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Australian Energy Market Operator

Consumer Risk Preference Values

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Glossary

Acronym	Full name
AEMO	Australian Energy Market Operator
ABS	Australian Bureau of Statistics
CDP	Candidate Development Pathway
CRM	Consumer Risk Metric
CRRA	Constant Relative Risk Aversion
DER	Distributed Energy Resources
ISP	Integrated System Plan
NEM	National Electricity Market
ODP	Optimal Development Pathway
VRE	Variable Renewable Energy
RP	Risk Premium
WTP	Willingness to Pay

Executive summary

Background
The National Electricity Market (NEM) is undergoing a transformation due to the rapid retirement of coal-fired power generation, high gas prices, accelerated deployment of distributed energy resources, and digitisation. These changes present risks to residential consumers in several ways if the transformation is not well managed, for example by introducing the risk of wholesale electricity prices being more expensive and significantly more variable. However, the impacts on consumers are not uniform. Households and retail business consumers are less impacted by direct wholesale price fluctuations, but they still see hedging costs passed on to their bills and face uncertainty around the future prices they will have to pay.

To some degree, decisions within the Integrated System Plan (ISP) can influence the uncertainty surrounding electricity prices. In particular, decisions can have an impact on the trade-off between the price of electricity and the risks to residential consumers. One prominent concern is over-investment, where the expenses associated with constructing and maintaining infrastructure for renewable energy integration can be transferred to consumers, potentially leading to escalated electricity costs. Conversely, there is the challenge of underinvestment, which can result in reliability issues and power shortages, negatively impacting consumers.

Given the significance of the ISP as a determinant of the evolution of the NEM, it is beneficial for the Australian Energy Market Operator (AEMO) to integrate residential consumer risk preferences with respect to price volatility more formally into the ISP process. Incorporating consumer risk preferences will help guide better consumer outcomes.

In the context of electricity markets, quantifying consumer risk preferences and incorporating them into decision-making hasn't been done before. In fact, consumer risk preferences are very rarely considered in decision-making in any infrastructure class. One reason contributing to this is the technical difficulties in both measuring consumer risk preferences and then applying them in practice to decision-making. As a result, this project involved an exploratory approach that trialled and tested a number of potential methods.

Importantly, the focus of this project is on the attitudes of residential consumers – we don't examine what is happening in wholesale or financial markets where much of the short-term volatility is effectively managed.

Process
Deloitte has measured consumer risk preferences relating to the energy market using a consumer-centric design process approach. This approach includes gathering data from three sources: live focus groups, online surveys and virtual focus groups. Some elements of a deliberative engagement approach were incorporated into the focus groups.

The data gathered has been used in statistical analysis to provide quantitative insights. In addition to gathering quantitative data, qualitative insights were gleaned from focus group discussions on consumer perceptions and knowledge regarding electricity networks and markets.

These methods aimed to capture the broadest possible range of residential energy consumers and their risk preferences, considering the various consumer categories covered by the NEM, which comprises approximately 9 million Australian customers.

An important part of this project was co-development with AEMO, and decisions made in conjunction with them occurred throughout.

Findings
Qualitative insights
In tandem with quantifying consumer risk preferences, this project seeks to gain a broader understanding of participants' knowledge of the electricity market, their sentiments towards its future shift and their understanding of risk. The insights gleaned hold significant relevance within the framework of ISP for future

energy systems. As these aid AEMO in making informed choices among diverse candidate development pathways, it offers a nuanced perspective that extends beyond quantitative metrics. Of particular importance is the exploration of preferences related to electricity price volatility, a factor that directly impacts consumers. Moreover, it underscores the importance of enhancing public understanding regarding the ISP, AEMO's role, and the intricacies of the transmission network.

Participants displayed a broad familiarity with electricity generation, transmission, and distribution but lacked an understanding of finer details. Most were aware of the shift towards renewables, emphasising visible changes like increased wind farms and solar installations. Participants also recognised shifts in their own energy usage, emphasising efficiency and sustainable sourcing. However, awareness of changes in transmission and distribution networks was limited.

While consumers acknowledged the necessity of transitioning to renewables due to environmental concerns, a critical issue emerged. Many were hesitant to fund the transition themselves, primarily due to a lack of clarity on what's changing, how it directly benefits them, and the costs of an alternative. While consumers understood how electricity reaches their homes, substantial knowledge gaps were observed concerning the commercial aspects of the supply chain and infrastructure funding.

Consumers were primarily focused on changes in generation and usage, often overlooking the need for infrastructure changes to support the network and the transition to renewable energy. However, they were receptive to the logic that such changes were necessary to align with evolving energy patterns.

In both our focus groups and online survey, most consumers preferred to invest early to mitigate the risk of future price volatility. While opinions vary about the upper limit individual consumers would be prepared to pay, there is a reluctance for consumers to pay too much for this transition. This is especially true in a climate of increasing living costs and electricity expenses.

Valid Responses

Obtaining 'rational' responses regarding attitudes towards risks proved difficult. Even after multiple rounds of refinement involving focus groups, two pilot surveys, and a final survey, this difficulty persisted. Responses were deemed to be 'rational' (henceforth known as 'valid') if the answers to key questions relating to the consumer's willingness to pay (WTP) for reduced volatility in their bills were logically consistent. Additionally, focus group responses were removed if participants responded more than $1000 for the willingness to pay (WTP) questions to maintain consistency with the boundaries of the survey questions. Section 5.3outlines how the logical consistency of the responses was assessed.

In the forums, out of 82 total responses, 46 (56%) answered both questions in a valid way and responded with $1000 or less for the WTP questions. In the survey, out of the total 2340 responses, 555 (24%) answered both questions in a valid way.

Scenario Preference

A scenario preference question asked participants to choose between two hypothetical electricity investment scenarios, "early investment" and "wait and see." Both investment strategies had different costs and benefits, mainly focused on the impact of investment timing on potential future electricity bills. The scenarios specifically illustrated how investment decisions in the energy network influence the volatility of energy prices for consumers. Rather than conceptualising energy investment as something that affects Australia as a whole, it aims to individualise the impacts of investment decisions.

Importantly, this question is designed without future potential bill ranges or immediate bill increases. By posing the question of investment strategy preferences before introducing concrete numerical data, we encourage participants to think in broader, conceptual terms rather than immediately diving into practical considerations.73% of people in the focus groups and 59% of people in the surveys expressed a preference for early investment over wait and see.

WTP based estimate

We have two approaches that provides estimates for WTP (as well as degree of risk appetite). These are:

- Direct WTP estimate
- Holt-Laury based estimate.

The WTP question asked participants how much they would pay to reduce their volatility to a certain range. There were five ranges: $1000, $750, $500, $250 and $0. This question builds on the more conceptual scenario question and encourages consumers to think about the price-volatility trade-off in explicit cost-benefit terms by removing any other factors affecting decision-making.

This question was designed to have applicability as a consumer risk metric. By asking consumers about their willingness to pay to maintain different bill ranges, a relationship between willingness to pay and bill range is created. Using this relationship, Deloitte can estimate a dollar value of the willingness to pay for the different bill ranges seen under different ISP development paths. Chapter 7 contains the process of calculating a risk metric from the willingness to pay estimate. After adjusting for the interpretation of the timeline of benefits (to a 15-year horizon), this question indicates that consumers are willing to pay 2.72 cents to reduce the bill range by $1.

An addendum to the previous question asked about consumers' willingness to contribute financially towards Australia's efforts to achieve emissions targets and support electricity infrastructure development. Although not intended to be turned into a consumer risk metric, it provides valuable insights into consumer values. Consumers were willing to pay more when the question was framed in the context of emissions reduction than transmission infrastructure investment.

Holt-Laury based estimate

The final question, the risk preference question, asked a modified version of the Holt-Laury Test. The Holt-Laury test is a survey question often used in academia to understand how people make choices when faced with different levels of risk and uncertainty. In this modified version, respondents were presented with scenarios revolving around the possibility of increased energy bills. When compared to the standard Holt-Laury test used in academia there is an important difference in that respondents are making choices between different levels of costs rather than the conventional question that involves monetary gains.

The purpose of this question is to quantify participants' level of risk aversion or risk-seeking behaviour in the context of electricity bills. The average level of risk preference can be estimated by a coefficient in a utility function: a Constant Relative Risk Aversion (CRRA) utility function, which can be applied as a consumer risk metric.

This question was designed to have applicability as a consumer risk metric. By eliciting the risk preferences of consumers, it is possible to place a dollar value on the volatility of different bills. Using this relationship, Deloitte can estimate a dollar value that represents the perceived cost to consumers of bearing risk under different ISP development paths, this value is called the Risk Premium (RP). Chapter 7contains the process of calculating a risk metric from the risk preference question. The median coefficient of constant relative risk aversion (cCRRA) was -1.48 for the focus groups and -0.14 for the survey. The cCRRA are negative as we are dealing with losses, rather than gains as conventional. Both estimates fall within the wide range of estimates in the literature, with participants relatively less risk-averse than most studies.[1]

Applying the cCRRA of -1.48 to electricity bills means that where there's a 50% chance of the electricity bill being $1700 and a 50% chance of it being $1800 compared to a certain bill of $1750, a $1.00 risk premium is necessary to compensate for the added uncertainty.

[1] 4 See Chetty (2006), Campo et al. (2011), Friend and Blume (1975), Gandelman and Hernández-Murillo (2013), Garcia et al. (2003), Gordon and St-Amour (2004), Hansen and Singleton (1983), Kapteyn and Teppa (2011), Layard et al. (2008), Mankiw (1985), Szpiro (1986), and Weber (1975).

Results comparison

While these two methods reflect a direct and an indirect means to arrive at a measure of risk preference, direct numerical comparisons between the two methods may not be highly informative due to the variability in RP values caused by changes in the probability distribution.

For illustrative purposes, it is possible to rebase both the WTP and the RP estimates to a range of $1000. Taking focus group results for WTP over a 15-year time horizon and RP, both estimates are approximately equal. Completely eliminating the bill range relative to the base case yields a WTP of $27 and RP of 25.25 (mean) and a WTP of $27 and RP of $34 (median).

An innovative approach

Estimating consumer risk preferences in the context of the changing NEM is challenging. This report is a new and exploratory study, and its findings are innovative. They offer a starting point for understanding how consumers respond to energy market risks.

The insights from this report are a valuable first step in incorporating consumer risk preferences into ISP decision-making, but there's still much to learn. As we continue to modernise our electricity infrastructure, this report's findings can serve as a foundation for future research and policymaking.

1 Introduction and background

1.1 Purpose of this Report

The purpose of this report is to understand and quantify the risk preferences of NEM residential consumers. The results of this report are intended to be used by AEMO in developing the Integrated System Plan (ISP). AEMO's Cost Benefit Analysis guidelines (p.32) require AEMO to explain why the level of risk neutrality or aversion inherent in the candidate development path selected is a reasonable reflection of consumers' level of risk neutrality or aversion.[2]

Quantifying consumer risk preferences for transmission infrastructure development is innovative. This report highlights the exploratory and iterative nature of research in this realm.

There are several detailed purposes of this report:

1) To establish an approach to quantifying consumer risk preferences.
2) To analyse the qualitative themes from the focus groups with deliberative elements (focus groups) and online focus groups.
3) To present quantitative results from the survey and the focus groups.
4) To highlight learnings within each question for subsequent ISP planning.
5) To present our two proposed consumer risk metrics, including how survey and focus group results are translated into the metric.

1.2 Project Background

The increasing adoption of renewable energy sources, particularly solar photovoltaic (PV) and wind is reshaping the dynamics of the NEM in Australia, as well as electricity markets worldwide. This paradigm shift toward renewable energy generation has presented unprecedented challenges for electricity system operators. These challenges revolve around managing the variability and intermittency inherent in renewable energy sources and ensuring a real-time equilibrium between electricity supply and demand. The inevitable progression towards a sustainable and low-carbon energy future will only intensify these trends in the future.

The integration of Distributed Energy Resources (DER), for example, rooftop solar panels and battery storage, is further redefining the electricity landscape. DER empowers households and businesses to not only generate their electricity but also to contribute surplus power back to the grid. This transformative capacity has profound implications for reducing energy costs and carbon emissions.

Simultaneously, energy storage technologies, epitomised by batteries, are assuming an increasingly pivotal role within the NEM and other electricity markets worldwide. These storage solutions enable the accumulation of excess renewable energy, thereby enhancing grid stability and diminishing reliance on fossil-fuel power generation during peak periods. Another pivotal development within the electricity sector is energy demand management. This strategy, facilitated by smart grid technologies like demand response programs and real-time pricing mechanisms, equips electricity system operators with the means to effectively harmonise supply and demand. Consequently, this approach can yield reduced energy costs for consumers while bolstering grid reliability.

Recognising the imminent financial implications of these structural changes, some consumers are actively exploring innovative solutions to fortify their capacity to adapt to market variability. The cost of developing the requisite infrastructure to accommodate these transformations will inevitably be borne by consumers and/or taxpayers. The timing and manner of these infrastructural changes hinge upon a multifaceted matrix

[2] (2020) *Cost benefit analysis guidelines: Guidelines to make the Integrated System Plan actionable*: publication. Canberra, ACT: Commonwealth of Australia, p.32

of factors, including population dynamics, technology cost trajectories, energy reliability and affordability considerations, and consumer preferences.

The transformation of the NEM introduces a complex array of risks distributed across stakeholders within the energy supply chain. Consumers, as integral participants, bear a substantial share of these risks through their electricity bills. Among these risks, one prominent concern is over-investment, where the expenses associated with constructing and maintaining infrastructure for renewable energy integration can be transferred to consumers, potentially leading to escalated electricity costs. Conversely, there is the challenge of underinvestment, which can result in reliability issues and power shortages, negatively impacting consumers. Generators operating in the wholesale market face market-related risks, such as fluctuations in energy prices and demand. Additionally, governments, acting as policymakers and regulators, shoulder budgetary risks tied to supporting renewable energy initiatives and grid resilience. Effectively managing this diverse spectrum of risks while aligning with consumer preferences and affordability concerns is a formidable challenge in navigating the evolving energy landscape of the NEM.

AEMO navigates these transformative developments in its role as both market operator and national transmission planner in the NEM. AEMO has a role as the National Transmission Planner, including the publication of a biennial Integrated System Plan with associated regulatory provisions for transmission augmentation projects.

AEMO, as recognised through the National Electricity Rules and the Australian Energy Regulator's Cost Benefit Analysis Guidelines, ought to balance the risks associated with both over- or premature investment and under- or overdue investment. These two dimensions of investment carry their distinct risk profiles, which may not always align. As illustrated in the 2022 ISP, discussions often centre around the potential regret of not pursuing specific investments, underscoring the importance of evaluating the advantages of undertaking these investments promptly against the potential drawbacks of over-investment. This nuanced assessment aligns with consumer risk preferences and serves as a vital input into the decision-making process of AEMO. AEMO relies on this evaluation to determine the optimal investment equilibrium for the developmental trajectory of the NEM. Maintaining this equilibrium is essential for addressing the ever-evolving energy landscape and for meeting the needs and desires of consumers while successfully navigating the transition towards a sustainable and resilient electricity future.

This ambitious transformation of the NEM, anticipated to span approximately two decades, will significantly impact more than nine million consumers. The scope and scale of this investment ought to be equivalent to the risk preferences of NEM end-users, as they are the ultimate beneficiaries and bearers of the ensuing benefits. Ensuring a judicious alignment between the evolving energy landscape and the interests of the consumers will be pivotal in navigating this transition towards a sustainable and resilient electricity future.

2 Methodology

The purpose of this research is to better understand how consumers perceive and respond to risks within the NEM. This understanding will inform policies and decisions in the energy sector, ensuring they align with consumer preferences and needs, ultimately contributing to a more consumer-friendly and sustainable energy future.

It's important to recognise that both the electricity market and risk preferences are complex subjects. There's a great deal of nuance involved, and finding the right balance between simplifying concepts for focus groups and surveys while capturing the complexity of risk can be challenging. Our approach represents an exploratory effort to navigate this balance. The findings it yields provide a foundational understanding of how consumers respond to energy market risks, with the recognition that there is more to learn in the future. These insights will contribute to future research and policy development, ensuring that our energy policies align with consumer needs and preferences.

2.1 Project Scope and timing

To elicit risk preferences, Deloitte, in conjunction with Antenna and Octopus, conducted seven focus groups of up to 12 participants, an additional three online focus groups with five participants each, and a consumer survey of over 2000 participants.

These focused on:

- general demographic questions
- generic risk preference questions to determine the respondents' general risk preferences
- questions relating to electricity infrastructure investment timing
- questions focusing on the willingness to pay of consumers to reduce electricity bill volatility
- risk preference questions in the context of electricity bills
- questions investigating consumer willingness to pay to meet climate goals and contribute to electricity infrastructure investment.

2.1.1 Focus groups

Focus groups serve to provide insights into participants' understanding, perceptions, attitudes, emotions, and ideas concerning a specific area of interest. However, the effectiveness of these sessions in capturing valuable data hinges on the participants' level of knowledge about the discussed topic, as observed by Kitzinger (1995).[3] As the interaction of risk and electricity is complex, educating participants before discussion can yield more meaningful results.

Deliberative forums (and the deliberative approach in general) aim to do this and more. A deliberative forum is a structured discussion that brings together a diverse group of individuals to consider and evaluate different perspectives on a specific issue, with the goal of reaching a collaborative decision or recommendation. The forum aims to promote education and mutual understanding among participants. Deliberative public opinion data are highly valued because the participants can learn about the unique circumstances and interests of competing arguments through this process. As participants engage and become more knowledgeable, more thoughtful and informed statements are expected to emerge, leading to better-quality data.[4]

As articulated by Fishkin and Lushkin (2005), five fundamental principles underpin these deliberations: (a) participants should possess the necessary information to provide accurate input, coupled with adequate support; (b) the information presented must be balanced, encompassing both the pros and cons of the

[3] Kitzinger, J. (1995). "Qualitative research. Introducing focus groups." *BMJ (Clinical research ed.)*, *311*(7000), 299–302.
[4] Gastil, J. and Levine, P. (2005) The Deliberative Democracy Handbook (Jossey-Bass, San Francisco).

subject matter, and (c) comprehensive; (d) voluntary engagement of participants is crucial; and (e) statements should be evaluated based on merit, rather than the identity of the speaker.[5]

The focus groups conducted by Deloitte and Antenna included all five of these elements to differing degrees.

(a), (b), (c): Almost one-third of the three-hour sessions was spent educating participants on the electricity market and risk.

Participants were educated on how energy is produced and distributed. There was discussion on how current energy usage and production trends are necessitating a modernisation of the electricity grid, as well as the challenges that accompany these changes. Such network modernisation, though necessary for meeting evolving energy needs, introduces uncertainty, particularly in timing, benefits, and costs. Furthermore, the overview underscores that the electricity market is subject to volatility and unpredictability. Factors like the closure of coal generators, fluctuations in energy demand, and emissions reduction initiatives can lead to price volatility, causing energy bills to fluctuate unexpectedly. The document highlights the trade-off between choosing lower risk for a more predictable energy supply (albeit with higher average costs) and embracing higher risk for potentially lower bills but greater variability and uncertainty. Additionally, it discusses consumer actions to mitigate risks, such as adopting energy-efficient technologies and rooftop solar systems. Education on the electricity market involved discussion on the production and distribution of electricity.

