Green building operation and maintenance: case study of a commercial building with BEAM Plus provisional platinum rating (existing buildings)

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Abstract

Hong Kong currently has over 42,000 existing buildings. Expediting green building operations and maintenance practices adoption is crucial in reducing the operation cost and environmental impacts of building stocks. BEAM Plus Existing Buildings provides building users with an environmental performance label that demonstrates the overall quality of a building that is already in use.

To advocate low carbon sustainable built environment, Business Environment Council ("BEC") has undertaken a Transformation Project which aims to upgrade the BEC Headquarters ("BEC-HQs") with building age of around 18 years, to a green building with BEAM Plus Existing Buildings Platinum rating. Since 2013, a number of green building management practices, audits and measurements, measures to drive behavioural changes of the occupants, and system retrofits have been implemented. These implementations aim to improve buildings energy and water efficiency, indoor environmental quality, resource uses, and occupant health and comfort, to meet with BEAM Plus targets in various aspects.

As an overall result, the electricity and water consumption of BEC-HQs was reduced. With green features and environmentally friendly operational practices introduced, the BEC-HQs has achieved the Platinum Rating of Provisional Assessment under the BEAM Plus Existing Buildings. It is the first commercial building in Hong Kong which has achieved the highest level of recognition under the BEAM Plus assessment for existing buildings. This project showcases how an 18-year-old building could contribute in green building transformation in Hong Kong.

Keywords

Existing buildings; BEAM Plus; management.

1 Introduction

Hong Kong currently has over 42,000 existing buildings which are consuming significant amount of energy and resources. As the majority of these buildings are expected to remain in use in 2050, improving the operations and maintenance practices of existing buildings will help significantly reduce cost and environmental impacts of the existing buildings. And at the same time, the health and well-being of the building users can be ensured.

In different countries, green building rating tools [1-5] have been developed to recognise existing buildings owners or building management companies as forerunner of green building management practices, achievable performance and continuous improvement. Moreover, they are encouraged to improve overall building green performance by educating, influencing and partnering with their supply chains, occupants and communities. In Hong Kong, BEAM Plus Existing Buildings [6] provides building users with an environmental performance label that demonstrates the overall quality of a building that is already in use.

Promoting green existing buildings requires substantial efforts in raising the awareness and inducing behavioural changes of building owners, building management officials and occupants. In this regard, Business Environment Council ("BEC") has launched the BEC Headquarters ("BEC-HQs") Transformation Project which adopted a phased approach.

The phase one project aims to achieve BEAM Plus Platinum Rating through implementing green building management practices, audits and measurements, measures to drive behavioural changes of the occupants, and system retrofits. This case study presents the details of the practices and measures adopted in this project to meet with BEAM Plus targets.

2 Background of the building

The BEC Headquarters – Jockey Club Environmental Building is a low rise office building located in Kowloon Tong, and conveniently located near the Kowloon Tong MTR station and a bus terminus. The building consists of 3 floors and a car park area on lower ground, with an area of about 4,000 square meters.

The building was designed to harmonise with its surroundings and to incorporate a number of environmentally friendly features, and has been the home of BEC since September 1996. It is a permeable, community friendly building with a walk-through passage and central atrium leading to the To Yuen Street Park. In addition, there is about

42% of the total site boundary with planting of trees and plants to preserve urban greenery to enhance quality of living environment and reduce surface runoff to drainage system in neighbourhood areas at Tat Chee Avenue and To Yuen Street respectively. When construction of the building was completed in 1996, it was certified as "Very Good" under Hong Kong BEAM for New Office Designs Version 1/96.

3 BEAM Plus for existing buildings

Building Environmental Assessment Method (BEAM) Plus is a comprehensive environmental assessment scheme for buildings on a voluntary basis. It defines the best practice criteria for a range of sustainability issues across the whole life-cycle of buildings and projects, such as how buildings should be designed, constructed, and operated. BEAM Plus for Existing Buildings is one of the series of rating systems that covers the management, operation and maintenance of a building.

