RESEARCH

DO OCCUPANTS IN GREEN BUILDINGS PRACTICE BETTER ENERGY SAVING BEHAVIOUR IN COMPUTER USAGE THAN OCCUPANTS IN CONVENTIONAL BUILDINGS?

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ABSTRACT

Green buildings are not entirely successful in achieving energy saving targets. One way of improving energy targets is to encourage occupants to adopt energy saving behaviour. To date, energy saving behaviour has been given less focus in improving green building performance than other energy saving initiatives, such as retrofitting buildings for green features. This study uses comparison case studies between green buildings and conventional buildings in New Zealand to better understand the energy saving behaviour of occupants. Questionnaires were distributed to occupants in green and conventional buildings to evaluate the extent of energy saving behaviour practiced and to identify potential strategies to encourage energy saving behaviour. The objective of this paper is to investigate the level of energy saving behaviour between green and conventional office buildings to see if people in green buildings perform better energy saving behaviour than people in conventional buildings in computer usage. The findings do show better energy saving behaviour from occupants in green buildings than occupants in conventional buildings. The paper shows why this is the case. The recommended strategies to encourage energy saving behaviour used by different buildings are also discussed. Strategies include raising education awareness on energy efficiency among the building occupants, energy saving commitments, and to have an active building manager assigned for energy related matters.

KEYWORDS

energy saving behaviour, energy efficiency, green buildings, conventional buildings

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1.0 INTRODUCTION

Green buildings often fail to achieve optimum energy efficiency performance. When calculated, the actual energy consumption is different from that predicted at the design stage. In some cases, more energy is consumed in green buildings in comparison to conventional buildings of the same size and function (Ashuri, 2010; Cohen et al., 2007; Howe and Gerrad, 2010; Sawyer et al., 2008; Scofield, 2009). Hes (2005), and Kato et al., (2010) reported that many 4 star certified buildings do not perform at a 2 star level. According to The National Australian Built Environment Rating System (NABERS), the 2 star rating is considered a below average performance, while a 4 star rating demonstrates a good performance.

Previous studies have shown that poor performance was primarily due to the differences between assumed and actual patterns of occupants, the use of controls, and building operation management (Bordass et al., 2001; Kubba, 2010; Reiss, 2005). Another study showed that buildings may fail to perform as planned because operators do not operate the buildings as intended and the occupants sometimes behave differently than expected (Andrews et al. 2010). Research showing poor performance of green buildings impedes the rate of implementation of green buildings (British Columbia Construction Association, 2011; D'Arelli, 2008; Gabe, 2011; Scofield, 2009; Turner and Frankel, 2008).

Commercial buildings in New Zealand account for 21% of the electricity use (EECA, 2014). The New Zealand government has expressed interest in greater implementation of green buildings (MoE, 2006). Successful performance of green buildings can be achieved by further reducing energy consumption through changes in human behaviour. Studies by Cole and Steigner (1999) and Steinberg et al., (2009) have shown that integration of energy saving behaviours has not been given sufficient focus in green buildings. The Energy Efficiency Conservation Authority (EECA, 2012) in New Zealand, as well as other organisations in developed countries, such as CarbonTrust, United Kingdom (2010), Energy Star, United States (2011), and international guidelines such as International Standard Organisation (ISO, 2011) encourages energy saving behaviour as a way to reduce energy consumption in office buildings.

A wide range of behaviour to save energy has been investigated, such as reducing waste, recycling, taking shorter showers, turning off lights, and keeping heating low (Black et al., 2009; Clevenger et al., 2013; Goldblatt, 2005). However, there are limited studies that investigate the level of practice in computer energy saving behaviours (Tajabadi, 2010; Kato et al., 2010; Steinberg et al., 2010). Computer usage is chosen as the focus in this study since it is one of the most common daily activities by occupants in office buildings and provides a good opportunity to save energy. A range of six computer energy saving behaviours were identified, such as shut down computer desktops, turn off computer monitor, put screen to sleep instead of using a screen saver, reduce screen brightness on computer monitor, work on a laptop instead of a desktop, and use one computer monitor instead of two (DoE, 2013; Porter et al., 2006; Webber et al., 2006).

Earlier studies showed that there is inconclusive evidence to show whether green building occupants practice better energy saving behaviour in computer use than occupants in conventional buildings (Tajabadi, 2010: Kato et al., 2010; Steinberg et al., 2010). The current study covers the six identified energy saving behaviours and compares the practice between green and conventional building occupants in New Zealand. This paper answers the question of whether the occupants in green buildings practice more computer energy saving behaviours as compared to occupants in conventional buildings. This information will contribute toward the improvement of developing an effective intervention strategy to increase energy saving behaviour.

