

Latest Development of Building Energy Code in Hong Kong

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Abstract

The Chief Executive of the Government of Hong Kong Special Administrative Region (HKSAR) states in the Policy Address 2008-09 that the Government will promote a low carbon economy in the HKSAR. One of the effective and proven means to achieve this goal is through energy efficiency enhancement. Mandatory implementation of Building Energy Codes is one of the major government initiatives for enhancement of the efficient use of energy in buildings. This paper will give a brief account of this government initiative.

Keywords: BEC, Building Energy Codes

1. Introduction

This paper outlines the HKSAR Government's philosophy and proposal on introducing legislation to require the specified types of buildings to comply with the Building Energy Codes (BECs) issued by the Electrical and Mechanical Services Department (EMSD). This is a major government initiative for enhancement of energy efficiency to make Hong Kong moving towards a low carbon economy.

2. Background

One of the issues that tops the agenda of the international community is climate change. Governments from around the world have been striving to formulate measures that strike an appropriate balance between economic development and the reduction of greenhouse gas emissions so as to achieve sustainable development including low carbon economy.

Hong Kong consumed a total energy of 288,155 Terajoule (TJ) at end-use level in 2006. The energy consumption was also increasing at an average annual rate of around 1.3% in the past years. About 50% of the energy consumed in 2006, i.e. 145,204 TJ, belonged to electricity consumption, of which around 90% were for buildings. Figure 1 below shows the distribution of energy consumption by sector in 2006. Figure 2 below shows the distribution of energy consumption by types of services in a typical office building. As electricity generation is the single largest source of air pollution in Hong Kong, contributing to 89%, 46% and 28% of emissions of sulphur dioxide (SO₂), nitrogen oxides

(NO_x) and particulates (RSP) respectively in 2007, it follows that improving energy efficiency would also help improve local air quality.

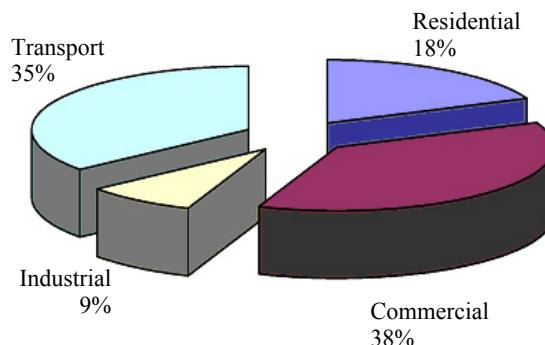


Figure 1: Energy Consumption by Sector in 2006

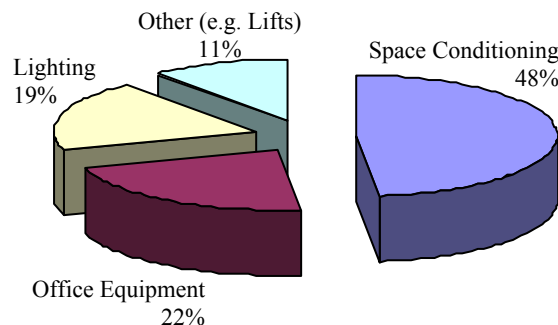


Figure 2: Energy Consumption in a Typical Office Building

As the Chief Executive has outlined in the Policy Address 2007-08, Hong Kong is committed to doing its part in improving the regional environment and fulfilling the applicable convention and consensus. HKSAR Government will honor its pledge and seek to achieve the reduction goal adopted in the Asia-Pacific Economic Co-operation Leaders' Declaration on Climate Change, Energy Security and Clean Development in September 2007, i.e. to reduce energy intensity by at least 25% by 2030 (with 2005 as the base year). To meet this target, we have to enhance our energy efficiency.

