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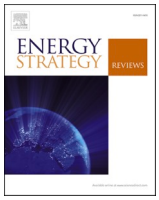

Green, guilty, and frugal: Facilitators of energy saving and the choice of energy-efficient appliances in the Australian energy market

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ABSTRACT

Empirical evidence concerning the effects of multiple identities on energy consumption is growing, but it is unclear if the strength of their influence depends on a given domain. This research contributes to the literature by using identity theory to examine routine energy-saving behavior and purchase-related behavior. The mediating role of anticipated guilt in this central relationship between identity and energy saving is also explored. The study also compares solar with non-solar households using multi-group analysis since energy saving in solar homes is underexplored. Survey data were obtained from 607 Australian respondents and analyzed using partial least squares structural equation modeling (PLS-SEM). The results show that multiple identities are linked to energy-related behaviors and mediated through anticipated guilt. Interestingly, when studying the mediated links, the results show that an environmental identity is more influential than a frugal identity in motivating the choice of energy-efficient appliances. The findings serve as an opportunity for policymakers and practitioners to 'nudge' people towards energy conservation. The study suggests that combining guilt appeals with identity is likely to be effective in motivating energy-saving behaviors in both solar and non-solar households.

1. Introduction

Electricity plays a vital role in people's lives. It supplies critical services, such as heating and cooling, and supports entertainment, nourishment, and work. Despite its significance in daily life, the electricity supply system is a major contributor to climate change. In Australia, 33 % of CO_2 emissions are attributed to the energy sector since electricity generation is mostly coal-fired [1]. The installation of solar photovoltaics, the purchase of energy-efficient appliances, and the promotion of lifestyle changes to reduce demand for energy services within households are all useful strategies to decarbonize the energy sector [2].

This study focuses on multiple identities and anticipated guilt and considers their influence on energy-saving habits and purchase behavior. While there is a large and growing literature dealing with the topic of residential energy practices, identity theory is relatively overlooked. There are gaps in the literature, such as the analysis of the indirect role of identity in energy saving and whether identities vary in the strength of their influence depending on a given domain. Previous studies have examined the role of social-psychological factors [3], human values [4], and environmental concerns [5], as well as demographic factors, such as gender [6] and income [7] in influencing energy consumption. The theory of planned behavior, with its standard constructs such as attitudes, subjective norms, and perceived behavioral control, is the most commonly used theory to explain energy-saving behavior in households [8]. Along with this theory, the values-belief norm theory provides a deep understanding of pro-environmental behaviors [9], including intentions to purchase energy-efficient appliances [10]. The well-known norm activation model, which highlights personal norms, ascriptions of responsibility, and awareness of consequences, has been applied to energy use in households [11], including solar households [12].

Identity is a fundamental construct that influences human behavior. People make choices and take actions that are aligned with their self-identity. Previous studies emphasize the role of frugal and 'green' identities in explaining energy saving and the purchase of fuel-efficient vehicles [13,14]. The role of self-identity, how individuals describe themselves, in predicting sustainable consumption is well established [15,16]. Several studies in the energy field highlight the role of a 'pro-environmental' identity in predicting energy saving [17–19] and the choice of an energy-efficient appliance [20]. While prior studies are useful, they generally do not examine the potential for trade-offs between identities. For instance, a frugal identity might strengthen one type of behavior but might weaken other types of behavior. Since an

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individual does not have just one identity only, multiple identities are produced, articulated, and contested through everyday practices [21]. Despite a solid body of evidence supporting the idea that people possess multiple identities [21–24], only a few studies have explored multiple identities in the literature on energy consumption [13]. The first contribution of this study is the focus on multiple identities, and it extends prior research by focusing on two domains: purchase-related behavior and curtailment behavior [7,25,26]. This approach is important since the question of which identity is salient at a particular time depends highly on situational cues [27]. For instance, buying an expensive, energy-rated appliance in a retail store differs from simply turning off lights when leaving a room. Identity might motivate one behavior and not the other [27]; according to Whitmarsh and O'Neill situational factors "can constrain opportunities for a green self-identity to be translated into effective pro-environmental behavior" [18]. However, it is recognized that individuals are typically motivated to act consistently [28]. By exploring the role of identity in activating energy saving in two domains, this work contributes to an ongoing debate in the literature on the stability of identity in the face of situational constraints.

This study focuses on anticipated guilt and the strength of its influence in two domains. This is important since the influence of anticipated negative emotions on behavior may vary depending on the type of behavior, such as whether the behavior requires effort or is linked to negative consequences [29]. It is posited that arousing emotions can motivate green behavior, but it depends on whether the behavior is high-impact or low-impact [30]. Scholars assert that guilt is related to identity [31], particularly moral identity [32]. The literature shows the relevance of emotion, including guilt, as a determinant of energy-related behavior and as a lever for behavioral change [33,34]. The role of guilt as a mediator of self-identity in influencing energy saving is underexplored in the literature [9,35], thus mediation analysis is another contribution of this study to the literature. A better understanding of the mechanism by which guilt works is essential to marketing campaigns that 'nudge' people to reduce energy consumption. A social science perspective complements the work on technology-based solutions to energy management. As stated by Fehr-Duda and Fehr, "Nudges — such as commitments to save or invest future income increases — will be crucial to changing behavior and should complement conventional policies" [36].

The final contribution of this study is the focus on a mature renewable energy market. Australia is selected for study because it is a country with one of the highest rates of rooftop solar adoption in the world [37]. The Australian government put in place several policies to support the adoption of solar photovoltaic (PV), such as the creation of a market for renewable energy certificates, the introduction of capital subsidies, and premium feed-in tariffs. Although these policies were criticized on energy justice grounds, they were highly effective in boosting installed capacity [38,39]. Over 30 % of Australian free-standing homes are powered by solar, and an estimated 15 % of total electricity demand is met by solar energy, as of the end of 2022 [40]. There is little research on the energy-saving habits of households that are consumers, but also producers, of electricity, and labeled 'prosumers' [12]. The study of solar households is important since people who have installed solar often view solar as 'free electricity' [41] and may be less motivated to buy energy-efficient appliances and save electricity, due to the solar rebound effect (which refers to the increase in energy use that follows efficiency improvements) or moral licensing effects (which means that people are less likely to behave morally after engaging in prior moral action) [42]. In addition, solar households may feel that it is not worthwhile to save energy in the home, since it may yield only minor cost savings. Much of the research on energy-efficient appliance purchasing predates the rapid adoption of rooftop solar [43,44], or focuses on developing markets such as Malaysia [45]. On the empirical front, this study provides some much-needed evidence on the energy choices of solar households, based on an advanced statistical technique, multi-group analysis [46].

Based on the aforementioned literature, this study aims to examine the influence of multiple identities and anticipated guilt on energy-saving intentions and behaviors in Australian households. The research questions are as follows.

