

WILLINGNESS TO PAY FOR GREEN RESIDENTIAL PROPERTY FEATURES IN ISKANDAR MALAYSIA

Yap Suk Yen, Choong Weng Wai, Low Sheau Ting
Wee Siaw Chui, Razlin bin Mansor

Department of Real Estate, Faculty of Built Environment and Surveying
Universiti Teknologi Malaysia, 81310 Skudai, Johor, Malaysia
Corresponding Author: cwengwai@utm.my

ABSTRACT

The surge in interest in environmentally friendly residential properties underscores the critical role of market demands in shaping the availability of green building developments. While previous research primarily focused on the general willingness to pay for green building attributes, limited attention has been given to understanding users' valuation of specific green features. This study addresses this gap by examining user willingness to pay for various green building features in residential properties. Through an electronic questionnaire that yielded 394 valid responses for frequency analysis, the study revealed that users exhibited a greater willingness to invest in green features related to "Indoor Environment Quality (IEQ)" and "Innovation and Others (IO)" criteria, while their willingness to allocate funds to green features associated with "Energy Efficiency (EE)" and "Water Efficiency (WE)" criteria was comparatively lower. These findings provide invaluable insights for both local and foreign developers seeking to integrate green features into their residential developments in Malaysia, thereby enhancing their marketability.

Keyword: *Willingness to pay, green features, residential property, preference study.*

1. INTRODUCTION

As global concerns over climate change intensify, the imperative to reduce carbon emissions has become a shared global objective. A striking statistic underscores the significance of this challenge: approximately 33% of global greenhouse gas emissions and nearly 40% of global resource and energy consumption stem from building-related activities, construction is among of them (Deng, Li & Quigley, 2012). Beyond their energy consumption, construction endeavors generate substantial waste (Yusof, Awang & Iranmanesh, 2017), making the construction sector essential in the pursuit of sustainable development (Feliciano & Prospero, 2011).

Research by Dwaikat & Ali (2016) demonstrated that the development of green buildings in Malaysia resulted in a remarkable 71.1% reduction in energy consumption compared to industry baselines. These green structures, in addition to curbing energy usage and carbon emissions, yield benefits such as lowered operational expenses, reduced waste-related costs, and enhanced environmental quality (Dwaikat & Ali, 2018). Notably, the incorporation of green features, whether within individual units or common areas, significantly influences household energy consumption and offers potential utility cost savings.

Given the distinct urgency of global climate concerns and the pivotal role of the real estate industry in environmental preservation (Deng et al., 2012), society has grown increasingly attuned to the attributes of environmentally friendly buildings (Fuerst & McAllister, 2011). Prospective buyers of residential properties emerge as pivotal actors in realizing the sustainability objectives of green buildings, necessitating alignment between developers and buyer preferences regarding green features. An exploration of potential homeowners' willingness to invest in green features can unveil their true appreciation of green building attributes and their commitment to real-world sustainability practices (Hostetler & Noiseux, 2010). Armed with insights into buyers' preferences, developers can tailor their offerings to align with these preferences. This study endeavors to elucidate the willingness to pay for green features among prospective homeowners within the Malaysian context.

2. GREEN BUILDING FEATURES OFFERED IN RESIDENTIAL BUILDINGS

According to Li, Long & Chen (2018), green buildings are buildings that provide people with healthy and comfortable living spaces, fully utilizing natural resources while minimizing the impact on the environment. Green building usually covers wide range of environmentally friendly aspects, to conserve energy and water, reduce waste, and increase air quality. Green building is described by Muldavin (2010) as an outcome of building performance determined by green features, strategies, and certification. The demand of green residential properties has increased as residents have started to consider the benefits of green feature performance and it has become an important factor when selecting a property (Aroul & Rodriguez, 2017). Residents are likely to purchase a green residential property with a higher price if they intended to enjoy a healthy and quality lifestyle (Hu, Geertman & Hooimeijer, 2014).

Fowler and Rauch (2006) explained that sustainable ratings or accreditation systems are used to examine the performance or expected performance of an entire building and translate performance assessments into a tool that can be used to compare the building performance of other buildings or a performance standard. The green rating tool that is developed and adopted for a local market can be used to evaluate whether a property is considered green (Runde & Thoyre, 2010), considering different countries likely to adopt different green building accreditation tools and systems. For example, the Leadership in Energy and Environmental Design (LEED) in the United States, Building

Research Establishment Environment Assessment Method (BREEAM) in the United Kingdom, Green Star in Australia, Green Mark in Singapore, and in Malaysia, the Green Building Index (GBI), GreenRE (by the Real Estate Housing Development Authority (REHDA)), Malacca Green Seal (by Malacca Green Development Organisation (MGDO)), Green Pass (by the Construction Industry Development Board (CIDB)), *Penarafan Hijau* (Green Ranking by the Public Works Department (JKR)), MyCREST (by CIDB-JKR), and CASBEE Iskandar (IRDA-Japan). Among the two most common Green Building Accreditation systems used in Malaysia are GBI and GreenRE, which are summarised in Table 1 below.

