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# Impact of Indoor Environmental Quality (IEQ) and Innovation (IN) Features on Residential Property Price in Malaysia: A Review

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## Abstract

**Purpose** – The purpose of this paper is to review the broad literature regarding the impacts of indoor environmental quality (IEQ) and innovation (IN) for residential building property and its implication towards property price and rental. The early hypothesis of this paper anticipate that innovation (IN) and indoor environmental quality (IEQ) features will indirectly increase residential property market price and rental in spite of the lack of comparative financial data.

**Research limitations/implications** – This research will focus on multi-storey residential buildings. They are condominium, apartment or service apartment with IN and IEQ features based on Green Building Index (GBI) assessment criteria. In this research, IN and IEQ features will be defined according to the description of Green Building Index (GBI) Assessment Criteria for New Residential Construction (RNC).

**Originality/value** – To the best of researcher's knowledge, in the context of Malaysia there is no single study emphasized on the significant role of IEQ and IN criteria especially its interrelation with property price and value.

From this paper, it is hope that the positive impacts of these features will encourage building owners, developers and other main development actors to put these criteria into the same consideration as other criteria in GBI as one of the way to compensate the impact of the building towards economic, environment and social.

**Keywords:** Green Building Index (GBI), green building features, indoor environmental quality, innovation, property price and rental, residential property

## 1. Introduction

Previous studies have identified four major categories of factors that affect house prices, namely structural, economic, demographic and environmental factors (Damigos and Anyfantis, 2011; Hui *et al.*, 2007; Jiao & Liu, 2010). Environmental factors are related to energy consumption and savings. Studies conducted revealed almost 40% of the total

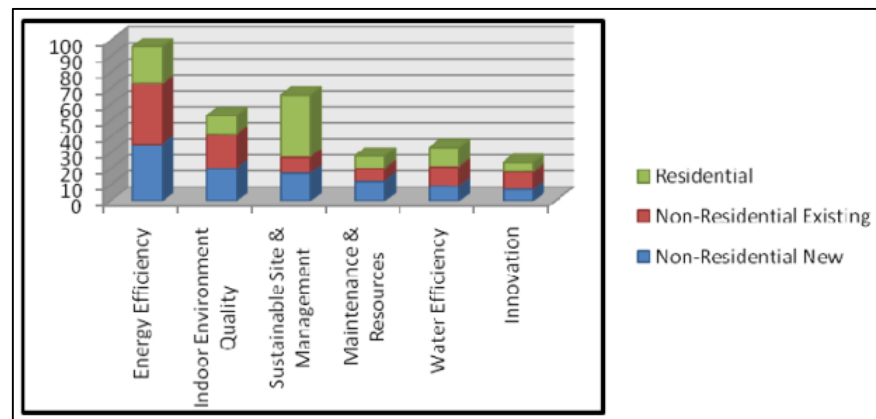
energy consumption is for the construction sector and of which 30% is for the purpose of housing (UNEP, 2006).

Malaysia shows a moderate population growth with population density of about 29.9 million and continues to grow at the rate of 2.4% per annum (Department of Statistics Malaysia, 2013). The need and demand for housing is overwhelming especially in urban area. The compact and rapid growth of development consists of several types of construction that leads to energy consumption as well as carbon emission. To overcome global warming and other imbalance environmental problem, construction sector took parts in reducing the impacts by balancing up the average air temperature and composition of greenhouse gases by introduced the green building concept (Tan, 2012).

However, Malaysian housing developers are still evaluating the costs and benefits to build a green building since many of them are very concerned with the extra construction cost. Besides, the additional cost during green construction is recognized among ten (10) main barriers in green building development. Thus, this issue becomes more crucial due to the unstable housing prices in Malaysia that may affect their profit.

In Malaysia, green building is certified by six main criteria. They are energy efficiency (EE), water efficiency (WE), indoor environmental quality (IEQ), sustainable site management and planning (SM), material and resources (MR) as well as innovation (IN) (Greenbuildingindex Sdn. Bhd., 2013). Figure 1 below ranked the importance of green building criteria in GBI. IEQ is located at the second position for new non-residential building and third for residential whereas IN took last position in every types of building. The significant criteria of IEQ and IN will be discussed later.

*Figure 1: GBI point allocation (Ghodrati, Samari and Mohd Shafiei, 2012).*



There are several studies on climate change impacts on diverse aspects of human life, such as energy consumption, water resources, health, public awareness, politics, government incentives and agriculture have been conducted. Other than that, direct contact with nature through green space allocation around the building for air quality enhancement, health and interior quality improvement does bring positive impacts on the urban real estate market. Therefore, every single aspect especially in terms of how much to pay for green and environmental benefits should be discussed.

