



# Understanding the Performance of Green Commercial Buildings

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the Performance of Green  
Commercial Buildings



Sustainable  
**Built Environment**  
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**PARSONS  
BRINCKERHOFF**



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## Synopsis

Efforts to reduce carbon emissions in the buildings sector have been focused on encouraging green design, construction and building operation; however, the business case is not very compelling if considering the energy cost savings alone. In recent years green building has been driven by a sense that it will improve the productivity of occupants,<sup>1</sup> something with much greater economic returns than energy savings. Reducing energy demand in green commercial buildings in a way that encourages greater productivity is not yet well understood as it involves a set of complex and interdependent factors. This project investigates these factors and focuses on the performance of and interaction between: green design elements, internal environmental quality, occupant experience, tenant/leasing agreements, and building regulation and management.

This paper suggests six areas of strategic research that are needed to understand how conditions can be created to support productivity in green buildings, and deliver significant energy consumption reductions.

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# 1. Introduction

The development of green buildings as a commercial imperative has happened in Australia over the past ten years, driven not by government regulation so much as by a collective set of values within the builders and tenants of central area office space. The role of the Green Building Council of Australia (GBCA) cannot be underestimated, but nor should the leadership shown by some key builders and NGOs, such as UDIA and the Property Council, along with consultants who were able to suggest that this direction was not only ethically right but would be necessary to attract the next generation of CBD workforce.<sup>2</sup> When the SBEnc asked for research submissions in this area it was clear the rationale for green commercial buildings was shifting to an evaluation of how well this period of building was performing in practice. Of course we must see how well they are doing in energy use and other resources, but the big driver was now how

well were the people doing who worked in these offices. The often stated words were: *'how was the human dimension of green buildings working out?'* or in simpler terms: *'what is the productivity gain from green buildings and how does it relate to green design?'* This research project was thus established to scope out the kind of work that would be necessary to determine these human and economic factors and their links back to green urban design elements (as the focus is on post-occupancy performance the study will not cover embodied energy of construction materials). The literature surveys have been pursued and stakeholder workshops held to try and find out how the productivity and green design of commercial buildings can be quantified. The project's goals and schedule are listed herein, along with the early findings leading to six strategic research areas that need to be pursued further.



## 2. How do we better understand the performance of green commercial buildings?

According to the US Department of Energy, in 2009 commercial buildings in the OECD were responsible for as much as 18% of a country's energy usage.<sup>3</sup> Given the current supply of energy is dominated by fossil fuels such demand creates significant associated greenhouse gases.<sup>4</sup> In seeking to encourage green buildings and in particular reduce energy consumption (and associated greenhouse gas emissions) in commercial buildings, it is necessary to harness

and enhance a range of enablers and overcome a range of disablers. Using a process based on the methodology of *'Collective Social Learning'*,<sup>5</sup> created by Emeritus Professor Valerie Brown, participants of stakeholder workshops held as part of the Sustainable Built Environment National Research Centre (SBEnc), brainstormed particular enablers and disablers for the development of green commercial buildings as shown in Table 1.

**Table 1: A sample of potential 'enablers and disablers' of green commercial buildings**

Enablers →	← Disablers
<ul style="list-style-type: none"> <li>• Legislation and government commitments</li> <li>• Increased corporate social responsibility</li> <li>• Market competition and innovation</li> <li>• Certification and accreditation tools such as GBCA and NABERS</li> <li>• Innovative research and development</li> <li>• Cross departmental collaboration</li> <li>• Industry associations (AIRAH, PCA, CISBE)</li> <li>• Education and awareness raising</li> <li>• New technologies and practices</li> <li>• Modelling software (BIM)</li> <li>• Building management systems</li> <li>• Rising energy and water costs</li> <li>• Qualified and dedicated professionals</li> <li>• Resource scarcity pressures</li> <li>• Performance guarantees as procurement method</li> <li>• Demonstrated cost savings</li> </ul>	<ul style="list-style-type: none"> <li>• Global economic conditions</li> <li>• Lack of demonstration of actual green building costs and benefits (quantitative evidence)</li> <li>• Lack of clarity on productivity enablers/disablers in buildings</li> <li>• Lack of quantifiable data related to IEQ, social benefits, productivity and lifecycle costing</li> <li>• Short term focus on capital expenditure, not other long term benefits</li> <li>• Legislation not strong enough, planning regulations limiting, and split incentives</li> <li>• Lack of research and technology trialling</li> <li>• Lack of feedback and ongoing education</li> <li>• Tenant control, lack of accountability, mismatched buildings to occupants</li> <li>• Energy/water prices not reflecting true costs</li> <li>• Lack of qualified and experienced people</li> <li>• Lack of validation of certification tools</li> <li>• Insufficient data collection, such as energy and water sub-metering</li> </ul>