Table 1: A Comparison of the Green Building Criteria for GBI and Green RE for Residential Building

Criteria	GBI	GreenRE	Total
Energy Efficiency	23	54	38.5%
Water Efficiency	12	8	10.0%
Indoor Environment Quality	12	4	8.0%
Site Planning and Management	33	-	16.5%
Innovation	8	4	6.0%
Materials & Resources	12	-	6.0%
Environment protection	-	28	14.0%
Carbon Emission of Development	-	2	1.0%
Total	100%	100%	100%

Source: Author Compilation

GBI and GreenRE developed six criteria that are similar but differ in their weightage of scores. GBI places more emphasis on Site Planning and Management and Energy Efficiency, whereas GreenRE emphasizes Energy Efficiency and Environment Protection. Compared to GBI, GreenRE substituted Environmental Protection for the Materials and Resources and Site Planning and Management criteria. It was noted that the Innovation criteria in GBI were equivalent to the other Green Feature criteria in GreenRE, as both encourage the possibility of new ideas in green features and building design.

The main benefits of green buildings are enhanced occupant health and wellbeing through a quality environment and reduced energy consumption as well as cost savings during the operational phase of a building (Wadu, Mesthrige & Kwong, 2018). These criteria were observed as achievable characteristics through a literature search that summarized green features into four categories: (1) Energy Efficiency; (2) Indoor Environment Quality; (3) Water Efficiency; and (4) Innovation and Other Green Features as shown in Table 2.

Table 2: Summary of Green Features Available In Residential Properties

Category	List of Green Features	Previous Studies
Energy-Efficiency	1. Solar Photovoltaic 2. Solar Shading 3. Wall Insulation Material 4. High-performance Glazing 5. Green Roof 6. Lighting with Motion Sensor	- Gul, Kotak & Muneer (2016) - Jeon, Ryu & Lee (2010) - Evangelisti, Guattari, Asdrubali & de Lieto Vollaro (2020) - Ozel (2013) - Meng, Gao, Wang, Yan, Zhang & Long(2015) - Wang, Huang & Heng(2007) - Ascione, Bianco, de' Rossi, Turni & Vanoli (2013) - Dikel, Newsham, Xue & Valdés (2018)
Indoor Environmental Quality	1. Low Toxicity Finishes and Furnishings 2. Natural Ventilation Design 3. Sufficient Daylight 4. Sound Insulation Design	- Uhde & Salthammer (2007) - Heracleous & Michael (2019) - Deru & Burns (2003) - Turan, Chegut, Fink & Reinhart (2020) - Berglund, Lindvall & Schwela (2000) - Ryu & Song (2019) - ISO (2013)
Water Efficiency	1. Water Efficient Fittings 2. Rainwater Harvesting System	- Lee & Tansel (2012) - Cheng, Peng, Ho, Liao & Chern (2016) - GBI (2020) - Kenway et al. (2015) - Mehrabadi, Saghaian & Haghighi Fashi (2013) - Abu-Zreig, Ababneh & Abdullah (2019)
Innovation and Other Green Features	1. Building Passive Cooling Design 2. Other Innovations	- GreenRE (2017) - Darko, Chan, Effah, He & Olanipekun (2017) - GBI (2020)

Source: Author Compilation

A desktop search was conducted to identify the list of green features that had been adopted and made available in existing residential properties. Studies scope was drawn down to the Iskandar Development Region, which is the main southern development corridor and economy hub in Johor, Malaysia, It has recorded a cumulative investment of about RM332.11 billion from 2006 to 2020, and numerous new residential projects have been announced and developed in the region, it is also the place where the questionnaire survey was conducted. The search provided insight into how

green tools were implemented by developers in existing projects and ensured that green features were currently offered by developers. Table 3 below provides an overview of the green features available in existing residential properties located in Iskandar, Malaysia.

Table 3: List of Green features made available by the developer in the existing residential properties in Iskandar, Malaysia

Project	List of Green features
Imperia Puteri Harbour Developer: UEM Group Berhad	Waste separation and recycling, green power, automated watering system, roof garden, and automated lighting
Forest City Developer: Country Garden Pacificview Sdn Bhd	Natural lighting, motion sensor lights, vertical greenery, rooftop garden, natural ventilation, rainwater harvest, water efficient fittings, and sound insulation design
Kempas Utama Township Developer: IOI Properties Group Berhad	Solar water heating system, rain water harvesting system, and smart home system
EcoBotanic Developer: EcoWorld Development Group Berhad	Solar PV, energy efficient electrical and mechanical appliances, natural ventilation, natural lighting, shading, cool roof, rainwater harvesting system, water efficient fittings, edible garden, recycling centre, composting centre, and solar water heater
Rumah Iskandar Malaysia Developer: Iskandar Regional Development Authority (IRDA)	Rainwater harvesting system, solar panel, cool roof system, eco-friendly paint, and green paver blocks
Citrine Residences Developer: Sunway Iskandar Sdn Bhd	Natural lighting, natural ventilation, and rainwater harvesting system
Sakura Residences Developer: Sunway Iskandar Sdn Bhd	Energy efficient appliances, solar insulation, and air ventilation systems.

Source: Author Compilation

A comparison was made between the green features listed in the literature, GBI, and GreenRE (Table 2) as well as the List of Green features made available by developers in existing residential properties in Iskandar, Malaysia (see Table 3). Only the Green features offered by a developer and supported by literature were included in the questionnaire. We categorized green features into four criteria that were used to develop the questionnaire, which are shown in Table 4.

