WILLINGNESS TO PAY RESEARCH STUDY

A Report for ACTEW Corporation and ActewAGL

Prepared by NERA and ACNielsen

September 2003
Sydney

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EXECUTIVE SUMMARY

NERA and ACNielsen were commissioned by ACTEW Corporation ('ACTEW') and ActewAGL in October 2002 to undertake a survey to establish customers' willingness to pay for: existing service standards; statutory requirements in relation to reliability, safety and environmental factors; and new or changed services and offerings.

The terms of reference specified that the survey was to cover electricity, gas, water and sewerage services within the residential, business and government segments of the Australian Capital Territory ('the ACT'), and that it was intended that the study would provide information for ACTEW and ActewAGL's forthcoming regulatory review.

Methodology and Approach

Stated preference choice modelling was recommended by the project team to estimate customers' willingness to pay. Choice modelling is widely used to evaluate multi-attribute products, and is based on the behavioural principle that products are composed of a number of attributes, and the total value of the product is the sum of the 'part worth' or value of each of these attributes or characteristics. Choice modelling has a number of advantages over other stated preference methods such as contingent valuation (as detailed in section 2 of this report).

The methodology involves presenting a number of service 'options' or scenarios to respondents, as part of a questionnaire, and asking respondents to choose between them. These scenarios offer the respondent a combination of service attributes, with a corresponding 'level' of service for each of those attributes, at a particular price. In doing so, the choice modelling survey 'simulates' a market situation, allowing researchers to gather information on the most preferred aspects of the service; and also the relative value consumers place on an incremental change in each aspect of the service.

Further details of the study methodology and approach are detailed in section 2 and 3 of this report.

Overview of Study Results

Initial research identified the following aspects of ACTEW/ActewAGL's services, including the natural gas service in both the ACT and Yarrowlumla Shire, as the focus of the study:

- the reliability of each utility service, including the frequency and duration of service interruptions;
- quality aspects of the electricity service, relating to variations in voltage;

- customer service attributes, including notification prior to an interruption, the method of distributing information to customers, and the time period in which planned service interruptions occur (including time of day and time of year); and
- aspects relating to water supply security, including the frequency of water restrictions, the duration of water restrictions, the types of days that water restrictions apply, the level of water restrictions, and the 'greenness' of Canberra's urban landscape.

Customers' attitudes and preferences relating to each of these were the focus of the main study. In addition, the initial qualitative research explored customers' views on a broader range of network service aspects, including safety and a number of new customer service ideas. The initial recruitment survey was used to examine customers' experiences and perceptions of ACTEW/ActewAGL and current service standards. The results for each of these topic areas are summarised below.

Service Reliability Preferences

The results show that customers have a strong preference for reliable utility services, as provided by ACTEW and ActewAGL. Customers dislike incurring service interruptions and are willing to pay both to reduce the frequency and duration of interruptions.

Residential customers' average willingness to pay to avoid disruptions was found to be greatest for wastewater overflows, closely followed by water, then electricity, and then gas interruptions. These rankings are consistent with the findings of the qualitative research, which suggested that, relative to the four utilities, gas was likely to have the least impact on household functioning in the event of a disruption. Focus group participants' main concern in respect to wastewater overflows and water interruptions was hygiene, which was perceived as a high priority.

Commercial customers' average willingness to pay to avoid disruptions was also found to be the greatest for wastewater overflows. The next most important factor was generally a continuous electricity supply, followed by a continuous water and gas supply (which are valued about equally at current service levels). Hygiene was also perceived as a high priority for business customers in the qualitative research, providing an explanation for the importance that customers attach to avoiding wastewater overflows. The importance of electricity interruptions is higher to businesses than to residential customers given that electricity interruptions generally affect businesses' entire operations, leading to lost product or custom and therefore profit. For many businesses, the effect of water interruptions can be localised to part of their operations; these interruptions are consequently less problematic for most business customers than electricity interruptions. It is important to note that these general statements do not apply to all customers. For example, business participants in the hospitality, tourism and entertainment sectors, along with irrigators, evidenced the lowest level of tolerance toward a water disruption, since their entire business would need to stop/close during a disruption.

Customers' rankings of the service attributes covered in the study are provided in table S1 (at current levels of service).[1]

Table S1: Relative Importance Placed on Service Attributes by Customers

Level of Importance	Residential	Commercial
1	Receive notification of an interruption	Receive notification of an interruption
2	Having someone answer the phone at the ActewAGL call centre	Having someone answer the phone at the ActewAGL call centre
3	Avoid regular water restrictions of stage 3 or higher	Avoid a wastewater overflow
4	Avoid a wastewater overflow	Avoid regular water restrictions of stage 3 or higher
5	Avoid a water interruption	Reduce length of wastewater overflow by 1 hour
6	Reduce length of wastewater overflow by 1 hour	Avoid an electricity outage
7	Reduce length of water interruption by 1 hour	Reduce length of electricity outage by 1 hour
8	Reduce length of wastewater overflow by 1 hour	Avoid a power surge
9	Avoid an electricity outage	Avoid a gas outage (winter and non-winter)
10	Avoid power surge	Avoid a water interruption
11	Reduce length of electricity outage by 1 hour	Avoid a momentary electricity outage
12	Avoid a winter gas outage	Reduce length of water interruption by 1 hour
13	Avoid momentary electricity outage	Reduce length of gas outage by 1 hour (winter and non-winter)
14	Avoid a non-winter gas outage	Avoid a flicker in electric current
15	Reduce length of winter gas outage by 1 hour	
16	Avoid a flicker in electric current	
17	Reduce length of non-winter outage by 1 hour	

The willingness to pay expressed by commercial customers is in most cases higher than residential customers, both as 'share of bill' and in absolute dollar terms. Again, this is consistent with the qualitative research findings, and is consistent with the fact that

[1] The derived 'willingness to pay' estimates indicate the relative strength of these rankings (the coefficients of the choice model also indicate the relative strength). These estimates are provided in, and indeed are the subject of, the remainder of the report.

commercial customers are likely to have more at stake with interruptions than residential customers.

A summary of customers' willingness to pay to avoid the types of events covered in the choice experiments is provided in table S2. These should be interpreted as the total amount a customer would be willing to pay to avoid each event entirely. For example, on average, a residential customer would be willing to pay $60, or 7 percent of their annual electricity bill, to avoid an 8-hour electricity outage when it occurs once a year. Similarly, a commercial customer would be willing to pay $207 to avoid a water interruption when it occurs once every 10 years.

Note that it is the average (mean) willingness to pay that is denoted. The medians and the distribution of estimates are provided in sections 5, 7 and 9 of the report.

Table S2: Average Willingness to Pay to Avoid Events
(per customer, per event, in dollars (share of current annual bill))

Event	***Residential***	***Commercial***
Electricity		
8-hour electricity outage when it occurs once a year	60 (7%)	694 (12%)
4-hour electricity outage when it occurs once a year	51 (6%)	556 (10%)
One-hour electricity outage when it occurs once a year	37 (5%)	341 (6%)
Half-hour electricity outage when it occurs once a year	33 (4%)	274 (5%)
Electric power surge [2]	32 (4%)	270 (5%)
Momentary electricity outage [3]	23 (3%)	238 (4%)
Flicker in electric current	9 (1%)	73 (1%)
Water/Wastewater		
Water interruption when it occurs once every ten years	113[4] (15%)	207 (4%)
Wastewater overflow when it occurs once every ten years	212 (28%)	2023 (42%)
Water restrictions that last all year, every day, stage 3-5	237 (31%)	1104 (23%)
All other water restrictions	0	0
Gas		
Gas outage in winter	28 (4%)	229 (5%)
Gas outage not in winter	20 (3%)	229 (5%)

2 No further explanation of power surges/spikes was provided in the choice sets. It should be noted that customers may not be able to differentiate between those events caused by the network versus those caused by the customer's own appliances/machinery/wiring without recourse to monitoring equipment.

3 That is, outages of less than one minute, requiring 'clocks to be re-set'.

4 This means that, on average, a residential customer would be willing to pay $11.30 ***per annum*** to avoid water interruptions that occur once every 10 years (ie, $113/10).

Implications for Existing Levels of Reliability

With respect to the implications of these results for the future priorities of ActewAGL's operations, given that the merit of changing service standards depends not only on customers' willingness to pay but also on cost, we recommend that ActewAGL develop a range of specific network options for assessment. The willingness to pay estimates can be used to calculate the benefit derived by customers for each network option, and so each option can be evaluated by comparing its cost against its benefits. The results of such analysis can be used to help formulate future operations strategy.

It is also possible however to derive customers' preferences for particular levels of service compared to others by using the willingness to pay results and a range of 'hypothetical' service scenarios (including price). The study results[5] can be used to calculate the relative satisfaction (or utility) that customers derive from each 'hypothetical' service scenario. The scenarios can therefore be ranked, and the scenario most preferred by customers can be determined. It is also possible to use such analysis to calculate the amount of compensation that customers would require to accept their less preferred service scenarios.[6]

An example adopting a broad cross section of hypothetical service scenarios is provided below. It indicates that customers value (that is, are willing to pay for) the current levels of reliability provided by ActewAGL/ACTEW, and, in some cases, it indicates that customers may even be willing to pay for higher levels of service.

Figures S1-S4, on the following pages, illustrate the relative satisfaction (or utility) that residential customers derive from a number of different service scenarios, for each service provided by ActewAGL. For each service, the existing level of reliability is compared to four different scenarios: two scenarios offering an increased level of service (together with a higher price), and two scenarios offering a decreased level of reliability (together with a lower price). The utility derived from each service scenario has been calculated using the study results. For ease of presentation,[7] the utility derived from existing service levels is assigned a value of 1, and the utilities derived from the other hypothetical service levels are recalibrated around this. The higher the number, the greater the level of customer satisfaction (or utility) derived from the service scenario.

In all cases, a degraded level of service (in return for a discount in price) is less preferred to existing service levels. Consider the electricity reliability scenarios, for example. The utility derived from the existing level of reliability is one.[8] This compares with a utility of only 0.88

5 That is, the coefficients of the choice models.

6 That is, the amount of monetary compensation (or discount in price) that they would require to ensure that their utility remains unchanged.

7 Given that it is relative (rather than absolute) utility that is important in the analysis, calibration to alternative values has no impact on the results.

8 The analysis assumes that the current frequency of interruptions is 1.2 a year, the average duration of an interruption is 1.5 hours, interruptions occur on a weekday after 8am, and 2 days notice is provided to customers.

if the level of reliability was decreased by a factor of two,[9] in return for a discount of 3 percent in the total electricity price. As it generates a lower level of customer utility, the service scenario is less preferred to the existing level of service.

In some cases in the analysis, however, an increase in reliability (in combination with an increase in price) is more preferred than existing service levels. Consider the water reliability scenarios. As before, the utility derived from existing service levels is one.[10] However, the utility derived from a service with ***half*** the number and length of interruptions compared to now, together with a corresponding increase in their total water and sewerage bill of 3 percent,[11] is a little higher at 1.034. This level of service, together with its hypothetical price, is therefore more preferred by customers than the existing service (at the current price).

As noted earlier, it is also possible to use this analysis to calculate the amounts of monetary compensation (or price discount) that customers would require to accept their less preferred service scenarios.[12] With respect to degraded service standards, the analysis indicates that customers would require significant compensation if reliability levels were to fall. For example, residential customers would require, on average:

- a reduction of 13 percent on their total annual electricity bill (or about 26 percent on their network bill) to compensate for a doubling in both the frequency and duration of electricity interruptions;[13]
- a reduction of 13 percent on their total combined annual water and sewerage bill to compensate for a doubling in both the frequency and duration of water interruptions;[14]
- a reduction of 15 percent on their combined annual water and sewerage bill to compensate for a doubling in both the frequency and duration of wastewater overflows;[15] and

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9 That is, the customer could expect 2.4 interruptions per annum, each interruption lasting 3 hours. The timing of the interruption, and the period of prior notification would remain unchanged.

10 The analysis assumes that currently interruptions occur once every 10 years, the average duration of an interruption is 1.5 hours, interruptions occur on a weekday after 8am, and 2 days notice is provided to customers.

11 That is, reducing the frequency of interruptions from once every 10 years to once every 20 years, and reducing the average duration of an interruption from 1.5 hours to 45 minutes. The timing of the interruption, and the period of prior notification would remain unchanged.

12 That is, the amount of monetary compensation (or discount in price) that they would require to ensure that their utility remains unchanged.

13 That is, increasing the frequency of interruptions from 1.2 to 2.4 a year, and increasing the average duration of an interruption from 1.5 hours to 3 hours.

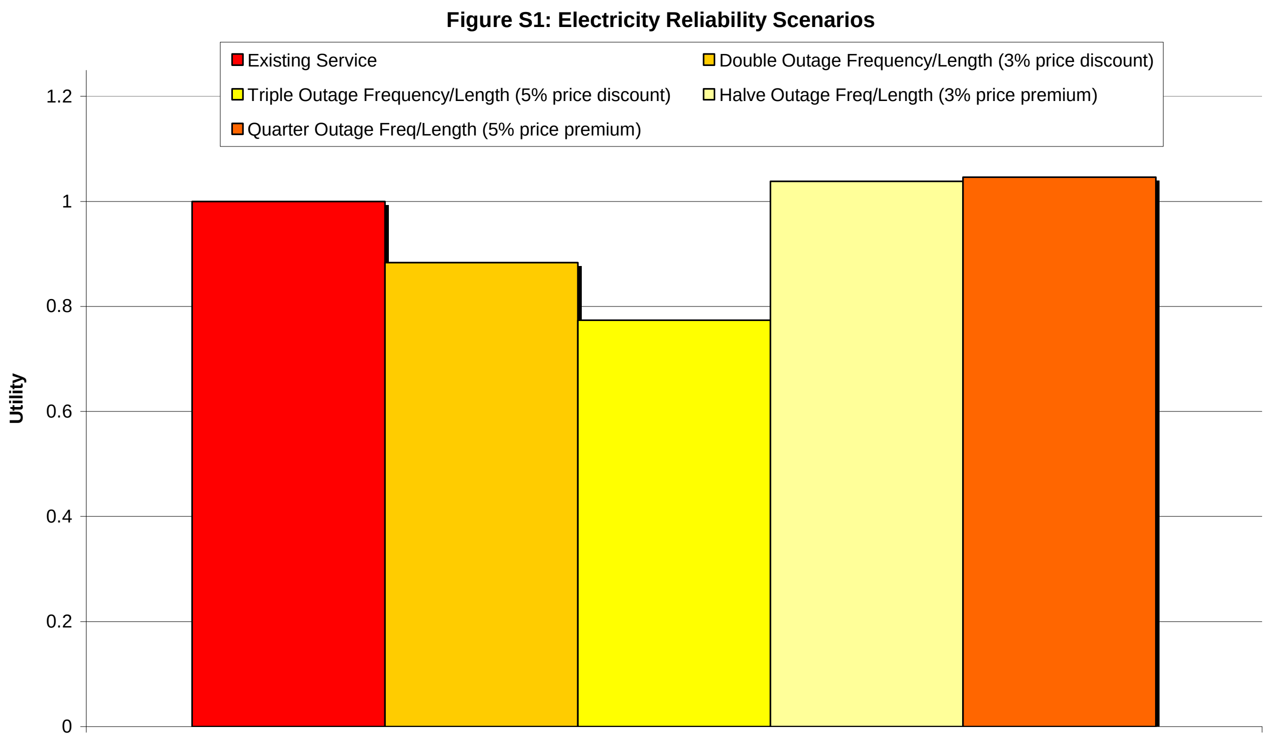
14 That is, increasing the frequency of interruptions from once every 10 years to once every 5 years, and increasing the average duration of an interruption from 1.5 hours to 3 hours.

15 That is, increasing the frequency of interruptions from once every 10 years to once every 5 years, and increasing the average duration of an interruption from 2 hours to 4 hours.

- a reduction of over 3 percent on their annual natural gas bill (or about 6 percent on their network bill) in compensation for a doubling in both the frequency and duration of gas interruptions.[16]

Overall, the study results suggest that customers would not prefer a lesser quality of service in return for a moderate discount in the price. Customers are willing to pay for existing service levels, and may indeed be willing to pay for higher levels of service. These results are consistent with the qualitative research, which suggested that customers' lifestyles and business operations are integrally based on the current levels of utility service reliability and any change would have a fundamental impact.

Figures S1-S4: Residential Customers' Ranking of Reliability Scenarios



16 That is, increasing the frequency of interruptions from once every 5 years to once every 2.5 years, and increasing the average duration of an interruption from 1 hour to 2 hours.

Figures S1-S4: Residential Customers' Ranking of Reliability Scenarios (cont …)

Figure S2: Water Reliability Scenarios

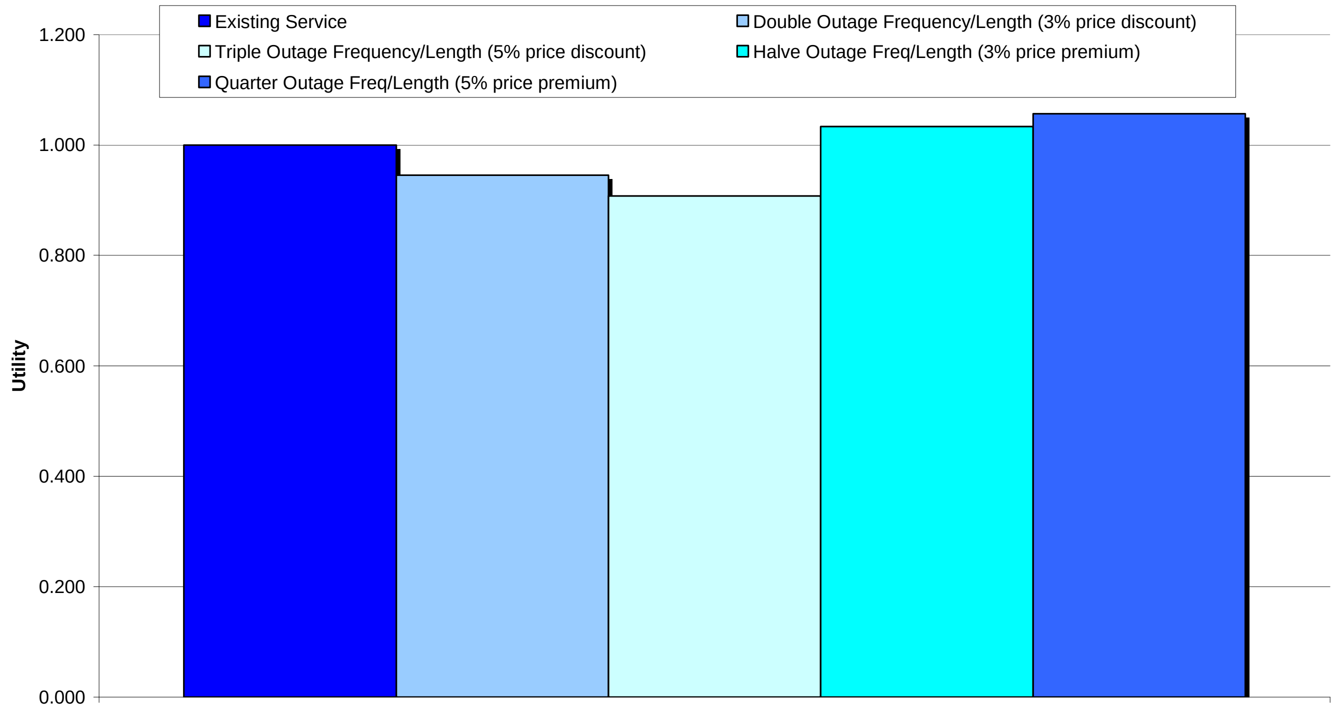
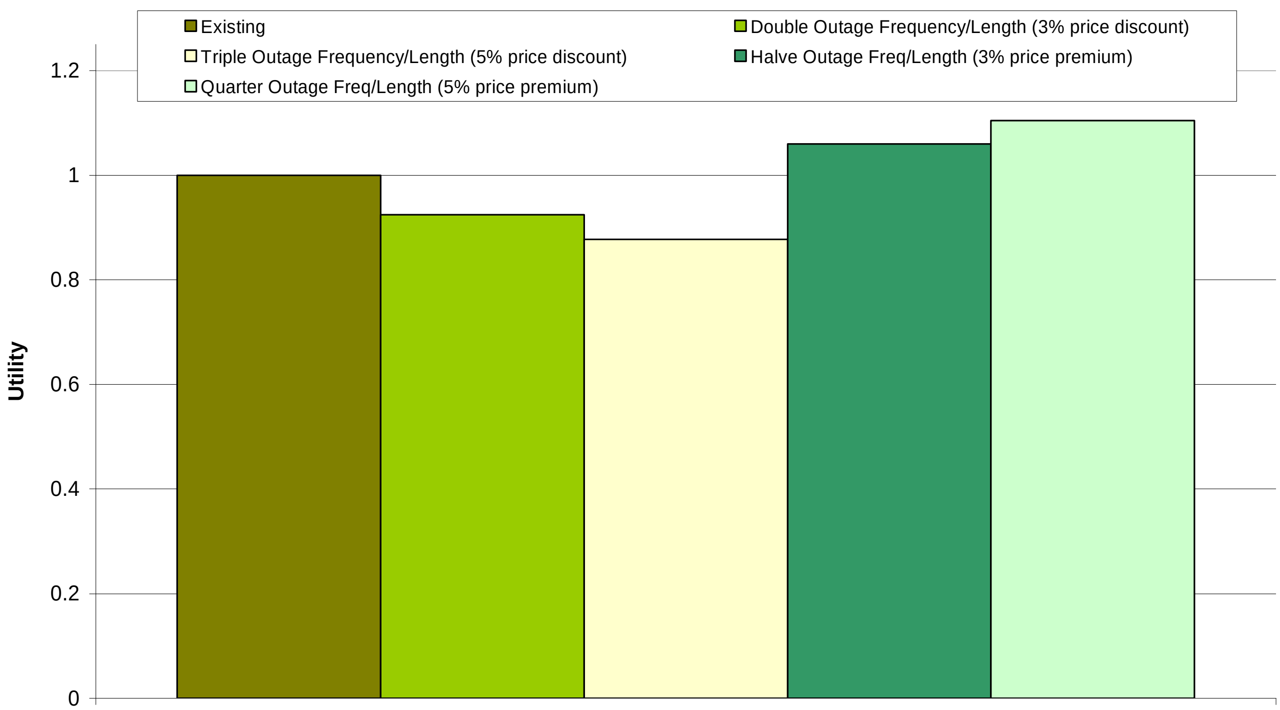
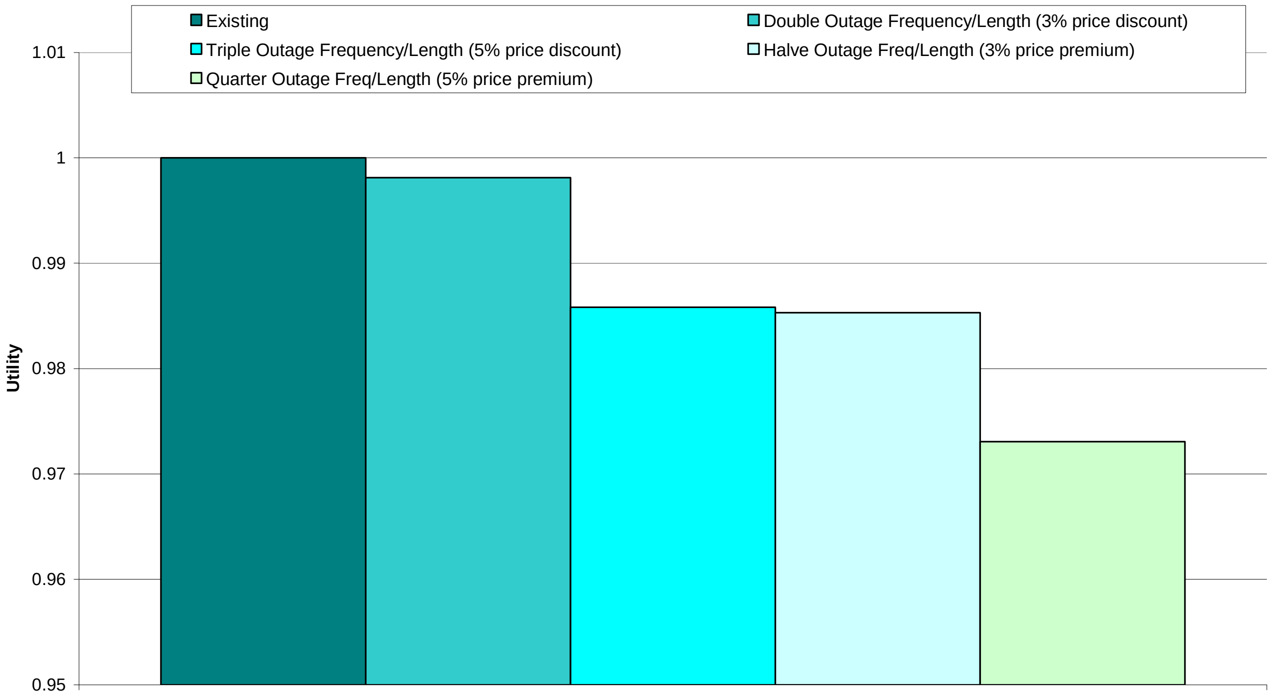


Figure S3: Wastewater Reliability Scenarios



Figures S1-S4: Residential Customers' Ranking of Reliability Scenarios (cont …)[17]

Figure S4: Gas Reliability Scenarios



Service Quality Preferences

The study confirms that customers dislike incurring variation in voltage – defined in the main study as 'flickering or dimming lights' and 'power spikes/surges'. The relative magnitudes of the estimated means of willingness to pay imply that, on average, customers consider power spikes/surges to be as inconvenient as a half-hour electricity outage. Residential customers are willing to pay $32 to avoid a power spike/surges and $9 to avoid a flicker in the electric current, while commercial customers are willing to pay $270 and $73, to avoid a power surge/spike and flicker, respectively.

Concerns relating to the quality of water, wastewater and gas services did not arise as particular issues in the qualitative research, and therefore did not form a substantive part of the main study. The issues covered in the focus groups included issues such as fluoridation, water and gas pressure, the 'heating' quality of the natural gas flame, and odours from sewer vents. The one possible exception is the issue of water chlorination.

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17 Note that this analysis assumes: for natural gas, the average frequency and duration of interruptions is currently once every 5 years and 1 hour respectively. In each case, the discount/increase in price relates to the total annual combined bill (network and retail) for an average customer. The discount/increase in price relates to the total annual combined bill (network and retail) for an average customer.

In the recruitment interviews, chlorine appeared to be an issue for a notable minority (29 percent of residential respondents).[18] It is a marginal issue of whether this result warrants further research. In the context of the pilot study results – which indicated that chlorine was not a willingness to pay issue for customers – and also results from the recruitment interviews, which indicated that between 80 and 85 percent of respondents had 'no concerns about health and safety aspects of the water supply' or 'no concerns whatsoever about drinking the water straight from the tap', we suggest that further research is not necessary. Rather the result suggests that ActewAGL should be mindful that chlorination is an issue for a small proportion of customers.

Customer Service Preferences

Customers signalled in the focus groups that the most important aspects of customer service (for a utility network) were prior notification of service interruptions, and the availability of information in the event of a disruption. Customers also indicated that they would derive value from having an option to choose, if they had to occur, the timing of a planned interruption.

The main study confirmed that customers greatly value having prior notice of service interruptions. Both residential and commercial customers expressed a willingness to pay for prior notification of an interruption, suggesting that ActewAGL should continue its practice of notifying customers of planned interruptions. The results also show that customers are forgiving of not receiving notice if the interruption was due to an emergency (ie, unplanned).

The length of notice was found to matter a little, but is not significant. Residential customers expressed a slight preference for 7 day's notice to either more or less notice, and commercial customers had a slight preference for two week's notice to either more or less notice.

With respect to the availability of information in the event of a disruption, customers expressed a strong preference for having a person answer the phone when they call to make an inquiry of ActewAGL, rather than having access to a recorded message. This is consistent with the qualitative research, during which customers indicated that the delivery of prompt and accurate information about the interruption was critical:

> "Communication is the key, so we are not just sitting around, not knowing what to do."

For commercial customers (with the exception of electricity customers), having an account manager handle their query is also less preferred to simply having someone answer the

[18] 'Total disagreement' with the statement 'they put far too much chlorine in your drinking water' as at 50 percent; 15 percent responded with 'neither agree nor disagree' with an additional 5 percent saying 'don't know'.

phone. Electricity commercial customers however expressed a preference for an account manager to handle their query to either having someone answer the phone, or having access to a recorded message.

The main study also confirmed that customers would value being able to choose the timing of planned interruptions. If they are to occur at all, residential customers expressed a preference for interruptions on weekdays and after midnight, while commercial customers would rather have interruptions out of standard business hours.

While not forming part of the main survey, the focus groups did also explore a number of additional customer-related service requirements set out in the Consumer Protection Code. These included:

- promptness of new customer connections;
- method of notification prior to a planned interruption;
- time to respond to a written query and/or complaint by a customer; and
- appointment windows, and timeliness of keeping appointments.

Participants generally noted that these customer service issues, although important, were generally perceived as an obvious part of any service. In this respect, participants noted that they would not be willing to pay for improvements in these services. Participants generally noted that in respect to responding to these types of service issues, they generally did not expect ActewAGL to adhere to a strict target (eg, respond within 24 hours). Rather, participants noted that they were generally satisfied if they could see that ActewAGL was acting 'reasonably' in response to the issue or request and could be considered as 'doing its best' under the circumstances.

With respect to the method of notification prior to an interruption, residential customers expressed a preference for receiving notice either by mail or letterbox drop, and commercial customers by mail or fax in the qualitative research.

'All day' was considered an acceptable appointment window to access their property (to carry out planned maintenance work) by the majority of respondents in the recruitment interviews. Of those stipulating a 'morning/afternoon' window, the vast majority (between 80 and 90 percent of respondents) considered some amount of lateness to be acceptable, although the amount of lateness varied considerably. The average acceptable lateness for the 'morning/afternoon' window was between 1 and 2 hours.

Water Restrictions and Supply Security

Customers evidenced a willingness to pay to avoid severe water restrictions. The point estimates imply that residential customers are willing to pay 31 percent of their water and sewerage bill, or $237 on average, to avoid a situation where stage 3 or higher restrictions are applied every day all year. Commercial respondents expressed a willingness to pay of 23 percent of their current water and sewerage bill to avoid these types of severe restrictions. Given commercial respondents' bills, this share translates into an average willingness to pay of $1104 and a median willingness to pay of $239. Similar median willingness to pay estimates between commercial and residential customers suggests that they are almost equally concerned about water restrictions.

Customers evidenced an unwillingness to pay to avoid less severe types of water restrictions, which were stage 1 or 2 level restrictions, in place at any time, and stage 3, 4 or 5 level restrictions, in place every other day or for part of the year. These results indicate that customers would prefer to adjust their watering schedules to non-restricted days, compared to paying a higher water bill to avoid stages 3-5 restrictions, in place every other day. Similarly, customers would also prefer to tolerate stage 3-5 restrictions for a period of a month (or even over the summer) each year, compared to paying a higher water bill.

In the main study, customers also indicated an unwillingness to pay to avoid brown lawns in public areas, suggesting that customers find having brown lawns occasionally, in drought conditions, acceptable.

Several points are important to consider when interpreting the results of this analysis for the purpose of planning and investment. First, if or when stage 3-5 restrictions are required, it is likely that they will be applied every day rather than every other day. The issue of customers' willingness to pay for stage 3-5 restrictions that apply every other day is therefore irrelevant from a planning perspective. Second, the choice experiments included only three lengths for the restrictions: one month, all summer, and all year. Interpolation of the results to other lengths is a matter of interpretation, beyond the actual data obtained in the study. For example, customers might be willing to pay to avoid stage 3-5 restrictions that last, say, 10 months, but since that length was not examined in the study, no conclusions can be drawn with regard to this length (beyond the necessary implication that the willingness to pay is no more than that for restrictions that last all year.) Third, in the experiments, the length of the restrictions was stated to the respondent, such that the respondent knew how long the restrictions would last when evaluating them. In practice, water restrictions have been, and probably will be in the future, imposed without a specified ending date. That is, the length of the restriction is not known beforehand, only after the restrictions have been lifted. It is possible that customers react differently to restrictions whose length is not known beforehand than to restrictions of a known length.

Despite these caveats, the findings from the main study are consistent with the findings of the project team's initial qualitative research, which suggested that more severe restrictions were an inconvenience to customers.

In the focus groups, residential participants indicated that they could 'live with' regular restrictions provided that they did not exceed stage three.[19] Customers did not perceive this as lowering water supply service standards. Rather, restrictions were perceived as the 'smart and sensible' way of doing things, and a way of reinforcing good (non-wasteful) behaviour. In this context, restrictions were perceived as actually saving customers money by the fact that it means that customers will not use (or pay for) water unnecessarily. Most participants also seemed to view restrictions as though they were a bit of a novelty and something that could be enjoyed:

> "Its good to get outside at that time of the evening anyway [referring to level 3 restriction watering time]. If you have to get outside every night to water, so be it."

However, some participants in the focus groups foresaw that living with water restrictions would soon become a difficult chore. These participants often qualified the initial 'acceptance' of water restrictions by stating that you would not want to endure restrictions for a long period of time (between six and eight weeks of restrictions was noted as the desired maximum restriction period by these participants).

Overall, the study findings indicate that customers do not derive value from the avoidance of regular, less severe water restrictions (stage one or two), or irregular, more severe restrictions (stage three or higher). There are two potential reasons for this. First, any loss of customer satisfaction (or utility) attributable to a forced reduction in water consumption (and associated inconvenience) may be offset by an increase in utility attributable to some 'novelty' factor inherent in having water restrictions in place (eg, a 'feel good' factor about using water 'responsibly'). Alternatively, customers may not be willing to avoid these types of restrictions because the restrictions are unlikely to result in any reduced water consumption (and therefore inconvenience). While the study cannot explain which of these scenarios is most likely to be the case, the results do suggest that the existing water supply security standards warrant further consideration.

Water Re-use or Recycling

With respect to recycled water, in the recruitment interviews, almost all households (96 percent) and businesses (91 percent) noted their willingness to use recycled water (for the garden among householders and for irrigation and industrial purposes among businesses). While this finding may not be particularly surprising, the recruitment interviews also explored respondents' willingness to pay for a number of recycling schemes. Customers exhibited a varied willingness to pay, dependent on the type of scheme:

[19] It is important to emphasise that at the time of the focus groups, participants were generally only familiar with the experience of abiding by 'voluntary restrictions'.

- the majority of households (70 to 80 percent) and businesses (60 to 70 percent) acknowledged a willingness to pay $50 or $100 per annum for 5 years to fund a scheme that would produce recycled water for ‘public parks and gardens to keep them green’. Half of householders and around 40 percent of businesses expressed a willingness to pay $250 per annum for five years to fund the same scheme.
- the majority of households (74 percent) acknowledged a willingness to pay $50 per year for five years to fund a scheme that would produce recycled water for private gardens (provided at a discount of 15 percent). Half of householders were willing to pay $150 or $250 per annum for five years to fund the same scheme.

Customers’ preferences for particular schemes also indicate that while the majority of customers would be willing to use recycled water for uses such as garden watering, they are generally not willing to use recycled water for drinking. Also, customers’ attitudes to recycled water are not strongly related to the location of the water recycling plant (eg, whether the plant is located near their home versus well away from their home).

Providing further insight into these preferences, the qualitative research on this issue indicated that:

- customers are willing to use recycled water for uses such as garden watering and toilet flushing because they perceive it as a cheaper and more efficient source of water, rather than due to environmental concerns;
- customers perceive that it is inefficient that the existing water supply is of drinking quality, yet only a small portion of the water supplied is used for this purpose; and
- if asked to choose between recycled water or fresh water from a dam, customers are likely to choose the cheapest option.

Overall, these results confirm that customers would be prepared to use and pay for water from a recycling scheme for non-drinking purposes. In order to progress this issue, we suggest that ACTEW/ActewAGL undertake further work on detailing the possible recycling options (including their cost). These should then be assessed in the context of other water supply options.

Safety

The study results indicate that customers are generally not concerned about the safety of the water supply, the gas network, or overhead electricity cables. The focus group results suggest that customers tend to perceive safety in respect to their use of a utility (such as use of an appliance), and that they take for granted that utility services are provided to them in a safe manner. In the recruitment interviews:

- there were high levels of total agreement with the statement ‘you don’t have concerns about health and safety aspects of your water supply’ (85 percent of residential, and 87 percent of commercial respondents).
- there were also high levels of total agreement with the statement ‘you don’t have concerns about the safety of the natural gas network’ (89 percent of residential, and 85 percent of commercial respondents).
- half of the residential respondents interviewed ‘agreed’ they ‘had no concerns about the safety of overhead electricity powerlines’.

It is notable that 37 percent of residential respondents ‘disagreed’ (11 percent disagreed ‘strongly’) with the statement ‘you don’t have any concerns about the safety of overhead electricity powerlines’.[20] As detailed in section 5 of this report however, evidence from the qualitative research indicates that while customers may recognise that overhead wires have implications for safety, they perceive this as reason for caution rather than a safety issue that specifically needs to be addressed.

Environment

Specific issues relating to the environment did not arise in the initial research phase of the project (with the exception of those relating to recycled water and water restrictions, as discussed above). Aspects relating to the environment therefore did not feature in the main study.