Note: Information, recommendations and opinions expressed herein are not intended to address the specific circumstances of any particular individual or entity. This table has been produced for general information only and does not represent a statement of the policy of the participants of the stakeholder workshop, the SBEnc, or the SBEnc partner organisations.

Source: Drawing on the findings of SBEnc Stakeholder Workshops, hosted by the Western Australian Department of Treasury and Finance in Perth on 11 July 2011, and the Queensland Government Department of Public Works in Brisbane on 8 September 2011, facilitated by Curtin University and QUT.



Many of the potential enablers identified in the workshops have underpinned the significant growth in the green building sector in Australia and internationally in the last decade. According to McGraw-Hill Construction 'the value of green building construction starts was up five-fold from 2005 to 2008 (from \$10 billion to \$36–49 billion), and could triple by 2013, reaching \$96–140 billion'.<sup>6</sup> In Australia there are around 21 million m<sup>2</sup> of commercial office space in cities, spread across nearly 4,000 buildings.<sup>7</sup> Of this over 4 million m<sup>2</sup> are Green Star certified.<sup>8</sup> According to the Green Building Council of Australia (GBCA) the private sector doubled its investment in Green Star projects between 2009 and 2010 to a total of \$12 billion.<sup>9</sup> However, considering the potential disablers it is clear that such growth will be affected by a range of factors, including global financial conditions, lack of demonstration of costs and benefits, and the lack of access to qualified and experienced people.



It is clear that an important aspect of encouraging green commercial buildings is to be able to convey to developers, owners, and lessees the full range of benefits that can flow to them. While they may be interested in the range of indirect benefits to the broader environment and society, they are mostly likely to be interested in the financial, functional, and other direct benefits that accrue to them. Hence, this project will focus on unravelling the complexity involved in reducing energy demand in green commercial buildings in a way that encourages greater productivity. This is of significant interest as staff costs significantly outweigh energy costs in commercial buildings. If green commercial buildings can actually increase productivity, all stakeholders stand to gain, with staff costs as high as 80% of business costs, typically as much as 200 times greater than energy costs. Hence, if building occupants will be more productive, owners may be able to lease out space at higher rents, and developers may be able to charge a premium for the purchase of the building.

The evidence so far appears to support this link. In 2006, Jones Lang LaSalle (JLL) surveyed corporate occupiers across Asia Pacific and found that 11% would consider paying more to occupy a green commercial building. A follow-up survey in March 2007 by JLL found this response had risen to 64%.<sup>10</sup> The GBCA commissioned a survey of industry stakeholders on drivers of green building practices, and the rental and value impacts of a Green Star rating. Some 45% of respondents indicated that tenant demand is driving the need for their organisations to implement green building practices. Two-thirds of interviewees were willing to pay more to invest in a Green Star building. Long-term rental growth, tenant retention, and operating cost savings, were the specific drivers

of market value of green buildings.<sup>11</sup> A recent report, 'Building Better Returns', looked at offices in Sydney and Canberra, and found buildings with a five star NABERS rating had up to a 9% green premium in value.<sup>12</sup>

However, as highlighted in the potential enablers, for these benefits to be realised, there has to be: tangible evidence of the productivity improvements; effective communication of such improvements to stakeholders; and the willingness to incorporate green elements from the beginning of the design stage to realise a later gain.

Hence, if efforts to reduce energy consumption in commercial buildings (such as through using green design elements) can also support staff to become more productive by just a few percentage points, this can significantly increase the business case for green buildings. There is growing understanding of the link between green buildings and improved occupant experience that may lead to improved productivity. For instance, the increased use of natural lighting and fresh air can reduce energy demand and provide a better working environment.

