Project 1.1
Design and Performance Assessment of Commercial Green Buildings

RESEARCH PROGRAM 1: GREENING THE BUILT ENVIRONMENT

Sustainable Built Environment National Research Centre

Stakeholder Engagement Report – Stakeholder Workshops

Workshop Details

Workshop One: PERTH

Date:	Monday 11 July 2011	Time:	9:30am – 3:30pm
Venue:	140 William Street, Perth	Facilitators:	C. Hargroves (Curtin), C. Desha (QUT)
Team:	S. Hall, D. Sparks, C. Hargroves, C. Desha, L. Whistler, and A. Farr.		

Workshop Two: TOWNSVILLE

Date:	Friday 29 July 2011	Time:	9:00am – 3:30pm
Venue:	AECOM building, Townsville	Facilitators:	C. Desha (QUT)
Team:	C. Desha, A. Reeve, D. Furnell.		

Workshop Three: BRISBANE

Date:	8 September 2011	Time:	9:30am – 3:30pm
Venue:	80 George Street, Brisbane	Facilitator:	C. Desha (QUT)
Team:	S. Hall, D. Sparks, C. Desha, A. Reeves, A. Matan, G. Field, O. Baghdadi		

Workshop Context

As part of the Sustainable Built Environment National Research Centre (SBEnrc) a research team from Curtin University and Queensland University of Technology (QUT) held a series of stakeholder and experts' workshops in Perth, Brisbane and Townsville. Topics investigated in the three workshops included: the post-occupancy assessment of the performance of green commercial/office buildings; an investigation into the role that roads will play in supporting Australia's response to climate change and other associated challenges; and a consideration of the application of E. O. Wilson's concept of 'Biophilia' to urban planning to enhance Australian cities.

Along with a project focused on sustainable infrastructure procurement based at Swinburne University and QUT and led by Professor Russell Kenley, the projects make up the first round of projects as part of the SBEnrc '*Greening the Built Environment*' program led by Professor Peter Newman, Curtin University. The program is investigating important aspects of greening the built environment that will assist Australia to respond to growing environmental, social and economic issues related to climate change and other environmental pressures. The projects are designed as industry collaborations and involve a number of government and industry partners.

Interested parties, stakeholders, SBEnrc partners, and experts in the field were invited to join each of the three workshops to contribute to informing the direction of the first stage of each of the projects, which will be completed in September 2012. Based on the learnings of the first stage the second stages of each project will be developed in close consultation with stakeholders and partners, beginning October 2012. The workshops were aimed at learning from the experiences of participants, identifying a range of challenges the research team must consider, and gaining a strong understanding of how the research can directly support and enhance industry and government practices and policies. Hence, the workshops were a valuable opportunity for the research teams to engage with the project partners and experts in the field to ensure that the projects are well informed and guided towards tangible outcomes.

Workshop Summary

Following an extensive literature review, stakeholder workshops were run on 11th July in the 140 William Street building in Perth; 29th July at the AECOM building in Townsville; and 8th September at 80 George Street in Brisbane. The workshops involved a range of industry and government representatives and SBEnrc core project partners. The workshops followed a Collective Social Learning (CSL) methodology, requiring participants to work through a facilitated process of identifying key considerations and priorities for the research team to explore. Attendees to the workshops consisted of ESD consultants, engineers, architects, academic, government and project partners from the Western Australian Department of Finance and Treasury, Townsville City Council, and the Queensland Government.

Some of the most relevant and significant outcomes for the project were the recognition of the need to develop a standardised post occupancy evaluation/performance framework for new and existing commercial buildings. Such a framework would focus on assessing both the actual performance of the building (indoor environment, energy etc) and compare this with the experience of the buildings occupants. Another important finding was the need for ongoing education and increased awareness on both: the long-term benefits of green building to shift from current 'business as usual' practices; and the provision of focused training on how to effectively operate green buildings.

The Townsville workshop also built upon ongoing conversations and learnings occurring as part of the IBM Smarter Cities Challenge. Participants were provoked to consider the role that the National Broadband Network, and technological innovation in the form of monitoring and measurement, as well as data acquisition, agglomeration and analysis, could play in achieving non-linear, systems change in creating a sustainable built environment.

Workshop Facilitation Process

The workshop facilitation was led by the project leaders Charlie Hargroves (Curtin) and Cheryl Desha (QUT), and was based on the 'Community Social Learning' methodology designed by Emeritus Professor Valerie Brown.[1] Tables were set up for participants to be seated at (4 or 5 per table) with butchers paper, marker pens, paper and biros supplied. Participants were welcomed and thanked for volunteering their time. An overview of the project was given and the objective of the workshop was outlined to be to gain a better understanding of the industry and the gaps the research project could aim to target. The participants were then facilitated through the following 4 stages of consideration:

- *Session One: What Should Be?*
- *Session Two: What Is? (Considering the current enablers and disablers)*
- *Session Three: What Could Be?*
- *Session Four: What Can Be?*

[1] Brown, V. (2008) *Leonardo's Vision: A guide to collective thinking and action*, SENSE, Rotterdam.

Workshop Discussion and Key Outcomes

Session One: What Should Be?

Participants were asked to imagine their ideal green building without limitations or consideration of barriers. They discussed and brainstormed ideas and listed these on the paper provided. Following this the papers were rotated around the tables for other groups to review and add on any other notes (see Appendix A, B and G for the full lists). Once the papers had rotated around the groups they were returned to the original group for open discussion. Each table presented their ideas, such as:[2]

Table 1: *Summaries of 'What Should Be'*

PERTH	– *Healthy buildings (light, air, space, acoustics, ergonomics, comfort, outlook, positive indoor environment quality).* – *Create a sense of place and community, connect interior and exterior, make buildings active.* – *Positive effects on health of occupants (promotes maximum productivity, promote interaction, inspirational, connected to the natural environment).* – *Make green buildings look and feel normal.* – *Communication - between building manager, tenant, facility managers. Having every stakeholder aware of what is going on and working together.* – *Buildings should sleep when unoccupied.* – *Off-grid, carbon and water neutral (self-sufficient).*
TOWNSVILLE	– *Tropical design - renewable energy, suitable materials, appreciation of thermodynamics, grey/blackwater recycling, passive cooling.* – *Beyond compliance - ecological buildings not just 'green', enhancing biodiversity, green roofs/walls on every building, designed on principles of network science.* – *Systems thinking - hybrid buildings (commercial and residential), Sustainability integrated in design and in operational aspects, buildings that enhance biodiversity* – *Data hub/share point - interconnected networks, tropical data hub, consideration of utility of NBN in enabling data sharing.* – *Policy and standards - regulation complements sustainability and provides vision, government incentives for green building, thematic communications to help shift behaviours, GST offsets.* – *Individual responsibility - sustainable individuals, new lifestyle philosophy, community/professional expectation of high-performance buildings.* – *Measuring and monitoring - develop a measurable use metric, energy use loggers and reward system, environmental accounting, thematic communication of building performance.* – *Transport - human powered transportation in CBD, foot/cycle paths connecting buildings, nodal public transport, solar light rail.*

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

BRISBANE	– *Connections to nature or access to the environment in and around buildings,* – *No buildings at all (put people where they want to work from instead of coming into cities),* – *Homely and integrated spaces that are designed for the user's needs,* – *Minimal energy and water use,* – *Comfortable (temperature, light, air, noise)* – *Good economic returns* – *Buildings that provide feedback to occupants and levels of personal control (i.e. personal temperature adjustment)* – *Educated occupants with leadership and change management initiatives* – *Design for location (i.e. climate, noise)* – *Productive environments with high levels of occupant satisfaction* – *High consideration of indoor air quality*

Source: SBEnrc Stakeholder Workshop (Perth), Hosted by the Western Australian Department of Treasury and Finance (held at 140 William Street), and facilitated by Curtin University and QUT, 11 July 2011, Perth. Stakeholder Workshop (Townsville), Hosted by AECOM (held at AECOM Building, Townsville), and facilitated by Curtin University and QUT, 29 July 2011, Townsville. SBEnrc Stakeholder Workshop (Brisbane), Hosted by the Queensland Government (held at 80 George Street), and facilitated by Curtin University and QUT, 8 September 2011, Brisbane.