Table 4: Selection and Integration Of Green Features Listed In The Literature, GBI and Green RE as well as The Green Features Made Available by Developers in Existing Residential Properties

Criteria	Selection of Green Features
Energy-Efficiency	1. Solar Photovoltaic 2. Solar Shading 3. Green Roof or Roof garden 4. Lighting with Motion Sensor 5. Solar Water Heating System
Indoor Environmental Quality	1. Low Toxicity Finished and Furnishing 2. Natural Ventilation 3. Natural Daylighting 4. Sound Insulation Design
Water Efficiency	1. Water Efficient Fittings 2. Rainwater Harvesting System
Innovation and Other Green Features	1. Building Passive Cooling Design such as Cool Roof and Vertical Greenery 2. Smart Home System

Source: Author Compilation

It can be seen that developers and building design professionals were familiar and kept pace with the guides provided by local green rating agencies. Although developers have shown an effort to implement green features into the building design, not all are keen to fulfill and make available all green feature criteria and attain high ratings in the GBI and GreenRE assessment tools. Among the green features listed in the rating tools, natural lighting, natural ventilation, rainwater harvesting systems, and motion sensor lights are the features most commonly made available by developers in existing residential properties.

It was also found that some developers were more innovative by adding other green features such as solar water heating systems, vertical greenery, automated watering systems, smart home systems, water separation and recycling, composting centres, green paver blocks, and edible gardens.

3. METHODOLOGY

A survey was carried out to determine the willingness to pay for the buyers of each particular green feature to understand their intentions to purchase a residential property with that feature. The non-probability sampling method was used in this study to select samples from the targeted population. Nonprobability sampling is a sampling technique where samples are gathered in a process that does not give all participants or units in the population an equal chance of being included (Etikan, 2016). When using this sampling method, only a small number or part of a population is required to make a conclusion regarding the whole population. However, this sampling method can still provide valid and credible results. This is because this sampling method is able to reflect the characteristics of the population from which respondents are selected. For this research study, the convenience sampling method was selected for the distribution of the questionnaire survey. The questionnaire survey was distributed through an electronic survey to potential buyers who intended to purchase a residential property located in the Iskandar, Malaysia Region in the near future for their usage or investment purposes. A partial respondent list was obtained from the customers of local developers, and this list was further extended through the snowballing sampling technique. Findings

have shown that email and Internet-facilitated surveys can yield higher returns at a lower cost per returned questionnaire (Al-Omiri, 2007). Moreover, such surveys are also a relatively inexpensive and expedient means of communicating with respondents, while facilitating a convenient way of correcting misunderstandings and following up on missing data. Studies have also shown that a hard-to-reach audience can be reached by the implementation of an electronic survey (Andrews et al., 2010).

The questionnaire consisted of two parts. Part A asked about the demographic background of each respondent and Part B list out the green features identified through the comparison of green features listed in the literature, GBI, and GreenRE, that were available by developers in the existing residential properties. Respondents were asked to fill in the percentage of premium he or she was willing to pay for each of the listed green features on top of the property price. Example:

“How much are you willing to pay for each of the following green features on top of the property price?”

<i>Solar Photovoltaic</i>	_____ %
---------------------------	---------

A total of 830 sets of questionnaires in the electronic format were distributed to potential buyers of a residential property in Iskandar, Malaysia via online distribution through the convenience sampling method. Buyers are contacted through emails. Based on the return rate of the completed questionnaire survey forms, this study had 410 respondents. 16 respondents were voided due to unreasonable responses. Overall, the response rate for this study was 49.3%.

4. FINDINGS

The collected data was submitted for descriptive analysis. The demographic background of the respondents was summarized in Section A of the questionnaire. Descriptive statistics calculate the number of respondents for each category, including gender, educational background, annual household income, etc. The purpose of descriptive analysis is to understand the demographic profiles of respondents and to identify whether they have plans to buy a residential property within the next three years. Respondent demographics are presented in Table 5.

Table 5: Respondent Demographics

Variable	Description	Percentage (%)
Gender	Female	58.6
	Male	41.4
Age	21-30	54.8
	31-40	15.7
	41-50	7.6
	51-60	16.2
	Above 60	5.6
Education Level	Degree	57.6
	Diploma	14.2
	Lower Secondary	5.1
	Master	6.6
	PhD	1.8
Annual Household Income	Above RM120,000	7.6
	Below RM24,000	34.0
	RM24,000 - RM36,000	18.8
	RM36,000 - RM48,000	13.2
	RM48,000 - RM60,000	10.4
	RM60,000 - RM120,000	16.0
Plan to buy a residential property within the next three (3) years	Yes	49.5
	No	50.5

Source: Author Compilation

In Part B of the questionnaire, the respondent was asked to fill in the percentage of premium he or she was willing to pay for specific green features on top of the property price. The green features were arranged according to the four common criteria shared by the Green Building Index and GreenRE, which were: (1) Energy Efficiency; (2) Indoor Environment Quality; (3) Water Efficiency; and (4) Innovation and Others. Frequency analysis was adopted to analyse their suggested percentage of the premium. The results will help researchers identify users' willingness to pay for each specific green feature available in a residential property.

Table 6: Percentage Premium for Each Green Feature

	Descriptive Statistics	
	N	Mean
Energy Efficiency (EE)		
Solar Shading Device	394	4.99%
Solar Water Heating System	394	5.22%
Green Roof or Roof Garden	394	5.25%
Solar Photovoltaic	394	5.47%
Lighting with Motion Sensor	394	5.51%
Indoor Environmental Quality (IEQ)		
Low Toxicity Finishes and Furnishing	394	5.83%
Natural Ventilation Design	394	6.36%
Sound Insulation Design	394	6.66%
Sufficient Day Lighting	394	6.95%
Water Efficiency (WE)		
Rainwater Harvesting System	394	5.59%
Water Efficient Fittings	394	6.23%
Innovation and Others (IO)		
Building Passive Cooling Design	394	6.62%
Smart Home System	394	7.25%

Source: Author Compilation

Among the 13 listed green features, the study found that users had the greatest willingness to pay for Smart Home System ($\mu=7.25\%$), followed by Sufficient Day Lighting ($\mu=6.95\%$), Sound Insulation Design ($\mu=6.66\%$), Building Passive Cooling Design ($\mu=6.62\%$), and Natural Ventilation Design ($\mu=6.36\%$). The study found that users had a higher willingness to pay for green features in the “Indoor Environment Quality (IEQ)” and “Innovation and Others (IO)” criteria.

