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Broadening equitable access to solar: renters, non-adopters and the impact of consumption values on attitudes and installation intentions

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ABSTRACT

Addressing inequities in rooftop solar access is crucial to achieving decarbonisation and energy justice goals. This study contributes to the literature by applying an adapted consumption values model to the rooftop solar context and by examining renters' perceptions of factors that would reduce barriers to solar uptake. An online survey ($n = 331$) of Australian households reveals that value-for-money perceptions are the only significant difference between adopters and non-adopters of solar. Structural equation modelling shows that, while idealistic values influence attitudes towards rooftop solar, pragmatic values drive installation intentions, which is aligned with prior research. Logistic regression shows that the higher the functional value (defined as the perceived utility of a product based on value for money, performance or quality perceptions) and the higher the conditional value (defined as the perceived utility of a product based on the circumstances faced by the decision maker), the higher the odds of installing solar. The findings are consistent with studies reporting significant cost barriers to solar adoption. Several recommendations for policy makers and practitioners are made to support equitable access to rooftop solar and help address the negative effects of past policies that favoured homeowners over renters.

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Consumption values; renters; residential solar; logistic regression; structural equation modelling; Australian solar market

1. Introduction

Solar photovoltaic (PV) is seen as a price-competitive technology that is crucial to the transition towards a low-carbon energy system (Michas et al. 2019). Generous subsidy schemes have resulted in Australia having one of the highest rates of solar PV installations worldwide (Shaw-Williams et al. 2022). Yet, there is considerable disparity and inequities in solar adoption across households in Australia. Inequities are defined as differences in solar panel uptake across households due to net wealth, income or dwelling status, and a just transition would provide all households the opportunity to contribute to climate change mitigation efforts and benefit personally from reduced electricity bills

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(Best, Marrone, and Linnenluecke 2023). Thus, the motivation for this study is to focus on non-adopters and rental households since solar delivers utility bill savings for consumers and also speeds up progress toward a more sustainable energy system.

Scholars are increasingly concerned with the welfare impacts of energy policies (Hammerle, White, and Sturmberg 2023; Sovacool et al. 2016). Authors argue that it is critical "to ensure climate and energy policies are just, equitable and beneficial for communities, both to sustain public support for decarbonisation and address multifaceted societal challenges" (Lamb et al. 2020, 1). It is recognised that rooftop solar adoption must encompass renters and lower-income households on the grounds of fairness (Bird and Hernández 2012; Carley and Konisky 2020; Healy, Stephens, and Malin 2019; O'Shaughnessy et al. 2021; Romero-Jordán, Del Río, and Peñasco 2016; Xu and Chen 2019). It is clear from the literature that access to capital and property ownership were essential conditions for the adoption of rooftop solar (Sommerfeld et al. 2017), which resulted in the exclusion of renters from the energy transition (Zander 2020). While older, wealthy Australian homeowners were beneficiaries of a policy model that was used to drive early solar adoption (Best, Burke, and Nishitate 2019), it disadvantaged a wide range of households who did not have adequate capital or access to a suitable rooftop and constituted a "regressive form of taxation" (Nelson, Simshauser, and Kelley 2011, 113).

There has been an increase in households in private rental agreements over the past two decades. Furthermore, the number of single-person and single-parent households have increased, and these household types tend to have lower home ownership rates (Australian Institute of Health and Welfare 2023). There has a been a significant decline in the home ownership rate of younger cohorts (i.e. 30–34) over the past few decades, due to the rising price of housing and changing demographics. As a result, longer periods are spent co-residing in the parental home or renting. Furthermore, home ownership rates for those entering retirement are likely to be lower than currently experienced. Trends in home ownership are a concern to policy makers since wealth inequality is clearly associated with housing tenure. It has been reported that people who own their own home outright experience the largest growth in wealth while renters, as the least wealthy group, experience very limited changes in wealth levels over time (Whelan et al. 2023). Thus, this study focuses on renters who were disadvantaged by past policies on solar. It seeks to capture their perceptions of solar as wellas the role of moral and financial motives and to examine their responses to measures that could reduce barriers to solar access.

New business models and policy measures have been proposed that could address inequities in access to solar. Potential solutions to the uneven pattern of diffusion are the promotion of landlord-tenant agreements and shared solar and leasing arrangements that mitigate the cost barrier (Augustine and McGavisk 2016; Marques et al. 2023). Solar rebates for rental properties and landlord-tenant agreements have been promoted in Victoria (Zander 2020), but they do not exist in Queensland. Given the recent increase in housing costs experienced by private renters (Australian Bureau of Statistics 2023a), access to affordable energy is important in easing the cost of living pressures for renters. The latest studies indicate that renewables (wind and solar) are now the cheapest form of energy in Australia (Graham et al. 2022). Approximately 30 per cent of Australian households rent their home in the private rental market (ABS 2023b), and since they cannot add solar PV or batteries, even if they want to, this creates an energy divide, defined as the rapidly growing gap between consumers who can easily access efficient, reliable, and affordable energy, and those who cannot (Energy Consumers Australia 2023). The question of how to create more value for underserved groups in society is important as it lays the foundations for a just energy transition, which rests on the active participation of different groups of society (Lekavičius et al. 2020). As noted by scholars, the challenge for policy makers is to ensure that government policies do not harm (Simshauser, Nelson, and Gilmore 2023) and do not 'lock in' inequality due to income differences (O'Shaughnessy 2022), while moving the power system towards net zero.

This study uses consumption value theory (Sheth, Newman, and Gross 1991) as the guiding theoretical framework. Consumption value theory posits that consumers' choices in the marketplace are influenced by five main values, which are functional, emotional, social, conditional and epistemic, and the relative importance of each value depends on the context (Sheth, Newman, and Gross 1991). Consumption value is defined as a "consumer's overall assessment of the utility of a product (or service) based on perceptions of what is received and what is given" (Zeithaml 1988, 14). Consumption value theory offers a multi-dimensional view of value, covering both the utilitarian and hedonic facets of consumption, and perceptions can be generated without the product or service being bought or used (Sweeney and Soutar 2001). Value is a personal and subjective experience that is essentially created by the customer (Mäntymäki and Salo 2015). Consumption value theory is a credible and well-established model, and it has been utilised successfully in various contexts such as destination marketing (Phau, Quintal, and Shanka 2014), food delivery apps (Chakraborty et al. 2022), electric vehicles (Han et al. 2017), energy efficient appliances (Issock Issock and Muposhi 2023), premium subscription services (Mäntymäki, Islam, and Benbasat 2020) and virtual goods or services (Mäntymäki and Salo 2015). In addition, scholars report that consumption value theory is relevant to explaining consumers' choices and motivations for behaviour in the field of 'green' or sustainable marketing (Tanrikulu 2021) and particularly for products that are complex and costly (Rana and Solaiman 2023). So, we draw from these arguments and since there is little or no research regarding consumption values and rooftop solar, this is the focus of this study.

