

# A Major Step towards Low Carbon Economy – Full Implementation of Buildings Energy Efficiency Ordinance

Ir Dominic S.K. Lau, *Senior Engineer*, and Ir David Li, *Engineer*  
*Electrical and Mechanical Services Department*  
*Government of the Hong Kong Special Administrative Region*

**Abstract**--Taking a major step towards low carbon economy aiming at raising energy efficiency performance of buildings, the Buildings Energy Efficiency Ordinance (Cap. 610) (Ordinance) will come into full operation on 21 September 2012. The Ordinance governs energy efficiency standards of building services installations in buildings, requiring the compliance with the Building Energy Code (BEC) for new construction and major retrofitting works, and requires the conduction of energy audit for central building services installations in commercial buildings in accordance with the Energy Audit Code (EAC). This paper introduces the legislative framework of the Ordinance with brief highlights on the requirements as stipulated in the codes, and the anticipated benefits that would be brought by the new legislation.

**Index Terms**--Building Energy Code, Buildings Energy Efficiency Ordinance, Certificate of Compliance Registration, Energy Audit, Energy Audit Code, Form of Compliance, Major Retrofitting Works

## I. INTRODUCTION

BEING an international metropolitan, Hong Kong (HK) given its very limited availability of built-up area is characterized by the many high rise buildings to render the spaces needed for our work, living and recreation, and with this landscape buildings in HK account for a significant portion of our carbon footprint. Energy use has been globally identified as the culprit of climate change, and to this end HK buildings are a major energy consumer, notably consuming some 90% of HK's electricity. To combat climate change, the reduction of our buildings' carbon footprint would likely top our agenda in the years to come, with aspiration towards a vision of low carbon building with state of the art energy efficient passive and active building designs that would generate green business opportunities for environmental industries and flourish a low carbon economy essential for sustainable development.

With this vision, Electrical and Mechanical Services Department (EMSD) of Government of HK Special Administrative Region (HKSAR) is tasked to promote building energy efficiency. Targeting at reducing building energy consumption, the Ordinance was enacted in late 2010 and will be in full operation with EMSD as the

enforcing department on 21 Sep 2012. Building services installations which are governed under the Ordinance include lighting installation, air-conditioning installation, electrical installation, and lift and escalator installation. The core parts of the Ordinance, i.e. Parts 2 to 6 regarding the scope of application and the compliance hierarchy of the legislative requirements, are now within the grace period. The Ordinance establishes the energy efficiency standards of a building for its design and introduces the means to evaluate its energy efficiency performance in operation. For building design, the BEC governs the design standards in respect of energy efficiency of building services installations, whereas for building operation, the EAC governs the steps in conducting energy audit of its central building services installations (which refers to the building services installation not solely serving an individual unit of the building).

## II. SCOPE OF COVERAGE OF ORDINANCE

### A. Types of buildings

The Ordinance governs most types of buildings of both private and government sectors, including buildings for commercial (office, shopping complex etc.), hotel, municipal, community, education, hospital, railway station, airport passenger terminal usages etc., in respect of BEC compliance. For industrial buildings, residential buildings and composite buildings, the common area and the portion not for residential or industrial use are governed. Residential units are not governed, to avoid undue disturbance to the general public. Industrial units, which are normally compelled to remain in competitiveness through efficiency gains, are not governed, so as to avoid undue disturbance to industrial operations that may require specific energy inputs.

### B. Newly constructed buildings and existing buildings

The building services installations in a newly constructed building i.e. a building in respect of which a consent to the commencement of building works for superstructure construction is given after 21 September 2012, should comply with the requirements in the BEC, and the compliance is applicable to all subsequent retrofitting works irrespective of whether the works are regarded as major retrofitting works or not. As for an

existing building, i.e. a building in respect of which a consent to the commencement of building works for superstructure construction is given on or before 21 September 2012, the BEC requirements have to be complied with only for major retrofitting works.

### C. Major retrofitting works

Major retrofitting works include the addition or replacement of a building services installation in retrofitting works covering a floor area of aggregated 500 m<sup>2</sup> or above (under the same series of works within 12 months) in a common area or a unit, or the addition or replacement of a main component of the central building services installations (including a chiller at rating 350 kW or above, or a complete electrical circuit at rating 400A or above, or motor drive & mechanical drive of a lift or escalator).

### D. Energy audit

The Ordinance requires energy audit to be carried out for the central building services installations in commercial buildings and commercial portions of composite buildings every 10 years in accordance with the steps specified in the EAC. After the audit, the building's energy utilization index (EUI, in Mega Joule/m<sup>2</sup>/annum) that reflects the building's energy intensity or energy performance is to be identified and exhibited.

