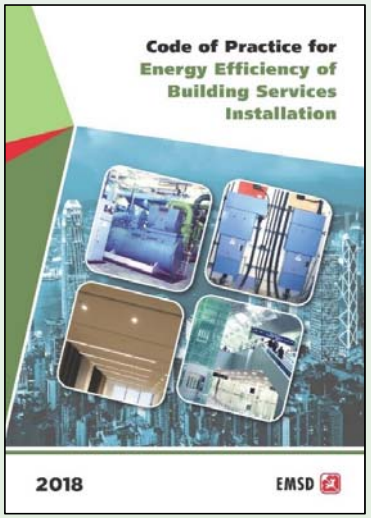
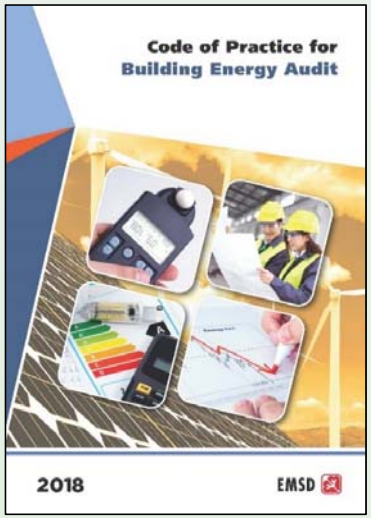
BEC 2018 & EAC 2018
The Changes

25 Feb. 2019
28 Feb. 2019
01 Mar. 2019

(REA Briefing 2019)





