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Best of the Best in Green Design: Drivers and Barriers to Sustainable Development in Australia

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Abstract:

According to the Green Building Council of Australia's Chief Executive, Romilly Madew, "Buildings in this country account for 23% of Australia's greenhouse gas emissions." (Green Building Council Australia, 2007).[1] Improving energy efficiency of buildings is the quickest and most cost effective way of reducing greenhouse gas (GHG) emissions.

Fortunately, there is a growing demand for sustainable, energy efficient buildings. According to a global survey of commercial building occupiers by Jones Lang LaSalle and CoreNet Global in September 2008, over 40% of corporate real estate executives will still pay up to 10% more rent to occupy a sustainable building despite the financial downturn.[2] Additionally, in Jones Lang LaSalle's annual Survey of Investor Sentiment (November 2008), 18% of investors said that they will still pay more for a sustainable building, all other things being equal, compared to 29% in 2007.[3] Achieving green ratings (GreenStar and NABERS) increased in importance as a driver from 64% in 2006 to 74% in 2008.[4]

This paper outlines the results of research carried out in Australia in 2009. The broad aims of the research are to identify property stakeholders' motivations for, and experiences of, achieving proven examples of best practice in sustainable development, and to assess the incentives, barriers, costs and benefits involved. If the knowledge gap and barriers to uptake of sustainability practices are addressed, the Australian property industry presents a unique opportunity to achieve innovation and global best practice in sustainable outcomes.

1. Background and Literature Review

At the 2007 United Nations Climate Change conference in Bali, Australia's Prime Minister Kevin Rudd noted that climate change is now one of the greatest moral and economic challenges of our time. Making the building stock more sustainable and energy efficient is one of the quickest and most cost effective ways of reducing greenhouse gas (GHG) emissions.

1.1 Greenhouse Gas Emissions from Buildings in Australia

Buildings in Australia account for 23% of Australia's greenhouse gas emissions, consume 40% of Australia's total energy output and the cost to the economy of poor indoor environmental quality is estimated at $12b annually" (Green Building Council Australia, 2007).[5] The most recent National Greenhouse Gas Inventory produced by the Australian Greenhouse Office[6] reports that Australia's net greenhouse gas emissions across all sectors in 2005 totalled 559.1 Mt of carbon dioxide equivalent (CO2-e).

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1 By comparison, US buildings account for 38% of America's GHG emissions, while the figure for the UK is around 42%.
2 Jones Land LaSalle (2008, October) "Perspectives on Sustainability: Results of the 2008 CoreNet and Jones Lang LaSalle global survey on CRE and sustainability"
http://www.us.am.joneslanglasalle.com/ResearchLevel1/JLL_Global_Trends_Sustainable_Real_Estate.pdf [accessed 14 August 2009].
3 Jones Land LaSalle (2008, December) "On Point: Survey of Investor Sentiment, November 2008"
http://www.joneslanglasalle.com.au/ResearchLevel2/JLL_Australia_Survey_Investor_Sentiment_December_2008.pdf [accessed 14 August 2009].
4 Jones Land LaSalle (2009) "The Green Phoenix: Perspectives on Sustainability"
http://www.nzgbc.org.nz/documents/greenbuildingreading/2009/GreenPhoenix_2009.pdf [accessed 14 August 2009].
5 By comparison, US buildings account for 38% of America's GHG emissions, while the figure for the UK is around 42%.
6 Now the Department of Climate Change.

By 2010 the residential building sector is expected to produce between 56.7 and 58.1 Mt of CO2-e, while the commercial sector is expected to increase greenhouse gas emissions nearly twofold to 63 Mt of CO2-e (Australian Greenhouse Office, 1999). The Green Building Council of Australia's more recent estimates suggest that commercial buildings currently contribute 8.8% to national greenhouse gas emissions.

In terms of source of greenhouse gas emissions in the residential sector, over half comes from *electrical appliances selected by residents or persons outside the building sector*, a quarter comes from water heaters, and nearly 15% comes from space heating and cooling (primarily by wood and natural gas). In the commercial building sector, electricity is responsible for the majority of emissions (89%). In terms of the operational energy applications cooling (28%), air handling (22%), lighting (21%) and heating (13%) account for 84% of commercial building greenhouse gas emissions. A commercial building sector baseline study found that office buildings and hospitals were the two largest emitters by building type, causing around 40% of total commercial building sector emissions (Green Building Council of Australia, 2008a).

1.2 Government Actions to Reduce Greenhouse Gas Emissions from Buildings

In recognition of the significant environmental impacts associated with buildings, in 2003 the Department of Environment & Heritage (DEH)[7] and others commissioned a scoping study "Sustainability and the Building Code of Australia" to investigate whether it was appropriate for sustainability requirements to be included in the Building Code of Australia (BCA). In June 2004 the Australian Building Code Board (ABCB) endorsed some of the key recommendations of the research and announced that sustainability should become a goal of the Building Code of Australia (alongside the existing BCA goals of health, safety and amenity).

In 2006, the DEH and the Australian Greenhouse Office (AGO) commissioned a study "to identify and quantify the range of environmental impacts, associated with the building fabric, using life cycle analysis; review the options for reducing these impacts; and identify a range of possible measures that could improve the sustainability of building materials across the life cycle/supply chain" (DEH & AGO, 2006, p. xii). The analysis is applied to materials, not to the buildings themselves and excluded operational aspects such as lighting, heating and cooling and appliances. Building materials included in the study were only responsible for 10% of the overall greenhouse impacts of buildings (the rest is from energy consumed for building operations that this project will focus on).

The findings from the above study show that the largest quantities of materials used in buildings occur in the *new residential construction sector*. The average size of new houses has grown significantly over the past twenty years to a current average of 258m2 while, at the same time, average household size has decreased to 2.6 persons per household. Thus, a reduction in the number and size of buildings led to the largest impact reductions of any single measure examined. Further, much of the environmental impact of buildings is determined at the design stage. It is therefore critical that environmental impacts be considered early in the design process. However, it can be difficult and costly to obtain good market information on building materials with credible environmental performance information. The development and use of tools allowing easy, accurate and quick quantification of environmental costs and benefits of design options was identified as a way to improve information flows.

According to the DEH and AGO 2006 study, the amount of new stock added annually to the residential sector comprises around 3.8% of the total stock.[8] The BCA also tends to focus on new works, including major renovations and refurbishments. Existing structures, that may not meet the new standards unless refurbishment is carried out, has been largely ignored. Yet this sector comprises the majority of the building stock. In Melbourne, for example, 49% of the CBD office stock was over 50 years old in 2005 (Wilkinson and Reed, 2005).[9] While buildings depreciate with age, adaptive reuse of existing buildings produces a more sustainable outcome than opting for demolition and redevelopment (Bullen, 2007). According to Cooper (2001) upgrading the existing stock is one of the most critical aspects of improving sustainability in the built environment.

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7 Now the Department of the Environment, Water, Heritage and the Arts.

8 New stock added each year in the commercial sector is around 2-3% (Jones Lang LaSalle, 2005).

9 In Sydney the average age of CBD buildings is 28, in Melbourne it is 31 and in Brisbane it is 25 (Jones Lang LaSalle, 2005).

About three-quarters of spending on buildings over the last five years have been on dwellings. About 55% of this involves construction of new dwellings and 45% involves alterations and additions to existing dwellings over $10,000. The mean asset life of a dwelling, as used by the Australian Bureau of Statistics, is 88 years for brick homes, and 58 years for timber homes. The remaining 27% of spending on buildings over the last five years has been for non-residential buildings: 40% commercial; 20% industrial, and 20% other. Commercial and industrial buildings are considered to have a 38-58 year life (DEH & AGO, 2006, p. 23). These figures show the importance of a focus on the residential sector due to the size of the spending and the longer life of these buildings compared to the non-residential sector.