Education necessitated a trade-off between complexity and brevity. To ensure the information was as accurate and comprehensive as possible within constraints, AEMO provided feedback on the educational material. Furthermore, focus groups included a sector expert from AEMO to ensure accuracy in the discussion. Future research on this topic should be informed by the qualitative outcomes presented in section 4. Key to improving the deliberative approach is refining what participants already understand, allowing more time to discuss risk in the electricity market.

(d) Antenna took care to select participants who were voluntarily engaged in the discussion. A full description of how Antenna selected participants is available in their attached report and in section 5.1.1.

(e) Focus group participants noted their answers down on individual questionnaires as well as in discussions with the group. Crucially, participants were asked to write answers down before sharing them with the group. Qualitative and quantitative analysis acknowledges who makes certain points (through demographic analysis), but opinions and answers are assessed on merit.

The seven pre-survey focus groups provided rich qualitative and quantitative data as well as informing the design of the survey. The three online focus groups investigated and elaborated on the survey results. The sampling approach for focus groups prioritised geographic coverage. The pre-survey focus groups were held in four metropolitan areas: Sydney, Melbourne, Adelaide, and Brisbane and 3 regional areas: Ballarat, Goulburn and Rockhampton.

Each focus group was delivered as a structured discussion led by a skilled facilitator from Antenna. The content and questions were co-designed with AEMO and explicitly tailored to allow comparisons to the consumer survey.

2.1.2 Consumer Survey

The consumer survey was carefully planned, drawing insights from pre-survey focus groups to ensure the questions were relevant and effective. Deloitte then conducted a pilot survey involving around 200 participants, using their feedback to fine-tune the survey, guaranteeing that it was easily understandable and that the results would be useful. For the main survey, the participants were chosen based on NEM quotas, ensuring representation from different segments of the target population.

To determine the appropriate sample size for the survey, a formula was used that takes into account the desired confidence level and margin of error. The formula, denoted as n = [Z^2 * p * (1-p)] / E^2 accounts for various factors such as the Z-score for the confidence level, the estimated proportion of the

[5] Fishkin, J. and Luskin, R. (2005) "Experimenting with a democratic ideal: Deliberative polling and public opinion" Acta Politica, vol. 40, pp. 284-298

characteristic in the population, and the margin of error. For a 95% confidence level and a 5% margin of error, the specific values used were Z=1.96 (corresponding to the 95% confidence level), p= 0.5 (representing the maximum variability since no specific population was targeted), and E= 0.05 (indicating a 5% margin of error).

Upon plugging these values into the formula, the calculated sample size was approximately 385 individuals. Rounding this figure up, it was determined that around 385 participants would be needed to ensure a 95% confidence level with a 5% margin of error for the NEM population. This process aimed to provide a robust and reliable representation of the NEM population's Online focus groups.

After completion of the focus groups and survey, a sample of participants from the focus groups were selected to participate in additional online focus groups. These were selected randomly from groups held in Sydney, Melbourne and Brisbane. The purpose of these focus groups was to:

- sense check the qualitative findings from focus groups,
- sense check participants' understanding of the WTP questions and results,
- identify any differences between the focus group findings and the survey findings,
- sense check the illustrated results from the Risk Premium question,
- discuss any additional comments that could influence the findings.

2.2 Data analysis

Data was collected through the survey and focus groups and was collated by Deloitte. Preliminary results collected through the survey pilot phase were shared with AEMO and provided for feedback and discussion ahead of the online focus groups. After validating preliminary results and priority areas, Deloitte collaborated with Antenna to present and use the results in the post-survey focus groups.

The results of the survey and the focus groups were then analysed and compared against a criterion that determined if each response was considered valid. The valid responses were then weighted using certain variables within each of the data sets to eliminate bias. Outliers were also removed from the focus group data, so the boundaries of responses were consistent with that of the survey. Refer to section 5.3 for information on valid responses and outlier boundaries. These were then analysed to determine the overall risk preferences of the participants. Some of the analysis involved breaking down responses by demographic to provide a more detailed picture of the respondent's responses.

Further, a detailed analysis of the weighted results was undertaken to understand consumer risk preferences and to determine which metric is the most suitable to illustrate a consumer's risk preference. Deloitte undertook this analysis with support and input from Dr Stephen Cheung.

2.3 Ensuring a usable consumer risk metric

The purpose of delivering the focus groups and the survey was to create a consumer risk metric (CRM). Deloitte used a direct method to elicit participants' risk preference in the form of a WTP question and an indirect method in the form of an augmented Holt-Laury test. As such, while the focus groups resulted in useful information outside of this metric, emphasis was placed on ensuring a usable CRM.

In the focus groups, two questions were dedicated to the Holt-Laury Test and two questions were dedicated to WTP. The results of the Holt-Laury test can be turned into a risk premium. A risk premium is a measure of excess return that is required by an individual to compensate for being subjected to an increased level of risk. In the context of the electricity market, the risk premium is the 'additional compensation required by the consumer to avoid price uncertainty'. [6] The risk premium is defined as the difference between the

[6] Gagliardini, P., Ossola, E., & Scaillet, O., 'Time-Varying Risk Premium in Large Cross-Sectional Equity Data Sets' (2016) *Econometrica Journal of the Econometric Society* 84(3) pp.985-1046

expected payoff and the certainty equivalent. This is the cost of risk — it is the amount of money an individual would be willing to pay to avoid the risk associated with a certain scenario.[7] WTP refers to the maximum amount of money an individual is willing to spend or pay for a good or service. Standard deviation is typically expressed in absolute terms, which has the benefit of comparing the magnitude of variability across different datasets.

The focus groups provided useful information on both topics and informed the development of the survey. Specifically, the survey cut the four potential questions on risk metrics to two: one for the Risk Premium and one for the WTP.

Our hypotheses about the results from the WTP question are as follows:

- Participants will have a higher WTP as the range of volatility decreases.
- Some participants will not have the capacity or the willingness to pay for any range.
- Participants will have a higher willingness to pay in the focus groups, as they have received education on risk and the electricity market.
- Participants will have a higher WTP when they are told their money will go to either emissions reduction or transmission infrastructure investment.
- As cost-of-living increases, people will have a lower WTP.

Our hypothesis about the Risk Premium question is as follows:

- Most participants will be risk-averse.

Deloitte believed that WTP was likely to be the most appropriate option, due to its consistency and ease of interpretation (see Chapter 7). The value consumers place on price reliability can be measured through a WTP per standard deviation or per range estimate.[8]

<https://www.econometricsociety.org/publications/econometrica/2016/05/01/time-varying-risk-premium-large-cross-sectional-equity-data >.

[7] McAfee, R. and Lewis, T., *Introduction to Economic Analysis* (Saylor Foundation, 2009) <https://saylordotorg.github.io/text_introduction-to-economic-analysis/s14-04-risk-aversion.html>.

[8] *Abegaz, D., Hjorth, K., Rich, J., 2015. Testing the slope model of scheduling preferences on stated preference data. Working Paper.*

3 Focus group, pilot survey and survey question iteration

It proved very difficult to get rational responses for attitudes to risks from asking participants and this remained the case even after we refined the questions through focus groups, two pilot surveys and a final survey.

To be considered a valid response, participants had to meet two criteria. First, participants had to report an increasing, or constant WTP as the potential increase range of their bill decreased. So, a participant ought to be willing to pay more for a range of $250 than for a range of $500, more for a range of $500 than $750, and so on.

Secondly, participants were expected to provide logically consistent responses to the modified Holt-Laury Test. The Holt-Laury Test is used to understand how people make decisions with varying levels of risk and uncertainty. In the modified version, respondents were presented with scenarios revolving around the possibility of increased energy bills, signifying potential losses rather than conventional monetary gains. Logical consistency in this context meant that participants should consistently choose option B for question 6, where a 100% chance of losing $250 (option B) is a more favourable choice compared to a 100% chance of losing $1300 (Option A). It was also emphasized that once a participant switched from option A to option B, they should maintain this choice to ensure the coherence of their responses.

Additionally, focus group responses were removed if participants responded more than $1000 for the WTP questions to maintain consistency with the boundaries of the survey questions.

The valid response rates are shown in Table 3.1 below:

Table 3.1 Valid response rates

	Focus group	Pilot 1	Pilot 2	Full survey
Valid response rate	56% (46/82)	26% (52/198)	28% (54/195)	24%

Low levels of internal consistency across risk elicitation tasks is very common in the literature. For instance, Lichtenstein and Slovic's (1971) [9] pioneering work attempted to compare risky choice behaviours using different elicitation tasks, revealing significant discrepancies in participant responses between direct choice and numerical valuation methods. These disparities, termed as preference reversals, initiated a subsequent exploration to reconcile these inconsistencies.

Isaac and James (2000)[10] further investigated this inconsistency, showing that individuals often displayed conflicting risk preferences across different elicitation tasks. Such inconsistencies, where individuals exhibiting risk aversion in one task showed risk-seeking behaviour in another. This type of finding continues to be seen including in studies by Berg, Dickhaut, and McCabe (2005)[11], Loomes and Pogrebna (2014)[12],

[9] Sarah Lichtenstein and Paul Slovic. Reversals of preference between bids and choices in gambling decisions. Journal of Experimental Psychology, 89(1):46–55, 1971
[10] R. Mark Isaac and Duncan James. Just who are you calling risk averse? Journal of Risk and Uncertainty, 20(2):177–187, 2000.
[11] Joyce Berg, John Dickhaut, and Kevin McCabe. Risk preference instability across institutions: A dilemma. Proceedings of the National Academy of Sciences, 102(11):4209–4214, 2005.
[12] Graham Loomes and Ganna Pogrebna. Measuring individual risk attitudes when preferences are imprecise. The Economic Journal, 124(576):569–593, 2014.

Sprenger (2015)[13], and Pedroni, Frey, Bruhin, Dutilh, Hertwig, and Rieskamp (2017)[14]. This trend underscores the prevalence of lack of internal consistency in risk elicitation, challenging the notion of a unified approach to understanding individual risk behaviour.

With this understanding in mind, between the focus group and the final survey, the wording of questions underwent significant changes. The first pilot survey was informed by learnings from the focus groups. In the first pilot survey, it quickly became apparent that participants were struggling to comprehend the questions related to their risk preferences, evidenced by low rates of valid responses (52 out of 198, or 26%). This unexpected hurdle served as a valuable learning experience, emphasising the need for clarity and precision in survey design. Rather than settling for low rates of valid responses, the research team recognised this as an opportunity for enhancement.

For the second pilot survey, the research team went back to the drawing board, carefully analysing the feedback and responses from the first pilot. They took a step-by-step approach to revising the survey questions, making them more accessible and concise. This iterative process involved refining the wording, providing clearer context, and ensuring that the questions truly captured the nuances of risk preferences in the NEM.

Despite the efforts put into the second pilot survey, the responses suggested that the challenge of comprehension persisted, evidenced by eerily consistently low rates of valid responses to the first pilot survey (54 out of 195, or 28%). The team took this as evidence, through iteration, that the low valid response rates were attributed to reasons other than the formatting, structuring, and ordering of survey questions. However, instead of resigning completely to the results, the team recognised that there were learnings from both pilot surveys that could still be implemented into the full survey.

The research team consulted with experts in survey design, behavioural economics, and energy markets to gain fresh perspectives on the survey questions. This collaborative approach led to further refinements and adjustments. The team then conducted cognitive interviews with potential survey participants to identify specific areas of confusion and made additional revisions based on this feedback. Table 3.2below provides an example of changes made to the willingness to pay question from the focus group to the final survey.

Table 3.2 Examples of changes made to WTP question from focus groups thorough to final survey.

	Focus Groups	Pilot 1	Pilot 2	Final Survey
Context	The next questions ask how much you'd be willing to pay today to reduce uncertainty on your future energy bill. We'll present you with different scenarios where the uncertainty around your bill is reduced to a specific range, and you'll tell us how much more you'd be willing to pay today to have	In the next set of questions, we would like to know how much you are **willing to pay** on top of your current bill for a "lock-in contract" that reduces uncertainty in your future electricity bill. These values are for a single year in the future (that is, you are committing to pay more in a single year to ensure your bill stays in that range for that year). By choosing a lock-in contract, you can have peace of mind knowing that your future bills	We would like to know how much more you are willing to pay at the start of the year to limit increases in your electricity bill for that same year. By choosing to pay upfront, you can have peace of mind knowing that your future bills will fall within the specified range.	Imagine that the cost of your annual electricity bill will potentially increase or decrease by an unknown amount this year compared to last year.

[13] Charles Sprenger. An endowment effect for risk: Experimental tests of stochastic reference points. Journal of Political Economy, 123(6):1456–1499, 2015.
[14] Andreas Pedroni, Renato Frey, Adrian Bruhin, Gilles Dutilh, Ralph Hertwig, and Jörg Rieskamp. The risk elicitation puzzle. Nature Human Behavior, 1:803–809, 2017.

	that level of certainty.	will fall within the specified range.		
Question	I would be willing to pay $_____ more today if the uncertainty around prices in the future was kept to a range of [RANGE] on my annual bill.	"I would be willing to pay $100 more on my bill for a year if the uncertainty around prices that year was kept to a range of $500"	I would be willing to pay $_____ at the start of the year if I could be guaranteed that my total electricity bill for the same year would not increase by more than $1,000 when compared to last year.	How much would you be willing to pay to limit your annual electricity bill increasing anywhere within the below range?
Mechanism	Free number text	Yes/No	Slider $0-$1000	Slider $0-$1000

The persistently low levels of understanding throughout the surveys suggest that question presentation and wording had a small impact on participants. In fact, a paper by Andrew Meyer, 'The formation and revision of intuitions', notices, through the observation of 59 new studies, the minimal impact wording changes may have on respondents' answers, with the concluding remarks mentioning "those whose thoughts most require additional deliberation benefit little from whatever additional deliberation can be induced".[15]

In summary, the journey from the first pilot survey to the completion of the full survey of NEM consumer risk preferences was marked by a commitment to iterative improvement and experimentation. This process serves as a valuable reminder of the importance of flexibility and determination in the pursuit of meaningful research outcomes and will help fuel decision-making around prospects aimed at measuring consumer risk on a large scale, whether for purposes of AEMO or otherwise.

[15] Andrew Meyer, Shane Frederick, The formation and revision of intuitions, Cognition, 240, 2023.

4 Qualitative themes from focus groups

The following section represents a summary of Antenna's Qualitative report, provided as an attachment to this report.

The insights gleaned from focus groups hold significant relevance within the framework of ISP for future energy systems. As these aid AEMO in making informed choices among diverse candidate development pathways, they offer a nuanced perspective that extends beyond quantitative metrics. Of particular importance is the exploration of preferences related to electricity price volatility, a factor that directly impacts consumers. Moreover, it underscores the importance of enhancing public understanding regarding the ISP, AEMO's role, and the intricacies of the transmission network. It is evident that knowledge gaps exist, as revealed by questions posed to participants regarding their comprehension of the current energy supply landscape. While a basic understanding of electricity generation and distribution exists among consumers, there are significant deficits in grasping the commercial dimensions of the supply chain, including how infrastructure costs are covered.

The seven pre-survey focus groups provided rich qualitative and quantitative data as well as informing the design of the survey. The pre-survey focus groups were held in Sydney, Melbourne, Adelaide and Brisbane and 3 regional areas: Ballarat, Goulburn and Rockhampton. The two online focus groups were administered after the survey data collection. They provided an opportunity to enrich the understanding of the data collection of the focus groups and survey results through further discussion and consultation with a subset of the original in-person population.

This section focuses on the outcomes of the focus groups whose purpose was to:

- sense check participants' understanding of WTP values
- identify any differences between the focus group findings and the survey results
- discuss any additional comments that could influence the findings.

Refer to section 5.3Valid Responses for our methodology on determining valid responses for the focus groups and survey. In the focus groups, out of 82 total responses, 46 answered both the Holt-Laury questions in a valid way and responded with $1000 or less for the WTP questions.

4.1 Understanding of their Current Electricity Supply

Several key insights regarding public awareness and perceptions of Australia's energy landscape emerged from the analysis of the qualitative data.

Firstly, it's evident that there is a significant reliance on coal for energy generation in Australia, with coal being the predominant source of energy, estimated by participants to contribute to around 70% of the nation's energy supply. Gas, on the other hand, is less frequently mentioned and appears to be less prominent in the public's perception of energy sources. Solar and wind energy are viewed more favourably, with participants readily associating these renewable sources with electricity generation. Hydroelectric power, particularly from Tasmania via Basslink, is also acknowledged but to a lesser extent.

> *"What is the cable that runs from Tasmania into Victoria? What kind of voltage does that carry?"* ***Female, Brisbane***

Notably, there exists a misconception among a minority of participants regarding the use of nuclear energy in Australia. However, this misconception is typically corrected by others in the sessions, highlighting a general awareness of the absence of nuclear power generation in the country.

Regarding energy distribution, participants distinguish between transmission and distribution but often perceive them as two facets of the same network. While they appreciate the analogy of highways and roads to describe this delineation, it's clear that this distinction may not be as prominent in their minds. The visibility of transmission lines and pylons contrasts with the inconspicuous nature of the distribution network.

Rooftop solar energy is prevalent and well-understood among participants, with a general awareness of schemes introduced by energy retailers. However, those who have adopted rooftop solar express concerns about diminishing returns over time, reflecting a nuanced understanding of the financial aspects of solar energy.

> *"Rooftop solar has been around for a while and has been steadily increasing over time. "* ***Male, Rockhampton***

Despite the prevalence of rooftop solar, none of the participants in the focus group reported having battery storage systems in their homes, primarily due to perceived high costs. The expectation is that battery prices will decrease in the future, making them a more attractive option.

Regarding the energy supply chain, participants outside of Queensland generally recognise that different companies manage generation, infrastructure, and retail aspects. However, they may not fully comprehend the intricacies of each company's role. In Queensland, where the government owns much of the supply chain, there's a clearer understanding of this arrangement.

> *"Queensland governments still owns our generating capacity. We have Energex, which is our distribution arm, and then the government decided to have a free market in terms of retail. So, that's Queensland. Other states have other things in place."* ***Male, Brisbane***

Participants have limited knowledge of the existence of a traded market for electricity, with many assuming contractual agreements govern energy transactions. The supply charges on their bills are not automatically associated with infrastructure costs, and this realisation often requires prompting.

While there's a belief that consumers ultimately cover infrastructure costs, the specific composition of the supply charge remains unclear to participants. Additionally, there's uncertainty about the extent of government involvement in regulating the energy sector, even in regions where government ownership is more significant, like Queensland.

In summary, the focus groups highlight the complexity of the topic and the lack of understanding of the intricacies of Australia's energy landscape, including the diversity of energy sources, the distinction between transmission and distribution, and the role of government and market forces in the energy sector.