## III. COMPLIANCE HIERARCHY OF ORDINANCE

The Ordinance prescribes the responsibilities of the developer, owner or responsible person of a building or a unit of the building, and the Registered Energy Assessor (REA), with compliance hierarchy involving the submissions and certifications to demonstrate the compliance at different stages of the building, from design to occupation approval and during normal course of operation.

### A. Compliance with BEC

The BEC requirements are the energy efficiency standards at the corresponding design conditions, and not the actual operational settings such as lighting level, air-conditioning room temperature etc., which are left to the discretion of building operators to suit the operational needs of individual buildings and installations.

The developer of a building, at building design stage (within 2 months after obtaining the aforesaid consent to the commencement of building works issued by HKSAR Government's Building Authority), is required to:

- submit to EMSD a "stage one declaration" certified by a REA to declare that the building services installations to be provided by the developer are designed and will be installed and completed in accordance with the BEC.

Subsequently at the occupation approval stage (within 4 months after obtaining of an "occupation permit" issued

by the Building Authority when the building is ready for occupation), the developer is further required to:

- submit to EMSD a "stage two declaration" certified by a REA to declare that the building services installations provided by the developer in the building at or before the time when the declaration is made have been designed, installed and completed in accordance with the BEC; and
- apply for a Certificate of Compliance Registration (COCR) from EMSD for the building.

The declarations are to be in specified forms and be accompanied by supporting documents specified in the forms. Based on merits of the declarations, EMSD will issue accordingly the COCR to the developer and maintains a register of COCR.

The aforesaid COCR for newly constructed buildings is subject to renewal every 10 years, and for the renewal the owner of the building is required to:

- engage a REA to certify that
  - the design (but not the operational performance) in respect of energy efficiency of the central building services installations (no need to include the installation only serving an individual unit) is maintained at a level not lower than the standard in the BEC version applicable to the COCR (issued by EMSD 10 years ago) of the building, and
  - if major retrofitting works have been undertaken for certain portions of the central building services installations, the design of the installation is maintained to a standard not lower than the latest BEC version applied to this part of the installation; and
- submit an application to EMSD for renewal of the COCR.

For all prescribed buildings under the Ordinance, irrespective of newly constructed or existing buildings, the owner of the central building services installations in the building, and the responsible person of a unit or a common area in the building, within 2 months after completion of major retrofitting works, are required to:

- engage a REA to certify that the replaced or additional installations in the major retrofitting works comply with the latest BEC; and
- obtain a Form of Compliance (FOC) from the REA for the said works.

In the course of operation of a building with COCR (i.e. a newly constructed building), the owner of the central building services installations (usually the owner of the building) and the responsible person (usually the owner or tenant) of a unit or a common area in the building are required to ensure that when a building services installation is replaced or added (not falling into the scope of major retrofitting works), its design shall comply with the standard in the original BEC applied to this installation.

## B. Energy audit

The owner of a prescribed building must, in respect of the central building services installations of the building, cause an energy audit to be carried out in accordance with the EAC at least once every 10 years.

The first energy audit for the central building services installations of a building issued with a COCR (i.e. a newly constructed building) is to be carried out within 10 years after the issue of COCR.

For existing buildings, the first energy audit for the central building services installations is to be carried out according to the timetable within 4 years from 21 September 2012 as specified in the Ordinance. The energy audit will be conducted in batches according to the age of buildings, the newer the earlier. The philosophy is that the information, such as energy bills, technical data of building services installations, design drawings, operational records etc., should be more available in a newer building so as to allow for the trade a smoother run-in of the first mandatory energy audit.

The owner of the building is required to:

- engage a REA to conduct the energy audit;
- obtain from the REA an Energy Audit Form and an energy audit report (with list and recommendation of energy management opportunities (EMO) identified in the audit); and
- exhibit the valid Energy Audit Form bearing the building's EUI at the main entrance of the building.

By the disclosure of the EUI, it is expected a benchmarking effect will be exerted on building operators to improve the building's energy efficiency, as the building's energy performance can be easily compared with that of other similar buildings. As for the EMO, the implementation will not be mandatory, in consideration of the wide variety of EMO in terms of scope and cost. Nevertheless, the REA's analysis and recommendations of the EMO in the energy audit report, will be conducive to the implementation of part or all of these EMO, as the energy saving from EMO is itself a paramount incentive.

## C. Registered Energy Assessor (REA)

The Ordinance opens up a new role of professional engineers who upon appointment by the developer, owner or responsible person have the obligation to:

- certify the compliance with the BEC for application of COCR or issue of FOC;
- issue FOC to the relevant owner or responsible person of a building or a unit in a building;
- conduct energy audit and issue the Energy Audit Form and energy audit report to the building owner; and
- send a copy of the FOC, Energy Audit Form and energy audit report to EMSD for record.

