FINAL

Forecast of Efficient Type-5/6 Metering Operating Costs

Prepared by ENERGEIA for Endeavour Energy

November 2017

Executive Summary

In Endeavour Energy's (EE's) FY15-19 Determination, the Australian Energy Regulator (AER) rejected EE's revised proposal on the basis that it did not reflect Rules compliant forecast expenditure. Instead, it determined:

- An opening Metering Asset Base (MAB) of 1.6 million Type 5 (interval) and Type 6 (accumulation) metering assets valued at $18.8 million ($ nominal),
- $14.6 million ($2014–15) in metering capex (a 34% reduction from EE's initial proposal), and
- $71.7 million in opex ($2014-15) (a 21% reduction from EE's initial proposal).

Three key policy and regulatory changes have occurred since EE's previous regulatory determination in 2015 that will impact on its FY20-24 determination.

1. **Power of Choice** (PoC) – Metering services across the National Electricity Market (NEM) will become contestable as of 1 December 2017. The capital and operating costs of Type-5/6 meters installed prior to 1 December 2017 will continue to be classified as ACS[1].
2. **AEMO Transition Strategy –** As part of the Australian Energy Market Operator (AEMO)'s transition strategy, Distribution Network Service Providers (DNSPs) will be permitted to continue installing basic meters for new connections and additions/alterations until 30 March 2017, while they will be permitted to replace faulty meters with only smart meters from 1 December 2017[2].
3. **Limited Merits Review** (LMR) – In Feb 2016, the Australian Competition Tribunal (ACT) directed the AER to use a broader range of modelling and benchmarking against Australian businesses and a "bottom up" review of the regulated suppliers' forecast opex.
4. **Abolition of LMR** – The Council of Australian Governments Energy Council's 2016 review of the LMR regime found that it was largely failing to deliver long-term benefits to energy consumers[3]. In response, the Australian Government passed a bill that means the AER's decisions are no longer subject to merits review.

Scope

EE engaged Energeia to provide expert technical advice to inform EE's FY20-24 regulatory proposal on the reasonably likely to occur, efficient and prudent operational cost of delivering Type-5/6 metering services, incorporating[4]:

- An estimation of the number of EE's Type-5/6 metering customers which are likely to churn to an advanced metering provider in the FY20-24 regulatory control period
- An estimation of the increase in the operating costs associated with EE's Type-5/6 metering services as a consequence of falling economies of scale due to customer churn
- An assessment of the reasonableness of Energeia's estimate of EE's forecast metering operating expenditure tested against the relevant benchmarks
- A review of other distributors' actual and allowed metering costs compared to those of EE.

Metering capital expenditure was deemed to be immaterial and therefore excluded from Energeia's scope.

[1] AER Final F&A for NSW, Jul 2017, p99

[2] https://www.aemo.com.au/-/media/Files/Electricity/NEM/Power-of-Choice/PM/2017/Executive-Forum-7-Meeting-Pack---10-Aug-17.pdf, p16

[3] https://www.australiancompetitionlaw.org/reports/2017meritsreview.html

[4] EE's Terms of Reference for the Calculation of Efficient Type 5 and 6 metering operating costs, 2017, p8

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Approach

Energeia's approach to estimating EE's revenue requirement for Type-5/6 metering services involved the following seven steps:

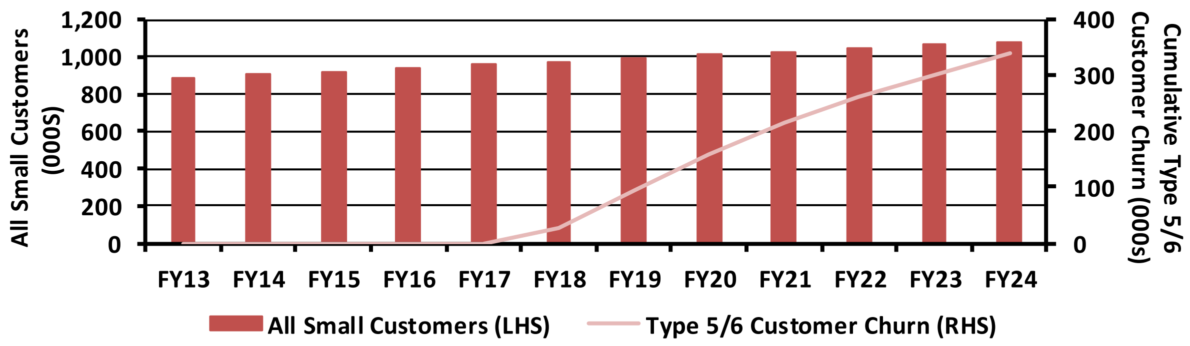
1. **Analysis of the Regulatory Framework** – Energeia identified the relevant National Electricity Rules (NER), AER Forecast Expenditure Assessment Guidelines, AER Framework and Approach policies and AER precedents relating to regulated metering expenditure.
2. **Initial Information Discovery** – Energeia managed a Request for Information (RFI) register, validated historical metering cost and volume data, and analysed costs and volumes to identify key cost categories and volume drivers.
3. **Forecast Volume Estimation** – Energeia developed a Type-5/6 meter churn model to forecast future volumes by driver.
4. **Base, Step and Forecast Trend Estimation** – Energeia analysed historical expenditure to determine an appropriate base, identifying any steps and calculating a trend based on historical expenditure.
5. **Benchmark Assessment** – Energeia analysed the AER's accepted benchmarking approach and inputs against potential alternatives. Energeia then applied its recommended approach to assess EE's estimated metering costs against the efficient benchmark, and applied any necessary efficiency adjustments.
6. **Development of Rules Compliant Expenditure Forecasts** – Energeia developed forecasts of Rules compliant operational Type-5/6 metering expenditure.
7. **Validation and Documentation of Results** – Energeia presented and discussed the data inputs, modelling results and accompanying models with EE to validate their accuracy.

Results

Forecast Volume

Energeia's analysis produced average forecast churn rates of 3.9% per year over FY18-24, primarily driven by retailer-initiated smart meter rollouts, followed by solar PV installations and proactive meter replacements. Figure E1 displays Energeia's forecast of Type-5/6 customers over the FY20-24 period.

Figure E1 – Forecast Type-5/6 Metering Customers (FY20-24)



Source: Energeia

Base, Step, Trend

Energeia estimated EE's base year opex to be $FY17 18.6 million, reflecting the average of the last 5-years' of actuals including overheads.

Energeia's bottom-up analysis of metering opex cost drivers found that for each Type-5/6 metering installation that is replaced with a smart meter, EE is likely to only avoid 23% of its base unit costs, for the reasons detailed in Table E1.

Table E1 – Assumed Per Customer Adjustment and Rationale by Cost Category

Category	Adjustment	Rationale
Meter Reading	Pro-rata 25% per customer	Field labour is 50% to total, savings is 50% of field labour
Maintenance	Pro-rata 0% per customer	No impact on testing
Data Services	Pro-rata 100% per customer	Reductions can be 100% managed

Source: Energeia

Benchmarking

Energeia evaluated 18 Ordinary Least Squares models based on the sign of the coefficients, the p-values and the R- (or adjusted R-) squared ability to explain differences in DNSP's cost per customer. The following model specification performed the best when considering FY14-16 Regulatory Information Notice responses by EE's closest benchmarks of Ausgrid and Energex:

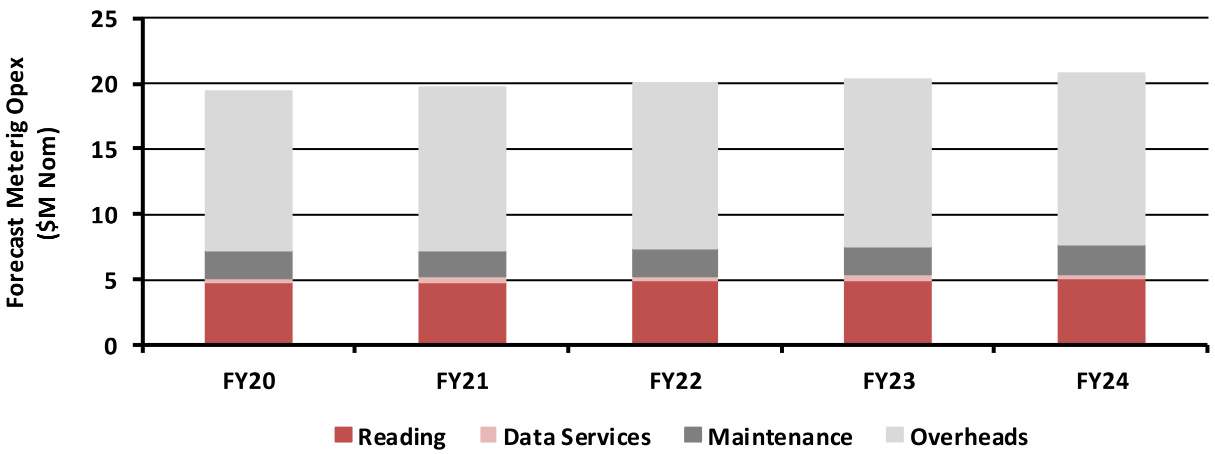
$$\frac{Metering\ Opex}{Type\ 5/6\ Customers} = -9.7 * 10^{-5} * Type\ 5/6\ Customers - 114.68 * \frac{Type\ 5/6\ Meters}{Type\ 5/6\ Customers} + 0.81 * \frac{Type\ 5/6\ Customers}{Service\ Area}$$

Using the best available benchmarking model for metering service costs, Energeia found that none of the Distribution Network Service Providers were significantly different in terms of their cost to serve, once their Operating Environment Factors were accounted for. Energeia therefore concluded that EE's own base and trend costs were therefore efficient.

Rules Compliant Expenditure Forecasts

As shown in Figure E2, Energeia forecasts that EE will require $101 M in metering opex over the regulatory period, including $26 M for metering reading, $2 M for data services and $11 M for maintenance and $61 M for overheads.

Figure E2 – Forecast Efficient, Prudent and Reasonably Likely to Occur Metering Opex (FY20-FY25)



Source: Energeia

Energeia concluded the above forecast of EE's metering opex satisfies the three opex criteria outlined in Chapter 6 of the NER as follows:

1. **Efficiency** – Benchmarking showed that EE's base year metering opex / Type-5/6 customers was no more or less efficient than its peers.
2. **Prudency** – Endeavour's forecast expenditure reflects taking measures to minimise the effect of PoC on its costs, e.g. via delaying its planned replacements until the PoC arrangements were clarified.
3. **Reasonably Likely Forecasts** – Developed using extrapolation and conservative, bottom-up, evidence-based assumptions.

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Disclaimer

While all due care has been taken in the preparation of this report, in reaching its conclusions Energeia has relied upon information and guidance from Endeavour Energy and publicly available information. 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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Expert Witness Acknowledgement

Ezra Beeman acknowledges the he has read, understood and complied with the Federal Court of Australia's Practice Note CM 7, Expert Witnesses in Proceedings in the Federal Court of Australia.

1 Structure of this Report

The report is structured as follows:

- **Section 2** – Background summarises the outcomes of Endeavour Energy (EE)'s distribution determination for the FY15-19 regulatory control period, the key policy and regulatory changes that have occurred since then and EE's key obligations for the upcoming FY20-24 regulatory control period;
- **Section 3** – Scope and Approach describes Energeia's scope of work and its methodology for forecasting Rules compliant metering expenditure over the FY20-24 regulatory control period;
- **Section 4** – Regulatory Framework summarises the relevant National Electricity Rules (NER), the Australian Energy Regulator (AER) Expenditure Forecast Assessment Guideline (the Guideline), the AER Framework and Approach (F&A) paper, and the AER precedents relating to metering expenditure;
- **Section 5** – Information Discovery describes Energeia's process of collecting, validating and analysing information;
- **Section 6** – Forecast Volume describes the key regulatory requirements, Energeia's forecasting methodology and the results of Energeia's Type-5/6 volume forecasting model;
- **Section 7** – Base, Step and Trend describes the key regulatory requirements, Energeia's estimation methodology and the results of Energeia's base-step-trend modelling;
- **Section 8** – Benchmarking describes the key regulatory requirements, Energeia's benchmarking methodology and the results of Energeia's benchmarking modelling;
- **Section 9** – Forecast Rules Compliant ACS Metering Expenditure summarises Energeia's Alternative Control Services (ACS) metering opex forecasts and describes how they satisfy EE's regulatory requirements.

2 Background

This section summarises the outcomes of EE's distribution determination for the FY15-19 regulatory control period, the policy changes that have occurred since then and EE's obligations for the upcoming FY20-24 regulatory control period.

