Chapter 11
Sustainable Education Buildings in Australia: A Green Star Review

Bo Xia, Jian Zuo, Martin Skitmore, and Albert Chan

Abstract In order to promote green building practice in Australia, the Green Building Council of Australia (GBCA) launched the Green Star rating tools for various types of buildings built since 2003. Of these, the Green Star-Education rating tool addresses sustainability issues during the design and construction phrases of education facility development. It covers a number of categories, including Management, Indoor Environment Quality, Energy, Transport, Water, Materials, Land Use & Ecology, Emissions and Innovation. This paper reviews the use of the Green Star system in Australian education facilities construction and the potential challenges associated with Green Star- Education implementation. Score sheets of 34 education projects across Australia that achieved Green Star certification were collected and analyzed. The percentage of green star points obtained within each category and sub-category (credits) for each project were analyzed to illustrate the achievement of credits. The results show that management-related credits and ecology-related credits are the easiest and most difficult to obtain respectively. The study also indicted that 6 Green Star education projects obtained particularly high percentages in the Innovation category. The investigation of points obtained in each category provides prospective Green Star applicants with insights into credit achievement for future projects.

B. Xia (✉) • M. Skitmore
School of Civil Engineering and Built Environment, Queensland University of Technology, Brisbane, Australia
e-mail: paul.xia@qut.edu.au; rm.skitmore@qut.edu.au

J. Zuo
School of Natural and Built Environments, University of South Australia, Adelaide, South Australia
e-mail: Jian.Zuo@unisa.edu.au

A. Chan
Department of Building and Real Estate, Hong Kong Polytechnic University, Hong Kong, China
e-mail: bsachan@inet.polyu.edu.hk

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11.1 Introduction

Sustainability aims to improve the quality of life within the carrying capacity of supporting ecosystems. It is widely accepted that the building sector plays a crucial role in achieving sustainability goals as it is the biggest energy consumer and greenhouse gas emitter globally [1]. According to the World Business Council for Sustainable Development (WBCSD) [2], the building sector accounts for approximately 40 % of the energy consumption of most countries. In order to reduce the negative impact of buildings on the environment, therefore, it is necessary to incorporate sustainable planning, design, construction, and operation practices into building projects.

Within the building sector, education buildings play an important role, not only in terms of environmental impact, but also in determining the health of students and teaching staff. In Australia, there are more than 3.5 million full time students in 9,435 schools. In addition, the number of teaching staff across government and non-government sectors rose to 290,854 in 2011 [3]. Most conventional education buildings do not provide a comfortable and healthy work environment for students and teachers as they were only designed to meet the minimum standards of the building codes [4]. As a result, many students and teachers spend every day in classrooms with poor indoor air quality and limited access to daylight, which affects the students' academic performance, the teachers' morale and productivity, and the health of all concerned.

In order to support the design and construction of high-performance, sustainable education buildings, the Green Building Council of Australia (GBCA) released the Green Star- Education rating tool in 2008. This enables owners of education facilities to minimize the environmental impact of their developments and achieve their design goals. Evidence shows that green schools offer significant benefits for facility owners, students, staff and the environment, by lowering operational costs, improving the wellbeing of students and teachers, etc., through to reputational equity [4].

In Australia, several schools have already received Green Star ratings, and others are currently in the process to doing so. However, there are significant challenges involved in the introduction of green education buildings. The Green Star Education rating tool assesses nine environmental categories (such as indoor environment quality, energy, land use and ecology) of new and refurbished education facilities. Different categories and their subsequent indicators represent different requirements for sustainable education buildings, and pose different challenges for the applicants. Additionally, although the Green Star Education rating tool has many indicators in common with the other major Green Star tools, it is unique to the education sector. Project contractors need to take into consideration the specific requirements of the intended recipients of education facilities.

In order to investigate the potential challenges and barriers associated with the application of Green Star in education buildings, this research analyzed the percentage of points awarded to each Green Star category/indicator for 34 projects certified at the time of the study. Although the number of projects is too small to draw general conclusions, the points frequency of the rating categories and indicators (used to depict the achievement of credits by each project) can, according to Silva and Ruwanpura ([5], p. 38), provide decision makers "with information on credits awarded in the past and insight into credit implementation in future projects with similar goals".

