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ARE WE GETTING BETTER AT PROMOTING ENERGY EFFICIENT HOUSING?

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ABSTRACT

Global warming has drawn attention to the impact of human activity upon the environment. Housing, and the way occupants behave, has long been recognised as a significant contributor to greenhouse gas emissions (GHG). Resulting from this reality, countries globally have sought to introduce measures to reduce GHG and Australia is no different. The uptake of these measures in many cases has been slow, particularly in retrofitting of older houses. With the benefits of energy efficient housing of lower energy cost and healthier homes being so obvious, it has become a conundrum for authorities. The housing ecosystem has numerous components and one of those believed to be important due its integral nature is the role of real estate agents in the marketing process. This research investigates how and to what extent real estate agents are doing this in the state of Victoria, one of Australia's more populated states. Findings are presented utilising previous research metrics as the benchmark.

Keywords: Energy efficient characteristics, property pricing, real estate agents, marketing, housing

INTRODUCTION

Home ownership is an ambition of many, if not most, people as they enter adulthood. Current housing data globally is indicating this ambition is progressively difficult attain with housing becoming increasingly expensive (World Economic Forum 2024a). Having overcome the tests and trials of saving for a deposit to buy a house, homeowners are faced with the ongoing day-to-day financial challenge of retaining the prized house. For many, this is being made more difficult because of increasing energy costs and these costs compounded by energy inefficient dwellings. For many years now governments have utilised financial incentives to encourage homeowners to upgrade and/or enhance the energy efficiency of their dwelling. The extent and type to which these schemes have been developed and applied largely depends upon individual governments ability to fund such schemes and climate in which the housing stock exists.

Many of the schemes developed and promulgated are transactionally based, whether this be sale or leasing transactions. In Australia, this has also been the case but is arguably behind other countries exhibiting similar socio-economic standards. Transaction based schemes typically aim to encourage sellers to enhance the energy efficiency of their house. One objective is to reduce energy consumption making household running costs cheaper, potentially making it attractive to prospective buyers, and possibly higher prices (Hurst & Halvitigala 2020; Caruna 2023).

Victoria is the most densely populated state in Australia with approximately 7 million people residing within it (.id 2021). It has nearly 2.811 million dwellings of which approximately 71.5% are detached, individually owned properties (ibid). This means existing housing is an important element of the overall housing stock to consider when aiming to reduce carbon emissions resulting from anthropogenic activity in housing. One effective means of improving energy efficiency for existing houses is the disclosure of energy efficient performance at the point of transaction (Fuerst & Warren-Myers 2018; Frondel et al 2020). Such a policy would aim to "adjust" house markets in a way that

makes buyers/tenants more aware the ability of the house to reduce energy costs. However, the Victorian government has not yet decided to introduce such a policy. In this, the Victorian government appears to be maintaining a neoliberal viewpoint. Therefore, it is important to understand how the market is reacting to public perceptions of the importance of reducing house energy costs via more efficient housing design and retrofit.

In Victoria newly built houses are subject to minimum energy performance, manifested as a star rating. This rating ranges from 0 to 10 stars with 10 being a passive house, or one with negligible energy consumption. No such rating applies to established housing and as the substantive component of the housing stock is already built it is considered important to examine how these houses are marketed to understand the emergence of public demand and therefore shift towards more energy efficient housing. If a market appetite for energy efficient housing is emerging and growing, it is only logical that real estate agents, who market houses on behalf of owners, will actively promote the house's energy performance capabilities.

This paper investigates how real estate agents are promoting house energy efficient technologies when advertising houses for sale, in particular how advertising and price premiums vary with income levels of differing suburbs. It does this by utilising an extensive dataset provided courtesy of the Real Estate Institute of Victoria (REIV), to which the authors are grateful for their ongoing support in this research. The paper reads as follows: firstly, a review of extent literature regarding housing and house markets with a focus on energy efficient housing, secondly the research methodology applied to the examination of the extensive dataset and this section is followed by an analysis and discussion of the findings. The paper concludes with recommendations for increasing the availability of energy efficient housing stock.