In a survey by Bond in 2010, six green buildings had begun productivity studies to estimate the value in building green.<sup>13</sup> For example, a post-occupancy study by CSIRO in 2008 of the City of Melbourne's CH2 building found that productivity increased nearly 11% compared to their former building. The study included physical indoor environmental quality (IEQ), evaluation of occupant health, wellbeing and productivity based on occupant questionnaires, questionnaires on health symptoms, focus group interviews, sick leave (absenteeism) and staff turnover data. They received responses from more than 260 employees. The productivity increase is estimated to lead to an annual cost saving of \$2.4 million.<sup>14</sup> Professor Rob Adams, Project Director for CH2, says this saving, together with savings of



\$370,000 from the energy-saving features of the building, will reduce the payback time to between just five and seven years.

One of the most significant Australian studies to date into productivity in green buildings was recently made by Bond University and the GBCA.<sup>15,16</sup> This research examined how occupiers of green buildings perceive and evaluate the role of green workplace environments. Data was derived across 31 different buildings that have been occupied for over 12 months, from three sample groups: building owners, tenants and employees. The data were collected through tailored online surveys, phone interviews and face-to-face interviews. Findings suggest that green workplaces offer greater psychological benefits than physical improvements (health and productivity gains). Occupants had high levels of satisfaction (particularly management), while the main weaknesses were in lack of privacy and noise levels. Below are the findings summarised from a report by Kato and Murugon (2010):



## Environmental Factors

1. Green Star certified buildings are almost double as energy efficient compared to the average office building.
  2. After 12 months of operation, 66% of Green Star certified buildings are performing better or on target for their expected energy efficiency.
  3. Green Star certified buildings are much more water efficient than average Australian offices.
  4. The commissioning process was very important to owners to achieve ultimate building performance.
  5. The private car is still the most frequently used transport mode among respondents.
  6. Many owners and tenants use a number of sustainability measures and activities above and beyond what is required by the Green Star rating system.
2. Green features cost more for smaller sized buildings than larger buildings.
  3. There was no correlation between cost of 'green' and 'date of construction'
  4. 'Build big with 5 star rating' is the way to minimise the cost.
  5. Green Star certified buildings have the advantages of securing tenants or selling the building more quickly, rather than adding rent premium.
  6. Green Star certified buildings and offices have positive internal branding impacts.

## Business Factors

1. It cost more to build green (average 10% addition) but it does not have to; 12% of the buildings had zero additional cost.



## Human Factors

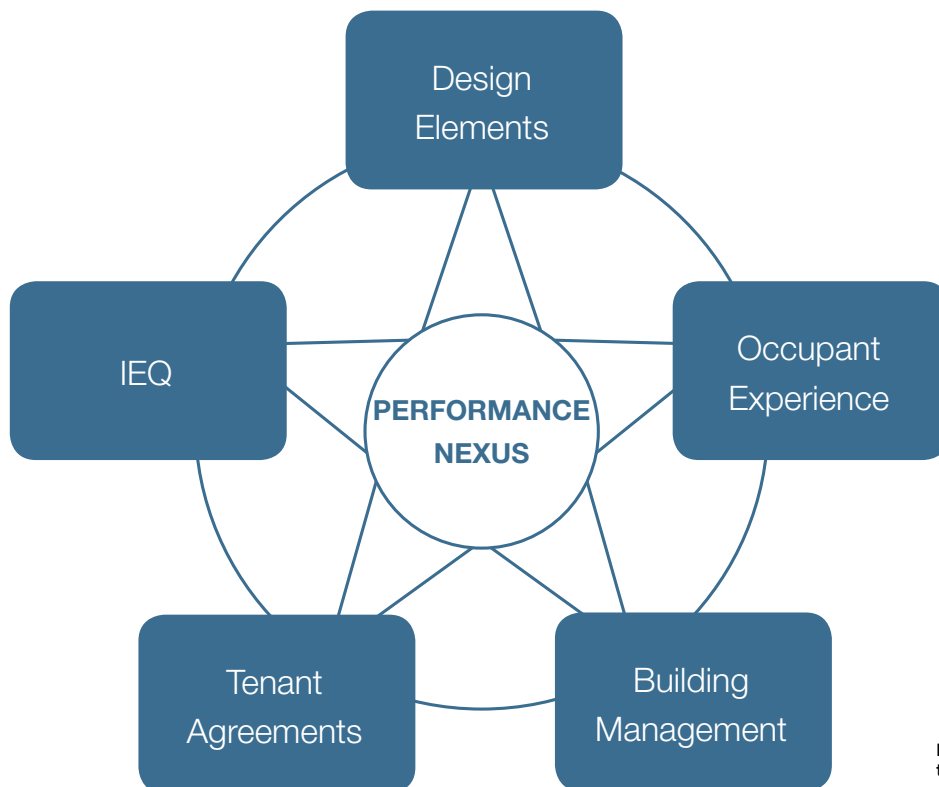
1. All three parties (owners, tenants and staff) show high satisfaction levels with their Green Star certified buildings, with tenants the most satisfied group.
2. 'Instability of air temperature' is the most common complaint (by staff).
3. 'Abundance of natural light' is the most complimented item (by staff).
4. Data from staff indicate that self-assessed health and productivity are not significantly improved in Green Star certified buildings and offices.
5. There is a gap between managers and staff on how a Green Star certified office affects environmentally friendly behaviours within the office.

