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BUILDING ENERGY CODE
THE WAY TOWARDS LOW CARBON BUILDING

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ABSTRACT

Climate change has become an unprecedented challenge of human. Being part of the international community, the Government of Hong Kong Special Administrative Region (HKSAR) has been striving to formulate long-term strategies and measures in combating climate change and focusing on a low carbon built environment. One of the effective and proven means to achieve this goal is by promoting energy efficiency in buildings.

To reduce carbon emission, it is imperative to improve energy efficiency in buildings. The Electrical & Mechanical Services Department (EMSD) has issued five sets of Building Energy Code (BEC) since 1998, covering lighting, air-conditioning, electrical as well as lift and escalator installations, which stipulate the minimum energy performance standards of these installations and has also launched the voluntary Hong Kong Energy Efficiency Registration Scheme for Buildings to promote the application of BEC. However, the participation rate of the private sector is on the low side. Hence, the Government proposed to mandate compliance of the BEC by means of legislation similar to that in the Mainland and in many overseas countries.

The public consultation in 2008 concluded that the mandatory implementation of BEC would be the right direction for promoting energy efficiency and conservation in buildings. Given the general support from the public and various stakeholders, the Buildings Energy Efficiency Bill was introduced into the Legislative Council (LegCo) of HKSAR in end 2009. The Bill seeks to require compliance with codes of practice promulgated by EMSD concerning the energy efficiency of key types of building service installations and energy audits in specified types of buildings. The Bill was passed by the LegCo on 24 November 2010. This paper will give a brief account of this new legislation.

1. BACKGROUND

Buildings account for about 89% of the total electricity consumption in Hong Kong. Improving building energy efficiency will help improve local air quality and alleviate the adverse effect of climate change. Considering that commercial building 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 the BEC[1] and at the meantime launched the voluntary Hong Kong Energy Efficiency Registration Scheme for Buildings (HKEERSB) to promote the adoption of the BEC. The BEC prescriptively stipulates energy efficiency requirements for four key types of fixed building services installations in buildings, namely, lighting, air conditioning, electrical and lift & escalator

[1] The latest version is the 2007 Edition. The BEC can be downloaded at http://www.emsd.gov.hk/emsd/eng/pee/eersb_pub_cp.shtml.

installations. These four types of building services installations have accounted for around 80% of the total electricity consumption of a modern office building, as show in Figure 1. In principle, the BEC mainly control the design standards but not the daily operation settings of the concerned building services installations. The BEC also sets out an alternative performance-based approach to evaluate and assess the energy efficiency performance of a building.

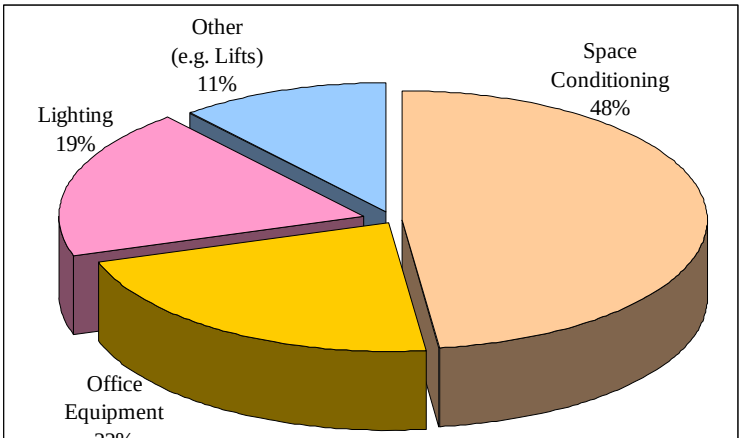


Figure 1 - Electricity Consumption in a Typical Office

At present, compliance with the BEC is on a voluntary basis. The building developers/owners may apply for certification for each of the four key types of fixed building services installations in their buildings provided that the relevant installations have complied with the respective minimum energy efficiency requirements in the BEC. Since implementation of the voluntary HKEERSB, the EMSD has issued a total of 2,795 certificates for 1,216 building venues (as at December 2010). However, only around 28% of the 1,216 building venues are non-government premises over the past 12 years. The participation rate of private sector is disconcertingly low.

Mandatory compliance with minimum building energy efficiency standards is widely practiced overseas including the European Union, the Mainland China, the United States, Australia and Singapore. As voluntary compliance with BEC appears not to be forthcoming in Hong Kong, we consider that the mandatory implementation of BEC will be an effective means to contribute to enhancing Hong Kong's overall energy efficiency.

