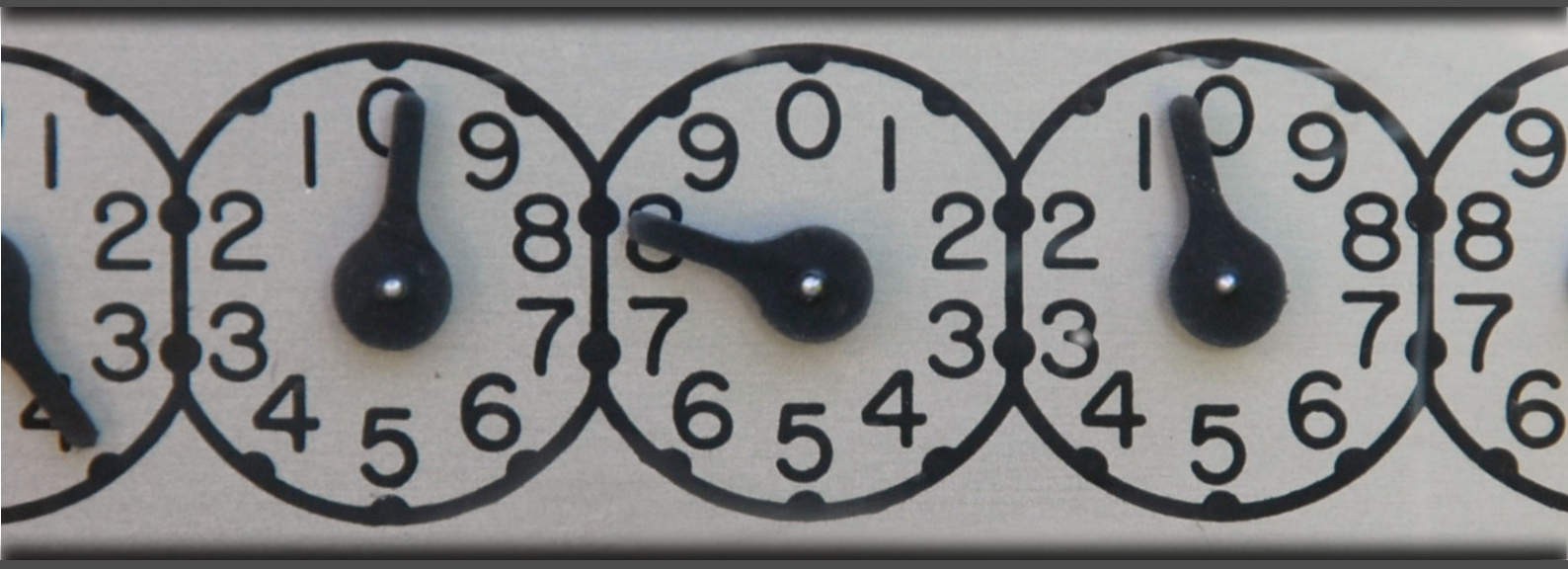
Benchmarking Jemena's Advanced Metering Infrastructure expenditure

Analysis of AMI expenditure between 2009-2015

huegin

05 October 2016

Commercial in confidence



Contents

Cost per meter benchmarking favours larger networks

1

Key points:

- **Significant investment** was required by all distribution networks to facilitate the rollout of smart meters throughout Victoria.
- Much of these costs were **fixed** in nature and **independent** of the number of meters installed.
- Accurate benchmarking needs to recognise the impact of fixed costs. Per meter benchmarks that fail to account for fixed costs will make larger networks appear more efficient at the expense of smaller networks.

The Advanced Metering Infrastructure (AMI) program in Victoria required significant investment

The AMI program, a government initiated metering program that involved a substantial upgrade of Victoria's metering infrastructure, involved significant investment by each of the Victorian Distribution Network Service Providers (DNSPs) to transition from existing interval meters to "up to date two-way, digital communication systems that record electricity usage every 30 minutes and automatically send this data to a customer's electricity distributor, virtually bringing an end to estimated bills and manual meter readings"[1]. For Jemena, as noted in their 2009-11 Budget Application, the rollout of smart meters presented a significant challenge and upgrade of existing systems;

" Not only does the AMI cost recovery order require JEN to deploy new complex and advanced meters to replace all existing residential meters, it also requires JEN to:

- *implement a large-scale, high-performance, two-way communications network (with 324,000 end points)*
- *establish new business processes for planning and management of the roll-out, including new processes to manage customer enquiries, claims and complaints*
- *establish a process for the ongoing management of the new metering and communication environment*
- *from 1 January 2012, provide metering data for each day by 6:00am the following day*
- *implement processes and information systems to capture data at half hourly intervals (48 reads per meter per day) implement new information systems to validate, process and store the metering data*
- *establish new processes and systems to manage the new meter, network and systems environment and achieve associated service obligations, and*
- *establish business processes to ensure that the current manual meter reading environment can be efficiently and effectively operated over the four-year period in which it is being replaced by AMI. "*

Page 4 Jemena AMI subsequent budget application 28 February 2011

The scale of this two-way, digital communications system was the installation of approximately 2.9 million smart meters across Victoria between 2009 - 2015 and involved expenditure in a number of different categories. In this report, data has been taken from the DNSPs' respective AMI Charges Models in which expenditure is aggregated in the categories outlined below. Where analysis has required further investigation of costs, the data set has been supplemented with metering data available in each businesses audited Category RIN. Reliance solely on the data reported within the AMI charges model would likely result in materially incorrect estimates of relative efficiency as there is insufficient disaggregation of expenditure to facilitate meaningful analysis of what could be considered fixed and variable costs. For example, the AMI Charges data only has opex information at an aggregated level (i.e total operating and maintenance expenditure). Given that much of the expenditure between 2009-2015 was on advanced metering *infrastructure,* which will have costs that are relatively independent of the number of meters installed, then failure to account for these fixed costs will benefit larger networks who can spread costs over a larger base using per meter benchmarking.

The AMI charge expenditure categories are outlined below.

Meter supply and installation - the replacement of existing interval meters with remotely read meters (referred to in this report as smart meters) that remove the need to manually read meters.

Communications - The communications infrastructure required to facilitate data collection from the customers smart meter. For Jemena, CitiPower, Powercor and United Energy this was achieved through a mesh radio system procured from Silver Springs Networks. The communications infrastructure involved includes the installation of access points, relays and extenders to collect and process data[2].

Information technology - Augmentation/installation of existing information technology systems to allow DNSPs to capture, process and store meter data at 30 minute intervals.

Operations and maintenance expenditure - Ongoing operating expenditure associated with IT maintenance, software licensing, customer services, data processing costs and the ongoing maintenance of smart meters.

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1 www.smartmeters.vic.gov.au, accessed 4th October 2016

2 Page 12, CitiPower's AMI Budget Application 2009-11

This investment included costs that can be considered both fixed and variable

As mentioned above, much of the expenditure incurred in the AMI program has been for the procurement, installation and hardware costs of communication and IT systems, required to manage the substantial increase in the volume of data flowing between smart meters and DNSPs. In the context of fixed and variable costs, a large portion of the expenditure incurred by the businesses was on the necessary metering infrastructure that is of a similar magnitude regardless of the number of meters installed. For example, the project management, procurement, installation and maintenance costs incurred building an IT system that can process 30 minute interval data for 600,000 meters would not be double the cost of implementing metering infrastructure for 300,000 meters. The cost allocation methodologies of CitiPower, Powercor, Jemena and United Energy provides an indication that they incurred capital expenditure that is not related to the number of meters installed - i.e fixed costs associated with the AMI rollout.