1) What is the direct, and indirect, influence of pro-environmental and frugal identities on energy-saving behavior?
2) Are multiple identities and energy-saving intentions mediated by anticipated guilt?
3) Does the influential role of identity and guilt vary depending on a given domain, such as consumption-oriented or purchase-oriented behavior?
4) Is the influence of identity and guilt on energy-saving intentions and behavior similar across solar and non-solar households?

A conceptual framework was developed to fill a gap in the literature, and robust analytical techniques were used. Practically, the work is useful for solar retailers and policymakers since it helps inform energy policy and the development of social marketing campaigns. The findings have implications for Australia and other countries characterized by a strong uptake of rooftop solar.

The remainder of this manuscript is organized as follows: section 2 presents an overview of the literature, and the hypotheses and theoretical framework are described; section 3 describes the research design and the approach to data analysis. In section 4, the results of the study are presented. In section 5, the significance of the results is discussed. Section 6 concludes with policy implications, limitations, and suggestions for future studies.

2. Literature review and hypotheses development

2.1. The role of self-identity and multiple identities in influencing behavior

Prior research shows that identity comes into play in driving pro-environmental behavior [23]. A person's identity – 'who am I?' –is described as a set of cognitive representations [47] that rely on self-reflection [48]. Identity theory was originally formulated by Stryker [49], who proposed that identities exist in a hierarchy of salience. Identity is derived from symbolic interaction theory, which takes the view that human beings are actors performing a role in social contexts [49]. Stryker defines identity as "self-concepts" or "cognitive aspects of the selves" [50]. Reed et al. define identity as any category label that offers a clear picture of what a person in that category looks like, thinks, feels, and does [51]. The concept of an identity fits with self-perception theory [52], which posits that people assess themselves according to their actions. Identities are intertwined with emotional profiles since specific emotions are linked to the enactment of an identity [53]. Although people generally behave in a way that is aligned with their self-identity [23], there is potential for identity conflict. Identities are sensitive to situational cues, and they often drive different decisions [27]. A recent literature review also supports the notion that people have multiple identities and identity can be salient depending on the context [54]. Thus, self-identity could have a facilitating effect on one type of behavior but the opposite effect on other types of behavior.

Scholars have identified specific identities that affect sustainable patterns of behavior. These include a connectedness to nature, a place identity and a social identity [16], a recycling identity [15,55], an organic food identity [56], and a good provider identity [57]. It is well established that people possess multiple identities and not just one [22]. Despite a solid body of evidence showing that people hold multiple identities, only a few studies have included multiple identities in models of pro-environmental behavior [23]. More recently, scholars have explored multiple identities in the area of car use [58], meat consumption, such as healthy and meat-eating identities [59], and environmental, and flexitarian identities [60]. Environmental and frugal identities have been well explored in prior energy literature [13,14].

Thøgersen (2018) found that energy saving is strongly influenced by green and frugal identities [13], and while the study makes a significant contribution to the literature, it did not consider the interplay between multiple identities and emotions.

2.2. The role of an environmental identity in influencing behavior

An environmental identity refers to the extent to which people perceive themselves as an environmentally friendly person [61]. Prior research demonstrates that incorporating an environmental identity in behavioral frameworks helps predict ethical behavior [62]. It is predicted that if an individual has empathy with nature and is concerned about environmental damage, then such a person will adjust their consumption habits. An environmental self-identity is reported to predict car use [58] and climate action [16,63]. The construct is a robust and stable predictor of behavior and has been validated across many cultures [64]. Several researchers have improved the explanatory power of the theory of planned behavior (TPB) by including this construct in the model [65]. An environmental self-identity affects attitudes towards the use of air conditioners [66] and directly predicts domestic energy conservation [13,18], rooftop solar installation [67], and green energy adoption [61]. Therefore, the following hypothesis is formulated.

H1. An environmental self-identity positively influences energy-saving intentions.

2.3. The role of a frugal identity in influencing behavior

A frugal identity is associated with a positive attitude towards saving, and not wasting, resources [68]. It underpins all kinds of waste reduction actions [23] and is linked to low-carbon lifestyles [69]. Frugality reflects a mindset of saving money, exercising self-restraint and discipline, and avoiding excessive consumption [70]. It is similar to the 'sufficiency' motivation, which refers to a perceived need for lifestyle changes to reduce energy consumption [71]. Frugality often has a moral dimension, such as a motive to preserve the environment or benefit distant strangers. Furthermore, a frugal identity is similar to, but distinct from, thriftiness, since thriftiness is the art of doing more (consumption) with less (money) and it could result in increased consumption, such as buying second-hand items or discounted items [72]. It is proposed that frugality captures a personality trait and is influenced by socio-cultural values; it is significantly and positively related to the intention to buy electric vehicles [14]. Frugal attitudes also influence intentions to use less electricity [73] particularly among low-income households [74]. Closely related to the concept of a frugal identity is bill consciousness. Bill consciousness refers to the level of attention given to bills and the concern about rising electricity bills, and it is found to be a significant motivation for conserving electricity ([74–77]. Electricity bills are a concern for Australians because of the sharp increase in energy prices in recent times [78]. Energy-efficient products have higher prices than less efficient products, but in the long run, consumers can save on electricity expenses [79]. In line with the aforementioned studies, it is hypothesized.

H2. A frugal identity positively influences energy-saving intentions.

2.4. The role of guilt and anticipated guilt in influencing behavior

Guilt is an internal feeling of responsibility for something a person has done, and is defined as a negative and unpleasant state that occurs when one's behavior (or intentions) contradicts one's moral standards [80]. There are three types of guilt: reactive guilt (which results from an explicit act that has violated a person's moral beliefs), existential guilt (which results from having a privileged life and comparing one's well-being to the well-being of others), and anticipatory guilt [81]. Anticipatory guilt is a prediction about future emotions, and it occurs when consumers imagine themselves doing something wrong and know that they will feel guilty [82]. Since anticipatory guilt relates to the future, it enables a person to avoid violating a moral or social standard and take guilt-reducing actions [83]. Guilt appeals are commonly used in advertising campaigns since they provide scope for behavioral change [81].

Guilt, as an emotion, plays a crucial role in decision-making, and it is speculated that it carries as much weight as cognitive factors and self-interest (i.e., the desire to save money) [33]. The impact of guilt on behavior can be explained by appraisal theory. This theory holds that affective and cognitive processes are interconnected. A strong emotional reaction to an object or situation clearly shows its relevance for an individual, and emotions hold up a mirror to a person's needs, values, and concerns [84]. The theory of emotion regulation posits that people are inclined to avoid negative feelings (e.g., guilt, regret, sadness) and seek out positive feelings (e.g., elation, happiness, awe) [85]. The literature also shows that anticipated guilt plays a role in altruistic behavior due to a desire to protect one's self-concept or bolster self-esteem, so the motive for helping can be a selfish one [86]. Scholars suggest that guilt is related to identity [31] and ethical brand choice is motivated by guilt and a moral identity [32].