EMSD maintains a register of the REA. The application as REA is opened up to Registered

Professional Engineers (RPE) under the Engineers Registration Ordinance and to corporate members of the Hong Kong Institution of Engineers (MHKIE), in electrical, mechanical, building services or environmental disciplines, who possess the knowledge and relevant post-qualification experience (2 years for RPE and 3 years for MHKIE) in the application of energy efficiency in buildings.

## D. Penalties

Penalties will mainly be in the form of monetary fine imposed on developers, building owners, responsible persons or REAs for non-compliance under the Ordinance. Imprisonment penalty will only 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.

## IV. TECHNICAL REQUIREMENTS OF BEC

To give an overview, the key technical requirements of BEC 2012 Edition issued under the Ordinance are extracted as follows.

### A. Lighting Installation

- Max allowable lighting power density (e.g. 15 W/m<sup>2</sup> for office space, 20 W/m<sup>2</sup> for retail)
- Min allowable no. of lighting control points (i.e. switching devices) for office space
- Lighting control points for lighting to which the Ordinance is applicable to be independent from those for lighting to which the Ordinance is not applicable
- Not applicable to lighting exterior to building, lighting not of fixed type, signage lighting and lighting solely for decoration

### B. Air-conditioning Installation

- Load calculation per specified outdoor and indoor conditions (e.g. max 35°C outdoor DB)
- Allowable air distribution system fan power per unit volume flow (e.g. max 1.6 W/L/s for CAV)
- Allowable percentage power of full load, of power drawn by motor of variable flow fan at 50% design flow (max 55% of full load)
- Air distribution ductwork leakage limit
- Piping system to cater for variable flow
- Allowable percentage power of full load, of power drawn by motor of variable speed pump at 50% design flow (Max 55% of full load)
- Allowable piping system frictional loss (e.g. 400 Pa/m for above 50 mm diameter)
- Allowable coefficient of performance of chiller and unitary air-conditioner (e.g. min 4.7 for water-cooled screw chiller at 500 to 1000 kW cooling)
- Min allowable thickness of thermal insulation to

pipework & ductwork

- Energy metering (e.g. for chiller at 350 kW cooling) to measure power and energy input/output
- Energy efficient system control, including temperature control, off-hours control, zone control

#### C. Electrical Installation

- Allowable power distribution loss (e.g. max allowable circuit copper loss)
- Allowable motor efficiency (e.g. min efficiency of 87% for 2-pole motor with rated output power at 5.5 kW to less than 7.5 kW)
- Allowable motor sizing ratio (max 125%)
- Allowable design total power factor (min 0.85 for circuit at or above 400A)
- Allowable design total harmonic distortion of current (e.g. max 12% for designed circuit current at 400A to below 800A)
- Balancing of single-phase loads (max allowable unbalance 10%)
- Metering & monitoring facilities requirements (e.g. sub-main circuit at or above 400A to facilitate measuring V, A, kWh, kVA, TPF & THD)

#### D. Lift & Escalator Installation

- Allowable running active electrical power of motor drive (e.g. max 36.1 kW for traction drive lift at 2.5 m/s to below 3 m/s rated speed and 1350 kg to below 1600 kg rated load)
- Allowable lift decoration load (e.g. max 50% of rated load or 600 kg, whichever lower)
- Shutting off of ventilation/air-conditioning of lift car during idling
- Min allowable total power factor
- Max allowable total harmonic distortion
- Metering & monitoring facilities requirements

#### E. Performance-based approach

The performance-based approach provides an alternative approach to comply with the BEC. This approach focuses on estimating the total energy consumption of the building by means of building energy simulation software. With this approach, the energy saving from energy efficient equipment and renewable energy installation can be evaluated and made known to the building owner at the building design stage for his/her cost and environmental benefits consideration.

### V. TECHNICAL REQUIREMENTS OF EAC

To give an overview, the key technical requirements of EAC 2012 Edition issued under the Ordinance are extracted as follows.