2.0 ENERGY SAVING BEHAVIOUR AND COMPUTER USAGE

An energy saving behaviour is defined as a specific action to reduce energy consumption (Browne and Frame, 1999; Cole and Steigner, 1999; Monroe, 2003). The following are typical recommended energy saving behaviours for occupants using computers in buildings; reduce multiple computer monitors to one; work on laptops instead of standalone computers, turn down computer screen brightness; put screens to sleep instead of using screen savers; shut down computer desktops and turn off computer monitors. These energy saving behaviours are common as they encourage occupants in buildings to help save energy via the management of their computer power consumption. Computers and monitors account for approximately 90% of office equipment energy costs (Sustainable Solutions Pty Ltd, 2001) and, in New Zealand, account for approximately 15% of an office building's energy consumption (EECA, 2011).

EECA (2010) recommends that occupants shut down computers if not used for an hour. Whereas other studies (DoE, 2013; Porter et al., 2006; Webber et al., 2006), advise occupants to switch computers off if a longer period of use is not needed, such as overnight, to avoid the time taken to restart computers during the working hour period. Switching computers on and off may be difficult if computers are being used throughout the day (Ulrich, 2008), although more energy is saved if computers are turned off. In terms of costs, computer desktops use up to 250 W per hour (DoE, 2013; Ulrich, 2008; Hinders; 2014), and so energy cost savings in New Zealand can be worked out as over $2,000 USD per year if computer desktops are turned off for an hour when not in use (calculated as USD0.23kWh for 100 computers).

Due to the time taken to restart computers during working hours, researchers have advised users to switch computer monitors off by using the sleep or energy-saver mode (DoE, 2013; Ulrich, 2008). Undertaking this action also saves money. Monitors use up to 60 W - 75 W per hour, for 100 computers a savings of USD599.66 extra per year could be made if computer monitors are switched off or turned to energy saving mode. The figures are based on a realistic estimate of consumption using Energy Efficiency Conservation Authority data (EECA, 2011).

Laptops consume less energy compared to a typical computer desktop and are approximately 50-80% more efficient (EECA, 2011). Adopting large-scale laptop use could save significant energy use. However, such a transition from desktops to laptops may adversely impact work productivity due to the smaller size of the screen and lower speed (Webber et al., 2006).

Other energy saving advice on computer management is to turn down the brightness setting on the computer monitor and reduce multiple computer monitors (Morris et al., 2013; Ryu, 2010; Steinberg et al., 2010). Both these activities reduce energy consumption.

Although recommended computer energy saving advice is available, the level of practice by occupants in buildings, including if there is a difference between people working in a green or conventional building, is not known. With the increasing demand for green buildings, energy saving behaviour represents a significant untapped potential for the increase of end-use energy efficiency in buildings (Lopes et al., 2012).

3.0 COMPARISON STUDIES ON ENERGY SAVING BEHAVIOUR BETWEEN GREEN AND CONVENTIONAL BUILDINGS

A study by Tajabadi (2010) surveyed occupants' energy saving behaviour between a green and conventional building, and showed that turning computer desktops off was practiced significantly more in a green building compared to a conventional building. However, turning off the computer monitor and putting a screen to sleep, instead of using a screen saver, was not significantly different between the two building types, and only 10% of the respondents performed monitor and screen sleep actions. The rest of the energy saving behaviours, such as reducing computer screen brightness, preference to work on a laptop instead of a computer desktop, and willingness to reduce multiple computer monitors to one was not assessed in the study. Furthermore, the study was a small case study where only two buildings were used and did not investigate the underlying reasons for such behaviour, such as whether working in a green building influenced occupants' behaviour.

Steinberg et al., (2009) surveyed occupants who were planning to work in a green building and discovered that none of the respondents shut down computers or turned off computer monitors when they were not in use for more than an hour. Also, none of the respondents claimed to turn down the computer screen brightness or use a laptop instead of a computer.

However, the majority of the respondents (80%) claimed to put the screen to sleep instead of using a screen saver. Steinberg et al., (2010) also compared occupants' willingness to change behaviour between occupants who were planning to work in a green building and occupants who were working in a conventional building; occupants planning to work in a green building claimed that they were more willing to change behaviour to support their new workplace, were encouraged by the green building certification and wanted to ensure the building performance success. Although occupants appear to be willing to change their behaviour, this is not necessarily the case in practice. For example, several studies in certified green buildings reported that occupants left computer desktops turned on when not in use (Andrews et al., 2010; Bordass et al., 2001; Browne and Frame, 1999; Heerwagen, 2010; Tajabadi, 2010) but these studies gave no underlying reasons for the behaviour.