The literature on guilt is extensive, and it has been studied in a variety of contexts. Studies have found that the intention to engage in prosocial behavior, such as recycling or low-carbon consumption, is positively and directly influenced by anticipated guilt [87–90]. A recent study found that anticipated guilt (rather than anticipated pride) plays an important role as a moderator of attitudes and the intention to purchase LED (light emitting diode) lights [91]. Other studies show that guilt (and pride) contribute to sustainable consumption, and perceived consumer effectiveness mediates the relationship between emotions and sustainable consumption [92]. A Chinese study found that the significant (positive) relationship between guilt and ethical consumption is (negatively) moderated by an interdependent self-construal [93].

Anticipated guilt is positioned as a mediating construct in this study for several reasons. Prior research has found that personal norms, using a scale that includes guilt, were a mediator of an environmental self-identity and a range of pro-environmental behaviors [9,35]. Anticipated guilt is found to play a mediating role between ethical beliefs and intentions [89]; between environmental concern and intentions to recycle [87]; between national identity and intentions to buy domestic goods [94], and between moral foundations and reduced consumption [58]. Based on the aforementioned studies, the following hypothesis is formulated.

H3. Anticipated guilt mediates self-identity (environmental and frugal) and energy-saving intentions.

2.5. Energy-related behaviors

Household residents can save energy in two main ways: firstly, through the careful use of energy daily, typically labeled 'curtailment behavior', and secondly through purchase behavior [7,25,95]. This study uses both forms of energy conservation as dependent variables. Examples of energy curtailment include adjusting the settings of an air conditioner, closing windows, and turning off lights after leaving a room [96]. As noted by Stern (1992), everyday actions might appear insignificant, but when aggregated across millions of people, they matter a great deal [97]. From an energy systems perspective, it is much cheaper to increase the energy efficiency of homes (and businesses, industry, and agriculture) rather than generate and distribute more energy to cover the inefficiency. Curtailment behavior is designated as habitual behavior and is thus difficult to modify [98–100]. Promoting a reduction in energy consumption, or sufficiency in lifestyles, is challenging [71], particularly since saving energy implies sacrifice [97]. Since human behavior is embedded in an 'energy culture', people's actions are often constrained by the social and material context [101].

Efficient household appliances are a key source of energy

conservation. The International Energy Agency (IEA) describes energy efficiency as 'the first fuel of a sustainable global energy system' since it provides some of the quickest and most cost-effective CO^2 mitigation options [102]. Direct investment in efficiency by a manufacturer avoids reliance on behavioral nudges and consumer engagement, i.e. it takes the burden off consumers and instead places responsibility on the manufacturer. In Australia, the Energy Rating Label is part of the Federal Government's Equipment Energy Efficiency (E3) Program, which allows consumers to compare the energy efficiency and running costs of appliances. Energy labeling was introduced in the late 1980s, and it covers major appliance groups such as fridges, air conditioners, and dishwashers [103]. Similar to other non-European countries, there are no tax rebates given by the government for the purchase of energy-efficient appliances [45]. Major appliances are bought infrequently, and their replacement can take years if not decades [43]. The purchase of energy-efficient appliances often involves a conflict between societal interest and self-interest [104]. Not only do consumers have to pay a higher price, but they need to expend extra time and effort in gathering information and evaluating different brands [105].

The theory of planned behavior [106] has a significant following in the social sciences and a plethora of studies have used the standard constructs of attitudes, subjective norms, and perceived behavioral control to predict intentions and behavior in the environmental domain [107]. The theory has been applied to residential energy use [8] and energy conservation in organizational settings [108]. Intentions refer to the degree to which a person has formulated conscious plans to perform a specific behavior [106]. In line with the literature, the following hypotheses are proposed.

H4a. Energy-saving intentions positively influence energy curtailment behavior.

H4b. Energy-saving intentions positively influence the willingness to buy energy-efficient (labeled) appliances.

2.6. Rooftop solar adoption

Studies on rooftop solar adoption have revealed several explanations for installing solar, including consumer innovativeness [109], an affinity for technology [110], and self-sufficiency (autarky) motives [111]. Self-oriented or personal gain motives, notably a desire to cut the electricity bill, are highly relevant [111]. Research shows that environmental motives are consistently associated with rooftop solar adoption [39,110,112]. Yet, it is still unclear if solar households use more, or less, electricity after installing rooftop solar. While energy-saving intentions may drive curtailment and investment behaviors, which are assumed to be complimentary, such behaviors may also be substitutable, particularly in solar homes. Energy economists use the term 'solar rebound' to show how consumers often consume additional electricity following solar adoption [113]. This occurs for various reasons, i.e., a rational reaction to a reduced electricity bill, the co-adoption of complementary technologies such as electric vehicles, and psychological drivers such as the rebound or moral licensing effect [114]. While energy-saving intentions may drive curtailment and investment in energy efficient appliances, which are assumed to be complimentary behaviors, such behaviors may also be substitutable, particularly in solar homesResearch also shows that solar production increases awareness of the energy system and interest in the cost of electricity [110], and also increases investment in more energy-efficient appliances [41]. Research shows that self-identity interacts with past buyer behavior [115] and since people are motivated to act in identity-congruent ways [23,28], it is likely that people will remain true to their identity and continue to save energy, irrespective of whether they have adopted solar or not. Therefore, the following hypothesis is formulated.

H5. The influence of multiple identities and guilt on energy-saving intentions and behavior is similar across solar and non-solar households.

2.7. Control variables: demographic variables

Socio-demographic variables play an important role in energy saving [7]. For instance, it has been found that medium to high-income households are less inclined to save energy daily than lower-income groups [7,17,116]. In addition, housing wealth has a significant, negative effect on residential energy consumption [117]. Consequently, the role of income in influencing energy-saving intentions was used in the model as a control variable.

Fig. 1 shows the conceptual framework for this study.

