ASIA-PACIFIC ECONOMIC COOPERATION (APEC) EGEE&C 53 AND EGNRET 52 JOINT MEETINGS AND ASSOCIATED WORKSHOPS

ASIA-PACIFIC ECONOMIC COOPERATION (APEC)

APEC Workshops

Energy Efficiency Regulation and Standards for Motor in Hong Kong, China

Date: 19 March 2019

Hong Kong, China

Content

- Hong Kong's Economy & Electricity Consumption Details
- Motor Applications & Electricity Use
- Legislative Framework on Building Energy Efficiency in Hong Kong
- Minimum Allowable Energy Efficiency for Motors
- Law Enforcement & Way Forward

Hong Kong's Economy
& Energy Consumption Details

Hong Kong, China

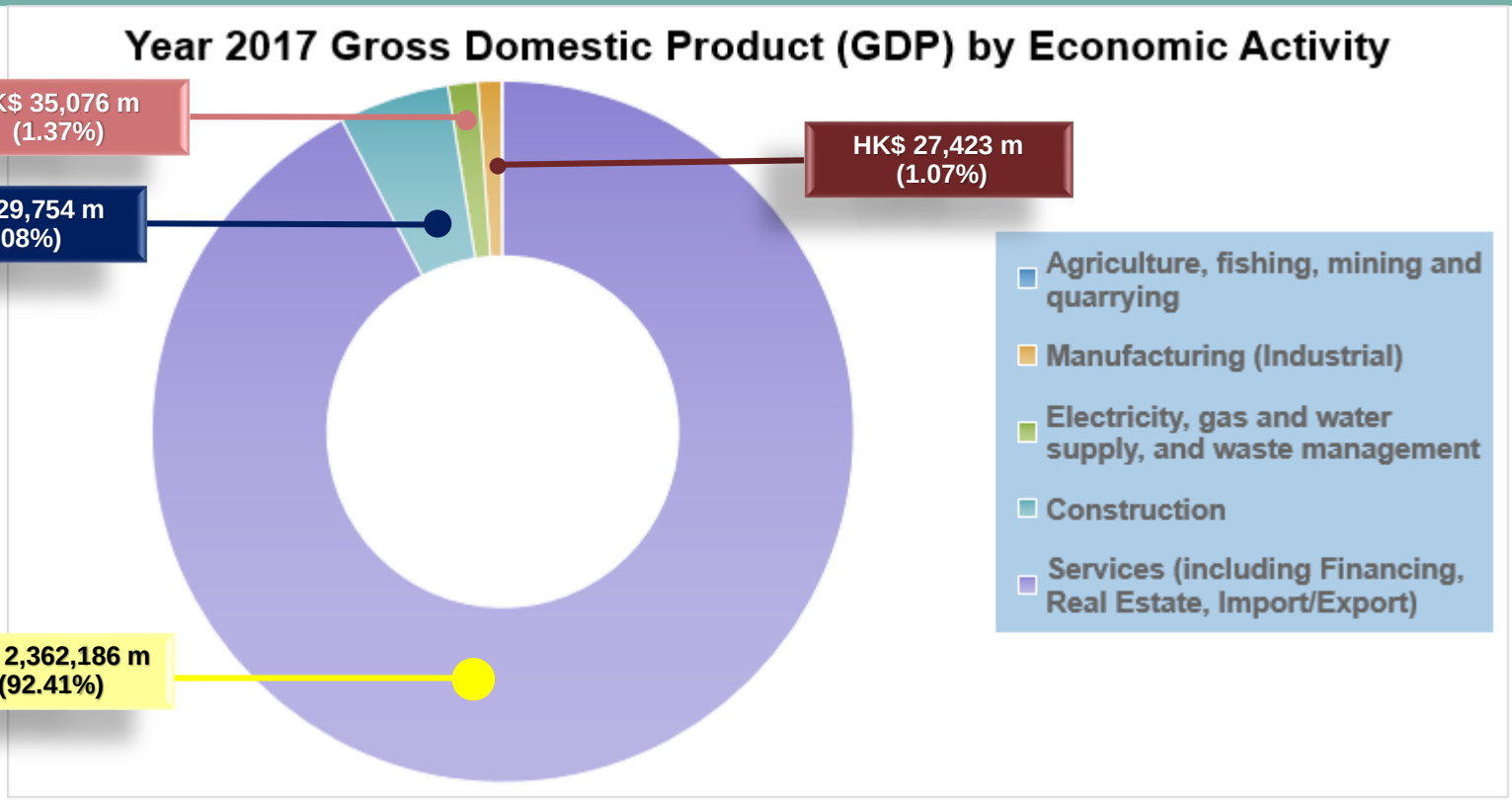
Characteristics of Hong Kong, China

Population
7.4 million

Living/working
263 km^2

Gov. & Private Buildings
8000+ 42000+

Hong Kong's Economy

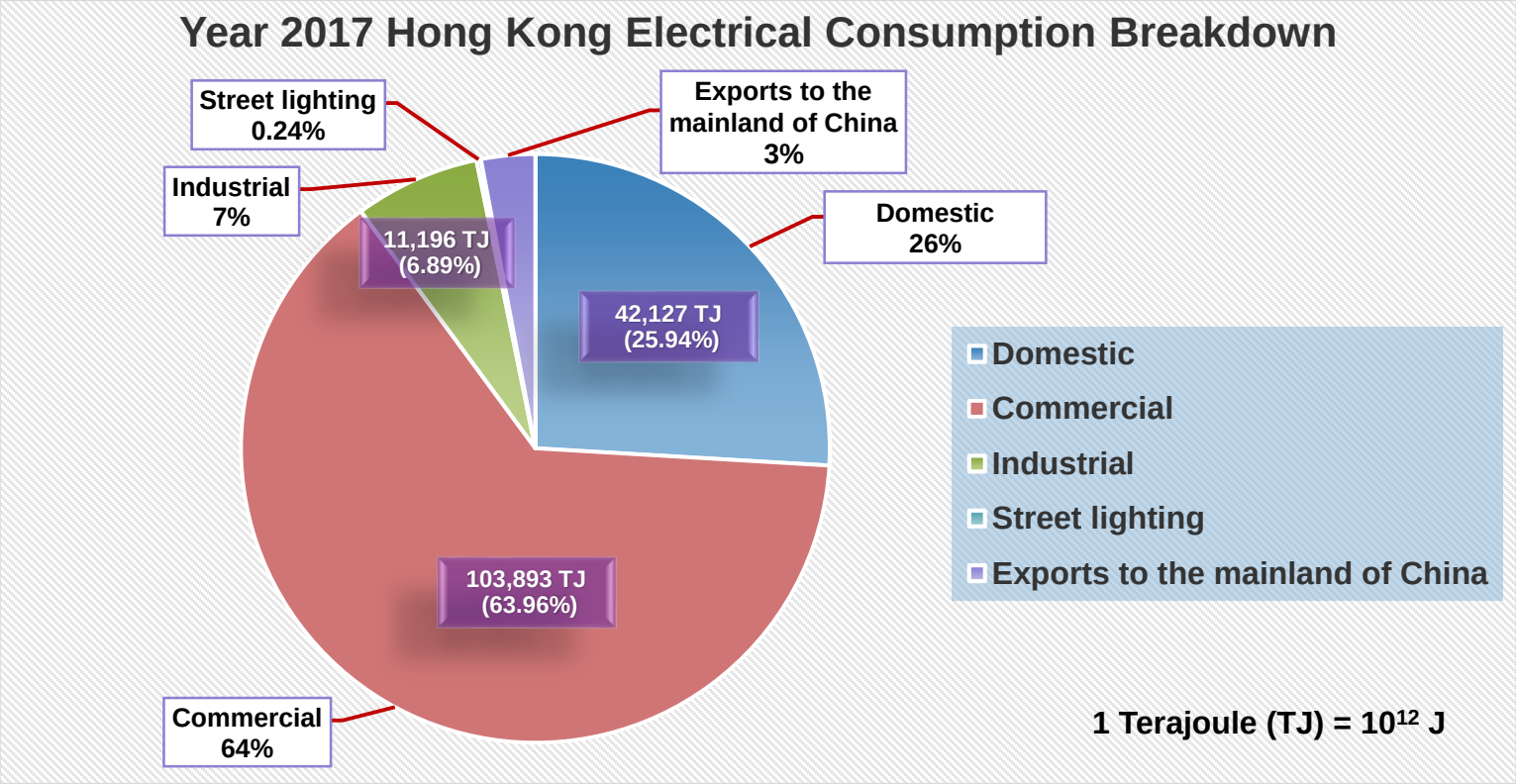


- Year 2017 GDP = HK$ 2,556,176 million
- Only 1.37% from industrial activity. Over 90% from commercial activity.

Source: Hong Kong Monthly Digest of Statistics February 2019
Census and Statistics Department, Hong Kong Special Administrative Region

Hong Kong, China

Electricity Consumption



- Year 2017 Electrical Consumption = 162,432 Terajoule
- Commercial activity consumes more than half of the electricity in Hong Kong

Source: Electricity consumption in Hong Kong 2017
Census and Statistics Department, Hong Kong Special Administrative Region

Hong Kong, China

Motor Applications & Electricity Use

Motor Application

Motor Size	Residential	Agricultural	Transportation	Commercial	Industrial
Small 0.12 – 0.75kW	• Large domestic appliances		• HVAC • Automotive auxiliaries	• Office equipment	• Power tools • Small fans & pumps
Medium 0.75 – 375kW	• Package HVAC Systems • Water pumps	• Water pumps for large fields	• Electric vehicle traction	• Fans, • Chillers • Water pumps for large building	• Fans, pumps • Compressors • Conveyors • Process machines
Large >375kW			• Electric vehicle traction		• Fans, pumps • Compressors • Exhaust fans • Process machines

Source: Accelerating the Global Adoption of Energy-Efficient Electric Motors and Motor Systems
UN Environment – Global Environment Facility I United for Efficiency (U4E)

