

Green and sustainable initiatives exist Universities in Hong Kong

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Abstract

Background: Universities in Hong Kong are working hard for environmental pollution control and sustainable development, show its prideful results of environmental protections. However, their environmental protections initiatives seem to deviate from international standards and exist deficiencies. *The purposes:* The study critically reviews and explores environmental pollution controls and sustainable development of existent Universities in Hong Kong. *Methodology:* Leadership in Energy & Environmental Design (LEED) is used in the study as a building environmental assessment tool to evaluate 3 representative campuses (HKU, CUHK and HKUST) in Hong Kong and observations on internet as well as secondary data. *Findings:* HKBU is showcase and demonstrates the characteristics of a LEED certified building. *Contributions:* an objective and comprehensive environmental assessment tool (LEED) adopts assessing a broad range of environmental issues for 3 representative Universities against explicitly proud results declared. 3 Universities reveal deficiencies as a result. Inspirations get from oversea Universities environmental protections initiatives for imitations

Key words: green buildings, environmental pollution control, sustainable development

Introduction

Most conservative projections estimates that there will be 2 billion more people by 2025 and energy demand will rise by at least 54 percent. Climate change experts determine what we should do to keep global warming within reasonable limits. According to the Intergovernmental Panel on Climate Change, limiting the average global temperature rise to 2 or 3°C would require the stabilization of greenhouse gas emissions in the atmosphere at 450 to 550 ppm CO₂eq. To do so, we should reduce carbon emissions by 60 to 80% by 2050. This means that, by this date, we should already be close to a post-fossil fuel economy.

Having conducted numerous researches, some scholars reveal that green building practices reduce the environmental impact. Green building (green construction or sustainable building) refers to that structures and using process are environmentally responsible and resource efficient throughout a building's life-cycle from sitting to design, construction, operation, maintenance, renovation, and demolition. Studies have shown over a 20 year life period, some green buildings have yielded \$53 to \$71 per square foot back on investment

Nevertheless, some Universities in Hong Kong publicize its environmental pollution control and sustainable developments in buildings are superior. Those claims probably mislead the public. The purposes of the study critically review and explore environmental pollution controls and sustainable development of existent Universities in Hong Kong. 3 Universities (HKU, CUHK and HKUST) are selected as representative cases Leadership in Energy & Environmental Design (LEED) recognized internationally green building certification and rating system is chosen as building environmental assessment tool. HKBU is showcase and demonstrates the characteristics of a LEED certified building.

Literature Review

Universities in Hong Kong have been striving for environmental pollution controls and sustainable development over the past 10 years. They recognize the need to be energy efficiency and responsibility using natural resources in campus. Various universities adopt different measures to avoid, minimize and mitigate environmental impacts.

The University of Hong Kong (HKU) had a progress in environmental pollution controls such as control of energy use, segregation of wastes and promotion of environmental protections. HKU has accumulated around \$90 million in energy savings since 1991

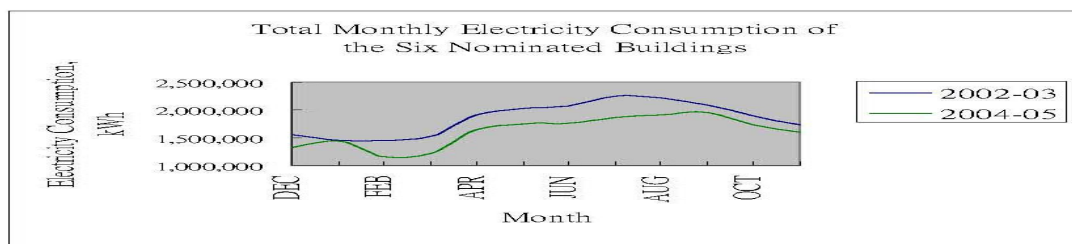
Currently HKU initiates carbon footprint, ecological footprints and the Hong Kong Enviro-point as sustainable development (HKU sustainability report 2007). Figure 1 shows consumption of electricity and gas are going lower. However the environmental pollution controls and sustainable development lack sustainable sites and water efficiency in HKU campus. New Centennial Campus just is expansion of the facilities in HKU. The environmental protections of existing and new buildings do not emphasize on how they evaluate and assess the impact of the environment as well. .