However, this is not to say that all ‘green’ design elements will support a productive environment for occupants; improving energy and water efficiencies will not necessarily improve, or even affect, the occupant experience. Sometimes they can even seem to be working against one another. For example, although open plan offices can allow natural light to reach a greater number of work spaces and encourage increased interaction with colleagues and workmates, such layouts can result in distractions from noise and people passing, if not considered in the fit-out design. Another example is that efforts to improve the thermal efficiency of buildings (such as making the building envelope as air-tight as possible) may conflict with efforts to circulate fresh air throughout the building — something that if considered in the design can lead to the use of

innovative technologies, such as heat exchangers that transfer heat from the outgoing air into the incoming air before it enters the building, a common practice in many European cities.

From the literature survey and workshops analysed above it has been determined that a study evaluating the performance of green commercial buildings will need to include the following factors, with Figure 1 showing the inter-related nature of each:

- energy performance of green design elements
- internal environmental quality (IEQ)
- occupant experience (based on occupant survey)
- tenant agreements
- building management



**Figure 1: The Performance Nexus - Considering the main elements that affect the performance of green commercial buildings in order to strengthen efforts to reduce fossil energy consumption and increase the productivity of occupants.**



### 3. A new focus on how tenant agreements can influence the performance of green commercial buildings?

Before considering the link between green commercial buildings and staff productivity it is important to consider the potential for tenant agreements to directly influence energy consumption.<sup>17</sup> In particular the addition of 'new' clauses to commercial buildings leases, with associated amendments to the terms of the lease, related to energy consumption. An important part of the process is to clarify the aspirations of both the tenant/lessor and lessee to use best endeavours to meet the energy targets and objectives, and outline the nature and extent of energy consumption reduction measures to be implemented in the building.

This can be helped by developing an energy management plan (EMP), containing the specific items related to increasing the energy productivity of the building. Such a plan would not prescribe individual responsibilities or penalties for failure to meet the objects or targets, but would cover items such as:

- identification of the key types of energy being consumed in the building
- identification of energy consumption targets for the building (or a particular tenanted portion of the building) over a specified periods, such as short, medium and long term
- clarification of the process for energy monitoring for common and individual usage
- details of the specific protocols for recording, keeping and disseminating data obtained through the monitoring process to ensure the prescribed targets and objectives are met.

An energy management committee can be set up to monitor progress, with members from both the lessor and the lessee. The committee can also be set up to create a process for prescribing responsibilities and/or penalties related to performance against the EMP. In practice this process can take a 'softly softly' approach that encourages defaulting parties to take supervised remedial action and, failing that, to use alternative dispute resolution means to deal with it. Alternatively, stricter conditions can be created with the green lease imposing sanctions on the defaulting party that impose more stringent penalties, which may lead to the eventual termination of the lease. The middle ground is to impose penalties on the non-complying party (such as financial sanctions) without the potential for termination. The nature of the penalty regime will be defined by the extent to which the parties to the lease wish to pursue sustainable outcomes, including (but not limited to) increased energy productivity.

Examples of possible clauses that can be included in to a lease to make it a 'green' lease are shown in Table 2, along with the nature of the modifications related to energy consumption.