The study also found that users had relatively lower willingness to pay for Solar Shading Device ($\mu=4.99\%$), followed by Solar Water Heating System ($\mu=5.22\%$), Green Roof or Roof Garden ($\mu=5.25\%$), Solar Photovoltaic ($\mu=5.47\%$), Lighting with Motion Sensor ($\mu=5.51\%$), and Rainwater Harvesting System ($\mu=5.59\%$). It was established that the willingness to pay for green features in the “Energy Efficiency (EE)” and “Water Efficiency (WE)” criteria were relatively lower than the other criteria. Among these two criteria (EE and WE), building users show a higher willingness to pay for Water Efficient Fittings ($\mu=6.23\%$).

4.1 Chi-square Test of Independence

The Chi-Square Test of Independence was adopted to analyse the relationship between the intention to buy a house within the next three years and the willingness to pay for each specific green feature available in a residential property. A significant likelihood ratio greater than 0.05 indicates that there is no association between the intention to buy a house within the next three years and the willingness to pay for each specific green feature available in a residential property, while a significance level less than 0.5 indicates the opposite. In the case where the alternative hypotheses ($\alpha \leq 0.05$) were accepted, Cramer's V value was then used to determine the measure of association. Cramer's V values equivalent to or lesser than 0.2 indicated a weak association, Cramer's V values greater than 0.2 but smaller than 0.3 indicated a moderate association, while Cramer's V values greater than 0.3 indicated a strong association between two variables.

In this study, it was found that the majority of respondents' willingness to pay for green features had no association with their plans to buy a house within the next three years, except the willingness to pay for Solar Photovoltaic and Low Toxicity Finishes and Finishing. A Cramer's V value (0.316) greater than 0.3 indicates that a plan to buy a house within the next three years had a strong and significant effect on a respondent's willingness to pay for solar photovoltaics. A Cramer's V value (0.282) between 0.2 and 0.3 indicates that a plan to buy a house within the next three years had a moderately significant effect on a respondent's willingness to pay for low toxicity finishes and finishing.

Table 7: Chi-Square Tests for "Are you planning to buy a residential property within the next three (3) years?" *Solar Photovoltaic

	Value	df	Asymptotic Significance (2-Sided)
Pearson's Chi-Square	39.222a	20	.006
Likelihood Ratio	42.889	20	.002
N of Valid Cases	394		

Table 8: Symmetric Measures for "Are you planning to buy a residential property within the next three (3) years?" *Solar Photovoltaic

		Value	Approximate Significance
Nominal by Nominal	Phi	.316	.006
	Cramer's V	.316	.006
N of Valid Cases		394	

Table 7 and 8 each show the Chi-Square Tests and Symmetric Measures, respectively, for "Are you planning to buy a residential property within the next three (3) years?" *Solar Photovoltaic. The asymptotic significance value (0.002) showed a likelihood ratio of less than 0.05. The null hypothesis was rejected and the alternative hypothesis was accepted. There was an association between the plan to buy a house within the next three years and the willingness to pay for solar photovoltaics. The Cramer's V value (0.316) was greater than 0.3, indicating that a plan to buy a house within the next three years has a strong and significant effect on the willingness to pay for solar photovoltaics.

Table 9: Chi-Square Tests for “Are you planning to buy a residential property within the next three (3) Years” *Low Toxicity Finishes and Furnishing

	Value	df	Asymptotic Significance (2-Sided)
Pearson's Chi-Square	31.303 ^a	20	.051
Likelihood Ratio	36.049	20	.015
N of Valid Cases	394		

Table 10: Symmetric Measures for “Are you planning to buy a residential property within the next three (3) years?” *Low Toxicity Finishes and Furnishing

		Value	Approximate Significance
Nominal by Nominal	Phi	.282	.051
	Cramer's V	.282	.051
N of Valid Cases		394	

Table 9 and 10 each show the Chi-Square Tests and Symmetric Measures, respectively, for “Are you planning to buy a residential property within the next three (3) years?” *Low Toxicity Finishes and Furnishing. The asymptotic significance value (0.015) showed a likelihood ratio of less than 0.05. The null hypothesis was rejected, and the alternative hypothesis was accepted. There was an association between a plan to buy a house within the next three years and the willingness to pay for low toxicity finishes and furnishing. The Cramer's V value (0.282) was greater than 0.2 but less than 0.3, indicating that a plan to buy a house within the next three years has a moderate but significant effect on the willingness to pay for low toxicity finishes and furnishing.

4.2 Discussion

The study found that the respondents had a higher willingness to pay for the green features in the “Indoor Environment Quality (IEQ)” and “Innovation and Others (IO)” criteria. Among the 13 listed green features, respondents showed the highest willingness to pay for Smart Home System ($\mu=7.25\%$). Smart home services are developing and proliferating today through the adoption of the Internet of Things (IoT) and Artificial Intelligence (AI) (Yang, Lee & Lee, 2018). Malaysian smart home is projected to reach US\$195m in the year 2021 (Statista, 2020). It was found that the components of safety and security controls were the main features that made a majority of respondents more willing to pay to install Smart Home Systems in their houses (Hidayati, Mokhtar & Ismail, 2018).

