment/c2697e4e-d485-4b6d-a5a5-11149fa3b3df/Electricity-Distribution-Code-May-2012.pdf

[20] Essential Services Commission, Electricity Distribution Code, May 2012 v7: http://www.esc.vic.gov.au/getattachment/c2697e4e-d485-4b6d-a5a5-11149fa3b3df/Electricity-Distribution-Code-May-2012.pdf

23 Key performance indicators

A safety management system must specify –

(a) the key performance indicators to be used to determine the asset operator's or the employer operator's level of compliance with the electricity safety management scheme, the relevant provisions of the Act and the regulations made under the Act; and

(b) the process to be adopted to analyse the key performance indicators and to ensure that appropriate action is taken to improve compliance if required.[21]

Section 4 Incidents to be reported monthly in a statistical summary (see Appendix 1).

The ESV has also published Electrical Safety Performance Reporting Guidelines for distribution businesses to aid in the compliance and application of the Electricity Safety Act and regulations 27 and 28 of the Electricity Safety (Management) Regulations 2009 when reporting incidents involving their assets.[22]

The Electricity Safety (Bushfire Mitigation) Regulations 2013 detail further safety requirements for operators and major electricity companies. The regulations describe the standards and timeline of inspection that the electricity companies and operators must abide by, as well as particulars for the Bushfire Mitigation plans. The key sections of relevance to Energeia's review include 7(1)(n) and 7(1)(q).[23]

7 Prescribed particulars for bushfire mitigation plans—major electricity companies

(1) For the purposes of section 113A(2)(b) of the Act, the following are the prescribed particulars—

…

(n) details of the processes and procedures by which the major electricity company will—

(i) monitor the implementation of the bushfire mitigation plan; and

(ii) audit the implementation of the plan; and

(iii) identify any deficiencies in the plan or the plan's implementation; and

(iv) change the plan and the plan's implementation to rectify any deficiencies identified under subparagraph (iii); and

(v) monitor the effectiveness of inspections carried out under the plan; and

(vi) audit the effectiveness of inspections carried out under the plan;

…

(q) a description of the measures to be used to assess the performance of the major electricity company under the plan.[24]

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[21] Electricity Safety (Management) Regulations 2009, Victorian Government, Part 2: Section 23 (a) and (b). http://www.legislation.vic.gov.au/Domino/Web_Notes/LDMS/PubLawToday.nsf/b12e276826f7c27fca256de50022686b/f7e0e2ad00be0335ca257c14008215a8!OpenDocument

[22] Energy Safe Victoria, DB Electrical Safety Performance Reporting Guidelines v4.0, July 2014: http://www.esv.vic.gov.au/Portals/0/DB%20Electrical%20Safety%20Performance%20Reporting%20Guidelines.pdf

[23] Energy Safe Victoria, Victorian Government, Electricity Safety (Bushfire) Regulations 2013 v 3, June 2015: . http://www.legislation.vic.gov.au/Domino/Web_Notes/LDMS/PubLawToday.nsf/b12e276826f7c27fca256de50022686b/f8f910a6cd1b9a91ca257e730016994e!OpenDocument

[24] Energy Safe Victoria, Victorian Government, Electricity Safety (Bushfire) Regulations 2013 v 3, June 2015: . http://www.legislation.vic.gov.au/Domino/Web_Notes/LDMS/PubLawToday.nsf/b12e276826f7c27fca256de50022686b/f8f910a6cd1b9a91ca257e730016994e!OpenDocument

4.2.4 AER Expenditure Assessment Approach

The Expenditure Forecast Guidelines, required under clause 6.2.8(a)(1) of the NEL, further clarifies the approach the AER will take when determining whether or not the proposed expenditure reasonably satisfies the capex criteria and the associated information requirements.[25]

As described in the Guideline, the AER's assessment approach involves the following main steps:

- Examination of the DNSP's proposal and other relevant information
- Comparison of the forecast with an alternative benchmark estimate
- Consideration of explanations for variations to the efficient benchmark
- Publication of an Issues paper
- Development of Draft and Final Determination

The AER will apply a filtering process through a two stage review, whereby an initial high level review is undertaken to identify the key issues requiring more detailed consideration. These will be reported in an Issues paper, the responses to which will be factored into the draft and final determinations.

In reviewing the DNSP proposal and supporting materials, the AER expects the DNSP to demonstrate that it is making expenditure decisions under a quantitatively based economic framework consistent with minimizing the long run cost of achieving the expenditure objectives.[26]

The Guideline also detail the AER's specific approach in assessing capex forecasts, such as using a combination of top down and bottom up approaches.[27] The AER's top down approach will involve a comparison of the proposed expenditure to peer DNSPs, adjusted for material differences in circumstances. Bottom-up approaches include detailed project reviews and cost-benefit assessments.

The AER expects the DNSPs to demonstrate the prudency and efficiency of their capital expenditure forecasts by substantiating that it will result in the lowest sustainable cost (in present value terms) to meet the legal obligations of the DNSP.[28]

Capital expenditure will be split into the following relevant categories:[29]

- Replacement
- Connection driven
- Non-network (i.e. Information Technology, Property, Plant and Equipment and vehicles)

Each category will be individually assessed against the capex factors.

The AER expects the DNSPs to provide reasons for any variation between forecast and historical expenditure. [30] The AER also expects to see analysis of the opex/capex trade-off, demonstrating the efficiency of the choices made.

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[25] AEMC, National Electricity Rule v 73, August 2015: http://www.aemc.gov.au/getattachment/ff018221-b609-4eb8-a67d-68bb07655e6e/National-Electricity-Rules-Version-73.aspx

[26] AER, Expenditure Forecast Assessment Guideline for Electricity Distribution, November 2013: http://www.aer.gov.au/sites/default/files/Expenditure%20Forecast%20Assessment%20Guideline%20-%20Distribution%20-%20FINAL.pdf

[27] Ibid, p.17

[28] Ibid, p. 17

[29] Augmentation capex has been omitted as it is not relevant to the scope of this report.

[30] AER, Expenditure Forecast Assessment Guideline for Electricity Distribution, November 2013: http://www.aer.gov.au/sites/default/files/Expenditure%20Forecast%20Assessment%20Guideline%20-%20Distribution%20-%20FINAL.pdf

The AER expects demand forecasts to reflect good industry practice demand forecasting, which is described in a separate explanatory statement. [31]

4.3 Assessment Approach

Energeia's overall approach to assessing whether the proposed repex complied with the NER's capex objectives and criteria was to develop appropriate technical framework for assessing whether it was in-scope, reflected a realistic forecast of future volumes and prices, and was reasonably efficient and prudent.

Energeia developed its technical assessment framework based on the following review methodology:

- Review DNSP modelling of forecast reliability, safety, power quality, and security performance gaps relative to requirements, including the model's key inputs, assumptions and estimates;
- Review DNSP modelling of investment inputs (repex) to outputs (i.e. KPIs), including the model's key inputs, assumptions and estimates; and
- Identify issues with DNSP repex objectives target setting, volume or price forecasting and efficiency assurance and undertake independent research and modelling where appropriate to inform our view.

Energeia's top-down assessment framework was refined over the course of the engagement based on the availability of data across the DNSPs, its ability to qualitatively identify issues to the AER, and constructive feedback received from DNSPs and the AER regarding our approach.

Table 3 map's Energeia's framework to the AER's assessment guidelines and framework and approach paper, showing that it essentially adopts a mix of benchmarking, trending, modelling, risk management and technical review elements in a fit-for-purpose technical assessment framework.

Table 3 – Mapping of AER's Assessment Methods to Energeia's Assessment Framework

	Governance	Risk Management	Methodology	Benchmarking	Trend	Modelling
In-Scope Expenditure?	✓	✓	✓	✓		
Repex to KPI Data?	✓	✓	✓	✓		
Improves Performance?	✓					
Realistic Forecast Volumes and Prices?				✓	✓	✓
Trending Gap at Existing Repex Rates?					✓	✓
Industry Standard Volume Projection?						✓
Period on Period Price Change?				✓	✓	✓
Reasonably Efficient?	✓	✓	✓	✓	✓	
Efficient Repex KPIs?	✓	✓	✓			
Efficient Replacement Rate?	✓	✓		✓	✓	
Efficient Replacement Prices?				✓		
Efficient Replacement Mix?		✓	✓			

Based on the results of our assessment, Energeia drew a qualitative conclusion as to level of risks or issues associated with DNSP's proposed repex meeting the NER's capex objectives and capex criteria. Our recommendation is for the AER to focus on those areas scored as being at significant and substantial risk.

