

Case Studies of Energy Efficiency Housing in South Australia

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Abstract

In July 2009, the Council of Australian Governments announced the agreement of National Strategy on energy efficiency to reinforce the adoption of energy efficiency across the Australian economy including the residential sector and move towards a lower carbon future. South Australia has promptly responded to the trend of being green in building development. However, lack of attention has been given to the residential housing in terms of the perceived benefits and actual performance based on occupant's evaluation. This paper aims to fill up the gap by using two energy efficiency houses as case studies by means of face-to-face interviews. Each case not only demonstrates the incentives and barriers of this type of housing, it also attempts to identify the possible improvements and strategies to promote the affordability of energy efficient housing in South Australia. Whilst the financial savings in energy bills have been affirmed as one of the major incentives that can assist in promotion to a wider community, energy efficient housing is still generally considered not as an affordable option due to a significant cost difference as compared with conventional housing. The interviewees advocate that both the government and the builders are considered to be a catalyst in promotion for wider acceptance. It is suggested that the state government should provide more financial incentives to make it more affordable.

Keywords

Energy efficient housing, affordable housing, South Australia

1. Introduction

Kubba (2012) and USEPA (2012) suggested that the concept of modern green movement was believed to first appear in America more than a century ago because of the energy crises happened in the 1970s. The uprising spike in energy cost brought a huge impact to the world and spurred research and activity to lower the reliance on fossil fuels as well as to achieve sustainability. In terms of building, approaches including reducing the size of building envelopes and applying both active and passive solar design have been applied to buildings since then in order to reduce the energy consumption.

The green building field in Australia began to come together more formally due to the launch of the rating schemes since late 1990s and the standard requirements of green building have been merged by the schemes to suit the nation's need. The Green Building Council Australia (GBCA) was found in 2002 which committed to encourage and promote the green building practices across the country as a not-for-profit organization. In July 2009, the Council of Australian Governments (COAG) announced the agreement of National Strategy on Energy Efficiency (NSEE) to reinforce the adoption of energy efficiency across the Australian economy including the residential sector and move towards a lower carbon future (COAG 2009). Furthermore, it aims to reduce impediments to the uptake of energy efficiency, and to ensure the buildings' performance to be more energy efficient. The governments across the nation have

picked up the leading role in promoting the NSEE by working in partnership, and it was last reviewed a year later after the official launch. Since then, a lot of emphasis has been targeted towards commercial buildings with the use of star rating tools as well as the perceived benefits. The pace of developing residential buildings into green buildings is rather slow because of various factors such as the consumer demand and higher initial cost. Limited investigations have been conducted to look into the residential housing especially in South Australia regarding to the perceived benefits and actual performance. In fact, both 'residential and commercial buildings in Australia are responsible for 23 per cent of the nation's greenhouse gas emissions' (GBCA 2009). Hence, there is a need to investigate the current development of green building practices in terms of the perceived benefits and actual performance in the residential sector. Furthermore, since there is a gap between the perceived benefits and performance in commercial green building (Beltrame 2013), it is necessary to investigate whether the same situation presents in the residential green building. Meanwhile, the users' satisfaction towards residential green building needs to be measured because of the direct relationship between the gap and satisfaction level. This will provide a significant assistance to the future development as well as promotion of residential green housing in South Australia. In order to obtain a better understanding of the various issues in energy efficient housing, an in-depth interview based on real-life case would allow the researchers to investigate various issues without the constraints of a structured questionnaire survey. Two cases were studied and it aims to identify the gap between the perceived benefits and actual benefits after living into the house. On the other hand, it also attempts to know the possible barriers and how to make energy efficient housing more affordable to a wider community.

2. Energy efficient housing, green housing and sustainable housing

The terms "energy efficiency", "green" and "sustainable" are jargons that can often be found in information of building construction projects and they are often used interchangeably within the written content. This has brought confusions to the general public of the actual definition of these terms. It should be noted that in fact, there are some differences and similarities lying within these terms.