It is evident from the foregoing energy consumption analysis that energy efficiency in buildings is an area where significant energy savings and greenhouse gas emission reduction can be made. There are thus very good reasons to make a strong push for its attainment to complement other Government's efforts on reducing energy intensity as well as alleviating global warming

and combating air pollution. The BEC will be an effective means to contribute to reducing energy intensity by enhancing the building energy efficiency.

3. The Voluntary Hong Kong Energy Efficiency Registration Scheme for Buildings (HKEERSB)

Considering that commercial buildings and the communal parts of residential and industrial buildings account for a significant portion of the total energy consumption, the EMSD has since 1998 developed a set of five BECs (latest edition: 2007) and at the meantime launched the voluntary HKEERSB to promote the adoption of the BECs. Under the voluntary HKEERSB, the building developers/owners may apply for certification for either one or more of the four key types of fixed building services installations, namely, lighting, air-conditioning, electrical and lift & escalator installations in their buildings provided that the relevant installations have complied with the minimum energy efficiency requirements in the respective BECs. If the submission is found satisfactory, the EMSD will issue a certificate as recognition of the energy efficiency performance of the individual installation. Together, the four key types of fixed building services installations consume up to about 80% of the total electricity consumption of a typical office building. Recognition is given by way of the issue of a certificate for compliance with any of the following BECs¹ in Table 1 below.

Title	Key performance standards
Code of Practice for Energy Efficiency of Lighting Installations [BEC (Lighting)]	<ul style="list-style-type: none"> a) Luminous efficacies of various types of lamps; b) Power loss of lamp control gears; c) Lighting power densities of various indoor areas; and d) Number of lighting control points
Code of Practice for Energy Efficiency of Air Conditioning Installations [BEC (Air Conditioning)]	<ul style="list-style-type: none"> a) Efficiency of air conditioning equipment; b) Fan power per unit volume of air flow; c) Frictional loss per unit length of pipe run; d) Thickness of thermal insulation; and e) Air conditioning control system
Code of Practice for Energy Efficiency of Electrical Installations [BEC (Electrical)]	<ul style="list-style-type: none"> a) Efficiency of electric motors; b) Power loss in electrical distribution system; c) Harmonic distortion in electrical system; and d) Provision of metering devices

Title	Key performance standards
Code of Practice for Energy Efficiency of Lift & Escalator Installations [BEC (Lift & Escalator)]	<ul style="list-style-type: none"> a) Electric motor power of lifts/escalators; and b) Lift and escalator control system
Performance-based Building Energy Code [BEC (PB)]	<ul style="list-style-type: none"> a) Specification of the method to derive the Design Energy value from the actual design and operational characteristics of a building; and b) Specification of the method to derive the Energy Budget value, which is evaluated based on a hypothetical building of the same size and shape of the building fully in compliance with the minimum requirements in the BEC (Lighting), BEC (Air Conditioning), BEC (Electrical) and BEC (Lift & Escalator)

Table 1: Key Performance Standards of the BECs

The 1st four BECs are prescriptive in nature. An installation will be in compliance with the respective BEC if it satisfies the minimum energy efficiency performance requirements stipulated therein. The remaining BEC (PB) sets out an alternative performance-based means to evaluate and assess the energy efficiency performance of a building.

Since implementation of the voluntary HKEERSB, the EMSD has issued a total of 2,331 certificates, covering 2,501 building services installations in 963 building venues (as at March 2009). However, only around 27% of the 963 building venues are non-government premises over the past 10 years. The participation rate of private sector is disconcertingly low.

There is no disagreement that improving building energy efficiency is a cost-effective measure to address the growing concerns of global warming, local air quality and energy security. Some may however argue that as energy saving measures are cost-effective, we may and perhaps should rely on market-driven forces to achieve efficiency gain, which is in fact in line with the Government's regulatory philosophy generally. Yet, such forces appear not promising over the past 10 years. There are impediments to the effective operation of the market force in Hong Kong's situation: the notable one being the split incentive between developers/landlords who make the capital investment and occupants who enjoy savings in the electricity bills later. With the pressing environmental aspiration and needs, the HKSAR Government thus proposed the mandate compliance with the BECs.

