

Project EDGE

Gaps in Existing DER Customer Insights Research

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Important notice

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PURPOSE

This report was produced by Deakin University's Better Consumption Lab and forms part of a broader project examining customer insights relating to DER aggregation services. This report focuses specifically on an analysis of research gaps in the existing research on DER customer insights.

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Executive summary

A review of existing customer DER customer insights research identified a range of research gaps:

- Research has preferentially focused on adoption-related issues rather than on what is required to retain customers long-term
- Substantially more is known about early adopters than about other customer segments
- Segmentation-based analyses of the pre- and post-adoption needs and perceptions of potential DER customers remain relatively unsophisticated
- Descriptive analyses predominate
- Benefits of DER tend to be examined abstractly and independently
- The motivational influence of certain DER benefits may vary with experience
- DER benefits identified in trials may not generalise to non-trial contexts
- An overemphasis on rational DER benefits may obscure the influence of more emotional DER benefits
- Customer expectations regarding the financial returns from DER are unclear
- Nuances in community benefits are often ignored
- Energy independence ignores subtle distinctions between autonomy and security
- What do consumers consider as their energy needs?
- How can ease of use be reconciled with customisation?
- How DERs compare with the status quo or to other energy products remains unclear
- What is the best way to communicate with consumers of varying levels of expertise?
- Specific pathways to increase trust and reduce risk perceptions are understudied
- What is required to develop relational interactions with customers?
- Who are the voices that people listen to and trust?
- What must an aggregator do to ensure a smooth acquisition and installation process?
- How can aggregators make customers feel comfortable accessing them?
- What can DER companies do to resolve service failures?

Wherever possible, researchers focused on generating future customer insights relating to DER should seek to address these research gaps.

Contents

Executive summary	2
1. Introduction	4
2. Method	5
2.1 Overview	5
2.2 Summary of the current state of knowledge	5
2.3 Conceptual framework	5
2.4 Research gap analysis	6
3. Gaps in the Current State of Knowledge	8
3.1 Broad Research Gaps	8
3.2 Benefits	10
3.3 Ease of Use and Customisation	15
3.4 Comparison	15
3.5 Expertise	16
3.6 Risk Perception and Trust	16
3.7 Relationship vs. Transaction	16
3.8 Social Norms	17
3.9 Process Ease	17
3.10 Service Accessibility	18
3.11 Service Interaction and Service Recovery	18
4. References	20
5. Appendix A: Customer Experience Attributes Examined in Each Study	24
6. Appendix B: Summary of the Results Reported in Each Study	27

1. Introduction

Distributed Energy Resources (DER) such as rooftop solar panels have fundamentally transformed the National Energy Market, and further transformations are likely as other DERs, including household batteries and electric vehicles, are increasingly adopted by consumers. The challenge for distribution network service providers, policy makers, and the community more broadly is in shaping this uptake of DERs in ways that enhance the stability and resilience of the National Energy Market while also helping Australia achieve its sustainability aspirations.

In support of this outcome, a growing body of research has examined how consumers perceive and react not only to different forms of DER (e.g., Ashworth et al., 2012; Energy Consumer Australia, 2021; Energy Consumer Australia 2020; Frederiks & Romanach, 2021; Romanach et al., 2013) but also to services that aggregate or manage DERs at scale (e.g., Ausgrid, 2021; AGL, 2020; van Veenendaal, 2021; Roberts et al., 2020; Temby & Ransan-Cooper, 2021). Several recent literature reviews have succinctly summarised this body of knowledge (ACIL ALLEN, 2022; ARENA, 2020a; ARENA, 2020b; Boughen et al., 2013), providing key learnings for distribution network service providers, energy retailers, policy makers, and other relevant stakeholders.

The purpose of this literature review is not to replicate these recent literature reviews but rather to identify gaps in the research that has been conducted to date. The aim of this review is therefore to provide a roadmap for future research that outlines areas where insufficient or insufficiently detailed research has been conducted to date.

2. Method

2.1 Overview

The identification of research gaps requires two components:

- A summary of the current state of knowledge.
- A conceptual framework outlining some idealised state of knowledge necessary to achieve a desired outcome.

By comparing these two components, potential gaps in the current state of knowledge can be discerned. An overview of how we approached these components is presented across the following sections.

2.2 Summary of the current state of knowledge

A search of the literature was performed using the following search strings:

"distributed energy resource" AND customer AND (survey OR interview) AND Australia

"virtual power plant" AND customer AND (survey OR interview) AND Australia

These searches were conducted on Google and Google Scholar to capture both academic and industry research, and the ensuing search results were supplemented with additional reports provided by industry stakeholders. Over 100 reports were identified through this process. Reports were then screened out if they met one or more of the following criteria:

- Not conducted in Australia.
- Not focused on residential households.
- Not focused on DER.
- Not reporting customer-focused outcome variables
- Not reporting original research findings.

A summary of the research that met these inclusion criteria is presented in Appendices A and B.

2.3 Conceptual framework

To assist in the development of a conceptual framework against which to compare the current state of knowledge, we assumed that to facilitate widespread and sustained adoption, future DERs would need to be:

- Attractive to broad segments of the Australian population.
- Trusted by customers.
- Situated within a high-quality service environment.

Each of these components are foundational to models of customer experience, an approach in marketing that examines how customers react and respond to each facet of the consumption experience, from evaluation and purchasing to post-purchase use (Holbrook & Hirschman 1982; Becker & Jaakkola, 2020; Lemon & Verhoef 2016). While no model of customer experience has been specifically developed for DER contexts, several broadly accepted models of customer experience have been advanced in the academic literature (Lemke et al., 2011; Maklan et al., 2011), including in adjacent contexts such as retailing (Verhoef et al., 2009) and digital platforms (Rose et al., 2012). Each of these models focuses on slightly different elements of customer experience, so we synthesised these models into a single conceptual framework. The resulting conceptual framework, and its connection to the contributing models, is presented in Table 1.

2.4 Research gap analysis

Eligible research identified through the literature search employed a range of methods (e.g., surveys; interviews), examined a variety of outcomes (e.g., attitudes towards DER; DER adoption; satisfaction with DER services), and explored a range of customer-relevant factors (e.g., adoption benefits; risk perceptions). At the same time, however, much of this research used different terms to describe the same underlying concept, making it difficult to identify broader trends across research reports. For this reason, all findings were coded relative to the 12 components outlined in our customer experience framework. For example, a report which found that the support of others was critical to DER attitudes would be coded against 'social norms', while a report which found that the environmental outcomes of DERs were a motivating factor for DER adoption would be coded against 'benefits: environment'.¹

The resulting findings, which are presented in Appendices A and B, provide a means for identifying not only the broad pattern of results that have been captured in the literature to date but also which components from the customer experience framework have been underexplored in this literature. Further description of the literature relating to each component from the customer experience framework, as well as broader research gaps associated with those components, are outlined in the sections that follow.

¹ Perceived barriers to DER adoption (e.g., cost) were coded within the category of their respective benefit (e.g., financial) as they are generally the inverse of those benefits. While barriers and benefits carry different psychological weightings, this coding approach was employed to facilitate cross-study comparisons into the types of issues that have typically been examined in existing research.



Table 1 Customer Experience Framework

Component	Lemke	Maklan	Rose	Verhoef
Product				
- Benefits[†] (the product provides me with benefits)	+		+	
- Ease of use (the product is easy to use and/or understand)	+		+	
- Customisation (the product is easy to customise to suit my needs)	+	+	+	
- Comparison (the product compares well with other offerings, including the status quo)	+	+		+
Trust				
- Expertise (the company/consumer knows what they are doing)	+	+		
- Risk perception (the company is a safe/reliable/trustworthy one to deal with)	+	+		+
- Relationship vs. transaction (the company is looking after me and my long-term needs)	+	+		
- Social norms (the product is perceived well by others)				+
Service				
- Process ease (the process of joining was easy)		+	+	
- Service accessibility (information or staff are easy to access)	+			
- Service interaction (staff listen to me and make me feel comfortable)	+	+		
- Service recovery (staff respond appropriately when things go wrong)		+		

[†]Due to the large number of benefits that have been explored in the literature, the summaries presented in Appendices A and B further distinguish between some of the most identified categories of benefits.