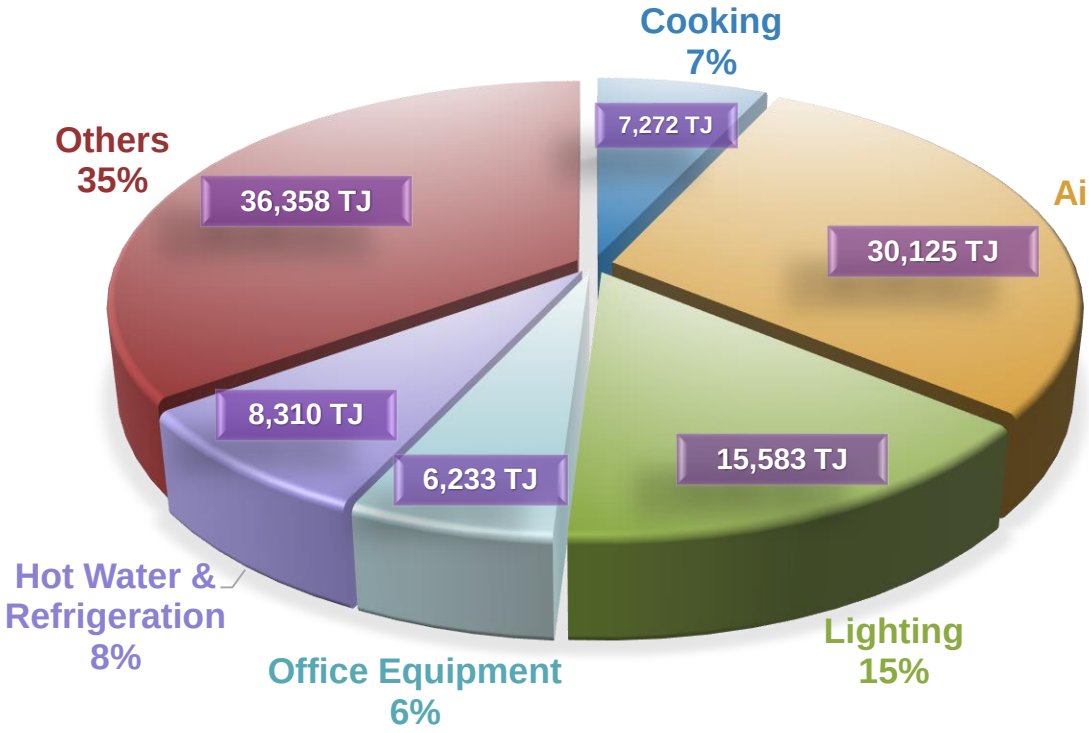
Motor Electricity

Motor Size	Percentage of Stock (%)	Percentage of Electricity used (%)
Small < 0.75kW	90%	9%
Medium 0.75 – 375kW	10%	68%
Large >375kW	0.03%	23%

Source: Accelerating the Global Adoption of Energy-Efficient Electric Motors and Motor Systems
UN Environment – Global Environment Facility I United for Efficiency (U4E)

Composition of Electricity in Commercial buildings

YEAR 2016 ELECTRICITY COMPOSITION BY COMMERCIAL END-USES



Total Consumption
= 103,881 TJ

- Air-conditioning (29%) and Others (35%) are consumed by motor-driven equipment .
- More than 60% electricity consumed by motors in commercial buildings.

Source: Hong Kong Energy End-use Data 2018

Benefits in Enhancing Motor Efficiency

How does motor efficiency impact us…?

- **Case in Hong Kong**
  - ✓ Commercial Building consumes 103,881 TJ yearly
  - ✓ Around 60% electricity consumed by motor in buildings
  - ✓ Equivalent to 62,328 TJ (17,313 Mega kWh)

Does it has a Great Potential ?

Benefits in Enhancing Motor Efficiency

- For example : a 1% increase in motor efficiency at commercial building…

Electrical Energy Saving per year :

17,313 Mega kWh x 1%

= 173 Mega kWh

Utility Cost Saving per year :

173 Mega kWh x HK$1.3/kWh

= HK$224 million

Remark: (average tariff ~ HK$1.3/kWh)

Carbon footprint – Reduction of GHG emission per year :

