Residential Housing and the Green Agenda

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Abstract:
“Australia’s residential development industry is at least superficially embracing environmental and sustainability issues in urban design. Rapidly emerging use of recycled water, lower impact outfalls, the use of roof water and water sensitive design for both housing and landscapes are all trends of interest to the property profession. There is particular interest in the cost of meeting end-user, local Government, State Government and development industry expectations for a green agenda for the residential sector.”

Introduction
Traditionally the decision criterion behind a house purchase decision was based on a relative small number of variables such as for sale price, number of bedrooms and location. However purchasers in today’s market are faced with many other factors including a myriad of competing financers, varying design types, different construction materials, quality of fit-out. In addition, there is the rapidly emerging issue of sustainability. In reference to the environment, it is surprising that not long ago many houses were accompanied by backyard incinerators, with recycle bins and water usage meters were being rare as were weekday rosters for watering the garden. At the same time technology has provided energy efficient solutions to assist the promotion of sustainability including energy efficient light bulbs, dual-flush toilets and efficient whitegoods with mandatory 0 to 5 star ratings. There have also been changes in the perception of and the demand for an energy efficient home, at times referred to as ‘the green agenda for the residential sector’ and also extending to a ‘green housing loan’ (Bendigo Bank, 2006). This trend then produces the following questions: what is driving this green agenda and how does it affect residential housing? And what are the latest developments in environmental and sustainability issues, and how are they relevant to the property profession and the broader property market?

This paper outlines the growing importance of sustainability and energy efficiency with reference to residential housing. It summaries the importance of climate change in the context of the residential housing markets and discusses efforts to embrace sustainability by the residential housing industry stakeholders including government, industry bodies and individual builders. In addition, there is discussion on the property value aspects of sustainability and the definition of market value with regards to the ‘market’ and ‘cost’ approaches.

Climate change and energy efficiency
Many experts believe that greenhouse gases are linked to global warming and climate change via an enhanced greenhouse effect, being the process by which water vapour, carbon dioxide and other gases form a blanket around the earth and trapping heat (ABS, 2005). Projections indicate annual average temperatures in Australia could be 0.4 to 2.0 degrees Celsius (°C) higher by 2030 and 1.0 to 6.0 Celsius (°C) higher by 2070 (CSIRO, 2004). According to the Australian National Greenhouse Gas Inventory, Australia’s total net
emissions of greenhouse gases increased by 23 MT of CO₂ (4.5%) between 1990 and 2002 as shown in figure 1 (AGO, 2004).

**Figure 1.** Australia’s Total Net Emissions

![Figure 1](source: AGO, 2004)

At the same time vegetation has an important role in reducing the level of greenhouse gases in the atmosphere since trees and other plants absorb carbon dioxide from the air and store it as carbon (ABS, 2005). It has been argued that under ideal conditions one million hectares of new forest could absorb approximately 25 MT of carbon dioxide per year, which would lower Australia’s current carbon dioxide production by approximately 9% (CSIRO, 2004). There is little argument that residential housing, as a major component of the overall built environment, is a major consumer of fossil fuels which in turn has wider implications for broader climate change. It is noted that Australia is a large continent incorporating eight climatic zones within its borders (refer figure 2) and that the breakdown of emissions related to specific operational use of residential buildings will vary substantial across these climatic zones. The same analogy can be applied to New Zealand, and therefore no single optimal approach to sustainable housing exists.

**Figure 2.** Eight Climate Zones in Australia

![Figure 2](source: ABCB, 2006)
The relationship between buildings and the environment

Initially the construction of residential buildings was to provide humans with protection from the harsh natural environment, with buildings being of solid massive construction often involving the destruction of the surrounding natural environment. More recently, the idea that buildings should ‘touch the ground lightly’ and minimise environmental impact has become increasingly important (Thomas, 2003). Many corporate identities are increasingly aware of the Triple Bottom Line benefits, namely economic, social and environmental aspects, associated with the incorporation of energy efficiency or green design into their buildings. In addition, commercial tenants are becoming more demanding in terms of the energy efficiency of the buildings they occupy, partly due to the massive savings in energy that can be made by occupying well designed buildings (Larsen, 2002).

