

**City Central:**

**A sustainable  
high performance  
workplace**

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### Are green offices good for business?

The City Central development in South Australia is one of Woods Bagot's most recent achievements in the field of sustainable built environments<sup>1</sup>. The 16 800 m<sup>2</sup> site contains two towers and a plaza area combining new buildings with refurbished heritage works. Tower 1 houses predominantly commercial office space and was completed in 2007, with Tower 2 scheduled for completion in 2008. The broader site masterplan includes a five star hotel and multi-storey apartment complex.

From the outset of the design process Woods Bagot was guided by the Australian Green Star rating tool in setting sustainability targets. The Green Star building accreditation system assesses the environmental impact of building design, construction, commissioning and management by awarding credits across the categories of *management, indoor environment quality, energy, transport, water, materials, land use and ecology, emissions, and innovation*. Following the lengthy and rigorous accreditation process, the Green Building Council of Australia has awarded Tower 1 a 5 Star Green Star rating (indicating Australian excellence), with plans for the remainder of the City Central development to maintain this standard.

While the environmental performance of their workplace is becoming increasingly important to tenants, what most of our clients want to know is whether green buildings provide a positive working environment. It is therefore crucial to understand the effects of any sustainability initiatives on occupant job performance and general wellbeing during the operational stage via the process of post-occupancy evaluation.

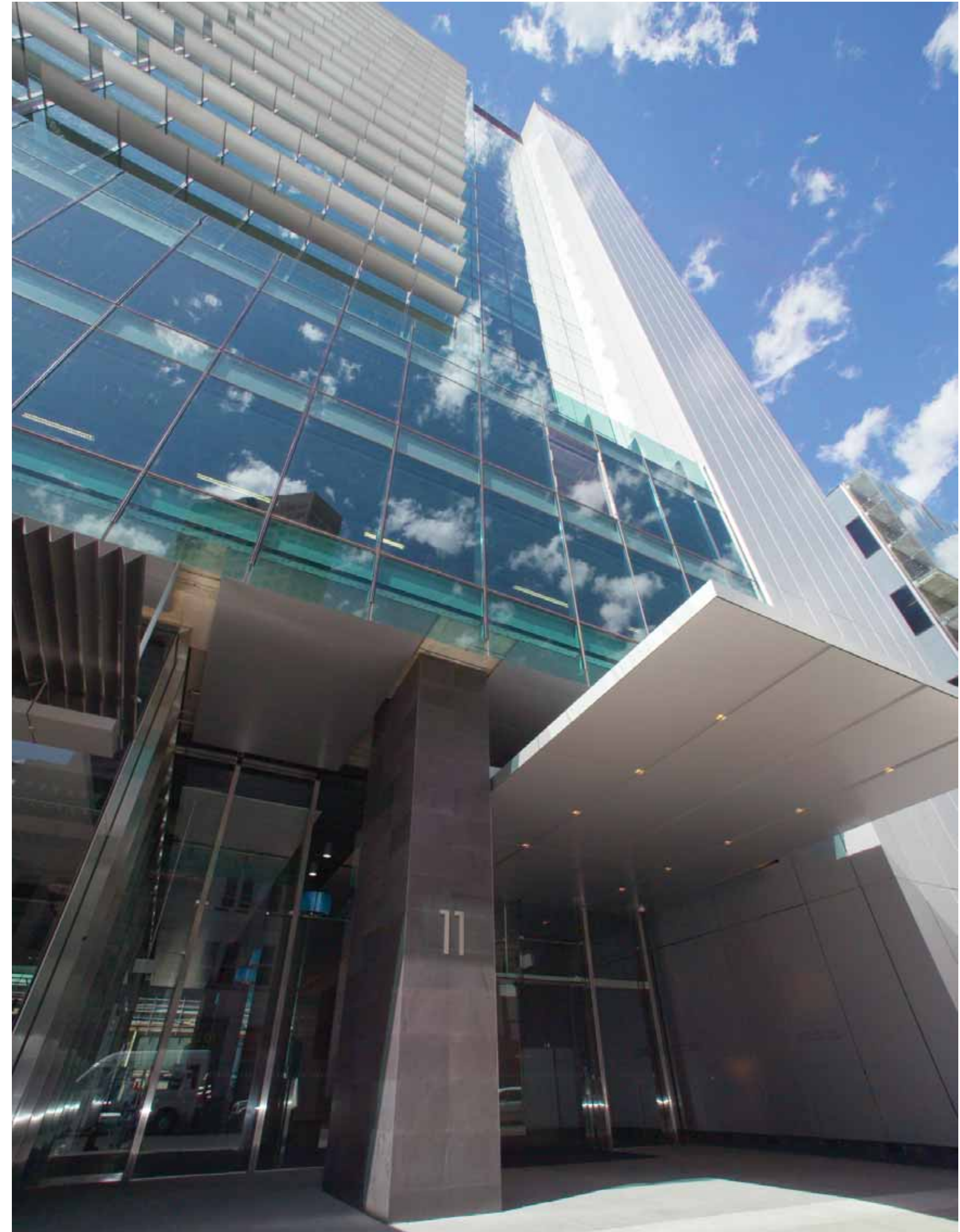
The present study involved three analyses. First, a current City Central tenant completed an online survey designed to measure the extent to which various workplace features impact on job performance, with their scores then compared to a baseline derived from a database of previous results. Second, a different organisation completed the same measure both before and after their move into City Central, allowing us to track the performance of a single company. Finally, an additional set of questions completed by both tenants sought to reveal employees' attitudes and knowledge regarding the sustainable design features of Tower 1. By examining how the sustainability initiatives integral to the design of a 5 Star Green Star building are impacting the tenants of Tower 1, we seek to, in effect, 'close the loop' on the City Central sustainability story.