4.2 How the Supply of Electricity Supply is Changing

Consumer awareness of Australia's evolving energy landscape is growing, with a general recognition of the shift towards renewable energy sources. Participants in the focus group have observed the physical presence of more renewables, such as wind and solar farms, both in Australia and abroad. Additionally, renewables are becoming an integral part of retail energy offerings, with consumers increasingly opting for renewable energy plans.

> *"There's more renewables, there's more of a push to renewables. There's more pressure to have renewables and to get rid of coal and gas."* ***Female, Sydney***

The study also reveals that consumers are conscious of their own electricity consumption and are taking steps to become more energy efficient. This awareness is driven by greater transparency in monitoring energy use and improvements in the energy efficiency of household appliances. However, the adoption of energy-efficient devices can be hindered by perceived high costs.

The rise of electric vehicles (EVs) is noticeable to participants, even though EV usage remains relatively low in the overall population. They recognise that EVs have an impact on household electricity consumption and are becoming a part of Australian living. Smart metering and real-time energy consumption tracking through mobile apps provided by retailers are also gaining attention.

> *"Yeah, which is going to be pretty crazy for everyone plugging their chargers at 6:00 at night."* ***Male, Melbourne***

Despite consumers' awareness of changes in energy generation and usage, there is comparatively little consideration of the infrastructure needed to support these changes. Consumers tend to focus on the ends of the supply chain, such as generation and usage, without fully recognising the need for infrastructure updates to accommodate shifting energy demands. When prompted, they acknowledge the necessity of infrastructure changes.

Costs of electricity have risen, but consumers often struggle to understand the reasons behind these increases. Regional variations in electricity pricing contribute to confusion among consumers, who also compare these rising costs to alternatives like solar power to alleviate their financial burden.

> *"People that are paying $1.70 for fuel up in Sydney and we are paying $1.90... we are getting slammed because we're in the country."* ***Female, Goulburn.***

In summary, consumers in the focus group exhibit a growing awareness of the transition to renewable energy and increasing energy efficiency. They are also cognisant of the impact of emerging technologies, such as electric vehicles. However, there is a need for greater consumer education and communication regarding the importance of infrastructure upgrades to support these changes and to address rising energy costs.

4.3 Sentiments to Change

Consumer attitudes toward the shift from fossil fuel generation to renewable energy in Australia vary significantly based on age, region, and economic factors. While there is enthusiasm for transitioning to renewables, there are notable concerns and differences in perspectives.

Younger Australians generally exhibit a more positive attitude and greater acceptance of the need for change to reduce greenhouse gas emissions. They are well-informed about climate change, renewables, and the importance of acting quickly to combat global warming. Many younger participants express a WTP more for renewable energy, viewing it as an investment in their future and the environment.

> *"I feel like speaking to people my kind of stage in life, which comfortable and have a home, but you're going to have a lot more choice. You're going to be a lot more informed and making those decisions to have more ownership over how your electricity is produced and generated when in your own home. I feel like that's the way it kind of has to go a bit more,*

> *because you can't rely on the government all the time and everything."* ***Female, Melbourne***

Conversely, some, but not all, older participants are more sceptical about the transition. Some express doubts about climate change and its severity, while others perceive renewables as more expensive than fossil fuel generation. Concerns about the timeframe of change and whether they will personally benefit from it are also raised. Affordability is a significant issue for older participants, especially those on fixed incomes, who may be reluctant to bear the financial burden.

> *"What's the point of spending so much money when I'm not going to get a return myself?"* ***Male, Ballarat***

In Queensland, where coal and mining are crucial to the economy, there is less enthusiasm for transitioning to renewables. Participants from these regions are concerned about the potential economic impact on their communities. Additionally, there appears to be a gap in communication regarding the shift to renewables and its importance for the future. Participants feel that more information and transparency are needed to help them understand the reasons behind the change and its benefits.

> *"You've got a hundred thousand school students who will wag school because they feel very, very strongly about the environment, but none of them will ever turn off a screen, or a ceiling fan, or an air conditioner, or shut the fridge. So, there's a little disconnect there between the amount of passion for not going to school and the amount of passion for actually the environment."* ***Male, Brisbane***

Overall, while there is general positivity about the shift to renewables, consumer attitudes are influenced by factors such as age, economic circumstances, and regional considerations. Addressing concerns related to affordability, providing clear information, and fostering understanding are essential steps in gaining broader consumer support for the transition to renewable energy.

4.4 Perceptions of Risk

The perceptions of risk among participants in the focus group sessions can be summarised as follows:

In general, participants have not considered the potential risks associated with making changes to our energy supply. Their concerns are primarily centred around the shift to renewable energy sources and their individual views on climate change and Australia's role in addressing it. Some participants express worries about the increasing costs of electricity and gas, with **one female** participant from **Goulburn** noting*, "I heard that electricity and gas are going up either 20% this year and 30% next year or 30% this year and 50% up again in the next few years,"* and a **male** participant from **Ballarat** mentioning *"price gouging."*

Outside of the formal sessions, consumers have not naturally contemplated the potential risks associated with transitioning from fossil fuels to renewables. Even when prompted during our discussions, they do not spontaneously identify risks. However, when prompted within the sessions, participants do acknowledge and understand the risks of cost volatility, reliability of supply, and meeting greenhouse gas emission targets. It is evident that these risks had not been previously considered by them. Upon being educated about the potential risks associated with changing our generation's approach while maintaining the same infrastructure, participants tend to focus on the more tangible and immediate impacts of such changes. Their primary concern is cost volatility, which they perceive as a tangible negative outcome, especially based on their recent experiences over the last few years. While blackouts represent a more significant impact, particularly in regional areas, participants view them as less likely to occur than cost volatility. Consequently, most participants rank blackouts as a secondary risk compared to price volatility. Additionally, participants consistently regard meeting greenhouse gas emission targets as a lesser concern, as they perceive it to have a less immediate impact on their cost of living and lifestyle.

> *"I was thinking maybe coal-powered generated electricity might be a little bit cheaper because there's so much availability of coal, whereas I don't know for sure, but maybe renewables are a little more expensive at the moment. "* ***Female, Adelaide***

In summary, the focus group participants have generally not extensively considered the potential risks associated with altering our energy supply. Their concerns primarily revolve around cost volatility, followed by blackouts, while greenhouse gas emission targets are seen as a lesser concern due to their perceived distant impact on daily life. Many participants viewed the transition to renewables as inevitable. It is possible that this is the reason why risks are not front of mind.

4.5 Participant Interpretation

In general, participants were familiar with electricity generation, transmission, and distribution. However, they lacked a more granular understanding of how their electricity is produced and supplied.

Participants were aware of changes in their energy supply, particularly regarding the transition from fossil fuels to renewables.

Consumers recognise the need for change and are positive about it. Greenhouse emissions and the shift from fossil fuels to renewables is an important issue for most. But in the absence of a clear understanding of what's changing and how it will benefit them, there's a hesitancy by many to directly pay for that change.

5 Data Collection & Analysis

5.1 Recruitment and implementation

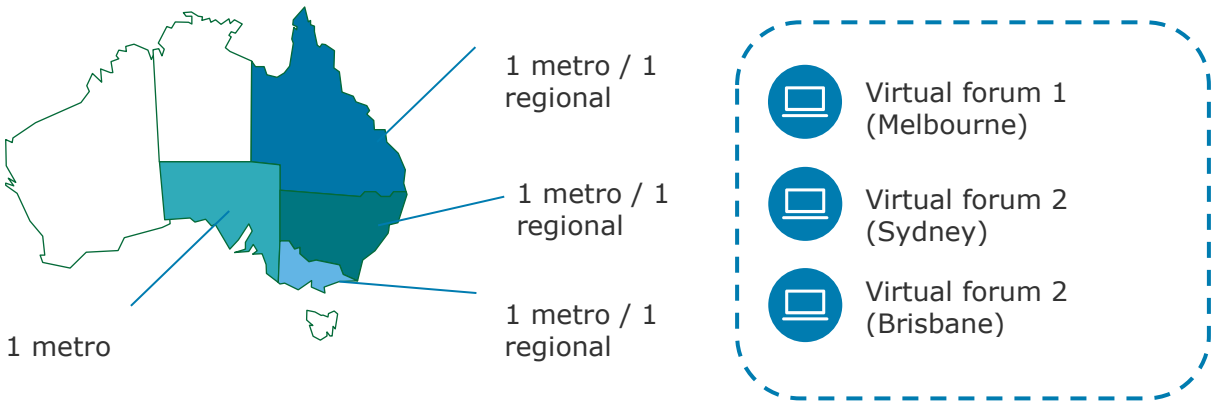
5.1.1 Focus groups

The focus groups were delivered by Antenna, a specialist focus group survey house. Based on Antenna's advice, focus groups targeted 10-12 participants for each group. The focus groups screened out participants from electricity production, policy, fuel production, and market research to avoid biased results.

To be representative of residential consumers, the sampling approach for focus groups prioritised geographic coverage. The pre-survey focus groups were held in four metropolitan areas: Sydney, Melbourne, Adelaide and Brisbane and 3 regional areas: Ballarat, Goulburn and Rockhampton as shown in Figure 5.1below. The post-survey focus groups were held online but focused on attaining a mix of regional and metropolitan participants.

The content and questions were explicitly tailored to insights from the literature review as well as the consumer survey (for online focus groups). The questions, discussion points and baseline information provided to participants were carefully drafted. Questions intended for qualitative analysis were open-ended, when possible, to elicit open discussion and idea sharing. Questionnaires for quantitative analysis were provided to each participant and focused on specific investment choices or risk preferences.

Figure 5.1 Focus group and Online Focus Group Locations



5.1.2 Survey

The survey was delivered by Octopus. To ensure that our survey results accurately reflected the demographics and geographic distribution of the NEM, we instructed Octopus to employ a stratified sampling approach. This approach involved stratification by three key variables: age, income, and state of residence. By stratifying our sample in this manner, we aimed to achieve a more representative and balanced representation of the NEM population. This strategy allowed us to account for variations in energy consumption patterns, preferences, and regional factors, ultimately enhancing the reliability and validity of our survey findings.

5.2 Total responses

5.2.1 Focus groups

Table 5.1 The distribution of responses in % out of the 82 total focus group responses

Characteristic	Percentage
Gender	
Female	49%
Male	50%
Others	1%
Age Group	
18-24 years	6%
25-34 years	26%
35-50 years	34%
51-65 years	24%
Over 65 years	7%
No age provided	2%
Location	
New South Wales	28%
Queensland	29%
South Australia	13%
Victoria	29%
Residence Area	
Rural	44%
Urban	56%

5.2.2 Survey

Table 5.2 Distribution of responses in % out of the 2430 total survey responses

Characteristic	Percentage
Gender	
Female	49.5%
Male	50.2%
Others	0.3%
Age Group	

18-24 years	10%
25-34 years	23%
35-44 years	23%
45-54 years	20%
55-64 years	15%
Over 65 years	10%
Location	
New South Wales	36%
ACT	2%
Queensland	23%
South Australia	8%
Victoria	29%
Tasmania	2%
Household Income Levels (NEM Range)	
Below $26,000	12%
$26,000 to $33,799	4%
$33,800 to $41,599	6%
$41,600 and $51,999	7%
$52,000 to $64,999	7%
$65,000 and $77,999	8%
$78,000 to $90,999	6%
$91,000 to $103,000.	6%
$104,000 to $129,999.	12%
$130,000 to $155,999	8%
$156,000 to $181,999	7%
$182,000 to $208,000,	4%
Incomes exceeding $208,000	13%

5.3 Valid Responses

As the questions asked are based on theoretical economic concepts, it is possible to establish boundaries on responses that are valid. To be considered a valid response, participants had to meet two criteria. First, participants had to report an increasing, or constant WTP as the potential increase range of their bill decreased. So, a participant ought to be willing to pay more for a range of $250 than for a range of $500, more for a range of $500 than $750, and so on.

Secondly, participants were expected to provide logically consistent responses to the modified Holt-Laury Test. The Holt-Laury Test is used to understand how people make decisions with varying levels of risk and uncertainty. In the modified version, respondents were presented with scenarios revolving around the possibility of increased energy bills, signifying potential losses rather than conventional monetary gains. Logical consistency in this context meant that participants should consistently choose option B for question 6, where a 100% chance of losing $250 (option B) is a more favourable choice compared to a 100% chance of losing $1300 (Option A). It was also emphasized that once a participant switched from option A to option B, they should maintain this choice to ensure the coherence of their responses. The augmented Holt-Laury Test is displayed below (see Table 5.3)

Table 5.3 Augmented Holt-Laury Test

Option A	Option B
10% chance of a $700 increase and a 90% chance of $900 increase to your annual bill	10% chance of a $250 increase and a 90% chance of $1300 increase to your annual bill
25% chance of a $700 increase and a 75% chance of $900 increase to your annual bill	25% chance of a $250 increase and a 75% chance of $1300 increase to your annual bill
50% chance of a $700 increase and a 50% chance of $900 increase to your annual bill	50% chance of a $250 increase and a 50% chance of $1300 increase to your annual bill
75% chance of a $700 increase and a 25% chance of $900 increase to your annual bill	75% chance of a $250 increase and a 25% chance of $1300 increase to your annual bill
90% chance of a $700 increase and a 10% chance of $900 increase to your annual bill	90% chance of a $250 increase and a 10% chance of $1300 increase to your annual bill
100% chance of a $700 increase and a 0% chance of $900 increase to your annual bill	100% chance of a $250 increase and a 0% chance of $1300 increase to your annual bill

Additionally, focus group responses were removed if participants responded more than $1000 for the WTP questions in order to maintain consistency with the boundaries of the survey questions.

In the forums, out of 82 total responses, 46 (56%) answered both questions in a valid way and responded with $1000 or less for the WTP questions.

In the survey, out of the total 2340 responses, 555 (24%) answered both questions in a valid way.

5.3.1 Focus groups

Table 5.4 Distribution of responses in % out of the 46 valid focus group responses

Characteristic	Percentage
Gender	
Female	48%
Male	50%
Others	2%
Age Group	
18-24 years	7%
25-34 years	33%
35-50 years	24%

51-65 years	30%
Over 65 years	7%
Location	
New South Wales	35%
Queensland	24%
South Australia	11%
Victoria	30%
Residence Area	
Rural	48%
Urban	52%

5.3.2 Survey

Table 5.5 Distribution of responses in % out of the 555 valid responses to the survey

Characteristic	Percentage
Gender	
Female	52.1%
Male	47.4%
Others	0.5%
Age Group	
18-24 years	7%
25-34 years	23%
35-44 years	23%
45-54 years	23%
55-64 years	14%
Over 65 years	11%
Location	
New South Wales	33%
ACT	2%
Queensland	25%
South Australia	7%
Victoria	31%
Tasmania	2%
Household Income Levels (NEM Range)	

Below $26,000	9%
$26,000 to $33,799	4%
$33,800 to $41,599	6%
$41,600 and $51,999	7%
$52,000 to $64,999	6%
$65,000 and $77,999	8%
$78,000 to $90,999	5%
$91,000 to $103,000.	6%
$104,000 to $129,999.	14%
$130,000 to $155,999	8%
$156,000 to $181,999	8%
$182,000 to $208,000,	4%
Incomes exceeding $208,000	14%

5.4 Determination of Quotas and Weighting Process

It can be seen from sections 5.1, 0 and 5.3 that the sample data obtained by Octopus and Antenna, and the valid responses are not substantially different from the NEM population. Key criteria for the focus groups were targets on urban/rural and state and for the survey, emphasis was placed on age, state and NEM income. While responses are broadly representative of the NEM, Deloitte has reweighted the data for the focus groups according to urban and rural and the survey for age. The decision was made to reweight the forum using urban/rural population by state and the survey using the age ranges of the respondents rather than using income or state as the proportions of each of these variables in the data were not significantly different, therefore it was determined they should be disregarded as weighting variables.

There is no standardised or recognised database that comprehensively reflects customers of the NEM, therefore, to determine our data population we needed to understand what areas the NEM services, as this would be where the NEM customers (our population) reside. We used publicly available AEMO maps of the NEM to determine what areas of Australia the NEM service area covers.[16] Furthermore, we know that AEMO estimates the NEM customers to be around 9 million, including households, commercial and industrial.[17] We then used QGIS, to analyse a map of the NEM regions and identify which postcodes fall within the NEM's service area.

To determine what quotas should be used for the age and state of residence variables, we used the Australian Bureau of Statistics (ABS) Table Builder to download the census population of Australia, split by postcode and age and then applied to the NEM postcodes. Only population data for those over the age of 18 was included. NEM weightings for each state were determined as a percentage of the total population based on this data. Salary breakdowns for each of the NEM postcodes were obtained from the ABS and used to determine salary splits for each state. ABS Household income data may or may not include full and part-time workers (not specified), depending on the composition of the household. This allowed us to first split by the NEM weightings and then distribute by household income.

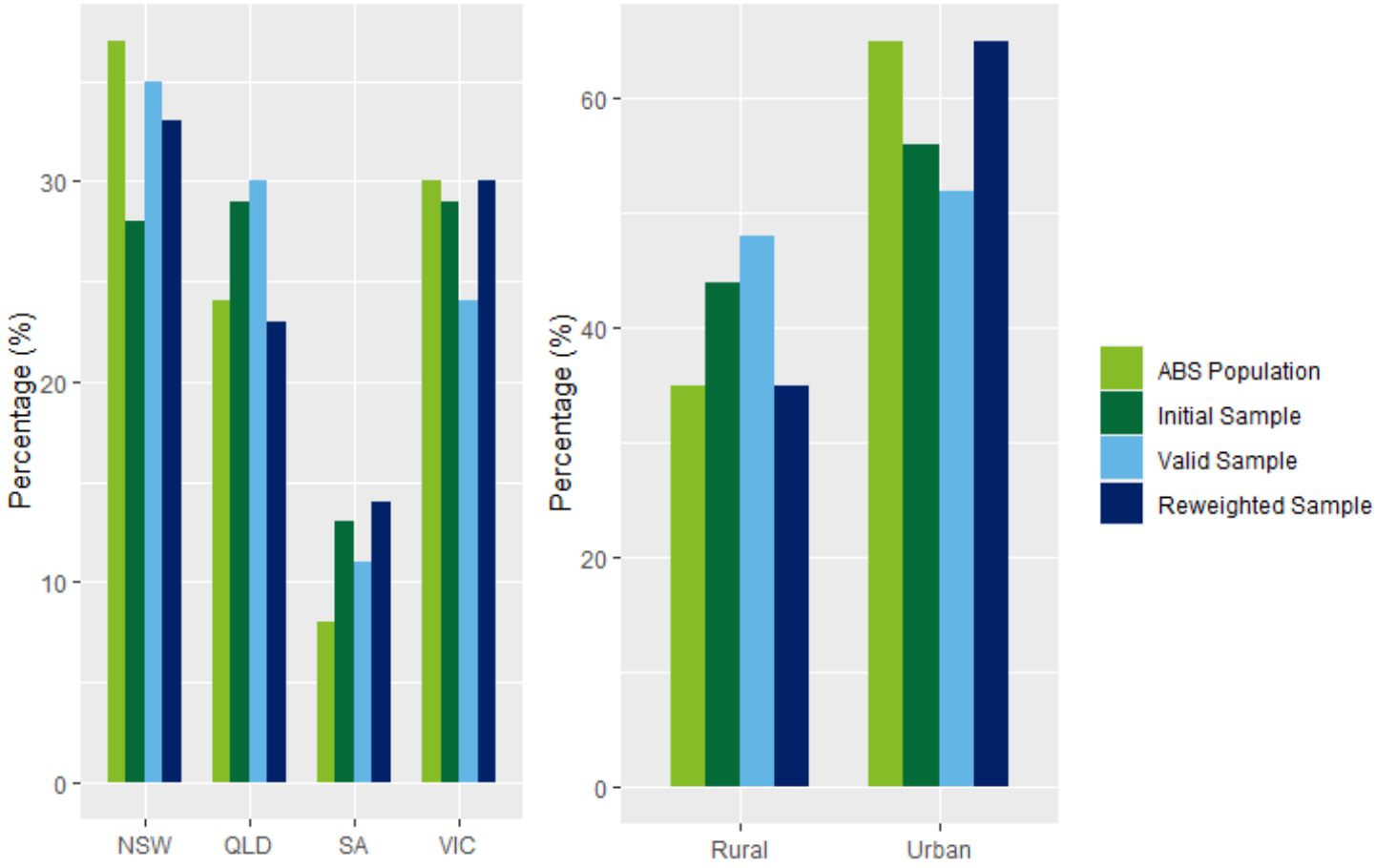
[16] National Electricity Market (2023) AEMC. Available at: https://www.aemc.gov.au/energy-system/electricity/electricity-system/NEM (Accessed: 29 September 2023).