There are also conflicting views in the research. For instance, Deuble and Dear (2012) reported that occupants in green buildings were more environmentally concerned compared to occupants in conventional building, but Lynam (2007) reported that occupants in conventional buildings were more environmentally concerned compared to occupants in green buildings. Deuble and Dear (2012) predicted that occupants in green buildings practice more energy saving behaviour; however, Lynam (2007) showed that occupants practice more energy saving behaviour in conventional buildings. The difference in the relative dates between the studies might account for some of the contradiction. More awareness of green buildings in the later study may account for the change.

Focusing on green buildings, Kato et al., (2010) studied occupants' behaviour in 10 certified green buildings and showed that more than half of the respondents turned off computer desktops and monitors at the end of the day. The study found that the image of working in a green building had a positive impact on employees where almost half of the respondents agreed that they felt loyal to their organisation because of its sustainability practices and policies. Kato et al.,(2010) did not investigate the influence of green certification on other energy saving behaviours (i.e putting computer monitor screens to sleep, turning down computer screen brightness, working on a laptop instead of a computer desktop and reducing multiple computer monitors to one), nor assess the different occupant practices between green and conventional buildings.

In summary, the earlier studies showed that occupants felt encouraged to reduce computer energy usage when they worked in green certified buildings (Steinberg et al., 2010; Kato et al., 2010). However, these studies did not cover all six identified behaviours that can potentially reduce computer energy use. Tajabadi (2010) showed that occupants in a green building practiced better energy saving behaviour in computer usage than occupants in conventional buildings. However, the study did not cover the range of computer usage behaviours, nor did it provide reasons. As a result, it is difficult to draw conclusions that green building occupants' practice better energy saving behaviour in computer usage than those in other buildings and to understand the range of computer energy saving behaviour. Kato et al., (2010) also did not compare the green building occupants practice with the conventional building occupants. A comparison is required to investigate whether or not working in green buildings affects how occupants behave.

4.0 CASE STUDY DESCRIPTIONS

Four case study buildings were selected to compare energy efficiency practices among occupants in green and conventional buildings with respect to their use of computers. New Zealand is known for its green image and awareness of green issues that is highly valued among the general population (Brown and Stone, 2007; Smith, 2008). The New Zealand Ministry for the Environment acknowledged that energy efficiency is an important aspect of sustainability that needs to be addressed.

Four educational buildings on The University of Auckland campus (located in central Auckland, NZ) were chosen as they represent high occupancy buildings with modern facilities and have occupants with high computer usage. Two of each category of buildings was chosen to understand the influence of building design with occupants' behaviour in saving energy.

The conventional buildings were selected from the conventional buildings on the university campus. The Faculty of Engineering (FoE) and Old Choral Hall (OCH) buildings were selected as conventional buildings because they lack a specific energy efficient design. As for the selection for the green buildings, three green buildings with the design intent to be energy efficient were identified. The buildings are the Population Health Complex (PHC), the Thomas Building (TB) and the Owen G Glenn Building (OGGB). Only two of the green buildings (TB and OGGB) were used in the study since the response rates for the green (PHC) building were extremely low. Occupants in the buildings were all university academic staff and university administrative staff. Given these staff types, knowledge of green buildings and environmental behaviour was expected to be moderate to high (Anne et al., 2015; Frick, et al., 2004; Lynam, 2007).

The energy management strategies applied to encourage energy saving behaviour in green buildings include using e-mails to remind staff to power down personal computers and manually turn off monitors when leaving at night. No similar reminder e-mails were sent to the staff in conventional buildings. Energy-efficiency information is circulated in green and conventional buildings through the general university website. A list of energy saving behaviours to help save energy is uploaded on the website where it is accessible to all staff and students. The energy saving behaviours related to computer management include turn off computer screen when not in use and at the end of the day. However, computer desktops are sometimes advised to be left on at the end of the day for IT managers to arrange back up data and updates. Other energy saving behaviours related to computer management such as reducing multiple screens to one, work on laptop instead of a desktop, turn down computer screen brightness and put screen to sleep are not mentioned. Another energy management strategy is to assign a building manager to encourage reduced energy consumption. In both green buildings, there are building managers assigned. Whereas in the conventional buildings, only FoE has a building manager, while OCH has no building manager for energy usage matters.