The Lawrence Berkeley National Laboratory (2014) defines energy efficiency as using less energy to provide the same service, and meanwhile it can help reducing greenhouse gas emissions. However, it should be noted that energy efficiency is not energy conservation. While energy conservation is referred as using less energy through behavioural change, energy efficiency is about the integrated changes within technologies which improve the energy use to be more effective (Natural Resources Canada 2014). Furthermore, 'energy efficiency measures the difference between how much energy is used to provide the same level of comfort, performance or convenience by the same type of ... building' (Natural Resources Canada 2014). Hence, to the extent of an energy efficiency building, the energy use within the building is more efficient and effective through incorporating advanced technologies compared with a conventional building, although energy efficient building cannot reduce energy consumption through using less of an energy service.

Green building is a building '... incorporates design, construction and operational practices that significantly reduce or eliminate its negative impact on the environment and its occupants' (GBCA 2014). Kibert (2013) adds that green building can be considered as a facility which provides a healthier environment for its occupants, and it is designed and constructed in a resource-efficient manner through applying ecologically based principals. In other words, the idea of being green is incorporated since the beginning of the building life cycle of a building and it is implemented throughout the whole cycle until the end. Nevertheless, a green building is not necessary to be a sustainable building. Buildings which promote energy and water efficiency and minimizing waste generated during building construction, operation and demolition can be classified as sustainable building, and the quality of indoor environment is particularly encompassed in this type of building (VBA 2014). However, it should be noted that the core value of sustainable development is to '... meet the needs of the present without compromising the ability of future generations to meet their own needs' (World Commission on Environment and Development 1987). In other words, the focus of being sustainable is to ensure that the use and production of resources can be shared in an equitable manner across generations over time. Elkington (1998) developed the concept of triple bottom line which suggests that sustainability practice is in fact operated simultaneously with the considerations of social, economic and environmental. Furthermore, a development of a

sustainable building has to consider present versus future needs, determine and apply suitable technologies and resources to meet those needs, and balance responsibilities between multiple stakeholders (Gimenez, Sierra & Rodon 2012). Hence, the importance and standard of sustainable building are more advanced and complex than both energy efficiency and green building as it involves different levels of considerations.

To sum up, the focus and level of complexity involved within these three types of building above are different. While the fundament of energy efficiency building is to reduce the level of energy consumption compared with the conventional buildings, this principle is further advanced and incorporated throughout the whole building life cycle in green building. In addition, existing buildings can achieve energy efficiency through retrofitting or upgrading, while the new built ones can be constructed in either a green or energy efficiency manner. Finally, sustainable building which is developed based on the concept of sustainability has a broader emphasis on the fair and equal use of resources between individuals across generation in a long run, although it shares some similarities with the green building.

In South Australia, Renewal SA (formerly known as the Urban Renewal Authority) is the major official body which promotes residential projects that incorporate sustainable elements in the Adelaide metropolitan area. There are currently six residential projects are either completed or being carried out, including: Bowden, Lightsview, Lochiel Park, Playford Alive, The Square at Woodville West, and Port Adelaide (Renewal SA 2014).

As one of the first completed projects, Lochiel Park is considered as a piloting residential project as well as an important element in the implementation of the South Australia Strategic Plan. It is approximately eight kilometers from the Adelaide Central Business District alongside the River Torrens in the suburb of Campbelltown. The total area of the site is 15 hectares in size, while only 4.25 hectares of the site is allocated for residential housing. The remaining area has been incorporated as parklands, and it is protected by legislation against future development. Lochiel Park serves as a model for other urban developments and assists in educating and promoting sustainable housing and land development to the public and the property development industry in South Australia. There are Ecologically Sustainable Development (ESD) technologies include energy efficient building design, solar energy systems, a recycled water system and the effective management of waste to minimize the impact on the environment (Government of South Australia 2014).

3. Greenwashing

Ceremonial greening, or commonly known as greenwashing, refers to a phenomenon that businesses essentially ‘... exploit consumers’ demands for more environmentally or socially responsible products, which are justified in either third-party certification schemes or having misleading or fake labels and make false claims’ (Warren-Myers 2012).

In South Australia, the redevelopment of Port Adelaide is argued to be a possible example of greenwashing. Szili and Rofe (2007) pointed out that the advertising materials including promotional brochures and corporate websites which have been used for the promotion of waterfront redevelopment are considered to be marketing strategies while legitimizing a lucrative project. Furthermore, the local community of Port Adelaide considered the statements of environmental remediation of are only hollow words. Finally, the Port Adelaide Resident’s Environmental Protection Group rejected the statements made by the developers with the support of local governmental representative stating that the redevelopment is only beneficial to both the Government and developers.