2.1 FY15-19 Determination

In EE's FY15-19 Determination, the AER rejected EE's revised proposal on the basis that it did not reflect Rules compliant forecast expenditure. Instead, it made the following Determination:

- An opening Metering Asset Base (MAB) of 1.6 million Type 5 (interval) and Type 6 (accumulation) metering assets valued at $18.8 million ($ nominal),
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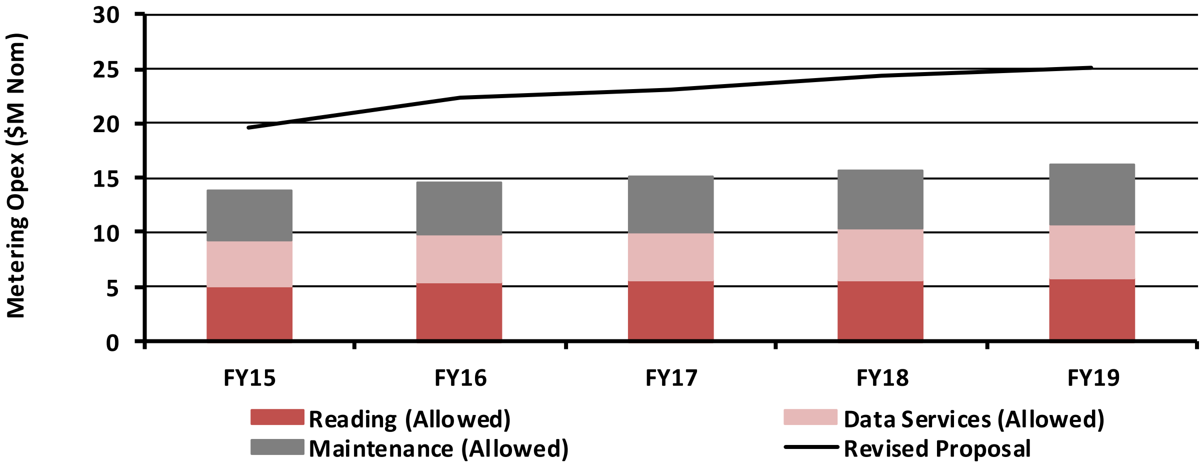
- $71.7 million in opex ($2014-15) (a 21% reduction from EE's initial proposal).

Figure 1 presents the AER's allowed opex by cost category by year with the black line representing the expenditure proposed by EE in its revised regulatory proposal.

Figure 1 – EE's Allowed Metering Opex by Post-Tax Revenue Model (PTRM) Category for FY15-19



Includes Overheads

Source: AER Final Decision EE Metering Model 2015, 'Pricing Calc (Per Service)' tab; EE Revised Metering Model 2015, 'Pricing Calc (Per Service)' tab

In substituting EE's opex forecasts with their own forecasts, the AER relied upon their own benchmarking analysis, which found EE's operating efficiency to be below that of Energex.[5] The AER's expenditure allowances over the FY15-19 regulatory control period therefore reflected Energex's 'efficient' costs, which the AER determined to be the benchmark efficient entity, rather than EE's forecast of their own efficient costs.[6]

[5] Ibid., p54

[6] Ibid., p55

2.2 Policy and Regulatory Changes

2.2.1 Power of Choice

As part of the Power of Choice (PoC) reforms, the Australian Energy Market Commission (AEMC) introduced a rule change in 2015 intended to support competition in metering and to facilitate the market-led deployment of advanced meters. The rule change[7]:

- Transferred the role and responsibilities of the existing Responsible Person performed by distribution networks to a new type of Registered Participant called a Metering Coordinator, performed by the retailer by default
- Allows any person to become a Metering Coordinator, subject to meeting the registration requirements
- Permits large customers to appoint their own Metering Coordinator

This means that from 1 December 2017 (and therefore before the commencement of the next regulatory control period on 1 July 2019), metering services across the National Electricity Market will become contestable.

As part of the Australian Energy Market Operator (AEMO)'s transition strategy, Distribution Network Service Providers (DNSPs) will be permitted to continue installing basic meters for new connections and additions/alterations until 30 March 2017 while they will be permitted to replace faulty meters with only smart meters from 1 December 2017[8].

2.2.2 Framework and Approach

In its Final F&A paper for NSW, the AER outlined the two key implications for the classification of Type-5/6 metering services throughout the FY20-24 regulatory control period:

1. As metering providers will no longer be permitted to install or replace existing meters with Type-5/6 meters, the AER will not classify these services. [9]
2. As the NSW distributors are required to continue to operate and maintain existing Type-5/6 metering equipment until they are replaced, they will recover the capital and operating costs of this equipment installed prior to 1 December 2017[10] as an ACS (specific monopoly service).[11]

2.2.3 Limited Merits Review of 2014-19 Determination

A Limited Merits Review (LMR) regime was introduced into both the National Electricity Law and the National Gas Law in 2008, and amended in 2013. The regime allows parties affected by prescribed decisions to have those decisions reviewed by the Australian Competition Tribunal (ACT) where it can be established that there is a serious issue and grounds for review[12]. The available grounds for review are: that the AER made material error of facts, its exercise of discretion was incorrect or its decisions were unreasonable in all the circumstances[13].

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[7] http://www.aemc.gov.au/getattachment/87a49036-707f-446b-92fb-b333543da21b/Information-sheet-%E2%80%93-overview.aspx Competition in metering services Information Sheet 2015, p1

[8] https://www.aemo.com.au/-/media/Files/Electricity/NEM/Power-of-Choice/PM/2017/Executive-Forum-7-Meeting-Pack---10-Aug-17.pdf, p16

[9] AER Final F&A for NSW, Jul 2017, p24

[10] Energeia assumes that the AER will extend this deadline to 30 March 2018 in line with AEMO's transition strategy.

[11] Ibid., p99

[12] COAG Energy Council Limited Merits Review – Terms of Reference, 19 Aug 2016, p1

[13] Australia Competition Tribunal in the matter of Applications by PIAC, Ausgrid and Others Summary, 26 Feb 2016, p3

Under this regime, the network businesses across NSW and the ACT, and the consumer group the Public Interest Advocacy Centre sought a LMR of the AER's determinations for the FY15-19 regulatory period[14].

In Feb 2016, the Tribunal directed the AER to remake its decisions in relation to the networks' operating expenses, cost of corporate income tax and cost of debt[15]. The ACT decisions relevant to EE's upcoming metering expenditure proposal include:

- The AER should use a broader range of modelling and benchmarking against Australian businesses and a "bottom up" review of the regulated suppliers' forecast opex[16].
- The AER's use of a 5-year average rather than a single year to calculate Ausgrid's metering opex does not demonstrate a reviewable error[17].

The ACT's broader benchmarking and bottom-up review decisions have been reflected in this report in Section 8 on benchmarking and in Section 7.4.2.2 on the bottom-up analysis of the forecast trend.

2.2.4 Changes to Merits Review

As required under the 2013 reforms to the LMR, the Council of Australian Governments (COAG) Energy Council reviewed the LMR regime in 2016[18]. The review found that the 2013 amendments to the regime had largely failed. The reasons given included that the LMR:

- remained routine
- had significant costs to all participants
- presented barriers to meaningful consumer participation
- led to significant regulatory and price uncertainty, and
- was failing to demonstrate outcomes that were in the long-term interests of consumers[19].

In response, the Australian Government announced on 20 June 2016 that it would divest the ACT of its LMR function, effectively abolishing the regime[20]. The Senate bill passed 16 Oct 2016 prevents the ACT from reviewing certain decisions made under the national energy laws, including electricity network revenue determinations and gas access arrangements, but excluding decisions relating to disclosure of confidential or protected information[21]. Further, the bill ensures that decisions made by the AER under those laws are not subject to merits review by any other state or territory body[22]. This means that the revised proposal stage of the determination process will be the NSPs' final opportunity to dispute the AER's expenditure assessment frameworks and assumptions.

While the AER's decisions are longer subject to LMR, Energeia expects the AER will incorporate the ACT's decisions regarding broader benchmarking and bottom-up analysis in its forthcoming determinations.

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[14] https://www.aer.gov.au/news-release/federal-court-judgement-on-aer-electricity-and-gas-price-decisions-disappointing-outcome-for-nsw-and-act-consumers

[15] Ibid.

[16] Australia Competition Tribunal in the matter of Applications by PIAC, Ausgrid and Others Summary, 26 Feb 2016, p5

[17] Ibid., p8

[18] COAG Energy Council Limited Merits Review – Terms of Reference, 19 Aug 2016, p1

[19] https://www.australiancompetitionlaw.org/reports/2017meritsreview.html

[20] Ibid.

[21] http://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;page=0;query=BillId%3Ar5929%20Recstruct%3Abillhome

[22] Ibid.

3 Scope and Approach

EE engaged Energeia to provide expert technical advice to inform EE's FY20-24 regulatory proposal on the realistically likely to occur, efficient and prudent cost of delivering Type-5/6 metering services, incorporating[23]:

- An estimation of the number of EE's Type-5/6 metering customers which are likely to churn to an advanced metering provider in the FY20-24 regulatory control period
- An estimation of the increase in the operating costs associated with EE's Type-5/6 metering services as a consequence of falling economies of scale due to customer churn
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- A review of other distributors' actual and allowed metering costs compared to those of EE

Metering capital expenditure was deemed to be immaterial and therefore excluded from Energeia's scope.

Energeia's approach to estimating EE's revenue requirement for Type-5/6 metering services involved the following 7 steps:

1. **Analysis of the Regulatory Framework** – Energeia identified the relevant NER, AER Guidelines, and AER F&A policies, and examined the AER's relevant precedents relating to regulated metering expenditure.
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7. **Validation and Documentation of Results** – Energeia presented and discussed the data inputs, modelling results and accompanying models with EE to validate their accuracy.

[23] EE's Terms of Reference for the Calculation of Efficient Type 5 and 6 metering operating costs, 2017, p8

4 Regulatory Framework

This section outlines the regulatory framework against which EE's proposed FY20-24 metering expenditure will be evaluated, with specific reference to the NER, the AER's Guideline, the AER's F&A paper, and precedents from the AER's most recent determinations.

4.1 The National Electricity Rules

Chapter 6 of the NER governs the AER's regulation of distribution services. Part B confers power on the AER to classify distribution services, to determine the forms of control for distribution services, and to make distribution determinations. Part C sets out the building block approach to the regulation of services classified as standard control services (SCS). Part E sets out the procedure and approach for the making of a distribution determination.

4.1.1 Service Classification and Distribution Determinations

Part B dictates that the AER may classify a distribution service as either a direct control or a negotiated service. Direct control services can be further classified as SCS or ACS. The NER require the AER to keep the previous classification unless circumstances change.[24]

A determination is made to control revenue or prices or both for direct control services. While the control mechanism for SCS must be of the form CPI-X, or some incentive based variant of this approach, there is no constraint on the control mechanism for ACS other than that it be documented in the determination.[25] It may, but does not need to, utilise elements of the building bock approach specified in Part C.[26]

4.1.2 Building Block Approach

Where the AER makes an ACS determination on the basis of a building block approach, it must specify the annual revenue requirement. The annual revenue requirement for each year must be based on a building block approach. The relevant building block for ACS metering services and this review are:

- Indexation of the Regulated Asset Base (RAB)
- The forecast operating expenditure.
- The forecast capital expenditure.

Indexation of the RAB involves the addition of approved capital expenditure, the subtraction of depreciation and the indexation of the remainder using the AER's Roll Forward Model.[27]

DNSP's operating expenditure forecasts must be approved if the AER is reasonably satisfied it reflects each of the following operating expenditure criteria:[28]

1. The efficient costs of achieving the operating expenditure objectives,
2. The costs that a prudent operator would require to achieve the operating expenditure objectives, and
3. A realistic expectation of the demand forecast and cost inputs required to achieve the operating expenditure objectives.

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[24] NER, clause 6.2.2(d)

[25] Ibid., clause 6.2.6(b)

[26] Ibid., clause 6.2.6(c)

[27] Ibid., clause S6.2.3(c)

[28] Ibid., clause 6.5.6(c)

The operating expenditure objectives are specified in Section 6.5.7(a) of the Rules:

1. Meet or manage the expected demand for SCS over that period,
2. Comply with all applicable regulatory obligations or requirements associated with the provision of SCS,
3. Maintain the quality, reliability and security of supply of SCS, and
4. Maintain the reliability, safety and security of the distribution system through the supply of SCS.

