The development of a simple multi-nodal tool to identify performance issues in existing commercial buildings
Partners

SBEnrc Core Partners:
- Government of Western Australia
- Queensland Government
- Parsons Brinckerhoff
- John Holland
- Curtin University
- QUT
- Swinburne

Project In-Kind Partners:
- PEL
- hfm asset management
- City of Townsville
- AGIC
- Green Building Council Australia
- PLANT UP
- Green Roofs Australasia

Sustainable Built Environment National Research Centre
To provide a low cost, low complexity tool to assist efforts to improve the energy performance of existing commercial buildings and foster a productive workplace.
Improving the Performance of Existing Commercial Buildings:

Industry-led insights:

• **A focus on existing commercial buildings**: Existing buildings represent the bulk of the stock, yet little attention on energy management. Requires a strategic approach to improving their performance

• **A holistic approach to energy management**: Going beyond a focus on energy management to help deliver cost effective and lasting solutions that achieve multiple benefits across the building

• **Options for enhancing stakeholder collaboration in buildings**: Buildings are complex systems with many stakeholders involved. Consider the various stakeholders within a building and their relative contributions to improving energy performance in a way that encourages productivity

• **Consideration of the impact of energy programs on productivity**: Exploring the link between energy management initiatives and productivity

• **Consideration of associated agreements**: Exploration of the various agreements that can be used to enhance energy management in buildings
‘Performance Nexus’ — basis of the Tool

- Design Elements
- Indoor Environment Quality
- Agreements and Culture
- Occupant Experience
- Building Management
Design Elements

- Monitoring & Control Technology
- Lighting
- HVAC
- Other Plant and Equipment
- Building Fabric
- Tenancy Design and Fit out
Occupant Experience

- Occupant Satisfaction
- Perceived Productivity
- Communication and Reporting
- Training, Education and Guidance
- Use of Controls
Building Management

- Operation and Management
- Reporting and Evaluation
- Maintenance and Cleaning
- Commissioning and Tuning
- Management Personnel, Communication and Education
- Procurement
Agreements and Culture

- Lease Agreements
- Organisational Culture
- Communication and Education
- Ratings, Mandates and Incentives
- Commitments and Targets
Indoor Environment Quality

- Basic IEQ Monitoring
- Advanced IEQ monitoring
- IEQ Management Programs
- Health and Well-being
- Reporting and Communication of Results
Table 1: Example of application of each node of the Nexus to ‘lighting’

<table>
<thead>
<tr>
<th>Design Element</th>
<th>Indoor Environment Quality</th>
<th>Occupant Experience</th>
<th>Building Management</th>
<th>Agreements and Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the lighting system energy efficient?</td>
<td>Are the lighting levels suitable for tasks?</td>
<td>How satisfied are occupants with light levels and controls?</td>
<td>Is there a maintenance schedule for lighting?</td>
<td>Is there a fit out guide in place for lighting systems?</td>
</tr>
</tbody>
</table>

Table 2: Typical responsibilities for ‘Performance Nexus’ nodes in commercial buildings

<table>
<thead>
<tr>
<th>Design Elements</th>
<th>Building Management</th>
<th>Indoor Environment Quality</th>
<th>Occupant Experience</th>
<th>Agreements and Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Building</strong></td>
<td>Building Owner</td>
<td>Building Manager</td>
<td>Building Manager</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Tenancy</strong></td>
<td>Tenancy Representative</td>
<td>Property Manager</td>
<td>Tenancy Representative</td>
<td>Occupants</td>
</tr>
</tbody>
</table>
Case Studies
Mapped to Nexus

40 Albert Rd (VIC)
250 St Georges Tce (WA)
201 Charlotte St (QLD)
187 Melbourne St (QLD)
60 Leicester St (VIC)
Trevor Pearcey House (ACT)
182 Capel St (VIC)
500 Bourke St (VIC)
500 Collins St (VIC)
115 Batman St (VIC)
Design Elements

Energy efficient design elements; occupants engaged through CitySwitch

**Key Features**

DE: efficient envelope and passive design features
- Mixed-mode HVAC; operable windows; blinds; louvres
- Daylighting; clearstory windows; T5, LED, and task lighting

TA: Commitments and Targets
- NABERS Energy target and involvement in CitySwitch

**Impacts**

- Occupants engaged in energy reduction targets through involvement in CitySwitch
- Occupants are provided with education on correct operation of the building

