Sustainable and affordable housing: a myth or reality?

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Abstract

The Australian government has released a draft National Building Framework that will likely tighten the building standard for new houses to meet higher sustainability requirements. There are uncertainties about the impact this could have on the cost of housing and the supply of affordable housing. This paper aims to provide evidence-based conclusions on the possibility of delivering sustainable and affordable housing for low income people. The case studies are gathered from Brisbane and Gold Coast. Case studies are analysed by unpacking the features that were included to meet sustainability and affordability goals for housing. This paper outlines the key factors for their success and also challenges for replication of the projects. The study shows that the key success drivers for delivering sustainable and affordable housing are providing planning incentives, subsidies for increased energy efficiency, supportive regulatory frameworks and appropriate allocation of infrastructure charges. It shows that government can prioritise their resources to support affordable and sustainable housing for low income people.

Keywords: Sustainable housing, affordable housing, energy efficiency, Australia

1. Introduction

Housing is defined as 'affordable' if the cost of housing (rent or mortgage payment) is not more than 30 per cent of household income for households in the lowest 40 per cent of the income distribution range (Susilawati, 2009; National Housing Strategy, 1991; Miles, Weiss and Berens, 2000:293). This affordable housing definition is known as the 30/40 rule.

Lack of accessibility to affordable housing has been a major problem for low income people. The annual international Housing Affordability Survey conducted by Demographia uses the 'median multiple', which compares the median house price to median household income, in order to measure housing affordability. The affordable score is under '3'. The latest survey (for 3rd quarter 2011) suggested that all Australian major cities (population > 1,000,000) are above the severe unaffordability threshold of 5.1 and that the Australian national median of 5.6 fell into the severely unaffordable category (Bruegmann, 2012). The survey has not discussed whether the unaffordability level is caused mainly by increases in house prices or by decreases in household income or a combination of both. Whatever the reason, the very

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high median house prices can present affordability difficulties for low income families in both the home ownership and rental markets.

In the third quarter of 2011, the median housing price in Sydney was $637,600 which is the highest in the country, followed by Melbourne ($567,000) and Canberra ($513,000). The highest median household income is in Canberra ($105,100), followed by Darwin ($82,500), Alice Springs ($79,600) and Perth ($78,900) (Bruegmann, 2012). Sydney and Melbourne, with the highest median housing prices, have the tenth and eleventh highest median incomes (i.e. the disparity between median house price and median income is very high). This paper will focus on case studies in Brisbane and Gold Coast. Bruegmann (2012) ranks the Gold Coast and Brisbane as the 4th and 12th most unaffordable Australian cities for housing affordability (based on the median multiple methodology).

Table 1 illustrates the latest census data for the Greater Brisbane area. The average household size is 2.7 persons and the median weekly income is $1,388. The table shows that whilst the median weekly rental equates to only 23% of median income, the median mortgage repayments represent 35% of median household income. These statistics would seem to indicate that affordability is more of an issue for low income home buyers (mortgage repayments greater than 30% of income) than for renters in this region.

Table 1: Census (2011) information for Brisbane (ABS, 2012)

	Greater Brisbane
Population	2,065,996
Average people per household	2.7
Median weekly household income	$1,388
Median monthly mortgage repayments	$1,950
Median weekly rent	$325

It could be argued that the ideal housing solution for low income families would have a low initial cost (to meet the affordable housing criteria) and low operation and maintenance costs. Lower operating costs were potentially a benefit of sustainability requirements in building regulations. The first environmental sustainability requirement introduced into national housing regulations in Australia related to the energy efficiency of the building envelope. Despite the core aim being the reduction of greenhouse gas emissions from space heating and cooling, this regulation would also conceivably reduce the operational costs of the home by reducing the need for occupants to 'purchase' thermal comfort. This is an example, in theory at least, that affordable housing with sustainability features would be an ideal solution for the housing affordability problem. However, in real world application, there are many reports of industry, government and public perceptions that 'sustainable' housing costs more than 'standard' housing (Kenny, 2003; Salama and Alshuwaikhat, 2003, Senick, 2006) or perceptions that affordability and environmental quality are mutually exclusive (Salama and Adams, 2004) or require some 'tradeoff' (Crabtree and Hes, 2009). On the other hand there is strong evidence supporting the view that cost barriers are perceptual rather than real (van Hal, 2007) and that the benefits of sustainability outweigh the costs (Power, 2008).