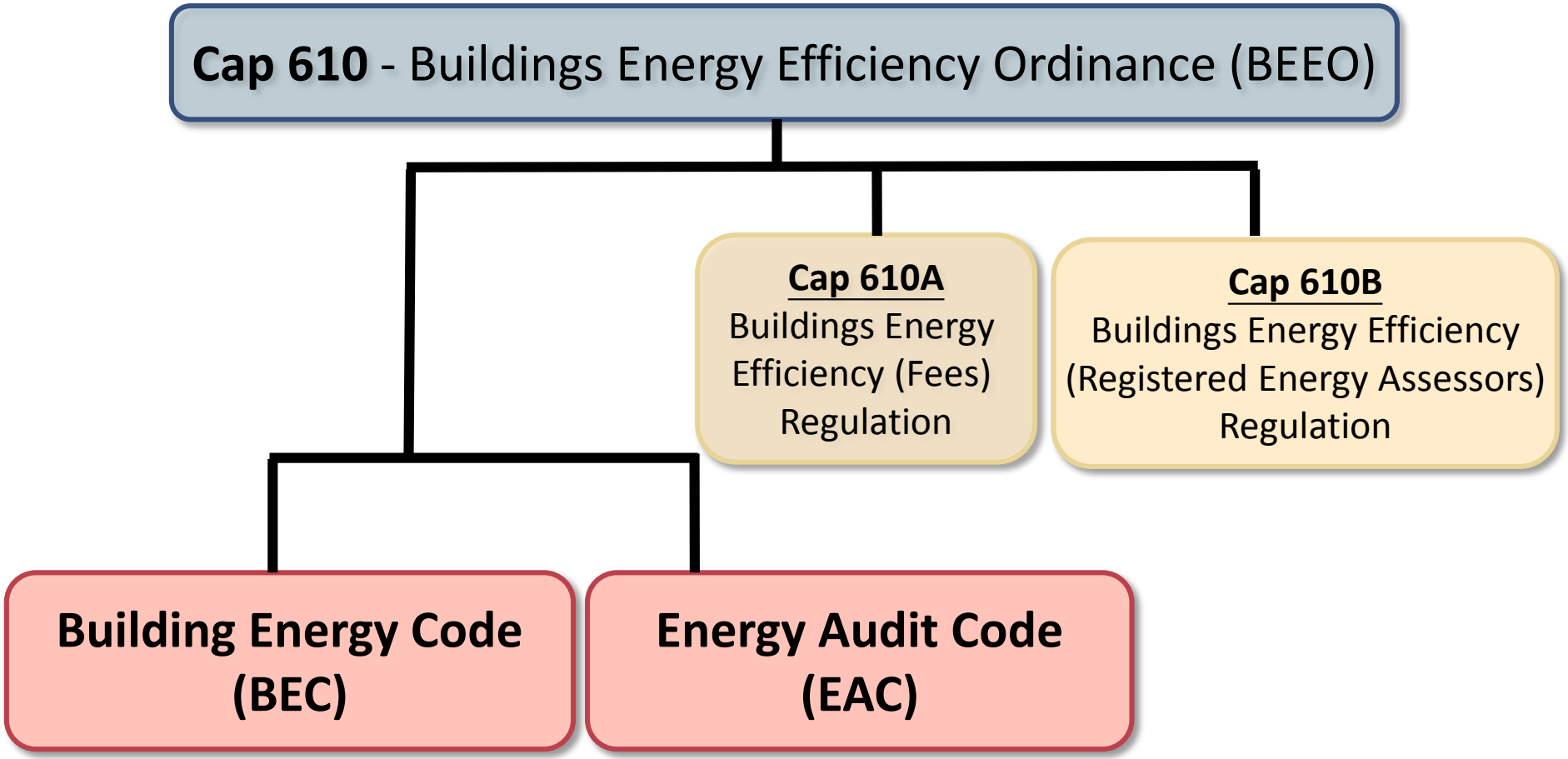
173 Mega kWh x 0.6 kgCO_2-e

= 103,800 TonCO_2-e

Legislative Framework on Building Energy Efficiency in Hong Kong

Hong Kong, China

BEEO & relevant energy Codes



Building Energy Efficiency Ordinance

Scope and Coverage by the Ordinance

Energy Efficiency Standards

- Hotel & guesthouse
- Educational building
- Community building
- Municipal services
- Hospital & clinic
- Government building
- Airport passenger building
- Railway station
- Commercial building
- Industrial building – **common area**
- Residential building – **common area**
- Composite building –
  - commercial portion
  - **common area** of portion for residential or industrial use

Energy Audit

- Commercial building
- Composite building – commercial portion

Legislation

Buildings Energy Efficiency Ordinance (BEEO) Cap. 610

Enacted since 21 September 2012

Lighting

Electrical

Air-conditioning

Lift & Escalator

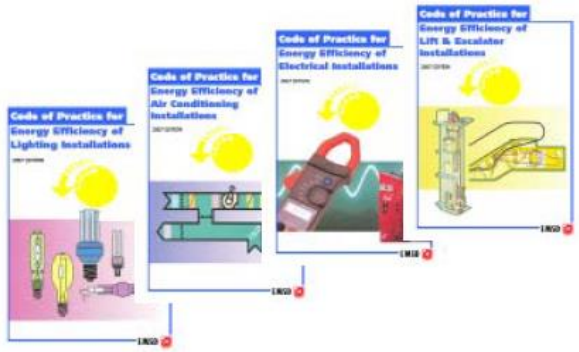
Road Map of the Codes

10/1998
HK Energy Efficiency Registration Scheme for Buildings (Voluntary Basis)

12/2010
BEEO was published in gazette

12/2015
BEC 2015 & EAC 2015

1998 1999 2000 2001 2002 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019



09/2012
BEEO came into full operation
BEC 2012 & EAC 2012

11/2018
BEC 2018 & EAC 2018

Hong Kong, China

Minimum Allowable Energy Efficiency for Motors

Considerations

Situation in Hong Kong

1. Lots of motors inside various types of buildings.
2. Commercial activities dominate HK economy and also electrical consumption.

OUR FOCUS on Establishing Minimum Motor Energy Efficiency under Legislation

- Use of Motor
- Motor Type
- Motor Size
- Standards

Motor that is being Governed

1. Motor used in the prescribed buildings under the Ordinance
2. Fixed installation of motor
3. 3ø (3 Phase) 2-poles or 4-pole induction motor
4. Single–speed and totally enclosed
5. Motor rating range from 0.75kW to >200kW
6. Industrial motor and integrated motor not governed




- Example of governed motor: AHU/PAU/fan motor, A/C chilled/condenser water pump, potable/sewer water pump, gondola…,etc.

