THE INFLUENCE OF CLIMATE ZONES ON ENERGY EFFICIENCY ADVERTISING OF RESIDENTIAL PROPERTIES

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ABSTRACT

Problem/purpose – Energy used in housing is a major contributor to Australia's energy consumption and associated environmental impacts. 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 home buyers in purchasing energy efficient housing through advertising. The objective of this research is to examine whether the nature of promoting energy efficient features in sales advertisements is influenced by the climate zone where the houses are located.

Design/methodology/approach – The research examined all 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. Logistic regression analyses were performed to examine the appearance of different energy efficient characteristics in housing advertisements and if they were influenced by the type of climate zone.

Findings – The results highlight that energy efficiency and housing sustainability features were not considered to be a major factor by real estate agents when advertising residential properties. However, there were differences in advertising characteristics related to energy efficient features in different climate zones where the advertisements in colder zones tend to have more words related to energy saving characteristics. Yet distinctive design characteristics for different climate zones are not significantly differentiated in real estate advertisements and agents tend to follow standard wording when describing such features.

Originality/value – Much research emphasis has been given to the performance and appropriateness of particular energy efficient technologies within differing climate zones but little regard has been given to how real estate agents engage with the narrative relating to the diffusion of such technologies into the marketing process. This study contributes to the body of knowledge by setting a platform for future research.

Research limitations/implications – The specific location of the keywords within the text string was not examined and this will be the subject of future research as it may illuminate the importance given by real estate agents to energy efficient characteristics.

Keywords: Energy efficiency, Advertising, Real estate agents, Housing, Climate.

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INTRODUCTION

The scientific community advocate the reduction of damaging human activity upon the environment as essential for future existence. Predictions of ongoing extreme weather events attributed to excessive amounts of green-house gas (GHG) emissions is causing considerable concern and is likely to impact upon society in ways that are possibly yet to be known. Governments in particular have struggled to identify effective methods of stemming and reversing damaging trends anticipated by environmental research. Housing GHG emissions, through its innate relationship with human activity, is a contributor to harmful environmental effects. Australian housing in particular emits between 7% (Department of Industry 2014) and 20% (Environment Protection Authority 2014) of nations GHG emissions. Victorian housing, due to its substantial dependence on coal for electrical generation, releases slightly less than 20% of the State's total GHG emissions (Environment Victoria 2014).

Governments globally have been frustrated in developing strategies to imbue energy efficient housing into social acceptance. Some have chosen regulatory frameworks for building standards aimed at new and extensively renovated homes, whereas others also require reporting requirements on existing houses. In 2007 the Australian Federal and State governments planned the introduction of mandatory energy efficiency reporting at the time of sale but the political will to implement this decision has waned. Queensland was the only State to implement the policy, however it was repealed after a relatively short period. The prevailing Australian government favours market mechanisms to generate demand for energy efficient housing retaining a legislative frame that requires new homes and extensions to comply with prescribed energy efficiency standards.

Existing Australian housing is considered to exhibit poor energy performance standards. Utilising the NATHERS system of 0-10 stars, many Australian houses rate at 2 stars or less (Environment Victoria 2014) where 10 stars suggests no artificial heating/cooling is required for thermal comfort. Whilst it is probable that market forces will produce change over time, it is likely to be slow (Cudmore 2011). Furthermore research suggests that homebuyers are unlikely to respond to general

information alone when it comes to developing sustainable practices (Mackenzie-Mohr & Smith 1999, Henning 2008).

Heating and cooling costs have not featured heavily in the home-buying decision. However many people believe this will change as energy costs increase. As energy costs rise, buyers are likely to seek means of reducing energy bills and more energy efficient houses could become a lens for this. If so, an increase in market demand for such housing is the probable outcome. Between 2008 and 2013 electrical energy costs in Victoria increased a total of 63% for the average household (Essential Services Commission Victoria 2013). If rising energy cost is to be a stimulus for generating demand for more energy efficient housing, evidence of markets trending towards more energy efficient housing should be visible to observers.

