Giving Power to Energy Networks:

Are Australian Households Willing to Adopt Demand-Side Management Programs?

July 2024

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Acknowledgement of Country

The authors of this report would like to respectfully acknowledge the Traditional Owners of the ancestral lands throughout Australia and their connection to land, sea and community. We recognise their continuing connection to the land, waters and culture and pay our respects to them, their cultures and to their Elders past, present, and emerging.

What is RACE for 2030?

RACE for 2030 CRC is a 10-year co-operative research centre with AUD350 million of resources to fund research towards a reliable, affordable, and clean energy future. https://www.racefor2030.com.au

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Glossary

Benevolence	Dimension of trust related to perceptions of how institutions or individuals are generous, kind, and considerate of others interests
Competence	Dimension of trust related to perceptions of how institutions or individuals are knowledgeable, competent or experts in a defined area
Confidence in Governance	Dimension of social licence to operate related to perceptions of the ability and legitimacy of laws and legislations to hold institutions accountable for wrong doings
Control Demand-Side Management	A type of demand-side management that includes directly adjusting or curtailing the energy consumption of a premise
Demand-Side Management (DSM)	Includes several strategies that aim to modify household energy demand to relieve pressure on the energy grid and optimise energy consumption
Dimensions	Specific aspects or facets of an overall construct that help break it down and explain its complexities
Distributional Fairness	Dimension of social licence to operate related to perceptions of the equity of the allocation of risks and benefits to stakeholders
Honesty	Dimension of trust related to perceptions of how institutions or individuals are transparent and keep to their word
Persona	A user-centric approach to understanding consumers, where one consumer will stand for a particular group and be given a rich narrative (e.g. Sally the busy young executive). Based on behavioural science rather than demographic data.
Procedural Fairness	Dimension of social licence to operate related to perceptions of the justice of the processes used to make and implement decisions
Social Licence to Operate (SLO)	The broad and ongoing acceptance or approval of operations by impacted communities and stakeholders
Trust	Dimension of social licence to operate related to the confidence that energy organisations, actors and systems will meet positive expectations for a specific task under conditions of unknown outcomes
Visibility Demand-Side Management	A type of demand-side management that includes communicating and informing directly with premise owners about their energy consumption and the occurrence of peak-energy periods


10:30
Living Room
25°C
77°F
Schedule

1.0 Executive Summary

Background

One of the key challenges facing the energy sector is how to address grid instability and high pricing during peak demand periods. Demand-side management (DSM) is one solution to this problem. DSM encompasses several strategies that aim to modify household energy demand. These strategies range from alerting households when their energy consumption is high to energy networks having the ability to curtail certain household appliances during periods of peak demand. Therefore DSM requires energy networks to have some degree of visibility and/or control of household's real-time energy consumption. However, recent reports have shown that the energy sector currently lacks trust and that many households have negative perceptions of the sector (Edelman, 2023; Schönauer & Glanz, 2020). Energy networks are therefore questioning whether they have enough social license to operate (SLO) for their customers to be willing to sign up for DSM and provide them with the visibility and/or control they need for these programs to be successful.

While only a small number of papers have investigated consumer willingness of DSM programs, those that have suggest that willingness to adopt DSM varies across countries and regions (Wang et al., 2020; Xu et al., 2018) indicating that willingness rates may differ across Australian consumers. Furthermore, these studies show that consumer demographics such as age, gender and income are relatively poor determinants of consumer willingness, resulting in a call for a greater focus on psychological factors (Lehmann et al., 2020). This research aims to extend these findings by comparing SLO, willingness to sign up for a control and visibility program as well as overall DSM adoption likelihood in both the general population of Australia and in a subsample of rural New South Wales consumers. Furthermore it will explore psychological factors by investigating whether household decision making style or if emphasising different motivational values of DSM impacts household willingness to adopt DSM programs. Filling these knowledge gaps will help policymakers and industry develop DSM communication and programs that cater to various households which in turn encourages uptake and therefore helps maintain stable and affordable energy for everyone.

Method

A 39-item survey with mostly Likert, multiple choice, and some open-ended questions was developed using Qualtrics surveys software. All survey items for SLO besides those relating to trust were taken from Zhang et al., 2015. Trust SLO measures were taken from Casaló et al., 2011 in order to ensure a separate measurement for each dimension of trust (competence, benevolence, honesty) recognised in the literature (Mayer et al., 1995). The survey included measures to gauge Australian consumers: (1) SLO for electricity networks to offer visibility and control DSM programs, (2) willingness to give electricity networks visibility and control for DSM, (3) likelihood of signing up to any DSM program, (4) previous awareness of DSM, (5) demographic factors, and (6) household decision making style. The full survey can be found in Appendix A.

The survey was distributed by Qualtrics to a total of 612 participants in September 2023, of which 301 were rural energy consumers from New South Wales and the remaining 311 made up an accurate representation of the Australian population. Results were then analysed using statistical software SPSS to answer the following four research questions:

1. How much social licence do electricity networks have to obtain visibility and control of household energy consumption for DSM programs?
2. How willing are households to give electricity networks visibility and control of their energy consumption for DSM programs?
3. Does the Value Framing of DSM Communication Impact Likelihood to Adopt DSM?
4. How does household demographics and decision-making style impact DSM preferences?

Results

Overall, the survey revealed that just under one-third of Australian consumers are likely to adopt DSM, just over one-third are undecided, and one-third are unlikely to adopt DSM. The findings and recommendations from each specific research question are discussed in depth in the following sections of this report but are also summarised below in Table 1.

Table 1: Summary of Findings and Recommendations

RQ1: How much Social Licence do Electricity Networks have to Obtain Visibility and Control of Household's Energy Consumption for DSM?

Findings

- Consumers indicate mid-range scores for both visibility and control SLO, scoring 3.5 and 3.4 out of 5 respectively. These scores represent both ambivalence and high variability amongst consumers.
- SLO for visibility DSM programs were significantly higher than the SLO for control DSM programs.
- Rural NSW consumers indicated significantly lower SLO scores for both visibility and control DSM programs than the general population.
- Procedural fairness was the dimension of SLO consumers scored the lowest, indicating a relative lack of confidence in electricity networks intent to consider consumers best interests when making decisions regarding DSM.
- While all dimensions of SLO were associated with DSM adoption likelihood, Distributional fairness, and trust in the honesty of electricity networks were the dimensions of SLO most strongly associated with DSM adoption likelihood.

Recommendations

1. Prioritise DSM programs that require visibility over those that require control
2. Make it easy for consumers to contribute to decision making and have their voices heard
3. Prioritise improving consumer trust and ensuring the benefits of DSM are fair and salient

RQ2: How Willing are Households to give Electricity Networks visibility and control of their energy consumption for DSM programs?

Findings

- Participants indicated mid-range levels of willingness to give electricity networks visibility and control of their household energy consumption for DSM programs with average willingness scores sitting at 3.28 and 3.0 out of 5 respectively.
- While the mean visibility and control willingness scores for rural NSW consumers was lower than those of the general population, a significant difference was not found between the two groups.
- Roughly 25% of participants indicated that they would not be comfortable giving energy networks any level of visibility, while 30% indicated they would be comfortable giving visibility of both their overall and individual appliance energy consumption. Visibility of only overall consumption (32%) was more popular than visibility of only individual appliances (12%).
- 38% of participants indicated that they would not be comfortable giving energy networks any level of control over their household energy consumption. Hot water systems and air conditioners were the most acceptable appliances to include in DSM programs, gaining acceptance from 40% of participants.
- Five common themes were identified from open-ended questions that asked participants to provide their current perceptions of DSM, including any reasons they would or would not adopt it in their household. These themes are as followed:
    1. Consumers need more information on DSM before they will accept it in their homes
    2. Consumers are concerned that DSM will interfere with their privacy and put their personal data at risk
    3. A lack of trust in Energy Networks and Government is preventing DSM adoption
    4. Financial savings, environmental sustainability, and improved energy knowledge motivate consumers to adopt DSM
    5. Rural NSW consumers are particularly distrustful and have greater concerns regarding giving up control of their energy consumption for DSM than the general population

Recommendations

4. Make it easy for consumers to access the information they need to make a decision regarding DSM
5. Ensure information about DSM is supported by a trusted source
6. Ensure DSM programs give consumers control and flexibility
7. Undergo small DSM trials before expanding to the wider population
8. Give consumers access to their real-time energy consumption to encourage DSM

RQ3: Does the Value Framing of DSM Communication Impact Consumer's Likelihood to Adopt DSM?

Findings

- No significant differences in adoption likelihood were found between different value messaging conditions

Recommendations

9. Conduct further research to confirm or expand on these results

RQ4: How does household demographics and decision-making style impact DSM preferences?