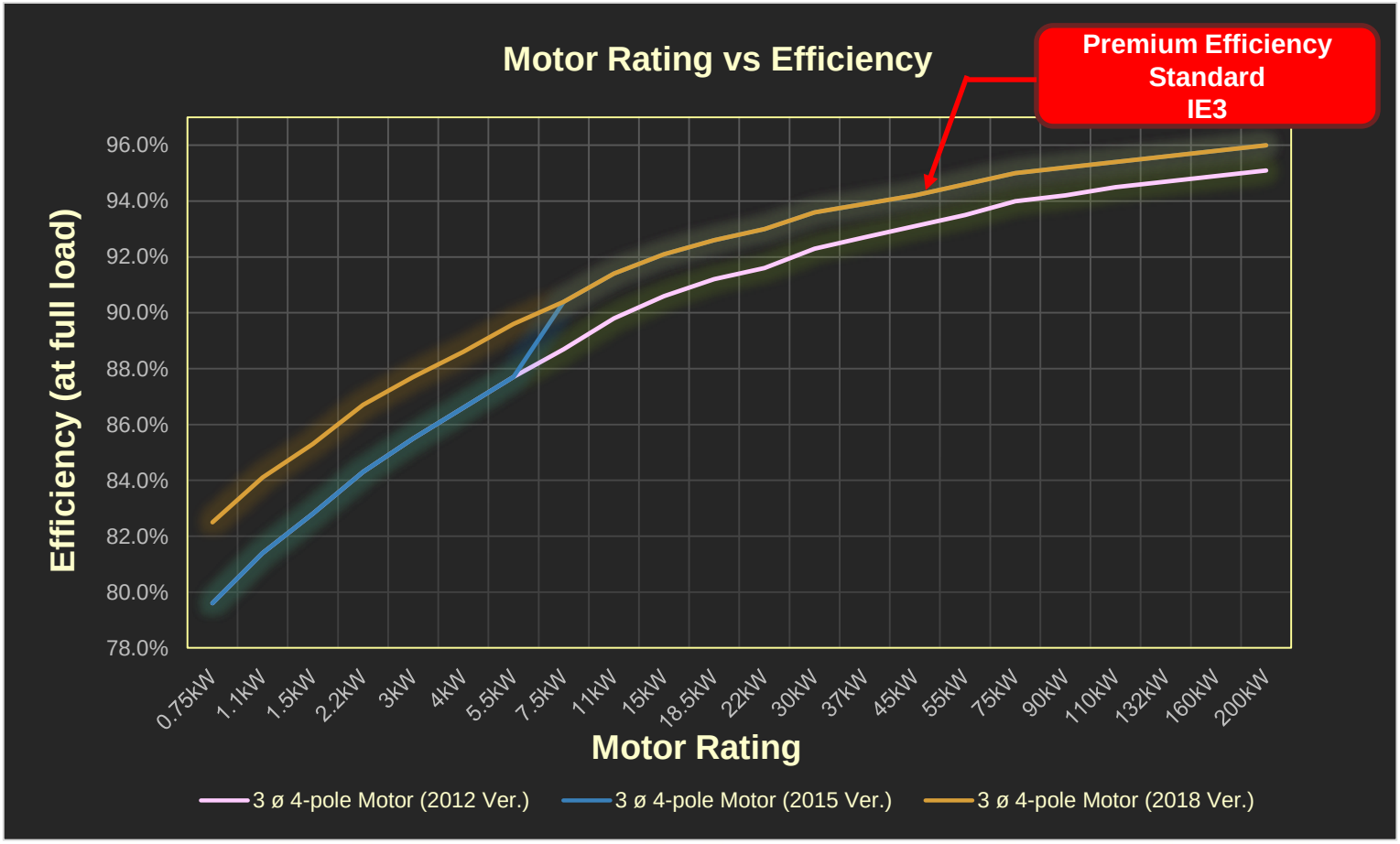
International Standards Adopted

Table 7.5.1 : Minimum Nominal Full-Load Motor Efficiency for Single-Speed Three-phase Totally Enclosed Motor		
Motor Rated Output (P, in kW)	Minimum Rated Efficiency (%)	
	2-pole	4-pole
0.75 kW ≤ P < 1.1 kW	80.7%	82.5%
1.1 kW ≤ P < 1.5 kW	82.7%	84.1%
1.5 kW ≤ P < 2.2 kW	84.2%	85.3%
2.2 kW ≤ P < 3 kW	85.9%	86.7%
3 kW ≤ P < 4 kW	87.1%	87.7%
4 kW ≤ P < 5.5 kW	88.1%	88.6%
5.5 kW ≤ P < 7.5 kW	89.2%	89.6%
7.5 kW ≤ P < 11 kW	90.1%	90.4%
11 kW ≤ P < 15 kW	91.2%	91.4%
15 kW ≤ P < 18.5 kW	91.9%	92.1%
18.5 kW ≤ P < 22 kW	92.4%	92.6%
22 kW ≤ P < 30 kW	92.7%	93%
30 kW ≤ P < 37 kW	93.3%	93.6%
37 kW ≤ P < 45 kW	93.7%	93.9%
45 kW ≤ P < 55 kW	94%	94.2%
55 kW ≤ P < 75 kW	94.3%	94.6%
75 kW ≤ P < 90 kW	94.7%	95%
90 kW ≤ P < 110 kW	95%	95.2%
110 kW ≤ P < 132 kW	95.2%	95.4%
132 kW ≤ P < 160 kW	95.4%	95.6%
160 kW ≤ P < 200 kW	95.6%	95.8%
P ≥ 200 kW	95.8%	96%

Table 7.5.1 Motor Efficiency Table under BEC 2018

- Compliance to table should be based on testing to relevant international standards such as IEC 60034-2-1 or IEEE 112-B.

