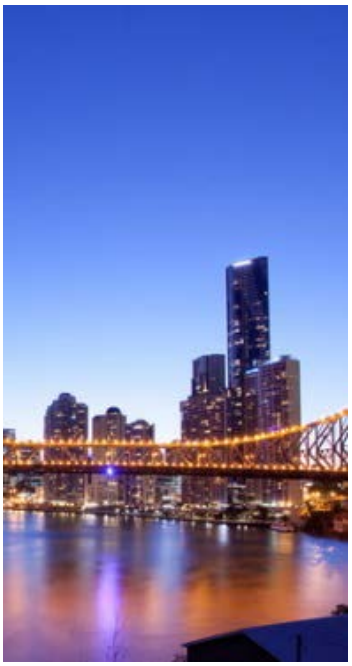
Revised Proposal

Attachment 5.13.L.4

GHD independent review of the Network Digitisation Project

January 2019

GHD Advisory



Independent Review of Network Digitisation Business Case

Ausgrid

07 January 2019

Contents

Figures

No table of figures entries found.

Tables

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1. Introduction

GHD Advisory was engaged to independently review the proposed Ausgrid network asset digitisation business case, modelling methodology and input assumptions.

Ausgrid proposed expenditure related to a project to collect and maintain network data through Light Detection and Ranging (LiDAR) and high resolution photography in its most recent regulatory proposal. Ausgrid proposed $11.95 million of capex for the project over the next regulatory control period to expand its current LiDAR surveying activities to include greater asset detail, greater network coverage (from approximately 25% to the majority of the network) and additional capture techniques (ground based surveys and inclusion of high resolution photography). The Australian Energy Regulator (AER) did not accept the proposed expenditure on the basis that "Ausgrid has not justified that proposed expenditure for this project would form part of a total forecast capex that reasonably reflects the capex criteria"[1]. The AER stated the lack of a business case and cost benefit analysis (CBA) from Ausgrid was the basis of its decision.

Ausgrid have advanced the business case and CBA model for the network asset digitisation project since the original proposal and this report constitutes documentation of the independent review of this material conducted by GHD Advisory.

1.1 List of Assumptions

We have made a number of assumptions in undertaking this review, including:

1. We have accepted the discount rate applied by Ausgrid without review, as this is outside the scope of our evaluation.
2. Ausgrid have assumed that initial data capture activities will be capitalised, with repeat data capture activities eventually becoming operating expenditure. Assessment of these assumptions against accounting standards are outside the scope of this review. We do however note that the AER's consultants, Arup, highlighted capitalisation assumptions in its review of Essential Energy's Aerial Patrol and Analysis (AP&A) program[2].
3. We have not independently verified the network asset statistics in the Ausgrid CBA model at attachment 5.13.L.5. This data has been predominately extracted from Ausgrid's GIS database and we have assumed that it is correct for the purpose of this review.
4. We accept all data provided to us by Ausgrid as without error for the purposes of this review.

[1] AER, page 5-95, Attachment 5 – Capital expenditure | Draft decision – Ausgrid distribution determination 2019–24

[2] Arup, page 17, Review of Essential Energy's past and forecast capital expenditure for the 2019/24 regulatory control period Final draft report

2. The Business Case

Capturing network imagery and digitisation of asset data is now common for electricity networks. Early adopters include Powercor[3] and Ergon Energy, which was the original owner of the ROAMES capability prior to selling the business unit to Fugro. Notable examples of network imagery and data capture projects that we have reviewed in the process of assessing the Ausgrid business case include:

- The AER accepted[4] Powercor's bushfire prevention related programs in its 2016-2020 Regulatory Proposal. This included $1m for LiDAR survey and a $4m spacer installation and rebuild program.
- Essential Energy's recent proposal for $57 million Aerial Patrol and Analysis program, which includes LiDAR surveying, was accepted by the AER in its draft determination[5], albeit with a small adjustment for a CPI related error.
- Ergon Energy credits ROAMES technology for significant decreases in its vegetation management costs and cites up to $15 million of annual savings related to the program.
- United Energy proposed $6.8 million for a LiDAR project in its most recent regulatory submission, however it was not accepted by the AER due to the absence of a net benefit to customers in the cost benefit analysis[6].