One of the primary factors leading to environmental change is the construction and operational aspects of buildings. Buildings impact on the environment differently at various stages throughout their life cycle. For example, energy is consumed in the production of building materials and in the construction of the building, commonly known as ‘embodied energy’. In addition, buildings consume energy throughout their operating life for heating, cooling and otherwise occupying the building, commonly referred to as ‘operating energy’ (Lawson, 1995). All buildings contribute to both ozone depletion and global warming. Notably CFCs, which contribute to ozone depletion, are used in building components such as insulation, air-conditioning systems, refrigeration plant and fire protection systems, as well as packaging foams, aerosol sprays and soft furnishings (Somerville, 1996). It is not possible to simply cease using those products containing CFCs because in many cases there are no viable alternatives. However, as outlined in the Montreal Protocol, there are substitutes available such as hydrochlorofluorocarbons (HCFCs) that are substantially less damaging to the ozone layer. In addition, hydrofluorocarbons (HFCs) are not harmful and therefore increasingly used and developed (Johnson, 1993).

Carbon dioxide is the most common greenhouse gas being emitted and its release is mostly related to human inhabitation of buildings. For example, in developed countries approximately 50% of all carbon dioxide is emitted from buildings, with 16% is solely from housing (Department of Natural Resources and Environment, 2002). Electricity generation commonly relies on the burning of fossil fuels that release carbon dioxide into the atmosphere. This is further complicated by the high water content of brown coal used in Victoria, which in turn makes combustion very inefficient (Department of Natural Resources and Environment, 2002). As electricity is used predominantly for space heating and cooling, water heating, ventilation and lighting, it must be used efficiently in order to reduce global warming. Thus, energy efficiency can be improved but depends largely on the type of building and use thereof, although most buildings can incorporate some form of energy conservation (Johnson, 1993). There is no doubt that the release of CFCs can lead to global warming. While the amount of CFCs released from buildings is continually reducing and substantially less in comparison to carbon dioxide, the effect is still substantial because CFCs are many times more potent in adding to the greenhouse effect (Somerville, 1996). Methane, being one of the natural constituents of natural gas, is another greenhouse gas linked to building use. To prevent pollution by methane there must be no leaking gas supplies and therefore should remain a major safety priority (Johnson, 1993).

Building Code of Australia

The Building Code of Australia (BCA) was developed as a national uniform approach to technical building requirements. It is managed by the Australian Building Codes Board (ABCB), which is responsible for the BCA as well as developing a simpler and more efficient building regulatory system and enabling the building industry to adopt new and innovative construction technology and practices (ABCB, 2006). In July 2000 the Commonwealth Government announced that agreement had been reached with industry, State and Territory governments with regards to adopting a two-pronged approach to reducing greenhouse gas emissions from buildings – this was via the introduction of mandatory minimum energy performance requirements through the BCA, as well as the encouragement of best practice voluntary initiatives by industry (ABCB, 2006). Following on from this, the ABCB and the Australian Greenhouse Office (AGO)
entered into a formal agreement to jointly develop the BCA energy efficiency provisions. The Energy Efficient Project has been endorsed under the National Framework for Energy Efficiency (NFEE), an agreement between all Australian governments established to improve energy efficiency – this project comprises two elements, namely (a) development of energy efficiency provisions for BCA Volume 2 covering housing (Class 1 and 10 buildings) and (b) development of energy efficiency provisions for BCA Volume 1 covering commercial buildings (Class 2 to 9 buildings).

**Energy Rating Systems**

Improving the energy efficiency of dwellings is the first stage of a long term program by the Government to improve the ecological sustainability of buildings. Overall, it appears that reforms to current energy standards have the following primary objectives:

- Improve the energy efficiency of the building fabric of houses to save energy and reduce greenhouse gas emissions;
- Deliver economic and consumer benefits for homeowners by reducing energy consumed to heat and cool homes;
- Slow rapid growth rates in domestic energy consumption and peak energy utility loads; and
- Cushion homeowners against escalating energy prices.