This study uses case studies to evaluate and reflect the opportunities and challenges for mutual inclusion of sustainability and affordability for future low income housing. Many sustainable and affordable housing initiatives are designed exclusively to either sustainability or affordability, not generally both. Thus, this study will use case studies which have a combination of both features. The selection criteria for the case studies were sustainable housing projects and affordable housing projects that included sustainable features.

The case studies represent exemplar projects, including an affordable housing project in Brisbane's city fringe which provides some sustainability features; a sustainable housing project that has flexible features to make it potentially more affordable; a sustainable house with a building system that reduces the time and cost of construction; and a sustainable housing estate that embraces a very broad and prescriptive definition of sustainable housing. The next two sections review aspects of affordable housing and sustainable housing. This will provide a theoretical framework for the review of the case studies that contain elements of both affordability and sustainability.

2. Affordable Housing

2.1 Affordable housing features

The Queensland government's broad definition of affordable housing includes not just the initial housing cost criteria, but also other criteria such as meeting household needs (e.g. size and functionality) and being well located in relation to services, employment and transport (Queensland Department of Housing, 2001). In order to provide a long term affordable housing solution, low income housing should also have low long-term operation costs. This includes energy efficient homes which will be discussed in the next section under sustainable housing.

2.2 Supply of affordable housing

An indication of affordable housing needs for low income people can be illustrated by the number of people on the waiting list. The Queensland government consolidated all waiting lists under one social housing system and one housing register from 2005. The waiting list illustrates the distribution of both short term needs and long term affordable housing solutions by locality (suburb). The Queensland government facilitates the increase of affordable housing in the very high need areas, for example by providing incentives for affordable housing projects located in these high need areas. Table 2 shows the localities in Brisbane that collectively incorporated 30% of the total waiting list in Brisbane.

3. Sustainable Housing

3.1 Sustainable housing features and regulation

Sustainability is defined in the National Strategy for Ecologically Sustainable Development (1992) as "development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends" (Queensland

Government Department of Public Works, 2008:2). The Queensland Government breaks down the elements of sustainable housing into social sustainability (safety, security and universal design), environmental sustainability (water, waste and energy efficiency) and economic sustainability (cost-efficiency, peace of mind and resale value) (Queensland Government Department of Housing and Public Works, 2012).

Table 2: Housing register (wait list) for long term social housing Queensland (Department of Housing and Public Works, 2012)

Wait list area	Very high need	High need	Moderate need	Lower need	Total
Brisbane	1357	2780	2571	167	6875
Annerley	156	274	251	25	706
Chermside	95	194	135	8	432
Bowen Hills	71	75	59	3	208
Acacia Ridge	55	191	219	19	484
Corinda	31	102	94	4	231
	30%	30%	29%	35%	30%

Views and practices on how and to what extent sustainability is or should be incorporated into housing are varied and sometimes conflicting, but despite this, the definition of 'sustainable housing' appears to be widening, encompassing issues such as energy and water efficiency, indoor air quality, accessibility, affordability, reduced carbon emissions, life cycle considerations etc. (Gething and Bordass, 2006; Williams and Dair, 2006). The National Building Energy Standard-setting, Assessment and Rating Framework was drafted, after public consultation, to establish a pathway for possible future increases in minimum building standards to 2020 in order to significantly improve housing standards. The draft Framework proposes increases in the energy efficiency requirements of the building envelope and the potential inclusion of broader sustainability issues such as greenhouse gas emissions, on-site electricity generation, energy and water efficient fixed appliances, indoor air quality, embodied energy etc (DCCEE, 2012).