Use of energy to create thermally comfortable housing environments will in part depend upon the climate in which to house exists and house designs need to be adapted to specific climates in order to minimise harmful environmental effects (Horne and Hayles 2008). Cooler climates inherently create greater need for heating whilst warmer and tropical climates create the need for cooling (Ren et al 2011). Given the disparate house thermal conditioning needs driven by climate it is plausible that house buyers in differing climatic zones would respond to the imperative of energy efficient housing differently. House sale advertisements are typically fashioned by real estate agents to attract the attention of suitably qualified buyers with objective of enticing them to view the property. The agent has a mutual interest in creating quality advertising as it is: a source of buyer inquiry, an opportunity to promote the agency's profile, and "positions" the property in the market arena via the use of persuasive textual construction (Bruthiaux 2000).

RESEARCH AIM AND OBJECTIVES

The objective of this research is to examine the relationship between energy efficient housing and differing climate zones and how real estate agents are promoting houses in different climate zones. The main question examined here is; "are real estate agents influenced by climatic zones when including words and phrases promoting energy efficient characteristics?" The principal-agent theory, when applied to the real estate

agents suggests that agents act ethically on behalf of clients but retain an element of self-interest (Anglin & Arnott 1991). Therefore if real estate agents perceive a benefit in promoting house energy efficient technologies they are likely to do so and will do so in a manner that best aligns to the desires of the market which would include the desire to be comfortable within the particular climate zone in which they seek to live. As market facilitators real estate agents exhibit significant influence over the sales process (Jauregui & Hite 2010) and therefore it is essential that their role in the uptake of energy efficient technologies be understood.

The geographic region for the research is the state of Victoria, Australia's most southern mainland state. Victoria has within it three climate zones as defined by the national Bureau of Meteorology (BOM) and these are: hot, mild and cool. As houses are designed to provide protection and thermal comfort for its occupants it is expected that the houses in each of these areas will exhibit different design emphasis and technologies. As real estate agents are expected to script advertisements that reflect market demand and will make every effort to promote the most attractive and desirable features of the house being sold, it is also expected that there would be subtle variations within the advertisements to reflect the benefits of the energy efficient technologies relative to the climate in which it resides. Therefore this research will examine advertisements in each of the three climate zones to determine if climate zones influence energy efficient characteristics mentioned within the advertisements.

This paper has been structured as follows. Next section reviews the literature concerning the importance of energy efficient housing and real estate agents' role in promoting energy efficient features in buyers' purchasing decisions. The methodology is then presented followed by a summary of the results. The concluding section highlights the key findings of the study, comments on the implications of these findings and makes recommendations for future research.

LITERATURE REVIEW

Energy used in buildings is a major contributor to the global energy consumption and associated environmental impacts. Building impacts on the environment include 55%

of timber consumption, 27% of plastics use, 30% of raw material consumption, 40% of atmospheric pollution, 25% of solid waste, 24% of all water use, 20% of substantial indoor air quality issues, 37% of all energy, and 68% of all electricity use (Lenssen & Roodman, 1995; Newton et al., 2001). Given that building impacts could be split almost evenly between homes (55%) and commercial buildings (45%), the impact of residential housing on total energy use is substantial and increasing (Eves and Bryant, 2011; Sullivan, 2007).

In terms of energy efficiency performance standards houses vary enormously and governments have struggled to find effectual solutions to enhancing house energy performance in order to abate further environmental damage due to GHG emissions resulting from human occupation. Energy efficient housing also has the potential to enhance living condition, increase energy affordability thus moderating social inequity (Boardman 2010; Kuholski et al 2010). Given these identified benefits is therefore important to determine, as much as possible, a point of reference of what energy efficient housing actually is. A search of literature did not reveal a consistent view in terms of a definition of an energy efficient house; instead definitions appeared to be contextualised to research undertaken. This is somewhat intuitive, as research into housing can be considered from numerous perspectives such as technical compositions or markets. For this research the definition of improved energy efficient housing provided by Golubchikoc & Deda (2012 pg.736) is considered useful namely; *"....achieving reduced energy intensities in residential services without compromising the well-being of the residents or the environment"*. Such a definition has universal application and overcomes climate specific constraints.