3. Methods

3.1. Measures

The measures for the key constructs were informed by the literature and are reported in Table 1. The frugal identity scale was informed by prior research [74] and the environmental identity scale was used in previous studies [18,118]. The scale for anticipated guilt was taken from the work of Huneckee et al. [119] and Elgaaied [87]. It mirrors the scale used by Floress et al. [35] who sought to measure guilt for not taking action to reduce impacts related to energy, food, and water. Two dependent variables were chosen, energy curtailment, which refers to repeated, low-cost actions taken to save energy, and choice of energy-efficient appliances, which are generally once-off, high-cost actions [116]. Several energy curtailment practices were chosen for the dependent variable [13,120,121]. Items were carefully selected to reflect the climate and social conditions. For instance, the targeted population lives in an area characterized by hot and humid summers, and the use of an air conditioner is a necessity rather than a luxury. The item 'opening and closing the refrigerator door' was included in the energy curtailment scale since unpaid work activities are performed by both males and females, and Australia is a high-income country. The practices were measured using a frequency scale, ranging from 'almost never' to 'almost always'. The survey included questions on socio-demographic variables since these variables drive energy-saving [7]. Data on gender, age, income, educational level, occupation, and household size were collected. Multiple item scales were used and most of the constructs were measured on a seven-point scale with anchor points 1 = strongly disagree to 7 = strongly agree. A pilot study (n = 69) was undertaken to test the measures and improve the design of the final survey.

3.2. Data collection, sampling, and participants

Ethical approval was granted by a Human Ethics Committee (H6601) before the commencement of the study. To recruit respondents for the study, an online panel, maintained by Qualtrics, was used. Respondents received the standard remuneration from the research company after submitting their responses. Purposive sampling was used so that there would be diversity in terms of income and education. The geographic location was the State of Queensland, Australia. The rate of rooftop solar adoption is higher than in most other States in Australia, due to supportive government policies, such as the premium feed-in tariff policy, as well as the climate which leads to abundant solar resources [125,126]. More than one-third of homes (39 %) in the State have installed rooftop solar technology [38], so it was easy to capture solar households and meet an inclusion criterion. Exclusion criteria consisted of people under the age of 18 and those who had no responsibility for paying the electricity bill. Data was collected in 2022. The sample was screened for incomplete and low-quality responses and a large sample size of 607 was achieved. The sample size exceeds the recommended rule of thumb, that is, the 'ten times rule' for models, a stipulation that the sample size should be at least ten times the number of paths in the structural model [127].

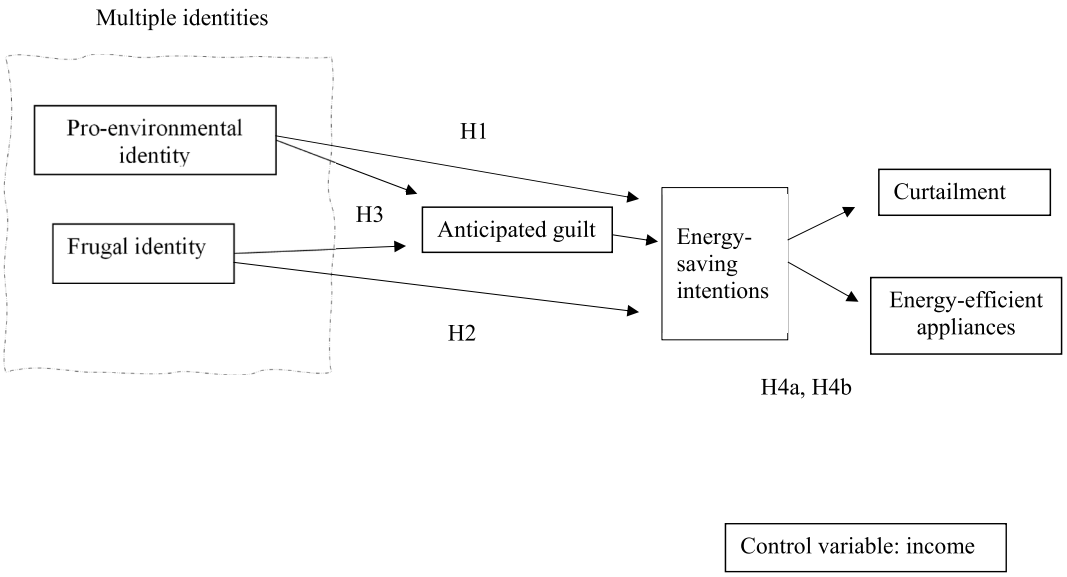

Fig. 1. Proposed conceptual framework: multiple identities, guilt, and behavior.

3.3. Data analysis and statistical techniques

Partial Least Squares Structural Equation Modeling (PLS-SEM) was used to analyze the data for several reasons. This technique is similar to covariance-based, structural equation modeling (CB- SEM) as it enables a hypothesized model, an entire system of variables with complex relationships, to be tested simultaneously. Several aspects of PLS-SEM set it apart from CB-SEM [46]. It lends itself to exploratory data analysis and facilitates theory building, particularly when drawing on a hypothesized model that enjoys solid theoretical support. In contrast, CB-SEM takes a confirmatory approach to data analysis. Concerning small sample sizes, the PLS-SEM approach achieves greater statistical power than CB-SEM. It works well with non-normal data [46], whereas an important assumption associated with CB-SEM is that the data have a multivariate normal distribution [128]. PLS-SEM can also incorporate several dependent variables, which is useful for this study. The technique has been used before in studies of energy behavior [129]. Another feature of PLS-SEM is that it treats theoretical concepts (such as self-identity and frugality) as 'latent constructs', meaning that the constructs are not directly observable and must be measured with scale items. A reflective measurement model was chosen for this study since reflective constructs have a long tradition in the social sciences [46]. A reflective model is based on the idea that latent constructs cause specific measured indicators, and all reflective indicators are interchangeable [46].

3.4. Common method bias

Common method bias can easily occur in research, particularly when data for the independent and dependent variables are obtained from the same person in the same survey, and thus the relationship between one construct and another might be inflated [130]. Common method bias was addressed using procedural remedies, as recommended by MacKenzie and Podsakoff, such as ensuring the wording of scale items was clear and unambiguous and separating the independent and dependent variables [131]. Several techniques were adopted to reduce the social desirability bias. Respondents were assured that their responses would be anonymous, were asked to provide honest responses, and were told that there were no right or wrong responses. A post-hoc statistical procedure, Harman's single-factor test, was also used. A factor analysis was undertaken, and the first factor accounted for 38 % of the variance; this value is well below the threshold of 50 % [132], showing that common method bias is not a major concern in this study. Since the shortcomings of Harman's test have been highlighted [130], another statistical technique was used to identify common method bias. For PLS-SEM, Hair et al. recommend identifying the variance inflation factors (VIF) and checking for multicollinearity when estimating the path analysis [46]. This step was undertaken, and all of the Variance Inflation Factor (VIF) values were below 5, which indicates that there is no strong indication of common method bias.

4. Results

The next section of the paper summarises the key findings from the survey.