The barriers to reducing impacts on the environment highlighted in the DEH & AGO report include: lifestyle choice whereby people want large houses; a trend to smaller household sizes driving building demand for more dwellings, and resistance to urban densification and consolidation. In August 2004, the Ministerial Council on Energy announced a major advance nationally for energy efficiency, productivity and the environment, by agreeing a comprehensive set of measures comprising the first stage of the National Framework for Energy Efficiency (NFEE). The National Framework is a comprehensive package of measures covering the residential, commercial and industrial sectors, designed to overcome the barriers and challenges that prevent the market delivering the actual economic potential of energy efficiency.

At the Council of Australian Governments (COAG) meeting on April 30th 2009, the States and the Federal Government signed the National Strategy on Energy Efficiency 2009-2020 Memorandum of Understanding (MOU) and released a draft National Strategy on Energy Efficiency.[10,11] Work commenced on five key measures to drive growth in the number of highly energy efficient homes and commercial buildings across Australia:

- Increasing the stringency of energy efficiency requirements for all classes of commercial buildings in the Building Code of Australia from 2010;
- Phase in from 2010 the mandatory disclosure of energy efficiency in commercial buildings– phase 1 applying to large office buildings of 2000m2 or larger and commercial buildings owned or leased by Commonwealth, State or Territory Governments. Phase 2 may apply to other building types including hotels, retail, schools and hospitals;
- Increasing energy efficiency requirements for new residential buildings to six stars, or equivalent, nationally in the 2010 update of the Building Code of Australia, as well as introducing new efficiency requirements for hot-water systems and lighting;
- Phasing in mandatory disclosure of residential building energy, greenhouse and water performance at the time of sale or lease, commencing with energy efficiency, from May 2011;
  - Vendors and landlords will need to have an energy-efficiency report when selling or renting a home
  - The report card is expected to include insulation & building design and to be completed by an accredited assessor. Cost approximately: $150 - $250
- Reforming current building energy efficiency standard and assessment processes to achieve consistency across the nation.

The Strategy also recognises that governments are significant users of energy and proposes measures for government to "work in partnership and lead the way". Measures include improving the performance of buildings owned or occupied by governments by the promotion of energy performance contracting to upgrade buildings; developing a National Green Lease Policy, placing greater emphasis on energy efficiency in procurement practices; and increasing the energy efficiency of street lighting including the consideration of

10 See COAG: Action on energy efficiency and renewables, Media Statement 20 April 2009, http://www.alp.org.au/media/0409/msccwenhpm300.php

11 The European Union is taking a much more ambitious approach under the EU Energy Performance of Buildings Directive, with the requirement for new buildings or existing buildings to be sold or let to have an Energy Performance Certificate by October 2008. Display Energy Certificates that show the actual energy usage of a building will be required for all public buildings by July 2008 (Dixon, et al., 2008)

mandatory standards and whether an incentive mechanism for distributors to install efficient equipment is needed (De Wit and Webb, 2009).

The Property Council of Australia (PCA, 2009) has opposed many of these changes on the basis that they are too costly, too difficult to achieve, and in many cases current technologies and practices in Australia cannot deliver. The PCA is urging governments to provide property owners with a monetary incentive to "green" *existing buildings* (which account for 97% of office space).

According to a survey in the US by the American Institute of Architects, AIA, the incentives that are most effective at stimulating green building include: tax incentives, credits or rebates; density bonuses, and faster building permits.[12]

1.3 Initiatives to Encourage Environmental Sustainability

Legislation and government initiatives like those outlined above have been introduced to encourage sustainability in the built environment that will help Australia meet its' Kyoto emission reduction targets. Further, a range of tools have been developed internationally and in Australia to measure the various aspects of the environmental performance of new and existing buildings against benchmarks. The three most prominent environmental rating systems for commercial properties in operation are: Green Building Council of Australia's (GBCA) Green Star; Australian Building Greenhouse Rating (ABGR); and the National Australian Built Environment Rating System (NABERS).

For residential properties, currently the BCA's 4-star energy rating requirement provides a minimum standard adopted by all Australian states and territories which did not already have an equivalent system in place, with requirements for 5-star energy ratings introduced for new homes through the BCA in Western Australia and the ACT in 2006.[13] NSW has not adopted requirements under the BCA and operates its own Building Sustainability Index (BASIX), a web-based planning tool. BASIX requires new homes, major alterations and additions to existing homes in NSW to use up to 40% less potable water and produce up to 40% fewer greenhouse gas emissions than the average home. Although, under the National Strategy on Energy Efficiency, a nation-wide approach will soon be taken.

The development of green rating schemes such as Green Star and NABERS has been a key factor in assessing sustainability in commercial property. According to a Jones Lang LaSalle's annual Survey of Investor Sentiment (November 2008), achieving green ratings (GreenStar and NABERS) increased in importance as a driver from 64% in 2006 to 74% in 2008.[14]

The government and other public-sector bodies are leading by example in their briefs for sustainable buildings. For example, South Australia, Victoria and Queensland state governments have set a minimum 5 Star Green Star standard for all government office accommodation. The Federal Government has a 4.5 Star NABERS rating minimum requirement for office areas over 2000 m2, with all new buildings to be 5 Star NABERS energy. Kats (2003) helps to explain this. He suggests that governments see the benefits of sustainable buildings more through social and environmental benefits with some regard to the financial, whereas the private sector is more driven by the financial returns, particularly when most of the benefits of sustainable development accrue to the tenants rather than the investor. However, the large progressive corporations in the private sector are also a leading driver for green buildings. According to a study by Newell (2008), a number of listed property trusts (LPTs) are providing leadership in the implementation of sustainable commercial property practices. For example, Investa, Mirvac, Stockland, ING, DB RREEF and GPT are delivering excellence and international best practice.

1.4 Use of Renewable energy to Reduce Greenhouse Gas Emissions

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12 Survey by AIA and Developers Roundtable at the end of 2007. Source: www.Metrogreenbusiness.com/news (in Miller et al. 2008).
13 The average home has a rating of 2-stars.
14 Jones Land LaSalle (2009) "The Green Phoenix: Perspectives on Sustainability" http://www.nzgbc.org.nz/documents/greenbuildingreading/2009/GreenPhoenix_2009.pdf [accessed 14 August 2009].

A method supported by the Australian government to reduce greenhouse gas emissions is the use of renewable energy, power produced from wind, water or solar sources. The Government's Mandatory Renewable Energy Target (MRET) currently requires 20 percent share for renewable energy in Australia's electricity supply by 2020.

From an individual building perspective, solar energy can be used for the generation and provision of both electricity (photovoltaic systems) and hot water (solar hot water systems). Wind turbines can be placed on buildings for the production of power. Together these systems are known as micro-generation technology, "heat and/or electricity on a small-scale from a low carbon source".[15] However, the uptake of these technologies has been slow. A study by Roberts and Sims (2007) suggests that the barriers to the adoption of micro-generation technology amongst residential developers in the UK were the initial costs, long payback periods, and the current market immaturity, reliability and liability of micro-generation products.[16]

1.5 Cost as a Barrier to the Uptake Sustainable Development[17]

Despite initiatives to encourage sustainable practices, the built environment is not contributing sufficiently to greenhouse gas emission reduction targets. One argument commonly put forward against "going green" is that it costs more than it would to build a comparable conventionally designed building. However, several reports refute this. Kats (2003) concluded that the average premium for all 33 green buildings studied is slightly less than 2% (premiums varied, depending on the standard of rating, from 1% to 6.5%). Davis Langdon (2004 & 2007) found that the cost per square foot for buildings seeking basic LEED certification falls into the existing range of costs for buildings of a similar program type.