LITERATURE REVIEW

Housing and energy efficiency

Globally the need to reduce the consumption of energy generated by fossil fuels has been extensively acknowledged and consequently, many governments have committed to carbon reduction targets (UN 2024). Human activity in housing is but one of the recognised major contributors of carbon emissions. Although quantities of CO_2 claimed to be emitted vary, it is recognised as being considerable. Currently, the World Green Building Council (2019) estimates around 39% of all CO_2 emissions emanate from buildings with 28% being operational emissions. By building category, housing contributes around 17% of this figure (2024). Victoria, the region of interest for this research, produces around 17% of all CO_2 emissions in Australia (DEECA 2024), and Victorian housing sector is responsible for approximately 30% of the state's emissions (ibid). In this 30% figure all sources/causes of emissions resulting from human activity and behaviours are accounted for. It is worth noting in this figure items such as decomposition of food scraps, generated power for electrical supply etc. are all included. Heating and cooling are stated as being the most significant component of this figure. This situation is further exacerbated by poor thermal performance of existing housing stock. Sustainability Victoria (2024) state the CSIRO, Australia's premier research agency, state that around 65.4% of all Victorian homes are less than 2 stars in their energy performance meaning these houses are very inefficient in terms of thermal performance and therefore significant opportunity exists for improvement.

Globally governments have struggled to effectively curtail carbon emissions with a report commissioned by the OECD (Hoeller et al 2023:7) noting 'Housing and environmental policies are highly decentralised in many countries. Reforms and resources are needed to align incentives and agendas across levels of government. Local-level regulations, spending power and resources must be

consistent with national decarbonisation goals.' The date of this publication highlights the concern that the issue of green housing is yet to be resolved. This seemingly ad-hoc approach by governments to a serious global problem somewhat places the solution, or more realistically part of the solution, in the hands of the market. The next section discusses the role of real estate agents (also referred to as brokers in some countries) as they relate to engagement with energy efficient housing.

Real estate agent's role and influence

Real estate agents, as intermediaries, are a critical part of the housing ecosystem. They facilitate sales and renting between buyer and seller, landlord and tenant. When engaged to sell a property agents are required to understand the nature and characteristics of the property and its relationship to the nuances and prevailing trends of the market (Perkins et al 2008; Pryce & Oates 2013). One could argue, this is their stock and trade and the economic benefit they bring to sellers. In the case of residential property, this generally translates to the popularity of areas, household trends such as family size/needs etc. among several household characteristics that exert pressure on housing markets. The working from home phenomena that emerged after the recent Covid19 pandemic is an example of how these household trends can change or emerge. Rising energy costs and climate change are very much in the minds of households and as such agents would be aware of these and no doubt respond accordingly in their advertising.

Hurst & Halvitigala (2019) studied how agents in Victoria, Australia promoted house energy efficient when advertising. They found agents generally include energy efficient technologies in the advertisement but noted they were not often supported with hyperbole to enhance emotive appeal. They also found that in many cases, words and phrases relating to these technologies were often 'buried' in the middle of the text resulting in their importance potentially becoming lost. This notion is supported by primacy recency theory, a phenomenon describing that people tend to remember information presented in the beginning or end of a message, whether text or verbal (Loginova 2009).

Therefore, regarding house energy efficient characteristics and technologies, how agents recognise, understand and develop advertisements for houses that exhibit such characteristics will arguably have an impact upon market perceptions and potentially the uptake of these carbon reducing houses. Some researchers have found more energy efficient houses are typically selling for higher prices (Fuerst & Warren-Myers 2018 for example), which potentially implies more affluent buyers are seeking such housing. If this is the case, it should be visible in literature.

Household profiles and energy efficiency uptake in houses

One of the major challenges for governments is how to support/encourage lower income households to purchase or retrofit energy efficient technologies into the house fabric. The challenges of this have been widely recognised (Vassileva & Campillo 2014; Trotta 2018). Understandably lower-income households will struggle to purchase housing and are often found renting, and sadly, they are the cohort that can benefit most from lower energy bills. Such a situation can only be addressed by government. There appears to be an understanding that this group is not likely to engage, or more accurately stated, seek energy efficient housing as more imperative family needs will be met first (Ameli & Brandt 2015; Trotta 2018). In terms of the continuum of housing stock this raises concerns as it seems only the more affluent households, most likely residing in more affluent areas, are likely to engage with and/or retrofit energy efficient technologies into their home. Although a somewhat intuitive standpoint, this suggestion is examined in this research.

RESEARCH METHODOLOGY

The aim of this research is to examine if the level of average annual family income in different suburbs had any implication on the prominence of energy efficiency characteristics in residential property advertisements in those suburbs. Additionally, the research seeks to explore how the willingness of buyers to pay for houses is influenced by the presence of energy efficiency attributes, particularly when compared to properties that do not offer such features.

