

# Building Energy Efficiency in Hong Kong: Case Study of a Commercial Building with BEAM Plus Provisional Platinum Rating (Existing Buildings)

POON Ka-man<sup>a</sup>, CHAN Wai-yee<sup>b</sup>, HUI Pui-shan<sup>c</sup>

<sup>a</sup> Business Environment Council Ltd., Hong Kong SAR, [carmen@bec.org.hk](mailto:carmen@bec.org.hk)

<sup>b</sup> Business Environment Council Ltd., Hong Kong SAR, [veronica@bec.org.hk](mailto:veronica@bec.org.hk)

<sup>c</sup> Business Environment Council Ltd., Hong Kong SAR, [effie@bec.org.hk](mailto:effie@bec.org.hk)

---

## ABSTRACT

Hong Kong currently has over 42,000 existing buildings that account for over 90% of the total electricity consumption in the territory. The Energy Saving Plan by the Hong Kong Government and the “HK3030” Campaign by the Hong Kong Green Building Council (“HKGBC”), both put forth an electricity consumption reduction target of buildings. Expediting green building adoption with better energy performance is identified critical to achieve the target. To advocate low carbon sustainable built environment, Business Environment Council (“BEC”) has undertaken a Transformation Project which aims to upgrade its Headquarters (with building age of around 20 years) to an energy wise green building with BEAM Plus Platinum rating. This paper presents the details and major findings of the project.

Since 2013, a number of energy-retrofit measures has been implemented, which including lighting system upgrade, installation of variable speed oil-free air cooled chiller, light and motion sensors, smart metering, and commissioning of building services equipment. These implementations aim to reduce electricity consumption of the building, future replacement, maintenance cost, and to enhance the energy efficiency of different building facilities. Meanwhile, driving behavioural changes of the occupants is also an important element for energy conservation. Stair-Days was one of the adopted measures which contributed to approximately 5% reduction in daily electricity consumption of lift. As an overall result, the electricity consumption of BEC Headquarters was reduced by 24% from 2013 to 2015. Together with other green features and environmentally friendly operational practices introduced, the BEC Headquarters 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 a 20-year-old building could contribute in energy saving and green building transformation in Hong Kong.

**Keywords:** *existing buildings, BEAM Plus, energy consumption*

---

## 5. INTRODUCTION

Hong Kong currently has over 42,000 existing buildings that account for over 90% of the total electricity consumption in the territory. To enhance the public awareness of energy saving, the “HK3030” Campaign was initiated by the Hong Kong Green Building Council (“HKGBC”). The objective was to reduce the electricity consumption of buildings in Hong Kong by 30% by 2030, compared to 2005 level. In 2015, the Energy Saving Plan by the Hong Kong Government also set a target to reduce energy intensity by 40% by 2025, compared to 2005 level. Expediting green building adoption with better energy performance is identified critical to achieve the target. To advocate low carbon sustainable built environment, Business Environment Council Limited (“BEC”) has undertaken a Transformation Project which aims to upgrade the BEC Headquarters (with building age of around 20 years) to an energy wise green building with BEAM Plus Platinum rating.

This paper presents the narrative of the Transformation Project and energy performance achieved to demonstrate that it is feasible for existing buildings to make themselves green and energy efficient.

## 1.1 BEC headquarters

BEC Headquarters (“BEC-HQs”) is situated at 77 Tat Chee Avenue, Kowloon since September 1996. It is a low rise commercial building. The building consists of 3 floors and a car park area on the lower ground floor, totalling an area of about 4,000 m<sup>2</sup>. Apart from offices, auditorium and classrooms are also provided in the building. The building, when constructed in 1996, achieved “Very Good” rating under Hong Kong BEAM for New Office Designs Version 1/96.

## 1.2 Transformation project of BEC-HQs

Since BEC-HQs is almost 20 years old, the installed hardware became out-dated and inefficient in energy. Therefore, a Transformation Project was carried out and it commenced in 2013. The objectives of the Transformation Project were a) To provide optimum energy savings, better indoor environment quality, and more importantly greater connection to the community; and b) To provide environmental and green building related education and information to different community segments and create a large scale impact. A number of measures, relating to energy use, waste management, plumbing and drainage installation, have been implemented in order to improve building performance.

This paper focuses on the measures related to energy use. The measures are divided into two categories: a) Energy-retrofit and b) Driving behavioural change, and they are listed in the tables overleaf. The detail of these measures are discussed in the following sections.