This study makes several contributions to the literature. First, it incorporates context-specific dimensions into the theory of consumption value and applies it to rooftop solar adoption. This is important since consumption value theory has been largely neglected in the energy literature. Other theories such as the theory of planned behaviour (Ajzen 1991) and values-beliefs-norms (Stern et al. 1999) have, by far, attracted the most popularity in the energy field (Alipour et al. 2021). Second, it investigates which consumption values are the most salient, thereby building on the work of energy scholars on the role of economic versus non-economic motives in determining rooftop solar adoption. Prior research has highlighted economic considerations, such as government policies, electricity tariffs and pay-back periods (Chapman, McLellan, and Tezuka 2016; Lan et al. 2020; Simshauser, Nelson, and Gilmore 2023) as well as social influence or peer effects (Chadwick et al. 2022), consumer innovativeness (Huang and Cheng 2023) and pro-environmental values (Simpson and Clifton 2017). Thirdly, the study compares the consumption values of actual adopters of rooftop solar with non-adopters. This is important given the well-known gap between intentions and behaviour (Biswas and Roy 2015), and many studies on PV adoption still focus on intentions, attitudes, willingness to pay and acceptance (Alipour et al. 2021). Finally, the study focuses on renters, an often-overlooked group in research and policy making (Zander 2020), and responds to the call by Best, Marrone, and Linnenluecke (2023) for more research on non-participants in the solar market. The study proposes recommendations for the types of business models and policy interventions that may be most suitable for rental households in Australia and in other similar energy markets. This is important since there is a scarcity of research on new support schemes that could help increase the market potential for solar (Michas et al. 2019). The consumption value model is flexible enough to lend itself to "what if" analysis, such as whether non-adopters might be swayed to adopt solar by a change in circumstances that reduces barriers.

This study aims to apply the model of consumption values to solar adoption, compare the consumption values of adopters and non-adopters, and examine renters' perceptions of measures that could reduce barriers to solar access. In line with this aim, three research questions are formulated and six hypotheses are proposed. The research questions are as follows:

(1) What are the attitudes of renters towards business models and policy measures that could reduce barriers to solar access?
(2) Do the consumption values of adopters and non-adopters vary?
(3) What is the effect of consumption values on the attitudes and installation intentions of renters and non-adopters?

This article is structured as follows. Section 1 introduces the research and provides a rationale for the study. Section 2 analyses the theoretical foundations of the study and outlines the hypotheses. The methodology used for measuring variables and the data collection process is outlined in section 3, and the results are presented in section 4. Finally, section 5 discusses the findings, outlines the limitations, and proposes avenues for future research.

2. Literature review: consumption value theory

The concept of value is well-established in the literature. For economists, value arises during the exchange process, when people are willing to exchange money for a product or a service due to its utility, and utility refers to the power to satisfy wants (Viner 1925). However, for marketers (Sheth, Newman, and Gross 1991; Swait and Sweeney 2000) the concept of value is much broader than the economist's version of value and is subjective in nature. Value has been analysed from the lens of benefits and losses. If the perceived value (e.g. quality of the product) is greater than the perceived cost (e.g. price, search costs), then the consumer's overall evaluation of the product is positive (Zeithaml 1988). Following the landmark paper by Zeithaml (1988), consumption value theory was proposed by Sheth, Newman, and Gross in 1991 to improve understanding of the diverse values that influence consumer decision-making. Unlike Zeithaml (1988), they treat perceived value as a function of five categories of consumption values, such as functional, conditional, social, emotional and epistemic value. Consumption value theory has been used to explain choice behaviour in many contexts, including ‘green’ or sustainable consumption (Biswas and Roy 2015; Gonçalves, Lourenço, and Silva 2016; Sivapalan et al. 2021), energy-rated appliances (Zhang, Xiao, and Zhou 2020) and electric vehicles (Han et al. 2017). It is well suited to studying solar adoption since motives for solar adoption are complex and extend beyond a simple cost-benefit analysis (Reames 2020), covering economic, environmental, market, personal, demographic, technical and regulatory factors (Shakeel et al. 2023).

2.1. Functional value

Functional value refers to the fulfilment of consumer needs based on the functional or utilitarian aspects of the product. It refers to people’s perception of the product’s quality, durability, price or value for money (Biswas and Roy 2015). Consumer attitudes towards rooftop solar are largely positive, particularly since the installation cost has fallen and the pay-back period has been reduced (Kunreuther, Polise, and Spellmeyer 2022; Vaishnav, Horner, and Azevedo 2017). Rooftop solar is perceived to be a good investment and offers value for money (Karakaya and Sriwannawit 2015; Lau et al. 2021; Schulte et al. 2022). There is ample evidence that the desire to decrease one’s electricity bill is the main reason for installing solar PV (Best, Burke, and Nishitate 2019; Bondio, Shahnazari, and McHugh 2018; Korcaj, Hahnel, and Spada 2015; Sommerfeld et al. 2017). For new technologies, there is often a fear that the technology will fail to perform (Parasuraman 2000), and some consumers worry about the quality of solar systems (Karakaya and Sriwannawit 2015). However, since rooftop technology is now a mature technology, concerns about performance should no longer be a barrier to adoption. The following hypotheses are proposed:

H1: Functional value positively influences attitudes towards rooftop.
H2: Functional value positively influences installation intentions.

2.2. Symbolic value

The significance of social image to people often results in the adoption of group norms in society (Pothitou et al. 2016). Symbolic value refers to the value people derive from external factors such as status, recognition or prestige associated with a product (Holbrook 1998). Previous studies show that consumers can use ‘green’ or sustainable consumption as a means to gain approval from others due to their socially responsible behaviour (Biswas and Roy 2015; Wolske, Gillingham, and Schultz 2020). In the context of rooftop solar, symbolic value is relevant to early adopters and helps demonstrate care for the planet and concern for the source of household energy (Palm 2018).

In the literature on rooftop solar adoption, researchers have focused on peer (or neighbourhood) effects rather than on symbolic value. Numerous research reports that social influence can expedite the adoption of rooftop solar (Bollinger and Gillingham 2012; Chadwick et al. 2022; Curtius et al. 2018; Graziano and Gillingham 2015). Scholars note that rooftop solar is a visible technology, and therefore social norms are highly relevant. As the number of important others (i.e. family and friends) who have solar increases, interest in rooftop solar also increases, and the effect is explained by ‘success expectations’ (i.e. confirms that the system will work as intended) and ‘normative expectations' (i.e. social approval) (Horne and Familia 2021). Given the significance of symbolic value, the following hypothesis is proposed:

H3: Symbolic value positively influences attitudes towards rooftop solar.

2.3. Moral value

Emotional value refers to feelings and affective states such as pleasure or relaxation, and it is typically associated with experiential services (i.e. a candle-lit dinner or a holiday) rather than with durable goods (Sheth, Newman, and Gross 1991; Sweeney and Soutar 2001). Thus, it is seen as less critical in the present study, and moral value is considered instead. Holbrook (1999) posits that ethical value (i.e. morality) plays an important role in the consumption of goods and services, and potential externalities created by marketing exchanges cannot be ignored. Ethical value captures 'other-oriented value' and is gained when consumption is for the sake of others (Holbrook 1999). For philosophers, morality is understood to be a general belief about right and wrong, and it reflects universal principles that serve to reduce harm to nature and society (Singer 2016). Prior research has established that moral emotions underpin an individual's political orientation and that this is enacted through their individual sustainable consumption choices (Watkins, Aitken, and Mather 2016). Given the moral nature of sustainability-oriented decisions such as energy conservation, many scholars have explored the role of pro-environmental values in explaining behaviour (Martínez-Espiñeira, García-Valiñas, and Nauges 2014; Schulte et al. 2022). Research shows that environmental motives are consistently associated with the actual uptake of, or intentions to install, rooftop solar (Best, Burke, and Nishitate 2019; Palm 2018), particularly early adopters of solar (Simpson and Clifton 2017), and both low-income and high-income households share such concerns (Wolske 2020).