4.3.1 In-Scope Expenditure

Whether or not the proposed repex addresses the NER's capex objectives directly addresses the AER's requested information by identifying whether or not it achieves or exceeds them. The AER's definition of repex:

> *…The capital expenditure is regarded as replacement expenditure if it is primarily determined by the existing assets ability to efficiently maintain its service performance requirement.*[32]

[31] AER, Explanatory Statement, Expenditure Forecast Assessment Guideline, November 2013: http://www.aer.gov.au/sites/default/files/Expenditure%20Forecast%20Assessment%20Guideline%20-%20Explanatory%20Statement%20-%20FINAL.pdf.

[32] Ibid. p 275.

and the NER's capex objectives themselves define the relevant expenditure scope, being for the replacement of assets in order to maintain existing performance levels.

Energeia assessed expenditure which was for objectives other than reliability, safety, security and power quality, or for targets other than those required by the NER's capex objectives, or for investment other than to maintain an asset's ability to efficiently maintain its service performance requirement, as being out of scope.

As part of the assessment, Energeia asked the DNSPs to specify which KPIs they were using to determine whether or not they were meeting the NER's capex objectives, and reviewed their responses to identify KPIs that in our view were unrelated or indirectly related to achieving the objectives. We also reviewed the responses to identify where targets exceeded the objectives, e.g. where repex was to improve and not just maintain safety. This assessment is labelled as 'Improves Performance' in our assessment framework.

Energeia also asked the DNSPs to specify how they determined the impact of the proposed expenditure on the targets. In other words, we asked the DNSPs to explain how they were sure that the inputs, repex, would only meet and not exceed the targets they were obligated to meet.

Where DNSPs were unable to provide data linking their investment to their objectives, e.g. maintaining the reliability, safety, security or power quality of their assets or network, they were deemed to be at higher risk of including expenditure that may not meet the requirements of the NER's capex objectives. This was labelled as the 'Repex to KPI data?' assessment in our assessment framework.

Importantly, inclusion of indirect KPIs in their responses was considered more as a problem of asset management system efficiency, and considered as part of that assessment process, and not one of scope.

In response to our approach, a number of the DNSPs claimed that this level of reporting was not an indication of the quality of their asset management system or the compliance of their repex. [33,34] Energeia notes that the Code and good industry practice asset management as defined by ISO 55001[35] appears to require that DNSPs assess and record the condition and performance of its distribution system assets.

4.3.2 Realistic Forecast

Whether or not the proposed repex will achieve or exceed the NER's capex objectives depends on whether or not the forecast volumes and unit prices are realistic. If they are unrealistic, they are more likely to vary from achieving the targets, being either too high or too low. Realistic forecast volumes and unit prices are also required under the capex criteria.

Assessing Volume Forecasts

The main future volume drivers of replacement expenditure include the underlying condition of assets, for which age is typically used as a proxy; the true lifetime of the assets assuming a perfect asset management system (AMS); and the efficiency of the AMS in identifying imminent failures.

As the true lifetime of assets is unobservable and AMSs are imperfect, the industry relies on a number of simplifying assumptions to develop estimates of future replacement volumes. Forecasts typically project future volumes as a function of asset age and current 5 year replacement levels. These two factors are parlayed into estimates of asset mean lifetimes and standard deviations, and ultimately forecast volumes.

Energeia's assessment approach was to check that the proposed volumes did not exceed projections using simplified approach (simplified failure model), relying on the work conducted by the consultants on behalf of

[33] CitiPower and PowerCor, Comments on Energeia Presentation, 150901 CP PCR on Energeia analysis v1 0, 1 September 2015

[34] Jemena, Response to AER Questions, JEN AER IR#020 Part B, 3 September 2015

[35] ISO 55001 Standard, Section 6.2.2 (a) – (k), Section 7.5 (b) and (e), p. 5-6.

the businesses. Where the DNSPs varied from the results in the simplified failure model, we considered them to be at higher risk of being unrealistic for the purpose of this assessment. This is referred to as the 'Industry Standard Volume Projection?' assessment in our assessment framework.

In order to mitigate the risk that current levels of replacement were above or below appropriate levels, which would then inappropriately drive future levels, Energeia reviewed safety and reliability performance trends. This is labelled as the 'Trending Gap at Existing Repex Levels?' assessment in our assessment framework.

Energeia note that good industry practice forecasting is more likely to be based on Weibull based models using actual functional failure data, and that each of the DNSPs have their own internal forecasting methods. However, it is not practical in the time and budget available to review each of their internal systems in detail. The simplified failure model was used as the benchmark instead as it is also the de facto standard for regulatory purposes, noting that the AER typically applies it differently to the DNSPs.

Energeia also note that our approach means that we did not review the volume forecasts for all categories where they were excluded from the consultant's analysis. Another limitation of our approach is that it does not account for any potential change in the efficiency of DNSP AMS, which would tend to increase the effective lifetime of assets over time.

Assessing Unit Price Forecasts

While economic theory would tell you that reasonable forecasts of future unit prices should be based on contracts covering the forecast period and/or forecasts of sector specific inflation, this information was not always available, particularly where much of the work is completed by internal resources.

Energeia's approach to assessing the reasonableness of the unit prices was therefore based on a comparison of a DNSP's own period on period price trends. This is consistent with the AER's approach, and recent unit prices are, in our view, a reasonable benchmark for future prices, *ceteris paribus*. Energeia's approach, labelled as the 'period on period price change?' assessment in our assessment framework, adjusted reported repex by CPI to provide an 'apples to apples' price comparison.

Where a step change in pricing occurred, such as that experienced by UED when it changed its operating model, Energeia examined their contracting method to determine how realistic their proposed prices were likely to be. Prices were deemed to be realistic where they were comparable to benchmark peers, such as JEN, taking appropriate differences between them into account.

Energeia notes that a realistic forecast is not the same as a prudent and efficient forecast, and that the current trend considered for the purpose of being a realistic benchmark for future trends may not be prudent or efficient. Given all DNSPs other than CIT substantially overspent their allowance, which the AER had determined to be the prudent and efficient level, the efficiency and prudency of current prices in the absence of material changes in business conditions, is highly questionable.

4.3.3 Reasonably Efficient and Prudent

Determining whether or not proposed expenditure is reasonably efficient and prudent is required by the capex criteria in order for the AER to accept it. The AER requires DNSPs substantiate that proposed repex will result in the lowest sustainable cost (in present value terms) to meet the legal obligations of the DNSP.[36]

[36] AER, Explanatory Statement, Expenditure Forecast Assessment Guideline, November 2013: http://www.aer.gov.au/sites/default/files/Expenditure%20Forecast%20Assessment%20Guideline%20-%20Explanatory%20Statement%20-%20FINAL.pdf.

Energeia's approach to assessing the prudency and efficiency of DNSP's proposed repex focused on the effectiveness of the DNSP's asset management system in:

- avoiding repex that would be best addressed through lower cost opex or augex;
- minimising asset replacements without impacting risk adjusted performance; and
- optimising the repex mix to minimise overall repex without impacting risk adjusted performance.

Assessing Repex-Augex-Opex Trade-off Efficiency

Not all asset failure modes have the same risk of shocking someone or starting a fire, and not all high priority failure modes are efficiently addressed by replacing the asset. Energeia assessed those systems that did not provide reporting at the failure mode level, or did not provide prioritised lists of potential expenditure options across opex and augex in support of their repex proposals as being at greater risk of being inefficient under the 'Efficient Repex KPIs?' assessment in our assessment framework.

For example, using repex to respond to a declining SAIDI trend is prima facie inefficient because, while reducing the number of outages will lead to reduction in asset failure driven SAIDI, there are a wide range of alternatives to asset replacement that are traditionally much lower cost, e.g. changing personnel rosters (opex) or installing enhanced fault findings and network reconfiguration technology (augex).