In Australia, Davis Langdon (2007) found that at present, the initial impact on construction costs (above comparable non-Green projects) is likely to be in the order of 3 – 5% for a 5 Star solution, with an impact of a further 5% plus for a 6 Star non-iconic design solution. While there may be a marginal cost premium to build green, there is extensive evidence that greener properties can cost less to run and a growing body of evidence that they can achieve not only higher rents but higher property values too.

Another issue mentioned in the literature is the split incentives between landlords and tenants (see Myers 2008, for example) where the landlords are investing in green buildings but the tenants are benefiting through reduced energy and water costs, greater productivity, etc. According to Borger (in Armitage 2009), however, there is a growing practice of leases to be structured gross of outgoings to ensure the benefit of the efficiencies in outgoings revert to the building owner/investor.

It is worth noting that if the Government requires office buildings to meet a minimum Green Star or NABERS rating, the marginal costs of achieving the rating becomes zero as there will be no alternative.

1.6 The Economic Argument for Sustainable Practices

According to Myers et al. (2008), for sustainability to gain industry-wide acceptance and uptake, the majority of building owners and investors need to be assured of depth in the market as well as the financial certainty and viability of sustainable buildings. Economic return is a key driver in the property investment market. Lorenz (2007) supports the view that evidence on the economic advantages of sustainable property investment is needed to persuade business practices, to inform the public debate and to transform the markets for sustainable buildings. While there have been numerous surveys of industry stakeholders to determine the value of sustainability, there are very few quantitative studies. Some of these are outlined in the next two sections.

1.6.1. Examples of Surveys to Determine Value Impacts of Green Buildings

In 2006, Jones Lang LaSalle (JLL) surveyed corporate occupiers across Asia Pacific and found that 11% would consider paying more to occupy a sustainable building. However, a survey conducted in March 2007

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15 Department of Trade and Industry (DTI) Micro-generation Strategy 2006.

16 The demand for micro-generation technology in the UK is been driven by the Code for Sustainable Homes that aims to achieve "zero-carbon status for new housing by 2016".

17 The report *Our Common Future* (1987), put forward by the World Commission on Environment and Development (subsequently renamed the Brundtland Commission), popularized the notion of "sustainable development" and is defined in the report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

by JLL in collaboration with CoreNet found that this response had risen to 64% (Jones Lang LaSalle, 2007). The Green Building Council of Australia (2008b) commissioned a survey of industry stakeholders to determine the drivers for implementing green building practices, and the rental and value impacts of a Green Star rating. Nearly half (45%) of respondents indicated that tenant demand is driving the need for their organizations to implement green building practices, yet two thirds of respondents believe that that tenants are not willing to pay more to lease a Green Star building. About two-thirds of interviewees would be willing to pay more to invest in a Green Star building. Long-term rental growth, tenant retention and operating cost savings were nominated as the key drivers of market value of green buildings.

1.6.2. Examples of Quantitative Studies is to Determine Value Impacts of Green Buildings

The only comprehensive studies known to date are coming from the US where sales data are more readily available and sustainable ratings for buildings have been in existence longer (Leadership in Energy and Environmental Design (LEED) was developed in 1998 in the US,) than is the case for Australia, or NZ, (2003 and 2005 respectively)).[18]

A study by Miller et al. (2008), using the CoStar database, compared all USA-based Energy Star and LEED certified office buildings with a large sample of buildings without these ratings that were of similar size, location, class, tenancy and year-built. There were more than 900 Energy Star-rated buildings and 580 LEED certified buildings in the database. According to the study, LEED buildings command rent premiums of $11.33 per square foot over their non-LEED peers and rental rates in Energy Star buildings represent a $2.40 per square foot premium over comparable non-Energy Star buildings. Energy Star buildings are selling for an average of 5.76% more, while LEED buildings command a 9.94% premium.

However, the LEED certification was not broken down into the various levels of certified, silver, gold or platinum, so the results provide a preliminary indication only as to the value added by the general LEED rating. This aspect of the study was strongly criticized by Muldavin (2008), who had concerns too about the peer building selection approach used in the study. Muldavin further points out that the study does not directly link the costs and risks undertaken to achieve the stated rent or value premiums, which the title of the work implies.

A study by Eichholtz, Kok and Quigley (2008) provides more substantive evidence on the economic value of the certification of “green buildings” in the commercial sector. They analysed data on 694 certified Energy-Star and LEED-rated office buildings and on 7489 other office buildings located within a quarter mile of the certified buildings. They found evidence that rents for green offices are about 2% higher than rents for comparable buildings located nearby. Effective rents, i.e., rents adjusted for the occupancy levels in office buildings, are about 6% higher in green buildings than in comparable office buildings nearby. The selling prices of green buildings, all things being equal, are about 16% higher than other nearby buildings that do not have these green credentials. When the certification is reported separately for the Energy Star and the LEED systems, there is no evidence that the latter is associated with higher selling prices, or higher rents. Further, the authors point out that it is not yet possible to distinguish between the effects on market value of energy savings and conservation from the other valuable attributes of a rating. Lastly, the authors note that the results are neighbourhood specific.

1.7 Productivity Studies

According to a report by the Green Building Council of Australia (2008c) tenants have become less focused on savings in operating costs, and are placing a higher value on the intangible benefits such as productivity, staff attraction and retention, and reduced sick leave and absenteeism.

Miller et al. 2008 estimate the productivity benefits from environmentally sustainable building designs to be as much as 10 times the energy savings from green efforts. Such benefits include lower absenteeism, higher productivity, fewer headaches at work, etc.

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18 BRE Environmental Assessment Method **(**BREEAM) was one of the earliest rating tools to measure the sustainability of new non-domestic buildings, developed in the UK in 1990.

The problem has been that productivity and health benefits are much harder to assess and measure with any degree of accuracy than the more easily quantifiable energy and water savings from green buildings. However, there are a growing number of such studies that demonstrate the correlation between improvements in indoor air quality, better lighting and building comfort and worker health and productivity (see in particular, Fisk, 2000 and Kumar and Fisk, 2002).[19] According to the GBCA (2008c) current productivity studies involve the use of post-occupancy evaluation. But to effectively compare one individual building against another standardized, well tested and reliable methods are needed.

1.8 Summary

According to the Commonwealth Scientific and Industrial Research Organisation (CSIRO), "Climate change is perhaps the greatest environmental challenge facing human society".[20] If the knowledge gap and barriers to uptake of sustainability practices are addressed, the Australian property industry presents a unique opportunity to achieve innovation and global best practice in sustainable outcomes. The aim of the research reported here is to investigate the drivers and barriers to sustainability in commercial buildings, the results from which will aid in the uptake of sustainability practices in new and existing buildings.

2. Research

The limited number of sales of green buildings in Australia precludes a quantitative study to determine any expected value premium from such buildings. This study, instead, investigates the barriers and drivers to sustainable development, not to prove the "business case" for such development, but so that we can learn from the experiences of others of what not to do, and how to do it better with reduced risks and costs to aid the uptake of sustainable building practices.[21]

2.1 Methodology: Evaluate best practice in the commercial property sector

There are a growing number of best practice examples that can be adopted as case studies for analysis. The drivers and successes as well as the barriers and impediments to the uptake of sustainable practices were investigated. This involved conducting field research: inspecting best practice buildings and using participatory techniques, including interviews with key stakeholders in the commercial property sector. The survey results will be subsequently compared and contrasted to a parallel survey of owners and investors and developers in the residential property sector.