Designation	Item
a)	Installation of variable speed oil-free air cooled chiller
b)	Upgrade of lighting system
c)	Installation of daylight and occupancy sensor
d)	Installation of power meters and energy meters
e)	Commissioning of building services installation

Table 1: Energy-retrofit measures in BEC-HQs

	Item
a)	“Stairs Days”
b)	Setup of Lighting zones
c)	Switching off lights during lunch hours
d)	Energy Saving Reminder

Table 2: Driving behavioural change measures in BEC-HQs

## 6. ENERGY-RETROFIT MEASURES

### 2.1 Installation of variable speed oil-free air-cooled chiller

The old air-cooled chiller was installed since the building completion. In other words, the operation time was almost 18 years in 2014. Its performance deteriorated from its original. To improve the energy efficiency of air conditioning, this chiller was replaced by an oil-free variable speed air-cooled chiller in July 2014. The new chiller consists of high energy efficiency compressors with magnetic bearings and variable speed permanent magnet motors. In addition, on the operation side, maintenance cost of the new chiller will be significantly reduced due to the maintenance free compressors.

The advantage of the oil-free chiller is its better COP and part load performance. Considering the thermal load of BEC-HQs is relatively low compared to a commercial building due to its scale, allowing part load operation of chiller could achieve energy conservation. According to the meter reading, the energy consumption of chilled water system (i.e. including chilled water pump) reduced by approximately 29.9%.

## 2.2 Upgrade of lighting system

Apart from the air-conditioning system, lighting system is also dominant in the building energy consumption, and hence, the lighting system was also upgraded since 2014. The lighting system originally adopted in BEC-HQs was mainly T8 fluorescent tubes. The system was firstly saved by de-lamping of the lighting panels by reducing the number of fluorescent tubes. In 2014, to further enhance the saving, LED panels were installed in the building. There were mainly three features to achieve energy conservation:

- The rated power of LED panel is much lower than T8 lighting panel (3 T8 fluorescent tubes in one panel), where approximately 40% of energy can be saved.
- Due to the luminance of LED panel is higher, the required amount of fittings is less than original plan. For instance, for the BEC office areas, totally 207 nos. of lighting fittings were originally installed, but it only requires 111 nos. of LED panels to provide satisfied working environment for staff members, which is in compliance with CIBSE.
- The heat generated from the LED panel is much lower than that of T8 fluorescent tubes. This can reduce the cooling load of the air-conditioning system.

By calculation, the replacement of lighting system contributed approximately 54.9% reduction in the consumption of lighting system.

It is targeted to install LED panels/ tubes for the whole lighting system in the building. At the current stage, office areas, common corridors, lift, back of house corridor, external staircases and floor lights, exit sign were all replaced.

## 2.3 Installation of daylight and occupancy sensor

To enhance energy saving, both daylight and occupancy sensors were provided for light fittings at common area (essential lighting is excluded). Inside the building, totally 5 daylight sensors were installed at perimeter zones at 1/F and 2/F, including corridor and offices. The light fittings at the controlled area were pre-set to provide at maximum 80% of lux level of the rated performance. The light fittings are dimmed when there is sufficient lighting level at the controlled area. There were totally 9 occupancy sensors installed at toilets and corridor at lower ground floor. The light fittings are switched on when there is occupant in the sensed area, and switched off if no occupant is detected within the certain time interval.

## 2.4 Installation of power meters and energy meters

In order to enable better monitoring and measuring the energy performance of the building engineering systems, 20 power meters and 12 energy meters were installed in 2014.

The installed power meters could separately monitor the power consumption of chillers, air handling units, lighting system, lift installation and small power. By checking metering record, the management office could take prompt and targeted actions to improve energy efficiency of specific facilities.

Energy meters were installed at the areas occupied by tenants in order to evaluate their respective amounts of energy consumption associated with air-conditioning. The data is targeted to be adopted as a factor to implement green lease in the future.

## 2.5 Commissioning of building services installation

Re-commissioning has been carried out since 2014, covering air conditioning system, water pumps and pressure vessels, and electricity system. The property manager has set up a schedule to maintain and inspect the systems regularly. Regular inspection and adjustment of building services installations optimise system performance throughout the lifetime of the equipment.

## **7. DRIVING BEHAVIOURAL CHANGES**

Driving behavioural changes of the occupants is also an important element for energy conservation. As mentioned, several campaigns has been introduced and implemented since 2014. These campaigns were initiated by the Green Office Team of BEC. The team members meet regularly for discussing if any campaign can be held for engaging building occupants to live and work greener.

### **3.1 'Stairs Days'**

'Stairs-Days' encourages building occupants to take the stairs instead of lift for the purpose of health and energy conservation. It commenced in March 2015 and was originally proposed for Friday only. With the support of the building occupants, the campaign was extended to Monday. With increased idling time of the lift, this campaign contributed to a 5% reduction in daily electricity consumption of lift.

### **3.2 Energy saving reminder**

To promote energy saving and influence the building occupants to have better habit, the energy saving reminders were allocated around the office, near the switches of lighting system, computers, air-conditioning system. The users are always reminded to switch off the equipment or lights that are not in use, and to keep the air-conditioning set point at 25°C or above.