#### A. Key steps of energy audit

- (i) Collection of information
- (ii) Review of energy consuming equipment
- (iii) Identification of EMO
- (iv) Cost benefit analysis
- (v) Recommendations
- (vi) Compiling energy audit report

#### B. Contents of energy audit report

- Executive summary
- Energy audit scope
- Description of building characteristics and equipment/systems
- Energy consumption & performance evaluation
- Indication of key characteristics of air-conditioning equipment/systems
- Indication of total lighting power of lighting installation
- Analysis of historical energy consumption of the building
- Indication of the building's EUI
- Indication of the energy supply from central building services installations to the building's units
- Findings from review & site inspection of energy consuming equipment, focusing on identification of potential EMO
- Evaluation of potential EMO
- Recommendations of EMO and further studies

### VI. BENEFITS OF ORDINANCE

The approach of mandatory implementation of BEC and energy audit is in line with international efforts in addressing to the barriers to energy efficiency and will have the following notable benefits -

- pull up sub-standard designs to the level of the mandatory standard;
- cohere market force in driving service providers to offer and consumers to use more energy efficient products & deliverables with performances over the mandatory standards;
- remove the obstacle of split incentive where the energy saving from an energy efficient installation being only enjoyed by its user but not the owner who had paid for the installation;
- render more quality building services designs by qualified professionals, as only REAs can process certifications under the Ordinance;
- encourage EMO implementation based on findings in energy audits;
- trigger paradigm shift of customers' expectations, from hoping to meet a certain level of energy efficiency to actually expecting as a norm a deliverable or product above the energy efficiency level specified in the mandatory standard; and
- reinforce & ascertain Government's leading role in the pursue of energy efficiency, paving the way for

promulgation of further energy efficiency programs for the society at large.

On the other hand, the HKSAR Government will regularly review the minimum energy efficiency standards under the BEC with reference to the latest international standards and the advancement of relevant technologies. This is in line with the recommendation made in the report of a public engagement on combating climate change published in 2012 by the Council for Sustainable Development of HK. In respect of energy audit, the report also points out that it is believed that “what gets measured gets managed”, and that the audit will help to provide a baseline against which future performance can be benchmarked, and facilitate as a tool to identify measures to reduce energy consumption & associated costs. In addition, the data collected through the mandatory audit may help establish a benchmarking tool for buildings in HK.

## VII. CONCLUSION

With the full implementation of the Ordinance to capture the above benefits, HK has taken the very major step forward towards a low carbon economy. This mandatory approach will reinforce the foothold of the minimum energy efficiency standards in the BEC and the minimum energy audit requirements in the EAC, and pave the way for further enhancement of the standards. EMSD will review and tighten the standards at suitable time intervals, and the tightening will further trigger a new round of improvement to bring us closer to a low carbon economy.

## VIII. ACKNOWLEDGMENT

Sincere thanks are extended to members (including IET-HK) of the Technical Taskforce on Mandatory Implementation of the BEC and its working groups in offering their expertise advice and support in the development of the BEC & EAC.

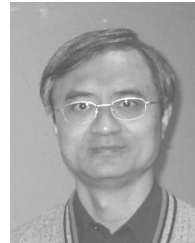
## IX. REFERENCES

- [1] Buildings Energy Efficiency Ordinance (Cap. 610)
- [2] *Code of Practice for Energy Efficiency of Building Services Installation*, EMSD, 2012.
- [3] *Code of Practice for Building Energy Audit*, EMSD, 2012.
- [4] *EMSD web-page for the Ordinance* [Online]. Available: [http://www.emsd.gov.hk/emsd/eng/pee/mibec\\_beco.shtml](http://www.emsd.gov.hk/emsd/eng/pee/mibec_beco.shtml)
- [5] *HK's Climate Change Strategy & Action Agenda Consultation document*, ENB, Sep. 2010.
- [6] *Mainstreaming Building Energy Efficiency Codes in Developing Countries*, The World Bank, 2010.
- [7] *Pathways to Energy Sustainability : Measuring APEC Progress in Promoting Economic Growth, Energy Security and Environmental Protection*, Asia Pacific Energy Research Centre, Sep. 2010.
- [8] *Report on the Public Engagement Process on “Combating Climate Change: Energy Saving and Carbon Emission Reduction in Buildings”*, Council for Sustainable Development, HKSAR Government

## X. BIOGRAPHIES



**Ir Dominic S.K. Lau** is a senior engineer with EMSD, HKSAR Government. He has over 20 years experience in building services design and project management of a wide variety of government premises. Ir Lau is now leading a team of engineers tasked to promote the Ordinance & its codes, and process the registration of Registered Energy Assessors under the Ordinance. Supporting his leading role is his strong background of extensive & in-depth experience on steering & managing of operation & maintenance programmes & projects that embraced, amongst various activities, BEC compliance and energy audit.



**Ir David Li** is an engineer with EMSD. He has over 20 years experience in building services design and project management of a wide variety of government premises. Ir Li has actively involved over the past few years in technically supporting the development of the Ordinance, served the Technical Taskforce for developing the BEC, and played a prominent role in soliciting and consolidating views from Taskforce members and the public in finalizing the Ordinance and the BEC contents. In addition, Ir Li has conducted research & study of overseas BEC, and has published papers & conducted technical talks on the Ordinance and the BEC.