## Performance is a function of two independent individual attributes: ability and motivation.

### The role of post-occupancy evaluation

For most designers their involvement with a building ends with the opening festivities, yet in many ways this is just the beginning. With the building constructed and the doors open for business, the sustainability performance of the facility depends on two very influential elements: occupant behaviour and building operations. Mendler and Odell (2000) cite research showing that the average tenant can reduce energy costs by twenty per cent simply by operating the building as intended by the designers (keeping in mind that energy use is only one part of the sustainability equation). Indeed, designers are aware of the need to support occupants in understanding how their building works. Building user guides are a start, but it is also important that occupants understand why sustainability is a key objective, how the design solution meets this objective, and how new technologies have been used to support the design vision.

Ideally, this communication should be a two-way street, with occupants given the opportunity to provide feedback concerning the building. Post-occupancy evaluation is a key element of this dialogue and a valuable learning tool, both for building managers seeking to ensure the successful realisation of design and sustainability objectives, and for the design team in understanding the needs and responses of occupants (as well as determining their team's capacity for future projects). Furthermore, post-occupancy evaluation is useful for client groups looking to review and validate strategic decisions about their workplace, as well as for building owners seeking to manage their portfolios and procure future office accommodation. As part of the post-occupancy evaluation of Tower 1, Woods Bagot employed a proprietary assessment tool, the *Workplace Evaluation Survey*, and extended it to capture information directly relevant to the sustainability initiatives of City Central.



City Central Tower 1, Adelaide, Australia

# An employee needs to both possess the skills required to complete a task and be motivated to execute these skills effectively.

## The Workplace Evaluation Survey

A wide variety of methods have been employed in an attempt to gauge the impact of the physical environment on work output. An accurate indicator of workplace effectiveness offers managers a means of evaluating the suitability of their office for supporting profitable business practices. In perhaps the most cited formula in organisational psychology, Vroom (1964) claimed that performance is a function of two independent individual attributes: ability and motivation. In contrast to the traditional view that performance is primarily determined by ability (e.g. Dunnette, 1973, cited in Mitchell, 1982), Vroom's formula reflects the influence attributed to work motivation in more recent accounts (see special issues of the *Harvard Business Review*, 2003, Vol. 81, Iss. 1, and the *Academy of Management Review*, 2004, Vol. 29, No. 3; both of which are dedicated to the discussion of work motivation). In short, an employee needs to both possess the skills required to complete a task and be motivated to execute these skills effectively, and the environment is capable of influencing both of these attributes.

Using this theoretical position as a methodological foundation, Woods Bagot's Workplace Evaluation Survey (WES) assesses a wide range of workplace features in terms of how they impact on employees' ability and motivation to perform their work. These complementary indices of performance are rated by the employee using two seven-point Likert scales, ranging from -3 (indicating an extremely negative impact) to +3 (indicating an extremely positive impact). Additional questions or topics can be included for investigation, thus tailoring the survey to the specific needs of the client. The results of the survey provide a diagnostic assessment of the impact that an organisation's current workplace has on staff performance, and can be contrasted with pre-move results from the same organisation or with baseline values extracted from a database of previous studies. This information enables the consultant to identify features of the current workplace that facilitate work performance, as well as those that are inhibiting the effectiveness of staff.



City Central tenant breakout space: Department of Further Education, Employment, Science and Technology and Department for Transport, Energy and Infrastructure



# Analysis 1: Comparing City Central with the average workplace

## Aim

In a situation which serves to demonstrate how the WES is typically employed in terms of a single measurement, a corporate tenant of Tower 1 was approached to participate in the study. This tenant completed the WES five months after moving in, with the results compared against average scores taken from a database of non-Green Star rated offices. Thus, Analysis 1 tested whether a 5 Star Green Star rated office building exerts a more positive influence on work performance than do non-accredited facilities.

## Method

The analysis involved a simple contrast of scores from Company A with baselines extracted from the WES database. The survey was made available to thirty-two employees of Company A in October, 2007, with sixteen respondents completing the survey (50% response rate). Baseline scores were provided by averaging the results of 1048 previous WES respondents (all of whom were occupants of non-Green Star rated buildings).

