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Climate zones, energy efficient technologies and advertising: what are residential real estate agents saying?

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ABSTRACT

Energy used in housing is a major contributor to Australia's energy consumption. The country's vastness leads itself into a broad range of climate conditions and each climate zone demands different energy efficient characteristics in housing. Real estate agents play an active role in motivating buyers in purchasing energy efficient housing through advertising. The objective of this research is to examine whether the promotion of house energy efficient features in advertisements is influenced by the climate zones. The research examined detached dwelling advertisements in three climate zones in Victoria, Australia – hot, mild and cool – during the period of 2008 – 2013 with over 40,000 advertisements reviewed. This was complemented by in-depth interviews with nine senior real estate agents practising within these climate zones. Results highlight that energy efficiency features were not considered to be a major factor when advertising residential properties. However, there were differences in advertising characteristics related to energy efficient features across climate zones. Advertisements in colder zones tended to have more energy saving related words. Yet, distinctive design characteristics for different climate zones are not significantly differentiated and agents tend to follow standard wording when describing them.

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Introduction

The need to reduce greenhouse gas emissions emanating from anthropogenic activity is viewed as considerable importance by the scientific community. Whilst the issue is immense, collective and measured change can occur through targeted action and this is best achieved through research that can lead to positive outcomes. Housing is one element that warrants examination. Australian housing emits up to 20% of the nation's Green House Gas (GHG) emissions (Environmental Protection Authority, 2014; Environment Victoria, 2018)

The magnitude of energy consumed by houses is typically related to the climate in which the house is located (Horne & Hayles, 2008). In excessively cold or hot climates the need for conditioned air is greater than in temperate climates and its generation is often via GHG emitting fuels. Therefore, one means of reducing energy consumption is through the creation of more energy efficient housing stock.

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Creating housing bespoke to the climate requires technical expertise. For example, exposure to the sun's rays is considered desirable in cooler regions in order to attain the heating effects of solar radiation while shading is preferable in warmer regions (Schnieders, Feist, & Rongen, 2015; Yilmaz, 2007). The issue being addressed in this paper is how real estate agents, as facilitators of house transactions, engage with such energy efficient features when houses are being offered for sale.

Due to the potential influence of residential agents during the sale process, it is argued by the authors that agents need to engage with the narrative of climate change, as it relates to reduced household carbon emissions, through their business activities. Therefore, as a starting point of this discourse, it is first necessary to comprehend the extent of engagement by agents with house energy-efficient technologies during the sale process. One means of doing this is an evaluation of how agents advertise house energy efficient technologies when they exist.

Agents are important in the house sale process and it is therefore imperative they understand and engage with energy-efficient technologies and the benefits they bring to buyers and society more broadly.

Research aim and objectives

The objective of this research is to examine how real estate agents are advertising energy efficient houses and the relationship of such practices across disparate climate zones. This work was part of a larger project examining real estate agent behaviours and attitudes to energy efficient housing. In this paper the question being examined is "Does the climate zone where properties reside influence how real estate agents advertise their house energy efficient technologies?" It is important to understand this as agents are often intermediaries in the house transaction process (Jauregui & Hite, 2010).

Consistent legal framework was considered important as this affects agency practice. To that end Victoria, Australia's most southern mainland state was chosen. The Real Estate Institute of Victoria (REIV) supported this research through the provision of sales transaction and advertising data. Defined by the Bureau of Meteorology (BOM), Victoria has within it three climate zones being hot, mild and cool. A fourth zone named Alpine also exists but this was not taken into account due to the limited number of transactions and unique nature of the housing with the majority of house sales transacted for purposes of accommodation for recreational snow skiing.

As a result of increased awareness of energy costs and environmental concerns, it is anticipated that real estate agents will emphasise energy-efficient characteristics in house advertisements. The basis of this contention is that agents will seek to highlight the more appealing attributes of the dwelling to buyers. To test this proposition, this research examined house advertisements in the three nominated climate zones with specific focus on the inclusion of energy-efficient technology lexis.