4.1 Case Study Building Design

4.1.1 Thomas Building – Green Building (TB)

The Thomas Building, a 4 storey building, was built in 2011 with the design intention to be green building certified by GreenStar New Zealand. The area of the building is 4,958m^2 with an estimated population of 160 occupants. The design was intended to produce a NZGreen-Star rating between 4 star to 5 star. Energy efficient features in the building incorporated double glazed tinted low E windows with double skin façade. The outer glazing with fritted dot pattern provides 30 % shading. Natural ventilation is provided through inoperable window louvers. Most areas in the building have occupancy sensors. The building also adopts the variable air volume (VAV) system, which is energy efficient compared to a typical air-conditioning system.

4.1.2 Owen Glenn Building – Green Building (OGGB)

The Owen G. Glenn Building, a 7 storey building, was completed in 2007. The area of the building is 74,000m^2 with an estimated population of 400 occupants. The main energy efficient features incorporated in the building were highly glazed windows to optimise daylight, with layered facades to provide solar shading. Occupancy sensors and automatic building control systems are connected to an energy management system.

4.1.3 Old Choral Hall– Conventional Building (OCH)

The Old Choral Hall building is a 4 storey building completed in 1872. The total estimated population in the building is 100 occupants. This building was identified as an historic building in New Zealand (Jones, 2001). No energy efficient design was incorporated at the time it was built. As the building is protected under the Historic Places Act 1993, there is limited ability to incorporate significant changes to the building (McClean, 2012; MfE, 2004).

4.1.4 Faculty of Engineering- Conventional Building (FoE)

The Faculty of Engineering building is a 12 storey building with an estimated 300 occupants. The building was reported to have no energy efficient features. It was built in 1969 (UoA, 2013). In 2003, the building was refurbished where an atrium was built with a large space common room area including a cafeteria on the lower floor. The building provides a 250-seat lecture theatre. At the end of the building, a long glass-enclosed colonnade was designed to create a transparent effect as well as to gain natural daylight.

4.2 Research Method

Invitations to participate in this study were sent through an e-mail and a follow up call to the building managers. The building managers in each of the three case study buildings (TB, OGGB, FoE) then distributed an online survey uploaded onto the building website to the occupants in the buildings. As for the OCH building, there is no on site building manager. The OCH building is occupied by the International Relations office. Therefore, the Head of the International Relation Office was contacted to invite the subordinate staffs to participate in this study.

The researcher conducted a follow up e-mail requesting the building manager to circulate the website link to the occupants in the building after two weeks. Hardcopies were also provided to the building manager for occupants who wished to fill in the questionnaire manually. In order to increase the response rate, the researcher was given permission to invite participants in the research to face-to-face meetings in the common room areas. Hardcopies as well as the website link were given to interested participants.

The purpose of the questionnaire was to evaluate the extent of energy saving behaviour practice, and to identify potential strategies to encourage energy saving behaviour. A total of 6 energy saving behaviours related to computer management were identified as having the potential to reduce the energy usage of occupants. These energy saving behaviours are:

- reduce multiple computer monitors to one,
- work on a laptop instead of a computer,
- turn down computer screen brightness,
- put screen to sleep instead of using screen saver,
- shut down computer
- turn off computer monitor.

The questionnaire required respondents to rate their actions using a Likert scale (Likert, 1932) of 5 – Always to 1- Never. For energy saving behaviour actions that were not relevant to the respondents, they were given the option to select "N/A". Analysis using SPSS Statistic 22 software was used to run the statistical relevance of the research. The Mann-Whitney U test was used to identify which of the energy saving behaviours is significantly different between the two building types. Energy saving behaviours identified as significantly different via Mann-Whitney U test were further analysed using frequency description and crosstab analysis to ascertain which building types have the most energy saving behaviour practice. The questionnaire also asked respondents to report when they usually implement the energy saving behaviour using a categorical scale of three which are *"At the end of the day", "If away for an hour or more" and "If away for 10 minutes or more"*. Frequency and crosstab analysis was used to see the difference in occupants' behaviour between the building types.

5.0 RESULTS AND DISCUSSION

The building managers estimated that there were 1,100 people in the four buildings. A total of 270 responses were received. It is difficult to definitely know the response rate, as some of the occupants may never have received the information about the survey, or known of the study. However, if the actual numbers are taken as correct, and the assumption made that everyone received the information this would mean a response rate of 25%. Table 1 shows the response rate broken down by building.