## Results

All analyses in the present study involved the calculation of effect size (Cohen's *d*)—for both the ability and motivation scales comprising each item—by contrasting average scores from each sample. In short, this statistic provides a measure for deciding whether the observed difference is large enough to be considered meaningful (a large difference between average scores, combined with a high degree of agreement between respondents, will return a large *d* value). Cohen (1988) provides the following conventions as a guide to interpreting this statistic:

- /  $d \geq \pm 0.2$  = small effect
- /  $d \geq \pm 0.5$  = medium effect
- /  $d \geq \pm 0.8$  = large effect



The overall average ability (1.24) and motivation (1.14) scores for Company A were both larger than the baseline averages (0.36 and 0.31 respectively), and both of these comparisons returned medium effects. This finding can be interpreted to mean that Tower 1 facilitates staff performance more than non-Green Star rated facilities, and that this advantage is moderate in magnitude. Rather than breaking down these overall scores in order to analyse every component item, only those workplace features relevant to Green Star rating criteria will be analysed in this paper. The WES items of relevance, and their corresponding Green Star Credit categories, are as follows:

/ *Acoustic access to others (as related to communication distraction/privacy)*. This item relates to the Green Star credit IEQ-12 (Internal noise levels).

/ *Access to an outside view*. This item relates to the Green Star credit IEQ-8 (External views).

/ *Indoor temperature*. This item relates to the Green Star credit IEQ-9 (Thermal comfort).

/ *Indoor air quality (e.g. movement, freshness)*. This item relates to the Green Star credits IEQ-1 (Ventilation rates), IEQ-2 (Air change effectiveness), IEQ-11 (Asbestos), IEQ-13 (Volatile organic compounds), IEQ-14 (Formaldehyde minimisation), and IEQ-15 (Mould prevention).

/ *Daylight*. This item relates to the Green Star credits IEQ-4 (Daylight) and IEQ-5 (Daylight glare control).

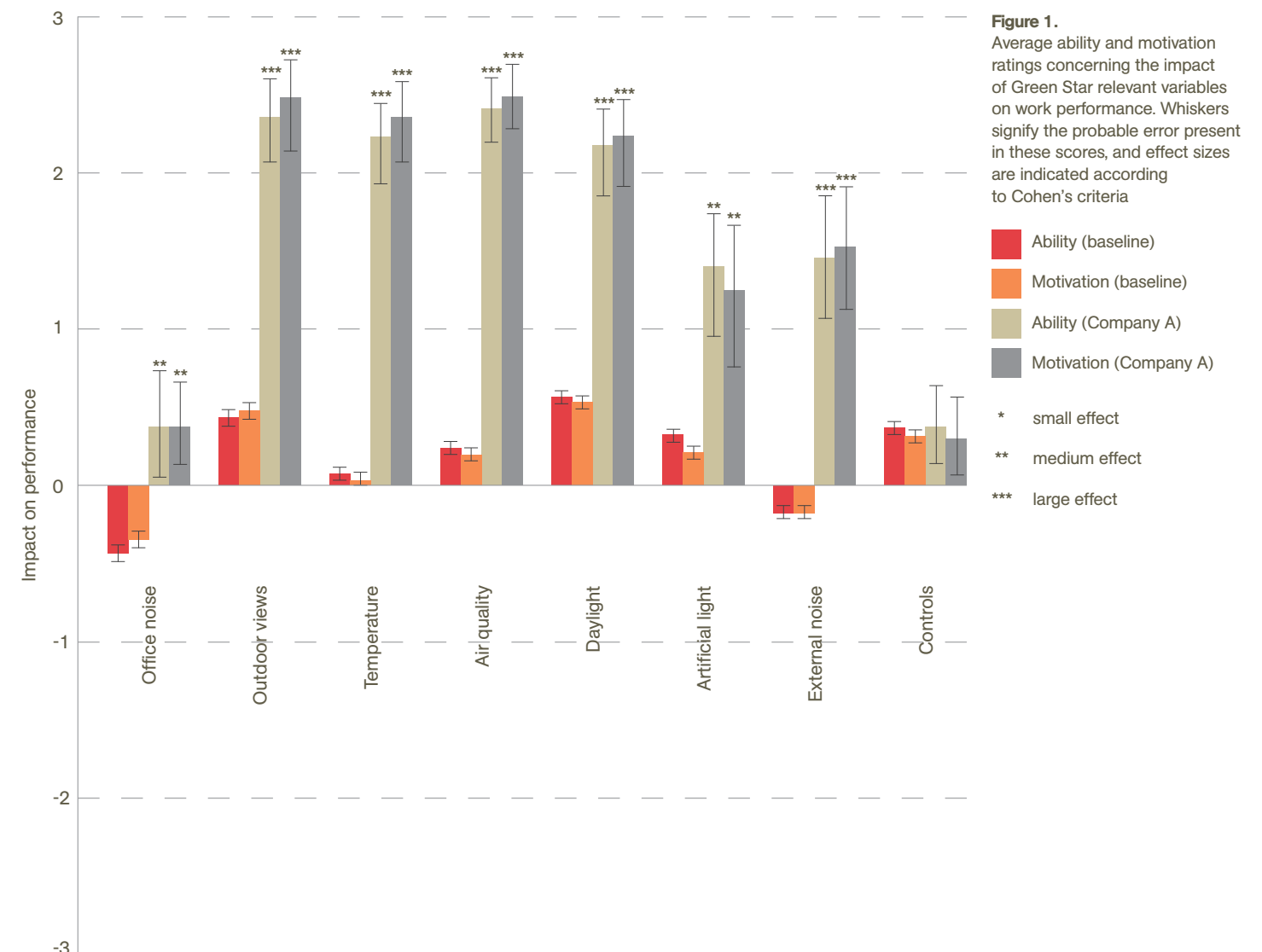
/ *Artificial lighting*. This item relates to the Green Star credits IEQ-6 (High frequency ballasts) and IEQ-7 (Electric lighting levels).