3. Gaps in the Current State of Knowledge

3.1 Broad Research Gaps

In the sections that follow, focus will be directed towards the research gaps associated with the various components of our customer experience framework. Before doing so, however, more general research gaps that sit across the broader DER literature will be briefly discussed.

Gap 1: Research has preferentially focused on adoption-related issues rather than on what is required to retain customers long-term

As outlined in Appendices A and B, much of the identified research has examined:

- Outcomes relevant to the early phases of the customer journey, such as pre-adoption attitude or adoption decisions.
- The factors that tend to motivate adoption-related decisions, such as the various benefits associated with using DER.

While these factors are crucial, they provide an incomplete overview of the DER experience in that customers are also interested in the broader process of acquiring, integrating, and using DERs. Moreover, and as a substantive body of marketing research has found (Mascarenhas et al., 2006; Oliver 1999; Caruana, 2002), post-adoption experiences are central to outcomes that are likely to be key to the longer-term success of DERs in the Australian context, including customer satisfaction, customer loyalty and retention, and positive word-of-mouth. Further research is consequently required to examine other elements of the customer experience framework, particularly those relating to customers' post-adoption experiences.

Gap 2: Substantially more is known about early adopters than about other customer segments

Rogers (2003) identified five categories of adopters, with a person's membership in these categories determined by how soon they adopted a focal product relative to the broader population:

- Innovators (first 2.5% of adopters)
- Early adopters (next 13.5% of adopters)
- Early majority (next 34% of adopters)
- Late majority (next 34% of adopters)
- Laggards (last 16% of adopters)

Given current DER adoption rates, and setting rooftop solar panels to one side, the users of most DERs in Australia would consequently be characterised as either innovators or early adopters.

Research examining the motivations or experiences of DER users would therefore almost exclusively be drawing on customers who are innovators or early adopters. The relevance of this distinction is that the decision-making processes and personality characteristics of early adopters tend to differ in substantive ways to those of other adopter categories. For example, Rogers (2003) noted that while early adopters tend to shape the opinion of others about a new product, the early majority tend to wait to hear about the experiences of others before adopting a product. Insights relating to the reasons why early adopters chose to purchase DER may therefore not translate to other segments of the Australian population.

Addressing this gap will be challenging, not least because a person's adopter category cannot be formally determined until such time as they have adopted the product. Nevertheless, more work is required to:

- Better segment potential customers based on their likely readiness to adopt DER.
- Understand how these different customer segments perceive, adopt, and interact with DER.

Gap 3: Segmentation-based analyses of the pre- and post-adoption needs and perceptions of potential DER customers remain relatively unsophisticated

Segmentation is a foundational concept of marketing: it permits the identification of consistent variations in customer needs across cohorts of customers while also supporting the targeting of those cohorts with customised communications. Despite the value of segmentation, much of the research on DER has employed relatively rudimentary segmentation approaches. For example, research has tended to examine the relative importance of a set of benefits across a broad sample of customers rather than identifying the profile of benefits that resonate with specific customer segments (e.g., Agnew & Dargusch, 2017; Ausgrid, 2021; Simpson & Clifton, 2017).

Several recent DER research reports have begun to employ more sophisticated approaches to segmentation. AGL (2020) and Synergy (2021), for example (as cited in ARENA 2020b), segmented consumers using Experian's proprietary segmentation framework, while van Veenendaal (2021) employed latent class analysis to identify four potential customer segments: early adopter, go with the flow, caring community, and personal gain. ARENA (2020b) also advocated the use of a values-based approach to segmenting potential DER customers. Nevertheless, and despite these recent positive developments, several important gaps remain:

- Few studies quantify the proportion of customers that sit within each identified segment, making it difficult for businesses to justify the development of targeted DER offerings that resonate with specific customer segments.
- Customer segments are often defined ambiguously or with psychosocial variables that are difficult for businesses evaluate. This, in turn, hinders the ability of businesses to reach specific customer segments with tailored, segment-specific communications.
- Application of segmentation is often focused on understanding the pre-adoption needs of customers; relatively few studies examine how the post-adoption experiences of DER differ by customer segment (for an exception, see van Veenendaal, 2021).

Future research is consequently required that:

- Quantifies the size of potential DER customer segments.
- Identifies segments using variables that are relatively easy for business to capture.

- Examines how the post-adoption experiences and expectations of customers differs by segment.

Gap 4: Descriptive analyses predominate

As the summary of results presented in Appendix B shows, a considerable proportion of the DER evidence base has been generated using descriptive analyses, such as examining the proportion of participants who nominated a particular benefit as being important to them. Descriptive statistics have a role to play in research, not least in (as the name suggests) describing or summarising broad patterns in a dataset of participant responses. However, they suffer from a range of limitations. Most notably, descriptive statistics cannot demonstrate patterns of association, such as which factors (e.g., benefits) are significantly associated with an outcome of interest (e.g., adoption intentions), and which are not. In the absence of this information, it becomes impossible for DER stakeholders to understand which factors to prioritise in their efforts to increase DER uptake and maximise long-term customer satisfaction with DER. Future studies should consequently make stronger use of the broad suite of statistical tools available to researchers, particularly with a view to identifying statistically significant associations or differences, so that DER stakeholders have a clearer sense of which factors to preferentially target or address.

3.2 Benefits

Of all the components in the customer experience framework, the one examined most often was “benefits”. For this reason, our review examined different sub-categories of benefits (and their related barriers).

When examined holistically, both self-interested benefits (e.g., financial benefits, energy independence) and more communal benefits (e.g., helping the environment, helping the community) were found to have motivational or perceptual influences on DER-related outcomes. Moreover, studies consistently found that this influence was not mutually exclusive; customers may adopt a DER because it can achieve both self-interested and communal outcomes. However, several limitations were identified with this evidence base.

Gap 5: Benefits of DER tend to be examined abstractly and independently

Research examining the relative motivational influence of benefits has tended to examine those benefits in a relatively abstract manner. For some indicative examples:

- Research might examine whether a benefit like “provides financial returns” influences customers’ intention to adopt DER but not evaluate the specific thresholds at which that benefit exerts a motivational influence. Put differently, earning \$5 a month from a DER aggregator is likely to exert a different motivational influence than earning \$100 a month, even though both would be characterised as providing a financial benefit.
- Studies might find that “helping the environment” provides a motivational influence for adopting DER but not examine the magnitude of environmental benefits that resonate with customers.

Unless potential benefits are evaluated with greater specificity:

- Research cannot determine the thresholds of benefits that customers perceive to be fair, reasonable, or attractive.
- It is difficult to evaluate whether – and to what degree – customers are prepared to make trade-offs between benefits (see Figure 1/Roberts et al., 2020, for a notable exception).
- Potentially contradictory combinations of benefits may be evaluated, providing results that might not be possible to achieve. For example, maximising personal energy independence through the adoption of DER will reduce the potential to achieve financial benefits from those DER.

Figure 1 Customer Trade-offs Evaluated by Roberts et al. (2020)

	Option A No VPP Battery Only	Option B Occasional VPP	Option C Shared Use	Option D Full time VPP
How often does the VPP control your battery?	Never	10 occasions per year	30 occasions per year	Constant control to maximise income
Proportion of Battery capacity retained for household	100%	0% VPP has control of entire battery	50%	0% VPP has control of entire battery
Information and Choices		Advance notice - able to opt out	Advance notice - no opt out	No advance notice
Annual Financial Benefit (Battery + VPP)	\$800-\$1200	\$1200-\$1600	\$1200-\$1600	\$1600-\$1900
Payback	10 years	7 years	7 years	5 ½ years

Gap 6: The motivational influence of certain DER benefits may vary with experience

Adoption of many DERs, such as household batteries and electric vehicles, is currently relatively low in Australia, so a considerable body of research has evaluated the DER perceptions of non-adopters drawn from the general population. While such research can provide important insights into the motivational factors likely to influence DER adoption, it is unable to evaluate how the motivational weighting that customers attach to those benefits change over time as customers gain greater experience with DER.