**Table 2: A sample of potential features of green leases for commercial buildings**

Feature	Description of modification
Rent and Rent Review	Under a standard lease the level of rent and the process to review the rent levels do not consider the tenant or the lessor's performance. However, in a green lease these issues would be linked to the terms of the energy management plan. Therefore, if through the tenant's prudent energy use the building's outgoings decrease, then this could be reflected in reconsidering the rent level.
Repair and alterations	A standard lease commonly permits the tenant/lessee to make alterations or additions (although not usually of a structural nature) with the consent of the lessor. Hence, as part of a green lease items could be included that relate to the type of materials or technology used to make repairs or alterations that have demonstrated contributions to meeting the energy management plan. If the tenant failed to comply with such conditions, the lessor would not be held to be unreasonably withholding its consent.
Outgoings	In a standard lease outgoings, such as energy bills, are generally charged separately from rent. Where a building contains multiple lessees, the outgoings are typically calculated by dividing the total outgoings for the buildings between each of the lessees in proportion to the area that they occupy. While this approach may be sound if all of the lessees have the similar energy consumption levels, if a tenant makes changes to lower its energy use, the terms of a green lease should reflect and reward this. This then acts as an incentive for further energy conservation efforts.
Assignment and subletting	Under a standard lease, assignment or subletting a tenancy is permitted following the lessor's consent. While a green lease would not necessarily change this obligation, it would be prudent to impose a condition on the assignment or the subletting that states that a landlord will only agree to such an activity if the assignee or sublessee agrees to comply with the energy management plan.

## 4. How are we researching the link between green buildings and staff productivity?

It is a relatively straightforward process to access, collect, and interpret data related to building energy performance and the IEQ, as the data are quantifiable and have clear industry performance benchmarks and requirements. However, when considering the influence of green buildings on staff productivity there are a number of factors to take into account. Further once such data are collected and interpreted, the challenge will be to compare the complex inter-relations with the other areas of performance data, see Figure 1. When considering the link between productivity and occupant experience in green commercial buildings it is important to qualify the term 'productivity'. In a general sense productivity is the quality and quantity of outputs — work achieved — in relation to the inputs — the labour and materials — required to achieve the work. When considering an office building the picture becomes more complicated and a range of factors must be considered, including:

- There are many variables that may influence productivity: lighting; temperature; humidity; ventilation; air quality; furniture ergonomics; outlook; acoustics; aesthetics; layout; closeness to or separation from other staff (determined by distance or by visual or auditory barriers); equipment provision; facilities for meetings, socialising, recreation and refreshments; and many other factors. The extent to which each of these factors affects productivity is not easy to establish.
  - Outputs from offices range from quantifiable activities, such as attending to customers or clients, or meeting project timeframes, to less tangible elements, such as quality of service.
- Sales or levels of provision of products and services in relation to staff and other costs may be seen to reflect productivity levels. However, a particular work team or team member may play only a small part in the overall collaborative process of generating, selling or providing these products and services, and so the specific contribution of that team or team member to the end result may be very hard to isolate.
  - Given recent advances in telecommunications it is now common for teams to have members located in many different offices across a range of organisations, making it difficult to consider the productivity of the various sub teams.



- Productivity can be influenced by a range of social conditions and corporate culture, such as the quality of management systems, the management styles of senior staff, the quality of relations with colleagues, the quality of capacity building and training provided, the suitability of staff to tasks assigned, the level and relativities of pay and bonuses, and the flexibility of various workplace conditions.
- Moreover, while profitability is often used as a yardstick for productivity, this is much less likely to be the case in government and not-for-profit agencies. There will probably be much more emphasis on the quality of service provided to the client, but it may be very difficult to measure this quality, or to measure the efficiency with which the work is done. For example, in a social service agency, clients normally do not pay (so there is no dollar return reflecting their level of satisfaction with the service) and the number of clients seen may be much less important than the resolution of issues facing clients. However, one issue may take 15 minutes to resolve, while another takes 15 or 50 hours, even for the most productive social worker. Thus, measuring productivity in all these circumstances becomes very fraught indeed.
- Levels of job satisfaction, wellbeing, and health can contribute to, or detract from, productivity; however, their influence is difficult to measure. For example, the commonly cited example of reduced sick days in green buildings can be confused with a workplace culture that allows sick day allowances to be used as personal leave

