SA Power Networks

Supporting document 5.18

Oakley Greenwood - The Economic Efficiency of Improving Reliability on Low Reliability Feeders

2020-25 Revised Regulatory Proposal

10 December 2019

Oakley Greenwood

The Economic Efficiency of Capex Investment to Improve Reliability for Customers Connected to Low Reliability Feeders

prepared for:
SA Power Networks

Melbourne +613 9016 2550 **Sydney** +612 8091 3650 **Brisbane** +617 3283 3249

DISCLAIMER

This report has been prepared at the request of SA Power Networks as part of its revised proposal to the AER regarding capital expenditure over the 2020-2025 regulatory period to improve reliability in selected low reliability feeders (LRFs).

The analysis and information provided in this report is derived in part from information provided by SA Power Networks. OGW explicitly disclaims liability for any errors or omissions in that information, or any other aspect of the validity of that information. We also disclaim liability for the use of any information in this report by any party for any purpose other than the intended purpose.

This report can be made public and published on the AER website as part of SA Power Networks' Revised Regulatory Proposal.

DOCUMENT INFORMATION

Project	The Economic Efficiency of Improving Reliability on Low Reliability Feeders
Client	SA Power Networks
Status	Final report
Report prepared by	Lance Hoch (lhoch@oakleygreenwood.com.au) Rohan Harris (rharris@oakleygreenwood.com.au)
Date	30 November 2019

Table of CONTENTS

Table of FIGURES

Table of TABLES

1. Purpose and summary

This report has been prepared at the request of SA Power Networks as part of its revised proposal to the AER regarding capital expenditure over the 2020-2025 regulatory period to improve the reliability of selected low reliability feeders (LRFs). It draws heavily on the methodology and findings of work we undertook in late 2017 and early 2018 for the Essential Services Commission of South Australia (ESCoSA) as part of its review (ESCoSA's review) of the reliability standards that would apply to SA Power Networks for the 2020-2025 period.[1]

That work determined that the aggregate amount that people connected to LRFs were willing to pay to improve their reliability of supply by 10% was not sufficient by itself to fund the expenditure required to do so. However, the explicit willingness of other customers to subsidise this level of improvement in reliability, when made aware of the significantly poorer reliability that customers connected to LRFs experience, exceeded the cost of the projects proposed by SA Power Networks for this purpose.

In its original *2020-2025 Regulatory Proposal* (January 2019), SA Power Networks proposed a smaller, targeted capex proposal than that considered in the ESCoSA review. The Australian Energy Regulator (AER) rejected that part of SA Power Networks' capex proposal. SA Power Networks is re-submitting the LRF program and has asked Oakley Greenwood (OGW) to assess the economic efficiency of the 2020-2025 LRF program in light of the findings of the study undertaken for ESCoSA.

Based on the levels of willingness to pay and willingness to subsidise determined in the ESCoSA study, it is our view that the proposed 2020-2025 LRF program – which focusses on a smaller set of LRFs and delivers a greater level of improvement than the program assessed in the ESCoSA study – is economically efficient.

2. Overview of the methodology and findings of the ESCoSA study

2.1. Methodology

South Australia's Electricity Distribution Code defines reliability in terms of USAIDI and USAIFI[2] for each of four feeder types (CBD, Urban, Short Rural and Long Rural) and sets different standards for each. ESCoSA and SA Power Networks recognised that there was a small number of feeders whose performance is significantly and consistently worse than the relevant reliability standard.

The research therefore separately examined the value of reliability improvements for metropolitan and non-metropolitan customers, and for customers on low reliability feeders. Other factors motivating the research included:

1 OGW, *Economic assessment of electricity distribution reliability standard packages*, for ESCOSA, June 2018.

2 USAIDI and USAIFI are measures of the average duration and frequency of outages experienced by a customer within the distribution network (i.e., they are calculated as the sum of the total time each customer is without supply (duration) and the sum of the total number of each customer outage (frequency) respectively, divided by the total number of customers).

- Previous customer engagement activities undertaken by SA Power Networks and the Commission had identified that customers are interested in improved reliability, whether across the board, for non-metropolitan customers only, or for customers on low reliability feeders, though they also expressed some sensitivity about the cost associated with any such improvements.
- Targets for average performance, such as those in the *Electricity Distribution Code* and in the Australian Energy Regulator's (AER) Service Target Performance Incentive Scheme (STPIS), mean that improvements in higher density areas (which tend to have a lower per customer cost and therefore may be preferred by SA Power Networks and have lower impacts on customers' bills) can offset declines in reliability in lower density areas. It is possible for this to lead to an increased divergence in the levels of reliability across the network as a whole.