## 2. Green building

Samari *et al.*, (2013) stated that green buildings are designed to reduce negative impacts on the environment as well as increase occupant's health by addressing five factors. They are:

- i. Sustainable site planning;
- ii. Safeguarding water and water efficiency;
- iii. Energy efficiency, renewable energy and lower greenhouse gas emissions;
- iv. Conservation and the reuse of materials and resources; and
- v. Improved health and indoor environmental quality.

Many researchers have listed green building benefits through different stand point and aspects. When it comes to green building, the environmental benefits will be the ultimate aims to be achieved. Solidiance Singapore and Singapore Green Building Council (2010) explained that the benefits of green building are mainly to reduce pollution, waste and environmental degradation.

Table 1 below shows the numbers of benefits reported by those engaging in green building for new green buildings as well as the greening of existing building through retrofits and renovation projects according to Mc-Graw Hill Construction (2013).

**Table 1:** Green Building benefits expected from green building investment

Benefits	New Green Building	Green Retrofit
Decreased operating costs over one year	8%	9%
Decreased operating costs over five years	15%	13%
Increased building value for green versus non-green projects	7%	5%
Increased Asset value for green versus non-green projects	5%	4%
Payback time for green investments	8 years	7 years

Another significant of green building construction is to improve quality of life of its inhabitants and also translates the building design into better health and productivity. Green building concept also meant to construct a building to minimize the impact of the building to the environment by reducing demand on resources and materials.

### 2.1 Indoor environmental quality features

IEQ is a key component in the evaluation for meeting the concept of green building that aims towards sustainable development. There are four main elements in IEQ, which are (1) thermal (temperature and humidity); (2) noise comfort; (3) indoor air quality (air movement CO<sub>2</sub> concentration); and (4) lighting. The main purpose of applying the IEQ element is to prevent from experiencing sick building syndrome (Sulaiman, Yusof and Kamarudin, 2013).

Global warming is anticipated to have strong implications on future energy demands of buildings; with regards to the overheating aspects. Therefore, IEQ characteristic is

the solution. An imbalance of IEQ will give negative impacts to facilities, building and occupants. It is not limited for air pollution, thermal conditions, humidity, sound, lighting and odor but also includes the use of energy, design and natural ventilation (Aliffadilah, 2008).

IEQ is rarely considered as a priority in most development planning and management. IEQ elements account for 12% of green building evaluation criteria for residential building (Greenbuildingindex Sdn. Bhd., 2013). However, the concentration for the balancing of IEQ is crucial as it very closely related to thermal comfort that comprise the temperature and humidity that will influence the indoor quality. Moreover, the quality of occupant's health and satisfaction are more important since they will be affected by the quality function in a building. According to Sulaiman, Yusof and Kamarudin (2013), 13% of respondent give suggestions to improve building indoor quality through green technology.

According to GBI, IEQ can be achieved through good quality performance in indoor air quality, acoustics, visual and thermal comfort. These will involve the use of low volatile organic compound materials, application of quality air filtration, proper control of air temperature, movement and humidity. Based on this achievement, IEQ will contribute to conducive environment to human health and productivity (Browning and Romm, 1995). Hence, occupants will be more satisfied on the thermal comfort, air quality and overall workspace.

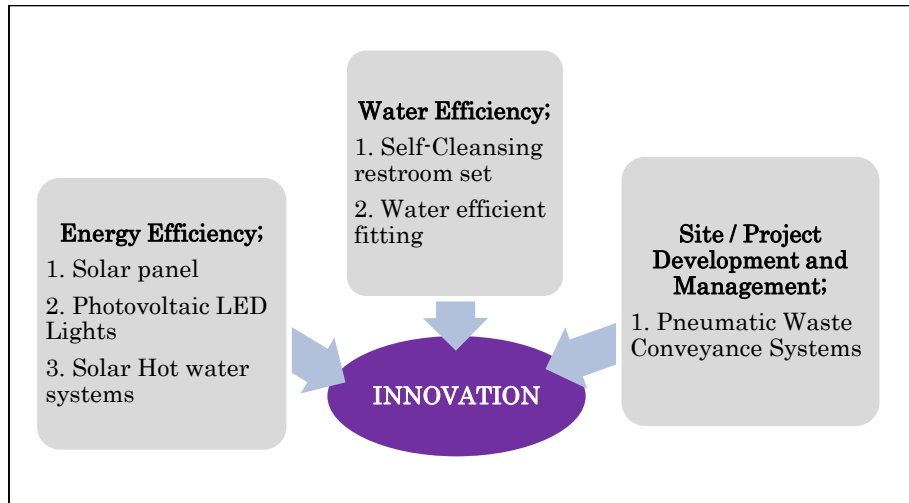
## **2.2 Innovation (IN)**

IN is more likely associated with innovative design and green approaches to meet GBI objectives. Among the green approaches by developer include the application of green landscape on the wall, roof and around the building which can help to reduce the energy usage and improve thermal comforts of the occupants (Akbari and Taha, 1992). This will also contribute to better interior environment quality in the building. Thus, among the green approaches that can contribute under this criterion are vertical green wall, herb and food garden, and external shading devices as well as LED façade lighting.