3.2 Sustainable housing supply

Sustainability in housing tends to be addressed in a segmented manner with multiple criteria being examined in isolation and with a strong focus on the construction industry segment (Holloway and Bunker, 2006). The incorporation of sustainability into housing can occur at difference phases: concept, design, materials selection, construction processes and building operations (Birkeland, 2002; Crabtree and Hes, 2009; Gray, 2002). It has been argued that the failure to apply a 'systems approach' leads to an underestimation of savings (from energy efficiency measures), an overestimation of costs and less stringent policies relating to energy use and greenhouse gas emissions (Harvey, 2008; Larsson, 2004). The traditional linear design-construct process, together with entrenched building practices and a conservative culture, constrain the implementation and optimization of sustainability requirements and frequently lead to high cost of implementation (Miller and Buys, 2012; Osmani and Reilly, 2009; Ryghaug and Sorensen, 2009).

Assigning costs to the delivery of sustainability outcomes in housing is also complex. A typical method applied in Australia is to consider the costs of a 'standard' house, then calculate the 'additional' costs of implementing features that are considered to be sustainable. This method is frequently deployed by the housing industry in fighting against any proposed changes in building regulations, and was the method deployed by Luxmoore (2005) in his evaluation of the 'additional costs' of integrating sustainability features into small lot developments west of Brisbane. He reported that sustainability features (passive design, energy efficiency, rainwater tanks etc) added about 9% to 'standard' construction costs. This 'cost analysis' process however is flawed. Lack of clarity about what defines a 'standard' house and the diversity of factors that impact on housing costs make it difficult to conduct robust comparisons of 'affordable' versus 'sustainable' versus 'standard' homes. These factors include the wide range of housing types, locations, sizes and construction volumes; the variety and depth of sustainability features that could be included compared with what is 'standard' in traditional housing; the time span of the cost calculations (infrastructure and development costs; project management costs; construction costs; operational costs; lifecycle costs; finance costs); the design/construction phase at which sustainability is incorporated; and the 'avoided' costs or benefits associated with environmental protection, improved human health and enhanced community well-being (van Hal, 2007; Miller, 2012b).

4. Case studies

As mentioned in the introduction section of this paper, four case studies that are classified as affordable and/or sustainable are reviewed. **Case study 1** is a *sustainable affordable housing development* located near a major activity centre. The development, on 900 m^2 of land, consists of two detached town houses each with 2 bedrooms and 2 bathrooms, and three attached town houses each with 3 bedrooms and 2 bathrooms. The dwellings were designed to meet a 4½ star building envelope efficiency rating (in a 10 star rating scheme), using building orientation, landscaping and natural ventilation to reduce the need (and cost) for space heating and cooling. The dwellings also incorporate natural lighting and water sensitive design (rain water harvesting). The development is well located within walking distance of shops and public transportation. Such in-fill development is supported by local and state government because it is widely believed that increasing urban density helps lower the cost of providing housing whilst still meeting the profit requirements of housing providers. The small size of this development, and other similar in-fill projects, is also thought to benefit from a shorter development approval process which can reduce holding costs.

Case study 2 is an *affordable rental housing development* provided by a not-for-profit organisation (social developer). The medium rise housing complex (32 studio and 1-2 bedroom units) has used passive design principles to optimise natural ventilation, cross ventilation and natural light into individual dwellings. A water tank (for rain water harvesting) is located in the core of the building. The design incorporates wide balconies and extensive moveable sun screens to maximise privacy, sun protection and natural ventilation. Strategies for maximising the value of the capital outlay (short term and long term) included applying a uniform floor plan, selecting materials with low maintenance costs and consideration of life cycle costs. Government subsidies and incentives were utilised to the fullest extent

possible, such as state government rebates for rainwater collection and local government planning incentives allowing increased density and relaxation of car park requirements for affordable housing projects. In addition to the above incentives, not-for-profit organisations have additional tax concession such as income tax and GST exemption. This would indicate that the social developer may be in a better position to offer affordable housing because maximising shareholder profits is not a core consideration for development decisions.