11.2 The GBCA Green Star Education Rating Tool

In order to drive the Australian property industry's transition into sustainability, the GBCA launched its Green Star rating tools in 2003 for various types of buildings, including educational, healthcare, industrial, offices, retail and multi-unit residential. Green Star is a "national, voluntary environmental rating system that evaluates the environmental design and construction of buildings and communities" [4]. It assesses the sustainability of projects and community against nine categories, comprising: Management, Indoor Environment Quality, Energy, Transport, Water, Emission, Materials, Land use & Ecology, Innovation. These Green Star 'categories' are divided into credits (indicators), each of which address a specific aspect of sustainable performance. For each Green Star project, points are then awarded to these indicators based on the extent to which each indicator's objective is met.

Launched in 2008, the Green Star Education V1 rating tool assesses the sustainability of new and refurbished education buildings in Australia. It can be applied from the design phase of a project and up to two years after practical completion [4]. Within this rating system, there is a total of 156 (unweighted) points available for distribution to eight categories (see in Table 11.1).

Environmental weightings are then applied, to a maximum of 100, to the total number of points awarded. Five extra points are available for the Innovation category if the building has innovative strategies and technologies exceeding the Green Star benchmarks and environmental design initiatives. GBCA certifies three different levels of "Star" ratings:

- 4 Star: 45–59 points, indicating "Best Practice"
- 5 Star: 60–74 points, indicating "Australian Excellence"
- 6 Star: 75–100 points, indicating "World Leader"

During the Green Star Certification process, the project team applies the Green Star rating tool to guide the design or construction process, and documents are submitted as proof that this has been done. The GBCA commissions a panel of third-party Certified Assessors to evaluate the documentation and establish whether all the claimed indicators meet the requirements outlined in the Technical Manual

Table 11.1 Summary of indicators and points for Green Star education V1

Categories	Number of indicators	Points available (unweighted)
Management	9	14
Indoor environment quality	14	26
Energy	10	30
Transport	5	13
Water	6	16
Materials	15	32
Land use and ecology	5	8
Emissions	8	17

of each rating tool. Project teams are then notified of their final score based on the recommendation of the Assessment Panel. If the scores are within the range of the Green Star levels, the project team receives the corresponding rating certificate along with an award letter, marketing kit and relevant Green Star logos.

11.3 Research Method

With the approval of GBCA, the database of 34 score sheets of Green Star education projects was accessed and analyzed. Similarly to Silva and Ruwanpura [5], the point frequency was analyzed for each category/indictor to measure the categories/indicator values for each project. The points claimed (PC) and points obtained (PO) for each indictor were retrieved from the score sheets. The point achievement degree (PAD) is be calculated as

$$\mathrm{PAD} = \frac{\mathrm{PO}}{\mathrm{PC}} * 100\,\% \tag{11.1}$$

11.4 Data Analysis

11.4.1 Project Landscape

Table 11.2 summarizes the geographical distribution of the 34 projects, with Victoria and Queensland accounting for approximately 77 % of the total number of buildings involved. The majority of these projects were awarded a 5 Star rating, with only 6 (18 %) buildings being certified as 6 Star (Table 11.3).

Table 11.2 Certified projects across states and territories in Australia

Locations	Number of education projects	Percentage
Victoria (VIC)	17	50
Queensland (QLD)	9	26.5
South Australia (SA)	3	8.8
New South Wales (NSW)	2	5.9
Australia Capital Territory(ACT)	2	5.9
West Australia (WA)	1	2.9

Table 11.3 Number of projects for each Green Star rating

Green Star rating	Number of education projects	Percentage
4 Star	8	23
5 Star	20	59
6 Star	6	18

11.4.2 Overall Percentage Awarded: Point Achievement Degree (PAD)

The overall percentage awarded for each rating category is shown in Fig. 11.1. The results range from 55 % to 97 %. The Management category, addressing the adoption of sustainable development principles from project conception through design, construction, commissioning, tuning and operation, is the most frequently used category, with 97 % of the claimed points being awarded. This includes 9 indicators with a total of 14 unweighted points to measure Management performance. With a percentage as high as 97 %, Management is clearly regarded as the most easy category to obtain in the Green Star Education rating tool.