CitiPower and Powercor's allocation principles are outlined below;

"CitiPower and Powercor Australia operate from a single IT platform, thus delivering significant operating efficiencies. The approach agreed between the businesses for allocating costs is based on if the system is considered volume related then costs are split based on customer numbers of each business (70% Powercor, 30% CitiPower). ***If the systems are non-volume based costs are split 50:50****"*

(emphasis added, page 38, CitiPower Budget Application 2009-11)

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and from Jemena's Asset Management submission to the AER outlining cost allocation between United Energy and Jemena;

"The business requirement for sovereign solutions for both UED and JEN is in fact built as two identical stand alone end to end systems that share common locations but no common components. To ensure clear demarcation of UED and JEN IT assets equipment and systems are installed only in their respective designated UED or JEN racks for each and every Production, Disaster Recovery, Quality Assurance, Development and Test Environment.

The entirety of the shared regulated service business unit (JAM SNACS) is resourced to provide a single pool of staff, contractors and service providers for UED and JEN in combination. For each resource function or service the cost of providing that service is apportioned according to the volume of activities to provide the given service for each DNSP. ***In most cases a service can be apportioned either equally (50:50) where the activity is not influenced by the network size or apportioned according to network size (68:32)****. In a few cases other factors may result in an apportioning other than those two indicated above."*

(emphasis added, page 24, Jemena Asset Management, Response to the AER Draft Determination on the Victorian Advanced Metering Infrastructure Review)

The respective cost allocation methods highlighted above indicate that whilst there are costs that vary with network size (variable) there are also costs that are not influenced by network size (fixed). In addition to the different cost allocation methodologies outlined by the businesses themselves, the AER in the recent Victorian Determinations[3] benchmarked communications and IT capex at an aggregate level rather than on a per meter basis, recognition that much of the costs in these categories are fixed.

" We compared the overall amounts of communications/IT capex proposed across the businesses to understand the relative overall amounts of expenditure being proposed. If a business proposed a relatively high amount of metering communications/IT metering capex, we did a further review on an individual project basis."

16-36, Attachment 16 - Alternative control services | Jemena Preliminary decision 2016-20

Fixed costs are costs that would have been incurred independently of the number of smart meters installed. As outlined by the AER above, IT and communications capex is likely to be relatively fixed as each business incurs costs associated with updating their

3 2016-2020 Determinations for the Victorian DNSPs

respective IT architecture. In the case of CitiPower and Powercor, CitiPower's IT capex forecast in its 2009-11 Budget Application was $31.7M ($2008) whilst Powercor's was $48.3M ($2008)[4] . If IT capex did vary with the number of meters installed then given the relative customer base of the two businesses (Powercor 70% and Citipower 30%) Powercor would incur a capex amount of $74M ($2008)[5] which is significantly higher than the $48.3M that was actually forecast.

Fixed costs are not just isolated to capital costs but would also be a significant component of operating expenditure through project management, procurement and ongoing IT licensing costs that would also not increase linearly with meter installation volumes. This impact on a businesses opex was recognised by the AER in Jemena's Draft 2016-20 Determination.

"In past metering decisions we have used data on "opex per customer" as a partial performance indicator to benchmark the relative efficiency of non–Victorian distribution businesses' base opex. We, however, consider that the rollout of AMI services means that circumstances in Victoria are sufficiently different to other regions. ***In Victoria, metering costs are largely fixed and relate to IT and communications that tend not to vary according to customer numbers. In contrast, a majority of operating costs in the other regions are not fixed****. Specifically these relate to 'manual meter reads' – the cost of which does vary according to the number of customer. As such, we have not used benchmarking techniques."*

16-37, Attachment 16 - Alternative Control Services | Jemena Preliminary decision 2016-20

The AER quotes included above regarding IT and Communications opex and capex are instructive because they acknowledge these costs are largely fixed and will therefore not exhibit the same increases in response to meter volume as a variable cost such as manual meter reading or meter installation costs.

Before outlining the extent of AMI costs that can be considered fixed, it is important to understand the different circumstances for each of the businesses involved in the AMI rollout:

- CitiPower / Powercor; Single IT platform, shared IT capex, communication and opex costs,
- United Energy / Jemena: Individual IT platforms, shared project management office costs, and
- AusNet Services: Single IT platform, no partnership with other DNSPs.

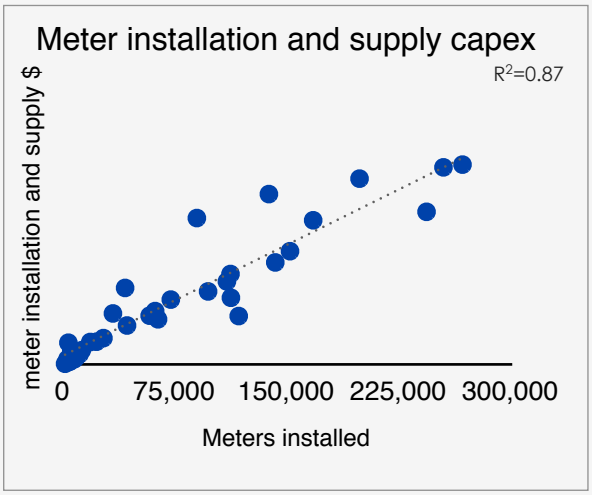
The distinction between CitiPower/Powercor and United Energy/Jemena is important because whilst United Energy and Jemena shared costs through a joint agreement with Alinta Asset Management, they still incurred the costs of upgrading their own stand alone IT systems whereas CitiPower/Powercor operating from a single IT platform could share the costs of upgrading a single system. In effect, this means that for the comparison of IT costs (both capex and opex) CitiPower and Powercor should be considered as a single business for the purposes of benchmarking what could be considered efficient expenditure.

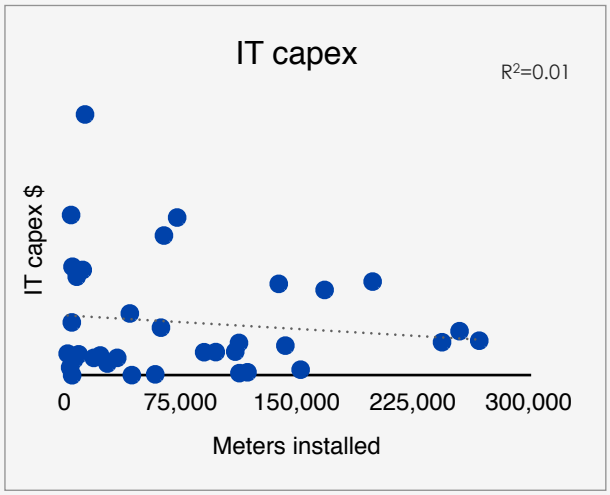
4 Page 38, Table 18, CitiPower's Budget Application 2009-11
Page 39, Table 18, Powercor Australia's Budget Application 2009-11