The assessment of moral value has become more complex in recent times. The deployment of renewable energy technologies has negative implications given the rise of modern slavery[1] in the Global South, its association with the extraction of critical minerals and the handling of waste streams in the supply chain (Sovacool et al. 2020). In the recent report by the Intergovernmental Panel on Climate Change (IPCC 2023, 114), it was noted that, while an energy transition is vital to climate mitigation action, "technological innovation can have trade-offs that include externalities such as new and greater environmental impacts and social inequalities". These issues may undermine value for the well-informed consumer and raise uncertainties regarding the moral value of solar panels and battery storage. Mindful of these complexities, the following hypothesis is formulated:

H4: Moral value positively influences attitudes towards rooftop solar.

2.4. Epistemic value

Epistemic value refers to the capacity of a product or service to satisfy a thirst for knowledge and a curiosity about the world (Sheth, Newman, and Gross 1991). Previous studies of consumption value show that consumers gain epistemic value from 'green' consumption, and such knowledge helps bridge the well-known attitudes-behaviour gap (Biswas and Roy 2015). Epistemic value is related to, but separate from, the construct of consumer innovativeness, which describes people's traits and their readiness to embrace new technologies (Parasuraman 2000). This personal characteristic of rooftop solar adopters has been extensively studied. In a recent meta-review, it was concluded that novelty seeking has a large correlation with solar adoption intention and with perceived benefits (Schulte et al. 2022). Rooftop solar systems can offer epistemic value to consumers, such as learning about how the system works, its technical features, or sustainability. Thus, the following hypothesis is posited:

H5: Epistemic value positively influences attitudes towards rooftop solar.

2.5. Conditional value and barriers faced by renters

Conditional value refers to the perceived utility derived from a product (or service) that is linked to a particular situation (Sheth, Newman, and Gross 1991), and it depends on the context in which the evaluative judgment is made (Holbrook 1999). According to Sheth, Newman, and Gross (1991), this dimension is linked with inhibitors in the marketplace with emergency situations and social contingencies (for example, a Christmas card only has seasonal value). Thus, preferences can vary depending on the time or the place (Holbrook 1999). Conditional value is most ambiguous of all value dimensions, and prior research has equated it with more favourable conditions in the marketplace and with climate change. It is typically measured by the willingness to buy if price incentives were available, if suppliers were easily available, and if environmental conditions deteriorated further (Biswas and Roy 2015). This research aims to test a broader range of value-creation scenarios that are specific to rental households.

Research shows that state interventions help expand PV adoption among low-income and moderate-income households and reduce inequity in the United States (O'Shaughnessy et al. 2021). For example, to reduce the capital cost of rooftop solar for rental households, useful polices include the offer of grants, interest-free loans and feed-in tariffs. However, many consumers may be unaware that these types of incentives exist and assume that rooftop solar is outside of their reach (Wolske et al. 2018). In Australia, the policy model to encourage residential adoption of solar PV systems was targeted at homeowners and structured around energy certificates (that reduced the upfront of the system) and feed-in tariffs (which guaranteed consumers a fixed price for the electricity produced by the solar panels over a specified time period). The policy favoured property owners disadvantaged renters and low-income households (Li et al. 2020; Nelson, Simshauser, and Kelley 2011; Sommerfeld et al. 2017).

Various policies (Nelson, Simshauser, and Kelley 2011) and financial and structural barriers to installing rooftop solar have been identified in the literature (Dodd and Nelson 2022; Hammerle, White, and Sturmberg 2023; Heeter et al. 2021). Renters who reside in multi-unit buildings face numerous barriers to rooftop solar installation, including the shortage of roof space, unsuitability of roof or need for roof renovation, higher installation costs (i.e. plant hire for roof access), the presence of complex (strata title) laws, the problem of negotiating with multiple owners, control of the system and ongoing maintenance (Chester, Elliot, and Crossley 2018; Heeter et al. 2021; Roberts, Bruce, and MacGill 2019).

The split incentive (or principal-agent) barrier to installing solar on rental properties is well documented in the literature. It means that landlords are unlikely to install solar since they do not derive any benefit from the investment decision; instead it is the tenants who benefit from a reduction in the cost of electricity (Gillingham, Harding, and Rapson 2012). Solar is a relatively immobile investment, and renters stand to lose money if they install solar and then move (Ameli and Brandt 2015). Tenancy laws make it easy for landlords to terminate leases, so renters have little or no incentive to install solar PV systems (Chester, Elliot, and Crossley 2018). Furthermore, landlords may seek to recover the investment cost of solar by increasing the rent of the corresponding property (Ameli and Brandt 2015), and the perception of property investors is that renters are not willing to pay higher rents for homes with solar (Hammerle and Burke 2022). The ability to enter into a shared solar agreement with the landlord is a potential solution to the 'split incentive' issue. Shared solar refers to "a PV system that provides power and/or financial benefit to multiple community members" (Augustine and McGavisk 2016, 37). Solar leases are a common feature of shared solar agreements (Davidson, Steinberg, and Margolis 2015; Roberts, Bruce, and MacGill 2019), which means that the customer typically pays a one-off downpayment and monthly fees, regardless of the solar system's energy production. The main reason for entering a lease contract is to save money on the electricity bill. Leasing arrangements have been instrumental in the expansion of the residential solar market (Sigrin, Pless, and Drury 2015). Such models are attractive to consumers who do not wish to take on debt or make large up-front payments (Davidson, Steinberg, and Margolis 2015; Roberts, Bruce, and MacGill 2019) or who do not wish to be responsible for operations and maintenance (Rai, Reeves, and Margolis 2016). Thus, different business models have facilitated the expansion of the market and the attraction of new demographic segments (Davidson, Steinberg, and Margolis 2015; Rai, Reeves, and Margolis 2016; Shih and Chou 2011). This study tests a broad range of conditional factors. Based on prior literature, the following hypothesis is proposed:

H6: Conditional value (general and rental-specific) positively influences installation intentions.

The conceptual framework that is derived from the literature review is shown in Figure 1. The symbolic, moral and epistemic values are categorised as idealistic values since they are related to the social self, personal values, and the value attached to knowledge and curiosity about the world. Functional and conditional values are categorised as pragmatic values since they are more instrumental in nature and linked to economic self-interest.

3. Methodology

3.1. Data collection, sampling procedure and measurement scales

Purposive sampling was used in this study. Exclusion criteria consisted of people under the age of 18, people on very low incomes and people who were not responsible for paying the electricity bill. A regional sample (i.e. state of Queensland) was used to obtain specific insights within one state and control for climatic and regional variations.