The Ausgrid business case covers a broader scope than just LiDAR surveying, which is now used by most networks. Regional and rural networks have been able to capture more of the network through aerial patrols historically due to ease of access and less prohibitive flight restrictions. The Ausgrid business case includes ground based data and image capture now that the technology has become economically feasible.

2.1 Options

The Ausgrid network asset digitisation business case includes three options, namely:

- Option 1 - Complete asset capture of remaining network assets near roadways and ongoing LiDAR plus photos on a 3 yearly cycle.
- Option 2 - Complete asset capture of remaining network assets near roadways,
- Option 3 - Opportunistic manual data collection with pole and line inspections.

The inclusion of multiple options accords with good business case practice. We note that they include limitation of the scope (Option 2 versus Option 1) and alternative collection methods (Option 3 versus Option 1).

There is a CBA analysis and NPV result reported for each option in attachment 5.13.L.5 and described in the Appendix of attachment 5.13.L.3, which are the basis of our methodology review in the next section.

[3] https://www.powercor.com.au/media/1168/mr-lidar-program-gen-25-feb-2010.pdf

[4] AER, Attachment 6 – Capital expenditure | Powercor Preliminary decision 2016–20

[5] AER, page 5-64,Attachment 5 - Capital expenditure | Draft decision - Essential Energy distribution determination 2019-24

[6] AER, page 6-79, Attachment 6 – Capital expenditure | United Energy distribution determination final decision 2016–20

3. Methodology and Assumptions

We reviewed the methodology behind the Ausgrid asset digitisation business case and the input assumptions relevant to the NPV analysis for the three options. Our findings are presented below.

3.1 Costs

Costs for each of the options are related to the data capture and management and analytics processes. Each of the capture methods for aerial surveys are well established and cost estimates are based on supplier quotations or historical contract data. Ground based data capture, as a more recently introduced capability, relies more on estimation for cost information. However we do note that Ausgrid has used trial data of a reasonable sample size (over 32,000 poles) for estimation of ground based capture unit rates.

3.1.1 Unit Costs of Data Collection

Ausgrid has used actual contract data for unit rates of data collection for both fixed wing and helicopter based asset data capture. [redacted] We note that the AER has previously confirmed that it considers the use of rates from established suppliers that are sourced in a competitive environment on the open market as a suitable basis of efficient costs. We consider that the use of these rates is reasonable as an input.

Unit rates for ground based data capture is based on a trial conducted over a sample of the network. [redacted] is the supplier of these services identified by Ausgrid. These costs may be conservatively high, as the costs may reduce with time and scale of collection. However, they cover a dense area of Ausgrid's network, are lower than alternative suppliers and in the absence of any evidence that this will be the case, we are satisfied that the trial data is an appropriate basis for estimation of ground based data collection costs.

3.1.2 Data and Analytics Costs

Data management and analytics costs are a combination of the known [redacted] hosting costs and an estimate by Ausgrid of the internal management costs. The internal management cost estimate is based on an assumption of 15% of the data capture costs. Whilst there is little data which can be used to benchmark this assumption, we do not consider it unreasonable given the significant volumes of data involved in imagery capture, storage and analysis and the fact that the NPV outcome is not critically dependent on this assumption.

3.1.3 Other Costs

Some of the other incidental costs associated with the CBA analysis (i.e. not directly related to data capture) include installation of additional LV spreaders and additional trimming of trees identified as at risk of causing vegetation related outages. The cost of additional trimming is based on an assumed identification rate (which is considered in the next section) and the overall vegetation management program costs. We consider this a reasonable basis for the estimate. The cost of additional spreaders of $442 per spreader is based on actual data recorded between July 2017 and September 2018. We therefore also consider this a reasonable estimate.