Session Two: What Is? (Considering the current enablers and disablers)

Participants were asked to take a new sheet of paper, draw a line down the centre and on the left column add in the title 'Enablers' and on the right column add in 'Disablers'. From here they were asked to imagine the centre line is the vision that they created in the previous step and to list the existing things that are enabling this to be achieved and also the existing factors that are disabling reaching this vision. Each table presented their ideas, (see Appendix B for the full list) including:

Table 2: A *selection of brainstorm items on 'enablers and disablers' of what commercial green buildings should be*

PERTH	
Enablers →	← **Disablers**
– *Legislation (ISO 19001, BCA, CBD, National Strategy for Energy Efficiency, Office Accommodation Policies, carbon tax, OH&S standards)* – *Some POEs* – *Corporate social responsibility,* – *Market competition,* – *GBCA and NABERS,* – *Innovation, research and development,* – *Cross departmental collaboration,* – *Industry associations (AIRAH, PCA, CISBE),* – *Education and awareness,* – *New technology,* – *Modelling software (BIM),* – *Rising energy and water costs,* – *Dedicated professionals, and* – *Resource scarcity.*	– *Lack of demonstration of actual green building benefits (quantitative evidence), unclear productivity enablers/disablers in buildings,* – *Complexity, lack of awareness and knowledge,* – *Values in wrong places, short term focus on capital expenditure, not other long term benefits* – *Legislation not strong enough, planning regulations limiting* – *Lack of research* – *Lack of POEs* – *Lack of feedback and ongoing education* – *Tenant control, lack of accountability* – *Financial/ political cycles* – *Energy/water prices not reflective of true costs*

Source: SBEnrc Stakeholder Workshop (Perth), Hosted by the Western Australian Department of Treasury and Finance (held at 140 William Street), and facilitated by Curtin University and QUT, 11 July 2011, Perth.

TOWNSVILLE	
Enablers →	← **Disablers**
– *Proactive councils, governments, and businesses* – *Shared knowledge, existing project learning, demonstration projects, knowledge clusters, tropical expertise* – *Data collection: more open, from more sources, in real time, using smarter technologies* – *Financial incentives, drivers* – *Rising cost of energy/greenhouse emissions* – *Tropical expertise, local knowledge clusters* – *Community desire, civic pride, engaged residents and businesses* – *Vision, ideas, long term direction*	– *Government policy/regulation often a disabler and disincentive for innovative design* – *Building codes, regulations and planning policies* – *Lack of information, understanding of new technologies,* – *Lack of funding, access to funding,* – *Business as usual, current business model, corporate KPIs,* – *Pricing and market forecasting complicates decisions* – *Construction costs, cost of technology* – *Perceptions* – *Risk education and awareness*

Source: SBEnrc Stakeholder Workshop (Townsville), Hosted by AECOM (held at AECOM Building, Townsville), and facilitated by Curtin University and QUT, 29 July 2011, Townsville.

BRISBANE	
Enablers →	← **Disablers**
– *Global economic conditions* – *Cost of operation* – *Shift in office behaviour (i.e. hot desk)* – *Qualified professionals (people upskilling)* – *State government commitment* – *Performance guarantees as procurement method* – *Common framework and knowledge* – *Certification and accrediation tools* – *Cost savings* – *Branding/marketing tool* – *CSR competition between companies* – *Education on building use* – *BMS consideration in design* – *Occupant engagement*	– *Global economic conditions* – *Mis-matched buildings to occupants* – *Lack of quantifiable data related to IEQ, social benefits, productivity and lifecycle costing* – *Split incentives* – *Traditional procurement methods* – *Lack of access to qualified and experienced people (i.e. FMs)* – *Lack of technology trialling R&D* – *Minimum practice regulations* – *Fear of and resistance to change and poor understanding/ scepticism* – *Privacy and fear of internal issues* – *'Snake oil'* – *Lack of validation of certification tools*

– *IT interoperability* – *Early engagement of users* – *Measurability* – *Two way communication*	– *Lack of evidence on cost/benefits* – *Insufficient data metering and activity variances within a building* – *Guidance and education on building use* – *Industry standards (non-collaborative)* – *One way communication* – *Budget and cost* – *Inflexibility of building stock* – *Understanding IEQ is difficult*

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Source: SBEnrc Stakeholder Workshop (Brisbane), Hosted by the Queensland Government (held at 80 George Street), and facilitated by Curtin University and QUT, 8 September 2011, Brisbane.

Sessions Three and Four: What could be and what can be?

These sessions were run slightly differently with the Townsville and Brisbane workshops being used to further investigate findings from Perth. Findings are grouped below for each workshop.

***Perth** Session Three: What Could Be?*

Participants were asked to brainstorm what 'could' occur to reduce the disablers and increase the enablers. They were asked try and come up with 4 or 5 main points and write these on post-it notes. Some of the points raised as things that 'could' be included (see Appendix C for the full listing):[3]

Table 3: *Perth summary of 'What Could Be'?*

PERTH	– *Framework (standardised methodology) for Post-Occupancy evaluation of all (not just green) buildings* – *Quantification of the human experience, including productivity – link to costs/benefits* – *Life cycle analysis of buildings (standardised methodology) including embodied energy,* – *Financial and non-financial benefits (cost/benefit analysis)* – *Codes and regulation – inform government policy with research, implement IEQ standards* – *Education of stakeholders in buildings, industry and community* – *Comparisons to international examples* – *Design feedback*

Source: SBEnrc Stakeholder Workshop (Perth), Hosted by the Western Australian Department of Treasury and Finance (held at 140 William Street), and facilitated by Curtin University and QUT, 11 July 2011, Perth.

Participants then presented these ideas to the group and grouped the post-it notes in categories on a wall. From here they were asked to continue adding post-it notes and rearranging to come up with 3 or 4 categories, as shown in Table 2. Full listing of topics raised is available in the appendix.

Table 4: Perth, *a brainstorm of things that 'could be' to assist in overcoming disablers and enhancing enables to achieving what commercial green buildings should be*

PERTH	
A. Post Occupancy Experience Framework	
– *Quantification of the human experience,*	– *Building elements design to consider value of lifecycle,*

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– *Activities to crossing silo's,* – *Performance monitoring,* – *Undertaking life cycle assessments,* – *Standardisation,* – *Quantifying the value of non direct elements,* – *Data on performance of improvements,* – *Hard evidence on productivity changes,* – *Providing feedback to designers,* – *Understanding better what occupants would put up with for improvements,* – *Understanding options for future proofing, and if they are preferred,* – *Ways to balance for variation in personal comfort preferences,* – *GBCA performance tool to involve IEQ emphasis as well as energy and water,*	– *Case studies that show real economic analysis (dollars) over time,* – *Enrolling occupants in building management,* – *Undertaking post occupancy evaluation,* – *Good test/bad test evaluations,* – *Deliver information to various stakeholders and parties,* – *Understanding issues related to model vs. Reality,* – *Quantitative evidence for different audiences such as (Users, tenants, facility managers, owners, developers, financers and,* – *Better understand weighting on IEQ.*
B. Codes and Regulation	**C. Education**
– *Overcome fear of litigation,* – *Informing government policy,* – *Overcoming short-termism – (political, financial),* – *Overcoming compartmentalism (Silo effect),* – *Schemes to reduce upfront costs,* – *Regulation and incentives (tax?),* – *Information/education, and* – *national standard for evaluation of IEQ that are affordable to implement.*	– *Increased awareness of cost/benefits,* – *Research to inform education,* – *Disseminating information,* – *Productivity to be related to individual design initiatives,* – *A multi-disciplined and integrated focus to education,* – *Increased local skills, knowledge, product, industry,* – *Overcoming the 'business as usual' approach and addressing the limitation of capital cost,* – *Availability of life cycle analysis data and case studies.*

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Source: SBEnrc Stakeholder Workshop (Perth), Hosted by the Western Australian Department of Treasury and Finance (held at 140 William Street), and facilitated by Curtin University and QUT, 11 July 2011, Perth.

Perth *Session Four: What Can Be?*

One of the main categories that came out of the first Perth sessions was a post-occupancy evaluation (POE) of a building. Participants were asked to assess what the important components of a POE that would need to be included within the categories of 'energy', 'occupant experience' and 'indoor environment'. Three tables were formed with a piece of butchers paper at the centre of each marked with one of these three categories, participants were asked to join a group closest to their specialisation, experience, or interest. Each group then brainstormed components of a POE that would need to be included under that category.