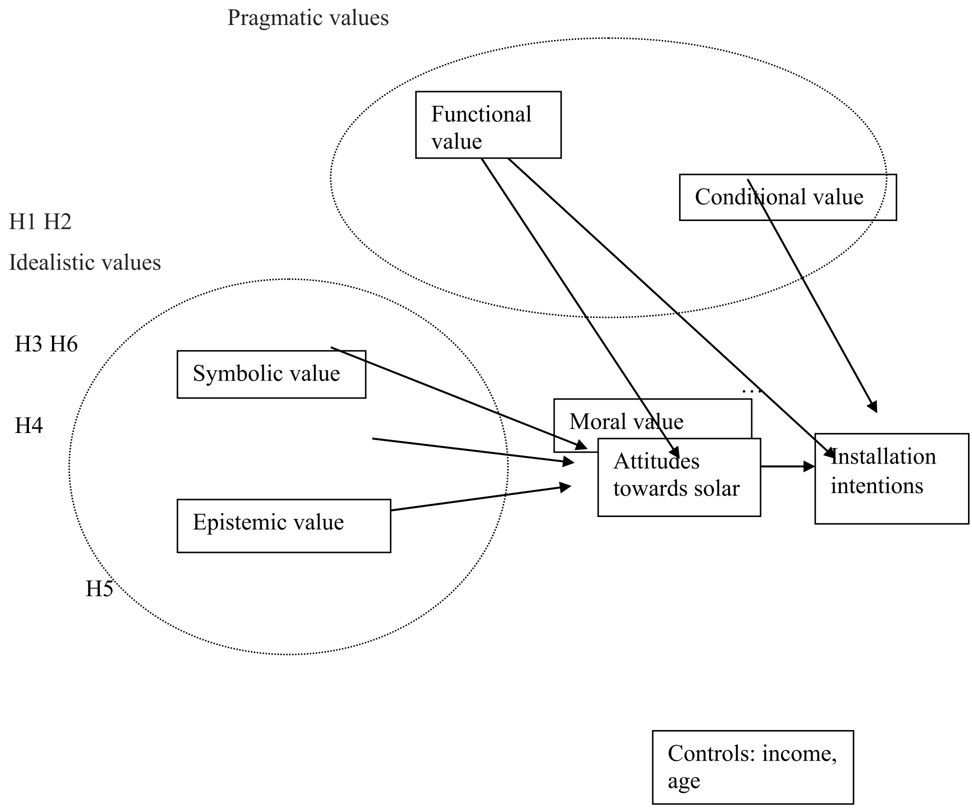

Figure 1. Attitudes towards rooftop solar: augmented consumption values framework.

Solar exposure is a basic requirement for solar PV systems, and the more exposure to the sun, the greater the competitiveness of PV systems (Karakaya and Sriwannawit 2015). Prior studies show that regional differences, including access to government incentives (Kwan 2012) and peer effects (Graziano and Gillingham 2015), could explain positive attitudes towards solar, thus selecting a sample of respondents from the same location helps control for some of these regional differences.

Data was collected through the use of a large, web-based panel belonging to Qualtrics, a market research company. Survey respondents are generally paid an incentive by the agency's panel partners. As the respondents have already agreed to be part of a panel, online samples tend to achieve higher response rates than traditional survey methods (Qualtrics 2024). The survey was designed to be short, easy to complete and mobile-friendly. Respondents were assured of confidentiality and offered a copy of the results to improve the response rate. To reduce the potential for socially desirable responses, participants were asked to answer all questions honestly, reassured that their contributions mattered, and informed that the survey would help solar retailers and policy makers make better decisions.

During December 2022, invitations were sent to the panellists who met certain quotas and screening criteria, i.e. over 18, responsible for paying the electricity bill, living in Queensland, renters, adopters and non-adopters of solar. Ethical approval for the study was granted by the Human Ethics Committee at the author's university. The survey was conducted in a year when there was a significant increase in wholesale electricity prices. This market event could have influenced attitudes towards rooftop solar, given that electricity pricing is an important driver of solar PV adoption (Simshauser, Nelson, and Gilmore 2023). However, a cost-of-living rebate was offered to households in Queensland which mitigated the problem of high electricity bills (Australian Competition and Consumer Commission 2023).

The core section of the survey consisted of questions relating to consumption values and policy measures. All constructs and measurement scales were informed by the literature (see Appendix A, Table A1). Multiple-item scales, rather than single-item constructs, were selected, as recommended by scholars (Hair et al. 2022), to control for measurement error. The latent constructs were measured using a seven-point Likert scale with anchor points ranging from 1 (strongly disagree) to 7 (strongly agree).

Data on dwelling status, solar installation and consumer demographics were gathered such as gender, age, income, education, employment status and area of residence. Sociodemographics are critical factors that influence energy-related decisions (Medojevic, Medojevic, and Delic 2021). In this study, controls such as age and income were used in the model. Income is frequently used in studies to predict solar adoption since it is a proxy of affordability (Best, Chareunsy, and Taylor 2023; Bondio, Shahnazari, and McHugh 2018; Chadwick et al. 2022; Jacksohn et al. 2019; Nelson, Simshauser, and Kelley 2011). However, inconsistent findings have been reported in the literature (Alipour et al. 2020; Sommerfeld et al. 2017). High-income households and those with very high levels of net wealth, manifested in savings and home ownership (Best, Burke, and Nishitate 2019), may not care about an expensive electricity bill, so solar is not an attractive investment. Low-income households, in contrast, may care about the bill, but are unable to afford the capital cost of solar installation (Best and Chareunsy 2022). Age is another important control variable. Research on early adopters found that older age was linked to solar uptake (Alipour et al. 2020), and wealthy retirees in particular were attracted to solar in Australia (Best, Burke, and Nishitate 2019). In Queensland, early adopters were people approaching retirement, those aged over 55 years, who responded positively to the premium $0.44 feed-in tariff and viewed solar as an investment and a cost-effective means of managing future electricity bills (Sommerfeld et al. 2017). Furthermore, the stay-at-home lifestyles of retirees are well suited to gaining utility from solar as they can shift energy use to the daytime. Yet, age may intersect with motives in complex ways. Zander (2020) concluded that younger people are more likely than older people to install solar PV independently of incentives, which is explained by environmental motives. While retirement planning can act as a trigger for solar investment (Sigrin, Pless, and Drury 2015), some research shows that the older the house owner, the less likely the person will engage in retrofit activities (Achtnicht and Madlener 2014) or install battery storage (Best et al. 2021; Poier 2023), which is explained by reduced income in retirement.

3.2. Common method bias

The risk of common method bias being present in the study is increased when the independent and dependent variables are all captured in the same survey (Podsakoff et al.

2003). A statistical test, Harman's single-factor test, was employed after data collection to detect common method bias. The result was satisfactory since the first factor was below the threshold of 50 per cent. In addition, the variance inflation factor (VIF) values were less than the threshold value of 5, suggesting that common method bias was not a major concern (Kock and Lynn 2012).

3.3. Data analysis and statistical techniques

Data analysis was carried out using the SPSS program, version 24, and SmartPLS, version 4. The statistical analysis consisted of frequency distributions, and partial least squares structural equation modelling (PLS-SEM). Factor analysis and logistic regression analysis were also undertaken to bolster the findings and ensure empirical robustness (Field 2013). PLS-SEM was chosen since it works well with confirmatory and exploratory research approaches, and this research has features of both. This research seeks to test and validate consumption values theory and explore the influence of specific conditional factors that address the barriers faced by renters. Furthermore, the PLS-SEM approach achieves greater statistical power than covariance-based, structural equation modelling (CB-SEM) for smaller sample sizes (Hair et al. 2022).