[17] *National Electricity Market (NEM)* (2023) *AEMO*. Available at: https://aemo.com.au/en/energy systems/electricity/national-electricity-market-nem/about-the-national-electricity-market-nem (Accessed: 28 September 2023).

A comparison of the NEM population, the initial sample, the valid sample and the reweighted sample are presented in Figures Figure 5.2-5.3. More detailed numbers are presented in Appendix 10.4.

5.4.1 Focus groups

Figure 5.2 Focus groups Quotas and Weighting by State and Urban/Rural



5.4.2 Survey

Figure 5.3 Survey quotas and weighting by Age Range and State

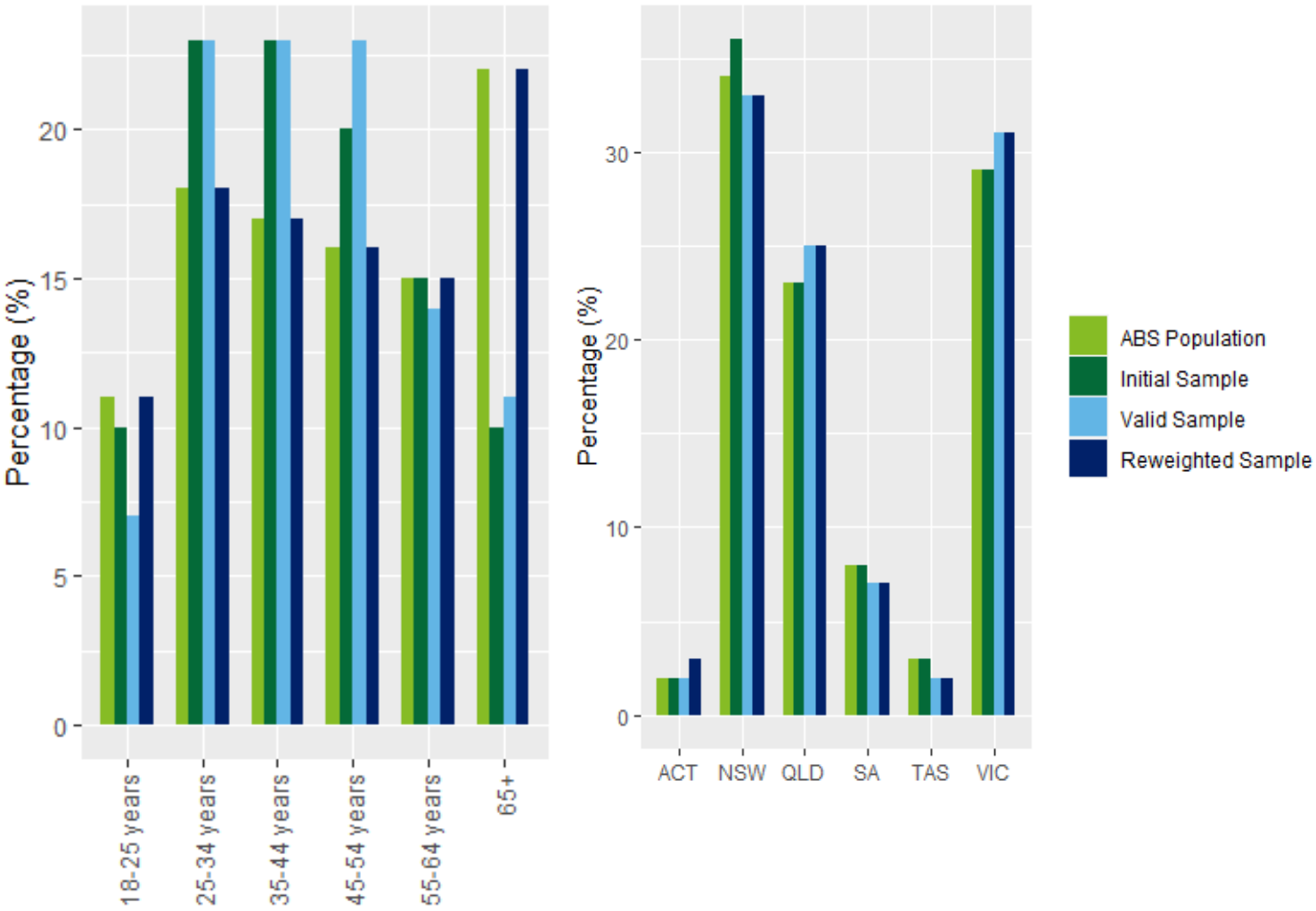
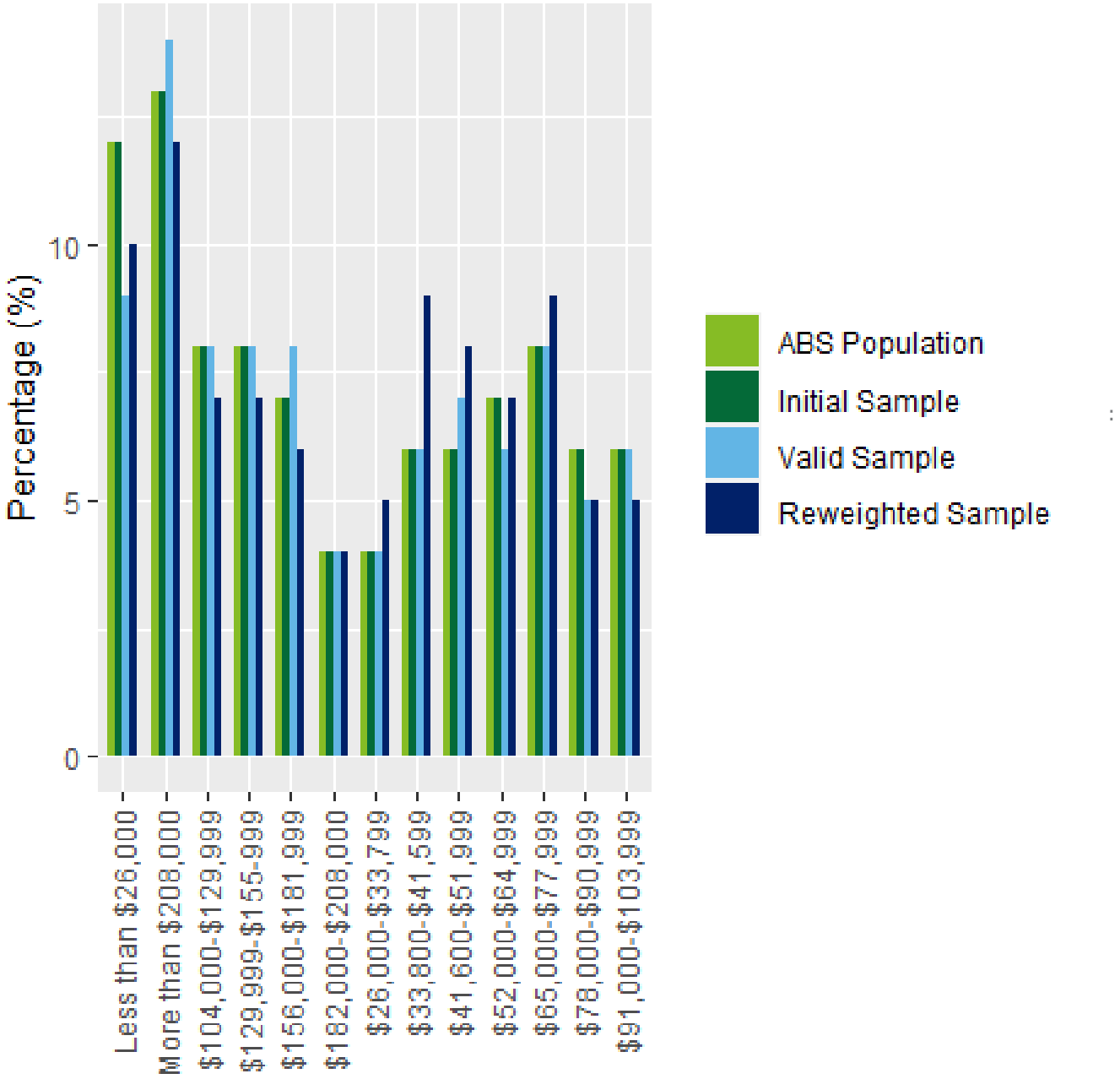


Figure 5.4 Survey quotas and weighting by NEM household income



6 Quantitative Analysis

6.1 Scenario preference

6.1.1 Purpose

This question asked participants to choose between two hypothetical electricity investment scenarios, 'Early Investment' and 'Wait and See'. Both investment strategies had different costs and benefits, mainly focused on the impact of investment timing on potential future electricity bills. Specifically, it illustrates how investment decisions in the electricity market influence the volatility of energy prices for consumers. Rather than conceptualising energy investment as something that affects Australia as a whole, it aims to individualise the impacts of investment decisions.

Importantly, this question is designed without future potential bill ranges or immediate bill increases. By posing the question of investment strategy preferences before introducing concrete numerical data, we encourage participants to think in broader, conceptual terms rather than immediately diving into practical considerations.

While this question does not have specific applicability as a consumer metric, preference for one scenario over the other contributes to an overall risk and investment preference profile of survey and focus group participants. Combined with the qualitative insights of Chapter 3, WTP for transmission and emissions reduction in Chapter 7 and levels of risk aversion in Chapter 8, this question is a valuable sense check.

6.1.2 Evolution of the focus group and survey question

The focus group to survey the evolution of this question was minimal. The overall choice of 'Early Investment' versus 'Wait and See' remained the same, with key changes in the exact wording of what dictated 'Early Investment' and 'Wait and See' scenarios, and the addition of a graphic to assist with understanding the impacts of the two contrasting scenarios.

The 'Early Investment' scenario in the focus group and final survey were described as:

Early Investment – Focus Groups	Early Investment - Final Survey
Investing more and earlier in electricity infrastructure will result in higher electricity bills, but it will help to stabilize energy prices over time by reducing the impact of external factors that cause price fluctuations, and by allowing more efficient energy distribution and dispatchable electricity generation. This means the total energy bill increases over time, but with relatively low price volatility when compared to scenario 2.	Early Investment in electricity infrastructure can: • Increase bills but reduce the volatility of bill prices, making them more stable and predictable over time. • Help Australia move more quickly to renewable energy and meet climate reduction targets. Hypothetical Example: A household's bill averages around $1600 a year. Under this scenario, the bill would increase to a (smaller) range of $2300 to $2500 in the future.

The 'Wait and See' scenario in the focus group and final survey were described as:

Wait and See – Focus Group	Wait and See - Final Survey
Investing less and later in electricity infrastructure will result in relatively lower electricity bills in the short term, but it will result in higher price volatility due to an aging and less reliable grid, dependence on fossil fuels, insufficient energy efficiency measures, and insufficient investment in new generation capacity. This means the total energy bill increases over time, but not as much as scenario 1. The results in a high risk of volatile prices, especially on the upside.	Australia taking a Wait and See approach to investments in electricity infrastructure can: • Lead to smaller bill increases in the short-term, but will increase the volatility of bill prices, making them less stable and predictable over time. • This increases the risk that we will not meet our climate reduction targets. • Allow us to more easily incorporate future technologies that do not exist yet. Hypothetical Example: A household's bill averages around $1600 a year. Under this scenario the bill could increase to a (larger) range of $1800 to $2900 in the future.

6.1.3 Outcomes from focus groups

The weighted responses to the forum have a mean of 73% indicating that 73% of respondents would prefer to invest early than wait and see. The standard deviation was 0.44, indicating that there was a general consensus among respondents.

Table 6.1 Scenario Preference outcomes for Focus groups by demographics

Category	Mean (% who preferred early investment)
Overall observations	73%
Gender	
Female	68%
Male	77%
Other	100%
State	
QLD	93%
NSW	66%
SA	60%
VIC	71%
Age Range	
18-24	100%
25-34	88%
35-50	41%
51-65	75%
65+	27%
Urban/Rural	
Urban	71%
Rural	77%

Table 6.1 illustrates the percentage of respondents who chose to invest early rather than wait and see, by demographic. All respondents who were between the ages of 18 and 24 chose to invest early when

compared to other age ranges. Those who resided in rural areas were more likely to invest early than those in urban areas.

6.1.4 Outcomes from the survey

The weighted responses to the survey (see Table 6.2) have a mean of 59% suggesting that when compared to the results of the forum, proportionally more respondents chose to wait and see on average. Conversely, the standard deviation of the weighted results is 0.491 which is more than that of the forum, therefore there was slightly less of a consensus in the survey than in the forum.

Table 6.2 Scenario Preference outcomes for Survey by demographics

Category	Mean (% who preferred early investment)
Overall observations	59%
Gender	
Female	67%
Male	64%
Other	100%
State	
QLD	53%
NSW	59%
SA	67%
VIC	53%
TAS	44%
ACT	69%
Age Range	
18-24	87%
25-34	69%
35-44	66%
45-54	56%
55-64	49%
65+	42%
NEM Income	
Less than $26,000	53%
$26,000-$33,799	55%
$33,800 - $41,599	46%
$41,600 - $51,999	64%
$52,000 - $64,999	56%
$65,000 - $77,999	40%
$78,000 - $90,999	50%
$91,000 - $103,999	59%
$104,000 - $129,999	68%
$130,000 - $155,999	61%
$156,000 - $181,999	62%
$182,000 - $208,000	89%
More than $208,000	70%

Table 6.2 illustrates the percentage of respondents who chose early investment rather than wait-and-see, by demographic. It shows that more respondents residing in the Australian Capital Territory chose to invest early when compared to respondents residing in other states. More respondents who were between the ages of 18 and 24 also chose to invest early when compared to other age ranges. It should be noted that more respondents in the $41,600 - $51,999 NEM income range preferred to invest early when compared to the other lower NEM income ranges such as $33,800 -$41,599 and $52,000 - $64,999.

6.2 Willingness To Pay for reduced volatility

6.2.1 Purpose

This question asks participants how much they would pay to reduce their volatility to a certain range. There were five ranges: $1000, $750, $500, $250 and $0. Designed to build on the more conceptual scenario question, this question encourages consumers to think about the price-volatility trade-off in explicit cost-benefit terms by removing any other factors affecting decision-making.

Further, it was designed to have applicability as a consumer risk metric. By asking consumers their WTP to maintain different bill ranges, a relationship between WTP and range can be created. Using this relationship, Deloitte can estimate a WTP for all bill ranges. Chapter 7 contains the process to of calculating risk metric from the WTP estimate.

6.2.2 Evolution of the focus group and survey questions

Refinement of the questions was required when shifting from the focus group to the survey. These changes were integrated as a result of the learnings in their first presentation as well as via the required formatting changes.

The original focus group question asked respondents "The next questions asks how much you'd be willing to pay today to reduce uncertainty on your future energy bill. We'll present you with different scenarios where the uncertainty around your bill is reduced to a specific range, and you'll tell us how much more you'd be willing to pay today to have that level of certainty," for five uncertainty ranges ($0, $262.5, $525, $787.5, and $1050).

The final survey question asked respondents to "Imagine that the cost of your annual electricity bill will potentially increase or decrease by an unknown amount this year compared to last year. How much would you pay to limit your annual electricity bill increasing anywhere within the below range: (RANGE)", for 5 different ranges ($0, $250, $500, 750, 1000).

The first key change was altering the question to indicate that the Willingness to Pay was a once-off, separate payment (separate from the electricity bill itself), for an annualised reduction in volatility (reduction in total cost of all electricity bills for that year), rather than a payment today to reduce a single electricity bill in the future. The second key change is to ask participants about potential bill increases within a range, instead of potential bill increases or decreases within a range. The idea of a range is less intuitive than dealing with an increase and this change removes some ambiguity. This key also reflects the current situation facing the NEM of rising prices, which will likely mean that price rises within a range are more front and centre of respondents' minds. The WTP as an increase is one, more relatable for respondents, and two, more likely to reduce misinterpretation or biases of the question that may arise from the situation of price increases. Other changes were to make the question more readable and user-friendly based on the findings of the pilot surveys.