Findings

- Participants who have previously heard of or have experience with DSM are more likely to adopt a DSM program than those that have never heard of or experienced DSM before.
- Households with mid to high incomes (between $AUD80k – 149k combined per annum) are more likely to adopt DSM than those with low incomes.
- Households with children are more likely to adopt DSM than those without children.
- Consumers that have a lion pride household decision making style are less likely to adopt DSM than all other household decision making styles besides the cat family.
- While all dimensions of household decision making style were associated with DSM adoption likelihood, households that generally agree on decisions and those that actively seek out information are the households that express the highest likelihood to adopt.

Recommendations

10. Start by targeting households identified as being more likely to uptake DSM
11. Make DSM fun and child-friendly
12. Use energy personas to give consumers personalised recommendations based on their household

2.0 Sample Characteristics and Overall Likelihood to Adopt a Demand-Side Management Program

In total n = 612 participants completed the survey. The characteristics of this sample can be seen in Table 2. Compared to the general population, the rural subsample was found to be significantly older, have a lower income, are more likely to be female, own their home instead of rent and have fewer people living in their home.

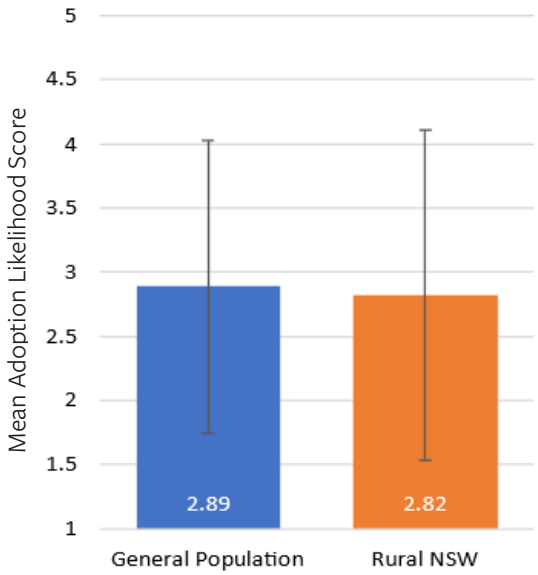
Table 2: Sample Characteristics

Characteristic		Representation
Sub-Samples	General Population	50.8%
	Rural NSW Population	49.2%
Gender	Male	41.0%
	Female	57.6%
	Non-Binary	1.3%
	Prefer not to say	0.1%
Age Group	18 - 24	7.8%
	25 – 3 4	15.5%
	35 - 44	17.0%
	45 - 54	13.9%
	55 - 64	16.5%
	65 - 74	20.5%
	75+	8.8%
Location	New South Wales	63.4%
	Victoria	13.9%
	Queensland	10.9%
	South Australia	4.2%
	Western Australia	4.9%
	Tasmania	1.4%
	Northern Territory	0.3%
	Australian Capital Territory	1.0%
Household Income	Up to $30,000	17.1%
	- $49,000	18.8%
	- $79,000	23.4%
	- $99,000	11.3%
	- $149,000	18.1%
	- $199,000	5.6%
	More than $199,000	5.7%
Home Ownership	Own	59.0%
	Rent	33.5%
	Live with Relatives	7.5%
Living Situation	Live Alone	20.4%
	Live with Children	8.2%
	Live with Partner	29.6%
	Live with Partner and Children	27.9%
	Live with Sole Parent	0.9%
	Live with Parents	6.2%
	Live with Relatives	1.5%
	Live with Housemates	5.2%

2.1 How Likely are Consumers to Adopt a DSM Program?

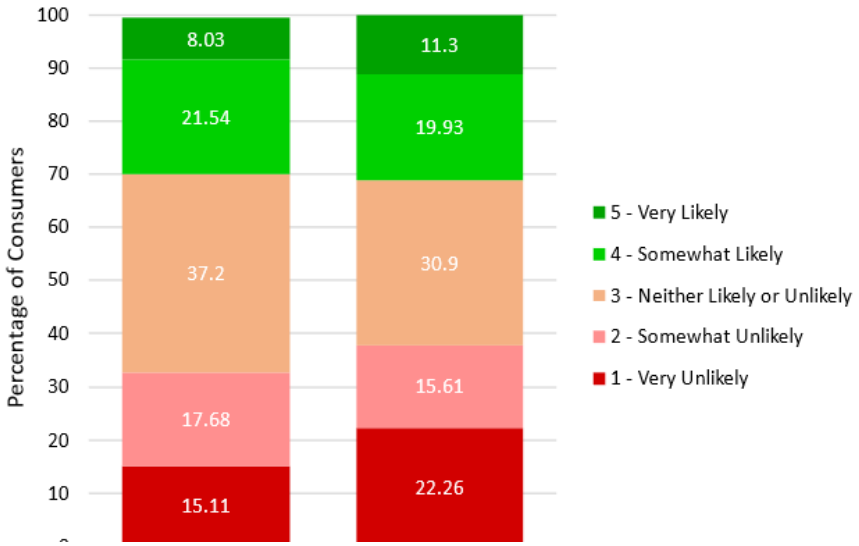
Average likelihood to adopt DSM scores for both the general population and rural NSW consumers sat just below the mid-point (see Figure 1). While there was no significant difference between the two groups, these scores indicate that most participants are either uncertain or somewhat unlikely to adopt a DSM program in their home.

Figure 1: DSM Adoption Likelihood - General Population vs Rural NSW Consumers



Looking at the distribution of likelihood scores, around 30% of participants indicated that they are at least somewhat likely to adopt a DSM program in their home (see Figure 2). However, the largest segment of consumers were those that expressed neutrality or uncertainty regarding DSM options with over 30% of participants claiming to be neither likely nor unlikely to adopt a DSM program in their home. Adopting strategies that address the uncertainties of this sizable segment of consumers may be a promising avenue to boost overall DSM participation rates. Furthermore, while there was no significant difference in adoption likelihood between the general population and rural NSW consumers, a larger number of rural NSW consumers indicated that they are very unlikely to adopt DSM. These results suggest that this subgroup may be less likely participate in DSM than the general population.

Figure 2: Adoption Likelihood Distribution of Scores - General Population vs Rural NSW Consumers



3.0 How much Social Licence do Electricity Networks have to Obtain Visibility and Control of Household's Energy Consumption for DSM? (RQ1)

RQ1 Results Summary

The survey revealed that consumers score in the mid-range for both visibility and control SLO, scoring 3.5 and 3.4 out of 5 respectively. These scores indicate some level of ambivalence and uncertainty amongst consumers regarding energy networks SLO for DSM and suggests that consumers will be more willing to give energy networks visibility than control of their energy consumption for DSM.

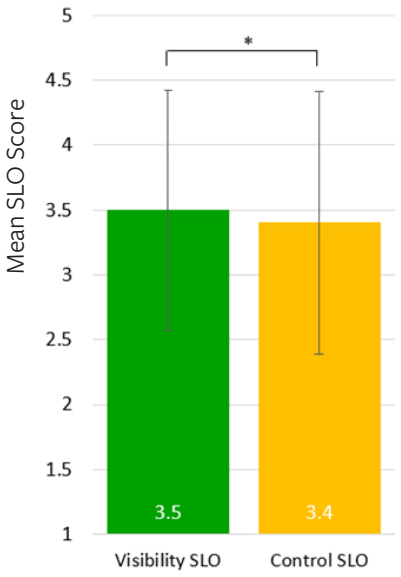
3.1 How much SLO do Energy Networks have for Demand-Side Management?

Overall social licence to operate for both visibility and control of household energy consumption for the purpose of DSM sits just above the mid-point at 3.5 and 3.4 out of 5 respectively (see Figure 3). These mid-range scores are indicative of ambivalence and uncertainty amongst consumers regarding energy networks SLO for DSM programs. However, these scores are also reflective of the variability of scores across individuals, with all scores from 1 (Strongly Disagree) – 5 (Strongly Agree) being represented in the sample.

While the difference between the mean SLO for visibility and control was small, visibility SLO was found to be significantly higher than control SLO. Therefore, indicating that participants are more likely to be willing to accept electricity networks having visibility of their energy consumption than control of their energy consumption for the purpose of DSM.

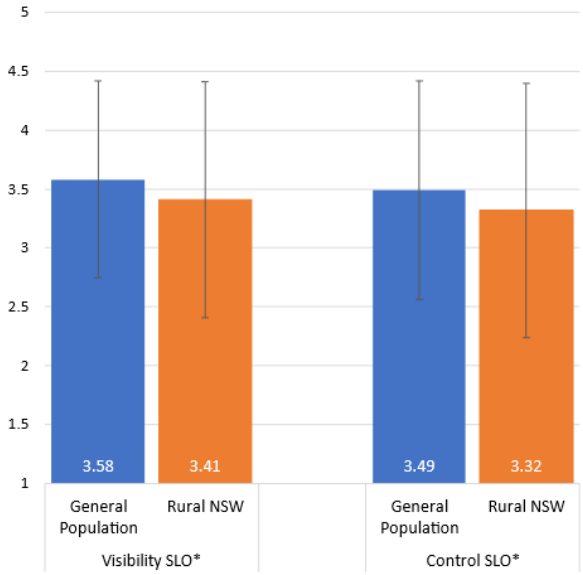
Rural NSW participants indicated significantly lower visibility and control SLO scores than the general population participants suggesting that this subgroup of consumers may be less likely to accept DSM than the rest of the Australian population (see Figure 4). Interestingly, rural NSW participants had higher instances of extremely low and extremely high SLO scores, indicating that these consumers have stronger opinions (both positive and negative) regarding their energy networks and DSM.