This paper has been structured as follows. It commences with a review of literature concerning the importance of energy-efficient housing and real estate agents' role. The methodology adopted in this research is then presented and this followed by the results summary. The paper concludes by highlighting the key findings of the study with comments on the implications of these findings. Recommendations for future research are then provided.

Literature review

All buildings contribute to global warming and have associated environmental impacts. They do this through construction, in-use activity and demolition and consume approximately 40% of global energy resources (Li et al., 2013; Motuzienė et al., 2016). Residential buildings, while varying globally in their emission levels, are nonetheless significant emitters of CO_2 gasses. The impact of housing on total energy use is considerable and increasing (Sullivan, 2007). It is this impact and the apparent lack of progress towards mitigation that has many housing researchers concerned (Nejat et al., 2015) and the call to do so has become more urgent (Golubchikov & Deda, 2012; Nejat et al., 2015)

Building standards have generally been developed with regard to prevailing climatic conditions but in turn this has the potential to create confusion amongst market participants (Moser, 2014). Irrespective, it remains that energy-efficient housing has the potential to enhance living conditions and increase energy affordability addressing social inequity (Boardman, 2013; Kuholski, Tohn, & Morley, 2010). Creating energy-efficient housing is important as is the need for buyers, sellers and market facilitators to understand their use and worth in the housing market. Before discussing market participants however, it is first necessary to give meaning to the term "energy-efficient housing".

A literature search did not divulge a consistent view in terms of a definition of an energy-efficient house; rather definitions appeared to be contextualised to research undertaken. While this may be considered sensible from an academic perspective, it doesn't necessarily reflect what residential markets understand such housing to be. In order to give understanding of the authors' perspective, the definition forwarded by Golubchikov and Deda (2012, p. 736) was adopted for this research. This definition is: *" . . ..achieving reduced energy intensities in residential services without compromising the well-being of the residents or the environment"*. This definition guided the selection of the energy efficient technologies evaluated in this research and these are discussed in the methodology section of this paper.

As climates vary globally, it is necessary to take measures that reflect the climate demands in which the house is located to maximise energy-efficient outcomes. Knowing which technologies, or measures, maximise householder benefit is essential (Dalton, 2007; Willrath & Logic, 1997). For example, the extent of thermal protection required in cold regions will be different to that required in tropical climates. Thus, all parties involved in house markets must be able to understand which technologies are most effective in their particular region. As this research aims to understand real estate agent engagement with energy-efficient technologies during the marketing process, it is appropriate to examine how energy-efficient technologies are promoted and if there is variation across climate zones.

Residential real estate agents are expected to exhibit a thorough understanding of the markets in which they operate. However, they face a dilemma regarding house energy-efficient technologies. In their professional activities agents aim to promote the features of a house that are considered to be desirable to buyers (Bridge, 2001; Brinkman, 2009; Perkins, Thorns, & Newton, 2008). With regard to house energy efficiency, research is somewhat disparate but is generally suggesting buyers are not considering such technologies when selecting houses (Bruegge, Carrión-Flores, & Pope, 2016; Bryant & Eves, 2012; Eves & Kippes, 2010). Although, in markets where energy performance certificates

exist, there is emerging evidence of price impact (Fuerst et al., 2015; Fuerst & Warren-Myers, 2018). With limited evidence confirming buyers are factoring house energy efficent measures into their buying decision, it is likely their focus remains upon the more traditional elements in the house search such as location, accommodation, affordability, etc. In marketing, the agent will logically seek to highlight these characteristics when advertising a house for sale. This behaviour is potentially attributable to remuneration arrangements of agents. Fee structures vary regionally and in this research region, success fees are common (Dunning et al., 2018). To be successful, real estate agents must possess a sound knowledge of the demographic composition of the region in which they work and apply that knowledge to develop successful marketing campaigns (Arndt et al., 2013). In this behaviour, it is expected that agents will target buyer appetites to achieve success. If buyers are not prioritising low-energy cost housing in their search, there is little incentive for agents to promote it.