To the extent of the building industry, some property developers attempt to promote the housing products in order to improve their profit without implementing suitable technologies or materials to improve the building performance of the buildings. Exaggerated or false facts may be found within the wording of advertisements or promotion. The practice of greenwashing in real estate marketing has a negative impact upon the house buyers as it provides a misleading information to those interested parties who genuinely believe that they would get the maximum performance as a result of the purchase.

3. Case Studies – Two energy efficient houses in South Australia

In order to achieve the research objectives, two project cases were selected to enable a more in-depth understanding of the various issues associated with energy efficient housing. The data of case studies was collected through the use of structured interviews with the owners who are currently living in an energy efficient dwelling. These two houses were located within the Adelaide metropolitan areas. The background information of the two houses was described below:

House A - is located in the suburb of Campbelltown in South Australia. It is approximately seven and a half kilometer away from the Adelaide CBD. The household engaged with one of the local domestic builders to carry out the design and construction work. The construction work was completed in the year of 2011 and the owner moved into the dwelling at the same year. The size of double storey dwelling is approximately 320m² in size and there are three occupants living in the dwelling at the moment. A 7.5-Star deemed-to-satisfy rating was given.

House B - is located in the suburb of Parkside in South Australia. It is approximately three and a half kilometers away from the Adelaide CBD. The household carried out the design of the dwelling, and engaged with one of the local domestic builders to complete the construction work. It is a relatively new construction given the fact that the owner has started occupying in the dwelling three months ago in the year of 2014. The size of double storey dwelling is approximately 600m² and there are two occupants living in the house at the moment. The owner was not sure about the star rating at the time of the interview conducted, however, it is believed that the dwelling has achieved a minimum of 6-Star deemed-to-satisfy rating in order to meet the requirement of the National Construction Code for Energy Efficiency Provisions.

The responses gathered from the two interviews have reflected and addressed the importance of being energy efficient within the residential housing. However, they indicated that the star rating system might not been able to reflect the actual performance of the upper storey within a double storey energy efficient dwelling. There was no indication showing that any of the interviewees have been impacted by greenwashing. General energy efficient appliances such as solar panels, double glazing and insulation have been applied within the dwellings in order to achieve energy efficiency. However, it is possible that all interviewees would replace the appliances if there are new ones coming out in the market which can be more energy efficient than the current ones. Energy efficient housing was generally considered not as an affordable housing option in South Australia due to the significant cost difference compared with conventional housing. Traditional thinking, builders' performance and knowledge, and the design appearance of energy efficient housing have been considered as the major barriers of broader promotion of energy efficient housing in South Australia. The financial savings in energy bills has been affirmed as one of the major incentives that can assist in promoting energy efficient housing by all interviewees. Meanwhile, the roles of both the state government and builders were considered to be a catalyst in promotion for wider acceptance. The key findings from the two cases were summarized in Table 1 below:

Table 1: Summary of Two Case Studies

No.	Questions	House A owner	House B owner
1	Personally, do you think the dwelling is an energy efficient, a green or a sustainable housing?	Energy efficient housing.	Energy efficient housing but the vegetable garden add some green value to the dwelling.