Figure 3: Average Visibility and Control SLO Scores



* Represents a significant difference between scores (p<.05)

Figure 4: General Population vs Rural NSW Consumers Visibility and Control SLO Scores

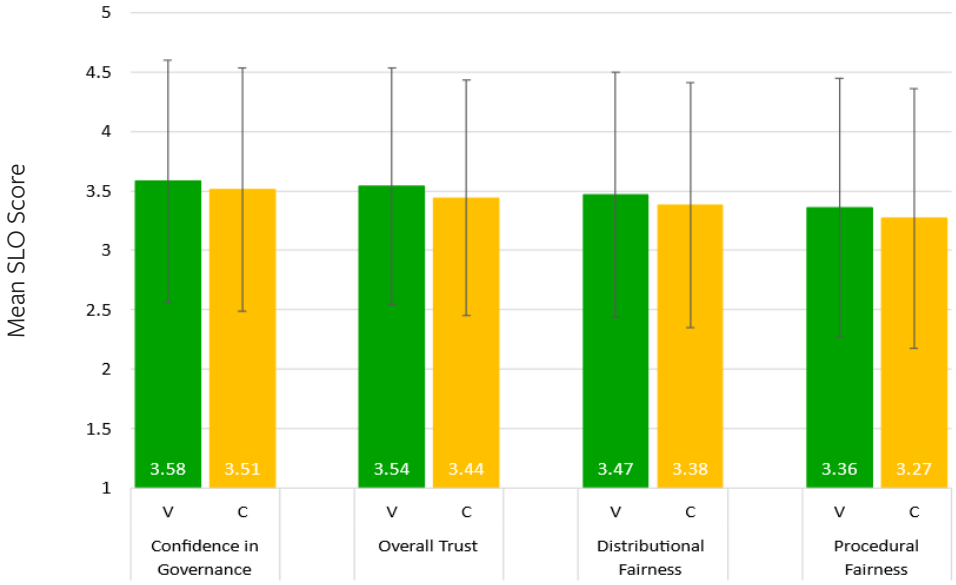


* Represents a significant difference between scores (p<.05)

3.2 How did the Dimensions of SLO Differ?

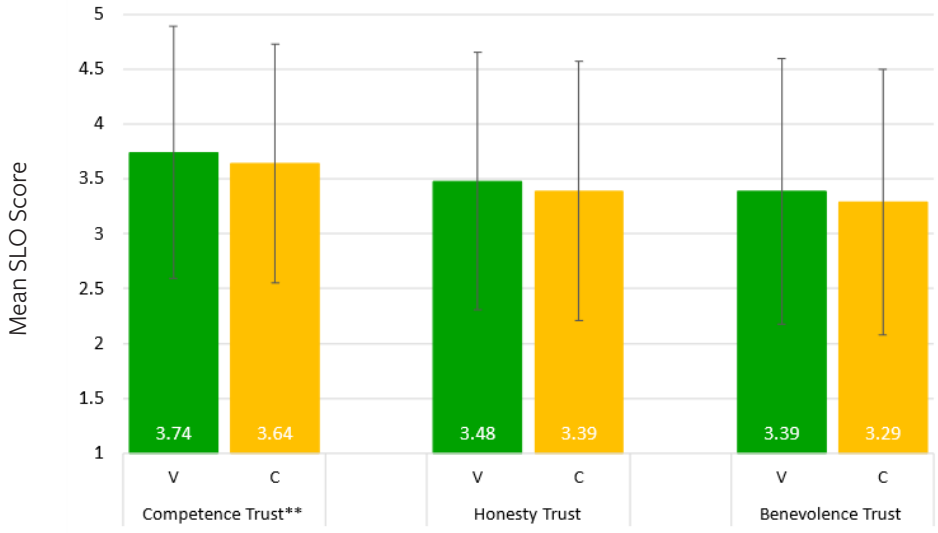
The average score for each dimension of visibility and control SLO sat around the mid-point (see Figure 5). Confidence in Governance was the SLO dimension with highest score for both visibility and control indicating that Australian consumers are somewhat confident in the Government's ability to regulate DSM. On the other hand, the SLO dimension Procedural Fairness was scored the lowest for both visibility and control indicating that Australian consumers are least confident in energy networks willingness to listen to their concerns regarding DSM. There was no significant difference between visibility and control scores for any specific dimension of SLO showing that consumer beliefs remain consistent across both contexts.

Figure 5: Mean Scores for Each Dimension of Social Licence to Operate



Looking more closely at each of the three dimensions of trust – participants appear to have more trust in energy networks competence to carry out visibility and control DSM projects than they are that energy networks will act honestly and benevolently towards consumers regarding DSM (see Figure 6). Competence was the only dimension of trust where a significant difference between visibility and control was found indicating that participants have less trust in energy network's ability to manage having control of consumers energy consumption than they are in their ability to manage having visibility.

Figure 6: Mean Scores for Each Dimension of Trust



3.3 Which Dimensions of SLO are Most Strongly Associated with Adoption Likelihood?

Bivariate correlations revealed that all dimensions of visibility and control SLO have a significant positive relationship with DSM adoption likelihood. Therefore with higher SLO scores being indicative of higher likelihood to adopt DSM scores, these results show support for using SLO in the DSM context.

Linear regression analyses were undertaken in SPSS in order to determine which dimensions of SLO are most predictive of DSM adoption. Adoption likelihood was taken as the predictive variable, with each dimension of SLO for visibility and control separately used as explanatory variables. Both visibility ($R2 = .29$, $F(1, 610) = 62.61$, $p < .001$) and control ($R2 = .31$, $F(1, 610) = 68.43$, $p < .001$) SLO models were found to significantly predict adoption likelihood, explaining 29% and 31% of the variance in adoption scores respectively.

Interestingly, the regression revealed that the impact of confidence in governance and procedural fairness on willingness is driven entirely by distributional fairness and trust in both visibility and control models. Therefore, energy networks should focus on increasing distributional fairness and trust to encourage the adoption of DSM by consumers.

SLO Dimensions Ranked by Ability to Predict DSM Adoption Likelihood

1. Distributional Fairness

2. Trust (honesty most predictive dimension)

3. Procedural Fairness*

4. Confidence in Governance*

*Predictivity becomes insignificant when considered together with distributional fairness and trust

Recommendations from RQ1

The findings of RQ1 suggest the following recommendations to encourage DSM adoption:

1. Prioritise DSM programs that require visibility over those that require control

SLO scores indicate that consumers are more likely to accept DSM programs that give networks visibility over those that give networks control. Therefore, networks should prioritise visibility DSM programs in order to appeal to the largest number of households. However, the relatively small difference between visibility and control SLO suggests that networks should not disregard control DSM programs. Instead control DSM should be optional addition for consumers that feel like they would benefit from this extra level of support.

2. Make it salient and easy for consumers to have their concerns voiced and addressed

Relatively low procedural fairness and benevolent trust scores indicate that consumers do not believe that energy networks act in their best interests or consider their concerns when making decisions regarding DSM. In order to address these negative perceptions networks need to focus on facilitating consumer feedback and giving consumers an opportunity to contribute to decisions that impact them. Energy networks should facilitate opportunities that allow for two-way communication with consumers, such as through hotlines or feedback forms. Furthermore, energy networks should aim to get consumer feedback on key decisions and the design of new services through the use of focus-groups and/or community meetings during the early stages of the services creation. Together these strategies allow for consumer-centric decision making which not only reduces the likelihood of negative backlash but also fosters collaborative and trusted relationships.

3. Prioritise improving consumer trust (particularly honesty) and ensure the benefits of DSM are fair and salient

Trust (particularly trust in honesty) and distributional fairness were the dimensions of SLO most closely associated with consumers' willingness to adopt a DSM program. While trust will need to be built over time through consistent displays of competence, benevolence and honesty, networks can target distributional fairness by making sure DSM can provide tangible benefits to consumers, and by making these benefits salient.