The energy rating system is a performance-based assessment of the energy efficiency of the building fabric. The aim of this type of regulation is to avoid the problems of inflexibility and over-design, often associated with prescriptive regulation (Building Commission, 2002). In addition, it recognises the complexity involved in defining individual building elements and accordingly provides a whole building approach to energy efficiency. The regulation also gives consumers clear information on the building’s environmental performance, as well as flexibility for designers and homeowners to choose how to best meet the standard. The energy rating measures the relative energy efficiency of the building ranging from one to five stars, however the number of stars possible is likely to be increased to ten. By assessing the building fabric, the rating measures the need to heat the house in winter and cool it in summer (Sustainable Energy Authority, 2002a). There are three types of residential rating systems currently in use, namely NatHERs, FirstRate, and BERS, with AccuRate developed as the next generation of software representing a national benchmark.

(a) NatHERs refers to both the scheme and the software, namely ‘National House Energy Rating Software’ and ‘Nationwide House Energy Rating Scheme’. NatHERs is based on decades of CSIRO simulation research into the thermal performance of over 40,000 buildings - the software performs hourly calculations for heating and cooling over a year based on specific information including dwelling design, dimensions, construction materials, orientation and climate zone for a standardised occupant pattern (SBE, 2006). The results produce the ranking on a 0 to 5 star basis based on a detailed computer simulation of the house using hourly weather data.

(b) The FirstRate house energy software was developed by the Sustainable Energy Authority of Victoria (www.sustainability.vic.gov.au). The house energy rating measures the energy efficiency of a house by allocating a point score for various design features (such as building fabric, window design, insulation, orientation and other features) and provides an overall rating on a scale from 0 to 6 stars with half star increments (SEAV, 2006). The house energy rating is independent of the size and type of housing, so that both large and small houses, attached and detached dwellings each have the potential to achieve a good energy efficiency rating. FirstRate is based on the results of around 55,000 simulations in each Australian climatic zone.

(c) BERS (Building Energy Rating Scheme) is a computer program used to simulate and analyse the thermal performance of Australian houses in climates ranging from alpine to tropical – a BERS rating of 3.5 stars or better is recognised by the ABCB as a way of complying with the BCA (Building Code of Australia) (Star Logic, 2006).
(d) **AccuRate** is an upgraded version of NatHERs software that has been developed by the CSIRO. **AccuRate** provides ten star rating levels for building fabric performance so it can be utilised to assess innovative residential solutions (SBE, 2006). **AccuRate** software more precisely assesses the heating and cooling energy efficiency of even complex building designs and overcomes many of the limitations of other existing software (CSIRO, 2006). Two of **AccuRate**’s important improvements are its modelling of natural ventilation and its incorporation of all 69 regions for which the Bureau of Meteorology has sufficient weather data. It has been argued that natural ventilation is a vital strategy for reducing use of air conditioners, where good ventilation flushes heat from a building and provides cooling air movement – for example, an indoor air speed of one metre per second can have a cooling effect of 3.8 °C.

**Further considerations for energy ratings**

The Government’s announcement of the introduction of compulsory house energy ratings has lead to substantial debate within the housing industry. There are various conflicting views regarding both the effect of these new compulsory requirements and the necessity for regulation.

The Housing Industry Association (HIA) referred to the legislation in its policy statement (dated 17/03/06) as follows:

“The Australian Building Codes Board brushed aside the overwhelming weight of evidence from independent and government experts and the recommendation of its own energy efficiency steering committee to press ahead with mandatory five-star energy ratings in BCA 2006. The ABCB decision was not based on a proper, credible analysis of the costs to industry (ultimately borne by home buyers) nor has it demonstrated that 5 star regulations will deliver the claimed environmental benefits. The ABCB decision has polarised government opinion, with the Federal and various State Governments having publicly condemning 5 Star. The housing industry does not seek to evade its fair and reasonable contribution to the national effort regarding energy efficiency; however HIA’s main concern is the impact of unsubstantiated regulatory reforms on the housing industry, particularly their impact on housing affordability. Some governments have taken a myopic view of energy efficiency, approaching it as a 'political populist' issue – energy efficiency has become a race which is being run on ideological grounds with governments progressively adding layers of regulation with little regard to substantive evidence which would validate its net benefit. The residential building industry is already highly regulated. Energy efficiency regulations not only add significantly to the cost of housing but do not necessarily provide public or private benefits. Housing is price sensitive and responds quickly to rising costs. First home owners are especially vulnerable to rising material and construction costs stemming from new regulation.” (HIA, 2006).