6.2.3 Focus groups

Table 6.3 Overall WTP for reduced volatility outcomes for Focus groups by demographic

Category	Mean ($)	Median ($)	Standard Deviation
Gender			
Female	157	95	188
Male	205	167	189
Other	410	286	350
State			
QLD	188	143	181
NSW	187	143	192
SA	181	95	175
VIC	191	114	231
Age Range			
18-24	348	381	159

25-34	209	143	198
35-50	207	100	229
51-65	148	95	176
65+	77	48	93
Urban/Rural			
Urban	186	119	193
Rural	190	120	207

Figure 6.1 WTP for reduced volatility outcomes for each range for Focus groups mean and median

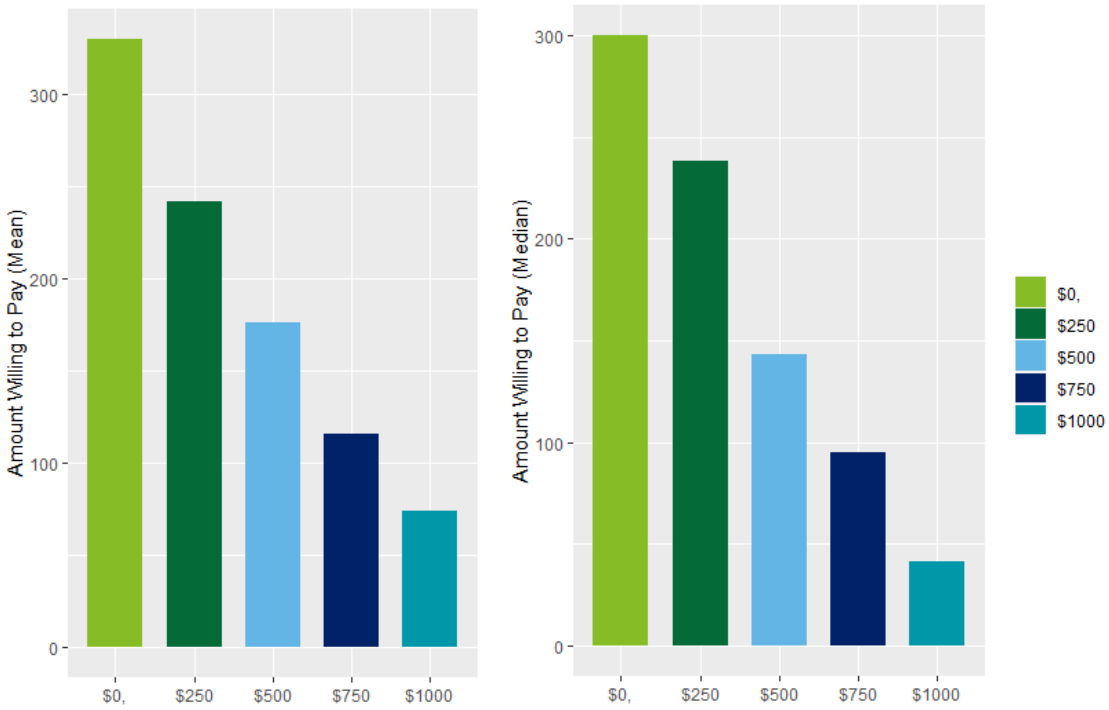
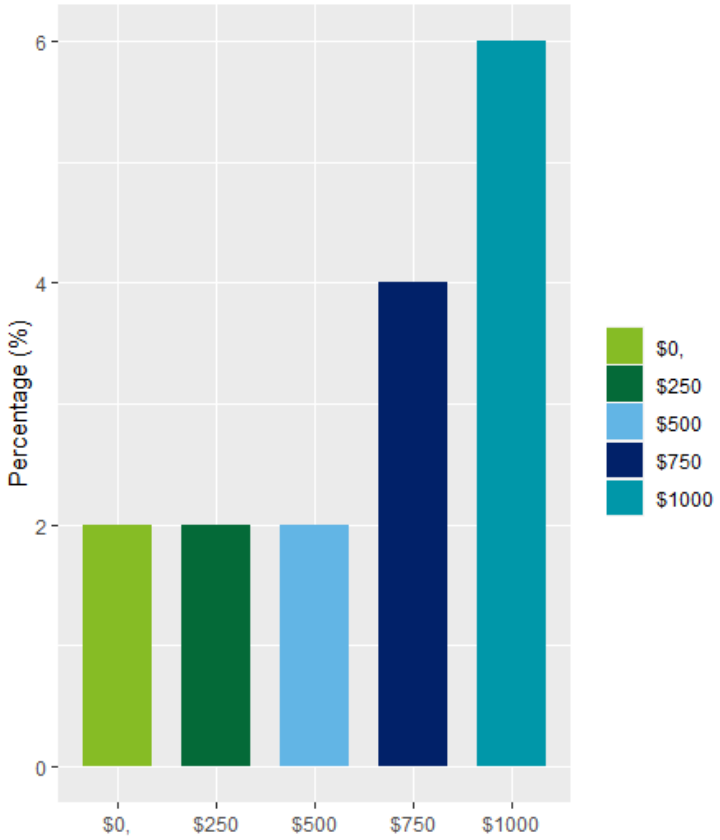


Table 6.4 WTP for reduced volatility outcomes for each range for Focus groups

Range	Mean ($)	Median ($)	Standard Deviation
$0	330	300	276
$250	242	238	194
$500	176	143	145
$750	116	95	117
$1000	74	41	94

Table 6.4 illustrates that more respondents were willing to pay progressively less the more the amount of limiting their electricity bill increased.

Figure 6.2 Proportion of respondents who answered $0 for each WTP for reduced volatility question (unweighted data) for Focus groups



6.2.4 Survey

Table 6.5 WTP for reduced volatility outcomes for Survey by demographic

Category	Mean ($)	Median ($)	Standard Deviation
Gender			
Male	141	50	224
Female	176	100	224
Other	110	50	124
State			
QLD	144	50	198
NSW	171	50	246
SA	144	50	215
VIC	163	100	222
TAS	134	25	254
ACT	143	100	144
Age Range			
18-24	221	200	220
25-34	198	100	250
35-44	155	50	244
45-54	160	50	249
55-64	113	50	152
65+	129	50	196

NEM Income			
Less than $26,000	143	50	233
$26,000-$33,799	91.2	50	101
$33,800 - $41,599	117	50	171
$41,600 - $51,999	119	50	135
$52,000 - $64,999	134	100	161
$65,000 - $77,999	157	25	260
$78,000 - $90,999	131	50	178
$91,000 - $103,999	161	50	233
$104,000 - $129,999	158	50	216
$130,000 - $155,999	150	100	198
$156,000 - $181,999	194	100	267
$182,000 - $208,000	197	100	208
More than $208,000	260	100	308

In Table 6.5, the medians for all demographics are lower than the means, therefore the data is positively skewed with some outliers that are higher than the mean.

Figure 6.3 WTP for reduced volatility outcomes for each range for Survey mean and median

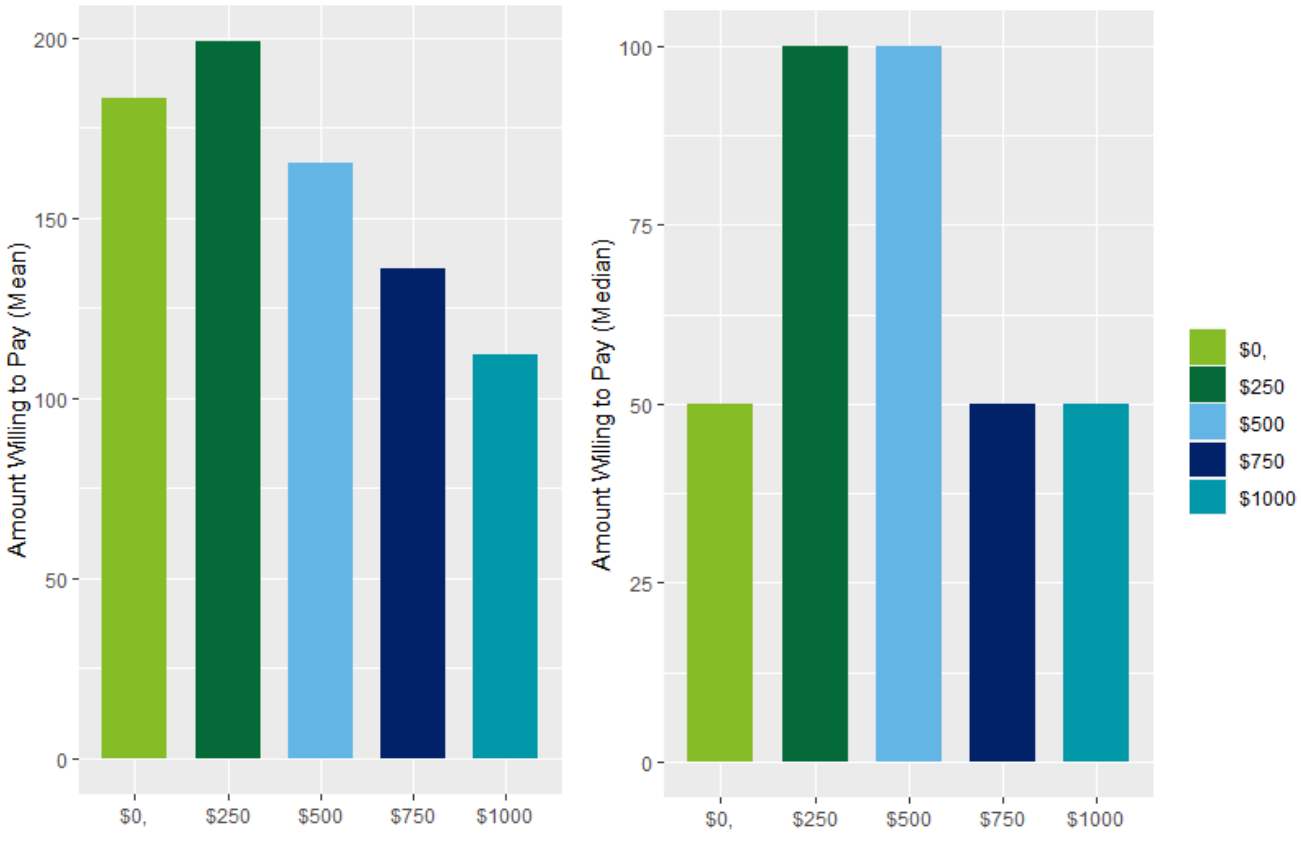


Table 6.6 WTP for reduced volatility outcomes for each range for the survey

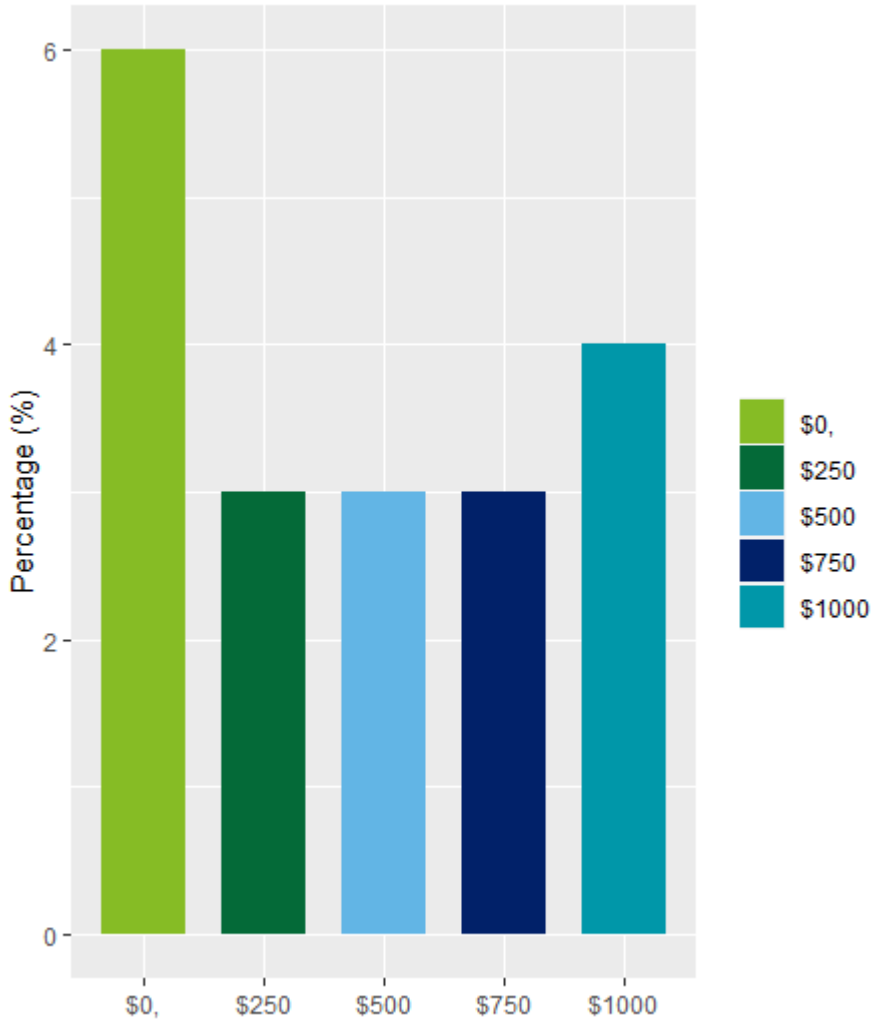
Category	Mean ($)	Median ($)	Standard Deviation

$0	183	50	259
$250	199	100	260
$500	165	100	223
$750	136	50	187
$1000	112	50	164

Table 6.6 illustrates that more respondents were willing to pay progressively less the more the amount of limiting their electricity bill increased.

Some participants were unwilling to pay anything to reduce volatility. This percentage was relatively stable at 2-3% for all non-zero ranges, but up to 6% to reduce volatility to 0 as shown in Figure 6.4.

Figure 6.4 Proportion of Survey respondents who answered $0 for each WTP for reduced price volatility question (unweighted data)

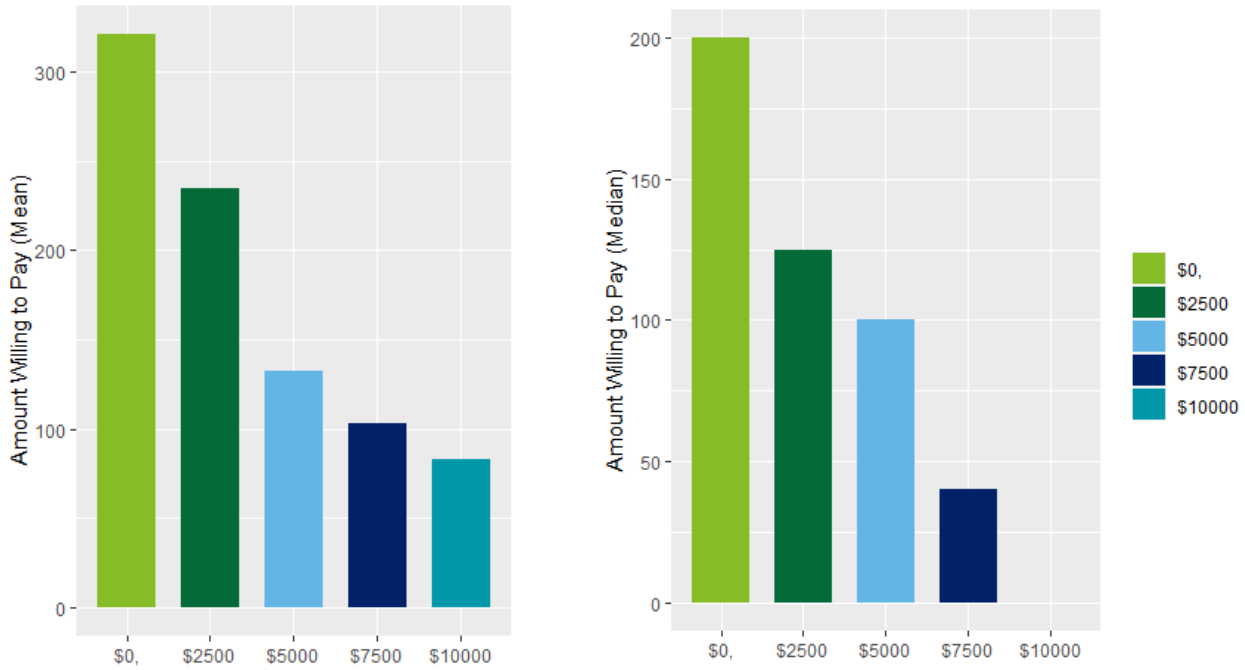


6.2.5 The impact of cost of living on WTP

Participants' WTP is not static. In a world of rising costs, it is useful to quantify the impact of rising costs on willingness to pay. Focus group participants were asked how much they would be willing to accept their future energy bill increase to eliminate uncertainty around prices in the future if their necessities increased by $0, $2500, $5000, $7500 or $10000 a year. As the cost of living increased, respondents were willing to accept decreasing amounts for their future electricity bills. A $5000 increase in the cost-of-living halves the WTP (in terms of median) and more than halves the WTP (in terms of mean).

This question did not appear in the survey. It was cut from the survey due to the existing length and complexity. The decision was made to focus on the questions designed to be used as a consumer risk metric.

Figure 6.5 Mean and Median WTP for reduce volatility as cost-of-living increases



6.3 WTP for emission reduction and transmission investment

6.3.1 Purpose

This question asked about consumers' willingness to contribute financially towards Australia's efforts to achieve emissions targets and support electricity infrastructure development. Although not intended to be turned into a consumer risk metric, it provides valuable insights into consumer values.

6.3.2 Evolution of the focus group and survey questions

The focus group asked how much participants would pay to reduce their volatility to zero if they knew this money went to either emissions targets or electricity infrastructure. The survey asked participants directly how much people would pay to assist Australia in achieving those goals without mention of a reduction in volatility.

For the survey this question was changed in format compared to the focus groups, like the WTP overall question (as they share the same format), however, the actual questions asked were the same. The question essentially asks respondents in both cases to quantify how much they would pay on top of their electricity bill to:

1. Improve the transmission infrastructure and reduce the risk of volatile electricity prices that might occur when coal-fired power plants are closed?

2. How much would you pay now in addition to your electricity bill to ensure we are following a pathway to achieve Australia's goal of reducing emissions to 43% below 2005 levels by 2030?

The largest difference in the full survey question is the way we standardised responses. In the focus groups, these scenarios were in addition to reducing uncertainty in their annual bill, however in the full survey we treated these as stand-alone questions.

For example, the focus group questions asked" I would be willing to pay $_____ more today if the uncertainty around prices in the future was kept to a range of [RANGE] on my annual bill…And how would your answers change if the additional cost meant we were certain to be following a pathway to achieve Australia's goal of reducing emissions to 43% below 2005 levels by 2030"

The survey asked directly "How much would you pay now in addition to your electricity bill to improve the transmission infrastructure and reduce the risk of volatile electricity prices that might occur when coal-fired power plants are closed?

Ultimately, we are after the amount willing to be paid for the specific scenario, not for reducing uncertainty in their annual bill, so we removed that aspect for respondent's understanding and ease of use.

6.3.3 Focus groups

Table 6.7 Transmissions Investment and Emissions Reduction outcomes for Focus groups

Category	Mean ($)	Median ($)	Standard Deviation
Transmissions Investment	367	364	234
Emissions Reduction	406	375	392

The above table illustrates that respondents in the focus groups were more willing to pay more for guaranteed emissions reduction than transmission investment.

6.3.4 Survey

Table 6.8 Transmissions Investment and Emissions Reduction outcomes for Survey

Category	Mean ($)	Median ($)	Standard Deviation
Transmissions Investment	106	50	175
Emissions Reduction	108	50	189

6.4 Direct elicitation of risk preferences (Holt-Laury Test)

6.4.1 Purpose

This question asked a modified version of the Holt-Laury Test, a test used to understand how people make choices when faced with different levels of risk and uncertainty. In this modified version, respondents were presented with scenarios revolving around the possibility of increased energy bills, signifying potential losses rather than conventional monetary gains.