2.1.1 Database

Various steps were involved in identifying the most highly rated commercial buildings in Australia as well as identifying key stakeholders to interview. These steps are outlined below:

- The NABERS and Green Building Council of Australia (GBCA) databases of rated building were obtained that enabled the most highly rated buildings to be identified, as well as the owners or contacts for the buildings.
- The on-line GBCA database with associated maps enabled buildings to be indentified that were centrally located.
- Garry Baverstock, an early architect in solar design, and responsible for setting up the Solar Energy Information Centre in Perth, as well as winning numerous awards for his environmentally sustainable developments helped to identify the key architects around Australia involved in environmentally sustainable designing.
- CEO of the GBCA, Romily Madew, suggested buildings not yet listed on the GBCA database.

Stakeholders identified that included architects, developers, facility managers, project managers, property managers, sustainability managers and tenants were contacted by email and phone to identify their wiliness to participate in this research. Those willing to be involved helped the final list of properties to be confirmed.

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19 As reported in Kats (2003), "The Rocky Mountain Institute has been a pioneer in developing and publishing studies on green buildings and productivity. See Rocky Mountain Institute website, "Buildings & Land," Available at: http://www.rmi.org/sitepages/pid174.php.

20 CSIRO, http://www.csiro.au/science/ps10k.html, accessed 8 February 2008.

21 This study is part of an Australian Research Council Discovery grant with Professor Peter Newman titled "The divers and barriers to sustainability in residential and commercial buildings.

2.1.2 Field surveys

Phone calls or emails to the building contacts were made/sent to arrange interview times and building inspections. These were carried out between Monday 24th August and 1st September 2009. A survey instrument was employed to guide the interview questions (see Appendix 1). This was based on an on-line survey developed as part of parallel research to survey building professionals. The latter survey is part of on-going research to investigate the drivers and barriers for sustainable development. To aid in the recording of the interviews an Olympus DS-40 Digital Voice recorder was employed.

2.2 Results: Best practice examples of ESCD

2.2.1 Interviewees

A total of twenty-two buildings were selected for the case studies: five in Adelaide; eleven in Melbourne and six in Sydney (see Appendix II). Twenty-three interviews were held with a range of stakeholders, some of whom were also tenants of the buildings they were discussing. As can be seen in Table I below, the highest proportion of respondents (48%) were architects, with tenants (30%) and project managers/sustainability managers (26%) being the next largest group of respondents. This indicates that we were able to gauge the views of a wide range of stakeholders/property professionals.

Table I – Stakeholders Interviewed

City	No. Buildings	Facilities Manager	Tenant	Architect	Project Mgr/ Sustainability Manager	Property Manager	Developer/ Owner
Adelaide	5	1	1	3		1	1
Melbourne	11		5	6	3	1	1
Sydney	6	1	1	2	3		
TOTAL	**22**	**2**	**7**	**11**	**6**	**2**	**2**

2.2.2 Building Ratings

As mentioned above, the selection of the buildings were based on the GBCA and NABERS databases. GBCA ratings are either “Office Design” (OB), or “As Built” (AB) and range from 4 stars to 6 stars Green Stars. 4 stars signify 'Best Practice' in environmentally sustainable design and/or construction and 6 stars signify “World Leadership”. “Office Design” evaluates the environmental potential of the design of commercial offices (base buildings), for both new and refurbished projects whereas “As Built” assesses the delivery of the same design criteria as in “Office Design”, but at construction completion. Thus, projects can only be assessed for “As Built” after the building has been completed and has been operational for at least 12 months, as it requires collection of energy and water use data, amongst other information, over that period of time. Of the 184 certified Green Star projects, only seventeen of them are “As Built”. There are reasons for this low number that will be discussed under the main results from the interviews, in the next section.

Another GBCA rating is for the interior fit-out of an office (FO). The Green Star - Office Interiors rating tool is designed for building owners, tenants and interior designers to assess the environmental impact of an interior fit-out. A green fit-out will include issues such as access to natural light, waste management, energy conservation, low emission paints and timber from sustainable forests.[22]

NABERS measures an existing building's environmental performance during operation. NABERS rates a building on the basis of its measured operational impacts and may include energy, water, waste and indoor environment. It benchmarks a building’s greenhouse impact on a scale of one to five: one star being the most polluting and five stars the least.[23]

Three of the case study buildings had neither a GBCA nor a NABERS rating. This was because two of them are educational facilities (one high school and one technical college) for which no educational tool yet exists (still in the pilot stage). The only office building in the sample that did not have a rating was an historic building refurbished prior to the establishment of the GBCA in 2003. However, each of these buildings has

22 See http://www.gbca.org.au/green-star/rating-tools/green-star-office-interiors-v1-1/1530.htm, accessed 29 September 2009.
23 http://www.nabers.com.au/page.aspx?cid=533&site=2, accessed 29 September 2009.

won various awards for their sustainable features. For example, the office building has won the following awards:

- The Premier's Sustainability Award 2003
- Banksia Awards 2003: Winner Category 10: Leadership in Sustainable Buildings
- Australian Property Institute, 2003 Excellence in Property Awards: Winner Colonial First State Environmental Development Award
- Planning Institute Australia - Victorian Division - 2003 Awards for Planning Excellence: Winner Ecologically Sustainable Development (Built) Award

Table II below shows the type of ratings of the building sample. As we were attempting to survey best practice, it is not surprising that ten (47%) of the GBCA rated sample buildings had the highest green star rating possible “World Leadership” (7OD, 1AB, 1Pilot, 1 FO); eight (42%) represented “Australian Excellence” with 5 star ratings (4OD, 3AB, 1FO), and only one was rated as “Best Practice” with 4 stars. Only eight of the sample buildings had also undertaken a NABERS rating, with five of these (62.5% of NABERS rated buildings) achieving the highest level of rating at 5 stars. All 6 star Green Star rated buildings in Adelaide, Melbourne, and Sydney were included in the sample. These results give us a confidence in the sample as representing leadership in sustainable development.

Table II - Green Star & NABERS Ratings

City	4*AB	5*AB	6*AB	5*OD	6*OD	5*FO	6*FO	6*Pilot	4*N	4.5*N	5*N
Adelaide	1	2		1	1					1	2
Melbourne			1	2	2	1	1	1	1	1	2
Sydney		1		1	4						1
TOTAL	**1**	**3**	**1**	**4**	**7**	**1**	**1**	**1**	**1**	**2**	**5**

2.2.3 Building Ages

Currently only six existing buildings have received a Green Star Office Design rating. Four of these buildings were included in the sample. Two have achieved 6 star Green Star status; 39 Hunter St, Sydney and 40 Albert Rd, Melbourne and two achieved 5 Star Green Star: 88 George St, Sydney and 530 Collins St, Melbourne. Two of these buildings are heritage listed and two are 1980’s structures. Two other heritage buildings in the sample were not listed: one has submitted an application for a 5 Star Office Interiors rating and the other, mentioned above was refurbished before the GBCA was established, but won prestigious awards in recognition of the sustainable features within the building. The remaining sixteen buildings in the sample were completed within the last five years.

2.2.4 Environmentally Sustainable Building Features

A number of sustainable features have been included in the buildings. Appendix III shows a range of features evident in the sample buildings. Not every building had all features, but from the interviews it became apparent that the features selected for inclusion were motivated heavily by the GBCA rating tools and desire to achieve a certain GBCA “Design” rating outcome. However, while there is a perceived need to obtain a Green Star rating in order to market a building to potential investors and/or tenants, the motivation to go the next step to obtain the “As Built” rating after construction was far less. Having successfully marketed the building, interviewees generally felt that the time, effort and cost in obtaining an “As Built” rating was not worth it. A NABERS rating, which also measures how the building is performing, was considered more important than the Green Star “As Built” rating when weighed against the time and cost factors involved in achieving these.