The interpretation of house market nuances should be reflected in advertisements when the house is being offered for sale. It is typical agent behaviour to script house advertisements utilising emotive words to create mental images for the reader (Pryce & Oates, 2008). This practice of manipulating linguistic patterns in order to attain desirable outcomes has been the subject of considerable research in the past (Beangstrom & Adendorff, 2013; Perkins et al., 2008; Schöllmann, Perkins, & Moore, 2001). Thus real estate agent advertisements can be an informative medium to examine textual and linguistic patterns in the study of societal trends. Rodriguez and Siret (2009) examined house advertisements over a 20 year period and noted *"advertisements are a compact description of the characteristics and qualities that dwellers and real estate-agents give to a house in order to make the best sale"* (p93).

Therefore, from the study of house advertisements, it is possible to examine if real estate agents are discerning buyer reactions to house energy consumption through the inclusion of words and phrases to highlight house energy-efficient technologies. Considerable research emphasis has been given to the appropriateness of particular house energy-efficient technologies within variant climate zones (for examples see: Chel & Kaushik, 2018; Hee et al., 2015; Ottelin, Heinonen, & Junnila, 2015), but little effort has been given to how agents engage with these technologies during the marketing process. Therefore, this study contributes to this noticeable research gap. In doing so future research can better inform and influence government policy with regard to encouraging and/or mandating greater engagement with desirable house energy-efficient characteristics.

Research methodology

A two-stage, sequential explanatory strategy, which was characterised by the collection and analysis of quantitative data followed by the collection and analysis of qualitative data, was adopted in this research (Creswell & Creswell, 2018). In sequential explanatory strategy, the quantitative approach is the dominant research approach, while the qualitative approach is used to further clarify findings of the quantitative approach (Kumar, 2005). In the quantitative stage, all real estate agent advertisements that were used to promote detached residential properties within the selected climate zones between July 2008 and June 2013 were analysed to examine if the appearance of energy efficiency

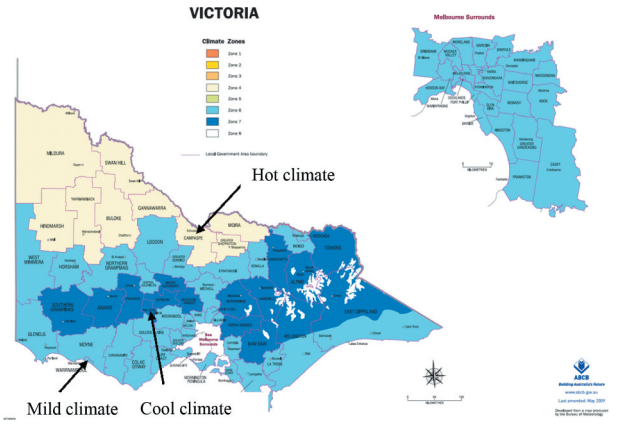

Figure 1. Victorian climate zones.

words were influenced by the climate zone where the property was located. These advertisements were provided by the Real Estate Institute of Victoria (REIV) who represents nearly 100% of all residential real estate agents in Victoria. Regions for analysis have been selected based on the Local Government Areas (LGAs) defined by the Australian Bureau of Statistics (ABS). Their respective climate zones were obtained from maps provided by the Bureau of Meteorology (BOM). Figure 1 illustrates the climate regions considered in this research with arrows showing the three areas reviewed in this study.

The dataset used in the quantitative analysis stage consisted of 40,952 advertisements with 2,470 advertisements from "hot zone", 28,015 advertisements from "mild zone" and 10,415 advertisements from "cool zone".