The overall willingness to pay for green features in the “Indoor Environment Quality (IEQ)” criteria is high because of the hot and humid weather in Malaysia. Nevertheless, Malaysia also has plenty of rainfall and erratic wind movements throughout the year, making it rational to integrate both passive and active designs into a building (Al-Obaidi, Ismail & Abdul Rahman, 2014), as negligence towards climate control in the design of residential buildings can lead to uncomfortable indoor thermal conditions, affecting the efficiency, health, and quality of life of residents (Jamaludin, Mohammed, Khamidi & Wahab, 2015). When deciding to buy a house, comfort is the most important factor for house buyers or owners. The hot and humid climate of Malaysia has become the main factor that makes house owners willing to make financial

compensation or pay extra for green features that contribute to increased indoor environment quality and have cooler and more comfortable internal temperatures.

Passive cooling techniques showed a high willingness to pay from building users, probably because Free Running (FR) passive cooling strategies are effective for indoor thermal environments in a Malaysian two-storey terrace house (Tuck et al. 2019). The installation of ceiling insulation and window shading systems in Malaysian terraced houses helps decrease operating temperatures in the afternoon (Kubota, Chyee & Ahmad, 2009). Night-time ventilation has also been found to be efficient in reducing the nocturnal use of air-conditioners. Building users also rely on passive cooling by opening windows instead of solely relying on the use of air-conditioners and electric fans when maintaining thermal comfort. These passive cooling techniques contribute to energy savings and are efficient at reducing household running costs (Majid, Salehudin, Rahim & Othman, 2015).

Apart from indoor thermal comfort, the indoor noise environment, taking into account the sound insulation of building components such as floors, walls, and windows, is an important factor in the selection of residential buildings (Jeon et al., 2010). Building users or owners are willing to pay more for sound insulation to avoid noise from the external environment and to increase privacy. On the other hand, it is established in this study that the willingness to pay for green features in the "Energy Efficiency (EE)" and "Water Efficiency (WE)" criteria was relatively lower than the other criteria. Among these two criteria (EE and WE), building users showed a higher willingness to pay for Water Efficient Fittings ($\mu=6.23\%$). The debate over whether the inclusion of other energy efficiency and sustainable systems, such as rainwater harvesting ($\mu=5.59\%$) and solar panels ($\mu=5.47\%$) is essential seems to be even-handed (Majid et al., 2015). Respondents perceived that although these green features might provide certain advantages but were not necessarily willing to pay more money just to include them in the house.

Building users showed an inclination toward energy efficiency in houses while comfort (64%) and privacy (47%) were the main considerations in choosing and building new houses (Majid, et al, 2015). Residents were willing to pay more when purchasing a green residential property as they needed a safe and healthy environment in which to reside and enjoy their lives (Hu, Geertman & Hooimeijer, 2014). Occupants found it pertinent to install air conditioning for their indoor comfort, which contributes to increased energy usage in a building (Jamaludin, Mohammed, Khamidi & Wahab, 2015). The overall lower willingness to pay for "energy-efficiency (EE)" green features can be attributed to the low electricity tariff in Malaysia. However, low energy prices and a lack of financial incentives for energy efficiency are key barriers that have prevented the widespread adoption of energy-efficient practices in Malaysia. Low energy prices prevent energy efficiency as consumers are less concerned about energy costs. Furthermore, the return from energy efficiency investments will take longer as returns in terms of energy savings are small due to low energy prices. Moreover, dedicated finance for energy efficiency from commercial lending institutions has been difficult to obtain, as banks have not built sufficient capacity to deal with energy efficiency project evaluation and project finance schemes. The lower willingness to pay for "Water Efficiency (WE)" green features can be attributed to the low water tariff in Malaysia. This low tariff does not encourage new water reduction technology innovations and stands in contrast to the Green Technology aspirations (Malek, Nor & Leong, 2013). As demand is price-responsive, low water pricing has caused severe water wastage. The ability of almost all households in Malaysia to pay a low-priced water bill has contributed to the extravagant use of water and

poor water conservation in the nation (Chan, 2009). Furthermore, most respondents will consider changing domestic activities to use less water and changing their behaviour before considering water conservation technologies (Adeyeye, 2012).

In this study, it was found that the majority of respondents' willingness to pay for green features had no association with their plans to buy a house within the next three years, except the willingness to pay for Solar Photovoltaic and Low Toxicity Finishes and Finishing. Regarding solar photovoltaics, the Sustainable Energy Development Authority (SEDA) in Malaysia and Tenaga Nasional Malaysia, the only electricity utility company have promoted the benefits of installing solar panels in Malaysia and are well-received by the public. Feed-in tariff for solar panels is available in Malaysia and there is an opportunity that the energy generated from the energy produced to the utility grid at a premium Rate. However, the public may still take further caution when it comes to installing and investing in solar panels. Mariadas, Abdullah & Abdullah (2019) found that financial factors had a positive relationship with residential property purchase decisions. The period for the payment, interest rate, ability to meet monthly payments, and mortgages were included in financial factors, and there are some hidden costs, such as homeowner insurance premiums and utilities, that needed to be considered. The initial cost of installing photovoltaic (PV) panel systems has also become a major consideration for house owners when adopting green features (Gul et al., 2016). The components of a residential solar PV system may include solar array mounting racks, inverters, array DC disconnects, battery packs, breaker panels, AC panels, and circuit breaker panels. This means it will take around RM60,000 or more for a full collection of solar PVs, excluding installation costs (Solar Panel Malaysia, 2020). The homeowners may have to use personal loans to install the solar panels for their homes.