This is an important oversight, with findings from several studies suggesting that non-users and users of DER potentially differ in how they evaluate certain DER benefits. Zenkic et al. (2022a), for example, found that people who do not currently own a battery would be prepared to make more than half of the power stored in their battery (if they owned one) available for trading. However, a separate study from the same research team found that those with a battery were far more protective of their stored power, knowing that they sometimes deplete it (Zenkic et al., 2022b). A similar conclusion was made by Thiébaux et al. (2019), who concluded that companies need to be more “cautious in projections of household sharing” as “it was expected by our industry partners that householders would be happy

to share their battery with the network if they were well-paid for its use, but our findings suggest this is not necessarily the case". Research that evaluates how customer perceptions change across the pre-adoption, adoption, and post-adoption phases of the customer journey is consequently critical for ensuring that pre-adoption marketing sets expectations that align with customers' post-adoption experiences.

Gap 7: DER benefits identified in trials may not generalise to non-trial contexts

Numerous DER-focused trials have been conducted across Australia to generate learnings for the sector. By virtue of the nascent state of many DERs, many of these trials have had to use various financial incentives to motivate customer adoption or have been conducted in community contexts deemed particularly receptive to DER. Research focusing on the participants of these trials may consequently identify certain benefits that may not translate to customers approached to join future, non-trial DER offerings. For example:

- People who are especially sensitive to financial incentives may be attracted to join trials offering financial incentives, so any research conducted among this customer cohort might overstate the motivational importance of financial benefits in adopting DER. This research gap becomes especially important if the funding base for introducing certain incentives in DER-focused trials (such as receiving government funding) cannot be replicated in purely commercial contexts.
- Research on trials conducted in communities characterised by high levels of community engagement may accentuate the importance of community-related benefits in adopting DER.

Future research examining the customers of non-trial offerings available across geographically diverse communities is therefore important to determine whether the motivational influence of the benefits identified in DER trials translates to non-trial contexts.

Gap 8: An overemphasis on rational DER benefits may obscure the influence of more emotional DER benefits

Most of the benefits that have been examined to date are largely instrumental in nature. That is, emphasis has focused on the extent to which DER adoption can achieve largely rational outcomes, such as achieving financial benefits, improving environmental outcomes, or supporting the community. However, and as decades of marketing research has identified, adoption decisions are not exclusively (or even primarily) driven by instrumental outcomes; experiential outcomes, such as the emotional experience of purchasing and consuming, are also key drivers of adoption. Consistent with this notion, Zenkic (2022a) found that the strongest predictor of interest in adopting a virtual power plant was the perception that it was "exciting". Similarly, Cornwell et al. (2019) found that "curiosity" was commonly identified as a motivator for joining a community battery. Further research is consequently required to better understand the potential non-instrumental benefits associated with adopting and using DER.

3.2.1 Sub-categories of benefits

The general research gaps outlined in the previous section broadly relate to each of the benefits that have been examined in the literature to date. For example, examining benefits abstractly (Gap 5) and not assessing potential experience-related variations in the motivational influence of benefits (Gap 6)

relate to the financial, environmental, community, energy independence, and pioneering leadership benefits captured in Appendices A and B. However, certain benefit-specific research gaps were also identified. These benefit-specific gaps are discussed in the following sections.

3.2.2 Financial benefits

Consistent with previous reviews (e.g., ARENA 2020b), financial benefits were identified as a consistently strong motivator for customers. However, and extending on Gap 5, certain limitations with this body of knowledge were identified.

Gap 9: Customer expectations regarding the financial returns from DER are unclear

When financial benefits are examined in an abstract manner (see Gap 5), it also precludes an assessment of the financial returns that consumers are expecting or would perceive as fair should they adopt DER. The relevance of this gap stems from the fact that one of the primary reasons for being dissatisfied with DER services like a virtual power plant is that the service did not meet customers' financial expectations (van Veenendaal, 2021). Understanding pre-adoption expectations of what prospective customers deem to be appropriate financial returns is consequently critical, particularly if those expectations exceed what is currently possible within the context of existing DER capabilities and business models.

3.2.3 Community benefits

Community benefits are another set of instrumental outcomes that resonate with certain customer segments, although again, there are potential ways in which the fidelity of this set of findings can be enhanced.

Gap 10: Nuances in community benefits are often ignored

As an instrumental outcome, the community benefits arising from DER are broad; they can capture dimensions ranging from financial (e.g., reduced energy costs for the community) and environmental (e.g., increasing the uptake of green energy within the community) to energy independence (e.g., minimising power outages within the community) and leadership (e.g., helping a community become a leader in DER adoption). While these dimensions may equally resonate among customer segments with high levels of community identification, it is likely that for many customer segments, some of these dimensions will exert a greater motivational influence than others.

There are always trade-offs in the level of specificity that can be incorporated into survey instruments; more specificity usually means less space is available to evaluate other factors that may implicate DER decision-making. Nevertheless, if there is reason to believe that community benefits will have an especially strong motivational influence among specific customer segments, further fidelity in the measures used to elicit or evaluate community benefits is recommended.

3.2.4 Energy Independence

Energy independence is often examined as a potential motivation for adopting DER, yet there are subtle nuances in what constitutes 'energy independence' that deserve further attention.

Gap 11: Energy independence ignores subtle distinctions between autonomy and security

Energy independence subsumes two related but distinct benefits: having a feeling of control over one's energy (energy autonomy) and wanting access to a source of back-up power should a power outage occur (energy security). Surveys that evaluate the extent to which joining a virtual power plant program was due to "having a feeling of independence from the grid" (e.g., van Veenendaal, 2021) are unable to get at these differing motivations.

The importance of distinguishing between these two motivational antecedents lies in their implications for efforts to enhance DER adoption. A desire for energy autonomy, for example, can be the product of distrusting energy companies, a symbolic need to be self-reliant, and a general longing for freedom. However, and as articulated by Roberts et al. (2020, p.18), "a household battery is seen by many solar households as a step towards energy autonomy and independence from electricity companies; attaching it to a complex and opaque business arrangement with – potentially – those same companies makes it considerably less attractive."

Energy security, on the other hand, is grounded in more pragmatic concerns about maintaining a reliable power supply, particularly in areas where power outages are frequent or severe. While energy security may be a key motivating factor for installing DER, its ability to motivate the joining of a DER aggregation service is unclear and may even act as a deterrent. That is, if a customer bought a battery to maintain a source of reserve power, they may naturally feel some hesitation at the proposition of having some of that power traded to others.

Ultimately, further distinguishing the segments and factors underlying the desire for 'energy independence' remains an important area for future research.

Gap 12: What do consumers consider as their energy needs?

A desire for energy independence (however defined) implicates a related issue: what are the current or anticipated energy needs that customers are seeking to maintain should they achieve energy independence? As Roberts et al. (2020) found, participation in a virtual power plant by households that had purchased batteries for largely non-financial reasons was contingent on 'home energy needs' being met first. What those needs are and how they might be met by a battery is unclear and complex, varying as it will by:

- The size of the solar panel and battery.
- The household's energy consumption.
- Their lifestyles and perceptions.
- The degree to which they are prepared to modify energy consumption practices while their household is dependent on stored battery power.

In a virtual power plant context, the relevance for this understanding is twofold:

- It may inform how much of their battery a household is prepared to dedicate to supporting the trading activities of the virtual power plant.

- It could influence their post-adoption satisfaction with the virtual power plant, particularly if there is a perception (or a reality) that the trading activities of the virtual power plant interferes with the ability to meet their home energy needs.

3.3 Ease of Use and Customisation

Relatively little research has examined either ease of use or customisation (see Appendix A), and while both are independently important for enhancing customer experience, it is the intersection between these two components where considerable opportunities for future research exist.

Gap 13: How can ease of use be reconciled with customisation?

Findings from interviews and surveys often report that customers desire at least some degree of control over DERs or DER-related services (van Veenendaal, 2021; Nicholls et al., 2017; Patterson-Hann & Watson, 2022), which would suggest a need for providing customers with the ability to undertake ‘under the hood’ customisation. Consistent with this insight, not providing customers with sufficient choice can lead to frustration due to a perceived lack of autonomy (Ransan-Cooper et al., 2020). At the same time, however, customers often become overwhelmed when they are presented with too much choice (i.e., choice overload; Chernev, Bockenholt & Goodman 2015), which sits awkwardly with the need to maximise ease of use. Indeed, DER customers have often noted that the complexity of the DER information they are presented with, the DER installation process, and the ongoing use of the DER system are important factors that can negatively affect their DER experience (ARENA 2020b; Temby et al., 2021). Further research is consequently required to better understand optimal levels of choice that allow customers sufficient customisation while still facilitating ease of use. Differences by customer segmentation – and how these differences can be incorporated within a single product or system design – are associated areas for future research.