The Building Control Commission funded studies to determine the effects of such regulation on homeowners prior to proposing the introduction of compulsory five star energy ratings. Two of these previous studies are discussed in detail below.

**Implementation costs in 2002.**

The study determined that in 2002 it would cost the average new home buyer around $3,000 to improve their house to a five star level, although this cost will decrease rapidly as building techniques and materials become more readily available (Energy Efficient Strategies, 2002). It was also argued that savings in energy bills would outweigh increased home-loan repayments associated with the additional energy efficiency requirements. There would be additional benefits, such as a more comfortable house all year round being up to 10°C cooler in summer and 5°C warmer in winter, in comparison to a two star house (Allen Consulting Group, 2002). For example, a case study undertaken by the Building Commission (2002) concluded that a typical current house design on a concrete slab would require the following to achieve a five star rating:

- Higher levels of wall and ceiling insulation;
- Weather-strips to external doors;
• Superior seals around openings and pipe penetrations;
• Self-closing exhaust fans;
• Slightly reduced glazing in areas in non north orientations or relocation of windows to the north; and
• Improved aluminium window frames with lower heat losses.

Issues relating to the initial cost of construction and subsequent long-term savings are of paramount importance. To improve a house to meet a five star energy rating there would be an anticipated increase in the construction cost of between 0.7% to 1.9%, which in 2002 equated to between $1,100 and $3,300 added to the price of a typical new dwelling. However, a house with a five star energy rating would save its occupants approximately $210 on energy bills each year as shown in Table 1. After taking into account the increased loan repayments required to cover the extra construction costs, the effect on the owner's annual costs would vary between paying an additional $40 (worst case scenario) or a saving of $120 (best case scenario). In addition to direct savings on energy bills, homeowners may be able to reduce the size and capacity of heating and cooling appliances, further lowering construction cost (Energy Efficient Strategies, 2002).

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<thead>
<tr>
<th>Effect</th>
<th>4 Star rating</th>
<th>5 Star rating</th>
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<tr>
<td>Energy bill savings</td>
<td>$150 per year</td>
<td>$210 per year</td>
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<td>Projected increase in home loan payments</td>
<td>$35-130 per year</td>
<td>$90-250 per year</td>
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<tr>
<td>Increase in house costs</td>
<td>$440-1,700</td>
<td>$1,100-3,300</td>
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<td>Net change in household income</td>
<td>$20-120 increase</td>
<td>$40 decrease - $120 increase</td>
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<td>Relative house price increase</td>
<td>0.3%-1%</td>
<td>0.7%-1.9%</td>
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(Source: Energy Efficient Strategies 2002)

Implementation costs in 2005.

The BCA engaged a consultant to investigate, analyse and report on the cost impact on house to comply with the current requirements of the 5 Star standard by seeking cost information from a sample of nine Victorian domestic builders producing between 100-2,000 houses per annum. Incremental costs were:

• $2,840 for single storey houses – 100 to 160m² (average list price $118,000).
• $3,450 for single storey houses – 160 to 250m² (average list price $150,000).
• $3,950 for single storey houses – 250 to 380m² (average list price $209,000).
• $5,910 for double storey houses – 250 to 380 m² (average list price $311,000) (BC, 2006).

Incremental compliance cost increases average 2.1% to 2.4% for best case orientations and 2.4% to 3% for worst case orientations for a range of house designs studied.

Residential Developers and Builders

While the construction industry has been generally sympathetic to the idea of energy efficient housing, there have been mixed opinions regarding the introduction of compulsory energy ratings. In the UK it was found that industry uncertainty was one of the main barriers to change when reviewing the introduction of compulsory energy regulations (Bell and Lowe, 2001). On this occasion the construction industry raised
concerns regarding increased cost and technical risk associated with new regulation, and a similar situation is occurring in Australia. Accordingly, the Sustainable Energy Authority in Australia believed educating the building industry will be a key step to improving housing energy efficiency (Houston, 2003).