4.1. Summary statistics

Table 2 shows the profile of the sample. There were more females than males in the sample. A high percentage of respondents were middle-aged and senior. Regarding the level of educational attainment, 27 % of respondents had a bachelor's degree, which is close to the national average of 32 % [133]. Household income varied: a small percentage (13.6 %) were very low-income households, such as less than AU$30,000. Approximately half of the sample were in the lower income bracket, AU$30,000 to AU$64,999. One-fifth of the sample was in the middle-income bracket, AU$65,000 to AU$99,999, and around a quarter were in the higher income bracket (greater than AU$100,000).

4.2. Evaluation of the measurement model

Developing a structural model consists of two main stages. The first stage, the measurement model stage, involves assessing reliability and validity, and the second stage, the structural model stage, entails testing the hypotheses and assessing the results [46].

Table 3 displays the results of the reliability and validity tests. Cronbach's Alpha values range from 0.69 to 0.92 and are close to, or well above, the recommended value of 0.7. The Rho A values are higher than 0.7 and less than 1, although one value is borderline, at 0.69. The composite reliability values exceed the 0.7 threshold value [134]. The average variance extracted (AVE) values surpass the threshold value of 0.5 [134]. The values of the factor loadings (i.e. the extent to which each item within a factor correlates with the rest within the factor) are satisfactory, meeting the threshold value, that is, greater than 0.7 [135]. Two items load on 0.68 and 0.66, related to energy curtailment

Table 1
Measurement items.

Construct and definition	Measurement items	Source
Intentions: the likelihood that households will hold intentions to save electricity.	I intend to conserve electricity in the future.	Ajzen (1991) [106]
	I will conserve electricity in the future.[a]	Wang et al. (2019) [79]
	I am ready to conserve electricity.	Neves and Oliveira (2021) [20]
Energy curtailment: behaviors that save energy.	Turn off lights when going out, even for a short time.	Gaspar et al. (2017) [120]
	Reduce the use of the air conditioner, by opening the windows, using fans etc.	Nachreiner and Matthies (2016) [121]
	Unplug, or switch off, the main power of an electrical device when not using it.	Wittenberg, Blöbaum and Mathies (2018) [12]
	Shorten the duration that the fridge door is kept open.	
Choice of energy-efficient appliance: the degree to which the energy-efficient label is important to the consumer in the buying decision.	The energy label is important in the decision to buy an appliance.	Wang et al. (2019) [79]
	When I buy an appliance, I pay attention to the energy label.	
	I am more willing to buy an appliance with an efficient energy class.	
	I have purchased energy-efficient electrical appliances in the past few years.	
An environmental identity: the extent to which a person identifies as being an environmentally friendly person.	I think of myself as someone who is concerned about environmental issues.	Nguyen, Lobo and Greenland (2016) [122]
	I see myself as being an environmentally friendly consumer.	Barbarossa and de Pelsmacker (2016) [118]
	I would be embarrassed not to be seen as having an environmentally friendly lifestyle.*	Whitmarsh and O'Neill, (2010) [18]
A frugal identity: the degree of interest in avoiding waste, living a disciplined life, and saving money.	There are things I resist buying today so that I can save for tomorrow.	Seebauer (2018) [123]
	When shopping, I discipline myself to get the most from my money.	Goldsmith et al. (2014) [124]
	I lead a simple and modest life although I could afford a higher standard of living.[a]	
Anticipated guilt: the degree to which a person feels that wasting electricity would arouse negative emotions in the future such as guilt.	I would feel guilty if I did not save electricity on a daily basis.	Huneckee et al. (2001) [119]
	My conscience would bother me if I did not save electricity on a daily basis.	Elgaaied (2012) [87]
	I would have a bad conscience toward the environment if I did not save electricity on a daily basis.	Floress et al. (2022) [35]

Note.
[a] excluded from PLS-SEM analysis due to low reliability.

behaviors, but since the values are close to 0.7, there is little cause for concern.

Discriminant validity for the constructs was established using the heterotrait-monotrait (HTMT) ratio and the Fornell-Larcker ratio [46]. The HTMT test is seen as superior to the Fornell-Larcher test for detecting discriminant validity and is a measure of the similarity between latent variables [136]. The results of the HTMT test are shown in Table 4, and the values are satisfactory, since no value is close to 1, and all are below the recommended threshold of 0.85 or 0.90 [135]. The results of the Fornell-Larcker test are shown in Table 5, and the results indicate no cause for concern.

Table 2
Description of sample (n = 609).

Item		n	%
Gender	Male	238	39.1
	Female	371	60.9
Age	18–25	30	4.9
	26–35 years	71	11.7
	36–45 years	82	13.5
	46–55 years	80	13.1
	56–65 years	114	18.7
	66–75 years	161	26.4
	76 years or over	71	11.7
Education	Primary school, no qualification	34	5.6
	High school certificate	150	24.6
	Trade or vocational qualification	105	17.2
	Diploma of advanced diploma	99	16.3
	Bachelor's degree	166	27.3
	Post-graduate degree	55	9.0
Employment	A student	4	0.7
	Employed	252	41.4
	Self-employed	38	6.2
	Unemployed	29	4.8
	Looking after home or family	49	8.0
	Retired	237	38.9
Income group	Less than $30,000	83	13.6
	$30,000 to $64,999	176	28.9
	$65,000 to $99,999	133	21.8
	$100,000 to $149,000	94	15.4
	$150,000 to $199,000	50	8.2
	$200,000 to $249,000	22	3.6
	$250,000 to $299,999	7	1.1
	More than $300,000	5	0.8
Income: subjective	Finding it very difficult to live on my current income	29	4.8
	Finding it difficult to live on current income	68	11.2
	Coping on current income	250	41.1
	Living comfortably on current income	206	33.8
	Living very comfortably on current income	56	9.2
Household size	1 person household	103	16.9
	2 persons	288	47.3
	3 persons	112	18.4
	4 persons	70	11.5
	5 persons or more	36	5.9
Solar adoption	Yes	307	50.4
	No	302	49.6

4.3. Evaluation of the structural model

An important stage in analyzing the output of the PLS-SEM model consists of the evaluation of the structural model. Significance testing requires researchers to use the bootstrapping technique and the test statistic follows a t distribution, based on the null hypothesis of no effect [137]. The bootstrapping procedure, with 5000 subsamples, was used in this study. Table 6 reports the results of the path analysis, the hypotheses testing, the multi-collinearity statistics (VIF), the f^2 values, and the bias-corrected confidence intervals. Fig. 2 displays the model and the t values generated by SmartPLS software. Income was used as a control variable and was not found to be significant in predicting energy-saving intentions.

About the individual path coefficients, the closer the estimated coefficients are to 0, the weaker the relationships [46]. As shown in the table, the path coefficients for the relationships range from 0.29 to 0.59 and all of the hypothesized relationships are significant ($p < 0.05$). The strongest (positive) relationships are found between energy-saving intentions and willingness to buy energy-efficient appliances ($t = 19.357$), a pro-environmental self-identity and guilt ($t = 9.929$), and energy-saving intentions and energy curtailment behaviors ($t = 8.613$). While the two identities are significant, the significant relationship between a pro-environmental identity and energy-saving ($t = 7.217$) is stronger than that of a frugal identity and energy-saving ($t = 5.970$).