This research is confined to the Melbourne Metropolitan Area, which provides a diverse range of suburbs with varying income levels. The Local Government Areas (LGAs) selected for this analysis have been meticulously chosen based on average annual family income statistics obtained from the Australian Bureau of Statistics (ABS). Table 1 below illustrates the specific LGAs included in this study, offering insights into the economic context that will enhance the analysis.

Table 1: Local Government Areas selected in the research

Weekly household income (Source: ABS)	**Melbourne suburbs**			
	Northern	**Eastern**	**Southern**	**Western**
Low income Less than $1,740	Mill Park Reservior Campbellfield	Dandenong Springvale Bayswater	Frankston Cranbourne Hampton Park	Sunshine Albanvale Keilor Park
Medium income ($1,741-$2,949)	Greensborough Yallambie Yarrambat	Balwyn Blackburn Croydon Hills	Edithvale Beaumaris Murrumbeena	Williamstown Cairnlea Essendon
Highest group (Above $2,950)	Fitzroy North Northcote Clifton Hill	Hawthorn Surrey Hills Warrandyte	Black rock Hampton Brighton	Newport Yarraville Spotswood

(Source: ABS, 2021)

The study utilises data derived from real estate agent advertisements for detached residential properties across selected LGAs from January 2016 to December 2022. The advertisements were sourced from the Real Estate Institute of Victoria (REIV), which represents approximately 70% of real estate agents in Victoria. Only advertisements for detached houses were included in the analysis, as energy efficiency characteristics are more readily incorporated into these properties than into units. The analysis focused on properties with 3, 4, or 5 bedrooms, as these tend to exhibit a greater prevalence of energy efficiency features, attributable to the increased energy demands associated with their relatively larger physical size. The final dataset comprises 21,438 advertisements: 8,116 from 'low-income areas', 6,565 from 'mid-income areas', and 6,757 from 'high-income areas'.

The advertisements were then subjected to a detailed audit to identify the presence of energy efficiency attributes within each advertisement. Due to the financial incentives associated with solar technologies, the energy efficient technologies considered in this research are those relating to solar and hot water energy efficiency technologies. Table 2 provides a summary of the examined energy efficiency variables and their respective descriptors.

Table 2: Energy efficiency variables examined in advertisements and their descriptors

Variable	Word descriptors (words that SPSS looked for within the advertisement)
Solar boosted	Solar boosted, Solar enhanced
Solar electricity	Solar electricity, Solar electric
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

(Source: Authors)

The dataset was rigorously analysed to uncover insights regarding the promotion of solar technologies by real estate agents in their listings. The frequency of solar-related terminology in advertisements was assessed across various income brackets using descriptive statistics to identify potential disparities in the marketing of energy efficiency features in suburbs with distinct economic characteristics.

To further investigate these differences, a One-Way ANOVA test was conducted to evaluate whether there were significant differences in the mean property prices between houses equipped with solar technologies and those without, across different income group locales. ANOVA tests compared the variance (variability in house prices) between different groups (believed to be due to the independent variable) with the variability within each of the group (believed to be due to chance) (Pallant 2004).

RESULTS AND DISCUSSION

The research firstly concentrated on analysing the presence and frequency of keywords related to solar technology in advertisements. The findings are presented in detail in Table 3, which highlights the variations in the use of solar-related terminology in real estate listings based on the income demographics of the area.

Table 3: Appearance of solar technology terms in advertisements by income group areas

Appearance of solar technology terms	Income group		
	Low	Medium	High
Advertisements with solar technology terms	9%	13%	16%
Advertisements without solar technology terms	91%	87%	84%

(Source: Authors)

Despite the growing number of legislative frameworks aimed at promoting energy efficient housing, findings indicate that the adoption of solar technologies remains limited, particularly in suburbs characterised by lower economic characteristics. It is important to reiterate a fundamental principle that real estate agents can only highlight features of properties that genuinely exist. Given the potential financial benefits provided by solar technologies, one would expect that these features would be prominently advertised when present in a property.

The analysis subsequently concentrated on investigating how the presence of energy efficiency features in advertisements differed based on the size of the property. For this purpose, the number of bedrooms served as a proxy for the overall size of the house, as larger homes typically have more bedrooms. The results of this examination are presented in Table 4.