Motor Efficiency Requirements under BEC



Motor Efficiency Governance

Motor Rated Output (P, in kW) 4-pole 3 Phase Motor	Minimum Rated Efficiency (%)		
	BEC 2012	BEC 2015	BEC 2018
0.75 kW ≤ P < 1.1 kW	IE2	IE2	IE3
1.1 kW ≤ P < 1.5 kW			
1.5 kW ≤ P < 2.2 kW			
2.2 kW ≤ P < 3 kW			
3 kW ≤ P < 4 kW			
4 kW ≤ P < 5.5 kW			
5.5 kW ≤ P < 7.5 kW			
7.5 kW ≤ P < 11 kW		IE3	
11 kW ≤ P < 15 kW			
15 kW ≤ P < 18.5 kW			
18.5 kW ≤ P < 22 kW			
22 kW ≤ P < 30 kW			
30 kW ≤ P < 37 kW			
37 kW ≤ P < 45 kW			
45 kW ≤ P < 55 kW			
55 kW ≤ P < 75 kW			
75 kW ≤ P < 90 kW			
90 kW ≤ P < 110 kW			
110 kW ≤ P < 132 kW			
132 kW ≤ P < 160 kW			
160 kW ≤ P < 200 kW			
> 200kW			

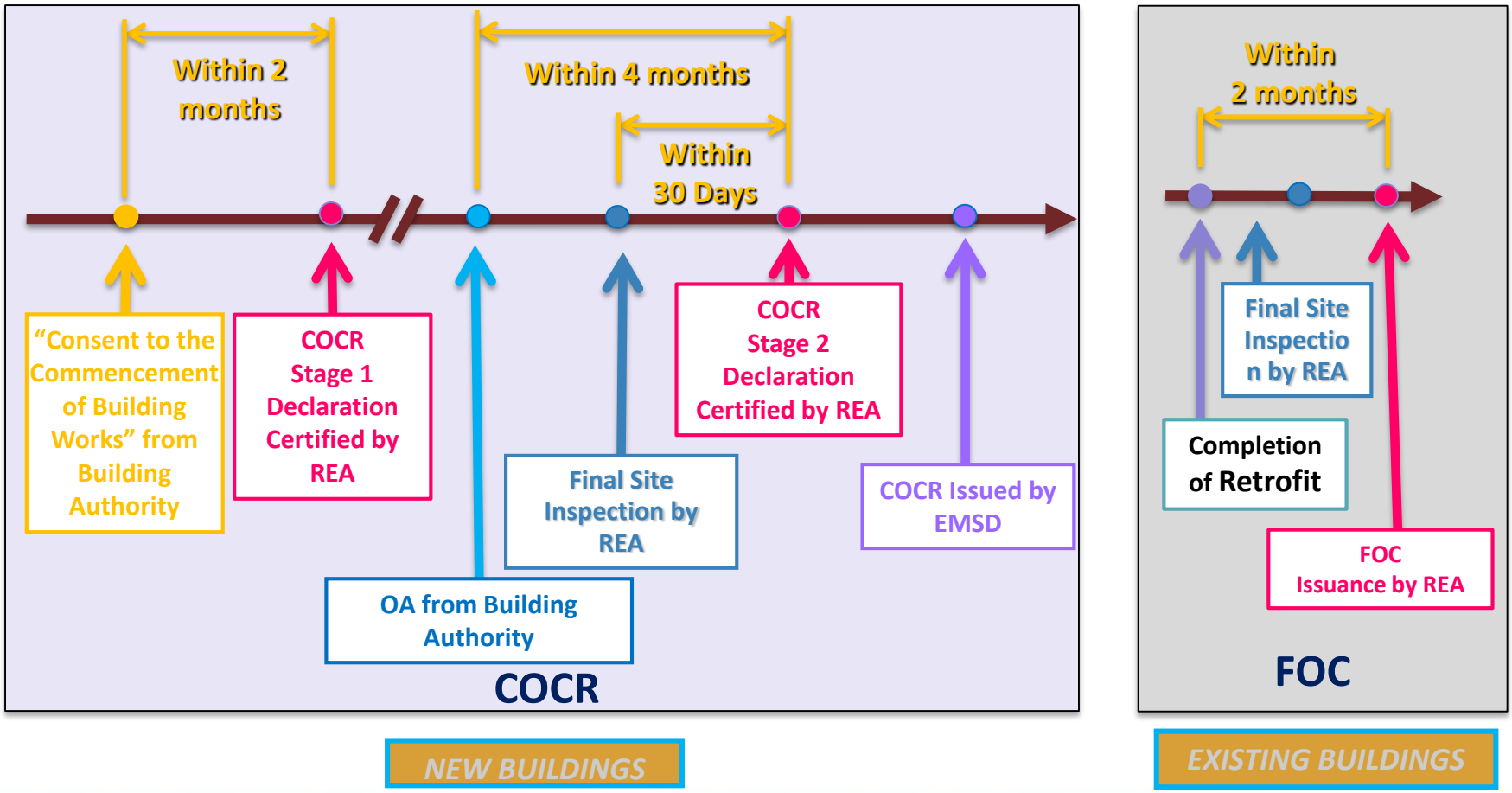
Minimum Energy Efficiency Requirement

- BEC 2012 – IE2 for all
- BEC 2015 – 0.75kW ≤ P < 7.5kW is IE2 & thereafter IE3
- BEC 2018 – IE3 for all (after full implementation in mid.-2019)

More and More Efficient !