The papers were then rotated and participants were asked to look at the topic from the same perspective (for example, the energy group now observed the indoor environment paper from an energy perspective) and brainstormed other things that need to be considered. After three rotations the papers were returned to the original group and were reviewed by participants and each group presented their discussion.

Table 5: Perth, *a brainstorm of components of a 'post occupancy evaluation'*

<table>
<tr><th colspan="2">PERTH</th></tr>
<tr><td colspan="2">Energy
– Gather data (Interval energy data with individual loads needed for buildings)
– Establish performance benchmarks for other buildings
– Correlate against IEQ data
– Occupant density and activity use need to be considered
Energy profile needs to include occupant satisfaction data and IEQ results</td></tr>
<tr><td>Indoor Environment Quality (IEQ)
– Light (artificial, natural, glare, uniformity)
– Temperature (temperature, radiant heat, air change)
– Ventilation (oxygen, CO2, system type, ACE)
– Light, temperature, ventilation close relation to IEQ and occupant satisfaction</td><td>
– Plants/ indoor greenery
– Individual control
– Particulates
– Noise/acoustic quality
– Volatile Organic Compounds (VOCs)</td></tr>
<tr><td colspan="2">Occupant Satisfaction
– 3 areas: Productivity, satisfaction, health
– Satisfaction – ergonomics, noise, privacy, nature/views, thermal, ventilation, number of complaints
– Productivity – self rated, time taken to complete a task, impacted by temperature, noise and air quality
– Health: building design and impact on IEQ, also impacts energy
– Individual occupancy control, also impacts IEQ and energy</td></tr>
</table>

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Source: SBEnrc Stakeholder Workshop (Perth), Hosted by the Western Australian Department of Treasury and Finance (held at 140 William Street), and facilitated by Curtin University and QUT, 11 July 2011, Perth.

The topic of post-occupancy evaluation came up multiple times and there seems to be a strong agreement that there is a lack of evidence available on the benefits of green building. The workshops also confirmed the findings of the literature review in that there is still confusion as to how to measure the performance of a building, and a standardised methodology needs to be developed and implemented. From here benchmarks on performance can be developed, and this information can feed into policy. The health, comfort and safety of occupants were found to be important to productivity, with the indoor environment quality (IEQ) being a major factor for consideration. This again confirms findings from the literature review that IEQ is often neglected in buildings.

Other topics that frequently arose were:

- The need for long term vision of benefits,
- Evidence informed policy,
- Increased collaboration and partnership between stakeholders (architects, engineers, consultants, tenants, owners, occupiers),
- Education for operators of buildings and stakeholders, and
- Designing buildings for use and adaptability/flexibility for the future.

After placing participants into groups around the topics of how energy, indoor environment and occupant experience interact, strong overlaps were seen and active constructive discussions were occurring between government and industry participants. Participants actively made the connections between building elements and the impacts on indoor environment, occupant experience and energy use. Although water was not included in the scope it was raised as an important topic that should be considered for inclusion in the study, potentially as part of the second stage. An important finding from the workshop confirmed the research teams current understanding was that people really do not know how to measure productivity effectively on a large scale, and that there are no known measures in place at the moment linking these areas together.

Townsville Session Three: What Could Be?

Session three required participants to discuss potential indicators and metrics that could be used to assess green building performance. Participants were asked to suggest as many potential indicators/considerations as possibly and write these on post-it notes. Participants then came together to discuss the suggestions and group them into subcategories. Some of the points raised as things that could be used as indicators are provided below (see Appendix G for the full listing):[4]

Table 6: *Townsville summary of 'What Could Be'?*

Townsville	– *Sustainability metrics - 'Butterfly measure' (measure of number of butterfly species attracted), lifecycle value analysis of project/building (quantitative and qualitative),* – *Building use - Occupant density, interruption by non-work incidents such as maintenance faults, energy:productivity ratio, work delivered and generated, building usage patterns, lift vs. stair use* – *Building performance - HVAC efficiency, age of assets, solar output, extreme weather resilience, area of green space, usage patterns, capital vs. operational expenditure* – *Occupant experience - occupant satisfaction, happiness, wellbeing, health, comfort, temperature, vertical temperature stratification, air quality, air flow, lighting, access to natural light, circadian rhythms, visitor experience* – *Communication and feedback - thematic communication, communication of energy performance to occupants, communication of future energy cost at current usage level, sms/smartphone app surveys of building occupants* – *Data sharing - information transfer between buildings and cities, demonstration of successful initiatives* – *Individual responsibility - education on optimum operation of building design elements, personal energy meters, engage staff in measuring individual energy use (with rewards), positive reinforcement, empowerment to make change, measuring sustainability behaviours, transportation audit*

Source: SBEnrc Stakeholder Workshop (Townsville), Hosted by AECOM (held at AECOM Building, Townsville), and facilitated by Curtin University and QUT, 29 July 2011, Townsville.

A common theme that emerged from discussions in the Townsville workshop was consideration of buildings as elements interconnected within an urban system. This systems view of buildings and communities led to themes surrounding sustainability metrics and 'beyond compliance' visions for future green building. Access to data and sharing of knowledge between cities and between buildings was frequently suggested as a positive method of increasing the uptake of more sustainable buildings. Another theme that emerged was the idea

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of individual responsibility in relation to interacting with buildings. Educating occupants on how to properly operate the building, and empowering occupants with the responsibility for individual energy conservation and sustainability behaviours was suggested frequently.

Townsville *Session Four: What Can Be? Personal Commitments*

In Townsville, 'Session Four' consisted of participants making a personal commitment. The commitments could be for any action item they could perform that would help move society towards the ideal green building they had envisioned in the first session. This session is used to generate a closing discussion and encourage networking. Commitments are kept confidential and are not reported here.

Brisbane *Session Three: What Could Be?*

Participants in the Brisbane workshop were also asked to brainstorm what 'could' occur to reduce the disablers and increase the enablers. They were asked try and come up with 4 or 5 main points and write these on post-it notes. Participants were asked to give special consideration to the interactions between design elements, building-occupant interactions, and management/commissioning and how these relationships could be measured. Below are the outcomes from this session.

Table 7: Brisbane, *a brainstorm of things that 'could be' to assist in overcoming disablers and enhancing enables to achieving what commercial green buildings should be*

BRISBANE	
A. Occupant experience (left column) and measures for occupant feedback (right column)	
– *Description of occupant level of control of personal workspace (lighting, air, layout)* – *Subjective assessment of work/life balance* – *Toilet breaks* – *Time on phone (indicator of need for social contact/stimulation)* – *Selection of desks in hot-desk workplaces (user preferences for different locations in buildings)* – *Time spent in office/at desk (use of spaces and occupancy)* – *Quantity of unpaid voluntary hours of work* – *When it comes to survey - bigger is better - look for international opportunities* – *Attendance profile of staff (e.g. early vs. late starts)* – *Operation of blinds (position and angle) vs. irradiance and illumination on window* – *Subjective quality of view out window vs. photographs (for computer analysis of view quality criteria)* – *POE structure with rating how <u>important</u> each element is and weighting responses*	– *Tenancy power consumption information communicated to tenants* – *External irradiance and daylight conditions* – *Mood-o-meter (building occupant computer/mobile app to measure occupant mood)* – *Measure/compare ratios of service maintenance to complaints/satisfaction (mandatory; predictive; breakdown)* – *Operation of lighting controls near and far from users* – *POE measure - health (sick days per year); happy meter* – *Green-o-meter (whole-of-building energy use -> filtered; as a sculpture; as an ambient feedback)* – *Thermal comfort information available to tenants* – *Measure average time spent commuting each day and methods of transport* – *Measure percentage of waste produced over total occupants in the building per day (excluding recycling)*