Topics

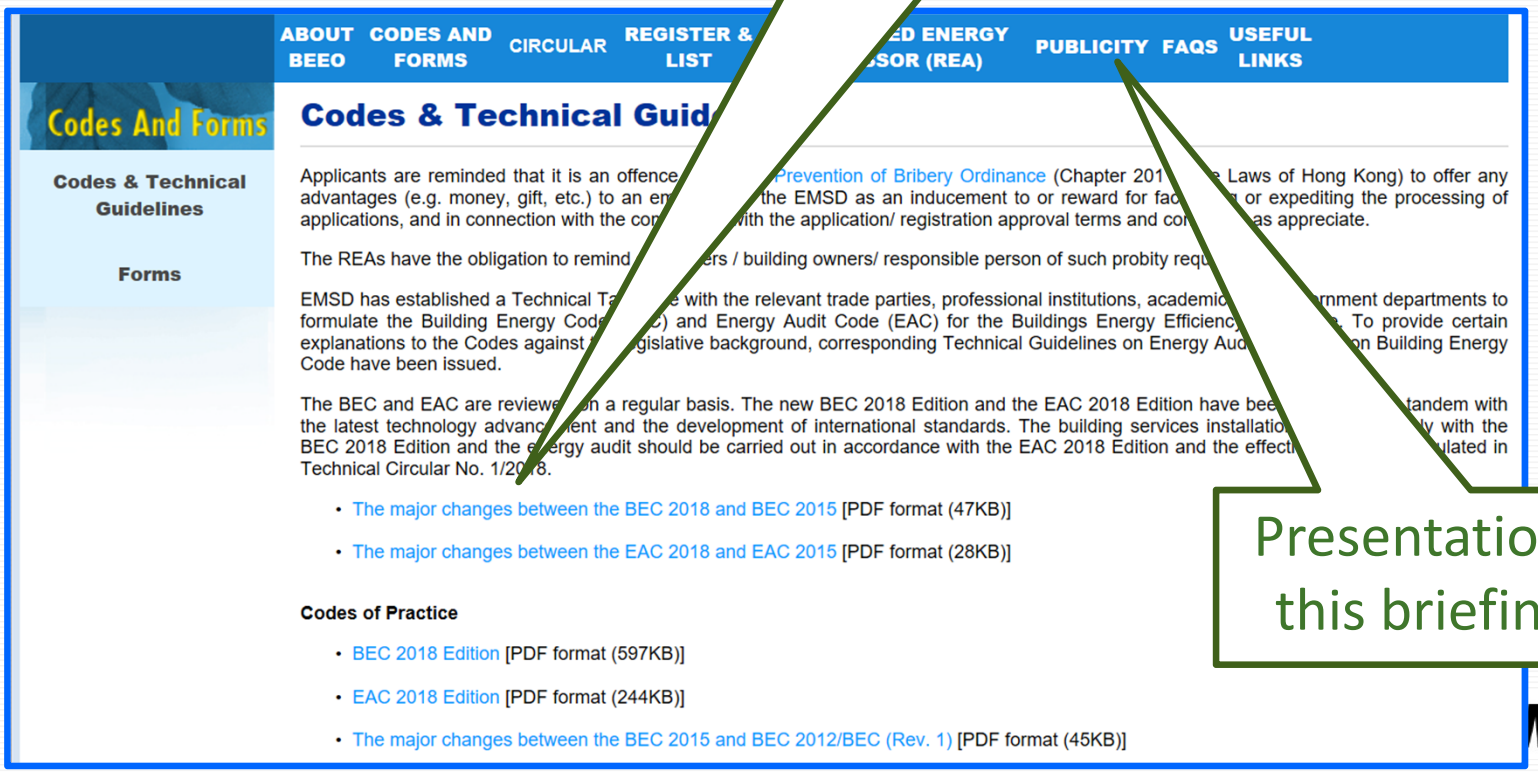
BEC 2018

1. Four Prescribed Installations
2. Performance-based Approach
3. Major Retrofitting Works

EAC 2018

Information Source

Major Changes
BEC 2018 & EAC 2018



Presentation slides of this briefing session

Lighting Installation

Summary
LPD requirement covers new spaces
LPD requirement of certain spaces tightened
Lighting control point (introducing exception)
Automatic lighting control (minor Changes)
Daylight responsive control (no Change)

Table 5.4 LPD Requirement Covers New Spaces

Type of spaces	BEC 2018 LPD (W/m^2)
Common room/ Break Room	8
Copy/ Printing Room, Photocopy Machine room/ Changing room/ Locker room	10
Covered playground/ Sky Garden/ Confinement Cell/ Pantry	12
Fast food/ Food court	14
Indoor swimming pool, for recreational or leisure purposes	15
Long stay ward for elderly/ Porte Cochere (>5m headroom)	15
Nurse station/ Porte Cochere	13

Includes Underwater Lighting

Table 5.4 LPD Requirement of Certain Spaces Tightened

Type of Spaces	BEC 2015 (W/m^2)	BEC 2018 (W/m^2)	%
Banquet Room/ Function Room/ Ball Room	20	17	15
Entrance Lobby	14	13	7
Library – Reading Area or Audio Visual Centre	15	12 (15 for stack area)	20
Lift Lobby	11	10	9
Patient Ward/ Day Care	15	13	13
Retail	17	16	6

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Office – LPD Tightening

Internal Floor Area (m^2)	BEC 2015 (W/m^2)	BEC 2018 (W/m^2)
	Demarcation: 15m^2	Demarcations: **15m^2** & **200m^2**
A ≤ 15	13	**12**
15 < A	12	-
15 < A ≤ 200	-	**10**
200 < A	-	**9**

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Lighting Installation - LCP

Exception on LCP

BEC clause 5.5.1 (Revised)
Space with fixed lighting installations ≤ 70W

BEC clause 8.5.6 (b) – (NEW)
Lift car lighting – No LCP

Lighting Installation - ALC

BEC Table 5.4
Occupant sensor for ALC is applicable to toilet

Exception on ALC
BEC clause 5.6.1.6
Space occupied in 24-hour-a-day and 7-day-a-week

Air-conditioning Installation

Tightening Requirement	Elaborated / New Requirement
Chiller COP	Heat Pump COP
VRF System COP	Cooling Tower Fan Speed Control
	Off-hours Control • Control Setback • Automatic Equipment Shutdown
	Energy Metering (Monitoring Requirements)