In deciding whether the AER is satisfied that the DNSP's operating expenditure forecasts reflect the operating expenditure criteria, the AER must have regard to the following operating expenditure factors[29]:

1. The most recent annual benchmarking report and the benchmark operating expenditure that would be incurred by any efficient DNSP over the relevant regulatory period
2. The actual and expected operating expenditure of the DNSP during any preceding regulatory control periods
3. The extent to which the operating expenditure forecast includes expenditure to address the concerns of electricity consumers as identified by the DNSP throughout its engagement with electricity consumers
4. The relative prices of operating and capital inputs
5. The substitution possibilities between operating and capital expenditure
6. Whether the operating expenditure forecast is consistent with any incentive scheme or schemes that apply to the DNSP under clauses 6.5.8A or 6.6.2 to 6.6.4
7. The extent the operating expenditure forecast is preferable to arrangements with a person other than the DNSP that, in the opinion of the AER, do not reflect arm's length terms
8. Whether the operating expenditure forecast includes an amount relating to a project that should more appropriately be included as a contingent project under clause 6.6A.1(b)
9. The extent the DNSP has considered, and made provision for, efficient and prudent non-network options
10. Any relevant final project assessment report (as defined in clause 5.10.2) published under clause 5.17.4(o), (p) or (s)
11. Any other factor the AER considers relevant and which the AER has notified the DNSP in writing, prior to the submission of its revised regulatory proposal under clause 6.10.3, is an operating expenditure factor.

If the AER is not satisfied, they must not accept the forecast and instead substitute an alternative forecast that they are satisfied reasonably reflects the expenditure criteria[30]. Whether they accept or do not accept a forecast, the AER must provide reasons for their decision.[31]

4.2 The AER's Expenditure Forecast Assessment Guideline

The AER is required under clause 6.2.8(a)(1) of the NER to publish the Guideline, setting out their approach to determining whether the proposed expenditure reasonably satisfies the operational expenditure criteria and the associated information requirements for carrying out their assessment.

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

1. Examination of the DNSP's proposal and other relevant information
2. Comparison of the forecast with an alternative benchmark estimate
3. Consideration of explanations for variations to the efficient benchmark

[29] Ibid., clause 6.5.7(e)

[30] Ibid., clause 6.5.7(d)

[31] Ibid., clause 6.12.2

4. Publication of an Issues paper
5. Development of Draft and Final Determinations

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 minimising the long run cost of achieving the expenditure objectives.[32]

In assessing the reasonableness of specific expenditure forecasts, the AER will apply a range of qualitative and quantitative techniques on a case-by-case basis, including[33]:

- Benchmarking, including econometric and category analysis
- Methodology review
- Governance and policy review
- Predictive modelling
- Trend analysis
- Cost benefit analysis
- Detailed project review

A detailed explanation of each of these approaches is contained in the Guideline. The Guideline also details the AER's specific approach to assessing operational expenditure forecasts, which is summarised in the following section.

4.2.1 Operational Expenditure Assessment Approach

Operational expenditure is almost entirely recurrent and the AER therefore prefers to assess it against the operational expenditure criteria using the base-trend-step methodology[34].

Under this approach, the base year expenditure (exclusive of any movements in provisions) is assessed to determine whether it is a reasonably prudent and efficient starting point using the range of assessment techniques described in Section 5.3 of the Guideline. Any identified inefficiencies will be used to adjust the base year to an efficiency benchmark base year[35].

The trend is estimated using the historical change in output costs as a function of real input price growth, productivity growth and output growth[36].

Step changes reflect structural shifts in the cost of supply, for example due to changes in the regulatory environment or the impact of an efficient capex/opex trade off.[37] They can be due to both positive and negative change events. Step changes should not double count costs included in other elements of the opex forecast, namely they:

- Should not double count the costs of increased volume or scale compensated through the output measure in the rate of change

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[32] AER, Expenditure Forecast Assessment Guideline for Electricity Distribution, November 2013, p9

[33] Ibid., p12

[34] Ibid., p22

[35] Ibid., p22

[36] Ibid., p23

[37] Ibid., p24

- Should not double count the cost of increased regulatory burden over time, which forecast productivity growth may already account for
- Should not double count the costs of discretionary changes in inputs (not required to increase output).

The approach assumes that:

- The efficiency criterion and the prudence criterion in the NER are complementary
- Past actual expenditure was sufficient to achieve the expenditure objectives in the past[38]

4.3 The AER's Framework and Approach

Under clause 6.8.1 of the NER, the AER is required to publish an F&A paper at the commencement of each regulatory determination process to inform stakeholders of its intentions with respect to service classification and price control mechanisms.

The AER's F&A paper for the FY20-24 regulatory control period sets out its intention to classify Type-5/6 metering services as ACS[39] and the specification of ACS metering services to include the following sub-services[40]:

- **Metering Provision** – Recovery of the capital cost of Type-5/6 metering equipment installed prior to 1 December 2017
- **Metering Maintenance** – Covers works to inspect, test, maintain and repair meters
- **Meter Reading** – Refers to quarterly or other regular reading of a meter
- **Meter Data Services** – Involves the collection, processing, storage and delivery of metering data and the management of relevant NMI Standing Data in accordance with the NER.

Metering Installation Services are unclassified and hence will not be regulated by the AER[41].

In determining a control mechanism to apply to ACS, the AER had regard to the factors in clause 6.2.5(d) of the NER as well as the provision of cost reflective prices[42]. The AER noted that the NSW distributors' ACSs are currently subject to price cap regulation, and that the continuation of the price cap methodology over the FY20-24 regulatory control period best meets factors in clause 6.2.5(d)[43].

The AER did not specify the basis of the control mechanism for ACS, suggesting it could be based on a building block approach, or a modified building block cost build up[44]. Energeia notes that a building block approach was adopted in the setting of SA and QLD distributor prices for ACS metering in the most recent round of regulatory determinations.[45] Energeia therefore assumes that EE will need to largely meet the same regulatory tests for their forecast volume, and operational expenditure for ACS metering as they will for their SCS network services expenditure.

[38] Ibid., p8

[39] AER Final F&A for NSW, Jul 2017, p24

[40] Ibid., p99

[41] Ibid., p27

[42] Ibid., p45

[43] Ibid., p54

[44] Ibid., p54

[45] SAPN, Ergon Energy, Energex Final Determinations ACS 2015

Although the F&A paper is meant to provide guidance to the DNSPs and stakeholders regarding the AER's approach to key regulatory decisions, the AER notes that the classification of distribution services and the formulae that define each control mechanism may change in 'unforeseen circumstances'. [46]

Nevertheless, in Energeia's view, the F&A paper represents the best available information upon which to base a proposal for providing ACS metering.

4.4 AER Precedents

This section summarises the AER's approach to setting revenues for ACS metering over the most recent determinations for NSW, SA and QLD[47].

4.4.1 Forecast Volumes

Over the most recent determinations, the AER has consistently assessed both reactive and proactive replacement volumes relative to historical trends due to the statistically random nature of meter failures[48]. The AER has only accepted trend divergent forecasts when supported by prudent business cases[49] or updated test result data[50].

4.4.2 Base-Step-Trend

There are three recurring themes across the most recent distribution determinations with regards to the AER's implementation of the base-step-trend approach:

1. The AER accepts base years that reflect a DNSP's 5-year historical average expenditure[51] or a comparable DNSP's expenditure if their own expenditure is deemed to be inefficient. For example, EE's base metering opex was derived from Energex's[52] while Essential Energy's was derived from Ergon Energy's[53].

2. The AER only accepts step changes associated with a new regulatory obligation or a capex/opex trade off[54]. For example, the AER rejected Ergon Energy's proposed step changes due to increased meter read frequency or increased voltage testing[55]. Similarly, the AER rejected South Australian Power Networks' proposed step changes due to increased meter read frequency or the impact of metering contestability[56].

3. The AER accepts trends that assume zero real price and productivity growth[57].

4.4.3 Benchmarking

In its Final Rule Determination on the Economic Regulation of Network Service Providers, the AEMC recommended that the AER consider exogenous factors and not consider endogenous factors when undertaking a benchmarking

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[46] AER Final F&A for NSW, Jul 2017, p11

[47] Victorian metering determinations are not relevant because they implemented a large scale roll out of smart meters

[48] SAPN Final Determination ACS 2015, p29

[49] Ibid., p30

[50] EE Final Determination ACS 2015, p52

[51] ActewAGL Final Determination ACS 2015, p33

[52] EE Final Determination ACS 2015, p55

[53] Essential Energy Preliminary Decision ACS 2014, p42

[54] AER Expenditure Forecast Assessment Guideline 2013, p11

[55] Ergon Energy Final Decision ACS 2015, p14

[56] SAPN Preliminary Decision ACS 2015, p10

[57] Energex Preliminary Decision ACS 2015, p47

exercise[58]. Building on this recommendation, the AER assessed potential operating environment factors (OEFs) using the following three OEF criteria in its Preliminary Decision on Energex' operating expenditure for FY16-20[59]:

1. **Exogeneity –** An OEF should be outside the control of service providers' management.
2. **Materiality –** An OEF should create more than a 0.5% difference in the service providers' opex. Where the effect of an OEF is not material, the AER would generally not provide an adjustment for the factor, although they note that in this decision, they have provided a collective adjustment for individually immaterial factors.
3. **Duplication –** An OEF should not have been accounted for elsewhere.

In future reviews, as the AER collects more information on OEFs, the AER has stated that they are likely to adopt a stricter approach to the consideration of OEFs[60].

In its 2015 Final Determination, the AER used EE's historical annual metering opex per customer adjusted for customer density (measured as total customers per km of route length) as a partial performance indicator of the efficiency of the most recent complete year's operational expenditure (known as the 'revealed cost' because DNSPs have an incentive to minimize this expenditure)[61]. While the AER considered customer density to be a network characteristic that exogenously influences opex requirements[62], they did not consider differences in economies of scale to be a factor which would materially affect the benchmarking results[63].

Table 1 shows the AER's chosen comparator for each DNSP in NSW, QLD, SA and TAS from recent determinations.

Table 1 – The AER's Chosen Comparator for Each DNSP in NSW, QLD, SA and TAS

DNSP	Customer Density (Customers/km)[1]	AER's Comparison	Customer Density (Customers/km)[1]
Endeavour	34	Energex[2]	32
Ausgrid	34	Energex[3]	32
Essential	4	Ergon[4]	5
SAPN	11	TasNetworks[5]	14

Sources:
1. Economic Benchmarking RINs FY16
2. Energex Preliminary Determination ACS FY14-19, p47
3. Ausgrid Preliminary Determination ACS FY14-19, p40
4. Ergon Final Determination ACS FY14-19, p38
5. SAPN Prelimary Determination ACS FY14-19, p40

Figure 2 shows how the metering opex per customer of the NSW, QLD and SA distributors relative to their AER defined customer density has changed since this determination was made. Specifically, Ausgrid, EE and Energex's metering opex per customer have converged to some extent.

[58] AEMC, Rule Determination, National Electricity Amendment (Economic Regulation of Network Service Providers) 2012, p113

[59] Energex Preliminary Decision Opex 2015, p161

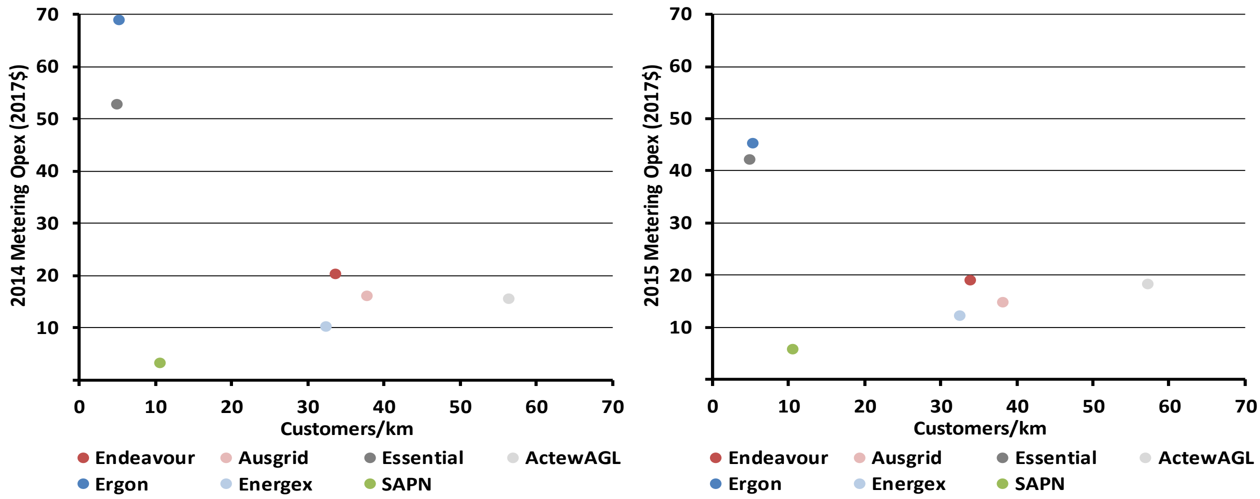
[60] Energex Preliminary decision Opex 2015, p157

[61] EE Final Decision ACS 2015, p39-40

[62] Ibid. p40

[63] Ibid. p55.