### **3.3 Energy saving measures of lighting**

Considering it is a waste of energy when only a few staff member is working but with all lights are on in office, lighting zones were setup in BEC offices to allow individual control from BEC staff member. A lighting zones map is posted to draw staff's attention. BEC staff member who is the last one leaving the zone is responsible for turning off the light.

Apart from setup of lighting zones, lunch hour is also an opportunity to achieve energy saving. In BEC, staff members are recommended to switch off the lights during lunch hour. By estimation, if the lights are turned off 1 hour, approximately 2.2kWh could be saved daily, which may contribute to over 570kWh reduction in annual consumption.

Meanwhile, the measures not only benefit the reduction of lighting power consumption, but also indirectly help for reducing the thermal load, implying that less energy is required for air-conditioning system.

## **8. ENERGY PERFORMANCE OF IMPLEMENTED MEASURES**

To study the effect on the energy performance of the adopted measures, the electricity consumption of the BEC-HQs from 2013 to 2015 is considered and presented in Figure 1. It is found that the consumption decreased year by year. As mentioned in Sections 2 and 3, most of the measures, especially the hardware upgrade, were implemented in 2014. Over 14% of electricity consumption was saved in this year; while the total electricity consumption of 2015 was further reduced by 10%, reaching 424,330kWh. In other words, approximately 24% of electricity consumption has been reduced since the commencement of transformation project (compared with 557,696kWh in total in 2013).

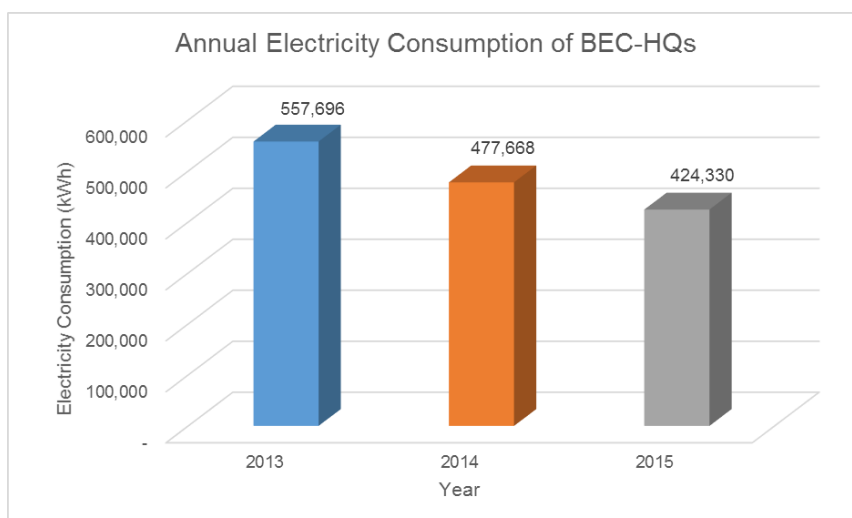


Figure 1: Annual electricity consumption of BEC-HQs

## 9. BEAM PLUS ACHIEVEMENT

BEC-HQs has achieved the Platinum Rating of Provisional Assessment under the BEAM Plus Existing Buildings (Version 1.2), as a result of the green features and campaigns adopted. Table 3 shows the credits achieved in different categories under BEAM Plus Provisional Assessment. The measures described in Sections 2 and 3 contribute to Energy Use category, which has the largest weighting among all categories in the assessment tool.

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	-	5
<b>Total</b>		<b>79.7</b>

Table 3: BEAM Plus credit achievement

## 10. CONCLUSION

A series of hardware upgrade and campaign have been implemented to improve the energy performance of BEC-HQs. In 2015, the overall energy consumption was approximately 24% lower compared with that of 2013. Both energy retrofit and driving behavioural change measures are essential to achieve this accountable energy saving performance.

BEC-HQs has achieved the Platinum Rating of Provisional Assessment under the BEAM Plus Existing Buildings. With the achievement of the first commercial building attaining the highest level of recognition under the BEAM Plus Provisional Assessment for Existing Buildings, BEC-HQs is a successful case for industry to learn from. This is not the end, continual improvement in energy performance is essential for existing buildings. It is believed that there would be more opportunities in the future for making existing building more green and energy efficient.

## REFERENCES

- [1] Environment Bureau of HKSAR, 2015, Energy Saving Plan: For Hong Kong's Built Environment 2015~2025+. Hong Kong.
- [2] Hong Kong Green Building Council, 2013, HK3030: a vision for a low carbon sustainable built environment in Hong Kong by 2030. Hong Kong.
- [3] The Chartered Institution of Building Services Engineers, 1994, Code for Interior Lighting. London, UK.