Table 4: Appearance of energy efficiency technologies in advertisements of different sized houses

No of bedrooms	Solar in ads with low income	Solar in ads in middle income	Solar in high income
3 beds	7%	6%	8%
4 beds	13%	17%	22%
5 beds	19%	26%	29%

(Source: Authors)

The findings indicate a notable increase in the prevalence of energy efficiency terminology within advertisements corresponding to properties with a greater number of bedrooms, across various suburbs characterised by differing average income levels. It can be posited that detached houses typically incur higher operational costs; consequently, the incorporation of enhanced energy efficiency features may serve as an incentive to attract prospective buyers by mitigating their ongoing expenses. As such, real estate agents may be more inclined to emphasise attributes that contribute to reduced running costs in larger houses.

In Australia, there is a growing trend towards the construction of larger homes, with many individuals occupying properties that exceed their current needs, resulting in multiple underutilised bedrooms. Therefore, promoting the concept of rightsizing Australian homes should be advocated, as suitably sized dwellings are likely to enhance energy efficiency and sustainability. This approach would also alleviate housing shortages in established suburbs while diminishing energy expenditures and carbon footprints. The rising demand for energy is at odds with global initiatives aimed at combating climate change; thus, there exists a pressing need to fundamentally reassess Australia's housing energy policy.

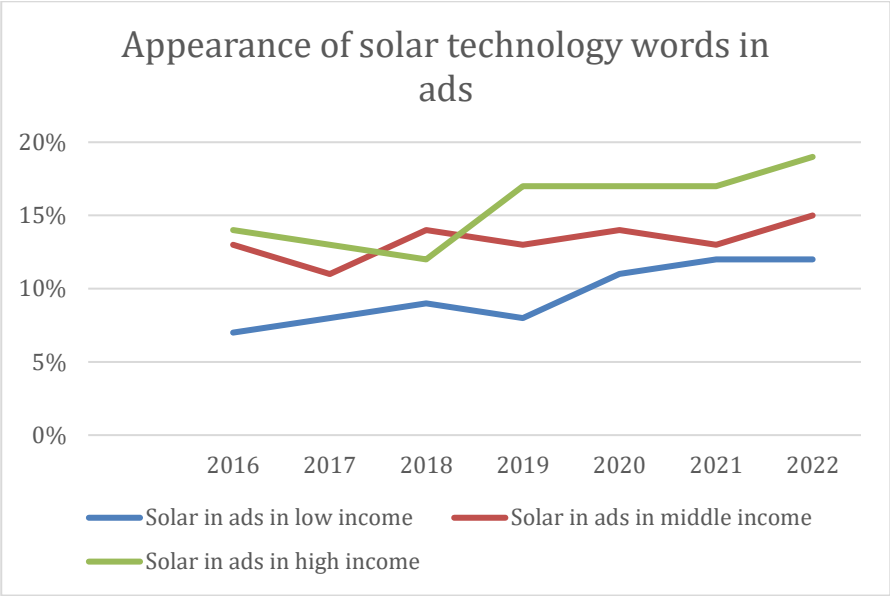
The research focus subsequently shifted to analysing the variation in the frequency of solar-related terminology in advertisements for residential properties over the course of the study period. The findings are presented in Table 5 and illustrated in Figure 1.

Table 5: Appearance of solar technology terms over the study period

Year	Low Income			Mid Income			High Income		
	No. of ads with solar	Total no. of ads	%	No. of ads with solar	Total no. of ads	%	No. of ads with solar	Total no. of ads	%
2016	113	1604	**7%**	142	1097	**13%**	169	1174	**14%**
2017	112	1379	**8%**	96	914	**11%**	129	1013	**13%**
2018	84	933	**9%**	105	734	**14%**	91	767	**12%**
2019	79	945	**8%**	116	879	**13%**	137	826	**17%**
2020	82	763	**11%**	103	724	**14%**	123	734	**17%**
2021	151	1305	**12%**	149	1179	**13%**	208	1194	**17%**
2022	152	1277	**12%**	158	1075	**15%**	212	1132	**19%**

(Source: Authors)