The findings also suggest that the plan to buy a house within the next three years has a moderate but significant effect on the willingness to pay for low-toxicity finishes and furnishing. When choosing the finish and finishing materials for a house, the main consideration of a house owner is how the finishes will make the interior appealing, beautiful, and attractive. The second utmost important matter is the hygiene and health factor (Zinas, 2013). The cost of opting for non-toxicity finishes and finishing such as low VOC paint will be higher than their counterparts. However, it is worth the extra cost when compared to the reduced risk of chemical harm during application and future occupation. When moving into a new house, the pungent smell of the newly applied finishes and finishing will often be a main concern for house occupants (Freed & Daum, 2010). The odour intensity and the potential particle reaction among reactive compounds and reaction products can hurt the health of a building occupant. House owners are willing to pay more for low-toxicity finishes and finishing to reduce the negative impact of allergy-causing toxins. Overall, the results revealed that the green features contribute most to providing users was home experience and comfort, which represents how much a user feels comfortable and engaged when at home. This was observed through a higher willingness to pay of such features by building users.

5. CONCLUSION

Overall, the results revealed that the green features that contribute most to a user's willingness to pay were comfort and a better home experience. The "Smart Home System" had the highest mean score for a user's willingness to pay while the "Green Roof or Roof Garden" had the lowest mean score for a user's willingness to pay. This study found that users had a higher willingness to pay for

green features in the “Indoor Environment Quality (IEQ)” and “Innovation and Others (IO)” criteria. The willingness to pay for green features in the “Energy Efficiency (EE)” and “Water Efficiency (WE)” criteria was relatively low.

In this study, it was found that the majority of the willingness to pay for green features had no association with an intention to buy a house within the next three years, while the willingness to pay for Solar Photovoltaic and Low Toxicity Finishes and Finishing has an association with an intention to buy a house within the next three years. As this research focuses on identifying the willingness to pay for each specific green feature available in a residential property, the results will be best applied and provide the biggest advantages to property developers, real estate agents, and home buyers themselves. Although developers have made an effort to implement green features into building design, not all are keen to or have made efforts to fulfil the needs and demands of buyers. Looking into the green features that have been made available in existing residential properties, it was found that green features with a lower willingness to pay were Solar Water heating System ($\mu=5.22\%$). Green Roof or Roof Gardens ($\mu=5.25\%$) and Rainwater Harvesting System ($\mu=5.59\%$) were the green features that are most made available by developers in existing residential properties.

Developers who wish to undertake a green residential project should seize the initiative to incorporate green features with a high willingness to pay by users, as an implementation of a premium pricing strategy that will maximise profits. Therefore, referring back to the research findings, residential properties are suggested to incorporate green features in the “Innovation and Others (IO)” and “Indoor Environmental Quality” criteria. Smart Home System ($\mu=7.25\%$) is a rising trend that is most demanded by residential property buyers and users in this Internet of Things (IoT) era. The focus should also be to green features that provide comfort, especially indoor thermal comfort, and privacy to residential property users, such as Sufficient Day Lighting ($\mu=6.95\%$), Sound Insulation Design ($\mu=6.66\%$), Building Passive Cooling Design ($\mu=6.62\%$), and Natural Ventilation Design ($\mu=6.49\%$).

The findings mentioned herein should be regarded in the light of certain limitations. First, this study focused on the Iskandar, Malaysia region and therefore cannot be generalized to the entire population. In addition, a questionnaire was distributed in electronic form to potential house buyers, which may cause bias that reduces the overall validity of this analysis. The researcher may have had a limited capacity to gain access to participants or an appropriate type or within a certain geographic scope. It is recommended that in future studies, questionnaires be distributed face-to-face in order to increase the representativeness and validity of the study. It is also recommended that the willingness to pay for green features be identified using some other method, besides the Contingent Valuation Method, in the Stated Preference Techniques. Other valuation approaches such as the Revealed Preference Technique can also be used to identify the willingness to pay for green features.

ACKNOWLEDGEMENT

This work was supported by Universiti Teknologi Malaysia under the UTM Fundamental Research (UTMFR, Q.J130000.3852.21H80).