4. Results

4.1. Summary statistics and sample size

A profile of the sample is shown in Appendix A (Table A2). There was a skew towards females, with 69 per cent of respondents being female. Most respondents were in the 30–39 age group, followed by older age groups. There was diversity in terms of educational background. Data from the last census, published by the Australian Bureau of Statistics (ABS 2022), shows that the median household income for people living in Queensland, Australia, as of 2021, was $1,675. Most respondents were at, or above, the median income, so the sample captured moderate-income earners who are likely to have the financial capacity to install solar.

The sample consisted of adopters ($n = 104$) and non-adopters of solar ($n = 226$). In relation to property ownership and solar adoption, 42 per cent of all homeowners ($n = 83$) had solar systems installed, whereas only 16 per cent of all rental households ($n = 21$) had solar systems installed. In terms of housing tenure, 40 per cent of the total sample were renters and 60 per cent were homeowners. The vast majority of renters did not have solar installed ($n = 111$). In relation to age, homeowners were generally older than renters. Homeowners had more people in the over 60 and retirement age category (33.7 per cent) than the renters (14.4 per cent).

A total of 331 individuals responded to the survey. To model the factors that influence attitudes and installation intentions, a sub-set of the dataset was chosen, that is, non-adopters of solar ($n = 226$). This sample size comfortably meets the 'ten times rule', which states that the sample size should be greater than 10 times the maximum number of model links pointing at any latent variable in the mode (Hair et al. 2017). Power analysis was conducted (Faul et al. 2007), which indicated that the minimum sample size needed for a two-tailed t-test to detect a 'medium' effect size with 80 per cent power at an alpha level of 0.05 is approximately 64 for each group. Based on the aforementioned studies, the sample size is adequate.

4.2. Renters' perceptions of the mechanisms that help overcome barriers to solar adoption

To address the first research question, the responses of renters (those who do not live in homes with rooftop solar) to policy measures that might address barriers to access were explored. Table 1 presents the results. The results show that attitudes were positive and generally supportive of the measures, and respondents "somewhat agreed" (value = 5) and "agreed" (value = 6) with all statements. Availability of discounts received the highest score and the need to gain approval from the Body Corporate received the lowest score.

4.3. Adopters and non-adopters of solar: perceptions of consumption values

To address the second research question (comparison of adopters and non-adopters), parametric tests were used to investigate whether different households varied in their perceptions of consumption values. The t-test for two unrelated means is a statistical test that compares the mean values of two independent samples (Field 2013). The null hypothesis states that there is no significant difference in group means, and the alternative hypothesis states that the difference in group means is different from zero (Field 2013). Table 2 presents the results. The results show that there are significant differences between adopters and non-adopters in terms of functional value. In contrast to non-adopters, adopters show stronger agreement with the statements relating to functional value.

4.4. The consumption values model

To address the third research question, which concerns the influence of consumption values on the attitudes and installation intentions of non-adopters ($n = 226$), structural equation modelling was performed. The steps outlined by Hair et al. (2022) were

Table 1. Attitudes of renters towards policy measures ($n = 111$).

Statements	Mean	SD
Conditional value – general		
I would buy a rooftop solar system if it was offered at a discount or with promotional incentives	5.67	1.57
I would buy rooftop solar instead of using electricity from the grid under worsening environmental conditions	5.67	1.61
I would buy a rooftop solar system if it was offered at a subsidised rate	5.65	1.56
I would buy rooftop solar if suppliers/installers were easily available	5.29	1.72
Conditional value – rental-specific		
If I had more control over the rental dwelling and could lease the panels from the solar retailer	5.66	1.52
If I could sign an agreement with the landlord to install rooftop solar panels and share the benefits	5.61	1.51
If I was eligible for a rebate aimed at renters	5.57	1.86
I would buy rooftop solar if the Body Corporate allowed installation on the commonly owned roof	4.94	2.27

Note [1]: Attitudes were measured on a 7-point scale where 1 = strongly disagree and 7 = strongly agree. A 'not applicable' category was also used.

Table 2. Solar adopters and non-adopters, consumption values.

Statements about consumption values	Adopters ($n = 104$) Mean	Adopters Std D	Non-adopters ($n = 226$) Mean	Non-adopters Std D	*P*	t	Cohen's d
Functional value							
Solar panels perform consistently	5.27	1.108	5.00	1.193	0.052*	2.001	0.231
Functional value – price							
In the current market rooftop solar systems are reasonably priced	5.18	1.313	4.52	1.389	**0.000**	4.168	0.484
A rooftop solar product is a good product for the price	5.37	1.239	4.71	1.304	**0.000**	4.375	0.509

Note[1]: The scale for consumption values ranges from 1 = strongly disagree to 7 = strongly agree.
Note[2]: Significant values ($p < 0.05$) are in bold, and *$p < 0.10$.

followed, where the outer measurement model is assessed, followed by the inner structural model. A reflective measurement model was chosen, which means that reflective indicators are exchangeable and the deletion of one, or more, scale items does not change the essential character of the construct (Hair et al. 2022).

Table 3 displays the findings related to the measurement model. Concerning internal consistency, values for Cronbach's alpha, composite reliability and Dijkstra-Henseler's Rho_A are shown in the table. Cronbach's Alpha values range from 0.75 to 0.92 and are well above the recommended value of 0.7. The Rho A value is also within the recommended range i.e. higher than 0.7 and less than 1. The composite reliability values exceed the threshold value of 0.7 (Bagozzi and Yi 2012). The convergent validity measure comprises the average variance extracted, which surpasses the threshold value of 0.5 (Bagozzi and Yi 2012). The values of the outer loadings (which refer the extent to which each item within a factor correlates with the rest within the factor) meet the threshold value, which is higher than 0.7 (Benitez et al. 2020).

Table 3. Construct reliability and validity, and outer loadings.

	Outer loadings	Cronbach's alpha	Composite reliability (Rho A)	Composite reliability (Rho C)	Average variance extracted
Attitudes towards solar	0.961 0.971	0.928	0.943	0.965	0.933
Conditional value (general)	0.905 0.932 0.900	0.900	0.907	0.937	0.833
Epistemic value	0.820 0.865 0.772	0.759	0.778	0.860	0.672
Functional value –	0.787 0.816 0.771 0.853 0.866 0.873	0.909	0.914	0.929	0.687
Moral value	0.901 0.909 0.822	0.856	0.906	0.910	0.771
Symbolic value	0.931 0.937 0.837	0.887	0.922	0.930	0.815

Table 4. Discriminant validity: the heterotrait-monotrait ratio.

	1	2	3	4	5	6	7	8
Attitudes towards solar								
Conditional value	0.326							
Epistemic value	0.586	0.484						
Functional value	0.562	0.299	0.677					
Income (control)	0.059	0.061	0.039	0.059				
Installation intentions	0.239	0.476	0.392	0.384	0.156			
Moral value	0.638	0.489	0.678	0.697	0.05	0.369		
Symbolic value	0.524	0.383	0.513	0.607	0.039	0.306	0.701	
Age	0.088	0.186	0.068	0.14	0.235	0.300	0.039	0.048

Concerning discriminant validity, the heterotrait-monotrait criterion was used and Table 4 presents the results. The results show that no value is close to 1, and all are below the recommended threshold of 0.85 or 0.90 (Benitez et al. 2020), so discriminant validity is confirmed.