Interestingly, however, in the qualitative research when participants were asked about their perceptions of electricity relative to natural gas, a few participants noted that gas had environmental benefits over electricity, although most participants did not consider gas and electricity in this context. Across all the residential and business focus groups, participants perceived electricity as being distinctly different from gas. No participant conveyed the impression that they considered electricity and gas as a more holistic and interchangeable entity (eg, energy).

Customers’ Perceptions of ACTEW/ActewAGL and Existing Services

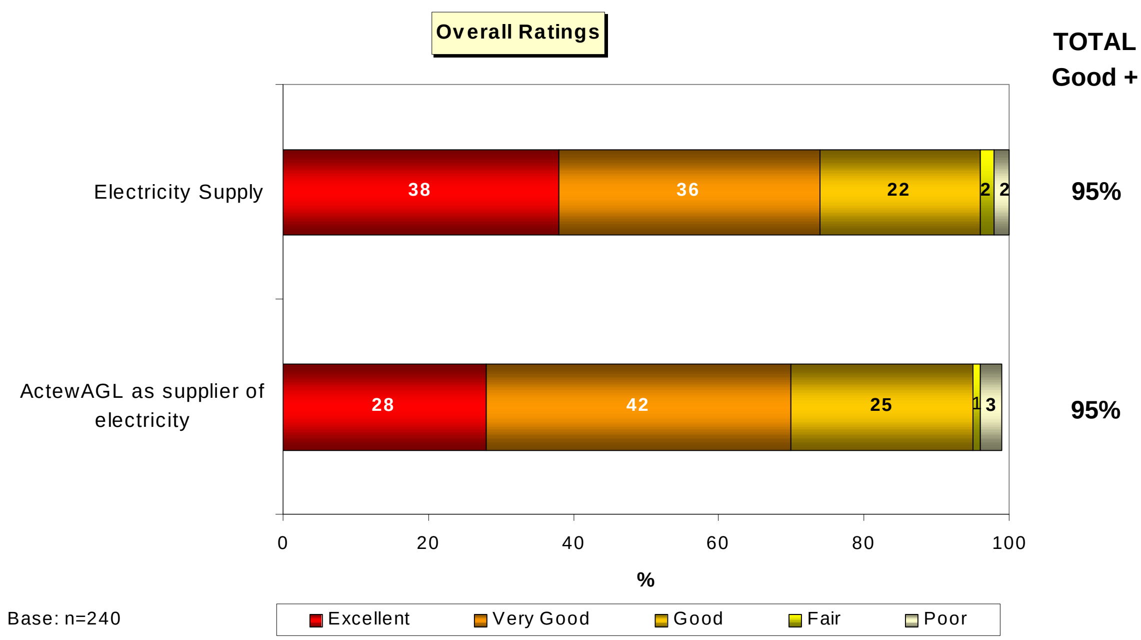
Ratings of ACTEW/ActewAGL as either a supplier of the electricity, gas, water and wastewater service were very high with almost all respondents (residential and commercial) giving a rating of ‘good’ or better in the recruitment interviews. ‘Poor’ ratings were extremely low at between 0 and 3 percent, depending on the utility service and customer segment.

[20] Total ‘disagreement’ was higher among households with overhead power (42 percent) compared to households with underground power (26 percent).

The electricity, gas, water and wastewater services in the ACT were also rated very highly, again with almost all respondents (residential and commercial) giving a rating of 'good' or better – 'good' or better ratings were provided by at least 90 percent of respondents from each segment for each utility, and again the level of 'poor' ratings was extremely low at no more than 3 percent.

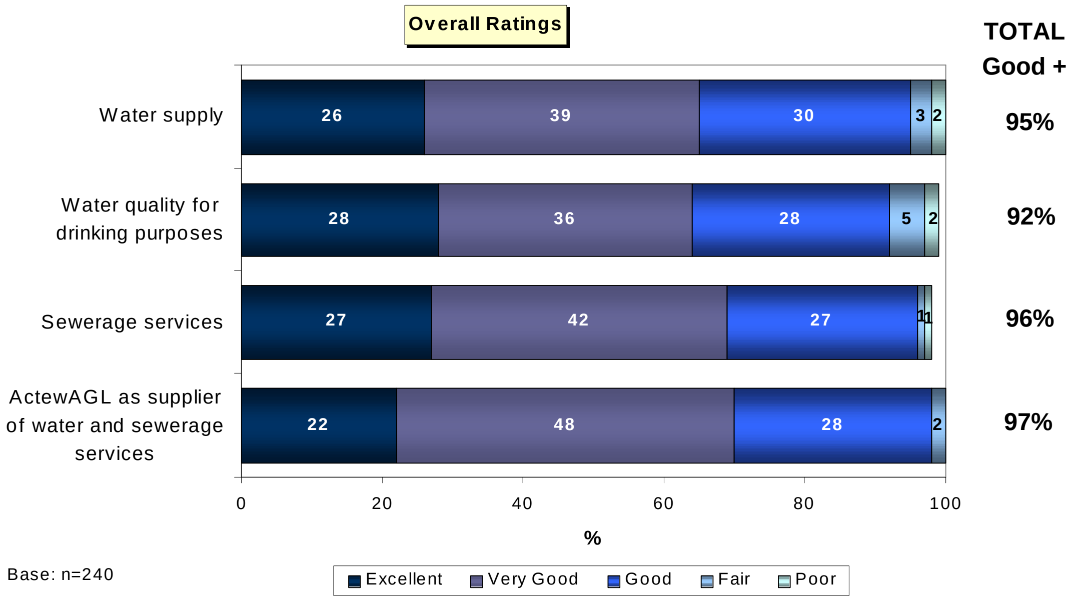
Residential customers' responses are summarised in figures S5 – S7, below and over the page.

Figure S5: Residential Customers' Ratings of ActewAGL and the Electricity Service



O1. Firstly, overall how would you rate the electricity supply to the home in which you live? Would you say it was….(SINGLE RESPONSE)
O3. And overall how would you rate ActewAGL as the supplier of electricity to the home in which you live? Would you say… (SINGLE RESPONSE)

Figure S6: Residential Customers' Ratings of ACTEW/ActewAGL and the Water Service



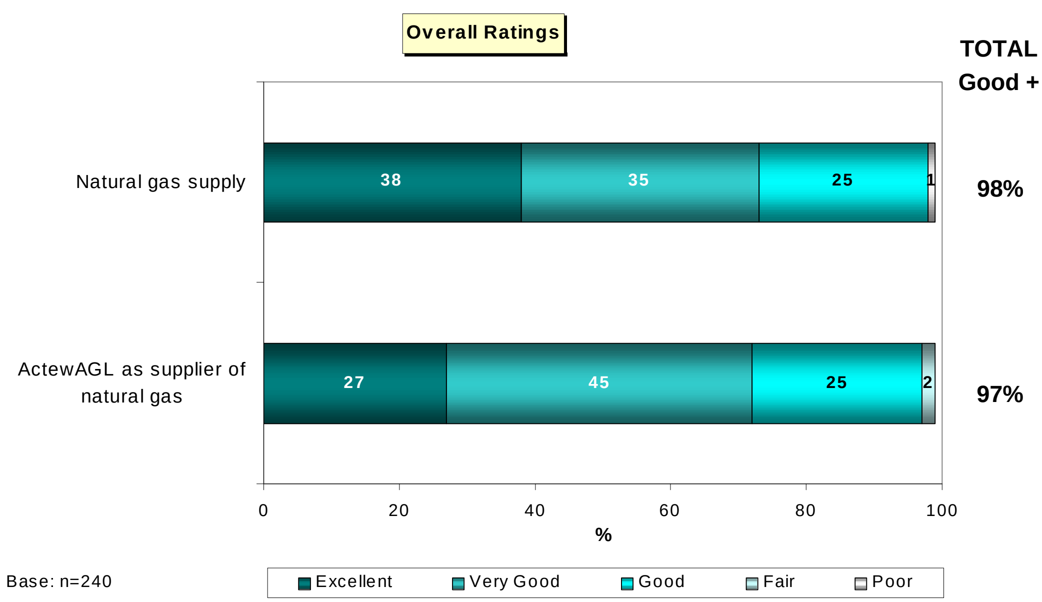
O1. Firstly, overall how would you rate the water supply to the home in which you liveas currently delivered by ACTEW? (SINGLE RESPONSE)

O3. And overall how would you rate the quality of the water supplied to your home for drinking purposes as currently delivered by ACTEW? (SINGLE)

O5. And now what about sewerage services, this means taking sink water and sewerage away from your home, and treating it. Overall, how would you rate the sewerage service for the home in which you live? Would you say it was…..(SINGLE RESPONSE)

O7. And overall how would you rate ActewAGL as the supplier of water and sewerage services to the home in which you live? (SINGLE RESPONSE)

Figure S7: Residential Customers' Ratings of ACTEW/ActewAGL and the Gas Service



O1. Firstly, overall how would you rate the natural gas supply to the home in which you live? Would you say it was...(SINGLE RESPONSE)

O3. And overall how would you rate ActewAGL as the supplier of natural gas to the home in which you live? Would you say... (SINGLE RESPONSE)

Across all segments, there was a strong relationship between the ratings of service and ACTEW/ActewAGL and claimed customer experiences of service disruptions. In other words, customers who said they had not experienced a disruption were more likely to rate their supply and ACTEW/ActewAGL more favourably compared to those claiming they had experienced a disruption.

Most households perceived that they had experienced some kind of disruption to their electricity service, with the majority stating that they had experienced an electricity cut of between 1 and 4 times per year (67 percent). Only 7 percent of householders had 'never' experienced an electricity outage. Outages were experienced 'less than once per year' or 'never' by almost half of all the businesses interviewed.

Overall, the electricity network was believed to be 'maintained in good working order' by the majority of respondents, with 90 percent of households and 92 percent of businesses 'agreeing' with this statement. Agreement was also high (at around three quarters of householders and businesses) with the statement that 'ActewAGL is very responsive in the event of a power failure'.

For the water and wastewater service, the majority of both householders and businesses noted that they had 'never' experienced any form of disruption to their water or wastewater supply/service, nor had water pressure issues:

- among householders 52 percent said that they had never experienced a supply interruption, and about two thirds had not experienced a sewer overflow (68 percent) or water pressure problems (63 percent). Of those with water pressure problems, the dominant issue was 'low' water pressure (experienced by 90 percent of those with pressure problems);
- among businesses two thirds noted that they had never had a supply interruption, 73 percent had never had a sewer overflow, 70 percent had never had a water quality problem, and 81 percent had never had water pressure issues.

Overall, the water supply network was believed to be 'maintained in good working order' by almost all respondents, with about 9 in 10 households and businesses 'agreeing' with this statement. Agreement was also high with the statement that 'ActewAGL is very responsive in the event of a disruption to the water supply' with 63 percent of households and 70 percent of businesses agreeing.[21]

Turning now to the natural gas network about 80 percent of both householders and businesses said that they had 'never' experienced an interruption to their gas supply; almost

21 Although, these results are in fact more favourable than they first appear as around 2 in 10 households and businesses responded with a 'don't know' to this statement, arguably reflecting the low level of disruptions experienced.

all of those that had experienced an interruption have had this occur only once or less often per year. Similarly with gas quality and pressure issues, these were very rare with 90 percent 'never' having experienced problems in these areas.

The gas network was believed to be 'maintained in good working order' by the majority of respondents, with 95 percent of households and 89 percent of businesses 'agreeing' with this statement. Agreement was also high (at over 80 percent of householders and businesses) with the statement that 'ActewAGL takes a very responsible attitude in relation to the natural gas supply'.

The qualitative research indicated that residential and business customers have little to no awareness of ActewAGL/ACTEW's supply reliability commitments in respect to any of the four utilities examined.

Potential New Service Offerings

Tree-trimming, Aerial Bundled Cable and Undergrounding

Just over a quarter of residential respondents (28 percent) responded in the recruitment interviews that 'keeping trees clear of powerlines was a problem for them'; 10 percent 'agreed strongly'. Nearly six in ten (58 percent) disagreed with this statement, with another 12 percent saying this statement was 'not applicable' to them. Those with overhead wires were significantly more likely to agree with the statement that 'keeping trees clear of powerlines was a problem for them' compared to those with underground cabling. Around 37 percent of respondents with overhead cables agreed with the statement, while 57 percent disagreed and 3 percent noted that the statement was 'not applicable' to them.

The qualitative research indicated that Aerial Bundled Cable (ABC) is not the preferable solution to reducing tree-trimming requirements for those customers who perceive trees near powerlines as an issue. Participants were concerned about the look and durability of the cable cover, and, overall, the costs of ABC were perceived to out weigh the benefits:

> "It is a lot of money and you are still going to have poles and wires."

In general, customers in the focus groups noted that they would prefer to have electricity cabling underground, although participants also made it very clear they were not prepared to pay the costs associated with laying underground the overhead cables located near their premises. Rather, a number of participants noted that underground cabling would be a consideration in deciding where they might next choose to live. For example many noted that they would consider moving to a newer Canberra suburb where the cabling was underground.

Interestingly, a number of residential respondents (14 percent) did suggest 'underground cabling' when asked what improvements could be made to the electricity service in the recruitment interviews. In fact, 22 percent of those with overhead powerlines, when asked what improvements to supply were required, said ‘put cables underground’. Qualitative study results suggest that respondents are likely to have made these suggestions from a combination of perspectives, such as tree-trimming, visual amenity or improved reliability. Overall, the study results support the case for further analysis of the merits of undergrounding.

It is also worth noting that in the recruitment survey four households out of every ten in overhead cabled areas perceived that ‘keeping trees clear of powerlines was a problem for them’. Furthermore, those who said they had experienced ‘2 or more’ instances of ‘lights flickering or dimming’ per annum were much more concerned about trees (35 percent) than those who had ‘never’ experienced such instances (19 percent). This is consistent with early findings in the study that poorly trimmed trees contribute to interruptions to the electricity service. Given customers’ preference for reliability, the results suggest that ActewAGL should undertake further analysis of the impact of trees and trimming requirements on service reliability, as well as any network options which would help to address this.

ActewAGL Supplied Generator in the Event of a Disruption

In the recruitment interviews, about two thirds of businesses noted an interest in being supplied with a generator by ActewAGL, to keep vital equipment functioning, in the event of a 4 to 8 hour outage during business hours. However, it should be noted that the findings of the qualitative research suggested that customers would be reluctant to pay for such a service.

Energy Efficiency Advice

The qualitative research found that there was a mixed reaction amongst business participants when asked for their opinion on ActewAGL providing an electricity/energy auditing/efficiency advisory service. Participants were mixed in respect to who they would prefer to rely on to conduct an electricity/energy audit of their business operation. Some participants considered ActewAGL would be a knowledgeable and credible organisation for the task as ‘energy’ was clearly their business. Other business participants were more sceptical believing that ActewAGL had a vested interest in selling energy to customers and therefore, advice on how to save energy was inconsistent with this core function.

Interval and Pre-Paid Metering

Customers’ interest in interval metering and pre-payment meters was explored in the focus groups. However, neither residential nor business participants expressed any interest in these potential new service offerings:

- residential participants noted that they had no interest in monitoring their electricity consumption in real time, because electricity was used as required, and knowing the current level of consumption would not change behaviour. Business participants’ impressions were very similar to residential participants in respect to perceiving little ability to be able to respond to real time information on consumption.

- some residential participants commented that prepaid metering was archaic, reminding them of their earlier days in England.

Filtration of Water after Treatment

At the time of the focus groups (in November/December last year), participants lacked interest in the concept of having their water filtered at the time of treatment (and prior to transportation). Participants at the time considered Canberra water to be of excellent quality, and in general, participants noted that they would prefer to filter their drinking water themselves. There was a feeling that much of the value in filtering the water at the dam treatment plant would be lost, once the water had flowed through the supply network to their homes.

Gas Disruption Insurance (Pilot Light Re-ignition)

The possibility of offering customers a 'pilot light re-ignition' service in the event of a disruption was explored in the focus groups, however participants were not supportive of the gas disruption insurance concept. Fundamentally, participants believed that the likelihood of a gas disruption was extremely low and accordingly, the need for this type of insurance was negligible:

> "When the pilot light goes out, it doesn't take long to fix. Its just an annoyance when you get in a cold shower."

Enhanced Gas Connection

The concept of either re-laying gas service lines deeper in the ground, or sleeving the existing pipes in metal protective casing, to reduce the risk of third parties 'hitting' gas mains or service lines while digging was explored in the qualitative research. However neither residential nor business participants were supportive of the idea. Participants believed the current situation involving 'warning tape' was adequate to remind people about the location of underground pipes.

Conclusions and Recommendations

The study indicates that customers in the ACT are willing to pay for existing levels of service reliability for electricity, gas, water and wastewater. Indeed, the study suggests that there are a number of potential improvements that could be made to service levels, which customers might be prepared to pay for. This includes:

- reducing both the frequency and length of service interruptions;

- having a person answer inquiries at the ActewAGL call centre instead of an automatic voice answering system; and
- scheduling planned maintenance out of standard business hours for commercial customers and during the day on a weekday or after midnight for residential customers.

With respect to the implications of the results for the future priorities of ActewAGL's operations, given that the merit of changing service standards depends not only on customers' willingness to pay but also on cost, we recommend that ActewAGL develop a range of specific network options. The cost of these options can then be assessed against the willingness to pay estimates, to help formulate a future strategy for the network.

The study confirms that the practice of notifying customers prior to a planned interruption is highly valued by customers, and should continue as a high priority. A minimum of one day's notice should be given to customers. Onerous requirements relating to the period of notification should not be specified however, given that timing was not found to be of significant concern to customers. Where possible, residential customers indicated that they would prefer receiving 7 day's notice (to any more or less notice), while commercial customers would prefer receiving two week's notice (to any more or less notice). Similarly, the method of notification was not found to be a particular issue for customers. Where possible however, residential customers would appreciate receiving notice either by mail or a letterbox drop. Commercial customers would generally appreciate receiving notice either by mail or fax.

The study also indicates that onerous requirements relating to other customer-related service standards – such as appointment windows, response times to customer queries, and promptness of new customer connections - are not warranted, as customers derive little value from these. Customers are generally quite forgiving when it comes to these aspects of the utility service, indicating that they would be satisfied as long as they could see that ActewAGL was acting 'reasonably' in response to the issue or request and could be considered as 'doing its best' under the circumstances.

Conclusions and recommendations specific to each product segment are outlined below.

Electricity

The study indicates that customers dislike incurring momentary electricity outages, flickering of lights and power spikes/surges, suggesting that ActewAGL should more closely monitor these events.

The study indicates that customers take for granted that the electricity service is provided to them in a safe manner, suggesting that a standard level of network safety should simply form part of the standard utility service.

Commercial electricity customers indicated a willingness to pay for an account manager in the study, in preference to relying on the ActewAGL call centre for information, suggesting that ActewAGL should give consideration to establishing network account managers for large electricity commercial customers.

Mixed results were obtained relating to the issue of undergrounding in the study. While this was not nominated by ActewAGL as a topic of particular interest for the study, it did arise in both the qualitative and quantitative work. The qualitative research suggested that customers were unwilling to pay to replace electricity cables underground (in the context of reducing tree-trimming requirements), however, almost a quarter of customers, unprompted, raised it as a potential improvement that could be made to the electricity service in the recruitment survey. Qualitative study results suggest that respondents are likely to have made these suggestions from a combination of perspectives, such as tree-trimming, visual amenity, or improved reliability.

Overall, the study results support the case for further analysis of the merits of undergrounding. As a start, we suggest that the estimates of customers' willingness to pay for reliability be used in cost-benefit analysis to assess the merits of undergrounding cables (with respect to its reliability benefits). Also, as noted previously, given customers' preference for reliability, the results also suggest that ActewAGL should undertake further analysis of the impact of trees and trimming requirements on service reliability, as well as any network options which would help to address this.

Customers exhibited a lack of interest in (and willingness to pay for):

- interval metering;
- pre-payment meters;
- aerial bundled cabling as a solution to reduce tree-trimming requirements; and
- provision of a generator to keep vital equipment functioning, in the event of a 4 to 8 hour outage during business hours.

There was a mixed reaction amongst business customers about the provision of an energy efficiency advisory service by ActewAGL in the qualitative research, suggesting that this service could be offered on a case-by-case basis.

The qualitative research suggests that customers perceive electricity as being distinctly different from gas, and tend not to perceive electricity and gas as a holistic and interchangeable entity (eg, energy).

Water and Wastewater

While customers expressed a willingness to pay to avoid severe water restrictions, customers also expressed an unwillingness to pay to avoid regular, low-level water restrictions (stage one or two), or irregular (less frequent than everyday, all year, every year) restrictions of stage three or more. There are two potential reasons for this. First, any loss of customer satisfaction (or utility) attributable to a forced reduction in water consumption (and associated inconvenience) may be offset by an increase in utility attributable to some 'novelty' factor inherent in having water restrictions in place (eg, a 'feel good' factor about using water 'responsibly'). Alternatively, customers may not be willing to pay to avoid less severe restrictions because these restrictions do not affect their water consumption (and therefore inconvenience). While the study cannot explain which of these scenarios is most likely to be the case, the results do suggest that the existing water supply security standards in the ACT warrant further consideration. As a first step, we suggest that ACTEW/ActewAGL update the water demand assumptions/forecasts which underpin these standards.

The study confirms that customers would be prepared to use and pay for water from a recycling scheme for non-drinking purposes. Providing further insight into these preferences, the qualitative research on this issue indicated that:

- customers are willing to use recycled water for uses such as garden watering and toilet flushing because they perceive it as a cheaper and more efficient source of water, rather than due to environmental concerns;
- customers perceive that it is inefficient that the existing water supply is of drinking quality, yet only a small portion of the water supplied is used for this purpose; and
- if asked to choose between recycled water or fresh water from a dam, customers are likely to choose the cheapest option.

In order to progress this issue, we suggest that ACTEW/ActewAGL undertake further work on detailing the possible recycling options, including their cost. These should then be assessed in the context of other water supply options.

The study indicates that customers take for granted that the water/wastewater service is provided to them in a safe manner, suggesting that a standard level of network safety should simply form part of the standard utility service.

Customers exhibited a lack of interest in (and willingness to pay for) water filtration at the time of treatment, prior to transportation, at the time of the focus groups. At the time, customers perceived Canberra's water supply to be of excellent quality, and indicated a preference for filtering water themselves over having it filtered at the time of treatment.

Gas

Gas was rated as the most highly reliable service provided by ActewAGL. In the qualitative research customers indicated that they perceived the gas network as 'totally' dependable.

While gas is generally considered less safe than electricity (due to the flame), the study indicates that customers take for granted that the gas service is provided to them in a safe manner, suggesting that a standard level of network safety should simply form part of the standard utility service.

Customers exhibited a lack of interest in (and willingness to pay for):

- a 'pilot light re-ignition' service in the event of a disruption; and
- re-laying gas service lines deeper in the ground, or sleeving the existing pipes in metal protective casing, to reduce the risk of third parties 'hitting' gas mains or service lines.

Customers confirmed that the use of 'warning tape' to indicate the depth of mains/lines and the availability of 'service maps' was of considerable value, confirming that this service should be maintained.

There was a mixed reaction amongst business customers about the provision of an energy efficiency advisory service by ActewAGL in the focus groups, suggesting that this service could be offered on a case-by-case basis.

The qualitative research suggests that customers perceive electricity as being distinctly different from gas, and tend not to perceive electricity and gas as a holistic and interchangeable entity (eg, energy). That said, customers do perceive that gas has environmental benefits over electricity. They also prefer gas for space heating, boiler heating, and cook-top heating. Customers noted a preference for gas heating in the qualitative research because it is perceived as instant, relatively inexpensive, and providing 'a more pleasant heat'. Gas was not preferred for oven heating, given that it was perceived to leave a particular 'taste' in food.

1. INTRODUCTION

NERA and ACNielsen were commissioned by ActewAGL and ACTEW Corporation Limited (‘ACTEW’) in October 2002 to undertake a survey to establish customers’ willingness to pay for: existing service standards; statutory requirements in relation to reliability, safety and environmental factors; and new or changed services and offerings.

The terms of reference specified that the survey was to cover electricity, gas, water and sewerage services within the residential, business and government segments of the Australian Capital Territory (‘the ACT’), and that it was intended that the study would provide information for ACTEW / ActewAGL’s forthcoming regulatory review.

Stated preference choice modelling was recommended by the project team to estimate customers’ willingness to pay. Choice modelling is widely used to evaluate multi-attribute products, and is based on the hedonic principle that products are composed of a number of attributes, and the total value of the product is the sum of the ‘part worth’ or value of each of these attributes or characteristics.

The study has been conducted in three phases. The purpose of the initial two study phases was to identify the attributes and levels for the survey. The first phase involved a combination of research and consultation with ActewAGL, ACTEW and other stakeholders, and the second phase utilised customer focus groups to test and refine a draft list of attributes and levels. The third and final phase of the project involved the design and conduct of the survey, and an analysis of its results.

This is the project team’s final report. It builds on the project team’s first and second interim reports, and provides details on all aspects of the study including survey design and results.

The remainder of this report is structured as follows:

- section two details the study methodology, and an explanation for the choice of methodology;
- section three explains the project team’s approach, detailing the tasks undertaken to complete the study including the qualitative research, questionnaire design, pilot study, and the conduct of the main survey;
- section four details the electricity attributes and levels chosen for the study, and section five presents the survey results for the electricity segment;
- section six details the water and wastewater attributes and levels chosen for the study, and section seven presents the survey results for the segment;
- section eight details the gas attributes and levels chosen for the study, and section nine presents the survey results for the segment; and

- section 10 summarises the conclusions from the study.

The companion volume to this report contains a number of appendices with further details of the work completed for the study, including:

- the terms of reference for the study;
- an explanation of the potential uses of the willingness to pay estimates, in a regulatory context;
- background research that was undertaken to help define the attributes and levels for each of the segments, including:
  - the legislative requirements governing standards of service in the ACT, and ActewAGL's recent performance with respect to these requirements;
  - a review of other, recent studies on service standards;
  - the project team's discussions with ActewAGL and other stakeholders as part of phase one;
- ACNielsen's qualitative report;
- a complete list of the attributes and levels adopted for the study;
- a copy of the recruitment questionnaires, and examples of the choice experiments provided to respondents;
- further details on the form of the discrete choice model used in the study;
- details of analysis undertaken to assess a number of incremental changes to service levels using the estimates of customers' willingness to pay, and cost estimates provided by ActewAGL; and
- a comprehensive overview of the findings of the recruitment survey.

2. THE METHODOLOGY

2.1. Why Stated Preference Choice Modelling?

2.1.1. Stated Preference versus Revealed Preference

Methodologies used to estimate consumer value, or customers' 'willingness to pay', are generally separated into two categories: revealed preference and stated preference methodologies. Revealed preference methodologies rely on data that arises when individuals/entities act on real (as opposed to hypothetical) options. Stated preference methodologies rely on data that is derived from individuals/entities describing how they would act in given circumstances. The difference between revealed preference and stated preference methodologies is that with the latter consumers are asked how they would respond in a hypothetical circumstance and with the former it is observed how they actually do respond in a real market circumstance.

With perhaps the exception of ACTEW and ActewAGL's largest customers, currently customers have no choice of the standard of service they receive. No direct market data therefore currently exists to enable a revealed preference study to be undertaken. Deriving estimates of customers' willingness to pay must therefore rely on a stated preference method.

2.1.2. Stated Preference Methodologies

Three stated preference methods are commonly used for valuing willingness to pay:

i. the contingent valuation method;

ii. conjoint analysis; and

iii. stated preference choice modelling.

Contingent valuation (CV) typically elicits willingness to pay from respondents by asking respondents whether they would be willing to pay a certain amount for a particular type of good or service. For example, one of the questions respondents may be asked in a CV survey on electricity service standards is whether or not they would be willing to pay an additional $X per annum for their electricity if the number of service interruptions they experienced in a year was reduced by Y percent rather than continuing to experience the current number of interruptions at the current price. Random utility theory is then used to represent this choice in a 'binary choice model', which is estimated by using the choice data obtained by varying X and Y across respondents. A utility function is then calculated, using the parameters estimated by the binary choice model, allowing the value for a specific quality improvement to be derived.

As distinct from CV, which involves a dichotomous choice,[22] both conjoint analysis and choice modelling are more widely used to evaluate two or more multi-attribute products. The approaches involve presenting a number of alternative service options to respondents, and asking them to state their preference for each. Each service alternative is described according to a number of pre-determined attributes or characteristics of the service, each with a corresponding 'level', including price. For example, one of the questions – or 'choice experiments' - in a questionnaire may require respondents to choose between two electricity distribution service alternatives A and B, where:

i. the service alternative "A" involves the following attributes: automated telephone answering service for enquiries, two outages each year of up to 10 minutes each and a price of $100 per annum; and

ii. the service alternative "B" involves the following attributes: operator answered telephone enquiry line, three outages each year of up to 5 minutes each and a price of $150 per annum.

Conjoint analysis can involve asking respondents to rate or rank one bundle of attributes over another bundle of attributes, or can involve asking respondents to select their preferred bundle of attributes from a number of alternatives. Choice modelling on stated preference data is a type of conjoint analysis, and involves estimating a discrete choice model. Conjoint analysis also involves a broader set of analytical techniques - such as regressing the rank of an alternative against the attributes. Strictly, discrete choice modelling can also accommodate ranks and rates in addition to the (1,0) setting of choice.

Both approaches are based on the hedonic principle that products are composed of a number of attributes, and the total value of the product is the sum of the 'part worth' or value of each of these attributes or characteristics. For example, a consumer who decides to choose an alternative electricity supplier may make trade-offs between product attributes such as price, reputation of the supplier, friendliness of service centre staff, alternative billing options, or the environmental appeal of the service. The total value the consumer derives from the electricity service will be equal to the sum of the value he/she derives from each of these attributes.

Such methods have a number of distinct advantages over CV:

i. CV methods typically ask respondents the amount they would pay for a specific improvement in a good or service. This method is highly reliant on the accuracy of the description of the good or resource. In contrast, choice modelling relies more on the accuracy and completeness of the product characteristics and attributes used to

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22 While CV is a type of choice model, it is a very restricted version, where the respondent is asked to compare only one alternative against a status quo. In choice modelling/conjoint analysis, the respondent can be asked to compare several alternatives at a time, and may/may not be asked to compare alternatives against a status quo.

describe alternatives. Respondents are questioned about a sample of events, rather than a single event in detail.

ii. The choice modelling method provides a richer set of data than the CV methods. As well as calculating implicit prices for each of the attributes, substitute choices are included allowing compensating amounts in non-monetary terms to be calculated. Choice modelling also allows a broader range of potential quality changes to be examined, and welfare impacts can be estimated for multiple scenarios.

iii. Choice modelling may also decrease strategic behaviour such as 'free-riding' or 'yea-saying' by respondents, which are a common criticism of CV studies, since asking respondents to choose from a number of alternative scenarios makes it more difficult to conceal true preferences.

CV also focuses respondents' attention on price by asking, "Are you willing to pay $X for this quality improvement." This interview-induced attention can create prevalence bias, by which the respondent answers in accord with the most prevalent attributes, which in this case is price. In contrast choice modelling places price and non-price attributes on the same footing, by listing all the attributes and asking the person to choose. The respondents place their attention as they please, the same as in a market.

For these reasons, and in the context of the study objective, the project team recommended stated preference choice modelling as the methodology for the willingness to pay research study.

2.2. Attributes, Levels, and Choice Experiments

A stated preference choice modelling survey involves presenting a number of service 'options' or scenarios to respondents, as part of a questionnaire, and asking respondents to choose between them. These scenarios offer the respondent a combination of service 'attributes', with a corresponding 'level' of service for each of those attributes, at a particular price. In doing so, the choice modelling survey 'simulates' a market situation, allowing researchers to gather information on the most preferred quality aspects of the service, and the value consumers place on an incremental change in each aspect of the service. An example of a choice experiment for the electricity ***retail*** service is provided in the figure below.

Figure 2.1: Example of a Choice Experiment

If you had to choose one of these *four electricity supply offers*, which ONE would you choose?
(Circle one letter)

A	B	C	D
◆ A neighboring electric company	◆ An affiliate of your local electric company	◆ A well-known energy company	◆ An unfamiliar energy company
◆ Fixed price of 4 ¢ per kWh	◆ Fixed price of 5 ¢ per kWh	◆ Fixed price of 3 ¢ per kWh	◆ Fixed price of 5 ¢ per kWh
◆ 50% renewable energy	◆ 25% renewable energy	◆ 50% renewable energy	◆ 100% renewable energy
◆ Mix of renewables, including geothermal, biomass, and solar energy	◆ Primarily wind energy sources	◆ Primarily wind energy sources	◆ Primarily wind energy sources

Source: Goett, Hudson and Train, 2000

This experiment lists four service offers or scenarios – A, B, C, and D – between which the respondent must choose its preferred offer. The attributes in the experiment are ‘electricity company brand’, ‘price’, ‘proportion of energy that is renewable’, and ‘type of renewable energy’. These are common across all offers A, B, C, and D. However, the levels are designed to vary across offers. For example, the level for price in offer A is 4 cents per kWh, while in B and D it is 5 cents per kWh. Similarly, the level for ‘electricity company brand’ in offer A is ‘a neighbouring electric company’, and in C it is ‘a well known energy company’. Hence, this choice experiment would provide data to enable the researcher to determine customers’ willingness to pay, in absolute and relative terms, for example, for the brand of the electricity company and the extent to which their electricity supply is from a renewable energy source.

2.3. Study Objectives and Priorities

As noted in the introduction, the study was commissioned to gain information on customers’ willingness to pay for certain aspects of their utility services, and it was intended that this quantitative information would be used in ACTEW/ActewAGL’s forthcoming regulatory review. Details on the potential application of the willingness to pay estimates in a regulatory context are discussed in appendix B.

In the context of these study objectives, the attributes/levels that are most relevant to the study are ***network*** aspects of each of the services such as service reliability and quality, rather than ***retail*** aspects such as retail customer service or renewable energy (as in the example provided in section 2.2).

In addition, ActewAGL’s terms of reference specified that the willingness to pay estimates were to be derived for each utility service, as well as by customer type. Hence, the study was segmented by each product (electricity, water/wastewater, and gas), and according to each of the broad customer categories (commercial and residential). The attributes/levels, choice experiments, and sample for the survey were therefore defined according to six segments – residential electricity, residential water/wastewater, residential gas, commercial electricity, commercial water/wastewater, and commercial gas.

3. OUR APPROACH

The willingness to pay research study was undertaken in three distinct phases:

- the objective of the first phase was to begin defining the attributes and levels for the choice experiments, drawing on ACTEW and ActewAGL's technical knowledge and experience;
- the purpose of the second phase of the assignment was to refine the list of attributes identified in phase one, drawing on direct customer input; and
- the third and final phase of the study was to design the questionnaires, conduct the survey, and analyse the results.

An explanation of the project team's approach for each of these phases, including survey design is outlined below.

3.1. Phase One: Consultation with Stakeholders

The study team began to identify the attributes for each of the services by reviewing arrangements governing electricity, gas, water and wastewater service standards in the ACT, as well as the standards actually delivered by ActewAGL. This included a review of the service standards set out in the ***Utility Act***, and associated industry codes of practice such as the Consumer Protection Code, Electricity Distribution Supply Standards Code, and the Water Supply and Sewerage Services Standards Code. A summary of this research can be found in appendices C, F, and I. We supplemented this research with a review of other studies on utility service standards, a summary of which is provided in appendices D, G, and J.

Once this research was completed, the study team held four workshops with ActewAGL, ACTEW and other stakeholders on 15 and 18 November 2002. The objective of these workshops was to identify priority areas for the study. Each workshop involved about 10-12 representatives from either ActewAGL, ACTEW, and/or Agility, and 3-4 representatives from the study project team. The following questions were discussed at each of the workshops:

- what are all the possible characteristics or attributes of each network service (eg, aspects of service reliability, quality, customer service, etc)?
- which of these attributes can be measured and managed by ActewAGL?
- which attributes customers are most likely to prefer or consider important and why?
- what are the ways in which each attribute could be described or articulated to a customer?

- what is the range of variability for each of the identified attributes?
- are there any new market ideas or concepts that could be tested/explored in the customer focus groups?

The study team also met with the ICRC on 18 November 2002 to discuss these issues.

A summary of each of the discussions with stakeholders is set out at appendices E, H, and K.

The information gained from the initial research and discussion at the workshops was used to prepare briefs for the qualitative research, or ‘focus groups’, undertaken as part of phase two.

3.2. Phase Two: Focus Groups

To achieve the objectives of the second phase, a series of exploratory, qualitative group discussions were conducted with a range of customers. In total, three focus groups were conducted with residential customers and eight mini-groups were conducted with business (including government) customers. The group discussions were conducted during the period 4 to 16 December 2002.

The primary purpose of these group discussions was to explore the perceptions and experiences of various customer groups regarding the supply of electricity, gas, water and wastewater services in Canberra and Queanbeyan (for gas), in order to recommend the final list of attributes for the choice experiments. Interestingly, there was remarkable similarity observed across the customer sectors examined. These customer groups included small and large business organisations, government organisations, and residential (including concession card holder) consumers.

Appendix L contains ACNielsen’s qualitative report, which outlines the findings of the qualitative research.