Not surprisingly, cost was a major factor for not including certain features in the buildings. According to the Green Building Council of Australia’s matrix of cost versus sustainability, the following items are considered to be the lowest cost and highest sustainability benefit:[24]

- Building user training program
- Automatic HVAC switch off

24 Green Building Council of Australia (2008), “*The Dollars and Sense of Green Buildings 2008*”, http://www.gbca.org.au/docs/dollars-sense08, p.63 [accessed 23 May 2009].

- Passive solar orientation
- Fire test water retention
- Reduction in photocopiers/printers due to dedicated rooms
- T5 fluorescent lighting
- Xeriscape landscaping
- Zero ODP building insulation
- Energy use targets and monitoring

Where possible many of the buildings in the sample included all of the above features. Those features not achievable were due to site constraints, surrounding buildings or existing structure constraints. Other features included consistently in the sample were: zero or low ODP refrigerants; internal plants (GBCA suggest one plant/person); low VOC paints, stains, adhesives, sealants, carpets; water efficient fixtures and fittings; high frequency ballasts; efficient lighting design and zoning; PVC minimisation in materials, and bicycle storage, change rooms, and showers. The following table shows how many of the sample ***office*** buildings (n=19) included the described features:

Table III – Sustainable Features

Atrium	Campus Style/ Open plan	Heating & Cooling	Use of Renewable Energy	Bike racks, showers, lockers	Grey-water	Co-generation plant
10 (52%)	17 (71%)	Variable air volume systems: 9 (47%); chilled beams 8 (42%)	10 (53%)	19 (100%)	8 (42%)	5 (26%)

Heating and cooling systems varied with variable air volume (VAV) systems making up 47% (9), chilled beams 42% (8), with only one office building (and the Melbourne Convention and Exhibition Centre) using an underfloor air displacement system. Other systems used in the remaining 10.5% (2) of the sample buildings included: reverse cycle split system and a gas driven variable refrigerant volume (VRV) system.[25] Most of the buildings also had the ability to provide natural ventilation through operable windows.

Of the renewable energy sources adopted (excluding purchasing Green Energy) the most predominant application was solar panels (26%, n=5) for heating hot water within the building; 16% (3) had a harbour heat rejection system (saves water and replaces the need for cooling towers), and 16% had photo-voltaic solar energy arrays. Only one of the buildings made use of wind energy.

Of the most expensive systems to include in buildings are photo-voltaic arrays, wind turbines, gas co-generation plants, greywater treatment plants, chilled beam cooling systems, air displacement ventilation and low E double glazing. It was not surprising that the building that had the most extensive use of these features (Council House 2 (CH2), Melbourne) was funded by the government at a cost premium of 22.1% ($11.3million AU). However, it must be noted that this cost was offset by increases in the productivity of staff, which together with the savings in energy from the ESD features reduced the payback time considerably (5-7 years) (see section 2.2.5 below). The SA Water building in Adelaide also included an extensive use of sustainable features at a cost premium of 10%. Many of the newer buildings are now trying to achieve a sustainable outcome at low or no cost premium. This was a direct goal of The Gauge in Melbourne. Lend Lease architect, Darren Kindrachuk describes the Gauge as "representing an environment solution at a highly competitive construction cost, delivered on the conventional cost of a commercial building."[26]

Annual savings and reductions in greenhouse gas emissions varied widely between buildings depending on the ESD features within them. For example, 60 Leicester Street Melbourne that was built in 1870 and refurbished in 2002 consumed only a third of the energy of a typical commercial building. Workplace6 in Sydney that was completed in 2008 and has a blackwater treatment plant, a gas powered co-generation plant

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25 The volume or flow rate of refrigerant is accurately matched to the required heating or cooling loads thereby saving energy and providing more accurate control.(Source: http://www.comfort.uk.com/faq.htm#vrv, accessed 30 September 2009)
26 Interview with Darren Kindrachuk, Lend Lease, Sydney Tuesday 1st September 2009.

and a harbour heat rejection system reduced greenhouse gas emissions by 70%, saved 90% on water consumed and 45% on energy. The harbour heat rejection system saved 4.8million litres of water p.a.

2.2.5 Productivity Studies

Six (27%) of the sample buildings' tenants have commissioned Building User Surveys/Productivity Studies to determine the impact of relocating to their new space. Such studies are an increasingly important part of ensuring the ESD principles actually work and also provide the business case for going green. For example, a post-occupancy study by Paevere and Brown (2008) of CH2 found that productivity increased 10.9% by moving from their former building CH1, to CH2. Their study included physical indoor environmental quality (IEQ) measures as well as evaluation of occupant health, wellbeing and productivity based on occupant questionnaires, spot health symptoms questionnaires, focus group interviews, sick leave (absenteeism) and staff turnover data. For the occupant surveys they received responses from more than 260 employees in CH1 and CH2. The 10.9% productivity increase translates to an annual cost saving of $2.4million (AU). According to Professor Rob Adams, Project Director for CH2, this saving, together with savings in energy of $370,000 from the ESD features of the building, will reduce the payback time to between just five and seven years.[27]

The results of this productivity study were similar to those from other productivity studies from the sample buildings. Generally, employees were highly satisfied with their new premises, the facilities, and the fit-out. However, the most common areas for concern were thermal comfort, which was either perceived as too cold and/or that there was too much draft (50 Lonsdale St), or conversely that there was not enough airflow (CH2). Another area for concern that was the space was too noisy (CH2, CCT1 and 50 Lonsdale), or did not have enough natural light (CH2 and Szencorp). The noise issues are not surprising as many of these employees have moved from individual offices to an open plan environment. The response to results from the building user surveys by the building owner/manger has been to introduce more task-lighting, and tenant education programs to teach about the building controls, such as heating, cooling, lighting and how tenants can influence these. Szencorp's response to this aspect of the survey results is to investigate the use of The Green Training Company's online educational program to enhance tenants' understanding of environmental issues.

2.2.6 Interview Results

Each building is a unique case study but for the sake of brevity and confidentiality the results from the interviews will be summarised. The survey instrument in Appendix I was used to guide the interviews. The responses below will follow a similar format.

Size and Type of Building

The majority of the sample buildings were high-rise offices (82%), one was a convention and exhibition centre, two were educational campuses, and one was a single floor office fit-out. Of the office buildings, Net lettable areas ranged from 1,200m2 (Szencorp Building, Melbourne) to 65,775m2 (Stock Exchange building, Melbourne), with an average size of 19,253m2. The buildings are from 2 to 38 storeys high, with an average of 10 storeys. Of the buildings where the Property Council of Australia building grade was known (9 in total), eight of these had a PCA A-grade, and one was a PCA premium-grade building. Bicycle racks, showers and lockers were provided in all office buildings with racks ranging from accommodating 12 bikes (88 George St, Sydney) up to 260 bikes (Macquarie Bank building, Sydney).

The main drivers for ESD?

Generally, the demand for ESD was driven either by the tenant (36%, n=8), owner/investor (36%, n=8), or the Government (27%, n=6). Many respondents wanted to show leadership in sustainability, especially where the company has a strong environmental focus or sustainability policy. For example, Melbourne City Council has sustainability as a core policy: Melbourne 2020 program targets zero net emissions and reducing the city's water consumption by 12%. The Council premises were to reinforce the Melbourne 2020 plan and to be a demonstration project. Similarly, Sustainability Victoria, a statutory authority that helps communities, government and businesses to reduce environmental impact, felt their role extends to demonstrating best practice in their own space. Another government example is the Sydney Harbour Foreshore Authority with its vision of sustainability, social responsibility and economic viability of The Darling Harbour, The Rocks and

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27 Interview with Prof. Rob Adams, Project Director CH2, Melbourne City Council, Wednesday 26th August 2009.