While some developers are already marketing and selling energy efficient houses, others may consider that expenses involved with a uniform energy requirement will have a dramatic impact on the industry. There may be a view that house and apartment buyers have little awareness regarding the benefits of energy efficiency. Relatively little is known about the additional benefits provided by energy efficiency, such as whether reduced power bills and reduced greenhouse emissions are actually valued in the market. In other words, the market may not pay the premium associated with the increased cost of meeting the energy requirement. Another complication may arise from within the housing construction industry itself, with some builders and developers unaware of the theories behind energy efficiency, its benefits, and how to build efficient houses. It has been found that in many cases their knowledge is only marginally greater than that of the general public (Davis, 1995).

Most builders and industry bodies have acknowledged the importance of sustainability and energy efficiency. For example, the Housing Industry Association (HIA) is promoting the environment via its ‘HIA GreenSmart’ initiative, which is promoted to HIA members as “showing you practical ways of incorporating environmental design, building practices and products into your homes to meet the growing market trends for environmentally sustainable homes” (HIA, 2006). Furthermore, the GreenSmart Code of Practice encourages national leaders and partners, regional partners and all GreenSmart professionals to:

- Contribute to improving the environmental performance of Australia’s building industry;
- Deliver environmental improvements in a way that responds to community expectations on building types and cost; and
- Work with other GreenSmart professionals to pursue good environmental management in the building industry (HIA, 2006).

Previously developers and builders, through the Housing Industry Association (HIA), made submissions to the Victorian government regarding alternatives and changes to the proposed rating, where the main concern was the additional cost involved with implementing the rating (Building Australia, 2002). Developers claim the materials and building expertise required to successfully build to this rating are not yet widely available, and that, materials and workmanship are currently both expensive, and under developed. In addition, the HIA have claimed that the anticipated cost increase to achieve a five star rating, predicted by the Building Commission, is underestimated and the actual cost is between $4,500 to $10,000 per dwelling (HIA, 2002). However, it appears inevitable that as demand for energy efficient housing grows and builders increasingly incorporate energy efficient measures into new houses over time, the industry will be forced to adopt new technologies and skills.

Marketing

There are conflicting opinions and evidence regarding the marketability of energy efficient houses. Many house and apartment builders actively marketing the energy efficiency and general environmental benefits of their dwellings. For example, the Henley Properties Group and Australand are two building companies that are building new houses and apartments to the five star energy rating (Houston, 2003). Both companies use the energy rating of their houses as a major selling point and an item of difference from their competitors, where the Henley Properties Group have altered construction practices and are marketing their five-star houses to families and first home buyer market (Houston, 2003). Australand incorporated energy efficient principles into their development of the 2006 Commonwealth Games Village and argued there are clear marketing benefits associated with energy efficiency (Houston, 2003). The marketing from both companies appears to highlight that the construction of an energy efficient house is no more costly than a non-energy rated dwelling, and provides the added benefit of reduced energy bills. Furthermore, Henley argue that five-star energy houses will achieve better resale values, as well as saving up to 50% on energy costs (O’Conner, 2002). This aspect is important when considering the long-term implications of
homeownership, which remains a priority for many purchasers. In creating a five star energy requirement for all of their houses, Henley has shown how creating a large demand for energy efficient construction products enables construction costs to be reduced (O’Conner, 2002).

Other developers are also claiming that the benefits of house energy efficiency are not fully understood by purchasers, and the required changes to design will reduce marketability. In other words, an energy efficient house will no longer conform to a purchaser's preconceived ideas about their potential new house. This viewpoint was supported by the failure of Australia’s first ever environmentally designed house, where the designers neglected to recognise who the likely purchasers would be, their demographics, and their needs with respect to housing appearance and cost (Okraglik and Pollard, 1995). Thus, the energy efficient house generally failed to fit purchasers preconceived ideas about what they wanted and expected in a new house, although the importance of preserving our environment has undoubtedly risen in importance in recent years.

**Building Designers**

Architects and building designers have concerns that the introduction of compulsory energy ratings may stifle design and limit innovation. For example, the energy rating proposed by the Victorian government is seen as very prescriptive, causing limitation of design options (Slattery, 2002). On the other hand, the government believes that rating software will enable architects and designers to come up with various new and innovative designs, whilst at the same time achieving the required energy efficiency (Building Commission, 2002). Particular concern should be assigned to the limited design options for some building sites. Vacant allotments views facing south or those are built out to the north will have to either seriously compromise the design aspects, or alternatively fail to meet the rating (Lindsay, 2003). Over the long term this may cause problems with land sales, with subsequent changes to land prices due to the expenses associated with reaching a five star rating.