A description of the final set of attributes and levels adopted for the study is set out in sections 4, 6 and 8. Appendices M, N, and O contain a complete list of the attributes and levels used in the study.

3.3. Phase Three: Pilot Study

Following ActewAGL’s approval of the attributes and levels, choice experiments were designed and prepared. These experiments were then tested using a two-stage pilot study.

The first stage of the pilot was a qualitative pilot, involving 12 face to face interviews, conducted in Canberra. These interviews were about an hour in length, and were conducted with the aim of testing respondents’ understanding of the choice experiments. In each of the

12 interviews, ACNielsen probed to determine whether respondents understood the wording of the attributes and levels, the layout of the choice experiments, and the trade-offs that they were being asked to make. Respondent fatigue was also tested. A number of minor revisions were made to the attributes and levels for each of the segments following this pilot stage. These were largely wording refinements to the descriptions of the attributes and levels to help clarify them to the respondents.

The second stage involved a total of 30 CATI interviews, in accordance with the methodology adopted for the main survey. These were conducted between the 30 January and 5 February 2003. No revisions were made to the attributes or levels or to the survey design following this stage of the pilot, with the exception of a reduction in the number of choice experiments provided to respondents as discussed further below.

3.4. Phase Three: Main Survey

The main survey was conducted in two parts - an initial recruitment interview and the choice experiment task.

The recruitment phase of the fieldwork was conducted between 27 February and 21 March 2003. A total of 240 recruitment interviews were completed for each segment of the sample, and a total of 1440 respondents were recruited to participate in the study.

The choice experiment call back interviews were conducted between 3 March and 1 April 2003. A total of 1243 respondents were called back successfully to complete the choice experiment phase of the study.

The table below summarises the number of interviews completed for each segment for the study.

Table 3.1: Number of Interviews Conducted Across All Segments

Segment	Total Recruitment	Total Choice Experiment
Residential Electricity	N= 240	n = 204
Residential Water/Waste	N = 240	n = 211
Residential Gas	N = 240	n = 213
Commercial Electricity	N = 240	n = 203
Commercial Water/Waste	N = 240	n = 205
Commercial Gas	N = 240	n = 207
TOTAL:	N = 1440	n = 1243

The interview response rate details are provided in the table below.

Table 3.2: Response Rates Across All Segments

	Contact achieved & in-scope[23]	Recruited and Interviewed	Refused	Excluded[24]	Response Rate[25]
RECRUITMENT INTERVIEW:					
RESIDENTIAL					
Electricity	466	240	175	51	52%
Water/Wastewater	486	240	179	67	49%
Gas	458	240	172	46	52%
COMMERCIAL					
Electricity	838	240	260	338	29%
Water/Wastewater	861	240	211	410	28%
Gas	706	240	270	196	34%
FOLLOW-UP CHOICE EXPERIMENT INTERVIEW:					
RESIDENTIAL					
Electricity	213	204	7	2	96%
Water/Wastewater	214	211	3	0	99%
Gas	214	213	0	1	99%
COMMERCIAL					
Electricity	209	203	5	1	97%
Water/Wastewater	212	205	3	4	97%
Gas	211	207	4	0	98%

3.4.1. Residential Customer Segment

3.4.1.1. Recruitment

The sample for the residential customer segment was randomly generated from the Electronic White Pages. Quotas were not set for the residential segment of the study.

The recruitment questionnaires were designed to target the person in the household who would be "responsible for dealing with any of the ***selected utility type*** decisions such as dealing with supply issues and ensuring the bill gets paid." Other recruitment criterion used was as follows:

23 Includes: those 'recruited and interviewed', 'refused', and those that were 'excluded'.

24 'Exclusion' reasons were: 'not available during survey period' and 'quota's being full'.

25 'Response Rate' = 'total recruited & interviewed' divided by 'total contacted & in-scope'.

- participants were to be connected to the utility service;
- participants were either to receive a bill directly from ACTEW/ActewAGL or a written notice from their landlord;
- participants had to be able to provide a ballpark estimate of their annual utility service bill; and
- participants were not to be employed in the market research industry, advertising, media or public relations, or by a gas, electricity or water utility (according to standard market research practice).

This criterion was designed to capture respondents who could meaningfully relate to the types of trade-offs that were covered in the choice experiments. For example, individuals who do not use ActewAGL's services, or do not have access to the billed value of their utility service were excluded from the survey.

Computer Assisted Telephone Interviewing (CATI) was conducted to recruit the respondents to participate in the study.

While the primary purpose of the recruitment questionnaire was to recruit individuals for the choice experiment task, the questionnaire was also used to collect background information on the respondents to help contextualise the willingness to pay issues covered in the choice experiments. The interview was also used to collect important information on customers' willingness to pay for re-use.

The recruitment survey was structured under the general areas including ***Introduction & Recruitment, Overall Ratings, Behaviour, Attitudinals,*** and ***Demographics,*** and the interviews ranged in length from 15 to 21 minutes. A copy of the recruitment questionnaires is provided at appendix P.

Once the respondent was successfully recruited the choice experiments were mailed out to the respondents. An appointment time was also set to call back and lead the respondent through the choice experiment questionnaires. The appointment was made to allow sufficient time for the respondent to receive the package in the mail.

3.4.1.2. The Choice Experiment Task

The choice experiment packages for the residential segment included the choice experiments, a gift voucher for $20 as a token of appreciation, and a personalised general introductory letter, which included an ACNielsen contact name and telephone number if the respondent had any questions.

The choice experiments differed in colour for ease of identification by respondents, and in number, depending on the utility, as illustrated below:

Table 3.3: Residential Choice Experiments

Utility	Colour	Number of Sets of experiments	Number of experiments
Gas	Sand	1	10[26]
Water & Sewerage	Blue – Reliability Green – Restrictions White – Wastewater	3	18[27]
Electricity	Grey – Reliability Pink – Supply & Quality	2	16[28]

The number of choices given to respondents in the main survey was a reduction on the number of choices that were given to respondents in each stage of the pilot, due to a combination of concerns relating to interview length and respondent fatigue. For example, in the second stage of the pilot, 15 choices were provided to respondents in the gas segment, which a significant proportion of respondents found fatiguing. The variety in the choice experiments given to respondents in the water and electricity segments however,[29] seemed to keep respondents 'fresh', which meant that they were able to complete a larger number of choices without fatiguing.

Each choice experiment was presented on a single page. The experiment listed ***two*** service options (along with their descriptions), and the respondent was asked which service option he/she would choose to buy for each pair of options presented. The choice experiments were constructed using a randomised design.

A number of examples of the choice experiments sent to residential respondents are provided in appendix Q.

3.4.2. Commercial Customer Segment

3.4.2.1. Recruitment

The sample was randomly generated from the Electronic Business Pages (White and Yellow Pages Business Listings). Quotas by industry size and type were set based on Australian Bureau of Statistics (ABS) data for each utility except for the 'commercial gas' segment. As gas connection has a relatively low incidence rate in Canberra and Queanbeyan, it was not possible to establish meaningful quotas given that the natural population distribution of gas

26 10 choices for the one cluster.

27 6 choices per cluster.

28 8 choices for each attribute grouping or cluster.

29 Because there is more than one cluster of attributes in each of the water and electricity segments.

connections by industry and organisation size were unknown; hence a random sample approach was taken for the 'gas commercial' segment.

The recruitment questionnaires were designed to target the person in each business who was "responsible for dealing with the ***selected utility type*** on behalf of the organisation". If the decision maker for an ACT business site was located in another state, interviewers contacted that decision maker in his/her interstate office. The other recruitment criterion used for the commercial segments were as follows:

- participants were to be connected to the utility service.
- participants were to either receive a bill directly from ACTEW/ActewAGL or a written notice from their landlord indicating the value of the billed utility service;
- participants had to be able to provide a ballpark estimate of their annual utility service bill. For multi-sited organisations, the ballpark estimate was for a single ACT site nominated by the respondent. This approach was adopted after the pilot study, which indicated that that multi-sited businesses found it difficult to think in 'aggregate' terms for their utility bills given that these are currently issued by ActewAGL on a 'per site' level.
- participants were not to be employed in the market research industry, advertising, media or public relations, or by a gas, electricity or water/wastewater utility (according to standard market research practice).

This criterion was designed to capture respondents who could meaningfully relate to the types of trade-offs that were covered in the choice experiments. For example, individuals who do not use ActewAGL's services, or do not have access to the billed value of their utility service were excluded from the survey.

The breakdown of industry type and size in Canberra was established after analysing data provided by the ABS, which is illustrated in the table below.

Table 3.4: Quota Table for the Electricity and Water/Wastewater Commercial Segment

COMMERICAL QUOTA'S	Quota Cell	Pop'n Prop'n
Organisation Size	Less than 5 employees	67%
	5 – 19 employees	25%
	20 or more employees	8%
Industry Type	Property & business services	25%
	Retail trade	18%
	Construction	10%
	Health & community services	9%
	Personal & other services	7%
	Accommodation, cafes & restaurants	5%
	Wholesale trade	5%
	Finance & insurance	4%
	Cultural & recreational services	4%
	Transport & storage	3%
	Education	3%
	Manufacturing	3%
	Govt., admin. & defence	2%
	Agriculture, forestry, fishing & mining	1%
	Communication services	1%

Table 3.5 details the number of interviews that were achieved for each industry type and size for each of the commercial customer segments - commercial electricity, commercial water and commercial gas.

As with the residential customer segment, CATI was used to recruit the respondents to participate in the study. The recruitment survey covered a number of topics, which came under the general areas including ***Overall Ratings, Behaviour, Attitudinals,*** and ***Firmographics.*** The commercial recruitment questionnaires ranged in length from 15 to 18 minutes. A copy of the recruitment questionnaires is provided at appendix P.

Table 3.5: Number of Commercial Respondents Recruited

Industry	Commercial Gas Achieved	Commercial Water Achieved[30]	Commercial Electricity Achieved
Organisation Size			
< 5 employees	161	160	160
5-19 employees	34	61	60
20+ employees	45	20	20
Industry Type			
Property & Business Services	40	41	58
Retail Trade	15	24	45
Construction	34	37	24
Health & Community	16	29	23
Personal & Other	15	21	17
Accommodation	25	15	12
Wholesale trade	3	7	9
Finance	1	7	10
Cultural & Recreation	11	12	11
Transport & Storage	3	7	6
Education	25	9	7
Manufacturing	38	21	9
Government & Defence	6	5	5
Agriculture & Forrest	7	4	2
Communication	1	1	2

Once the respondent was successfully recruited, the choice experiments – or 'choice experiment package' - were mailed out to the respondent's preferred address. An appointment time was also set for calling respondents back and leading them through the choice experiment questionnaire. As with residential respondents, the appointment time was set sufficiently in advance to allow enough time for the respondent to receive the choice experiments in the mail.

3.4.2.2. The Choice Experiment Task

The choice experiment package issued to respondents included the choice experiments, a gift voucher for $25 as a token of appreciation, and a personalised general introductory

[30] Sample achieved for the 'commerical water' segment fell short in the 'property & business services' and 'retail trade' industries due to the entire population in those industries being exhausted for the electricity and gas sector interviews. Hence the number of interviews in other industries was able to be boosted. In order to maintain the integrity of the representativeness of the true population distribution, results for the 'water & waster water' survey were 'weighted' back to the known population distribution (as per standard market research practice).

letter, which included an ACNielsen contact name and telephone number if the respondent had any questions.

The number and appearance of the choice experiments was different depending on the utility, allowing ease of identification by respondents, as illustrated below:

Table 3.6: Commercial Choice Experiments

Utility	Colour	Number of Sets	Number of Experiments
Electricity	Mauve – Reliability cluster Gold – Supply & Quality cluster	2	16[31]
Water & Sewerage	Purple – Reliability cluster Red – Restrictions cluster Turquoise – Wastewater cluster	3	18[32]
Gas	Yellow	1	10[33]

As with the residential segments, the number of choice experiments given to commercial respondents in the main survey was a reduction on the number of choices that were given to respondents in each stage of the pilot. This was due to a combination of concerns relating to interview length and respondent fatigue, as discussed in section 3.4.1.2.

Choice experiments for the commercial segments were designed and presented, in the same manner as described for the residential segment, as outlined in section 3.4.1.2. A number of examples of the choice experiments sent to commercial respondents are provided in appendix Q.

3.5. Implications of the Canberra Bushfires

In January 2003, the city of Canberra and the surrounding region experienced the most severe bushfires on record. We have every expectation that these events will have had an effect on the survey results and the estimates of customers' willingness to pay. What is less clear (and more important) however is whether the responses are better (closer to customers' true willingness to pay) or worse as a result of the bushfires. Unfortunately, this is a feature of the survey that can never be definitively explained. However, we can be sure that the events will have heightened Canberra residents' awareness of service interruptions, service quality, etc, which would suggest that the survey responses are better. Residents are more likely to have experienced the situations that they were asked to consider in the choice

[31] 8 choices for each attribute grouping or cluster.

[32] 6 choices per cluster.

[33] 10 choices for the one cluster.

experiments, and therefore the trade-offs that they were asked to make in the survey were more meaningful to them. As such, the estimates of willingness to pay are likely to better reflect customers' true willingness to pay.

The remaining sections of the main report provide details of the survey results. These sections have been structured according to the three product segments or utility services – electricity, water / wastewater, and natural gas – at the request of ActewAGL.

4. ELECTRICITY ATTRIBUTES AND LEVELS

4.1. Summary of Attributes

The following electricity attributes were chosen for the study:

- The annual frequency of service interruptions, expressed as 'number of times electricity is completely unavailable';
- The average duration of an interruption, expressed as 'length of time that electricity is completely unavailable each time that it goes out';
- The time of day that electricity is interrupted, expressed as 'time of day that electricity is completely unavailable each time that it goes out';
- Notification of an interruption (if any), expressed as 'prior notification that electricity will be unavailable';
- Information service provided during an interruption, expressed as 'response to phone inquiries in the event of electricity becoming unavailable';
- The annual frequency of momentary interruptions (less than 1 minute), expressed as 'number of times electricity is momentarily unavailable (eg, clocks need to be re-set)';
- The frequency with which voltage fluctuates, expressed as 'number of times lights flicker or dim' and 'number of times power surges/spikes are experienced'; and
- Price, expressed as 'total electricity bill for the year'.

These were adopted for both residential and commercial customers, albeit with varying levels for each customer type, as discussed below. The choice of wording reflects terms that were most commonly used by participants in the customer focus groups, and also suggestions made by participants during the qualitative pilot of the choice experiments.

Given the large number of attributes identified for the study, the electricity attributes were clustered into two groups – 'reliability' and 'quality' - before creating the choice experiments.

An entire list of electricity attributes and their levels is contained in appendix M.

4.2. Network Reliability

Network reliability is a key focus of the regulatory arrangements governing service standards in the ACT, which establish, for example, limits on the frequency and duration of service interruptions, minimum requirements relating to customer notification of planned service interruptions (for planned maintenance work), and specifications for the information to be provided to customers in the event of an interruption to the electricity service. The focus groups revealed that reliability was indeed an important feature of the electricity service for customers, and that there were a number of dimensions to it.

4.2.1. Frequency and Duration of Interruptions

The regulatory arrangements in the ACT establish standards for:

- the ***average amount of time*** that a customer is without electricity each year;
- the ***average duration*** of each interruption;
- the ***maximum duration*** of an interruption experienced by any ***single*** customer;
- the ***average frequency*** with which a customer is interrupted each year; and
- the ***maximum frequency*** with which any ***single*** customer is interrupted each year.

The focus groups confirmed that outage frequency and duration were important dimensions of supply reliability to customers. The following attributes were therefore included in the study:

- the ***frequency*** of service interruptions each year, expressed as 'number of times electricity is completely unavailable each year'; and
- the ***duration*** of an interruption, expressed as 'length of time that electricity is completely unavailable each time that it goes out'.

With respect to 'levels' for these attributes, existing standards require that:

- any ***single*** customer experience no more than 4 outages, of no more than 4 hours each, per year; and
- on average, customers are to experience no more than 1.2 outages, of 1.2 hours per outage, each year.

ActewAGL has met these standards in the past.

Interestingly, the ***residential*** focus groups indicated that 4 hours was an upper 'tolerable' limit for the duration of an outage for customers - the main concern being that food in freezers would begin to thaw after a period of four hours. Participants in the business focus groups also signalled that thawing food was a driver of 'tolerable' duration periods, however, there was a wide degree of opinion in these groups as to the length of time it would take for food to thaw – varying from '4 hours or less' to 'up to 2 days'.[34]

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[34] See page 15 of ACNielsen's qualitative report, attached as appendix L.

Discussions with ActewAGL suggested that the absolute ***minimum*** amount of time that service crews would need to rectify an unplanned interruption would be about 'half an hour', while a lower limit for the probability of outage frequency would be about 'once every five years' due to planned maintenance requirements (for example, poles are inspected every 5 years and may be replaced, and a proportion of meters are tested once every 15 years, both of which cannot be undertaken without interrupting supply). Discussions also determined that the ***maximum*** period of time that a customer had been without electricity in recent years was 21 hours (due to the December 2001 bushfires), while 9-10 interruptions over a 4 month period was thought to be an absolute upper limit for interruption frequency based on recent experience with customer queries.[35]

On the basis of this information, for the residential customer segment, 5 levels were adopted for the 'frequency' attribute (varying from 'once every 5 years' to '12 times per year', and including 'once per year'), and 8 levels were adopted for the 'duration' attribute (varying from '24 hours' to '30 minutes', and including '1 hour' and '4 hours'). For the commercial customer segment, 7 levels were adopted for the 'frequency' attribute (varying from 'once every 5 years' to 'once a fortnight', and including 'once per year'), and 8 levels were adopted for the 'duration' attribute (varying from '24 hours' to '30 minutes, and including '1 hour' and '4 hours').

4.2.2. Momentary Interruptions

'Momentary' interruptions are interruptions that last for a period of less than one minute. In both the residential and commercial customer focus groups, the frequency with which a customer experiences a momentary outage was raised as an important characteristic of the service. Participants noted that tolerance and inconvenience associated with an electricity interruption was not solely confined to the period without electricity. For example, participants noted that following an interruption they had to re-set appliances that relied on electricity for the control of their automated functioning.[36]

The frequency of momentary outages was therefore included as an attribute in the study. For residential customers, the attribute was further clarified with the addition of a definition for momentary outage - 'eg, clocks need to be re-set', which is consistent with the terminology used by residential participants in the focus groups. Five levels were included for the attribute for both the residential and commercial customer segments, varying from 'every day' to 'once per year'.

4.2.3. Timing of Interruption

The time period in which a service interruption occurs was initially identified as a possible attribute during our discussions with ActewAGL. It was suggested that ActewAGL could

[35] See appendix D for further details of the discussion.

[36] See page 20 of ACNielsen's qualitative report, attached as appendix L.

be flexible as to the timing of its planned maintenance, and that customers may have a preference as to the time in which they were interrupted (eg, a business customer is likely to prefer an interruption ***outside*** business hours compared to an interruption ***during*** business hours). The latter was confirmed in the customer focus groups – in both residential and commercial groups,[37] and while regulatory arrangements do not specify or limit the time period in which service interruptions can occur, the attribute 'time of day that electricity is completely unavailable each time that it goes out' was included in the choice experiments.

Five levels were adopted for both residential and commercial customer segments, established according to the timing preferences signalled by participants in the customer focus groups. Each level was carefully worded to ensure that it made sense against each level of the 'duration of outage' attribute. The levels chosen were 'over the weekend', 'over a weekday', 'Mon-Fri sometime after 6pm', 'Mon-Fri sometime after 8am', and 'Mon-Fri sometime after midnight'.

4.2.4. Notification of Interruption

One of the key themes to come out of the qualitative work suggested that customers are more accepting of service interruptions if they are notified ***prior*** to the event.[38] Notification is also an important feature of the regulatory arrangements governing service standards in the ACT. The existing regulatory arrangements require ActewAGL to notify customers at least two days in advance of an interruption. In discussions with ActewAGL, it was suggested that the notification period could affect the flexibility and therefore efficiency of ActewAGL's maintenance crews. The smaller the notification period, the more flexible were the maintenance crews, thereby increasing their efficiency.

Notification was therefore included as an attribute, expressed as 'prior notification that electricity will be unavailable'. The following levels were adopted for the residential customer segment: 'no notification provided', '1 day', '2 days', '7 days', and 'two weeks'. The same levels were adopted for the commercial customer segment, with the addition of '5 days' and 'one month'. The choice of levels essentially followed the notification period in regulatory arrangements, plus or minus an increment, although 'one month' was included in the commercial customer segment given that a number of participants in the focus groups signalled a preference for this time period.

The level 'electricity unavailable due to emergency – no notification possible' was also included for both segments, to cover the possibility of no notification in the case of an unplanned outage.[39] The distinction between 'no notification provided' and 'no notification

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[37] See page 19 of ACNielsen's qualitative report, attached as appendix L.

[38] See page 17 of ACNielsen's qualitative report.

[39] ActewAGL cannot know the timing of unplanned outages in advance - given that these are caused by events such as storms, back-hoe operations, and vehicle collisions, which are outside ActewAGL's control. ActewAGL is therefore unable to notify customers prior to these events.

possible' was introduced, given that participants in the focus groups signalled that they viewed these two situations quite differently.

4.2.5. Information Provided During an Interruption

Another theme coming out of both the discussions with ActewAGL and the customer focus groups was that customers value, in the event of a service disruption, receiving current details about the disruption – including the expected time period that the service would be disrupted.

Regulatory arrangements require ActewAGL to maintain a 24-hour telephone service in the event of an unplanned service interruption. Participants in the focus groups confirmed that this would be helpful, and noted that in the event of a disruption they would like to call a recorded information line (without having to wait in a queue). The recorded message would state the areas disrupted, (this provides peace of mind that ActewAGL is aware of the situation and addressing it) and outline the likely restoration duration. Participants also noted that it would be preferable that, following the recorded message, there was an option to stay on-line and be transferred to an operator. In calling a utility company, in general, participants also noted a preference to speak to a person rather than a 'machine'.

Some commercial customers, for whom electricity was 'mission critical', noted a preference for access to a 'duty manager' or 'account manager' to keep them informed of the disruption. This is consistent with our discussion with ActewAGL, during which it was suggested that a number of business customers had requested a 'gold' phone service, providing a dedicated line to call in the event of an interruption.

The attribute 'response to phone inquiries in the event of electricity becoming unavailable' was therefore incorporated into the choice experiments, with the following levels:

- your call is answered by an AUTOMATIC VOICE - the voice gives you the option of hearing a recorded message that gives you an up-to-date status report on any electricity supply issues by suburb, or to speak to someone but you may be put on hold before a person answers;
- you get straight through to a PERSON - you are not put on hold and there is no machine directing you to press buttons; and
- the electricity company PERMANENTLY provides you with a SPECIAL phone number for a dedicated account manager who would handle your query - you are not put on hold and there is no machine directing you to press buttons.

The third level was only included for the commercial customer segment.

4.3. Supply Quality

The regulatory arrangements specify a number of requirements relating to voltage. These include limitations on 'dips' and fluctuations in voltage, with which ActewAGL is required to "take all reasonable steps" to comply with.

While few participants in the focus groups noted any issues or concerns with voltage consistency, many participants noted that they had at some stage experienced 'dimming' or 'flickering' of lights and some participants also mentioned surges or spikes.[40] The following two attributes were therefore included in the choice experiments:

- 'number of times lights flicker or dim', with 5 levels varying from 'every day' to '1 time per year'; and
- 'number of times power surges/spikes are experienced', with 5 levels varying from '12 times per year' to 'once every two years'.

No other supply quality issues were identified during either our discussions with ActewAGL or during the customer focus groups.

4.4. Price

Choice experiments all include price as an attribute, so as to provide a basis for determining customers' willingness to pay for particular service options and therefore attributes/levels of the service. The critical question to be resolved, however, is how the price attribute should be expressed to ensure that it is meaningful to a survey respondent.

The focus groups revealed that, with the exception of large commercial customers, customers have little interest in the actual tariffs that they pay or the derivation of their bills. Participants revealed that they thought about price in terms of the 'total amount payable'. Larger businesses tended to perceive this total amount in terms of annual spend, however, residential and small business customers tended to refer to their 'last bill' or 'their bill this time last year' – suggesting that they perceive the amount paid in terms of their billing cycle.[41] Nevertheless, the project team recommended that price should be expressed as a total annual amount in the choice experiments, for both residential and commercial customer segments, due to the seasonality of the billing cycle.

Moreover, to ensure that the price attribute was meaningful to the respondent in terms of its size, the price given in each choice experiment was tailored for each respondent by anchoring it to the respondent's estimate of her/his bill (provided at the time of recruitment). For multi-sited commercial customers, the bill estimate was for a single ACT

[40] See page 23 of ACNielsen's qualitative report, attached as appendix L.

[41] For further details see page 24-25 of ACNielsen's qualitative report.

site nominated by the respondent. This was done because the pilot study indicated that multi-sited businesses found it difficult to think in 'aggregate' terms for their utility bills, given that these are currently issued by ActewAGL on a 'per site' level.

4.5. Identified Attributes/Levels Not Included in the Choice Experiments

4.5.1. Customer Service

In addition to specifying minimum requirements relating to customer notification and telephone services, the regulatory arrangements also set out minimum requirements for:

- promptness of new customer connections;
- method of notification prior to a planned outage;
- response time in the event that a customer notifies ActewAGL of a problem or concern;
- time to respond to a written query and/or complaint by a customer; and
- appointment windows, and timeliness of keeping appointments.

The findings from the focus groups, suggested that, while these were all important aspects determining the perceived quality of a utility service, participants viewed these as given and not something that was 'paid for'.[42] These attributes were therefore not recommended for the choice experiments. Nevertheless, the recruitment surveys were designed to collect information on:

- customer preferences for particular appointment windows;
- expectations relating to ActewAGL's timeliness of keeping appointments; and
- attitudes to ActewAGL's current performance in relation to response times, and handling of calls to the call centre.

4.5.2. Tree-trimming Requirements

During our initial discussions with ActewAGL, tree-trimming specifications was identified as a potential attribute for inclusion in the choice experiments. ActewAGL's experience suggested that customers were often unhappy with the amount of foliage that they were required to remove, and as a solution, ActewAGL suggested that trimming requirements could be reduced if existing overhead wires were replaced with aerial bundled cable (ABC) or replaced underground.

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42 For further details see page 28 of ACNielsen's qualitative report at appendix L.

Tree-trimming, and the concepts of ABC and undergrounding were explored in the focus groups. The focus group findings, however, suggested that there were few customers that were concerned about tree-trimming requirements. Moreover, customers indicated that they were not interested in paying more for electricity in order to have ABC or underground cables installed to enable a reduction in tree-trimming requirements.[43] None of these concepts, or associated attributes, was therefore recommended for the choice experiments. Nevertheless, the recruitment survey included a question on tree-trimming to supplement the qualitative research.

4.5.3. Safety Aspects

'Safety' was identified early on in the study as a potential topic. The issue of safety was tested in the focus groups, however, business and residential participants were generally not concerned about the safety of overhead cables. Indeed, when discussing safety, participants generally considered safety within the context of 'safe use of appliances' in their business or residential premises. Participants assumed, or even took for granted that electricity was provided to their premises in a safe manner.[44]

No attributes relating directly to safety were therefore recommended for the choice experiments. Nevertheless, the recruitment survey included several questions on safety aspects of the electricity service in order to supplement the qualitative work on the issue.

4.5.4. Environment

Specific issues relating to the environment did not arise in the initial research phase of the project (with the exception of those relating to recycled water and water restrictions, as discussed later in the report). No attributes directly relating to the environment therefore were included in the study for electricity.

Interestingly, however, in the qualitative research when participants were asked about their perceptions of electricity relative to natural gas, a few participants noted that gas had environmental benefits over electricity, although most participants did not consider gas and electricity in this context. Across all the residential and business focus groups, participants perceived electricity as being distinctly different from gas. No participant conveyed the impression that they considered electricity and gas as a more holistic and interchangeable entity (eg, energy).[45]

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43 See page 30, ACNielsen's qualitative report, at appendix L.

44 See page 26, ACNielsen's qualitative report.

45 See page 27 of ACNielsen's qualitative report.

4.5.5. Streetlighting

A number of other, similar studies on service standards have adopted attributes relating to the repair or maintenance of streetlights. The concept was not pursued for the study, however, given that the responsibility for streetlighting in the ACT lies ultimately with the Department of Urban Services, rather than ActewAGL.

4.5.6. Interval Electricity Metering

Both ActewAGL and the ICRC identified interval metering as a possible new service offering for electricity customers. The concept was explored in focus groups, however, neither residential or business participants expressed any interest in interval metering. Residential participants had no interest in monitoring their electricity consumption in real time because electricity was used as required, and knowing the current level of consumption would not change behaviour. Business participants' impressions were very similar to residential participants in respect to perceiving little ability to be able to respond to real time information on consumption.[46]

No attributes or levels relating to interval metering were therefore included in the choice experiments.

4.5.7. Pre-Paid Electricity Metering

ActewAGL identified the possibility of offering pre-payment meters to electricity customers. However, when tested in focus groups, neither residential or business participants were interested in pre-paying for their electricity or using pre-paid meters. Some residential participants commented that prepaid metering was archaic reminding them of their earlier days in England.[47]

No attributes or levels relating to pre-paid metering were therefore adopted in the choice experiments.

4.5.8. Generators in the Event of a Disruption

ActewAGL, as a potential service offering, identified the possibility of providing a small portable generator to customers, in order to run several applications in the event of a disruption. However, when explored in the focus groups, both business and residential participants were generally not supportive of the idea of being provided with a small electricity generator. Participants expressed a number of concerns in respect to how the generator would be set up and monitored for continued operation.[48] No attributes or levels

[46] See page 31 of ACNielsen's qualitative report.

[47] See page 31 of ACNielsen's qualitative report.

[48] See page 32 of ACNielsen's qualitative report.

relating to the generator service were therefore adopted in the choice experiments. A question was included in the recruitment questionnaire, however, to supplement the qualitative research findings.

4.5.9. Electricity/Energy Audit/Efficiency Advice

Although ActewAGL noted in discussions with the project team that advice on energy efficiency was more the role and responsibility of the retail business rather than the network business, the issue of energy efficiency was explored in the focus groups. Business participants were asked for their opinion on ActewAGL providing an electricity/energy auditing/efficiency advisory service. Participants were mixed in respect to who they would prefer to rely on to conduct an electricity/energy audit of their business operation. Some participants considered ActewAGL would be a knowledgeable and credible organisation for the task as 'energy' was clearly their business.[49] Other business participants were more sceptical believing that ActewAGL had a vested interest in selling energy to customers and therefore, advice on how to save energy was inconsistent with this core function.

Given the mixed reaction of participants in the focus groups, and that the nature of the attribute does not readily lend itself to a trade-off context, no attributes or levels relating to energy efficiency were adopted in the choice experiments.

49 See page 31 of ACNielsen's qualitative report.

5. SURVEY RESULTS FOR ELECTRICITY

5.1. Overview

5.1.1. Preferences for Reliability, Quality, and Customer Service

The survey results show that both residential and commercial customers value reliability of the electricity service provided by ActewAGL. Both the frequency and the duration of outages are important to customers, and customers value incurring fewer and shorter outages, compared to more frequent and longer outages.

Residential customers expressed an average willingness to pay of $37 or 4.6 percent of their annual electricity bill to avoid a one-hour outage. The willingness to pay of commercial customers is relatively higher than residential customers, and, unlike residential customers, is dependent on the expected duration ***and*** frequency of outages. The average willingness to pay of commercial customers is 6.1 percent of their bill or $341 to avoid a one-hour outage (assuming they expect one outage a year).

Interestingly, the result that commercial customers willingness to pay depends on both the expected frequency and duration of outages, suggests that commercial customers are more able and willing to adapt to longer and more frequent outages - by taking measures to counteract some of the ill effects - compared to residential customers. This result seems reasonable since commercial customers have more at stake with outages than residential customers, and perhaps are more able to purchase equipment to help minimise the effect of interruptions.

The results also indicate that additional outages are more bothersome to customers when they last a long time compared to when they are short, although increasing the length of the outage increases the burden less than proportionately. For example, the average willingness to pay to avoid a 4 hour outage is 6.25 percent of a bill for a residential customer, or $51, which is larger than the willingness to pay to avoid a 1 hour outage, but not four times larger. Similarly, the average willingness to pay to avoid a 4 hour outage is 9.89 percent of a bill for a commercial customer, or $556, which is greater than the willingness to pay to avoid a 1 hour outage, but not four times larger.

Customers also dislike incurring momentary outages, flickering of lights, and power spikes/surges. The relative magnitudes of the estimated means of willingness to pay imply that customers, on average, consider power surges to be worse than momentary outages, and momentary outages to be worse than flickers. The results however indicate that there is significant variation in the extent to which respondents find these events bothersome. Residential respondents evidence a willingness to pay of 4.0 percent of their bill or $32 to avoid a power surge, 2.8 percent of their bill or $23 to avoid a momentary outage, 1.1 percent of their bill or $9 to avoid a flicker. Commercial customers are willing to pay a larger share of their bill to avoid these events than residential customers.

A summary of customers' willingness to pay to avoid these types of events is provided in table 5.1. These should be interpreted as the total amount a customer would be willing to pay to avoid each event entirely. For example, on average, a residential customer would be willing to pay $60 to avoid an 8-hour electricity outage when it occurs once a year.

Table 5.1: Average Willingness to Pay to Avoid Events
(per customer, per event, in dollars)

Event	*Residential*	*Commercial*
8-hour electricity outage when it occurs once a year	60 (7%)	694 (12%)
4-hour electricity outage when it occurs once a year	51 (6%)	556 (10%)
One-hour electricity outage when it occurs once a year	37 (5%)	341 (6%)
Half-hour electricity outage when it occurs once a year	33 (4%)	274 (5%)
Electric power surge	32 (4%)	270 (5%)
Momentary electricity outage[50]	23 (3%)	238 (4%)
Flicker in electric current	9 (1%)	73 (1%)

If an outage must occur, residential customers expressed a preference to have outages during the day on weekdays; this time is better than after midnight, although after midnight is better than after 6pm or on weekends. Commercial customers are the opposite; they prefer having outages on weekends and after normal business hours on a weekday to having them during normal business hours.

The willingness to pay estimates also indicate that customers, particularly commercial customers, greatly value having notice of an outage when the outage is planned. Respondents are forgiving of not receiving notice if the outage was due to an emergency.

The period of notice is important, but not critical. Residential customers prefer one week's notice, and commercial customers prefer two week's notice to any more or less notice. Further, residential customers expressed a preference to receive notice by either mail or letter box drop, and commercial customers by mail or fax in the qualitative research.

'All day' was considered an acceptable appointment window to access their property (to carry out planned maintenance work) by the majority of respondents (73 percent of residential, and 53 percent of businesses) in the recruitment interviews.

In the event of a disruption, both commercial and residential customers expressed a strong preference for having a person answer the phone when they call to make an inquiry of ActewAGL rather than a voice message. Commercial customers also indicated a preference for having a dedicated account manager to handle their electricity queries.

50 That is, outages of less than one minute, requiring 'clocks to be re-set'.

5.1.2. Implications for Existing Service Levels

With respect to the implications of these results for the future priorities of ActewAGL's operations, given that the merits of changing service standards depend not only on customers' willingness to pay but also on cost, we recommend that ActewAGL develop a range of specific network options for assessment. The willingness to pay estimates can be used to calculate the benefit derived by customers for each network option, and so each option can be evaluated by comparing its cost against its benefits. The results of such analysis can be used to help formulate future operations strategy.

It is also possible however to derive customers' preferences for particular levels of service compared to others by using the willingness to pay results and a range of 'hypothetical' service scenarios (including price). The study results[51] can be used to calculate the relative satisfaction (or utility) that customers derive from each 'hypothetical' service scenario. The scenarios can therefore be ranked (according to their respective resulting utilities), and the scenario most preferred by customers can be determined. It is also possible to use such analysis to calculate the amount of compensation that customers would require to accept their less preferred service scenarios.[52]

An example adopting a broad cross section of hypothetical service scenarios is provided below. It indicates that customers value (that is, are willing to pay for) the current levels of reliability provided by ActewAGL / ACTEW. In fact, it indicates that customers may even be willing to pay for higher levels of service.

Figure 5.1, over the page, illustrates the relative satisfaction (or utility) that residential customers derive from a number of different service scenarios. For each service, the existing level of reliability is compared to four different scenarios: two scenarios offering an increased level of service (together with a higher price), and two scenarios offering a decreased level of reliability (together with a lower price). The utility derived from each service scenario has been calculated using the study results. For ease of presentation,[53] the utility derived from existing service levels is assigned a value of 1, and the satisfaction levels derived from the other hypothetical service levels are recalibrated around this. The higher the number, the greater the level of customer satisfaction (or utility) derived from the service scenario.