When provided by the REIV, the dataset had specific address details removed for privacy reasons. The data comprised the following: suburb, postcode, sale price, sale month, advertisement used when property sold. The estate agent's advertisement was the unit of analysis. House age was not provided separately in the dataset. Recently built houses would have been subject to energy-efficient standards while older houses not so. While the omission of house age may be considered to cause result bias, the research aim is not contingent upon capturing such information. New houses, that include mandatory energy-efficient standards, are unlikely to appear in the data as these are generally sold by sales staff internal to the construction company, not real estate agents, who are the focus of this research. As the vast majority of houses are sold via the services of real estate agents, and these being REIV members, the data is considered the "population" of sales over the research period. Therefore selection bias does not exist when attempting to represent the broader housing stock.

The dataset was then analysed to examine how real estate agents promote energy-efficient characteristics in their advertisements and to produce evidence whether the words and phrases promoting energy-efficient characteristics were influenced by the climate zone. Only tangible energy-efficient building technologies were considered because of the familiarity people have with such building characteristics for example,

Table 1. Energy efficiency variables examined in advertisements and their descriptors.

Variable	Word descriptors (words that SPSS looked for within the advertisement)
Energy efficient	Energy efficient, Energy-efficiency, Energy efficiency, Energy saving, Energy-saving, Energy save, Energy bill, Low energy, Energy conservation, Energy reports, Energy-efficient, Energy conscious, Energy cost, Low-energy, Energy consumption
Eco friendly	Eco-friendly, Eco technologies, Eco-waste, eco features, Eco home, eco conscious, Eco design, Eco-sustainable, Eco efficient
Recycled material	Recycled
Recycled water	Water recycling, recycled water
Sustainable	Sustainable
Environmental	Environmentally minded, Environmentally friendly, Environmentally-friendly, Environmentally-conscious, Environmentally conscious, Environmentally sensitive, Environmentally-sensitive, Environmentally green, Environmentally efficient, Environmentally responsible, Environmentally sound, Environmentally sustainable, Environmentally economical
Green	Greenhouse gas, Certified green builder, Green technology, Environmentally green
Insulation	Insulation
Grey water	Grey water
North aspect	North facing, Northern aspect, Facing north, North-facing, North sun, Northerly aspect, Northern sun
Design	Efficient design, Solar design, Sustainable design, Passive design, Eco design
Windows	Double glazing, D/glazed, Double glazed, Miglas windows, Double-glazed, Smart glass
Solar boosted	Solar boosted, Solar enhanced
Solar electricity	Solar electricity, Solar electric
Solar home	Solar home
Solar heating	Solar heating
Solar system	Solar system
Solar energy	Solar energy, Solar-energy
Solar HWS	Solar HWS, Solar hot water, Solar heated, Hot water
Solar power	Solar power, Solar-power
Solar panel	Solar panel
Solar	Solar

double-glazed windows or orientation. Table 1 illustrates the primary categories of energy-efficient words and phrases examined and their word descriptors.

Logistic regression models were used to examine whether the appearance of energy-efficient terms was influenced by the climate zone. The outcome in logistic regression analysis is coded as 0 or 1, where 1 indicates that the outcome of interest is present, and 0 indicates that the outcome of interest is absent. If p is defined as the probability that the outcome is 1, the multiple logistic regression model can be written as follows:

$$\widehat{p} = \frac{\exp(b_0 + b_1X_1 + b_2X_2 + \ldots + b_pX_p)}{1 + \exp(b_0 + b_1X_1 + b_2X_2 + \ldots + b_pX_p)}$$

The model was based on the concept that the likelihood of appearance of energy-efficient features was a function of various financial, demographic and locational determinants, including the relevant climate zone. As there are three main climate zones in Victoria, they were categorised as 1 = hot zone, 2 = mild zone and 3 = cool zone. They were presented as categorical data where category 1 represented climate zones with least climate variation while category 3 represented climate zones with most climate variation. A series of regressions with the following strategic determinants as independent variables (Table 2) were run in the quantitative stage.

Table 2. Independent variables included in the model.