Energeia's initial RFI requested DNSPs provide evidence of their optimisation process, such as a model or a spreadsheet of prioritised investments.

Assessing Asset Replacement Rate Efficiency

A theoretically efficient AMS would only replace assets just before they failed. Achieving this in practice is extremely difficult, as leading indicators for controllable failures may be imperfect and the failures themselves are likely to be stochastic in nature – requiring a safety margin. The efficiency of a system is difficult to assess without allowing failures to happen, which may not be acceptable due to the potential risks involved.

Energeia's approach to assessing the relative efficiency of each DNSP's proposed repex in this context was to compare their effective rate of replacement against each other, and against the accounting and engineering lifetimes represented by the modern equivalent asset concept. AMS delivering replacement rates below leading rates while maintaining performance were assessed as being at higher risk of being inefficient under the 'Efficient Replacement Rate?' assessment in our assessment framework.

Assessing Unit Price Efficiency

An efficient DNSP is able to deliver a given asset replacement at sustainably least cost, taking any material differences in business conditions into account.

Energeia's approach to assessing the relative efficiency of each DNSP's proposed repex in this context was to compare unit rates of comparable businesses against each other. The unit prices of the suburban DNSPs JEN and UED and the rural DNSPs PCR and ANS were compared to each other, respectively. CIT's prices are relatively unique, but were generally assessed against the suburban DNSPs for the given assets.

DNSPs with any unit prices below their benchmark peer were deemed to have a higher risk of including inefficient repex. A key limitation of our analysis is the use of a sub-set of asset categories for price benchmarking. While we believe that our approach is efficient, it does not exclude the potential for unit prices in other categories to vary significantly from the representative category being assessed.

Assessing Repex-to-Repex Trade-off Efficiency

A least cost approach to achieving the NER's capex objectives requires the ability to trade off the risk adjusted costs of different types of asset failure modes within and across assets. Energeia assessed DNSPs without the ability to trade-off the risk adjusted costs between asset categories as less efficient than those that could. This assessment is labelled as the 'Efficient Replacement Mix?' assessment in our assessment framework.

4.4 Information Gathering and Validation Approach

DNSPs provided a large number of documents in support of their proposals (see Table 4). While not all of these documents were directly relevant to the repex proposals, many of them were potentially, and filtering them to identify the key documents took time.

Table 4 – Number and Size of Files Provided by DNSPs in their Regulatory Proposals

DNSP	Documents Available	Total Pages	Spreadsheets Available	Spreadsheet Total MB Size
PCR	81	3,131	10	36.6
JEN	22	1,404	10	22.4
CIT	52	1,836	11	32.1
ANS	109	4,093	11	28.0
UED	131	4,907	27	53.5

Source: Energeia

Where DNSP's Regulatory Proposals did not appear to contain sufficient information for Energeia to apply our technical assessment framework, Energeia developed questions to address our information gaps.

Two rounds of questions were issued to DNSPs, with a request to respond within five business days due to tight project timeframes. The second RFI targeted more granular information and areas to make the data more comparable across the DNSPs.

Two meetings were held with the DNSPs to discuss the RFIs, our assessment framework and approach, and ultimately our findings and conclusions. The first meeting was held via a teleconference, while the second meeting was held in person at each DNSP's offices. The AER attended each meeting.

Energeia acknowledges the pressure this process and the RFIs put on each DNSP, and would like to thank their regulatory managers in particular for their understanding, support and cooperation.

4.5 Out of Scope

Anything not specified as being in scope for Energeia's limited review of DNSP's proposed repex in their Initial Proposals is out of scope with respect to our review, including:

- Modelling of future repex using the AER's Repex Model
- Review of zone substation replacement expenditure (submitted on a project basis)
- Augmentation capex
- Opex

5 Review Findings and Conclusions

Overall, Energeia found the Victorian DNSPs to have proposed repex programs that were largely in keeping with current levels of volumes, prices and overall efficiency, which were on average more than 50% higher than the prudent and efficient levels approved by the AER, excluding bushfire expenditure.

There was one case identified where proposed expenditure may be better categorised as augex (UED's distribution automation project), and one case where a higher than maintain level of performance was being explicitly targeted (ANS 20% safety improvement). That being said, Energeia remains of the view that further efficiencies are possible, mainly in the optimisation of investment triggers and replacement mix and timing.

Table 1 presented our assessment of each DNSP's performance against our top-down technical assessment framework. It is repeated here for ease of reference.

Table 1 – Summary of Qualitative Repex Review Findings and Conclusions

	UED	JEN	CIT	ANS	PCR
In-Scope Expenditure?	✓	✓	✓	✓	✓
Repex to KPI Data?	✓	✓	✓	✓	✓
Improves Performance?	Automation	✓	✓	Safety	✓
Realistic Forecast Volumes and Prices?	✓	✓	✓	✓	✓
Trending Gap at Existing Repex Level?	SAIFI	No Gap	No Gap	No Gap	No Gap
Industry Standard Volume Projection?	✓	✓	✓	?	✓
Period on Period Price Change?	✓	✓	✓	✓	✓
Reasonably Efficient?	✓	✓	✓	✓	✓
Efficient Repex KPIs?	SAIDI, Failures	✓	Leading	✓	Leading
Efficient Replacement Rates?	✓	✓	✓	?	✓
Efficient Replacement Prices?	✓	✓	✓	✓	✓
Efficient Replacement Mix?	?	?	?	?	?

✓ = Limited or no risks/issues identified ✓ = Significant risks/issues identified ✓ = Substantial risks/issues identified
? = Unable to assess due to lack of information, high risk issue

Source: Energeia

The following sections describe the results of our technical assessment in terms of our key findings and reasoned conclusions.

5.1 *In-Scope Expenditure*

The findings from Energeia's assessment of whether the selected categories of proposed expenditure would meet the AER repex definition and the NER's capex objective requirements are summarised in Table 5.

Table 5 – Energeia's Assessment of Scope of Proposed Repex

	Repex to KPI Data?	Improves Performance?	In-Scope?
UED	✓	Automation	✓
JEN	✓	✓	✓
CP	✓	✓	✓
ANS	✓	Safety	✓
PCR	✓	✓	✓

✓ = Limited or no risks/issues identified
✓ = Significant risks/issues identified
✓ = Substantial risks/issues identified

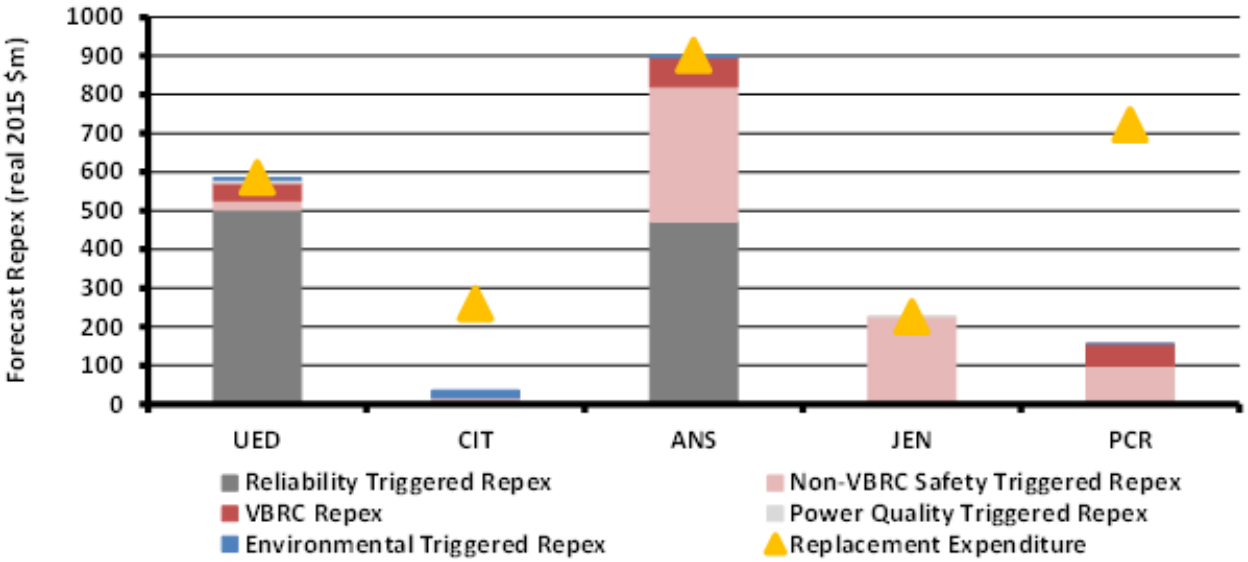
Source: Energeia

Energeia's first request for DNSPs to provide historical and proposed repex by year, asset category and sustained failure rates initially resulted in only UED and ANS being able to provide the requested information. However, subsequent to our second meeting, JEN, CIT and PCR provided evidence that their systems were able to link AER specified replacement expenditure to the NER's capex objectives with additional time and effort.