Figure 2 – Change in Metering Opex/Customer from 2014 to 2015



Source: Economic Benchmarking RINs FY14 and FY15, 3.2 Opex tab, Table 3.2.2.1, "Opex for Metering"; Economic Benchmarking RINs FY14 and FY15, 3.4 Operational Data tab, Table 3.4.2.1, "Total customers"

5 Information Discovery

This section describes Energeia's methodology for collecting, verifying and analysing EE's historical and current metering expenditure.

5.1 Collection

Data collection involved:

- Development and maintenance of the initial and subsequent RFIs (see Table 2)
- Review of publicly available data sources, including Category Analysis and Economic Benchmarking Regulatory Information Notice (RIN) responses

Table 2 – Summary of Areas Covered in the RFI and Corresponding Status

	Status (Closed/Open)
Contracts	Closed
Models	Closed
Procurements	Closed
Plans	Closed
Policies	Closed
Reporting	Closed
Resourcing	Closed

Source: Energeia

5.2 Verification

Data was verified by:

- Cross checking line items against the NER to ensure they were in scope
- Tracing them back to the audited RIN responses
- Developing and maintaining of a key questions register
- Engaging with the relevant EE personnel, including those listed in Table 3

Table 3 – Summary of key EE Metering Personnel

Position
Metering Asset Engineering Manager
Regulation Strategy Manager
Manager Network Regulation
Contracts Director - Metering
Manager Network Data & Performance

Source: Endeavour Energy

The sources of each key input are reported in Appendix A unless otherwise stated.

5.3 Analysis

Data was analysed to determine:

- Fixed vs. variable cost categories – Determines impact of changes in volumes on cost-to-serve.
- Key volume drivers – Determines future volumes.

6 Forecast Volume

This section outlines the regulatory requirements underpinning Energeia's 'reasonably likely to occur' forecast of EE's Type-5/6 metering customers over the FY20-24 period, and explains Energeia's forecasting methodology and results.

6.1 Regulatory Requirements

The NER dictate that the forecast expenditure must reflect a realistic expectation of the demand forecast required to achieve the capital expenditure objectives[64]. The Guideline suggests that the revealed volumes are a good indicator of forecast requirements[65].

For reactive and planned replacement forecasts, the AER precedent is to assess DNSP's forecasts relative to historical trends due to the statistically random nature of full functionality meter failures[66].

6.2 Methodology

Based on the regulatory requirements and precedents described above, Energeia forecasted Type-5/6 metering customer numbers over the FY20-24 regulatory control period using a bottom-up approach that analysed the following key drivers:

- New Type-5/6 metering customer connections up to 30 March 2018[67]
- Abolishments and in-situ meter faults
- Planned replacements
- Gross Feed in Tariff (FiT) conversion volumes
- Retailer business case rollout volumes
- Solar PV uptake volumes

For each driver, Energeia:

1. Collected historical data on each driver to develop a trend estimate
2. Identified key factors impacting trend-based projections, the AER's preferred approach
3. Developed a forecast of each driver's impact on the number of Type-5/6 customers over the forecast period
4. Applied the forecast to the number of Type-5/6 customers in the base year

The sources of each key input are reported in Appendix A.1 unless otherwise stated.

64 NER, clause 6.5.7(c)

65 The Guideline, p8

66 SAPN Final Determination ACS 2015, p29

67 https://www.aemo.com.au/-/media/Files/Electricity/NEM/Power-of-Choice/PM/2017/Executive-Forum-7-Meeting-Pack---10-Aug-17.pdf, p16

6.3 Results

Energeia's volumes forecast is presented in Table 4. Forecast churn rates average 3.9% per year, resulting in 31% of EE's small customers having smart meters by FY24. Retailer-initiated rollouts are expected to be the primary churn driver over the forecast period, followed by solar PV installations and proactive meter replacements.

*Table 4 – Summary of Energeia's Volume Forecasts**

	Actual					Forecast						
	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24
Type-5 and 6 Customers	**883,692**	**910,534**	**923,162**	**937,657**	**957,661**	**949,194**	**899,394**	**852,564**	**810,897**	**784,925**	**762,223**	**740,177**
Res Customers	806,519	830,658	843,867	859,445	879,357	871,582	825,853	782,853	744,592	720,744	699,898	679,655
Non-Res Non-Demand Customers	77,173	79,876	79,296	78,212	78,305	77,612	73,540	69,711	66,304	64,180	62,324	60,522
All Small Customers	**883,692**	**910,534**	**923,162**	**937,657**	**957,661**	**975,059**	**992,565**	**1,010,072**	**1,027,578**	**1,045,084**	**1,062,590**	**1,080,096**
Type-5/6 Customer Changes	**-9,357**	**13,102**	**3,595**	**-14,148**	**-30,356**	**-8,467**	**-49,801**	**-46,829**	**-41,668**	**-25,972**	**-22,702**	**-22,046**
Plus	**15,242**	**25,287**	**29,320**	**27,191**	**26,190**	**20,357**	**0**	**0**	**0**	**0**	**0**	**0**
Small New NMIs	15,242	25,287	29,320	27,191	26,190	20,357	0	0	0	0	0	0
Less	**24,599**	**12,185**	**25,725**	**41,339**	**56,546**	**28,823**	**49,801**	**46,829**	**41,668**	**25,972**	**22,702**	**22,046**
Abolishments	12,463	529	4,204	14,160	5,714	6,447	6,390	6,055	5,740	5,459	5,284	5,132
Solar PV	8,721	5,140	9,493	5,625	5,175	2,386	9,460	8,964	8,497	8,082	7,823	7,597
Gross FiT				2,088	25,482	665	2,635	2,497				
Meter Faults	3,415	6,516	12,028	8,032	4,260	2,351	14,551	13,787	13,069	12,431	9,595	9,317
Proactive		2,799	8,150	3,188	665	250	10,387	9,842	9,329	8,873	6,152	5,974
Reactive	3,415	3,717	3,878	4,844	3,595	2,101	4,164	3,945	3,740	3,557	3,443	3,344
Retailer Business Case				11,434	15,915	16,975	16,764	15,526	14,362			
Historical and Forecast Churn			**2.8%**	**4.5%**	**6.0%**	**3.0%**	**5.2%**	**5.2%**	**4.9%**	**3.2%**	**2.9%**	**2.9%**
Type-5/6 Market Share		100%	100%	100%	100%	97%	91%	84%	79%	75%	72%	69%

***grey=Energeia estimate, white=EE historicals**

Source: Energeia

The volume forecasts satisfy regulatory requirements by demonstrating they are reasonably likely to occur as follows:

- They extrapolated historical trends when they are likely to be a relatively likely indicator of future trends, such as with abolishments and in-situ meter faults
- The drivers have been adjusted to reflect declining Type-5/6 customer numbers over time
- The alternative to trend forecasts are supported by evidence-based assumptions, such as the Meter Asset Management Plan (MAMP), retailer business case driven meter rollouts and changes in the solar PV FiT
- The alternative forecasts reflect conservative assumptions as indicated for retailer business case rollouts, solar PV installations and Gross FiT conversion volumes

Energeia's analysis of each volume driver is discussed in the following sections.

6.3.1 Type-5/6 Customers

Type-5/6 customer numbers are used to drive forecast opex using the base-step-trend forecasting approach.

PoC will cap the number of Type-5/6 customers as at 30 March 2018. A forecast is therefore needed to estimate the number of Type-5/6 customers at this time. After this time, Type-5/6 metering customer numbers will decline as customer's churn away from Type-5/6 metering on to smart metering.

Energeia used historical residential and non-residential 'non-demand' customers as defined in the RIN as a proxy for historical Type-5/6 metering customers. In Energeia's view, this audited data source is the most reliable indicator of Type-5/6 customer numbers available.

As Energeia did not foresee any material changes to these drivers over the forecast period, the average new customer growth rate over the past 4 years was used to project new Type-5/6 customers to 30 March 2018.

6.3.2 Abolishments and In-Situ Meter Faults

Abolishments refer to Type-5/6 meters typically removed due to brownfield property developments. In-situ meter faults refer to reactive Type-5/6 meter replacements.

As Energeia did not foresee any material changes to these drivers over the forecast period, the average churn rate over the past 4 years was used to project abolishments and in-situ meter faults.

6.3.3 Planned Replacements

Planned replacements refer to Type-5/6 meter replacements on the basis of population failures during in-service compliance testing and detailed in EE's MAMP. The retailer will be obligated to replace these meters to comply with their Metering Coordinator obligations under the NER[68].

Energeia adopted EE's MAMP volumes as our planned replacement forecast rather than their historical rate of replacement, based on their replacement being a regulatory obligation for the retailer under POC, and therefore reasonably likely to occur.

6.3.4 Gross FiT Conversion Volumes

Gross Feed-in Tariff (FiT) conversion volumes refer to Type-5/6 meter replacements due to solar PV customers who were previously part of the NSW Gross FiT programs that concluded on 31 Dec 2016[69] changing their gross-metered solar PV systems to net-metered arrangements to access the current net-metered FiT.

Although there were over 27,000 Gross FiT conversions over FY16 and FY17, Energeia did not use a straight line projection of these volumes due to there being a limited population of gross FiT customers in EE's network area. Instead, Energeia undertook a bottom-up estimate of the reasonably likely number of gross FiT conversions using the following methodology:

1. The number of small scale solar PV installations that occurred in NSW while the NSW 60c and 20c Gross FiT programs were open to new entrants (1 Jan 2010 – 18 Nov 2010 for the 60c Gross FiT and 18 Nov 2010 – 28 Apr 2011 for the 20c Gross FiT[70]) was estimated using data collected from the Clean Energy Regulator (CER) on Small Technology Certificate (STC) applications.

2. The number was reduced based on the number of customers who were forced to leave either NSW Gross FiT program due to move-in/ move-outs, taking into account whether the program allowed the benefits to be transferred to new occupants if the home was sold/rented (allowed under the 20c Gross FiT program, but not under the 60c program[71]) and assuming an average annual move-in/move-out rate for NSW of 2.18% (derived from 2013-14 Australian Census results).

3. The remaining customers were then allocated to EE on a pro-rata residential customer basis due to the CER data not being DNSP specific.

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[68] NER, clause 7.6.1

[69] NSW Solar Bonus Scheme Statutory Review: Report to the Minister for Resources and Energy 2014, p10

[70] Ibid.

[71] Ibid., pII

4. The remaining EE Gross Fit customers was then reduced by the number of EE customers who have already replaced their gross meters.

5. Ninety percent of the remaining Gross FiT customers were then assumed to be converted over the next 3 years, due to the significant financial benefits of doing so.

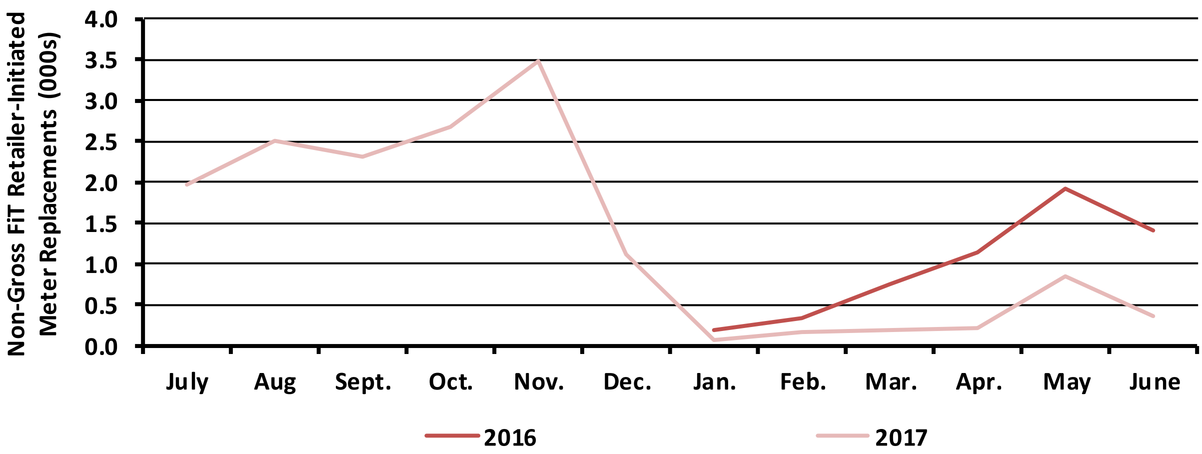
6.3.5 Retailer Business Case Rollout Volumes

In addition to customer and technical drivers of meter churn, Energeia has identified several potential business cases that we believe are reasonably likely to drive proactive retailer-led meter replacements over the FY20-24 timeframe:

- **Working Capital Cost Savings** – Smart meters allow retailers to bill customers more frequently, which is favourable from a cash-flow perspective, especially in the case of larger electricity consumers.
- **Hardship Customer Cost Savings –** Remote connection/disconnection and more frequent billing is also likely to reduce the number of write-offs that retailers would have to bear, as customers experiencing hardship tend to find small regular bills easier to pay than large quarterly bills.
- **Rental Customer Cost Savings** – Smart meters would help retailers avoid special meter reading charges arising from relatively frequent move-in/move-outs.
- **Metering Cost Savings** – Economies of scale associated with operating meters are likely to incentivise competitive metering providers to replace Type-5/6 meters whenever the opportunity arises, such as when a customer moves out.