The BEAM Plus awards are classified as Bronze, Silver, Gold and Platinum, corresponding to the buildings' overall environmental performance, with BEAM Plus Platinum as the highest certification. In BEAM Plus Existing Buildings Version 1.2, buildings are assessed on a range of factors in various performance aspects. They are grouped within the six categories, i.e. the Site Aspects (SA), Materials Aspects (MA), Energy Use (EU), Water Use (WU), Indoor Environmental Quality (IEQ), and Innovations and Additions (IA). The final certificate grading for Platinum is subject to satisfying all pre-requisites; achieving overall score of 75%; obtaining minimum 70% for each category of SA, EU and IEQ; and a minimum of 3 credits earned under the IA category.

4 Green building management practices

4.1 Environmental management system

The building is managed by BEC and a building management company. The building management company has been implementing ISO 14001 Environmental Management System ("EMS") for the operation of BEC-HQs. The basic principle of plan-do-check-act in EMS was adopted. Environmental objectives and targets have been set up; vision, mission, values, policies and practices have been developed and reviewed regularly. BEC has also gone through the formal certification by external auditor and awarded with an ISO 14001 certificate.

Besides, the cleaning contractor and the contractor for pest control appointed are also certified with ISO 14001 EMS certification to ensure the services providers are environmental considerate.

4.2 Regular inspection, cleaning and maintenance

Operation and maintenance manual for building & site was created to outline standards

and practices of management and safety in relation to the external parts of a building that are to be observed and followed to achieve effective management and maintenance. The elements of the building covered in the manual include window, wall, cladding, louver, roof, external areas surrounding the building, columns, beams, floor slabs, structural walls and cantilevered balconies/ canopies. Regular inspection, cleaning and maintenance of building's fabric, external slopes and landscape areas have been performed by contractor and the records are kept in proper manner. And the maintenance and inspection of slope within the site was conducted and endorsed by a Registered Professional Engineer.

Operation and maintenance manuals for building systems were gathered and consolidated with regular maintenance programmes and record for HVAC, electrical, plumbing & drainage, fire services and lift systems.

4.3 Green cleaning

A Green Cleaning Plan was established and the building management company has been requesting the cleaning contractor to adopt this Plan. The landlord collaborates with building management company and the cleaning contractor in investigating a range of environmentally friendly cleaning products in accordance with Green Cleaning Plan. And more than 50% by total volume of Green Seal certified products have been purchased and relevant purchasing records are properly kept.

4.4 Environmental purchasing

Environmental purchasing is also known as green procurement, environmentally-responsible purchasing or environmentally-preferable purchasing. Every item being purchased consumes some of the Earth's resources and generates certain pollution and waste in its life cycle. Some products also pollute the indoor environment and have an adverse impact on human health, or cause harm to endangered species. Thus, consumption behaviour plays a major role in generating all kinds of local and global environmental problems from indoor air pollution to climate change.

BEC is committed to sourcing operation and maintenance related products that are environmentally friendly. An Environmentally Purchasing Plan endorsed by senior management which provides guidance to staff in sourcing environmental products, was developed. An implementation programme is carried out according to the plan. By purchasing products that are more environmentally-friendly, the company not only can contribute in alleviating the impacts to the planet, but also the indoor environment will become safer and healthier for users, staff and contractors.

4.5 Water conservation plan

A water conservation plan covering water conservation measures and management practices is developed and endorsed by senior management. The plan details the staff deployment showing who is responsible for undertaking implementation of water conservation measures, carrying out water auditing and monitoring water consumption;

the communication channels detailing how the message of water conservation is delivered to staff at all levels, and building users; the water conservation measures providing the water conservation measures that are currently implemented; and the management practices providing practices that monitor water consumption.

4.6 Integrated pest management

A contractor for pest control is committed to conduct pest control works in a sustainable approach in managing pests and to minimise economic, health and environmental risks to its building occupants.

An Integrated Pest Management Plan was established and the building management company has been requesting the cleaning and pest control contractor to adopt the Plan. Pesticide used is odourless and biodegradable, and relevant records are kept.

5 Audits and measurements

5.1 Audit on the effectiveness of the O&M practice

An audit for operation and maintenance practices in accordance with BSRIA's guide [7] has been completed. The audit proves that the organisation is meeting its operational objectives. The audit measures the performance of the operation and maintenance process, checks and coordinates information on the effectiveness of the activities carried out at different levels of the organisation and feeds back results to management. The effectiveness of the operation & maintenance practices at BEC-HQs has been assessed following the BSRIA guidelines [7], and the report was made to the management team for improvements.