Barangaroo precincts and an ambitious target to be carbon neutral by 2010. Integral to this sustainability strategy is the pledge to the Green Star Business Partnership to adopt a minimum Green Star rating for all new buildings and major refurbishments.

In addition to government, private companies are also showing leadership in ESD. Szencorp wanted to set the benchmark of sustainable buildings in Australia and demonstrate the commercial viability of sustainable development. Further, they wanted the building to act as a test bed for innovative technologies to be demonstrated and commercialised. Building owners/developers such as GPT (General Property Trust), Lend Lease, Brookfield Multiplex, and Investa each have a strong sustainability agenda. For example, GPT signed a voluntary Sustainability Covenant, a statutory agreement under section 49AA of the Environment Protection Act 1970 in February 2008 with EPA Victoria. The parties agree to work together to reduce the ecological impact of GPT's Australian assets and operations, amongst other things.[28]

Other interviewees see ESD as leverage to attract young Gen-Y staff that value sustainable features and want to work in environmentally friendly buildings. Investor interviewees also want to future proof their property asset as there is a perception in the market that if the building is not green they will not be able to lease or sell it in the future.

What were the most successful ESD features in the building

Three of the interviewees felt that the success was in the design process, selecting a dedicated team and getting the whole team involved early in the process, including the contractors. They felt this "holistic approach" was critical to getting commitment from the outset and allowed the team to find the most innovative solutions to achieve the best outcome. For example, for CH2 in Melbourne the design approach taken by the project director, Professor Rob Adams, was to bring over from Zimbabwe an architect known for his innovative skills in designing green buildings: Mick Pearce. Following a tender process, the team was then invited and paid an additional fee to debate, brain storm, create, and design the best outcome. They did this over an intensive three week period, working for half a day, each day.

In terms of achieving a cost effective outcome, a number of interviewees stressed the importance of a truly green philosophy: "If you don't need it, don't have it". For example, savings were made by not painting columns, not having elaborate decoration or expensive common area flooring tiles, by insetting columns in from walls/windows so it would be easier and quicker to build around, etc. Further, only the most cost effective green measures were adopted such as solar passive design. This cost-consciousness was also given as a reason not to include black water treatment plants, photovoltaic arrays or other expensive features. Such features were considered cost prohibitive. When this philosophy was followed the additional cost of the ESD was either zero or only 1-2% premium, over a comparable non-green office building. Other interviewees that incurred much higher cost premiums were commonly owner occupiers who were able to gain the benefits of increased staff productivity and savings in energy and water costs. These owner occupiers were also using their building as a demonstration project (CH2) or as a test bed for innovative technologies to be demonstrated and commercialized (Szencorp).

Of the ESD features that were considered most successful, chilled beam technology was mentioned by a number of interviewees. Not only did the chilled beam system need less ceiling height, so additional floors were able to be added from the ceiling height saved (more NLA and thus, more rent and more building value) but they do not need balancing as they self regulate. Space is saved as there are no ducts needed to pump air.[29] The chilled beam system uses 30% less energy than a regular air conditioning system. However, one interviewee that has experience with variable air volume HVAC systems considered this type to be very energy efficient as well (and less expensive to install).[30]

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28 http://epanote2.epa.vic.gov.au/EPA/Publications.nsf/d85500a0d7f5f07b4a2565d1002268f3/073454363d2ed25eca257392001cdbaa/$FILE/1194.pdf, accessed 30 September 2009.

29 A single pass system is used - convection currents are created (hot air rises, cold air falls) to circulate the air (swirl vents help aid this).

30 A reviewer of this paper responded that "VAV systems when in a fitout situation cannot provide the ability to provide outside air rates consistently, due to the variable throttling (an issue the GBCA do not properly evaluate). VAV systems that are energy

The skill and quality of the facility manager, and the sophistication of the BMS to closely monitor the building, were seen as critical to the success of how well the building performed and whether it could achieve the desired NABERS rating. One interviewee noted that the 12 month monitoring for NABERS required detailed analysis of consumption that was beneficial to providing the necessary data to being better informed about how well the building was performing and what needed to be addressed and fine tuned for optimal results.[31]

Reducing heat at the façade through the use Low E double glazing (high performance insulated glazing), was another mentioned successful ESD feature, though it was noted to be very expensive (the payback time at today's energy costs is so long that it is not justified on purely economic grounds). The Low E glass provides 80% more light so there is less need for artificial lighting.

What did not work?
One interviewee felt that passive chilled beam air cooling systems that require dry conditions are not suited to the Southern Hemisphere which tends to be humid. This need for dry conditions necessitates ensuring that the building is well sealed. If dry conditions are not maintained the air turns to rain which could have catastrophic results. The swirl diffusers used to help circulate the cool air of these systems was reported to create a draft of cold air, a complaint received by occupiers.[32] This technology is also high maintenance and very technical, requiring highly skilled facilities managers.

Similarly, many interviewees noted that these buildings are becoming too technical and complex requiring not only more regular but finer tuning. An average building only needs tuning annually whereas high performance buildings require tune ups at least quarterly, adding to the operating costs of the building.

Temperature was mentioned as an issue in a number of the buildings, with the common complaint being that it was too cold especially where tenants cannot control the temperature themselves, where it is regulated by zone, automatically. Facilities managers can change the set points if need be, finding a balance to satisfy everyone, but it was considered to be more of an education process teaching occupants the need to treat the building like "a third skin" and to dress appropriately.

The fit-out not matching the design of the building was a more common irritation of building managers and owners. For example, to maximize light tenants were placing their computers and desks near windows which created glare and too much heat so they compensated by using more air conditioning than necessary or ideal for the space. Further, some tenants in their fit-out use materials that are not recyclable, have PVC content, or that off-gas, and this contradicts the ideals of the base building.

Another concern voiced was that the tuning/commissioning period after practical completion (PC) was not long enough, in some cases only a month or two. It was considered that the ideal would be for the whole design team to be involved for 12 months after PC, and at least until the NABERS rating is achieved, as the consultants are often needed to provide information for the rating submission. Further, commissioning issues can be resolved more promptly if the team is still in place.

Some materials were not green rated (by the GBCA) and one interviewee had to ask various companies to apply for the rating. The process took twice as long as a result. Further, some of the GBCA approved

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efficient in obtaining high ratings usually come at the expense of IEG and amenity." (Email correspondence from Matthew Salisbury, WSP Lincolne Scott, 2 December 2009).

31 Commissioning and tuning of Central City Tower was considered long enough, however the capability of the industry in actually tuning a building to perform better was uncovered. "They really has no idea or interest." (Email correspondence from Matthew Salisbury, WSP Lincolne Scott, 2 December 2009).

32 A response by a reviewer of this paper responded that "chilled beams are controlled such that there is never a humidity issue internally. The air is dehumidified to an acceptable level prior to entry into the building and also the beams have humidity control sensors. The swirl diffusers have no connection with the operation of the chilled beams and are independent providing very low velocity outside air at 100% above code requirements. Recent studies have demonstrated CO2 levels at 450ppm in the building almost matching external conditions at 400ppm, whereas traditional buildings are deemed to be problematic at 1000ppm." (Email correspondence from Matthew Salisbury, WSP Lincolne Scott, 2 December 2009).

materials were only available from overseas or interstate which added to the cost and time to acquire them (and increased the embodied energy of the product).