After evaluating the measurement model, the second stage proceeds to the evaluation of the structural model. The bootstrapping procedure, with 5,000 subsamples, was applied to assess the significance of the structural model relationships. Table 5 shows the results of the path analysis, the hypotheses testing, multi-collinearity statistics (VIF) and f2 values. Figure 2 depicts the model. Bias-corrected confidence intervals are reported in the table. The path coefficients (which lie between −1 and +1) show the variables that have a statistically significant, positive effect on attitudes, which are epistemic, functional, moral and symbolic value. Conditional and functional value have a significant effect on installation intentions. The table also depicts the test statistic. The strongest relationship is found between conditional value and installation intentions ($t = 5.287$) and functional value and installation intentions (t = 5.076). In our sample, the f^2 values for several of the hypothesised relationships range from small to medium; the largest values are associated with conditional value, functional value and installation intentions.

Finally, the R-square value for attitudes was 0.428, showing that attitudes were explained by the consumption values. The value for R-square in relation to installation intentions was 0.356.

Table 5. The consumption value framework and hypotheses testing ($n = 226$).

Path: IV to DV	SD	β	t values	*P*	CI Lower	CI Lower	VIF (inner)	f Square
Attitudes → Installation intentions	0.088	−0.073	0.823	0.410	−0.234	0.115	1.481	0.006
Conditional value→ Installation intentions	0.061	0.324	5.287	**0.000**	0.200	0.441	1.170	0.140
Epistemic value → Attitudes	0.074	0.187	2.523	**0.012**	0.043	0.333	1.651	0.037
Functional value → Attitudes	0.065	0.151	2.320	**0.020**	0.027	0.283	1.991	0.020
Functional value → Installation intentions	0.070	0.353	5.076	**0.000**	0.204	0.479	1.501	0.129
Moral value → Attitudes	0.099	0.315	3.169	**0.002**	0.097	0.496	2.152	0.081
Symbolic value → Attitudes	0.064	0.134	2.087	**0.037**	0.002	0.254	1.707	0.018

Note[1]: The critical T values around 1.65, 1.96, and 2.58 are considered with the significance level of 10 per cent, 5 per cent and 1 per cent respectively (Two-Tailed Test).
Note[2]: Significant values ($p < 0.05$) are in bold, and *$p < 0.10$.
Note[3:] The VIF values are <3 or are not >5, indicating no collinearity issues.
Note[4:] The effect sizes (?^{2}) of 0.02 (small), 0.15 (medium), and 0.35 (large) are considered.

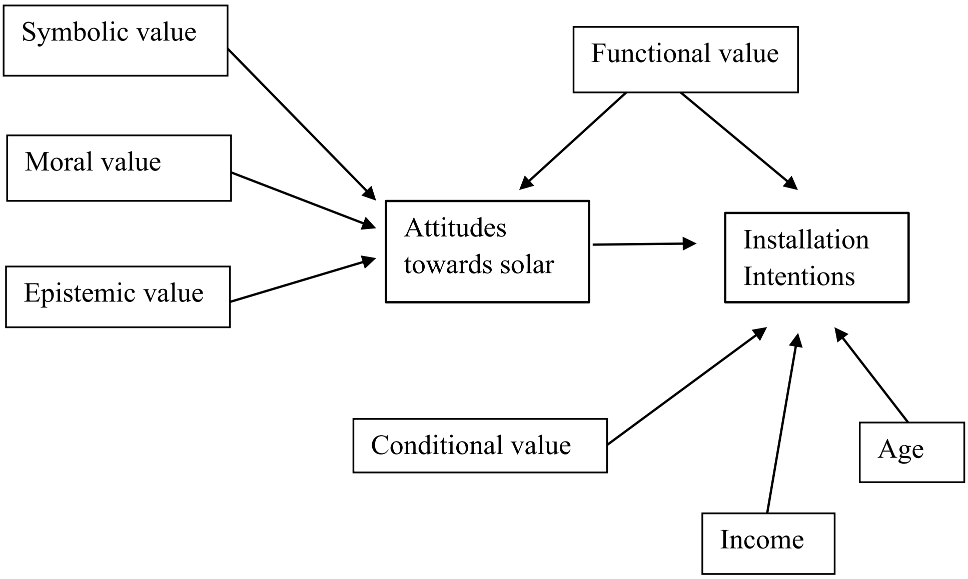

Figure 2. The consumption values model and factors influencing non-adopters.

4.5. Exploratory factor analysis

Factor analysis was conducted on perceived consumption values. As shown in Table 6, the Eigenvalues for three factors were greater than 1; therefore, these factors were retained. Correlation and sampling adequacy tests were performed. The results for Bartlett's Test of Sphericity were significant, x2(n = 226) = 2353.407 ($p < 0.000$). The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.887, and values above 0.800 are considered appropriate for factor analysis. The factor analysis yielded three factors, which accounted for 68 per cent of the variation in the data. Although consumption value theory positions symbolic value as a stand-alone construct, factor analysis predicted three factors, and since symbolic and moral value loaded on one factor, this factor was retained. Each factor was then used in regression analysis (and the multiple-item scales were transformed using the mean function).

4.6. Logistic regression analysis: nonadopters

Logistic regression analysis was performed on the sample of non-adopters ($n = 226$). This technique was used to bolster the findings from structural equation modelling and ensure

Table 6. Factor analysis.

Factor	Eigenvalue	Variance	Cumulative
Factor 1 – Functional	7.465	49.768	49.768
Factor 2 – Symbolic/moral	1.498	9.989	59.757
Factor 3 – Epistemic	1.299	8.660	68.417
Method		Principal component factors	
Retained factors	5		
Rotation method		Varimax	

empirical robustness (Field 2013). Binary logistic regression was used, and installation intention was the dependent variable. The factors identified in the factor analysis were treated as independent variables, along with conditional values (general). The latter construct included items related to discounts, access to solar installers and willingness to buy solar under worsening environmental conditions. Age and income were also entered into the regression model as control factors.

The omnibus test showed that the model describes the data well and there is a good model fit. The result of the Hosmer and Lemeshow test was not significant (0.645), so the model adequately fits the data. The Pseudo R-square value (Cox and Snell) was 0.258 and the adjusted version (Nagelkerke R Square) was 0.344, which shows the approximate variation in the criterion variable. The classification table was checked and the model correctly classified 70.4 per cent of the cases overall.

The results of the logistic regression (see Table 7) show that the higher the functional value, so do the odds of installing solar. As conditional value increases, the odds of installing solar increases. The more idealistic values, such as symbolic, moral and epistemic values, are not significant in predicting installation intentions.

4.7. Exploratory factor and analysis and logistic regression analysis: renters

Logistic regression was also performed on renters ($n = 111$), a subset of the sample of non-adopters. Before performing logistic regression, factor analysis was performed on survey items relating to various forms of conditional value. Correlation and sampling adequacy tests were performed. Bartlett's Test of Sphericity was significant, $x^2(n = 111) = 1126.941$ ($p < 0.001$), thus the data was suitable for factor analysis. The Kaiser-Meyer-Olkin measure of sampling adequacy was appropriate since the result was 0.826 which was above the 0.800 threshold value. The factor analysis yielded two factors, which accounted for 75.23 per cent of the variation in the data (see Table 8). Both forms of conditional value were then used in the logistic regression analysis (and the multiple-item scales were transformed using the mean function).

The results of the logistic regression are shown in Table 9. The higher the functional value, so do the odds of installing solar. Conditional value (general), referring to discounts, access to solar installers, and worsening environmental conditions, is weakly significant at the 10 per cent level. Conditional factors (specific to renters) which cover the ability to lease panels while renting; landlord-tenant agreement, rebates aimed at renters and permission from body corporate were not significant.