3.4 Comparison

The choice to adopt a DER product or join a DER-related service does not occur in isolation; it is instead made relative to other choices that exist within the marketplace. This competitive lens is not always apparent in the research that has been conducted to date, with many studies examining the motivation to adopt DER as a relatively abstract proposition.

Gap 14: How DERs compare with the status quo or to other energy products remains unclear

Based on the current research, it is not clear whether – and to what extent – the benefits of DER are perceived by customers as exceeding those of other marketplace offerings. For instance, while financial benefits may be a salient motivator, whether there are significant financial benefits for joining a DER aggregator over and above owning one’s own rooftop solar panels and battery is not always evident. Similarly, whether owning DER offerings or joining a DER aggregator are perceived to provide sufficient financial benefit over and above sourcing power exclusively from a conventional energy retailer is not always an explicit focus of research. In the absence of this information, it is

difficult to evaluate the customer value proposition for adopting DERs or DER-related services, or to identify ways of enhancing that customer value proposition.

3.5 Expertise

Expertise can help to allay potential product- or service-related concerns, hence its common inclusion in customer experience frameworks (e.g., Lemke et al., 2011; Maklan et al., 2011). For example, customers' confidence and trust tends to be bolstered if a company is deemed to have expertise in the domain of their product or service offerings. At the same time, customers who themselves feel a degree of expertise tend to have greater confidence in their own ability to overcome challenges that may present themselves in the adoption or use of a product or service.

Gap 15: What is the best way to communicate with consumers of varying levels of expertise?

Existing research has identified that customer expertise is particularly relevant in the context of DERs. For example, Ransan-Cooper et al. (2020) found that feelings of incompetence around DERs and virtual power plants were a substantial cause of customer anxiety and dissatisfaction. The challenge for DER stakeholders – and a gap in the existing evidence base – is how to effectively communicate with customers who have varying levels of expertise. To further exemplify this challenge, Nicholls et al. (2021), in the context of demand response, found that with the exception of energy or data enthusiasts (who would be classified as having high customer expertise), most households had limited interest in data, particularly if it was not clearly translated into meaningful outcomes for households. How to develop effective, within-platform communications that satisfy the needs of customers with varying levels of expertise is therefore an important area for future research, particularly from the perspective of maximising post-adoption satisfaction.

3.6 Risk Perception and Trust

As a new suite of technologies, the adoption and use of DERs carries with it a set of potential perceived risks. Having trust in the companies responsible for deploying or managing those DERs is consequently important for allaying those perceived risks.

Gap 16: Specific pathways to increase trust and reduce risk perceptions are understudied

Existing research has placed particular emphasis on the perceived risks associated with adopting or using DER, and in perceptions of trust; this body of work is summarised nicely by ACIL ALLEN (2022). What remains less clear are specific, evidence-based mechanisms that companies can employ to allay perceptions of risk and enhance levels of customer trust.

3.7 Relationship vs. Transaction

Related to issues of risk perceptions and trust is the extent to which customers feel that companies are working in their longer-term best interests. This perspective can be characterised by whether a

company is perceived as having a relational or transactional approach with their customers. Transactional companies, for example, prioritise short-term gains for the business and the acquisition of new customers. Relational companies, in contrast, emphasise the development of long-term customer relationships that are personalised and grounded in reciprocity and loyalty.

Gap 17: What is required to develop relational interactions with customers?

While there are broad principles that define companies with a relational focus (e.g., interactions with customers that are grounded in reciprocity and loyalty; Ndubisi, 2007; Palmatier et al., 2006), how this focus can be manifested in actual business practices is not always immediately apparent. Further complicating this issue is that what is seen as a relational focus is broadly determined and defined by the customer. Further research is consequently required to explore:

- The style of interaction that customers are looking for from DER-focused companies.
- The activities that companies can adopt to achieve a relational style of interaction with their customers (as perceived by customers).

3.8 Social Norms

Central to Rogers' (2003) diffusion of innovations theory – and, most importantly from the perspective of DER stakeholders, to the speeding-up of the adoption process – is having a social environment that is supportive of a focal innovation. For this reason, research has increasingly focused on whether customers feel there is broad social support for adopting and using DER.

Gap 18: Who are the voices that people listen to and trust?

While having a social environment that is supportive of an innovation is critical for the adoption of that innovation, the views and opinions of the people that make up that social environment are not treated equally; the voices of some people are trusted more than others. A question for future research is who these trusted voices are. The importance of this research question is only likely to grow as DER stakeholders look to expand the uptake of DER beyond early adopters. Indeed, Rogers (2003) noted that the adopter category referred to as the 'early majority' tend to rely on the views and opinions of others before making adoption choices, highlighting the importance of understanding who this cohort is likely to turn to for trusted views and advice.

3.9 Process Ease

ACIL ALLEN (2022) and ARENA (2020a) have provided useful summaries of some of the common difficulties experienced by customers as they adopt DERs or DER-related services. For example, during the installation phase, a long and protracted installation process that involves several visits or the identification of damaged or faulty technology can lead to dissatisfaction and anger.

Gap 19: What must an aggregator do to ensure a smooth acquisition and installation process?

While issues resulting in process difficulties have been well-documented (e.g., ACIL ALLEN, 2022; ARENA, 2020a), solutions to these problems have been understudied (see Temby & Ransan-Cooper, 2021, Table 1, for an exception). For example, while ARENA (2020a) rightly highlight the importance of ensuring a smooth customer experience – such as by minimising the number of customer touch points, making the installation as non-intrusive as possible, and having sufficient resources and training for the installation phase – further research could examine how these suggested process improvements intersect with the needs of different customer segments. Some customers, particularly those who are technologically proficient, may feel satisfied with a smaller number of customer touchpoints, while others might appreciate a more ‘hands on’ level of interaction to allay any concerns they might otherwise have. Identifying segment-specific expectations around the level of support required through the acquisition and installation processes would consequently help businesses develop processes for onboarding customers in ways that minimise opportunities for potential customer dissatisfaction.

3.10 Service Accessibility

While process ease focuses particularly on the onboarding process, service accessibility refers to the perceived availability of customer support or self-service information across the broader customer journey.

Gap 20: How can aggregators make customers feel comfortable accessing them?

There is both a supply and demand dimension to service accessibility: while companies must have appropriate levels of staffing and resourcing to respond to customer queries, customers must also feel comfortable lodging their queries with companies. From a demand perspective, there is some evidence to suggest that customers may not always feel comfortable lodging repeated requests for support, laying a potential foundation for future dissatisfaction. For example, in a qualitative study conducted by Ransan-Cooper et al. (2020, p. 5), one participant reported that *“I feel like every time I talk to somebody about something that’s gone wrong, “oh not her again”. You know, whinging. I just think, why can’t it [the system] just work like everybody else’s?”*

The challenge for businesses offering DERs and DER-related services is how to develop a trusted relationship with their customers such that customers feel comfortable and supported in reaching out for assistance in a timely manner. Indeed, Ransan-Cooper et al. (2020, p. 5) went on to note that *“many of the strongest anxieties householders had were saved up for our social research interviews, rather than being shared by contacting the official technical support channels offered by our industry partners.”* Future research is consequently required to examine ways of helping customers feel comfortable seeking timely assistance.

3.11 Service Interaction and Service Recovery

Having positive service interactions with customers is important, but so too is being able to address service failures in ways that meet the expectations of customers (that is, service recovery). While a

growing number of studies have examined customer perceptions of service interactions, far fewer have explored issues of service recovery.

Gap 21: What can DER companies do to resolve service failures?

While service failures occur in every organisation, they are more likely to occur as companies develop and rollout new products or services. An area for future research is exploring the responses or activities that companies with DER products or DER-related services can employ to both address service failure and maximise the likelihood that customers will remain satisfied with their broader DER experience.