The research was undertaken by designing and fielding a questionnaire to 1,313 residential and business electricity customers, and analysing their responses in order to:

- quantify
  - customers' willingness to pay (WTP) for improved reliability in the areas in which they live;
  - customers' willingness to subsidise (WTS) reliability improvements in areas that experience materially poorer reliability than their own area; and
- compare the sum of those WTP and WTS amounts to the cost of making those reliability improvements in each of the areas.

This approach sought to identify reliability levels that were economically efficient, where economic efficiency is defined as:

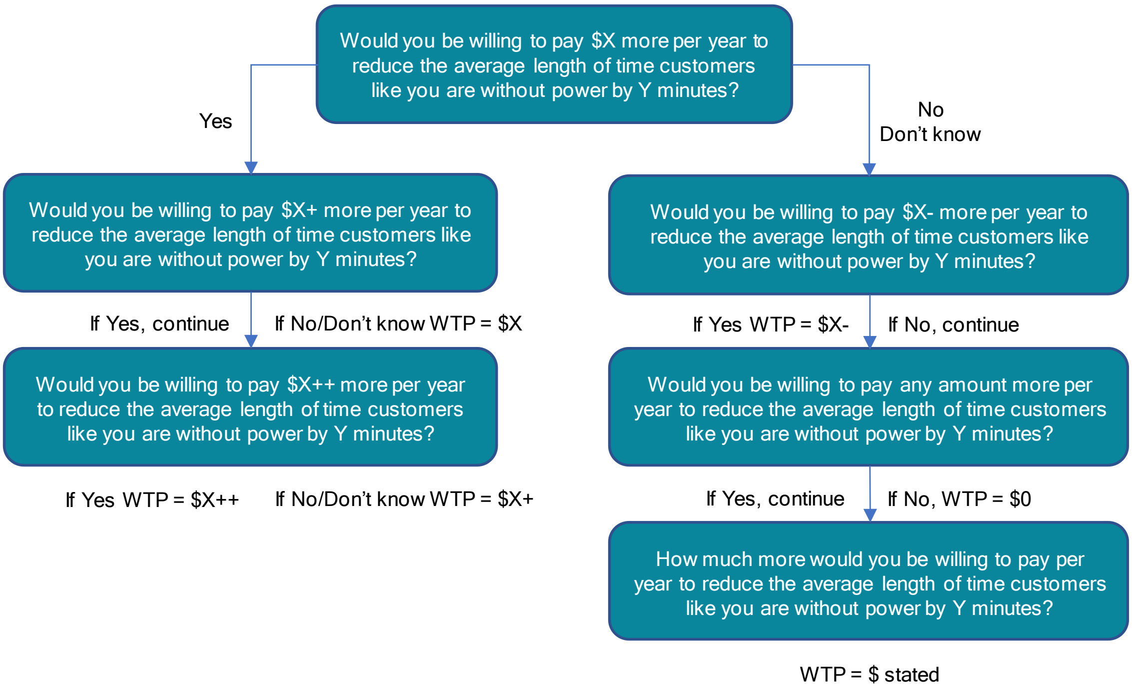
Willingness to pay on the part of customers within the region + Willingness of customers from other regions (where applicable) to subsidise ≥ Annualised project costs

A contingent valuation (CV) methodology was employed in the survey. Contingent valuation is an economic, non-market-based survey valuation method that is most usually employed to infer individuals' preferences for public goods, such as environmental quality. CV questionnaires directly ask respondents for their maximum WTP for specified improvements in the public good in question. CV circumvents the absence of markets for public goods by presenting consumers with a survey market in which they have the opportunity to 'buy' the good in question.

Contingent valuation provides a means for getting a specific estimate in absolute dollar terms of the value each respondent places on each reliability improvement option. It does so by explicitly asking whether the respondent would be willing to pay different dollar amounts and can be used for both WTP and WTS. This is important as it allows the construction of a demand curve for customers' WTP and WTS, which in turn can be used to calculate the aggregate WTP and WTS of the respondents (and the customer segments they represent) for each reliability improvement option.

The questioning in the ESCoSA survey that was used to identify customers' willingness to pay for reliability improvements in the area in which they live (and which therefore could, but would not necessarily, affect their personal reliability) followed the pattern shown in **Error! Reference source not found.** below.