Table 7. Logistic regression, non-adopters of solar ($n = 226$).

Variables in the equation								
	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(β)	
							Lower	Upper
Functional	0.742	0.224	11.014	1	**0.001**	2.100	1.355	3.255
Symbolic and moral	0.020	0.201	0.010	1	0.920	1.020	0.688	1.513
Epistemic	−0.105	0.231	0.204	1	0.652	0.901	0.572	1.418
Conditional (i.e. discounts)	0.484	0.146	11.030	1	**0.001**	1.623	1.220	2.160
Constant	−4.675	1.401	11.128	1	0.001	0.009		

Note[1]: Significant values ($p < 0.05$) are shown in bold, * $p < 0.10$.

Table 8. Factor analysis.

Factor	Eigenvalue	Variance	Cumulative
Factor 1 – Conditional – general	3.886	48.571	48.571
Factor 2 – Conditional – rental specific	2.133	26.659	75.230
Method		Principal component factors	
Retained factors		2	
Rotation method		Varimax	

The omnibus test showed that the model describes the data well and there is a good model fit. The result of the Hosmer and Lemeshow test was not significant with a value of .645, so the model adequately fits the data. The Pseudo R-square value (Cox and Snell) was 0.258 and the adjusted version (Nagelkerke R Square) was 0.344, which gives some indication of variation in the criterion variable. The classification table was checked, and the model correctly classified 70.4 per cent of the cases overall.

5. Discussion

The main contribution of the work is the development and testing of an adapted consumption value model to explain attitudes towards solar and installation intentions. This study examines the response of renters to measures that could address barriers to solar adoption, compares the consumption values of non-adopters with those of adopters and models the factors influencing installation intentions of non-adopters and renters. To address the first research question, descriptive data was analysed to assess the response of renters to measures that could assist in the transition towards a more equitable and sustainable energy system. Renters' response to specific conditional factors (i.e. landlord-tenant agreements, leasing, rebates aimed at renters, navigating consent from the corporate body) was positive. However, logistic regression showed that this set of circumstances did not influence the installation intentions of renters. This is surprising and several explanations are offered. Firstly, renters may aspire to home ownership and might prefer to wait and buy or lease solar on a privately owned home rather than a rental property. Secondly, respondents may be confused or unsure about the idea of landlord-tenant agreements. Thirdly, renters may be reluctant to enter third-party agreements due to a lack of trust in the landlord and anxieties about rent increases. Prior research suggests that tenants are reluctant to request energy efficiency improvements from landlords due to the risk of rental increases (Easthope 2014).

Table 9. Logistic regression, renters ($n = 111$).

Variables in the equation							95% C.I.for EXP (β)	
	β	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Functional	0.598	0.303	3.884	1	**0.049**	1.818	1.003	3.295
Symbolic and moral	0.116	0.271	0.185	1	0.667	1.123	0.661	1.910
Epistemic	−0.463	0.347	1.777	1	0.183	0.629	0.319	1.243
Conditional (1) General	0.392	0.234	2.800	1	0.094*	1.480	0.935	2.344
Conditional (2) Rental-related	0.147	0.228	0.413	1	0.521	1.158	0.740	1.812
Constant	−2.822	2.019	1.954	1	0.162	0.059		

Note[1]: Significant values ($p < 0.05$) are shown in bold, * $p < 0.10$.

To address the second research question, t-tests were used to assess differences in the perceived consumption values of adopters and non-adopters. The results showed significant differences between adopters and non-adopters in terms of functional (i.e. economic) value. This is somewhat surprising given the changes in the solar market in Australia. While government subsidies have been largely phased out, the price of solar has decreased and the installer market is competitive (Simshauser, Nelson, and Gilmore 2023). Business models such as leasing, power purchase agreements and credit facilities have emerged that mitigate the cost barrier (Ford et al. 2017; Inderberg et al. 2020). Given that cost-related factors remain an impediment to adoption, this has clear implications for policy makers and practitioners.

To address the third research question and test the hypotheses, robust analytical techniques were used to analyse the data. Table 10 summarises the findings about each consumption value.

Functional values significantly influence attitudes (along with installation intentions) confirming hypothesis 1. The results show that pragmatic values (conditional and functional), significantly influence installation intentions, confirming hypotheses 2 and 6. The results highlight the importance of idealistic values (symbolic, moral and epistemic) in cultivating positive attitudes towards rooftop solar, thus hypotheses 3, 4 and 5 were confirmed (see Table 10).

Regression analysis found that only functional and conditional values (pragmatic values) influenced the installation intentions of non-adopters. The analysis convincingly supports prior research showing the link between functional values and solar adoption (Karakaya and Sriwannawit 2015; Lau et al. 2021; Schulte et al. 2022). It is well established that the cost of solar systems is a barrier to adoption (Fauzi et al. 2023). Solar adoption is an investment decision driven by electricity prices, feed-in tariff policy and avoided energy costs (Jacksohn et al. 2019; Lan et al. 2020; Shakeel et al. 2023; Simshauser, Nelson, and Gilmore 2023). Concerning late adopters of solar, economic motivations are prioritised over environmental concerns (Palm 2018; Sigrin, Pless, and Drury 2015).

In the case of renters, it is plausible to assume that there could be non-financial motives for installing solar. Renting complicates the solar adoption decision since renters are confronted with factors outside of their control, i.e. now owning the roof or sharing the roof space with others. We offer several explanations for the non-significant findings concerning idealistic consumption values. While previous studies have affirmed a positive relationship between novelty-seeking and solar installation intentions (Schulte et al. 2022), the market for rooftop solar in Australia is mature, making epistemic value a weak predictor for the purchase of what is now a well-known and familiar product. While pro-environmental values have been shown to influence rooftop solar

Table 10. The influence of consumption values on attitudes and installation intentions.

Value		Hypotheses	Findings
Pragmatic	H1	Functional value (quality, price) positively influences attitudes towards rooftop solar	Confirmed
	H2	Functional value (quality, price) positively influences installation intentions	Confirmed
Idealistic	H3	Symbolic value positively influences attitudes towards rooftop solar	Confirmed
	H4	Moral value positively influences attitudes towards rooftop solar	Confirmed
	H5	Epistemic value positively influences attitudes towards rooftop solar	Confirmed
Pragmatic	H6	Conditional value (general) positively influences installation intentions.	Confirmed.

adopters (Simpson and Clifton 2017), it is perhaps risky to extrapolate findings from early adopters to late or non-adopters. While researchers associate symbolic value with solar installations (Horne and Familia 2021), rooftop solar is in the mature stage of its product life cycle, the range of systems has expanded to include budget brands, and the capacity of the product to act as a costly signal of status or signal of care for the fate of the planet is somewhat reduced.