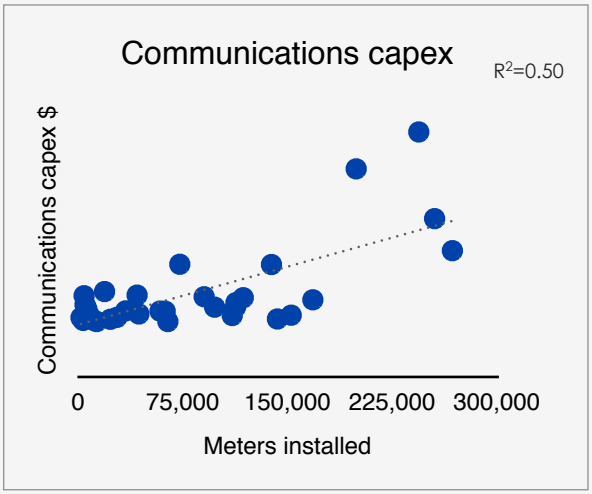
5 Powercor as 2.3 times the size (0.7/0.3) should incur an IT capex amount 2,3 times higher than CitiPower's $31.7M

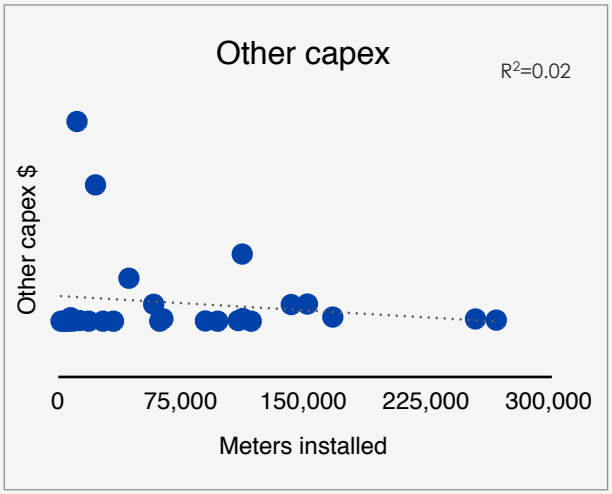
Identifying fixed costs - capex

By definition, variable costs are those that vary with output. In the context of the AMI rollout this means costs that increase as the volume of smart meters increases. The scatterplots below show the relationship between each of the AMI Charges capex categories with smart meter installation numbers[1]. Using the R-squared for each as an estimate of the strength of the relationship between each capex category and smart meter installation it is meter installation and supply capex that has the strongest relationship followed by communications capex. IT and Other capex do not appear to vary with meter installations. The analysis below supports the AER's position that IT capex is largely fixed whilst meter installation and supply costs can be considered variable.







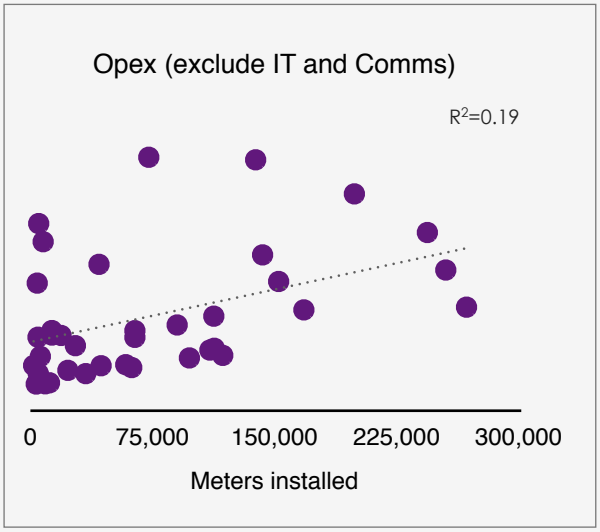


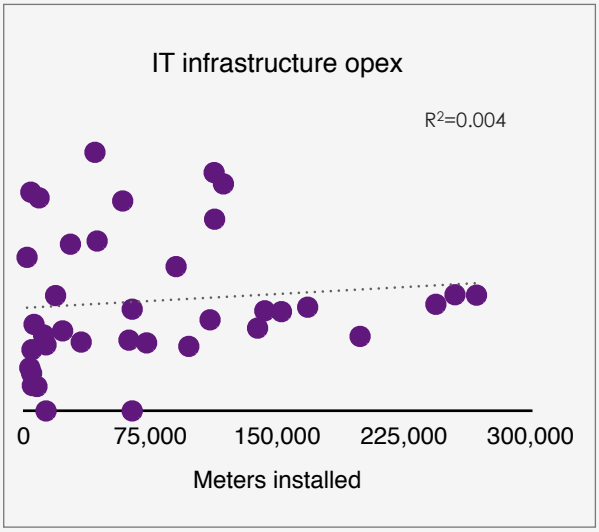
Key point: If the AER is going to rely on benchmarking to inform its regulatory decision making it should incorporate into its assessment analysis identifying the extent to which capex costs are fixed or variable. The analysis above suggests that IT capex and Other capex does not vary with meter installation volumes whilst remotely read interval meter & transformer capex and communications capex does increase as meter installation volumes increase.

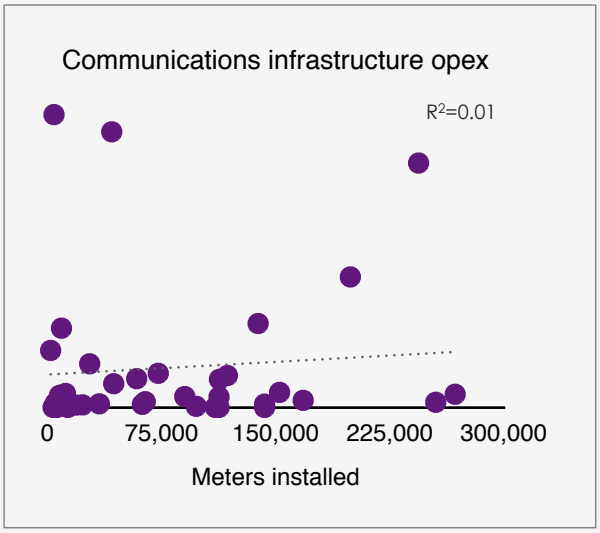
[1] Installation numbers have been taken from each of the businesses Category RIN type 4 meter replacement data due to difficulties finding publicly available actual AMI rollout figures over the period. Jemena's installation numbers are actual AMI rollout numbers whilst CitiPower, Powercor, AusNet Services and United Energy's installation numbers will include BAU installation volumes.

Identifying fixed costs - opex

The graphs below plot the same meter installation numbers used in the preceding capex section and DNSP opex. As mentioned previously, AMI Charge data is not sufficiently detailed to allow an examination of IT infrastructure and communications infrastructure opex. With this in mind we have used Category RIN data to investigate the relationship between the different opex categories and smart meter installations. Below three scatterplots are presented, the first is total opex excluding IT and communications infrastructure costs, followed by IT infrastructure opex and then communications infrastructure opex.







Key point: There is a very weak relationship between IT infrastructure opex and communications infrastructure opex and meter installations. Remaining opex shows a weak, albeit stronger, positive relationship with meter installation. (IT and Communications opex sourced from Category RIN data).