¹ The BECs can be downloaded at http://www.emsd.gov.hk/emsd/eng/pee/eersb_pub_cp.shtml.

4. Overseas Practices on Mandatory Building Energy Codes

Indeed, the useful role of mandatory compliance of minimum energy efficiency requirements in promoting energy efficiency and conservation in buildings has been well established internationally. The Mainland China and some overseas countries, such as Australia, Singapore, England, California of United States of America etc., have implemented minimum energy efficiency requirements for buildings by legislation for years. We of course make reference to these countries' practices when formulating our legislative proposal of the mandatory BEC.

A comparison of some of the latest standards adopted in our BECs with the standards adopted by some overseas countries and the Mainland China is shown in Tables 2 to 4 below (as at December 2007). Our standards on air-conditioning systems and electrical installations are broadly comparable to the standards adopted by other jurisdictions, whereas our standards on lighting installations are relatively less stringent to meet the general local preference for better-illuminated interior spaces. Besides, the EMSD has put in place the BEC (Lift & Escalator), unique to the built environment of Hong Kong which is dominated by high-rise buildings. We are not yet aware of other overseas practices that have introduced energy efficiency standards for lifts and escalators.

Spaces	Maximum Allowable Lighting Power Density (W/m ²)					
	Hong Kong BEC	Australia BCA	Singapore SS 530	US ASHRAE 90.1	Europe (e.g. UK Approved Document L2)	China GB 50034
Open Plan Office / Cellular Office	17	7-10	15	11.8 - 16.1	Not less than 40 luminaire-lumen per circuit watt	11 - 18
Retails	20	25	25	18.3	No specific requirement	11 - 20
Restaurant	23	20	15	15		13
Atrium / Foyer	25	10	10	-		-

Table 2: Comparison of some standards of Lighting Power Density in various jurisdictions

Type/Rating of air-conditioning Chiller	Coefficient of Performance					
	Hong Kong BEC	Australia BCA	Singapore SS 530	US ASHRAE 90.1	Europe (e.g. UK Approved Document L2)	China GB 50189
Air cooled, scroll / screw	2.7 – 2.9	2.2 – 2.5	2.80	2.80	Requirement is set on overall air-conditioning system performance instead of on coefficient of performance for chillers	2.40 – 2.60
Water cooled, screw, 500 – 1000kW	4.6	4.5	4.45 – 4.90	4.90		4.30
Water cooled, screw, >1000kW	5.5	5.5	4.90 – 5.50	5.50		4.60
Water cooled, centrifugal, 500 – 1000kW	4.5	4.5	5.00 – 5.55	5.55		4.70
Water cooled, centrifugal, >1000kW	5.7	5.5	5.55 - 6.10	6.10		5.10

Table 3: Comparison of some standards of Coefficient of Performance of typical air-conditioning chillers in various jurisdictions

Motor (4-pole) Rating, P (kW)	Minimum Efficiency (%)					
	Hong Kong BEC	Australia BCA	Singapore SS 530	US ASHRAE 90.1	Europe (e.g. CEMEP ²)	Mainland GB 50189
1.1 ≤ P < 5.5	76.2 – 84.2	No specific requirement	83.8 – 88.3	84.0 – 87.5	76.2 – 84.2	No specific requirement
5.5 ≤ P < 22	85.7 – 90.0		89.2 – 92.2	89.5 – 92.4	85.7 – 90.0	
22 ≤ P < 55	90.5 – 92.5		92.6 – 93.9	92.4 – 93.6	90.5 – 92.5	
55 ≤ P < 90	93.0 – 93.6		94.2 – 94.7	94.1 – 94.5	93.0 – 93.6	
P ≥ 90	93.9		95.0	94.5	93.9	

Table 4: Comparison of some standards of Electrical Motor Efficiency in various jurisdictions

² The motor efficiency figures represent the major market share of electrical motors in European countries.