TABLE 1. Response Rate.

Type	Total Population	Total Respondents Received	Response rate	Name of Building	Population	Respondents received	Response rate
Conventional Buildings	400	113	28%	**FoE**	300	80	27%
				OCH	100	33	33%
Green Buildings	700	157	22%	**TB**	300	68	23%
				OGGB	400	89	22%
TOTAL	**1100**	**270**	**25%**	TOTAL	1100	270	25%

5.1 Comparison between Green and Conventional Buildings

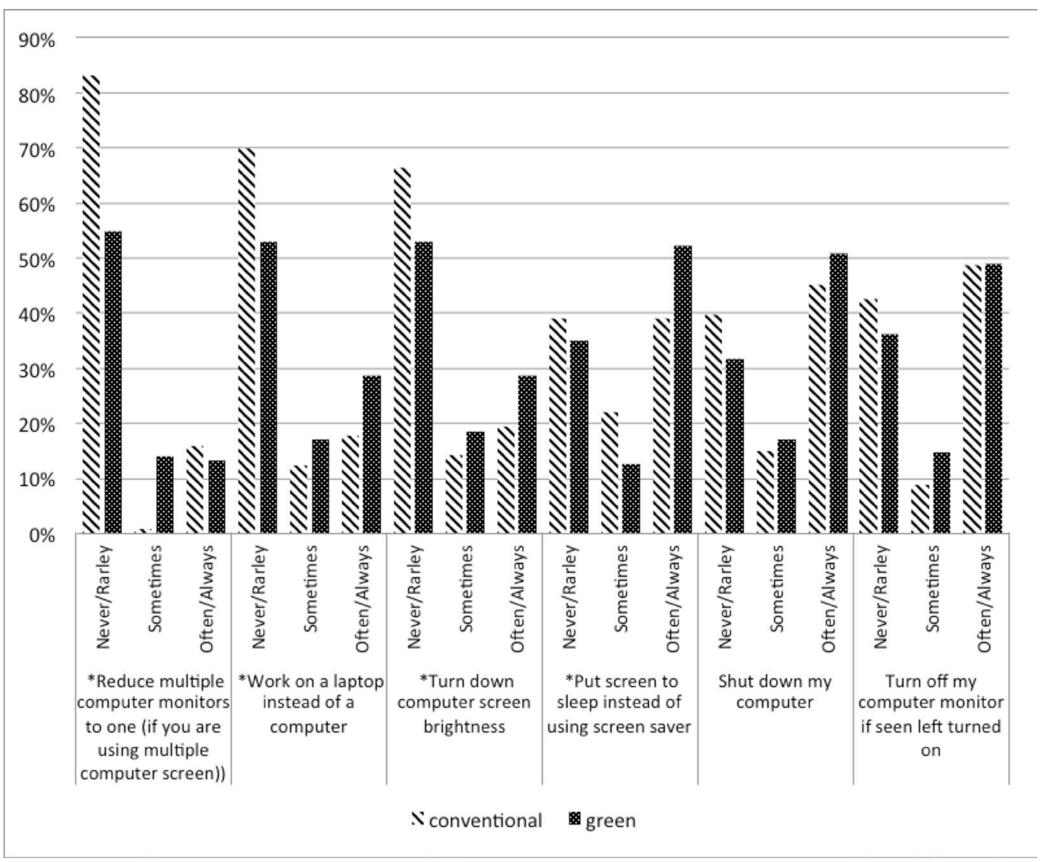
Table 2 shows that the percentage of occupants working as administration, lecturers and PhD students/tutors are almost similar between the green and conventional buildings.

TABLE 2. Occupants job position.

	Conventional Buildings (OCH and FoE)	Green buildings (TB and OGGB)
Administration	28%	28%
Lecturers	18%	17%
PhD Students/ tutors	54%	55%

Figure 1 shows the difference in computer usage between occupants in green (TB and OGGB) buildings and conventional (OCH and FoE) buildings. Statistical analysis using the Mann-Whitney U test shows that there are four energy saving behaviours that are significantly different between the green (TB and OGGB) and conventional buildings (OCH and FoE). Energy saving behaviours identified as significantly different were reducing multiple computer screens to one, working on a laptop instead of a computer, turning down computer screen brightness, and putting the screen to sleep instead of using a screen saver.