Figure 1: Appearance of solar technology words over the study period



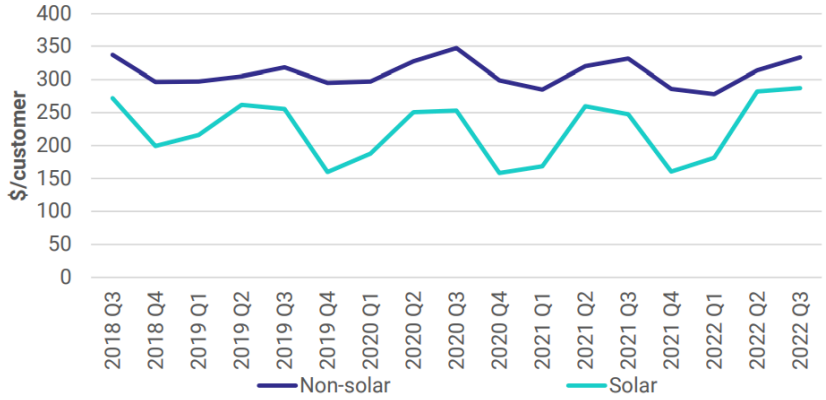
(Source: Authors)

Despite a low percentage of buyers actively seeking energy-efficient housing, there has been a notable increase in the number of properties for sale that incorporate energy-efficient features in their advertisements across all three income brackets. This trend has been particularly evident since the onset of the COVID-19 pandemic, which has fundamentally altered the priorities and preferences of Australian homebuyers. The pandemic acted as a transformative catalyst, reshaping how Australians live and work. With remote working becoming more prevalent, there has been a significant re-evaluation of how people utilise their homes and the locations in which they choose to live. As a result, energy efficiency has emerged as a key consideration for many buyers, especially as the shift to working-from-home trend continues and the return to traditional office environments remains uncertain.

Additionally, rising energy costs have further underscored the importance of energy-efficient housing. Australians are now facing some of the highest energy bills globally, leading to widespread reports of "bill shock" among consumers. This financial pressure makes homes equipped with energy-saving technologies, such as solar technologies, increasingly appealing to buyers. Homeowners with solar technology often benefit from reduced electricity expenses, due to both decreased consumption and the ability to offset costs by exporting excess energy back to the grid. They can also take advantage of solar feed-in tariff credits, which provide financial compensation for surplus energy supplied.

Further illustrating this trend, Figure 2 presents a comparative analysis of the electricity bills incurred by homeowners with solar photovoltaic systems versus those without. This detailed perspective reinforces the growing demand for energy-efficient housing options among Australian buyers, driven by economic considerations and evolving lifestyle choices.

Figure 2: Homeowners with solar panels have lower electricity bills



(Source: Australian Competition & Consumer Commission, 2023)

In examining Table 5, it becomes evident that the frequency of solar-related keywords in advertisements significantly increases in regions populated by middle and high-income households. This observation is consistent with existing literature, which suggests that more affluent households tend to display a greater engagement with environmental issues and advanced technologies related to sustainability (Mills & Schleich, 2012). This trend indicates that real estate agents are likely adapted to this environmentally conscious mindset and are adjusting their marketing strategies accordingly to attract these demographics.

However, despite this responsiveness in advertising, the relatively subdued level of engagement with solar technologies among high-income households remains puzzling. One possible explanation for this phenomenon lies in the tendency of these households to leverage their housing choices as a means of signalling their values and social status. Research indicates that high-income individuals often prioritise factors such as location and architectural style over energy efficiency and sustainability (Gram-Hanssen & Bech-Danielsen, 2004; Wu, Zhang & Dong, 2013). This focus on aesthetic and symbolic dimensions of housing may overshadow their potential interest in energy-efficient technologies. Additionally, it is crucial to consider that both high and middle-income households are likely to pursue long-term financial benefits through reduced energy consumption. In contrast, lower-income households face significant barriers in accessing and investing in energy-efficient technology due to financial constraints (Ramos, Labandeira & Löschel, 2016).

The existing body of literature indicates growing evidence showing that enhanced energy performance in houses tends to have a favourable impact on their market values and, consequently, on their selling prices (Cerin, Hassel & Semenova 2014; Fuerst et al. 2015; Fuerst & Warren-Myers 2018). Particularly, buyers with higher income are increasingly willing to pay a price premium for homes that exhibit greater energy efficiency (Högberg 2013). However, it is important to note that these findings may differ based on regional factors, as regulatory frameworks regarding energy disclosures and varying climatic conditions can significantly influence market responses. Despite these variations, existing research posited that household wealth levels could shape attitudes toward the adoption of energy-efficient technologies in housing, affecting purchasing decisions to some extent.