Carbon Footprint 碳足跡* (kg CO₂ eq./公斤二氧化碳當量)

	electricity consumption 用電量	gas consumption 煤氣用量	road transport 道路交通	Total 總額
2002	106,143,876	1,712,167	393,469.39	108,249,512
2003	101,357,832	1,751,855	364,780.18	103,474,467
2004	95,989,895	1,552,423	362,306.59	97,904,625
2005	92,724,904	1,647,825	364,138.79	94,736,867
2006	92,262,943**	1,616,987	351,417.31	94,231,348
2007 (up to Jun 至六月止)	42,580,186	741,372***	****	43,321,558

Figure 1

The Chinese University of Hong Kong (CUHK) devoted to provide an environmental pollution controls in campus, such as energy conservation and wastes reduction. Figure 2 indicates around 12.7% energy saving per year.



所提名六樓宇成果 Achievement of Six Nominated Buildings	
2002/03 系統年用電量 Yr 2002/03 System Consumption	22,214,499 kWh
2004/05 系統年用電量 Yr 2004/05 System Consumption	19,390,060 kWh
測定節省電量 Measured Savings per year	2,824,389 kWh (12.7%)

Figure 2

Recently CUHK adopts carbon reduction and tree preservation as sustainable development. So as to reduce fuels combustion pollutions on campus, electric bikes are used on campus for gradual replacement of the diesel engines. Unlike HKU, 70% CUHK campus area are occupied by green vegetations. Strives keen on environmental friendly campus for all stakeholders and visitors. But those controls and sustainable measures neglect 2 issues (energy & atmosphere, and materials & recourses)

The Hong Kong University of Science and Technology (HKUST) established in 1991 whose environmental pollution control mainly is energy conversation (annual savings of about HK\$5 million for electricity and gas). At the present time sustainable development concentrates on recycling such as plastic bottles. Figure 3 shows results of cycling for plastic bottles are going to increase. HKUST, like HKU and CUHK, in common practices of environmental pollution controls and sustainable development belong to energy conservation, 3Rs and etc. 2 components (indoor environment quality, and innovation in design) are missed.

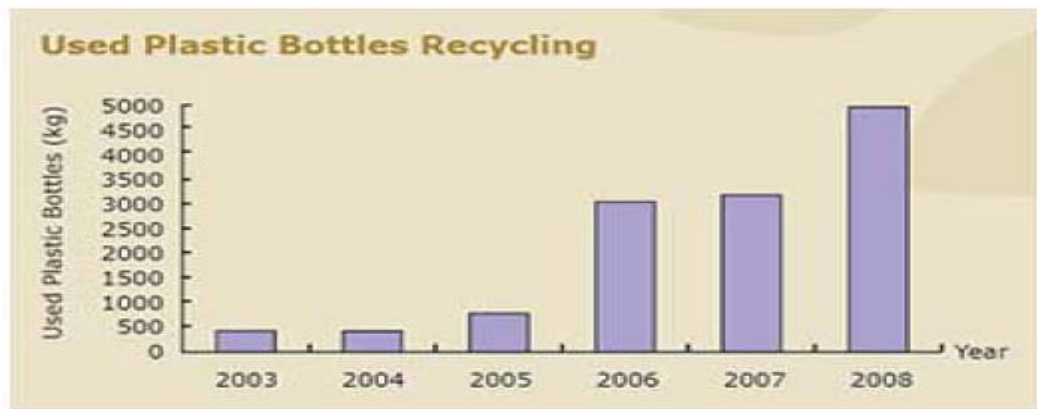


Figure 3

Methodology

From the Review of 3 University in Hong Kong, their environmental pollution controls and sustainable development are incomprehensive and non-international standards. It is better and ideal approach that an international standard identifies & evaluates the environmental effects of building development or operation, and promotes sustainable development. Leadership in Energy & Environmental Design (LEED), developed by the U.S. Green Building Council, is an internationally recognized green building certification and rating system. The LEED rating system for exiting buildings is in terms of sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality and innovation in design (U.S. Green Building Council. 1 th March 2011). Appendix 1 shows more details about criteria of LEED for evaluation of buildings. The assessment will help to determine whether the building meets requirements of environmental pollution controls and sustainable development, and issues an award for encouragement and recognition afterwards. In addition to LEED, there are a number of building assessment tools such BRE Environmental Assessment Method (BREEAM) and Green Star.