Independent variable	Measurement	Measurement type
Sale price	Dollars	Interval
Sale quarter (as a proxy to the seasonal effect)	Number	Ordinal
Number of bedrooms (as a proxy to the house size)	Number	Interval
Median total weekly family income (by suburb)	Dollas	Interval
Median age (by suburb)	Years	Interval
Average household size (by suburb)	Number	Interval
Education qualifications (by suburb)	Number	Ordinal
Climate zone	Number	Ordinal

To further clarify the findings of quantitative analysis, in-depth semi-structured interviews were then carried out (three in each zone) with nine real estate agents who practised in markets located in three different climate zones. Accordingly, interviews from Echuca (hot zone), Ballarat (mild zone) and Warrnambool (cold zone) were conducted. Interviewees were selected using purposive sampling on the basis that they were senior members of the profession. The interview questions included their awareness of energy efficient features, reasons to promote/not to promote them, whether or not promoting such features varied in different climate zones. The qualitative data were analysed using thematic analysis, which aimed to identify patterns or themes within qualitative data collected (Creswell, 2009). They provided an opportunity to increase the interpretability, meaningfulness, and validity of quantitative findings (Amaratunga et al., 2002).

Results and discussion

Advertising of energy efficiency related words and phrases

Well-designed houses are deliberately designed to effectively harmonise with its environment and the climate zone (Pellegrini-Masini 2010). Therefore, it is expected that the way real estate agents script energy efficient features in advertisements vary with the climate zone in which the property is located. In the first stage of the analysis, the appearance of energy efficient words in advertisements were examined by climate zones. Results are illustrated in Table 3.

The findings show that real estate agents had not considered energy efficient characteristics as an important factor when advertising with less than 1% of the advertisements mentioning most of the energy efficient features examined. Energy efficienct terms "north aspect", "solar" and "energy-efficient" were the mostly cited with around 10% of advertisements stating the northern orientation and 5.5% and 4% stating solar use and energy efficiency respectively. However, more specific building measures such as water efficiency, energy efficiency ratings and measures, and energy efficient housing designs were rarely mentioned in the advertisements.

Victorian consumer law only allows the promotion of house energy-efficient characteristics by real estate agents where they actually exist (Estate Agents Act, 1980 s42). While specific data documenting the actual number of house renovations occurring across Victoria each year is difficult to source, it is estimated that approximately 40,000 homeowners apply for permits to renovate each year (Capuano, 2016). As building permits are not required for minor internal renovations, it can reasonably be assumed that the substantial proportion of these annual applications made are for major

Table 3. Percentages of advertisements with energy efficient terms by climate zone.

	% of advertisements with the energy efficient term		
Energy efficient term	Hot zone (out of 2470)	Mild zone (out of 28,015)	Cool zone (out of 10,415)
Energy efficient	3.52%	4.05%	3.90%
Eco friendly	0.08%	0.17%	0.13%
Recycled material	0.20%	0.24%	0.45%
Recycled water	0.08%	0.45%	0.15%
Sustainable	0.04%	0.11%	0.14%
Environmental	0.04%	0.14%	0.15%
Green	0%	0%	0.02%
Insulation	0.57%	0.57%	0.58%
Grey water	0.12%	0.20%	0.30%
North aspect	8.46%	10.61%	11.32%
Design	0.20%	0.15%	0.16%
Windows	0.61%	1.05%	1.26%
Solar boosted	0.04%	0.07%	0.10%
Solar electricity	0.12%	0.17%	0.21%
Solar home	0%	0%	0.01%
Solar heating	0.16%	0.20%	0.21%
Solar system	0.08%	0.11%	0.22%
Solar energy	0%	0.06%	0.10%
Solar HWS	1.58%	1.13%	1.19%
Solar power	0.32%	0.47%	0.44%
Solar panel	0.61%	0.62%	0.56%
Solar	5.95%	5.55%	5.23%

renovations. Such renovations require the new house section and possibly the original to be completed to existing energy efficiency standards (Victorian Building Authority, 2015). Additionally, Australian Building Codes Board (ABCB, 2019) in 2005 legislated to ensure that some level of energy efficiency and sustainability is incorporated into the national housing construction code. With such a volume of improved properties being upgraded to include energy-efficient characteristics and new house constructions with such features, mention of energy-efficient characteristics ought to be observed in housing advertisements.