Summary

Without further publicly available information it is difficult to identify a specific fixed cost value for opex and capex. Using the relationships explored above however, it is reasonable to assume that to a large extent IT costs (both opex and capex) are fixed, communications opex is fixed whilst communications capex is variable. Other capex does not appear to have a positive cost relationship with meter installations and has therefore also been considered a fixed cost in the analysis below.

Per meter benchmarking allows larger networks to spread fixed costs over a larger base - appearing more efficient

By ignoring the fixed nature of much of the costs, Energeia's analysis penalises Jemena - the smallest distributor in Victoria with stand alone IT infrastructure and systems. The perceived efficiency of expenditure is heavily influenced by the extent to which costs are considered fixed.

What is a reasonable estimate of fixed costs over the program (2009-15)?

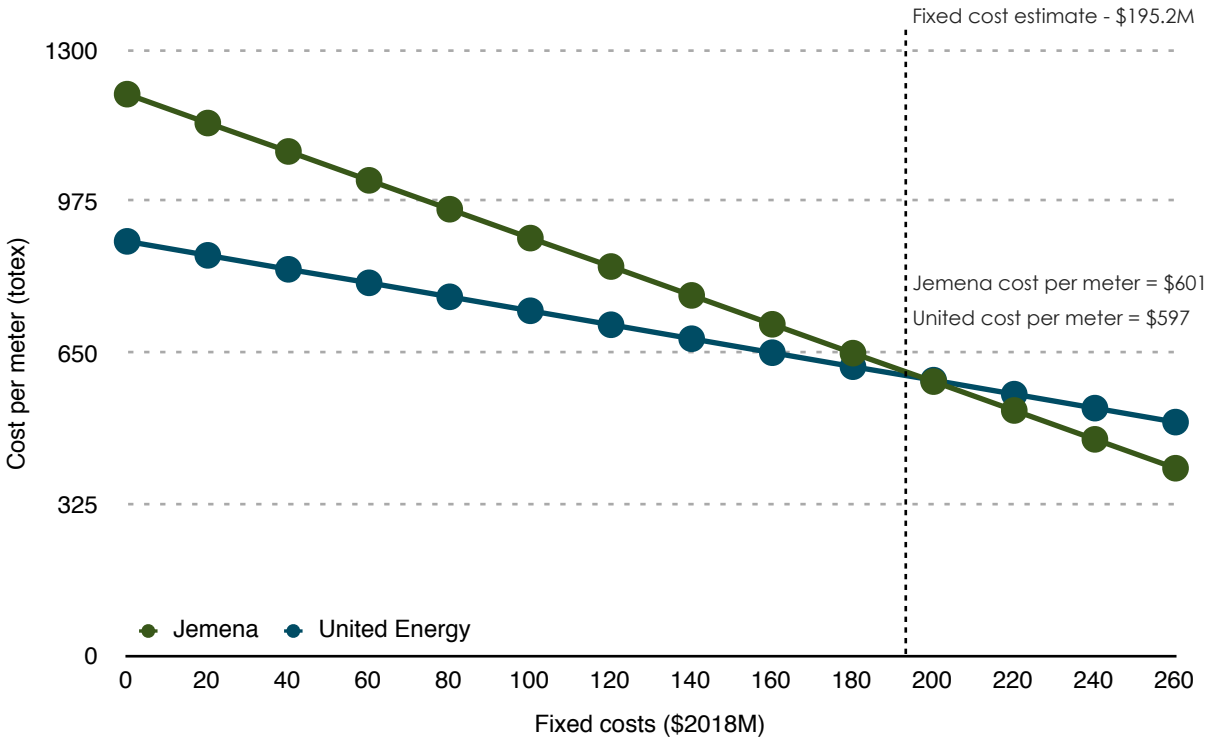
The table below uses AMI Charge data for IT and Other capex and Category RIN data for IT and Communications infrastructure opex.

	IT and Other capex ($2018M)	IT and Communications Infrastructure Opex ($2018M)
Jemena	**$121.6M**	$75.4M
CitiPower/Powercor	$149.1M	$77.2M
United Energy	$164.2M	**$73.6M**

CitiPower and Powercor have been aggregated as they share a single IT platform.

AusNet Services, having implemented a different network solution have not been considered in this analysis (their equivalent IT and Comms expenditure was $297.7M over the period). Jemena have the lowest IT and Other capex over the period ($121.6M) whilst United Energy have the lowest combined IT and communications infrastructure opex between 2009-15 (73.6M). From these values we estimate a benchmark program fixed cost amount of $195.2M ($121.6M capex + $73.6M opex) for the AMI rollout program.

The graph below highlights the significance of recognising fixed costs when benchmarking on a per meter basis. Energeia's approach of benchmarking all costs on a per meter basis effectively compares United Energy and Jemena at the point on the far left of the graph where fixed costs are $0. A more accurate benchmark would be to estimate the fixed costs associated with the AMI rollout (and compare those costs at an aggregate level between businesses) and benchmark the variable expenditure component on a per meter basis. Below we have included a fixed cost estimate of $195.2M ($2018) at which point the variable costs per meter for United are $597 per meter and $601 per meter for Jemena.



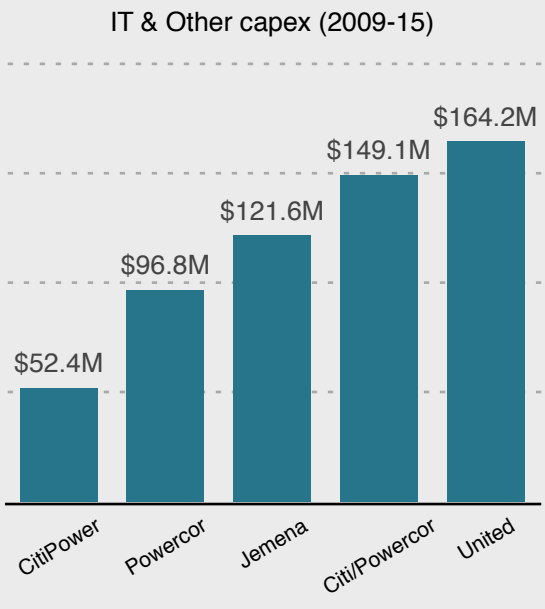
Incorporating fixed cost estimates into capex benchmarking

Capex category	% of total capex (2009-15)	Classification
Remotely read interval meters & transformers (smart meters)	61%	Variable
I.T.	26%	Fixed
Communications	8%	Variable
Other	5%	Fixed

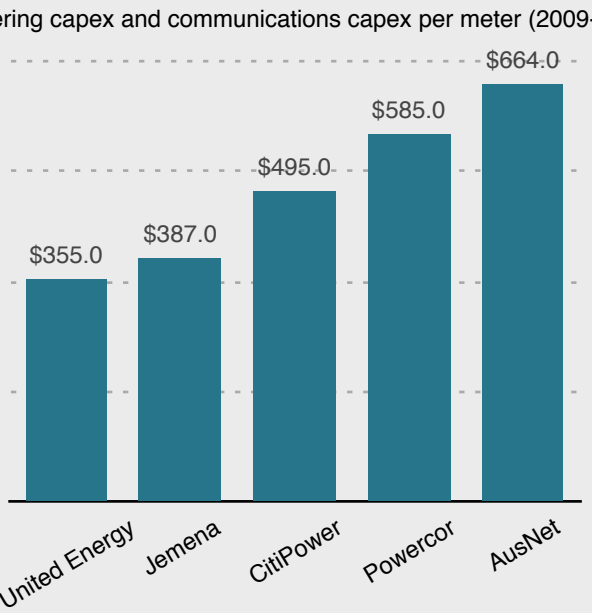
As discussed, a significant part of the capex incurred between 2009-15 for the AMI rollout was for upgrading/enabling existing I.T infrastructure - a fixed cost. Capex benchmarks should attempt to distinguish between the costs that are driven by meter installations (variable expenditure) and capex that would have been incurred regardless of the number of meter installations required (fixed costs). Energeia's approach of treating all expenditure as variable by using a per meter benchmark is too simplistic and will overstate the efficiency of larger networks relative to smaller ones.