Knowing which technologies, or measures, maximise householder benefit is essential to improving house energy efficiency (Willrath & Logic 1997, Dalton 2007). Understanding the most appropriate energy efficiency technologies to provide maximum benefit to the particular house can be daunting without professional assistance. Direct government action and education programs are likely to assist in alleviating these hurdles (Mlecnik et al 2010, Hepburn 2010) although these appear to absent in the Australian context which will undoubtedly hinder future engagement by homebuyers with the concept of residential energy reduction aims. In order to provide clarity of the typical characteristics of energy efficient housing considered in this

article, often mentioned in literature, a list has been provided in Table 1 together with relevant authors and research findings supporting the appropriateness of such measures to the discourse of energy efficient houses. The existence of other measures are acknowledged but not considered here as they fall outside the frame of this research.

Table 1: Typical characteristics of energy efficient housing

Energy efficient measure	**Author(s)**	**Finding**
Insulation performance	Taylor et al (2013)	Insulation performances vary and complex thermal imaging is necessary to assess.
	Chirarattananon et al (2012)	Insulation type must be matched to climatic conditions to attain economic viability
Solar PV (Investment viability)	del Río, P. and P. Mir-Artigues (2012).	Policy makers significantly influence design and viability of PV systems.
Window systems	Nilsson and Roos (2009).	Selection of window systems is of importance and should be dependent on climate
Orientation	Morrissey et al (2011).	Energy efficient gains are made through appropriate orientation with regard to building design

Despite the increasing government legislative frameworks affecting energy efficient housing, the extant literature has found that energy efficiency features in residential properties are rarely considered to be a major factor in residential house purchase decisions. Particularly for the first home buyers, the financial aspects of the house were the most significant factor in purchasing decisions whereas the environmental factors have very little impact (Reed and Mills, 2007). More specifically, buyers are more concerned about the price of the property, its location and number of bedrooms, than the energy efficiency or green rating of the property (Eves and Kippes, 2010). Kippes and Eves (2010) suggest that home buyers were generally unaware of the energy efficiency measures and considered the most important environmental aspect of the residential dwelling to be the aspect of the building.

Therefore real estate agents as the transaction facilitator play a significant role in promoting and enhancing a market led uptake for energy efficient housing. The aim of real estate advertising is to make potential buyers aware of the houses' available features. The role of the agent is a delicate dichotomous one as they act for one party, transacts with the opposing party whilst their own interests are contingent on a successful outcome. As real estate agents are typically remunerated via success fees the alignment of their skills and expertise to the nuances of transaction is crucial. The collective objective of a successful transaction is inherently linked to a marketing campaign that highlights the houses' most attractive attributes to attract the most suitable buyer (Bridge 2001, Perkins et al 2008, Brinkman 2009). To achieve this successfully real estate agents must possess in-depth knowledge of the geographic and demographic composition of the region in which they work utilising this knowledge to develop successful marketing campaigns (Arndt et al 2013). Thus if the particular region in which they work is developing, or has developed, an appetite for energy efficient housing, real estate agents would undoubtedly include such references in their advertisements.

In order to be successful, real estate agents must be able to interpret market nuances to ensure advertisements are scripted to attract buyers who are most suitable for the house being offered for sale. The principal objective of real estate agents in developing advertisements is to use emotive words to create mental images of the of the house in the mind of reader (Pryce & Oates 2008). Studies have demonstrated that real estate agents manipulate linguistic patterns in order to achieve desirable outcomes (Schollmann et al 2000, Perkins et al 2008, Beangstrom and Adendorff 2013). The examination of textual and linguistic variations of real estate advertisements can be informative when examining social change. Reviewing house advertisements over 20 years Rodriguez and Siret (2009) found *"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).

If house owners were discerning the effect of climate on thermal comfort then words and phrases highlighting the benefits of house energy efficient technologies ought to appear in real estate agent advertisements when such properties are being offered for sale. Much research emphasis has been given to the performance and appropriateness

of particular energy efficient technologies within differing climate zones but little regard has been given to how real estate agents engage with the narrative relating to the diffusion of such technologies into the marketing process. Therefore, this study address this conspicuous research gap by evaluating the influence of climate zones on how energy efficient characteristics are advertised in sales advertisements for residential dwellings.