BREEAM was established in the UK. BREEAM is an environmental standard and rates the sustainability of buildings. Its fundamental objective minimizes environmental impact by ensuring sustainability best practices and lower organizations costs through energy efficiency (BREEAM 2011). Comparing with LEED, BREEAM neglects the issue of indoor air quality. Most guides of green buildings have a section for indoor air quality, ventilation or filtration systems and etc. Green Star being a voluntary environmental rating system for buildings establishes in Australia. Green Star adopts 9 angles with management, indoor environment quality, energy, transport, water, materials, land use & ecology, emissions, innovation (Green Star 2011). Unlike LEED, Green Star is too complex for assessor to evaluate existing buildings

Findings in HKBU

In recent years Hong Kong Baptist University (HKBU) aims at a low carbon campus, plans the first tertiary education institution to be a sustainable low carbon campus among Universities in Hong Kong. In 2009 the Environmental Health and Safety Committee of HKBU successfully obtained HK\$5 million from the University's Strategic Development Fund (BU 2011). A series of sustainable developments except traditional environmental pollution control measures initiate. The HKBU will be used as a showcase, and demonstrate the characteristics of a LEED certified building.

For sustainable site point of view in HKBU, environmentally-friendly and energy saving features are incorporated into the building design and the green roof is compulsory to the new buildings, and there will be more than 50 per cent increase in green campus area (HKBU 2011). Figure 4 displays that HKBU campus expands for coming 3-3-4 academic reform. Figure 5 points out existing trees are going to be relocated because of construction works of new campus. As for water efficiency, HKBU targets for reducing the consumption of water in environmental policy committed (HKBU 2011). Figure 6-7 reflects energy and atmosphere issues for devices and measures to enhance the energy efficiency, and utilising renewable energy in HKBU. Since 2000, comprehensive recycling programme retrieves 11 types of recycling materials e.g. waste paper, metals and laser cartridge. Figure 8 shows materials and resources measures. For indoor environmental quality, HKBU is via planting and building of green roof and green wall and smoke-free in campus. Figure 9 demonstrates innovation in design in HKBU. With continuous hard work on environmental pollution controls and contribution to sustainable development, HKBU gets gold prize of Hong Kong Green Awards in 2010