Min. COP of Chiller

Air-Cooled Chiller		BEC 2015	BEC 2018	%
Screw	< 500 kW	2.9	3.0	3.4
	>= 500 kW	3.0	3.1	3.3
VSD Screw	< 500 kW	2.8 (3.6)	3.0 (3.8)	7 (5.6)
	>= 500 kW	2.9 (3.7)	3.1 (3.9)	6.9 (5.1)
VSD Centrifugal	All Ratings	3.1 (4.0)	3.2 (4.2)	3.2 (5.0)

Min. COP of Chiller

Water-Cooled Chiller		BEC 2015	BEC 2018	%
VSD Screw	< 500 kW	(6.1)	(6.4)	(4.9)
	500 to 1,000 kW	(6.3)	(6.7)	(6.3)
	> 1,000 kW	5.2 (6.7)	5.3 (7.0)	1.9 (4.5)
VSD Centrifugal	< 1,000 kW	5.1 (6.6)	5.3 (7.0)	3.9 (6.1)
	1,000 to 3,000 kW	5.5 (7.1)	5.6 (7.5)	1.8 (5.6)
	> 3,000 kW	5.6 (7.2)	5.8 (7.6)	3.6 (5.6)

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Min. COP of VRF System

	BEC 2015	BEC 2018	%
Air-cooled (cooling mode)	3.3 (7.5kW & Below 40kW)	3.6 (20 kW or below)	9.1
		3.6 (> 20 to 40 kW)	9.1
	3.3 (40 to 200kW)	3.45 (> 40 to 200 kW)	4.5
Air-cooled (heating mode)	3.8 (7.5kW & Below 40kW)	4.0 (20 kW or below)	5.3
		3.8 (> 20 to 40 kW)	0
	3.6 (40 to 200kW)	3.8 (> 40 to 200 kW)	5.6

Min. COP of Heat Pump

Table 6.12c (*New Requirement*)

Heat Extract	*500 kW & Below*	*Above 500 kW*
Air to Water	2.8	3.1
Water to Water	4.4	4.5

Standard Rating Conditions:

- Heated Water Temp: 40 ^{0}C in / 45 ^{0}C out
- Ambient: 7 ^{0}C db @ 90 % RH
- Chilled Water Temp: 12.5 ^{0}C in / 7.0 ^{0}C out

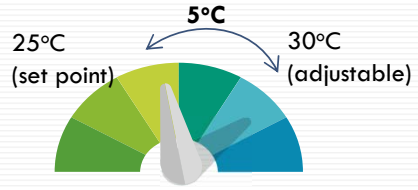
Cooling tower fan speed control

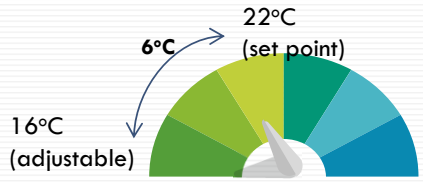
Clause 6.12.5 (*New Requirement*)

- Open-circuit CT fan rated motor power **≥3.7 kW**
- Fan motor power consumption **≤30%** of design input power at **50%** design air flow
- **Automatic fan speed control:** to control the leaving condenser water temperature of the cooling tower

Clause 6.10.4 – Off-hours Control

Control setback	Cooling Mode • Adjustable setback set point at least 5^0C above occupied set point • Maintain space temp. below the setback set point.
	Heating Mode (if provided) • Adjustable setback set point at least 6^0C below occupied set point • Maintain space temp. above the setback set point.





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Clause 6.10.4 – Off-hours Control

Equipment Shutdown	Time scheduling: • 7 different day types per week; • Retain program & time setting – power loss period 10 hours • Manual overriding control (a/c operation lasting for up to 2 hours)
	Occupant sensor: • Activation time – 30 min. or less

System designer's decision on which mechanism to take

Clause 6.13 Energy Metering (Monitoring Facilities Elaborated)

Table 6.13 (a) : Energy Metering for Air-conditioning Equipment and Chilled/Heated Water Plant		
Equipment / Plant	Capacity	Parameters to be measured
Chiller, heat pump or unitary air-conditioner	≥ 350kW (cooling /heating)	Input, electrical power (kW); energy (kWh)
Chilled/heated water plant		Output, cooling/heating power (kW); energy (kWh), COP

TG-BEC2012 & TG-BEC2015 Cl. 6.13 (b) & (c):

- At the same instant of time;
- Data logging, data storage.