To delve deeper into these dynamics, a one-way between-groups analysis of variance (ANOVA) was performed to ascertain whether there were significant differences in house prices between properties equipped with solar technologies and those without, particularly in different suburbs characterised by varying annual family income. The findings are illustrated in Table 6 and Figure 3 below.

Table 6: Mean house prices with and without solar technology

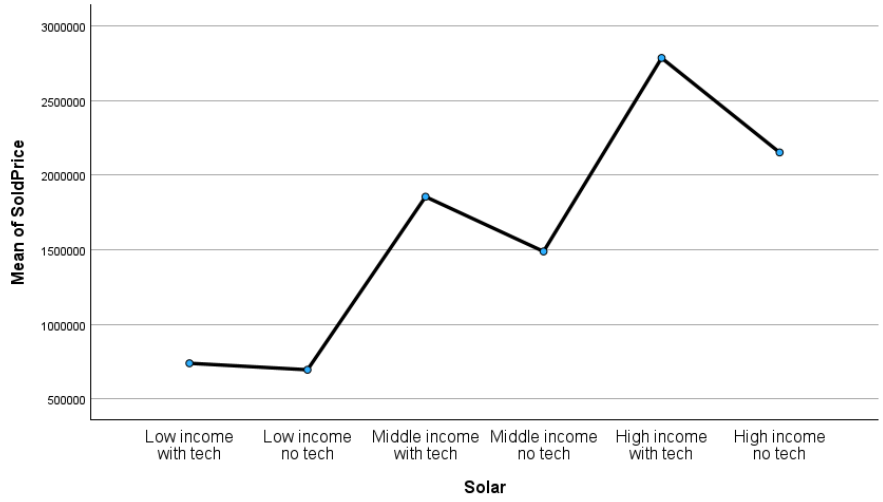
Descriptives

SoldPrice

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Low income with tech	770	739660.96	249022.076	8974.133	722044.25	757277.66	310000	2776000
Low income no tech	7346	696178.44	236337.361	2757.445	690773.06	701583.83	224000	5050000
Middle income with tech	864	1855726.61	975009.510	33170.497	1790622.32	1920830.90	591000	8360000
Middle income no tech	5701	1489042.54	791186.709	10478.605	1468500.49	1509584.59	280000	9480000
High income with tech	1056	2785660.95	1552942.947	47788.516	2691889.60	2879432.30	760000	13671579
High income no tech	5701	2152553.11	1424311.389	18863.811	2115572.87	2189533.36	400000	25000000
Total	21438	1445536.35	1150299.951	7856.316	1430137.39	1460935.32	224000	25000000

(Source: Authors)

Figure 3: Mean of sold prices with and without solar technology in their advertisements



(Source: Authors)

The findings indicate a notable trend that houses equipped with solar technologies consistently command higher prices across all examined income groups when compared to their counterparts without such technologies. The most substantial price disparity, amounting to $633,108, was observed in suburban areas characterised as high-income suburbs. In contrast, properties situated in low-income suburbs showed the smallest price difference of $43,483. Meanwhile, homes in mid-income areas displayed a moderate price difference of $366,684.

These findings suggest that while energy efficiency features like solar technologies may not be the initial priority for the majority of homebuyers, there is a clear inclination among buyers to pay a premium for homes that incorporate such features. This willingness to invest more may not stem solely from a conscious desire for a greener living space; rather, it seems that buyers are drawn to properties with enhanced liveability attributes. Buyers may not fully recognise the sustainability benefits or the potential for lower utility costs associated with such homes, yet these factors subconsciously influence their purchasing decisions.

An ANOVA test was then conducted to investigate the relationship between average annual family income in suburbs and the price premium associated with homes featuring solar technologies to determine how income levels influence the market value of homes equipped with solar energy systems compared to those without such technological enhancements. To facilitate this analysis, the advertisements were categorised into six distinct groups based on their respective average annual family incomes:

- Group 1: Houses equipped with solar technologies located in low-income suburbs.
- Group 2: Houses without solar technologies situated in low-income suburbs.
- Group 3: Houses equipped with solar technologies located in in mid-income suburbs.
- Group 4: Houses without solar technologies located in mid-income suburbs.
- Group 5: Houses featuring solar technologies located in high-income suburbs.
- Group 6: Houses absent of solar technologies located in high-income suburbs.

The findings are presented in Table 7.