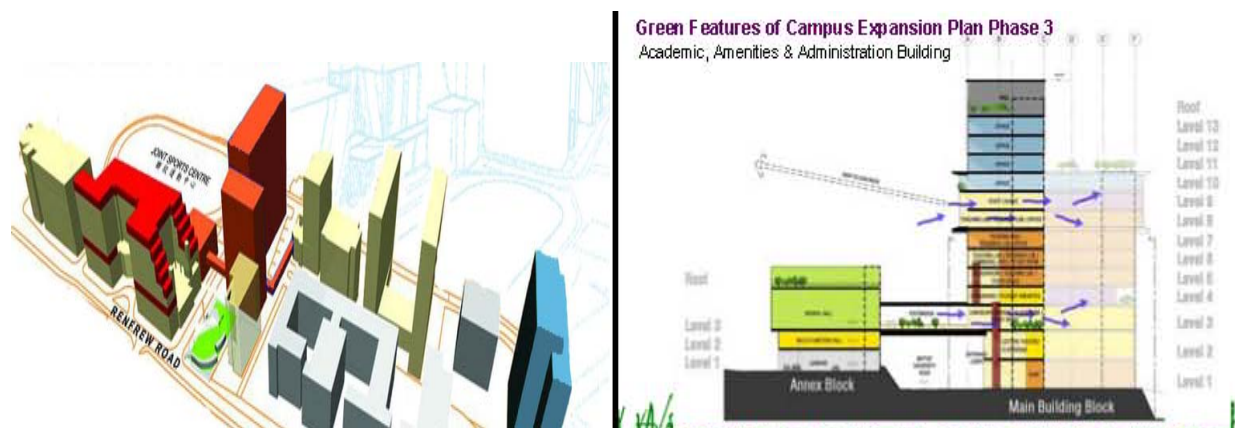


Figure 4

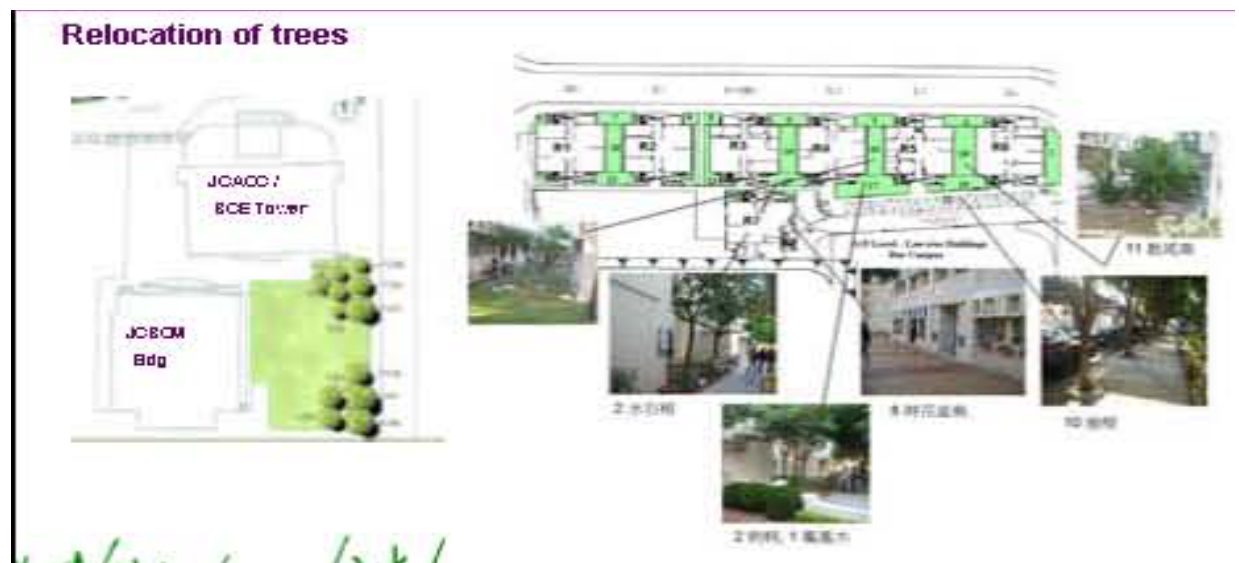


Figure 5





Energy Saving Measure	Energy Saving Measure	Energy Saving Measure	Energy Saving Measures
			
Solar Water Heater	Automatic Sensing Device	Air Conditioning Plant Upgrade	Occupancy Sensor

Figure 6




Renewable Energy Measure	Renewable Energy Measure	Renewable Energy Measure	Renewable Energy Measure
			
Solar Panels	Horizontal Wind Turbine	Solar Lamp	Solar Irrigation System

Figure 7

			
Waste Recycling Bin-Station	Polyfoam Recycling	Waste Recycling Station	Fluorescent Tube and Bulb Recycling

Figure 8

	
Solar Mosquito Killing Device	Solar Irrigation System

Discussion

HKBU has a remarkable performance in environmental pollution controls and sustainable development among Universities in Hong Kong at this time, satisfied 6 criteria of LEED, and outperforms the 3 representative Universities in the study. However, comparing with oversea Universities, deficiencies exist in HKBU and other Universities in Hong Kong. 3 cases are cited for imitations or reference.