In all cases, a degraded level of service (in return for a discount in price) is less preferred to existing service levels. For example, the utility derived from the existing level of reliability

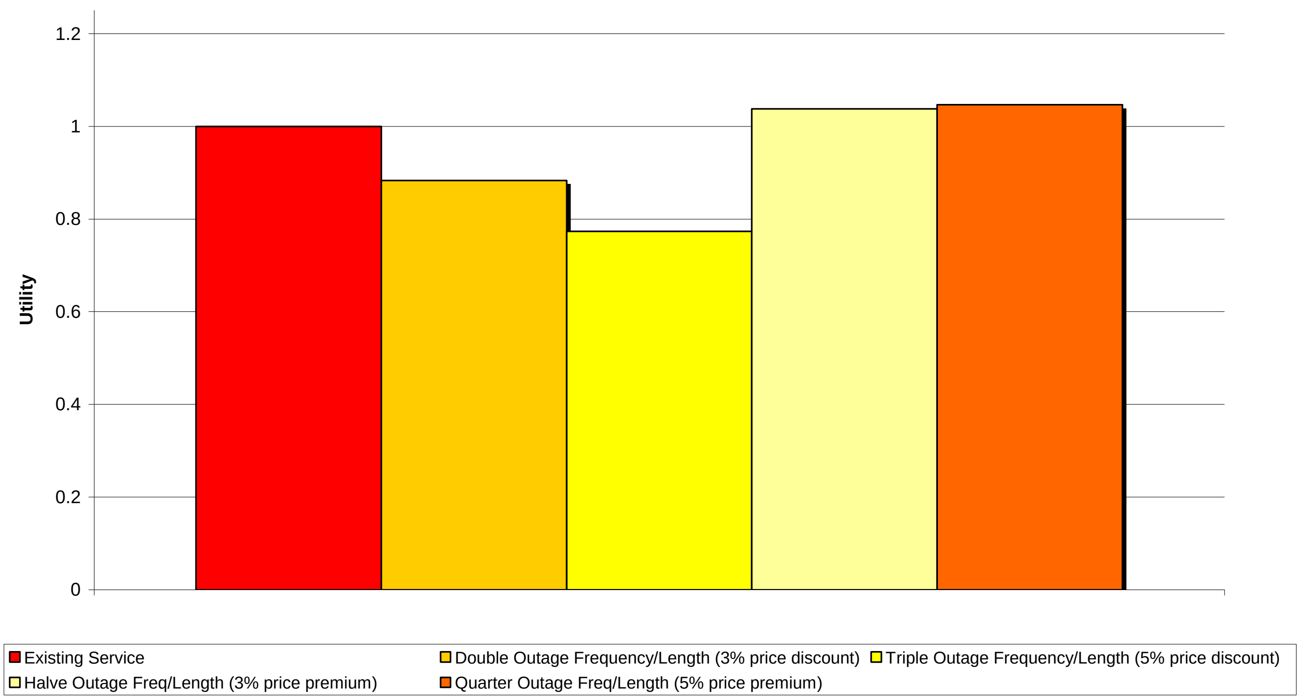
51 That is, the coefficients of the choice models.

52 That is, the amount of monetary compensation (or discount in price) that they would require to ensure that their utility remains unchanged.

53 Given that it is relative (rather than absolute) utility that is important in the analysis, calibration to alternative values has no impact on the results.

is one,[54] while customer utility would be 0.88 if the level of reliability was decreased by a factor of two,[55] in return for a price discount of 3 percent in the total electricity price. As it generates a lower level of customer utility, the service scenario is less preferred to the existing level of service. Similarly, in all cases, the service scenarios involving an increase in reliability (in combination with an increase in price) are ***more*** preferred to existing service levels as they generate higher customer utility.

Figure 5.1: Householders' Ranking of Electricity Reliability Scenarios[56]



As noted earlier, it is also possible to use this analysis to calculate the amounts of monetary compensation (or price discount) that customers would require to accept their less preferred service scenarios.[57] With respect to degraded service standards, the results show that customers would require significant compensation if reliability levels were to fall. For

[54] The analysis assumes that the current frequency of interruptions is 1.2 a year, the average duration of an interruption is 1.5 hours, interruptions occur on a weekday after 8am, and 2 days notice is provided to customers.

[55] That is, the customer could expect 2.4 interruptions per annum, each interruption lasting 3 hours. The timing of the interruption, and the period of prior notification would remain unchanged.

[56] Note that this analysis assumes that the average frequency and duration of interruptions is currently 1.2 per year and 1.5 hours respectively. The discount/increase in price relates to the total annual combined bill (network and retail) for an average customer.

[57] That is, the amount of monetary compensation (or discount in price) that they would require to ensure that their utility remains unchanged.

example, residential customers would require, on average, a reduction of 13 percent on their total annual electricity bill (or about 26 percent on their network bill) to compensate for a doubling in both the frequency and duration of electricity interruptions.

Overall, the study results therefore suggest that customers would not prefer a lesser quality of service in return for a discount in the price of electricity. Customers are willing to pay for existing service levels, and may indeed be willing to pay for higher levels of service. This finding is consistent with the qualitative research, which suggested that customers' lifestyles and business operations are integrally based on the current levels of utility service reliability and any change would have a fundamental impact:

> "It [electricity, gas, water and wastewater supply reliability] is an expectation that is set and you can't do anything about it. … You have structured your business in a certain way because these things (electricity supply) are available."

5.1.3. Ratings of Existing Service Standards and ActewAGL

In the initial recruitment interviews, respondents rated the existing electricity service very highly, with almost all respondents (residential and commercial) giving a rating of 'good' or better – 'good' or better ratings were provided by at least 90 percent of respondents, and the level of 'poor' ratings was extremely low at 3 percent.

Most households perceived that they had experienced some kind of disruption to their electricity service, with the majority stating that they had experienced an electricity outage of between 1 and 4 times per year (67 percent of respondents). Only 7 percent said that they had 'never' experienced an electricity outage, about one quarter said that had 'never' experienced lights flickering or dimming, and over half (53 percent) of households stated that they had 'never' experienced a power surge.[58]

Outages were perceived to have been experienced 'less than once per year' or 'never' by almost half of all the businesses interviewed. A total of 38 percent said that they had 'never' experienced spikes or surges. Dips were said to be experienced much more frequently, with just over half of the businesses saying that they had experienced dips 'twice a year or more'.

Ratings of ActewAGL as the supplier of the electricity services were also very high with almost all respondents (residential and commercial) giving a rating of 'good' or better. 'Poor' ratings were extremely low at 2 percent.

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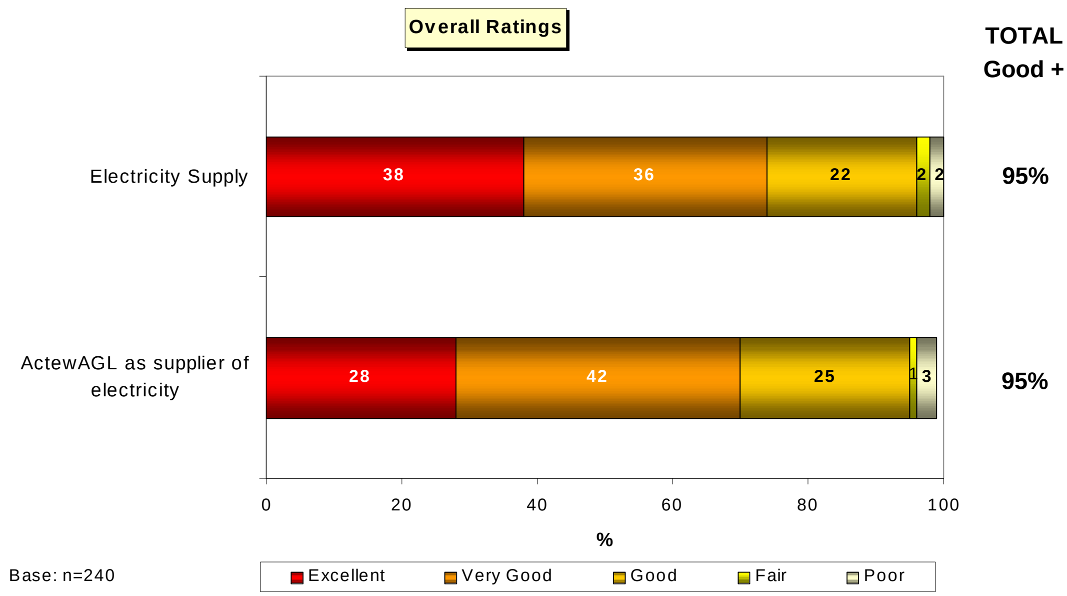
58 The recruitment survey sought information from respondents using a generic reference to 'power spike or surge'. It should be noted that customers may not be able to differentiate between those events caused by the network versus those caused by the customer's own appliances/machinery/wiring without recourse to monitoring equipment.

Overall, the electricity network was believed to be 'maintained in good working order' by the majority of respondents, with 90 percent of households and 92 percent of businesses 'agreeing' with this statement. Agreement was also high (at around three quarters of householders and businesses) with the statement that 'ActewAGL is very responsive in the event of a power failure'.

Figure 5.2: Householders' Ratings of the Electricity Service and ActewAGL



O1. Firstly, overall how would you rate the electricity supply to the home in which you live? Would you say it was....(SINGLE RESPONSE)
O3. And overall how would you rate ActewAGL as the supplier of electricity to the home in which you live? Would you say… (SINGLE RESPONSE)

Further details of the choice modelling results are set out below, along with selected results of the recruitment survey and qualitative research. More detailed results from the recruitment survey can be found at appendix S, and ACNielsen's qualitative report can be found at appendix L.

5.2. Residential Customers' Willingness to Pay

5.2.1. Willingness to Pay for Service Reliability

The choice experiments for the service reliability cluster required respondents to choose between electricity reliability scenarios that differed in levels for each of the attributes. The service attributes, as detailed in section 4, were: expected number of outages per year, the length of each outage in hours, the time that the outages occur, the extent of notice (if any) that the customer receives prior to the outages, the type of service that the customer receives if he/she calls the utility for information about the outage, plus the amount of the annual electricity bill that the customer would pay under that scenario. Respondents were presented with two scenarios at a time and were asked which one of the two scenarios he/she preferred. Each respondent was given a series of eight such choices. The levels of the attributes in each of the scenarios varied over the eight choices that each respondent faced, as well as over respondents.

Statistical models of respondents' choices were estimated. The form of these models is described in appendix R. For each choice situation, the model relates the choice of the respondent to the attributes of the two scenarios that were presented to the respondent. The variables of the model reflect the impact of each attribute on the respondents' choices.

Table E1 gives the estimated model for residential customers' choice among electricity reliability scenarios. The specification of variables that enter in the model was determined through extensive testing of alternative specifications. Unless otherwise noted, only variables that enter significantly are included in the models. Similarly, non-linearities in variables and interactions among variables are included only to the extent that they were found to be significant.

The impact of attributes on customers is often quite different for different customers. The model structure is capable of handling these differences, as noted in appendix R. In particular, coefficients in the model can be allowed to vary over customers, if such variance is found to be important. Instead of estimating one coefficient that applies to all customers, the coefficient can be specified to be normally distributed in the population. The mean and standard deviation of the distribution are therefore estimated.

Tests were performed for whether each coefficient varies significantly over customers. If the variance of the coefficient was found to be significantly different from zero, then a distribution is estimated for the coefficient; that is the mean and standard deviation are estimated (for example, in table E1, the coefficients for number and length of outages are specified as random).

Any coefficient whose variance is not significant was specified to be the same for all customers, ie, is fixed for all customers rather than varying over customers (eg, the coefficient for price is fixed). Note of course that a fixed coefficient does not imply that all respondents actually have the same coefficient but rather that the differences across respondents are not sufficiently strong to be identified by the data.

The t-statistics in Table E1 are very high, indicating that respondents were indeed taking each attribute into consideration and choosing thoughtfully among the scenarios.[59] The t-statistic is simply a measure of confidence, indicating how well each variable relates to customers' choices/preferences. A higher t-statistic indicates a higher degree of confidence. A t-statistic of 2 indicates that the coefficient is significantly different from zero at the 95

59 Stated conversely, if respondents were choosing fairly randomly, without paying attention to the attributes, then a model estimated on their choices would have very low t-statistics

percent confidence level.[60] That is, we can be 95 percent sure that the variable actually affects customers' choices. A t-statistic of 3.5 indicates 99.96 percent confidence. The t-statistics for many of the coefficients in Table E1 are far in excess of 2 and even 3.5. For example, the t-statistics on the price coefficient is over 10 and the mean coefficients for the number and length of outages are in excess of 4 and 7, respectively. This means that we can be nearly absolutely sure that these variables affect customers' choices.

Table E1: Model of Customers' Choice Among Electricity Reliability Scenarios

Variables	***Estimates***	***Std. err.***	***T-stat.***
Price as share of current bill	-3.0335	0.3031	-10.007
Number of outages per year: mean	-0.1007	0.0245	-4.113
standard deviation	0.0753	0.0357	2.109
Length of outages in hours: mean	-0.0921	0.0125	-7.368
standard deviation	0.0548	0.0151	3.630
Interaction: Ln(1+length)x number: mean	-0.0558	0.0162	-3.439
standard deviation	0.0624	0.0190	3.291
M-F after 8am	0.4466	0.1371	3.257
M-F after 6pm	-0.0734	0.1330	-0.552
M-F after midnight	0.2405	0.1321	1.821
Weekdays	0.5504	0.2682	2.052
1 day's notice	0.5171	0.1565	3.305
2 day's notice	0.6923	0.1596	4.337
7 day's notice	0.9194	0.1618	5.683
Two week's notice	0.6645	0.1608	4.133
Emergency	0.5430	0.1581	3.435
Person answers: mean	0.5651	0.0980	5.767
Standard deviation	0.4490	0.2152	2.086

"Price" is the annual electricity bill that the customer would receive under the scenario. The estimated coefficient of price is negative, indicating that, if the price of a scenario rises and none of the levels for the other attributes change, respondents like the scenario less. Stated differently, raising the price of a scenario reduces the chance that a respondent will choose it, holding all other levels of the attributes in the scenario constant.

In this, and all subsequent models in the study, price is entered as a share of the respondents' current bill. For example, suppose the price of a scenario is $900, and the respondents' current annual bill is $1000; in this case, the price of the scenario as a share of the customers' bill is 0.9. Various ways of entering the price of the scenario were tested, including price alone, non-linear transformations of price, and price as a share of current bill. The best fit to the data was obtained with price as a share of bill. This specification

60 A t-statistic over 1.96 indicates that the impact is significant at the 95% confidence level, and a t-statistic over 1.0 indicates significance at the 70% confidence level.

implies that a $100 bill reduction to a respondent whose annual bill is currently $1000 has the same effect on the respondents' choices as a $80 bill reduction to a respondent whose annual bill is $800, since both constitute a 10 percent reduction.

5.2.1.1. Interpretation of the Model

5.2.1.1.1. Frequency and Duration of Service Interruptions

The number of outages per year enters in the choice model as an important variable. The coefficient of this variable is specified to be random - that is, assumed to vary over customers - with a normal distribution. The mean of the distribution is estimated to be -.1007 and the standard deviation is estimated to be 0.0753. Both the mean and standard deviation are significant, as indicated by their t-statistics. The negative mean indicates, as expected, that the average customer dislikes outages. Stated more directly, respondents prefer a scenario with fewer outages to one with more outages, all else (including importantly, price) held constant. The standard deviation being significant indicates that there are identifiable differences across respondents in the extent to which they find outages to be bothersome, that is, some respondents find the outages to be less bothersome than others.

The length of outages is also important to respondents. This variable has a random coefficient with an estimated mean of -.0921 and estimated standard deviation of .0548. Respondents prefer shorter outages to longer ones, all else held constant, and there is considerable difference across respondents in the strength of these preferences.

The next variable is an interaction between number of outages and length of the outages. This variable captures the fact that additional outages are more bothersome when they last a long time than when they are short. For this variable, the length of the outage enters in log form. This non-linearity (which fits better than length itself) indicates that increasing the length of the outage increases the burden less than proportionately. That is, an extra outage that lasts 2 hours is not twice as troublesome as an extra outage that lasts 1 hour. The interaction variable has a random coefficient with an estimated mean that is negative, as expected, and a significant standard deviation.

The estimated coefficients can be used to calculate the amount that respondents have evidenced, through their choices, that they are willing to pay to reduce the number of outages each year. The willingness to pay for any attribute is the coefficient of that attribute divided by the price coefficient (intuitively, the coefficient of the attribute gives the importance of that attribute in respondents' choices; the price coefficient gives the importance of price in their choices; and the ratio of the two gives the importance of the attribute relative to price, that is, the value of the attribute denominated in dollars).[61]

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[61] Stated more correctly, willingness to pay is the derivative of utility with respect to the attribute divided by the derivative of utility with respect to price.

Because of the interaction term, the willingness to pay to reduce the number of outages depends on the length of the outages. Also, since the coefficients are random, the model implies that there is a distribution of willingness to pay, with some respondents willing to pay more than others.

Tables E2 and E3 give statistics on the distribution of willingness to pay that respondents evidenced to reduce the expected number of outages by one per year. Table E2 gives willingness to pay as a share of the respondent's bill, and E3 gives willingness to pay in dollars. Consider the willingness to pay to avoid a one-hour outage. Table E2 gives the mean willingness to pay as 0.0460 share of the respondent's current bill. This number indicates that the average residential respondent evidenced in their choices that they were willing to pay 4.6 percent extra on their electricity bill in order to reduce the expected number of outages per year by one. Given the electricity bill of respondents, this share comes to $37.48, as shown in Table E3.

The willingness to pay to pay to avoid an outage is greater for longer outages, yet not proportionately so. The average willingness to pay to avoid a 4 hour outage is 6.25 percent

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Assume the utility that a customer obtains from a scenario is denoted U, which depends on the price and other attributes of the scenario. The estimation of the choice model for each type of scenario (eg, electric outages, waste water overflows) identifies the form of U that best fits respondents choices, that is the functional relation between the scenario attributes and the utility that the customer obtains from the scenario.

In some instances, U is linear in an attribute and sometime U is non-linear in the attribute. The marginal willingness to pay for change in attribute X is, by definition:

[(dU/dX)/(dU/dP)]

where dU/dX is the partial derivate of utility with respect to X, and dU/dP is the partial derivative of utility with respect to price. In the text, we, for convenience, call dU/dX "the coefficient of X" and dU/dP "the coefficient of P". However, the precise definitions are partial derivatives.

The form of the partial derivatives depend of course on the form of utility. Some examples are as follows. If utility is linear in X, then U=c*X + other terms where c is the coefficient of X, such that dU/dX=c. Utility might be nonlinear in X, taking the form U=c*ln(1+X). In this case, by the rules of differentiating logs, dU/dX=c/(1+X). The value of dU/dX in this case depends on the level of X. Utility might also include interaction terms between two attributes. For example, utility from attributes X and Z might be U=c*X + g*X*ln(1+Z), such that dU/dX=c+g*ln(1+Z) and the value of dU/dX depends on the level of Z. Stated succinctly: the estimation determines the form of U that best fits the data, and then willingness to pay is obtained by deriving dU/dX from this utility function.

Often, X can be specified according to different increments. For example, the number of outages per year can be reduced by one. However, it might also be useful to know the willingness to pay to reduce the number of outages from one per year to one every other year (which is a reduction of .5 in the number of outages per year) or from one per year to one every ten years (which is a reduction of .1 per year. The willingness to pay for a change of X of magnitude DeltaX is calculated as marginal willingness to pay times the amount of the change, ie:

[(dU/dX)/(dU/dP)]DeltaX

For a 1 unit change, DeltaX is just 1, such that willingness to pay is simply calculated as (dU/dX)/(dU/dP), without needing to explicitly deal with the size of the change. However, for changes that are not one unit, the amount of change in the attribute needs to be factored into the calculation. Suppose for example, that the marginal willingness to pay for a reduction in the number of outages is $100. Then the willingness to pay for a reduction of .1 (from say one outage per year to one every other year) is $50, and willingness to pay for a reduction of .1 (from one per year to one every ten years) is $10.

of bill, or $51.23, which is larger than the willingness to pay to avoid a 1 hour outage, but not four times larger.

To illustrate the procedure for calculating willingness to pay, consider Table E3. The table gives $60 as the residential customers' average willingness to pay to avoid an 8-hour electricity outage. This figure is based on the estimated coefficients from Table E1, the model of residential customers' choice among reliability scenarios. In this model, the number of outages enters by itself and interacted with the length of the outage in log form. The coefficient of number of outages incorporates both of these variables. Specifically, the average coefficient of number of outages is: -.1007 - .0558 * ln(1+length), where the length is expressed in hours. The price coefficient is –3.0335, where price is expressed as a share of current bill. The willingness to pay is therefore (-.1007 - .0558*ln(1+length))/-3.0335, expressed as a share of bill. For an eight-hour outage, the willingness to pay becomes: (-1007-.0558*ln(1+8))/-3.0335 = (-.1007 -.0558*2.197)/-3.0335 = .0736. That is, the average willingness to pay is 7.36 percent of current bill. Since the average bill for residential customers is $815, the average willingness to pay is 0.0736*815=60.

Table E2: Residential Customers' Willingness to Pay to Avoid an Electricity Outage
(per customer, per event, as share of customer's current electricity bill)

Outage Length	*Mean*	*Std. Dev.*	*25tile*	*Median*	*75tile*
30 minutes	0.0408	0.0261	0.0232	0.0408	0.0584
1 hour	0.0460	0.0286	0.0266	0.0460	0.0653
2 hours	0.0533	0.0336	0.0305	0.0533	0.0761
4 hours	0.0625	0.0415	0.0346	0.0625	0.0910
6 hours	0.0685	0.0474	0.0368	0.0685	0.1006
8 hours	0.0736	0.0519	0.0384	0.0730	0.1083
12 hours	0.0796	0.0587	0.0403	0.0796	0.1197
24 hours	0.0914	0.0713	0.0441	0.0914	0.1402

Table E3: Residential Customers' Willingness to Pay to Avoid an Electricity Outage
(per customer, per event, in dollars)

Outage Length	*Mean*	*Std. Dev.*	*25tile*	*Median*	*75tile*
30 minutes	33.17	28.266	15.05	28.78	45.67
1 hour	37.48	31.223	17.43	32.55	51.19
2 hours	43.57	36.514	20.11	37.84	59.62
4 hours	51.23	44.368	22.81	44.43	70.92
6 hours	56.28	49.990	24.30	48.76	78.60
8 hours	60.05	54.343	25.35	51.98	84.41
12 hours	65.57	60.887	26.79	56.70	93.03
24 hours	75.38	72.874	29.17	65.09	108.56

The other columns in Tables E2 and E3 provide information about the distribution of willingness to pay around its mean. The standard deviation and quartiles are provided. Note that the willingness to pay as a share of bill is normally distributed, since the coefficients upon which it is based are normal. Since the mean and median of a normal distribution are the same, the figures in the first and next to last columns in Table E2 are the same. In Table E3, the mean and median willingness to pay are not the same. The figures in Table E3 are calculated by multiplying the willingness to pay as a share of bill by the current bills of the respondents. The empirical distribution of customers' bills is skewed, with the mean being greater than the median. As a result, the distribution of willingness to pay, when expressed in dollars, is also skewed. The median willingness to pay to avoid a one-hour outage is $32.55 while the mean is $37.48.

As the figures indicate, there is considerable variation over respondents in the willingness to pay that they evidenced in their choices. Half of the respondents evidenced a willingness to pay of between $17.43 and $51.19 to avoid a one-hour outage. A quarter of the respondents evidenced a willingness to pay of less than $17.73, while a quarter evidenced willingness to pay in excess of $51.19. The figures for avoiding outages of other lengths are interpreted similarly.

5.2.1.1.2. Timing of Service Interruption, Prior Notification and Customer Information

Consider now the other variables in the model of Table E1. The time of the outages was specified in the scenarios. The alternative times were: 'weekends', 'Monday through Friday after 8am', 'Monday through Friday after 6pm', and 'Monday through Friday after midnight'. Monday through Friday was also used for weekday outages that were too long to fit within the specific time periods (eg outages of greater than 24 hours). In the model, the coefficient associated with weekends was normalized to zero, and the coefficients of the other time periods are interpreted as indicating the preference for that period relative to weekends.

The coefficient for 'M-F after 6pm' is small in magnitude and not significantly different from zero. This result indicates that respondents are essentially indifferent between having an outage on a weekend and having it on a weekday after 6pm. The coefficients for the other time periods are significantly positive, indicating that respondents prefer having an outage on weekdays after 8am or after midnight to having it on a weekend or after 6pm on a weekday. Weekends and weekdays after 6pm are traditionally times when members of the household are more likely to be at home and engaged in activities that would be hampered by electricity outages. In contrast, members of the household are often away from home at school or work during the day on weekdays and asleep after midnight, such that an outage creates less interference. The best time to have an outage, in terms of respondents' preferences, is during the day on weekdays; this time is better than after midnight, though after midnight is better than after 6pm or on weekends.

Each scenario included a statement of the extent of notice, if any, that the customer is given before the outage. For scenarios without notice, the outages were described as either due to an emergency or as being planned but without notice being given. In the model, the coefficient for planned outages with no notice was normalized to zero, and the coefficients of the other variables are to be interpreted as reflecting preferences relative to no notice with a planned outage. The estimates indicate that respondents greatly value having notice of an outage when the outage is planned. Two day's notice is slightly better for respondents than one day's notice, and seven day's notice is better than two day's notice. Respondents consider two week's notice to be less desirable than one week's notice. This finding mirrors the comments of respondents in focus groups, where they expressed concern that they would forget about the upcoming outage, or lose the notification, if they were to receive it two weeks in advance. These differences over notification periods are intuitively reasonable; however, it should be noted that the differences are not statistically significant. Each notification period is significantly preferred to having no notice when the outage is planned.

A positive coefficient is estimated for emergency outages. This result indicates that respondents tend to be forgiving of not receiving notice if the outage is due to an emergency. The point estimates indicate that respondents consider an emergency outage without notice to be about equivalent to a planned outage with one day's notice.

The scenarios also described the type of reception that a customer would receive when calling the electric company about an outage. Two alternatives were distinguished: (1) the caller connects to a voice machine that gives a recorded message with information about the outage, and the caller has the option to press a button to be connected to a person, or (2) a person answers the phone. The coefficient for the variable representing the first alternative was normalized to zero. The coefficient for the second alternative is estimated to be positive and significant, indicating that respondents prefer having a person answer the phone to having a voice message with the option to connect to a person. The point estimates indicate that respondents consider having a person answer the phone at the utility's call centre during an outage to be more valuable than receiving one day's notice of the outage.

5.2.2. Willingness to Pay for Quality of the Electricity Service

Aspects of service quality that were included in the study were momentary outages, flickering or dimming of lights, and power surges. Respondents were asked to choose among service quality scenarios that differ in the number of these events that occurs each year and the bill that the respondent would receive under the scenario.

Table E4 gives the model estimated on these choices. Each of the variables except price is specified to be normally distributed, while the price coefficient is fixed. For momentary outages and flickers, the scenarios included frequencies as high as daily. Daily occurrences of these two events are entered as separate variables from the number of events per year, since 365 occurrences per year is far greater than the next highest frequency (12 per year).

Table E4: Model of Residential Customers' Choice among Electricity Quality Scenarios

Variables	***Estimates***	***Std. err.***	***T-stat***
Price as share of current bill	-4.6463	0.6807	-6.826
Number of momentary outages per year, not daily: mean	-0.1311	0.0167	-7.837
Standard deviation	0.0763	0.0281	2.716
Daily outages: mean	-5.1805	0.5851	-8.855
Standard deviation	2.9421	0.4876	6.034
Number of flickers per year, not daily: mean	-0.0503	0.0136	-3.696
Standard deviation	0.0045	0.0312	-0.143
Daily flickers: mean	-1.6936	0.2145	-7.897
Standard deviation	1.1298	0.3029	3.730
Number of power surges per year: mean	-0.1841	0.0230	-8.000
standard deviation	0.1570	0.0314	5.007

5.2.2.1. Interpretation of the Model

The mean coefficients are highly significant for all the variables. The estimated means are negative, indicating that respondents dislike incurring all three types of events. The relative magnitudes of the estimated means imply that that respondents on average consider power surges to be worse than momentary outages, and momentary outages to be worse than flickers.

With one exception, the standard deviations are significant for all the coefficients. This result indicates that there is significant variation in the extent to which respondents find these events bothersome. The one exception is the standard deviation of the coefficient for number of flickers. The mean of this coefficient is small such that its standard deviation must also be small; with a small standard deviation, it is reasonable not to be able to reject the hypothesis that the standard deviation is zero.

The estimates imply that respondents tend to adapt somewhat to daily occurrences of outages and flickers. The mean coefficients for daily occurrence of momentary outages and flickers are large in magnitude, indicating the respondents greatly dislike scenarios with these events occurring daily. However, the magnitudes are not 365 times larger than the mean coefficient for the number of events per year. For example, the mean coefficient for number of momentary outages is -.1331. If respondents considered daily outages to be 365 times worse than one outage per year, then the mean coefficient for daily momentary outages would be -.1331 x 365 = -48.58. The estimated mean for daily outages is –5.18, which is far smaller in magnitude than –48.58. Partial adaptation to these events seems reasonable since respondents can buy devices to reduce or eliminate the impact of momentary outages and flickers.

Tables E5 and E6 give statistics for the distribution of willingness to pay that respondents evidenced in their choices. The willingness to pay is expressed as a share of bill in Table E5 and in dollars in Table E6. Respondents evidence a willingness to pay of $32 to avoid a power spike/surge, $23 to avoid a momentary outage, and $8.83 to avoid a flicker. The relative magnitudes of these average willingness to pay figures seem reasonable: a power surge is most problematic since it can damage equipment, and a momentary outage is more problematic than a flicker since even a momentary outage can necessitate that the respondent reset clocks.

Table E5: Residential Customers' Willingness to Pay to Avoid Specified Events
(per customer, per event, expressed as share of customer's current electricity bill)

	Mean	***Std Dev***	***25tile***	***Median***	***75tile***
Momentary outage	0.0283	0.0164	0.0169	0.0283	0.0394
Flicker	0.0108	0.0010	0.0102	0.0108	0.0115
Surge	0.0401	0.0335	0.0173	0.0401	0.0630

Table E6: Residential Customers' Willingness to Pay to Avoid Specified Events
(per customer, per event, in dollars)

	Mean	***Std Dev***	***25tile***	***Median***	***75tile***
Momentary outage	23.01	18.30	11.22	20.02	30.96
Flicker	8.83	4.23	6.08	7.98	10.07
Surge	32.30	33.97	10.99	27.80	48.05

The willingness to pay to avoid a momentary outage that respondents evidenced in the electricity quality scenarios is consistent with the willingness to pay that respondents evidenced in the reliability scenarios. As shown in Table E3, the average willingness to pay to avoid an outage is $43 if the outage lasts two hours, $37 for a one-hour outage, and $33 for a half-hour outage. The average willingness to pay to avoid a momentary is $23, which continues this downward progression of willingness to pay as outage length decreases.

5.3. Commercial Customers' Willingness to Pay

5.3.1. Willingness to Pay for Service Reliability

Commercial customers were presented with reliability scenarios with the same attributes as in the scenarios faced by residential customers; however, the levels of some of the attributes differed. In particular, a category for one month notice was included for commercial customers that had not been included for residential customers, and the response to phone calls was further differentiated for commercial customers to include a category for the customer having an account manager available. This category was stated to respondents as "The electricity company PERMANENTLY provides you with a SPECIAL phone number for a dedicated account manager who would handle your query - you are not put on hold and there is no machine directing you to press buttons."

The model of commercial respondents choice among electricity reliability scenarios is given in Table E7. As in the residential model, the t-statistics are very high, indicating a high level of confidence in the results.

Table E7: Model of Commercial Customers' Choice Among Electricity Reliability Scenarios

Variables	***Estimates***	***Std. err.***	***T-stat***
Price as share of current bill	-2.1751	0.3181	-6.838
Number of outages per year: mean	-0.0695	0.0127	-5.449
standard deviation	0.0680	0.0148	4.577
Ln(1+length in hours): mean	-0.5126	0.0971	-5.281
standard deviation	0.4401	0.1183	3.721
Ln(1+number)ln(1+length): mean	-0.1823	0.0527	-3.460
standard deviation	0.2220	0.0608	3.651
M-F after 8am: mean	-0.7631	0.1752	-4.355
standard deviation	1.1495	0.2511	4.579
M-F after 6pm	0.0650	0.1404	0.463
M-F after midnight	-0.0019	0.1436	-0.013
Weekdays	-0.5610	0.2523	-2.224
1 day's notice	0.7297	0.2087	3.497
2 day's notice	0.6109	0.2056	2.972
5 day's notice	0.8116	0.2108	3.850
7 day's notice	0.6627	0.2090	3.172
Two week's notice	0.9094	0.2144	4.242
One month's notice	0.9163	0.2139	4.284
Emergency	0.4085	0.2072	1.971
Person answers:	0.3979	0.1351	2.945
mean standard deviation	0.7300	0.2401	3.041
Acct manager:	0.4864	0.1311	3.711
mean standard deviation	0.5957	0.2424	2.457

5.3.1.1. Interpretation of Model

5.3.1.1.1. Outage Frequency and Duration

The number and length of outages significantly affect respondents' evaluation of the scenarios, as expected. The specification of these variables differs in two regards from those in the model for residential customers.

First, the length of outage enters in log form rather than linearly. Recall that in the residential model, the log of length entered the interaction term, but length itself entered the non-interaction term. For commercial customers, the log form fits better for length in both the non-interaction term and the interaction term. This difference suggests that commercial customers are more able and willing to adapt to long outages, by taking measures to counteract some of the ill effects, than residential customers. This result seems reasonable since commercial customers have more at stake with outages than residential customers. Second, in the interaction term, the log of number of outages enters instead of number of outages itself, as in the interaction term in the residential model. This difference suggests that commercial customers are more able to adapt to scenarios with numerous outages by taking measures, such as buying backup equipment, to mitigate the ill effects. Again, this difference is expected since outages have a greater potential impact for commercial than residential customers.

The willingness to pay to avoid an outage depends on the number and length of the outage, due to the specification of the interaction term. Table E8 gives the average willingness to pay in dollars for each number and length of outages. The willingness to pay to avoid an outage is greater for longer outages, but not proportionately more. For example, if outages occur twice a year, the average willingness to pay to avoid a 2 hour outage is $351, which is greater than the willingness to pay of $287 to avoid a one hour outage, but not twice as much. Also, the willingness to pay to avoid an outage is less when the respondent is already facing many outages than when the respondent is facing fewer outages. For example, the average willingness to pay to avoid a one hour outage is $341 if there is only one outage per year but is $204 if outages occur monthly. That is, the average willingness to pay to reduce the number of outages per year from one to none is $341, while the willingness to pay to reduce the number of outages per year from 12 to 11 is $204. This difference reflects the adaptation of commercial customers, as discussed above, to numerous outages.

Table E8: Commercial Customers' Willingness to Pay to Avoid an Electricity Outage, for each length of outages and number of outages per year (per customer, per event, in dollars)

	Every five years	***Every two years***	***Once a year***	***Twice a year***	***4 times a year***	***Monthly***	***Fortnightly***
30 minutes	337	306	274	242	217	193	186
1 hour	450	396	341	287	244	204	191
2 hours	608	522	436	351	282	218	198
4 hours	808	682	556	430	330	237	207
6 hours	939	787	635	481	361	249	213
8 hours	1038	866	694	522	385	258	217
12 hours	1181	981	780	580	419	271	223
24 hours	1437	1185	934	682	481	295	235

The distribution of willingness to pay can be calculated for each number of outages. To save space and to focus the discussion, statistics on the distribution of willingness to pay are given only for one outage per year, which is the number that has occurred most typically historically. Statistics for the other numbers of outages per year are analogous. Table E9 gives willingness to pay statistics as a share of the customers' bill, and Table E10 in dollars.

Table E9: Commercial Customers' Willingness to Pay to Avoid an Electricity Outage, when the expected number of outages is 1 per year (per customer, per event, expressed as a share of current electricity bill)

Outage Length	***Mean***	***Std. Dev.***	***25tile***	***Median***	***75tile***
30 minutes	0.0490	0.0373	0.0239	0.0490	0.0741
1 hour	0.0609	0.0469	0.0296	0.0609	0.0927
2 hours	0.0777	0.0637	0.0346	0.0777	0.1205
4 hours	0.0989	0.0872	0.0399	0.0989	0.1576
6 hours	0.1129	0.1033	0.0438	0.1129	0.1822
8 hours	0.1233	0.1155	0.0460	0.1233	0.2011
12 hours	0.1386	0.1335	0.0498	0.1386	0.2289
24 hours	0.1657	0.1660	0.0549	0.1657	0.2779

Table E10: Commercial Customers' Willingness to Pay to Avoid an Electricity Outage, when the expected number of outages is 1 per year
(per customer, per event, in dollars

Outage Length	***Mean***	***Std. Dev.***	***25tile***	***Median***	***75tile***
30 minutes	274	1056	26	80	222
1 hour	341	1322	33	100	276
2 hours	436	1735	39	126	354
4 hours	556	2284	45	159	452
6 hours	635	2655	48	180	517
8 hours	694	2935	51	196	566
12 hours	780	3347	54	219	637
24 hours	934	4085	61	260	764

Commercial respondents evidenced a higher willingness to pay to avoid outages than residential customers. There are two components of this difference. First, commercial respondents evidenced that they were willingness to pay a larger share of their bills than did residential respondents. Second, commercial customers electricity bill are generally much larger than residential customers' bill. The larger willingness to pay indicates that outages are more problematic for commercial customers than residential customers, since the operations of the firm, and its ability to earn income (and therefore profit), are affected by outages.

As shown in table E9, there is considerable variation in the share of bill that commercial customers are willing to pay to avoid an outage. Since the coefficients in the model are normally distributed, the mean willingness to pay and the median willingness to pay are the same. The quartile results indicate that a quarter of commercial customers are willing to pay less than 2.96 percent of their bill to avoid a one-hour outage, while another quarter are willing to pay more than 9.27 percent.