RESEARCH METHODOLOGY

The aim of this research is to examine if real estate agents are scripting advertisements to include energy efficient technologies and if climatic zones influence the appearance of such words and phrases within the advertisements. This research adopts a quantitative methodology and assembles a substantial database, founded upon extant literature, to explore the research question posited. Data used in this study are real estate agent advertisements that were used to promote detached residential properties within the selected climate zones between July 2008 and June 2013. These advertisements were provided by the Real Estate Institute of Victoria (REIV); the REIV represent approximately 70% of all real estate agents in Victoria. Regions for analysis have been constructed from 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). The dataset used in this study 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'. Demographic information related to each local government area, informed by literature, for the sub-markets within the identified climate zones was obtained from the Australian Bureau of Statistics (ABS). Previous research has revealed that buyers who are more educated and affluent are more likely to adopt energy efficient behaviours and are willing to pay for such technologies (Jansson et al 2011, Mills & Schleich 2012). This therefore would suggest that markets exhibiting such demographic profiles would have a greater prevalence of energy efficient language appearing in the advertisements. This information was then constructed to form the required dataset for evaluation.

The dataset were then explored and tested to find insights on how real estate agents promote housing energy efficient characteristics in their advertisements and, more particularly, to produce evidence whether the words and phrases promoting energy efficient characteristics were influenced by the climate zone where the property resides. The advertisements were audited to examine the energy efficient characteristics stated in each advertisement. Energy efficient building technologies considered in this research are those relating to building characteristics. These were chosen because the familiarity people have with building characteristics such as double glazed windows or orientation. Energy efficiency related words and phrases within advertisements were grouped into primary categories that identified the "nature" of the lexis used in order to further understand if certain technologies were preferred in favour of others. Strings of text were examined for words that suggested a form of energy efficient building fabric and/or design. Table 2 illustrates the energy efficiency related words and phrases examined and their primary categories.

Table 2: 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
	Energy rated, Energy rating, Energy-rated, Star energy
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

Logistic regression models were used to examine whether the appearance of energy efficiency terms examined was influenced by the climate zone. The dependent variable was the presence or the absence of the energy efficient characteristic examined; since the dependent variable was binary, logistic regression technique was used to explore the data. Each energy efficient characteristic was regressed with several potential independent variables that might affect the preference for energy efficient housing, including the relevant climate zone. Climate zones were categorized as 1 = hot zone, 2 = mild zone and 3 = cool zone.

We modeled a logistic regression based on the theory that the likelihood of appearance of energy efficient features in advertisements was a function of a vector of various economic, demographic and locational determinants. With a binary dependent variable where presence of the variable equals one and zero if it is absent, a series of regressions with the following strategic determinants as independent variables (Table 3) were run.

Table 3 – Independent variables included in the model

- Sale price
- Sale quarter
- Number of bedrooms (as a proxy to the size of the house)
- Median total weekly family income
- Median age

- Average household size
- No degree or vocational education (as a proxy to the level of education)
- Climate zone

RESULTS AND DISCUSSION

Globally housing has many forms with designs and building fabric often intended, as much as prevailing technologies allowed, providing protection from the elements for occupiers. The very nature of human behaviour and how we interact with houses when influenced by the climatic conditions poses real challenges for development a uniform approach to developing uniform standards. It is generally recognised that specific energy performance standards should depend on the climatic region in which the house exists (Ren et al 2011). Also it is expected that the way real estate agents script the energy efficiency features in housing is influenced by the climate zone in which the property is located. Therefore, the research focus was first placed on examining the appearance of energy efficiency related words and phrases in the advertisements for dwellings for sale in the main three climate zones in the context of the region of Victoria. Results are illustrated in Table 4.

Table 4: Percentages of advertisements with energy efficiency related terms by climate zone

Energy efficient term examined	% of advertisements with the energy efficient term examined		
	Hot climate zone (out of 2470)	Mild climate zone (out of 28,015)	Cool climate 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%

Despite the increasing legislative frameworks encouraging energy efficiency in housing, findings suggest that energy efficient characteristics were not considered to be a major factor by real estate agents when advertising detached dwellings. As shown in Table 4, less than 1% of the advertisements have mentioned most of the energy efficient and housing sustainability features examined in the study. The main energy efficient features the real estate agents considered most important were the northern orientation of the house, solar use and energy efficiency. Around 10% of advertisements have stated the northern orientation and this percentage was around 5.5% and 4% for solar use and energy efficiency respectively. Even though the terms energy efficiency and solar use were generally stated, more specific building measures for energy maximization and water efficiency, energy efficiency ratings and measures, and energy efficient housing designs and construction were rarely mentioned in the advertisements. However, the findings suggest that housing energy efficient features were more frequently stated in the advertisements for properties in colder climate zones than the properties in warmer climate zones. It might be because homes in colder climates use substantially more energy to achieve thermal comfort than homes with the same NATHERS star rating in more benign climates. Due to rising energy and water costs in home ownership and occupation, the advertisements in colder climate zones therefore may have more emphasis on energy efficient characteristics.