Figure 1: Question flow to establish customers' WTP for reliability improvements in their own area



The initial amount put to the respondent was set at the annualised per capita cost of the reliability improvement package assuming that the package would be entirely funded by the customers in that geographic area. That starting point and the following questions allowed us to develop a demand curve for reliability among these customers that included the specific proportion of the customers that were willing to pay specific amounts for each reliability improvement package, including $0, some value between $0 and the per capita cost of the improvement package, the actual per capita cost of the improvement package, and two specific amounts higher than the actual per capita cost of the improvement package. Assessing the aggregate WTP was then a simple matter of applying the proportion of the survey group to the total population in the geographic area and multiplying that number of customers by the amount that portion of the survey group was willing to pay. Where the aggregate WTP exceeded the annualised cost of the reliability package, it could be concluded that the affected customers would be willing to fund that reliability improvement on their own.

A similar question flow was used to assess customers' willingness to pay more on their bill to fund reliability improvements for customers in areas where reliability is significantly poorer than their own. The willingness to subsidise questions were preceded with information that compared the level of reliability in the respondent's area with that experienced in LRFs. The text below provides an example of how the reliability in the LRFs being considered compared to the reliability in the greater Adelaide area.

Example of the text used to provide context for the WTS questions in the ESCoSA survey regarding a 10% reliability improvement in LRF areas

There are about 25,000 customers (3% of all customers) who have much longer outages than other customers. On average, these customers experience two or three unplanned outages each year, and around seven hours without power – almost four times the amount of time the average customer in metropolitan Adelaide and major regional centres is without power.

*The standard could be changed to reduce the amount of time the average customer in low reliability areas would experience a power outage by **90 minutes** – from about seven hours to about five and a half hours.*

In the willingness to subsidise questions the phrase:

Would you be willing to pay $X more per year – about $A on each quarterly bill – to reduce the average length of time customers like you are without power by Y minutes?

was re-cast as:

Would you be willing to pay $X more each year – about $A on each quarterly bill – for that improvement?

2.2. Findings

The results of the ESCoSA study regarding the willingness of customers within the LRF areas to pay for the reliability improvement projects considered for the LRF areas in the ESCoSA study and the willingness of other customers to subsidise the cost of those projects are shown in Table 1 below.

Table 1: Proportion of LRF customers willing to fund and other customers' willingness to subsidise reliability improvements in LRF areas

Customer segment	Willing to pay an amount equal to or greater than the per customer cost	Willing to pay some amount, but *less than* the per-customer cost	Not willing to pay any amount at all
LRF customers			
Residential	14.0%	12.0%	74.0%
Business	12.0%	21.8%	66.2%
	Willing to provide a subsidy equal to or greater than the per customer cost	**Willing to provide some subsidy, but less than the per-customer cost**	**Not willing to provide any subsidy at all**
Customers in other areas			
Metropolitan – residential	40.5%	5.3%	54.2%
Metropolitan – business	39.4%	9.1%	51.5%
Non-metropolitan – residential	55.6%	6.3%	38.1%
Non-metropolitan – business	40.0%	7.1%	52.9%

Table 2 translates these results into the average amount that customers connected to LRFs were willing to pay for a 10% reliability improvement in their own area,

Table 2: Average amount customers in LRF areas were willing to pay for a 10% improvement in reliability[3]

LRF customer segment	Average amount they were willing to pay for / subsidise a 10% improvement	Actual amount needed per customer to fund a 10% improvement
Residential	$11.15	$54.76
Business	$30.96	$108.74

Based on these figures it was determined that the aggregate willingness of LRF customers to pay for a 10% reliability in their own electricity supply was **not** enough to cover the costs of the projects that would do so.

However, as shown in Table 3, when the average amount that customers in other areas were willing to pay as a subsidy to improve the reliability of supply for customers in LRF areas was calculated it showed that this would more than cover the costs of those projects.

Table 3: Average amount other customers were willing to pay to subsidise a 10% improvement in reliability in LRF areas[4]

Non-LRF customer segments	Average amount they were willing to pay to subsidise a 10% improvement in LRF areas	Actual amount needed per customer to fund a 10% improvement in LRF areas
Residential		
Metropolitan	$3.21	Less than $2.00
Non-metropolitan	$3.84	
Business		
Metropolitan	$5.43	Less than $5.00
Non-metropolitan	$6.33	

As can be seen, in each case the average amount that non-LRF customers were willing to pay to subsidise reliability improvements in LRF areas always exceeded the amount required to deliver the improvements. Based on these survey results, our conclusion was that the proposed expenditure for those projects would be economically efficient.