Qualitative results

The above findings were further emphasised in in-depth interviews. Interviewees shared a common view that energy efficient features were rarely considered to be a major factor in residential purchase decisions suggesting buyers' views on such features would be "*if it's got it, it's got it, if it doesn't, it doesn't*" (Interviewee 3). According to agents, typical buyers are more concerned about the price of the property, its location and number of bedrooms, than the energy efficiency of the property. As explained by one interviewee, "*People wouldn't say 'let's buy an environmental home', they would say 'let's buy a house in that location' and any sustainable features would tip them one way or the other*" (Interviewee 2). As a result, they tend to follow standard wording when describing features and put more emphasis of house characteristics that are typically more likely to attract buyers.

However, the interviewees highlighted that "solar technologies" were the most commonly advertised energy-efficient technology. Terms such as "solar panel", "solar power", "solar energy", "solar system", "solar hot water system", "solar electricity" and "solar boosted" would have more attraction to potential buyers. They also suggested that buyers

who are more educated and buyers from older aged groups who are more concerned about their energy bills are more likely to adopt energy-efficient behaviours and are willing to pay for such technologies. This suggests that markets exhibiting such demographic profiles would have a greater prevalence of energy-efficient language appearing in the advertisements. Overall, the interviewees emphasised that "*if the market is seeking energy efficient technologies as part of their nominated search criteria . . . .*" (Interviewee 7), they would include them as a main factor in the advertisements.

Energy efficiency advertising and climate zones

House design features in different climate zones should ensure that the occupants remain thermally comfortable with minimal auxiliary heating or cooling. Given the wide variety of climates, the same house specifications will not be equally appropriate to all climate zones in Victoria. Therefore, it can be posited that real estate agents practising in different climate zones perceive the market demand for energy-efficient technologies differently and promote them differently.

Shown in Table 3, energy-efficient features were more frequently stated in the advertisements for houses in colder climate zones. Therefore, in the next stage, advertisements were tested using logistic regression to examine if the appearance of energy-efficient words varied with the climate zone. The dependent variable was the appearance of each energy-efficient variable, while the independent variables were the climate zone and other common property and demographic variables that affect the demand for energy-efficient housing (see Table 2). Unlike Ordinary Least Squares regression, logistic regression does not require normally distributed variables, nor assumes homoscedasticity (Pallant, 2004). It does not assume linear relationship between the independent and dependent variables. Instead, it estimates the effect of a vector of independent variable on the log odds of an event occurring. The null hypothesis for logistic regression model is:

$$H_0 = \text{Thereisnorelationshipbetweentheclimatezonewherethe propertyislocatedandtheappearanceofenergyefficiencywords}$$

The positive Exp(B) values for the independent variable climate zone for most regression models indicate that the increase in code given for the climate zone resulted in an increased probability of the appearance of energy-efficient features (see Table 4). This indicates the colder the zone gets, the more likely it is that advertisements include energy-efficient lexis. The appearance of terms "recycled material", "north aspect", "windows", "solar system" and "solar energy" in advertisements were significantly influenced by the climate zone and appeared more frequently in colder zones. On the other hand, the appearance of water efficiency measure "grey water" appeared more frequently in the advertisements of houses located in warmer zones.

Qualitative results

Interviewees emphasised that the type of energy-efficient features they mention in advertisements would vary with the climate zone of the property. They would advertise

Table 4. Logistic regression results.