Case study 3 is a *single family detached sustainable house in a greenfield in-fill development* within 3km of shopping, school and train services. It was constructed in 2011 utilising a new 'manufactured housing' system. This 8 ½ star house has been designed to provide a very high level of occupant thermal comfort through excellent insulation and natural ventilation, as well as very low operating costs through incorporation of rainwater collection, energy and water efficient appliances and solar power. The construction system allows for homes to be constructed in much shorter time frames, impacting on the cash flow and finance of both the builder and the client. It also appears to be cheaper (materials cost) than common alternatives.

Case study 4 is a *144 lot sustainable housing development* on the Gold Coast, 90 kilometers south of Brisbane. The estate, 65% complete, consists of detached housing of 1, 2 or 3+ bedrooms, for either single family housing or co-housing. Extensive and quite prescriptive covenants are applied over and above existing state and national building regulations. These covenants attempt to embrace a very broad range of sustainability considerations that could be loosely characterised as environment protection (of land, soil, hydrology and landscape), resource management (of energy, water, waste, materials) and social cohesion (reducing transport needs, accessibility, and balancing security, safety, privacy and social interactions). House construction costs, based on study of eight houses 2008-2011, ranged from slightly less than a 'standard' house on the Gold Coast built to minimum regulation standards to costs similar to a medium level finish of an architecturally design executive home (2010 prices). Performance evaluation of the eight homes revealed no correlation between house construction costs and environmental performance outcomes.

5. Discussion

Table 3 provides a comparative overview of the affordability and sustainability features of these case studies. The four case studies illustrate that a range of affordability strategies and a range of sustainability strategies can be incorporated to achieve housing that has a measure of both affordability and sustainability. From a sustainability perspective, all four case studies addressed, to different levels, the thermal efficiency of the building envelope. Passive solar design and natural ventilation were no / low cost strategies to minimize the need for mechanical cooling. All case studies provided ceiling fans to enhance occupant comfort when natural ventilation is insufficient. Maximising natural lighting was another common energy efficiency strategy incorporated, as was rainwater harvesting.

In the affordable housing case studies (1 and 2), sustainable features have been included when it required no or minimal additional cost, such as passive solar design and rainwater tanks (with government rebates). Reduction in time and cost are also driven from

government initiatives such as tax exemptions, deferred payment of infrastructure charges and planning gains (e.g. increased density and car park relaxation). Government incentives have a significant impact on implementation of sustainable features in affordable housing projects. In the sustainable housing case studies (3 and 4), sustainability features were integral to the design, and costs were managed through a variety of measures such as changing construction processes, special purchase arrangements with suppliers, government rebates, use of recycled or second hand goods, and end-user time investment.

Table 3: Case study comparison of affordability and sustainability features

	Case study #1	Case study #2	Case study #3	Case study #4
Year of completion	2007	2007	2011	2006 - ongoing
Affordable housing features				
Increase density	Yes	Yes	No	No
Car park relaxation	No	Yes	No	*Alternate approach
Tax exemption	No	Yes	No	No
Not for profit	No	Yes	No	No
Discounted rent	No	Yes	No	No
Discounted sales	No	No	No	Yes, for 1-2 bedrooms lots
Location close to employment	No	Yes	No	*Alternate approach
Public transport	Yes	Yes	No	*Alternate approach
Government incentives and support	Yes, rebates	Yes, grants and rebates	Yes, rebates	Yes, rebates
Time reduction	Yes, planning approval	No	Yes,construction time	No
Sustainable housing features				
House and lot layout optimise solar orientation	Yes	No	Yes	Yes
Natural lighting	Yes	Yes	Yes	Yes
Natural ventilation	Yes	Yes	Yes	Yes
Shading	Yes	No	Yes	Yes
Space cooling appliances	Ceiling fans	Ceiling fans	Ceiling fans	Ceiling fans; no air conditioners permitted
Energy and water efficient appliances	Buyers' choice	Tenants' choice	Provided	Buyers' choice within limits
Energy efficient hot water system	Yes, gas	Yes, gas	Yes, gas and heat pump	Yes, gas-boosted solar
Solar (PV) power	No	no	Yes	Yes
Rainwater harvesting	Yes, for toilets and gardens	Yes, for toilets and gardens	Yes, outside use only	Yes, potable water supply is rainwater
Recycle water supply	No	No	No	Estate level waste water treatment plant and reticulated recycled water
Food production area	No	No	No	Yes
Materials life cycle considerations	No	No	No	Yes