The category of Water addresses the reduction of potable water consumption of building occupants, landscape irrigation, building cool systems, fire protection and essential water storage systems. In order to reduce the consumption of potable water, the project teams should provide an efficient design of building services, water reuse and substitution with other water sources. Given the high percentage of points awarded in this category (94 %), it can be concluded that most of the education buildings in Australia are water efficient.

With 92 % of the points awarded, the Innovation category obtained far better results than most other types of Green Star buildings, whose frequency of points awarded is normally lower than 50 %. The Innovation category, with a total of 5 points, includes three indicators, namely, innovative strategy and technologies, exceeding the Green Star benchmark, and environmental design initiatives. According to GBCA [4] (2011), the Innovation category helps to foster the industry's transition towards sustainable building.

The categories of Material, Emissions, and Transportation were awarded more than 80 % of the claimed points. With 85 % point frequency, the category of Material addresses resource consumption through material selection, reuse initiatives and efficient management practices. The Emissions category (84 %)

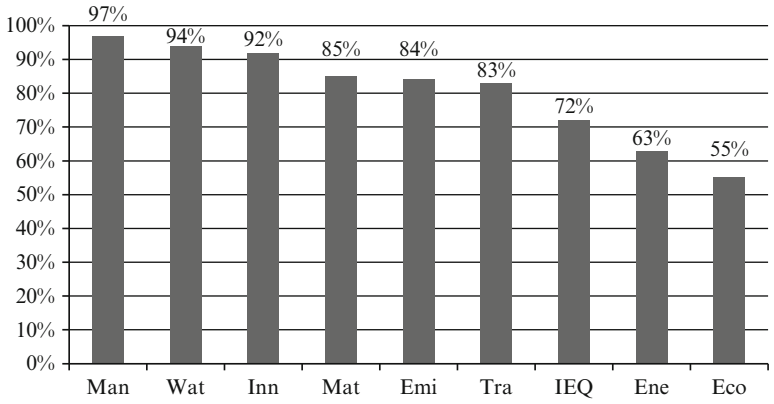

Fig. 11.1 Point achievement degree for Green Star education rating categories

targets pollution emission from buildings and building services to the atmosphere, watercourse, and local ecosystems. It encourages and recognizes reduction of light pollution, water pollution and potential damage to the earth's atmosphere. The category of Transportation, with 83 % of points awarded, recognizes the reduction of demand for individual cars by both discouraging car commuting and encouraging the use of alternative transportation.

The categories of Indoor Environmental Quality (IEQ), Energy and Ecology were awarded between 50 % and 80 %, which are comparatively lower ranges. IEQ is important for education buildings as students and staffs spend a long time in classrooms. This category addresses the HVAC system, lighting, occupant comfort and pollutants. Education buildings should provide a healthy indoor environment and improve the wellbeing of students and staff. The Energy category, with 63 % of points awarded, recognizes the reduction of greenhouse emissions by addressing energy demand reduction, use efficiency, and energy generation from alternative sources. The category of Ecology addresses the project's impact on the ecosystem. It reveals the challenges involved in increasing the ecological value of project sites, as only 55 % of the claimed points were awarded in this category.

11.4.3 Cross-Sector Comparison: Green Star Ratings

The average percentage of points awarded for 4 Star, 5 Star and 6 Star green projects is shown in Table 11.4. This provides a clear impression of the level of difficulty involved in acquiring different Green Star ratings for education buildings.

The distribution of the percentages awarded within different categories for 4 star, 5 star, and 6 star certified green projects is shown in Table 11.5 and Fig. 11.2.