Recommendation: For the I.T and Other capex cost categories from the AMI Charges data, which have been shown not to vary with meter installation numbers, the AER should compare aggregate capex outcomes and where costs appear high undertake further investigation - this would also be consistent with their approach in Jemena's 2016-20 Revenue Determination[6]. Where capex costs can be shown to vary with meter installation then benchmarks should be undertaken on a per meter basis.

Fixed costs



Variable cost benchmark



When costs are split into a fixed and variable component Jemena's program costs over the period do not appear materially inefficient. Metering and communications capex per meter[1] is $32 higher than United Energy which is not unreasonable given United Energy has a 25% higher meter density than Jemena. Whilst CitiPower has the highest meter density these results would suggest the cost premium associated with installing meters within the CBD counteracts the efficiency benefits of having a high meter density. Powercor and AusNet Services, the two businesses with the lowest meter density, incur the highest per meter installation and communications capital expenditure.

6 16-36 Attachment 16 - Alternative control services, Jemena Preliminary decision 2016-20

The benchmarks above highlight the significance of accounting for fixed and variable costs when benchmarking the cost outcomes of the different DNSPs over the course of the AMI rollout. Identifying remotely read interval meter and communications capex as variable costs, which over the period accounted for 69% of the total expenditure, Jemena is much closer to United Energy on a per meter basis than suggested within Energeia's analysis[7].

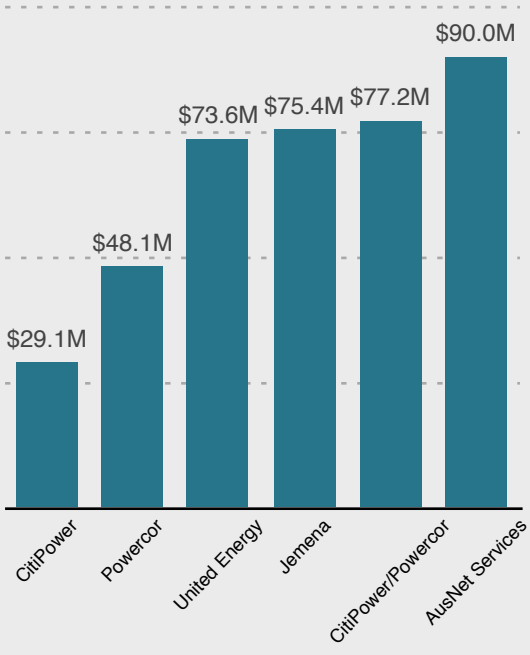
Incorporating fixed costs in opex benchmarking

Opex category	% of total opex (2009-15)	Classification
I.T Opex	31%	Fixed
Communications opex	6%	Fixed
Other opex	64%	Variable

Using the categorisation of fixed and variable opex costs above would indicate that 37% of opex expenditure could be considered fixed with the remaining 64% of opex costs increasing with meter installation volume. Similar to capex benchmarking, this approach of considering the fixed nature of opex is more aligned to the approach adopted by the AER in Jemena's 2016-20 determination.

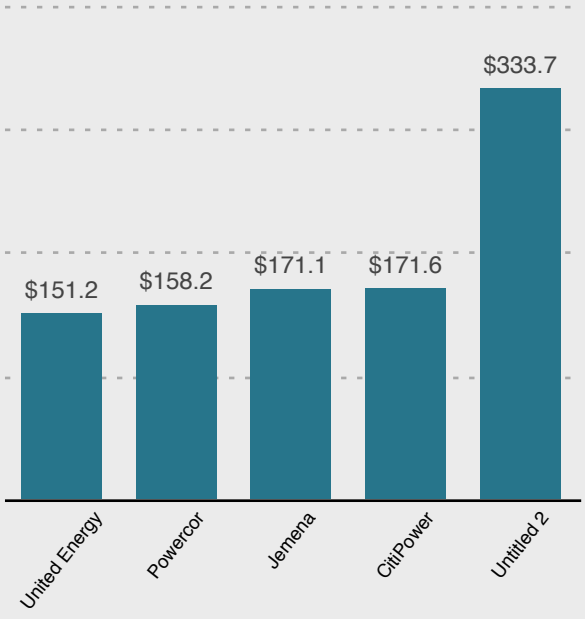
Fixed cost benchmark

IT and Communications infrastructure opex (2009-2015)



Variable cost benchmark

Opex per meter (excluding IT & Comms infrastructure opex)



Once fixed costs have been accounted for, Jemena's opex over the period is slightly below CitiPower - its closest comparator in terms of meter population.

All data displayed is in $2018. AMI Charges opex has been supplemented with IT and communications infrastructure opex from the Category RINs to allow an estimate for a fixed cost component. The number of meters in 2015 is used as the denominator

7 Review of Victorian Distribution Network Service Provider's 2017 Advanced Metering Infrastructure Transition Applications, September 2016

Our credentials and experience

This chapter outlines the credentials and experience of the personnel who contributed to this report.

2

Our Instructions

Huegin has been asked to prepare this report by Jemena. The subject of this report is the AER's benchmarking of the relative performance of the Victorian electricity distribution businesses for the provision, maintenance and reading of advanced metering infrastructure.

The scope of the engagement covers:

1. provide economic analysis and advice;

2. prepare a written expert report (or reports).

An excerpt of our instructions from Jemena are attached as Annex A to this report.

The qualifications and experience of report contributors

Huegin is a significant contributor to the body of knowledge for benchmarking as applied to businesses in the National Electricity Market (NEM). Huegin is also the benchmarking partner to the majority of businesses in the NEM.

The Huegin team has an appropriate mix of tertiary education and professional experience commensurate with the requirements of the task to review and critique the benchmarking analysis relied upon by the AER in their Draft Decision on Advanced metering infrastructure Transition Charges Applications.

Qualifications and headline experience of those members who have contributed to this report include:

- Jamie Blair. BEng (Chemical): Jamie is the Executive Director of our Data Analytics branch. Jamie is the lead author of major domestic and international benchmarking studies for the electricity industry. Jamie provides regulatory support to numerous Distribution Network Service Providers (DNSPs) throughout Australia.
- Oliver Skelding. BA (Economics), MEc: Oliver is a Senior Analyst in our Data Analytics branch. Oliver has a Masters of Economics, specialising in Econometrics and is a major contributor to both the analysis and written articles on economic benchmarking relied upon by over 80% of the DNSPs operating in the NEM.
- Naomi Donohue. BBus (Accountancy and Computer Applications), CPA: Naomi is a Manager in our Data Analytics branch. She worked for eight years in the regulatory and finance areas of a large DNSP, developing an in-depth understanding of cost structures and drivers within the regulatory construct.