3.2 Benefits

The benefits identified are a combination of revenue, safety, productivity and risk mitigation benefits. Specifically, Ausgrid has identified the following sources of benefit:

- Additional revenue capture through identification of third party assets mounted on poles;
- Improved capex efficiency through reduced site visits;
- Identification of missing LV spreaders, leading to a reduction in outages, fire risk and repair costs caused by conductor clashing;
- Reducing capital and operational expenditure associated with vegetation encroachments; and
- Reducing operational expenditure by optimising vegetation management cycles.

We note that many of the other network businesses that have published project details or business cases for asset digitisation initiatives also include benefits related to the identification and rectification of non-compliance with minimum clearance distances between conductors and the ground or structures. However we also acknowledge that the Ausgrid business case states that it has included the above five, primary benefits as those most readily quantified and of higher certainty. The business case includes a comprehensive list of other potential benefits that are not included in the cost benefit analysis due to uncertain timing and value. We consider this approach reasonable.

Our evaluation of the scope and justification of benefits in the Ausgrid business case is included below. Assessment of the input assumptions and quantitative estimates in included in Section 4.

3.2.1 Additional Revenue Capture

Additional revenue capture accounts for 22% of the total benefit over the business case period for the preferred option. Not only does the preferred solution account for identification of current devices that are unknown, it allows for future devices that would be fitted to existing Ausgrid poles. Technologies such as 5G have a much shorter transmission distance than current devices and, as such, it is reasonable that the number of devices on poles will increase. The revenue increase that this model represents for Ausgrid is around a 10% increase on current values, which would be reasonable given the expected increase in devices associated with new technologies.

Table 1: Additional Revenue Assumptions

Input	Value	Basis	Assessment
Existing low impact devices	20,000	Ausgrid estimate.	Whilst the assumption of 20,000 existing devices that are currently unaccounted for is difficult to verify, any error in this estimate does not affect customers as it is unregulated revenue.
Low impact device growth rate	500 per 100,000 poles per 3 year cycle	Ausgrid forecast.	This forecast seems reasonable, given the current rate of device connections and expected expansion of this rate with technologies such as 5G which

Input	Value	Basis	Assessment
			have only on effective radius of 200 or 300 m.
High impact device growth rate	20 per 100,000 poles per 3 year cycle	Ausgrid forecast.	This forecast seems reasonable, given the current rate of device connections and expected expansion of this rate with technologies such as 5G which have only on effective radius of 200 or 300 m
Low impact device revenue	[redacted]	Current Ausgrid rate.	Reasonable, given basis of actual charge.
High impact device revenue	[redacted]	Current Ausgrid rate.	Reasonable, given basis of actual charge.

3.2.2 Improved Capex Efficiency

Improved capex efficiency accounts for 3% of the total benefit over the business case period for the preferred option. Reduction in site visits is an obvious and commonly referenced benefit of network asset digitisation projects. The value of productivity improvements can be difficult to quantify, however. United Energy estimated a $340,000 per annum reduction in site surveys for a $9.675 million project to conduct a LiDAR survey of 209,000 poles[7]. We note that this represents twice the benefit assumed by Ausgrid related to reduction in site visits for a project less than half the scale (based on poles). But we also observe that the scope and value of other benefits for the United Energy project are much smaller than the Ausgrid case (the United Energy case is also for LiDAR only, not complete asset capture). As indicated earlier in this report, the United Energy proposal was not accepted by the AER due to the absence of a customer benefit in its business case.

Both Ergon Energy and Essential Energy report cost savings related to their design services through reduction in site visits as well as capital and maintenance works scheduling efficiencies.

Whilst it can be difficult to quantify, we find that Ausgrid's conservative approach of limiting the benefit to only a proportion of site visits and only for replacement of poles and cross arms is reasonable.

Input assumptions and estimates relevant to this benefit are outlined below along with our evaluation of the reasonableness of each.

[7] United Energy, Project Justification Light Detection and Ranging (LiDAR) Asset Management PJ1400, RRP5-16

Table 2: Capex Productivity Assumptions

Input	Value	Basis	Assessment
Volume of pole and cross arm replacements	5,696	Taken from the Ausgrid Prioritised Investment Plan, 2020.	Reasonable, given the basis of forecast replacements. May be conservative, as many networks report higher defect identification rates through increased LiDAR and image capture efforts.
Number of site visits per replacement	2	Standard Ausgrid practice.	Reasonable
Site visits avoided through LiDAR	0.2	Estimate of 1 visit per 5 replacements avoided	Reasonable
Cost per site visit	$159	Average time of 1.5 hours per visit and using actual labour rates and costs determined by the AER (in its draft determination) for field worker for Ancillary Network Services.	Reasonable, given basis is benchmarked through the AER determination processes.