**Property Owners**

Although Australians have a high awareness and concern for environmental issues, there is little understanding concerning how the greenhouse effect works, or how household behaviour and actions relate to the environment (Young, 2002). In relation to energy use in the house, comfort and savings on energy bills were identified as the main reasons for adopting energy conservation practices. However, the main disincentives were costs of insulation and energy saving devices (Young, 2002). It appears that the lack of knowledge and awareness by households are the main reasons why financially viable energy efficiency measures have not been adopted. It has been argued that many households are not sufficiently aware of the benefits associated with building and living in an energy efficient house, and cannot comprehend how easily this can be incorporated (Stynes, 2002).

A study based on the Irish housing market concluded that the largest factors preventing people incorporating energy efficiency measures into their houses were the expensive cost of installation, as well as a misunderstanding about the full benefits of energy efficiency (Clinch and Healy, 2000). Some owners have concerns regarding investing in energy efficiency as they believe they may not receive any financial benefits (Nevin and Watson, 1998). Furthermore, when making a decision individuals usually only consider the direct benefits they receive, and not fully considering the wider benefits to society such as reduced pollutant emissions (Clinch and Healy, 2000).

As the majority of savings are made over the long term, some owners may not keep their house long enough to fully recover the initial costs of complying with energy efficiency. On the other hand, energy efficient homes may produce immediate positive cash flows for owners as the savings in energy bills more than offset the higher monthly mortgage payments needed to finance the additional investment (Nevin and Watson, 1998). Research into the relationship between house values and energy costs in the USA concluded that properties with higher energy efficiencies had higher values, suggesting the housing market in the USA identified and valued improved energy efficiency.
Case studies – Environmental friendly developments

Parkville Gardens (www.parkvillegardens.com.au)

The 2006 Commonwealth Games Village is a 20 hectare development located 4km from the Melbourne CBD and one of the greenest, large scale inner-city developments designed to achieve a star energy rating. Specific environmental initiatives include:

- Northern orientation;
- Double glazing throughout;
- Gas boosted solar hot water;
- Insulated walls and ceilings;
- AAA rated water efficient fittings;
- Intelligent light system (motion detectors);
- Rainwater storage tanks;
- Thermostatically controlled roof vents;
- Self sealing exhaust fans;
- In house time-in-use energy metering; and
- Plantation timbers.

SALA Homes (www.salahomes.com.au)

According to SALA Homes (2006), a sustainable house should have a lesser impact on the environment and should save money through the planning stages, during construction and throughout its life. Characteristics of a sustainable house are as follows:

- Harvesting rainwater;
- Treating sewerage;
- Generating energy for its own use;
- Use materials that are renewable and recyclable;
- Avoids the use of toxic chemicals and poisonous substances;
- Offers improved security;
- Is adaptable; and
- Is affordable (SALA homes, 2006).

Masterline Homes (HIA, 2006)

This 6 star energy rated home has been accredited by HIA as a GreenSmart display home because of a range of sustainability features built into the home. These include:

- Energy efficient solar hot water service;
- High efficiency gas heating unit;
- AAA-rated tapware and toilet cisterns;
- Sealed extractor fans in bathrooms;
- Low emitting diodes and compact fluorescent lighting
- Low emission water based paints;
- Thermally improved windows;
- Passive ventilation; and
- Water efficient garden, with the use of minimal turf and a drip irrigation system.

Relevance to market value

From a valuation perspective there are two definitions of value that are commonly used to value a residential building, namely the market approach and the cost approach. According to the International
Valuation Standards Committee (IVSC), ‘market value’ is defined as “the estimated amount for which a property should exchange on the date of valuation between a willing buyer and a willing seller in an arm’s-length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently and without compulsion” (IVSC, 2006). Alternatively, the ‘cost approach’ can be defined as “a set of procedures through which a value indication is derived for the fee simple interest in a property by estimating the current cost to construct a reproduction of, or replacement for, the existing structure plus any profit or incentive; deducting depreciation from the total cost; and adding the estimated land value” (API, 2006).