Energeia was not able to find evidence of DNSPs including performance targets outside of those set by the NER's capex objectives in their proposals, other than potentially for ANS and UED. ANS's safety targets, as outlined in their Electricity Safety Management Scheme (ESMS) document, include targets for a 20% period on period improvement in their safety performance.[37] UED's repex program appears to include a network automation project, which may be better classified as augmentation expenditure.

Figure 5 displays each DNSP's categorisation of their repex in terms of being triggered by the need to maintain safety and reliability performance levels. CIT and PCR's reporting stands out among the DNSPs as being the only DNSPs to not account for their repex in these terms. While Energeia believes that NDSP's repex needs to be related back to the NER's capex objectives explicitly, we believe the current gap is likely due to terminology. We were unable to resolve the issue before the report was due to be completed.

Figure 5 – Categorisation of Proposed Repex with Respect to the NER's Capex Objectives



Source: Victorian DNSPs, Energeia

ANS's repex to improve its safety performance by 20% over the period appears to be in addition to the investments identified by the Victorian Bushfire Royal Commission (VBRC) recommendations and the Victorian Government funded safety improvement programs.[38] While the Victorian Electrical Safety (Management) Regulations require DNSPs to respond to community expectations, both bodies may be said to represent the community. ANS nevertheless claims to have identified additional community expectations, which appears to be the basis for their safety KPI improvements.[39]

[37] AusNet Services Initial Review RFI Response to Energeia titled "Initial Review RFI- ANS 150803_AusNet response to questions". Received August 12, 2015 from the AER, and Additional information following discussion at the Capex Review Briefing at AusNet Services on 1 September 2015, provided to Energeia on 2nd September 2015

[38] 2009 Victorian Bushfires Royal Commission, Final Report Recommendations, 2009: reference http://www.royalcommission.vic.gov.au/Assets/VBRC-Final-Report-Recommendations.pdf and Victorian Government, Powerline Bushfire Safety Program, August 2015: http://www.energyandresources.vic.gov.au/energy/safety-and-emergencies/powerline-bushfire-safety-program

[39] AusNet Services, Electricity Distribution Price Review 2016-20, pp 24, 30th April 2015.

Energeia found that UED's proposal includes $10M for their distribution automation system, which is being designed to be able to restore unaffected customers in less than 1 minute, reducing SAIFI in the process. This system will not prevent the outage in the first place, and will therefore not contribute to maintaining the safety of UED's network, but it will improve the performance capability of its network, and is arguably better classified as an augmentation expenditure, which is how ANS has classified it.[40]

Based on the findings from our approach to testing the likelihood of DNSP submitted expenditure proposals being for out of scope repex, Energeia has reached the following reasoned conclusions:

1. UED's proposed repex includes expenditure for network automation, which other DNSPs have categorised as augex due to it improving the performance of existing assets. Energeia have therefore concluded that UED's proposed repex includes at least $10M of out of scope expenditure if network automation is more appropriately classified as augmentation expenditure.
2. ANS's repex proposal includes repex for safety improvements, which ANS identifies as being consistent with 'community expectations' as required under the Electrical (Safety) Regulation.[41] The NER defers to jurisdictional performance levels where they exist.[42] Energeia have therefore concluded that ANS' proposed repex may include out-of-scope expenditure under the NER to the degree that the VBRC and Victorian Government represent the relevant community.
3. Although their AMS does not appear to be as capable as that of UED and ANS, at least in terms of providing key asset and repex performance information within a week of request, the JEN, CIT and PCR's AMSs do appear to be able to link expenditure to repex KPIs with additional effort and time. However, CIT/PCR's categorisation of repex against the NER's capex objectives appears to leave a large gap. While it is an issue that needs to be resolved, Energeia expects it to be largely a categorisation issue, and may be able to be redefined as either reliability or safety driven.

The above conclusions notwithstanding, Energeia's believe it is important to note that our review was necessarily limited given time and budget and not comprehensive. It may therefore be the case that additional, out of scope expenditure may be found by the AER with additional time and effort.

5.2 Reasonably Likely Forecast Volumes and Prices

The results of Energeia's review and assessment of the DNSP's quantity and price forecasts and forecasting methodologies are summarised in Table 6.

Table 6 – Energeia's Assessment of Reasonable Forecasts

	Trending Gap at Existing Repex Level?	Consistent with Simplified Failure Model	Period on Period Price Change?	Reasonably Likely Forecast
UED	✓	✓	✓	✓
JEN	No Gap	✓	✓	✓
CP	No Gap	✓	✓	✓
ANS	No Gap	?	✓	?
PCR	No Gap	✓	✓	✓

✓ = Limited or no risks/issues identified
✓ = Significant risks/issues identified
✓ = Substantial risks/issues identified
? = **Unknown**

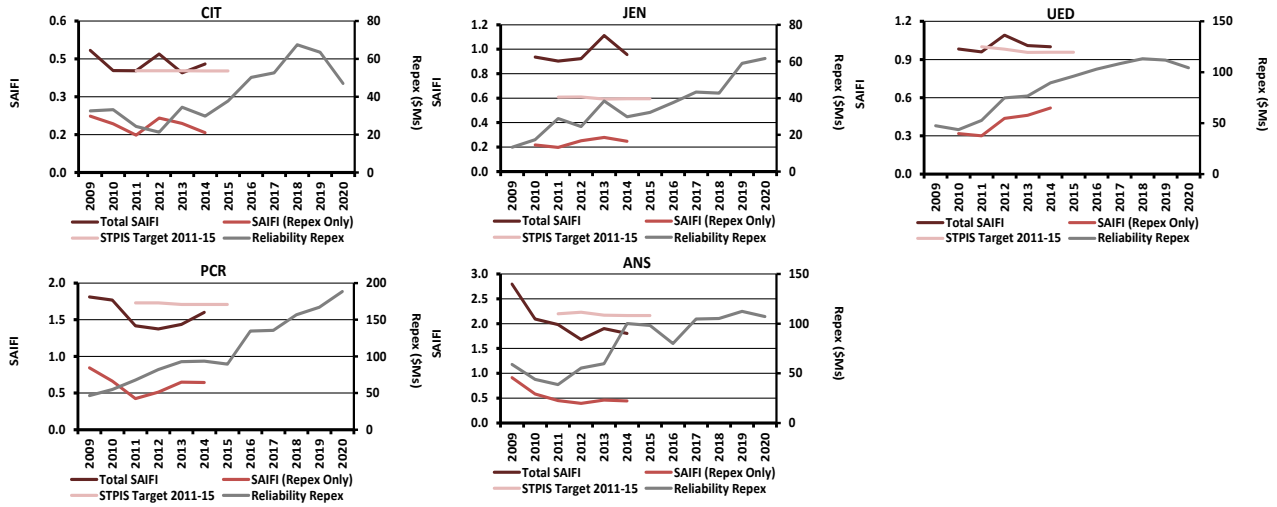
[40] United Energy, AER Category Expenditure Explanatory Statement – Other Programs, Expenditure Justification – Other Programs Version 1.0, p 29. Note that the $10m expenditure only includes the installation costs for automatic circuit re-closers and remote control gas switches, and does not include the supporting IT and communications system, which can be substantially more costly.