4.0 How Willing are Households to give Electricity Networks Visibility and Control of Their Energy Consumption for DSM Programs (RQ2)

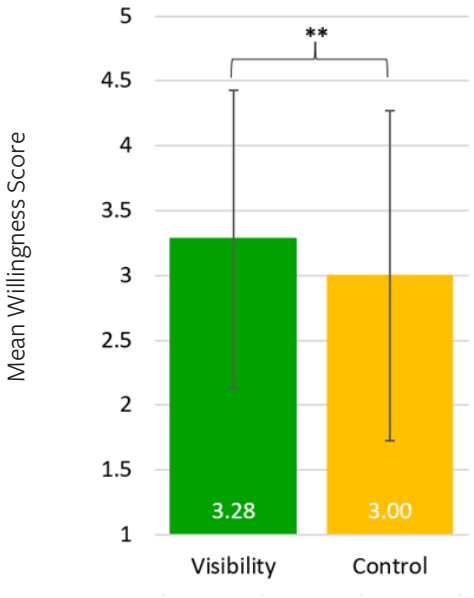
RQ2 Results Summary

In alignment with the results of RQ1, participants indicated mid-range levels of willingness to sign up for both visibility and control DSM programs with average willingness scores sitting at 3.28 and 3.0 out of 5 respectively. These results suggest that while some participants have strong feelings for or against DSM, overall consumers are uncertain about whether they should sign-up to these programs. Furthermore, these results support the finding that consumers are more willing to sign-up for DSM programs that give energy networks visibility over those that give them control.

4.1 Did Willingness Differ Between Visibility and Control?

Overall, the average willingness score for visibility was slightly above the mid-point, whereas the average willingness score for control was exactly on the mid-point (see Figure 7). The difference between these two scores was significant and suggests that while people are less willing to give energy networks control of their electricity for DMS than visibility, they are uncertain about both.

Figure 7: Average Control and Willingness Scores

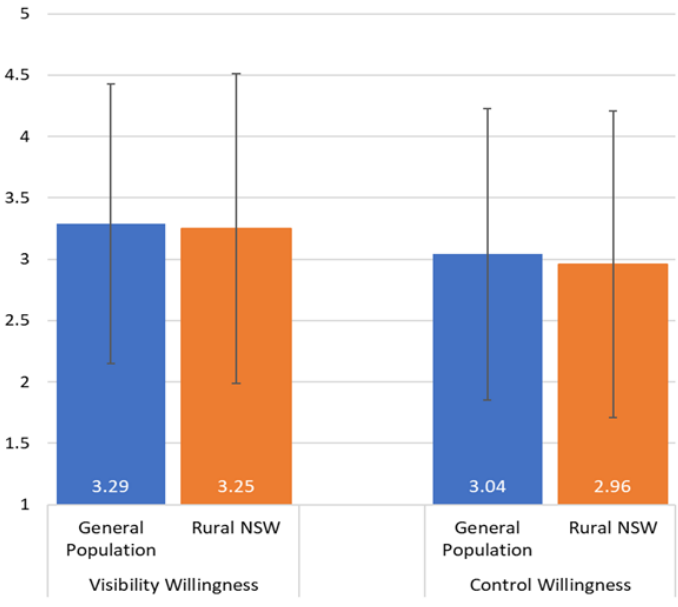


** Represents a significant difference between scores (p <.001)

4.2 Did the General Population and Rural NSW Consumers Differ in their Willingness to Sign-up for Visibility or Control DSM programs?

Although the rural NSW subsample had significantly lower SLO scores, this result was not found for willingness scores (see Figure 8). The difference between visibility and control willingness scores for these samples was not significant – suggesting that the groups are equally willing to allow electricity networks to have visibility and control of their energy consumption for DSM programs. Similarly to SLO scores, rural NSW consumers had a higher percentage of respondents indicate very high (5) and very low (1) willingness than the general population – showing further support for the finding that rural NSW consumers have stronger opinions (both positive and negative) on DSM than the general population.

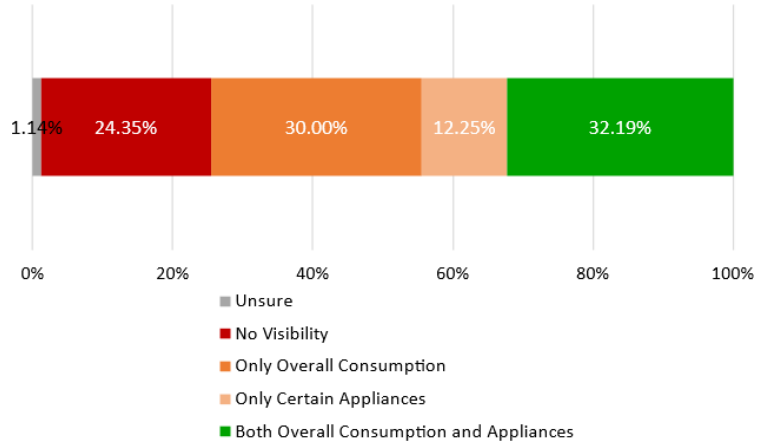
Figure 8: General Population vs Rural NSW Consumers Visibility and Control Willingness



4.3 What Level of Visibility are Consumers' Willing to Give?

Roughly one quarter of participants indicated that they would not be happy for electricity networks to have any visibility of their energy consumption. While visibility of overall consumption alone (30%) was more than double as popular as visibility of individual appliances alone (12%), the most popular option selected by consumers was allowing networks to have visibility of both overall energy consumption and individual appliances (32%) (see Figure 9). There were no significant differences found between the visibility preferences of rural NSW consumers and the general population.

Figure 9: Level of Visibility Willingness

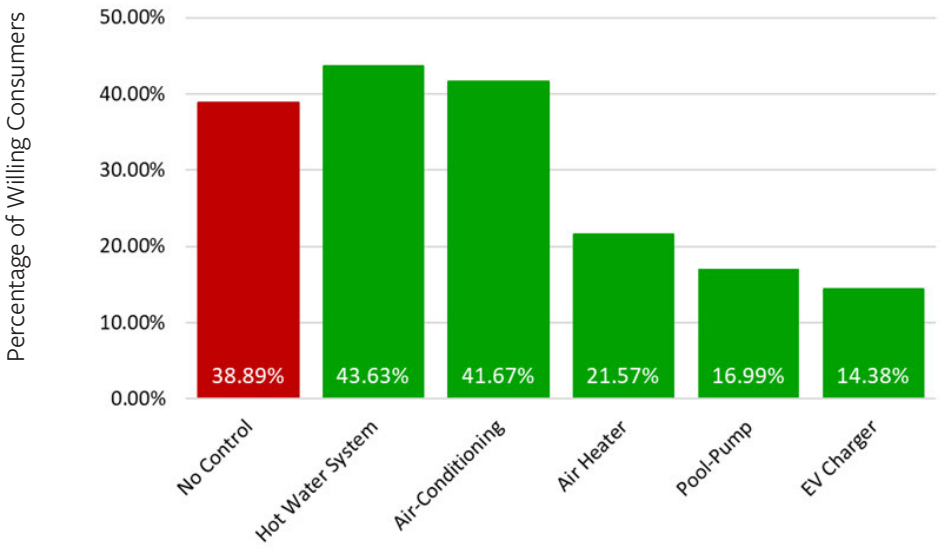


4.4 What Level of Control are Consumers' Willing to Give?

Just under 40% of participants indicated that they would not feel comfortable giving their electricity company control of any of their household appliances for the sake of DSM (see Figure 10). Hot water systems and air-conditioners were the two most accepted appliances for DSM with just over 40% of participants indicating willingness. Despite the high willingness rates for air-conditioners, only 21% of participants indicated willingness for air-heaters. Pool-pumps and EV chargers were the least popular appliances for DSM control; however this may be at least somewhat indicative of the fact that not everyone has these appliances in their home.

No differences were found between the level of DSM control willingness between the general population and rural NSW consumers.

Figure 10: Level of Control Willingness



4.5 Participant Opinions on DSM

To get a greater understanding of consumers opinions on DSM, all participants were asked to provide their perceptions of DSM including any reason why they would or would not be interested in adopting a DSM program. These responses were categorised based on whether they were positive (indicating reasons they would sign up), negative (indicating reasons they would not sign up) or neutral (responses that were not negative or positive). Negative perceptions were most common and found to be significantly more common in the rural NSW sample than the general population sample. Neutral perceptions were the second most common while positive perceptions were found least often in both samples (see Figure 11). Responses were then further categorised into key themes which are described below and visualised in more depth in Figure 12.

Theme 1: Consumers need more information on DSM before they will accept it in their homes

The most common response from participants was that they needed more information about DSM before deciding whether they wanted to sign up. In fact, several participants indicated that this survey was the first time they had become aware of DSM. Participants indicated that they would need to know more about:

1. The benefits to them
2. The cost to install
3. How intrusive/strict the program would be
4. What data is gathered and what happens to the data
5. What measures are in place to protect their data
6. What Government regulation are in place to prevent networks from using DSM to exploit their customers.

Theme 2: Consumers are concerned that DSM will interfere with their privacy and put their personal data at risk

The biggest concern participants had was related to privacy and data safety. Many participants indicated that they thought the program was *"an invasion of privacy"* and *"too big brother"* and that *"with all these data breaches, it wouldn't be safe"*. These were some of the main factors consumers indicated would prevent them from adopting DSM.