Energeia's analysis of EE's recent churn found that it shows strong evidence of retailer business case driven rollouts by the most advanced retail players. Figure 3 shows the total number by month of non-gross FiT related retailer-initiated meter replacements undertaken in EE's network over Jan 2016-June 2017.

Figure 3 – Jan 16-Jun 17 Non-Gross FiT Retailer-led Meter Replacements by Month in EE



Source: Stats 20170906 170927v2

In forecasting the number of retailer business case driven replacements over the next regulatory period, Energeia made the following key assumptions:

- The number of retailer-initiated meter replacements (excluding Gross FiT) that occurred during the first half of FY16 was equal to that which occurred during the second half of the year.
- The other retailers serving EE customers achieve 90% of the leading retailer's business cases over the next 4 years, scaled to reflect the number of Type-5/6 customers remaining in each year.

Energeia believes the pro-rata assumption used to gross-up the volume of retailer business case volumes is conservative, given the seasonal nature of meter replacements illustrated in Figure 3. It is also highly conservative as it does not reflect the impact of falling metering costs on making additional business cases viable over time.

Most retailers are currently treating PoC as a compliance project and have not yet turned their attention to the costs and benefits of accelerating the deployment of smart meters to their customers. We think it is reasonable to assume that they will pursue the same business cases as the most advanced retailers as they become more sophisticated, which we as market experts believe is likely to occur over the next 3-5 years.

6.3.6 Solar PV Uptake Volumes

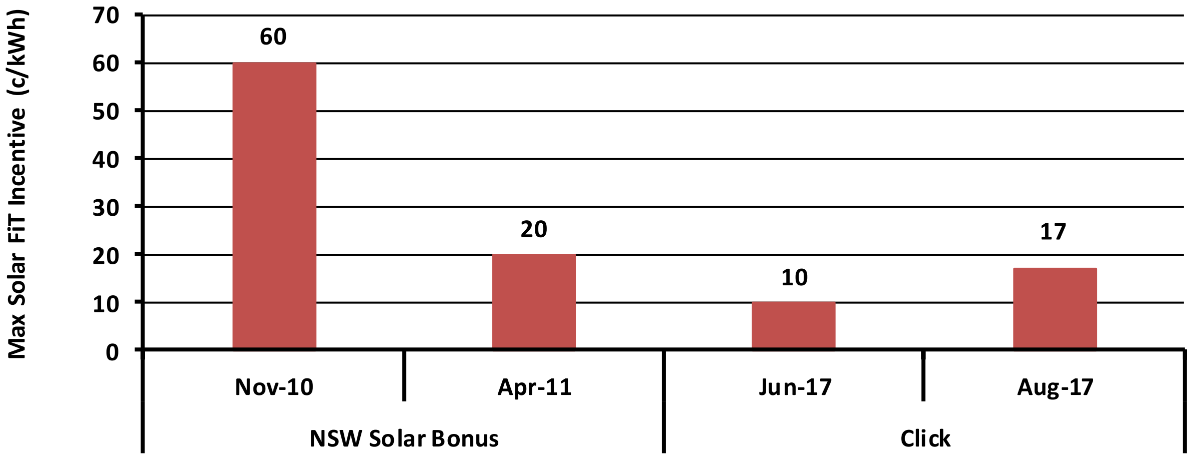
Solar PV installations drive Type-5/6 meter churn as a new two-way meter is typically required. Since 2010, solar PV uptake has largely been driven by FiTs and falling solar PV prices. Solar PV driven meter upgrades have averaged 6,831 per annum over the last 5 years.

Energeia's analysis of solar PV uptake found that a straight line projection did not meet the 'reasonably likely to occur' Rules test, on the basis that the NSW FiT was significant modified in July 2017, and likely to result in a material change to forecast volumes compared to historical volume trend.

In Jun 2017, the Independent Pricing and Regulatory Tribunal (IPART) released its final recommendation regarding the benchmark range for solar FiTs for FY18, proposing 11.9-15.0 c/kWh, up from 5.5-7.2c/kWh for FY17[72]. IPART's rulings are non-binding, however, the evidence shows they are influential.

Click Energy, identified as a market leader by IPART, increased its offer to 17c/kWh in Aug this year (see Figure 4), a 70% increase from June. When considered alongside solar PV prices being 60% lower than what they were when the 20c/kWh NSW Gross FiT program closed to new entrants in Apr 2011, Energeia concluded that EE is reasonably likely to see a step change in the number of solar PV installations over the forecast regulatory period.

Figure 4 – Key Solar FiTs Offered in NSW Over Time



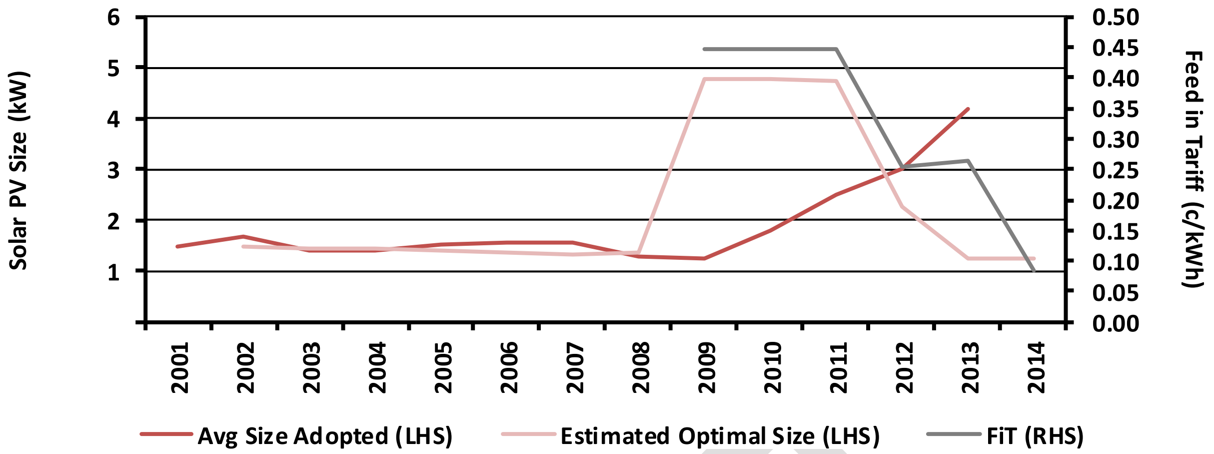
Source: IPART Jun 17, Wattever Aug 2017, Solar Bonus Scheme Statutory Review Report August 2014

In developing an alternative forecast to a straight line projection, Energeia analysed year-on-year changes in monthly volumes, historical volumes at comparable FiT rates, and publicly available market forecasts.

Energeia found that changes in market demand are not yet obvious in the data, however, the IPART report has only been released in the last two months, and it takes time for the market to adjust to changes in the FiT. This conclusion is supported by Energeia's analysis of the market's reaction to significant changes in the solar PV FiT in South Australia undertaken for SA Power Networks, which showed a 3-4 year delayed reaction (see Figure 5).

[72] IPART Solar feed-in tariffs in 2017-18 Final Recommendation Fact Sheet 16 Jun 2017

Figure 5 – Market Reaction to FiT Changes in South Australia



Source: CER, http://www.sa.gov.au/topics/energy-and-environment/energy-bills/solar-feed-in-payments

Energeia was unable to find publicly available market forecasts incorporating the new IPART FiT. Energeia therefore forecast the number of Type-5/6 meter replacements due to solar PV installations using the average of the top two years of solar PV installations over the past 5 years. We believe this is a relatively conservative estimate given the significantly higher FiT moving forward.

7 Base, Step and Trend

This section describes Energeia's application of the AER's base-step-trend approach to forecasting metering opex.

7.1 Regulatory Requirements

Although the ACS revenue determination framework is up to the discretion of the AER under the NER, precedent indicates that the AER is likely to apply the base-step-trend approach[73].

- **Base** – Base opex should be set equal to actual expenditure if actual expenditure in the base year reasonably reflects the opex criteria[74]. AER precedent is to use the last 5 years of historical opex rather than any single value[75].
- **Step** – Step changes should be due to changes in the regulatory environment or due to the impact of an efficient capex/opex trade[76].
- **Trend** – The trend should be estimated using the historical change in output costs as a function of real input price, productivity and output growth[77].

7.2 Base

The base year expenditure acts as a starting point from which to forecast a DNSP's expenditure requirements for the next regulatory control period[78].

7.2.1 Methodology

To calculate the base year metering opex, Energeia averaged historical data over the most recent 5-year period for which audited figures were available.

No adjustments were made to the base year opex to reflect changes in regulatory provisions.

[73] EE Final Decision ACS 2015, p40

[74] The Guideline, p22

[75] EE Final Decision ACS 2015, p40

[76] AER, Expenditure Forecast Assessment Guideline for Electricity Distribution, November 2013, p24.

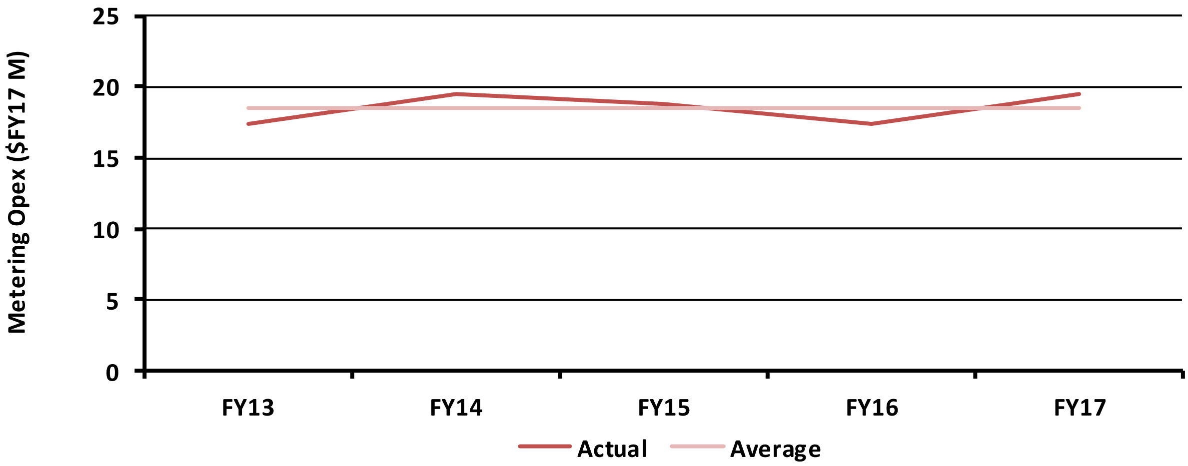
[77] Ibid., p23

[78] Ibid., p22

7.2.2 Results

Figure 6 shows EE's historical actual metering opex over the last 5 years. The average of the last 5 years of actuals including overheads is $FY17 18.6 million.

Figure 6 – Actual and Average Metering Opex for EE Over Current Regulatory Period



Source: EE Economic Benchmarking RINs for FY14, FY15, FY16 and FY17

7.3 Step

No step changes due to changes in the regulatory environment or due to the impact of an efficient capex/opex trade off were identified by Energeia[79].

7.4 Trend

The trend is used to project the impact of changes in forecast volumes, prices, and productivity on future operational expenditure requirements.

7.4.1 Methodology

Energeia's trend estimation followed the AER's methodology:

- Energeia first applied the AER's trending approach to identify historical trends in the cost per customer.
- Energeia then undertook a bottom-up analysis of each cost factor to determine which factors were variable and which would be fixed over the period, and their share of total costs.

Energeia ultimately chose to use a bottom-up estimate of the forecast trend due to key change in EE's regulatory environment, scope of activities and cost structure over the next regulatory period compared to the last 5 years.