[41] AusNet Services, Electricity Price Distribution Review 2016-20, p. 24, 30 April 2015,

[42] AEMC, National Electricity Rule v 73, 20.8.15, p.669 http://www.aemc.gov.au/getattachment/ff018221-b609-4eb8-a67d-68bb07655e6e/National-Electricity-Rules-Version-73.aspx

Energeia's assessment of DNSP's performance trends found that repex driven safety performance was maintained over the current period. While there is some indication of deteriorating fire start performance, this appears to be more due to dry conditions over the past few years, than changes in underlying asset safety. Figure 6 shows repex driven reliability performance was also largely maintained, except in the case of UED.

Figure 6 – Repex Driven Reliability Trends



Source: DNSPs, Energeia

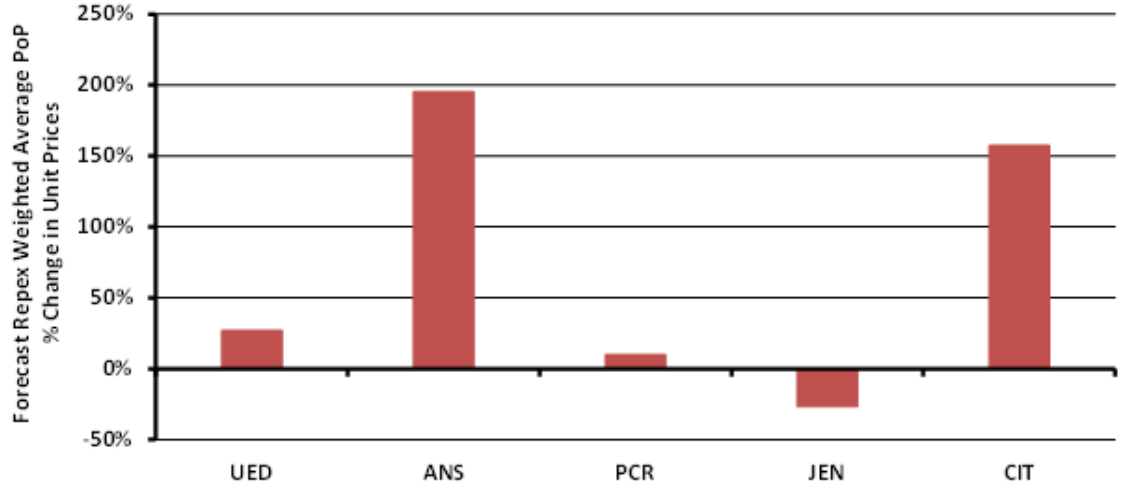
Energeia's review of DNSP repex volume forecasts found that DNSP's repex proposals (excluding ANS) included credible evidence from independent consultants that they were consistent with the forecasts that would be produced by a simplified failure model, at least for the categories of repex that were deemed to be correlated with asset age.[43]

Energeia's review of DNSP repex price forecasts found that PCR and JEN's repex proposals were based on unit price forecasts that were the same or lower than current period prices in real terms. UED, ANS and CIT's weighted average forecast prices appear in Figure 7 to be materially higher than their current actual prices.

Energeia only identified an explanation for the price increase in UED's proposal, which claimed prices were realistic due to their being based on current market tested contracts, the prices in which increased sharply in 2012 when they changed their operating model and the service providers.

[43] Energeia notes that replicating simplified failure model results as part of our review was not in scope.

Figure 7 – Weighted Average Unit Prices for Current Actual and Proposed Repex



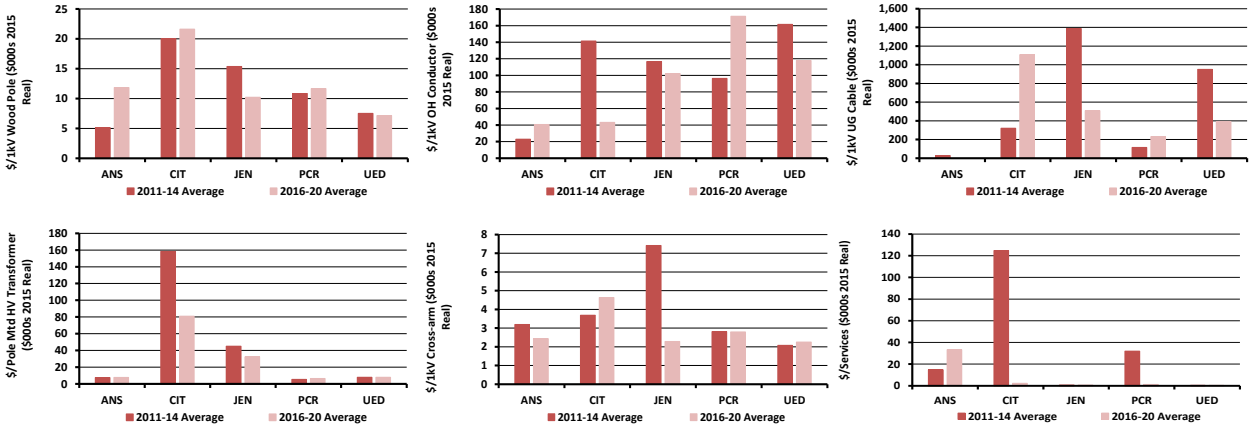
Source: DNSP's Category Analysis RINs

[redacted]

44

Energeia therefore examined the weighted average prices of key repex asset categories to assess whether UED's or ANS's prices were likely to increase from their current levels. The results of our analysis are provided in Figure 8.

Figure 8 – Current and Forecast Unit Prices for Key Repex Asset Categories



Source: DNSP's RIN Category Analysis

Energeia's comparison shows that UED's forecast prices are comparable to or cheaper than its closest comparator, JEN, in each case except that of Overhead Conductors, where UED's forecast prices are higher than all Victorian DNSPs except for PCR.

44 UED have asked for the statement to be withdrawn. This request was received after the advice was finalized, therefore Energeia did not have the opportunity to consider the implications of withdrawing the statement.

ANS's forecast unit prices were found to be significantly higher than historical levels for underground cables, services, LV overhead conductors and transformers. However, assuming their closest comparator's (PCR) prices are realistic, ANS prices are largely the same or lower in all cases except UG cables and services.

Based on the findings from our approach to testing the likelihood of DNSP submitted repex volume driver and unit price forecasts, Energeia has reached the following reasoned conclusions:

1. UED's proposed volume forecast is consistent with a simplified failure model, however their forecast unit prices higher than historical levels due to a change in their operating model and contracting strategy. However, they are reasonably likely to be consistent with JEN's unit prices. We therefore conclude that UED's forecast repex volumes and unit prices are reasonably likely to occur.
2. ANS' proposed repex volume forecast is not substantiated by a comparison to a simplified failure model, and is not therefore able to be confirmed as being consistent with current replacement rates and changes in the underlying age of the asset base. ANS forecast unit prices are higher than their current rates, but lower than those of PCR. Energeia therefore conclude that ANS's forecast of repex volumes could be unrealistic, but their forecast unit prices appear to largely be reasonable.
3. Energeia found the forecast volumes and unit prices of the remaining DNSPs to be largely consistent with a simplified failure model and their current unit prices in real terms, except for CIT, whose unit prices are estimated to be 150% higher than current prices on a weighted average basis. Energeia therefore conclude that the forecast repex volumes and unit prices to be realistic, except in the case of CIT, which lacks a quality price benchmark.

Energeia believes it bears noting that our conclusions here do not mean that we are of the view that the forecasts reflect a prudent and efficient level of asset replacement, only that they reasonably reflect future replacement requirements and unit pricing at current levels of DNSP prudency and efficiency.

5.3 Prudent and Efficient Expenditure

The results of Energeia's review and assessment of the prudency and efficiency DNSP's repex proposals are summarised in Table 7.

Table 7 – Energeia's Assessment of the Prudency and Efficiency of Expenditure

	Efficient Repex KPIs?	Efficient Replacement Rate?	Efficient Unit Prices?	Efficient Replacement Mix?	Efficient?
UED	SAIDI, Failures	✓	✓	?	✓
JEN	✓	✓	✓	?	✓
CP	Leading	✓	✓	?	✓
ANS	✓	?	✓	?	✓
PCR	Leading	✓	✓	?	✓

✓ = Limited or no risks/issues identified
✓ = Significant risks/issues identified
✓ = Substantial risks/issues identified
? = Unknown

Source: Energeia

5.3.1 Efficient Repex KPIs

Energeia's review of the efficiency of DNSP's repex KPIs found that DNSPs were generally not able to precisely define which of their comprehensive system of safety and reliability indicators was efficiently driven by the specific type of repex proposed and not an alternative type of repex or augex or opex.