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5. Appendix A: Customer Experience Attributes Examined in Each Study

	Benefits: Financial	Benefits: Environment	Benefits: Community	Benefits: Energy Security	Benefits: Energy Autonomy	Benefits: Pioneering	Ease of use	Customisation	Comparison	Expertise (consumer)	Expertise (company)	Risk perception	Relationship vs. transaction	Social norms	Process ease	Service accessibility	Service interaction	Service recovery
Adams et al. (2021)	+	+	+	+	+	+			+	+		+						
Agnew & Dargusch (2017)	+	+		+	+		+		+			+		+				
Agnew et al. (2018)	+	+		+	+							+	+					
Ausgrid (2021)	+	+		+			+					+			+			
Chang & Newton (2020)	+					+	+		+			+	+					+
Cornwell et al. (2019)	+	+	+		+									+				
Dex (2019)					+					+		+			+	+		
Ergon Energy (2022)	+	+		+	+		+	+		+								+



	Benefits: Financial	Benefits: Environment	Benefits: Community	Benefits: Energy Security	Benefits: Energy Autonomy	Benefits: Pioneering	Ease of use	Customisation	Comparison	Expertise (consumer)	Expertise (company)	Risk perception	Relationship vs. transaction	Social norms	Process ease	Service accessibility	Service interaction	Service recovery
Ergon Energy (2017)	+			+			+			+	+	+		+		+		+
Essential Energy (2021)	+	+					+	+	+									
EWOV (2020)	+									+	+	+	+			+	+	+
Flow Systems (2016)	+	+	+		+		+					+						+
Frederiks & Romanach (2021)	+	+	+	+	+	+						+	+	+				
Gardner et al. (2008)	+	+					+					+					+	
Institute for Sustainable Futures (2019)	+	+	+	+	+	+												
KPMG (2016)	+	+			+		+			+		+		+	+	+		
La Machia & Newton (2018a)	+	+	+		+				+									
La Machia & Newton (2018b)	+		+				+											
La Machia & Newton (2018c)	+	+		+														
Loveday (2021)	+	+	+		+					+							+	
Newgate (2021)	+	+		+	+							+						
Nicholls et al. (2019)	+	+	+	+	+		+		+			+						
Patterson & Watson (2022)							+	+				+				+		
Ransan-Cooper et al. (2020)				+	+		+			+	+	+				+	+	+
Roberts et al. (2020)	+	+	+	+	+	+	+	+	+	+		+		+				



	Benefits: Financial	Benefits: Environment	Benefits: Community	Benefits: Energy Security	Benefits: Energy Autonomy	Benefits: Pioneering	Ease of use	Customisation	Comparison	Expertise (consumer)	Expertise (company)	Risk perception	Relationship vs. transaction	Social norms	Process ease	Service accessibility	Service interaction	Service recovery
Romanach et al. (2013); Ashworth et al. (2012)	+	+		+	+		+		+	+		+		+			+	
Sehic et al. (2017)	+	+		+				+	+			+		+				
Simply Energy (2021)	+	+	+	+	+						+	+						
Simpson & Clifton (2017)	+	+				+				+				+				
Strengers et al. (2021)	+	+		+	+				+	+				+				
Temby & Ransan-Cooper (2021)	+	+	+	+	+	+	+		+	+	+	+		+	+	+	+	
Thiébaux, S. et al. (2019); Watson et al (2019)	+	+	+	+	+	+	+			+	+	+		+	+	+	+	+
United Energy (2019)	+			+	+					+		+	+					
van Groenou et al. (2018)	+	+											+					
van Veenendall. (2021)	+	+	+	+	+	+	+	+		+			+	+	+	+	+	+
Zenkic et al. (2022a)	+	+	+	+		+			+	+		+			+	+	+	
Zenkic et al. (2022b)	+	+	+	+	+				+	+		+			+			
Total	34	29	16	23	24	10	18	6	13	18	6	25	7	13	8	10	11	6

6. Appendix B: Summary of the Results Reported in Each Study

Several coding conventions were used to summarise the results identified in each report:

- Statistical analysis was used, and the result was significant
- Statistical analysis was used, and the result was not significant
- ◇ Statistical analysis was not used, but the result was quantitative in nature (e.g., percentages)
- Qualitative analysis was used

When sufficient information was available to do so, the three findings that made the greatest contribution to explaining the outcome variable in each study were also ranked.

Study	Context	Outcome variable	Consumer cohort	Method	Findings
Adams et al. (2021)	VPP / LEM	Attitude (project concept)	81 participants in the Latrobe Valley community		<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Environment (2nd) ◇ Benefit: Community (3rd) ◇ Benefit: Pioneering ◇ Benefit: Energy Autonomy ◇ Risk Perception ◇ Comparison
Adams et al. (2021)	VPP / LEM	Attitude (project concerns)	81 participants in the Latrobe Valley community		<ul style="list-style-type: none"> ◇ Expertise (consumer) (1st) ◇ Benefit: Financial (2nd) ◇ Benefit: Energy Security (3rd) ◇ Risk Perception



Agnew & Dargusch (2017)	Battery	Attitude	268 respondents in Queensland, Australia (market characterized as early-adopter)	Survey / Discrete Choice Experiment	<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Energy Autonomy (2nd) ◇ Benefit: Environment (3rd) ◇ Benefit: Energy Security
Agnew & Dargusch (2017)	Battery	Attitude (Hypothetical Choice)	268 respondents in Queensland, Australia (market characterized as early-adopter)	Survey / Discrete Choice Experiment	<ul style="list-style-type: none"> ◇ Risk-perception (1st) ◇ Comparison (2nd) ◇ Ease of use (3rd) ◇ Benefit: Environment ◇ Benefit: Energy Autonomy ◇ Benefit: Energy Security ◇ Social Norms
Agnew et al. (2018)	Solar and battery	Adoption	68 stakeholders (including regulators, policy makers, representatives from the electricity supply chain, new market entrants, technology developers, PV and battery installers, consumer advocacy groups and consumer representatives) in Queensland Australia	Interviews/ focus groups	<ul style="list-style-type: none"> □ Benefit: Financial □ Benefit: Environment □ Benefit: Energy Autonomy □ Benefit: Energy Security □ Risk perception □ Relationship vs. transaction □ Comparison
Ausgrid (2021)	VPP	Adoption (trial)	134 participants VPP Trial (early adopters) Sydney, the Central Coast and the Hunter region.	Survey	<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Environment (2nd) ◇ Benefit: Energy Security (3rd) ◇ Risk perception ◇ Ease of use ◇ Process Ease
Chang & Newton (2020)	Energy Management Platform	Attitude	17 participants; users (7) and non-users (10) of	Interview	<ul style="list-style-type: none"> □ Relational vs. Transaction Comparison □ Risk-perception □ Benefit: Pioneering □ Benefit: Financial □ Ease of use □ Service Interaction



Cornwell et al. (2019)	Household PV, community battery	Adoption (join trial)	56 members of the Alkimos Beach Energy Storage Trial	Survey	<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Environmental (2nd) ◇ Benefit: Energy Autonomy (3rd) ◇ Benefit: Community ◇ Social norms
De Bortoli (2012)	Commercial and residential solar PV systems (Adelaide Solar City)	Adoption (trial)	230 households randomly selected from 1960 trialling electricity pricing products / 880 households and 19 businesses participating in energy efficiency trials	Survey	<ul style="list-style-type: none"> □ Benefit: Financial □ Benefit: Environment □ Service-interaction □ Expertise (consumer) □ Comparison □ Social Norms
Dex (2019)	DER aggregation Platform	Adoption (enrolment)	Enphase customers from South Australia, Victoria, Tasmania and Western Australia (number unspecified)	Experiment/Observation	<ul style="list-style-type: none"> □ Benefit: Energy Autonomy □ Expertise (consumer) □ Process Ease □ Service accessibility □ Risk-perception
Ergon Energy (2022)	DER	Adoption	34 responses to online survey (from 176 registrants)	Survey	<ul style="list-style-type: none"> ◇ Benefit: Energy Autonomy ◇ Benefit: Financial ◇ Benefit: Pioneering ◇ Benefit: Environment ◇ Benefit: Energy Security ◇ Ease of use ◇ Customisation ◇ Service interaction ◇ Expertise (Consumer)
Ergon Energy (2017)	Hybrid Energy Systems (HE Systems) and Virtual Power Plants (VPPs)	Intention (Join trial)	25 of 33 Residential pilot customers in Toowoomba (13), Cannonvale (7) and Townsville (13)	Survey (statistics not reported)	<ul style="list-style-type: none"> □ Benefit: Financial □ Expertise (Consumer) □ Ease of use □ Benefit: Energy Security