The purpose of this question is to quantify participants' level of risk aversion or risk-seeking behaviour in the context of electricity bills. The average levels of risk aversion, otherwise known as the coefficient of Constant Relative Risk Aversion (cCRRA), can be used to estimate a risk premium and then applied as a consumer risk metric. In this version of the Holt-Laury Test, the more negative the cCRRA is, the more risk-averse they are. If the CRRA is zero, the participants are risk neutral. The further away the cCRRA moves from zero, the less risk-averse participants are perceived to be.

The risk premium is defined as the difference between the expected payoff and the certainty equivalent. This is the cost of risk — it is the amount of money an individual would be willing to pay to avoid the risk associated with a certain scenario.[18] In the electricity market, we can then define the risk premium as the maximum WTP as it represents the maximum 'insurance' amount that a consumer is willing to pay to avoid price uncertainty or the minimum acceptance amount for a consumer to take on additional risk.

6.4.2 Evolution of the focus group and survey questions

The Holt-Laury in losses question evolved over the course of the focus groups to the full survey, however, for the full survey we went back to the original focus groups, and there were no significant changes. We determined that the focus group format had the greatest levels of understanding and were able to provide us with the most comprehensive and meaningful data, and therefore reverted back to that format for the full survey.

6.4.3 Focus groups

The cCRRA mean for the weighted forums was -1.09. As the Holt-Laury test was performed in terms of losses, rather than gains as traditional, this suggests that the respondents tended to be more risk averse. The median of the cCRRA for the weighted forum was -1.48, indicating that participants were more cautious and tended to choose options that minimised potential losses, even if it meant foregoing potential smaller losses in favour of avoiding larger ones. The standard deviation of the cCRRA was 1.35. This means there was significant variation between responses, therefore, participants had diverse attitudes towards losses.

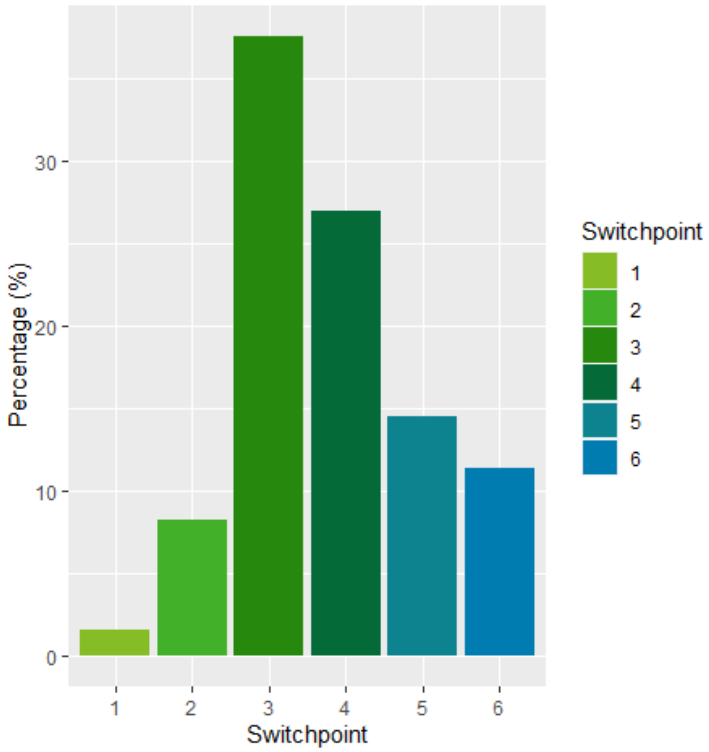
Table 6.9 illustrates the risk-averse tendencies of the respondents by demographic. It shows that respondents who identified as other were more risk averse than males or females. Additionally, those residing in New South Wales and Victoria were more risk-averse than those residing in other states. Respondents who were 35-50 years of age were more risk-averse than those who were in other age ranges. Finally, those who resided in rural areas were more risk-averse than respondents residing in urban areas.

Table 6.9 Weighted Mean and Median Results split by key demographics for Focus groups - cCRRA

Category	Mean	Median
Overall Observations	-1.09	-1.48
Gender		
Female	-1.05	-1.48
Male	-1.02	-1.48
Other	-2.95	-2.95
State		
QLD	-0.843	-1.48
NSW	-1.26	-0.135
SA	-0.725	-0.135
VIC	-1.25	-1.48
Age Range		
18-24	-0.582	-0.135
25-34	-1.41	-1.48
35-50	-1.36	-1.48
51-65	-0.835	-0.135
65+	0.067	-0.135
Urban/Rural		
Urban	-1.08	-1.48
Rural	-1.10	-1.48

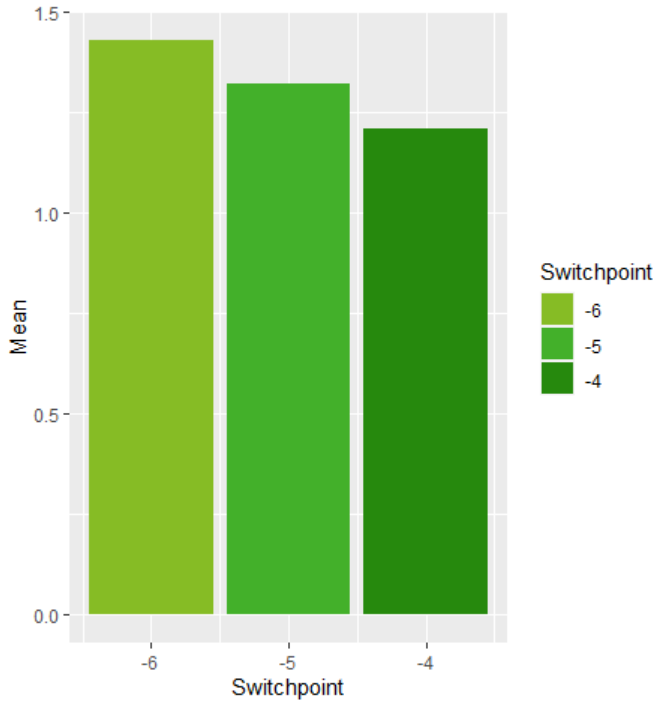
[18] McAfee, R. and Lewis, T., *Introduction to Economic Analysis* (Saylor Foundation, 2009) <https://saylordotorg.github.io/text_introduction-to-economic-analysis/s14-04-risk-aversion.html>.

Figure 6.6 Focus groups switch point analysis



For respondents who switched from A to B in the last option, there is some leeway in defining their cCRRA. The original cCRRA would be undefined as it is a dominant choice and considered to be negative infinity. As negative infinity cannot be measured, switch point 6 was changed to equal -4, -5 and -6 and tested to determine how this influences the overall results. As seen in Figure 6.6, the means of each of these instances were different for the weighted focus group.

Figure 6.7 Focus groups sensitivity analysis



6.4.4 Survey

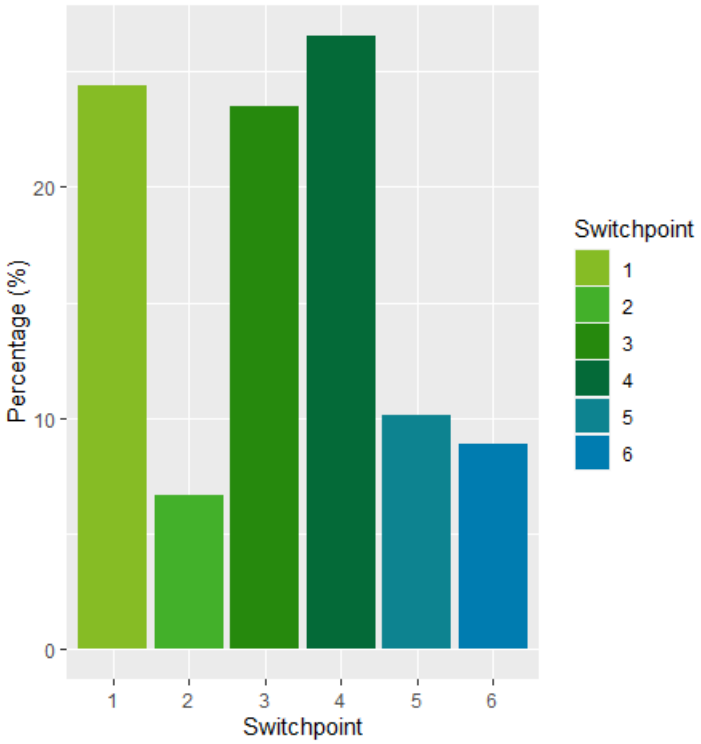
The cCRRA mean for the survey was -0.38. As the Holt-Laury test was performed in terms of losses, this suggests that the respondents tended to be more risk-averse, but less risk-averse than respondents of the forum. The median of the cCRRA for the survey was -0.14, indicating that participants were more cautious and tended to choose options that minimised potential losses, even if it meant foregoing potential smaller losses in favour of avoiding larger ones. It should be noted that the median for the survey is consistent with that of the forum. The standard deviation of the cCRRA was 1.82. This means there was significant variation between responses, therefore, participants had diverse attitudes towards losses. However, when compared to that of the weighted forum, the survey respondents had less of a consensus.

Table 6.10 Weighted Mean and Median Results split by key demographics for Survey - cCRRA

Category	Mean	Median
Overall Observations	-0.38	-0.14
Gender		
Male	-0.245	-0.135
Female	-0.510	-1.48
Other	-0.330	-0.135
State		
QLD	-0.047	-0.135
NSW	-0.480	-0.135
SA	-0.594	-1.48
VIC	-0.394	-0.135
TAS	0.541	2.17
ACT	-0.677	-1.48
Age Range		
18-24	-0.830	-1.48
25-34	-0.457	-0.135
35-44	-0.235	-0.135
45-54	-0.400	-0.135
55-64	-0.358	-0.135
65+	0.218	-0.135
NEM Income		
Less than $26,000	-0.413	-0.135
$26,000-$33,799	-0.499	-0.135
$33,800 - $41,599	-0.175	-0.135
$41,600 - $51,999	-0.655	-1.48
$52,000 - $64,999	-0.447	-1.48
$65,000 - $77,999	-0.245	-0.135
$78,000 - $90,999	-0.493	-0.135
$91,000 - $103,999	-0.192	-0.135
$104,000 - $129,999	-0.541	-0.135
$130,000 - $155,999	-0.483	-0.135
$156,000 - $181,999	0.138	-0.135
$182,000 - $208,000	-0.222	-0.135
More than $208,000	-0.445	-1.48

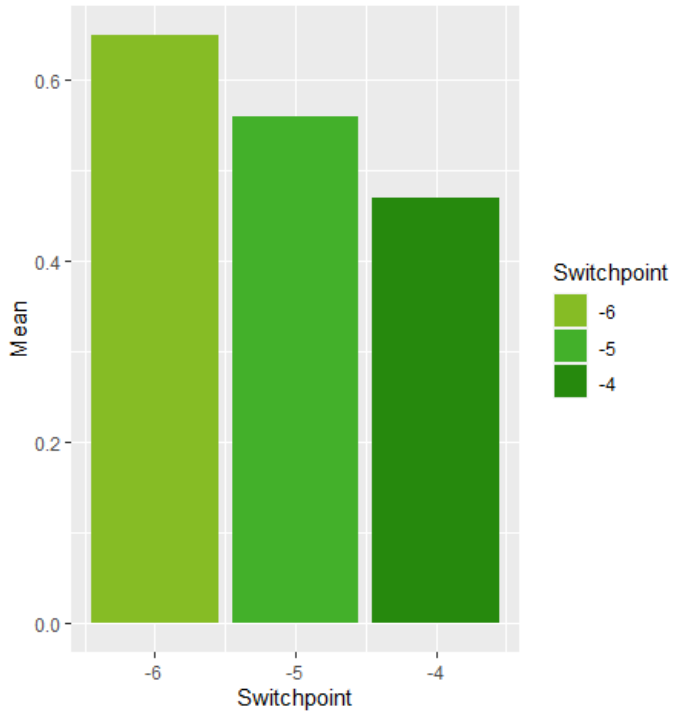
Table 6.10 illustrates the risk aversion of respondents by demographic. It shows that respondents who identified as female were more risk-averse than males or others. Additionally, those residing in Australian Capital Territory were more risk-averse than those residing in other states. Respondents who were 18-24 years of age were more risk-averse than those who were in other age ranges. Finally, those who fell within the $41,600 - $51,999 NEM income range were the most risk averse compared to respondents in other NEM income ranges.

Figure 6.8 Survey switch point analysis



For respondents who switched from A to B in the last option, there is some leeway in defining their cCRRA. The original cCRRA would be undefined as it is a dominant choice and considered to be negative infinity. As negative infinity cannot be measured, switch point 6 was changed to equal -4, -5 and -6 and tested to determine how this influences the overall results. As seen in Figure 6.9, the means of each of these instances were different for the survey. However, the result is quite stable.

Figure 6.9 Survey Sensitivity Analysis



7 Choosing a Metric

The following section explores and compares two consumer risk metrics: WTP and the Risk Premium, derived from the modified Holt-Laury test. Both metrics offer distinct advantages and considerations, each shedding light on consumer preferences and attitudes towards risk in the energy market.

WTP is the first option for assessing consumer risk within the ISP framework. This metric's robustness is underscored by its consistent performance across focus groups and surveys, two distinct data sources. What sets WTP apart is its direct quantification of consumer WTP, offering a tangible measure of their valuation of electricity services. Moreover, feedback from online focus groups affirms that the survey results generally align with consumers' prevailing views, further establishing WTP as a reliable indicator.

The choice of sample in WTP measurement is significant, with focus groups offering participants who possess a better understanding of the electricity market and its relation to volatility. Although this comprehension may not be imperative for answering the metric's questions, it provides valuable context. However, surveys boast greater statistical significance with a larger sample size, ensuring a broader representation of the NEM.

In determining the average for WTP, both mean and median are considered. The mean, often preferred in estimating population totals, is chosen due to its practicality, even in non-normally distributed data. On the other hand, the median gains prominence when dealing with data exhibiting skewness or extreme values, as is the case in WTP.

Integration into the ISP hinges on the comparison of potential bill ranges. This involves assigning WTP values to different bill ranges and assessing the impact of various development pathways on these ranges. The resulting calculations reveal how much consumers are willing to pay to remain within specific bill ranges, providing insights into their risk preferences.

However, this approach is not without risks and limitations. It assumes AEMO's ability to predict bill ranges under different scenarios while acknowledging that transmission infrastructure investment only contributes partially to the total consumer bill. Nevertheless, it underscores the importance of understanding consumer perspectives and their financial considerations within the ISP's decision-making framework.

The second candidate for a consumer risk metric is Risk Premium, derived from a modified Holt-Laury test. This metric offers theoretical grounding in behavioural economics and is a recognised measure of risk attitudes. Its versatility stands out as a significant advantage; unlike WTP, it can be applied more broadly as a general risk metric.

When considering the choice of sample for CRRA measurement, both focus groups and surveys present their merits. Focus groups stand out as a suitable option due to their capacity to aid participants in grasping intricate concepts and questions. These groups offer an educational setting that fosters a deeper understanding of consumer risk attitudes. On the other hand, surveys, with their larger sample sizes, provide greater statistical significance and broader representation.

In terms of averaging CRRA values, both mean and median is considered, with the median gaining preference in cases where participants exhibit technically infinite CRRA values. This choice enhances interpretability and practicality.

The integration of CRRA into the ISP involves assigning CRRA values based on the results of the Holt-Laury Test and calculating risk premiums for different development pathways. This provides insights into how much compensation consumers require to accept varying levels of risk in their electricity bills.

Similar to the WTP approach, the CRRA metric carries risks and limitations, relying on AEMO's ability to predict bill ranges and estimate bill likelihood under different scenarios. However, it offers a different lens through which to view consumer risk preferences, emphasizing the importance of understanding how consumers perceive and respond to risk in the energy market.

7.1 Consumer Risk Metric Option 1: WTP based estimate

WTP is the first candidate for use as a consumer risk metric in the ISP. The results from the WTP question are robust across both the focus groups and the survey. The strength of this as a metric is it is a direct measure of consumer WTP.

WTP can be measured through a per-standard deviation estimate or a per-range estimate. Standard deviations can provide insights into the variability in consumers' preferences and tolerance for price fluctuations. By analysing the distribution of WTP values, AEMO can identify different market segments with varying levels of sensitivity to price volatility. This information can directly inform the assessment of CDPs. Moreover, it can help allocate resources more efficiently, targeting initiatives toward segments willing to pay more for stable energy costs. Overall, incorporating standard deviations in WTP analysis can empower the energy market operator to make data-driven decisions that align with consumer preferences and enhance market stability.

7.1.1 Choice of sample

7.1.1.1 Focus groups

The primary reason for choosing the focus group as the sample is that these participants were educated on the electricity market and how this relates to volatility. While these concepts are not strictly necessary to answer the questions, participants in the focus group have more context.

7.1.1.2 Survey

While the results from the survey and the focus groups are broadly similar, the survey is more statistically significant, at n=2340 (valid n = 555) rather than the focus groups, at n=82 (valid n=46).

The weighting of the survey is better aligned to the NEM than the focus groups, with quotas exactly met for age, location and income. The small number of focus group participants, and the fact that ACT and TAS were not included, means that the forum quotas are less representative of the NEM.

The WTP survey questions were simplified and clarified significantly. Participants in the online focus groups reported understanding the survey question much more easily.

7.1.2 Choice of measure of central tendency

7.1.2.1 Mean

The mean is preferred over the median because the parameter selected will be multiplied by the number of households in the NEM. When multiplied by the total count of observations, the mean yields the total value. Generally, in the context of estimating a population's total, the mean is considered a more useful measure than the median, regardless of the distribution's characteristics.

7.1.2.2 Median

The strength of the median over the mean is that due to the number of people who have 0 WTP, the data is slightly skewed.

7.1.3 Risks and limitations

This approach assumes that AEMO can predict bill ranges under different CDPs. Deloitte acknowledges that CDPs relate to wholesale price projects and transmission costs, not overall bills. However, Deloitte understands that AEMO can estimate the overall bill.

7.2 Consumer Risk Metric Option 2: Holt-Laury-based estimate

The CRRA, derived from the modified Holt-Laury test, is the second candidate for the consumer risk metric. When applied the CRRA is used to calculate a Risk Premium, which is a dollar value that represents the perceived cost to consumers of bearing risk.

The Holt-Laury test has strong theoretical foundations in behavioural economics and CRRA is a well-recognised measure of risk attitudes. The strength of using the CRRA over the WTP is its versatility. Rather than needing a bill range, the CRRA can be applied as a general risk metric.

7.2.1 Choice of sample

7.2.1.1 Focus groups

There are several reasons to choose the focus group sample over the survey. The first is complexity. Participants within the focus groups and the online focus groups both reported struggling to answer the questions and required assistance from the focus group leader to answer questions. Furthermore, participants were given generous time to complete the task. Survey participants were unable to ask the focus group leader for help, and while time restrictions were placed on answering too quickly, were under fewer obligations to take their time.