Most DNSPs focused on the STIPIS metrics as the key repex reliability KPIs. Although the safety KPI is clearly articulated by ESV[45] as being electrical shocks, only ANS was able to articulate this clearly in their responses to Energeia's request for clarification of their repex KPIs.[46]

UED's response said it focused on asset failures, but also included the ESV's fire related KPIs. CIT/PCR's response focused on their health index system, and the asset defect rates it uses to manage safety performance. Discussions with CIT/PCR also confirmed that their system is focused on managing the risks leading to failure, rather than managing the risks stemming from asset failure. ANS's response included shocks, fires and asset failures as its safety repex KPIs and the STIPIS KPIs as their repex KPIs. Jemena did not provide a response to the question of what the key reliability KPIs were for them.

5.3.2 Efficient Replacement Levels

Energeia's review of whether proposed replacement rates were prudent and efficient found that those DNSPs that provided a calibrated rate[47] generally seemed to be managing their assets at a more efficient rate than that implied by standard economic or accounting lifetimes. However, although UED provided a simplified failure model results comparison in their proposal[48] it did not specify the calibrated means.[49]

As shown in Figure 9 below, CIT/PCR and JEN's calibrated means, implying their current and projected future rate of replacement, is above the economic lifetime estimates they have provided in the RIN. The only major variation identified was with respect to overhead conductors, where JEN's replacement rate is significantly higher (i.e. a lower calibrated mean) than that of CIT/PCR.

UED's calibrated means were not clearly set out, but a review of their consultant's report suggests that they were not as high as JEN, CIT/PCR in their replacement rates for poles, pole top structures and service wires.[50] This may in part be due to the declining safety performance of UED's cross-arms, which is spurring higher replacement rates next period. UED's modelled means for these asset categories is provided in Figure 9, which the consultant's report says are higher than the means calibrated from actual recent replacements.

The AER calibrated estimates in Figure 9 are from their review of proposed expenditure by Energex.[51]

[45] Energy Safe Victoria, Safety Performance Report on Victorian Electricity Distribution and Transmission Businesses 2010, June 2013: http://www.esv.vic.gov.au/Portals/0/About%20ESV/2012%20Safety%20Performance%20Report%20on%20MECs%20%20-%20FINAL%20FOR%20WEBSITE%2020130812.pdf

[46] AusNet Services, Initial RFI Response, Response to Initial Review RFI – ANS 150803v1

[47] A calibrated rate is the mean that generated an annual replacement rate equal to the current replacement rate using a simplified failure model.

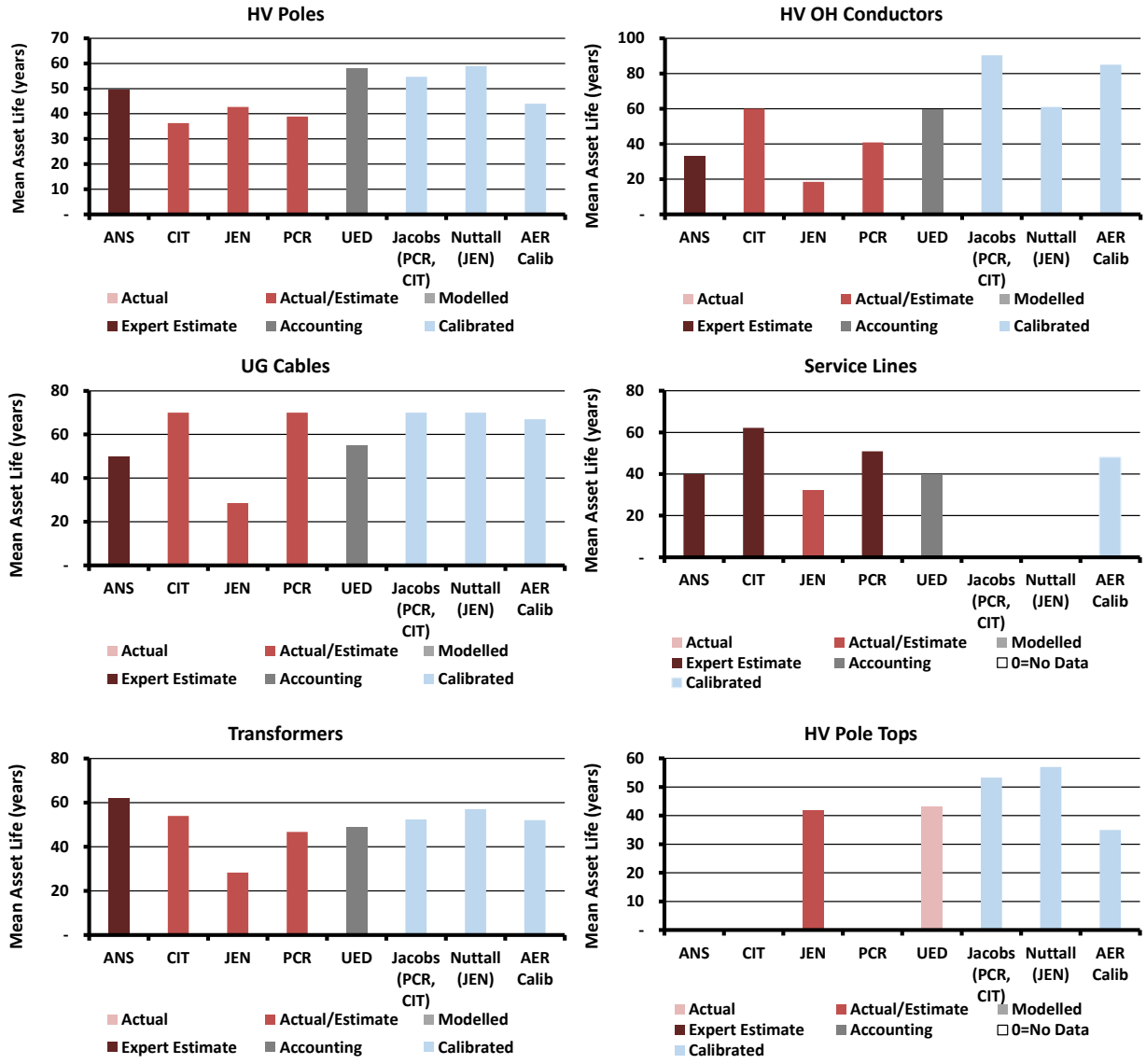
[48] Nuttall Consulting, AER Repex Modelling: Assessing UED's Replacement Forecast, April 2015.

[49] Responses from UED in Energeia RFI and Second RFI. Excel Soreadsheets titled "Time Series Data- AER IR19- FINAL v3 with insurance" received August 20, 2015 from the AER and "Revised Second RFI – UE- FINAL" received August 25, 2015 from the AER.

[50] Nuttall Consulting, AER Repex Modelling: Assessing UED's Replacement Forecast, April 2015, p 6.

[51] Jacobs Consulting, Energex - Appendix 4.1 Jacobs AER REPEX Review, Appendix A, June 2015, pp. 26-27.

Figure 9 – Comparison of Selected Proposed Replacement Rates



Source: DNSP 2009-13 RIN Category Analysis, Jacobs, Nuttall

ANS did not provide calibrated means, so Energeia was unable to compare their effective asset replacement rate with the other Victorian DNSPs.

Energeia's review of the prudency and efficiency of DNSPs repex optimisation processes found that while most DNSPs appeared to be able to optimise reliability repex across asset categories, safety repex was only optimised within asset categories. Provided explanations typically implied that the conditional failure criteria were immutable, and that there was no scope for trading-off risk adjusted costs between classes.

5.3.3 Efficient Replacement Prices

Energeia's review of the efficiency of DNSP's unit prices found that none of the DNSPs delivered the least cost unit price in all cases across the selected asset sub-categories. Each DNSP had at least one example where a lower cost price was being achieved by a DNSP operating under comparable business conditions. Given our analysis was limited to a few key asset sub-categories, the true number of examples where DNSPs are higher than a benchmark peer is likely to be significantly greater.