Sidwell friends Middle School where 90% reduced municipal water use Washington, D.c. awarded LEED. A wetland to treat wastewater from the kitchen and bathrooms constructs between the new and old wings of the Middle School, and serves as a living laboratory. The treated water is reused in the toilets and cooling towers as a result. (Project Profiles of LEED 2011). From the case, we recognize that water can be reused in campus on the condition that sufficient facilities and comprehensive design prior construction. Clearview Elementary Hanover PA, awarded LEED, is superior indoor air quality in school. Through a floor-mounted, air-diffusing system, temperature, humidity and oxygen levels are adjusted to optimal level. Air comes via the floor rather than vents in the ceiling, the fresh air thus is closer to the breathing zone of students, teachers and stakeholders. Low and even no volatile organic compound, non-solvent-based adhesives, and low-emitting carpeting exist in school (Project Profiles of LEED 2011). A common practice among Universities in Hong Kong is that natural resources are concerned e.g. energy savings, renewable energy and etc. Energy efficiency technology is the most effective technology for reducing energy consumption and carbon dioxide emissions. Human is a kind of resources and always is neglected. Indoor air quality should be considered in green building for public health as sustainable development.

Conclusion

Universities in Hong Kong are working hard for environmental pollution control and sustainable development, namely use of renewable energy, solid waste management, reduction of CO₂ emission, waste recovery and recycling and minimization of energy consumption in buildings, show its prideful results of environmental protections. However, their environmental protections initiatives seem to deviate from international standards, such as Green Star established Australia, LEED set up United States and BREEAM founded United Kingdom. LEED is used in the study as a building environmental assessment tool to evaluate 3 representative campuses in Hong Kong. The outcomes show deficiencies among 3 Universities. HKBU is showcase and demonstrates the characteristics of a LEED certified building. Comparing with oversea Universities in environmental technologies, methodologies applied, environmental performance and engineering, Universities in Hong Kong need imitations and further improvements. Contributions in the study include an objective and comprehensive environmental assessment tool (LEED) adopted of simultaneously assessing a broad range of environmental issues for 3 representative Universities against explicitly proud results declared, and reveal environmental protections activities and sustainable developments in Universities as well as inspirations from oversea Universities environmental protections initiatives for imitations. Like other research, the study has limitations as well. All information bases on observations as well as secondary data. An ideal and accurate study should be created and administered to collect information from the building occupants. Respondents are asked through self-administrative questionnaires. Researchers evaluate temperature and humidity, noise level, lighting, daylight, odors, and thermal comfort with physical equipment as well.

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LEED 2009 FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS PROJECT CHECKLIST

Sustainable Sites

26 Possible Points

<input checked="" type="checkbox"/>	Prerequisite 1	Construction Activity Pollution Prevention	Required
<input type="checkbox"/>	Credit 1	Site Selection	1
<input type="checkbox"/>	Credit 2	Development Density and Community Connectivity	5
<input type="checkbox"/>	Credit 3	Brownfield Redevelopment	1
<input type="checkbox"/>	Credit 4.1	Alternative Transportation—Public Transportation Access	6
<input type="checkbox"/>	Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
<input type="checkbox"/>	Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
<input type="checkbox"/>	Credit 4.4	Alternative Transportation—Parking Capacity	2
<input type="checkbox"/>	Credit 5.1	Site Development—Protect or Restore Habitat	1
<input type="checkbox"/>	Credit 5.2	Site Development—Maximize Open Space	1
<input type="checkbox"/>	Credit 6.1	Stormwater Design—Quantity Control	1
<input type="checkbox"/>	Credit 6.2	Stormwater Design—Quality Control	1
<input type="checkbox"/>	Credit 7.1	Heat Island Effect—Nonroof	1
<input type="checkbox"/>	Credit 7.2	Heat Island Effect—Roof	1
<input type="checkbox"/>	Credit 8	Light Pollution Reduction	1