according to this – *Measuring the unmeasurable values* – *What people do with controls (all levels) (individual; group; management) [and differences]* – *Influence of 'halo' effect - positive user perception*	
B. Mainstream/mandating green building	**C. Productivity/occupancy evaluations**
– *Implement NABRS/Green Star on all buildings like electrical appliance Star Ratings. No Star, no sale* – *Builders and designers to become more involved/accountable for building performance* – *Leadership policy* – *Sustainable growth* – *Carbon*	– *Productivity vs. subjective assessment of workplace culture* – *Analysis of satisfaction across multiple similar floors of high rise with different tenants (looking for organisational bias)* – *Energy use per email sent* – *Effect of colours on occupants (productivity)* – *Constant light levels vs. changing light levels during the day* – *Lighting colour temperature vs. productivity, visual comfort*
D. Needs vs deliverables	**E. Transparent reporting**
- *Building need (how much space is required; alternative options - hot desking, work on-site, work from home)* - *Don't overcomplicate things. Carefully respect the simple things that deliver <u>adequate</u> results. Don't over-engineer everything. KISS* - *IAQ Cleaning* - *Tenant habits* - *Waste management* - *Deal breakers for users (prioritise to avoid)* - *Lighting quality vs./with energy efficiency of lighting* - *Daylighting (glare; intensity)* - *Users' comfort needs/<u>levels</u> being met*	– *IEQ benefits quantified (absenteeism, productivity vs. VOCs, Fresh air, plants)* – *Don't be lured into direct connections between <u>elements</u> and <u>outcomes</u>. The contribution of elements is often more complex than it appears* – *Measure maintenance costs for building/for users ($/yr; hr/yr)* – *Third party data (performance; social benefit; construction costs)* – *Measure outcomes rather than indicators - i.e. ask people what they think rather than measuring light, temperature etc. Often cheaper and more accurate* – *Building automation system that predicts occupant behaviour* – *True POEs (include design meeting brief; happiness of users; system/service efficiencies; IEQ measures; external factors (i.e. transport availability)* – *Total carbon monitoring across building life cycle*
F. Building communities	**G. Research methods and tools**
- *Develop community to bring managers and occupants to same table* - *Social interactions (space; people; design)* - *Building assessibility (travel time and cost; personal, public)*	- *Building research marketplace 'computer dating for buildings'* - *Transparent research of 'real' application of high-performance buildings (economic pros/cons)*
H. Incentives	**I. Data accessibility and communication**
- *Incentives (availability; reach; amounts)*	- *Data on ratings tools and their reach (tool by*

- *Environmental KPIs for employees*	*tool; cost; rigour)* - *Convergence of rating systems (design (correct design) - post-occupancy (correct use))*
J. Perception Management	**K. Greenwash radar**
- *Adaptive model of thermal comfort - promotion/education* - *Building psychologist - facilitate perceptions of occupant control* - *Balance matrix (comparing the three parts of the triangle to obtain the best balanced position between design/management/users* - *Effectiveness of various video-conferencing facilities*	- *Innovation of research (knowledge sharing; government support; industry adoption)* - *Bullsh*t metre* - *Looking out for spin - don't believe everything people say* - *Government support for research*
L. Capacity building knowledge	
- *Don't reinvent the wheel - this HAS been done before. Make sure you learn from what others have done before* - *Training (what's available; curriculum; cost comparative)* - *Education of managers to understand buildings to get outcomes not just procedures* - *Improved building operation education - inform how the building should be operated and occupied*	- *BMS - use of technology, tenant feedback and connectivity* - *BMS - self-diagnostic reporting* - *BMS - more than a glorified time clock* - *Measure understanding (what does the facility manager know and what difference does it make)* - *A greater focus on facility manager (at design; adequate handover of knowledge at project completion)*

Source: SBEnrc Stakeholder Workshop (Brisbane), Hosted by the Queensland Government (held at 80 George Street), and facilitated by Curtin University and QUT, 8 September 2011, Brisbane.

Brisbane Session Four: What Can Be? Personal Commitments

In Brisbane Session Four consisted of general discussion and participants making a personal commitment something they could do as an action item towards the ideal green building they had envisioned in the first session. This session is used to generate a closing discussion and encourage networking. Commitments are kept confidential and are not reported here.

Project/Scope Recommendations

It became obvious that the findings from the literature review were well supported by the discussions and findings of the workshop. There is limited evidence available on the benefits of green buildings, which seems due to it being very difficult to measure holistically. The themes that ran through the workshops did vary considerably, with Perth focusing a lot on the need for post-occupancy evaluations that measure occupant experience and the building performance. However in Brisbane the participants were specialized in the area and indicated that these evaluations do exist and it is not worth re-inventing the process.

Our understanding that productivity is difficult to measure was confirmed, participants were asked how they think it could be measured and self-rated productivity came up frequently and also the testing of a building for functional support of productivity. Other suggestions included measurement of time to complete tasks (however a costly and extensive research exercise) and interviews with line managers. A number of other measures came up in the Brisbane workshop which could be looked at integrating into future SBE research. For example, smartphone apps were raised several times as a way of real-time recording for people's moods/experiences in the building.

There is definitely the need for true representative evidence on the benefits of green buildings which needs to come from a reliable and strong source to properly inform future policy. From the first workshop we recommended that the first step for the project be to establish and trial a post-occupancy evaluation (POE) that assesses the energy, water (water has been removed from the scope but stakeholders suggested it should be included), indoor environment and occupant satisfaction/productivity in a building. Such results would inform building tuning efforts to improve the performance of existing commercial buildings as well as inform design and construction of new buildings. Once the framework is developed and trialled within the SBE scope, it can be used on a large scale to set up industry wide benchmarks and provide guidance.

After the second workshop it became evident that for this POE we need to consider work that has already been done in greater detail and the complexities of external variables which can influence outcomes, particularly when working with a small sample size. Individual buildings have varied activity uses and occupants, so generalised responses on design element performance may not be accurate. The importance of how a building is managed was raised again and this may need further consideration in the building evaluation process.

It was also discussed that using Green Star merely as a guide may not deliver an effective building. This is an important implication for government departments currently using the framework as a guide only (due to expense of certification). Through either a lower cost or the long term benefits of a rating being proven, this initial cost may be a small percentage in the overall benefits from a rated building. Further review of this literature will be conducted.

It is also recommended that the SBE project keeps in mind the importance of existing buildings. The majority of Australia's building stock is over 20 or 30 years old and as mandatory disclosure has been implemented there will be more drive to increase the energy efficiency of this stock. Green Star buildings reflect a small proportion of the total building stock so the evaluation framework needs to encompass non Green Star rated buildings also. The POE can become a valuable tool to measure the effectiveness of large scale changes (such as Green Star retrofits or new-builds) and small changes, such as servicing the BMS. Both can have major impacts on occupants, energy and water consumption and the indoor environment.

Appendix A: PERTH Session 1 Participant Notes – "What Should Be"

Group 1

- Domesticating the office environment - domesticating behaviour at work. Sense of responsibility and ownership. Challenges related to the separation between home vs. office. Need to feel well connected. Office environment needs to draw out connection and understanding with the building. People understand the systems and technology in their home better than they understand the systems and technology in the office environment. Improve building/occupant interface. Align 'smart' with personal
- Normalising - make green buildings look and feel normal.
- Match needs to demand - for example, night-time draw of electricity. Currently not being tackled. Buildings should sleep when unoccupied
- Utility - using buildings 24 hours each day. Accommodate flexible working hours
- Use in future. Adaptable to different audiences and tenants to draw more utility from the building. Increasing utilisation (not just 9am-5pm). Total lifespan needs to be measured in centuries - increased utility
- Encourage an active lifestyle. Walk or cycle to work. Transport connection. Walk between levels. Must be better than health neutral
- Encourage interaction with building. Creating a sense of place. Vibrant. Mixed use. Closer connection between internal and external environment
- Buildings should be off grid and carbon neutral and water neutral
- Make performance monitoring data relevant

Group 2

- Longevity
- Flexibility/adaptability. Diversity of space/use
- Sense of community - get energised by being in the building. Community (working relationships between owners/tenants)
- Tuned to people's needs - availability of quiet space and community areas. Good retention of staff. Individual control (A/C {mixed mode, natural ventilation}, lighting)
- Intuitive, easy to navigate. Integrated design/fitout (intuitive systems). Intelligent (active feedback for users)
- Communication - between building manager, tenant, facility managers. Having every stakeholder aware of what is going on and working together.
- Intelligent - provide feedback, can respond to feedback (interaction). Have a usable and simple interface so that even complicated building systems are easily used by occupants.
- Locally appropriate - local materials, local design, local architecture. All create a sense of community. Helps people feel connected. Low embodied energy. recycled
- Engineer-designed vs. architect-designed. Segregation.
- Appropriate use of technology