5.3.4 Efficient Replacement Mix

Risk is a continuum, and each DNSP's inspection regime is typically designed to deliver a target rate of asset failure linked to a certain level of consequential risk, which good practice asset management as defined by ISO 55001[52] requires be linked to the failure's expected impact, e.g. either a shock or fire in the case of safety KPIs. Where there is an opportunity to achieve the same level of safety risk at lower cost by marginally reducing safety repex in one asset category and increasing it in another, an efficient repex optimisation would ensure this trade-off occurred and a good practice AMS would ensure this was documented.

In support of their safety repex optimisation processes, each DNSP provided examples of company policies or procedures explaining that the businesses are required to trade-off risk adjusted costs, typically in a business case style report. However, only UED produced a spreadsheet that appeared to show they had followed this approach, albeit not in time for the initial proposal as it was still in draft.

None of the DNSPs provided a spreadsheet or any other kind of comparable evidence of their repex optimisation processes actually trading of risk adjusted costs, particularly for safety related expenditure, in response to question 12 of our initial RFI. This question specifically asked for evidence of repex portfolio optimisation, e.g. a spreadsheet with a ranked list of risk adjusted potential repex investments, such as the one UED provided in defence of the optimisation of its reliability repex.

5.3.5 Conclusions

Based on the findings from our approach to testing the efficiency and prudency of DNSP submitted repex, Energeia has reached the following reasoned conclusions:

- UED's repex is based on an asset management system that is geared towards maintaining SAIDI, and on managing asset failures. While they have provided the most robust evidence of trading-off their reliability repex, they have not evidenced trading-off their safety repex between asset categories. Their rate of asset replacement appears to be better (lower) than industry standard economic lifetimes but higher than CIT/PCR and JEN in some cases.

  Based on the foregoing findings, Energeia cannot conclude that UED's proposed repex is prudent and efficient due to the number and degree of risks and/or issues identified.

- While JEN have provided evidence of policies and procedures for trading-off on the basis of risk adjusted costs[53], 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 UED'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.

- CIT/PCR claim their repex focuses on the drivers of asset failure more than the consequences of those failures. While CIT/PCR have provided evidence of policies and procedures for trading-off on the basis of risk adjusted costs[54], they have not evidenced that this process is followed by providing a ranking of potential safety repex options by category. Nevertheless, their rate of asset replacement appears to be the lowest for the categories we have reviewed.

  Based on the foregoing findings, Energeia cannot conclude that CIT/PCR's proposed repex is prudent and efficient due to the number and degree of significant risks and/or issues identified.

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[52] ISO 55001 Standard, Section 6.2.2 (a) – (k), Section 7.5 (b) and (e), pp. 5-6

[53] Response to Energeia from JEN titled "JEN Response to AER IR #020, 27 August 2015". Received from the AER August 26, 2015.

[54] Meeting between Energeia, AER and CIT/PCR representatives at 9.30am on 31St August, 2015 at CIT/PCR Melbourne office.

- ANS claim their repex is focused on STIPIS, shocks and fires. Like most of the other DNSPs, ANS provided evidence of policies and procedures for trading-off on the basis of risk adjusted costs[55] but did not evidenced that this process is followed by providing a ranking of potential safety repex options by category. Finally, their relative rate of asset placement has not been able to be identified, but their proposed repex is now significantly higher than their nearest comparator, PCR.

  Based on the foregoing findings, Energeia cannot conclude that ANS's proposed repex is prudent and efficient due to the number and degree of significant risks and/or issues identified.

[55] Meeting between Energeia, AER and AusNet Services representatives at 12pm on 31st August, 2015 at ANS Melbourne office.

Appendix 1 – Victorian Safety Reporting Requirements

Section 4.1 Monthly Statistical Summary of Schedule 1 and 2 Incident Reports[56]

Cross Reference to Schedule 2 Report	Consequence – Public (involves members of the public excluding MEC Workers at work)	Definition
16B.ii	Fatalities (excluding wilful) directly caused by electricity	Electrocution
16B.iii	Fatalities (excluding wilful) indirectly caused or involving electricity	Eg. Fatality due to a fire started by an electrical infrastructure incident
16B.iv	Wilful deaths	Suicide
16B.vii	Serious Injuries	is bodily harm requiring medical treatment by a registered medical practitioner other than a precautionary check or first aid treatment
16B.x or 16B.xvi	Serious incident - highly unsafe situation	No go zone infringements, unauthorised contact with live electrical asset or unauthorised access.
16B.xv	Vehicle contacting network asset (other than No Go Zone)	Contact with assets (poles, overhead, underground, etc)
Cross Reference to Schedule 2 Report	**Consequence – MEC (involves MEC Worker only)**	**Definition**
16.A.ii	Fatalities – MEC Workers	Involving the release of electrical energy.
16A.vii	Serious injuries – MEC Workers	is bodily harm requiring medical treatment by a registered medical practitioner other than a precautionary check or first aid treatment.
17.f and 16A.v or 17.f and 16A.vi or 17.f and 16A.xi	Serious incident – significant damage to property	Asset failure resulting in a fire (excluding network asset fires), or asset failure resulting in significant damage to property
17.f and 16A.xvi and Not (16Av or 16A.vi)	Serious incident – highly unsafe situation	Electrical asset failure (no fire) resulting in serious risk to public safety. eg. live conductor on ground or live asset accessible to non-authorised person
16A.v	Fires – Number of contact incidents	Number of fires caused by contact with assets
16A.v or 16A.vi	Fires – Number of electricity related fires	Number of fires caused by asset failure (includes fires caused by contact with assets above)

Cross Reference to Schedule 2 Report	Root Cause Classification for Schedule 1 & 2 Incidents Reported to ESV - Asset Failure	For incidents which are reported to ESV as a Schedule 1 or Schedule 2 incident.
17.f and either 19.am,an,ao or ap	Asset Failure – Underground cable	Underground cable failure
17.f and 19.w	Asset Failure - Pole fire	Pole failure resulting in a pole fire
(not 16.vi) and 17.f and 19.w	Asset Failure - Pole (other than pole fire)	Pole failure not resulting in a pole fire
16.vi and 17.f 19.x	Asset Failure - Crossarm fire	Crossarm failure resulting in a crossarm fire
(not 16.vi) and 17.f and 19.x	Asset Failure - Crossarm (other than crossarm fire)	Crossarm failure not resulting in a crossarm fire
17.f and either 19.f,g,h, or i	Asset Failure - Fuse	Fuse failures e.g. candling, fire choke not containing all sparks
17.f and either 19.m,s,t or v	Asset Failure - Conductor	Broken conductor, broken ties
17.f and either 19.r or u	Asset Failure - OH cable	ABC, Covered Conductor, service cable.
17.f and either 19.c,d or j	Asset Failure - Connections	Service connections, LV connections, HV connections
17.f and either 19.a, b,e,k,l,n,o,p,q,y,z,aa,ab,ac, ad, ae,af, ag,ah, ai,aj,ak,al, ap or ar	Asset Failure - Other	Public Lighting, substations, SDs, etc

Source: Victorian Government

[56] Energy Safe Victoria, DB Electrical Safety Performance Reporting Guidelines v4.0, July 2014: http://www.esv.vic.gov.au/Portals/0/DB%20Electrical%20Safety%20Performance%20Reporting%20Guidelines.pdf

Appendix 2 – About Energeia

Energeia Pty Ltd (Energeia) based in Sydney, Australia, brings together a group of hand-picked, exceptionally qualified, high calibre individuals with demonstrated track records of success within the energy industry and energy specialist academia in Australia, America and the UK.

Energeia specialises in providing professional research, advisory and technical services in the following areas:

- Smart networks and smart metering
- Network planning and design
- Policy and regulation
- Demand management and energy efficiency
- Sustainable energy and development
- Energy product development and pricing
- Personal energy management
- Energy storage
- Electric vehicles and charging infrastructure
- Generation, including Combined Heat and Power (CHP)
- Renewables, including geothermal, wind and solar PV
- Wholesale and retail electricity markets

The quality of our work is supported by our energy-only focus, which helps ensure that our research and advice reflects a deep understanding of the issues, and is often based on first-hand experience within industry or as a practitioner of theoretical economic concepts in an energy context.