Table 3
Construct reliability and validity tests.

Construct	Cronbach's Alpha	Rho A	Composite Reliability	Average Variance Extracted	Outer Loadings	HTMT (>0.85?)
Anticipated guilt	0.908	0.909	0.942	0.845	0.919	Yes
					0.912	
					0.926	
Energy curtailment behaviors	0.712	0.755	0.820	0.534	0.682	Yes
					0.760	
					0.667	
					0.809	
Energy-efficient appliances	0.892	0.901	0.926	0.758	0.889	Yes
					0.925	
					0.888	
					0.775	
Energy-saving intentions	0.901	0.902	0.953	0.910	0.955	Yes
					0.953	
Frugal identity	0.690	0.692	0.866	0.763	0.878	Yes
					0.870	
Pro-environmental identity	0.926	0.926	0.964	0.931	0.965	Yes
					0.965	

Table 4
The Heterotrait-Monotrait (HTMT) test.

	Anticipated Guilt	Energy curtailment behaviors	Energy-efficient appliances	Energy- saving intentions	Frugal identity	Pro-environmental Identity
Anticipated Guilt						
Energy curtailment behaviors	0.244					
Energy-efficient appliances	0.481	0.388				
Energy-saving intentions	0.630	0.395	0.663			
Frugal identity	0.565	0.398	0.478	0.610		
Pro-environmental identity	0.579	0.245	0.579	0.624	0.474	

Table 5
The Fornell-Larcher test.

	Anticipated Guilt	Energy curtailment behaviors	Energy-efficient appliances	Energy-saving intentions	Frugal identity	Pro-environmental Identity
Anticipated Guilt	0.919					
Energy curtailment behaviors	0.200	0.732				
Energy-efficient appliances	0.435	0.316	0.871			
Energy-saving intentions	0.570	0.324	0.594	0.954		
Frugal identity	0.447	0.282	0.375	0.481	0.874	
Pro-environmental identity	0.533	0.204	0.526	0.570	0.378	0.965

Table 6
Structural estimates: hypotheses testing (bootstrapping).

Path: IV to DV	SD	β coefficient	t values	p values	CI lower	CI upper	VIF (inner)	f square
Anticipated guilt - > Energy-saving intentions	0.047	0.296	6.358	0.000	0.207	0.391	1.550	0.106
Energy-saving intentions - > Energy curtailment behaviors	0.038	0.324	8.613	0.000	0.247	0.396	1.000	0.117
Energy-saving intentions - > Energy-efficient appliances	0.031	0.594	19.357	0.000	0.530	0.649	1.000	0.546
Frugal identity - > Anticipated guilt	0.043	0.287	6.672	0.000	0.200	0.369	1.167	0.109
Frugal identity - > Energy-saving intentions	0.038	0.226	5.970	0.000	0.151	0.299	1.295	0.074
Pro-environmental identity - > Anticipated guilt	0.043	0.425	9.929	0.000	0.340	0.505	1.167	0.239
Pro-environmental identity - > Energy-saving intentions	0.045	0.324	7.217	0.000	0.231	0.406	1.450	0.136

Note: The critical t values around 1.65, 1.96, and 2.58 are considered with the significance level of 0.10, 0.05, and 0.01 respectively (two-tailed test).

Effect size was calculated to show the relative impact of predictor constructs on the R^2 value and the f^2 values are shown in Table 5. The f^2 value assesses how strongly one exogenous construct contributes to explaining a certain endogenous construct in terms of R^2. Guidelines for assessing f^2 are that values of 0.02, 0.15, and 0.35, respectively, represent small, medium, and large effects [138]. Large effects were found for the energy-saving intentions and energy-efficient appliance relationship (0.546) and medium effects for the pro-environmental identity and guilt relationship (0.239).

Mediation identifies indirect relationships between constructs and occurs when a third mediator construct intervenes between two other related constructs [46]. Mediation analysis was conducted using the SmartPLS bootstrapping technique. Table 7 reports the specific indirect effects. The results show that mediation occurs through constructs such

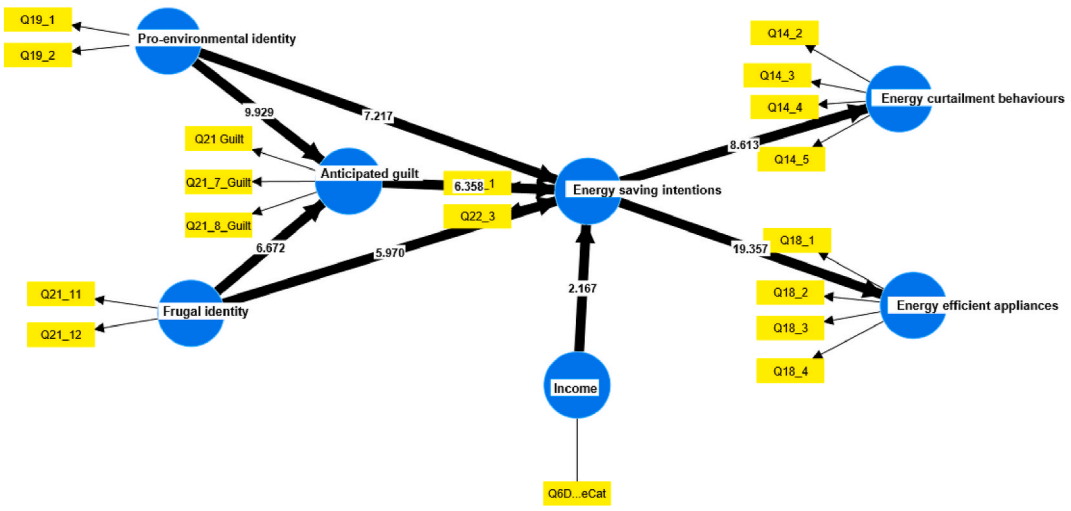

Fig. 2. Multiple identities, anticipated guilt, and energy-related behaviors.

Table 7
Mediation results: specific indirect effects (two-tailed test).