Overall we find the assumptions and values associated with this benefit reasonable, albeit potentially somewhat conservative.

3.2.3 LV Spreaders

Benefits related to LV spreaders accounts for 39% of the total benefit over the business case period for the preferred option. This includes a reduction in unserved energy, reduction in fire start risk and reduction in repair costs.

Installation of LV spreaders is a common practice and is mandated in some jurisdictions. In Victoria, one of the outcomes of the Victorian Bushfire Royal Commission after the 2009 fires was a direction to install spreaders on all spans in high bushfire risk areas by 2015 and in low bushfire risk areas by 2020. The Ausgrid business case posits that complete data capture will allow the identification of existing spreaders, but also the spans without spreaders and the proportion of those deemed to require them.

We consider it is reasonable to assume that reduction in outages, fire risk and repair costs would occur through identification of spans requiring spreaders and that this is a benefit that can be attributed to the asset digitisation project compared to the more expensive and less effective manual identification process.

Input assumptions and estimates relevant to this benefit are outlined below along with our evaluation of the reasonableness of each.

Table 3: LV Spreader Assumptions

Input	Value	Basis	Assessment
Volume of spreaders to be installed	31,815	10% of spans that currently do not have spreaders installed to be targeted.	It is difficult to assess the merit of this assumption, however 10% does not appear to be unreasonable.
Number of outages avoided per year	159	An assumption that 0.5% of the feeders that are within the 10% to have spreaders installed cause outages each year.	Potentially high. Western Power, for example, have reported 220 conductor clash outages in a year but over a longer network. However the NPV of the project is still positive even if this value is reduced to zero.
Average interruption duration	4 hours	Ausgrid estimate.	Reasonable, the average duration from arcing related outages in the Ausgrid 2018 RIN is higher than 4 hours.
Average customers impacted per LV feeder	50	Ausgrid estimate.	Reasonable, the average customers impacted from arcing related outages in the Ausgrid 2018 RIN is higher than 50.
Average repair cost	$2000	Ausgrid estimate.	Difficult to assess, however this does not seem unreasonable, given the outage duration, labour rates and crew sizes for repairs.
Average hourly consumption	0.63kWh	Based on average 5.5MWh per customer per annum.	Reasonable, given actual data.
Value of Customer Reliability (VCR)	$40 per kWh	Based on Ausgrid STPIS value.	Reasonable, given approved STPIS value.
Number of fire starts per annum	1.6	Based on a five year total of 8 reported fire starts for clashing of low voltage lines.	Reasonable, given historical average actual value. We note that the 2018 Ausgrid Category RIN lists 2 fire starts related only from vegetation related grow-ins and 10 fire starts from blow-ins.

Overall, the assumptions and estimates appear reasonable for this benefit.

3.2.4 Vegetation Encroachments

Vegetation encroachment benefits account for 9% of the total benefit over the business case period for the preferred option. The benefit is based on a reduction in service mains failures attributed to vegetation and avoidance of a proportion of the trees targeted for trimming around the overhead network in the LiDAR capture area. These are capital and operating expenditure savings respectively. Vegetation management cost savings are the most commonly cited benefit of LiDAR programs. We note that the Ausgrid vegetation management benefits forecast overall are more conservative than some reported benefits, such as those claimed by Ergon Energy due to ROAMES technology. Without actual data relevant to the Ausgrid network, however, we consider this approach suitable.

Input assumptions and estimates relevant to this benefit are outlined below along with our evaluation of the reasonableness of each.