FIGURE 1: Energy Saving Behaviour Practice (Green vs. Conventional Buildings)



Note* energy saving behaviours that are significant different through Man-U Whitney test (p values< 0.05)

There are significantly more occupants in the conventional buildings who do not reduce multiple screens to one, work on a laptop instead of a desktop and turn down computer screen brightness than the green building occupants. This is seen from the results in Figure 1 where 83% of the occupants in the conventional (OCH and FoE) buildings and 55% of the green (TB and OGGB) buildings do not reduce multiple screens (p = 0.001). 70% of the occupants in the conventional (OCH and FoE) buildings and 53% of the green (TB and OGGB) building occupants do not work on a laptop instead of a desktop (p = 0.005). 66% of the conventional (OCH and FoE) building occupants and 53% of the green (TB and OGGB) building occupants do not reduce the computer screen brightness (p =0.000).

Although occupants in neither the green (TB and OGGB) nor conventional (OCH and FoE) buildings practiced these energy saving behaviours regularly, there were comparatively fewer occupants doing them in the conventional buildings vs green buildings. Therefore, occupants in the green buildings practiced better energy saving behaviour compared to conventional buildings. However, there is room for improvement in both building types. It is difficult to compare previous studies to this study as previous studies came from different countries and are likely to be influenced by different population types. However, comparisons may be of interest although they can only be an indication of difference. These results are different from Steinberg et al., (2009) where none of the green building occupants turn down the computer screen brightness or use a laptop instead of a computer desktop. The study in this paper shows that these practices are used.

Reduce multiple screens to one, work on a laptop instead of a desktop and turning down computer screen brightness were least practiced as compared to putting the computer screen to sleep. There are significantly more occupants in the green buildings who put their screen to sleep than occupants in the conventional buildings (p value = 0.016). This is seen from Figure 1 where 52% of the occupants in the green buildings and 39% of the conventional buildings put their screen to sleep. The result reinforces findings by Steinberg et al., (2010) where putting screens to sleep are seen more in the green building than in the conventional building, but contradicts the findings by Tajabadi (2010) where no significant differences in the practice between occupants in the two building types were found.

In summary, there are more occupants in the green buildings than in the conventional buildings who *reduce multiple computer screens to one, work on laptops,* and *turn down computer screen brightness*. Nevertheless, these behaviours are neither regularly practiced in the green nor conventional buildings. Putting screens to sleep is the only energy saving behaviour that is regularly practiced by the green building occupants. The findings reveal that putting screens to sleep is already practiced regularly and that there is a lack of practice in reducing multiple screens to one, work on laptops, and turning down computer screen brightness. Therefore, this shows that there is room for improvement to further reduce energy usage in buildings.

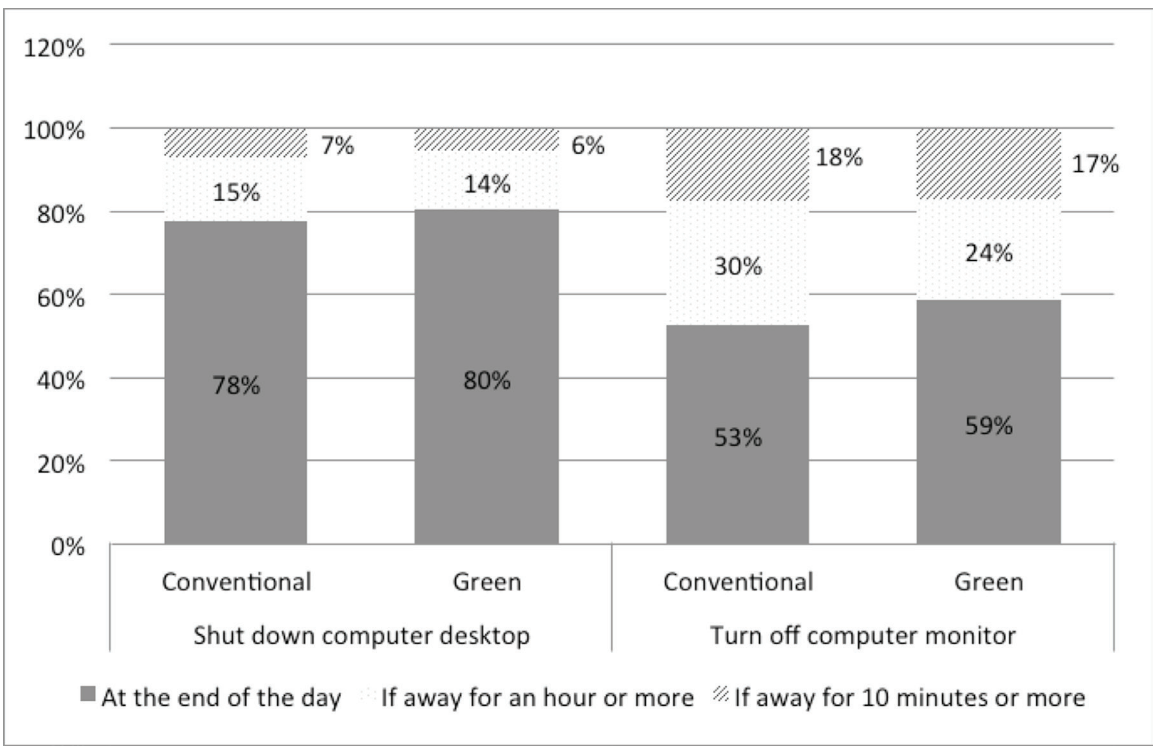
Earlier studies by Tajabadi (2010) and Steinberg et al., (2010) showed that green building occupants practiced only one computer energy saving behaviour more than occupants in conventional buildings, while the current study showed four computer energy saving behaviours. Given that there is more variety of energy saving behaviours practiced in the green buildings, the results in this study reinforces the findings from earlier studies that conclude that green building occupants do practice more energy saving behaviour than conventional building occupants.