As table E10 shows, the distribution of willingness to pay in dollars is very highly skewed. This result is due to the fact that the distribution of commercial customers' bills is highly skewed, with a few customers having extremely large bills compared to the majority of customers. Because of this skewedness, the average willingness to pay is far greater than the median willingness to pay. For example, to avoid a one-hour outage, the average willingness to pay is $341 while the median is $100. The average willingness to pay is even greater than the seventy-fifth percentile willingness to pay.

This enormous amount of skew is the distribution suggests that average willingness to pay might not be the relevant statistic to consider when deciding among potential changes in reliability levels for commercial customers. From a majority-rule perspective, the median willingness to pay is the relevant statistic. Also, if the few customers with very large electricity bills can be provided with a different level of reliability than the rest of commercial customers, then the average willingness to pay is less relevant than the median willingness to pay for making decisions regarding appropriate reliability levels for the mass of commercial customers.

5.3.1.1.2. Timing of Interruption, Notification and Customer Information

The model in table E7 provides information about respondents' reactions to other attributes of the scenarios. As in the residential model, the coefficient for weekend outages is normalized to zero, and the coefficient for other times are interpretable as reflecting preferences relative to weekends. The coefficients for Monday through Friday after 6pm and after midnight are not significantly different from zero. This result implies that commercial customers consider outages in these time periods to be about the same as outages that occur over the weekend.

The coefficient for Monday through Friday after 8am (that is, during normal business hours) has a significant mean and standard deviation. The estimated mean is negative, which indicates that commercial customers dislike having outages during normal business hours more than they dislike outages during weekends or on weekdays after normal business hours. Stated in the reverse: commercial customers prefer having outages on weekends and after normal business hours on weekdays to having them during normal business hours. This finding is the opposite of that for residential customers, which evidenced a preference for weekday outage over weekend outages. However, the results for residential and commercial respondents are consistent in that each type of customer prefers outages when their activities are least disrupted, which is during normal business hours for residential customers (when they are normally away from home) and not during normal business hours for commercial customers (when their operations are not as likely to be affected.)

Commercial respondents evidenced a strong preference for receiving notice in advance of an outage. Notice is even more important to commercial customers than to residential customers. Any length of notice between one day and seven days is considered about the same, with no significant differences. Two week's notice and one month's notice are preferred to having a week's or less notice. This result is different from that for residential customers, who were found to prefer one week's notice over two week's notice presumably because they are concerned that they will forget the date of the outage or lose the notification. Commercial customer prefer having Two week's notice over one week's notice, presumably so that they have a longer time to plan for and accommodate the outage in the least disruptive way possible. Two week's notice is apparently sufficient for this purpose, since one month and Two week's notice are valued essentially the same by the commercial respondents.

Like residential customers, the commercial respondents tend to be forgiving of not receiving notice if the outage is due to an emergency. However, since commercial customers value notice so greatly, they do not consider an emergency to be on par with a planned outage with one day's notice, as residential customers evidenced.

Like residential customers, the commercial respondents evidenced a strong preference for having a person answer their phone calls to the 'electricity company' rather than a voice message. The scenarios for commercial customers included a category for the customer having a special phone number to call their own account manager. The point estimates in Table E7 imply that commercial customers on average prefer having the account manager to having a person answer their phone calls. However, the difference is not statistically significant. Also, as discussed below, the models for gas and water reliability indicate that commercial customers prefer just having a person answer the phone to having a special account manager.

5.3.2. Willingness to Pay for Quality

Table E11 gives the model for commercial respondents' choice among electricity quality scenarios. The model has the same specification as that for residential customers in table E4.

Table E11: Model of Commercial Customers' Choice among Electricity Quality Scenarios

Variables	*Estimates*	*Std. Err.*	*T-stat.*
Price as share of current bill	-3.1471	0.3659	-8.602
Number of momentary outages per year, not daily: mean	-0.1335	0.0175	-7.622
standard deviation	0.0908	0.0280	3.242
Daily momentary outages: mean	-4.1869	0.4358	-9.608
standard deviation	1.9563	0.4059	4.819
Number of flickers per year, not daily: mean	-0.0410	0.0136	-3.007
standard deviation	0.0087	0.0852	0.102
Daily flickers: mean	-1.3235	0.1782	-7.427
standard deviation	0.7147	0.3119	2.291
Number of power surges per year: mean	-0.1512	0.0203	-7.444
standard deviation	0.1529	0.0260	5.880

5.3.2.1. Interpretation of the Model

Statistics regarding the distribution of willingness to pay to avoid momentary outages, flickers, and power surges are given in Table E12 as a share of bill and in Table E13 in dollars. Commercial customers are willing to pay a larger share of their bill to avoid these events than residential customers. The larger share, combined with the fact that commercial bills are generally larger than residential bills, translates into willingness to pay in dollars being larger for commercial customers than residential customers. This difference is consistent with the findings cited above regarding the reliability scenarios. Also, as discussed with respect to the reliability scenarios, the distribution of willingness to pay in dollars is highly skewed, with the mean being far greater than the median.

Other implications of the estimates are the same as for residential customers. First, the rank ordering of the events is the same. Power surges are considered more problematic than momentary outages, and momentary outages are considered worse than flickers. Second, adaptation to momentary outages and flickers is evidenced when these events occur daily. The coefficients for daily occurrence of these events are very large but are not 365 times larger than the coefficient for the number of these occurrences per year. Third, the willingness to pay to avoid a momentary outage is consistent with the willingness to pay figures that were evidenced in the reliability scenarios.

From table E9, the willingness to pay to avoid an outage is 7.77 percent of bill if the outage lasts two hours, 6.09 percent of bill for a one-hour outage, and 4.90 for a half-hour outage. From Table E13, the willingness to pay to avoid a momentary outage is 4.24, which continues the downward movement of willingness to pay as the length of the outage decreases.

Table E12: Commercial Customers' Willingness to Pay to Avoid Specified Events,
(per customer, per event, expressed as a share of the customer's current electricity bill)

	Mean	***Std Dev***	***25tile***	***Median***	***75tile***
Momentary outage	0.0424	0.0290	0.0225	0.0424	0.0622
Flicker	0.0131	0.0028	0.0112	0.0131	0.0149
Surge	0.0484	0.0487	0.0159	0.0484	0.0816

Table E13: Commercial Customers' Willingness to Pay to Avoid Specified Events,
(per customer, per event, in dollars)

	Mean	***Std Dev***	***25tile***	***Median***	***75tile***
Momentary outage	237.71	883.16	25.85	71.13	192.41
Flicker	72.88	225.71	12.32	24.04	55.52
Surge	269.58	1193.30	17.19	74.80	220.54

5.4. Customers' Preferences Not Covered in the Choice Experiments

5.4.1. Attitudes to Safety

The qualitative research indicated that customers were generally not concerned about the safety of overhead cables, and tended to assume, or even take for granted that electricity was provided to their premises in a safe manner.

In the recruitment survey, half of the residential respondents interviewed 'agreed' they 'had no concerns about the safety of overhead electricity powerlines'. While another 10 percent noted that this issue was 'not applicable' to them, 37 percent 'disagreed' with this statement (11 percent 'strongly'). It is notable that a third of residential respondents 'disagreed' with the statement.[62] However, the main study results do not provide further details on why some respondents may have concerns with overhead wires.

The results of the focus groups perhaps provide further insight. One group of participants in the focus groups, without dwelling on the matter, did comment that there was a sense of complacency in respect to overhead powerlines:

> "I think there is some complacency. That ad where the kid got electrocuted as he was trying to retrieve his frisbee from a tree was good (at keeping people aware)."[63]

This suggests that while customers may recognise that overhead wires have implications for safety, they perceive this as reason for caution rather than a safety issue that specifically needs to be addressed.

This reasoning is consistent with the conclusion from the qualitative research that safety is not a 'willingness to pay' issue for customers. This was based on the fact that, as mentioned previously, focus group participants signalled that they assume or take for granted that services were provided to them in a safe manner (as part of the standard level of service). Also, participants expressed a distinct unwillingness to pay for undergrounding or ABC when these options (together with corresponding prices) were discussed in the focus groups.

That said, a small number of residential respondents (14 percent) did suggest 'underground cabling' when asked what improvements could be made to the electricity service. While this may have been prompted by safety concerns, these suggestions are more likely to have been made by respondents for reasons relating to visual amenity or improved reliability attributable to undergrounding – as discussed further in the following section. This interpretation would be consistent with comments made in the focus groups.

Overall, on the issue of safety, the study results indicate that while some customers may recognise that overhead wires have implications for safety, they perceive this as reason for caution rather than a safety issue that specifically needs to be addressed.

5.4.2. Attitudes to Tree-Trimming

Just over a quarter of respondents (28 percent) responded in the recruitment interviews that 'keeping trees clear of powerlines was a problem for them'; 10 percent 'agreed strongly'. Nearly six in ten (58 percent) disagreed with this statement, with another 12 percent saying this statement was 'not applicable' to them. Those with overhead wires were significantly more likely to agree with the statement that 'keeping trees clear of powerlines was a

62 Total 'disagreement' was higher among households with overhead power (42 percent) compared households with underground power (26 percent).

63 For further details see ACNielsen's qualitative report at appendix L.

problem for them' compared to those with underground cabling. Around 37 percent of respondents with overhead cables agreed with the statement, while 57 percent disagreed and 3 percent noted that the statement was 'not applicable' to them.

While this may appear inconsistent with the findings of the qualitative research, it should be noted that in focus groups, participants were asked whether they would be willing to pay for measures that would reduce tree-trimming requirements. The question in the recruitment survey was not designed to raise the price trade-off with respondents.

The evidence from the focus groups was that while there were a few participants who noted that trees near powerlines was an issue, they did not express a willingness to pay for measures to address the issue. Neither aerial bundled cable ('ABC') nor undergrounding of cables was considered a solution to tree-trimming concerns. With respect to ABC, participants were concerned about the look and durability of the cable cover. The cable was perceived to be bulky and therefore visually prominent. Further, many believed cockatoos would readily 'chew' through the cover. They perceived that there would be an on-going maintenance cost associated with the cable (in respect to maintaining the cable cover) and, along with what was perceived as a very high installation cost, overall, the costs of ABC were considered to far out weigh any benefits:[64]

> "It is a lot of money and you are still going to have poles and wires."

In general, customers in the focus groups noted that they would prefer to have electricity cabling underground, although participants also made it very clear they were not prepared to pay the costs associated with laying underground the overhead cables located near their premises. Rather, a number of participants noted that underground cabling would be a consideration in deciding where they might next choose to live. For example many noted that they would consider moving to a newer Canberra suburb where the cabling was underground.

That said, as noted earlier, in the quantitative work, a small number of residential respondents (14 percent) did suggest 'underground cabling' when asked what improvements could be made to the electricity service. In fact, 22 percent of those with overhead powerlines, when asked what improvements to supply were required, said 'put cables underground'. The qualitative research indicates that respondents are likely to have made these suggestions for a combination of reasons including visual amenity and improved reliability reasons. The results therefore support the case for further analysis of the issue. One possibility would be to use the willingness to pay estimates to assess the merits of undergrounding (with respect to its reliability benefits).

It is also worth noting that in the recruitment survey four households out of every ten in overhead cabled areas perceived that 'keeping trees clear of powerlines was a problem for

[64] For further details see ACNielsen's Qualitative Report, at appendix L.

them'. Furthermore, those who said they had experienced '2 or more' instances of 'lights flickering or dimming' per annum were much more concerned about trees (35%) than those who had 'never' experienced such instances (19%). This is consistent with early findings in the study that poorly trimmed trees contribute to interruptions to the electricity service. Given customers' preference for reliability, the results suggest that ActewAGL should undertake further analysis of the impact of trees and trimming requirements on service reliability, as well as any network options which would help to address this.

5.4.3. Preferences for an ActewAGL Supplied Generator in the Event of a Disruption

In the recruitment interviews, about two thirds of businesses noted an interest in being supplied with a generator to keep vital equipment functioning by ActewAGL in the event of a 4 to 8 hour outage during business hours. Again, while this may appear inconsistent with the findings of the qualitative research, it should be noted that in focus groups, participants were asked whether they would be willing to pay for an ActewAGL supplied generator, while the recruitment survey did not raise the price trade-off with respondents.

6. WATER AND WASTEWATER ATTRIBUTES

6.1. Summary of Attributes

The following water attributes were chosen for the study:

- The frequency of service interruptions, expressed as ‘number of times water is unavailable’;
- The average duration of an interruption, expressed as ‘length of time that water is unavailable each time that it goes off’;
- The time of day that the water service is interrupted, expressed as ‘time of day that water is unavailable each time that it goes out’;
- Notification of an interruption (if any), expressed as ‘prior notification that water will be unavailable’;
- Information service provided during an interruption, expressed as ‘response to phone inquiries in the event of water becoming unavailable’;
- Aspects relating to water supply ‘security’, expressed in terms of water restrictions:
  - ‘chance that drought water restrictions will occur’;
  - ‘duration of water restrictions’;
  - ‘types of days that water restrictions apply’;
  - ‘level of water restrictions’;
  - ‘appearance of urban landscape including public lawns, parks and spaces’; and
- Price, expressed as ‘total water and sewerage bill for the year’.

The following wastewater attributes were also chosen for the study:

- The frequency of disruptions to the wastewater service, expressed as ‘number of times you experience an overflow of sewerage’;
- The coverage of the disruption, expressed as ‘source of overflow’;
- The average duration of a disruption, expressed as ‘length of time before overflow is contained’;
- Information service provided in the event of an overflow, expressed as ‘response to phone inquiries in the event of a sewerage overflow’; and
- Price, expressed as ‘total water and sewerage bill for the year’.

These were adopted for both residential and commercial customers, albeit with varying levels for each customer type, as discussed below. The choice of wording reflects terms that were most commonly used by participants in the customer focus groups, and also suggestions made by participants during the qualitative pilot of the choice experiments.

Given the large number of attributes identified for the study, the attributes were clustered into three groups – 'water reliability', and 'wastewater reliability' and 'restrictions' - before creating the choice experiments.

An entire list of water/wastewater attributes and their levels is contained in appendix N.

6.2. Service Reliability

6.2.1. Water Service Reliability

6.2.1.1. Frequency and Duration of Water Disruptions

The regulatory arrangements for water tend to focus on the ***time*** aspect of reliability, rather than the frequency of interruptions. The arrangements establish the following standards for the water service:

- a customer must not be without drinking water for more than 12 hours;
- planned interruptions to the water supply should not exceed 25 hours in total per annum; and
- a burst pipe should be attended to within 3 hours if it is causing damage to property, etc, or within 24 hours if it is not causing damage.

In addition, to complement these regulatory standards, ActewAGL has its own internal measures of service reliability, which it aims to meet each year. These measures have both time and frequency dimensions, and are:

- water main bursts should be attended to within 5 hours in 95 percent of cases; and
- there should be no more than 8 interruptions to water supplies per 100 properties each year (ie, a customer has no more than an 8 percent chance of being interrupted in any one year, and may experience an interruption once every 12-13 years).

The focus groups confirmed that supply reliability is important to customers. However, participants' main concern in respect to reliability tended to be the duration of ***each*** interruption, rather than the frequency of interruptions or total disruption time per year. This was driven by participants' concern for hygiene – such as the need for toilet flushing and washing. Most residential participants believed they could tolerate a disruption of between two and four hours (although the experience would be an inconvenience), and some business participants signalled that they could tolerate a disruption of between 1 and 2 hours. Some business participants however - particularly those in hospitality, tourism and entertainment sectors, along with irrigators - noted that their entire business would need to stop/close in the event of a disruption, regardless of the length of the interruption, suggesting that frequency of interruptions is also important.[65]

ActewAGL's response time to burst pipes, etc, was not of particular concern to participants. While participants generally acknowledged that these types of incidences were beyond ActewAGL control and noted that ActewAGL was 'very responsive' in such situations, the relevant imperative for participants was the length of time that services would be unavailable.[66]

The following attributes were therefore adopted for the study:

- the frequency of service interruptions, expressed as 'number of times water is unavailable'; and
- the duration of an interruption, expressed as 'length of time that water is unavailable each time that it goes off'.

With respect to the levels for these two attributes, for both residential and commercial segments:

- four levels were adopted for the 'frequency' attribute, varying from '12 times per year' to 'once every 10 years'; and
- six levels were adopted for the 'duration' attribute, varying from '24 hours' to '1 hour'.

These ranges were adopted as they incorporate existing and regulatory-required service levels, as well as potential levels of service that could be targeted in the future.

6.2.1.2. Timing of a Water Disruption

As for electricity, the time period in which a planned service disruption occurs was initially identified as a possible attribute. During our discussions with ACTEW and ActewAGL, it was suggested that ActewAGL has some scope for flexibility as to the timing of its planned maintenance, and that customers may have a preference as to the time in which they were interrupted. The latter was confirmed in the customer focus groups, and while regulatory arrangements do not specify or limit the time period in which service interruptions can occur, the attribute 'time of day that water is unavailable each time that it goes off' was included in the choice experiments.

[65] See page 45 of ACNielsen's qualitative report, at appendix L.

[66] See page 45 of ACNielsen's qualitative report.

Five levels were adopted for both residential and commercial customer segments, established according to the timing preferences signalled by participants in the customer focus groups. Each level was carefully worded to ensure that it made sense against each level for the 'duration' attribute. The levels chosen were 'over the weekend', 'over a weekday', 'Mon-Fri sometime after 6pm', 'Mon-Fri sometime after 8am', and 'Mon-Fri sometime after midnight'.

6.2.1.3. Notification of Water Disruption

As with electricity, notification prior to a planned interruption was found to be an important aspect of the standard of service.[67] Notification is also mandated in the regulatory arrangements governing service standards. The existing arrangements require ACTEW/ActewAGL to notify customers at least 2 days in advance of an interruption. In discussions with ACTEW/ActewAGL, it was suggested that the notification period could affect the flexibility and therefore efficiency of ActewAGL's maintenance crews. The smaller the notification period, the more flexible were the maintenance crews, thereby increasing their efficiency.

Notification was therefore included as an attribute, as with the other product segments, expressed as 'prior notification that water will be unavailable'. The following levels were adopted for the residential customer segment: 'no notification provided', '1 day', '2 days', '7 days', and 'two weeks'. The same levels were adopted for the commercial customer segment, with the addition of '5 days' and 'one month'. The choice of levels essentially follow the notification period in regulatory arrangements, plus or minus an increment, although 'one month' was included in the commercial customer segment given that a number of participants in the focus groups signalled a preference for this time period.

The level 'water unavailable due to emergency – no notification possible' was also included for both segments, to cover the possibility of no notification in the case of an unplanned outage (rather than due to the actions of ActewAGL). ActewAGL cannot know the timing of unplanned outages in advance, given that these are caused by events which are outside ActewAGL's control. The distinction between 'no notification provided' and 'no notification possible' was introduced, given that participants in the focus groups signalled that they viewed these two situations differently.

6.2.1.4. Information Provided During a Water Disruption

Regulatory arrangements require ActewAGL to maintain a 24-hour telephone service in the event of an unplanned service disruption. A finding of the focus groups suggested that up-to-date information is of value to customers. Participants in the focus groups noted that it would be helpful during an unplanned disruption for ACTEW-ActewAGL to have a recorded information line, as this would enable customers to directly and immediately

[67] See page 49 of ACNielsen's qualitative report, attached as appendix L.

access information about the extent of the disruption and the likely disruption duration.[68] Participants also commented that in the event of a disruption, they would like the option of speaking directly to a person, rather than a 'machine'. In addition, some commercial customers, for whom water was 'mission critical', noted a preference for access to a 'duty manager' or 'account manager' to keep them informed of the disruption.

On this basis, the attribute 'response to phone inquiries in the event of water becoming unavailable' was incorporated into the choice experiments, with the following levels:

- your call is answered by an AUTOMATIC VOICE - the voice gives you the option of hearing a recorded message that gives you an up-to-date status report on any water supply issues by suburb, or to speak to someone but you may be put on hold before a person answers;
- you get straight through to a PERSON - you are not put on hold and there is no machine directing you to press buttons; and
- the water company PERMANENTLY provides you with a SPECIAL phone number for a dedicated account manager who would handle your query - you are not put on hold and there is no machine directing you to press buttons.

The third level was only for the commercial customer segment.

6.2.2. Reliability of the Wastewater Service

Reliability of the wastewater service relates primarily to the frequency of incidents called sewer 'overflows' or 'surcharges'. These incidents occur due to pipe blockage or other capacity limitations, and involve raw sewage spilling out of drains, either in or at a customer's premise or out in the street. The regulatory arrangements require ActewAGL to respond to such events within 6 hours of being notified by a customer.

In the focus groups, a limited number of customers had ever experienced such an incident, and the discussion about overflows was somewhat limited. The discussion indicated however, that participants perceived such events as a matter for concern (for hygiene reasons), although they also viewed such events as largely outside the control of ACTEW/ActewAGL. Participants indicated that they'd prefer to avoid such events occurring and, in the event of an overflow, appreciated ActewAGL responding quickly to rectify the problem.[69] Participants suggested that an information service in the event of such an event would also be helpful.[70]

The following attributes were therefore adopted in the choice experiments:

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68 See page 48 of ACNielsen's qualitative report.

69 See page 45 of ACNielsen's qualitative report.

- the frequency of disruptions to the wastewater service, expressed as 'number of times you experience an overflow of sewage';
- the coverage of the disruption, expressed as 'source of overflow'; and
- the average duration of a disruption, expressed as 'length of time before overflow is contained'.
- information service provided in the event of an overflow, expressed as 'response to phone inquiries in the event of a sewage overflow'.

With respect to levels, for both the residential and commercial segments:

- three levels were chosen for the 'frequency' attribute, varying from '2 times per year' to 'once every 10 years' (an additional level 'once every 2 years' was included for the residential segment);
- three levels were chosen for the 'source' attribute', inside your home', 'immediately outside your home' and 'at the nearest sewer manhole in the street';
- seven levels were chosen for the 'duration' attribute, varying from '2 days' to '1 hour', and including '12 hours', '8 hours' and '4 hours'.

The levels for the 'information service' attribute were the same as those adopted for other product segments, ie:

- your call is answered by an AUTOMATIC VOICE - the voice gives you the option of hearing a recorded message that gives you an up-to-date status report on any water/wastewater supply issues by suburb, or to speak to someone but you may be put on hold before a person answers;
- you get straight through to a PERSON - you are not put on hold and there is no machine directing you to press buttons; and
- the water company PERMANENTLY provides you with a SPECIAL phone number for a dedicated account manager who would handle your query - you are not put on hold and there is no machine directing you to press buttons

The third level was only for the commercial customer segment.

6.3. Security of Supply

'Security of supply' was identified as a potential attribute for the study in phase one. The concept of supply security can be defined, in simple terms, as the probability of running out

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[70] See page 48 of ACNielsen's qualitative report.

of water at some defined future point in time.[71] The level of supply security adopted by a water utility is a key driver of its capital works program, including decisions about when to increase the capacity of existing water storages (such as building new dams), as well as its policies on the 'draw-down' of existing water storages. It will also affect water companies' use of demand management measures, such as the use of drought water restrictions, and/or alternative water sources for irrigation, such as effluent re-use or storm water.

At any point in time, a water utility can choose to augment the security of its future water supplies by either expanding its supply capability, or restricting customers from consuming as much water as they would prefer. Each of these actions imposes a cost on the community now, in return for a future benefit in the form of a reduction in the probability of a (more significant) future demand curtailment. Security of supply is therefore an integral (but often overlooked) feature of service standards for the water service.

We understand that ACTEW, in practice, manages the water supply capacity in the ACT to deliver a supply security of more than 95 percent reliability. From the customer's perspective, this means that water supply restrictions could be expected, at most, once every 20 years. When storage capacity reaches particular levels, a staged restriction process across the ACT is implemented to manage the remaining water supply in storage. The process comprises five stages of restrictions, defined separately for business and residential customers, and restrictions are implemented on an 'odds and evens' basis (ie, every other day).

These types of concepts and trade-offs were explained and discussed in the focus groups, revealing that security of supply was likely to be a willingness to pay issue for customers.[72] The following attributes, relating to water supply security, were therefore included in the choice experiments:

- 'chance that drought water restrictions will occur', with four levels comprising 'once per year', 'once every 3 years', 'once every 10 years', and 'virtually none';
- 'duration of water restrictions', with four levels: 'all year', 'all summer', '1 month in summer' and 'no restrictions';
- 'types of days that water restrictions apply', with three levels: 'every day', 'on alternate days', and 'no restrictions'; and
- 'level of water restrictions', with six levels incorporating the 5 stage restriction process adopted in the ACT. For the residential segment, the six levels adopted were:

[71] Alternatively, the more common concept for defining supply security incorporates the possibility of imposing some form of water restriction, rather than the probability of running out of water completely. In practice, security of supply is usually expressed in a form which establishes that a water system is designed to meet all demands in a normal year, with a risk of, say, 1 year in 10 of some defined level of demand restriction being imposed.

[72] See page 53-57 of ACNielsen's qualitative report, attached as appendix L.

- Stage 5 - a ban on all outdoor water use (recycling water is permitted);
- Stage 4 – watering of lawns is not permitted. Hand held hoses and buckets can be used in the morning and evening;
- Stage 3 – use of sprinklers is not permitted. Hand held hoses and buckets can be used in the morning and evening;
- Stage 2 - can use sprinklers for up to three hours in the morning and evening;
- Stage 1 – can use sprinklers morning and evening; and
- No restrictions.

Levels for the commercial segment were provided on a separate handout given to respondents. A copy of the handout is attached as part of appendix J.

For both residential and commercial customers, the descriptions of the water restriction stages included in the choice experiments reflect the existing water restriction stages utilised by ACTEW/ActewAGL.

One other attribute relating to security of supply - 'appearance of urban landscape including public lawns, parks and spaces' - was also included in the choice experiments, in recognition of the trade-off between not only price and supply security (defined in terms of water restrictions), but also the visual amenity of Canberra's urban landscape. Only two levels were adopted for this attribute: 'some brown lawns and no lush green lawns' and 'lush green lawns'.

6.4. Price

As explained previously, choice experiments must include price as one of the attributes to provide a basis for determining customers' willingness to pay for particular service options and therefore attributes/levels of the service. The critical question to be resolved, however, is how the price attribute should be expressed to ensure that it is meaningful to a survey respondent.

Similar to the findings reported for gas and electricity, the focus groups suggested that customers have little interest in the actual tariffs that they pay or the derivation of their bills. While both residential and business participants tended to be aware that there was an incremental pricing step for water, often referring to it as the 'excess water bill', participants generally did not know any specific details regarding pricing steps, other than a vague notion that at some point, pricing changed. Instead, participants viewed price in terms of the 'total amount payable'. Larger businesses tended to perceive this total amount in terms of annual spend, while, residential and small business customers, tended to refer to their 'last bill' or 'their bill this time last year' – suggesting that they perceive the amount paid in terms of their billing cycle.[73]

The project team recommended expressing price as a total annual amount in the choice experiments, rather than per bill, for both residential and commercial customer segments. The primary reason for this was to avoid problems associated with the seasonality of the billing cycle. This total annual amount was expressed in the experiments as the total water and sewerage bill, given that participants in the focus groups perceived these as being one bill. Moreover, to ensure that the price attribute was meaningful to the respondent in terms of its size, the price given in each choice experiment was tailored for each respondent by anchoring it to the respondent's estimate of her/his bill (provided at the time of recruitment). For multi-sited commercial customers, the bill estimate was for a single ACT site nominated by the respondent given that the pilot study indicated that multi-sited businesses found it difficult to think in 'aggregate' terms for their utility bills given that these are currently issued by ActewAGL on a 'per site' level.

6.5. Identified Attributes Not Included in the Choice Experiments

6.5.1. Supply Quality

A number of attributes relating to the ***quality*** of the water service were identified in phase one. Regulatory requirements, for example, require ActewAGL/ACTEW to treat drinking water to a quality in accordance with a national industry standard, which prescribes water content levels for fluoride, chlorine, lead, and other chemicals. Similarly, regulatory arrangements specify certain water pressure and flow rate requirements, which are to be maintained by ActewAGL. Odour from sewer vents was also identified by ActewAGL and/or ACTEW as a potential quality attribute for the wastewater service.

Customers' perceptions of water quality, fluoride, chlorine, water pressure, and odour from sewer vents were all consequently explored in the focus groups. For example, participants were asked about their perceptions and experiences of water quality (including its taste, colour, odour, and turbidity), and were prompted to determine whether they had noticed heavy chlorination or 'cloudiness' during summer. Business participants were also asked about the impacts, if any, that water quality had on their business operations. All participants were asked about their awareness and level of understanding of the supply quality commitments of their water provider, and to discuss how they perceive their water service provider to perform in respect to these commitments.

With the possible exception of chlorine (as discussed further below), however, both residential and business participants noted that they had few, if any, concerns with the

73 See page 58 of ACNielsen's qualitative report, attached as appendix L.

quality of Canberra's water.[74] Therefore, no quality attributes were adopted as part of the experiments. A number of general questions were, however, adopted in the recruitment questionnaires, in order to supplement the findings of the qualitative research.

6.5.1.1. Filtration of Water after Treatment

The filtration of water during treatment (and prior to transportation) - a potential quality improvement identified by ACTEW and ActewAGL - was also identified as a possible attribute in phase one.

The concept was explored in the focus groups in December 2002, as part of phase two. However, it resulted in little interest from customers. Participants already considered Canberra water to be of excellent quality, and in general, participants noted that they would prefer to filter their drinking water themselves. There was a feeling that much of the value in filtering the water at the dam treatment plant would be lost, once the water had flowed through the supply network to their homes.[75]

No attributes relating to filtration were therefore recommended for the study.

6.5.1.2. Chlorination

While the qualitative research identified that most Canberra residents are likely to have few, if any, concerns with the quality of their water, it also suggested that some Canberra residents may prefer less smell or taste of chlorine in their water.[76] This issue was raised by a couple of participants in the focus groups, and they suggested that they would indeed be willing to pay to reduce the chlorine smell and/or taste in the water supply.

On the basis of the qualitative work, the project team developed an attribute describing this characteristic of water, with the levels 'no change', 'less chorine smell and/or taste' and 'more chorine smell and/or taste', for inclusion in the choice experiments. This attribute was recommended to ACTEW/ActewAGL following the completion of phases one and two.

During the process of creating the choice experiments, however, it became evident that this 'water quality' attribute did not readily relate to any of the other attributes that were identified for the study (ie, those relating to 'reliability' and 'water restrictions'). For this reason we recommended moving the chlorination issue to the attitudinal section of the recruitment questionnaire, and proposed the addition of two questions:

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74 See page 50-51 of ACNielsen's qualitative report.

75 See page 61 of ACNielsen's qualitative report, attached as appendix L.

76 See page 50 of ACNielsen's qualitative report.

- Would you be willing to pay 1 percent[77] more on your total water bill to have slightly less chlorine smell or taste in your water?
- Would you be willing to accept slightly more chlorine smell or taste in your water for a 1 percent reduction in your total water bill?

These questions were included in the questionnaire that went to quantitative pilot. However, respondents in the pilot consistently stated that they were not willing to pay less/more to have more/less chlorine smell in the water. In fact, respondents seemed ambivalent about the question, suggesting that the chlorine smell/taste is not a significant willingness to pay issue for the majority of Canberra residents.

For this reason, the project team recommended the removal of these willingness to pay questions from the recruitment questionnaire. One question on chlorination was retained in the recruitment questionnaire, however. The question was designed to provide quantitative evidence of whether chlorine levels is of concern to Canberra residents.

6.5.2. Customer Service

In addition to specifying minimum requirements relating to customer notification and telephone services, the regulatory arrangements also set out minimum requirements for:

- promptness of new customer connections;
- method of notification prior to a planned outage;
- time to respond to a written query and/or complaint by a customer; and
- appointment windows, and timeliness of keeping appointments.

As with both electricity and gas, the findings from the focus groups suggested that, while these were all important aspects determining the perceived quality of a utility service, these were not aspects that participants were willing to pay for. These features of the service were either assumed or taken for granted by the participants.[78] These attributes were therefore not recommended for the choice experiments. Nevertheless, the recruitment surveys were designed to collect information about these aspects of service, including:

- customer preferences for particular appointment windows;
- expectations relating to ActewAGL's timeliness of keeping appointments; and

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[77] or 3 percent - two prices were recommended. Half of respondents would be asked whether they would be willing to pay 1 percent more and the other half would be asked whether they would be willing to pay 3 percent more.

[78] See page 59 of ACNielsen's qualitative report, attached as appendix L.

- attitudes to ActewAGL's current performance in relation to response times, and handling of calls to the call centre.

6.5.3. 'Re-use'

In phase one, ACTEW, ActewAGL and the ICRC identified 're-use' as a potential area of interest for the study. ACTEW/ActewAGL suggested that it would like to know more about customers' attitudes to the re-use (or the recycling) of water, and in particular:

- whether customers would be willing to use re-cycled water on their garden and/or for drinking purposes;
- whether customers understood that increasing the use of recycled water could impact on downstream river flows and/or the cost of treating any remaining wastewater/solids at the Lower Molonglo sewerage treatment plant;
- whether customers would be willing to fund the development of a recycling scheme – such as using water from the sewerage treatment plant on public parks and gardens; and
- whether customers would consider a 'co-operative approach' to the treatment of sewerage (ie, local treatment plants treating and distributing recycled water on private gardens)?

Given the generic nature of these questions and the information sought by ACTEW/ActewAGL, the project team recommended excluding 're-use' from the choice experiments. Instead, the project team recommended that the topic be covered in the attitudinal section of the recruitment questionnaire. We suggested that specific questions - such as those identified by ACTEW/ActewAGL - could be asked in the recruitment questionnaire, covering both customers' general attitudes to re-use as well as any willingness to pay issues.

ACTEW/ActewAGL signalled that it was reluctant to adopt this suggestion, and requested the project team to further consider the treatment of re-use. Two options were identified:

i. incorporate an additional attribute in the existing choice sets capturing the 'grade' of water available for use on gardens, the levels being 'standard drinking water' and 'recycled water'; or

ii. create an additional set of attributes representing all of the implications of making re-use available to customers – including its impact on the quality of water, its implications for the frequency of water restrictions, its impacts on the urban environment, and its environmental impacts (including the environmental implications of deferring a new dam).

ACTEW/ActewAGL subsequently agreed with the project team to dismiss both options.

The first option oversimplifies the issue of re-use. It expresses re-use simply as a lower grade of water, without articulating the wider implications of its use to respondents. Structuring the question in this way would simply determine whether customers were willing to pay more or less for recycled water compared to standard mains water, which is only part of the information that ACTEW/ActewAGL sought to obtain.[79]

The more relevant question is whether customers are willing to use re-cycled water, compared to standards mains water, in order to avoid more frequent/deeper water restrictions or constructing a new dam (and any associated environmental impacts). To elicit this information from the choice experiments, these latter aspects must be in the choice experiments.

The second option identified would do exactly this. It would involve adding a number of additional attributes so that the choice experiments articulate to respondents all of the consequences of choosing to use (or not to use) recycled water. For example, an attribute that describes how the necessary water is obtained could be added, with levels being: (1) no new restrictions or dams, (2) new restrictions (with number, length etc specified), and (3) new dams (specifying the number and location). Each of these levels would need to be stated very specifically – that is, exactly what the new restrictions would involve (number, length, depth, etc) and what the new dams would be (number, location, environmental impact, etc). Without these descriptions, the respondent cannot make a meaningful choice,[80] and the respondent will inevitably envision their own scenarios as to what "new dam" or "restrictions" actually mean. Without specifying these precisely, the survey results would not be able to explain what the estimated willingness to pay is for.

ACTEW/ActewAGL, however, were at the time only in the early development stages of considering recycling options. The information required to properly specify the attributes/levels was therefore not available for the study. The project team therefore recommended that re-use should be handled in the attitudinal section of the questionnaire.

The recruitment questionnaire was designed to elicit the following information:

- are customers willing to use recycled water supplied by ACTEW on their garden?

79 In any event, the qualitative research provides ACTEW/ActewAGL with information on this. The qualitative research suggested that customers would be willing to use recycled water, although their expectation was that recycled water would be offered at a discounted price compared to mains water (see pages 53-57 of the ACNielsen qualitative report).

80 For example, consider a choice between Option A: recycled water with a $100 per annum charge and no restrictions or new dams, versus Option B: no water recycling and no per annum charge but more frequent restrictions on use. To make this choice, the person needs to know what the restrictions will be. If the restrictions are negligible, then the person is unlikely to choose to pay $100 to avoid them, but if the restrictions are very severe, then the person might be willing to pay. The answer depends entirely on the type of restrictions that will occur. Similarly, if the choice is against extra dams, the respondent needs to know how many, and where they are

- are customers willing to use recycled water on their garden if the water came from an ACTEW recycling plant located ***in*** their neighbourhood?
- are customers willing to use recycled water on their garden if the water came from an ACTEW recycling plant located ***remotely*** from their neighbourhood?
- are customers willing to use recycled water on their garden if they had to pay an upfront fee of between $50 and $250 per annum for 5 years?
- are customers willing to use recycled water for drinking purposes?
- are customers willing to fund the development of a scheme involving the use of recycled water on only public parks and sports grounds to ensure that Canberra's public parks and sports grounds would be lush and green for public use even during drought times.

located (eg, whether they are located in environmentally sensitive areas). A meaningful choice cannot be made without this information.