7.4.2 Results

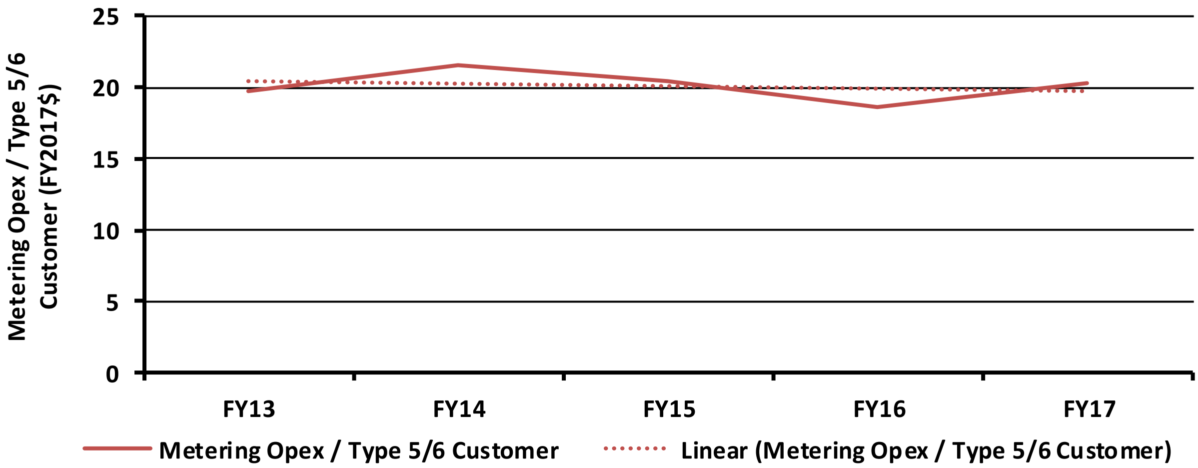
This section explains the results of Energeia's top-down and bottom-up analysis of trends in EE's metering opex.

7.4.2.1 Top-down Analysis

Figure 7 displays the results of Energeia's top-down analysis of EE's real opex per customer trend over the past five years. The trend analysis shows that Endeavour's opex per customer has remained relatively flat over the period.

[79] The Guideline, p24

Figure 7 – EE's Cost per Customer Trend by Year



Source: EE Economic Benchmarking RINs for FY14, FY15, FY16 and FY17

The above analysis is consistent with the AER's tendency to assume no material changes in trend.

7.4.2.2 Bottom-up Analysis

Energeia's review of EE's current service contracts and subsequent consultation with key EE personnel yielded the findings displayed in Table 5 regarding whether future costs were governed by contract or internal management.

Both data services and maintenance services for Type-6 meters were identified as internally resourced, and proposed changes are therefore subject to Collective Bargaining Agreements (CBAs), which limit EE's ability to reduce these costs in line with changes in metering volumes. Although contracts for Type-5/6 meter reading specify a fixed unit price, they may be cancelled by either party at any time should they become materially unfavourable, leading to a new negotiation and costs that more accurately reflect the meter reading service provider's actual costs[80].

Table 5 – Service Provider by Metering Service

Meter Type	Service Provider			
	Meter Reading	Data Services	Maintenance Services	Replacements
Type 5 and Sample Load Control Sites	Ausgrid	Ausgrid	Ausgrid	Ausgrid
Type 6 and Non-Sample Load Control Sites	Skilltech	Internally Resourced	Internally Resourced	Select Solutions

Source: Email "Re: Metering service providers" 5 Sep 2017

In examining the underlying cost structure of each service, Energeia developed the following bottom-up estimates of savings over the regulatory period per customer reduction:

- **Meter Reading** – Meter reading costs are mainly driven by travel times. Meter readers can skip houses, but must still travel past them, so the only time savings arise from avoiding going into the house and reading the meter. Energeia estimates avoidable effort represents approximately 50% of the meter reader's total effort and meter reader labour to be approximately 50% of total meter reading costs (other costs include the service provider's overheads, as well as the cost of maintaining the meter reading technology and vehicles). This translates to a 25% cost saving per customer reduction.

80 150727 NNSW Signed Agreement Skilltech Meter Reading Services, p27

- **Meter Maintenance –** Meter maintenance volumes are largely set by the condition of metering assets and statutory testing obligations under the NER and AEMO's Metrology Procedure. Meter populations, the key driver of testing requirements, are expected to stay relatively constant, as are testing equipment, labour and infrastructure costs. Based on this analysis, Energeia concluded that EE is likely to see little to no cost saving per customer reduction over the five year forecast period.
- **Data Services –** Data services are mainly carried out by EE's back office staff, and its costs are driven by the number of no access sites (because those bills have to be estimated) and the number of data streams. While EE's CBA creates some rigidity, Energeia estimates that reductions in data stream volumes and no access sites due to reductions in customers can be managed over the next five years to the extent that a 100% cost saving per unit customer reduction is reasonable.

Table 6 summarises the analysis and estimate of reasonable cost reductions per customer by metering opex category. Together, this means that for each Type-5/6 metering installation that is replaced with a smart meter, EE is estimated to only recoup 23% of the unit costs over the next five years.

Table 6 – Assumed Per Customer Adjustment and Rationale by Cost Category

Category	Adjustment	Rationale
Meter Reading	Pro-rata 25% per customer	Field labour is 50% to total, savings is 50% of field labour
Maintenance	Pro-rata 0% per customer	No impact on testing
Data Services	Pro-rata 100% per customer	Reductions can be 100% managed

Source: Energeia

8 Benchmarking

As per the Guideline[81], Energeia used benchmarking to determine whether EE's revealed opex costs (that formed the basis of Energeia's base and trend cost calculations) were efficient.

This section describes how Energeia's benchmarking model builds on the AER's current benchmarking approach and the ACT's benchmarking related decision, and explains the results of Energeia's benchmarking analysis.

8.1 Methodology

Energeia developed an Ordinary Least Squares (OLS) econometric model to calculate the Operating Environment Factor (OEF) adjustments that should be applied to EE's base metering opex to make it comparable to comparable DNSPs[82]. This section details the underlying dataset, the assessment framework used to determine the most appropriate model and the process of applying the adjustment factors.

8.1.1 Dataset

Since publishing its Final Determination on ACS for EE in 2015[83], the AER has collected an additional two years' worth of Category Analysis and Economic Benchmarking RIN responses from 7 DNSPs across NSW, Queensland (QLD), South Australia (SA) and Victoria (VIC). This represents an additional 14 data points with which to build an econometric model. Appendix A.2 identifies the source of each input and output Energeia considered during its benchmarking analysis.

8.1.2 Model Development

Due to the findings of the ACT regarding the benchmarking model used by the AER in the previous ACS determination, Energeia developed its own benchmarking model using a first-principles, expertise-informed, data-driven approach.

The key steps the development of our fit-for-purpose benchmarking model were:

1. **Determine Target Variables –** The variable that the benchmarking model is designed to predict or explain.
2. **Identify Potential Explanatory Variables –** Variables that might best explain changes in the target variable.
3. **Determine Data Filters –** The basis for excluding certain data from the analysis, e.g. DNSPs and years.
4. **Specify the Model –** Identify the best model using standard statistical techniques.

The benchmarking model was then used to adjust each DNSP's actual opex for their specific OEFs in order to determine which DNSP was operating at a level more efficient than could be explained by their OEFs alone.

8.2 Results

The results of Energeia's benchmarking analysis are reported in Table 7, which shows that on average, EE, Energex and Ausgrid exhibit similar levels of efficiency after considering the OEFs included in Energeia's model. Based on the results of our comprehensive benchmarking analysis, Energeia concludes that EE is neither more nor less efficient than its peers, and therefore its revealed costs should be used as the basis for forecast opex.

[81] The Guideline, p8

[82] EE Final decision ACS 2015, p55

[83] Better Regulation Explanatory statement for Final regulatory information notices to collect information for category analysis Mar 2014, p1

Table 7 – Comparison of Estimated Versus Actual Metering Opex per Type-5/6 Customer

	EE (FY$17)		Actual vs.	EGX (FY$17)		Actual vs.	AUS (FY$17)		Actual vs.
	Model	Actual	Model	Model	Actual	Model	Model	Actual	Model
FY14	20.9	21.4	2.6%	10.1	10.2	0.9%	15.7	18.0	14.2%
FY15	19.9	20.4	2.3%	11.5	10.5	-8.5%	15.4	15.0	-2.5%
FY16	19.8	18.6	-5.9%	13.7	14.7	7.1%	16.8	15.0	-10.7%
Avg.	20.2	20.1	-0.3%	11.8	11.8	-0.1%	16.0	16.0	0.3%

Source: Energeia

While EE's average performance was the lowest (more efficient) of each of the benchmarked DNSPs, the differences are within the error bounds of the model, and likely to be zero.

The results of each of Energeia's benchmarking steps are detailed in the following section.

8.2.1.1 Target Variables

In its Final Determination for EE's ACS for FY15-19, the AER selected Metering Opex / Total Customer as the target[84].

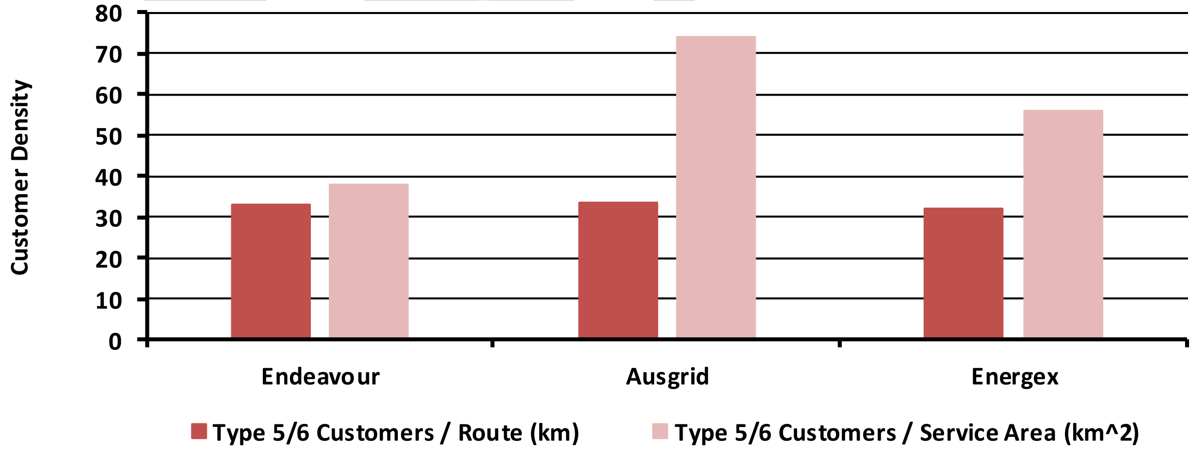
Based on its own knowledge of metering opex drivers, and the results of regression analysis, Energeia selected Metering Opex / Type-5/6 metering customers as the target variable because metering opex only includes expenditure relating to metering services for Type-5/6 customers, and because regression analysis confirmed a stronger relationship between Type-5/6 metering opex drivers and Type-5/6 customers compared to total customers.

8.2.1.2 Explanatory Variables

In its Final Determination for EE's ACS for FY15-19, the AER selected Total Customers / Route Length as the only explanatory variable[85].

Figure 8 compares route length as a measure of customer density against network area (square kilometres). It shows that using route length leads to Endeavour being as dense as the major metropolitan networks of Ausgrid and Brisbane, which is in Energeia's view, an unreasonable outcome.

Figure 8 – Comparison of Customer Density Metrics Among Key Benchmark DNSPs



Source: As specified in Table A.2.1

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84 EE Final decision ACS 2015, p54

85 Ibid.

Based on Energeia's expert knowledge, analysis of EE's cost structure and regulatory work to date[86], Energeia tested the following potential explanatory variables in addition to AER's previously used Total Customers / Route Length for the following reasons:

- **Type-5/6 Customers / Route Length** – The more customers per km of route length, the less distance the meter reader must travel between each meter read. However, Energeia notes that route length shows Endeavour having a higher customer density than Energex and Ausgrid, suggesting the variable is likely to be flawed, at least with respect to customer density.
- **Type-5/6 Customers / Service Area** – The more customers per km of route length, the less distance the meter reader must travel between each meter read. Unlike the route length metric, network area results in customer density relativities that are consistent with common understanding that the Sydney and Brisbane CBDs and surrounding areas are more densely populated than Endeavour's largely suburban network.
- **Type-5/6 Meters / Type-5/6 Customers** – The more meters per customer, the longer the meter reader must spend at each meter site reading all the meters. Also, the more meters per customer, the larger the number of data streams and assets to manage per customer.
- **Number of Type-5/6 Customers** – The more customers, the greater the economies of scale (arising from lower fixed costs on a per customer basis). The greater the role of fixed costs on opex, the greater the role this variable is likely to play in total metering opex / customer.