/ *Noise from external sources*. This item relates to the Green Star credit IEQ-12 (Internal noise levels).

/ *Environmental controls (e.g. blinds, doors, windows, etc.)*. This item relates to the Green Star credits IEQ-3 (Carbon dioxide monitoring and control), IEQ-10 (Individual comfort control), and IEQ-16 (Tenant exhaust riser).

As can be seen, the WES items selected relate exclusively to IEQ (indoor environmental quality) credits, and it is hereby assumed that this Green Star category is primarily responsible for any variance in work performance. Figure 1 shows average ratings for each of these items,<sup>2</sup> along with an indication of the effect size for differences between Company A and baseline.

Figure 1 shows that the workplace in Tower 1 offers significant improvements over baseline in the majority of features linked to environmental sustainability, and that these features serve to both assist employees' ability and enhance their motivation to perform their work. Interestingly, while *outdoor views* was one of the best performing categories, Woods Bagot did not submit for any points within the corresponding Green Star credit category. Only *environmental controls* failed to score differently from baseline (once again, the designers did not submit for either of the points on offer within the relevant Green Star category).



**Figure 1.** Average ability and motivation ratings concerning the impact of Green Star relevant variables on work performance. Whiskers signify the probable error present in these scores, and effect sizes are indicated according to Cohen's criteria

- Ability (baseline)
- Motivation (baseline)
- Ability (Company A)
- Motivation (Company A)

\* small effect  
 \*\* medium effect  
 \*\*\* large effect

# Analysis 2: Before and after: One company's relocation to City Central

## Aim

Analysis 2 demonstrates how the WES is used to contrast pre- and post-relocation data from a single company. This method offers more reliable findings than those obtained using the previous method as the company under review provides its own baseline prior to the move, thus eliminating a range of confounding variables. Analysis 2 tests whether the benefits identified in Analysis 1 are maintained when pre- and post-relocation scores are obtained for a single organisation.