Table 4: Vegetation Encroachment Assumptions

Input	Value	Basis	Assessment
Number of service mains failures or tree trimmings avoided	1%	Ausgrid estimate.	Difficult to assess, however we consider a 1% rate in either program (service mains or overhead vegetation management) may be conservative based on benefits reported by other networks.
Capex avoided through reduction in service main failures or opex avoided through across overhead network	$400 per affected span	Ausgrid estimate sourced from a combination historical and forecast service wire replacement costs.	This value benchmarks well compared to all DNSPs included in the AERs repex modelling outcomes and reflects Ausgrid's actual service replacement costs. This cost does not seem unreasonable given labour rates, crew sizes and call out durations.

Overall we find the benefits and assumptions related to vegetation encroachment reasonable, if not potentially conservative.

3.2.5 Optimised Vegetation Management

Optimisation of vegetation management cycles accounts for 27% of the total benefit over the business case period for the preferred option. The benefit is based on a reduction in vegetation management costs through deferral of tree trimming where possible and a reduction in unserved energy – that is, a customer benefit rather than a cost saving – through additional tree trimming as required to prevent outages.

Input assumptions and estimates relevant to this benefit are outlined below along with our evaluation of the reasonableness of each.

Table 5: Optimised Vegetation Management Assumptions

Input	Value	Basis	Assessment
Deferral period for tree trimming	1 year (from 1 year to 2 year cycle)	Ausgrid estimate	It is difficult to assess the merit of these assumptions, however the total value that they represent in terms of cost savings and avoidance of outages appears reasonable compared to benefits reported by networks with near total or total coverage of LiDAR data (e.g. Ergon Energy). We are therefore satisfied that these assumptions are not unreasonable. By way of high level comparison, by the end of the upcoming regulatory period, total vegetation management related savings for Ausgrid will be around 11% of that reported by Ergon Energy for a network around 14% the size.
Percentage of trees identified for deferral	2% first cycle, 4% post first cycle	Ausgrid estimate	
Reduction in period for outage risk vegetation	0.5 years (from 1 year to 6 month cycle)	Ausgrid estimate	
Percentage of outage risk vegetation identified	0.5% first cycle, 1% post first cycle	Ausgrid estimate.	
Customer benefit (VCR, average customers and average duration)	As per Table 3	As per Table 3	Reasonable, if not conservative. The Ausgrid 2018 Category RIN indicates that the average customers impacted by vegetation outages was 126 with an average duration of just under 5 hours (291 minutes).

Overall we find the benefits and assumptions related to optimised vegetation management reasonable, if not conservative.

4. Conclusions

Our review covered the methodology and input assumptions associated with the Ausgrid business case and CBA model for its network asset digitisation program. In summary, our review found:

- The technology and capability proposed by Ausgrid is proven to be an effective means of cost savings, safety improvements and customer benefits through many case studies across Australia and other countries. LiDAR is currently a more established method of data capture than photography, and aerial surveys have been more common than ground based surveys, however the considerably increased accessibility and granularity of data offered by the Ausgrid solution is worth pursuing.

- The costs of data capture in the Ausgrid business case are based on known rates of established suppliers that compete in an open market, and are therefore a sound basis of overall project cost estimate.
- The scope of benefits included in the analysis is limited to increased revenue, fire safety risk reduction, reduction in unserved energy and cost savings in the vegetation management and pole and cross arm replacement programs. Other benefits such as clearance compliance, scheduling efficiencies, asset management effectiveness, etc are listed in the business case, but not quantified due to lack of certainty of timing and/or value. We find this conservative approach suitable as an "offset" to any risk of potential overstatement of benefit value for those included in the CBA.

On balance, we find that the project is sufficiently defined for its purpose (justification of expenditure for inclusion in the forecast of expenditure in the next regulatory period), the financial analysis is sound and the assumptions reasonable. We would expect the business case continue to be developed as the project progresses toward execution. The preferred option has a payback period within the regulatory control period of its spend, where benefits are a combination of revenue, direct capital and operating expenditure savings and externalities such as reduction in unserved energy and fire safety risk.

In reviewing other, similar project business cases and submission for Australian networks embarking upon LiDAR and other image capture projects, we find the Ausgrid business case to be of similar – and in some cases greater – robustness and quality.

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