Energeia's Relevant Experience

Energeia's recent regulatory and network management related engagements are summarised below.

Review of Victorian DNSPs' 2013 Revised Advanced Metering Infrastructure Budgets

The Australian Energy Regulator engaged Energeia to undertake a review of Victorian Distribution Network Service Providers' (DNSPs) 2013 revised budget proposals for Advanced Metering Infrastructure against the regulatory criteria specified in the revised Order in Council.

Review of Victorian DNSPs' 2012-15 Advanced Metering Infrastructure Budgets

The Australian Energy Regulator engaged Energeia to undertake a review of Victorian Distribution Network Service Providers' (DNSPs) 2012-2015 budget proposals for Advanced Metering Infrastructure against the regulatory criteria specified in the revised Order in Council.

Review of Victorian DNSPs' 2009-11 Advanced Metering Infrastructure Budgets

The Australian Energy Regulator engaged Energeia to undertake a review of Victorian Distribution Network Service Providers' (DNSPs) 2009-2011 budget proposals for Advanced Metering Infrastructure against the regulatory criteria specified in the revised Order in Council.

Review of Advanced Metering Infrastructure Enabled Load Control Performance Levels

A Victorian DNSP engaged Energeia to undertake a review of current load control enabling performance levels and to make recommendations considering the impact of updated use case benefits and communications cost information.

Best Practice Regulation of Smart Metering

A smart metering vendor engaged Energeia to identify policy and regulatory options for improving the smart meter deployment in Victoria. The engagement included a detailed review of leading international smart metering deployments in California, Texas, Pennsylvania, Ontario and Sweden.

Smart Grid Design and Development

Energeia was engaged by a major Australian utility to develop a smart grid solution for minimising the costs and carbon intensity of generating power in a remote island energy system. The engagement included designing a fit-for-purpose smart grid concept, developing functional and technical specifications, supporting market engagement, modelling project costs and benefits, and developing the project business case.

Smart Grid, Smart City Proposal Support

Energeia was engaged by a DNSP to support the development of their winning proposal for the $100M Smart Grid, Smart City project. The engagement included the development of a retailer value proposition and engagement strategy, development of the project's delivery and operating models, and development of related proposal documentation.

Network of the Future Design

A top tier field services provider engaged Energeia to support the development of a Network and Substation of the Future concept design and development roadmap. The engagement included researching international best practice, facilitating a number of concept development workshops with project stakeholders, developing the client proposal, and sourcing the skilled resources needed to deliver it.

Future Operating Model Design

An Australian DNSP engaged Energeia to support the development of their Future Operating Model blueprint and roadmap to 2026. The engagement included facilitating a series of whole-of-business workshops to gain strategic alignment on the DNSP's future customers, network and organisation, and the development of documentation to support stakeholder engagement and communication.

Embedded Networks for Electric Vehicles

Energeia was engaged by a leading electric vehicle infrastructure company to review the existing market arrangements around embedded networks and to provide recommendations regarding how these arrangements may be used to support the deployment of electric vehicle charging infrastructure.

Appendix 3 – Resumes of Key Personnel

EZRA BEEMAN

MANAGING DIRECTOR

SUMMARY OF EXPERIENCE

Ezra Beeman has consulted on business strategy, asset transactions, contract structuring, energy and information technology, market design and industry regulation for company directors, executives and managers of major oil, gas and power companies across Europe, the Americas and the Asia Pacific region.

Ezra's industry career has spanned a number of strategic and internal advisory roles where he helped propel EnergyAustralia into a position of international leadership in smart metering, products and services. During his time with the company, he built a reputation for tackling some of the company's toughest challenges and achieving exceptional results.

In addition to his consulting and utility executive experience, Ezra is an internationally recognized expert on advanced metering infrastructure, wholesale and retail markets, customer research, and demand response.

QUALIFICATIONS

- Masters of Applied Finance, Macquarie University, Australia
- Bachelor of Arts in Economics and Philosophy, Claremont McKenna College, United States

SUMMARY OF EXPERIENCE AT ENERGEIA

As the Managing Director, Ezra has overall responsibility for achieving the company's vision of becoming Australia's leading specialist consultancy and industry research firm. Ezra is responsible for setting and delivering the company's research agenda and developing new business. In this role his major achievements have been:

- Advising and supporting 21 companies pursuing ground-breaking outcomes, representing a broad cross-section of Australia's energy industry.
- Developing a 20 year industry roadmap for the establishment of a smart grid in Australia on behalf of the Electricity Networks Association (ENA).
- Authoring two chapters of EnergyAustralia's winning proposal for the $100M Smart Grid, Smart City project and contributing to its overall development.
- Developing a smart grid solution for minimising the costs and carbon intensity of generating power in a remote system on behalf of Hydro Tasmania.
- Reviewing over $2 billion in Victorian distribution network's smart grid budget proposals on behalf of the Australian Energy Regulator (AER).
- Creating a continuous improvement process for promoting best available technology for energy efficiency and carbon reduction on behalf of Newcastle City Council.
- Identifying international best practice in smart meter enabled retail pricing and related customer protections on behalf of the Essential Services Commission (ESC) of Victoria.
- Developing a business plan and authoring a winning proposal for the supply of electrical vehicle charging infrastructure on behalf of ChargePoint Australia.
- Creating a value framework, integrated network and retail price and benefits capture strategy to maximise the value of demand response on behalf of a new entrant retailer.
- Estimating the market and network value of demand response across a range of service levels on behalf of CitiPower-Powercor.

- Identifying the key risks and opportunities related to smart metering and the emerging smart energy market strategy on behalf of Origin Energy.
- Authoring major studies of the smart energy market, personal energy management and electric vehicles on behalf of Integral Energy, Hydro Tasmania, Energex and Ergon.

SUMMARY OF EXPERIENCE ENERGY AUSTRALIA

As the A/Mgr – Alliance Strategy, Ezra was responsible for managing the implementation of two Alliances to deliver up to $1.5B in capital projects over five years. In this role his major achievements were:

- managing the legal and commercial negotiations to achieve commercial alignment, and developing a comprehensive Alliance implementation plan, including a resourcing model for $8B capital program

As the A/Executive Mgr – Strategic Services, Ezra was responsible for the coordination of the Executive team on behalf of the Executive General Manager, Network. His duties included:

- providing advice to the Executive General Manager, Network; Strategy development, business planning and divisional communication; performance measurement, monitoring and reporting; Board, ministerial and inter-divisional interfaces and coordination of the exec.management team

As the Mgr – Network Metering & Pricing Strategy, Ezra was responsible for the formulation, justification and delivery of company's strategic pricing and metering initiatives. His responsibilities included:

- leading the development and delivery of the $500M Advanced Metering Infrastructure (AMI) strategy, which included Australia's largest technology pilot & customer research study
- driving the deployment of Australia's largest smart metering fleet and representing the Division during a $70M strategic metering procurement

As the Network Business Consultant, Ezra was responsible for internal business consulting, including:

- providing strategic advice to senior management on B2B, metering, pricing and retail services; managing retail market interfaces, including internal service providers; managing strategic initiatives including the Time-of-Use (ToU) / interval meter rollout; leading negotiations between EA Network, retailers and end-users, and increasing faltering ToU project output from 2,500/ year to 16,000/ year.

SUMMARY OF EXPERIENCE CAMBRIDGE ENERGY RESEARCH ASSOCIATES

As the Senior Associate, Global Gas & Power, Ezra provided expertise to the group's four regional gas and power teams. Projects included:

- overseeing the Asia Pacific gas and power component of a Board level strategy project; lead author of long-term N.A. gas scenarios study and editor and co-author of regional Latin American power sector briefings.

As an Associate Director, European Power, Ezra was a senior member of a team serving 50 clients. His role was responsible for the network sector, retail & wholesale markets and player strategy, ad-hoc client advisory service and new business development. In this role Ezra's achievements were;

- becoming the youngest Associate Director in the company's history; developing a pan-European pricing model for due diligence on $800M IPP; providing Board level due diligence to a major trading bank's generator investment in South Australia.

Ezra Beeman has published more than 15 articles and papers in his field of expertise.