7. SURVEY RESULTS FOR WATER AND WASTEWATER

7.1. Overview

7.1.1. Preferences for Reliability, Quality and Customer Service

The results indicate that reliability of the water and wastewater service is of value to both residential and commercial customers. Both frequency and the length of disruptions are important, such that customers are willing to pay to reduce the frequency and the duration of water interruptions and wastewater overflows.

Residential customers' willingness to pay to avoid a water interruption depends on the number of interruptions that the customer faces per year. For a residential customer, the average willingness to pay to reduce the number of interruptions from 2 per year to 1 per year is $41.51 (5.4 percent of their water and sewerage bill), while the willingness to pay to reduce the number of interruptions from 12 per year (monthly) to 11 per year is only $9.58 (1.25 percent of their water and sewerage bill). There are two reasons for this difference. First, if customers faced more frequent interruptions, they are more likely to adapt by taking actions to reduce their impact, such as storing water. Second, from a psychological perspective, a reduction from 12 to 11 seems less important than a reduction from 2 to 1.

Residential customers' willingness to pay to reduce the length of a water interruption also depends on the length of the interruption that respondents face, which again indicates that they are willing and able to adapt. For example, reducing the outage length from 2 hours to 1 hour is worth 4.82 percent of the annual water and sewerage bill or $36.50 to an average residential customer) while reducing the length from 24 hours to 23 hours is worth only $4.38 (or 0.58 percent of their annual water and sewerage bill).

The willingness to pay expressed by commercial customers either to avoid a water interruption or to reduce its length is not related to the frequency or length of interruptions. This suggests that, unlike householders, commercial customers are not able to adapt to the length or frequency of water interruptions. The average willingness to pay of a commercial customer to avoid a water interruption is 4.37 percent of their annual water and sewerage bill, or $207. Their average willingness to pay to reduce the length of an interruption by 1 hour is 2.25 percent of their annual water and sewerage bill or $106.

Table 7.1: Average Willingness to Pay to Avoid a Water Interruption
(per customer, per event, in dollars)

Event	***Residential***	***Commercial***
When the water interruption occurs once every ten years	113[81] (15%)	207 (4%)
When the water interruption occurs once a year	62 (8%)	207 (4%)
When the water interruption occurs monthly	10 (1%)	207 (4%)

Table 7.2: Average Willingness to Pay to Reduce the Length of a Water Interruption
(per customer, per event, in dollars)

Event	***Residential***	***Commercial***
From two to one hours	36 (5%)	106 (2%)
From 5 to 4 hours	18 (2%)	106 (2%)
From 12 to 11 hours	8 (1%)	106 (2%)

With respect to the timing of an interruption, if they are to occur at all, residential customers expressed a strong preference to have water interruptions during weekdays rather than on weekends, and the later in the day on weekdays, the better. Commercial customers prefer having interruptions on weekends and after normal business hours on a weekday to having them during normal business hours.

The willingness to pay estimates also indicate that customers, particularly commercial customers, greatly value having notice of an interruption when the interruption is planned. Customers are however forgiving of not receiving notice if the interruption was due to an emergency.

The period of notice is important, but not critical. Residential customers slightly prefer one week's notice, and commercial customers slightly prefer two week's notice to any more or less notice. In the qualitative research, residential customers expressed a preference for receiving notice of a water interruption by either mail or letter box drop, and commercial customers by mail or fax.

'All day' was considered an acceptable appointment window to access their property (to carry out planned maintenance work) by most respondents (70 percent of residential, and 63 percent of businesses) in the recruitment interviews. A further one quarter (26 percent) thought a 'morning/evening' window to be acceptable. Of those stipulating a

81 This means that, on average, a residential customer would be willing to pay $11.30 ***per annum*** to avoid water interruptions that occur once every 10 years (ie, $113/10).

'morning/afternoon' window, almost all considered some amount of lateness to be acceptable, although the extent of the lateness varied widely.

Customers expressed the greatest willingness to pay to avoid wastewater overflows than any other disruption event, including water or electricity interruptions. Customers' willingness to pay to avoid an overflow is dependent on the frequency of overflows. For example, if an overflow is expected once every 10 years, then householders' average willingness to pay to avoid that overflow completely would be $212 (or 28 percent of their annual water and sewerage bill), while it would be worth on average $2023 (or 42 percent of their annual water and sewerage bill) to businesses to avoid the overflow. The more frequently overflows occur, the greater is customers' willingness to pay, each year, to avoid an overflow.

Customers' willingness to pay to reduce the length of an overflow is similarly dependent on the expected length of the overflow. The longer the overflow is expected to last, the lesser amount a customer is willing to pay to reduce its length by an hour. Willingness to pay figures are summarised in the following tables.

Table 7.3: Average Willingness to Pay to Avoid a Wastewater Overflow
(per customer, per event, in dollars)[82]

Event	*Residential*	*Commercial*
When the overflow occurs once every 10 years	212 (28%)	2023 (42%)
When the overflow occurs once a year	116 (15%)	1113 (23%)

Table 7.4: Average Willingness to Pay to Reduce the Length of an Overflow
(per customer, per event, in dollars)

Event	*Residential*	*Commercial*
From 2 to 1 hours	62 (8%)	499 (10.5%)
From 4 to 3 hours	38 (5%)	299 (6%)
From 12 to 11 hours	14 (2%)	115 (2%)

As expected, overflows inside the house/business premise are considered much more problematic than overflows on the street. Overflows that are outside but nearby the house or a business' premise are also considered worse than overflows on the street. On average,

82 Note that these figures imply that ***each*** year, on average, a residential customer is willing to pay $21.20 to avoid a 10 year wastewater overflow event (ie, $212/10), and $116 to avoid an annual overflow event (ie, $116/1). Similarly, a commercial customer would be, on average, willing to pay $202.30 each year to avoid a 10 year overflow event, and $1113 each year to avoid an annual overflow.

an overflow inside the house is four times worse than an overflow nearby outside, relative to on the street.

In the event of a service disruption, and particularly in the event of a wastewater overflow, both commercial and residential customers expressed a strong preference for having a person answer the phone when they call to make an inquiry of the water utility. For commercial customers, having an account manager handle their query is less preferred to simply having someone answer the phone.

7.1.2. Implications for Existing Levels of Reliability/Customer Service

With respect to the implications of these results for the future priorities of ActewAGL's operations, given that the merits of changing service standards depend not only on customers' willingness to pay but also on cost, we recommend that ActewAGL develop a range of specific network options for assessment. The willingness to pay estimates can be used to calculate the benefit derived by customers for each network option, and so each option can be evaluated by comparing its cost against its benefits. The results of such analysis can be used to help formulate future operations strategy.

It is also possible however to derive customers' preferences for particular levels of service compared to others by using the willingness to pay results and a range of 'hypothetical' service scenarios (including price). The study results[83] can be used to calculate the relative satisfaction (or utility) that customers derive from each 'hypothetical' service scenario. The scenarios can therefore be ranked (according to their respective resulting utilities), and the scenario most preferred by customers can be determined. It is also possible to use such analysis to calculate the amounts of monetary compensation that customers would require to accept their less preferred service scenarios.[84]

An example adopting a broad cross section of hypothetical service scenarios is provided below. It indicates that customers value (that is, are willing to pay for) the current levels of reliability provided by ActewAGL/ACTEW, and may even be willing to pay for higher levels of service.

Figures 7.1 and 7.2, over the page, illustrate the relative satisfaction (or utility) that residential customers derive from a number of different service scenarios. The existing level of reliability is compared to four different scenarios: two scenarios offering an increased level of service (together with a higher price), and two scenarios offering a decreased level of reliability (together with a lower price). The utility derived from each service scenario has

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83 That is, the coefficients of the choice models.

84 That is, the amount of monetary compensation (or discount in price) that they would require to ensure that their utility remains unchanged.

been calculated using the study results. For ease of presentation,[85] the utility derived from existing service levels is assigned a value of one, and the utilities derived from the other hypothetical service levels are recalibrated around this. The higher the number, the greater the level of customer satisfaction (or utility) derived from the service scenario.

In all cases, a degraded level of service (in return for a discount in price) is less preferred to existing service levels (at the current level of price). Consider the water reliability scenarios, for example. The utility derived from the existing level of reliability is one.[86] This compares with a utility of only 0.945 if the level of reliability was decreased by a factor of two,[87] in return for a discount of 3 percent in price. As it generates a lower level of customer utility, the service scenario is less preferred to the existing level of service.

In all cases, however, an increase in reliability (in combination with an increase in price) is more preferred than existing service levels. Consider the wastewater reliability scenarios. As before, the utility derived from existing service levels is one.[88] However, the utility derived from a service with half the number and length of interruptions compared to now,[89] together with a corresponding increase in price of 3 percent, is higher at 1.059. This level of service, together with its hypothetical price, is therefore more preferred by customers than the existing service (at the current price).

As noted earlier, it is also possible to use this analysis to calculate the amounts of monetary compensation (or price discount) that customers would require to accept their less preferred service scenarios.[90] In relation to a degraded level of service, the analysis shows that customers would require significant compensation if reliability levels were to fall. For example, residential customers would require, on average:

- a reduction of 13 percent on their total combined annual water and sewerage bill to compensate for a doubling in both the frequency and duration of water interruptions;[91] and

85 Given that it is relative (rather than absolute) utility that is important in the analysis, calibration to alternative values has no impact on the results.

86 The analysis assumes that the current frequency of interruptions is once every 10 years, the average duration of an interruption is 1.5 hours, interruptions occur on weekdays after 8am, 2 days notice is provided to customers, and the customer has access to a recorded message giving them information about the interruption.

87 That is, the frequency of interruptions changes from once every 10 years to once every 5 years, and the average duration of an interruption increases from 1.5 hours to 3 hours. The timing of interruptions and prior notification is assumed to remain unchanged.

88 The analysis assumes that overflows occur once every 10 years, and on average take 2 hours to fix.

89 That is, increasing the frequency of overflows from once every 10 years to once every 5 years, and increasing the average duration of an overflow from 2 hours to 4 hours.

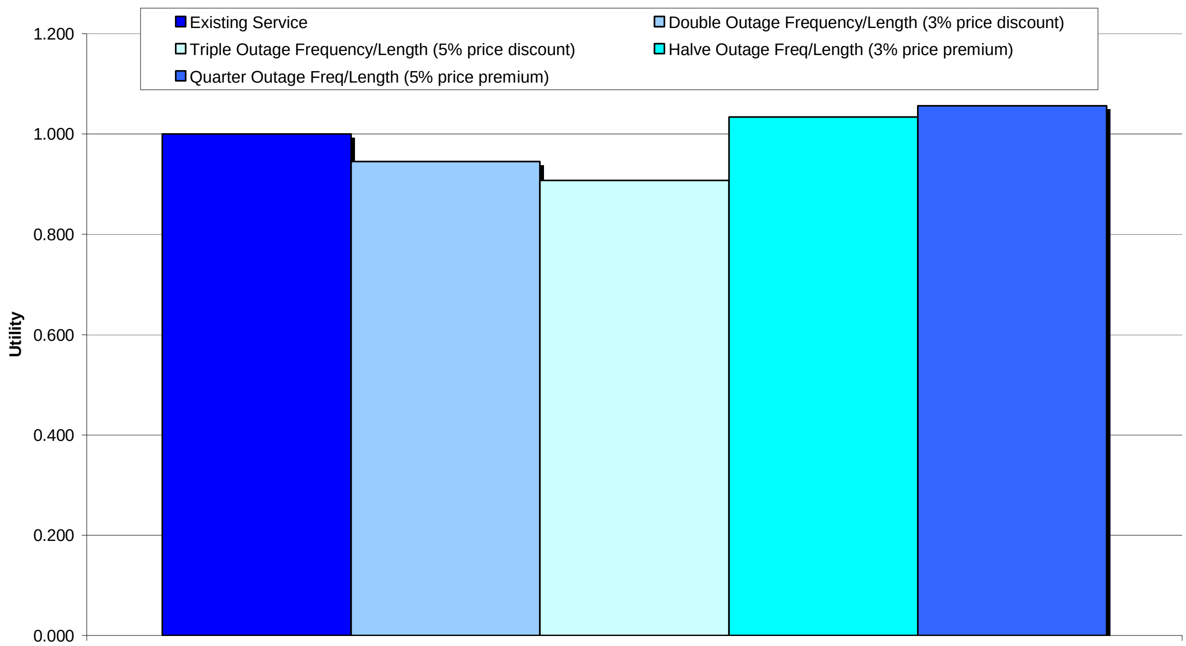
90 That is, the amount of monetary compensation (or discount in price) that they would require to ensure that their utility remains unchanged.

91 That is, increasing the frequency of interruptions from once every 10 years to once every 5 years, and increasing the average duration of an interruption from 1.5 hours to 3 hours.

- a reduction of 15 percent on their combined annual water and sewerage bill to compensate for a doubling in both the frequency and duration of wastewater overflows.[92]

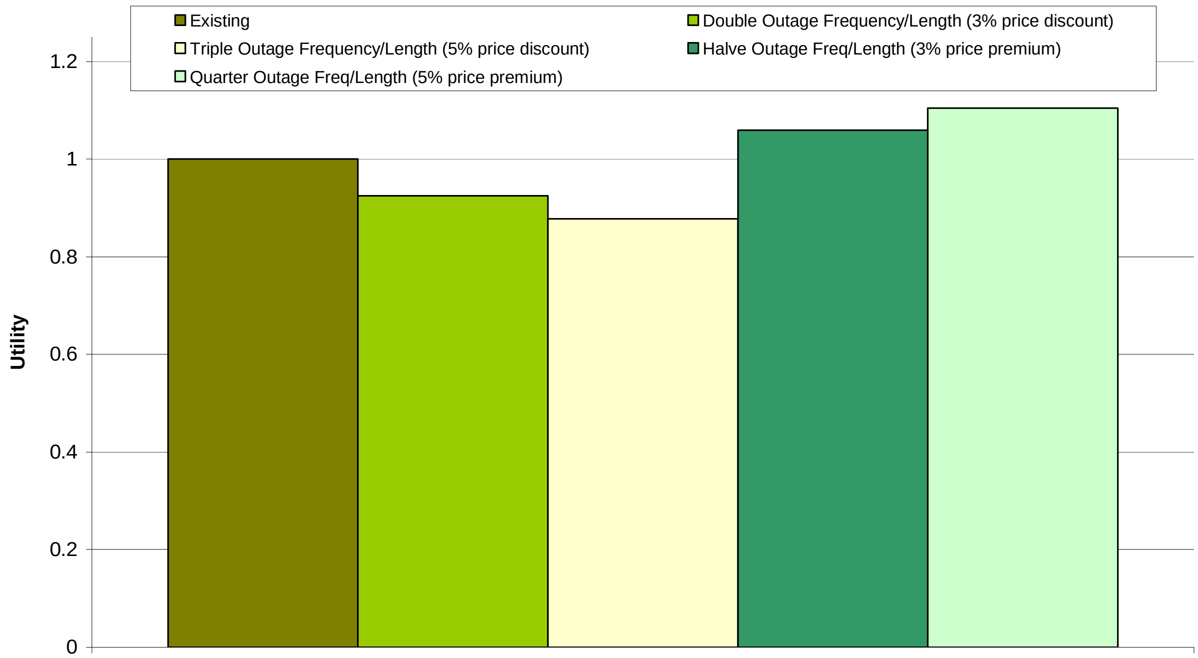
Overall, the study results therefore suggest that customers would not prefer a lesser quality of reliability in return for a discount in price. Customers are willing to pay for existing reliability levels, and may indeed be willing to pay for higher levels of service. This is consistent with the qualitative research findings, which suggested that customers' lifestyles and business operations are integrally based on the current levels of utility service reliability and any change would have a fundamental impact.

Figure 7.1: Householders' Ranking of Water Reliability Scenarios



92 That is, increasing the frequency of interruptions from once every 10 years to once every 5 years, and increasing the average duration of an interruption from 2 hours to 4 hours.

Figure 7.2: Householders' Rankings of Wastewater Reliability Scenarios



7.1.3. Water Restrictions and Supply Security

Customers evidenced a willingness to pay to avoid severe water restrictions. The point estimates imply that residential customers are willing to pay 31 percent of their water and sewerage bill, or $237 on average, to avoid a situation where stage 3 or higher restrictions are applied every day all year. Commercial respondents expressed a willingness to pay of 23 percent of their current water and sewerage bill to avoid these types of severe restrictions. Given commercial respondents' bills, this share translates into an average willingness to pay of $1104 and a median willingness to pay of $239. Similar median willingness to pay estimates between commercial and residential customers suggests that they are almost equally concerned about water restrictions.

Customers evidenced an unwillingness to pay to avoid less severe types of water restrictions, which were stage 1 or 2 level restrictions, in place at any time, and stage 3, 4 or 5 level restrictions, in place every other day or for part of the year. These results indicate that customers would prefer to adjust their watering schedules to non-restricted days, compared to paying a higher water bill to avoid stages 3-5 restrictions, in place every other day. Similarly, customers would also prefer to tolerate stage 3-5 restrictions for a period of a month (or even over the summer) each year, compared to paying a higher water bill.

In the main study, customers also indicated an unwillingness to pay to avoid brown lawns in public areas, suggesting that customers find having brown lawns occasionally, in drought conditions, acceptable.

Several points are important to consider when interpreting the results of this analysis for the purpose of planning and investment. First, if or when stage 3-5 restrictions are required, it is likely that they will be applied every day rather than every other day. The issue of customers' willingness to pay for stage 3-5 restrictions that apply every other day is therefore irrelevant from a planning perspective. Second, the choice experiments included only three lengths for the restrictions: one month, all summer, and all year. Interpolation of the results to other lengths is a matter of interpretation, beyond the actual data obtained in the study. For example, customers might be willing to pay to avoid stage 3-5 restrictions that last, say, 10 months, but since that length was not examined in the study, no conclusions can be drawn with regard to this length (beyond the necessary implication that the willingness to pay is no more than that for restrictions that last all year.) Third, in the experiments, the length of the restrictions was stated to the respondent, such that the respondent knew how long the restrictions would last when evaluating them. In practice, water restrictions have been, and probably will be in the future, imposed without a specified ending date. That is, the length of the restriction is not known beforehand, only after the restrictions have been lifted. It is possible that customers react differently to restrictions whose length is not known beforehand than to restrictions of a known length.

Despite these caveats, the findings from the main study are consistent with the findings of the project team's initial qualitative research, which suggested that more severe restrictions were an inconvenience to customers.

In the focus groups, residential participants indicated that they could 'live with' regular restrictions provided that they did not exceed stage three.[93] Customers did not perceive this as lowering water supply service standards. Rather, restrictions were perceived as the 'smart and sensible' way of doing things, and a way of reinforcing good (non-wasteful) behaviour. In this context, restrictions were perceived as actually saving customers money by the fact that it means that customers will not use (or pay for) water unnecessarily. Most participants also seemed to view restrictions as though they were a bit of a novelty and something that could be enjoyed:

> "Its good to get outside at that time of the evening anyway [referring to level 3 restriction watering time]. If you have to get outside every night to water, so be it."

However, some participants in the focus groups foresaw that living with water restrictions would soon become a difficult chore. These participants often qualified the initial 'acceptance' of water restrictions by stating that you would not want to endure restrictions for a long period of time (between six and eight weeks of restrictions was noted as the desired maximum restriction period by these participants).

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93 It is important to emphasise that at the time of the focus groups, participants were generally only familiar with the experience of abiding by 'voluntary restrictions'.

Overall, the study findings indicate that customers do not derive value from the avoidance of regular, less severe water restrictions (stage one or two), or irregular, more severe restrictions (stage three or higher). There are two potential reasons for this. First, any loss of customer satisfaction (or utility) attributable to a forced reduction in water consumption (and associated inconvenience) may be offset by an increase in utility attributable to some 'novelty' factor inherent in having water restrictions in place (eg, a 'feel good' factor about using water 'responsibly'). Alternatively, customers may not be willing to avoid these types of restrictions because the restrictions are unlikely to result in any reduced water consumption (and therefore inconvenience). While the study cannot explain which of these scenarios is most likely to be the case, the results do suggest that the existing water supply security standards warrant further consideration.

A summary of customers' average willingness to pay to avoid water restrictions (compared to water interruptions and wastewater overflows) is set out in the table below.

Table 7.5: Average Willingness to Pay to Avoid Events
(per customer, per event, in dollars)

Event	***Residential***	***Commercial***
Water restrictions that last all year, every day, stage 3-5	237 (31%)	1104 (23%)
All other water restrictions	0	0
Water outage when it occurs once every ten years	113[94] (15%)	207 (4%)
Wastewater overflow when it occurs once every ten years	212 (28%)	2023 (42%)

7.1.4. Water Re-use/Recycling

On the issue of re-cycled water, almost all households (96 percent) and businesses (91 percent) noted their willingness to use recycled water (for the garden among householders and for irrigation and industrial purposes among businesses) in the recruitment interviews. There was variation in customers' willingness to pay to establish a recycling scheme, depending on the type of recycling scheme – as discussed further in section 7.4.1. Results also suggest that customers are not prepared to use recycled water for drinking, and their willingness to support particular schemes is not strongly related to the location of the recycling plant (eg, near their home versus located remotely). Interestingly, the qualitative research indicated that customers consider recycling attractive, not necessarily for environmental reasons, but for the fact that it is seen as less costly and more efficient.

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94 This means that, on average, a residential customer would be willing to pay $11.30 ***per annum*** to avoid water interruptions that occur once every 10 years (ie, $113/10).

7.1.5. Customers' Perceptions and Ratings of Existing Services and ACTEW/ActewAGL

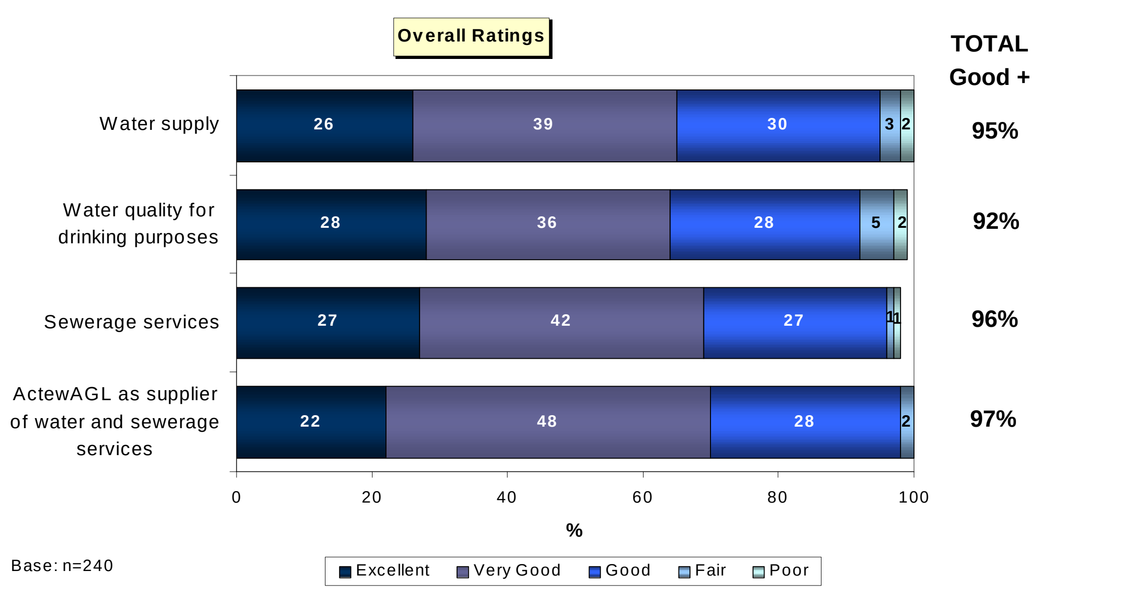
In the initial recruitment interviews, the water and wastewater services in the ACT were rated very highly, with almost all respondents (residential and commercial) giving a rating of 'good' or better – 'good' or better ratings were provided by at least 90 percent of respondents, and the level of 'poor' ratings was extremely low at no more than 3 percent.

The majority of both householders and businesses noted that they had 'never' experienced any form of disruption to their water or waster water supply/service, nor had water pressure issues:

- among householders 52 percent had never experienced a supply cut-off and about two thirds had not experienced a sewer overflow (68 percent) or water pressure problems (63 percent). Of those with water pressure problems, the dominant issue was 'low' water pressure (experienced by 90 percent of those with pressure problems);
- among businesses two thirds had never had a supply cut-off, about 7 in 10 (73 percent) had never had a sewer overflow or water quality problems (70 percent), and 81 percent had 'never' had water pressure issues.

Overall, the water supply network was believed to be 'maintained in good working order' by almost all respondents, with about 9 in 10 households and businesses 'agreeing' with this statement.

Figure 7.3: Respondents' Ratings of Services and ActewAGL/ACTEW



O1. Firstly, overall how would you rate the water supply to the home in which you liveas currently delivered by ACTEW? (SINGLE RESPONSE)
O3. And overall how would you rate the quality of the water supplied to your home for drinking purposes as currently delivered by ACTEW? (SINGLE)
O5. And now what about sewerage services, this means taking sink water and sewerage away from your home, and treating it. Overall, how would you rate the sewerage service for the home in which you live? Would you say it was…..(SINGLE RESPONSE)
O7. And overall how would you rate ActewAGL as the supplier of water and sewerage services to the home in which you live? (SINGLE RESPONSE)

Ratings of ACTEW/ActewAGL as a supplier of water and wastewater services were also very high with almost all respondents (residential and commercial) giving a rating of 'good' or better. 'Poor' ratings were extremely low at less than 3 percent.

Agreement was also high with the statement that 'ActewAGL is very responsive in the event of a disruption to the water supply' with 63 percent of households and 70 percent of businesses agreeing; these results are in fact more favourable than they first appear as around 2 in 10 households and businesses responded with a 'don't know' to this statement arguably reflecting the low level of disruptions experienced. This low level of exposure to disruptions was also arguably behind the even higher level of 'don't know' responses (around one quarter of households and businesses) in relation to the statement 'ActewAGL is very responsive in the event of a disruption to the sewerage service'; here 53 percent and 60 percent of households and businesses respectively agreed with this statement.

Further details of the choice modelling results are set out below, along with selected results of the recruitment survey. More detailed results from the recruitment survey can be found at appendix T.

7.2. Residential Customers' Willingness to Pay

7.2.1. Willingness to Pay for Reliability of the Water Service

Residential respondents were presented with choices between water reliability scenarios, as described in section 3.4. Table W1 gives the model that was estimated on these choices. The form of this model is similar to that developed for other segments, and is described in appendix R. For each choice situation, the model relates the choice of the respondent to the attributes of the two scenarios that were presented to the respondent. The variables of the model reflect the impact of each attribute on the respondents' choices.

The specification of variables that enter in the model was determined through extensive testing of alternative specifications. Unless otherwise noted, only variables that enter significantly are included in the models. Similarly, non-linearities in variables and interactions among variables are included only to the extent that they were found to be significant.

The impact of attributes on customers is often quite different for different customers. The model structure is capable of handling these differences, as noted in appendix R. In particular, coefficients in the model can be allowed to vary over customers, if such variance is found to be important. Instead of estimating one coefficient that applies to all customers, the coefficient can be specified to be normally distributed in the population. The mean and standard deviation of the distribution are estimated. Tests were performed for whether each coefficient varies significantly over customers. If the variance of the coefficient was found to be significantly different from zero, then a distribution is estimated for the coefficient; that is the mean and standard deviation are estimated. Any coefficient whose variance is not significant was specified to be the same for all customers, ie, is fixed for all customers rather than varying over customers. Note of course that a fixed coefficient does not imply that all respondents actually have the same coefficient but rather that the differences across respondents are not sufficiently strong to be identified by the data.

The t-statistics in table W1 are very high, as with other models in the study, indicating that respondents were indeed taking each attribute into consideration and choosing thoughtfully among the scenarios. As noted earlier, the t-statistic is a measure of confidence, indicating how well each variable relates to customers' choices/preferences. A higher t-statistic indicates a higher degree of confidence. A t-statistic of 2 indicates that the coefficient is significantly different from zero at the 95 percent confidence level.[95] That is, we can be 95 percent sure that the variable actually affects customers' choices. A t-statistic of 3.5 indicates 99.96 percent confidence (an upper limit often quoted in statistical tables). The t-statistics for many of the coefficients in table W1 are far in excess of 2 and even 3.5. For example, the t-statistics on the price coefficient is over 7 and the mean coefficients for the number and length of outages are in excess of 8. This means that we can be nearly absolutely sure that these variables affect customers' choices.

Table W1: Model of Residential Customers' Choice Among Water Reliability Scenarios

Variables	***Estimates***	***Std. Err.***	***T-stat.***
Price as share of current bill	-5.6504	0.7753	-7.288
ln(1+number of outages): mean	-0.9279	0.1108	-8.377
standard deviation	0.7211	0.1369	5.269
ln(1+length in hours): mean	-0.8153	0.0984	-8.281
standard deviation	0.2943	0.1973	1.491
M-F after 8am	0.3751	0.1853	2.025
M-F after 6pm	0.5394	0.1922	2.807
M-F after midnight	0.8156	0.1955	4.172
Weekdays	0.3689	0.2504	1.473
Any weekday time: standard deviation	0.9757	0.2739	3.562
1 day's notice	1.0730	0.2165	4.955
2 day's notice	1.0561	0.2174	4.858
7 day's notice	1.0327	0.2171	4.756
Two week's notice	0.8632	0.2212	3.903
Any notice: standard deviation	0.9431	0.2742	3.439
Emergency	0.6686	0.2033	3.290
Person answers: mean	0.2632	0.1197	2.198
standard deviation	0.6185	0.7753	2.301

"Price" is the combined annual water and sewerage bill that the customer would receive under the scenario. The estimated coefficient of price is negative, indicating that, if the price

95 A t-statistic over 1.96 indicates that the impact is significant at the 95% confidence level, and a t-statistic over 1.0 indicates significance at the 70% confidence level.

of a scenario rises and none of the levels of the other attributes changes, respondents like the scenario less. Stated differently, raising the price of a scenario reduces the chance that a respondent will choose it, holding all other levels of the other attributes in the scenario constant.

In this, as in other models in the study, price is entered as a share of the respondents' current bill. For example, suppose the price of a scenario is $900, and the respondents' current annual bill is $1000; in this case, the price of the scenario as a share of the customers' bill is 0.9. Various ways of entering the price of the scenario were tested, including price alone, non-linear transformations of price, and price as a share of current bill. The best fit to the data was obtained with price as a share of bill. This specification implies that a $100 bill reduction to a respondent whose annual bill is currently $1000 has the same effect on the respondents' choices as a $80 bill reduction to a respondent whose annual bill is $800, since both constitute a 10 percent reduction.

7.2.1.1. Interpretation of the Model

7.2.1.1.1. Outage Frequency and Duration

The frequency and length of outages both enter in log form, which fit the data better than entering these variables linearly (ie, without the log transformation). This result suggests that households adapt somewhat to both the length and number of water outages.

As noted earlier in the report, the amount that respondents have evidenced, through their choices, that they are willing to pay to reduce the number of outages each year can be estimated using the coefficients of the choice model. Intuitively, the willingness to pay for any attribute is the coefficient of that attribute divided by the price coefficient (the coefficient of the attribute gives the importance of that attribute in respondents' choices; the price coefficient gives the importance of price in their choices; and the ratio of the two gives the importance of the attribute relative to price, that is, the value of the attribute denominated in dollars).[96] Tables W2 and W3 give statistics for the amount that respondents evidenced that they are willing to pay to avoid outages, as a share of bill and in dollars.

To illustrate the procedure for calculating willingness to pay, consider table W3. The table gives $41.51 as the residential customers' average willingness to pay to avoid a water outage, assuming outages normally occur twice a year. This figure is based on the estimated coefficients from table W1. In this model, the number of outages enters in log form, and the average coefficient of number of outages is: -0.9279/(1+number of outages). The price coefficient is –5.6504, where price is expressed as a share of current bill. The willingness to pay is therefore (-0.9279/(1+number of outages))/–5.6504, expressed as a share of bill. If outages occur twice a year, the willingness to pay to avoid one outage becomes: -

[96] Stated more correctly, willingness to pay is the derivative of utility with respect to the attribute divided by the derivative of utility with respect to price.

0.9279 / (1+2) / –5.6504 = -0.9279 / 3 / –5.6504 = 0.0547. That is, the average willingness to pay is 5.47 percent of current bill. Since the average water and sewerage bill for residential customers is $759, the average willingness to pay is 0.0547*759=$41.51.

Table W2: Residential Customers' Willingness to Pay to Avoid One Water Outage Per Year, for each number of outages per year
(per customer, per event, expressed as share of current water and sewerage bill)

Outages per year	*Mean*	*Std. Dev.*	*25tile*	*Median*	*75tile*
Once in 10 Years	0.1478	0.1163	0.0698	0.1478	0.2255
Once a Year	0.0813	0.0640	0.0384	0.0813	0.1240
Twice a Year	0.0542	0.0427	0.0256	0.0542	0.0827
Monthly	0.0125	0.0098	0.0059	0.0125	0.0191

Table W3: Residential Customers' Willingness to Pay to Avoid One Water Outage Per Year, for each number of outages per year
(per customer, per event, in dollars)

Outages per year	*Mean*	*Std. Dev.*	*25tile*	*Median*	*75tile*
Once in 10 Years	113.20	96.30	49.49	105.80	168.92
Once a Year	62.26	52.97	27.22	58.19	92.91
Twice a Year	41.51	35.31	18.15	38.79	61.94
Monthly	9.58	8.15	4.19	8.95	14.29

Since number of outages enters in log form, the willingness to pay to avoid an outage depends on the number of outages that the customer faces per year. For example, the average willingness to pay to reduce the number of outages from 2 per year to 1 per year is $41.51, while the willingness to pay to reduce the number of outages from 12 per year (monthly) to 11 per year is only $9.58. There are two reasons for this difference. First, if customers faced more outages, they are more likely to take actions to reduce their impact, such as storing water. Second, from a psychological perspective, a reduction from 12 to 11 seems less important than a reduction from 2 to 1.

Note that the willingness to pay that is listed for once a year is the amount that respondents evidenced they are willing to pay to reduce the number of outages per year from 1 to none. The willingness to pay for a reduction from 1 per year to 1 every other year is half this amount. Similarly, the willingness to pay that is listed when outages occur once every 10 years is a rate per outage. It is not possible to reduce the number of outages by 1 per year when the base is 1 every ten years; the figures in this row indicate, for example, that the average willingness to pay to reduce the number of outages from 1 every ten years to never is $11.32, and the willingness to pay to reduce the number of outages from once every ten years to once every twenty years is $5.66 (ie, one twentieth of $113.20). Given the number of outages that customers currently experience, willingness to pay to avoid a water outage is greater than willingness to pay to avoid an electricity outage.

Table W4 and W5 gives statistics for the willingness to pay that respondents evidenced to reduce the length of a water outage by one hour. Again, since length enters the model in log form, the willingness to pay depends on the length of outages that respondents face. For example, reducing the outage length from 2 hours to 1 hour is worth $36.50 on average, while reducing the length from 24 hours to 23 hours is worth only $4.38.

Table W4: Residential Customers' Willingness to Pay to Reduce Length of Water Outage by One Hour, for each length of outage,
(per customer, per event, expressed as share of current water and sewerage bill)

Outage Length	*Mean*	*Std Dev*	*25tile*	*Median*	*75tile*
1 hour	0.0723	0.0260	0.0549	0.0724	0.0897
2 hours	0.0482	0.0173	0.0366	0.0483	0.0598
5 hours	0.0241	0.0087	0.0183	0.0241	0.0299
8 hours	0.0161	0.0058	0.0122	0.0161	0.0199
12 hours	0.0111	0.0040	0.0084	0.0111	0.0138
24 hours	0.0058	0.0021	0.0044	0.0058	0.0072

Table W5: Residential Customers' Willingness to Pay to Reduce Length of Water Outage by One Hour, for each length of outage,
(per customer, per event, in dollars)

Outage Length	*Mean*	*Std Dev*	*25tile*	*Median*	*75tile*
1 hour	54.75	25.34	37.03	51.30	69.12
2 hours	36.50	16.89	24.69	34.20	46.08
5 hours	18.25	8.45	12.34	17.10	23.04
8 hours	12.17	5.63	8.23	11.40	15.36
12 hours	8.42	3.90	5.70	7.89	10.63
24 hours	4.38	2.03	2.96	4.10	5.53

7.2.1.1.2. Timing of Interruption, Notification and Customer Information

The other attributes enter the model of Table W1 in ways that are similar, with one exception, to the model for residential electricity reliability. Respondents strongly prefer to have water outages during the weekdays than on weekends, and the later in the day on weekdays, the better. For the weekday times after 8am and after midnight, this result is the same as for electricity outages. However, for the time period after 6pm on weekdays, there is a difference: respondents consider this time to be worse than other weekday times for electricity outages but not for water outages. This difference could reflect the fact that households' evening activities that utilise electricity, such as watching TV, are disrupted by an electricity outage and often cannot be rescheduled, while the activities that use water, such as bathing, can be performed at another time before or after the outage.

Notice is important to respondents. There is no significant difference between 1, 2 and 7 day's notice. However, as with electricity outages, two week's notice is considered worse than 1 week's notice.