3. Application of ESCoSA study findings to SA Power Networks' revised LRF reliability improvement proposal

3.1. Key features of the LRF reliability projects in SA Power Networks' revised regulatory proposal

Table 4 below presents the key features of the LRF reliability improvement projects in SA Power Networks' revised regulatory proposal and compares them to the features of the LRF projects that were discussed in the ESCoSA study.

3 Includes customers who were not willing to pay any amount at all.

4 Includes customers who were not willing to pay any amount at all.

Table 4: Key features of the LRF reliability projects in SA Power Networks' revised regulatory proposal compared to those in the ESCoSA study

Features	LRF reliability improvement projects in	
	Revised regulatory proposal	ESCoSA study
Number of affected customers		
Residential	10,590	23,865
Business	5,132	3,219
Total	15,772	27.084
Capital cost	$15.6 million	$30.6
Improvement in reliability		
Reduction in minutes off supply	116	25
Percentage improvement	38%	10%

As can be seen the LRF reliability program in SA Power Networks' revised regulatory proposal, as compared to that tested in the ESCoSA survey:

- Provides a significantly larger improvement in reliability for LRF customers: 116 less minutes off supply, over 4 times the reduction provided in the reliability package assessed in the ESCoSA survey and representing a 38% improvement for affected customers as compared to a 10% improvement in the projects tested in the ESCoSA survey;
- Delivers benefits to fewer customers – about 58% of the number that would have been affected by the projects discussed in the ESCoSA survey;[5]
- But would be significantly more cost effective given that although the costs and overall number of customers affected have both reduced, the reduction in minutes off supply would increase by a factor of a bit more than four.

3.2. Economic efficiency of the LRF reliability improvement projects in SA Power Networks' revised regulatory proposal

As noted in Table 4 above, the capital cost of the LRF reliability projects that SA Power Networks is putting forward in its revised proposal is $15.6m, which equates to an annualised cost of approximately $600,000[6]. This would require the recovery of approximately $0.40 per residential customer per year and $2.95 per business customer per year.[7]

5 Although the current proposal would affect less than half the number of residential customers that would have been affected by the projects discussed in the ESCoSA survey, it would affect slightly more than half again as many more small business customers.

6 Capital and annualised cost provided by SA Power Networks.

7 The cost per residential customer per year was provided by SA Power Networks and is based on the following inputs: 815,000 residential and 105,000 business customers in total, an asset life of 55 years, a nominal WACC of 4.5%, and cost recovery being allocated 51% / 49% to the residential and business sectors respectively..

Table 5 below reiterates the figures calculated in the ESCoSA survey for the average LRF customer's willingness to pay for improved reliability in their own areas and the average willingness of customers in other areas to subsidise those improvements. In each case, the figure is the weighted average across all customers within that category – including the customers that were not willing to pay anything.

Table 5: Average willingness to pay for and willingness to subsidise reliability improvements in LRF areas

LRF	Average per-customer WTP[8]
Residential	$11.15
Business	$30.96
Metropolitan & non-metropolitan	**Average per- customer WTS[9]**
Metro - residential	$3.21
Metro - business	$5.43
Non-metro - residential	$3.84
Non-metro - business	$6.33
Annualised cost per customer of the revised LRF reliability improvement projects[10]	
Residential	$0.40
Business	$2.95

As can be seen, the average willingness of all customer segments outside the LRF areas to subside reliability improvements for customers on low reliability feeders exceeds the annualised cost per customer of the revised LRF reliability improvement projects. In fact, even the lowest of the willingness to subsidise figures – that of residential metropolitan customers, who represent the largest of the customer segments – is about eight times the amount required to fund the projects on a per residential customer basis.

On this basis, it is our view that the revised LRF reliability program is economically efficient.[11]

8 Includes those respondents who were not willing to pay anything at all.

9 Includes those respondents who were not willing to pay anything at all.

10 Calculated by SA Power Networks.

11 A comparison of the annualised costs of the revised LRF reliability improvement projects to the aggregate willingness to pay and willingness to subsidise based on the results of the ESCOSA survey is provided in Appendix A.

3.3. Sensitivity analysis

It should be recalled that the revised set of LRF reliability projects will affect a smaller number of customers than were included in the program assessed in the ESCoSA study. However, even if we proportionally reduced the average amount that metropolitan residential customers were willing to pay to subsidise reliability improvements for customers served by LRFs – to reflect the possibility that this willingness to pay is directly proportional to the number of customers affected – it would still be $1.42.[12] This is still significantly higher than the amount required to fund the projects on a per-residential customer basis.