According to Figure 1, the IN criteria comprise three main criteria in GBI qualifications namely Energy Efficiency, Water Efficiency and Site Project Development and Management. These elements provide their own benefits and advantages prior to environmental enhancements. As reveal on Figure 1 above, it seems that IN features likely to take small part in green building. However, Figure 1 shows that IN covers the main criteria i.e. the tools in EE.

For instance, even though solar energy is the worst enemy to the thermal comfort, the use of photovoltaic energy in Malaysia, seems to be utilized well in order to assist in energy saving. Furthermore, the application of green roof where planting of vegetation on rooftop, is an extremely effective method for reducing heat island effect, which has become common phenomenon in the cities (Wagner and Omran, 2011).

**Figure 1:** Element tools compliance as IN.



### 3. Green building development in Malaysia: An overview

Sustainability has become more significant in today’s housing property market. The green homes have begun in Europe, United States and Australia around 25 years ago, while it is new construction concept in Malaysia. Along with the determination created in 10<sup>th</sup> Malaysia Plan, the introduction of Malaysia green building rating system, Green Building Index and the ultimate aim of saving 40% of CO<sub>2</sub> emission till 2020, Malaysia can be on the spearhead of the development to embark on viable environmental survival strategies (Wagner and Omran, 2011).

Today, the concept of green building is growing rapidly. The developers are racing to develop green technology to meet its high demand and the improvement of awareness to protect the environment. In built environment, green building is one of the methods for achieving sustainable development. In addition, encouragement and incentives provided by the government, properties with green technology have bright opportunity in property market compared with non-green technology properties.

In Malaysia, green building is assessed and recognized by Green Building Index (GBI). GBI has highlighted 6 criteria to be achieved by building owner to recognize their building as ‘green’. They are energy efficiency, water efficiency, material and resources, sustainable site management and planning, indoor environmental quality and innovation.

Most of the researchers have discovered the obvious contribution of green building in terms of energy efficiency, water efficiency, material and resources and also sustainable site management and planning. There are little specific studies in the literature to examine the effects of housing characteristics on green homes inhabiting intentions in Malaysians context. The idea seems to be that housing characteristics may lead to buying intentions for eco-friendly homes. The physical structure of the house could be important in explaining the motivations of green home owning (Tan, 2008). However, to the best of researcher's knowledge, in the context of Malaysia there is no

single study emphasized on the significant role of IEQ and IN criteria especially its interrelation with property price and value.

#### 4. Green building criteria affect price and rental

Green building is the sustainable construction developments' foundation. Construction industry with the high contributes with gross domestic product, has undeniable impacts on the economy. In addition, the United Nations explains that "sustainable development" is a collection of methods in order to relieve poverty, create the equitable standards of living, satisfy the basic needs of all peoples, and set up sustainable political practices while taking the essential steps to avoid irreversible damages to the environment in the long-term.

It has been pointed out that IEQ and IN is relatively providing many benefits for occupant's health as well as minimizing the building impact to the environment. IEQ can effect on occupant's productivity, organization profitability, customer satisfaction and innovation or at least satisfied on the thermal comfort, air quality and overall workspace compared to non-green building (Heerwagen, 2000). Additionally it has been said that IEQ create conducive environment for human health and improve productivity than building which use standards practices (Browning and Romm, 1995). While, green approach (Innovation) i.e. landscape on wall, roof and around building will provide better visual attraction which linked to better health as well as connection with nature (Gobster and Hull, 2000).

Kauko (2003) has identified environmental is one of the factors to be take into account in determining housing property value. Initially, selling price, take up rate, occupancy rate and rental rate are inter-related. When the demand for house increases, consequently there will be an increase in the rental rate, as the supply for housing in the short run is fixed. This will attract investor to purchase building as an investment and in due course as there is limited supply, the price for the building will increase.

Due to the increase of price in green building, investors will find it profitable to build new green building, hence increasing the supply in the long run. Occupancy and take up rate is dependent on the tertiary activity of national economies. Where there is an increase in the tertiary activity of the economy, it will reflect in the increase in demand for housing, hence it increases in occupancy and take up rate of existing green housing.

