

## Attachment: Research and Data Collection Framework

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, something with much greater economic returns than energy savings. The stakeholder engagement process revealed a desire within the industry to further investigate the issue of productivity within the built environment. This document outlines the proposed research and data collection framework that will be used to consider the performance of green commercial buildings, with a focus on informing efforts to reduce energy consumption and support staff productivity. As consideration of the nexus of various types of performance in green commercial buildings is complex and multifaceted the research team will analyse available, extractable or collected information in five key areas as outlined in Figure A below.

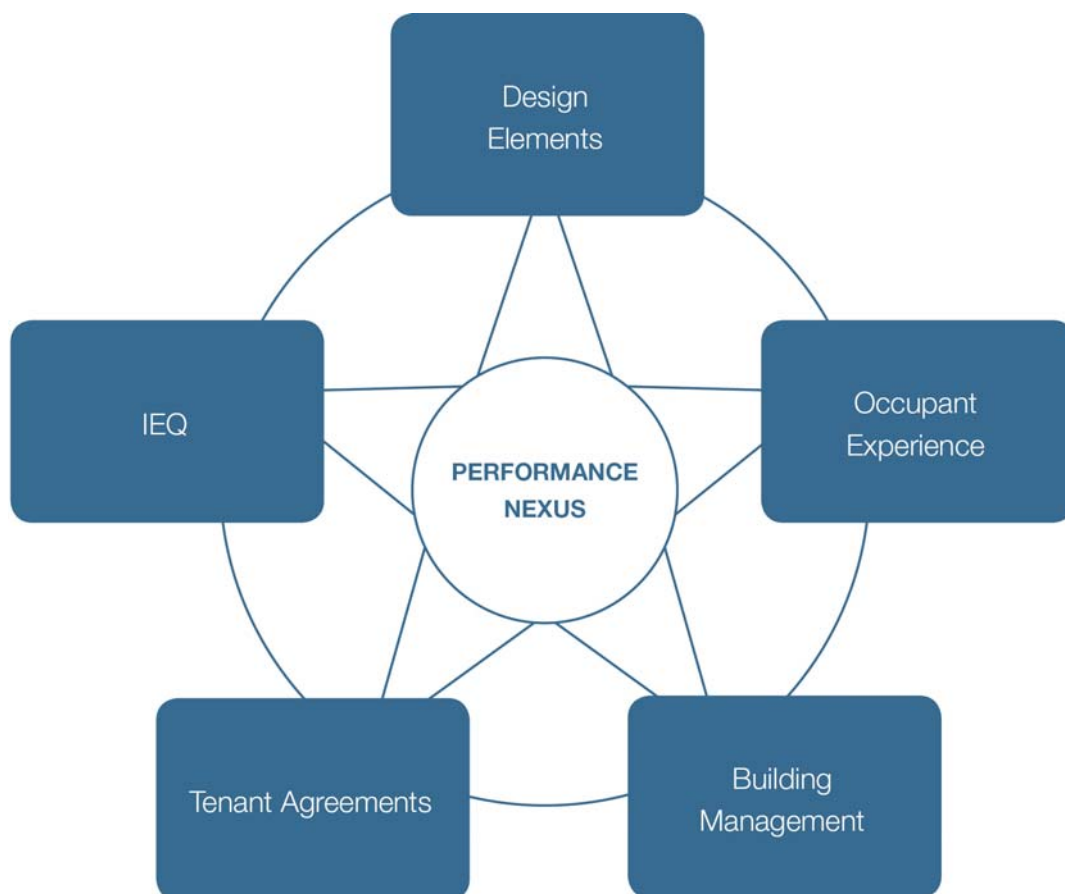


Figure A: *The Performance Nexus: Considering the main elements that affect the performance of green commercial buildings in order to strengthen efforts to reduce fossil energy consumption and increase the productivity of occupants.*

The framework has been informed by comprehensive research and stakeholder engagement workshops, and employs a mixed method research approach, combining qualitative and quantitative data collection in addition to analysis of other available data provided by project partners.

## Indoor Environment Quality

### Context

Indoor environment quality (IEQ) can have a significant impact on occupant health and productivity and provide key guidance as to how to improve conditions. Two sets of data will be collected in the study for comparison, firstly basic IEQ parameters that can be easily measured by a hand held device by the research team and secondly high-level IEQ parameters that require sophisticated equipment.

**Basic:** IEQ data is collected using the handheld device only and includes air temperature, relative humidity, ambient sound, and illuminance.

**High-level:** An in-depth analysis of indoor environmental quality is conducted, including the full list of parameters outlined below. Data is collected on two occasions to ensure results are better representative of the general conditions in the building and to account for seasonal bias.

### Data Collection

The research team, in partnership with Perth-based IEQ consultancy QED Environmental Services, collect IEQ base and tenancy measurements from buildings within the study. Collection of IEQ data by air quality specialists ensures reliability of data and proper procedures. Data collected in this manner will allow comparison with other similar commercial buildings in Australia that have undertaken a NABERS Indoor Environment rating. Parameters that are measured include:

#### *Physical measurements*

- Air temperature (internal/external)
- Relative humidity
- Air speed
- Ambient Sound
- Illuminance

#### *Chemical measurements*

- Carbon dioxide
- Carbon monoxide
- Particulate matter (PM10)
- Formaldehyde
- Volatile Organic Compounds

#### *Biological measurements*

- Airborne microbials

A sufficient number of samples are taken to give a representative picture of the environmental conditions throughout the office space. Measurements are taken in the same zones used to conduct the occupant experience surveys (see below) to allow correlation between occupant responses and IEQ data. Additionally, the research team collects data on air temperature, relative humidity, ambient sound and illuminance using a handheld instrument to allow comparison. These measurements are quiet and unobtrusive and are carried out while occupants are completing the survey. In some cases data already gathered by QED will be accessible.