5. Our Proposal of Mandatory Building Energy Codes

The HKSAR Government had conducted a public consultation on the proposal of mandatory implementation of the BEC from December 2007 to March 2008. The result indicated that there was overwhelming support from the stakeholders and the general public to the principal direction of legislation. They also supported to adopt the current BECs 2007 Edition as the basis of the future mandatory standards. The law drafting works and the fine-tuning of the BECs 2007 Edition to a legislative version is in progress at the moment of writing this paper. It is planned to submit the relevant bill to the Legislative Council of HKSAR in 2009.

In the build-up of the legislative proposal, the following philosophies have been taken into account:

- a) Major building energy consumers (at least commercial buildings, common areas of residential & industrial buildings etc.) should comply with BEC. However, small buildings (say smaller than some certain area or power rating etc.) should be exempted from compliance since the cost effectiveness of regulation for these buildings will be very low.
- b) To avoid over-disturbing general public's daily life, residential units are not recommended to be included. In parallel, another mandatory scheme in energy efficiency imminently coming into effect, the Mandatory Energy Labelling Scheme, will help improving energy savings in residential units, in which the energy performance of some major domestic appliances like room coolers, refrigerators and compact fluorescent lamp has been regulated.
- c) Industrial units are also not recommended to be included since industrial processes may require specific energy inputs and operators are normally compelled to remain in competitiveness through efficiency gains.
- d) Energy efficiency of new buildings may be raised through regular review/update of the BECs with consideration of the worldwide development trend and public aspirations.
- e) Energy efficiency of existing buildings should be improved when there are opportunities, i.e. when major retrofitting of the covered installations is carried out. Retrospectively compulsory compliance with the BECs in existing buildings, even after a transitional period, will not be appropriate since it will lead to large amount of environmental wastes if the installations are not near the end of their services life. Financial burdens to owners or responsible persons for the upgrading works are also of major concern.
- f) Commercial buildings are major energy consumers and should have more rooms for energy savings. Meanwhile, commercial operators should usually be the most capable group to fund energy audits.
- g) Exhibition of energy performance (energy audit results) of commercial buildings will drive owners or responsible persons to look for improvement for better business image.
- h) Implementation of Energy Management Opportunities (EMOs) identified from energy audit should be at owners' or responsible persons' initiatives, as the improvement should be self-driving through cost effectiveness of the EMOs and the energy savings in return.

On the basis of the above considerations, below are the key points of our latest legislative proposal:

- i. In general, buildings with main electrical switches rated at 100A or below, 1-phase or 3-phase and premises of internal floor areas less than 500 m² will be exempted from regulation (coverage of exemption subject to the requirements of various clauses).
- ii. The scope of buildings to be governed includes commercial buildings, residential buildings (common area only), industrial buildings (common area only), educational buildings, community buildings, municipal buildings, institutional buildings, hospitals and clinics etc.
- iii. Both private and government buildings will be governed.
- iv. For new buildings with building plans approved after the enactment of the new legislation, the concerned building services installations should comply with the energy efficiency requirements in the BEC upon construction completion. A registration certificate from the EMSD should be obtained.
- v. For existing building with major retrofitting works (such as addition/replacement of major components of the covered building services installations in premises of internal floor area not less than 500m² or works on the covered installations with a floor area not less than 500m²), the building services installations involved in the works should comply with the BEC upon works completion. A certificate from a competent person should be obtained.
- vi. For commercial buildings, an energy audit should be conducted once every 10 years. The energy audits should be certified by a competent person. The energy audit results should also exhibited at the buildings. However, implementation of EMOs identified from energy audit will not be compulsory.
- vii. The first round of energy audit for existing commercial buildings is proposed to be completed within 4 years after the enactment of the relevant part of the proposed ordinance.
- viii. Competent persons should be registered by the EMSD under the proposed new ordinance. They should be qualified engineers in building services, electrical, mechanical or environmental disciplines plus adequate post-qualification experience.

ix. Failing to comply with the proposed ordinance will be subject to fines.

comparison of some of our legislative proposals with the practices adopted by some other jurisdictions is shown in Tables 5 to 7 below (as at December 2008).