However, it is necessary here to state what may be considered obvious and that is real estate agents can only promote a given house characteristic if it actually exists. Breaching this credo would not only impact upon the agency's credibility it would also most likely have negative consequences upon the sales process and possibly attract the ire of consumer protection authorities. Therefore any statistics that aim to examine the extent of references made of energy efficiency, it is first necessary to attempt to establish the population of houses that are likely to exhibit such characteristics. In Victoria approximately 40,000 homeowners apply for permits to renovate each year (Smarter Homes Report 2014). No specific data is available as to what proportion of these renovations would include energy efficient characteristics.

However as building permits are not required for minor renovations it can reasonably be assumed that the substantial proportion of the 40,000 annual applications made are for major renovations, likely to be beyond the existing roof line. Such renovations require the new house section and possibly the original to be completed to existing energy efficiency standards (Victorian Building Authority, 2015). With such a volume of improved properties being upgraded to include energy efficient characteristics in the housing stock, mention of such characteristics ought to be observed in real estate advertisements. Although new residential construction standards have been legislated in Australia by Building Code of Australia in 2009 to ensure that some levels of energy efficiency and sustainability are factored into the design and construction of housing, they do not seem to be marketed sufficiently by real estate agents when selling residential properties.

Given the wide variety of climates in Victoria, the same house design and specifications will not perform equally well in all of Victoria's climate zones. Design for climate requires that homes be designed or modified to ensure that the occupants remain thermally comfortable with minimal auxiliary heating or cooling in the climate where they are built. Assessing literal arrangement of advertisements within climatic regions and comparing each to region will provide information as to whether real estate agents perceive a market demand for energy efficient technologies and if in fact there is a relationship with local climatic conditions. In the next step of data analysis, the data were explored and tested using logistic regression to produce evidence on the significance of the climate zone on the appearance of energy efficient characteristics in the advertisements. The appearance of each energy efficient variable was the dependent variable. The independent variables in the logistic regressions were the climate zone and other common property and demographic variables that might affect the demand for energy efficient housing: sale price, sale quarter, number of bedrooms (as the proxy to the size of the house), median total weekly family income, median age, education qualifications. With a binary dependent variable (presence or absence of energy efficient features), a series of regressions were run for each energy efficient feature examined with these independent variables. Unlike OLS regression, logistic regression does not require normally distributed variables, nor assumes homoscedasticity. It also does not assume linear relationship between the independent and the dependent variables. Instead, logistic regression estimates the effect of a

vector of independent variable on the log odds of an event occurring. The results are shown in Table 5.

Table 5: Logistic regression results

Binary dependent variable for each model	**Significance of 'climate zone' in 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

Overall, the positive B values for the independent variable climate zone for most regression models indicate that the increase in code given for the climate zone will result in an increased probability of the appearance of energy efficient features in advertisements. This indicates that colder the zone gets the more likely it is that advertisements located in those zones would have energy efficient features included. More specifically, the appearance of energy efficient features 'recycled material', 'north aspect', 'windows', 'solar electricity', 'solar system' and 'solar energy' were

significantly influenced by the climate zone where they tend to appear more frequently in the advertisements in colder zones. The results are significant at 5% confidence level. On the other hand, the appearance of water efficiency measure 'grey water' was significantly vary with the climate zone where the term tends to appear more frequently in the advertisements of houses located in warmer zones. The result is significant at 5% confidence level. Understandably, maximizing water productivity would be more crucial in dry, tropical climate zones where water is identified as a principal limiting factor and therefore real estate agents tend to pay more attention on water efficiency measures when advertising properties in dry zones.