## Method

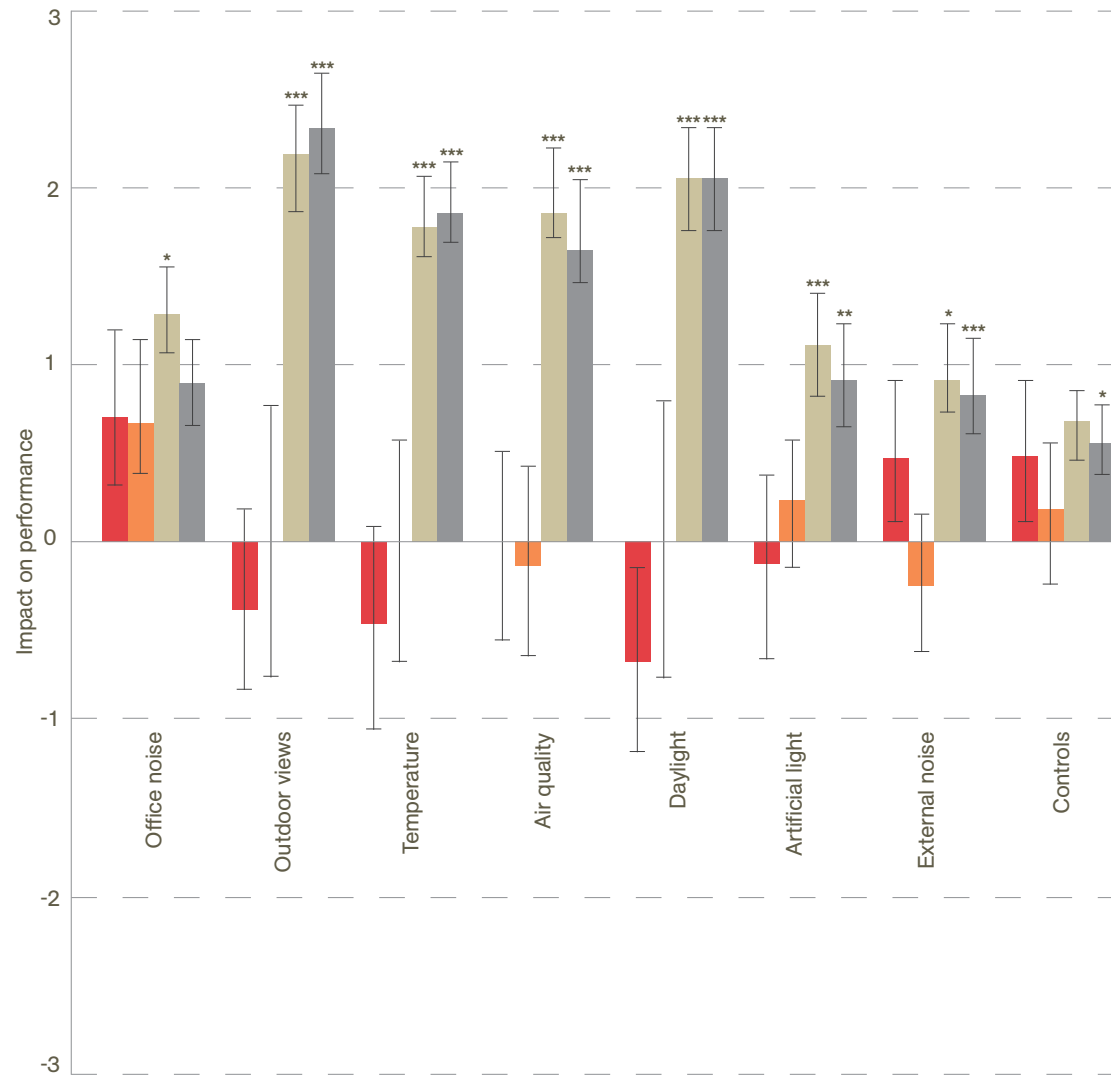
Company B completed the WES while still in their previous tenancy, and repeated the procedure following their relocation to City Central. The analysis for Company B consisted of a simple comparison of these two samples of scores (i.e. pre- and post-relocation). The WES was sent to thirty-eight staff pre-move, attracting fourteen responses (37% response rate). Seven months after moving into Tower 1 the survey was made available to forty-two staff, with thirty responses (71% response rate).

## Results

Post-relocation averages for ability (1.15) and motivation (1.03) were both superior to those acquired prior to the move (0.61 and 0.38 respectively). The difference in ability ratings was calculated to be a small effect, whereas the contrast of motivation ratings is classified as moderate according to Cohen's standards. While Company B appears to have received smaller benefits overall than did Company A, it must be remembered that Analysis 2 provides a more reliable indication of how a given organisation is likely to improve in relation to its own prior performance.