Table 7: ANOVA test results

Multiple Comparisons

Dependent Variable: SoldPrice

Tukey HSD

(I) Solar	(J) Solar	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Low income with tech	Low income no tech	43482.516	35622.143	.827	-58039.30	145004.33
	Middle income with tech	-1116065.653*	46606.194	<.001	-1248891.62	-983239.69
	Middle income no tech	-749381.580*	36106.439	<.001	-852283.63	-646479.53
	High income with tech	-2045999.990*	44564.897	<.001	-2173008.33	-1918991.65
	High income no tech	-1412892.157*	36106.439	<.001	-1515794.20	-1309990.11
Low income no tech	Low income with tech	-43482.516	35622.143	.827	-145004.33	58039.30
	Middle income with tech	-1159548.169*	33822.763	<.001	-1255941.82	-1063154.52
	Middle income no tech	-792864.097*	16598.704	<.001	-840169.80	-745558.39
	High income with tech	-2089482.506*	30949.509	<.001	-2177687.49	-2001277.53
	High income no tech	-1456374.673*	16598.704	<.001	-1503680.38	-1409068.97
Middle income with tech	Low income with tech	1116065.653*	46606.194	<.001	983239.69	1248891.62
	Low income no tech	1159548.169*	33822.763	<.001	1063154.52	1255941.82
	Middle income no tech	366684.073*	34332.452	<.001	268837.83	464530.32
	High income with tech	-929934.337*	43140.148	<.001	-1052882.20	-806986.48
	High income no tech	-296826.504*	34332.452	<.001	-394672.75	-198980.26
Middle income no tech	Low income with tech	749381.580*	36106.439	<.001	646479.53	852283.63
	Low income no tech	792864.097*	16598.704	<.001	745558.39	840169.80
	Middle income with tech	-366684.073*	34332.452	<.001	-464530.32	-268837.83
	High income with tech	-1296618.410*	31505.714	<.001	-1386408.55	-1206828.27
	High income no tech	-663510.576*	17614.054	<.001	-713709.99	-613311.16
High income with tech	Low income with tech	2045999.990*	44564.897	<.001	1918991.65	2173008.33
	Low income no tech	2089482.506*	30949.509	<.001	2001277.53	2177687.49
	Middle income with tech	929934.337*	43140.148	<.001	806986.48	1052882.20
	Middle income no tech	1296618.410*	31505.714	<.001	1206828.27	1386408.55
	High income no tech	633107.833*	31505.714	<.001	543317.69	722897.98
High income no tech	Low income with tech	1412892.157*	36106.439	<.001	1309990.11	1515794.20
	Low income no tech	1456374.673*	16598.704	<.001	1409068.97	1503680.38
	Middle income with tech	296826.504*	34332.452	<.001	198980.26	394672.75
	Middle income no tech	663510.576*	17614.054	<.001	613311.16	713709.99
	High income with tech	-633107.833*	31505.714	<.001	-722897.98	-543317.69

*. The mean difference is significant at the 0.05 level.

Results show that there was a statistically significant difference at the $p<0.05$ level in residential house prices for the six groups ($F(5, 21{,}438) = 2128$, $p = 0.001$). The findings suggest that the mean sale price for properties with solar technologies in properties located in high income areas (M = 2,785,661; SD = 1,552,943) was significantly higher from the mean sale price of houses without solar technologies (M = 2,152,553; SD = 1,424,311). Similar findings were observed in properties located in mid income areas with a significantly higher mean sale price for properties with solar technologies (M = 1,855,727; SD = 975,010) compared to the mean sale price of properties without such features (M = 1,489,043; SD = 791,187). Interestingly, the findings identify that the actual difference in the mean sale prices with and without solar technologies in the properties located in the areas with low income was not statistically different (properties with solar technologies: M = 739661; SD = 249,022

and properties without solar technologies: M = 696,178; SD = 236,337). This suggests that the features and enhancements provided by energy efficiency technologies may impact property values more significantly in affluent suburbs compared to those in lower-income suburbs.

The observation that there is no significant statistical variance between the average house prices of properties with solar technologies and those without in low-income households is regarded as both pragmatic and somewhat anticipated. In Victoria, lower-income households often face considerable limitations in their housing choices, which typically manifest in the form of smaller, more uniformly designed, and constructed homes. Limited access to financial resources means that this housing stock tends to remain relatively uniform, showing fewer instances of solar technology adoption as these households often exhibit significant constraints in their ability to engage with and invest in such technologies. In terms of acquiring access to energy efficiency resources, they are largely dependent on government subsidies, which significantly influence their capacity to incorporate sustainable energy solutions into their homes.