Indeed, our proposals are broadly comparable to the practices adopted by other jurisdictions. A brief

	Mandatory / Voluntary BEC	BEC document on energy efficiency standards	Legislations concerned
Hong Kong	Voluntary (under proposal for mandatory implementation)	Codes of Practice for Energy Efficiency in electrical, lighting, air-conditioning, lift & escalator Installations and Performance-based Building Energy Code	(Under proposal) Building Energy Efficiency Bill
Australia	Mandatory	Included in the Building Code of Australia	Implemented by States, e.g. Australian Capital Territory's Building Regulations
Singapore	Mandatory	SS 530 – Energy Efficiency Standard for Building Services and Equipment	Building Control Act 2003 – Building Control Regulations
England	Mandatory	Approved Document L2 – Conservation of fuel and power in buildings other than dwellings	Building Act – Building Regulations
California	Mandatory	Building Energy Standards, California Energy Commission	Energy Building Regulations
China	Mandatory	GB 50189 – 《公共建築節能設計標準》 (Design standard for energy efficiency of public buildings)	中华人民共和国国务院令 第 530 号 Act 530 of State Council of the People's Republic of China – 《民用建筑节能条例》 (Ordinance of Energy Conservation in Civil Buildings)

Table 5: Comparison of general BEC legislation in various jurisdictions

	Retrospective power to existing buildings	Applicable to alteration / additional works in existing buildings	Criteria for application in existing buildings	Reference document for requirements to existing buildings
Hong Kong	No (under proposal)	Yes (under proposal)	(Under proposal) Major retrofitting works such as addition/replacement of major components of the covered building services installations in premises of internal floor area $\geq 500\text{m}^2$ or building services installations works with a floor area of $\geq 500\text{m}^2$	(Under proposal) Building Energy Efficiency Bill
Australia	No	Yes	Substantial alteration of a building with the aggregate volume of the proposed alteration made to the building during the 3 years immediately before the day the application for building approval of the alteration made $> 50\%$ of the volume of the original building	Building Act 2004 – Building Regulation 2004 – Section 16
Singapore	No	Yes	Additions or extensions to existing buildings which involve increasing the gross floor area of the existing buildings $\geq 2,000\text{m}^2$; Building works which involve major retrofitting to existing buildings with gross floor area $\geq 2,000\text{m}^2$.	Building Control Act (Chapter 29) – Building Control (Environmental Sustainability) Regulations 2008 – Section 3

	Retrospective power to existing buildings	Applicable to alteration / additional works in existing buildings	Criteria for application in existing buildings	Reference document for requirements to existing buildings
England	No	Yes	Existing buildings > 1,000 m ² will be subject to energy performance improvements when they undergo major refurbishment or renovations. Their energy performance should be upgraded as much as is technically and economically feasible in accordance with national performance standards.	EU Directives 2002/91/EC (New Directives under consideration – removal of the 1,000 m ² threshold)
California	No	Yes	The envelope and lighting of the addition, any newly installed space-conditioning or water heating system serving the addition, any addition to an outdoor lighting system, and any new sign installed in conjunction with an indoor or outdoor addition shall meet the applicable requirements	California Energy Commission - Building Energy Standards – Subchapter 6
China	Subject to individual building proposal	Subject to individual building proposal	<p>Clause 24 – Transformation of energy conservation for existing buildings shall be implemented in a sorted, planned & step-by-step manner according to the actual situations of the local economic & community development levels and geographical & climatic conditions etc.</p> <p>The transformation of energy conservation for existing buildings mentioned in this Ordinance means the implementation of transformation activities of energy conservation for the building envelopes, heat supply systems, heating & cooling systems, lighting installations and hot water supply facilities etc. of the existing buildings that do not comply with the mandatory standards of energy conservation for civil buildings.</p> <p>Clause 25 – The construction authorities of local people’s governments at county level or above shall organise survey, statistic and analysis for the years of construction, forms of structure, energy consumption systems, energy consumption indicators and life cycle etc. of the existing buildings in the local administrative regions; establish transformation plan of energy conservation and define the target, scope & requirement of the transformation of energy conservation. The aforesaid plan, target, scope and requirement shall be submitted to the local people’s government for approval before implementation.</p> <p>Regarding the transformation of energy conservation for existing buildings of the Central Government’s organisations, the relevant management authorities shall establish, organise and implement the transformation plan of energy conservation.</p>	Act 530 of State Council of the People’s Republic of China – Ordinance of Energy Conservation in Civil Buildings: Clause 24 & Clause 25