Shutting down desktop computers and turning off computer monitors are the only energy saving behaviours that are not significantly different between the two building types with p values of 0.294 and 0.479, respectively. This result differs from Tajabadi (2010) where turning off computer desktops was found to be practiced significantly more in green buildings. However, for the action of turning off computer monitors, the findings are similar to Tajabadi (2010) where no significant difference was found. The findings in the current study confirms the findings by Kato et al., (2010) which showed that shutting down computer desktops and turning off computer monitors are regularly practiced by building occupants. Given that these are the most frequently practiced behaviours by the building occupants from both building types, this suggests that current energy management strategies applied in both green and conventional buildings in this study appear to be effective.

For shutting down desktop computers and turning off computer monitors, the current energy management strategies applied in both green and conventional buildings in this study appear to be effective (see Table 3). Kato et al., (2010) also commented on an energy management strategy applied in green buildings which included incentives for their staff to engage in various energy saving behaviours. Both the results in this paper and the results by Kato et al., (2010) show that energy management strategies are effective in encouraging occupants to shut down computer desktops and turn off computer monitors.

In order to gain better understanding of the energy saving behaviours, occupants were required to select when they perform the energy saving behaviours according to the following three options: *"at the end of the day"*, *"if away for an hour or more"* and *"if away for 10 minutes of more"*. Results in Figure 2 showed that occupants from both of the building types mostly turn off computer desktops at the end of the day (78% and 80% conventional and green

FIGURE 2: Computer Desktop and Computer Monitor turned off at different time events.



building, respectively). Computer monitors are also turned off at the end of the day (53% and 59% conventional and green building, respectively). The results are similar with the study by Kato et al., (2010) in 10 certified green buildings where half of the occupants turned off computer desktops and monitors at the end of the day.

The percentage of occupants turning off computer desktops and monitors increases with the length of time. Figure 2 shows less than 30% occupants turn off computer desktops and monitors if away for an hour or more. Figure 2 shows the least percentage below 20% turn off computer desktops and monitors if away for 10 minutes or more. These results confirm the study by Steinberg et al., (2009) where none of the occupants turn computers off if away for an hour or 10 minutes. Steinberg et al., (2009) and these results demonstrate that there is an opportunity to improve on the level of frequency in practicing these energy saving behaviours in both green and conventional buildings.

In summary, there are more occupants in the green buildings than in conventional buildings who *reduce multiple computer screens to one, work on laptops,* and *turn down computer screen brightness*, Nevertheless, these behaviours are neither regularly practiced in the green nor conventional buildings. Only the action of *putting screens to sleep* was seen practiced more regularly in the green buildings.

5.2 Building Management Strategies Used

Table 3 tabulates the strategies implemented in the green (TB and OGGB) and conventional (OCH and FOE) buildings. The green (TB and OGGB) buildings have slightly more strategies applied than in the conventional (OCH and FOE) buildings. The additional strategy implemented in the green (TB and OGGB) building is that e-mails are sent out occasionally by the building managers to remind staff to save energy. The effectiveness of the strategies implemented in the green (TB and OGGB) buildings may cause the occupants to be more aware of energy efficiency and could explain why there are more occupants in the green buildings than in conventional buildings who turn down computer screen brightness and put computer screens to sleep when not in use. Earlier studies showed that occupants have the perception that when they work in a green building, they felt encouraged to save energy (Steinberg et al., 2010; Kato et al., 2010). The findings in the current study extend these studies by providing a more in-depth explanation. Occupants in the green buildings are encouraged to save energy more than occupants in the conventional building because of the differences in how the buildings are managed. The findings in this study provide no evidence to show that occupants' behaviour is influenced by the green buildings per se.