As Table 11.5 indicates, projects with higher certified ratings generally have a higher percentage of points awarded. In particular, for the category of Energy, the

Table 11.4 Point frequency for different Green Star ratings

Green Star rating	Percentage of points awarded
4 Star	75 %
5 Star	78 %
6 Star	86 %

Table 11.5 Percentage of point awarded for different categories within Green Star levels

–	Man	Wat	Inn	Mat	Emi	Tra	IEQ	Ene	Eco
4 Star	97	91	100	89	84	86	63	54	53
5 Star	98	94	88	83	86	85	71	58	56
6 Star	98	99	100	86	81	78	82	88	52

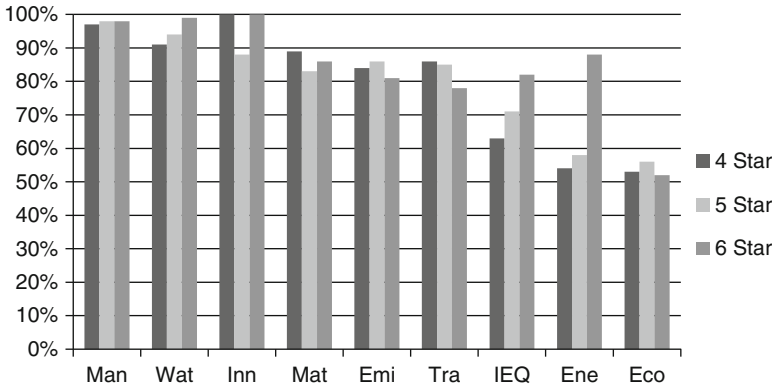

Fig. 11.2 Percentage of point awarded for different categories

point frequency for 6 Star education buildings is 30 % higher than for 4 Star and 5 Star buildings. Similarly, the indoor environment quality in higher level Green Star buildings is much better than the lower level ones.

For the category of Material and Transportation however, 4 star buildings have more points awarded than 5 and 6 star buildings. It is also worth noting that there is virtually no difference between 4, 5 and 6 star buildings in terms of being awarded points under the Management category. Land Use & Ecology remains the most difficult category, with all the certified projects being awarded less than 60 % of the claimed points.

11.5 Discussion and Conclusions

The Green Star Education rating tool was released in 2008 to promote green building practice in the provision of Australian education facilities. Similar to other Green Star rating tools, it covers nine categories, including Management, Indoor Environment Quality, Energy, Transport, Water, Materials, Land Use

and Ecology, Emissions and Innovation. Different categories target different sustainable requirements and present different challenges to project teams.

This study reviewed the score sheets of all education projects certified by the GBCA. The results show that Victoria has the most green schools, which account for half of the total number in Australia. This reflects the higher acceptance of sustainability for education buildings in this region. In addition, only 18 % of these buildings were awarded a 6 Green Star rating-regarded as "World Leader" level in sustainable development. Further research is required to investigate the difficulties involved in obtaining a world class level of green buildings in Australia.

The analysis of the points awarded in each category shows the different level of challenges involved in achieving different sustainable objectives. This can provide potential project teams with insights into the application of Green Star guidelines for future projects. The results show that Management, Water and Innovation are the most frequently awarded categories. This is similar to Silva and Ruwanpura's [5] findings-that indicator points in the innovation and design process and water efficiency are comparatively easier to obtain. Additionally, points relating to Energy and Indoor Environmental Quality categories are difficult to secure in these two studies. The study also found that points in the Material category are comparatively easier to obtain under GBCA rules compared with the much lower frequency awarded in LEED certified projects in Canada. Considering the Land Use & Ecology is the most difficult to be awarded points and poses the greatest challenges to the applicants, a further study is required to investigate the potential reasons.

The study is the first to review the project performance in the implementation of Green Star education buildings. With the support of the GBCA, it was possible to access the full 34 population of their green certified buildings at the time the research was undertaken (February 2012). By assessing different levels of challenges in obtaining points for different rating categories, the study helps developers and project teams in better understanding the rating scheme and increases the chances of obtaining claimed points and a desired rating level.

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