**Key Outcomes**

- 30% energy reduction (preliminary results)
Indoor Environment Quality

Indoor environment quality monitoring informing building management practices

**Key Features**

- Long-term indoor air quality management program
  - On-going IAQ Management Program
  - Tenancy Re-fit Testing
  - Intervention (Fire/Flood)
- Tenancy fit out guidelines specify re-fit IEQ testing
- IAQ Reports feed into building management processes

**Impacts**

- Facilitates continual building performance improvement
- Improved building management practices and identification of existing and future issues
- Tenants and contractors aware of their role in IEQ management

**Key Outcomes**

- 5 Star NABERS IE
- 5 Star NABERS Energy
Occupant Experience

Passive design principles; good building management; occupant education

**Key Features**

- Energy efficient design elements
  - Passive design features, user-controllable design elements
- Education and communication
  - Education ensures occupants understand how to operate the building in a comfortable and energy efficient manner
- Post-occupancy evaluation

**Impacts**

- Occupants have an active role in operating the building and understand how to correctly operate the building
- POE and staff surveys help identify potential issues
- Post-construction commissioning identified IEQ and energy-related issues

**Key Outcomes**

- 52% energy reduction
- High occupant satisfaction
- High perceived productivity
Agreements and Culture

Major renovation - close partnership between building owner and tenant

Key Features

• Lease Agreement:
  – Long term lease (12 years)

• Communication:
  – Cooperation between building owner and tenant
  – Shared cost and incentive between owner and tenant

• Commitments and Targets:
  – NABERS Energy target; Green Star Design, Interiors, As Built

• Organisational culture:
  – Corporate Responsibility program; Carbon Neutral goal

Impacts

• Helped overcome the split incentive and achieve an integrated refurbishment of base building and tenancy.

Key Outcomes

• 50% energy reduction
• 4.5 Star NABERS Energy
• 4.5 Star NABERS IE
Building Management

Best-practice building management - improved energy efficiency without major plant and equipment upgrades

Key Features

• Best-practice building management practices
  – Knowledge management
  – Regular monitoring and reporting
  – On-going maintenance and tuning
• Targeted efficiency upgrades
  – Energy metering and building management system
  – Improved control strategies

Impacts

• Improved performance of existing design elements and systems
• Significant energy efficiency improvement

Key Outcomes

• 34% energy reduction
• 3.5 Star NABERS Energy
Integrated Multi-Node Approach

Energy efficient retrofit; excellent building management, ongoing POE

Key features

• DE: Energy efficient design elements
  – BMS, sub-metering, HVAC, lighting, fabric, fit out
• BM: Good building management practices
  – commissioning, ongoing tuning, active use of POE results
• OE: Several years of occupant surveys (2006, 2009)
  – Post-occupancy evaluations (satisfaction, productivity)
• IEQ: Several years of IEQ testing (2006, 2009)
  – Multi-year IEQ testing (Temp, RH, Lux, CO₂)
• AC: Non-legal agreements
  – Corporate culture, communication and education, ratings

Impact

• Consideration of multiple nodes and active integration between nodes facilitates continual improvement

Key Outcomes

• 65% energy reduction
• High satisfaction
• High perceived productivity
• Maintained high performance
Multi-Node Approach

Energy efficient retrofit; Good building management; IEQ and Occupant Survey

**Key Features**

- **DE:** Energy efficient design elements
  - *Efficient chillers; active and passive chilled beams; VSD*
- **BM:** Good building management practices
  - *Commissioning; on-going energy monitoring and review; on-site management*
- **OE & IEQ:** Detailed pre- and post- occupancy studies
  - *Occupant satisfaction, productivity, indoor environment quality*
- **AC:** non-legal agreements
  - *environmental management plan, building users’ guide*

**Impacts**

- Improved building energy performance
- High occupant satisfaction

**Key Outcomes**

- 52% energy reduction
- High occupant satisfaction
- Productivity improvements
Value of the Performance Nexus

Identify key metrics and considerations for improved building performance

A pre- and post-retrofit evaluation tool

Identify areas for improvement

Identify where relationships between areas could be strengthened
Benefits of the Project for Industry

Succinct tool to collect key performance data

Providing precedent of a holistic approach to performance improvement

Succinct capacity building materials

Supporting focus on existing buildings

Improving strategic positioning
Benefits of the Project for Government

Informing legislation & policy development

Informing program and grant-funding

Succinct capacity building materials

Inform procurement policies