The basis of the framework to be used by the research team to investigate the impact on occupant experience of specific aspects of green buildings will be in four parts:

1. **Physiological factors** related to the conditions in which occupants are comfortable and function well. A certain level of light is needed to read and write, but not too much brightness or it will be unpleasant. Most occupants of commercial buildings are comfortable within a certain band of temperature or humidity. The design of chairs, desks and computers needs to match the dimensions to allow users to maintain a good posture. It is difficult to concentrate well if noise levels are too high. Air quality needs to keep toxins and microbes below certain levels. And so on. Although there are average optimal levels for all these factors, there may also be a wide range of preferred or tolerated levels.
2. **Aesthetic factors**, such as the colours and qualities of surfaces, dimensions of rooms, forms of adornment, the level of visual simplicity or complexity, whether there are plants, water features or exterior views, and the quality and style of furniture. However, aesthetics is subjective and culturally determined, and what ultimately matters is whether the physical environment matches occupants' tastes. For example, some prefer bright colours while others favour subdued tones; some like simplicity while others find it boring; and some prefer natural materials while others see synthetic materials as more contemporary.



3. **Interpersonal factors**, that is, the level of contact people have with each other: their physical proximity, whether there are walls or partitions between their work stations, and the kinds of common spaces there are. These factors will affect noise levels, privacy, concentration, sociability and communications in the workplace.
4. **Motivations** related to reciprocity, as if building occupants believe that their employer cares about them (or the wider world), as manifested in the design and provisioning of the workplace, they may reciprocate by working harder and being more productive. Reciprocity is fundamental to most societies and moral codes. This is not about specific features of a building but rather about the perceived reasons for providing them.



A review of the literature has identified a number of ways to investigate the effect of specific factors in the workplace environment on occupant experience, including: subject self-assessments, subject line managers' assessments of subjects' productivity, and through measurement of a set of factors such as light, temperature, humidity, air quality, and acoustics, combined with the use of data that reveal the best levels or characteristics for these factors.

- a) **Subject self-assessments of productivity:** there is a tendency to criticise subject self-assessments as they are seen as subjective and thus potentially inaccurate. Subjects are seen as having vested interests and will probably not be schooled in the scientific method. To reduce the inaccuracy researchers may ask subjects:
  - Whether they believe their productivity has gone up or down when moving to a new or retrofitted work environment, and roughly to what degree?
  - What differences there are in the two environments and how these differences affect them?
  - Whether and how these differences might account for the differing productivity levels?

Furthermore, if survey questions to the subject are properly phrased, they will be less likely to lead to defensive responses. Thus, the emphasis needs to be on 'the level of productivity that the environment *allows* the subject to achieve' rather than on 'the level of productivity that *is* achieved', and this way the environment is being judged, not the subject's work or character.

- b) **Subjects' line managers' assessments of subjects' productivity:** the line managers of subjects can also be surveyed to give a second opinion on any changes in the subjects' productivity within the two environments. They may be less able to identify factors in the physical environment that have caused the productivity changes, although these factors may have been reported to them or observed by them, but they will be in a position to assess the productivity of their subordinates, based on records and measures, or their own judgements.
- c) **Measurements or assessments of physical variables together with data on their optimum levels or forms:** variables in the subject's pre- and post-occupancy environments, such as light, temperature, humidity, air quality, acoustics and ergonomics, can also be measured or detailed, and then these measurements can be checked against data that has identified the best or acceptable levels or characteristics for these variables. This data can then be compared with subjects' and their line managers' assessments of the changes in these factors. In some cases, subjects may report a problem, such as drowsiness, and not be able to attribute it to a particular feature of the building, but data from the building may uncover a cause, such as high levels of carbon dioxide. Thus, it would be possible to conduct solid research on the aspects of buildings that affect productivity through a combination of subjects' assessments of their own productivity pre- and post- occupancy, their line managers' assessments of that



productivity, and data collection from buildings, assessed against studies that have established the best and acceptable levels or qualities for aspects of buildings affecting productivity.

Tenant behaviour is also a vital component of a building's performance. No two offices or buildings are identical and a number of European studies stress the importance for flexibility in both training and in the environmental rating tools. A US study into tenant behaviour showed tenants were aware of recycling processes but not of energy efficient behaviour, it is vital occupants are trained on how to use green building design features for the building to actually perform highly.<sup>18</sup> This raises the question of building governance through regulations and management systems.