Theme 3: A lack of trust in Energy Networks and Government is preventing DSM adoption

Not trusting Electricity Networks or the Government was a common reason why participants did not feel comfortable signing up for DSM programs – even if they thought DSM itself was a good idea. For example participants commented that *"It is a good idea in theory, but companies cannot be trusted to act in the interests of consumers"* and *"it could be very useful, but I don't trust the way information will be used"*. These comments align with the low benevolence trust scores found when measuring SLO – highlighting the strong beliefs from some consumers that energy networks *"only care about profits, not their customers"*.

Theme 4: Financial savings, environmental sustainability, and improved energy knowledge motivate consumers to adopt DSM

The possibility of financial savings was the most common positive response, with many participants commenting that *"If it'll help reduce my costs or give me advice on how to reduce my consumption it would be fantastic. Any help to survive in this economy is priceless"*. While not as common as financial motives, the idea that DSM could be a *"great way to help the planet"* or an opportunity *"to help me identify where my electricity usage is coming from"* were both common motivating reasons to adopt DSM.

Theme 5: Rural NSW consumers are particularly distrustful and have greater concerns regarding giving up control of their energy consumption for DSM than the general population

While responses from rural NSW consumers were similar to those of the general population, this subgroup expressed more distrust towards energy networks and expressed more discomfort regarding giving up any control of their energy consumption to energy networks. While the general population was most concerned about privacy, the rural subgroup indicated that a lack of trust was the main reason they would not adopt DSM. Furthermore, more than double the amount of rural NSW compared to general population participants emphasised their discomfort with energy networks having any control over their electricity consumption. For example, some comments included *"I don't think anyone should have this level of control when it comes to how I use electricity"* and *"we all want control over our own lives and not to be dictated to by an electricity company"*. The possibility that the Government could exploit DSM to gain greater control over the public was a reoccurring concern – for example comments included *"The government is trying to control our every move...this is just one more way of controlling the population"* and *"This is another government action to control our lives"*.

Figure 11: Consumer Perceptions of DSM amongst General Population (GP) Rural New South Wales (RNSW) Participants

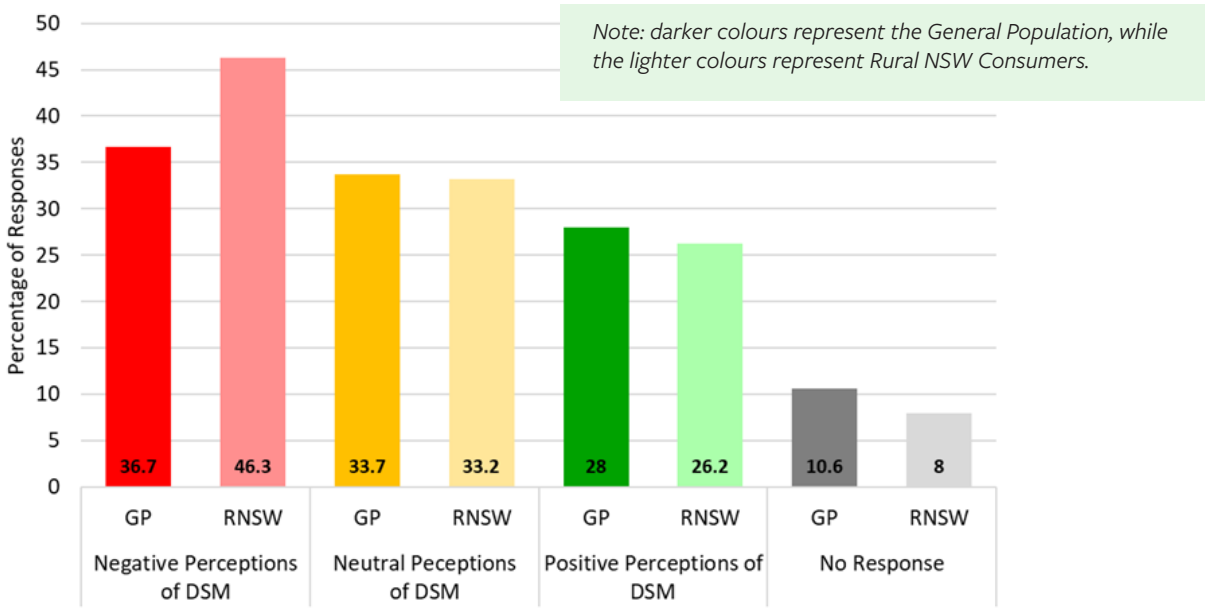
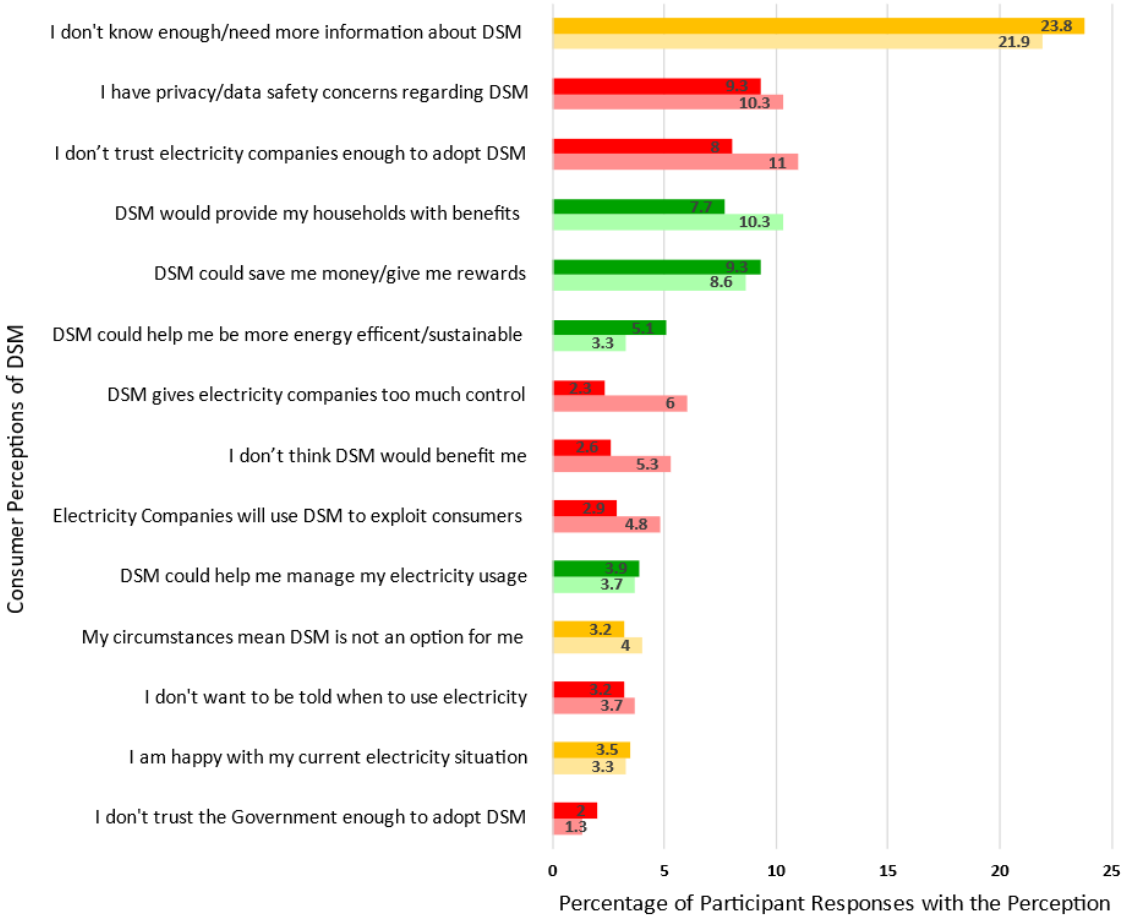


Figure 12: Negative, Neutral and Positive Perceptions of DSM amongst General Population and Rural New South Wales Participants



4.6 Recommendations from RQ2

In addition to supporting the previous recommendation that visibility DSM programs should be prioritised over control DSM programs, the findings from RQ2 suggest that energy networks should:

4. Make it easy for consumers to access the information needed to make a decision regarding DSM

Participants indicated that a lack of knowledge was preventing them from adopting DSM, suggesting that energy networks need to provide more information on these programs to consumers. Specifically, consumers wanted to know more about:

1. What benefits they get from adopting DSM
2. The cost to install DSM
3. How intrusive/strict the program would be
4. What data is gathered and what happens to the data
5. What measures are in place to protect their data
6. What Government regulations are in place to prevent networks from using DSM to exploit their customers

5. Ensure information about DSM is supported by a trusted source

The lack of consumer trust in energy networks and the Governments indicates that DSM information shared by these entities may be met with scepticism. Therefore these entities may benefit from working with a trusted third party such as an NGO or consumer advocate group to help spread information on DSM to consumers. The third-party would need to be perceived as fair, knowledgeable, and as having consumers' best interests at heart.