In order to further examine if the nature of the energy efficiency and housing sustainability features advertised by real estate agents were influenced by the nature of climate zone, the Spearman correlation coefficients between the climate zone and the appearance of various energy efficiency terms in advertisements were calculated next. The results are shown in Table 6.

Table 6: Correlation between the climate zone and the appearance of energy efficient characteristics in advertisements

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)

Despite the differences in energy reduction and housing sustainability strategies in different climate zones, the findings suggest that there are no significant differences in the manner the majority of the housing energy efficient features advertised by real estate agents in different climate zones. Even though the correlations are not very 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 where those terms were more frequently appeared in the advertisements in cooler zones than the advertisements in warmer zones. On the other hand, the terms 'recycled water' and 'grey water' were more frequently appeared in the advertisements in warmer zones than the advertisements in cooler zones. These findings support the findings of logistic regressions.

Overall, the results suggest that environmental issues were not considered to be a major factor by real estate agents when advertising detached dwellings. However, the results find some correlations between the appearance of energy efficient features in advertisements and the climate zone where the property is located. The advertisements in colder zones tend to have more words related to energy saving characteristics while advertisements in dryer zones tend to have more words related to water efficiency. However, distinctive design characteristics for different climate zones are not significantly differentiated in real estate advertisements. The study finds that agents tend to follow standard wording when describing such features and put more emphasis of typical housing characteristics such as number of bedrooms and bathrooms in their advertisements.

Conversely, in order for real estate agents to engage in the narrative surrounding 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 certainly cause agents to promote the most appealing attributes of a property in order to secure a sale. If the real estate agent does not perceive a market demand for energy efficient technologies they are not likely promote such characteristics in advertisements due to the cost of advertising space and the advertising creed of highlighting house features most likely to attract suitable buyers. Said another way, if

the agent cannot align the benefits of energy efficiency to future occupants, they are unlikely to include references of such in advertisements. Inability or reluctance on the part of real estate agents to actively promote house energy efficient characteristics could consequently act as a hindrance to long-term market acceptance of energy efficient technologies thereby jeopardizing the Australian government's policy of allowing market forces to lead the way more efficient housing. Overall, the research emphasize the importance of enhancing the public awareness of the importance of the need for energy reduction and housing sustainability through efficient house construction and design, as well as the promotion of such housing features to develop a more environmentally sustainable housing stock.

CONCLUSIONS

This paper examines the relationship between energy efficient housing and differing climate zones and whether the nature of promoting energy efficient features in sales advertisements is influenced by the climate zone where the houses are located. The study 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 housing advertisements.

This research examines the effectiveness of the Australian government's strategy of using market forces to create demand for energy efficient housing. The objective was to acquire a more 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 to buyers. Significantly, the results highlight that energy and water efficiency and housing sustainability features were not considered to be a major factor by real estate agents when advertising residential properties. However, the appearance of energy efficient features in advertisements varied with the climate zone where the property was located. The advertisements in colder zones tend to have more words related to energy efficient characteristics while advertisements in warmer zones tend to have more words related to water efficiency. The specific location of the keywords within the text string was not examined and this will be the subject of future research as it

may illuminate the importance given by real estate agents to energy efficient characteristics. However, distinctive design characteristics for different climate zones are not significantly differentiated in real estate advertisements and agents tend to follow standard wording when describing property features.

What can be concluded here is that real estate agent advertisements could be a useful tool for examining market reactions to energy efficient technologies. If the market is seeking energy efficient technologies as part of their nominated search criteria, then words and phrases referring to such characteristics should appear in advertising copy. Lack of importance given for energy efficient features in real estate advertisements shows the lack of market awareness from both buyers and sellers for residential properties. This could be addressed by implementing more public awareness campaigns formulated to raise awareness of the impact of residential properties on greenhouse gas emissions or by introducing more legislative sustainability targets for housing.

Recognising 86% of Victoria's housing stock was constructed prior to 2005 (Victorian Household Energy Report 2014), when energy performance regulations came into effect in Victoria, it is appropriate to consider barriers for retrofitting houses with energy efficient measures. This reality of inefficient housing stock composition is typical globally and therefore this research has global relevance. A study addressing such barriers for retrofitting houses with energy efficient measures would add another dimension to the findings of this research.

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