REFERENCES

- Abu-Zreig, M., Ababneh, F. and Abdullah, F. (2019) . Assessment of rooftop rainwater harvesting in northern Jordan. *Physics and Chemistry of the Earth*. Elsevier, 114(February), 102794.
- Adeyeye, K. (2012). User attitudes and preferences - a study for Water Efficiency in UK Homes [Paper Presentation]. International Congress on Construction Management Research, Canada, Montreal.
- Al-Obaidi, K. M., Ismail, M., & Abdul Rahman, A. M. (2014). Passive cooling techniques through reflective and radiative roofs in tropical houses in Southeast Asia: A literature review. *Frontiers of Architectural Research*, 3(3), 283–297. <https://doi.org/https://doi.org/10.1016/j.foar.2014.06.002>
- Al-Omiri, M. (2007). A preliminary study of electronic surveys as a means to enhance management accounting research. *Management Research News*, 30(7), 510–524.
- Andrews, D., Nonnecke, B. and Preece, J. (2010). International journal of human- electronic survey methodology : A case study in reaching hard-to-involve internet users electronic survey methodology : A case study in reaching hard-to-involve internet users. *International Journal of Human-Computer Interaction*, 16(2), 185–210.
- Aroul, R. R. and Rodriguez, M. (2017). The increasing value of green for residential real estate. *Journal of Sustainable Real Estate*, 9(1), 112–130.
- Ascione, F., Bianco, N., de' Rossi, F., Turni, G. and Vanoli, G. P. (2013). Green roofs in European climates. Are effective solutions for the energy savings in air-conditioning?', *Applied Energy*, 104, 845–859.
- Berglund, B., Lindvall, T. and Schwela, D. H. (2000). New Who Guidelines for Community Noise. *Noise & Vibration Worldwide*, 31(4), 24–29.
- Chan, N. W. (2009). Issues and challenges in water governance in Malaysia. *Iranian Journal of Environmental Health Science and Engineering*, 6(3), 143–152.
- Cheng, C. L., Peng, J. J., Ho, M. C., Liao, W. J. and Chern, S. J. (2016). Evaluation of water efficiency in green building in Taiwan. *Water (Switzerland)*, 8(6), 1–11.
- Darko, A., Chan, A., Effah, E., He, B.-J. and Olanipekun, A. (2017). Examining issues influencing green building technologies adoption: The united states green building experts' perspectives. *Energy and Buildings*, 144, 320–332.
- Deng, Y., Li, Z. and Quigley, J. M. (2012). Economic returns to energy-efficient investments in the housing market: Evidence from Singapore. *Regional Science and Urban Economics*. Elsevier B.V., 42(3), 506–515.
- Deru, M. P. and Burns, P. J. (2003). Infiltration and natural ventilation model for whole building energy simulation of residential buildings. *ASHRAE Transactions*, 109 PART 2(March), 801–811.
- Dikel, E. E., Newsham, G. R., Xue, H. and Valdés, J. J. (2018). Potential energy savings from high-resolution sensor controls for LED lighting. *Energy and Buildings*. Elsevier B.V., 158, 43–53.

- Dwaikat, L. N. and Ali, K. N. (2016). Green buildings cost premium: A review of empirical evidence. *Energy and Buildings*. Elsevier B.V., 110, 396–403.
- Dwaikat, L. N. and Ali, K. N. (2018). The economic benefits of a green building – Evidence from Malaysia. *Journal of Building Engineering*. Elsevier Ltd, 18(February), 448–453.
- Etikan, I. (2016). Comparison of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1.
- Evangelisti, L., Guattari, C., Asdrubali, F. and de Lieto Vollaro, R. (2020). An experimental investigation of the thermal performance of a building solar shading device. *Journal of Building Engineering*. Elsevier Ltd, 28(July 2019), 101089.
- Feliciano, M., & Prosperi, D. C. (2011). Planning for low carbon cities: Reflection on the case of Broward County, Florida, USA. *Cities*, 28(6), 505–516. <https://doi.org/https://doi.org/10.1016/j.cities.2011.04.004>
- Fowler, K. M. and Rauch, E. M. (2006). Sustainable building rating systems summary. *Contract*, (July 2006), 1–55.
- Freed, E. C. and Daum, K. (2010). Green Sense for the home : Rating the real payoff from 50 green home projects. Newton, CT: Taunton Press.
- Fuerst, F. and McAllister, P. (2011). Green noise or green value? Measuring the effects of environmental certification on office values. *Real Estate Economics*, 39(1), 45–69.
- Green Building Index (2020). GBI Residential New Construction (RNC). Retrived from <https://www.greenbuildingindex.org/Files/Resources/GBI%20Tools/GBI%20RNC%20Residential%20Tool%20V2.0%20Final.pdf>
- GreenRE (2020). Design Reference Guide for Residential Buildng and Landed Home. Retrived from https://greenre.org/uploads/1/0/7/1/107142097/res_v3.1_-_rev1.pdf
- Gul, M., Kotak, Y. and Muneer, T. (2016) . Review on recent trend of solar photovoltaic technology. *Energy Exploration and Exploitation*, 34(4), 485-526.
- Heetae Yang, Wonji Lee, Hwansoo Lee. IoT smart home adoption: The importance of proper level automation. *Journal of Sensors*, Vol. 2018, Article ID 6464036, 11 pages, 2018. <https://doi.org/10.1155/2018/6464036>
- Heracleous, C. and Michael, A. (2019). Experimental assessment of the impact of natural ventilation on indoor air quality and thermal comfort conditions of educational buildings in the Eastern Mediterranean region during the heating period. *Journal of Building Engineering*. Elsevier Ltd, 26(August), 100917.
- Hostetler, M. and Noiseux, K. (2010). Are green residential developments attracting environmentally savvy homeowners?. *Landscape and Urban Planning*, 94(3–4), 234–243.