Other issues mentioned, are listed below:

- Water efficient toilets (2/4 litre dual flush): these had too little water that did not wash away affluent (it cleared the bowel but not the pipes). These had to be replaced with less water efficient toilets (3/6 litre dual flush) to overcome this.
- Atrium: heated up excessively and created glare (despite being designed as a heat soak, and for light and natural ventilation)
- GBCA Star Ratings specify paints that do not last, and mark easily
- Bike credits require a bike-friendly city (with bike paths, lower traffic, less pollution)
- Under floor displacement ventilation adds to height of the building
- Connecting the co-generation plant to the electricity grid took a lot of time to negotiate with the various government departments
- Wind turbines were too heavy - do not turn sufficiently to generate energy (however, they still aided with drawing air out of the building)
- The idea of a green roof did not work. Unless there is a single tenant in the building the access to the green roof is complicated. Further, unless it is directly connected to the workspace it is very difficult to substantiate. Identifying who is responsible for the cost and maintenance of it was also problematic.

What lessons were learned?

For some of the interviewees they learned the detriments of using complex systems (wind turbines) rather than relying on proven (tried and tested) technology. Further, they discovered the need of having a facilities manager who is highly trained in working with all the complex, technical features in the building.

A number mentioned that ESD features that might enable a developer to get to a 6 star Green Star solution, such as co or tri-generation plants and grey or black water treatment plants, that are cost prohibitive are better on a precinct basis, than on building by building basis. Tuning/commissioning time should be much longer and guaranteed for a year.

Green walls within the building space as a form of shading or air purification were found to be problematic in a few of the sample buildings, with plants dying. Lighting and plant choice were the main reasons for the failure of the plants survival. Having a green wall was found to be energy and water consuming as it needs (in buildings, artificial) light and water to aid plant growth and survival. The amount of air actually filtered by the plants was questioned. The concept had to be reconsidered in some cases.

Empowering people to take responsibility for their actions by allowing tenant access to an environmental information system, through a computer-based Building Automation System, that manages and provides real-time data on the performance of the building's energy, water and waste systems, was recommended by some interviewees. In this way they are able to monitor their own use of energy and the building's water consumption. One interviewee felt that in order to make a building as environmentally sustainable as possible, some form of regulation and monitoring of tenant behavior is essential. Some companies have implemented environmental management plans (EMP) but the approach taken for the 60L Building in Melbourne was even more proactive by incorporating compliance with the EMP as part of the legally binding lease agreement.

What prevents the uptake of ESD?

Many interviewees commented on cost and the current difficult financial times, as a reason fewer owners/investors are taking up ESD initiatives. They are simply reluctant to spend the money during the current economic climate. From a tenant perspective, location and rent were said to be still more important to most tenants than environmental, or energy saving features. The need for tenant buy-in was considered to be essential as they speak with their feet and if they do not value or want ESD features they will not value or be willing to pay for them. It was generally expressed that tenant fit-outs also need to compliment the base building.

The cost of and problems with ESD features and gaining a Green Star rating were mentioned commonly as issues. The cost to get a GBCA rating was reported to be around $100,000. Further, it is time consuming and involves extra consultants thereby adding to the cost for certification. As mentioned above, these were reasons provided for not applying for the "As Built" rating after a building had been completed and had been operating for at least 12 months. Photovoltaic cells, black water treatment plants and co-generation plants are considered too expensive, with the embodied energy to produce them much more than the savings gained from having them. Fly ash (a recycled component in concrete) takes longer to cure, but means that it is not as strong so need bigger columns for structural strength, which translates into less Net Lettable Area (NLA) and less rent.

Another oft mentioned issue is the mismatch between who pays and who gains. The building owner pays for the ESD features but the tenant benefits in terms of operating cost savings (energy and water costs) and increased productivity.

The lack of skilled facility managers was mentioned by many respondents as an ongoing and mounting issue, especially with more high performance buildings coming on stream. Those building mangers employed had to be trained how to run the Building Management System (BMS) and how to closely monitor performance and finely tune the buildings. As noted by one interviewee, an average building needs a tune up annually, high performance buildings need a tune up quarterly (or more regularly). Further, these specialized buildings commonly need more monitors, and more data recording than an average building.

In terms of the existing building stock that makes up around 97% of the building stock, many respondents mentioned the need for a strong business case to encourage building owners to upgrade their buildings to be more environmentally sustainable. While there continues to be a lack of rental or sales evidence to show that the market is willing to pay for ESD, then energy and water savings, and less easily quantifiable productivity studies, are the only means to measure the benefits from ESD in monetary terms. Currently, without strong evidence to show that the benefits of "going green" outweigh the costs there is no incentive for owners to act.

What more could be done to encourage ESD?

Most of the interviewees acknowledged the need for government support to build, or refurbish buildings, to a green standard. For example, currently owners of green buildings are being penalized through the payment of higher Council rates. Many of these buildings are premium, new buildings and this is reflected in higher values, which leads to higher rates, and is passed back to the tenants through higher rents (to cover the increased costs of ownership). Yet, tenants in green buildings expect their overall occupancy costs to be reduced through occupying a more energy efficient and water conserving building. Hence, many respondents felt there should be a rate rebate or a concession to go green.

Other government initiatives suggested by interviewees to encourage more ESD and refurbishment of older buildings were as follows:

- Changes to the Building Code of Australia – with the suggestion that this needs to incorporate Green Star for commercial buildings
- Mandatory reporting of energy efficiency – to be phased in from 2010 for commercial buildings and 2011 for residential buildings
- Increase the cost of energy – energy prices could act as an incentive to save but it is currently it is too cheap for tenants to want to conserve
- Mandate the up-grading of existing buildings to a higher performance level in terms of ESD (e.g. government required that al earthquake risk buildings had to be upgraded and strengthened to specific standards even though it was very costly to do so).
- Alternatively to the above point, provide financial incentives for building owners of older building stock (commonly owned by family trusts, at least in Adelaide) to upgrade to a higher environmentally sustainable level.
- Legislate against energy use

As the fit-out of the interior not matching the base building was commonly mentioned as an issue, interviewees mentioned the need to make it mandatory through either the GBCA rating tool or through the lease that the fit-outs need to be designed by a GBCA accredited professional so it matched the base building. A few of the architect respondents thought it would be even more desirable and beneficial if the same design team that did base building was used to design the fit-out. As the base building team was most familiar with the building, it was considered that benefits in terms of time and cost savings would accrue to the tenant client through the design team not having to learn the intricacies of the building they were designing the interior for.

Some interviewees felt that the move to greener buildings will be market drive. They felt that if you cannot lease a 4 star Green Star building then the cost will be no more to build a 5 star solution as that becomes the new benchmark/standard. Another option to ensure the cost of a 5 star Green Star outcome are no more than a conventional non-green building is to use cheaper quality materials, such as instead of having granite in the foyer use polished concrete instead and the savings made can then be used to up-spec the façade or for other ESD features.

3. Summary and conclusion

This paper outlines the results of research carried out in Australia in 2009 to identify the drivers, barriers, costs and benefits to sustainable development. Proven examples of best practice in sustainable development were investigated as case studies for analysis. These case studies provide an overview of sustainable development in Australia from which we can learn. Since the GBCA was established in 2003, there has been a surge of not only interest in, but also examples of, ESD. Those developers who led the way in creating some of the most innovative and sophisticated green buildings that now exist in Australia had limited local examples to learn from. Many of them had to learn from overseas examples, but where the climates and/or economies differed from those of our own. These entrepreneurs took the risks but from their experiences many have gained valuable insights of how to build green, how to avoid the mistakes of some of the earlier examples and how to do it more cost-effectively.