2. PREPARATION OF THE LEGISLATIVE PROPOSAL AND CODES

The 3 month public consultation on the mandatory implementation of BEC was ended in March 2008. The vast majority of the views supported the direction of the proposal. Given the general support from the public and various stakeholders, the Environment Bureau and EMSD commenced preparing the legislative proposal for the mandatory implementation of BEC, i.e. the Buildings Energy Efficiency Bill, based on the views collected. A Technical Taskforce was also formed with relevant trade parties, professional institutions, academics and government departments to assist in the formulation of the legislative framework, and the BEC and the Energy Audit Code (EAC) for the mandatory scheme.

3. BUILD-UP OF THE LEGISLATIVE PROPOSAL

In formulating the legislative proposal, the following philosophies were taken into consideration:

(a) Major building energy consumers such as commercial buildings should comply with BEC. However, small buildings could be excluded from compliance from the angle of cost effectiveness of regulating these types of buildings.

(b) To avoid undue disturbance to the general public, residential units are not recommended to be included. Instead, the Mandatory Energy Efficiency Labelling Scheme will help improving energy savings in residential units, in which the energy performance of major domestic appliances like room coolers, refrigerators and compact fluorescent lamps are 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 BEC 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 concerned installations is carried out.

(f) Mandatory compliance with the BEC retrospectively in existing buildings, even after a transitional period, will not be appropriate if these buildings are not going to carry out major retrofitting work, as it will lead to environmental wastes if the existing 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.

(g) Exhibition of energy audit results of commercial buildings will drive owners or responsible persons to look for improvement for better business image and opportunities.

(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.

4. LEGISLATIVE FRAMEWORK OF MANDATORY IMPLEMENTATION OF BUILDING ENERGY CODE

4.1 Coverage

The following categories of buildings in the public and private sectors shall be required to comply with BEC:

i) Commercial building (e.g. office, shopping complex etc.);
ii) Hotel and guesthouse;
iii) A portion of a composite building that is not for residential or industrial use;
iv) Common areas of residential building;
v) Common areas of a portion of a composite building that is for residential or industrial use;
vi) Common areas of an industrial building;
vii) Educational building;
viii) Community building (e.g. community centers, elderly homes, youth centres etc.);
ix) Government building (e.g. government office buildings, fire stations, police stations etc.);
x) Municipal building (e.g. markets, libraries etc.);
xi) Hospital and clinic;
xii) Airport passenger terminal building;
xiii) Railway station

4.2 Exclusion

However, the following categories of buildings will be excluded from the legislative control:

(a) Buildings with the main electrical switch at approved loading of 100A or below, 1-phase or 3-phase;

(b) All small buildings with size not exceeding specified criteria;

(c) Declared or proposed monuments or historical building under the Antiquities and Monuments Ordinance; and

(d) Buildings that will be demolished or redeveloped in the coming one year.

Besides, it is proposed to exclude some certain types of building services installations based on operational and technical grounds such as those involving fire protection, life safety, construction site, industrial undertaking, research, air traffic safety, railway traffic safety, etc.

4.3 Control Regimes

Different control regimes will be imposed on post-enactment buildings and pre-enactment buildings. Post-enactment buildings mean buildings that obtain the consent to the commencement of building works for superstructure construction from the Building Authority of HKSAR after the new legislation comes into operation. Vice versa, pre-enactment buildings mean buildings that obtain the consent to the commencement of building works for superstructure construction on or before the new legislation comes into operation. Developers, owners or responsible persons as appropriate will be responsible for complying with the requirements depending on the stages of the buildings or the scale of the major retrofitting works.

4.3.1 Certificates of Compliance Registration (COCR) for Post-Enactment Buildings

Developers are required to submit a stage one declaration to the Director of Electrical and Mechanical Services (DEMS) after obtaining the consent to the commencement of building works for superstructure construction. The stage one declaration is to declare that suitable design provisions have been included to enable compliance with BEC. After obtaining the occupation approval, developers are required to submit a stage two declaration to confirm compliance with BEC. Both declarations have to be certified by Registered Energy Assessors (REAs). DEMS will issue Certificates of Compliance Registration (COCR) for buildings upon receipt of the required information and documents. A register of buildings issued with COCR will be available for public inspection. Building owners are required to apply for renewal of COCR in respect of the central building services installations once every ten years. Building services installations in individual unit and common area of post-enactment buildings, as well as their central building services installations, are required to comply with BEC at all times.