- Hu, H., Geertman, S. and Hooimeijer, P. (2014). Green apartments in Nanjing China: Do developers and planners understand the valuation by residents?. *Housing Studies*. Taylor & Francis, 26–43.
- ISO (2013) 'BS EN ISO 717-1 Standards Publication Acoustics — Rating of sound insulation in buildings and of building elements Part 1 : Airborne sound insulation', *Standards*.
- Jamaludin, N., Mohammed, N. I., Khamidi, M. F. and Wahab, S. N. A. (2015). Thermal Comfort of Residential Building in Malaysia at Different Micro-climates. *Procedia - Social and Behavioral Sciences*, 613–623.
- Jamaludin, N., Mohammed, N. I., Khamidi, M. F., & Wahab, S. N. A. (2015). Thermal comfort of residential buildings in Malaysia at different micro-climates. *Procedia - Social and Behavioral Sciences*, 170, 613–623.
- Jeon, J. Y., Ryu, J. K. and Lee, P. J. (2010) . A quantification model of overall dissatisfaction with indoor noise environment in residential buildings. *Applied Acoustics*. Elsevier Ltd, 71(10), 914–921.
- Kenway, S., Binks, A., Lane, J., Lant, P., Lam, K. L. and Simms, A. (2015). A systemic framework and analysis of urban water energy. *Environmental Modelling & Software*. 73, 272–285.
- Kubota, T., Chyee, D. T. H. and Ahmad, S. (2009). The effects of night ventilation technique on the indoor thermal environment for residential buildings in hot-humid climate of Malaysia. *Energy and Buildings*, 829–839.
- Lee, M. and Tansel, B. (2012). Life cycle based analysis of demands and emissions for residential water-using appliances. *Journal of Environmental Management*, 101, 75–81.
- Li, Q., Long, R. and Chen, H. (2018). Differences and influencing factors for Chinese urban resident willingness to pay for green housings: Evidence from five first-tier cities in China. *Applied Energy*, 229(July), 299–313.
- Majid, N. H. A., Salehudin, M. S., Rahim, Z. A. and Othman, R. (2015). Indoor environmental regulation through preference and behaviour of inhabitants in houses. *Procedia - Social and Behavioral Sciences*, 170(October), 527–536.
- Majid, N. H. A., Salehudin, M. S., Rahim, Z. A. and Othman, R. (2015). Indoor environmental regulation through preference and behaviour of inhabitants in houses. *Procedia - Social and Behavioral Sciences*, 170(October), 527–536.
- Malek, M. A., Nor, M. A. M. and Leong, Y. P. (2013). Water security and its challenges for Malaysia. IOP Conference Series: Earth and Environmental Science, 16(1).
- Mariadas, P. A., Abdullah, H. and Abdullah, N. (2019). Factors Influencing the First Home Purchase Decision of Middle-Income Earners (M40) in Selangor, Malaysia. e-Bangi, 16(1), 1–11.
- Mehrabadi, R., Saghafian, B. and Haghighi Fashi, F. (2013). Assessment of residential rainwater harvesting efficiency for meeting non-potable water demands in three climate conditions. *Resources Conservation and Recycling*, 73, 86–93.

- Meng, X., Gao, Y., Wang, Y., Yan, B., Zhang, W. and Long, E. (2015). Feasibility experiment on the simple hot box-heat flow meter method and the optimization based on simulation reproduction. *Applied Thermal Engineering*. Elsevier Ltd, 83, 48–56.
- Muldavin, S. R. (2010). Value Beyond Cost Savings. How to Underwrite Sustainable Properties 3(March), 323.
- Ozel, M. (2013). Thermal, economical and environmental analysis of insulated building walls in a cold climate. *Energy Conversion and Management*. Elsevier Ltd, 76, 674–684.
- Runde, T. and Thoyre, S. (2010). Integrating sustainability and green building into the appraisal process. *Journal of Sustainable Real Estate*, 2(1), 221–248.
- Ryu, J. and Song, H. (2019). Effect of building façade on indoor transportation noise annoyance in terms of frequency spectrum and expectation for sound insulation. *Applied Acoustics*. Elsevier Ltd, 152, 21–30.
- Solar Panel Malaysia. (2020). Installation Prices for Solar PV Power Systems. Retrieved 15 July 2020, from <https://www.solarpanelmalaysia.com/basic/solar-panel-installation-cost/#:~:text=It%20would%20take%20approximately%20RM60,be%20considered%20as%20worth%20it.>
- Statista (2020). Smart Home- Malaysia. Retrieved from <https://www.statista.com/outlook/279/122/smart-home/malaysia>
- Tuck, N. W., Zaki, S. A., Hagishima, A., Rijal, H. B., Zakaria, M. A., & Yakub, F. (2019). Effectiveness of free running passive cooling strategies for indoor thermal environments: Example from a two-storey corner terrace house in Malaysia. *Building and Environment*, 160, <https://doi.org/10.1016/j.buildenv.2019.106214>
- Turan, I., Chegut, A., Fink, D. and Reinhart, C. (2020). The value of daylight in office spaces. *Building and Environment*. Elsevier Ltd, 168(August 2019), 106503.
- Uhde, E. and Salthammer, T. (2007). Impact of reaction products from building materials and furnishings on indoor air quality-A review of recent advances in indoor chemistry. *Atmospheric Environment*, 41(15), 3111–3128.
- Wadu Mesthrige, J. and Kwong, H.Y. (2018). Criteria and barriers for the application of green building features in Hong Kong. *Smart and Sustainable Built Environment*, Vol. 7 No. 3/4, 251-276. <https://doi.org/10.1108/SASBE-02-2018-0004>
- Wan Hidayati Wan Mokhtar, Azizah Ismail. (2018) Adoption of smart home technologies features among the homeowners in Hulu Langat, Selangor. *International Journal of Real Estate Studies*, 12 (2): 2. 9-20. ISSN 1832-8505
- Wang, Y., Huang, Z. and Heng, L. (2007) 'Cost-effectiveness assessment of insulated exterior walls of residential buildings in a cold climate. *International Journal of Project Management*, 25(2), 143–149.

- Yusof, N., Awang, H. and Iranmanesh, M. (2017). Determinants and outcomes of environmental practices in Malaysian construction projects. *Journal of Cleaner Production*. Elsevier Ltd, 156, 345–354.
- Zinas, B. Z. (2013). Housing interior floor finishes choice and preference and motivations for achievement of person-environment congruence. *International Journal of Engineering Research and Applications*, 3(2), 1404–1412.