Additional strategies used in the buildings include provide guidelines through an accessible website to all occupants; a clear statement on the organization's commitment to saving energy; an active building manager informing occupants to work together with the facility management team; and participation in third party energy scheme such as Energy Efficiency Conservation Authority Energy Award.

In discussing strategies with building managers, the building managers in the green (TB and OGGB) buildings mentioned that they discourage occupants from having additional appliances in the buildings, such as multiple computer screens. Occupants working on laptops are claimed to be more in the green (TB and OGGB) buildings than in the conventional (OCH and FOE) buildings. It is difficult to know why this is the case, as neither the green or conventional buildings have a policy to encourage more usage of laptops instead of computer desktops. Since laptops are more portable than computer desktops, it is suspected

TABLE 3. Implemented strategies to encourage energy saving behaviour.

No	Implemented strategies to encourage energy saving behaviour	Conventional Buildings		Green Buildings	
		OCH	FOE	TB	OGGB
1	Guidelines on how to reduce energy usage	/	/	/	/
2	Posters on energy efficiency features of the building	-	-	-	-
3	Pamphlets on energy efficiency	-	-	-	-
4	Email to staff from time to time	-	-	/	/
5	Attending training and seminars on energy efficiency Key performance indicators for staff	-	-	-	-
6	Briefing on the objectives and goals of the organisations commitment to energy efficiency are given to new employed staff	/	/	/	/
7	Updating occupants on energy consumption of the building	-	-	-	-
8	Encourages staff to work together with the facility management team to identify opportunities for further improvement	/	/	/	/
9	Reminder sticker labels on computers	-	-	-	-
10	Participate in third party energy schemes	/	/	/	/
11	Building manager assigned on each floor to remind staff to save energy	-	-	-	-
12	Provide laptops	-	-	-	-
13	Building managers assigned for energy management	-	/	/	/
	Total	4/13	5/13	6/13	6/13

Note : / denotes as YES, - denotes as NO

that the reason could be due to the nature of the occupants' work where occupants in green (TB and OGGB) buildings are more flexible in their working condition than occupants in the conventional (OCH and FOE) building.

The strategies implemented in both green and conventional buildings have shown success for shutting down computers and computer monitors. These behaviours are the most commonly practiced in both building types and no significant difference in the level of practice was shown between the building types. The only additional strategy implemented in the green buildings that was not implemented in the conventional buildings was that the building manager sends out e-mails occasionally to remind occupants to save energy. However, this strategy provided no difference for energy saving behaviours that required more effort (i.e., shut down computer desktops and computer monitors). This strategy was shown to be successful for energy saving behaviours that are relatively easy to practice (i.e., turn down computer screen brightness, putting screens to sleep). Occupants probably became more aware of energy efficiency due to the active role played by the building manager.

6.0 CONCLUSION

This paper provides an understanding of whether occupants in green buildings practice more energy saving behaviours compared to occupants in conventional buildings in New Zealand. New Zealand is committed to improving its green image and a focus on building occupants energy saving behaviour shows how differences occur in different building types. The strategies adopted by the different buildings and the relative differences were recorded in this paper. The findings showed that reducing multiple screens to one, working on a laptop instead of a desktop, turning down of computer screen brightness, and putting screens to sleep are practiced significantly more in green buildings compared to conventional buildings. The findings further showed how building managers could increase occupants' energy saving behaviour practice.

Nevertheless, the current strategies implemented in both green and conventional buildings are successful for increasing occupants practice to shut down computer desktops and computer monitors. Given that overall computer energy saving behaviour is better in the green buildings, and green buildings had slightly more energy saving focus from the building manager, it would be sensible for the conventional buildings to use the same strategies for energy reduction. However, for both building types there is still room to improve the energy saving behaviour of their occupants. A limitation of this study is that it did not examine the sociological aspects of the building occupants. Further investigation on the sociological aspect will be examined in future research to learn more about the types of individuals in each of the buildings. For example, there are likely large differences in the relative proportions of which types of disciplines or faculty/staff ratios that could explain the differences. Alternatively, there may be differences in finances, which could impact the ability of building occupants to replace computers with laptops.

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