4.3.2 Form of Compliance (FOC) for Major Retrofitting Works

Pre-enactment buildings would be required to improve energy efficiency only when the buildings undergo major retrofitting works. Responsible persons or owners of pre-enactment buildings are required to obtain Forms of Compliance (FOC), to be certified by registered energy assessors (REA), for major retrofitting works. The responsible person (e.g. owners, tenants) of the relevant unit or common areas in a building, upon the completion of the works, is required to appoint REA to certify that the relevant retrofitted building services installations have complied with the BEC. The REA will then be required to issue FOC to the responsible

person upon certification. Major retrofitting works to be regulated are specified in Schedule 3 of the Ordinance as below:

(i) Works involving addition or replacement of a building services installation specified in a Code of Practice that covers one or more places with a floor area or total floor area of not less than 500 m^2 under the same series of works within 12 months in a unit or a common area of a prescribed building.

(ii) Addition or replacement of a main component of a central building services installation, including –

(a) addition or replacement of a complete electrical circuit at rating of 400A or above;

(b) addition or replacement of a unitary air-conditioner or air-conditioning chiller of a cooling or heating rating at or exceeding 350 kW; or

(c) addition or replacement of the motor drive and mechanical drive of a lift, an escalator or a passenger conveyor.

Similar to the requirements set out for pre-enactment buildings, the responsible person of the relevant unit or common areas in a post-enactment building are required to obtain FOC for major retrofitting works.

4.3.3 Energy Audit

Owners of commercial buildings and commercial portion of composite buildings (both post-enactment and pre-enactment buildings) are required to conduct energy audits for the central building services installations of their buildings once every ten years. Energy audits should be carried out by REA and the audit results should be exhibited in a conspicuous position at the main entrance of the buildings.

For post-enactment buildings, the first energy audit should be conducted within 10 years after the issue of the first COCR. In order to allow sufficient time for the public to conduct energy audit for pre-enactment buildings, the first round of energy audits for these buildings will be allowed to be conducted in batches according to the age of the buildings, the newer the earlier. We expect to complete the first round of energy audits in 4 years.

The energy audit will only be an assessment of the energy performance and energy management in order to identify the EMOs for the buildings. The building owners will not be compulsorily required to follow the improvement measures recommended by the energy audit in consideration of the wide variety of the possible measures in terms of scope and cost.

4.3.4 Registered Energy Assessors

Registered Energy Assessors (REAs) will play a key role under the legislation. They will be appointed by developers, building owners or responsible persons to carry out the following major duties -

(i) certifying compliance with the BEC for developers / building owners to apply for COCR;

(ii) issuing FOC to responsible persons of unit/common area, and copy it to EMSD; and

(iii) conduct energy audits for building owners

Registered professional engineers under the Engineers Registration Ordinance or corporate members of the Hong Kong Institution of Engineers in electrical, mechanical, building services or environmental disciplines, who possess relevant post-qualification working experience and knowledge, may apply to DEMS for registration as REAs. Detailed provisions concerning registration and regulation of REAs will be made in a subsidiary regulation to be made. A register of REAs will be available to the public for inspection. REAs failing to comply with requirements as imposed on them under the legislation may be subject to disciplinary actions.

4.3.5 Improvement Notice

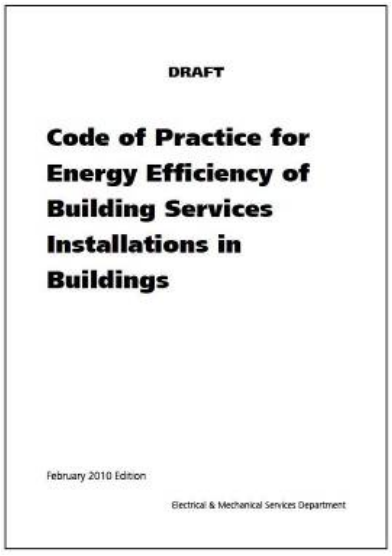
The prime objective of the legislation is to promote energy efficiency. A mechanism to require building owners or responsible persons to take action to comply with the BEC has been incorporated in the legislation so that DEMS may serve an Improvement Notice if contravention to the statutory requirements is found.