- Modular
- Consideration given to end of life. Whole of life cost rather than capital cost. Flexible building usage over building age
- Healthy (light, air, space, good acoustics, an interesting space, comfort {flexible, responsive, ergonomic})
- Biodiversity
- Self-sufficient (water, waste, energy)
- Appropriate use of legislation as a driver for green buildings
- Low embodied energy materials

Group 3

- Functional - easy to use. Workable for different stakeholders (facility managers, building owners, tenants, occupants, public). Functional and support the reason you are in the building)
- Positive effects on health of occupants (promotes maximum productivity, promote interaction, inspirational, connected to the natural environment). Inspiring. Lift people. Work/life balance (designed for life; gym; childcare; never have to leave). Comfortable and worry-free
- Feel natural - not artificial. Outside blending in. No difference between inside and outside
- Take human element out of the operation of the building
- Positive environmental impact - carbon positive (? Terminology ? - sequestering carbon).
- Community/social vibe - e.g. rooftop bars, childcare facilities. Sense of place. People feel connected to the building, Promoting arts and culture; sexy; incorporate the natural identify of site)
- Flexibility of design for different tenants
- Profitable
- Resilient and efficient in face of peak oil and climate change
- Accessibility for all people (e.g. those with a disability); accessible to public transport
- Simple - easy to operate
- Clean design

Group 4

- Feedback - assess performance over time. Accessible data. Transparent data reporting
- Positive physical environment
- Delivering intent - more input from design team beyond completion
- Transparency - knowing how a building is performing
- Involvement of facility manager
- Flexibility - repurposing (e.g. schools designed to be repurposed into aged care facilities as needs of population change).
- End of life cycle use, [or alternatively, Europe-purposing buildings].
- Lots of natural light
- Outlook to 'green'
- Indoor environment (IAQ, noise, temperature, glare, radiant temp, low velocity air movement)
- HVAC - VAV (if commissioned well)
- Tenants and building manager educated through accessibility of upfront data.
- Mandatory disclosure of water and other elements.
- Owners objective, same level.
- Tenants (GLA vs. NLA - Set amount for outgoings; GLA too limiting)
- Base building services
- No incentives now for building owner
- Appropriate technology for situation (not too complex; government?)
- Usability of technology (education, commissioning)
- Longer staged handovers (12 months, and after this another 12 months)
- Defects within the 12 months and after everything working properly
- Occupant feedback in the 12 months
- Handover needs feedback loop, consultants into longer term to prevent segregation (i.e. 12-24 month contract; 'performance incentive' for them to get it working in the 12 months)
- Keeping team included from delivery to performance (funds and incentives in place)
- NABERS commitment (team agrees and commits to performance)
- Minimum requirements in addition to NABERS
- Split funding (government) varied department priorities
- Over time, if performance declines ongoing FM attention
- FM beyond complaints management
- Real time monitoring of data

- Making performance data highly accessible/visible.
- Minimum quality of IEQ, no questions

Appendix B: BRISBANE Session 1 Participant Notes – "What Should Be"

Group 1

- Healthy and homely buildings with connections for people, able to eat, drink and relax with others.
- Views and access to the environment and greenery.
- Indoor environment: Daylight, thermal comfort, ergonomics, acoustic comfort, air quality
- Relaxed and stimulated environment for users, sensory engagement
- Social spaces
- Productive environment
- Accessibility (in the building and to the building)
- Vegetation (often overlooked)
- People/users needs met
- Some factors are easy to quantify but quantifying social needs are more difficult as needs change during the day

Group 2

- No building at all
- Conflict between building that works and green design – productivity may be maximised by not having an office at all
- Owners and tenants have different perspective on what is key performance indicators
- Optimise floorplate and orientation
- Minimise energy and water usage
- Maximise natural light
- Maximise use of building services
- Maximise flexibility
- Leadership and change management, just as important as how the building is physically important
- Feedback mechanisms
- Integrating people into spaces
- Minimise deterioration and prolong life

Group 3

- Put people where they want to be
- Transform spaces in now to natural spaces over the next 40 to 50 years
- Building use adapting from traditional to new
- BIM that provides feedback to occupants
- Infrastructure is built for cities to insist people come into 'unhappy concrete places'

Group 4

- People – HR is important not just building design, the information provided to employees impacts their happiness
- Comfort and needs change depending on an organisation's aims (i.e. different for schools vs hospitals).

- Sometimes increasing the costs for building green can be good if it is a research flagship. Sometimes it may cost more to build and operate a green building but this can be a learning opportunity that can be re-applied to other buildings
- Ensure occupants know how to use their building properly appropriately
- Design for people, not for building.
- Industry capabilities need to be met.
- Design for location – i.e. open windows won't always work (i.e. 30 The Bond, opening windows then realising too much noise from the Sydney Harbour Bridge).
- **Comfortable:** thermal, light, fresh air, noise, occupant satiscations
- **Economic:** Good economic design decision delivering successful outcomes (for the particular building's requirements), Short/long term cost
- **Relationship with environment, climate responsive**
- **Positive development – virtuous cycles**: Building boundaries (clean air, insulation), Biophillia
- **Prompts behaviour change**: Custodians of environment, community beyond building
- **Outcome focus**
- **Operation:** Industry capabilities
- **People**

Group 5

- Low energy/water use
- High level of occupant satisfaction
- Indoor greenery
- Better consideration of IAQ issues (at design stage)
- Acoustic considerations
- Hybrid ventilation
- View to outdoors
- Natural light
- Comfort and productivity
- Personal control (when people have control over their climate and air conditioning they will tolerate a greater range of discomfort).
- Occupant awareness
- Transformational working spaces

Appendix C: PERTH Session 2 Participant Notes – "What Is – Enablers and Disablers"

Group 1

Enabler	Disabler
– Dedicated professionals – Improved productivity (bang/buck) – Financiers for projects, varied some ethical – Resource scarcity (cost) – Codes/regulation/institution – Productivity – Ethical investment	– Complexity of the science – Codes/regulation – Split incentives – Lack of quantitative evidence based information (building performance, people, commercial yield) – Cheap utilities – Dodgy tariff structures

Group 2

Enabler	Disabler
– Voluntary rating tools – Technology – Legislation (state and commonwealth) i.e. Office Accommodation Policy, CBD) – Post Occupancy Evaluations – Corporate Social Responsibility (macro scale) – Market competition – Increased/ improving occupational health and safety – Rising energy/ water costs – Better building research – Industry lobbying – Industry education – Technology	– People doing positive things, doesn't filter down – BAU – capital cost – Legislation – is BCA strong enough? – Developer driven market – Planning regulations – Customer knowledge limitations (owners and tenants) – Water and energy prices which are not cost reflective – Inadequate public transport leading to increased car travel – Lack of research (for value proposition) – Lack of local skill, knowledge and product – Fear of the new (large momentum) with existing modes of construction (fear of litigation) – Lack of governing incentive – Lack of POE – Lack of appropriate use of technology (controls) and education of the user – Relationship between owner and tenant

Group 3

Enabler	Disabler

– Benchmarks NABERS/GBCA
– Lower life cycle costs
– Carbon tax
– New technology (BIM)
– Innovation, research and development
– Cross department collaboration and cooperation
– Desire to do the right thing
– Education and awareness
– Legislation and Policy (CBD, BMW requirements)
– Integrated project delivery
– Market competition
– Occupational health and safety requirements
	– Lack of demonstration of actual green buildings and benefits
	– Beliefs of sustainability costs and benefits
	  – Costs: lower in long term than imagined, more marketable, easier to tenant
	  – Benefits: Health, well-being and productivity savings (money, energy, water waste)
	– High upfront costs
	– Short term-ism (requiring payback within 10 years)
	– Tony Abbott
	– Lack of community engagement
	– Financial/ political cycles
	– McMansions
	– Short term gains vs. long term resilience
	– Lack of education (incl. curriculum, solar passive design)
	– Compartmenting design team
	– Design feedback of operation to designer (lack of info back and incentives)
	– Accountability