Ergon Energy (2017)	Hybrid Energy Systems (HE Systems) and Virtual Power Plants (VPPs)	Satisfaction	25 of 33 Residential pilot customers in Toowoomba (13), Cannonvale (7) and Townsville (13)	Case study	<input type="checkbox"/> Benefit: Energy Security <input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Risk perception <input type="checkbox"/> Service accessibility <input type="checkbox"/> Expertise (Company & Consumer) <input type="checkbox"/> Service recovery
Essential Energy (2021)	Energy solutions	Attitude	96 customer Focus Groups and 17 interviews with stakeholders (Phase 1)	Focus Groups and Interviews	<input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Ease of use <input type="checkbox"/> Customisation <input type="checkbox"/> Benefit: Environment
Essential Energy (2021)	Energy solutions and DERs	Attitude	82 Focus Group workshops and 617 surveys with residential customers and 162 small business customers.	Focus Groups and surveys	<input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Customisation <input type="checkbox"/> Comparison <input type="checkbox"/> Ease of use <input type="checkbox"/> Benefit: Environment
EWOV (2020)	Solar PV	Satisfaction	Customer complaints - 242 cases about the general feed-in tariff, and 368 cases about a delay in upgrading	Customer complaints	<input type="checkbox"/> Service accessibility (information) <input type="checkbox"/> Risk perception <input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Service recovery <input type="checkbox"/> Relational vs. Transaction <input type="checkbox"/> Expertise (Consumer & Company)
EWOV (2020)	Residential Batteries	Satisfaction	Customer complaints to the Ombudsman	Customer complaints	<input type="checkbox"/> Service accessibility (information) <input type="checkbox"/> Risk perception <input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Service recovery <input type="checkbox"/> Relational vs. Transaction <input type="checkbox"/> Expertise (Consumer & Company)
EWOV (2020)	Microgrid	Satisfaction	Customer complaints to the Ombudsman	Customer complaints	<input type="checkbox"/> Service accessibility (information) <input type="checkbox"/> Service recovery <input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Expertise (company)



EWOV (2020)	VPP and Peer to Peer trading (P2P)	Satisfaction	Customer complaints to the Ombudsman	Customer complaints	<input type="checkbox"/> Service recovery <input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Expertise (company)
Flow systems (2016)	DER	Adoption	Home buyers of Huntlee Energy Utility concept	Self-ethnographic exploration	<input type="checkbox"/> Benefit: Financial (1 st) <input type="checkbox"/> Benefit: Community <input type="checkbox"/> Benefit: Energy Autonomy <input type="checkbox"/> Benefit: Environment <input type="checkbox"/> Ease of use <input type="checkbox"/> Service recovery <input type="checkbox"/> Risk perception
Frederiks & Romanach (2021)	Community Solar	Attitude (perceived benefits)	2039 participants without solar (of 2968 participants)	Survey	<input type="checkbox"/> Benefit: Environment (1 st) <input type="checkbox"/> Benefit: Financial (2 nd) <input type="checkbox"/> Benefit: Energy Security (3 rd) <input type="checkbox"/> Benefit: Community <input type="checkbox"/> Benefit: Pioneering <input type="checkbox"/> Energy Autonomy <input type="checkbox"/> Relational vs. Transaction <input type="checkbox"/> Risk-perception <input type="checkbox"/> Social Norms
Frederiks & Romanach (2021)	Community Solar	Intention (participate in CS program)	766 participants (who responded to open-ended question)	Survey (open-ended question)	<input type="checkbox"/> Benefit: Environment (1 st) <input type="checkbox"/> Benefit: Financial (2 nd) <input type="checkbox"/> Benefit: Community (3 rd) <input type="checkbox"/> Benefit: Curiosity <input type="checkbox"/> Benefit: Energy Security <input type="checkbox"/> Benefit: Energy Autonomy
Frederiks & Romanach (2021)	Community Battery	Attitude (perceived benefits)	929 participants with solar (of 2968 participants)	Survey	<input type="checkbox"/> Benefit: Community (1 st) <input type="checkbox"/> Benefit: Energy Autonomy (2 nd) <input type="checkbox"/> Benefit: Financial (3 rd) <input type="checkbox"/> Benefit: Pioneering <input type="checkbox"/> Benefit: Environment <input type="checkbox"/> Benefit: Energy Security <input type="checkbox"/> Relational vs. Transaction <input type="checkbox"/> Risk-perception



					◇ Social Norms
Frederiks & Romanach (2021)	Community Battery	Intention (participate in CB program)	929 participants with solar (of 2968 participants)	Open-ended question survey question; n = 430 --- Survey	<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Community (2nd) ◇ Benefit: Energy Security (3rd) ◇ Benefit: Environmental ◇ Benefit: Curiosity --- ◇ Risk-perception (1st) ◇ Benefit: Energy security (2nd) ◇ Benefit: Financial (3rd) ◇ Social Norms ◇ Benefit: Energy autonomy ◇ Benefit: Community
Gardner et al (2008)	DER system	Attitude	706 householders from four Australian states (New South Wales, Victoria, Queensland, and South Australia)	Survey	<ul style="list-style-type: none"> • Benefit: Financial • Benefit: Environment ○ Ease of use ○ Service Interaction ○ Risk Perception
Institute for Sustainable Futures (2019)	Voltage regulation, Solar PV and Battery storage	Intention (Join trial)	8 United Energy customers (solar-storage), 14 Ausnet customers (solar-storage devices), 35 Ausnet customers (solar only)	Survey (VIC)	<ul style="list-style-type: none"> ◇ Benefit: Environment (1st) ◇ Benefit: Energy Security (2nd) ◇ Benefit: Community (3rd) ◇ Benefit: Financial ◇ Benefit: Energy Autonomy ◇ Benefit: Pioneering
Institute for Sustainable Futures (2019)	Voltage regulation, Solar PV and Battery storage	Intention (Join trial)	22 Essential Energy customers (solar storage)	Survey (NSW)	<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Energy Security (2nd) ◇ Benefit: Community (3rd) ◇ Benefit: Energy Autonomy ◇ Benefit: Environment ◇ Benefit: Pioneering
KPMG (2016)	Solar PV	Adoption	1,821 households with solar PV, and 630 without.	Survey	<ul style="list-style-type: none"> ◇ Benefit: financial (1st) ◇ Benefit: Energy Autonomy (2nd)



					<ul style="list-style-type: none"> ◇ Benefit: Environment (3rd) ◇ Social Norms ◇ Process Ease
KPMG (2016)	solar, battery	Satisfaction (installation & technology)	74 phone interviews and 29 on-site case studies	Phone Interviews / On-site visits	<ul style="list-style-type: none"> □ Expertise (consumer) □ Service Accessibility □ Risk-perception □ Process ease
La Machia & Newton (2018a)	VPP / Energy sharing & trading	Intention	1,020 participants across Australia in standalone homes with solar and battery (105), solar (364), battery (12) and none (538)	Survey	<ul style="list-style-type: none"> • Benefit: Financial • Benefit: Environment • Comparison • Benefit: Energy autonomy ○ Benefit: Community
La Machia & Newton (2018b)	VPP / Energy sharing & trading	Intention	503 participants across Australia in multi-owned complexes with solar and battery (16), solar (60), battery (10) and none (417)	Survey	<ul style="list-style-type: none"> • Benefit: Financial • Benefit: Ease of Use • Benefit: Community
La Machia & Newton (2018c)	VPP	Intention & Trust	470 participants (Australian residents)	Experiment	<ul style="list-style-type: none"> ○ Benefit: Financial ○ Benefit: Energy security ○ Benefit: Environment
Loveday (2021)	Solar & Battery	Adoption	Occupants of developments Gen Y (3 occupants), SHAC (4 occupants), Evermore (7 occupants)	Semi-structured interviews	<ul style="list-style-type: none"> □ Benefit: Environment □ Benefit: Community □ Benefit: Financial □ Benefit: Energy autonomy □ Expertise (consumer) □ Service interaction
Newgate (2021)	Solar / transition to renewables	Attitude	Focus groups (n = 101) and survey (n = 1948, of which 1257 had a smart meter installed and 691 had not)	Focus groups (n =101) and survey (n =1948)	<ul style="list-style-type: none"> ◇ Benefit: Environment (1st) ◇ Benefit: Energy Autonomy (2nd) ◇ Benefit: Financial (3rd) ◇ Benefit: Energy security ◇ Risk perception