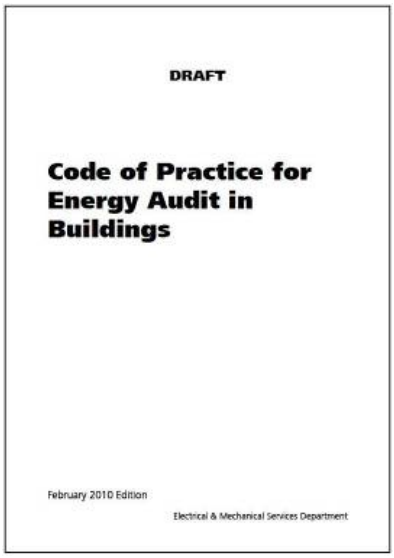
4.3.6 Monetary and imprisonment penalties

Monetary penalties will be imposed on developers, building owners, responsible persons or REAs for non-compliance under the legislation. Imprisonment penalty may be applied to a person who is liable for obstructing an authorized officer in exercising the power under the Ordinance or who provides any false or misleading information/document required under the Ordinance.

5. BUILDING ENERGY CODE AND ENERGY AUDIT CODE FOR MANDATORY SCHEME

The BEC has taken into account the development of energy efficiency technology, design practices, local needs incorporated with good engineering practices. It sets out the minimum energy efficiency standards governing the prescribed building services installations. The prescribed building services installations designed in accordance with the BEC will be deemed to have satisfied the relevant statutory requirements in the technical aspects.





An energy audit is a systematic review of the energy consuming equipment/systems in a building to identify EMOs and provide useful information for the building owners to decide and implement energy saving measures for environmental consideration and economic benefits. Similar to BEC, compliance with the EAC will also be deemed to have satisfied the relevant statutory requirements in the technical aspects.

To prepare for the new legislation, EMSD has prepared the BEC and EAC of which the draft copies are available from EMSD's website. The key energy efficiency requirements of the draft BEC and the key technical requirements of the draft EAC are summarized in Table 1 and Table 2 respectively.

Table 1: Key Energy Efficiency Requirements of the draft BEC

BEC	
Four Key Building Services Installations	**Key energy efficiency requirements**
Lighting Installations	a) Lighting power densities of various indoor areas; and b) Number of lighting control points
Air Conditioning Installations	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; e) Air conditioning control system f) Energy metering in chiller plant
Electrical Installations	a) Efficiency of electric motors; b) Power loss in electrical distribution system; c) Harmonic distortion in electrical system; and d) Metering devices for main, feeder and sub-main circuits
Lift & Escalator Installations	a) Electric motor power of lifts/escalators; b) Provision of metering for power quality measurement, c) Lift decoration load and Parking mode
Performance approach	a) Specification of the method to derive the Design Energy

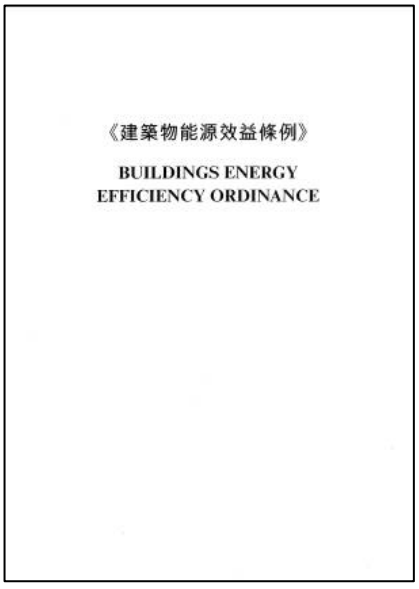
Table 2: Key Energy Audit Requirements of the draft EAC

EAC	
Steps	**Key energy audit requirements**
1	Collection of building information of various energy consuming equipment/systems a) collect building operation characteristics b) collect technical characteristics
2	Review of energy consuming equipment a) study the information collected b) conduct site inspections c) make record of the characteristics of the energy consuming equipment and systems d) identify or calculate the power and energy consumptions of the major energy consuming equipment/systems e) take measurements when the operation records not be sufficient
3	Identification of EMO a) conduct an appraisal and evaluation on the energy consuming equipment and systems b) compare with original design and relevant benchmarks c) identify any deviations from efficient operation d) identify the potential EMO for improving energy efficiency
4	Cost benefit analysis of EMO a) made an estimate on the energy saving b) carry out a cost benefit analysis when capital cost is involved
5	Recommendations