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Clause 6.13 Energy Metering (Monitoring Facilities Elaborated)

Table 6.13 (a) : Energy Metering for Air-conditioning Equipment and Chilled/Heated Water Plant		
Equipment / Plant	Capacity	Parameters to be measured
Chiller, heat pump or unitary air-conditioner	≥ 350kW (cooling /heating)	Input, electrical power (kW); energy (kWh)
Chilled/heated water plant		Output, cooling/heating power (kW); energy (kWh), COP

Clause 6.13.5 (New) Trends the parameters in:

- 15-min interval
- Hourly, daily, monthly & annual data
- 36-month data storage

3-Ph Induction Motor (Single Speed 4-pole)

	BEC 2015 (IE2/IE3)	BEC 2018 (IE3)	%
0.75 to <5.5 kW	79.6 – 86.6	82.5 – 88.6	2.3
5.5 kW to <7.5 kW	87.7	89.6	2.2
7.5 to <22 kW	90.4 – 92.6	90.4 – 92.6	-
22 to <55 kW	93.0 – 94.2	93.0 – 94.2	-
55 to <90 kW	94.6 – 95.0	94.6 – 95.0	-
90 to >200 kW	95.2 – 96.0	95.2 – 96.0	-

Clause 7.7.4 (New Requirement - THD Related)

Metering device (MD) for THD, including 31st harmonic order

- MD for **main** circuit ≥ 400A
- MD for **feeder** or **sub-main** circuit ≥ 400A
- MD for circuit serving CBSI with circuit rating ≥ 400A
- MD for Lift & Escalator Installation

Not mandatory:

- MD for **feeder/sub-main** circuit > 200A & < 400A (not specified with taking THD measurement)
- MD for **feeder/sub-main** circuit ≤ 200A (MD not prescribed under the BEC)

Clause 7.7.5 – Monitoring Related

Trends the measured parameters specified in Clause 7.7.1 to 7.7.3:

- 15-min interval;
- hourly, daily, monthly and annual data; and
- Maintain min. 36-month data storage.

Only for the prescribed MDs under the BEC i.e.

- MD for feeder/sub-main circuit rated > 200A
- MD for circuit serving CBSIs

For analysis, identifying improvement works and evaluation of energy saving items.

Lift and Escalator Installations

Max. allowable traction lift electrical power ⇩ **5 %**
(for new installation)

Max. allowable traction lift electrical power ⇩ **5 %**
(for existing installation)

Max. lift decoration load ⇩ **10 %**

Max. allowable escalator electrical power – No change

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Lift and Escalator Installations

Regenerative braking (lift):

- Rated speed at or above **2.5 m/s**; and
  Rated load at or above 1000 kg

Metering device: At least up to **31st** harmonic order

Trend the measured data:

- 15-min interval;
- hourly, daily, monthly and annual data; and
- Maintain 36-month data storage.

Lift and Escalator Installations

Lift car lighting:

- ALC: 10-minute activation time
- LPD: follows Table 5.4, unless total electrical power consumed < 70W
- LCP: Not applicable

Escalator THD & TPF measurement locations:

- At isolator connecting to escalator to building's electrical supply circuit; or
- At circuit protective device serving the equipment.

Lift and Escalator Installations

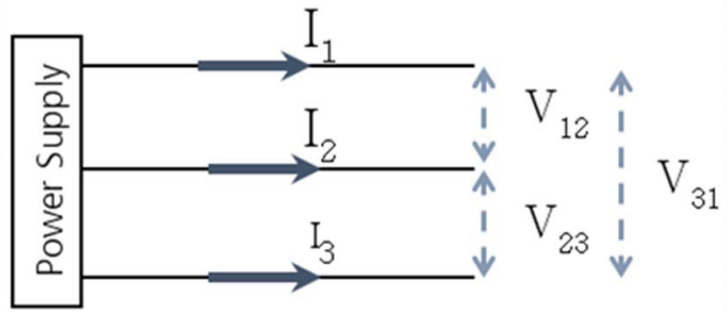
Total Power Factor (TPF)