Respondents are forgiving of not receiving notice if the outage was due to an emergency. And respondents prefer to have a person answer the phone when they call the water utility rather than have a voice system provide a message. While respondents prefer to have a person answer the phone for both electricity and water outages, the concern is not as strong with water outages as for electricity outages.

7.2.2. Willingness to Pay to Avoid Wastewater Overflows

Respondents were asked to choose between scenarios involving wastewater overflows. The scenarios differed in the number of overflows per year, the location of the overflow (inside the house, near the house outside, on the street), amount of time required before the overflow was fixed, and whether a voice message or a person answered customers' calls, as explained in sections 3.4 and 6. Table W6 gives the model that was estimated on the respondents' choices.

Table W6: Model of Residential Customers Choice among Wastewater Overflow Scenarios

Variables	***Estimates***	***Std. err.***	***T-stat***
Price as share of current bill	-4.0125	0.8161	-4.916
Ln(1+number of outages): mean	-1.2343	0.2338	-5.280
standard deviation	1.5024	0.3619	4.151
Inside house: mean	-2.0734	0.2769	-7.488
standard deviation	2.0869	0.3436	6.074
Outside near house	-0.5177	0.1511	-3.426
Person: mean	0.6233	0.1618	3.853
standard deviation	1.2150	0.2490	4.880
ln(1+hours to fix): mean	-0.9946	0.1189	-8.362
standard deviation	0.7291	0.1460	4.992

7.2.2.1. Interpretation of the Model

The number of overflows and time to fix the overflows enter in log form, since this transformation fits the data better than entering these variables without transformation. The willingness to pay to avoid an overflow, given in Tables W7 and W8, depends on the number of overflows that the customer experiences each year. For example, the average willingness to pay to reduce the number of overflows from 2 per year to 1 per year is $77.85, while the willingness to pay to reduce the number of overflows from 1 per year to never is $116.77. If the customer currently experiences one overflow in ten years, then the average willingness to pay to reduce the number to one overflow in twenty years is $16 (one twentieth of $212.32).

Table W7: Residential Customers' Willingness to Pay to Avoid One Overflow Per Year, for each number of overflows per year, (per customer, per event, expressed as share of water and sewerage bill)

Overflows per year	***Mean***	***Std Dev***	***25tile***	***Median***	***75tile***
Once in 10 Years	0.2794	0.3406	0.0504	0.2794	0.5076
Every Other Year	0.2049	0.2498	0.0370	0.2049	0.3722
Once a Year	0.1537	0.1873	0.0277	0.1537	0.2792
Twice a Year	0.1025	0.1249	0.0185	0.1025	0.1861

Table W8: Residential Customers' Willingness to Pay to Avoid One Overflow Per Year, for each number of overflows per year, (per customer, per event, in dollars)

Overflows per year	***Mean***	***Std Dev***	***25tile***	***Median***	***75tile***
Once in 10 Years	212.32	273.90	35.59	197.96	373.73
Every Other Year	155.70	200.86	26.10	145.17	274.07
Once a Year	116.77	150.64	19.58	108.88	205.55
Twice a Year	77.85	100.43	13.05	72.59	137.03

For the location of overflows, the coefficient for overflows occurring on the street is normalized to zero, and the coefficients of the other locations are interpretable relative to this location. As expected, overflows inside the house are considered much more problematic than overflows on the street. Overflows that are outside but nearby the house are also considered worse than overflows on the street. On average, an overflow inside the house is four times worse than an overflow nearby outside, relative to on the street.

Respondents strongly prefer to have a person answer the phone when they call about an overflow. Respondents place far greater value on having a person answer the phone when they call about wastewater overflows than for electricity or water outages.

Tables W9 and W10 gives statistics for the willingness to pay to reduce repair times by an hour. The value of reducing repair time by an hour depends on the total amount of time lapsed until repair. For example, respondents evidenced a willingness to pay of $62.71 on average to reduce repair time from 2 hour to 1 hour but only $7.53 to reduce repair time from 24 hours to 23 hours.

Table W9: Residential Customers' Willingness to Pay to Reduce Repair Time by One Hour, for each length of repair time,
(per customer, per event, expressed as share of bill)

Time Until Fixed	*Mean*	*Std Dev*	*25tile*	*Median*	*75tile*
1 hour	0.1232	0.0916	0.0625	0.1232	0.1857
2 hours	0.0821	0.0611	0.0416	0.0821	0.1238
4 hours	0.0493	0.0367	0.0250	0.0493	0.0743
8 hours	0.0274	0.0204	0.0139	0.0274	0.0413
12 hours	0.0190	0.0141	0.0096	0.0190	0.0286
24 hours	0.0099	0.0073	0.0050	0.0099	0.0149

Table W10: Residential Customers' Willingness to Pay to Reduce Repair Time by One Hour, for each length of repair time,
(per customer, per event, in dollars)

Time Until Fixed	*Mean*	*Std Dev*	*25tile*	*Median*	*75tile*
1 hour	94.06	75.87	43.72	87.88	137.81
2 hours	62.71	50.58	29.15	58.59	91.87
4 hours	37.63	30.35	17.49	35.15	55.12
8 hours	20.90	16.86	9.72	19.53	30.62
12 hours	14.47	11.67	6.73	13.52	21.20
24 hours	7.53	6.07	3.50	7.03	11.02

7.2.3. Willingness to Pay to Avoid Water Restrictions

Respondents were presented scenarios regarding restrictions on the use of water. The scenarios differed in the frequency of restrictions (such as once every ten years or once every other year), the duration of the restrictions (all year, all summer, or one month during summer), whether the restrictions applied every day or every other day, the level of restrictions (stage 1-5 constituting increasingly onerous restrictions), whether public areas were brown or lush green, and the customer's water bill under the scenario. Importantly, a scenario consisting of no restrictions was included in the choice experiments.

The main finding regarding water restrictions is that respondents evidenced a lack of willingness to pay to avoid most types of restrictions. In particular:

- Restrictions that last one month or all summer were found to be not statistically different from having no restrictions. Stated more precisely, the respondents' choices indicated that they were not willing to pay to avoid restrictions that lasted a month or a summer; only restrictions that lasted all year were severe enough for the respondents to be willing to pay to avoid.
- No statistical difference was found in respondents' choices between restrictions that apply every other day and no restrictions at all; apparently, the ability to use water on the "off" days made the every-other-day restrictions fairly benign. Respondents

evidenced a willingness to pay to avoid restrictions only if the restrictions applied every day.

- Stage 1 and 2 restrictions were found not to be significantly different from no restrictions. Respondents evidenced a willingness to pay to avoid only restrictions that were stage 3 or higher.
- Brown lawns in public areas were not found to significantly affect respondents. They evidenced no willingness to pay to avoid brown lawns in public areas. Apparently, respondents felt that having brown lawns occasionally, in drought conditions, was acceptable.

Table W11 gives the model estimation results that incorporate these findings. The scenario of no restrictions is taken as the base against which other scenarios are compared. Indicators are not included in the model for restrictions that last a month or all summer, apply every other day, are stage 1 or 2, or result in brown lawns in public areas, since these were found not to be significantly different from no restrictions. Indicators are included for restrictions lasting all year, every day, and for stage 3 or higher, each of which respondents were found to evaluate negatively.

Table W11: Model of Residential Customers Choice Among Water Restriction Scenarios

Variables	***Estimates***	***Std. err.***	***T-stat***
Price as share of current bill	-3.4539	0.4401	-7.846
Number of restrictions that don't matter	-0.0298	0.1112	-0.268
Number of restrictions that matter	-1.0798	0.3428	-3.149
All year	-0.2667	0.0976	-2.732
Every day	-0.0997	0.0885	-1.126
Stage 3	-0.3881	0.1179	-3.291
Stage 4	-0.4871	0.1220	-3.992
Stage 5	-1.1069	0.1260	-8.784

In preliminary analysis, the number of restrictions obtained an estimated coefficient that was small in magnitude and highly insignificant. This result is consistent with the finding that customers are not willing to pay to avoid most types of restrictions. Reflecting the findings about which restrictions matter to respondents, the number of restrictions was entered separately for restrictions that "matter" and restrictions that "don't matter". Restrictions that matter are those that last all year, apply every day, and are stage 3 or higher. All other restrictions are included in the "don't matter" category.

The coefficients of the two variables for the two types of restrictions confirm and re-enforce the findings discussed above. The coefficient for the number of restrictions that don't matter is very small and not statistically significantly different from zero, indicating that respondents are not willing to pay to avoid these types of restrictions. The coefficient for the number of restrictions that matter is statistically significant, indicating that respondents are indeed willing to pay to avoid restrictions that last all year, apply every day, and are stage 3 or higher.

The point estimates imply that respondents evidenced a willingness to pay of 31 percent of their water bill, or $237 on average, to avoid a situations where stage 3 or higher restrictions are applied every day all year. In terms of the frequency of restrictions, $237 is the amount that respondents evidenced they are willing to pay on average to reduce the expected frequency of these severe restrictions by one per year. Since a restriction that “matters” lasts all year, the highest possible frequency is once per year, which means that the restrictions are in place continuously every year.

The $237 is the amount that customers are willing to pay, on average, to move from a situation with continuous restrictions at stage 3 or above every day all year to a situation with no restrictions ever (since this is a reduction in frequency by 1, from 1 per year to 0 per year). The amount that customers are willing to pay to reduce the frequency of restrictions that matter from, say, once every ten years to once every twenty years is $11.85 on average (one-twentieth of $237 - since the situation reflects a reduction in frequency of restrictions by one-twentieth).

Similarly, relative to the current context, the amount customers would be willing to pay to reduce the frequency of restrictions that matter from once every twenty years to once every thirty years, say, is $3.95 on average (one-sixtieth of $237). While customers would need to be compensated by $225 on average (95 percent of $237) to accept an increase in the frequency of restrictions that matter from once every twenty years to once every year.

Several points are important to consider when interpreting the results of this analysis for the purpose of planning and investment. First, if or when stage 3-5 restrictions are required, it is likely that they will be applied every day rather than every other day. The issue of customers' willingness to pay for stage 3-5 restrictions that apply every other day is therefore irrelevant from a planning perspective. Second, the choice experiments included only three lengths for the restrictions: one month, all summer, and all year. Interpolation of the results to other lengths is a matter of interpretation, beyond the actual data obtained in the study. For example, customers might be willing to pay to avoid stage 3-5 restrictions that last, say, 10 months, but since that length was not examined in the study, no conclusions can be drawn with regard to this length (beyond the necessary implication that the willingness to pay is no more than that for restrictions that last all year.) Third, in the experiments, the length of the restrictions was stated to the respondent, such that the respondent knew how long the restrictions would last when evaluating them. In practice, water restrictions have been, and probably will be in the future, imposed without a specified ending date. That is, the length of the restriction is not known beforehand, only after the restrictions have been lifted. It is possible that customers react differently to restrictions whose length is not known beforehand than to restrictions of a known length.

7.3. Commercial Customers' Willingness to Pay

7.3.1. Willingness to Pay for Reliability of the Water Service

Table W12 gives the model of commercial respondents' choices between water reliability scenarios. The number and duration of outages enter linearly, rather than in log transformation, since the linear form fits the data better. This suggests that commercial customers are less able to adapt to longer and more frequent water interruptions, compared to residential customers.

Weekends constitute the base time period with a coefficient of zero, with the coefficients for the other time periods being relative to the zero for weekends. Commercial customers prefer water outages to occur on weekdays after 6pm or after midnight than on weekends. The worst period for water outages is weekdays after 8am, ie, during normal business hours. This result is consistent with the findings for electricity outages.

Commercial respondents greatly value receiving notice of an outage beforehand. The length of notice is not particularly important (ie, the differences are not significant or large). As with electricity outages, the respondents are forgiving of not receiving notice if the outage is due to an emergency.

Table W12: Model of Commercial Customers' Choice Among Water Reliability Scenarios

Variables	***Estimates***	***Std. err.***	***T-stat.***
Price as share of current bill	-3.2892	0.6858	-4.796
Number of outages per year: mean	-0.1428	0.0186	-7.685
standard deviation	-0.0944	0.0304	-3.106
Length of outages in hours: mean	-0.0730	0.0129	-5.653
standard deviation	-0.0599	0.0167	-3.574
MF after 8am	-0.1459	0.1861	-0.784
MF after 6pm	0.1351	0.1880	0.719
MF after midnight	0.3474	0.1858	1.869
Weekday	-0.0375	0.2841	-0.132
Any weekdays: standard deviation	1.0710	0.2844	3.766
1 day's notice	0.7379	0.2485	2.970
2 day's notice	0.6280	0.2425	2.590
5 day's notice	0.6966	0.2561	2.721
7 day's notice	0.7730	0.2515	3.073
Two week's notice	0.5633	0.2528	2.228
One month's notice	0.8330	0.2555	3.261
Any notice: standard deviation	0.7927	0.3390	2.338
Emergency	0.4161	0.2387	1.743
Person answers	0.4581	0.1421	3.225
Account manager: mean	0.2106	0.1516	1.389
standard deviation	0.8278	0.2836	2.919

Respondents value having a person answer the phone when they call the water utility. Having an account manager is better than having a machine answer calls but is perceived as being worse than simply having someone answer the phone. Perhaps the respondents are concerned that their account manager might not be available to answer questions when they call. This result was also found for water overflows and gas outages.

Tables W13 and 14 give statistics relating to the distribution of willingness to pay that respondents evidenced in their choices. As for willingness to pay to avoid electricity outages, the distribution of willingness to pay in dollars is highly skewed such that mean is far higher than the median. On average, commercial respondents evidenced a willingness to pay of $207 to avoid a water outage and $106 to reduce the length of an outage by one hour.

Table W13: Commercial Customers' Willingness to Pay to Avoid
One Water Outage Per Year
(per customer, per event, expressed as share of current water and sewerage bill)

	Mean	***Std. Dev.***	***25tile***	***Median***	***75tile***
Share of Bill	0.0437	0.0291	0.0242	0.0437	0.0632
Dollars	207.34	943.39	21.99	45.32	113.96

Table W14: Commercial Customers' Willingness to Pay to Reduce Length of
Water Outage by One Hour
(per customer, per event, in dollars)

	Mean	***Std. Dev.***	***25tile***	***Median***	***75tile***
Share of Bill	0.0225	0.0182	0.0103	0.0225	0.0345
Dollars	105.89	521.58	9.41	23.02	58.91

7.3.2. Willingness to Pay to Avoid Wastewater Overflows

Table W15 gives the estimated model for commercial respondents' choices among wastewater scenarios. The specification is the same as the model for residential respondents, with an extra variable for having an account manager.

Unlike residential customers, commercial respondents considered an overflow outside the building to be not significantly worse than an overflow on the street. However, an overflow inside the building is considered to be very problematic. Having a person answer the phone is preferred to having a voice machine answer, and, as with water outages, having an account manager is not considered as desirable as simply having someone answer the phone.

Table W15: Model of Commercial Customers Choice among Wastewater Scenarios

Variables	***Estimates***	***Std. err.***	***T-stat.***
Price as share of current bill	-2.3084	0.6525	-3.538
Ln(1+number of overflows per year): mean	-1.0767	0.1704	-6.320
standard deviation	0.9930	0.2759	3.599
Overflow located inside building: mean	-1.3120	0.1839	-7.136
standard deviation	1.0630	0.2322	4.578
Overflow located outside building	-0.0711	0.1259	-0.564
Person answering the phone	0.6876	0.1366	5.033
Account manager: mean	0.3097	0.1374	2.253
standard deviation	0.5294	0.2866	1.847
Ln(1+time to fix in hours):mean	-0.7259	0.0817	-8.880
standard deviation	0.3540	0.1195	2.962

Tables W16 and W17 give statistics for the distribution of willingness to pay to reduce the frequency of overflows. As with residential customers, the willingness to pay to reduce the frequency of overflows depends on the frequency of overflows that the customer currently faces. The first row in Table W17 indicates, for example, that commercial customers are willing to pay $2023 on average to avoid an overflow when overflows are very infrequent (once every ten years). Commercial customers however would be willing to pay only $741 to avoid an overflow when overflows occur twice a year.

Since the estimates are for reductions in the frequency of overflows, the $2023 willingness to pay in the first row implies that commercial customers are willing to pay, for example, $101 on average to reduce the frequency of overflows from once every ten years to once every twenty years (one-twentieth of $2023.)

Table W16: Commercial Customers' Willingness to Pay to Avoid One Overflow Per Year, for each number of overflows per year, (per customer, per event, expressed as share of current water and sewerage bill)

Overflows per year	***Mean***	***Std. Dev.***	***25tile***	***Median***	***75tile***
Once in 10 Years	0.4238	0.3913	0.1607	0.4238	0.6859
Once a Year	0.2331	0.2152	0.0884	0.2331	0.3773
Twice a Year	0.1554	0.1435	0.0589	0.1554	0.2515

Table W17: Commercial Customers' Willingness to Pay to Avoid One Overflow Per Year, for each number of overflows per year, (per customer, per event, in dollars)

Overflows per year	***Mean***	***Std. Dev.***	***25tile***	***Median***	***75tile***
Once in 10 Years	2023.02	10497.02	154.49	438.28	1135.03
Once a Year	1112.66	5773.36	84.97	241.05	624.26
Twice a Year	741.77	3848.91	56.65	160.70	416.18

Tables W18 and W19 gives figures for the willingness to pay to reduce by one hour the length of time it takes to repair an overflow. The willingness to pay to reduce the repair time depends on the total repair time. For example, customers are willing to pay $499 on average to reduce repair time from 2 hours to 1 hour, but are only willing to pay $31 to reduce repair time from 48 hours to 47 hours. This reduced willingness to pay to reduce repair time when repair time is long is consistent with the findings for residential respondents.

Table W18: Commercial Customers' Willingness to Pay to Reduce Repair Time By One Hour, for each length of repair time, (per customer, per event, expressed as share of current water and sewerage bill)

Time Until Fixed	***Mean***	***Std. Dev.***	***25tile***	***Median***	***75tile***
1 hour	0.1579	0.0765	0.1063	0.1579	0.2092
2 hours	0.1053	0.0510	0.0709	0.1053	0.1395
4 hours	0.0632	0.0306	0.0425	0.0632	0.0837
8 hours	0.0351	0.0170	0.0236	0.0351	0.0465
12 hours	0.0243	0.0118	0.0164	0.0243	0.0322
24 hours	0.0126	0.0061	0.0085	0.0126	0.0167
48 hours	0.0064	0.0031	0.0043	0.0064	0.0085

Table W19: Commercial Customers' Willingness to Pay to Reduce Repair Time by One Hour, for each length of repair time, (per customer, per event, in dollars)

Time Until Fixed	***Mean***	***Std. Dev.***	***25tile***	***Median***	***75tile***
1 hour	748.14	3139.86	91.32	166.85	405.63
2 hours	498.76	2093.24	60.88	111.23	270.42
4 hours	299.25	1255.94	36.53	66.74	162.25
8 hours	166.25	697.75	20.29	37.08	90.14
12 hours	115.10	483.05	14.05	25.67	62.40
24 hours	59.85	251.19	7.31	13.35	32.45
48 hours	30.54	128.16	3.73	6.81	16.56

7.3.3. Willingness to Pay to Avoid Water Restrictions

The model of commercial customers' choice among water restriction scenarios is given in Table W20. Importantly, commercial respondents evidenced exactly the same pattern of willingness to pay, and an un-willingness to pay, to avoid water restrictions as residential respondents. In particular, no significant difference was found in respondents' choices between a situation of no restrictions and restrictions that last one month or all summer, apply every other day, or at stage 1 or 2. Also, respondents evidenced no willingness to pay to avoid brown lawns in public areas during periods of drought.

Table W20: Model of Commercial Customers Choice among Water Restriction Scenarios

Variables	***Estimates***	***Std. err.***	***T-stat***
Price as share of current bill	-2.4839	0.2758	9.005
Number of restrictions per year that don't matter	-0.0661	0.1658	0.399
Number of restrictions per year that matter	-0.5763	0.4202	1.371
All year	-0.3326	0.0998	3.334
Every day	-0.0562	0.0892	0.630
Stage 3	-0.2248	0.1271	1.769
Stage 4	-0.3840	0.1204	3.188
Stage 5	-0.7387	0.1285	5.750

The only restrictions that commercial respondents evidenced a willingness to pay to avoid were restrictions that last all year, are applied every day, and are at stage 3 or above. Commercial respondents evidenced that they were willing to pay 23 percent of their current water bill to avoid these types of severe restrictions. Given the respondents' bills, this share translates into an average willingness to pay of $1104 and median willingness to pay of $239.

The share is smaller than for residential customers, but the median amount in dollars is nearly exactly the same as for residential customers. This comparison suggests that commercial and residential customers are about equally concerned about water restrictions, which makes sense since the restrictions do not generally affect the commercial customers' businesses (under current rules, commercial customers whose business is hurt by the restrictions can apply for an exemption). The main impact is aesthetic, which is valued the same by households and businesses.

7.4. Customers' Preferences Not Covered in the Choice Experiments

7.4.1. Customers Views on Recycled Water

In the initial recruitment interviews, almost all households (96 percent) and businesses (91 percent) noted their willingness to use recycled water (for the garden among householders and for irrigation and industrial purposes among businesses). Of these respondents, a number of specific water recycling concepts were put forward at a range of different prices to ascertain the level of willingness to pay for each:

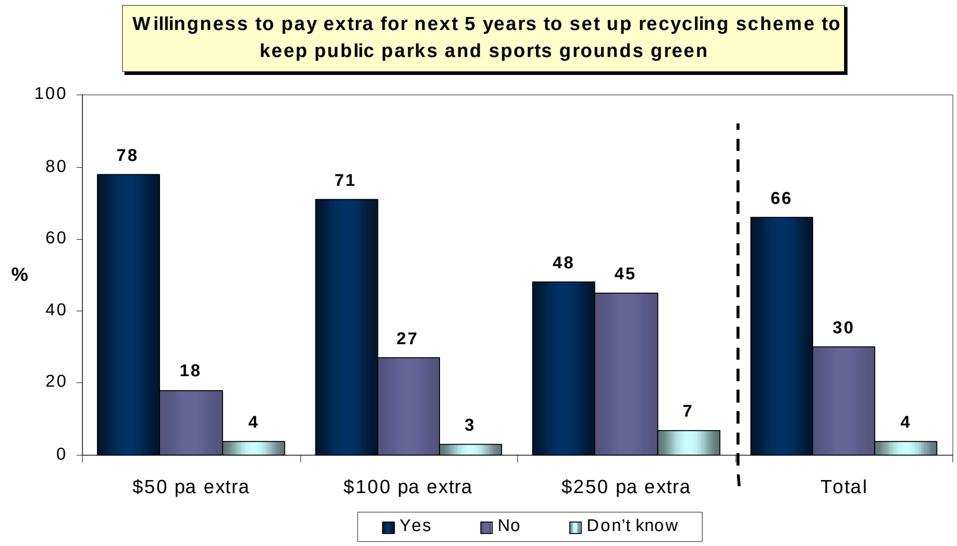
- the majority of households (70 to 80 percent) and businesses (60 to 70 percent) acknowledged a willingness to pay $50 or $100 per annum for 5 years to fund a scheme that would produce recycled water for ‘public parks and gardens to keep them green’. Half of householders and around 40 percent of businesses expressed a willingness to pay $250 per annum for five years to fund the same scheme. Figure W1 below summarises householders’ responses for this particular question.
- the majority of households (74 percent) acknowledged a willingness to pay $50 per year for five years to fund a scheme that would produce recycled water for private gardens (provided at a discount of 15 percent). Half of householders were willing to pay $150 or $250 per annum for five years to fund the same scheme.

Customers’ preferences for particular schemes also indicate that while the majority of customers may be willing to use recycled water for uses such as garden watering, they are generally not willing to use recycled water for drinking. Also, customers’ attitudes to recycled water are not strongly related to the location of the water recycling plant (eg, whether the plant is located near their home versus well away from their home). Full details of the questions on recycling in the recruitment survey and their results are provided in appendix T.

The findings from the qualitative research provide further insights, explaining these preferences:

- customers are willing to use recycled water for uses such as garden watering and toilet flushing because they perceive it as a cheaper and more efficient source of water, rather than due to environmental concerns;
- customers perceive it as inefficient that the existing water supply is of drinking quality, yet only a small portion of the water supplied is used for this purpose; and
- if asked to choose between recycled water or fresh water from a dam, customers are likely to choose the cheapest option.

Figure W1: Householders’ Willingness ‘to Fund the Development of a Water Recycling Scheme to Keep Public Parks and Sports Grounds Green’



Base: Willingness to pay for recycled water for parks: $50 n=82; $100 n=79; $250 n=75; Total n= 236

A12. The final idea I'd like your opinion on is the use of recycled water on PUBLIC parks and sports grounds. This would ensure that Canberra's public parks and sports grounds would be lush and green even during drought times, Would you be willing to pay $… per year extra on your water bill, for the next 5 years, to fund the development of a water recycling scheme for use on public parks and sports grounds to keep them green?

Overall, these results confirm that customers would be prepared to use and pay for water from a recycling scheme for non-drinking purposes. In order to progress this issue, we suggest that ACTEW/ActewAGL undertake further work on detailing the possible recycling options (including their cost). These should then be assessed in the context of other water supply options.

7.4.2. Attitudes to Chlorine Levels and Other Water Quality Aspects

There were high levels of total agreement with the statement 'you have no concerns whatsoever about drinking the water straight from your tap' (82 percent) in the recruitment interviews – and 15 percent disagreed in total. The majority of businesses also noted that they had 'never' experienced any form of water quality issue (70 percent). These findings are consistent with the findings of the qualitative research, which indicated that customers have few, if any, concerns with the quality of Canberra's water.

The one possible exception is the issue of chlorination. Chlorine appeared to be an issue for a notable minority (29 percent) in the interviews. 'Total disagreement' with the statement 'they put far too much chlorine in your drinking water' was at 50 percent; 15 percent responded with 'neither agree nor disagree', and an additional 5 percent saying 'don't know'. It is marginal whether this result warrants further research. In the context of the pilot study results – which indicated that chlorine was not a willingness to pay issue for customers – and the other results from the recruitment interviews, we suggest that further research is not necessary. Rather, the result suggests that ACTEW/ActewAGL should be mindful that chlorination is an issue for a small proportion of customers.

7.4.3. Perceptions of Water Pressure

In the recruitment interviews, the majority of both householders and businesses noted that they had 'never' experienced any water pressure issues:

- among householders about two thirds had not experienced water pressure problems (63 percent). Of those with water pressure problems, the dominant issue was 'low' water pressure (experienced by 90 percent of those with pressure problems);[97] and
- among businesses about 81 percent had 'never' had water pressure issues.

These findings are consistent with the findings of the qualitative research, which indicated that customers have few concerns with water pressure.

7.4.4. Attitudes to Safety

There were high levels of total agreement with the statement 'you don't have concerns about health and safety aspects of your water supply' (85 percent 'total agreement') – and 13 percent disagreed in total.

This is consistent with the qualitative research which indicated that customers were generally not concerned about safety. Interestingly, participants in the focus groups tended to assume, or even take for granted that water was provided to their premises in a safe manner.

[97] Customers' experience of low water pressure may have been as a result of the Canberra bushfires.

8. GAS ATTRIBUTES AND LEVELS

8.1. Summary of Attributes Adopted for the Study

The following attributes for the natural gas service were chosen for the study:

- The annual frequency of service interruptions, expressed as 'number of times per year that gas is completely unavailable';
- The average duration of an interruption, expressed as 'length of time that gas is completely unavailable each time that it goes out';
- The time of year that the gas service is interrupted, expressed as 'time of year that gas is completely unavailable each time that it goes out';
- The time of day that the gas service is interrupted, expressed as 'time of day that gas is completely unavailable each time that it goes out';
- The period of prior notification of an interruption, expressed as 'prior notification that gas will be unavailable';
- Information service provided during an interruption, expressed as 'response to phone inquiries in the event of gas becoming unavailable'; and
- Price, expressed as 'total gas bill for the year'.

These were adopted for both residential and commercial customers, albeit with varying levels for each customer type, as discussed below. The choice of wording reflects terms that were most commonly used by participants in the customer focus groups, and also suggestions made by participants during the qualitative pilot of the choice experiments.

An entire list of gas attributes and their levels is contained in appendix O.

8.2. Reliability

With the exception of a number of customer service type standards, the only service standards that are specified in regulatory arrangements for natural gas relate to service reliability.

8.2.1. Frequency and Duration of Disruptions

Regulatory arrangements establish that:

- planned interruptions to the gas network should be no more than 25 hours per year; and

- burst pipes should be attended to within 3 hours, in an average of 90 percent of cases, when the burst pipe is likely to cause damage or harm to customers, property, etc, or within 24 hours where the burst or leaking pipe is not likely to cause damage or harm to customers, property, etc.

In addition to these legislated standards, ActewAGL adopts the following measures for internal management purposes:

- at least 90 percent of gas disruptions should be restored within 4 hours; and
- gas interruptions should not exceed 1 per 100 properties per year.

Essentially then, existing standards adopted in the regulations and by ActewAGL are defined in terms of the following four attributes:

- the ***total amount of service interruption time*** each year;
- the ***frequency*** with which a customer could expect to be interrupted each year;
- the maximum time taken ***to respond*** to a gas pipe leak or burst; and
- the maximum ***duration*** of each service interruption.

Customers' perceptions of, and preferences relating to these dimensions of reliability were tested in the customer focus groups. While participants noted that gas was the utility that would have the least impact on them in the event of a short disruption (for example 2 to 4 hours), participants signalled that they did perceive the existing service as 'highly reliable', and that this was of value to them.[98] The following two attributes were therefore recommended for the study:

- the annual frequency of service interruptions, expressed as 'number of times per year that gas is completely unavailable'; and
- the average duration of an interruption, expressed as 'length of time that gas is completely unavailable each time that it goes out'.

These two attributes were chosen as they were considered to be the most important aspects of reliability, from a customers' perspective. The 'time taken ***to respond*** to a gas pipe leak or burst' was not recommended as an attribute, given that the focus groups indicated that, as with water/wastewater, it was the duration of the interruption that was of critical importance to customers, rather than the time ActewAGL takes to arrive at the site of a leak or burst pipe. The inclusion of an attribute for 'the total amount of interruption time each year' was not necessary given that the 'frequency' and 'average duration' attributes could be used to evaluate customers' preferences relating to the attribute.

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98 See page 33 of ACNielsen's qualitative report, attached as appendix L.

With respect to 'levels' for these two attributes, the following were adopted:

- for the 'frequency' attribute, six levels were chosen, varying from 'once every 10 years' to '4 times per year'; and
- for the 'duration' attribute, six attributes were chosen, varying from ' 24 hours' to '1 hour'.

8.2.2. Timing of Interruption

The time period in which a service interruption occurs was initially identified as a possible attribute during our discussions with ActewAGL. During our discussions, ActewAGL suggested that it could be flexible as to the timing of its planned maintenance, and that customers may have a preference as to the time in which they were interrupted. For gas, ActewAGL suggested that customers might value being given the option of a particular 'time of day' and 'time of year' for planned interruptions. These were confirmed in the customer focus groups – in both residential and commercial groups,[99] and while regulatory arrangements do not specify or limit the time period in which service interruptions can occur, the attributes 'time of day that gas is completely unavailable each time that it goes out' and 'time of year that gas is completely unavailable each time that it goes out' were included in the choice experiments due to customers' high reliance on gas during winter.

Five levels were adopted for the 'time of day' attribute for both residential and commercial customer segments, established according to the timing preferences signalled by participants in the customer focus groups. Each level was carefully worded to ensure that it made sense against each level for the 'duration of outage' attribute. The levels chosen were 'over the weekend', 'over a weekday', 'Mon-Fri sometime after 6pm', 'Mon-Fri sometime after 8am', and 'Mon-Fri sometime after midnight'.

Two levels were included for the 'time of year' attribute for both residential and commercial customer segments – 'during winter only' and 'not during winter'.

8.2.3. Notification of Interruption

Participants in the focus groups indicated that notification ***prior*** to a gas disruption was of value.[100] As with the electricity and water services, notification is also required for planned interruptions to the gas service by the regulatory arrangements. The existing regulatory arrangements require ActewAGL to notify customers 2 days in advance of an interruption if access to the customer's property is ***not*** required, and 7 days if access to the customer's property ***is*** required. As with both electricity and water, in discussions with ActewAGL, it was suggested that the notification period could affect the flexibility and therefore efficiency

[99] See page 36 of ACNielsen's qualitative report, attached as appendix L.

[100] See page 36 of ACNielsen's qualitative report.

of ActewAGL's maintenance crews. The smaller the notification period, the more flexible were the maintenance crews, thereby increasing their efficiency.

Notification was therefore included as an attribute, expressed as 'prior notification that gas will be unavailable'. The following levels were adopted for the residential customer segment: 'no notification provided', '1 day', '2 days', '7 days', and 'two weeks'. The same levels were adopted for the commercial customer segment, with the addition of '5 days' and 'one month'. The choice of levels essentially followed the notification period in regulatory arrangements, plus or minus an increment, although 'one month' was included in the commercial customer segment given that a number of participants in the focus groups signalled a preference for this time period.

The level 'gas unavailable due to emergency – no notification possible' was also included for both segments, to cover the possibility of customers being given no notification due to an unplanned outage (rather than due to the actions of ActewAGL). ActewAGL cannot know the timing of unplanned outages in advance, given that these are caused by events which are outside ActewAGL's control. The distinction between 'no notification provided' and 'no notification possible' was introduced, given that participants in the focus groups signalled that they viewed these two situations differently.

8.2.4. Information Provided During an Interruption

Another theme coming out of both the discussions with ActewAGL and the customer focus groups was that in the event of a service disruption, customers' value receiving current details about the disruption – including the expected time period that the service would be disrupted.

Regulatory arrangements require ActewAGL to maintain a 24-hour telephone service in the event of an unplanned service interruption. Participants in the focus groups confirmed that this would be helpful, and noted that in the event of a disruption they would like to call a recorded information line (without having to wait in a queue). The recorded message would state the areas disrupted, and outline the likely restoration duration. Participants also noted that it would be preferable that, following the recorded message, there was an option to stay on-line and be transferred to an operator. In calling a utility company, in general, participants also noted a preference to speak to a person rather than an IVR or 'machine'. However, some commercial customers, for whom gas was 'mission critical', noted a preference for access to a 'duty manager' or 'account manager' to keep them informed of the disruption.

The attribute 'response to phone inquiries in the event of gas becoming unavailable' was incorporated into the choice experiments, with the following levels:

- your call is answered by an AUTOMATIC VOICE - the voice gives you the option of hearing a recorded message that gives you an up-to-date status report on any gas supply issues by suburb, or to speak to someone but you may be put on hold before a person answers;

- you get straight through to a PERSON - you are not put on hold and there is no machine directing you to press buttons; and
- the gas company PERMANENTLY provides you with a SPECIAL phone number for a dedicated account manager who would handle your query - you are not put on hold and there is no machine directing you to press buttons

The third level was included only for the commercial customer segment.

8.3. Price

As explained previously, choice experiments all include price as an attribute, so as to provide a basis for determining customers' willingness to pay for particular service options and therefore attributes/levels of the service. The critical question to be resolved, however, is how the price attribute should be expressed to ensure that it is meaningful to the customer.

The focus groups revealed that, with the exception of large commercial customers, customers have little interest in the actual tariffs that they pay or the derivation of their bills. Participants revealed that they thought about price in terms of the 'total amount payable'. Larger businesses tended to perceive this total amount in terms of annual spend, however, residential and small business customers, tended to refer to their 'last bill' or 'their bill this time last year' – suggesting that they perceive the amount paid in terms of their billing cycle. Nevertheless, the project team recommend that price should be expressed as a total annual amount in the choice experiments, for both residential and commercial customer segments, due to the seasonality of the billing cycle.[101]

Moreover, to ensure that the price attribute was also meaningful to the respondent in terms of its size, the price given in each choice experiment was tailored for each respondent by anchoring it to the respondent's estimate of her/his bill (provided at the time of recruitment). For multi-sited commercial customers, the bill estimate was for a single ACT site nominated by the respondent. The pilot study indicated that multi-sited businesses found it difficult to think in 'aggregate' terms for their utility bills given that these are currently issued by ActewAGL on a 'per site' level.

[101] See page 38-39 of ACNielsen's qualitative report.

8.4. Identified Attributes Not Included in the Choice Experiments

8.4.1. Customer Service

In addition to specifying minimum requirements relating to customer notification and telephone services, the regulatory arrangements also set out minimum requirements for:

- promptness of new customer connections;
- method of notification prior to a planned outage;
- time to respond to a written query and/or complaint by a customer; and
- appointment windows, and timeliness of keeping appointments.

As with both electricity and water, the findings from the focus groups, suggested that, while these were all important aspects determining the perceived quality of a utility service, these were not aspects that participants were willing to pay for. These aspects were either assumed or taken for granted.[102] These customer service aspects were therefore not recommended for the choice experiments. Nevertheless, the recruitment surveys were designed to collect information on these aspects, including:

- customer preferences for particular appointment windows;
- expectations relating to ActewAGL's timeliness of keeping appointments; and
- attitudes to ActewAGL's current performance in relation to response times, and handling of calls to the call centre.