Another common feature of case studies 1, 2 and 4 was the controlling of overall costs (or the maximization of project investment) by limiting the size of the dwellings. These three developments all offered a range of dwelling types suitable for different household types, in contrast to standard market offerings. The high proportion of small units in their dwelling portfolio prompted the social developer (case study 2) to petition the state government

(unsuccessfully) for a review of water infrastructure charge methodologies. This is discussed in more detail in the next section.

Case studies 3 and 4 had different means of achieving cost effective sustainability. The key benefit of case study 3 is in the combination of good design for the climate (to reduce operational costs for heating and cooling) with a construction system that reduces building error that can compromise indoor climate performance and reduces construction time (and hence finance costs). Case study 4 reduced development infrastructure costs through water sensitive urban design (no connection to centralized storm water system), an estate level waste water treatment plant (no connection to centralized waste water system), and energy efficiency covenants (reduced capacity electricity network). These reduced infrastructure costs impact on land purchase prices and ongoing household rates and operational costs. This case study also implemented a number of 'alternate solutions' that included maximizing non-car options for mobility (e.g. cycle and walking facilities) and reducing the need for mobility for work and recreation (home offices, fibre-to-the-home communications network, neighbourhood enterprises and recreational facilities).

Because of the diversity of options and sustainability inclusions presented by the case studies, it is not possible to conduct a benefit:cost comparison between the developments. It would be reasonable to assume that the total 'house cost' of case studies 3 and 4 are not likely meet the cost target of the developers of case studies 1 and 2, however significant learnings can be transferred between the affordable and sustainable housing sectors.

6. Future sustainable and affordable housing

Housing is a critical national asset more than just shelter that underpins Australians' and Australia's economic, social and environmental well-being. The role of housing could be argued as '*sustaining occupants' safety, health and physiological comfort*' (Kim, 1998) or as *'expressing personal and social identity and enabling and supporting inhabitants in living sustainably'* (Miller, 2012c). Clearly defining, as a society, the essential elements of housing will help to determine levels of affordability and sustainability and identify the processes required to achieve these levels. Two key questions frame the context:

Can we, as a society, afford to provide housing that is NOT sustainable?
Can we, as a society, afford NOT to provide housing to low income families?

The challenge of providing housing that (i) sustains its inhabitants socially, economically and environmentally, (ii) is inherently sustainable for the planet as a whole, and (iii) is accessible to families in the lowest 40% of income distribution, may best be achieved by focusing on the *process* of achieving sustainability and affordability rather than looking at the multiple issues in isolation (Salama and Alshuwaikhat, 2003). There are convincing arguments supporting the belief that addressing how houses are produced is bound to have limited effects unless the focus expands to the broader housing sector to simultaneously address issues of urban design, occupants, infrastructure, finance and housing markets (Miller, 2012c).

What are some of the strategies revealed in the case studies that could be successful in the joint implementation of affordability and sustainability? The *planning incentives* to develop

affordable housing in Queensland had been based on the case by case negotiation between the local government and the developer. The new Sustainable Planning Act 2009 has supported both sustainable housing and affordable housing projects. Some of the case studies were developed prior to the new Act and required great involvement by the owners or occupants. The incorporation of both affordable and sustainable housing in the new planning scheme will increase certainty and fast track the planning approval process. The certainty of the planning process will help to reduce project holding costs and increase the certainty of the project, reducing risk. This has the potential to enhance affordability provided the housing developer passes on the savings.