## 5. What are the key strategic areas for investigation?

**Strategic Area 1: Indoor environment quality and the impact on health, wellbeing and productivity (including defining indoor environment factors that impact productivity, such as air quality, thermal comfort, and lighting, and measuring indoor environment and productivity, such as through occupancy surveys and consideration of physiological measurements).**

As green building has emerged as a concept, a range of factors have been identified as important in creating an environment within commercial buildings that promotes health, wellbeing and productivity. The indoor environment covers workspace (public and private), air quality and ventilation, dust, acoustics, lighting and thermal comfort. Exposure to the indoor environment can affect the wellbeing and productivity of occupants as a result of interactions between the structure, building systems, furnishings, outdoor environment and the building occupants and their activities.<sup>19</sup> Illness and absenteeism from low indoor environment quality can also have a major effect on productivity and performance. Close observation of all these factors and detailed interviews will be needed to ensure that IEQ variations can be understood.

**Strategic Area 2: Energy and water performance of buildings (including energy consumption, water consumption, technologies and building performance evaluation frameworks).**

There are few assessment methods for environmental performance of buildings in operation that are used with green rating schemes. Green Star does not have any mandatory monitoring for buildings to demonstrate actual energy and water savings, although GBCA is in the planning stages of a performance tool, which will rate a building based on its performance over 12 months. This tool will be in addition to the existing InDesign and AsBuilt tools. After scrutiny in this area LEED has implemented tighter energy reduction standards to monitor and record energy consumption. Under the new version 3 of LEED, building owners are now required to record energy usage and report it to the USGBC, and have a plan in place if improved energy saving is needed.<sup>20</sup> Australia has done some research into benchmarking tools. NABERS is also a benchmarking tool that has previously been a voluntary program for building owners to rate their building's energy, water, waste and/or indoor environment. For buildings over 2000 m<sup>2</sup> being leased or sold energy disclosure is now mandatory under the Commercial Building Disclosure legislation.<sup>21</sup> Data from these assessments will be sought so energy performance can be related back to the design predictions of the various schemes outlined above.

### Strategic Area 3: Building Management and Tenant Behaviour

Studies measuring building performance often neglect tenant behaviour post-construction or retrofit. For example, a study is being conducted in the UK into why lights are left on in London's workplaces at night and what can be done to address this problem. Lighting accounts for 8% of London's emissions annually, and the Carbon Trust estimates bills could be cut by 15% if they were used only when genuinely required.<sup>22</sup> Looking out over any of Australia's capital cities at night reinforces that tenancy behaviour is absolutely essential to a building's level of sustainability. The methodology for this London study is not yet available but the results could be a benchmark for all cities and integrated into building education and management. Europe shows many behaviour change programs and energy efficiency initiatives, some of which are backed by the European Commission or other joint partnerships with public funding. All buildings have management systems and when detailed surveys are made of tenants, they will also collect data on the effectiveness of building management systems to facilitate energy saving behaviour.

### Strategic Area 4: Economic Performance of Buildings

The most significant study into the economic value of green building was Eichholtz, Nok and Quigley's (2008) 'Doing good by doing green',<sup>23</sup> which has recently been extended to consider the Australian building sector. Building Better Returns has found increased value in NABERS

rated buildings in the Australian market. The 2008 US version of the study compared the rental rates and selling prices of LEED rated and Energy Star buildings to conventional buildings. It found buildings with green ratings on average commanded a 3% higher rental return and a 16% higher selling price. Another US study recently released by McGraw-Hill Construction, CBRE and the USD Burnham-Moores Centre for Real Estate<sup>24</sup> showed that sustainably managed building owners expect: a 4% higher return on investment; 5% increase in building value and occupancy; 8% drop in operating costs; and 1% rise in rental income. The research in our study will seek to collect economic data on the value of the building and whether its green credentials or lack of them has an influence on these values.

### Strategic Area 5: Achieving triple bottom line results (including environmental implications, social implications, and economic implications).