2	What is the motivation behind the purchase of this house?	Wanting to live in a greener house, and buying into a green community.	Preferred a more comfortable living environment with lower operation cost.
3	What is the star rating for this dwelling? Do you think the rating has reflected its actual performance?	7.5 star rating but the upper storey is not performing as expected.	Believed it was a deemed-to-satisfy requirement of 6.5 rating. Upper storey could still be pretty hot.
4	Considering the issues of cost and actual performance of this dwelling, do you think that there are influences from greenwashing?	No influences from greenwashing.	Did not understand the term.
5	What are the strategies that you think can be applied to prevent greenwashing in energy efficient housing?	Government guidance to work out in discussion with the private sector and set up a minimum standard to regulate the industry's performance.	Cannot give any further suggestion for preventing greenwashing due to the lack of understanding of the term.
6	What are the energy efficient appliances (e.g. solar panels) and design features have been incorporated into this dwelling to achieve energy efficiency?	Double glazing Solar panels Extra eaves Highest rated insulation in the roof, walls and floor Might consider to move on to new technology in the future if there is any.	Double glazing. Solar panels. Roof insulation. Wide eaves. Water tanks (underground). Look forward to new technology in the future, and might consider replacement if it is proved that the new technology can be more energy efficient than the old ones.
7	Do you think energy efficient dwelling is an affordable housing option to both South Australians and yourself? Why?	Cost a lot to build as one has over capitalized a lot with putting different features.	Up-front cost for constructing an energy efficient housing is really expensive.
8	What are the incentives that can influence the broader promotion of energy efficient housing in South Australia?	Government incentives and energy bills are in credit.	Government incentives and energy bills are in credit.
9	What are the barriers that can influence the broader promotion of energy efficient housing in South Australia?	Traditional thinking Builder's performance Disappointed with the recycled water system Studies in the cooling effect of the upper storey. Design of energy efficient	Older generations do not realize the cost of energy Design of energy efficient housing Builders are lack of experience and knowledge of sustainable living.

		housing	
10	Finally, how can the State Government and the building industry improve the affordability of energy-efficient housing?	Educating the public Builder's continuing education Financial incentives	Educating the public Builder's continuing education Financial incentives

4. Conclusions

The interview results indicated a similar level of satisfaction toward their invested energy efficient housing. Nevertheless, the owners who are living in double storey dwelling stated that the thermal performance of the upper storey have brought them concerns. They continued that there is a temperature difference between storeys, and the rise in temperature in the upper storey during hot

weather has brought uncomfortable feeling to the occupants. Hence, the occupants have to switch on the cooling system to maintain the comfort level of the local area. The interviewees believed that the situation happens because the dwellings are the only double storey building located in the surrounding area, in other words, there is no neighbouring shading provided for the upper storey of the dwellings from direct solar radiation. Therefore, the upper storey absorbs more heat energy compared with the lower storey, causing a temperature difference between storeys. One interviewee emphasised that an urgent rectification is needed since the situation would have caused the dwelling no longer to be energy efficient because of the reliance on air-conditioning. And most importantly, this contradicts the major objective of energy efficient housing, which is to be energy efficient. The interviewee then revealed that the housing investment has been over capitalised and the proposed rectification work will place extra pressure on top of the financial commitment. This has reflected that the star rating can only partially reflect the actual performance of an energy efficient dwelling. The actual performance of a dwelling can be influenced by external factors such as the number of storey of a dwelling and the neighbouring area around a dwelling, which both have not been included as part of the deem-to-satisfy requirements. According to the Deemed-to-Satisfy Provisions of energy efficiency in the Building Code of Australia, the thermal performance of a dwelling only has to achieve the minimum requirement for compliance, and there are no extra considerations given to the double storey housing. This may have caused an inconsistency between the as-built and deem-to-satisfy performance, which is similar to one of the interviewee's comment.

It is suggested that the government has to take the lead of the promotion through providing financial subsidies to households. It is considered that the rebates would have an enormous help for the households because the housing option has a higher up-front cost. The support from the government has to take the lead as the needs are become stronger for people and housing to change, incentives will be needed. However, given the fact that there is lack of attractive rebates provided to the South Australian households, this may have weakened the broader promotion of energy efficient housing in the State. Improving the public's knowledge on energy efficiency along with actual facts and numbers gathered from the existing energy efficient dwellings is essential, and this can improve the public's interest in energy efficient housing. The South Australians may still have a relatively weak understanding of the terminologies of "energy efficiency housing", "green housing" and "sustainable housing". One of the interviewees had mistakenly interpreted the term "green housing" as having a vegetable garden and was not able to define the term "sustainable housing" and "greenwashing". Hence, education provided by the government is essential in order to enhance the public's understanding of the use of terminologies.

Finally, the builders should consider to combine the design elements of energy efficient and conventional housing as the appearance of a dwelling plays a significant role of attracting the home buyers. Some interviewees mentioned that the reason why traditionalists cannot accept energy efficient housing could be because of the appearance of those dwellings are different from the conventional housing. In the authors' opinion, given the substantial upfront initial cost with minimal financial return, affordable energy efficient housing to a wider communities is still having a long way to go and achieve.

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