7.2.1.2 Survey

The main purpose of the deliberative aspect of the focus groups was to build understanding so participants could answer questions in an informed manner rather than from cognitive biases. However, answering this question does not require education on the energy market. Furthermore, the survey is more statistically significant, at n=2340 (valid n = 555) rather than the focus groups, at n=82 (valid n=46). In addition to statistical significance, the survey and survey weights better target the subsections of the NEM population: these being income, state and age rather than urban/rural and state. Lastly, people who did not answer the question in a logically consistent way were removed. To aid understanding, survey participants were told that A was most favourable for option 1 and B was most favourable for option 6.

Survey data survey is skewed to the left (risk-loving), whereas the forums displayed a more normal distribution as expected. The mean and median results both fall within reasonable CRRA ranges.[19]

7.2.2 Choice of measure of central tendency

7.2.2.1 Mean

The Holt-Laury test presents participants with specific choice pairs, each associated with particular values and risk levels. Using the mean CRRA allows you to move beyond these predefined categories and consider the nuances of risk aversion that participants express through their choices.

7.2.2.2 Median

Alternatively, the median of the Holt-Laury test scores can be used to estimate the CRRA parameter. The median is traditionally used as a measure when dealing with skewed or non-normally distributed data. This is not a problem in this case.

A stronger case to use the median is that in the last Holt-Laury choice (100% chance of a $700 bill increase or a 100% chance of a $250 bill increase), one option dominates the other. Technically, the CRRA for this choice is infinity. A sensitivity analysis was conducted to assess the impact of different CRRA levels for these participant values, considering a range of possible CRRA values.

In cases where participants exhibit technically infinite CRRA values, using the median provides a more interpretable estimate. Infinity as a CRRA value lacks practical meaning and can be challenging to work with in subsequent analyses, and choosing a value from the sensitivity analysis is more art than science. By using the median, you avoid these issues and instead focus on a finite and more meaningful measure of central tendency.

7.2.3 Risks and limitations

This approach assumes that AEMO can predict bill ranges under different CDPs. Deloitte acknowledges that CDPs relate to wholesale price projects and transmission costs, not overall bills. However, Deloitte understands that AEMO can estimate the overall bill.

[19] Gandelman, N. and Hernández-Murillo, R. (2014) *Risk Aversion at the Country Level*. working paper. St Louis: Federal Reserve Bank of St Louis, pp. 1–16.

7.3 Insights from online focus groups for choice of metric

7.3.1 Qualitative discussion

Online focus group participants generally agreed with Antenna's assessment of their understanding and perspectives on Australia's transition from fossil fuels to renewables.

Consumers generally have a good grasp of how the current electricity supply system operates, primarily focusing on the generation aspect while overlooking the infrastructure involved in delivering electricity. They are also aware of the broader shift toward renewables, influenced by media coverage, the closure of the Liddell power station, and the proliferation of wind and solar farms, as well as rooftop solar adoption.

While participants show a moderate understanding of the commercial aspects of the energy market, they lack awareness that it operates as a traded market with spot prices and price volatility. They recognise that household electricity consumption has risen due to factors like increased technology use, electric vehicles, and population growth.

Participants generally struggle to fully understand service fees on their electricity bills and the drivers behind recent price increases. Moreover, they have not actively considered the potential risks associated with transitioning to renewables, with their focus primarily on the anticipated benefits. When prompted, cost volatility emerges as a greater concern than the risk of unreliability, like blackouts, which they have experienced infrequently. Meeting global commitments to emissions reduction ranks lower in priority for them compared to other concerns.

7.3.2 Quantitative discussion

Participants were shown the results of the three key questions from the survey and focus groups. Namely, scenario preference, WTP and the risk premium. The purpose of doing so was to sense-check the results and clarify the differences between the survey and focus group results.

7.3.2.1 Scenario preference: Wait-and-See vs Early Investment

Participants exhibited a reasonable grasp of the prevailing preference for Early Investment over adopting a Wait-and-See approach. Furthermore, a consensus emerged among participants that younger individuals and women were inclined towards endorsing early investment strategies. Notably, participants also engaged in discussions regarding the disparities in outcomes between the survey and the focus groups. Several factors were identified as contributing to the forum's relatively stronger endorsement of early investment. These included the forum participants' higher level of prior education on the subject, which stemmed from preceding discussions, and a potential sense of societal responsibility among forum attendees, who may have felt compelled to make more ethical choices.

7.3.2.2 WTP

Participants were presented with the survey and focus group versions of the WTP question, and asked to interpret both and explain the differences. The main difference occurred in the interpretation of the timeframe. Participants believed that the survey question was clearly a yearly payment for a yearly reduction in volatility. Participants believed that the focus group question referred to a once-off payment for a once-off reduction in volatility. Most participants believed this once-off reduction in volatility lasted in perpetuity. Consequently, participants preferred the survey results, primarily because of the enhanced clarity associated with this rendition.

7.3.2.3 Risk Premium

Participants' initial reactions to these results did not align with their expectations, especially given the far higher WTP values presented in the previous question. To allow comparison between the WTP and the Risk Premium question and to aid participant understanding of a complex concept, Deloitte presented the Risk Premium results in a similar format to the WTP. This was presented in the form "how much you would have to be paid to accept a particular bill range" and results were approximately 10x lower than the WTP equivalent.

In hindsight, these results are not comparable and the presentation of these findings in such a way may have contributed to the disagreement of results. When viewed within their appropriate context, these results appear more reasonable and logical.

Taking the median result of -1.48, in the case of CDP1, where there's a 50% chance of the electricity bill being $1700 and a 50% chance of it being $1800 compared to a certain bill of $1750, a $1.00 risk premium is necessary to compensate for the added uncertainty. This compensation reflects the willingness of consumers to bear the risk associated with potential bill fluctuations. This is much more logical than the equivalent $1.50 to accept a $100 range.

Similarly, for CDP 2, where there's a 25% chance of the bill being $1600, 25% for $1700, 25% for $1800, and 25% for $1900 as opposed to a certain bill of $1750, an extra $5.25 in compensation is required to entice consumers to accept the risk. Again, this seems more logical than the equivalent of $5.25 to accept a $300 range.

In essence, participants' initial reactions stemmed from the presentation format rather than the inherent logic of the results. When properly contextualized, these outcomes align more closely with rational consumer behaviour, demonstrating a willingness to accept or mitigate risks associated with electricity bill variability.

8 Results discussion

8.1 WTP

In the follow-up online focus groups, respondents noted that they understood the WTP question from the focus group to be a once-off payment. However, there were meaningful differences in interpretation over the period of benefits. This is likely because, during the focus groups themselves, there was a discussion that indicated that the benefits would be realised over an extended period.

As a result, in feedback from AEMO, there is a preference towards an annualization adjustment to the willingness to pay number.

To create an annualization adjustment, the WTP that has been reported by focus group respondents should be considered as the present value of a future flow of benefits. Table 8.1 shows the annual payment required to receive a Net Present Value (NPV) of the indicated WTP over a 10- and 20-year time horizon, assuming a discount rate of 7% for mean values. 7% has been chosen as the discount period to broadly align with other areas of the ISP. For example, the yearly benefits that would create an NPV of $330 (completely reducing volatility) over a 10- and 20-year time horizon is $47 and $31 respectively. That is, under these assumptions, the annual benefit is approximately 15% and 10% respectively of the reported WTP. Roughly this equates to 1c and 1.5c per yearly payment for each dollar of NPV. Table 8.2 shows the same calculations for median values.

If we take the range and the annualised benefits that create an NPV of the reported WTP (for mean values), we have a 10-year time horizon coefficient of 0.036 and a 20-year time horizon coefficient of 0.024 (see Table 8.2). This means that over the 10- and 20-year time horizons, the average WTP per dollar of range (from 0-1000) is 3.6c and 2.4c respectively.

Understandably, participants value the reduction of the first $250 in range (from $0-$250), more than the last $250 (from $750-$1000). Over a 10-year time horizon, consumers would pay 5.1c per dollar of range from $0-$250, but only 0.6c per dollar of range from $750-$1000. Similarly, over a 20-year time horizon, consumers would pay 3.4c per dollar in the range from $0-250 compared to 0.4c per dollar in the range from $750-$1000 (see Table 8.2). Table 8.4 contains the same calculations for median values.

Table 8.1 Focus group WTP for reduced volatility as a yearly payment on a 10, 15- and 20-year time horizon (mean)

Range	Focus Group WTP **($)**	10 Year time Horizon **($)**	15 Year time Horizon **($)**	20 Year time horizon **($)**
0	330	47	36	31
250	241	34	27	23
500	176	25	19	17
750	116	17	13	11
1000	73	11	9	7

Table 8.2 Focus group WTP for reduced volatility as a yearly payment on a 10, 15- and 20-year time horizon (median)

Range	Focus Group WTP **($)**	10 Year time Horizon **($)**	15 Year time Horizon **($)**	20 Year time horizon **($)**
0	300	43	33	28
250	238	34	26	23
500	143	20	16	14
750	95	14	10	9
1000	41	6	5	4

Table 8.3 Focus group WTP to reduce volatility per dollar of range on a 10- 15- and 20-year time horizon over different ranges (mean)

Range	10 Year time Horizon **(cents)**	15 Year time Horizon **(cents)**	20 Year time horizon **(cents)**
0-250	5.08	3.90	3.40
250-500	1.86	1.43	1.22
500-750	1.13	0.88	0.75
750-1000	0.60	0.43	0.40
Average WTP per dollar of range (slope)	3.56	2.72	2.40

Table 8.4 Focus group WTP to reduce volatility per dollar of range on a 10- 15-10- and 20-year time horizon over different ranges (median)

Range	10 Year time Horizon **(cents)**	15 Year time Horizon **(cents)**	20 Year time horizon **(cents)**
0-250	3.54	2.72	2.32
250-500	2.72	2.09	1.80
500-750	0.91	0.71	0.60
750-1000	0.77	0.60	0.52
Average WTP per dollar of range (slope)	3.76	2.88	2.48

When considering these results, it's worth noting that, in the survey, the question was refined to make it as clear as possible that it was a one-off payment for a one-off benefit. If the focus group interpreted the question with a variable time range of benefits, then it becomes challenging to explain why the WTP results are broadly similar between the survey and the focus groups. A possible explanation relates to the fundamental differences between the focus group approach and the survey approach. Alternatively, although the wording was intended to be clear in the survey, it may be that people also understood the survey question as generating a stream of benefits into the future.

8.2 Holt-Laury based estimate

By setting an expected value of the electricity bill based on a bill range and a probability distribution and using the cCRRA to estimate the Utility (Expected Value) and the Expected Value (Utility) of the bill, a risk premium can be estimated. Table 8.5 presents the results of the risk premium calculation for the focus groups, with cCRRA of 1.48 (median) and 1.09 (mean). Table 8.6 presents the results of the risk premium calculation for the focus groups, with cCRRA of 0.14 (median) and 0.38 (mean). Each bill has an expected value of $1750.

Table 8.5 Risk Premium for focus groups based on a $1750 expected bill

Range	1.09 (Mean) ($)	1.48 (Median) ($)
0	0	0
100	0.75	1.00
300	3.75	5.25
600	9.00	12.25
800	16.25	21.75
1000	25.25	34.25

Table 8.6 Risk Premium for surveys based on a $1750 expected bill

Range	0.38 (Mean) ($)	0.14 (Median) ($)
0	0.00	0.00
100	0.25	0.00
300	1.25	0.50
600	3.00	1.00
800	5.50	2.00
1000	8.75	3.25

8.3 Comparing the Holt-Laury based estimate and the WTP based estimate.

Comparing the results from the Holt Laury based estimate and the WTP based estimate is challenging due to the framing of the results. The Holt Laury estimate is a willingness to accept an increase in range and the WTP is a willingness to pay for a decrease in range. In this way, the RP increases with range (you need to be paid more to accept a wider bill range), but the WTP is decreases with range (I am willing to pay less the larger the range). As such, the two estimates cannot be compared directly to each other.

To overcome some of these difficulties, Deloitte has rebased both estimates to a range of $1000. This means that both estimates increase as range decreases. For the WTP the range is $1000 over a 15-year time horizon, providing values of $9 for the mean and $5 for the median. For the RP this is $25.25 for the mean and $34.25 for the median. This is displayed in Figure 8.1 and 8.2.

Figure 8.1: Annualised WTP (15 years) and RP for a single household for a bill with $1750 expected value and range as shown, measured relative to a base case with bill range of $1000 - Mean focus group results

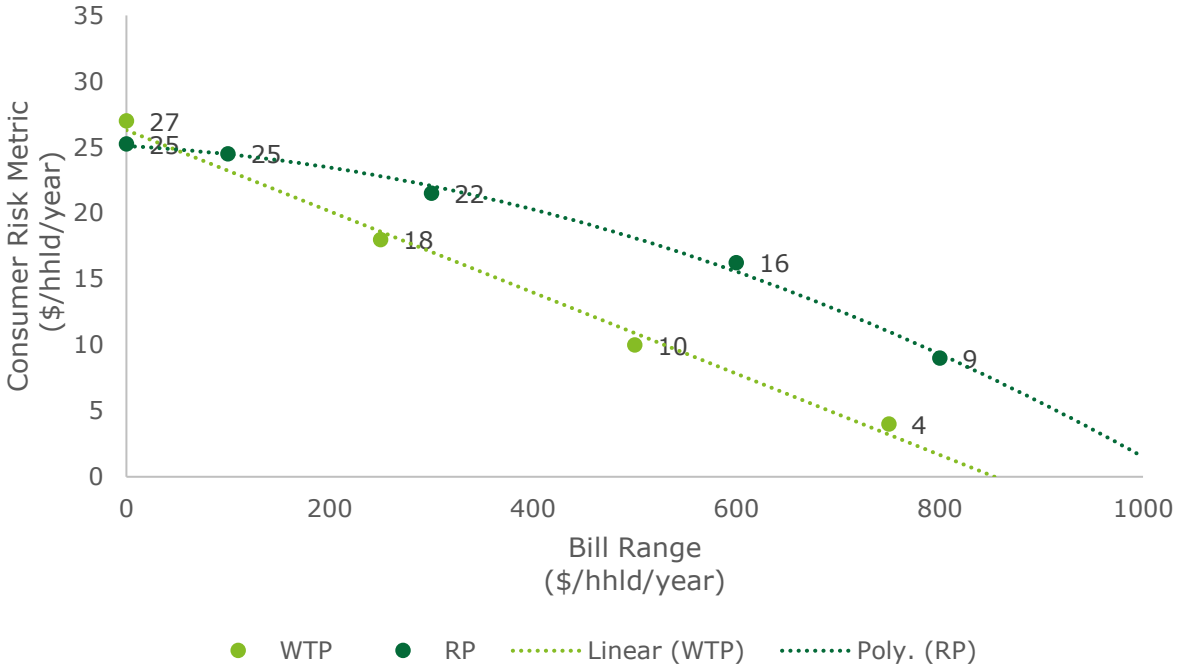
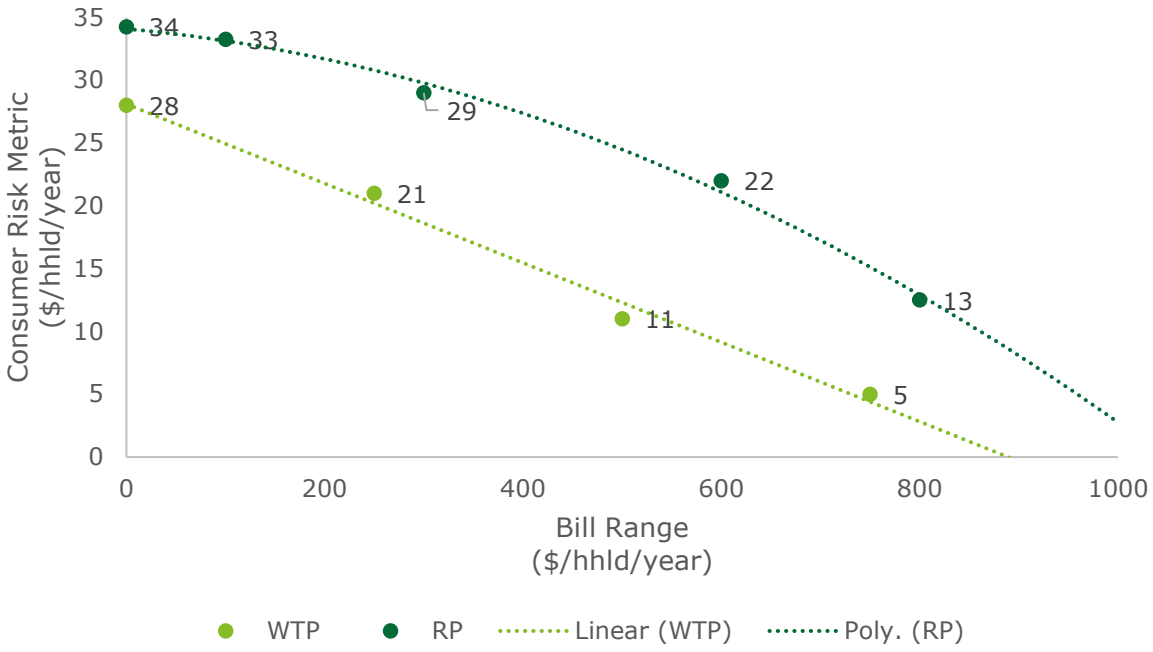


Figure 8.2: Annualised WTP (15 years) and RP for a single household for a bill with $1750 expected value and range as shown, measured relative to a base case with bill range of $1000 (median focus group results)



9 Conclusion

9.1 Application

The insights gained from Deloitte's comprehensive analysis of consumer risk preferences in the context of the NEM and the ISP have significant implications for various stakeholders, including consumers, society, and the electricity sector as a whole.

Understanding consumer risk preferences is crucial for shaping the future of the NEM. By comprehending how consumers perceive and respond to price volatility, policymakers and energy providers can make more consumer-centric decisions. This can lead to the development of pricing structures, infrastructure investments, and energy policies that align with the preferences and needs of households and businesses.

Integrating consumer risk preferences, as quantified through Deloitte's methodology, into the ISP modelling process provides a more holistic view of the energy landscape. This means that future infrastructure investments will be better informed, taking into account not only technical and economic considerations but also the expectations and sensitivities of energy consumers.

The transition from fossil fuel-based energy to renewables is inevitable for environmental sustainability. However, Deloitte's findings highlight the need for clear communication and education regarding this transition. To gain consumer support for funding renewable energy infrastructure, policymakers and energy providers must bridge the information gap and articulate the personal benefits of such investments. This is essential to avoid potential resistance or pushback from consumers concerned about rising costs.

The analysis underscores the importance of empowering consumers with knowledge about energy market dynamics, infrastructure funding, and the timeline for the transition to renewables. Informed consumers are more likely to support initiatives that contribute to a sustainable energy future. This empowerment can lead to greater engagement in demand-side management and energy efficiency practices, which, in turn, can contribute to a more resilient and efficient NEM.

The implications of Deloitte's research extend beyond individual consumers. A well-informed and engaged consumer base can drive positive societal outcomes. It can accelerate the adoption of clean energy technologies, reduce greenhouse gas emissions, and foster innovation in the energy sector. This, in turn, aligns with broader societal goals of sustainability and climate action.