Our findings have important theoretical and practical implications. First, this study is either the first, or one of the few studies, that tests consumption value theory in the context of rooftop solar adoption. It includes moral value in the framework and may be viewed as an attempt to extend current knowledge on the role of consumption values in influencing consumers' choices. It confirms the view of Sweeney and Soutar (2001) that consumption values drive purchase attitude and behaviour. The findings suggest that consumption value theory is bounded in the sense that value, as perceived by the consumer, may not be realised due to factors outside of the control of the consumer. Realising value for renters involves broader policy change, since adoption of solar is not so much a choice but is a product of housing and government policy, as noted by prior scholars (Best, Marrone, and Linnenluecke 2023; Nelson, Simshauser, and Kelley 2011). While Sheth, Newman, and Gross (1991) posits that all consumption values are independent, later applications of the theory have viewed the value dimensions as interrelated (Sweeney and Soutar 2001). The results of this study support this reasoning. The only difference between adopters and non-adopters is the value for money element and conditional value (i.e. discounts) would improve functional value for renters. Secondly, the research contributes to the literature by elaborating on the nature of conditional value for renters and developing a more sophisticated and contextualised measure of conditional value. Practically, it offers industry players and policymakers an understanding of the drivers of demand for rooftop solar given prevailing market conditions. Finally, it sheds light on renters' response to potential measures that are designed to address barriers to solar access and offer non-participants in the solar market the opportunity to realise functional value and contribute to climate change mitigation strategy.

6. Implications for policy makers and practitioners

Renewable energy is a core technology that underlies the decarbonisation of the energy system. Australia has established ambitious targets to reduce greenhouse gas emissions to 43 per cent below the 2005 level by 2030 and to achieve net zero emissions by 2050 (Australian Government 2022). To achieve these targets, promoting the uptake of renewable energy by non-adopters is important. Furthermore, renewable energy is currently the cheapest form of energy in the marketplace (Graham et al. 2022), and broadening the diffusion of rooftop solar, beyond homeowners to renters, might ease cost of living pressures and advance energy justice goals (Sovacool et al. 2019). Currently, feed-in tariffs have been reduced or phased out in many states of Australia, although small scale renewable energy certificates still exist that reduce the upfront cost of solar systems (Zhang et al. 2023). In the state of Queensland, a premium feed-in tariff was introduced in 2008 to drive solar uptake (i.e. 44 cents per kW hour). It was reduced to 8 cents per kW hour in 2012, and subsequently, the rates became determined by electricity retailers, which reduced the benefits of selling surplus solar back to the grid (Lan et al. 2020). There are also claims that utilities might curtail solar exports or refuse new connections to the grid due to congestion and technical issues (O'Shaughnessy 2022). Yet, the value of installing solar itself is not in question, and homes in Australia can still benefit financially from installing solar (Simshauser, Nelson, and Gilmore 2023). The study shows that for renters and non-adopters, the price of solar systems inhibits demand. To ensure renters are not left behind in the energy transition, policies such as low-interest loans, grants, small scale energy certificates or feed-in tariffs could be implemented to support solar purchase. Those policies should be measured and targeted, ensuring that rooftop solar is accessible to people that really need it, such as renters on low or modest incomes and single parents with dependents.

The results suggest that there is some potential to address inequities in solar access by encouraging tenants to enter into landlord-tenant agreements and share the benefits of solar. Education campaigns may be warranted so that renters and landlords can learn more about shared solar agreements. Guidelines on how to navigate consent and negotiate with landlords, property managers, and the Body Corporate could be formulated. The barriers faced by renters and landlords are well documented, and the 'split incentive' issue (Bird and Hernández 2012) will remain a challenge for policy makers. Therefore, broadening access is largely dependent on a supportive policy and regulatory landscape. Prior research had discussed the role of tax credits, rebates, energy efficiency obligations, and low-interest loans (Lang et al. 2022). Policy instruments that appeal to rational, economic motives, such as setting a modest feed-in tariff for rental properties and targeting low-interest loans at landlords to retrofit properties may be useful. The possibility for multi-apartment building residents to form an energy community exists (Beckett and Terziovski 2023; Fina et al. 2021; Roberts, Bruce, and MacGill 2019). However, regulatory support is lacking in Australia, and it is argued that apartment owners and residents will need assistance in navigating regulatory and administrative hurdles (Fina et al. 2021).

The study provides practical insights into the marketing strategies for solar retailers. The findings on the importance of functional value to renters are relevant to practitioners. It is recommended that solar retailers engage in price-based competition, emphasise budget brands and offer discounts. Furthermore, leasing and third-party ownership models may address cost-related barriers to installing solar. The recommendation for practitioners is to develop messaging that is consistent with the target market's pragmatic motives for installing solar. Respondents somewhat agreed that they would buy rooftop solar if suppliers and installers were easily available. This suggests an avenue for targeted marketing. Support for landlord-tenant agreements did not emerge as a significant factor influencing installation intentions. Specific types of solar technology, such as portable solar systems, might be appropriate for renters who do not wish to negotiate with landlords. For renters who live in units or small households, portable systems should offset some of the electricity drawn from the grid and help address inequities due to not owning roof space, the split-incentive issue, or not having enough money to pay for conventional rooftop systems. Solar manufacturers and retailers will no doubt play a crucial role in the diffusion of rooftop solar beyond the middle-class, homeowner segment. Innovative shared solar systems have emerged in recent times, such as those offered by Alume Energy (https://allumeenergy.com) which remove barriers for occupants of apartments and could help renters become more active in the energy system.

7. Limitations, future research, and conclusions

Similar to other research endeavours, this study has its limitations. Firstly, the risk of socially desirable responses is present even though respondents were urged to answer all questions honestly and anonymity was guaranteed. Secondly, a paid consumer panel was used to recruit survey respondents, which increases the potential for selection bias. Finally, the small sample size is also a limitation, although the size was adequate for statistical analysis. Future research would benefit from having a much larger sample.

Renters are not a homogenous group and the assumption that renters face significant constraints that prevent them from embracing solar needs to be tested in future studies. For instance, some renters may choose not to participate in the solar market even if the cost barrier is reduced. Given the complexity of the solar adoption decision in rental households, qualitative and mixed methods research would be useful to explore renters' and experts' perceptions of energy justice and gain deeper insights into motives, barriers, and creative ways of mitigating barriers to solar adoption. This study focused on rooftop solar adoption, but there are other options for reducing electricity consumption. Future studies could also investigate whether intentions to adopt solar are correlated with other energy investment decisions (i.e. housing retrofits, purchase of green power and energy-efficient appliances). This study showed that functional value outperforms moral value in the context of rooftop solar and future research could test whether this result could be extrapolated to other energy technologies such as community solar, battery storage and electric vehicles, and whether consumers perceive such technologies as ethical given negative externalities. Further research is needed to probe renters' attitudes towards landlord-tenant agreements. Constructs such as values, trust, familiarity, risk perceptions, and willingness to engage in collective action, could be explored as the determinants of willingness to participate in landlord-tenant agreements. Since landlords are important decision-makers in the solar adoption process, understanding their perspectives on shared solar is an avenue for future research. There is scope for more research on renters' acceptance of community solar, where multiple households buy solar from shared systems (O'Shaughnessy et al. 2023) and 'solar gardens' (i.e. community energy projects in which customers purchase panels in a solar array which is generally installed off-site) (Gai et al. 2021).

Despite the limitations of this study, the research makes important theoretical and empirical contributions to the literature since the consumption values of non-adopters and the perspectives of renters are not well understood. The chosen topic is worthy of research since the broader diffusion of rooftop solar is relevant to climate mitigation measures.

Note

1. Modern slavery has become an umbrella term that covers "a number of human rights violations and abuses including institutions and practices similar to slavery, slavery, forced labour, servitude, and human trafficking" (Jackson and Sparks 2020, 1).

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Data availability

Access to data is available on request.

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