Mediation path analysis	Path coefficient (β)	t values	p values
Frugal identity - > Anticipated guilt - > Energy-saving intentions	0.085	4.657	0.000
Frugal identity - > Anticipated guilt - > Energy-saving intentions - > Energy-efficient appliances	0.050	4.456	0.000
Pro-environmental identity - > Anticipated guilt - > Energy- saving intentions - > Energy-efficient appliances	0.075	4.919	0.000
Frugal identity - > Energy-saving intentions - > Energy-efficient appliances	0.134	5.576	0.000
Frugal identity - > Energy-saving intentions - > Energy curtailment behaviors	0.073	4.559	0.000
Anticipated guilt - > Energy-saving intentions - > Energy curtailment behaviors	0.096	5.128	0.000
Pro-environmental identity - > Energy-saving intentions - > Energy-efficient appliances	0.193	6.372	0.000
Frugal identity - > Anticipated guilt - > Energy-saving intentions - > Energy curtailment behaviors	0.027	3.960	0.000
Anticipated guilt - > Energy-saving intentions - > Energy-efficient appliances	0.176	6.097	0.000
Pro-environmental identity - > Anticipated guilt - > Energy-saving intentions - > Energy curtailment behaviors	0.041	4.379	0.000
Pro-environmental identity - > Energy-saving intentions - > Energy curtailment behaviors	0.105	5.470	0.000

as anticipated guilt and energy-saving intentions and all of the relationships are significant at the 0.05 level. Based on the t values, the strongest relationship is the 'pro-environmental identity-energy saving intentions-energy efficient appliances' (t = 6.372), followed by the 'anticipated guilt-energy saving intentions-energy efficient appliances' relationship (t = 0.6.097). Mediation can be classified as complementary since the direct and indirect effects are significant and point in the same direction.

4.4. Explanatory power of the model and the goodness-of-fit measure

Another test was necessary to complete an assessment of the structural model, namely the R-square (R^2) measure, which is a measure of explained variance. The guidelines of Hair et al. are that satisfactory R^2 values can range from 0.10 to 0.65, depending on the nature of the study and the literature [46]. The R^2 value for the constructs are as follows: anticipated guilt is 0.35; intentions to save energy is 0.47; willingness to buy energy-efficient appliances is 0.35 and energy curtailment behaviors is 0.10. The results confirm that anticipated guilt and identity explain energy-related behavior.

A standardized root mean square residual (SRMR) is an indicator that captures the goodness of model fit, and the recommended threshold value is 0.08 [135]. The SRMR of this study has a value of 0.05 (below the 0.08 threshold) which suggests that the model is well-suited for explaining energy-saving intentions and purchase behavior [46].

4.5. Comparison of models

Exploring different configurations of a model that might explain energy curtailment behavior is a crucial step in advancing knowledge. The results are presented in the supplementary data section. Fig. A1 shows the alternative model under consideration. This model is simpler than the original model since it has one mediator only and omits the energy saving intentions construct. To compare the models, guidelines from the literature were followed [46]. Table A1 shows the path coefficients and their significance, and as expected, the three driver constructs explain the two types of energy-related behaviors. Table A2 shows the results of the statistical tests, such as R^2, adjusted R^2 and the Bayesian Information Criterion (BIC) values. The original model has relatively larger R^2 and adjusted R^2 values, and this means (at least in the current sample) that the original model with the two mediators provides a marginally better explanation of energy saving behaviors. However, the alternative model has relatively lower BIC values, showing that this model would be the preferred option. Since both models do a good job of describing the data, the final choice of model was guided primarily on the basis of theoretical argument. Ajzen's (1991) highly cited theory of planned behavior emphasizes that intentions drive behavior, thus the original model represents the best-case scenario [106].

4.6. Multi-group analysis: comparison of solar and non-solar households

The guidelines from the literature were followed about undertaking multi-group analysis (MGA), such as checking that the groups are of relatively equal size to use the permutation test, and ensuring that measurement invariance of composite models (MICOM) is established [46]. Partial measurement invariance was confirmed, which means that there are solar-specific response biases that are caused by influences other than variations in the underlying factor. This result still permits the comparison of the path coefficient estimates across the two groups. No significant differences were observed for the path coefficients between the two groups. The analysis is presented as supplementary data

(Tables A3 and A4, Fig. A2 and Fig. A3). The hypothesis that there would be no significant differences between solar and non-solar households was confirmed.

5. Discussion

This study is theoretically important since it examines the role of multiple identities and anticipated guilt in influencing energy-saving intentions in two domains: routine energy-saving behavior in the home and the choice of energy-efficient appliances outside of the home. Although previous studies have analyzed multiple identities in the context of energy saving, they tend to focus on one type of behavior. In addition, they do not treat anticipated guilt as a mediator of multiple identities and energy-saving intentions, leaving a gap in the literature. The next section discusses the findings and presents the theoretical implications.

5.1. Discussion of findings and theoretical implications

The first objective of this study was to test the hypothesis that multiple identities are positively related to energy-saving intentions. Hypothesis 1, an environmental self-identity positively influences energy-saving intentions, was confirmed. This finding is congruent with prior research showing that it explains a broad range of pro-environmental [18] and ethical behaviors [62]. Recent studies show a relationship between an environmental identity and energy saving [13,17,19] and intentions to reduce car use [58]. Hypothesis 2, a frugal self-identity positively influences energy-saving intentions, was confirmed and corresponds with prior studies showing that frugality, sufficiency norms, and thrifty identities are relevant for pro-environmental behaviors [14,23,72,74,139]. Out of all the two identities tested, an environmental identity was stronger than a frugal identity as a determinant of energy saving. This finding is aligned with the work of Thøgersen who concluded that an environmental self-identity is a stronger and more consistent predictor of energy-saving behavior than frugality [13].

The hypotheses that energy-saving intentions predict energy curtailment (H4a) and choice of energy-efficient appliances (H4b) were confirmed. In other words, if a person identifies themselves as someone who cares about the waste of resources and who cares about the environment, then those identities will predict intentions and behaviors. The results suggest that curtailment and investment behaviors are complementary in nature. Yet, the study found that one identity was more salient in a particular situation. Mediation analysis revealed that the 'environmental identity-intentions-behavior' relationship was stronger for willingness to buy energy-efficient appliances than for energy curtailment.

Despite speculation that identities are stable and consistent across domains [23], this finding supports the idea that identities depend on situational cues [18,27,54]. The finding can be explained by the fact that energy usage is a routine activity, often performed habitually and unconsciously [100]. In contrast, the purchase of appliances is a high-involvement activity, requiring deliberation, and is more likely to evoke identity and make the individual more attentive to who they are in the marketplace.