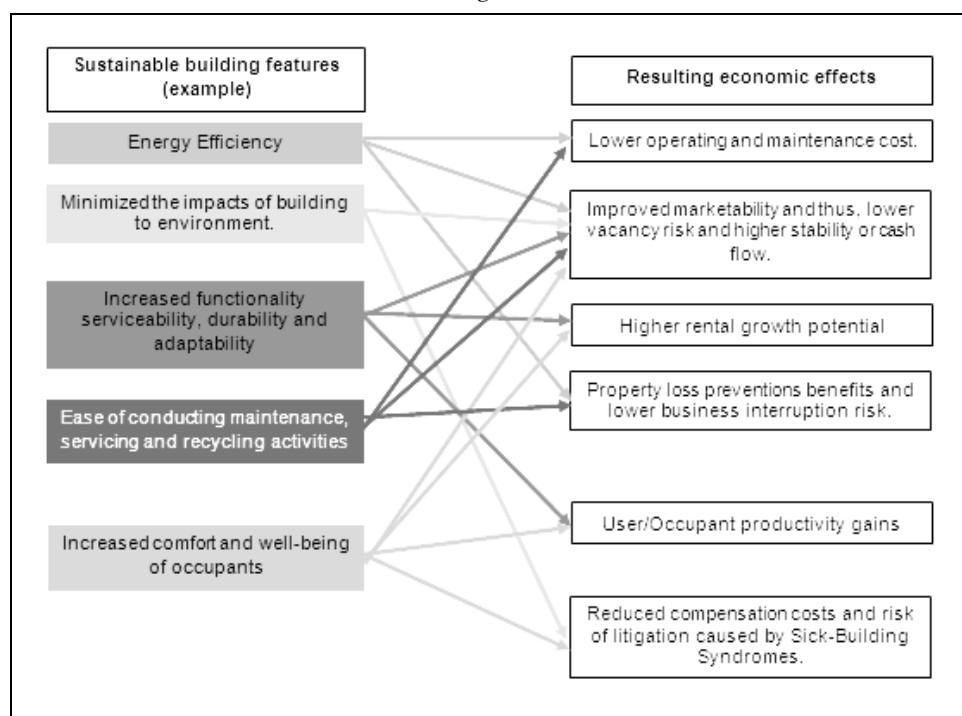
The main difference between green office building and conventional building is the green features implemented on the building and they are given green certification according to their degree of green features. In order to determine the greenness of the building, various countries have their own green accreditation agencies that are responsible in calibrating the green standard features. The green eco-labeling has a positive impact on the market and rental value (Falkenbach *et al.*, 2010; Eichholtz, Kok and Quigley, 2009; Fuerst and McAllister, 2010; Harrison and Seiler, 2011; Geltner *et al.*, 2007). At the local context, there are no studies yet to reveal that green eco-labeling give a positive impact on the market and rental value.

IN and IEQ will provide an attractive views, open space preservation and convenient recreation opportunities to the building occupant. People will value these amenities. This also can be reflected in increased real property values and increased marketability

for property itself. These values incorporate such criteria into planning, design and marketing for new and redeveloped properties.

A report published by the Royal Institution of Chartered Surveyors concludes “A clear link is beginning to emerge between the market value of a building and its green features and related performance” (Anghel and Onofrei, 2009). The shortcomings need to be dealt with for two reasons as show Figure 2.

**Figure 2:** The links between sustainable design features and economic benefits



There are several studies and articles that been measuring the impact of sustainable design features or particular aspects of environmental aspects on the building market value (Nevin and Watson, 1988; McNamara, 2002; Sayce *et al.*, 2004; Lutzkendorf and Lorenz, 2005). However, they’re still far behind the resolution and finding which can be concludes that there direct impact of these design features. For instance, generally there are many researcher focused on the energy efficiency impacts rather than other green features. The virtuous circles of green features impacts are consist of:

- The 3 classifications of main drivers in green investment are consisting of external drivers, corporate drivers and property level drivers; these three are responsible to assist to create opportunity to real estate. In green investment, investor could indicate that green property fetched a higher in market value compared to non-certified buildings (Falkenbach *et al.*, 2010, Harrison and Seiler, 2011; Fuerst and McAllister, 2011; Eichholtz *et al.*, 2009; Scen *et al.*, 2011).
- In energy efficiency building, it shows that this type of building quantify the added value i.e. green office building are 64% higher in sale price while Energy Star rated buildings were approximately 15% higher prices (Pivo and Fisher, 2009; Hodgson, 2008).