The monetary difference between these two approaches identifies to what degree the marketplace acknowledges ‘green’ or ‘sustainable’ residential buildings. Thus, the cost approach or depreciated replacement cost is based on comparing the cost to develop a new property or substitute property with the same utility as the subject property although the valuer must ensure this is commensurate with open market value. Traditionally the cost approach (less depreciation) and the market approach would be generally similar for a new house – the incorporation of varying degrees of sustainability may alter this relationship. For example, based on the definition of market value would a willing buyer be looking for a fully sustainable building and be ‘willing’ to pay (or close to) the full cost of construction? Or will there be a perceived degree of over-capitalisation that the market will recognise and therefore refuse to meet? The valuer must remain fully abreast of such changing perceptions in the marketplace. Whist it is still relatively easy to overcapitalise in the construction of a residential home (e.g. stainless steel guttering, black water recycling), an increasing number of sustainable features are being sought after by a growing band of ‘willing buyers’. This clearly has an effect on both the market and cost approaches to valuation – the gap between the two, if any, needs to be closely and continually monitored in each region.

Conclusion

The occupation of, and subsequent energy use within houses, is responsible for large amounts of CO₂ emissions. Of particular concern is the energy consumed through the increasing reliance on mechanical heating and cooling, although different houses in a range of climatic regions can have large variations in energy use. When designed effectively, dwellings can minimise the use of energy to almost zero, whilst inefficient dwellings can waste substantial amounts of energy. In addition, the incorporation of passive solar design through effective building orientation and material selection can cost effectively reduce the amount of power required to heat and cool a house. A passive solar designed house also creates greater levels of comfort for occupants.

While energy consumption declined markedly following the introduction of minimum insulation levels in the early 1990’s, little subsequent reduction has been observed without legislation. The government through the introduction of compulsory energy ratings for new dwellings has highlighted the lack of consideration given to energy efficiency by house purchasers and is encouraging change. However, the views of various stakeholders in the housing market must be considered. Housing developers and builders argue that construction costs will be increase, since the products required to meet this requirement are not yet well developed and therefore are not cost effective (Building Australia, 2002; HIA, 2006). It is also argued there is insufficient market awareness of energy efficiency to justify the increased cost and valuers must reflect changing perceptions in the marketplace.

Currently, few house builders and developers actively incorporate energy efficiency into their marketing strategies. However, there are an emerging number of developers, builders and architects who are undertaking energy efficient design and construction but it is remains unclear whether this has any effect on purchasers and their buying decision. While there is little argument as to the positive effects of energy efficient design, the perception of the residential property is yet to be fully assessed. Little research has been conducted in this area, with market opinion generally given by builders and developers as to what they believe the residential market perceives. Limited research has been undertaken in Europe, particularly in the United Kingdom to investigate the reasons behind the housing market’s failure to incorporate energy
efficient strategies. There remains a clear need for further research into the actual considerations given to energy efficiency by purchasers of residential property.

The well being of future generations ensures that preservation of the environment remains a high priority in our society and global agreements aim to reduce this impact. Continued research into energy efficiency aims to reduce the amount of pollution being released, and one of the most important challenges is to develop methods to control a residential building’s energy consumption. With theories on passive solar design now well documented and the principles are universally accepted, the next step is to raise awareness of the relationship between housing and the environment. Most importantly, there are numerous issues regarding energy efficiency in regards to both cost effectiveness and importance to purchasers as well as the identification of market value. There is disagreement within the construction industry regarding the lack of knowledge of purchasers and the inability to market energy efficient houses, in direct contrast to builders who are already selling energy rated houses. Furthermore, the information being supplied is unclear and conflicting at times e.g. see HIA (2006), ABCB (2006).

Directions for future research

The rapid growth in the field of energy efficiency, both through more stringent government requirements and a growing awareness of environmental issues, necessitates substantial research to fully comprehend all aspects of energy efficient housing. With an increasing requirement for energy efficient housing, the impact of purchasers’ knowledge and industry awareness is particularly important. Undoubtedly, a greater profile of energy star ratings is required in regards to residential property. This paper highlighted the need for research into the extent of knowledge of purchasers and clearly more work is required in this area, particularly in regard to housing energy ratings and efficiency. For example, in-depth interviews and discussions with property purchasers would provide an insight into the degree of their understanding and level of ignorance.