6. Ensure DSM programs give consumers control and flexibility

High variability across participant responses and concerns regarding DSM giving networks too much control indicates that having flexible programs that give control to consumers are more likely to be accepted. Programs should therefore:

- Be opt-in and allow customers to both override and re-start the program whenever they see fit
- Allow customisation regarding which appliances are included in the program and at what time of day these appliances are part of the program
- Offer customers a range of different incentives and rewards for exhibiting efficient energy behaviour

7. Undergo small trials before expanding to the wider population

Consumers indicated that they lacked trust due to inconsistent information and processes, and due to energy networks failing to follow through with initial plans and promises. While consumers saw this as evidence of a lack of benevolence and honesty, in many cases the issues arose due to the unpredictable and ever-evolving nature of introducing new products and services to the public. Therefore, to prevent these perceptions in the future, networks should conduct smaller trials of DSM to identify how best to implement these programs to ensure any issues are ironed out before the program is available to a wider audience.

8. Consumers desire on-demand and real-time data

Participants indicated that they would like the ability to monitor their energy consumption in real-time. Giving customers this ability can help foster more transparent relationships and provide a starting point to make it easier to expand to DSM programs later on.

5.0 Does the Value Framing of DSM Communication Impact Consumer's Likelihood to Adopt DSM? (RQ3)

RQ3 Results Summary

The value framing of demand-side management communication had no significant impact on adoption likelihood.

5.1 Value Framing Conditions

To explore whether the value framing of DSM communication impacts the likelihood of adoption participants were randomly assigned to one of four conditions. Each condition was based on one of Holbrook's Customer Value Dimensions (2006). While the body of the text explaining what DSM is remained the same, the title and first line of text emphasised a different value of DSM (see Table 3).

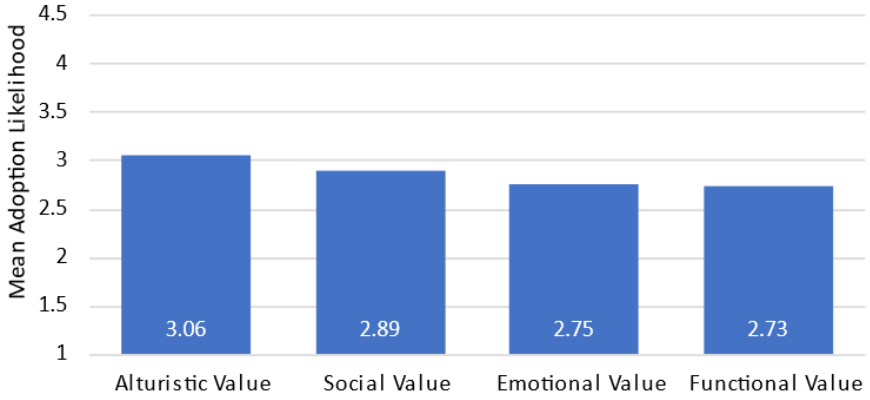
Table 3: Value Framing Conditions

Condition	Value	Message
1	Functional	**Join and be rewarded!** Demand-side management programs reward energy customers with bill credits for changing their energy consumption patterns
2	Emotional	**Get energy empowered!** Demand-side management programs allow energy customers to get access to tools and insights that empower them to make more informed and smarter energy choices
3	Altruistic	**Help us save the planet!** Demand-side management programs help create a cleaner energy future through better use of renewable energy
4	Social	**Help your community!** Demand-side management programs help keep the lights on and make energy prices more affordable for your community

5.2 Value Framing Results

Using statistical software SPSS a one-way ANOVA was conducted to explore if adoption likelihood scores varied significantly between conditions. While the altruistic condition had a higher mean than the rest of the conditions (see Figure 13), the ANOVA found the difference between groups was just out of the $p < .05$ significant range [$F(3, 570) = 2.24$, $p = .082$]. Therefore showing that adoption likelihood did not differ significantly between conditions.

Figure 13: Average Adoption Likelihood Score Across Value Framing Conditions



5.3 Recommendations from RQ3

the findings from RQ3 suggest the need to:

9. Conduct further research to confirm or expand on the impact of value framing

The insignificant results from this study mean that either value framing does not impact adoption likelihood or that the salience of the conditions in this study were not strong enough to trigger any significant differences. To explore the validity of these two narratives, future studies should similarly compare whether adoption likelihood differs whether a certain value of DSM is expressed, however they need to make sure these values are expressed more explicitly or through a different means.

6.0 How does household demographics and decision-making style impact DSM preferences? (RQ4)

RQ4 Results Summary

Awareness of DSM, household decision making style, income and whether a household has children are all factors associated with DSM adoption likelihood. Furthermore, consumers that have a lion pride household decision making style are less likely to adopt DSM than all other household decision making styles besides the cat family.

6.1 Do Demographic Factors and Household Decision Making Style Impact How Likely Consumers are to Adopt a DSM program?

Statistical tests including correlations, t-tests, ANOVAs and multiple comparisons were run to determine which demographic and decision-making factors were associated with likelihood to adopt DSM.

Factors Associated with DSM Adoption Likelihood

In order from most to least associated, below lists all factors explored that were associated with DSM adoption likelihood:

- **Awareness** – Consumers that have previously heard about or have experienced DSM are more likely to adopt DSM than those who have not.
- **Household Decision Making Style** – All dimensions of household decision making style were associated with DSM adoption likelihood. These are listed below from most associated to least associated.
    1. **Consensual vs Conflict** – Households that generally agree on goals are more likely to adopt DSM than those that disagree.
    2. **Passive vs Active** – Households that actively seek out information are more likely to adopt DSM than those that wait until issues arise.
    3. **Bureaucratic vs Organic** – Household that are more flexible are more likely to adopt DSM than those that have strict rules.
    4. **Top vs Shared** – Households that share decision making are more likely to adopt DSM than households where only select people make decisions.
- **Income** – Households with mid to high ($AUD80K to 149k) combined income are more likely to adopt DSM than those with low combined household incomes.
- **Children** – Households that have children are more likely to adopt DSM than those without children.

Factors Not Associated with DSM Adoption Likelihood

Below lists all the factors explored that were not found be associated with DSM adoption Likelihood:

- **Age** – Age had no association with DSM adoption likelihood.
- **Gender** – Gender had no association with DSM adoption likelihood.
- **Location** – Neither the state of residents, socioeconomic status of the neighbourhood or whether one lives in a rural or metropolitan area is associated with DSM adoption likelihood.
- **Home Ownership** – Whether one owns or rents their home is not associated with DSM adoption likelihood.

6.2 Do Households Decision-Making Personas differ in their Likelihood to adopt DSM?

In psychology and marketing personas are composite sketches of key segments of consumers. Personas aim to represent the variability of consumers across a range of individual factors such as decision-making style, purchasing preferences and behaviours. In the energy literature Russell-Benett and colleagues (2017) identified six separate segments of consumers based on how their household makes decision and interacts with technology (see Figure 14).

Figure 14: Household Decision Making Personas

The Ant Colony
In my household we work together for a common goals. We know what we are doing. When something new comes along we want an expert to assist us in making sure it is right. Technology needs to fit in with our way of doing things.

The Wallabies
In my household we don't have a lot of rules, we share decision making and everyone gets a say. We like technology to be fun as well as efficient. We prefer technology that assists us to manage our household.

The Flock of Geese
In my household we take turns in leading the decision making. We have household rules to help us work together. We wait for a problem to occur before making changes because we are busy. We rely on technology to do things for us.

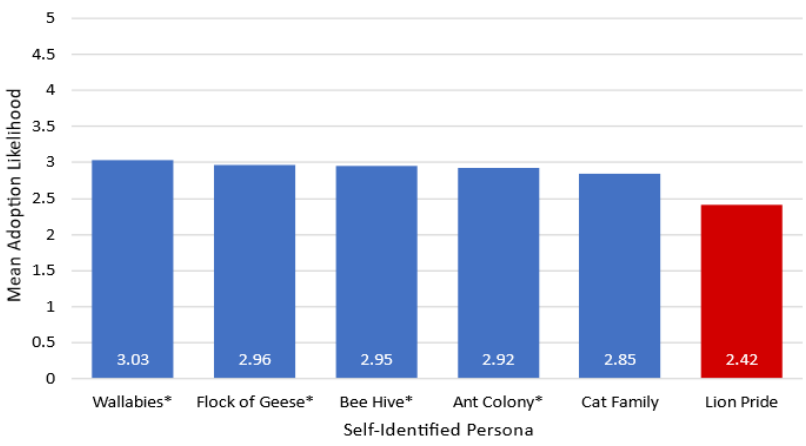
The Cat Family
In my household we are all independent and like to figure things out for ourselves. We actively seek information before a problem arises, and we trust technology to do things for us.

The Bee Hive
In my household we each have expert roles in finding information to make household decisions. One person tends to be in charge. We like things to run smoothly and like technology we can trust and control.

The Lion Pride
In my household we are independent, and we like to figure things out for ourselves. We actively seek information before a problem arises; and we trust in our ability to control technology.