- New clause 8.5.1.4
- Follows “Appendix B” for calculating the apparent power “S”
- And hence the TPF
- Part of the compliance demonstration
- Applicable to Lift, Escalator & Passenger Conveyor fed by 3-ph-3-W power supply system

TPF Calculation Procedure(Appendix B) (for 3-Ph-3-W power supply system)

- V_z – Phase voltages not directly measureable (w/o neutral)
- Take measurement on:
  - Line Currents (I_z)
  - Line Voltages (V_{xy})
  - Active Power (P)
- Follow procedures in Appendix B to compute the Phase voltages (V_z)
- Determine S
- Determine TPF

$$S = |V_1||I_1| + |V_2||I_2| + |V_3||I_3|$$



$$Total\ Power\ Factor = \frac{Active\ Power (P)}{Apparent\ Power\ (S)}$$

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TPF Calculation Procedure (Appendix B) (for 3-Ph-3-W power supply system)

B2.4 The apparent power (S) can be obtained by equation B2.

$$S = |V_1||I_1| + |V_2||I_2| + |V_3||I_3| \quad \text{(B2)}$$

Where the hypothesized phase voltages V_1, V_2, V_3 are obtained by equation B3, B4 & B5.

$$|V_1| = |V_{31}| \frac{\sin(\frac{\pi}{3} - \beta)}{\sin(\frac{2\pi}{3})} \quad \text{(B3)}$$

$$|V_2| = |V_{12}| \frac{\sin(\alpha)}{\sin(\frac{2\pi}{3})} \quad \text{(B4)}$$

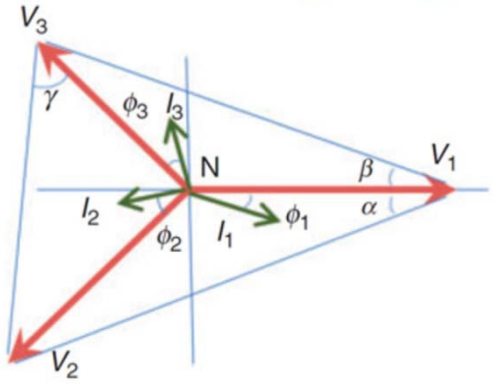
$$|V_3| = |V_{31}| \frac{\sin(\beta)}{\sin(\frac{2\pi}{3})} \quad \text{(B5)}$$

Denotes $\theta = \alpha + \beta$, then

$$\theta = \cos^{-1}\left[\frac{|V_{12}|^2 + |V_{31}|^2 - |V_{23}|^2}{2|V_{31}||V_{12}|}\right] \quad \text{(B6)}$$

$$\alpha = \tan^{-1}\left[\frac{\sin(\frac{\pi}{3}) - \frac{|V_{31}|}{|V_{12}|}\sin(\frac{\pi}{3} - \theta)}{\cos(\frac{\pi}{3}) + \frac{|V_{31}|}{|V_{12}|}\cos(\frac{\pi}{3} - \theta)}\right] \quad \text{(B7)}$$

$$\beta = \theta - \alpha \quad \text{(B8)}$$



- Relatively straightforward procedure
- Manageable thro' spreadsheet
- With solid academic study
- For full discussion:

  So A., Chan W. & Tsang K. (2017), "On the total power factor for lift systems", *Building Services Engineering Research and Technology*, Vol. 38, No. 4, pp 436-449.

Performance-based Approach

Trade-off items cover energy efficiency requirements on BSIs (revised in Table 9.4)

Lighting installation (Section 5)
Lighting Power Density (5.4)
Automatic Lighting Control (5.6)

Electrical installation (Section 7)
Power distribution loss (copper loss) (7.4)
Motor installation (motor efficiency) (7.5)
Power Quality (power factor, total harmonic distortion) (7.6)

Performance-based Approach

Air-conditioning installation (Section 6)
Air distribution system fan power (6.7)
Pumping system variable flow (6.8)
Pipe Friction Loss (6.9)
System control (6.10)
Equipment Efficiency (COP) (6.12)

Lift and escalator installation
Electrical power (max. power consumption) (8.4)
Utilization of Power (decoration load, regenerative braking or etc.)(8.5)
Total Harmonic Distortion (8.6)

Performance-based Approach

BEC clause 9.4.2:
Energy efficiency performance of trade-off item(s) should not be 15% below the prescriptive standard.