Nicholls et al. (2019)	DER, Solar and battery storage systems	Intention/ adoption	56 participants in Victoria, South Australia, New South Wales, Australian Capital Territory, and Queensland	Interviews	<input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Benefit: Community <input type="checkbox"/> Benefit: Energy security <input type="checkbox"/> Benefit: Energy autonomy <input type="checkbox"/> Benefit: Environment <input type="checkbox"/> Risk-perception <input type="checkbox"/> Ease of use <input type="checkbox"/> Comparison
Patterson-Hann, & Watson (2022)	Virtual power plant	Acceptance	14 Tasmanian households participating in the CONSORT trial; 9 industry stakeholders	Interview	<input type="checkbox"/> Service accessibility <input type="checkbox"/> Customisation <input type="checkbox"/> Ease of use <input type="checkbox"/> Risk perception
Ransan-Cooper et al. (2020)	VPP (solar, batteries system)	Satisfaction (trial)	36 households, Bruny Island, in Tasmania, Australia.	Interviews	<input type="checkbox"/> Expertise (Consumer & Company) <input type="checkbox"/> Risk Perception <input type="checkbox"/> Service Interaction <input type="checkbox"/> Service Accessibility <input type="checkbox"/> Service Recovery <input type="checkbox"/> Ease of Use <input type="checkbox"/> Benefit: Energy Security <input type="checkbox"/> Benefit: Energy Autonomy
Roberts et al., (2020)	VPP (solar, batteries, & SOLA monitoring)	Intention	Stage 1: 25 individuals with/without batteries Stage 2: 22 individuals no-solar, solar, solar & batteries	Interviews/ focus groups	<input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Benefit: Community <input type="checkbox"/> Benefit: Environment <input type="checkbox"/> Benefit: Pioneering <input type="checkbox"/> Benefit: Energy Security <input type="checkbox"/> Benefit: Energy Autonomy <input type="checkbox"/> Comparison <input type="checkbox"/> Customisation <input type="checkbox"/> Risk Perceptions <input type="checkbox"/> Ease of use <input type="checkbox"/> Expertise (Consumer)



Roberts et al., (2020)	Battery	Adoption (purchase)	Stage 1: 25 individuals with/without batteries Stage 2: 22 individuals no-solar, solar, solar & batteries	Interviews/ focus groups	<input type="checkbox"/> Customisation <input type="checkbox"/> Social Norms <input type="checkbox"/> Benefit: Energy Security <input type="checkbox"/> Benefit: Energy Autonomy <input type="checkbox"/> Benefit: Financial
Roberts et al., (2020)	VPP (data sharing)	Attitude	Stage 1: 25 individuals with/without batteries Stage 2: 22 individuals no-solar, solar, solar & batteries	Interviews/ focus groups	<input type="checkbox"/> Benefit: Community <input type="checkbox"/> Benefit: Environment <input type="checkbox"/> Benefit: Financial
Romanach et al. (2013)	DER	Attitude	2,463 observations across Australia and six focus groups in Brisbane, Melbourne and Sydney	Survey	<input type="checkbox"/> Benefit: Financial (1 st) <input type="checkbox"/> Risk perception (2 nd) <input type="checkbox"/> Benefit: Energy Security (3 rd) <input type="checkbox"/> Benefit: Environment <input type="checkbox"/> Benefit: Energy Autonomy <input type="checkbox"/> Ease of use <input type="checkbox"/> Social Norms
Romanach et al. (2013)	Solar PV and Solar Hot water	Adoption	Subsample that had solar PV (162 participants) and Solar hot water (110 participants) of the 2,463 participants across Australia	Survey	<input type="checkbox"/> Benefit: Financial (1 st) <input type="checkbox"/> Benefit: Environment (2 nd) <input type="checkbox"/> Benefit: Energy Autonomy (3 rd)
Romanach et al. (2013)	DER	Attitude (Support for various technologies)	2,463 observations across Australia and six focus groups in Brisbane, Melbourne and Sydney	Survey	<ul style="list-style-type: none"> • Benefit: Environment <ul style="list-style-type: none"> ○ Expertise (consumer-subjective) ○ Benefit: Financial ○ Risk-perception ○ Ease of use ○ Benefit: Energy Autonomy ○ Benefit: Energy Security ○ Social Norms
Romanach et al. (2013)	DER system	Adoption (signing contract with ESCO)	2,463 observations across Australia and six focus groups in Brisbane, Melbourne and Sydney	Survey	<input type="checkbox"/> Benefit: Financial (1 st) <input type="checkbox"/> Benefit: Energy Autonomy (2 nd) <input type="checkbox"/> Benefit: Environment (3 rd)



Romanach et al. (2013)	DER system	Non-Adoption (Not signing contract with ESCO)	2,463 observations across Australia and six focus groups in Brisbane, Melbourne and Sydney	Survey	<ul style="list-style-type: none"> ◇ Benefit: Energy Autonomy (1st) ◇ Risk-perception (2nd) ◇ Expertise (consumer) (3rd)
Romanach et al. (2013); Ashworth et al (2012)	DER system	Attitude (various DER technologies)	Six focus groups in Brisbane, Melbourne and Sydney	Focus Group	<ul style="list-style-type: none"> □ Comparison □ Benefit: Financial □ Expertise (consumer) □ Risk Perception □ Service interaction □ Benefit: Environment □ Benefit: Energy Autonomy
Sehic et al., (2017)	Battery	Attitude	1,015 survey participants from across Australia	Survey	<ul style="list-style-type: none"> • Benefit: Energy security • Benefit: Environment • Risk perceptions • Benefit: Financial
Sehic et al., (2017)	Battery	Adoption (intention)	58 focus group participants in Brisbane and Melbourne --- 1,015 survey participants from across Australia	Focus group, survey	<ul style="list-style-type: none"> □ Risk perceptions □ Customisation □ Benefit: Financial □ Comparison --- • Social norms • Ease of use --- ◇ Benefit: Financial (1st) ◇ Risk perceptions (2nd) ◇ Benefit: Energy security (3rd) ◇ Benefit: Environment ◇ Social norms
Simply Energy (2021)	Battery	Adoption (intention triggers)	100+ customers (signed up to VPP, waiting list, and did not purchase VPP)	Survey	<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Energy Security (2nd) ◇ Benefit: Energy Autonomy (3rd) ◇ Benefit: Environment ◇ Benefit: Community



Simply Energy (2021)	Battery	Adoption (purchasing consideration)	100+ customers (signed up to VPP, waiting list, and did not purchase VPP)	Survey	<ul style="list-style-type: none"> ◇ Risk-perception (1st) ◇ Benefit: Energy Security (2nd) ◇ Benefit: Financial (3rd)
Simply Energy (2021)	DER	Information search	100+ customers (signed up to VPP, waiting list, and did not purchase VPP)	Survey	<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Energy Security (2nd) ◇ Risk Perception (3rd) ◇ Expertise (company) ◇ Benefit: Energy Autonomy
Simply Energy (2021)	Battery	Adoption	100+ customers (signed up to VPP, waiting list, and did not purchase VPP)	Survey	<ul style="list-style-type: none"> ◇ Risk Perception (1st) ◇ Benefit: Financial (2nd) ◇ Benefit: Energy Security (3rd)
Simpson & Clifton (2017)	Solar systems	Satisfaction	338 householders in Western Australia (characterized as Early majority)	Survey / interview	<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Pioneering (2nd) ◇ Expertise (consumer) (3rd) ◇ Benefit: Environment
Simpson & Clifton (2017)	Solar systems	Intention (Re-adoption)	338 householders in Western Australia (characterized as Early majority)	Survey / interview	<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Pioneering (2nd) ◇ Expertise (consumer) (3rd) ◇ Benefit: Environment
Simpson & Clifton (2017)	Solar systems	Adoption	338 householders in Western Australia (characterized as Early majority) and 26 interviews	Survey / interview	<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Environment (2nd) ◇ Social Norms (3rd) ◇ Benefit: Pioneering ◇ Expertise (consumer)
Strengers et al (2021)	Energy Management, PVs and batteries, VPPs	Interest	72 households with 81 participants - 36 (Ausgrid) and 36 (AusNet Services)	Research recruitment survey and digital ethnography	<ul style="list-style-type: none"> □ Expertise (Consumer) □ Social norms □ Benefit: Environment □ Benefit: Financial □ Benefit: Energy Autonomy □ Benefit: Energy Security □ Comparison