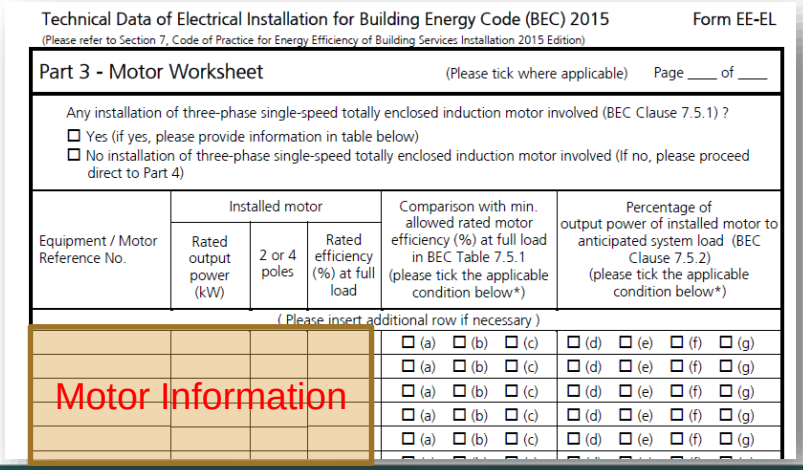
Law Enforcement

Submission Process



Law Enforcement

- **Submission Stage**
  - Newly installed or replaced motors in prescribed buildings under the ordinance.
  - Information of motor like kW & efficiency shall be specified in dedicated form (EE-EL).
  - Motor catalogue shall be submitted together with the Form.
  - All materials submitted shall be endorsed by a ***Registered Energy Assessor***, who ensures and declares that the motor complies with our standards.



Technical Data of Electrical Installation for Building Energy Code (BEC) 2015 — Form EE-EL

(Please refer to Section 7, Code of Practice for Energy Efficiency of Building Services Installation 2015 Edition)

Part 3 - Motor Worksheet (Please tick where applicable) Page ____ of ____

Any installation of three-phase single-speed totally enclosed induction motor involved (BEC Clause 7.5.1) ?

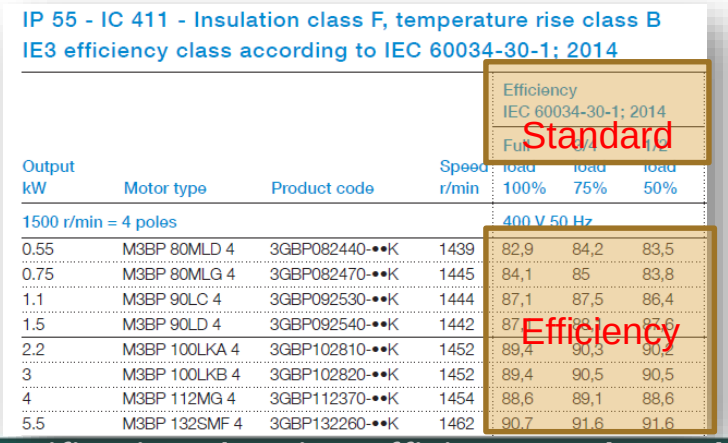
☐ Yes (if yes, please provide information in table below)

☐ No installation of three-phase single-speed totally enclosed induction motor involved (If no, please proceed direct to Part 4)

Equipment / Motor Reference No.	Installed motor: Rated output power (kW)	Installed motor: 2 or 4 poles	Installed motor: Rated efficiency (%) at full load	Comparison with min. allowed rated motor efficiency (%) at full load in BEC Table 7.5.1 (please tick the applicable condition below*)	Percentage of output power of installed motor to anticipated system load (BEC Clause 7.5.2) (please tick the applicable condition below*)
(Please insert additional row if necessary)					
				☐ (a) ☐ (b) ☐ (c)	☐ (d) ☐ (e) ☐ (f) ☐ (g)
				☐ (a) ☐ (b) ☐ (c)	☐ (d) ☐ (e) ☐ (f) ☐ (g)
				☐ (a) ☐ (b) ☐ (c)	☐ (d) ☐ (e) ☐ (f) ☐ (g)
				☐ (a) ☐ (b) ☐ (c)	☐ (d) ☐ (e) ☐ (f) ☐ (g)
				☐ (a) ☐ (b) ☐ (c)	☐ (d) ☐ (e) ☐ (f) ☐ (g)