Full profiles of team members are included at Annex B.

All contributors have read and understood the Practice Note CM7: Expert witnesses in proceedings in the Federal Court of Australia, June 2013. As lead author, Jamie Blair certifies that this report complies with Practice Note CM7.

In accordance with the Guidelines, I (Jamie Blair) confirm that I have made all inquiries that I believe are desirable and appropriate, and that no matters of significance that I regard as relevant have, to my knowledge, been withheld from the Court.

Huegin Expertise

Huegin focuses on providing analytical decision support which requires a knowledge of the way in which complex systems, such as electricity networks, work. Our team has significant experience in, and ongoing exposure to, operations improvement across many sectors including the electricity distribution sector. Given the ongoing drive for performance improvement in the electricity industry, a key focus in recent years has been understanding and modelling the drivers of performance and cost, as well as the degree to which businesses can influence these.

- Understanding and modelling the drivers of performance: The drivers of performance were first presented in the Australian DNSP benchmarking report in 2012. Since that time Huegin has continued to refine an explanatory model addressing the different drivers affecting Australian DNSPs. The effect of these eight drivers has been quantified and shown to significantly influence the results of benchmarking analysis.
- Understanding the degree to which drivers can be influenced: Huegin has developed a framework for explaining the degree to which organisations can influence the drivers of performance and cost. This framework highlights the need to understand the degree to which businesses can manage costs and performance when looking to assess relative performance and efficiency.

In addition to understanding and applying the benchmarking techniques as favoured by the AER, Huegin has focussed on the utility of benchmarking for supporting performance improvement decisions in the context of the Australian electricity industry.

The Huegin approach to benchmarking continues to evolve through the continued accumulation of this operational experience, application of specialist skills and research on the approaches and outcomes of benchmarking in other jurisdictions and industries. This experience includes many benchmarking investigations on behalf of Australian DNSPs.

Successful application of benchmarking techniques for the purposes of performance comparison and decision making requires fluency in specialist techniques. The techniques regularly used by Huegin include econometric analysis, statistical analysis and advanced mathematical techniques.

Despite benchmarking being relatively new in the context of electricity regulation in Australia, benchmarking has been applied in various ways in a number of industries and jurisdictions. Huegin continues to critically review the approaches and outcomes of benchmarking as applied by organisations such as the Office of Gas and Electricity Markets (OFGEM) in the United Kingdom.

Ongoing knowledge is developed, applied and tested by Huegin in various ways including:

- The development of reports and submissions
- The completion of investigative analyses
- The ongoing development of the Conduit benchmarking portal
- Ongoing participation in industry forums

Based on the specialist knowledge developed, Huegin is able to comment authoritatively on the application and utility of benchmarking in the context of the performance of the Victorian electricity distribution businesses in the provision, maintenance and reading of advanced metering infrastructure.

Annex A - Letter of Instruction

Jemena Electricity Networks (Vic) Ltd

Expert Terms of Reference

Benchmarking AMI metering services

Public

28 September 2016

An appropriate citation for this paper is:

Expert Terms of Reference - Benchmarking AMI metering services

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1. BACKGROUND

Jemena Electricity Networks (Vic) Ltd (**JEN**) is an electricity distribution network service provider in Victoria. JEN supplies electricity to approximately 300,000 homes and businesses through its 10,285 kilometres of distribution system. JEN's electricity distribution system services 950 square kilometres of northwest greater Melbourne.

2. SCOPE OF WORK

JEN wishes to engage a suitably qualified expert (**Expert**) to review the Australian Energy Regulator's (**AER**'s) draft decision on AMI transition charges applications (**draft decision**), in particular the benchmarking techniques adopted by the AER to assess the efficiency of the Victorian distribution businesses providing advanced metering services and to make recommendations on best practice models.

The Expert will provide an opinion report that describes the AER's draft decision and outlines its findings.

The approach should employ best practice techniques and should consider the requirements outlined in the.

The benchmarking approach should employ best practice techniques and be consistent with the requirements outlined in the advanced metering infrastructure order in council advanced metering infrastructure order in council (**AMIOIC**) incorporating all amendments including those gazetted by the Victorian Government on 16 Jun, 2016 (G 24), an extract of the relevant sections are pokrovided in Appendix A to this request.

3. DELIVERABLES

At the completion of its review the Expert will provide an independent expert model and report detailing the relative performance of the Victorian electricity distribution businesses for the provision, maintenance and reading of advanced metering infrastructure. Without limitation, this model and report must:

- Respond to the AER/Energeia's criticisms of Redify's[1] benchmarking approach submitted as a part of JEN's initial transition application.
- Comment on Energeia's benchmarking methods, including the robustness of the categories used (ie. customer density, meters per customer and proportion of business customers).
- Comment on the AER's use of and method for determining a benchmarking efficient entity.

Without limitation, this report must:

- be of a professional standard capable of being submitted to the Australian Energy Regulator (**AER**);
- clearly set out all findings and the reasons for those findings, justify the method(s) applied, separate facts from opinions, and explain all the assumptions made;
- contain a section summarising the Expert's experience and qualifications, and attach the Expert's curriculum vitae (preferably in a schedule or annexure);
- identify any person and their qualifications, who assisted the Expert in preparing the report or in carrying out any research or test for the purposes of the report;
- summarise JEN's instructions and attach these term of reference;
- include an executive summary which highlights key aspects of the Expert's work and conclusions, and;
- (without limiting the points above) carefully set out the facts that the Expert has assumed in putting together his or her report, as well as identifying any other assumptions made, and the basis for those assumptions.

The Expert is to provide an electronic (Excel) version of its benchmarking model(s), including any proprietary model(s) provided by a third party. These models should contain all input data with linkages to the outputs.

Use of the report

It is intended that the Expert's report will be submitted to the AER. The report may be provided by the AER to its own advisers. The report must be expressed so that it may be relied on by both JEN and the AER. The Expert agrees that the Intellectual Property Rights developed or created by the Expert in performing the services (as described in this document) to JEN (including the development and preparation of the report) (whether by the Expert, its related bodies corporate, its employees, contractor or agents) (**Developed IP**) will from the date that the Developed IP is developed or created will be owned by and vest in JEN.

[1] Formerly Huegin Consulting

"**Intellectual Property Rights**" means all present and future rights conferred by Law or in relation to any copyright, trademarks, designs, patents, circuit layouts, plant varieties, business and domain names and other results of intellectual activity in the industrial, commercial, scientific, literary or artistic fields whether or not registrable, registered or patentable.

The AER may ask queries in respect of the report and the Expert will be required to assist JEN in answering these queries. In addition, the AER may choose to interview the Expert and, if so, the Expert will be required to participate in any such interview.

The report will also be reviewed by JEN's legal advisers to provide legal advice to JEN about its rights and obligations under the National Electricity Law, the National Electricity Rules and jurisdictional laws (including the AMIOIC). The Expert will be required to work with JEN's legal advisors and personnel to assist them to prepare JEN's revised response to the draft decision.