8.4.2. Safety Aspects

'Safety' was identified early on in the study as a potential topic. The issue of safety was tested in the focus groups, and while gas was generally considered to be relatively less safe than electricity due to the 'flame' associated with the use of this fuel, no business or residential participants expressed any real concern about the safety of the gas network. It was assumed, or even taken for granted that gas was provided to their premises in a safe manner.[103] No attributes relating directly to safety were therefore recommended for the choice experiments. Nevertheless, the recruitment survey included several questions on safety aspects of the gas service in order to supplement the qualitative research on the issue.

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102 See page 41 of ACNielsen's qualitative report, attached as appendix L.

103 See page 40 of ACNielsen's qualitative report.

8.4.3. Environment

Specific issues relating to the environment did not arise in the initial research phase of the project (with the exception of those relating to recycled water and water restrictions, as discussed later in the report). No attributes directly relating to the environment therefore were included in the study for gas.

Interestingly, however, in the qualitative research when participants were asked about their perceptions of electricity relative to natural gas, a few participants noted that gas had environmental benefits over electricity, although most participants did not consider gas and electricity in this context. Across all the residential and business focus groups, participants perceived electricity as being distinctly different from gas. No participant conveyed the impression that they considered electricity and gas as a more holistic and interchangeable entity (eg, energy).[104]

8.4.4. Gas Disruption Insurance (Pilot Light Re-ignition)

The possibility of offering customers a 'pilot light re-ignition' service in the event of a disruption was identified in initial discussions with Agility and ActewAGL. This possibility was explored in the customer focus groups, however participants were not supportive of the gas disruption insurance concept. The concept was explained as an insurance scheme where the annual premium covered customers for the cost of having their gas appliance pilot lights re-ignited by ActewAGL, in the event that there was a disruption to the gas flow to their property resulting in appliance pilot lights being extinguished.[105] No attributes or levels relating to the concept were therefore recommended for the study.

8.4.5. Enhanced Gas Connection

Gas interruptions occur often due to third parties 'hitting' gas mains or service lines while digging. Agility and ActewAGL proposed that they could reduce the risk of such events occurring by either re-laying gas service lines deeper in the ground, or sleeving the existing pipes in metal protective casing. This concept was explored in the focus groups, however neither residential or business participants were supportive of the idea. Participants believed the current situation involving 'warning tape' was adequate to remind people about the location of underground pipes.[106] No attributes or levels relating to the concept were therefore recommended for the study.

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104 See page 35 of ACNielsen's qualitative report, attached as appendix L.

105 See page 43 of ACNielsen's qualitative report.

106 See page 43 of ACNielsen's qualitative report.

8.4.6. Energy Audit/Efficiency Advice

The issue of energy efficiency was explored in the focus groups. Business participants were asked for their opinion on ActewAGL providing an energy auditing/efficiency advisory service. Participants were interested in receiving such advice, however, signalled that they would prefer to receive such advice from an independent source.[107] No attributes or levels relating to energy efficiency were therefore adopted in the choice experiments.

[107] See page 43 of ACNielsen's qualitative report.

9. GAS SURVEY RESULTS

9.1. Overview

9.1.1. Preferences for Reliability and Customer Service

The survey results show that both residential and commercial customers value reliability of the gas service provided by ActewAGL. Customers value incurring fewer and shorter gas outages, compared to more frequent and longer outages. The amount that customers are willing to pay to avoid a gas outage, however, is in most cases less than that compared to the amount they would be willing to pay to avoid an electricity outage, water interruption or wastewater overflow.

Residential customers willingness to pay depends on whether the outage occurs in winter, or out of winter. Their average willingness to pay to avoid a gas outage is $27.92 (or 4.14 percent of their annual gas bill) for a winter outage and $19.72 (or 2.94 percent of their annual gas bill) for a non-winter outage. This result suggests that an outage is bothersome even if gas is not being used since it entails, for many customers, relighting the pilot lights or waiting for the gas utility representative to relight the pilot lights. Residential customers also evidenced a willingness to pay of $9.99 to reduce the length of a winter outage by one hour and $6.99 to reduce the length of a non-winter outage by one hour.

Commercial customers expressed an average willingness to pay to avoid a gas outage of 4.6 percent of their bill, or $229. Their average willingness to pay to reduce the duration of an outage by an hour is 1.57 percent of their bill, or $78.

A summary of customers' willingness to pay for specific gas events is set out in the table below. These should be interpreted as the total amount a customer would be willing to pay to avoid each event entirely.

Table 9.1: Average Willingness to Pay to Avoid Events
(per customer, per event, in dollars)

Event	*Residential*	*Commercial*
To avoid a gas outage in winter	28 (4%)	229 (5%)
To avoid a gas outage not in winter	20 (3%)	229 (5%)
To reduce length of gas outage by one hour in winter	10 (1.5%)	78 (1.6%)
To reduce length of gas outage by one hour out of winter	7 (1%)	78 (1.6%)

The main study also indicates that customers have the following preferences:

- If an interruption occurs, residential customers prefer to have gas outages during the day on weekdays; this time is better than after midnight, although after midnight is better than after 6pm or on weekends. Commercial customers consider the best time for gas outages to be weekdays after midnight. Other than that time, they prefer gas outages to occur on weekends rather than during normal business hours (weekdays after 8am or 6pm).

- Customers prefer having notice of an outage when the outage is planned, although this preference is not as strong as that expressed by residential customers for water or electricity interruptions. Respondents are forgiving of not receiving notice if the outage was due to an emergency. The period of notice is important, but is not significant. Residential customers tend to prefer one week's notice, and commercial customers prefer two week's notice to any more or less notice.

- Residential customers expressed a preference to receive notice by either mail or letter box drop, and commercial customers by mail or fax in the qualitative research. Also, 'all day' was considered an acceptable appointment window to access their property (to carry out planned maintenance work) by most respondents (72 percent of residential, and 61 percent of businesses) in the recruitment interviews.

- In the event of a disruption, both commercial and residential customers would prefer having a person answer the phone, rather than a voice message, when they call to make an inquiry of the gas utility. Commercial customers also expressed a preference for simply having someone answer the phone, rather than having a dedicated account manager to answer their queries.

With respect to the implications of these results for the future priorities of ActewAGL's operations, given that the merits of changing service standards depend not only on customers' willingness to pay but also on cost, we recommend that ActewAGL develop a range of specific network options for assessment. The willingness to pay estimates can be used to calculate the benefit derived by customers for each network option, and so each option can be evaluated by comparing its cost against its benefits. The results of such analysis can be used to help formulate future operations strategy.

It is also possible however to derive customers' preferences for particular levels of service compared to others by using the willingness to pay results and a range of 'hypothetical' service scenarios (including price). The study results[108] can be used to calculate the relative satisfaction (or utility) that customers derive from each 'hypothetical' service scenario. The scenarios can therefore be ranked (according to their respective resulting utilities), and the scenario most preferred by customers can be determined. It is also possible to use such analysis to calculate the amounts of monetary compensation that customers would require to accept their less preferred service scenarios.[109]

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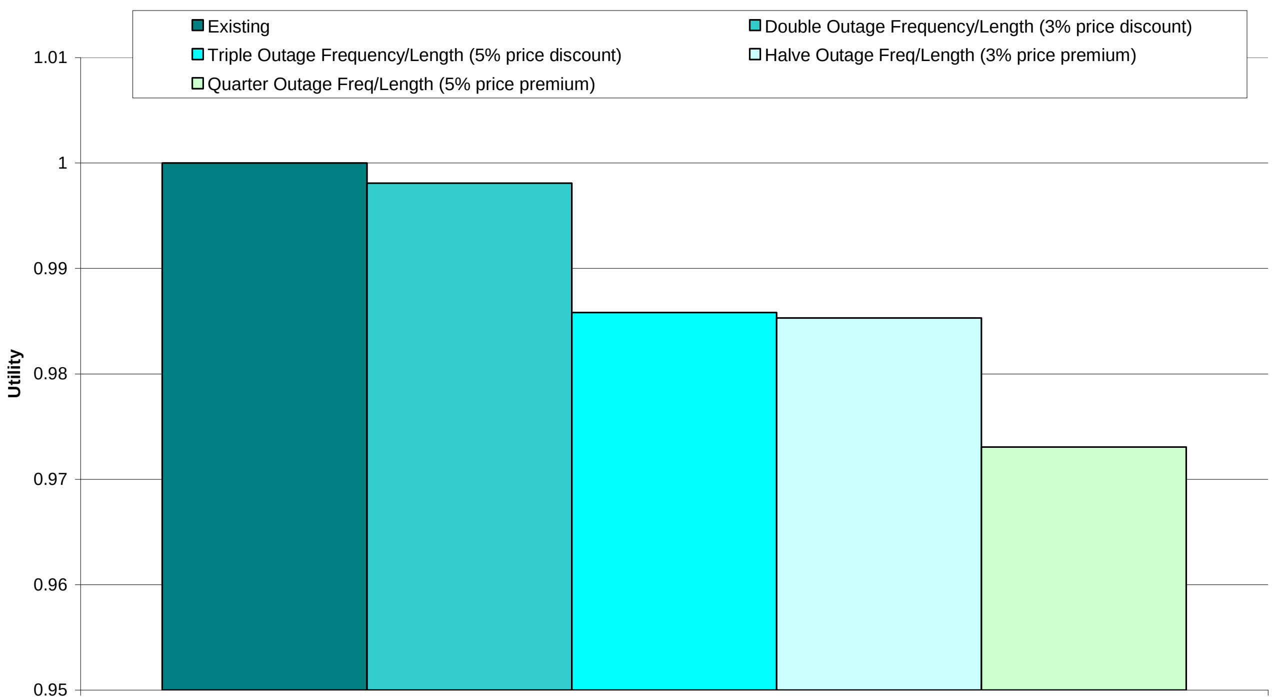
108 That is, the coefficients of the choice models.

109 That is, the amount of monetary compensation (or discount in price) that they would require to ensure that their utility remains unchanged.

An example adopting a broad cross section of hypothetical service scenarios is provided below. It indicates that customers value (that is, are willing to pay for) the current levels of reliability provided by ActewAGL.

Figure 9.1, below, illustrates the relative satisfaction (or utility) that residential customers derive from a number of different service scenarios. The existing level of reliability is compared to four different scenarios: two scenarios offering an increased level of service (together with a higher price), and two scenarios offering a decreased level of reliability (together with a lower price). The utility derived from each service scenario has been calculated using the study results. For ease of presentation,[110] the utility derived from existing service levels is assigned a value of 1, and the utilities derived from the other hypothetical service levels are recalibrated around this. The higher the number, the greater the level of customer satisfaction (or utility) derived from the service scenario.

Figure 9.1: Householders' Ranking of Gas Service Reliability Scenarios[111]



In all cases, a degraded level of service (in return for a discount in price) is less preferred to existing service levels. For example, the utility derived from the existing level of reliability

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110 Given that it is relative (rather than absolute) utility that is important in the analysis, calibration to alternative values has no impact on the results.

111 Note that this analysis assumes: the average frequency and duration of interruptions is currently once every 5 years and 1 hour respectively. The discount/increase in price relates to the total annual combined bill (network and retail) for an average customer.

is one,[112] which compares to a utility of only 0.998 if the level of reliability was decreased by a factor of two,[113] in return for a discount of 3 percent in the total gas price. As it generates a lower level of customer utility, the service scenario is less preferred to the existing level of service. Similarly, in all cases in the analysis, an increase in reliability (in combination with an increase in price) is less preferred to existing service levels.

As noted earlier, it is also possible to use this analysis to calculate the amounts of monetary compensation (or price discount) that customers would require to accept their less preferred service scenarios.[114] With respect to degraded service standards, the analysis shows that customers would require significant compensation if reliability levels were to fall. For example, residential customers would require, on average a reduction of more than 3 percent on their annual natural gas bill (or about 6 percent on their network bill) in compensation for a doubling in both the frequency and duration of gas interruptions.[115] Similarly, residential customers would require, on average a reduction of almost 6.5 percent on their annual natural gas bill (or about 13 percent on their network bill) in compensation for a three-fold increase in both the frequency and duration of gas interruptions.[116]

Overall, the study results suggest that customers are willing to pay for existing service levels, and would not prefer a lesser reliability in return for a discount in price. This is consistent with the qualitative research, which suggested that customers' lifestyles and business operations are integrally based on the current levels of utility service reliability and any change would have a fundamental impact:

> "It [electricity, gas, water and wastewater supply reliability] is an expectation that is set and you can't do anything about it. … You have structured your business in a certain way because these things (electricity supply) are available."

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112 The analysis assumes that the average frequency and duration of interruptions is currently once every 5 years and 1 hour respectively. Interruptions are assumed to occur both in and out of winter and on a weekday after 8am. The customer is assumed to be given 2 days notice of the interruption, and the customer is assumed to have access to a recorded message giving him/her information about the interruption. The discount/increase in price relates to the total annual combined bill (network and retail) for an average customer.

113 That is, increasing the frequency of interruptions from once every 5 years to once every 2.5 years, and increasing the average duration of an interruption from 1 hour to 2 hours.

114 That is, the amount of monetary compensation (or discount in price) that they would require to ensure that their utility remains unchanged.

115 That is, increasing the frequency of interruptions from once every 5 years to once every 2.5 years, and increasing the average duration of an interruption from 1 hour to 2 hours.

116 That is, increasing the frequency of interruptions from once every 5 years to once every 2.5 years, and increasing the average duration of an interruption from 1 hour to 2 hours. This assumes that the interruptions are equally spanned across the year, ie, the interruptions do not all occur in winter.

9.1.2. Ratings of Current Service Standards and ActewAGL

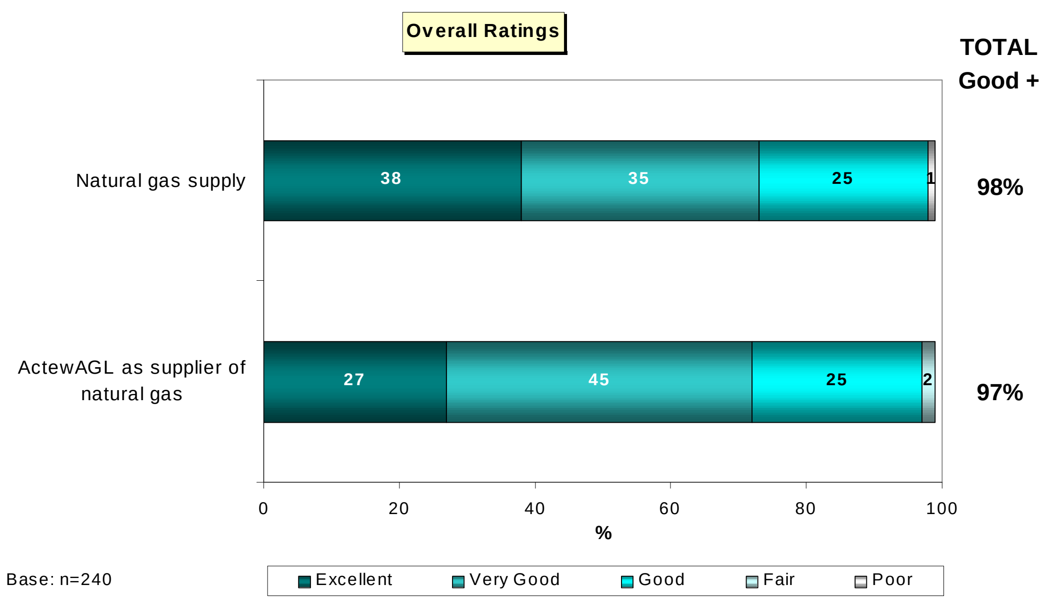
The gas service was rated very highly by respondents in the initial interviews, with almost all respondents (residential and commercial) giving a rating of 'good' or better – 'good' or better ratings were provided by 98 percent of respondents, with only 1 percent of householders rating it as 'poor'.

About 80 percent of both householders and businesses said that they had 'never' experienced an interruption to their gas supply; almost all of those that had experienced an interruption have had this occur only once or less often per year. Similarly with gas quality and pressure issues, these were very rare with 90 percent 'never' having experienced problems in these areas.

Ratings of ActewAGL as a supplier of gas services were also very high with almost all respondents (residential and commercial) giving a rating of 'good' or better. 'Poor' ratings were extremely low (2 percent of business and no householders).

The gas network was believed to be 'maintained in good working order' by the majority of respondents, with 95 percent of households and 89 percent of businesses 'agreeing' with this statement. Agreement was also high (at over 80 percent of householders and businesses) with the statement that 'ActewAGL takes a very responsible attitude in relation to the natural gas supply'.

Figure 9.2: Householders Ratings of the Gas Service and ActewAGL



O1. Firstly, overall how would you rate the natural gas supply to the home in which you live? Would you say it was...(SINGLE RESPONSE)
O3. And overall how would you rate ActewAGL as the supplier of natural gas to the home in which you live? Would you say... (SINGLE RESPONSE)

Further details of the choice modelling results are set out below. More detailed results from the recruitment survey can be found at appendix U.

9.2. Residential Customers' Willingness to Pay for Reliability

Residential respondents were presented with choice experiments which presented a number of gas reliability scenarios, similar to the choice experiments for electricity and water. Table G1 gives the estimated model, which explains customers' choices. The form of the model is similar to that developed for other models in the study, and is described in appendix R. For each choice situation, the model relates the choice of the respondent to each of the attributes of the two scenarios that were presented to the respondent in each choice experiment. The variables of the model reflect the impact of each attribute on the respondents' choices.

As with estimation of all the models in the study, the specification of variables that enter in the model was determined through extensive testing of alternative specifications. Unless otherwise noted, only variables that enter significantly are included in the models. Similarly, non-linearities in variables and interactions among variables are included only to the extent that they were found to be significant.

The impact of attributes on customers is often quite different for different customers. The model structure is capable of handling these differences, as noted in appendix R. In particular, coefficients in the model can be allowed to vary over customers, if such variance is found to be important. Instead of estimating one coefficient that applies to all customers, the coefficient can be specified to be normally distributed in the population. The mean and standard deviation of the distribution are estimated. Tests were performed for whether each coefficient varies significantly over customers. If the variance of the coefficient was found to be significantly different from zero, then a distribution is estimated for the coefficient; that is the mean and standard deviation are estimated. Any coefficient whose variance is not significant was specified to be the same for all customers, ie, is fixed for all customers rather than varying over customers. Note of course that a fixed coefficient does not imply that all respondents actually have the same coefficient but rather that the differences across respondents are not sufficiently strong to be identified by the data.

Table G1: Model of Residential Customers' Choice Among Gas Reliability Scenarios

Variable	***Estimates***	***Std. err.***	***T-stat.***
Price as share of current bill	-5.1073	0.5734	8.91
Number of outages per year in winter: mean	-0.2129	0.0465	4.58
standard deviation	0.1898	0.1155	1.64
Number of outages per year not in winter	-0.1501	0.0474	3.16
Length of outages in hours, winter: mean	-0.0760	0.0116	6.53
standard deviation	0.0417	0.0165	2.53
Length of outages in hours, not winter	-0.0532	0.0087	6.06
Winter: mean	-0.7846	0.1701	4.61
standard deviation	1.0129	0.1604	6.31
M-F after 8am	0.2994	0.1448	2.07
M-F after 6pm	-0.0428	0.1313	0.33
M-F after midnight	0.3134	0.1370	2.29
Weekday	0.5069	0.1968	2.57
Any weekday except after 6pm: std dev	0.6751	0.1318	5.12
1 day's notice	0.3620	0.1410	2.57
2 day's notice	0.3379	0.1554	2.17
7 day's notice	0.4195	0.1481	2.83
Two week's notice	0.2547	0.1366	1.86
Any notice: standard deviation	0.4690	0.2271	2.06
Emergency	0.1954	0.1498	1.30
Person answers: mean	0.3592	0.0995	3.61
standard deviation	0.7052	0.1739	4.05

The t-statistics in table G1 are very high, as with other models in the study, indicating that respondents were indeed taking each attribute into consideration and choosing thoughtfully among the scenarios. As noted earlier, the t-statistic is a measure of confidence, indicating how well each variable relates to customers' choices/preferences. A higher t-statistic indicates a better fit. A t-statistic of 2 indicates that the coefficient is significantly different from zero at the 95 percent confidence level. That is, we can be 95 percent sure that the variable actually affects customers' choices. A t-statistic of 3.5 indicates 99.96 percent confidence (an upper limit often quoted in statistical tables). The t-statistics for many of the coefficients in table G1 are far in excess of 2 and even 3.5. For example, the t-statistics on the price coefficient is almost 9 and the mean coefficients for the number and length of outages are between 3 and 6. This means that we can be nearly absolutely sure that these variables affect customers' choices.

"Price" is the annual gas bill that the customer would receive under the scenario. The estimated coefficient of price is negative, indicating that, if the price of a scenario rises and none of the levels of the other attributes changes, respondents like the scenario less. Stated differently, raising the price of a scenario reduces the chance that a respondent will choose it, holding all other levels of the attributes in the scenario constant.

In this, as in other models in the study, price is entered as a share of the respondents' current bill. For example, suppose the price of a scenario is $900, and the respondents' current annual bill is $1000; in this case, the price of the scenario as a share of the customers' bill is 0.9. Various ways of entering the price of the scenario were tested, including price alone, non-linear transformations of price, and price as a share of current bill. The best fit to the data was obtained with price as a share of bill. This specification implies that a $100 bill reduction to a respondent whose annual bill is currently $1000 has the same effect on the respondents' choices as a $80 bill reduction to a respondent whose annual bill is $800, since both constitute a 10 percent reduction.

9.2.1.1. Interpretation of the Model

9.2.1.1.1. Frequency and Duration of an Outage

As noted earlier in the report, the amount that respondents have evidenced, through their choices, that they are willing to pay to reduce the number of outages each year can be estimated using the coefficients of the choice model. Intuitively, the willingness to pay for any attribute is the coefficient of that attribute divided by the price coefficient (the coefficient of the attribute gives the importance of that attribute in respondents' choices; the price coefficient gives the importance of price in their choices; and the ratio of the two gives the importance of the attribute relative to price, that is, the value of the attribute denominated in dollars).[117]

Table G2 gives statistics relating to the willingness to pay to avoid a gas outage and to reduce the length of an outage.[118] Outages that occur in winter are differentiated from those that do not occur in winter.

[117] Stated more correctly, willingness to pay is the derivative of utility with respect to the attribute divided by the derivative of utility with respect to price.

Table G2: Residential Customers' Willingness to Pay Regarding Gas Outages (per customer, per event, expressed as share of customer's current gas bill and in dollars)[119]

	Mean	***Std Dev***	***25tile***	***Median***	***75tile***
To avoid an outage					
Share of bill					
Winter	0.0417	0.0371	0.0169	0.0414	0.0660
Not winter	0.0294				
Dollars					
Winter	27.92	30.11	8.51	23.36	42.84
Not winter	19.72				
To reduce length by 1 hour					
Share of bill					
Winter	0.0149	0.0081	0.0094	0.0149	0.0204
Not winter	0.0104				
Dollars					
Winter	9.99	7.52	4.76	8.63	13.67
Not winter	6.99				

To illustrate the procedure for calculating willingness to pay, consider table G3. The table gives $27.92 as the residential customers' average willingness to pay to avoid a gas outage, assuming that outage occurs in winter. This figure is based on the estimated coefficients from table G1. The average coefficient of number of outages is: -0.2129. The price coefficient is -5.1073, where price is expressed as a share of current bill. The willingness to pay is therefore (-0.2129/-5.1073) = 0.0417, expressed as a share of bill. That is, the average willingness to pay is 4.17 percent of current bill. Since the average gas bill for residential customers is $670, the average willingness to pay is 0.0417*670=$27.92.

The willingness to pay estimates indicate that winter outages are considered more onerous than outages in other seasons. Given that residential customers use gas primarily for heating, this difference is reasonable. The average willing to pay to avoid an outage is $27.92 for a winter outage and $19.72 for a non-winter outage. These amounts are lower than the average willingness to pay to avoid an electricity or water outage. Interestingly, customers are willing to pay to avoid a non-winter outage, even though residences use little gas during these seasons. This result is perhaps due to the fact that an outage is bothersome even if gas is not being extensively used since it entails, for many customers, relighting the pilot lights or waiting for the gas utility representative to relight the pilot lights. Also, while gas is used primarily for heating, a substantial proportion of customers in the ACT still use

[119] Note that because customers' willingness to pay to avoid and reduce the length of a gas interruption does not depend on the expected frequency or duration of the interruption, only a single willingness to pay estimate is required – unlike electricity and water.

gas out of winter. For instance, many customers use gas for cooking (56 percent) and hot water (50 percent), which is undertaken all year round.[120]

Respondents evidenced a willingness to pay of $9.99 to reduce the length of a winter outage by one hour and $6.99 to reduce the length of a non-winter outage by one hour. These estimates seem to be consistent with estimates for willingness to pay to avoid an outage, since the willingness to pay to avoid part of an outage is less than the willingness to pay to avoid the entire outage.

9.2.1.1.2. Timing of an Outage, Notification and Customer Information

If they are to occur at all, residential respondents prefer outages to occur during ‘weekdays after 8am’ or ‘weekdays after midnight’ rather than on weekends or on ‘weekdays after 6pm’. Respondents also prefer to have notice of an outage, and consider ‘seven day’s notice’ to be better than less than ‘seven day’s notice’ while considering ‘two week’s notice’ to be worse than ‘seven day’s notice’. Respondents tend to be forgiving of not receiving notice if the outage is due to an emergency.

Respondents prefer having a person answer the phone when they call the water utility rather than a voice-message machine. All of these results mirror those for electricity outages. However, the preferences are uniformly less strong in relation to gas outages than electricity outages (but still significant). This result is consistent with the lower willingness to pay to avoid a gas outage relative to that for electricity outages. Residential respondents evidence less concern about gas outages in general, both the frequency and the other attributes, than about electricity outages.

9.3. Commercial Customers’ Willingness to Pay for Reliability

Tables G3 and G4 give the model and willingness to pay statistics for commercial respondents’ choices among gas reliability scenarios. The specification is the same as for residential respondents except that the number and length of outages is not differentiated by season. Business customers use gas in non-winter seasons more extensively than residential customers, which is perhaps the reason for this difference in specification.

Like residential customers, commercial respondents evidenced a lower willingness to pay to avoid a gas outage than to avoid electricity or water outages. The willingness to pay to reduce the length of outages is considerably less than the willingness to pay to avoid an outage, as expected.

Commercial respondents consider the best time for gas outages to be weekdays after midnight. Other than that time, they prefer gas outages to occur on weekends rather than during normal business hours (weekdays after 8am or 6pm).

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[120] For further details see summary of findings from the recruitment interviews in appendix U.

Notice is valued highly, as for electricity and water outages. There is no significant difference in preferences for different lengths of notices, but the point estimates imply that business respondents consider two week's notice to be best, better even than one month's notice. Lack of notice is forgiven if the outage is an emergency.

As for other outages, respondents greatly value having a person answer the phone when they call the gas utility rather than obtaining a voice message. Having an account manager is not considered as useful as simply having a person answer the phone. This lack of interest in an account manager is the same as found for water outages and overflows and, as stated in relation to those events, could reflect a concern that the account manager will not necessarily be available when the customer calls.

Table G3: Commercial Customers' Choice among Gas Reliability Scenarios

Variables	***Estimates***	***Std. err.***	***T-stat***
Price as share of current bill	-4.8525	0.4444	-10.918
Number of outages: mean	-0.2232	0.0397	-5.623
standard deviation	0.2705	0.0632	4.280
Length of outages in hours: mean	-0.0762	0.0090	-8.437
standard deviation	0.0419	0.0104	4.023
Winter: mean	-1.0415	0.1359	-7.664
standard deviation	1.2114	0.1683	7.200
MF after 8am	-0.4466	0.1334	-3.348
MF after 6pm	-0.2275	0.1314	-1.731
MF after midnight	0.2979	0.1298	2.296
Weekdays	0.1982	0.2025	0.979
1 day's notice	0.6116	0.1911	3.200
2 day's notice	0.7315	0.1822	4.014
5 day's notice	0.6439	0.1852	3.476
7 day's notice	0.6695	0.1867	3.587
Two week's notice	0.9034	0.1909	4.733
One month's notice	0.6161	0.1905	3.235
Any notice: standard deviation	0.7476	0.1980	3.775
Emergency	0.4838	0.1817	2.662
Person answers: mean	0.6959	0.1288	5.402
standard deviation	0.8614	0.1738	4.956
Acct manager: mean	0.4050	0.1212	3.342
standard deviation	0.6532	0.2070	3.156

Table G4: Commercial Customers' Willingness to Pay Regarding Gas Outages (per customer, per event, expressed as share of customer's current gas bill and in dollars)[121]

	Mean	***Std. Dev.***	***25tile***	***Median***	***75tile***
To avoid an outage					
Share of bill	0.0460	0.0560	0.0078	0.0460	0.0838
Dollars	228.86	925.65	7.78	47.65	148.34
To reduce length by 1 hour					
Share of bill	0.0157	0.0087	0.0100	0.0157	0.0216
Dollars	78.25	223.88	8.12	18.41	49.64

9.4. Aspects not Covered in the Choice Experiments

9.4.1. Safety

The study results indicate that customers are generally not concerned about the safety of the gas network. In the recruitment interviews, there were also high levels of total agreement with the statement 'you don't have concerns about the safety of the natural gas network' (89 percent of residential, and 85 percent of commercial respondents).

This is consistent with the qualitative work, which indicated that customers tend to perceive safety in respect to their use of a utility (such as use of an appliance), and that they take for granted that utility services are provided to them in a safe manner.

9.4.2. Environment

Specific issues relating to the environment did not arise in the initial research phase of the project (with the exception of those relating to water, as discussed previously). Interestingly, however, in the qualitative research when participants were asked about their perceptions of electricity relative to natural gas, a few participants noted that gas had environmental benefits over electricity, although most participants did not consider gas and electricity in this context. Across all the residential and business focus groups, participants perceived electricity as being distinctly different from gas. No participant conveyed the impression that they considered electricity and gas as a more holistic and interchangeable entity (eg, energy).[122]

[121] Note that because customers' willingness to pay to avoid and reduce the length of a gas interruption does not depend on the expected frequency or duration of the interruption, only a single willingness to pay estimate is required – unlike electricity and water.

[122] See page 35 of ACNielsen's qualitative report, attached as appendix L.

10. CONCLUSIONS AND RECOMMENDATIONS

The study indicates that customers in the ACT are willing to pay for existing levels of service reliability for electricity, gas, water and wastewater. Indeed, the study suggests that there are a number of potential improvements that could be made to service levels, which customers might be prepared to pay for. This includes:

- reducing both the frequency and length of service interruptions;
- having a person answer inquiries at the ActewAGL call centre instead of an automatic voice answering system; and
- scheduling planned maintenance out of standard business hours for commercial customers and during the day on a weekday or after midnight for residential customers.

Given that the merit of changing service standards depends not only on customers' willingness to pay but also on cost, we recommend that ActewAGL develop a range of specific network development options. The cost of these options can then be assessed against the willingness to pay estimates, to help formulate a future strategy for the network.

The study confirms that the practice of notifying customers prior to a planned interruption is highly valued by them, and should continue as a high priority. A minimum of one day's notice should be given to customers. Lengthy periods of notification should not be mandated, however, given that timing was not found to be of significant concern to customers. Where possible, residential customers indicated that they would prefer receiving 7 day's notice (to any more or less notice), while commercial customers would prefer receiving two week's notice (to any more or less notice). Similarly, the method of notification was not found to be a particular issue for customers. Where possible however, residential customers would appreciate receiving notice either by mail or a letterbox drop. Commercial customers would generally appreciate receiving notice either by mail or fax.

The study also indicates that onerous requirements relating to other customer-related service standards – such as appointment windows, response times to customer queries, and promptness of new customer connections - are not warranted, as customers derive little value from these. Customers are generally quite forgiving when it comes to these aspects of the utility service, indicating that they would be satisfied as long as they could see that ActewAGL was acting 'reasonably' in response to the issue or request and could be considered as 'doing its best' under the circumstances.

Conclusions and recommendations specific to each product segment are outlined below.

10.1. Electricity

The study indicates that customers dislike incurring momentary electricity outages, flickering of lights and power spikes/surges, suggesting that ActewAGL should more closely monitor these events.

The study indicates that customers take for granted that the electricity service is provided to them in a safe manner, suggesting that a standard level of network safety should simply form part of the standard utility service.

Commercial electricity customers indicated a willingness to pay for an account manager in the study, in preference to relying on the ActewAGL call centre for information, suggesting that ActewAGL should give consideration to establishing network account managers for large electricity commercial customers.

Mixed results were obtained relating to the issue of undergrounding in the study. While this was not identified by ActewAGL as a topic of particular interest for the study, it did arise in both the qualitative and quantitative work. The qualitative research suggested that customers were unwilling to pay to replace electricity cables underground (in the context of reducing tree-trimming requirements), however, almost a quarter of customers, unprompted, raised it as a potential improvement that could be made to the electricity service in the recruitment survey. Qualitative study results suggest that respondents are likely to have made these suggestions from a combination of perspectives, such as tree-trimming, visual amenity, or improved reliability.

Overall, the study results support the case for further analysis of the merits of undergrounding. In the first instance, we suggest that the estimates of customers' willingness to pay for reliability be used in cost-benefit analysis to assess the merits of undergrounding cables (with respect to its reliability benefits). Also, as noted previously, given customers' preference for reliability, the results also suggest that ActewAGL should undertake further analysis of the impact of trees and trimming requirements on service reliability, as well as any network options which would help to address this.

Customers exhibited a lack of interest in (and willingness to pay for):

- interval metering;
- pre-payment meters;
- solutions to reduce tree-trimming requirements, including aerial bundled cabling; and
- provision of a generator to keep vital equipment functioning, in the event of a 4 to 8 hour outage during business hours.

There was a mixed reaction amongst business customers about the provision of an energy efficiency advisory service by ActewAGL in the qualitative research, suggesting that this service could be offered on a case-by-case basis.

The qualitative research suggests that customers perceive electricity as being distinctly different from gas, and tend not to perceive electricity and gas as a holistic and interchangeable entity (eg, energy).

10.2. Water and Wastewater

While customers expressed a willingness to pay to avoid severe water restrictions, customers also expressed a distinct unwillingness to pay to avoid regular, low-level water restrictions (stage one or two), or irregular (less frequent than everyday, all year, every year) restrictions of stage three or more. As noted previously, the findings of the study suggest that there are two potential reasons for this. First, any loss of customer satisfaction (or utility) attributable to a forced reduction in water consumption (and associated inconvenience) may be offset by an increase in utility attributable to some 'novelty' factor inherent in having water restrictions in place (eg, a 'feel good' factor about using water 'responsibly'). Alternatively, customers may not be willing to pay to avoid less severe restrictions because these restrictions do not affect their water consumption (and therefore inconvenience). While the study cannot explain which of these scenarios is most likely to be the case, the results do suggest that the existing water supply security standards in the ACT warrant further consideration. As a first step, we suggest that ACTEW/ActewAGL update the demand response assumptions/forecasts which underpin these standards.

The study confirms that customers would be prepared to use and pay for water from a recycling scheme for non-drinking purposes. Providing further insight into these preferences, the qualitative research on this issue indicated that:

- customers are willing to use recycled water for uses such as garden watering and toilet flushing because they perceive it as a cheaper and more efficient source of water, rather than due to environmental concerns;
- customers perceive that it is inefficient that the existing water supply is of drinking quality, yet only a small portion of the water supplied is used for this purpose; and
- if asked to choose between recycled water or fresh water from a dam, customers are likely to choose the cheapest option.

In order to progress this issue, we suggest that ACTEW/ActewAGL undertake further work on detailing the possible recycling options, including their cost. These should then be assessed in the context of other water supply options.

The study indicates that customers take for granted that the water/wastewater service is provided to them in a safe manner, suggesting that a standard level of safety should simply form part of the standard utility service.

Customers exhibited a lack of interest in (and willingness to pay for) water filtration at the time of treatment, prior to transportation, at the time of the focus groups. At the time, customers perceived Canberra's water supply to be of excellent quality, and indicated a preference for filtering water themselves over having it filtered at the time of treatment.

10.3. Gas

Gas was rated as the most highly reliable service provided by ActewAGL. In the qualitative research customers indicated that they perceived the gas network as 'totally' dependable.

While gas is generally considered less safe than electricity (due to the flame), the study indicates that customers take for granted that the gas service is provided to them in a safe manner, suggesting that a standard level of network safety should simply form part of the standard utility service.

Customers exhibited a lack of interest in (and willingness to pay for):

- a 'pilot light re-ignition' service in the event of a disruption; and
- re-laying gas service lines deeper in the ground, or sleeving the existing pipes in metal protective casing, to reduce the risk of third parties 'hitting' gas mains or service lines.

Customers confirmed that the use of 'warning tape' to indicate the depth of mains/lines and the availability of 'service maps' was of considerable value, confirming that this service should be maintained.

There was a mixed reaction amongst business customers' focus groups about the provision of an energy efficiency advisory service by ActewAGL, suggesting that this service could be offered on a case-by-case basis.

The qualitative research suggests that customers perceive electricity as being distinctly different from gas, and tend not to perceive electricity and gas as a holistic and interchangeable entity (eg, energy). That said, customers do perceive that gas has environmental benefits over electricity. They also prefer gas for space heating, boiler heating, and cook-top heating. Customers noted a preference for gas heating in the qualitative research because it is perceived as instant, relatively inexpensive, and providing 'a more pleasant heat'. Gas was not preferred for oven heating, given that it was perceived to leave a particular 'taste' in food.