As the number of houses being constructed with five star energy ratings increases, it would be possible to replicate this study for different housing types - this would provide an interesting comparison between purchasers of different dwelling types. In addition, this study could be replicated a few years after the implementation of compulsory energy ratings to highlight the awareness and knowledge of purchasers, and whether energy efficiency has become more important when making a purchasing decision. An investigation could be undertaken of future sales of dwellings constructed now with a five star energy rating, which would identify changes in market perceptions towards energy efficiency. It appears that as a greater number of dwellings are constructed with improved energy efficiency, the actual construction cost of its inclusion could be isolated. Furthermore, an examination of actual construction costs in the future would an insight as to whether costs are reducing over the long term, after complying with the requirement of energy efficiency.
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<td>Australian Greenhouse Office</td>
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<td>Australian Council of Building Design Professions</td>
<td><a href="http://www.bdp.asn.au">www.bdp.asn.au</a></td>
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<td>Aluminium Foil Insulation Association</td>
<td><a href="http://www.afia.com.au">www.afia.com.au</a></td>
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<td>Australian Institute of Building Surveyors</td>
<td><a href="http://www.aibs.com.au">www.aibs.com.au</a></td>
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<tr>
<td>Australian Institute of Refrigeration, Air-conditioning and Heating</td>
<td><a href="http://www.airah.org.au">www.airah.org.au</a></td>
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<td>Australian Local Government Association</td>
<td><a href="http://www.alga.com.au">www.alga.com.au</a></td>
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<td>Australian Window Association</td>
<td><a href="http://www.awa.org.au">www.awa.org.au</a></td>
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<td>Australia Glass &amp; Glazing Association</td>
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<td>Building Designers Association of Australia</td>
<td><a href="http://www.bdaa.com.au">www.bdaa.com.au</a></td>
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<td>BRANZ</td>
<td><a href="http://www.branz.org.nz">www.branz.org.nz</a></td>
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<td>Bureau of Meteorology</td>
<td><a href="http://www.bom.gov.au">www.bom.gov.au</a></td>
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<td>Cement and Concrete Association of Australia</td>
<td><a href="http://www.concrete.net.au">www.concrete.net.au</a></td>
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<td><a href="http://www.cmaa.com.au">www.cmaa.com.au</a></td>
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<td>Clay Brick and Paver Institute</td>
<td><a href="http://www.claybrick.com.au">www.claybrick.com.au</a></td>
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<td>Commonwealth Scientific and Industrial Research Organisation</td>
<td><a href="http://www.csiro.au">www.csiro.au</a></td>
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<td>The Department of Industry, Tourism and Resources</td>
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<td>Earth Building Association of Australia</td>
<td><a href="http://www.ebaa.asn.au">www.ebaa.asn.au</a></td>
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<td>Facility Management Association</td>
<td><a href="http://www.fma.com.au">www.fma.com.au</a></td>
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<td>Home energy efficiency</td>
<td><a href="http://www.yourhome.gov.au">www.yourhome.gov.au</a></td>
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<td>Housing Industry Association</td>
<td><a href="http://www.greensmart.com.au">www.greensmart.com.au</a></td>
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<td>Illuminating Engineering Society of Australia &amp; New Zealand</td>
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<td>Nathers</td>
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<td>National Association of Steel-framed Housing</td>
<td><a href="http://www.nash.mx.com.au">www.nash.mx.com.au</a></td>
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<td>Royal Australian Institute of Architects</td>
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<td>Skylight Industry Association Inc</td>
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<td>SOLARCH Group</td>
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<td>Standards Australia</td>
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<td>Sustainable Energy Authority Victoria</td>
<td><a href="http://www.seav.vic.gov.au">www.seav.vic.gov.au</a></td>
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<td>Timber Merchants Association</td>
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<td>Window and Door Industry Council</td>
<td><a href="http://www.wadic.asn.au">www.wadic.asn.au</a></td>
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