Bringing this work together will require a triple bottom line approach. There has been international criticism on the sustainability outcomes of green building certifications as they do not bring all three factors together. The GBCA has made a tremendous impact on the development of green building in Australia and has an MOU with the UNEP's Sustainable Building and Climate Change initiative to introduce a common international carbon measurement to support emissions reduction in the building sector at international, national and local levels.<sup>25</sup>





To be successful, the triple bottom line approach to the design of buildings could lower the Australian commercial building industry's contribution to GHG emissions by 30–35%.<sup>26</sup> The question is how successful are the existing green building programs in achieving triple bottom line results? There have been several studies into LEED and BREEAM that have mainly quantified the success based on immediate financial return from investing in green accreditations. One such study showed a 3% higher rent value and improved productivity in staff.<sup>27</sup> It is important the results of our research are aimed at demonstrating a combination of environmental, economic and social benefits.

**Strategic Area 6: Achieving productivity gains related to the triple bottom line benefits (demonstrating how productivity in green buildings relates to environmental, social and economic benefits).**

The overall goal of the research will be to highlight a multifaceted understanding of productivity in green buildings. It will seek to show how the green design elements set the physical and environmental framework, and how human behaviour factors and building management factors interact to enable an overall improvement in productivity.

## 6. The focus of the ‘Performance of Commercial Green Buildings’ project

Given the strong university, industry, and government collaborative nature of the SBEnrc, the project’s initial focus has been on preparing for and using a range of stakeholder engagement activities to inform its outcomes. A model has been developed that builds on this, ‘*The Performance Nexus*’, to form the framework for the project (see Figure 1). The team will investigate the performance of, and inter-relationship between, five key areas of green commercial building performance, namely: design elements, internal environmental quality, occupant experience, tenant agreements, and buildings management, through a number of steps:

- **Literature review:** a comprehensive literature review by the research team produced a summary of findings of over 30,000 words that was then refined to produce a 45-page summary. The literature review provides a valuable overview of a number of strategic areas, used as the basis of the stakeholder engagement.
- **Stakeholder engagement:** a series of stakeholder meetings have been held along with the facilitation of three stakeholder workshops involving over 50 participants, in Perth, Brisbane and Townsville. The workshops were facilitated using the ‘Community Social Learning’ methodology designed by Emeritus Professor Valerie Brown, ANU. Participants were asked to imagine their ideal green commercial building and then consider the enablers and disablers to achieving this vision (sample shown in Table 1). Participants then identified what could occur to enhance the enablers and reduce the disablers. Key findings included the basis for considering a wider scope than just energy performance and building management would include IEQ, occupant experience and tenant agreements.
- **Development of a new model:** based on the findings of the literature review and stakeholder engagement a new model was developed to consider the performance of green commercial buildings, namely ‘*The Performance Nexus*’. This model provides a sound structure for a detailed and multivariate consideration of the complexity involved in understanding the performance of green buildings. The model has included the development of a data collection and assessment methodologies for each of the five areas.
- **Data collection and analysis:** the team is focusing on the data collection and analysis step of the project and is focused on 6-8 buildings to undertake detailed investigations across the five nodes of ‘*The Performance Nexus*’, with two under way. This project builds on other studies associated with the performance of green commercial buildings that use greater numbers of buildings with less detail per building and will provide the next level of understanding of the inherent complexity and create a platform for performance improvement.
- **Report and recommendations:** the report for the project will focus on outlining the findings across each of the five nodes of ‘*The Performance Nexus*’ and exploring their interactions that will provide value to industry and government. This will include: the comprehensive data collection methodologies; outlining specific findings from the data collection; and making a series of recommendations to industry and government.

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The Sustainable Built Environment National Research Centre (SBEnc) is the successor to Australia's CRC for Construction Innovation. Established on 1 January 2010, the SBEnc is a key research broker between industry, government and research organisations for the built environment industry.

The SBEnc is continuing to build an enduring value-adding national research and development centre in sustainable infrastructure and building with significant support from public and private partners around Australia and internationally.

Benefits from SBEnc activities are realised through national, industry and firm-level competitive advantages; market premiums through engagement in the collaborative research and development process; and early adoption of Centre outputs. The Centre integrates research across the environmental, social and economic sustainability areas in programs respectively titled Greening the Built Environment; Developing Innovation and Safety Cultures; and Driving Productivity through Procurement.

Among the SBEnc's objectives is to collaborate across organisational, state and national boundaries to develop a strong and enduring network of built environment research stakeholders and to build value-adding collaborative industry research teams.

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