A one-way ANOVA was used to test whether self-identified household decision-making personas differ in their likelihood to adopt DSM. The ANOVA demonstrated that the effect of household decision making persona was significant for DSM adoption likelihood, [$F(5,611) = 3.70$, $p = .003$]. Tukey's HSD test for multiple comparisons found that the mean score for DSM adoption likelihood was significantly lower for those whose households are identified as Lion Prides (which accounted for 18.1% of participants) compared to all other persons besides the Cat Family. No other personas varied in their DSM adoption likelihood (see Figure 15).

Figure 15: Likelihood to Adopt DSM by Self-Identified Persona



* Represents a significant difference from the Lion Pride ($p < .05$)

6.3 Recommendations from RQ4

10. Target low-hanging fruit to encourage adoptions and spread awareness
Networks should initially target families with children in mid-to-high-income areas as they are more likely to adopt DSM. This population can provide networks with relevant case studies to further refine these programs.

11. Make it fun and child-friendly
The higher acceptability from households with children suggests that designing these programs in a way that allows children to interact with them in a fun, exciting and educational way may further encourage acceptance. This may include:

- Gamifying DSM programs through characters and stories.
- Incorporate learning opportunities through relevant energy experiments and educational videos.
- Implement a recognition system or rewards for children who actively participate in DSM. Acknowledging their contributions can motivate them to continue practising energy-efficient habits.

12. Use energy personas to suggest the options households are more willing to accept
Further identification of which sub-sets of consumers are likely to prefer certain features of DSM can provide custom recommendations for consumers.

7.0 Conclusion and Future Research

Overall, the results of this study found large variability amongst consumers regarding their preferences for DSM. While some consumers indicated strong preferences for and against adopting a DSM program, a large percentage of consumers were ambivalent or uncertain regarding their stance on these programs. Consumers indicated that they are more likely to adopt visibility DSM programs than control programs. Furthermore, social licence to operate was found to be an appropriate framework to explore DSM, with all SLO dimensions being associated with adoption likelihood. Consumer trust in energy networks as well as perceptions of distributional fairness were found to be a major determinant of whether a consumer is willing to adopt a DSM program. While the value proposition of DSM messaging was not found to impact adoption likelihood, awareness of DSM, household decision-making style, income and having children in the home were all found to be predictors of adoption likelihood - showing some support for the exploration of psychological factors in this context. Although the rural NSW sub-group did not differ in their willingness to adopt DSM, differences in SLO, and DSM perspectives suggest regional differences in DSM preferences may still exist, highlighting the need for regional considerations. Lastly, a general lack of awareness of DSM resulted in consumers indicating a strong desire for more information on DSM – in particular consumers wanted to know more about the benefits and risks of these programs to their households.

The main limitation of this study relates to this general lack of awareness of DSM among participants. DSM programs are not widely known amongst the Australian population and while the survey included a brief overview of DSM, limitations to the length of the survey prevented a detailed description of these programs. These factors ultimately limit participants ability to make fully informed survey responses which was reflected with the large percentage of participants that wanted more information on DSM before deciding whether to adopt DSM in their households.

Considering the strong desire from consumers for more information, future research should explore the most effective means to communicate DSM information to consumers. Information is likely to be disregarded or received with scepticism if consumers do not trust its source. Therefore, identifying which energy actor consumers trust most to disseminate DSM information can assist in ensuring the information is perceived as credible and taken seriously. Furthermore, the complex nature of DSM makes information on the topic susceptible to being disregarded or misinterpreted. Therefore it is important that energy actors identify the best means to be able to communicate DSM information in a clear way that does not overload consumers while also ensuring consumers have enough information to make an informed decision. Lastly, consumers are unlikely to adopt DSM if they feel like the programs do not give them enough benefits. Therefore, exploring what benefits and schemes appeal most to a wide range of consumers can help encourage adoption once the program is made available to the wider population.

The results from this study indicate that energy networks should focus on visibility DSM programs, provide and make salient the benefits of DSM while also addressing risks and work on building consumer trust (see Russell-Bennett et al., 2023 for insights into how the energy sector can build trust). Furthermore, energy networks need to provide consumers with more information on DSM to address the large array of questions and uncertainties they have regarding these programs. Together these strategies can help encourage consumer uptake of DSM which ultimately helps maintain stable and affordable energy for everyone.

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Appendices

Appendix A – Survey Design

Overview: Through Qualtrics participants will be randomly assigned to one of four conditions. The only difference between these four conditions is the heading of a short body of text that explains what DSM is. These headings differ by the type of value they highlight DSM providing to energy customers - either functional, emotional, altruistic or social. These four values are based on Holbrook's Customer Value Dimensions (2006). Participants will be asked to read this body of text and then proceed to the next pages to answer a series of questions related to their thoughts on DSM and the networks that run them as well as questions related to their household demographic and decision-making style.

SECTION 1: Context and Value Framing Conditions

RQ3: Does the value framing of DSM communication impact willingness to adopt DSM?

New Page

Please carefully read the following paragraph and then proceed to the next page by clicking "next" at the bottom of the page. By clicking 'next' you will be taken to answer a series of questions that ask you about your thoughts and preferences on DSM and the networks that run it.

Heading 1: Functional/ Economic Value	Join and be rewarded! Demand-side management programs reward energy customers with bill credits for changing their energy consumption patterns
Heading 2: **Emotional Value**	Get energy empowered! Demand-side management programs allow energy customers to get access to tools and insights that empower them to make more informed and smarter energy choices
Heading 3: **Altruistic Value**	Help us save the planet! Demand-side management programs help create a cleaner energy future through better use of renewable energy
Heading 4: **Social Value**	Help your community! Demand-side management programs help keep the lights on and make energy prices more affordable for your community
Body	Electricity companies now offer demand-side management (DSM) programs that aim to assist customers in managing their energy consumption. DSM involves implementing various techniques and initiatives that help customers modify their energy behaviour and optimise their electricity usage in line with peak energy demand periods. These programs can therefore improve the overall efficiency and reliability of the electricity network, prevent blackouts, support more renewable energy and reduce the costs of electricity for customers. Examples of demand-side management programs are: • Rewarding customers for changing when they consume electricity. • Allowing utilities to manage appliances, like hot-water systems, pool pumps or electric vehicle chargers, to operate at the best times. • Sending messages to customers to reduce their electricity consumption during peak times.

SECTION 2: Awareness and Experience with DSM

New Page

The following section will ask you a series of questions related to your experience with and willingness to sign up for DSM programs.

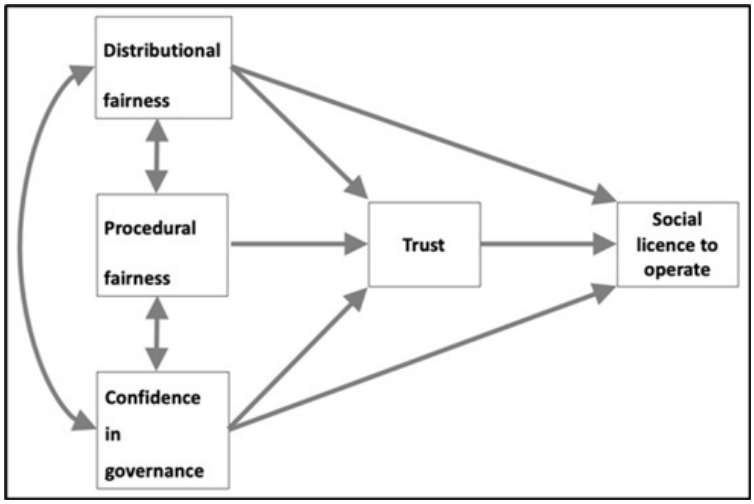
Measure	Question/Responses	Source
Awareness	Have you heard of demand-side management before? • Yes • No • I don't know	N/A
Experience	Has your household ever participated in a demand-side management program before? • Yes • No • I don't know	N/A

SECTION 3: Awareness and Experience with DSM

New Page

RQ2: How much social licence do electricity networks have to obtain visibility and control of household's energy consumption?

Visibility and control questions follow Moffat and Zhang's model of social license to operate (2014)



New Page

All demand management programs require two key elements to function – an ability for an electricity company to have visibility of their customer's energy consumption and/or a way to influence or control their customer's energy consumption. While electricity companies already have some capacity to do this today, it is mostly limited to electric hot-water systems. However, the introduction of smart meters has allowed utilities to have greater visibility and control of household energy consumption. This means that utilities can offer a larger range of DSM programs that offer customers better incentives.