The above explanatory variables were tested in both single and multi-variate models to determine the best sub-set.

8.2.1.3 Observation Filters

The 12 DNSPs that are regulated by the AER have been providing Category Analysis RIN responses since FY14. Overseas data was excluded based on the ACT decision, and our expertise regarding differences in operating environments. Energeia then filtered the potential observations by timing and DNSP.

Data from FY14-16 was included based on the availability of RIN data. The Victorian DNSPs were excluded from the analysis because they rolled out advanced metering technology in the last regulatory period, making their costs incomparable to distributors which have Type-5/6 meters[87]. This left a total of 21 observations from the SA, NSW and QLD distributors across the three years.

A subset of data incorporating the 9 observations that corresponded to Endeavour and its closest comparators in terms of customer density, Ausgrid and Energex[88], was also examined to identify any drivers that became more material when controlling for customer density.

8.2.1.4 Model Specification

Energeia used three criteria to assess the 18 OLS models tested:

1. **Sign of Coefficients** – The coefficient of each explanatory variable had to align with the logic described in Section 8.2.1.2, except in the case of multivariate models, where collinearity between dependant variables can lead to changes in the sign of coefficients compared to single variable models.

[86] Energeia's metering credentials are listed in Appendix B.

[87] AER Final Decision ACS EE FY16-19 p40.

[88] Energex Preliminary Determination ACS FY14-19, p47; Ausgrid Preliminary Determination ACS FY14-19, p40

2. **P-value** – The probability, under the null hypothesis, of obtaining a result equal to or more extreme than what was actually observed had to be less than the industry standard 10%. Energeia notes that collinearity also affects P-values in multivariate regressions.

3. **R-squared or Adjusted R-squared** – The explanatory power of the model inputs to predict the model outputs had to be maximized (R-squared applied to the single variate models while adjusted R-squared applied to the multi-variate models to account for the additional explanatory variables).

Table 8 – Benchmarking Model Evaluation Results

Option	Data points	Independent Variables					Dependent Variables		Sign	P-Value	R^2 or Adj R^2*
		All Customers / Route	Type-5/6 Customers / Route	Type-5/6 Meters / Type-5/6 Customer	Type-5/6 Customer / Service Area	Total Type-5/6 Customers	Metering Opex / All Customers	Metering Opex / Type-5/6 Customers			
1	21	√					√		√	√	31%
2	21		√					√	√	√	32%
3	21			√				√	√	√	19%
4	21				√			√	√	√	37%
5	21					√		√	√	X	5%
6	21			√	√			√	√	X	31%
7	21		√	√				√	√	X	26%
8	21				√	√		√	√	X	31%
9	21			√	√	√		√	√	X	30%
10	9	√					√		X	X	1%
11	9		√					√	√	X	0%
12	9			√				√	√	X	27%
13	9				√			√	√	X	21%
14	9					√		√	√	√	33%
15	9			√	√			√	X	X	28%
16	9		√	√				√	X	X	9%
17	9				√	√		√	X	√	75%
18	9			√	√	√		√	X	√	85%

Source: Energeia

Table 8 shows how each model performed against the assessment criteria. Energeia's findings and conclusions can be summarised as follows:

- Type-5/6 Customers / Service Area is a better measure of customer density than Type-5/6 Customers / Route in the case of both the full data set and the subset, based on the higher R-squared
- Type-5/6 Meters / Type-5/6 Customers is a significant indicator of Metering Opex / Type-5/6 Customers in the case of the full data set, but not in the case of the subset, based on the associated p-values
- Total Type-5/6 Customers is not significant in the case of the full data set, but becomes significant after controlling for customer density, based on the associated p-values
- Adding additional explanatory variables to the full data set model doesn't necessarily improve the explanatory power of the model and reduces the significance of each explanatory variable. In contrast, doing the same to the subset model improves the explanatory power of the model significantly whilst preserving the significance of each explanatory variable.
- The signs of the model coefficients are generally correct, except when Metering Opex / All Customers is regressed on All Customers / Route using the subset, and when multiple explanatory variables are included in the subset models. The latter is likely to be due to collinearity among explanatory variables.

Option 18 was taken forward based on its high explanatory power and low p-values. The signs of the coefficients – although unexpected – were accepted because they were correct on an individual basis, indicating the presence of collinearity in the explanatory variables.

The following equation was used to estimate the efficient level of Metering Opex / Type-5/6 Customers for EE and its peers (for comparison):

$$\frac{Metering\ Opex}{Type\ 5/6\ Customers} = -9.7 * 10^{-5} * Type\ 5/6\ Customers - 114.68 * \frac{Type\ 5/6\ Meters}{Type\ 5/6\ Customers} + 0.81 * \frac{Type\ 5/6\ Customers}{Service\ Area}$$

Energeia notes that the explanatory variables used in Energeia's model satisfy the AER's 3 OEF criteria as follows:

1. **Exogeneity** – They are all beyond the DNSP's control. The meters per customer is within the DNSP's control, but likely due to a historical business case showing it was more cost effective at the time, e.g. three single phase meters being lower cost than a single three phase meter.
2. **Duplication** – As described in Section 8.2.1.2, the three explanatory variables are intended to represent three different drivers of Metering Opex per Type-5/6 Customers. While the collinearity result suggests there is some duplication, the use of the regression model helps ensure that the duplication is corrected overall.
3. **Materiality** – According to Table 8, the explanatory variables together account for 85% of differences in the Metering Opex / Type-5/6 Customers across the 3 DNSPs and 3 years considered, making them material according to the AER's 5% materiality threshold.

9 Forecast Rules Compliant ACS Metering Expenditure

This section summarises Energeia's methodology for forecasting metering opex, the results of Energeia's analysis and how Energeia's forecast satisfies EE's regulatory requirements.

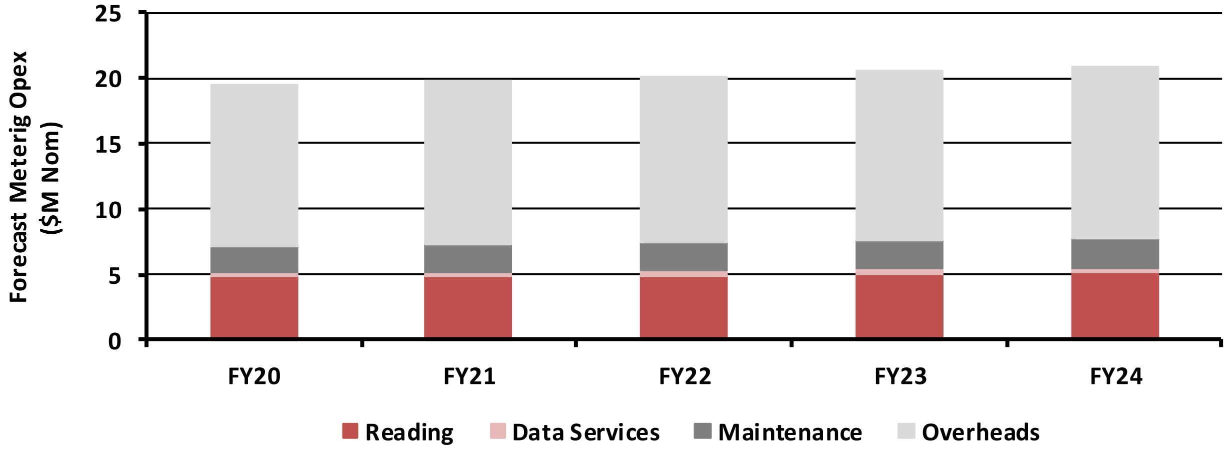
9.1 Methodology

Energeia's forecast of EE's efficient metering opex was developed by multiplying the forecast volumes detailed in Section 6.3 by the forecast trend for each cost category detailed in Section 7.4.2 to arrive at the final opex forecast by opex category.

9.2 Results

As shown in Figure 9, Energeia forecasts that EE will require $101 M in metering opex over the regulatory period, including $26 M for metering reading, $2 M for data services and $11 M for maintenance and $61 M for overheads.

Figure 9 – Forecast Efficient, Prudent and Reasonably Likely to Occur Metering Opex (FY20-FY24)



Source: Energeia

Energeia concludes the above forecast of EE's metering opex satisfies the three opex criteria outlined in Chapter 6 of the NER as follows:

1. **Efficiency** – Benchmarking showed that EE's base year metering opex / Type-5/6 customers was no more or less efficient than its peers.
2. **Prudency** – Endeavour's forecast expenditure reflects taking measures to minimise the effect of PoC on its costs, e.g. via delaying its planned replacements until the PoC arrangements were clarified.
3. **Reasonably likely forecasts** – Developed using extrapolation and conservative, bottom-up, evidence-based assumptions.

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Appendix A Data Sources

This appendix details the key data sources Energeia used to forecast EE's metering opex and capex requirements over FY20-24.

A.1 Forecast Volumes

Table A.1.1 – Type-5/6 Customers in Base Year

Data	Sources	Comments
Residential customers	2013-14 Economic Benchmarking RIN 2015-15 Economic Benchmarking RIN 2015-16 Economic Benchmarking RIN 2016-17 Economic Benchmarking RIN	3.4 Operational Data tab, "Residential customer numbers"
Non-residential Non-demand customers	2013-14 Economic Benchmarking RIN 2015-15 Economic Benchmarking RIN 2015-16 Economic Benchmarking RIN 2016-17 Economic Benchmarking RIN	3.4 Operational Data tab, "Non-residential customers not on demand tariff customers"

Table A.1.2 – *New Type-5/6 Metering Customer Connections*

Data	Source	Comments
Historical small new connections	Small new NMIS for last 5 years v0.1	"Summary" tab

Table A.1.3 – Abolishments and In-Situ Meter Faults

Data	Source	Comments
Historical abolishments	Small NMIs abolishments for last 5 years v0.1	"Summary" tab
Historical in-situ meter faults	Small meter fault and controlled load change for last 5 years v0.1	"Summary" tab

Table A.1.4 – Planned Replacements

Data	Source	Comments
Historical planned replacements	KISS-#10380456-v1-1633_12_Meter_Relay_Change_signed_agreement	P28
Future planned replacements	Stephen O'Halloran via Email "RE Metering Opex Review Draft Findings Presentation" 28/9/17	FY18 value
	MAMP Approved	P26
Historical actual planned replacements	MC99_Bulk_Meter_Changes	"Sheet 1" tab

Table A.1.5 – Gross FiT Conversion Volumes

Data	Sources	Comments
Historical small scale solar PV installations	CER	Includes upgrades, although the validation step in the methodology outlined above corrects for this
NSW move-in/move-out rate for FY14	Australian Bureau of Statistics, 41300DO004_201314 Housing Mobility and Conditions, 2013–14	
Historical residential customer numbers by DNSP	2013-14, 2014-15, 2015-16 Economic Benchmarking RINs	3.4 Operational Data tab, Table 3.4.2.1, "Residential customers"
Number of customers on NSW Gross FiT programs by DNSP as of 2014	Solar Bonus Scheme Statutory Review Report August 2014	P14
Number of EE customers who have already replaced their gross meters	Stats 20170906 170927v2	"COMMS4 this year by GFIT by Ret" tab

Table A.1.6 – Retailer Business Case Rollout Volumes

Data	Sources	Comments
Number of EE customers who have already replaced their gross meters	Stats 20170906 170927v2	"COMMS4 this year by GFIT by Ret" tab

Table A.1.7 – Solar PV Uptake Volumes

Data	Sources	Comments
Historical small scale solar PV installations	Small solar PV installation v0.1	"Summary" tab