Furthermore, energy-efficient homes typically command a price premium. Many potential homeowners in the low-income bracket may find it more appealing to purchase properties that lack these energy-saving features, as they are available at comparatively lower prices. This strategy allows them to take advantage of various government financial incentives aimed at facilitating the installation of energy efficiency features on existing homes at a reduced cost later on.

On the other hand, households with higher income naturally have a broader array of choices when it comes to house design and construction. This financial flexibility allows them to create more tailored and unique dwellings that reflect their personal tastes and preferences. Consequently, it is observed that both high and middle-income households demonstrate a greater willingness to invest in energy efficiency features for their homes. This trend not only boosts demand for energy-efficient options but also contributes to the establishment of price premiums in those suburbs. Several factors may underpin this phenomenon. For instance, higher-income households often exhibit a greater awareness of climate issues, which may drive their willingness to allocate more funds toward energy-efficient housing. Additionally, the allure of lower electricity bills is particularly appealing to these households, as it allows them to manage their household budgets more effectively in their relatively larger homes. By reducing their long-term energy costs, they can enjoy enhanced financial security and sustainability. Existing research supports these findings, suggesting that there is indeed a price premium associated with energy-efficient housing in non-regulated markets, as highlighted in the work of Gardener et al. (2019). This trend is especially observed in areas where higher-income households are prevalent, further underscoring the relationship between income levels and investment in energy efficiency features in residential properties.

CONCLUSION

The objective of this paper is to investigate whether evidence exists that homebuyers are willing to pay a premium for properties equipped with energy-efficient technologies and whether such willingness is affected by the income levels of households. This examination was conducted in the context of family income levels as defined by the Australian Bureau of Statistics (ABS) in the state of Victoria, Australia.

The research employed an analysis of advertisements created by real estate agents. This methodological choice was grounded in the behavioural practices of real estate agents, who often highlight house features that are believed to be desirable among potential buyers in their respective markets. By analysing these advertisements, the research aimed to uncover potential correlations between advertised energy-efficient features and market premium pricing in residential properties.

The findings indicate a significant upward trend in the inclusion of energy efficiency characteristics in property sale advertisements during the study period, 2016 – 2022. This increase is noteworthy as it spans across various social-economic groups, suggesting a broader recognition of the importance of sustainable living.

An in-depth analysis of house sale prices revealed significant differences between properties equipped with solar features and those without, particularly in regions characterised by higher household income. The data highlighted that advertisements targeting middle and high-income suburbs more frequently included terminology related to energy-efficient attributes. This observation aligns with previous research indicating that families with greater financial resources tend to value and actively seek out energy-efficient characteristics in their homes (Mandell & Wilhelmsson, 2011). This trend underscores the potential for promoting energy efficiency as a compelling selling point, especially given the strong demand among Australian homeowners for sustainable living solutions. Encouraging existing homeowners to upgrade their properties to include energy-efficient enhancements could represent a significant opportunity for the Australian housing market.

The findings underscore that income levels significantly hinder engagement with energy-efficient technologies in housing. This issue must be prioritised in future policy initiatives to effectively tackle the underlying problem of energy poverty faced by lower-income families. The additional costs associated with energy-efficient homes create a pronounced price premium, making these properties increasingly unattainable for those with limited financial resources. While energy efficiency can lead to long-term energy savings and lower utility bills, the substantial upfront costs serve as a barrier, alienating those who cannot afford these upgrades.

To make energy-efficient housing accessible to a wider range of budgets, a comprehensive approach is essential. This could include offering incentives for both developers and homeowners that promote greener living practices. Such measures might take the form of tax breaks, grants, or subsidies aimed specifically at the adoption of energy-efficient features in homes.

It is important to note that newly constructed homes are already subject to higher energy performance standards enforced by local councils, governments, and developers. As a result, the market is gradually shifting toward properties that not only meet but exceed contemporary energy efficiency benchmarks, creating a competitive edge for homes that incorporate these sustainable features.

Establishing a baseline standard of energy inclusions for all new homes could level the playing field. When energy-efficient features are integrated as standard rather than optional upgrades, their impact on market prices may diminish, making energy-efficient homes more financially viable for all buyers. Ultimately, the goal is to enhance the carbon footprint of Australian homes while reducing the financial burden of household bills, thereby contributing to a more sustainable and equitable housing market.

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