We understand that different households will have different attitudes, beliefs and preferences when it comes to how much visibility and control of their energy consumption they are comfortable giving electricity companies. So we can start to understand these attitudes, beliefs and preferences please select from a scale of 1 (strongly disagree) to 10 (strongly agree) how much you agree with the following statements:

SLO Visibility

Measure	Question	Source
Distributional Fairness	People like me will receive benefits from electricity companies having visibility of household energy consumption data	Zhang et al., 2015
Distributional Fairness	The economic benefits of electricity companies having visibility of household energy consumption will be fairly distributed	
Procedural Fairness	Electricity companies will listen to and respect customer concerns regarding having visibility of household energy consumption data	
Procedural Fairness	Electricity companies are prepared to change their practices in response to customer concerns regarding having visibility of household energy consumption data	
Confidence in Governance	Legislation and regulation can be counted on to ensure electricity companies do the right things with household energy consumption data	
Confidence in Governance	State and federal/central governments are able to hold electricity companies accountable for any issues that arise around having visibility of household consumption data	
Trust (Competence)	I think that electricity companies have the necessary abilities and resources to ensure they can successfully manage having visibility of household consumption data	Casaló et al., 2011
Trust (Benevolence)	I think that electricity companies will take into account their customer's interests when having visibility of household energy consumption data	
Trust (Honesty)	I think that electricity companies will follow through with the commitments they make regarding having visibility of household energy consumption data	
Overall Willingness	I would be willing to give electricity companies visibility of my household energy consumption data	N/A

SLO Control

Measure	Question	Source
Distributional Fairness	People like me receive benefits from electricity companies having control of some household energy consumption	Zhang et al., 2015
Distributional Fairness	The economic benefits of electricity companies having control of some household energy consumption will be fairly distributed	
Procedural Fairness	Electricity companies will listen to and respect customer concerns regarding having control of some household energy consumption	
Procedural Fairness	Electricity companies are prepared to change their practices in response to customer concerns about having control of some household energy consumption	
Confidence in Governance	Legislation and regulation can be counted on to ensure electricity companies do the right things when in control of household energy consumption	
Confidence in Governance	State and federal/central governments are able to hold electricity companies accountable for any issues that arise around having control of household energy consumption	
Trust (Competence)	I think that electricity companies have the necessary abilities and resources to ensure they can successfully manage having control of some household energy consumption	Casaló et al., 2010
Trust (Benevolence)	I think that electricity companies will take into account their customer's interest when having control of some household energy consumption	
Trust (Honesty)	I think that electricity companies will follow through with the commitments they make regarding having control of some household energy consumption	
Overall Willingness	I would be willing to give electricity companies control of some household energy consumption	N/A

SECTION 3: SLO Control & Visibility Preferences

New Page

You are now over halfway through the survey! Please read the following questions and tick the response that most accurately represents your preferences regarding DSM

Measure	Question/Responses	Source
Degree of visibility acceptance	Please tick below the level of visibility you would be comfortable in your electricity company having to facilitate DSM programs. • Visibility of my overall consumption • Visibility of my individual appliances' energy consumption (e.g., air-conditioning, pool pump, hot water system) • Visibility of my overall consumption and individual appliances' energy consumption • I do not feel comfortable letting energy companies have any visibility of my real-time energy consumption	N/A
Degree of control acceptance	Please tick below the household appliances you would feel comfortable with your energy company having some control over to facilitate DSM programs. • Hot water system • Air-conditioning • Air Heater • Pool-pump • Electric Vehicle Charger • Other (please insert) • I would not feel comfortable with my energy company having control over any of these appliances	N/A

SECTION 4: Overall Willingness and Thoughts about DSM

RQ1: How willing are households to sign-up for demand-side management programs?

New Page

Please read and answer the following questions related to your willingness to sign-up for DSM programs.

Measure	Question/Responses	Source
Willingness to adopt DSM	Overall, on a scale of 1 (not willing) to 10 (very willing) how willing would your household be to sign up for a DSM program?	N/A
Justification for Willingness (open-ended)	Please provide any reasons as to why your household would or wouldn't be interested in signing up for a DSM program	N/A
Other thoughts on DSM (open-ended)	Please provide any other thoughts on DSM that you would like to share with us	N/A

SECTION 5: Demographics

RQ4: How does household demographics and decision-making style impact DSM preferences?

New Page

Please read and answer the following demographic questions.

Measure	**Question**
Age	What is your age? [insert age]
Gender	What is your gender? • Male • Female • Non-Binary • Other
Postcode	What is your postcode? [insert postcode]
Income	What is your household income? • Less than $10,999 • $11,000 – $30,999 • $31,000 – $50,999 • $51,000 – $70,999 • $71,000 – $90,999 • $91,000 – $110,999 • $111,000 – $150,999 • $150,100 and above

Own/Rent	My house is: • Owned • Rented • Other
No. People in Home	How many people live in your house? • 1 • 2 • 3 • 4 ect.
Household Structure/Life-stage	Would you identify yourself as: • At home with my parents/guardian • At home with my sole parent/guardian • Couple without children • Couple with children • One-parent family • Group or shared household • One-person household • Other

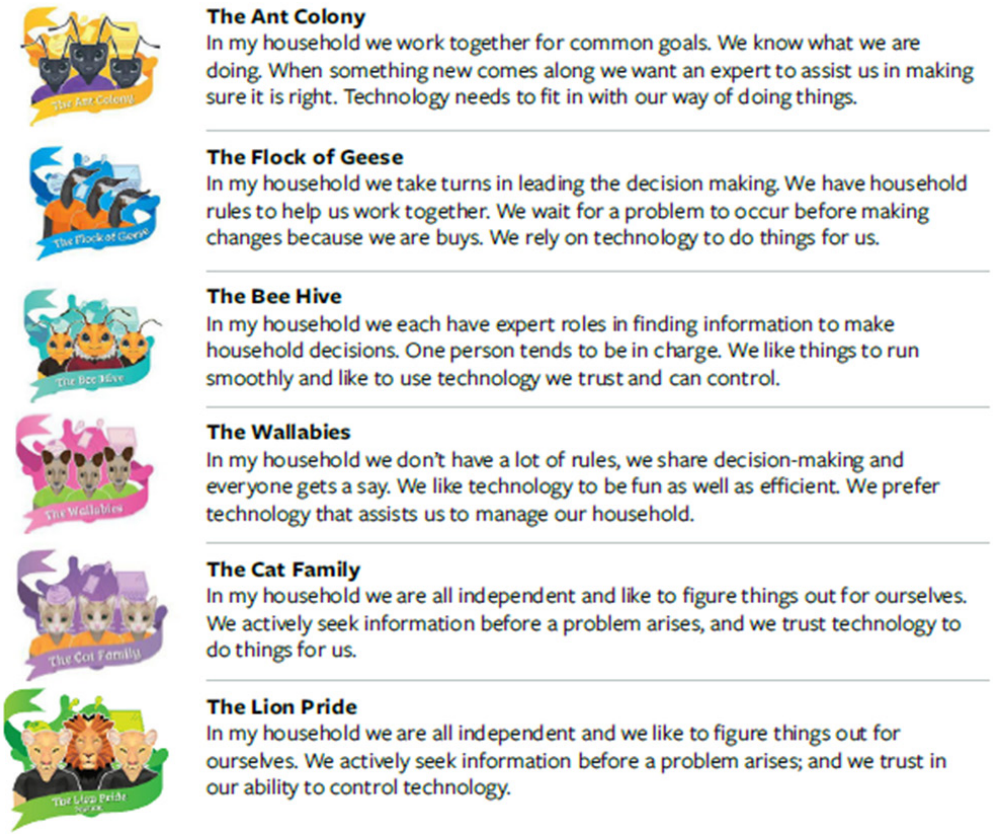
SECTION 5: How Your Household Makes Decisions (Household Segment)

RQ4: How does household demographics and decision-making style impact DSM preferences?

Theoretical Basis: Russell-Bennett et al. Electricity Segment Model (2017)

New Page

Please read the descriptions of the 6 electricity personas below and pick which one best describes your household.



The Ant Colony
In my household we work together for common goals. We know what we are doing. When something new comes along we want an expert to assist us in making sure it is right. Technology needs to fit in with our way of doing things.

The Flock of Geese
In my household we take turns in leading the decision making. We have household rules to help us work together. We wait for a problem to occur before making changes because we are buys. We rely on technology to do things for us.

The Bee Hive
In my household we each have expert roles in finding information to make household decisions. One person tends to be in charge. We like things to run smoothly and like to use technology we trust and can control.

The Wallabies
In my household we don't have a lot of rules, we share decision-making and everyone gets a say. We like technology to be fun as well as efficient. We prefer technology that assists us to manage our household.

The Cat Family
In my household we are all independent and like to figure things out for ourselves. We actively seek information before a problem arises, and we trust technology to do things for us.

The Lion Pride
In my household we are all independent and we like to figure things out for ourselves. We actively seek information before a problem arises; and we trust in our ability to control technology.

New Page

On a scale of 1 (strongly disagree) to 5 (strongly agree) how much do you agree with the following statements?

Measure	Question	Source
Top v Shared	Any major decision that I make has to have other household member's approval	McAndrew et al., 2019
Bureaucratic v Organic	Usually, my household makes decisions by "the rule book" we have established	
Consensual v Conflict	Our household usually agrees on the goal.	
Passive v Active	My household often seeks out information regarding which electricity plan to buy	

New Page

Thank you for completing our survey! If you would like a copy of the results please send an email to aleksandra.vanhummel@hdr.qut.edu.au. Have a lovely rest of your day.

END SURVEY

Total Questions: 39

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