A.2 Benchmarking

Table A.2.1 – Data Sources Used for Benchmarking Analysis

Value	Source File	Detailed Location	Notes
Metering Opex	2013-14, 2014-15, 2015-16 Economic Benchmarking RINs	3.2 Opex tab, Table 3.2.2.1, "Opex for Metering"	Nominal terms
Type-5/6 Meters	2013-14, 2014-15, 2015-16 Category Analysis RINs	4.2 Metering tab, Table 4.2.1, "Type 4: Single Phase", "Type 4: Multi Phase", "Type 5: Multi Phase", "Type 5: Multi Phase", "Type 6: Multi Phase", "Type 6: Multi Phase"	Only EE's RIN response contained Type-4 meter volumes and their Basis of Preparation clarifies that they form part of their regulated metering asset base
Service Area	DNSP Company websites	Endeavour value sourced from Annual Pricing Proposal 2017-18	Assumed constant over FY14-16
Residential Customer Numbers	2013-14, 2014-15, 2015-16 Economic Benchmarking RINs	3.4 Operational Data tab, Table 3.4.2.1, "Residential customer numbers"	All assumed to be using Type-5/6 meters
Non Residential Customers Not on Demand Tariff Customer Numbers	2013-14, 2014-15, 2015-16 Economic Benchmarking RINs	3.4 Operational Data tab, Table 3.4.2.1, "Non residential customers not on demand tariff customer numbers"	All assumed to be using Type-5/6 meters
Customer Density	2013-14, 2014-15, 2015-16 Economic Benchmarking RINs	3.7 Operating Environment tab, Table 3.7.1, "Customer density"	Route length calculated by dividing "Total Customers" by "Customer Density"
Total Customers	2013-14, 2014-15, 2015-16 Economic Benchmarking RINs	3.4 Operational Data tab, Table 3.4.2.1, "Total customers"	
Consumer Price Index	ABS 6401.0 Consumer Price Index, Australia	Data 1 tab, "All groups CPI; Australia"	Assumed June value for each year

Table A.2.2 – Raw Inputs Used for Benchmarking Analysis

DNSP	Year	Metering Opex (FY17$m)	Type-5/6 Meters (m)	Service Area (‘000 km^2)	Type-5/6 Customers (‘000)	Route Length (‘000 km)	Total Customers (‘000)
Endeavour	FY14	20	2	25	911	28	940
Ausgrid	FY14	29	2	22	1,612	49	1,651
Essential	FY14	47	1	769	807	174	854
ActewAGL	FY14	2	0	2	177	4	179
Ergon	FY14	54	1	1,700	713	140	712
Energex	FY14	14	2	25	1,363	43	1,376
SAPN	FY14	6	1	178	595	81	852
Endeavour	FY15	19	2	25	923	28	956
Ausgrid	FY15	25	2	22	1,632	39	1,670
Essential	FY15	43	1	769	819	181	867
ActewAGL	FY15	4	0	2	178	2	182
Ergon	FY15	45	1	1,700	719	139	723
Energex	FY15	15	2	25	1,383	43	1,397
SAPN	FY15	8	1	178	846	81	854
Endeavour	FY16	17	2	25	938	28	968
Ausgrid	FY16	25	2	22	1,652	49	1,688
Essential	FY16	30	1	769	825	182	879
ActewAGL	FY16	3	0	2	181	4	185
Ergon	FY16	39	1	1,700	726	140	736
Energex	FY16	21	2	25	1,406	44	1,422
SAPN	FY16	10	1	178	847	82	859

Source: as specified in Table A.2.1

Table A.2.3 – Calculated Ratios Used for Benchmarking Analysis

DNSP	Year	Total Customers / Route (km)	Type-5/6 Customers / Route (km)	Type-5/6 Meters / Type-5/6 Customer	Type-5/6 Customer / Service Area (km^2)	Metering Opex (FY17$) / Total Customers	Metering Opex (FY17$) / Type-5/6 Customers
Endeavour	FY14	33	32	2	37	21	21
Ausgrid	FY14	33	33	1	72	18	18
Essential	FY14	5	5	2	1	55	58
ActewAGL	FY14	44	43	1	75	11	11
Ergon	FY14	5	5	2	0	76	76
Energex	FY14	32	32	2	55	10	10
SAPN	FY14	10	7	2	3	7	10
Endeavour	FY15	34	33	2	37	20	20
Ausgrid	FY15	43	42	1	73	15	15
Essential	FY15	5	5	2	1	50	53
ActewAGL	FY15	79	77	1	75	20	20
Ergon	FY15	5	5	2	0	63	63
Energex	FY15	32	32	2	55	10	11
SAPN	FY15	11	10	1	5	9	9
Endeavour	FY16	34	33	2	38	18	19
Ausgrid	FY16	34	33	1	74	15	15
Essential	FY16	5	5	2	1	34	37
ActewAGL	FY16	45	44	1	77	17	17
Ergon	FY16	5	5	2	0	53	54
Energex	FY16	32	32	2	56	15	15
SAPN	FY16	10	10	1	5	12	12

Source: as specified in Table A.2.1

Appendix B 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 in Australia and the US.

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 Smart Metering Budgets 2009-11

The AER sought expert advice regarding whether Victorian DNSP's proposed 2009-2011 budgets to deploy smart metering complied with the Victorian Order in Council (OIC) at the time.

Review of Victorian DNSPs Smart Metering Budgets 2012-15

The AER sought a second expert to provide advice regarding whether Victorian DNSP's proposed 2012-2015 budgets to deploy smart metering complied with the revised Victorian Order in Council at the time.

Review of SP AusNet's WiMAX Related Expenditure

The AER sought expert advice regarding the prudency and efficiency of SP AusNet's proposed expenditure on a WiMAX based telecommunications solution as part of its Advanced Metering Infrastructure (AMI) solution. The AER required this advice in order to be able to respond to the Australian Competition Tribunal's (the Tribunal) order to amend the AER's Final Determination.

Review of Victorian DNSPs Smart Metering Budget Over-expenditure 2013

The AER sought expert advice regarding whether Victorian DNSP's actual overexpenditure in 2013 complied with the Victorian Order in Council (OIC) at the time.

ACS Metering Tariff Review

As a result of the AER's re-classification of Type 5-6 metering services from standard control services (SCS) to alternative control services (ACS), NSW DNSPs was required to ''unbundle'' its metering service charges for the 2014-19 regulatory control period.

NSW DNSPs therefore required a review of their proposed approach, methodology and resulting regulatory proposal for Type 5-6 metering services.

ACS Metering Tariff Design

Energeia is assisted SA Power Networks in the development of its South Australian metering charges for the 2015-20 regulatory control period.

ACS Metering Tariff Review

Energeia undertook an independent review of ActewAGL's regulatory proposal for Alternative Control Services – Metering. The project required a review of ActewAGL's proposed approach, methodology and resulting charges for its Type 5-6 metering services and proposed exit fee arrangements.

ACS Metering Tariff Design

Energeia undertook an independent review of Energex's regulatory proposal for Alternative Control Services – Metering. The project required a review of Energex's proposed approach, methodology and resulting charges for its Type 5-6 metering services and proposed exit fee arrangements.

Metering Cost of Service Model

As part of its Network Pricing Determination regulatory proposal to the Utilities Commission in the Northern Territory, Power and Water Corporation (PWC) required the development of a model to inform them on the efficiency of their metering service delivery model.

Based on its technical expertise in network regulation, financial modelling and regulatory analysis, Energeia developed a bespoke metering cost-to-serve model to analyse a range of potential service delivery approaches that ultimately was used to support PWC's hybrid model in its regulatory proposal.

Smart Metering Opportunity Assessment

Energeia was engaged to assess a range of different business opportunities, including smart metering, as part of the development of a business plan for a DNSP privatization.

The business plan for smart metering provided a 10-year view on the likely size of the market for smart metering, and an assessment of its relative attractiveness to other business lines, based on an assessment of margins across the metering value chain.

Market Outlook for Mass-Market Metering Services to 2024

Energeia was engaged to undertake a review of the current metering services market and to model the outlook until 2024 under different scenarios.

The report provided a 10-year view on the likely trajectory for policy and regulation, market potential and growth, customer requirements, solutions and pricing, and the competitive landscape.

Tariff and Distributed Energy Resources Uptake Modelling

Energeia was engaged to assist with the analysis feeding into SA Power Networks' tariff and metering strategy.

Network Pricing Policy and Distributed Energy Resources Analysis

The Energy Networks Association engaged Energeia to model the long-term impacts of cost reflective electricity tariff options on Australian electricity customer bills to inform the national debate. This involved developing 20 year outlooks for distributed energy resource adoption, including solar PV and storage, in the NEM as part of the assessment of various network tariffs.

Review of Network Benefits of Smart Metering

To support its submission to the Australian Energy Market Commission's (AEMC) Competition in Metering and Related Services Consultation Paper, the Energy Networks Association (ENA) engaged Energeia to undertake a review of the network benefits of smart metering.

Smart Grid, Smart City National Cost Benefit Assessment

Smart Grid, Smart City (SGSC) was a $100 million Australian Government funded program led by Endeavour Energy and supported by its consortium partners. SGSC was a landmark program representing one of the largest commercial scale deployments of smart grid technologies worldwide. Energeia developed the technical and economic model underpinning the national cost benefit assessment including a smart meter cost benefit.

Appendix C Resumes of Key Personnel

EZRA BEEMAN

MANAGING DIRECTOR

PROFILE

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 specialises in applying techno-economic modelling techniques to the electricity industry's most vexing issues. He was the Technical Director for the consortium undertaking analysis of the Smart Grid, Smart City trial results, which developed Australia's meter to mine model of the energy system using a range of innovative sampling and computational techniques. He has taken that work forward to develop what is one of the country's leading meter to mine modelling systems, which is increasingly being adopted by networks such as Ergon, Energex and SA Power Networks and is increasingly being requested by retailers and the market operator.

Ezra has over 10 years of specialised, industry experience in the US and Europe and another ten in Australia, including roles as the A/Executive Manager, Strategic Services; Manager, Metering and Pricing Strategy; and Network Business Consultant at Endeavour Energy (formerly EnergyAustralia).

As the Associate Director, European Power, with Cambridge Energy Research Associates (CERA), Ezra was responsible for the development of all wholesale power market models. Ezra led the development of an integrated European wide long-term and short-term power market pricing models, used by major European players to support trading and project investment decisions.

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:

- Lead advisor to the AER in their first ever Australian Competition Tribunal victory in the matter of whether a regulated business breached the commercial standard test
- Developed Australia's first real-time demand response solution for Hydro Tasmania on King Island, with sub-second control of hot water, air-conditioning, chilling and other loads.
- Technical Director of the Analysis and Modelling project to develop the national cost benefit assessment of smart grid technology and Australia's first end to end energy system model.
- Facilitated Executive Management Team to develop 15-year Future Operating Model for SA Power Networks, and underpinning five-year IT and customer service strategies
- 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 executive 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
- leading projects on retailer entry and an international investment framework
- 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

PUBLICATIONS

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

ROSELINE TAYEH

SENIOR ANALYST

PROFILE

Roseline is a key member of Energeia's modelling and research team, with experience in a range of programming languages including VBA, SQL and Python. Roseline has developed a range of customer, network and DER models.

Roseline has in depth knowledge of network data formats and availability having worked closely with a number of networks as well as extracting relevant data from regulatory information notices across all available regulatory information notices (both transmission and distribution.

Prior to working at Energeia, Roseline worked as an Intern in the Equities Research (Utilities) team at Credit Suisse. This role involved making stock recommendations based on complex financial models.

QUALIFICATIONS

- Bachelor of Engineering (Renewable Energy) with First Class Honours, University of New South Wales, 2016
- Bachelor of Commerce (Business Economics) with Distinction, University of New South Wales, 2016

SUMMARY OF EXPERIENCE – ENERGEIA

As an Energeia Analyst, Roseline has worked on a number of client engagements:

- **Australian Energy Regulator, Replacement Expenditure (repex) Review** – The project involved a top-down, qualitative review of the repex proposed by the Victorian Distribution Network Service Providers (DNSPs) over the 2016-20 regulatory period against the capital expenditure objectives and criteria as required under the National Electricity Rules.

  Roseline was a key member of the research and modelling teams, responsible for collecting data from the Regulatory Information Notices and analysing trends.

- **Institute for Sustainable Futures, Long Run Marginal Cost (LRMC) Estimation** – The project involved developing a tool that could produce LRMCs for four DNSPs using a consistent, transparent and auditable approach and publicly available data as much as possible.

  Roseline was a key member of the research and modelling teams, responsible for collecting data from the Regulatory Information Notices and developing the tool to convert the data into LRMCs given some configurable assumptions.

- **Energy Networks Australia, Network Transformation Roadmap** – The project involved the development of a national model of the changes in network topology driven by the uptake of distributed energy resources and the transition to micro grids at fringe of grid locations.

  Roseline was a key member of the modelling team.

SUMMARY OF EXPERIENCE – CREDIT SUISSE

As an Intern in the Equities Research (Utilities) team at Credit Suisse, Roseline:

- Developed a financial model to predict the effect of DER uptake on the relative stock performance of companies within the energy and utilities sectors in Australia.

Appendix D Expert Witness Acknowledgement

Ezra Beeman has made all the inquiries that he believes are desirable and appropriate and that no matters of significance that Ezra Beeman regards as relevant have, to Ezra Beeman's knowledge, been withheld.

Ezra Beeman has been provided with a copy of the Federal Court of Australia's "Guidelines for Expert Witnesses in Proceeding in the Federal Court of Australia" and this Report has been prepared in accordance with those Guidelines.