If JEN chooses to challenge any decision made by the AER in relation AMIOIC transition that appeal will be made to the Australian Competition Tribunal and the Expert's report may be considered by the Tribunal. JEN may also seek review by a court and as such the report may be subject to consideration by that court. The Expert should therefore be conscious that the report may be considered as part of these processes, including in connection with the review of a dispute between the AER or JEN. Due to this, in carrying out the requirements of these terms of reference, JEN requires that the Expert comply with the Federal Court requirements for expert reports, which are set out in Appendix A.

The Expert must be available to assist JEN in connection with the work defined in the scope of works (Section 2), until such time as the decision is made on the AMIOIC transition decision, including subsequent appeals (if any), is finalised.

Compliance with the code of conduct for expert witnesses

Appendix B is a copy of the Federal Court's Practice Note CM 7, entitled "Expert Witnesses in Proceedings in the Federal Court of Australia", which comprises the code of conduct for expert witnesses in the Federal Court of Australia (the Code of Conduct).

The Expert is required to be familiar with the Code of Conduct and comply with it at all times in the course of the engagement by JEN. In particular, the expert report prepared for JEN should contain a statement at the beginning of the report to the effect that the author of the report has read, understood and complied with the Code of Conduct.

In particular, the report should contain particulars of the timing, study or experience by which the Expert has acquired specialised knowledge. The report should also state that each of the Expert's opinions is wholly or substantially based on the Expert's specialised knowledge.

It is also a requirement that the report be signed by the Expert and a declaration that:

> "[the expert] has made all the enquires which [the expert] believes are desirable and appropriate and that no matters of significance which [the expert] regards as relevant have, to [the expert's] knowledge, been withheld from the report."

As noted previously, JEN requires a copy of these terms of reference to be attached the Expert's report, as well as copies of the curriculum vitae of each of the report's authors.

4. CONFLICTS

The Expert is to promptly identify and disclose any current or future realised or potential conflicts of interest.

5. TIMETABLE

The Expert will deliver its required output to JEN as follows by 5 Oct 2016.

6. TERMS OF ENGAGEMENT

The terms on which the Expert will be engaged to provide the requested advice shall be as provided in accordance with the Panel arrangements applicable to the Expert.

Annex B - Team Member CVs

B

Jamie **Blair** B.Eng (Chem)

Jamie is the Executive Director of our Data Analytics branch and our electricity regulation expert. Jamie has extensive experience in providing infrastructure companies with both technical and practical regulatory advice. He has assisted multiple businesses in the preparation of determination proposals and responses to the Australian Energy Regulator. Jamie's background in engineering has provided a foundation on which he has built expertise in the provision of capital and maintenance planning, including the development of optimisation and work simulation tools. He works with clients in a variety of industries to achieve significant improvements in the management of assets and prioritisation of funding for capital and maintenance programs.

Jamie has also worked with a number of distributors and transmission operators to highlight areas for productivity improvement using both economic benchmarking techniques and his in-depth knowledge of the Australian electricity industry. Jamie often presents at industry conferences and academic forums.

Relevant Skills

	Industry benchmarking and performance assessment
	Maintenance and cost modelling
	Project management skills
	Stakeholder communication
	Regulatory support, including revenue proposal preparation, analysis and review
	Risk Management
	Analytical decision support and statistical analysis

Relevant Experience

Jamie is an experienced engineer and consultant with specific expertise in the areas of investment and cost analysis, portfolio optimisation and performance benchmarking. His work is primarily for clients who own, manage or operate large physical assets.

- Jamie has led over twenty independent benchmarking studies of domestic and international electricity network
- Facilitated the corporate strategic planning of an electricity distribution business and a utilities maintenance organisation.
- Developed the asset management frameworks for a major transport infrastructure manager and a large Defence weapons logistics management organisation.
- Led the analytical review of five recent regulatory determinations on behalf of network service providers.
- Developed and implemented the investment decision support framework and systems of a large network operator.
- Developed and implemented the investment decision support framework and systems of a ports operator.

Professional Summary

Jamie Blair has over 20 years of management and consulting experience across a number of industries including utilities, construction, military aviation, banking and finance and fast moving consumer goods. Prior to joining Huegin in 2008, Jamie worked in industry specialist consultancies, management consultancies, military engineering and mining. His industry experience includes engineering, maintenance and logistics management of high value fleets of equipment and assets. Jamie's consulting experience spans all phases of the asset management lifecycle from investment planning and strategy to operations and maintenance and disposal and divestment.

Oliver **Skelding** M. Economics BA (Econ./ Political Science)

Oliver is a senior analyst in our Data Analytics branch who has experience in the regulation of monopoly industries, economic benchmarking and the application of econometric techniques. Oliver has been a key contributor to the development, analysis and understanding of econometric benchmarking and outcomes in the context of the AER's regulatory framework.

Relevant Skills

	Industry benchmarking and performance assessment
	Industry Cost Drivers
	Knowledge of the regulatory framework within the National Electricity Market
	Knowledge of Australian DNSP cost structures
	Maintenance and cost modelling
	Analytical decision support and statistical analysis
	Total factor and partial productivity analysis
	Econometric modelling

Relevant Experience

Oliver has worked with a number of Australian DNSPs to identify expenditure outcomes relative to other operators within the Australian electricity supply industry. Recent engagements include;

- Working with various DNSPs to benchmark their expenditure relative to other businesses in the NEM. These projects involved using both the AER's benchmarking techniques and other available benchmarking techniques such as Data Envelopment Analysis.
- Working with DNSPs to investigate and quantify the impact of Operating Environmental Factors on benchmarking performance.
- Assisting an Australian TNSP with benchmarking in preparation for its revenue proposal to the Australian Energy Regulator.
- Working with a number of DNSP's to highlight possible outcomes of the application of the AER's preferred benchmarking techniques.
- Developed performance reports and conducted performance analysis for a number of functions for a large infrastructure manager.
- Developed safety and risk analysis and reports for electrical safety incidents for a state safety regulator.

Professional Summary

Oliver has completed a Master of Economics, specialising in Econometrics. Prior to working with Huegin he worked for the NSW Department of Finance and Services.

At Huegin, Oliver responded on behalf of Australian DNSPs to the Australian Energy Regulator's Better Regulation Paper regarding the difficulties of using econometric benchmarking techniques within the context of Australian DNSPs and TNSPs. Oliver has also assisted with the benchmarking of Australian DNSPs and TNSPs in preparation for revenue proposals and revised regulatory proposals to the Australian Energy Regulator.

Naomi **Donohue** B.Bus, CPA

Role: Regulatory Expert

Naomi is an Associate Director in our Data Analytics branch. Naomi was previously involved in the AER's Better Regulation process and has expertise in distribution network service provider regulation and cost constructs. She has responded to numerous AER issues papers and AEMC rule changes. Naomi is one of our Industry experts and brings to the team a wealth of direct knowledge and experience in regulatory affairs. Naomi will provide regulatory advice, knowledge of the electricity industry and experience in the preparation of information and data to comply with regulatory and industry requirements.

Relevant Skills

	Regulatory Determination experience and knowledge
	Industry Operational knowledge
	Stakeholder management, engagement and communication experience with the Australian Energy Regulator, Network Service Operators and other key National Electricity Market participants
	Benchmarking knowledge
	Knowledge of the regulatory framework within the National Electricity Market
	Knowledge of Australian DNSP cost structures and reporting frameworks

Relevant Experience

Naomi is a qualified CPA with extensive experience in regulation and finance of electricity energy distributors. Naomi has specific expertise in the areas of regulatory determinations and national electricity market rule changes.