Water Efficiency

10 Possible Points

<input checked="" type="checkbox"/>	Prerequisite 1	Water Use Reduction	Required
<input type="checkbox"/>	Credit 1	Water Efficient Landscaping	2-4
<input type="checkbox"/>	Credit 2	Innovative Wastewater Technologies	2
<input type="checkbox"/>	Credit 3	Water Use Reduction	2-4

Energy and Atmosphere

35 Possible Points

<input checked="" type="checkbox"/>	Prerequisite 1	Fundamental Commissioning of Building Energy Systems	Required
<input checked="" type="checkbox"/>	Prerequisite 2	Minimum Energy Performance	Required
<input checked="" type="checkbox"/>	Prerequisite 3	Fundamental Refrigerant Management	Required
<input type="checkbox"/>	Credit 1	Optimize Energy Performance	1-19
<input type="checkbox"/>	Credit 2	On-site Renewable Energy	1-7
<input type="checkbox"/>	Credit 3	Enhanced Commissioning	2
<input type="checkbox"/>	Credit 4	Enhanced Refrigerant Management	2
<input type="checkbox"/>	Credit 5	Measurement and Verification	3
<input type="checkbox"/>	Credit 6	Green Power	2

Materials and Resources

14 Possible Points

<input checked="" type="checkbox"/>	Prerequisite 1	Storage and Collection of Recyclables	Required
<input type="checkbox"/>	Credit 1.1	Building Reuse—Maintain Existing Walls, Floors and Roof	1-3
<input type="checkbox"/>	Credit 1.2	Building Reuse—Maintain Existing Interior Nonstructural Elements	1
<input type="checkbox"/>	Credit 2	Construction Waste Management	1-2
<input type="checkbox"/>	Credit 3	Materials Reuse	1-2
<input type="checkbox"/>	Credit 4	Recycled Content	1-2

<input type="checkbox"/>	Credit 5	Regional Materials	1-2
<input type="checkbox"/>	Credit 6	Rapidly Renewable Materials	1
<input type="checkbox"/>	Credit 7	Certified Wood	1

Indoor Environmental Quality

15 Possible Points

<input checked="" type="checkbox"/>	Prerequisite 1	Minimum Indoor Air Quality Performance	Required
<input checked="" type="checkbox"/>	Prerequisite 2	Environmental Tobacco Smoke (ETS) Control	Required
<input type="checkbox"/>	Credit 1	Outdoor Air Delivery Monitoring	1
<input type="checkbox"/>	Credit 2	Increased Ventilation	1
<input type="checkbox"/>	Credit 3.1	Construction Indoor Air Quality Management Plan—During Construction	1
<input type="checkbox"/>	Credit 3.2	Construction Indoor Air Quality Management Plan—Before Occupancy	1
<input type="checkbox"/>	Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
<input type="checkbox"/>	Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
<input type="checkbox"/>	Credit 4.3	Low-Emitting Materials—Flooring Systems	1
<input type="checkbox"/>	Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
<input type="checkbox"/>	Credit 5	Indoor Chemical and Pollutant Source Control	1
<input type="checkbox"/>	Credit 6.1	Controllability of Systems—Lighting	1
<input type="checkbox"/>	Credit 6.2	Controllability of Systems—Thermal Comfort	1
<input type="checkbox"/>	Credit 7.1	Thermal Comfort—Design	1
<input type="checkbox"/>	Credit 7.2	Thermal Comfort—Verification	1
<input type="checkbox"/>	Credit 8.1	Daylight and Views—Daylight	1
<input type="checkbox"/>	Credit 8.2	Daylight and Views—Views	1

Innovation in Design

6 Possible Points

<input type="checkbox"/>	Credit 1	Innovation in Design	1-5
<input type="checkbox"/>	Credit 2	LEED Accredited Professional	1

Regional Priority

4 Possible Points

<input type="checkbox"/>	Credit 1	Regional Priority	1-4
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LEED 2009 for New Construction and Major Renovations

100 base points; 6 possible Innovation in Design and 4 Regional Priority points

Certified	40–49 points
Silver	50–59 points
Gold	60–79 points
Platinum	80 points and above