BEC clause 9.4.3 (*New*):
The following trade-off items should not exceed **20%** below the prescriptive standard.

- Lighting Power Density
- Air Distribution System Fan Power

Performance-based Approach

BEC clause 9.5.4.6 (*New Requirements*):

Measurement and monitoring facilities for:

- Recovered energy captured on site; and
- Renewable energy generated on site

Measure & Verify :

- Thermal energy/power; &
- Electrical energy/power.

(Facilitate evaluation of the system performance and verify the predicted saving etc.)

MRW (Existing Bldgs. or Bldgs. issued w/ COCR)

500m² Works Area Criterion	Main CBSI Component Criterion
BEEO - Item 1, Schedule 3 500m² Works Area; 12-month; same series of works	BEEO - Item 2, Schedule 3 Circuit 400A; 350kW Chiller or U-A/C; L&E Motor Drive & Mechanical Drive
BEC - Table10.1 **(a)** 3.0 kW - Lighting 60 kW – Chiller, U-A/C, AHU	BEC – Table 10.1 **(b)** Prescribes the EE Requirements Associated works as part of the MRW
BEC Table 10.1 Remarks 1: Ratings involved (Newly installed equipment) Remarks 3: Works Area ≠ Served Area	

MRW (Existing Bldgs. or Bldgs. issued w/ COCR)

500m² Works Area Criterion	Main CBSI Component Criterion
BEC - Table10.1 **(a)**	BEC – Table 10.1 **(b)**
Typically, responsible person of building unit (e.g. Tenant) Bldg. owner conducts renovation works in the non-leased area (e.g. lift lobby, corridor)	Bldg. owner conducts CBSI upgrade
Wholesale renovation/conversion with works area ≥ 500m² (e.g. bldg. change usage from office to hotel)	

Changes in BEC Table 10.1(a) [500m²]

Table 10.1

Major Retrofitting Works and Energy Efficiency Requirements

Category of Major Retrofitting Work	Condition for Applicability of BEC Requirement		Applicable BEC Requirement	BEC Clause No.
(a) Works involving addition or replacement of a building services installation that covers one or more places with a floor area or total floor area of not less than 500 m² under the same series of works within 12 months in a unit or a common area should include item (i), item (ii) and/or item (iii) as described below (please also see the remarks at the end of this table) –				
(ii) addition or replacement of air handling unit(s), unitary air-conditioner(s) ,VRF system(s), heat pumps(s) and/or chiller(s)	total cooling/heating capacity of the additional or replacement air handling unit(s), unitary air-conditioner(s), VRF system(s), heat pump(s) and/or chiller(s) at or exceeding 60kW	involving addition or replacement of unitary air-conditioner, VRF system, heat pump, cooling tower and/or chiller	air- conditioning equipment efficiency	6.12
		the additional or replacement air handling unit(s) forming a complete air distribution system in the context of clause 6.7	separate air distribution system for process requirements	6.5
			air distribution system fan power	6.7
			direct digital control	6.14
		the work involving additional water pipework	frictional loss of water piping system	6.9
		the work involving a complete replacement of		

AHU, U-A/C, CH

+ HP, + VRF System

+ Cooling Tower

+ HP, + VRF System

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Mod:
Escalator –
Automatic speed reduction mode