5.2 Waste audit

Waste audit was conducted to review the composition and quantities of waste (including recyclables) disposed from the premises; and to identify areas for improvement on waste management and recycling practices for BEC-HQs. Quantity of waste and recyclables have also been logged for the past 3 years.

5.3 Energy and carbon audit

A Registered Energy Assessor (“REA”) was engaged to conduct energy audit as per Buildings Energy Efficiency Ordinance (Cap 610). All the EMOs recommended by the REA were implemented, including (i) reducing lift downward travel frequency, (ii) shortening chiller run time, (iii) upgrading lighting system, (iv) installing sub-meters; and (v) replacing chiller.

Carbon audit in accordance with Environmental Protection Department and Electrical and Mechanical Services Department guidelines was conducted. Carbon audit result was verified by Qualified Service Provider. Carbon“Less” 10% certificate was awarded

under Hong Kong Awards for Environmental Excellence.

5.4 Water audit

To benchmark the water performance of the BEC-HQs, the consumption of fresh water, flushing water and irrigation water were estimated. An inventory list of water using fixture for the BEC-HQs is kept by the building management company. This information provides the base of water performance improvement and analysis.

5.5 Indoor air quality

Improvement works have been completed to ensure the indoor air quality of the building. Walkthrough of the building was conducted to inspect if any sources of volatile organic compound (VOC) existed such as painting or new furniture installed and if mechanical ventilation and air conditioning (MVAC) systems have been properly operating. Air filters installed in the Primary Air Units, Air Handling Units, have been replaced or cleaned regularly to minimise the content of respirable suspended particle in the building.

As a result of the enhancement works, “Good” class of indoor air quality certification has been achieved for all landlord, tenants and common areas. In usual practice of a commercial building, only common area is considered. However, BEC cares for all building occupants. Therefore, the indoor air quality in tenant area is also tested.

A tenant fitout guide has been setup in order to regulate the renovation/ fit out works from tenants. The IAQ management procedures at different stages of works are provided for tenant to follow. The potential of air pollution is hence minimised.

6 Building and system upgrades

6.1 Waste recycling facilities

A plantroom was converted to a refuse chamber with area fulfilling BEAM Plus requirements. Independent exhaust with de-odourising device was provided. Adequate recycling and waste management facilities are provided in the building in order to encourage building occupants to proactively take part in recycling. Recycling facilities, including recycling bins for paper, aluminium cans, plastic bottles and glass bottles, are provided in prominent locations of the building.

6.2 Chiller replacement

The old air-cooled chiller was replaced by a new air-cooled oil-free chiller with high energy efficiency compressors with components of the magnetic bearings and variable speed permanent magnet motors. The new chiller has increased energy efficiency and reduced approximately 30% of electricity consumption of chilled water system by making a comparison of annual consumption before and after the installation of the new

oil-free chiller. In addition, maintenance cost of the new chiller will be significantly reduced due to the maintenance free compressors.

6.3 Lighting system

T8 fluorescent light tubes have been replaced with LED panels in BEC office and other public areas of the building. Totally 346 nos. of T8 fluorescent light tubes and compact florescent light were replaced by 215 LED panels. Although the installed light fittings are reduced, the lighting quality is checked to be maintained at a level complying with CIBSE Guide Requirements [8]. Therefore, energy saving is achieved by reducing both rated power and amount of light fitting. The lighting control system has also been upgraded. For example, manual dimmable lighting control is installed in BEC office area. The improvements in the lighting system have resulted in a reduction in electricity consumption of lighting system by 55%. And a reduction of the replacement cost of new lighting as the life time of the LED panel is 50,000 operation hours.

6.4 Light and motion sensors

Light sensors were installed at the perimeter zones of the building. Electricity consumption can be reduced as the LED panels are dimmed when the light sensors detect that there is sufficient lighting in the surrounding area.