However, it is also the case that the revised set of LRF reliability projects will provide a greater improvement in the reliability of the affected LRF customers than the LRF reliability improvement proposal assessed in the 2017/2018 survey. Adjusting the willingness to subsidise of metropolitan residential customers in proportion to that difference in reliability improvement in addition to the lower number of customers affected yields an average willingness to subsidise amount of $5.41 for metropolitan residential customers. This is over 13 times the per-customer amount required to fund the projects.

It should be noted that metropolitan residential customers are the largest customer segment, representing about 62% of all customers, and each of the other customer segments' willingness to subsidise was higher, and in some cases, significantly higher than that expressed by metropolitan residential customers. Table 6 below provides the initial WTS of each of the customer segments and the amounts adjusted for the fewer customers and increased reliability improvement of SA Power Networks' revised proposal.

Table 6: Sensitivity analysis of customers' WTS for the characteristics of the revised LRF reliability improvement projects

Customer segment	Initial amount willing to pay to subsidise	Adjusted for the reduced number of customers	Adjusted for the reduced number of customers and the increased level of reliability improvement
Metropolitan residential	$3.21	$1.42	$5.41
Non-metropolitan residential	$3.84	$1.70	$6.48
Metropolitan business	$5.43	$8.66	$32.90
Non-metropolitan business	$6.33	$10.09	$38.35

As a result, in our view, the revised LRF reliability projects are economically efficient even if the revealed willingness to subsidise of other customers is adjusted to reflect the lower number of customers that will be affected by the revised LRF reliability improvement projects.

12 $3,21*(10,590 / 23,865) - see Tables 4 and 5.

4. Other considerations

4.1. Customers' views on 'equity'

We note that SA Power Networks has included the notion of equity in its engagement with its Consultative Panel. The discussion of equity focussed on the fact that there are groups of customers, usually located around the edges of the network, that experience very poor reliability – significantly worse than the average customer experiences.

Following those conversations there was general agreement amongst the Panel that it was unacceptable for some customers to experience such a vastly different level of service, and that SA Power Networks should be working to improve reliability for customers who have experienced significantly lower levels of electricity supply reliability for sustained periods. This reinforces the quantitative outputs of the study; namely, that customers are prepared to subsidise these improvements. Further, it suggests that a case can be made that customers would prefer that reliability improvements be prioritised for customers on LRFs where doing so would reduce the difference between the average and poorest levels of reliability across the customer base, and assist in increasing the reliability on LRFs to a community-acceptable level.

4.2. The fact that customers won't actually pay more

The previous study that we completed for ESCoSA, from which the above results have been sourced, was based on a suite of questions that tested customers willingness to pay for service level improvements (either for themselves, or for customers on low reliability feeders). To be very clear, the impacts were presented as bill increases – that is, as increased amounts the respondent would need to pay on their quarterly or monthly bill.

However, the impact of the AER's Draft Decision is expected decrease customers' annual bills – by about $60 for the average residential customer and by about $280 for a typical small business customer.[13] In this case, customers would not actually see a bill increase if the LRF reliability improvement projects were to be funded; rather they would receive a slightly smaller reduction in their bill.

This is conceptually different from the outcomes tested in the ESCoSA survey, where we only tested customers' willingness to pay more to subsidise the reliability of other customers. We did not test customers' willingness to accept smaller bill reductions as a trade-off for a subsidy of increased levels of reliability for customers on LRFs.

Whilst, technically, this represents a difference in the WTP and WTS circumstances in our earlier study as compared to those affecting SA Power Networks' revised capital expenditure proposal for reliability improvement in low reliability feeders, we would expect that this difference, if anything, would likely increase customers' willingness to pay for improved levels of reliability for customers served by LRFs.[14]

---

13 See page 18 in the Overview of the AER's Draft Determination (https://www.aer.gov.au/system/files/AER%20-%20SA%20Power%20Networks%202020-25%20-%20Draft%20decision%20-%20Overview%20-%20October%202019_2.pdf)

14 We undertook a literature search but were unable to identify any studies that compared customers' willingness to pay more as compared to their willingness to accept a lower discount in order to subsidise a service for other customers.

4.3. Regulatory considerations

4.3.1. This approach could offer a useful corrective to the STPIS

While there is no regulatory obligation on SA Power Networks to improve the reliability of these feeders, as the AER pointed out, there is also no reason why such improvements should not be undertaken where they are economically efficient. The results of our study indicate that customers' willingness to subsidise reliability improvements in for customers connected to LRFs exceeds the costs of those improvements, making such an expenditure economically efficient.