This study documents some of the experiences of leaders in the field of ESD and the tenants who occupy the buildings. While the benefits of green buildings are well documented, the challenges are still been unraveled. Cost is a common reason for not tackling ESD. But it is important, as mentioned in GBCA (2008), to differentiate clearly between costs that reflect overall building quality and target market and those that relate solely to green features. Fortunately, cost as a perceived barrier is slowly reducing as the needed technology, materials, knowledge and skills become more readily available and price-competitive. There is growing practical evidence in the case studies that the new generation green buildings do not need to cost more.

Some of the most successful outcomes have been achieved through the use of a holistic approach to design: allowing the design team to innovate solutions, and involving the builder, tenant, facility manager and contractors early in the design process. Further, using tried and tested technologies, ensuring the interior fit-out matches the base building, and requiring all relevant contractors to both stay involved during the commissioning and tuning process (at least 12 months) and also provide the necessary documentation to aid the Green Star and NABERS rating process help achieve successful ESD outcomes.

While the government is providing leadership in their requirement to procure minimum Green Star rated buildings for their own occupancy, the draft National Strategy on Energy Efficiency, the Carbon Pollution Reduction Scheme, and the Mandatory Reporting legislation there are still issues regarding uncoordinated codes, regulations and requirements between states and regulatory authorities. The GBCA (2008) calls this "Green Tape". Some of the interviewees have experienced this first hand with difficulties obtaining approvals for black and grey water treatment plants or not being permitted to generate energy for their building above a set amount of between 25-30% of peak load despite having the technology within the building to do so, even when city power cuts still occur.

If the barriers to uptake of sustainability practices are addressed, the Australian property industry presents a unique opportunity to achieve innovation and global best practice in sustainable outcomes that contribute to addressing the global problem of climate change and contribute towards improving the liveability and sustainability of Australian cities.

Appendix I: Survey Instrument

1. **Which of the following categories best describes you?**
   [ ] Developer
   [ ] Architect
   [ ] Builder
   [ ] Environmental consultant
   [ ] Other, please specify:____

2. **Please indicate where demand for green buildings (ESD) is coming from:**
   [ ] Client driven
   [ ] Government requirement
   [ ] Based on your recommendation
   [ ] Other, please specify: ____

3. **Name of the subject building/Address:**

____

____

4. **Size & Type of Building:**

[ ] How many storeys
[ ] How big - sq.m NLA?
[ ] PCA Grading? A, B, C?
[ ] Retail Tenancy at Ground Level?
[ ] Basement level car park?
[ ] What Star Green Star?
[ ] Design or As Built?
[ ] NABERS Rating?
[ ] Rental $/m2
[ ] Vacancy
[ ] Value/sale Price?

5. **Main ESD features of the building:**

Features:	**Description**
Automatic external louvers	
Active chilled beam air conditioning	
Thermal zoning	
Use of renewable energy sources: Gas [ ] Solar [ ] Wind Turbines [ ]	
Light zoning &/or light sensors	
Grey water recycling	
Low Ozone Depleting Potential refrigerants	
Low E glazing/double glazing	
Waterless urinals	
Structural concrete incorporates a percentage of fly ash	
Solar hot water systems	
Water efficient fixtures and fittings	
Bicycle racks and shower	
Other, please specify	

6. **Overall Cost Premium for _____ Star Building: ____% in total.**

7. **Annual savings: $__________ p.a.?**

8. **CO2 emissions saved compared to average office building?________________________**

9. Provide a brief description of the most successful energy efficiency ideas used:

____

____

____

10. In your opinion, what prevents the incorporation of sustainable features in developments?

____

____

____

11. What more do you think can be done to improve the uptake and incorporation of energy or water saving (or generating) features into the *design of new buildings*?

____

____

____

12 (a). What energy efficient, sustainable building *design features* are most effective in achieving positive sustainability outcomes?

____

____

____

____

12 (b). What did not work? (e.g. Szencorp Building Use Survey 2009 – tenants not happy with temperature)

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____

____

(c) What were the lessons learned from what did not work?

____

____

12. Do you think buildings that are designed to be more energy efficient are being used in a way that maximises the energy/resource use performance, as designed?

- Yes [ ]
- No [ ]
- Unsure [ ]

If "no", what do you think the reasons for this are and what do you think could be done to resolve this?____

Appendix II: Buildings

Name	GBCA Rating	NABERS	Contact
ADELAIDE			
City Central Tower 1	5AB	5	Woods Bagot - Architect, JLL - Property Manager
City central Tower 2	5OD		Aspen - Developer
VS1 (SA Water)	6OD	5	Hassell - Architects
Santos HQ	5AB	5	Hassell - Architect
Admiral House	4AB	4.5	CBRE - Facility manager
MELBOURNE			
Australian Technical College			Spowers, Architect
Williamstown HS			Spowers, Architect
60L Green Blg, 60 Leicester St (1870)			Spowers, Architect
CH2 Melbourne City Council	6OD		Prof. Rob Adams, Project director, Mick Pearce, Architect
Stock Exchange (1989)	5OD	4	JLL - Property Manager
Sustainability Victoria	AIM: 6FO	5	Sustainability Victoria, sustainability manager
Hassell Studio (1880)	4FO	5	Hassell - Architect
Melbourne Exhibition Centre	6pilot(AB)		Woods Bagot - Architect
Szencorp Building (1987)	6OD	5	Szencorp - Sustainability manager
The Gauge Docklands	6AB		Lend Lease - Architect
NAB Docklands	5OD	4.5	NAB - Head environment & sustainability
SYDNEY			
88 George Street, The Rocks (1886)	5OD		Sydney Harbour Foreshore Authority - Project manager
Workplace 6, Darling Harbour	6OD	Aim: 5	JLL - Facilities manager
39 Hunter St (1916)	6OD		Jackson Teece - Architect
The Ark, North Sydney	6OD	Aim: 5	Investa - Project manager
Macquarie Bank	6OD		Muliplex - Project Director
The Bond	5AB	5	Lend Lease - Architect

Appendix III – Sustainable Features

Building Design & Materials	Plumbing/ Water	Heating/Cooling	Ventilation Air Quality	Lighting Daylight	Use of Renewable Energy Sources
Specialised glazing (e.g. Low E; double glazing)	Flow restrictors &/or efficient fixtures/fittings	Specialised glazing (Low E; double)	Low VOC materials	Specialised glazing (Low E; double) T5 lighting	Photo-voltaic arrays
Solar passive	Waterless urinals	Chilled beams	Fresh air	Maximise natural light by siting of building	Solar panels
Large floor plates/campus style/open plan	Rainwater capture	External & Internal shading blinds	CO2 levels constantly monitored	Ext & Int shading blinds (some sensor controlled)	Wind turbines
Recycled timber; or sustainability harvested timber	Leak detection systems	Multi-zone tenant controlled	Opening windows	Motion light sensors	Harbour heat rejection system
Recycled materials	Sensor taps	Thermal massing (e.g. limestone wall)	Indoor plants	Open plan to maximise daylight penetration	Gas powered co-generation plant
Reduction in use of PVC piping	Multi-cycle systems for cooling towers	Perimeter water pipes to assist cooling			Fuel cell
Low volatile organic compound materials	Grey-water or black-water recycling systems	Solar chimneys (heat extraction & draw fresh air in); solar panels; PV cells			
No PVC backing on carpet tiles		Separate air handling units for each façade & interior zone			
Fit-out to match building		Vertical planting for shading			

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