Group 4

Enabler	Disabler
– ISO 14001/ 19001 – Tenant advocates – GBCA/ NABERS – CISBE/AIRAH/PCA – industry associations – Qualified industry – Modelling software (BIM)	– Tenant advocates – Wrong technology for wrong people, or lack of education – Education lacking – Values in wrong places (i.e. no understanding of maintenance costs beyond CAPEX)

– New technology – National strategy for energy efficiency (nationwide commitment) – BCA development, legislative push for change – CBD – mandatory disclosure – Some POE but needs further education and standard approach – Fine point controls (minimise tenant control)	– Demand for air-conditioning – Cost – Social expectations on design (i.e. glass box, demand for outlook causing massive heat gain) – Real estate agents uninformed – Unclear productivity enablers/disablers in buildings – Building owner/occupier different priorities, different parties have different visions – no long term united vision – Lack of connection between IEQ and design (i.e.) designing in double the fresh air, does it really improve the air quality? – Lack of connection between IEQ and productivity – No 'connect the dots' from IEQ to occupant satisfaction – Best case bias in current productivity studies – IEQ is an option, should be mandatory, market demand not enough to pull it – People don't realise how much IEQ impacts people – No POEs – Tenant control – Feedback not being carried through

Appendix D: BRISBANE Session 2 Participant Notes – "What Is – Enablers and Disablers"

Red – Strong / Blue – Medium / Black – Small

Group One

Enablers	Disablers
Transformation of global economic conditions - shrinking of offices, retro-fitting - some re-allocating of funds to green building Cost of operation (energy, waste, water) Shift in office behaviour - Hot desk, work from home, bring your own computer Qualified people - Upskilling - Access Life-cycle costing State government commitment Trialling technology	Transformation of global economic conditions - No money available to move into green building No price on carbon - Increase GDP and operation cost Mis-matched buildings to occupants - Planning for maximum space (100% occupancy) rather than reality - Behaviour of occupants Access to qualified people (FMs, PMs lack of experience) Lack of quantifiable data in productivity, IEQ, social benefits, G.B. costs and lifecycle costing Political climate - Lack of leadership (state and federal) but some governments are overcoming this Lack of technology advancement research

Group Four

Enabler	Disabler
End user and/or value (i.e. articulated vs driving demand) Minimum practice regulations Innovation Engagement and change management Knowledge (coming with experience of application) Common framework (across a multi-specialist industry) Tools (technology, systems, methods) Certification/ accreditation Real research and dissemination Occupant stewardship Design tools	Developer/tenant split incentives Minimum practice regulations (as goals) Poor understanding and lack of knowledge or scepticism Fear of change Privacy (outcomes confidentiality and fear of internal issues) Risk Lack of common knowledge Compartmentalisationa Fear of validation of tools – tolerance and accuracy of auditing Snake oil - false knowledge and misconceptions Occupant resistance Lack of validation of design tools

Group five

Enabler	Disabler
Cost savings Brand/marketing tool Market pressure Competition between companies (CSR) Design quality indicators (database) Education on how t use a building BMS control on design (i.e. north and south side variation) Education for user intervention	People resist change (occupants, bldg. managers – all levels) Cost (Maintenance and initial) Lack of evidence that benefits will outweigh costs (real life not computer modelled) BAU – risks Decision Makers Insufficient data metering (per technology and per zone) Guidance on how to use each design element Activity variances within building zones User-Building manager interventions

Group three

Enabler	Disabler
Occupant engagement - Information transfer - Empowerment Rating tools Building management system Procurement methodology (performance guarantees) IT interoperability	Cost prohibitive - Value for money Technology/ risk - Change, risk averse, support Practicality of rating tools (metrics for measurement) Knowledge transfer - Question value for money - Not fit for purpose, can't be used by staff Procurement methodology (traditional) Industry standards (non collaborative technology)

Group two

Enabler	Disabler
2 way communication Early engagement of users to provide input Change management Leadership (star) – do as I do Value-based mentaility Skills, knowledge and capabilities in design Demonstrating a sound economic case Measurability	One way communication People resistant to change Budget and cost Legacy buildings Inflexibility of existing stock Location variability IEQ – understanding of the variables is difficult Buildability

Appendix E: PERTH Session 3 Participant Notes – "What Could Be"

Group 1

1. Qualitative data to inform energy models
2. International examples for comparison
3. POE considering different audience needs/priorities (tenants, FM, financiers), they all need various feedback from cost to operational data
4. User/ tenant data,
    - *Cost of technology, utilities, HR, advertising, branding*
    - *Sick days*
    - *Churn rate*
    - *Bonus payments*
    - *Incentive package*
5. Developer, owner, moneymen,
    - *Yield*
    - *Rents*
    - *Depreciation*
    - *Vacancy rates*
    - *Insurance*
    - *LCA of building*
    - *Brand*

Group 2

1. Standardised method for POE including all elements (energy, water, performance, productivity)
2. Standardised methodology for life cycle analysis
3. Standardised methodology for embodied energy consumption
4. What are the financial and non-financial benefits for green buildings?
5. Case studies for successful green buildings
6. Go beyond BAU processes looking at just capex
7. There is a lack of skills on products and materials
8. Use research to inform better government policy/ building regulations
9. Education of industry and broader community
    - *Helping with the business case*
    - *Information on initiatives*
    - *Help grow the sector*
10. Practical and realistic outcomes for industry, recognition

Group 3

1. Design feedback
    - *Standard methodology for feedback/ reporting to designers*
    - *Rating of designers*
2. Short-termism
    - *Research existing solutions*
    - *Amortising upfront costs*
3. Costs/benefits awareness
    - *Case studies*
    - *Research on delivering research*
    - *Modelling of benefits*
        - Investment of potentials
    - *Harmonising different stakeholder interests*
4. Reducing silo effect
    - *Interest divisions*
    - *Low awareness of costs/benefits*

Group 4

1. Framework for POE of buildings (beyond just green buildings)
    - *Draw international comparisons*
    - *Life cycle analysis of good buildings*
    - *Indicators for POE, make the metrics adaptable for the future*
    - *IEQ and productivity focus, quantification including productivity, overview of best case bias*
2. Life cycle understanding (around each design element/feature)
    - *Take lessons learnt*
    - *Look at construction, maintenance etc stages and costs/benefits*
    - *Timeline, why are old buildings still working well? What makes those environments productive Maybe our analysis needs to look at old buildings as well*
    - *Future flexibility of design, what elements will be useful over the entire life cycle?*
3. Link productivity to costs and benefits
4. Performance monitoring
    - *Automated system monitoring, getting and organizing data*
    - *Inform next stage of development*
    - *Future for green building around productivity, energy and water and lower costs*

5. Education
    - *Incentives (vary for audience – schools, government, hospitals)*
    - *Provision of benchmarks for these groups*
    - *Understandable and visible, publicized*
6. Design element evaluation (i.e. evaporative HVAC)
    - *comparative data, i.e. adjusting the temp above or below 24 impacts cost by X amount, plus X in other costs*
7. Consultants
    - *Performance bonus when the building is actually operating on target*
8. Carbon emissions
    - *If putting the temp. up means savings in GHG emissions will occupants make the personal choice to do it?*

Appendix F: PERTH Session 4 Participant Notes – "What Can Be 'Part of a Post Occupancy Evaluation?'"