Motion sensors were installed in the washrooms in the 1/F and 2/F of the building and the corridor connecting the car park area and the lift on the lower ground floor. When the motion sensors detect that there is nobody occupying an area, the lights in the area are switched off, thereby reducing electricity consumption.

6.5 Rainwater collection system

A rainwater collection system, including a 6,000L rainwater collection tank and components of filters, ultraviolet lights for sterilization and water pumps, was installed so that rainwater can be harvested for irrigating the trees and plants in the building area and for cleansing purpose at outdoor areas of the building. It is expected that 165,000 litres of rainwater can be harvested annually for irrigation and cleaning purposes. Harvesting rainwater in BEC-HQs will lead to a reduction of 8% in the consumption of fresh water based on BEAM Plus baseline value.

6.6 Water saving devices

Conventional single flush systems in the washrooms in the entire building have been converted to dual flush systems to reduce the amount of flushing water used. The dual flush system was selected to be simply modified from the original system without dismantling the whole toilet. The waste generated was minimised and hence, reducing in landfill load. Besides, the urinals were also upgraded to be Grade 1 under Water Efficiency Labelling Scheme from Water Supplies Department. Water taps with low flow are also used, resulting in fresh water consumption being 42.6% less than the BEAM Plus baseline value.

6.7 Smart metering

Smart metering for electrical systems has been introduced. The power meters installed can track the power consumption of individual major electrical systems of the buildings, i.e. MVAC systems, lighting and small power, and lift system. It can provide detailed and comprehensive data for analysing and measuring energy performance.

Chilled water meters were also installed in tenants' areas to evaluate their chilled water consumption. The data is targeted to be adopted as a factor to implement green lease in the future.

7 Driving behavioural changes

Apart from the hardware upgrades and improvement in operation and maintenance practices, a building user guide was composed to advocate building users on building safety, hygiene and environmental issues. Green policies and promotional posters were introduced to drive behavioural change of users to achieve saving in environmental resources. Green initiatives were also promoted via professional seminars, building tours, BEC Institute of Environmental Education School Programme, public exhibition, television, radio, and newspaper.

7.1 Waste reduction

Recycling facilities were provided at the prominent location of the building to encourage waste sorting and recycling of paper, metal cans, and plastic bottles. A glass bottle recycling bin was also placed at the main entrance of the building to encourage glass bottle recycling. A poster of "Carry your own cutlery" was put at the lift compartment and lift lobbies to discourage the use of disposable cutlery in lunch or company event. In addition, BEC has purchased washable cutleries for staff to use. These measures successfully reduced the use of disposable cutleries.

7.2 Energy saving

Campaign of "Stairs Days" was introduced. As the building consists of only 3 floors, the building users are encouraged to take the stairs every Monday and Friday. Energy saving reminders were posted next to the switches of lighting and air conditioning, to remind users on energy saving measures, such as setting the air-conditioner's temperature above 25 °C, staff member who is the last one to leave the zone are responsible for turning off the light. A lighting zones map for controlling the lighting at each zone were posted around the office to encourage switching off lightings in unoccupied areas. Lighting have been turned off during lunch hour from 13:00 to 14:00 hours to avoid wastage.

8 BEAM Plus credit achievement

As a result of the green features and environmentally friendly operational practices introduced, the BEC-HQs has achieved the Platinum Rating of Provisional Assessment under the BEAM Plus Existing Buildings (Version 1.2). The following table shows the credits in each environmental performance category.

Table 1 - BEAM Plus credit achievement

Category	Weighting (%)	Credits achieved
Site Aspects	18	16
Materials Aspects	12	4.4
Energy Use	30	24.4
Water Use	15	10.7
Indoor Environmental Quality	25	19.2
Innovations and Additions	N/A	5
Total credit		**79.7**

9 Conclusion

In the transformation project, the BEC-HQs has upgraded to a green building through not only the system retrofit, but more importantly, by the green operation and maintenance practices and involvement of building users. The BEC-HQs has achieved the Platinum Rating of Provisional Assessment under the BEAM Plus Existing Buildings, which is the first commercial building in Hong Kong that has achieved this highest level of recognition. This project serves as a model for emulation to existing building owners on sustainability solutions. It showcases how an existing building can achieve on a lean budget, with innovative approaches and best practice.

10 References

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