9.2 Learnings

The study on risk preferences among consumers in the electricity market has provided valuable insights into the intricate nature of the topic.

Key learnings from the study on risk preferences in the electricity market are:

1. **Complexity of the Electricity Market**
   The electricity market is inherently complex, requiring a comprehensive understanding to uncover consumer preferences. Communicating electricity market concepts to non-experts is challenging, even with expert consultation. AEMO posits that excessive attention may have been given to the level of participant understanding of energy markets in Australia to the detriment of increasing participant understanding of the issues around risk in the NEM. This meant that too many of the qualitative themes discussed in the draft final report contributed very little to the understanding of consumer risk preferences. It is important to strike this balance in future studies.

2. **Benefits of Focus groups**
   Focus groups serve as valuable platforms for fostering discussions and allowing participants to seek clarifications. However, the feasibility of conducting nationwide forums may be hampered by limitations, particularly those related to time and budget constraints.

3. **Precision in Question Phrasing**
   What could have been improved and is a key learning for the next iteration of this project, is not to sacrifice clarity in terms of costs and benefits for simplicity in question design. While Deloitte made changes to the wording of the pilot survey to enhance understanding, the experience of the pilot survey and final survey show that the formatting, structuring, and ordering of survey questions did not impact the response rate.

4. **Enhancing Questionnaire Design**
   To improve research effectiveness and reliability, it is advisable to phrase questions using everyday language and active voice, enhancing accessibility for all participants. Creating separate explanation pages with user-friendly navigation and readability can assist in clarifying complex concepts. Implementing performance tracking measures, such as time stamps and incorporating open-ended questions, not only enhances participant engagement but also ensures higher data quality. These guidelines collectively aim to elevate future research endeavours, prioritising participant comprehension and research reliability.

10 Appendix

10.1 Focus group Questionnaire

10.1.1 Scenario Preference

Question:

The following questions will require an answer based off information provided on the screen. Please select the Scenario you prefer for each question.

Context:

(Scenario 1 - Early Investment) Stronger, earlier ISP investment in transition, generation and/or storage (especially transmission) . This could involve bringing forward one or more transmission project on the optimal development pathway.

For consumers this means total energy bill increases over time, but with relatively low price volatility when compared to scenario 2.

(Scenario 2 - Wait and See) Limited early ISP investment in generation or storage. Comparatively smaller investment in transmission, meaning the transition is no longer on the optimal development pathway.

For consumers this means total energy bill increases over time, but not as much as scenario 1. Ultimately lands at a point with high risk of volatile prices, especially on the upside.

Action:

Which Scenario do you prefer? 1 or 2

10.1.2 WTP overall

Question:

The next questions ask how much you'd be willing to pay today to reduce uncertainty on your future energy bill. We'll present you with different scenarios where the uncertainty around your bill is reduced to a specific range, and you'll tell us how much more you'd be willing to pay today to have that level of certainty.

Context:

I would be willing to pay $_____ more today if the uncertainty around prices in the future was kept to a range of [RANGE] on my annual bill.

Ranges:

$1050, $787.5, $525, $262.5, $0

Action:

Enter how much you would be willing to pay to reduce uncertainty around prices to each range.

10.1.3 The impact of cost of living on WTP

Question:

The following questions examine your energy preferences in a world of increasing costs. First, we'll tell you how much the cost of your other necessities increase by each year. Then, we'll ask you to tell us the most you would be willing to accept your energy bill increasing by to eliminate uncertainty around prices in the future.

Context:

If the cost of my other necessities increased by [RANGE] a year then the most I would be willing to accept my future bill increasing by to eliminate uncertainty around prices in the future is $_____ a year

Ranges:

$0, $2500, $5000, $7500, $10000

Action:

Enter how much you would be willing to pay to reduce uncertainty around prices to each range.

10.1.4 WTP for emission reduction and transmission investment

Question:

a) And how would your answers change if the additional cost meant we were certain to be following a pathway to achieve Australia's goal of reducing emissions to 43% below 2005 levels by 2030?
b) And how much would your answers change if the additional cost was used to improve the transmission infrastructure and reduce the risk of volatile electricity prices that might occur when coal fired power plants are closed?

Context:

I would be willing to pay $_____ more today if the uncertainty around prices in the future was kept to a range of [RANGE] on my annual bill.

Ranges:

$1050, $787.5, $525, $262.5, $0

Action:

Enter how much you would be willing to pay to reduce uncertainty around prices to each range.

10.1.5 Risk Premium (Holt-Laury in losses)

Question:

In the following test you will be presented with a series of choices between two different options that relate to potential energy bill increases. Each option will have a different level of risk and reward associated with it. Your task is to choose which option you prefer in each case.

For example, you may be asked to choose between a likely, small cost increase and an unlikely, large cost increase. There will be several rounds of choices like this, with different levels of risk and reward each time.

It's important to remember that there are no right or wrong answers in this test – we just want to understand your personal preferences when it comes to energy bills. So please choose the option that you feel most comfortable with, based on your own feelings and experiences.

Context:

Option A	Option B
10% chance of a $700 increase and a 90% chance of $900 increase to your annual bill	10% chance of a $250 increase and a 90% chance of $1300 increase to your annual bill
25% chance of a $700 increase and a 75% chance of $900 increase to your annual bill	25% chance of a $250 increase and a 75% chance of $1300 increase to your annual bill
50% chance of a $700 increase and a 50% chance of $900 increase to your annual bill	50% chance of a $250 increase and a 50% chance of $1300 increase to your annual bill
75% chance of a $700 increase and a 25% chance of $900 increase to your annual bill	75% chance of a $250 increase and a 25% chance of $1300 increase to your annual bill
90% chance of a $700 increase and a 10% chance of $900 increase to your annual bill	90% chance of a $250 increase and a 10% chance of $1300 increase to your annual bill
100% chance of a $700 increase and a 0% chance of $900 increase to your annual bill	100% chance of a $250 increase and a 0% chance of $1300 increase to your annual bill

Action:

Select either Option A or Option B to indicate your preference.

10.2 Survey Questionnaire

10.2.1 Scenario Preference

Question:

Choose the investment approach you prefer the most.

Context:

(Scenario 1 - Early Investment) Early Investment in electricity infrastructure can:

- Increase bills but reduce the volatility of bill prices, making them more stable and predictable over time.
- Help Australia move more quickly to renewable energy and meet climate reduction targets.

Hypothetical Example: A household's bill averages around $1600 a year. Under this scenario the bill would increase to a (smaller) range of $2300 to $2500 in the future.

(Scenario 2 - Wait and See) Australia taking a Wait and See approach to investments in electricity infrastructure can:

- Lead to smaller bill increases in the short-term, but will increase the volatility of bill prices, making them less stables and predictable over time.
- Increases the risk that we will not meet our climate reduction targets.
- Allow us to more easily incorporate future technologies that do not exist yet.

Hypothetical Example: A household's bill averages around $1600 a year. Under this scenario the bill could increase to a (larger) range of $1800 to $2900 in the future.

10.2.2 WTP overall

Question:

The next questions ask how much you'd be willing to pay today to reduce uncertainty on your future energy bill. We'll present you with different scenarios where the uncertainty around your bill is reduced to a specific range, and you'll tell us how much more you'd be willing to pay today to have that level of certainty.

Context:

Imagine that the cost of your annual electricity bill will potentially increase or decrease by an unknown amount this year compared to last year. $1050, $787.5, $525, $262.5, $0

How much would you pay to limit your annual electricity bill increasing anywhere within the below range:

$0 to $XYZ Ranges:

10.2.3 WTP for emission reduction and transmission investment

How much would you pay now in addition to your electricity bill to improve the transmission infrastructure and reduce the risk of volatile electricity prices that might occur when coal fired power plants are closed?

How much would you pay now in addition to your electricity bill to ensure we are following a pathway to achieve Australia's goal of reducing emissions to 43% below 2005 levels by 2030?

10.2.4 Risk Premium (Holt-Laury in losses)

Question:

In the following test you will be presented with a series of choices between two different options that relate to potential energy bill increases. Each option will have a different level of risk and reward associated with it. Your task is to choose which option you prefer in each case.

For example, you may be asked to choose between a likely, small cost increase and an unlikely, large cost increase. There will be several rounds of choices like this, with different levels of risk and reward each time.

It's important to remember that there are no right or wrong answers in this test – we just want to understand your personal preferences when it comes to energy bills. So please choose the option that you feel most comfortable with, based on your own feelings and experiences.

Context:

Option A	Option B
10% chance of a $700 increase and a 90% chance of $900 increase to your annual bill	10% chance of a $250 increase and a 90% chance of $1300 increase to your annual bill
25% chance of a $700 increase and a 75% chance of $900 increase to your annual bill	25% chance of a $250 increase and a 75% chance of $1300 increase to your annual bill
50% chance of a $700 increase and a 50% chance of $900 increase to your annual bill	50% chance of a $250 increase and a 50% chance of $1300 increase to your annual bill
75% chance of a $700 increase and a 25% chance of $900 increase to your annual bill	75% chance of a $250 increase and a 25% chance of $1300 increase to your annual bill
90% chance of a $700 increase and a 10% chance of $900 increase to your annual bill	90% chance of a $250 increase and a 10% chance of $1300 increase to your annual bill
100% chance of a $700 increase and a 0% chance of $900 increase to your annual bill	100% chance of a $250 increase and a 0% chance of $1300 increase to your annual bill

Action:

Select either Option A or Option B to indicate your preference.

10.3 Transmission Investment and Emissions Reduction Results

10.3.1 Focus groups

10.3.1.1 Transmission

The mean for the weighted focus group responses for how much respondents were willing to pay in addition to their electricity bill to improve the transmission infrastructure and reduce the risk of volatile electricity prices that might occur when coal-fired power plants are closed was $366.55. This means on average; respondents were willing to pay $366.55 to achieve this outcome. The median for this data was $364 indicating that half the respondents answered less than $364 and half answered they were willing to pay more than $364. The standard deviation of the weighted forum results was 234.51, therefore there is a significant variance between the responses, but more of a consensus of responses when compared to the base case for the survey data.

Table 10.1 WTP for Transmission Investment

Category	Mean ($)	Median ($)
Overall Observations	366.55	364
Gender		
Female	377	364
Male	356	364
Other	364	364
State		
QLD	307	350
NSW	344	250
SA	530	500
VIC	363	364
Age Range		
18-24	500	500
25-34	359	364
35-50	452	364
51-65	315	350
65+	272	150
Urban/Rural		
Urban	372	364
Rural	355	300

Table 10. illustrates the amount respondents willing to pay in addition to their electricity bill to improve the transmission infrastructure and reduce the risk of volatile electricity prices that might occur when coal-fired power plants are closed by demographic. It shows that respondents who identify as female were willing to pay less on average to improve transmission infrastructure than males and others. Additionally, those residing in South Australia were willing to pay more on average than respondents residing in other states. Respondents who were between the ages of 18 and 24 and resided in urban areas were also willing to pay more on average for transmission investment than other age ranges and compared to those residing in rural areas.

10.3.1.2 Emission reduction

The mean for the weighted focus group responses for how much respondents were willing to pay in addition to their electricity bill to ensure Australia is following a pathway to achieve its goal of reducing emissions to 43% below 2005 levels by 2030 was $405.55. Hence, respondents on average were willing to pay $405.55 to achieve this outcome. The median for this data was $375 indicating that half the respondents answered less than $375 and half answered they were willing

to pay more than $375. The standard deviation of the weighted forum results was 392.38, therefore there is a significant variance between responses.

Table 10.1 WTP for Emissions Reduction

Category	Mean ($)	Median ($)
Overall Observations	405.55	375
Gender		
Female	470	350
Male	336	400
Other	500	500
State		
QLD	334	350
NSW	373	200
SA	720	500
VIC	354	400
Age Range		
18-24	483	500
25-34	426	400
35-50	591	400
51-65	254	200
65+	365	150
Urban/Rural		
Urban	425	350
Rural	370	200

Table 10.1 illustrates the amount respondents were willing to pay in addition to their electricity bill to ensure Australia is following a pathway to achieve its goal of reducing emissions to 43% below 2005 levels by 2030 by demographic. It shows that respondents who identify as other were willing to pay more on average to guarantee emission reduction than females and males. Additionally, those residing in South Australia were willing to pay more on average than respondents residing in other states. Respondents who were between the ages of 35 and 50 and reside in urban areas were also willing to pay more on average for guaranteed emissions reduction than other age ranges and rural demographics.

10.3.2 Survey

10.3.2.1 Transmission

The mean for the weighted survey responses for how much respondents were willing to pay in addition to their electricity bill to improve the transmission infrastructure and reduce the risk of volatile electricity prices that might occur when coal-fired power plants are closed was $106.12. This means on average; respondents were willing to pay $106.12 to achieve this outcome. The median for this data was $50 indicating that half the respondents answered less than $50 and a half answered they were willing to pay more than $50. The standard deviation of the weighted forum results was 175.86, therefore there is a significant variance between the responses.

Table 10.2 WTP for Transmission Infrastructure

Category	Mean ($)	Median ($)
Overall Observations	106.12	50
Gender		
Male	93.9	25
Female	118	50
Other	63.8	100
State		
QLD	96.7	50
NSW	111	50
SA	110	50
VIC	89.0	50
TAS	164	25
ACT	73.2	50
Age Range		
18-24	159	100
25-34	129	50
35-44	104	50
45-54	95.8	50
55-64	70.6	25
65+	95.6	25
NEM Income		
Less than $26,000	105	25
$26,000-$33,799	61.4	50
$33,800 - $41,599	102	25
$41,600 - $51,999	84.1	50
$52,000 - $64,999	115	50
$65,000 - $77,999	78.5	25
$78,000 - $90,999	68.4	50
$91,000 - $103,999	50.4	25
$104,000 - $129,999	124	50
$130,000 - $155,999	110	50
$156,000 - $181,999	98.2	50
$182,000 - $208,000	83.5	50
More than $208,000	188	50

Table 10.2 illustrates the amount respondents willing to pay in addition to their electricity bill to improve the transmission infrastructure and reduce the risk of volatile electricity prices that might occur when coal-fired power plants are closed by demographic. It shows that respondents who identify as other were willing to pay less on average to improve transmission infrastructure than females and males. Additionally, those residing in Tasmania were willing to pay more on average than respondents residing in other states. Respondents who were between the ages of 18 and 24

and were in the more than $208,000 NEM income range were also willing to pay more on average for transmission investment than other age ranges and income brackets.

10.3.2.2 Emissions Reduction

The mean for the weighted survey responses for how much respondents were willing to pay in addition to their electricity bill to ensure Australia is following a pathway to achieve its goal of reducing emissions to 43% below 2005 levels by 2030 was $107.73. Hence, respondents on average were willing to pay $107.73 to achieve this outcome. The median for this data was $50 indicating that half the respondents answered less than $50 and a half answered they were willing to pay more than $50. The standard deviation of the weighted forum results was 189.46, therefore there is a significant variance between responses.

Table 10.4 WTP for Emissions Reduction

Category	Mean ($)	Median ($)
Overall Observations	107.73	50
Gender		
Male	104	25
Female	112	25
Other	38.4	50
State		
QLD	78.7	25
NSW	109	25
SA	125	50
VIC	123	50
TAS	175	25
ACT	62.2	50
Age Range		
18-24	208	100
25-34	138	50
35-44	102	50
45-54	86.6	25
55-64	67.4	25
65+	81.9	25
NEM Income		
Less than $26,000	93.1	25
$26,000-$33,799	69.3	50
$33,800 - $41,599	83.9	25
$41,600 - $51,999	88.4	50
$52,000 - $64,999	108	25
$65,000 - $77,999	66.7	25
$78,000 - $90,999	83.2	50
$91,000 - $103,999	52.4	25
$104,000 - $129,999	125	25
$130,000 - $155,999	93.2	50
$156,000 - $181,999	106	50
$182,000 - $208,000	124	100
More than $208,000	217	100

Table above illustrates the amount respondents were willing to pay in addition to their electricity bill to ensure Australia is following a pathway to achieve its goal of reducing emissions to 43% below 2005 levels by 2030 by demographic. It shows that respondents who identify as other were willing to pay less on average to guarantee emission reduction than females and males. Additionally, those residing in Victoria, South Australia and the Australian Capital Territory were willing to pay more on average than respondents residing in other states. Respondents who were

between the ages of 18 and 24 and were in the more than $208,000 NEM income range were also willing to pay more on average for guaranteed emissions reduction than other age ranges and income brackets.

10.4 Determination of Quotas and Reweighting Process Detailed Numbers

10.4.1 Focus groups

Table 10.3 Quotas and Weighting by Urban/Rural

Urban/Rural	ABS pop %	Initial Sample N=82	%	Valid sample N=46	%	Reweighted sample N=46	%
Urban	65	46	56	24	52	30	65
Rural	35	36	44	22	48	16	35

Table 10.4 Quotas and Weighting by State

State	ABS pop %	Initial Sample N=82	%	Valid sample N=46	%	Reweighted sample N=46	%
QLD	24	24	29	14	30	11	23
NSW	37	23	28	16	35	15	33
VIC	30	24	29	11	24	14	30
SA	8	11	13	5	11	6	14

10.4.2 Survey

Table 10.5 Quotas and Weighting by Age Range

Age Range (years old)	ABS pop %	Initial Sample N=2,340	%	Valid sample N=555	%	Reweighted sample N=555	%
18-24	11	234	10	38	7	60	11
25-34	18	527	23	125	23	100	18
35-44	17	527	23	126	23	95	17
45-54	16	468	20	125	23	90	16
55-64	15	351	15	79	14	83	15
65+	22	234	10	62	11	123	22

Table 10.6 Quotas and Weighting by State

State	ABS pop %	Initial Sample N=2,340	%	Valid sample N=555	%	Reweighted sample N=555	%
QLD	23	529	23	139	25	139	25
NSW	34	835	36	182	33	182	33
VIC	29	684	29	174	31	174	31
SA	8	189	8	40	7	40	7
TAS	3	60	3	11	2	11	2
ACT	2	44	2	9	2	9	3

Table 10.7 Quotas and Weighting by household income

NEM Income	ABS pop %	Initial Sample N=2,340	%	Valid sample N=555	%	Reweighted sample N=555	%
Less than $26,000	12	287	12	50	9	56	10
$26,000-$33,799	4	102	4	23	4	28	5
$33,800-$41,599	6	145	6	34	6	48	9
$41,600-$51,999	6	149	6	40	7	45	8
$52,000-$64,999	7	173	7	35	6	40	7
$65,000-$77,999	8	178	8	43	8	48	9
$78,000-$90,999	6	140	6	28	5	27	5
$91,000-$103,999	6	137	6	34	6	30	5
$104,000-$129,999	12	283	12	80	14	73	13
$129,999-$155,999	8	178	8	45	8	38	7
$156,000-$181,999	7	157	7	42	8	34	6
$182,000-$208,000	4	98	4	23	4	21	4
More than $208,000	13	312	13	78	14	66	12

Limitation of our work

General use restriction

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