BEC		EAC	
Four Key Building Services Installations	**Key energy efficiency requirements**	**Steps**	**Key energy audit requirements**
	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 energy efficiency requirements of Lighting, Air Conditioning, Electrical and Lift & Escalator installations		a) made recommendations of the EMO to be implemented b) highlight the known programmed operation & maintenance activities of the building c) list out suggestions for further studies of equipment or components
		6	Compiling energy audit report a) outline the objectives and scope of audit, description of operating characteristics of equipment/ systems audited, findings in the audit, potential EMO identified, cost benefit analysis etc. b) recommend any other follow-up actions

6. BUILDINGS ENERGY EFFICIENCY ORDINANCE

Under the efforts of all parties, the Buildings Energy Efficiency Bill for mandatory implementation of the BEC was completed and introduced into the Legislative Council (LegCo) of HKSAR in December 2009 for vetting. The Bill and the amendments proposed by the Administration in response to the comments received during the vetting process were passed by the LegCo in November 2010. The Bill and the amendments were then gazetted as the Buildings Energy Efficiency Ordinance (Cap. 610) in December 2010. The subsidiary regulations detailing the fees and registration of REA under the Ordinance will also be submitted to the LegCo soon for vetting. It is expected that such vetting could be completed in the 1st quarter of 2011 and the registration of REA could commence around the 2nd quarter of 2011. There will be an 18-month grace period to allow various stakeholders and public having ample time to be adapted to and familiarized with the requirements of the new legislation. It is anticipated that the Ordinance will be fully implemented after mid-2012.



The Ordinance sets out the following main requirements –

(a) Part 1 contains preliminary provisions. In particular, it provides for the application of the Ordinance to the Government and limit of the scope of application;

(b) Part 2 stipulates the compliance procedures for post-enactment buildings at design stage and occupation approval stage;

(c) Part 3 stipulates the compliance procedures for major retrofitting works in pre-enactment and post-enactment buildings;

(d) Part 4 stipulates the application, compliance procedures and other details of the requirements to conduct energy audit in pre-enactment and post-enactment buildings;

(e) Part 5 empowers DEMS to serve an Improvement Notice to direct the responsible party to take remedial action where there is a contravention of a requirement under the Ordinance;

(f) Part 6 empowers DEMS to be the enforcement authority under the Ordinance. It provides for DEMS to authorize public officers to exercise any power and perform any duties conferred or imposed on him for the purposes of the Ordinance, including entering a building or an unit for inspection;

(g) Part 7 provides for the registration of Registered Energy Assessors;

(h) Part 8 contains provisions relating to appeals against the decision of DEMS made under the Ordinance. It provides for the composition of the appeal board panel and the proceedings of the appeal board. It empowers the appeal board to confirm, revoke or vary the decision or direction of DEMS. The appeal board is also empowered to substitute its own decision for the decision or direction of DEMS;

(i) Part 9 empowers DEMS to establish a Code of Practice to provide practical guidance on requirements under the Ordinance;

(j) Part 10 contains miscellaneous provisions. It empowers the Secretary for the Environment to make regulations for operational matters such as fees and registration of Registered Energy Assessors and amend any Schedule. It also empowers DEMS to delegate its power under the Ordinance, stipulates the arrangements for the service of notice, and provides for the details of offences relating to Registered Energy Assessors and furnishing false information;

(k) Part 11 contains a transitional provision;

(l) Schedule 1 lists out buildings that require COCR and FOC;

(m) Schedule 2 lists out building services installations to which the Ordinance does not apply;

(n) Schedule 3 lists out the types of major retrofitting works that require FOC;

(o) Schedule 4 lists out buildings that are required to conduct an energy audit; and

(p) Schedule 5 sets out the schedule of conducting the first energy audit for buildings without COCR.

7. FUTURE OPPORTUNITIES AND CHALLENGES

The Government of HKSAR is committed to promoting a low carbon economy with mandatory implementation of BEC as one of the major initiatives. It is roughly estimated that there will be approximately 2.8 billion kWh saving in the post-enactment buildings in the first decade after the implementation of the Ordinance. In terms of reduction in carbon dioxide emission, it will be in the region of 1.96 million tonnes in the first decade.