	Significance of "climate zone" in each model					
Binary dependent variable for each model	B	SE	Wald	df	Sig.	Exp(B)
Energy efficient	0.052	0.050	1.067	1	0.302	1.053
Eco friendly	0.055	0.255	0.046	1	0.830	0.947
Recycled material	0.601	0.182	10.893	1	0.001*	1.825
Recycled water	−.102	0.203	0.253	1	0.615	0.903
Sustainable	0.462	0.283	2.670	1	0.102	1.587
Environmental	0.445	0.281	2.1512	1	0.113	1.561
Green	2.591	1.661	2.432	1	0.119	13.341
Insulation	0.033	.134	0.059	1	0.808	1.033
Grey water	−.384	0.200	3.685	1	0.05*	1.469
North aspect	0.066	0.033	4.547	1	0.033*	1.068
Design	0.103	0.246	0.174	1	0.676	0.902
Windows	0.262	0.093	7.857	1	0.005*	1.299
Solar boosted	0.337	0.353	0.911	1	0.340	1.401
Solar electricity	0.454	0.250	3.292	1	0.070	1.574
Solar home	0.784	1.379	0.324	1	0.569	2.191
Solar heating	0.131	0.240	0.299	1	0.584	1.140
Solar system	0.732	0.262	7.817	1	0.005*	2.079
Solar energy	0.921	0.415	4.939	1	0.026*	2.512
Solar HWS	−.030	0.089	0.109	1	0.741	0.971
Solar power	0.091	0.141	0.418	1	0.518	1.095
Solar panel	−0.044	0.128	0.121	1	0.728	0.956
Solar	−0.056	0.043	1.698	1	0.193	0.945

* Significant at 5% level.

" *. . . .more energy efficiency features in colder zones as houses in colder climates use substantially more energy to achieve thermal comfort . . . .*" (Interviewee 9).

Due to the increasing energy costs, the advertisements in colder climate zones tend to have more emphasis on energy-efficient characteristics. As suggested by one interviewee, "*In dry zones, you would talk more about cooling, solar and outdoors. But in Warrnambool, not many properties have solar because of the weather, nature of the housing stock and people's perceptions on sustainability*" (Interviewee 8). Agents also suggested that "*energy efficiency features such as grey water tanks are mentioned more frequently in dry zones where there are restrictions on water usage*" (Interviewee 1). Maximising water productivity is more crucial in dry climate zones where water is identified as a principal limiting factor and therefore they pay more attention to water efficiency measures when advertising properties.

To further examine if the nature of energy-efficient features advertised were influenced by the climate zone, the Spearman correlation coefficients between the climate zone and the appearance of various energy efficiency terms in advertisements were calculated. Climate zones were categorised as 1 = hot zone, 2 = mild zone and 3 = cold zone and the appearance of energy efficiency terms were categorised as 1 = present and 0 = absent.

Despite the differences in energy reduction and housing sustainability strategies used in different climate zones, the findings suggest there are no significant differences in the manner the majority of these features were advertised (see Table 5). Even though the correlations are not strong, the correlation coefficients suggest that the appearance of energy-efficient terms "recycled material", "north aspect", "windows", "solar system", "solar energy" were significantly correlated with the climate zone, and those terms more

Table 5. Correlation between the climate zone and the appearance of energy efficient characteristics.

Variable	Spearman correlation coefficient
Energy efficient	0.000
Eco friendly	0.000
Recycled material	0.016**
Recycled water	−0.013*
Sustainable	0.007
Environmental	0.004
Green	0.008
Insulation	0.002
Grey water	−0.010*
North aspect	0.017**
Design	0.000
Windows	0.014**
Solar boosted	0.005
Solar electricity	0.006
Solar home	0.004
Solar heating	0.002
Solar system	0.014**
Solar energy	0.011*
Solar HWS	−0.003
Solar power	0.001
Solar panel	−0.004
Solar	−0.008

** Correlation is significant at 1% level (2- tailed); * Correlation is significant at 5% level (2- tailed)

frequently appeared in advertisements in cooler zones than advertisements in warmer zones. On the other hand, terms "recycled water" and "grey water" more frequently appeared in advertisements in warmer zones than in cooler zones. These findings support the findings of the logistic regressions.