Motor Information

FORM EE-EL



IP 55 - IC 411 - Insulation class F, temperature rise class B

IE3 efficiency class according to IEC 60034-30-1: 2014

Efficiency IEC 60034-30-1: 2014

Standard

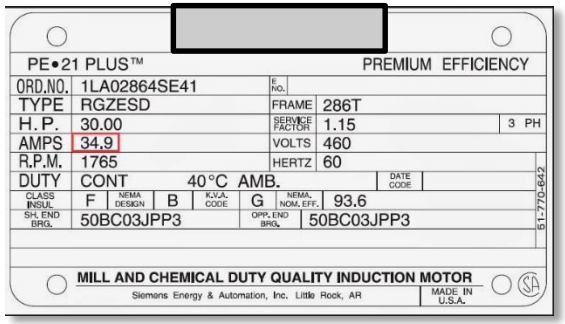
Output kW	Motor type	Product code	Speed r/min	Full load 100%	3/4 load 75%	1/2 load 50%
1500 r/min = 4 poles				400 V 50 Hz		
0.55	M3BP 80MLD 4	3GBP082440-••K	1439	82,9	84,2	83,5
0.75	M3BP 80MLG 4	3GBP082470-••K	1445	84,1	85	83,8
1.1	M3BP 90LC 4	3GBP092530-••K	1444	87,1	87,5	86,4
1.5	M3BP 90LD 4	3GBP092540-••K	1442	87,4	88,1	87,6
2.2	M3BP 100LKA 4	3GBP102810-••K	1452	89,4	90,3	90,2
3	M3BP 100LKB 4	3GBP102820-••K	1452	89,4	90,5	90,5
4	M3BP 112MG 4	3GBP112370-••K	1454	88,6	89,1	88,6
5.5	M3BP 132SMF 4	3GBP132260-••K	1462	90,7	91,6	91,6

Efficiency

Specification showing efficiency and standard

Law Enforcement

- **Inspection Stage**
  - Document check
  - Verification through site inspection (motor nameplate)
- **Non-compliance case**
  - Issue of ***Improvement Notice (IN)*** – Rectification of non-compliance item(s)
  - Replacement of non-compliance motor already installed on site


PE•21 PLUS™ PREMIUM EFFICIENCY

ORD.NO.	1LA02864SE41	E No.		
TYPE	RGZESD	FRAME	286T	
H.P.	30.00	SERVICE FACTOR	1.15	3 PH
AMPS	34.9	VOLTS	460	
R.P.M.	1765	HERTZ	60	
DUTY	CONT 40°C AMB.		DATE CODE	
CLASS INSUL	F	NEMA DESIGN	B	K.V.A. CODE
	G	NEMA NOM. EFF.	93.6	
SH. END BRG.	50BC03JPP3	OPP. END BRG.	50BC03JPP3	

51-770-642

MILL AND CHEMICAL DUTY QUALITY INDUCTION MOTOR

Siemens Energy & Automation, Inc. Little Rock, AR

MADE IN U.S.A.

Motor Nameplate

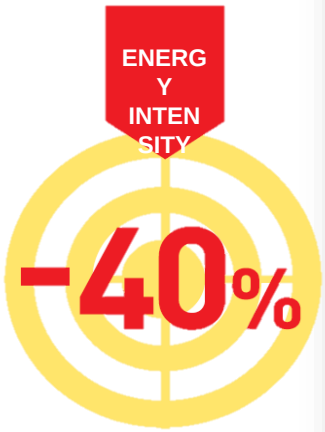
Non-compliance Motor

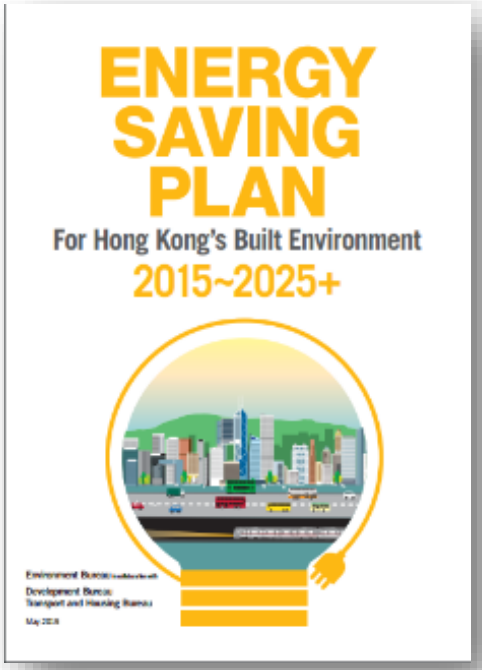
Replacement Work

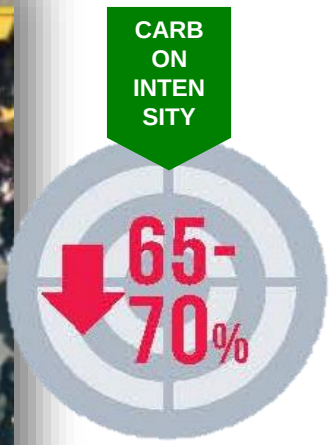
Benefits in Aligning Conformity Assessment

- In governor's view:
  - Easy for governor to follow and compare standards and update the efficiency regulations periodically.
  - More efficient governance by using harmonized international standards
- In supplier's view
  - Lesser non-compliance motor found in the market
  - A clear direction to supplier to import motor in accordance with the statutory requirements
- To future
  - Further upgrade or tightening of requirements can keep going on the same basis
  - Encourage manufacturers to improve motor efficiency continuously

Way Forward







Review of Building Energy Code on <u>every 3-year</u> basis to further tighten the requirements

Thank You…