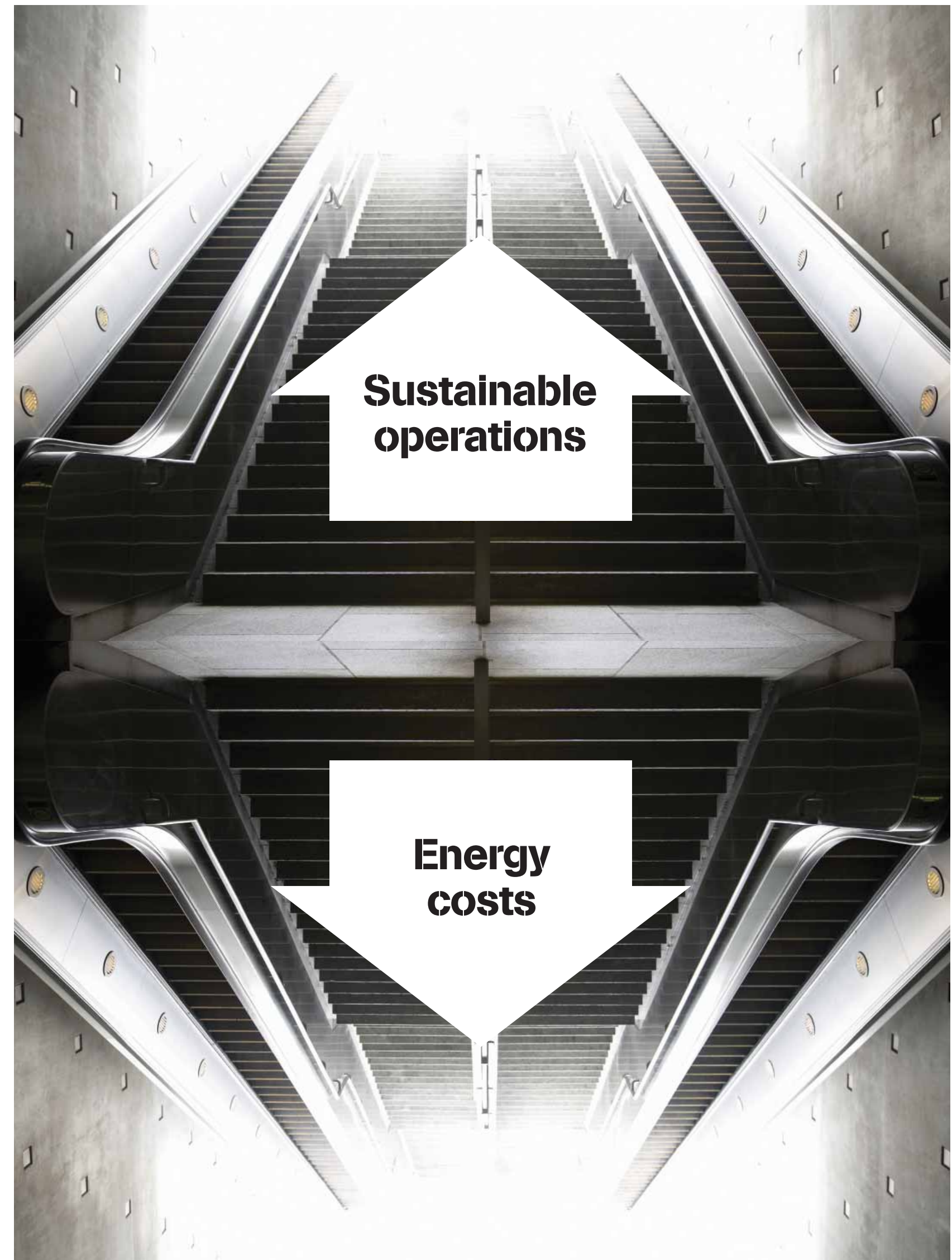
Figure 2 shows average ratings for each of the Green Star relevant items, along with an indication of the effect size differences between the pre- and post-move scores.

Figure 2 again reveals generally positive results, with some variability in effect sizes between the performance indices of ability and motivation. Acoustic conditions within the new office produced a small improvement in employees' ability to perform their work, and artificial lighting, while improving ratings for both measures, also produced a comparably greater facilitation of ability. By contrast, staff motivation was the variable most improved by both *noise from external sources* and *environmental controls*.



**Figure 2.** Average ability and motivation ratings concerning the impact of Green Star relevant variables on work performance. Whiskers signify the probable error present in these scores, and effect sizes are indicated according to Cohen's criteria

- Ability (prior tenancy)
- Motivation (prior tenancy)
- Ability (City Central)
- Motivation (City Central)
- \* small effect
- \*\* medium effect
- \*\*\* large effect