Strengers et al (2021)	Energy Management, PVs and batteries, VPPs	Adoption (Trial)	72 households with 81 participants - 36 (Ausgrid) and 36 (AusNet Services)	Research recruitment survey and digital ethnography	<input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Social Norms <input type="checkbox"/> Benefit: Energy Autonomy <input type="checkbox"/> Benefit: Energy Security <input type="checkbox"/> Benefit: Community <input type="checkbox"/> Relational vs. Transaction <input type="checkbox"/> Risk perception <input type="checkbox"/> Expertise (Consumer)
Temby & Ransan-Cooper (2021)	VPP / DER	Adoption (purchase) / Attitudes	92 householders and energy industry experts	Focus group / interview	<input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Benefit: Environment <input type="checkbox"/> Benefit: Energy Autonomy <input type="checkbox"/> Benefit: Energy Security <input type="checkbox"/> Benefit: Community <input type="checkbox"/> Benefit: Pioneering <input type="checkbox"/> Risk Perception <input type="checkbox"/> Ease of Use <input type="checkbox"/> Social Norms <input type="checkbox"/> Comparison <input type="checkbox"/> Process Ease <input type="checkbox"/> Expertise (consumer/company)
Temby & Ransan-Cooper (2021)	VPP / DER	Satisfaction (Installation & Use)			<input type="checkbox"/> Service interaction <input type="checkbox"/> Process ease <input type="checkbox"/> Expertise (company) <input type="checkbox"/> Risk Perception <input type="checkbox"/> Service accessibility <input type="checkbox"/> Ease of use
Thiébaux, S. et al., (2019); Watson et al., (2019)	VPP Trial	Adoption (trial)	34 individual interviews and 2 focus groups (of 36 participants (households) who installed a system in Bruny Island, Tasmania, Australia (pre-installation, post-installation, year one)	Interview & focus groups	<input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Benefit: Energy Security <input type="checkbox"/> Benefit: Community <input type="checkbox"/> Benefit: Environment <input type="checkbox"/> Benefit: Pioneering <input type="checkbox"/> Expertise <input type="checkbox"/> Process Ease <input type="checkbox"/> Service Interaction



□ Social Norms

Thiébaux, S. et al., (2019); Watson et al., (2019)	VPP Trial	Awareness (NAC)	34 individual interviews and 2 focus groups (of 36 participants (households) who installed a system in Bruny Island, Tasmania, Australia (pre-installation, post-installation, year one)	Interview	<ul style="list-style-type: none"> □ Expertise (consumer) □ Ease of use
Thiébaux, S. et al., (2019); Watson et al., (2019)	VPP Trial	Satisfaction (Installation)	34 individual interviews and 2 focus groups (of 36 participants (households) who installed a system in Bruny Island, Tasmania, Australia (pre-installation, post-installation, year one)	Interview	<ul style="list-style-type: none"> □ Ease of use □ Risk perception □ Service interaction □ Expertise (consumer and company) □ Risk-Perception □ Service accessibility □ Service recovery
Thiébaux, S. et al., (2019); Watson et al., (2019)	VPP Trial	Satisfaction (trial)	34 individual interviews and 2 focus groups (of 36 participants (households) who installed a system in Bruny Island, Tasmania, Australia (pre-installation, post-installation, year one)	Interview & focus groups	<ul style="list-style-type: none"> □ Benefit: Financial □ Risk perception □ Service interaction □ Service accessibility □ Expertise (consumer) □ Ease of Use
United Energy (2019)	Solar and storage	Attitude	42 Solar and Storage systems customers of UE		<ul style="list-style-type: none"> □ Benefit: Energy Autonomy □ Benefit: Energy Security □ Benefit: Financial □ Expertise (Consumer) □ Relational vs. Transaction □ Risk perception



van Groenou et al. (2018)	Battery	Adoption (intention)	Survey: 502 Tasmanian households --- Interview: 51 Tasmanian households	Survey, interview ---	<input checked="" type="checkbox"/> Benefit: Financial (1 st) <input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Benefit: Environmental <input type="checkbox"/> Relationship vs. transaction
van Veenendall (2021)	VPP	Adoption (Trial)	Baseline survey of 993 consumers / longitudinal qualitative study with 50 consumers / post-demonstration survey of 1451 consumers	Survey / Interview	<input checked="" type="checkbox"/> Benefit: Financial (1 st) <input checked="" type="checkbox"/> Benefit: Energy independence (2 nd) <input checked="" type="checkbox"/> Benefit: Environment (3 rd) <input checked="" type="checkbox"/> Social norms <input checked="" type="checkbox"/> Benefit: Community <input checked="" type="checkbox"/> Benefit: Pioneering <input checked="" type="checkbox"/> Service accessibility <input type="checkbox"/> Ease of use
van Veenendall (2021)	VPP	Satisfaction (Trial)	Baseline survey of 993 consumers / longitudinal qualitative study with 50 consumers / post-demonstration survey of 1451 consumers	Survey / Interview	<input type="checkbox"/> Service interaction <input type="checkbox"/> Service recovery <input type="checkbox"/> Service accessibility <input type="checkbox"/> Ease of use <input type="checkbox"/> Expertise (consumer) <input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Benefit: Environment <input type="checkbox"/> Benefit: Community <input type="checkbox"/> Process Ease <input type="checkbox"/> Relationship vs. transaction
van Veenendall (2021)	VPP	Satisfaction (Trial)	Baseline survey of 993 consumers / longitudinal qualitative study with 50 consumers / post-demonstration survey of 1451 consumers	Survey / Interview	<input type="checkbox"/> Service interaction <input type="checkbox"/> Service recovery <input type="checkbox"/> Service accessibility <input type="checkbox"/> Ease of use <input type="checkbox"/> Expertise (consumer) <input type="checkbox"/> Benefit: Financial <input type="checkbox"/> Benefit: Environment <input type="checkbox"/> Benefit: Community <input type="checkbox"/> Process Ease <input type="checkbox"/> Relationship vs. transaction



van Veenendall (2021)	VPP	Attitude	57 respondents of the 1451 consumers	Card sort exercise	<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Energy independence (2nd) ◇ Customisation? (3rd) ◇ Benefit: Community (3rd) ◇ Benefit: Environment (3rd) ◇ Ease of use ◇ Benefit: Pioneering
Zenkic et al. (2022a)	VPP	Adoption (Trial)	19 residents from 16 households in the Hume region participating in Project EDGE	Interviews	<ul style="list-style-type: none"> □ Benefit: Community □ Benefit: Financial □ Benefit: Environment □ Benefit: Energy Security □ Benefit: Pioneering □ Risk-perception □ Social Norms □ Expertise (consumer) □ Service accessibility (information) □ Comparison □ Service Interaction
Zenkic et al. (2022a)	VPP	Satisfaction (Trial)	19 residents from 16 households in the Hume region participating in Project EDGE	Interviews	<ul style="list-style-type: none"> □ Service Interaction □ Benefit: Energy Security □ Risk-perception □ Ease of use □ Expertise (consumer) □ Customisation □ Relational vs. Transaction
Zenkic et al. (2022b)	VPP	Intention (Join trial)	399 participants residing in non-metropolitan Victoria	Survey	<ul style="list-style-type: none"> ◇ Benefit: Financial (1st) ◇ Benefit: Energy Security (2nd) ◇ Benefit: Environment (3rd) ◇ Benefit: Community ◇ Benefit: Energy Autonomy ◇ Process Ease ◇ Risk-perception ◇ Expertise (consumer)



Zenkic et al. (2022b)	VPP	Attitude /Interest (Trial)	399 participants residing in non-metropolitan Victoria	Survey	<ul style="list-style-type: none">• Benefit: Financial• Comparison
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Note: The categorisation of findings (and their associated rankings) presented in this table may reflect an interpretation and/or an aggregation of multiple related findings (e.g., 'save money on power bills' and 'increase financial rewards' would both be coded under Benefit: Financial).