- Management and co-ordination of the financial related components of the revenue determination for an electricity distribution network service provider.
- Participation and involvement in the AER's Better Regulation program.
- In-depth understanding and knowledge of the energy regulation environment in Australia.
- Identification and strategic management of regulated and non-regulated revenue risks and opportunities, collation and presentation of expected costs for operations and infrastructure investment, and compliance with relevant national electricity law and regulatory requirements.
- Responsible for the compilation and AER approval of a network service providers' Cost Allocation Model.
- Completion of all financial modelling to a support a network service providers' Regulatory proposal utilising AER models without any compliance or regulatory issues.

Professional Summary

Naomi has significant experience working in the regulated electricity sector, having worked in a distribution network service provider's regulatory and financial departments for over 8 years prior to joining Huegin. She is also experienced working with government agencies to achieve both commercial and social outcomes. Naomi is a qualified CPA with over 20 years experience in management accounting, strategic planning, process improvement and regulation.

Annex C - Supporting Information

C

Annex C - Supporting information

AMI Charges Data used

United Energy - Expenditure data represented in $2018

	2009	2010	2011	2012	2013	2014	2015
Accumulation Meters	4,663,844	4,271,163	4,650,243	928,327	-	-	-
Manually read interval meters	-	-	2,046,805	1,446,913	-	-	-
Remotely read interval meters & transformers	7,728,599	24,584,476	49,299,492	55,625,890	61,756,470	26,352,279	3,397,471
IT	76,218,542	40,972,437	9,706,183	8,919,806	1,917,526	1,157,490	6,383,435
Communications	-	-	2,635,603	468,513	1,157,347	4,338,700	502,515
Other	121,682	437,022	12,216,898	3,027,983	3,124,995	-	-
Opex	16,901,759	19,058,303	31,678,895	32,431,342	28,389,984	25,196,532	21,159,655

Powercor - Expenditure data represented in $2018

	2009	2010	2011	2012	2013	2014	2015
Accumulation Meters	5,462,842	4,643,729	1,834,548	1,061,878	103,506	-	18,886
Manually read interval meters	5,000,699	5,734,440	880,928	179,097	131,166	15,687	14,689
Remotely read interval meters & transformers	2,664,622	78,630,919	107,526,190	109,021,400	79,848,514	12,188,764	7,222,788
IT	28,983,718	25,135,861	13,123,804	10,355,552	7,004,640	5,347,626	4,799,104
Communications	1,139,878	3,958,961	18,727,465	12,896,395	4,512,412	5,454,828	2,348,141
Other	636,054	747,068	404,256	195,446	41,378	-	-
Opex	29,907,581	23,749,704	31,059,791	25,190,060	24,061,488	20,152,086	14,737,258

CitiPower - Expenditure data represented in $2018

	2009	2010	2011	2012	2013	2014	2015
Accumulation Meters	1,770,074	1,553,083	134,290	31,048	21,755	-	-
Manually read interval meters	745,871	1,346,861	315,168	52,337	16,670	15,101	14,689
Remotely read interval meters & transformers	1,439,232	29,064,964	45,235,367	39,797,067	27,774,246	1,818,217	2,864,354
IT	15,680,870	14,150,530	7,173,552	7,038,260	5,357,709	299,142	2,548,540
Communications	598,632	1,882,752	1,097,971	2,618,901	1,944,996	3,083,386	208,794
Other	-	-	105,328	-	-	-	-
Opex	14,687,760	11,966,615	16,082,785	13,077,557	10,863,292	10,263,226	7,341,349

AusNet Services - Expenditure data represented in $2018

	2009	2010	2011	2012	2013	2014	2015
Accumulation Meters	6,800,545	6,744,753	282,546	754,055			
Manually read interval meters	5,289,377	7,028,909	6,948	77,808		1,073	
Remotely read interval meters & transformers	1,467,536	35,340,797	92,930,925	101,365,767	83,255,014	41,704,766	11,800,508
IT	31,887,338	46,214,505	26,902,146	27,565,171	9,909,602	18,280,453	46,947,074
Communications	1,070,946	10,422,903	10,374,715	27,779,142	34,497,384	4,806,804	4,702,577
Other							
Opex	32,702,537	47,383,421	49,574,240	44,957,662	44,462,693	50,251,388	45,110,950

Jemena - Expenditure data represented in $2018

	2009	2010	2011	2012	2013	2014	2015
Accumulation Meters	3,554,966	2,213,575	1,816,369	82,857	-	-	-
Manually read interval meters	1,048,990	1,359,074	1,115,150	812,341	-	-	-
Remotely read interval meters & transformers	5,603,859	12,352,527	21,195,991	26,555,867	36,342,339	14,315,434	312,666
IT	30,955,112	6,050,800	331,084	558,263	908,305	3,704,934	6,586,965
Communications	162,874	412,133	1,378,188	1,905,518	3,445,736	760,607	717,662
Other	36,336,249	24,800,362	7,817,042	3,078,970	490,395	-	-
Opex	10,169,458	12,102,303	19,467,761	22,440,167	23,918,179	23,210,702	19,531,116

2015 Meter numbers used

DNSP	Meters
United Energy	669,745
Jemena	323,790
CitiPower	321,901
Powercor	762,898
AusNet Services	695,361

Category RIN Data used

United - Expenditure data represented in $Nominal

	2009	2010	2011	2012	2013	2014	2015
IT infrastructure opex	3,609	5,625	13,540	5,892	5,958	13,913	13,359
Communications infrastructure opex	-	157	295	96	450	977	2,482
Type 4 Meter replacement (000's)	12.34	63.34	111.84	141.81	151.68	117.34	8.23
Type 4 Meter installation (000's)	0.00	0.00	3.60	8.25	8.41	10.87	10.00

	2009	2010	2011	2012	2013	2014	2015
Type 4 Meter replacement ($000's)	585	3,537	12,963	16,730	28,616	16,722	3,238
Type 4 Meter installation ($000's)	-	-	955	2,212	2,514	5,529	5,581

Jemena - Expenditure data represented in $Nominal

	2009	2010	2011	2012	2013	2014	2015
IT infrastructure opex	4,149	4,427	9,653	12,347	11,502	10,219	9,631
Communications infrastructure opex	380	68	672	844	842	1,335	1,785
Type 4 Meter replacement (000's)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Type 4 Meter installation (000's)	11.73	32.34	56.11	65.56	124.63	38.30	10.55
Type 4 Meter replacement ($000's)	-	-	-	-	-	-	-
Type 4 Meter installation ($000's)	1,538	3,278	5,195	8,619	19,944	10,890	298

CitiPower - Expenditure data represented in $Nominal

	2009	2010	2011	2012	2013	2014	2015
IT infrastructure opex	2,064	3,915	5,178	3,799	4,134	3,758	2,705
Communications infrastructure opex	-	83.2	-	31.2	106.9	-	0.00

Powercor - Expenditure data represented in $Nominal

	2009	2010	2011	2012	2013	2014	2015
IT infrastructure opex	1,338	5,736	6,603	6,811	8,659	7,071	5,427

	2009	2010	2011	2012	2013	2014	2015
Communications infrastructure opex	327.58	194.14	144.97	385.79	324.19	70.00	-

Contact Details

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