### Outcomes

The data collected will be compared with the other nodes of the productive nexus, informed by expert interpretation by project in-kind partners QED Environmental Services.

## Occupant Experience

### Context

The experience of occupants in the buildings being studied is an important measure of the performance of the building. Surveying building occupants to gather data on their experiences with the building's indoor environment, design elements, and building management practices provides insight into the influence of the office environment on respondents' perceived productivity. Measuring productivity is inherently difficult in an office environment; hence in this study occupant experience will be used to inform the level of satisfaction a person has with their working environment will often determine their ability to work effectively within that environment.

### Data Collection

An Occupant Experience survey has been developed, with consideration of a number of internationally recognised surveys such as the University of California Centre for the Built Environment Occupant Satisfaction Survey, and tailored to allow a cross consideration with the other four nodes of the performance nexus. Post-occupancy satisfaction surveys are administered to occupants in a number of different areas in the study tenancy. The survey takes approximately 12-15 minutes to complete and is delivered through an online platform, which employees can access securely, or through a hardcopy which employees complete and return directly to the research team. During pre-testing of the survey a questionnaire distributed to respondents in the trial building indicated that the survey was easy to understand, relevant to the office environment and an appropriate length, and following the trial there were no complaints lodged by participating staff.

The Occupant Satisfaction survey includes questions about employee satisfaction with the indoor office environment, such as thermal comfort and lighting, as well as perceived productivity. Survey questions cover a variety of physical and behavioural conditions to allow for meaningful comparison with measured environmental data. It also allows for comparison of subjective and objective factors explored within the survey, such as the relationship between different office layouts (objective) and acoustic comfort (subjective). The survey is comprised of questions about employee satisfaction with the indoor office environment, such as thermal comfort, lighting, air quality, and acoustics. In some cases buildings have already conducted their own occupant satisfaction surveys and the research team is not able to administer a second round of surveys. In this case information will be taken from the existing surveys.

### Outcomes

The data collected will be compared with the other nodes of the productive nexus

## Design Elements

### Context

Design elements include components such as HVAC systems, lighting/daylighting methods, building materials and layout. Design elements can impact the indoor environment, occupant experience and can dictate what building management options are available. Maintenance and upgrades to design elements can also have considerable impact on the performance of a building.

### Data Collection

Data will be collected based on review of architectural plans if available and on-site visits and interviews with architects, designers and facility managers. A review of sustainability initiatives aiming at improving IEQ and reducing energy consumption will be undertaken where appropriate in relation to specific design elements. Focus groups and/or semi-structured interviews may be used to investigate views and attitudes towards design elements and particular sustainability initiatives related to reducing the consumption of energy. Data will also be collected through interviews with management and maintenance personnel, requesting access to construction and operational costs, maintenance/refurbishment cycles, access to additional consultancy fees that may have resulted, and access to certification fees involved.

### Outcomes

The collection of data pertaining to design elements incorporated into each study building will allow for cross comparison with occupant experience and IEQ data.

## Building Management

### Context

Building management practices can have a profound impact on the overall functioning of the building, impacting the indoor environment and occupant experience. Building management can include the operation of an actual Building Management System (BMS) and a facility of building manager on site responsible for the maintenance and operation of the building.

### Data Collection

Interviews will be conducted with building managers to discuss common building management practices and requirements within contracts. This will include any energy performance contracts in place for building managers, handling of complaints related to temperature, and maintenance of the building. For those buildings in the study that have already undergone building management interventions the building management company's data and successful and unsuccessful interventions will be examined.

### Outcomes

Building management data will allow analysis of management practices and cross-comparison with occupant experience, energy consumption and indoor environment data. Building managers have the closest and most in-depth understanding of the building and the interactions with tenants.

## Tenant Agreements

### Context

A range of existing legal instruments can influence the performance of green commercial buildings and underpin greater energy conservation across the full lifecycle of commercial buildings, including design, operation and management, and demolition (i.e. 'cradle to grave'). Consideration is needed of potential revisions and enhancements to support the wide scale uptake of green commercial buildings to significantly reduce associated greenhouse gas emissions. However, a literature review has identified that the legal literature mainly assumes that energy is being appropriately conserved and a productive environment already exist. There are a number of emerging efforts to use legal instruments to encourage greater energy conservation that will be considered in the study, including Green leases (such as the Victoria 'Greener Government Buildings'). Consideration will also be given to the complexity of administration and the emergence of the opportunity provided by 'energy management committees' operating in a win-win partnership between owners, facilities management and occupiers.

### Data Collection

Consideration will be given to a range of existing legal mechanisms and the configuration in each of the buildings under investigation, including those related to: quiet possession; inherent defects (including obligations to repair and keep in the same condition); covenants to repair; break clauses; relocation notices; gross versus net rental leases (e.g. tenants metering); and single versus multi tenanted conditions and what arises with regard to care of the building. Further leases will be reviewed between building owners and tenants covering a number of key criteria – hours of operation, minimum NABERS requirements, economy cycles and temperature set points for requirements and retrofitting allowances.

### Outcomes

It is expected a greater level of understanding will be gained on the influence that a lease is able to have over the efficiency of a building.