- Certified green building and higher green index building had more environment friendly features and commanded a higher rental premium as well as fetched relatively higher in rental income (Falkenbach *et al.*, 2010, Harrison and Seiler, 2011; Fuerst and McAllister, 2011; Eichholtz *et al.*, 2009).
- Precisely, the green office buildings indicates 36% higher in rental rates while Energy Star rated buildings were approximately 8% higher in rental income compared to non-rated building (Pivo and Fisher, 2009; Hodgson, 2008).
- LEED and Energy Stars rated office building fetched better occupancy rate (Harrison and Seiler, 2011; Eichholtz *et al.*, 2009) and green building reported to be 5% higher occupancy rates compared to conventional buildings.
- US building owner indicates that energy efficiency building will assist increment building value (Eichholtz *et al.*, 2009) and large proportion of residential property market participants consider the buildings energy consumption as an important criteria when deciding to buy or rent a flat.
- On the other hand, green building practices can reduce operating costs by as much as 9%, increase building values by 7.5% and realize a 6.6% increase in return of investment (InviroTech, 2014).

**Figure 3:** Initial impact of Green Building (Langdon, 2007).

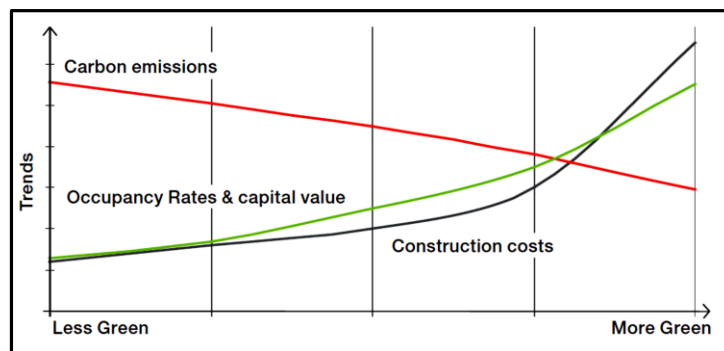


Figure 3 in the next page demonstrates the interrelations of green features level with occupancy rate and capital value and construction costs. The figure illustrate that there are directly proportional and positive impact between green aspects and capital as well as the occupancy rate. However, the construction costs are relatively increased as more green trends promoted.

#### 4.1 The Need for Sustainability Assessment Information

Generally, the idea of consumers' willingness to pay more for greener products is debated, it is reported that 60% would not pay more for greener products, 40% would pay more for greener products. Besides, some of the respondent said, "it makes no difference whether it is environmentally friendly or not (Sizelove, 2012).

The incremental cost to design and construction for high-performance or green buildings typically range from zero to 8% than the costs to design and construct conventional buildings. The fear that green buildings might increase construction costs tremendously makes it hard to sell to private developers or government agencies despite



their undeniable advantages for the environmental and thermal comfort. This factor was believed will lead to the additional price for the green housing price and rental. Although green buildings provide a wide range of benefits for the society, green building development suffers from different kinds of market barriers in developing countries including Malaysia. Therefore, it is important to observe information the emerging link between market value and green features.

Financial decision makers are provided with empirical proof of the positive effects of sustainable design features and able to reduce investment risks as well as to generate positive cash flow (Lutzkendoft and Lorenz, 2005). The expert believes that friendly buildings will become more desirable property assets in the future whereas the non-green buildings will have depreciation in value (McNamara, 2002). This is the reason why it is vital to get better understand on how sustainable building features affect property risks and return. Moreover, naturally most people want a good and useful product at a reasonable price and it is noticeable that when it comes to “green” products, quality can vary a lot and most of them cost extra. Moreover, the modernization factor implied in the building will affect the price i.e. Flats within fully modernized or new buildings lost only 6.5% during the ten year period, while prices for flats within partially or un-modernized buildings decreased by 12% and 13.5% respectively (Lutzkendoft and Lorenz, 2005). The perception of property with emphasize sustainability related building characteristics and performance aspects are seen important in determined of a property worth and market value (Lutzkendoft and Lorenz, 2005). Furthermore, the poor environmentally is seen as the investment risk and as reason for not buying or renting a commercial residential premise.

## 5. Conclusion

Green building is an investment option for investors following greater global awareness on sustainability. The Malaysia government highlights the importance to gear towards green building construction yet the numbers going green is still low compared to other nations.

As discussed IN and IEQ indirectly influence an increase in the market price and rental of residential property although there is a lack of studies conducted on green building and property market relationships. It is thus important to identify what are the drivers towards investment of such buildings and the strategies to overcome such barriers toward investing in green buildings.

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