Table 6: Comparison of BEC legislation on existing buildings in various jurisdictions

	Mandatory energy audit in buildings?	Brief scope of application	Reference document for mandatory energy audit requirements
Hong Kong	Yes (under proposal)	Commercial buildings and commercial portions of composite buildings with main electrical switches > 100A, 1-phase or 3-phase (under proposal)	(Under proposal) Building Energy Efficiency Bill
European Union	Widely adopted in EU member countries including England & Wales, Germany, Denmark, Italy, France, Netherlands, Portugal, Spain etc.	<ul style="list-style-type: none"> ◆ All buildings (excluding buildings to be demolished, buildings for worship, officially protected buildings, temporary buildings, industrial sites, workshops, & agricultural buildings with low energy demand, and stand-alone buildings < 50m²) ◆ Air conditioning systems of capacity > 12kW 	“Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings” (http://europa.eu/scadplus/leg/en/lvb/127042.htm)
USA	Not widely adopted but being emerging in various cities or states	<ul style="list-style-type: none"> ◆ Commercial building (excluding industrial buildings) ◆ Residential buildings ◆ Multi-family buildings 	For example, “An Ordinance adding A New Chapter 6-7 to The City Code relating to Energy Conservation Audit and Disclosure Requirements” approved on 6 November 2008 in Austin, Texas (http://www.ci.austin.tx.us/council_meetings/wams_item_attach.cfm?recordID=14388)
Canada	Not widely adopted but being emerging in various cities or provinces	Homes sold or rent	For example, the proposed Green Energy Act in Toronto, Ontario (http://www.nationalpost.com/most_popular/story.html?id=1321615&p=1)
Australia	No		
Singapore	No		

Table 7: Comparison of energy audit legislation in various jurisdictions

6. Way forward

HKSAR Government is committed to promoting a low carbon economy with mandatory BEC as one of the major initiatives. While implementing this initiative, we should at the meantime evaluate the responses from the public and the market, and the impacts on the resources and financial affordability of the building professions and building users. Indeed, a Technical Task Force with representatives from real estate developers association, professional organizations, contractors’ associations, property management associations, academes and government departments etc. has been set up to review the BEC requirements for the legislative purpose. In the future, the BEC should also be reviewed from time to time with reference to worldwide experience.

Another Trade Task Force with representatives from business trade associations, major professional organizations, property management associations, Construction Industry Council, Engineers Registration Board and government bureaus/departments etc. has also been established to discuss the legislative proposal for mandatory implementation of the BEC. Consultant has also been engaged to conduct a business impact

assessment to study the impact to local business in case of legislation.

As a long-run strategy to drive the stakeholders and the public to enhance the energy efficiency of their buildings in Hong Kong, development of a comprehensive local building energy benchmarking system may be considered after enactment of the proposed ordinance through which energy performance data of buildings may be more effectively collected.

In conclusion, energy efficiency and conservation is no doubt an essential means for a low carbon economy and a better tomorrow.

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