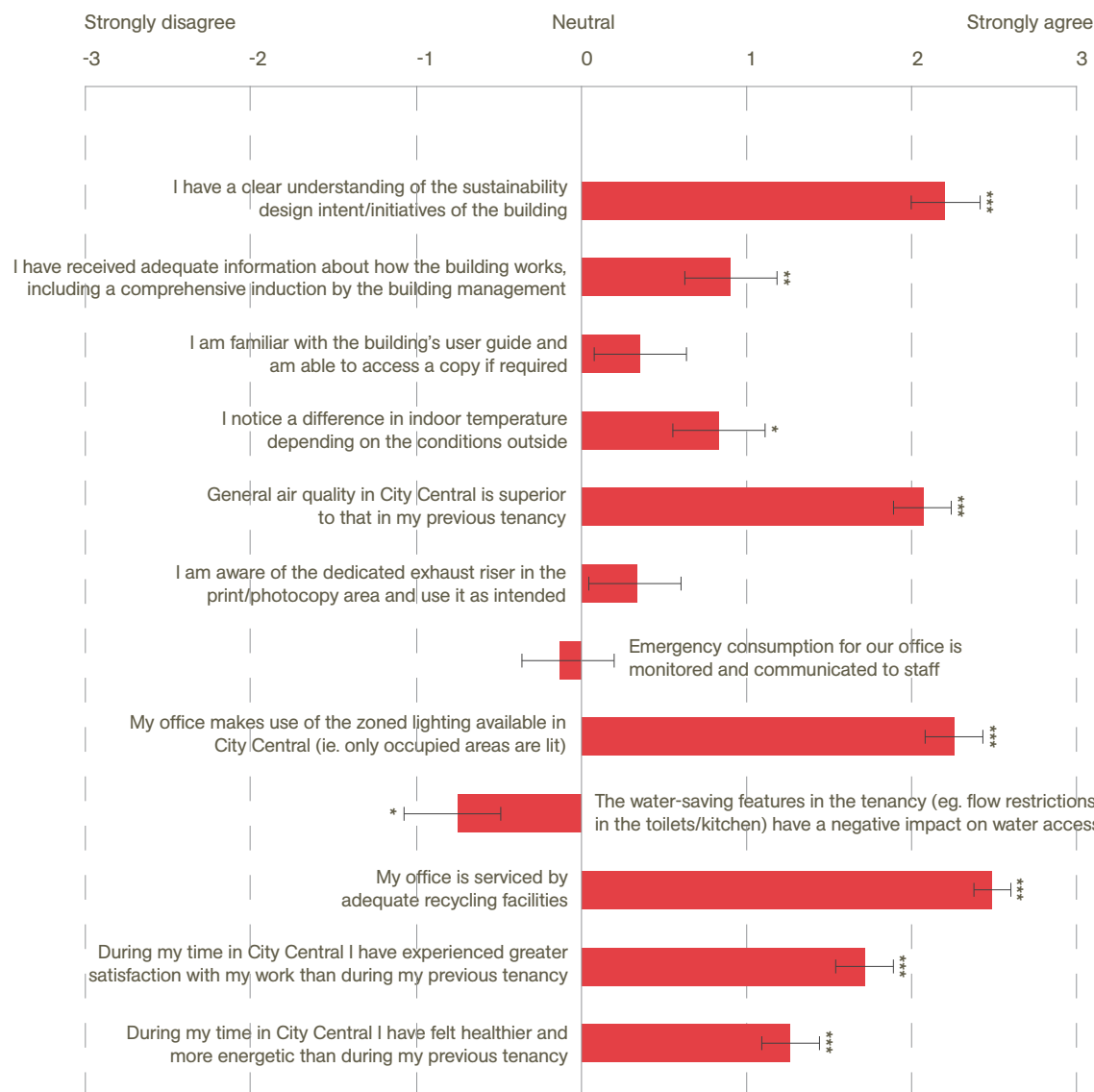


# Analysis 3: Staff attitudes and knowledge concerning City Central

Supplementing the standard WES format, the survey administered to both Company A and B also contained an additional set of questions addressing specific aspects of Tower 1. These questions were grouped under the headings *building operations, indoor environment quality, energy and water, recycling and transport and health and wellbeing*. In the interests of brevity all responses for these additional questions have been collapsed across the two companies. Figure 3 presents a list of statements that were scored by respondents to indicate their degree of agreement.

While the majority of statements attracted responses that reflect positively on City Central, a small number of items indicate areas for improvement. Content analysis of these statements suggests that staff do not believe that they have received sufficient information regarding the operation or performance of the building. This finding is consistent with the results reported earlier in relation to the building's environmental controls. Taken together, it seems that each company would benefit by providing staff with more information concerning their workplace.

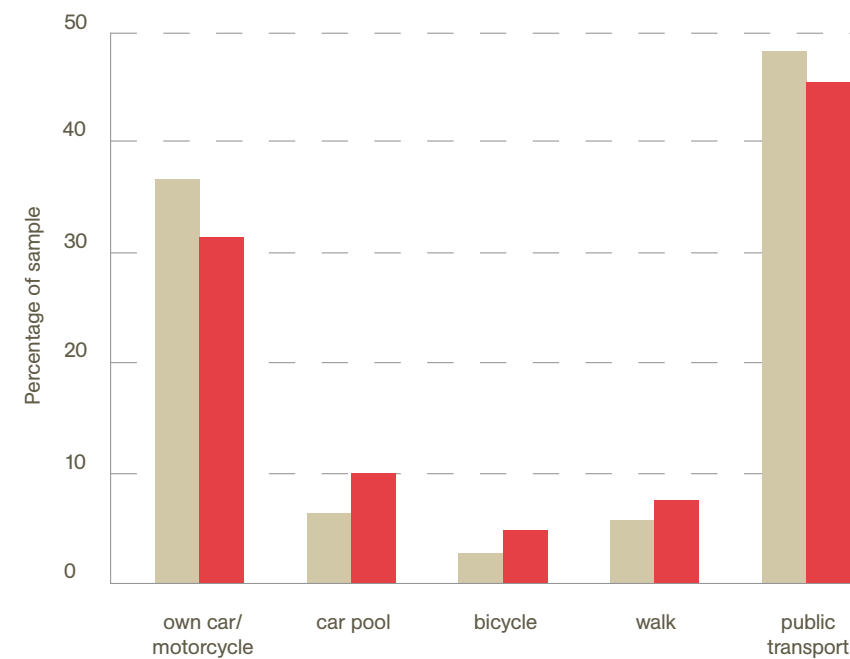
Figure 4 shows occupants' mode of transport to work both before and after their move to City Central. As can be seen, the move coincided with a decrease in the use of personal motor vehicles and small increases in more environmentally responsible commuting practices. The one exception to this trend is that the use of public transport decreased, despite the fact that City Central attained all five points available for the credit Tra-4 (Commuting Public Transport). Finally, respondents were presented with seven features from Tower 1—*daylight/views, café, sandwich bar, showers, bicycle facilities, external courtyards, and lobby/entrance spaces*—and were asked to select the amenity that adds the most value for them. Figure 5 depicts responses to this question, with the café rated as the most popular feature.