In this regard, it is important to note that the VCR, as currently constructed, reflects the average of individual customers' willingness to pay for improvements in their own level of service. As an average, it makes no allowance for the fact that some customers may not be willing to pay any amount at all.

It also makes no reference to, or allowance for, the willingness of other customers to subsidise an improvement in the level of service received by customers whose reliability is significantly poorer than their own. To this extent it does not, on its own, provide a complete assessment of the potential economic efficiency of proposed reliability improvement projects.

4.3.2. Equity (the fact that some customers did not want to pay is not a reason to not fund reliability improvements)

Whilst it is natural for stakeholders to consider the equity impacts of any expenditure, it is our view that the National Electricity Objective (NEO) is very much underpinned by economic considerations. For example, the AEMC has previously stated that "*the NEO is an economic concept and is intended to be interpreted as promoting efficiency in the long-term interests of consumers*[15]"). The AEMC's more detailed description of its interpretation (in the same document) further elaborates on what it means by economic efficiency, and in doing so, it breaks down its discussion into productive, allocative and dynamic efficiency.

The Australian Competition Tribunal (ACT) has provided the following interpretation of the NEO[16]:

> *"The national electricity objective provides the overarching economic objective for regulation under the NEL: the promotion of efficient investment and efficient operation and use of, electricity services for the long term interests of consumers. Consumers will benefit in the long run if resources are used efficiently, that is if resources are allocated to the delivery of goods and services in accordance with consumer preferences at least cost. As reflected in the revenue and pricing principles, this in turn requires prices to reflect the long run cost of supply and to support efficient investment, providing investors with a return which covers the opportunity cost of capital required to deliver the services."*

15 AEMC, "*Applying the energy objectives*", page 12

16 Australian Competition Tribunal - *Application by EnergyAustralia and Others [2009] ACompT 8 - Corrigendum*, p. 10.

Notwithstanding any of the above, it is self-evident that given that electricity services are provided to customers via a network of assets, it is impossible to carve out and provide discrete, different levels of service to each individual customer. By their very nature, networks provide similar services to all connected customers (or at least, all customers connected within a particular subset of the network, for example, a certain geographic area/feeder). This means that it may be efficient to make investments in response to a group of customers' willingness to pay, without having obtained a positive expression of willingness to pay from *all* customers. To conclude that "equity" considerations are such that if any individual or group of customers expresses an unwillingness to pay for changed service level, that automatically means that that investment should not be approved, limits business' ability to make investments that may be otherwise efficient.

In this regard it is worth noting that the VCR itself is an average across customers. When it is used as a threshold for determining what investments are economically efficient it essentially imposes costs on people whose personal VCRs are lower than the community average VCR.

Appendix A: Comparison of the annualised costs of the revised LRF reliability improvement projects to the aggregate willingness to pay and willingness to subsidise based on the results of the ESCoSA survey

In the table below, the figures calculated in the ESCoSA survey for the average LRF customer's willingness to pay for improved reliability in their own areas and the average willingness of customers in other areas to subsidise those improvements, are multiplied by the number of customers within the LRF and other areas to provide the aggregate funding this could provide on an annual basis. This is then compared to the annualised cost of LRF reliability improvement projects being proposed by SA Power Networks.

As can be seen, the aggregate funding provided by customers' WTP and WTS significantly exceeds the annualised costs of the projects.

Table 7: Aggregate WTP of LRF customers and WTS of customers in other areas for the LRF reliability improvement projects in SA Power Networks revised regulatory proposal

LRF	Average per-customer WTP[17]	Number of customers	Total WTP
Residential	$11.15	10,590	$118,079
Business	$30.96	5,132	$158,887
Subtotal			$276,965
Metropolitan & non-metropolitan	**Average per-customer WTS[18]**	**Number of customers**	**Total WTS**
Metro - residential	$3.21	566,964	$1,819,955
Metro - business	$5.43	63,482	$344,705
Non-metro - residential	$3.84	237,446	$911,792
Non-metro - business	$6.33	36,386	$230,326
Subtotal			$3,306,778
Total WTP + WTS benefit			$3,583,743
Annualised cost of LRF reliability improvement projects[19]			$631,800

17 Includes those respondents who were not willing to pay anything at all.

18 Includes those respondents who were not willing to pay anything at all.

19 Annualised cost figure provided by SA Power Networks.