Government subsidies play an important role in enhancing the immediate affordability of some sustainability features. From Table 3 it is clearly evident that rebates for specific appliances / technologies (e.g. solar water heaters and rainwater tanks) are important in the early stages of product diffusion into an established market, and become less important over time as the technology matures and the market adjusts to the new products.

Government regulatory frameworks have an important role to play in setting expectations and minimum requirements. Experience from the previous building regulation changes (2003-4) showed that additional regulatory requirements increased the housing price and put pressure on affordable housing delivery. Investors chose to switch the housing supply towards the higher-end market which provides a better return for their investment (Susilawati, Armitage, Skitmore, 2005). However this risk should be minimized by the nature of the Framework that clearly articulates the future pathways, providing industry with ample time to prepare for change in advance. The draft National Building Framework includes the whole building approach from planning and design through to construction, and includes built-in appliances such as hot water, lighting and heating, cooling and ventilation systems (DCCEE, 2012). Other sustainability requirements such as indoor air quality, water efficiency, onsite electricity generation and embodied energy of building materials may be considered for later inclusion. Building processes (e.g. design, simulation and rating tools), market processes (e.g. Mandatory Disclosure - requiring certain features of dwellings to be revealed to potential buyers and renters) and education and training initiatives, form part of the Framework. Some of these inclusions will conceivably enhance occupant comfort and health, and may reduce household operational costs, however the pressure on meeting the higher sustainable ratings has the potential, unless current industry practices change, to place upward pressure on housing prices. A key risk that still needs addressing, however, is lack of compliance: if the regulations are not enforced and housing is not inspected to ensure that the sustainability features are appropriately installed and operating, then the expected savings in operational costs may not be realized.

The *allocation and implementation of infrastructure charges*, in particular the synergies between dwelling energy and water efficiency, dwelling size and dwelling impact on infrastructure requires more scrutiny. Infrastructure charges (e.g. for potable water, waste water, storm water and/or electricity supply networks) could be restructured to reflect some of the significant reductions in consumption that occur with the implementation of high levels of energy and water efficiency, and by the lower consumption rates attributable to smaller units in affordable housing developments. The reduced impact on infrastructure has been verified in post occupancy evaluation of case studies 2, 3 and 4. The inequitable allocation of

infrastructure charges in water and energy (between high and low consumption households) stymie the further implementation of both sustainable and affordable housing. Other changes to infrastructure charges could include discretionary subsidies for affordable housing developments and delayed payment of infrastructure charges (using secondary mortgages as security).

Perhaps the biggest challenge lies in *identifying and determining the system boundaries*: what is meant by affordable sustainable housing? What sustainability features should be considered 'standard' for all housing, and what level of environmental performance is required? Over what time period? How are costs and value defined and calculated? From whose view point are costs and value determined? What conditions or assumptions contribute to affordability, cost and value calculations? What processes or development forms are more likely to be able to provide holistic systems solutions?

These are difficult questions to answer because an understanding of the exact nature and extent of current and future challenges that face housing occupants (e.g. higher incidence of heat waves, resource depletion, indoor air quality, human health, fuel poverty, resilience) is still evolving, and the economic and regulatory context of housing changes frequently. It is within this context of uncertainty of the end goal that the concept of 'sustainable affordable housing' needs to be developed and be implemented.

7. Conclusion

This paper presented Australia's dilemma of very high median house prices and the impact this has on housing affordability and the supply of affordable housing. It outlined sustainable housing features and key issues that affect the supply, and cost, of sustainable housing. Four case study residential developments were presented, providing a degree of comparison of strategies deployed to incorporate affordability and sustainability features. It showed that planning incentives, subsidies, regulatory frameworks and allocation of infrastructure charges all play a critical role in the feasibility of providing affordable sustainable housing in Australia.

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