Qualitative results

The interviews then examined why energy-efficient technologies received such little importance in advertisements. All interviewees emphasised that it was difficult to know which energy-efficient technologies maximise householder benefits and quantify their benefits without professional assistance. They suggested "*it is very difficult to conduct rational calculations as there was no hard quantitative evidence available on the costs and benefits of having energy efficient technologies*" (Interviewee 3).

Real estate agents' lack of knowledge about the added value of energy-efficient characteristics to property values was also highlighted as a reason for the limited appearance of such features. As explained by one interviewee:

> *"Personally, I don't know enough about it, but I don't think it offers that much, because I'm just a little bit worried about what it costs to install certain things, solar heating, solar hot water, whatever it may be? And probably because of ignorance, I don't know how much it may save in energy costs" (Interviewee 2)*

In Victoria, real estate agents operate within a regulatory framework that necessitates open dialogue with clients and claims made need to be verifiable. Alleged performance of energy-efficient technologies can be problematic in this regard. As explained by one

interviewee "*The society is quite litigious, therefore I only include verifiable facts in my advertisements*" (Interviewee 1). They also emphasised that occupant behaviours affect actual energy costs and an energy-efficient house with poor occupant behaviour can be no better in terms of energy consumption than a comparable house without such technologies. As a result, it is difficult for real estate agents to make specific claims about cost savings associated with energy-efficient technologies without prior knowledge of buyer's understanding and attitudes towards such technologies. Aware of the legal requirements of the environment in which they work, real estate agents were somewhat reticent to highlight the benefits of such technologies, potentially further inhibiting market awareness and engagement.

For real estate agents to engage in promoting house energy efficiency, their role dictates that they must first be able to perceive a market appetite for such technologies. Their success-based remuneration framework will cause agents to promote the most appealing attributes of a property in order to secure a sale. Since it appears they do not perceive a market demand for energy-efficient technologies, real estate agents are unlikely to promote such characteristics. Inability or reluctance of agents to actively promote house energy-efficient characteristics could consequently act as a hindrance to long-term market acceptance of such technologies thereby jeopardising the Australian government's strategy of allowing market forces to lead the way for more efficient housing. Overall, the research emphasises the importance of enhancing public awareness of the need for reduced energy consumption through appropriate house construction, as well as the promotion of such features to develop a more environmentally sustainable housing stock.

Conclusions

This research aims to acquire a thorough understanding of the extent that real estate agents promote house energy-efficient characteristics with consideration to the climate and in doing so, provide evidence of their understanding about the importance of such technologies. The research employed a sequential explanatory multi method approach. The quantitative stage examined all detached dwelling advertisements in three climate zones in Victoria, Australia – hot, mild and cool – during the period of 2008–2013. Logistic regression analyses were performed to examine the influence of the climate zone on the appearance of different energy-efficient characteristics in advertisements. These findings were supported by qualitative data collected through nine in-depth interviews with real estate agents practising in markets located in different climate zones.

The findings highlight that energy efficient features were not considered to be a major factor by real estate agents when advertising residential properties. However, the appearance of such features in advertisements varied with the climate zone where the property was located. The advertisements in colder zones tended to have more words related to energy-efficient characteristics while advertisements in warmer zones tend to have more words related to water efficiency. However, distinctive design characteristics for different climate zones are not significantly differentiated in advertisements and agents tend to follow standard wording when describing property features.

The findings conclude that house advertisements, created by real estate agents, could be a useful tool for examining market reactions to energy-efficient technologies. If the market is seeking these technologies as part of their nominated search criteria, then

words referring to such characteristics should appear in the advertisement. Lack of importance given for such features in advertisements shows the lack of market awareness from the market participants. Therefore, this research emphasises the importance of implementing more public awareness campaigns formulated to raise consciousness of the impact of residential properties on greenhouse gas emissions or introducing more legislative sustainability targets or financial incentives to have such features in housing. This reality of inefficient housing stock composition is typical globally and therefore this research has global relevance.

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