Occupant Experience	Energy implications	IEQ Implications
Self reported occupant satisfaction and reasons – Ergonomics – Noise – Privacy – Nature/views – Temperature – Humidity – Ventilation – Suggestions for improvement – Amenity	Need understanding of a building as temperature can have an impact on energy consumption	Need to monitor PMV for temperature, humidity and ventilation Location can also impact this.
Elements to measure affecting satisfaction and productivity – Temperature – Noise – Air quality		Ties to IEQ design parameters
Measure no. of sick days		Type of sick days
Quality of design i.e. a great place to work		Linked to energy, passive design
Productivity measured by expected time to complete a task		
Individual occupancy control		Impact of air speed, subjective evaluation?
Measures of productivity: – Self reported – Line manager's – Use of studies showing relationship between productivity & specific building features		

Energy	Occ. exp implications	IEQ Implications
Occupant density FTE		
Temp/humidity		External ambient conditions
Prediction vs expectation		
Benchmarking	Comparative data to encourage individual engagement with energy use	
Steps: 1. Gather and collate suitable data at high sample rates 2. Develop benchmarking tools for individual elements 3. Correlate		Correlate against IEQ results
Data collection – Utility bills, 15 min intervals (elec, gas) – Utility metre on site for FM/owner/tenant, 60 sec BMS data – Individual loads (cooling/heating, general power, lighting ventilation) – Data format, Kwh, time of use, profile (daily, weekend), peak power	Clarity of data, relate numbers to experience (i.e. graphs instead of numbers) Simplify, take out menial tasks (turning off lights)	Real time consumption of loads (individually grouped) Additionally monitor ventilation, thermal comfort, lighting
Other	Empower through signs and motivational messages, show organisational commitment Reward good behaviours, not just punish bad behaviour	

IEQ	Energy implications	Occ. Exp. Implications
		Occupant experience of IEQ will be very subjective, may have to aim for a range of experiences
Plants/ nature (leaf surface area per person)		
Ions		
Light – Flicker – Natural light (frequency) – Colour – Daylight & distance from perimeter – Glare – Discomfort and disability – Uniformity of light	Monitoring energy profiles Reduce LUX	Very important for occupants
Temperature – Air temperature – Radiant Heat – Air speed	Monitoring energy profiles Better control	Very important for occupants
Views – quality as important as quantity?		
Humidity		
Ventilation – Type (displacement) – CO2 – Oxygen – Air Change Effectiveness (ACE) (stuffiness)	Properly controlled ventilation means reduced energy consumption Natural ventilation Mixed mode Economy cycles	Very important for occupants Is there a true benefit from the initiative?
Individual control	Air-conditioned, ventilation Lighting	
Particulates (Pm10, Pm2.5)	Can come from photocopier exhaust, heat removal	
Noise/acoustic quality – Privacy – Reverberation/echo		Very important for occupant
VOCs – 90 days construction/ re-fit – Formaldehyde		

Appendix G: Townsville Session 1 Participant Notes – "What Should Be"

Group 1

- Renewable energy use outweighs all other forms
- Drivers
    - Lifestyle improvements
    - Economic benefit
    - Emotional/climate/awareness
- Incentives - Hard works varies on develop
    - Ergon contribution changes on building construction
    - GST offsets
- Constantly optimising
- Rules/regulations complement sustainability + drive towards the vision
- Act like our kids (youth-LED initiatives)
- Solar vs. wind vs. tides vs. Bio
- Townsville has world-class covenants – a unique community. "You cannot build a bad building"
- Government policy is an incentive to sustainable building/development
- Ecological buildings not "Green"
- Bio-diversity rich
- Buildings designed on principals of network science
- Interconnected network of fibres
- Solar Ivy
- Photo synthesis building for energy

Group 2

- A tropical data hub generates new knowledge that is actioned into tropical green building in Townsville and the world
- Environmental products and services have been generated in Townsville
- We have open access to data from local + global sources
- We will educate other regions on how to create and manage a sustainable city
- Kids will ask us why we were not more conscious about use of energy
- We will have "formal" agreements in place to define how we work together to achieve common objectives
- The creation of IP protested tropical, science, knowledge, innovation and knowledge into commercial products processes and services that we can sell to the world
- Applied -> tropical R+D/Expertise
- Data/research to have a measurable use metric i.e. research into use health tick
- City + green buildings that specifically attract our beautiful + abundant tropical butterflies that could then be used as a tourism marketing tool
- No "over chilling" in meeting rooms
- Human powered transportation in CBD
- Hybrid buildings (commercial + residential)
- At least one green wall/roof on every new building
- Energy usage data loggers + reward system

- Hybrid power ferry services
- All households and businesses should have solar hot water
- Free bicycle hubs with bikes for use
- Free access to high speed Wi-Fi network for IP telephone
- All building are at 25 degree
- Building automatically adjust to environmental and people

Group 3:

- Every building upload their building specification onto the cloud server with energy control system information and effectiveness (the feedback) to share
- A new building standard/building codes
- Government rewards for green building
- Thermodynamics – aware and creative
- New data driven business
- Weight has products and services
- System of environmental accounting for costs of producing
- Bamboo walls
- Cycle paths/zones connecting of buildings
- Solid waste reuse, reduce and recycle
- Nodal public transport
- Underground water tanks
- Passive cooling
- Grey and black water recycling
- Extraction and reuse
- Individual homes and business
- Solar light rail systems (Trams)
- Babylonian terrace gardens on building balconies
- Public transport

Group 4:

- Sustainable individuals
- Tropical design
- Apply the 241 behaviours
- Smart technologies
- Thematic communications
- Shift behaviours
- Sustainability integrated in design and in operational aspects.
- Integration of energy generation in building design. Footprints with ability to process waste onsite including smart communication to occupants
- Master planning transport/entertainment acts/sport/into building city designs.
- Social media as a link energy efficiency
- New lifestyle philosophy
- Create advisory group and within council to review DA’s to promote adoption of green building technology
- Staff requiring employers to be sustainable
- Solar panel/film on windows

Townsville Session 2 Participant Notes – "What Is"

Group 1

1 Title Date and Location of Workshop	
2 IDENTIFY THE FACTORS ENABLING AND LIMITING A "Title"	
❖ **Enabling Factors** Towards "Title" ⇨	**3 Limiting Factors** ⇦ Away from "Title"
❖ Pro F communities ❖ Knowledge ❖ Technology is here ❖ Winter climate ❖ Data collection is easier, real time ❖ Data is more open from more sources ❖ Existing project learning ❖ Community desire ❖ Tropical expertise	❖ Government policy are often a disincentive to new and innovative sustainability ❖ Pricing and market forecasting complicates decisions ❖ Peak demand vs. efficiency vs. carbon ❖ Building construction cost escalation ❖ Cost recovery for landlords in Townsville vs. Brisbane ❖ Infrastructure not in place for retrofitting ❖ Building codes, regulations and planning policy

Group 2:

4 Title Date and Location of Workshop	
5 IDENTIFY THE FACTORS ENABLING AND LIMITING A "Title"	
❖ **Enabling Factors** Towards "Title" ⇨	**6 Limiting Factors** ⇦ Away from "Title"
❖ Sharing of learning outcomes ❖ Forums such as today ❖ Savings ❖ Rising cost of energy ❖ Rising cost of carbon emissions ❖ IBM smarter city challenge ❖ Government initiatives ❖ Community discussion, understanding + behaviours change ❖ Loads of buildings achieving energy reduction ❖ Champions ❖ Synergy ❖ "Local" knowledge clusters ❖ Emergent environmental product and services ❖ Ergon Energy ❖ Under utilised tropical knowledge ❖ Sustainable energy opportunities	❖ Privacy issues ❖ Data loggers/loggers systems ❖ Cost of tech ❖ Current business model ❖ Our issue but perhaps not the customer's issue ❖ Corporate key performance indicators ❖ Perceptions ❖ Government policy ❖ Government regulation ❖ No Ergon Energy in Townsville ❖ Resistance to long terms vision/payback to change

Group 3:

7 Title Date and Location of Workshop	
8 IDENTIFY THE FACTORS ENABLING AND LIMITING A "Title"	
❖ **Enabling Factors** Towards "Title" ⇨	**9 Limiting Factors** ⇦ Away from "Title"
❖ Pro-active council ❖ Increased media awareness ❖ Planning ❖ Experts ❖ Financial incentives ❖ Financial drivers ❖ Engagement at many levels	❖ Historical building codes ❖ Funding ❖ Legislation in general ❖ Risk – education and awareness ❖ Power of one – public perception ❖ Steep learning curve ❖ Politics

Group 4:

10 Title Date and Location of Workshop	
11 IDENTIFY THE FACTORS ENABLING AND LIMITING A "Title"	
❖ **Enabling Factors** Towards "Title" ⇨	**12 Limiting Factors** ⇦ Away from "Title"
❖ Our community i.e. civic pride ❖ Smarter technologies ❖ Social media ❖ Champion in community business ❖ Kids/schools ❖ Discovery NBN ways ❖ Population and economic growth ❖ Demonstration Projects ❖ Business motivation ❖ New ways of communicating ❖ Cool schools doing cool things ❖ Long sighted/"creative tension" ❖ People with vision and ideas ❖ Implementation of CBSM project ❖ Engaged residents and businesses ❖ Necessity is mother of innovation ❖ Peer groups sharing expertise	❖ Cross-departmental/stakeholder agendas ❖ Lack of funding ❖ Old ways of doing things ❖ Costs ❖ Short sightedness ❖ Polices and procedures ❖ Current technology ❖ Wrong politics ❖ Understanding new technologies

Townsville Session 3 Participant Notes – "What Could Be"

GROUP A through to GROUP B ("What Should Be?" – draft?)