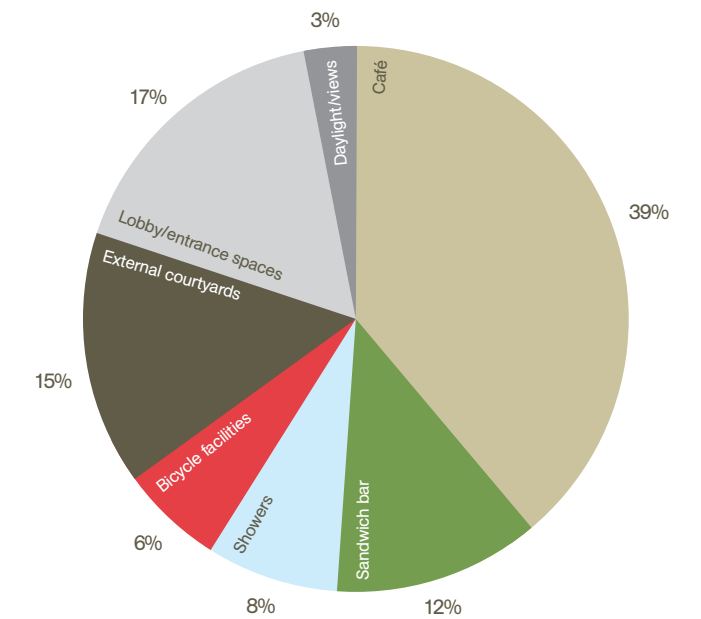
**Figure 3.** Average agreement ratings for each statement pertaining to City Central. Whiskers signify the probable error present in these scores, and effect sizes are indicated according to Cohen's criteria  
 \* small effect  
 \*\* medium effect  
 \*\*\* large effect<sup>3</sup>



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**Figure 4.** Percentage of respondents indicating their regular mode of transport to work, both at City Central and during their previous tenancy



**Figure 5.** Percentage of respondents indicating their most valued feature of City Central

**The results of Analyses 1 and 2 provide persuasive support for the notion that the sustainability features of Tower 1 have a positive effect on the job performance of occupants.**

**and environmental performance**

**Better bottom lines**

**go hand in hand**

#### Summary and conclusions

The results of Analyses 1 and 2 provide persuasive support for the notion that the sustainability features of Tower 1 have a positive effect on the job performance of occupants. Analysis 1 found that City Central performed well above baseline levels extracted from a database of all previous WES results, both overall and when Green Star relevant features were analysed separately; and Analysis 2 revealed that similar advantages can be seen with a single company tested before and during occupation in City Central. Outdoor views, daylight, temperature and air quality were rated to have the most positive impact on job performance, with responses to office acoustics and artificial lighting generally indicating smaller benefits. In both studies environmental controls were generally indistinguishable from the comparison groups, suggesting either that the controls are not seen as particularly effective or that occupants do not fully understand how to operate them.

Considering that Woods Bagot did not submit for credit allocation in IEQ-10 (individual comfort control), it might be argued that the building is characterised by a distinct lack of environmental controls. However, data collected using the additional set of questions designed for Analysis 3 provides support for a lack of adequate instruction. It is therefore possible that staff performance could be further improved with greater training in the use of Tower 1's features. (It is worth noting that occupants appear to understand and utilise both the zoned lighting and recycling facilities.) With respect to wellbeing, staff reported that both their health and job satisfaction had increased significantly following their move to City Central. The most popular of the building amenities surveyed is clearly the café, and the location and facilities have generally resulted in more environmentally responsible commuting practices.

In obtaining a 5 Star Green Star rating, the designers and developers of Tower 1 demonstrated a clear commitment to environmental sustainability. It is, however, important to remember that a primary purpose of the City Central development is the provision of high-quality commercial office space. With this goal in mind, the present study offers compelling evidence that Tower 1 is capable of enhancing the work performance of staff and that occupant work satisfaction and wellbeing appear to benefit from the superior environmental quality on offer. Based on these findings, one might suggest that Green Star certification—particularly when achieved via a high proportion of indoor environmental quality (IEQ) credits—should serve as the new benchmark for organisations seeking optimal triple bottom line results.

## ***City Central: A sustainable high performance workplace***

### *Notes*

1 A detailed description of the history and major design features of this development can be found in *Public #3: Worklife*.

2 In the graphs that follow, each bar representing an average value contains 'whiskers' indicating the standard error of the mean. The upper and lower limits of these whiskers define the range within which the true population average is likely to fall.

3 Effect size was calculated in this instance by contrasting the average agreement score with zero (ie a neutral response indicating neither agreement nor disagreement).

### *References*

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