The new legislation is a starting point and will be an effective tool to enhance public awareness in improving building energy efficiency. Its effect will be boosted by wide good publicity to major stakeholders and general public. EMSD is now devising a detailed publicity plan to raise awareness of the public and the measures, tentatively, include publication of leaflets and posters, announcements on radio and television, advertisements at public transports, seminars and workshops, etc to enhance understanding on the requirements of the Buildings Energy Efficiency Ordinance.

Following the enactment of the new legislation, we believe that new challenges to the stakeholders including developers, building owners, architects, engineers, contractors, etc. of the building industries are coming up. To prepare for the challenges ahead, we are working closely with key stakeholders to develop various measures, such as technical guidelines, publicity leaflets and booklets, internet platform, seminars and workshops, reinforcement of the legislative and technical requirements, etc.

As a long-term strategy, we believe that further uplifting of the energy efficiency standards can enable us to keep abreast of latest development in technology and social demands, and also can help our community to meet the challenges in combating climate change. We intend to review and update the BEC and EAC at an interval of three to five years with the following objectives:-

(a) in order to take advantage of new energy efficiency technologies and capture prevailing good engineering practices;

(b) address the community aspiration and comments received during the implementation of the mandatory scheme; and

(c) uplift the minimum energy efficiency requirements with reference to the development trend worldwide.

In conclusion, energy efficiency and conservation is no doubt an essential means for sustainable development for a low carbon economy and a better tomorrow. Mandatory implementation of the BEC will balance social, economic and environmental needs, both for present and future generations.

References

American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHARE), U.S.A. (2004) *ASHRAE 90.1-2004 (Energy Standards for Buildings Except Low-Rise Residential Building)*

Australian Building Codes Board (2006) *BCA 2006 (Building Code of Australia)*.

Communities and Local Government, UK (2006) *Approved Document L2A 2006 Edition (Conservation of fuel and power in new buildings other than dwellings)*.

Communities and Local Government, UK (2006) *Approved Document L2B 2006 Edition (Conservation of fuel and power in existing buildings other than dwellings)*.

Electrical and Mechanical Services Department, Hong Kong SAR Government (2010) *Hong Kong Energy End-use Data 2010*.

Electrical and Mechanical Services Department, Hong Kong SAR Government (2007) *The Code of Practice for Energy Efficiency of Air Conditioning Installations 2007 Edition*.

Electrical and Mechanical Services Department, Hong Kong SAR Government (2007) *The Code of Practice for Energy Efficiency of Electrical Installations 2007 Edition*.

Electrical and Mechanical Services Department, Hong Kong SAR Government (2007) *The Code of Practice for Energy Efficiency of Lift and Escalator Installations 2007 Edition*.

Electrical and Mechanical Services Department, Hong Kong SAR Government (2007) *The Code of Practice for Energy Efficiency of Lighting Installations 2007 Edition*.

Electrical and Mechanical Services Department, Hong Kong SAR Government (2007) *The Guidelines on Energy Audit, 2007*.

Environment Bureau and Electrical and Mechanical Services Department, Hong Kong SAR Government (2007) *Consultation Paper, A Proposal of the Mandatory Implementation of Building Energy Codes*.

Hong Kong SAR Government (2007) *The 2007-08 Policy Address "A New Direction for Hong Kong"*.

Hong Kong SAR Government (2008) *The 2008-09 Policy Address "Embracing New Challenges"*.

Hong Kong SAR Government (2009) *The 2009-10 Policy Address "Sharing Prosperity for a Caring Society"*.

Lee Greenberg, Canwest News Service, nationalpost.com, Canada *Mandatory home energy audits planned (published on 24 February 2009), http://www.nationalpost.com/most_popular/story.html?id=1321615&p=1*.

Ministry of Housing and Urban-Rural Development of the People's Republic of China and General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (2004) *GB 50034 – 2004 《建築照明設計標準》(Standard for lighting design of buildings)*.

Ministry of Housing and Urban-Rural Development of the People's Republic of China and General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China (2005) *GB 50189 – 2005 《公共建築節能設計標準》(Design standard for energy efficiency of public buildings)*.

SPRING Singapore (2006) *Singapore Standard SS 530 : 2006 (Code of Practice for Energy Efficiency Standard for Building Services and Equipment)*.

The City Council of the City of Austin, Texas *"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, http://www.ci.austin.tx.us/council_meetings/wams_item_attach.cfm?recordID=14388*.

The European Parliament and the Council of the European Union *Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings*.