- Control – Big Brother – as energy use increases, broadband speed decreases – break our addiction to computers
- Wisdom of the crowd – data on what our neighbours and other cities are accomplishing

- Capital vs operating cost – trade-offs (quantitative analysis)
- Lifetime value analysis of project, holistic view – quantitative and qualitative (emotional)
- Energy audits – Cont. Savings ->50% recycled to further energy efficiency/renewable energy measures

- Measuring Sustainable behaviours at work, ie: percent of people recycle/turn off at wall etc – place pride and sustainability in action
- Engage staff in measuring energy use in their work space – reward schemes, positive reinforcement, empowerment to make change.
- Difference in Behaviour/Difference in Energy Demand

- **$$**
    - The monthly bill includes the number if fuel costs go to 2020 predictions
    - Costings
    - Owners' electricity bill
    - Power usage – gains/losses
    - Community and business take-up of new, sustainable technologies
    - Occupants per square metre -> to create comparisons and benchmarks
    - Per cent occupancy measures, density/area (use security via entry/exit)
    - Determine how much food/wet waste a household generates and measure the benefits it would have if recycled
    - Staff productivity and health – sick days, work delivered and generated
    - Transportation audit: who drives to work/how many walk or cycle, etc. Providing sources/rewards to motivate cleaner transport
    - Number of trips taken from my workplace per day(efficiency/productivity)
    - Bike miles – people riding to work and school
    - Productivity Levels:
    - Number of times interrupted by non-work incidents,(ie: maintenance faults, problems, etc)
    - Measure utilisation of space (people per area) – optimise use of space
    - Measure and explain the benefits a white reflective roof can bring about
    - Explain job creation capability renewable energy developments hold
    - Power – all points for g---
    - Demonstrate successful sustainable initiatives at community level
    - Energy consumed per unit productivity per unit time for a given area
    - Facilities man--- education/knowledge and enthusiasm
    - Amount of free Wifi broadband bandwidth
    - Reduction in energy if desks have pedestal fans or ceiling fans
    - Air-conditioned retail spaces and outside door management
    - Energy use in relation to external conditions
    - Building management – how well the design intent is realised in the operation of the building
    - Workstation energy measurement ->motivating reduc--- personal energy meters and networked through office
    - Develop value propositions for energy/water efficiency and food recycling – qualitative and quantitative

- **Historical and Comparitive:**
    - Historical vs new visual performance (consumption data) data lodgers, large visual displays. Business as usual, vs new technologies
    - White roof for the city
    - White roof measure traking the take-up of white roof technology on new and existing buildings

- Education – Empowerment of staff re: optimum building operating mode – windows, natural lighting
- Measure total solar output of systems on buildings connected to the grid in the MSD freely available
- Information dissemination – how well energy performance data is communicated to occupants?
- The Butterfly Measure – smarter city with butterfly attracting plants; an audit of butterflies' numbers may be a measure of plant health, our health and liveability; numbers vary due to seasons that can be measured over time by area and species
- Workspace specific energy consumption
- How many people in a space for a specific period of time?
- "Earth Hour" - actual impact on Townsville, suburb and street power usage
- Amount of internal and external landscapes, hard and soft
- Air flow per cubic metre
- Temperature - vertical stratification – inside, window temperature, R humidity
- HVAC efficiency – COP, kWr/?/s, EER, IPLV, kWr/kWe
- Age of HVAC assets

- **Human Experience:**
  - Happiness measure – if you're happy at work, you're more productive
  - Worker wellbeing and happiness
  - The attraction of new residents due to the city's liveability and sustainability
  - Intangible but goodwill values for implementing initiatives, qualitative surveys/testimonies
  - Occupant beliefs about building's pleasantness
  - Occupant's satisfaction level/rating
  - What do occupants want to experience at work – vision
  - Visitor experience of building features
  - Customers' perceived comfort levels; drivers – cost; enablers – new technology learning from other (international) communities
  - Occupant comfort levels – qualitative account of comfort
  - Person's comfort
  - Individual's comfort factor
  - Comfort levels
  - Thermal comfort – predicted mean vote (PMV[ISO 7730])
  - Occupant comfort levels – in relation to clothing worn at time – optimise type of clothing
  - Air quality: positive air pressure-> FEEL GOOD: fresh vs return air-> volume of air change (wind and wind chill), smell (fresh outdoor), possible injection (vanilla essence), NO2, SO2, CO2 content; <-TEMPERATURE: degrees celcius relative to ambient, percent humidity dry/wet bulb, volume of air change (wind and wind chill)
  - Smart phone applications for lux levels -> in existence – staff choose one
  - Natural light vs electrical light

- **Measure Human Experience (physical):**
  - Office – do all desks have access to natural light?
  - Natural light – percent penetration, circadian rhythms
  - Lighting – why one constant spectrum? [Morning=red] ->[Midday=blue] ->[Evening=red], and use in rainy weather! *gloom*
  - Light luminance in office building could be measured
  - Lux - +glare, +colour
  - Lux per square metre
  - Lux levels - natural light vs electrical light
  - Smart phone applications for Lux levels! –in existence – staff choose own
  - Lighting performance – Lux levels, colour temperature, colour rendition, glare index
  - Dynamic temperature, eg: outside 33'C -> inside 25'C; outside 29'C -> inside 23'C
  - Security and safety perception within building, plus travelling to and from building
  - Human activity in buildings could be measured
  - Sight distances – opportunities to change eye focus distance
  - Space for reflection and peace

- Amount of reflective surfaces below 1800mm
- Occupant ratings of building: energy, efficiency, sustainability initiatives, waste reduction, etc
- Amount of low-level vibration noise
- Cost of space energy
- Virus level detector
- Level of air exchange in workplace
- Carbon dioxide level
- Humidity and temperature
- Temperature especially with regard to outside
- Per cent of humidity in insulation materials
- Micro -airflow, stratification, optimum cooling, window opening behaviour
- Hot or Not voting (measure of comfort levels/temperature); office feedback in temperature via Facebook/other social medium
- Exit Touchpad records comfort level experienced as you leave a building: too hot, too cold, freshness, humidity, time of visit, duration
- Amount of positively charged ions in the indoor atmosphere
- Air quality: hydrocarbons, aerosol chemicals, compared to 'outside'
- Air quality: CO2/CO, amines, SL
- Indoor air pollution: VOCs, CO, CO2, etc

- **Physical Infrastructure**
  - Occupant demography
  - Type of work conducted
  - Type of businesses occupying tenancies
  - Occupant behaviour: presence, use of blinds/doors/windows/air conditioning, 'productivity'
  - Usage patterns of building/floor and individual (scaling)
  - Bushfire/burn off smoke free days
  - Visibility to Palm Islands measure!
  - Water clarity measure, including number of stingers as an indicator of environmental health
  - Noise insulation ->office and home – lets blast the music ☺
  - Building colour
  - PV on roofs in TSUL...address normative behaviour
  - Ratio between NLA and wall and roof surface area
  - Variation of energy consumption over seasons and long term
  - Per cent of renewable or recyclable materials in a building
  - Drying space
  - Insulation installed
  - Building ratings *****
  - Number of plants in my workspace area
  - Per cent of green (soil covered) area on building and property
  - Hand wash gels in coffee/food areas
  - "stand-by" or baseload energy consumption per account
  - Energy efficiency rating system for retro-fit homes
  - Total energy use (vs meter – include losses, generation energy, lost water, etc
  - Customer survey question randomly sent as SMS to smart phone – "How's the building feel to you?"
  - Length of time people spend in an area
  - Internal stairways use measure – calories consumed, energy saved
  - Shower hours
  - Occupancy per peak time energy rating on each building beside the logo
  - Potential for footfall as a source of energy ->high traffic areas
  - Building characteristics
  - Resiliency for extreme weather events, ie: island power/water