The hypothesis that anticipated guilt plays a mediating role between self-identity (environmental and frugal) and energy-saving intentions (H3) was confirmed. This is an interesting finding and contributes to the literature. When dealing with guilt, other scholars emphasize other factors, such as past behavior. Lacasse concludes that guilt mediates the relationship between past behavior manipulation and climate change concerns [140]. Prior research has found that personal norms (which include the guilt construct) mediate an environmental self-identity and a range of conservation behaviors [35]. Scholars also assert that guilt is strongly intertwined with identity, the private aspects of the self [31]. The analysis shows that anticipated guilt has a significant effect on energy-saving intentions, which then affects energy-related behaviors. Prior studies have found that guilt has a significant effect on pro-environmental behavior and is seen as a lever for behavioral change [33,87,90,91]. Mediation analysis shows that the pathway from anticipated guilt to energy-saving intentions and energy-efficient appliances is stronger than that from anticipated guilt to energy-saving intentions and energy curtailment. The finding that anticipated guilt varies in the strength of its influence depending on the given domain contributes to the literature. Thus the study contributes to the debate as to whether the influence of anticipated negative emotions on behavior depends on the type of behavior [29].

The hypothesis that the influence of multiple identities and guilt on energy-saving intentions and behavior is similar across solar and non-solar households (H5) was confirmed. This finding suggests that consumer psychology does not change simply due to the installation of rooftop solar, and this finding is aligned with the theory that people need to be consistent in order to avoid cognitive dissonance [28]. The finding can be explained by Bem's theory of self-perception, which posits that people are observers of their behaviors and seek consistency between actions and cognitions [52]. The finding could also be explained by the concept of a positive spillover [141], which means that performing one sustainable action (i.e. installing solar) increases the likelihood of performing additional sustainable actions (i.e., saving energy, buying energy-efficient appliances). Finally, income was included in the model as a control variable and was not found to be significantly related to energy saving. This conflicts with much of the literature, although Hori et al. found that income had a very weak effect on household energy-saving behavior [142].

5.2. Implications for policy and practice

The results have implications for energy policy in the State of Queensland. Specific appeals in persuasive marketing campaigns could be used to induce energy-saving behavior. The salience of environmental and frugal identities implies that campaigns based on priming these identities should be effective. Campaigns that stress long-term savings could appeal to frugal consumers, with slogans such as "Avoid wasting money, here are tips to save electricity in your home". Campaigns that link energy-saving behavior with climate change mitigation could appeal to environmentalists, with slogans such as "Be a climate change champion, here are tips on how to save energy ". Customer personas, celebrities, or role models that evoke a particular identity could be used in campaigns. The study suggests that guilt-arousing communications should be effective in campaigns, particularly when guilt is paired with an environmental self-identity and linked to the purchase of an energy-efficient appliance. For example, a slogan such as "Guilt-free shopping for the greenie: choose the five-star label" could be persuasive. The design of mobile applications (*m*-apps) could also help consumers better monitor and reduce their energy consumption. App design could include typical features such as a carbon calculator linked to dwelling-related factors (i.e. floor area, number and type of appliances etc), along with emotional messages. Our findings support the notion that future initiatives and policies need to be integrative, multifaceted and sensitive to human dimensions. While knowledge of consumer psychology is important for marketing communications, policy measures can also be used as a 'lever' or a 'tool' to bring about behavioral change. It may be worthwhile for policymakers to promote, and even increase, efficiency standards, given that energy-saving intentions are strongly related to the choice of energy-efficient appliances. Since multi-group analysis revealed no significant differences between solar and non-solar households, this implies that persuasive messages do not need to be adapted.

5.3. Limitations and future research

This study tested a simple, parsimonious model to predict energy-related behaviors which is a limitation. Future studies could develop

more complex identity models and draw on Schwartz's norm activation model [143] and Stern's value-belief-norm theory [144]. Future research should investigate other, potentially competing identities, such as the interplay between an environmental identity, a good provider identity, or the hedonic identity, in larger, more representative samples. The development of segmentation profiles would also be worthwhile. Scholars have highlighted the effectiveness of positive emotions, such as pride, in motivating pro-environmental actions [82] and the interplay of identity with positive emotions deserves more consideration in future studies.

A limitation of the study is that it relies on self-reported, as opposed to observed, behavior. Numerous scholars highlight the 'intentions-behavior' gap or the 'attitudes-behavior' gap, briefly explained as the lack of consistency between words and deeds [145]. Hence, there is likely to be a disparity between what people state about their energy-related behavior in a survey and how they behave in real life. This study does not address structural and dwelling-related factors, such as floor area, the type of dwelling, the number of appliances [146,147] and the type of roof [148] that all affect energy consumption, and thus it offers a partial explanation of a complex phenomenon. There is a need for detailed studies that combine a focus on the psychology of the occupant with dwelling-related factors. Future research could use objective measures of energy consumption in the home (i.e. electricity bills) and focus on consumers who have bought an energy-efficient appliance so that the relationship between intentions and behavior could be strengthened. The findings are based on a study of households in the State of Queensland, which could restrict the generalisability of the results to Australia. In Queensland, older people (over 55 years of age) are more likely to be adopters of rooftop solar [125] and might exhibit stronger frugality norms than younger generations. Thus, future research should explore energy consumers of all ages and capture different generational cohorts. The sample reflects a developed economy and a highly individualized, Western culture. There is merit in examining energy saving in collectivist cultures where the focal constructs, such as multiple identities and guilt, may have different meanings. For example, group identity may be more important than self-identity in a collectivist culture. A related limitation is the non-probability sampling method used. Hence, it would be fruitful for future research to use probability sampling and capture respondents from diverse cultural backgrounds. Finally, this study relied on a questionnaire that captured individualized use of energy. Since energy services are shared in the home, future studies could use an inductive approach, such as ethnographic observation and interviews to ensure adequate rigour in capturing the influence of psychological factors on energy use, such as the interplay of subjective norms, or pressure from other family members to save energy, with anticipated guilt.

6. Conclusion

This study unites diverse energy-related choices with the perspective of anticipated guilt and multiple identities. It confirms the role of the pro-environmental and the frugal identities, mediated by anticipated guilt, in influencing energy-saving intentions and behaviors. Two dependent variables were used to measure different types of energy saving, routine energy saving within the home, and purchase-oriented behavior that occurs outside of the home. The findings show that an environmental self-identity, mediated by guilt, has a stronger influence than a frugal identity on the choice of an energy-efficient appliance, although this pathway is relevant for consumption-oriented behavior too. This finding has theoretical implications and shows that identity is sensitive to situational cues. Multi-group analysis revealed no significant differences between solar and non-solar households, suggesting that consistency plays a role in people's identity. This study has policy implications. Since energy consumption has ramifications for climate mitigation strategy, it is important to understand the precise path through which self-identity and anticipated guilt work to 'nudge' people towards energy conservation. The study supports guilt-based messaging in behavioral change campaigns and suggests that standardized campaigns will work for both solar and non-solar households.

CRediT authorship contribution statement

Breda McCarthy: Conceptualization, Methodology, Writing – review & editing, Resources, Administration.

Declaration of competing interest

The author declares no conflict of interest.

Breda McCarthy reports financial support was provided by Energy Consumers Australia. The author declares that there is no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.esr.2024.101400.

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