Lift Car –
Vent. & A/C
LPD
ALD

Table 10.1
Major Retrofitting Works and Energy Efficiency Requirements

Category of Major Retrofitting Work	Condition for Applicability of BEC Requirement	Applicable BEC Requirement	BEC Clause No.
(a) Works involving addition or replacement of a building services installation 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 should include item (i), item (ii) and/or item (iii) as described below (please also see the remarks at the end of this table) –			
(iii) addition or replacement of motor drive and mechanical drive, of a lift, an escalator, or a passenger conveyor	the work involving a traction drive lift with machine above and with 1:1 or 2:1 suspension roping system, a hydraulic lift, an escalator or a passenger conveyor	electrical power	8.4
	the work involving a traction drive lift, a hydraulic lift, an escalator or a passenger conveyor	total power factor	8.5.1
		total harmonic distortion	8.6
		metering & monitoring facilities	8.7
		automatic speed reduction of escalator (except public service escalator and heavy duty escalator)	8.5.7
	the work involving addition of a lift or replacement of a lift car	lift decoration load	8.5.2
		lift ventilation & air conditioning	8.5.4
		lighting power density	5.4
		automatic lighting control	8.5.6

Changes in BEC Table 10.1 (b) [CBSI]

Circuit 400A

Table 10.1
Major Retrofitting Works and Energy Efficiency Requirements

Category of Major Retrofitting Work	Condition for Applicability of BEC Requirement		Applicable BEC Requirement	BEC Clause No.
(b) Addition or replacement of a main component of a central building services installation should include item (i), item (ii) and/or item (iii) as described below (please also see the remarks at the end of this table) –				
(i) addition or replacement of a complete electrical circuit at rating of 400A or above	the work involving a complete main circuit, except for cable route between existing transformer room and associated LV switch room with length exceeding 20 m		power distribution loss	7.4.2
	the work involving a complete feeder			7.4.3
	the work involving a complete sub-circuit			7.4.4
	the work involving a complete final circuit			7.4.5
	the work involving a complete feeder, or involving a complete sub-circuit and all its downstream final circuits		total power factor	7.6.1
			total harmonic distortion	7.6.2
			balancing of single-phase loads	7.6.3
	the work involving a main circuit, a feeder or a sub-circuit, with addition of corresponding switch cubicle for the circuit termination at the main LV switchboard		metering & monitoring facilities	7.7
	in addition to the addition or replacement of the complete electrical circuit at rating of 400A or above	the work involving an addition or replacement of luminaires with a total circuit wattage at or exceeding 3kW	requirements as for (a) (i)	
		the work involving an addition or replacement of air handling unit(s), of unitary air-conditioner(s), VRF system(s), of heat pump(s) and/or of chiller(s), with a total cooling/heating capacity at or exceeding 60kW	requirements as for (a) (ii)	

Associated works as part of the MRW
Lighting ≥ 3kW

60kW C/H Cap.
AHU, U-A/C & CH
+ VRF System
+ HP

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Changes in BEC Table 10.1 (b) [CBSI]

Table 10.1
Major Retrofitting Works and Energy Efficiency Requirements

Category of Major Retrofitting Work	Condition for Applicability of BEC Requirement		Applicable BEC Requirement	BEC Clause No.
(ii) addition or replacement of a unitary air-conditioner or a chiller of a cooling rating or a heat pump of heating rating at or exceeding 350kW	applicable in any conditions; the work involving addition or replacement of cooling tower(s)		air- conditioning equipment efficiency	6.12
	the addition or replacement of air-conditioning equipment involving addition or complete replacement of the corresponding water side pumping system		frictional loss of water piping system	6.9
			energy metering	6.13
			direct digital control	6.14
	ditto, the corresponding water side pumping system forming an independent system		pumping system variable flow	6.8
	the work involving addition or replacement of pipework, ductwork or AHU		thermal insulation	6.11
	the work involving addition or replacement of water pump with new motor, of AHU with new motor, or of fan with new motor		motor efficiency	7.5.1
	in addition to the addition or replacement of the unitary air-conditioner, chiller or heat pump at or exceeding 350 kW	the work involving an addition or replacement of luminaires with a total circuit wattage at or exceeding 3kW	requirements as for (a) (i)	
		the work involving an addition or replacement of air handling unit(s), of unitary air-conditioner(s), of VRF system(s), of heat pump(s) and/or of chiller(s) with a total cooling/ heating capacity at or exceeding 60kW	requirements as for (a) (ii)	

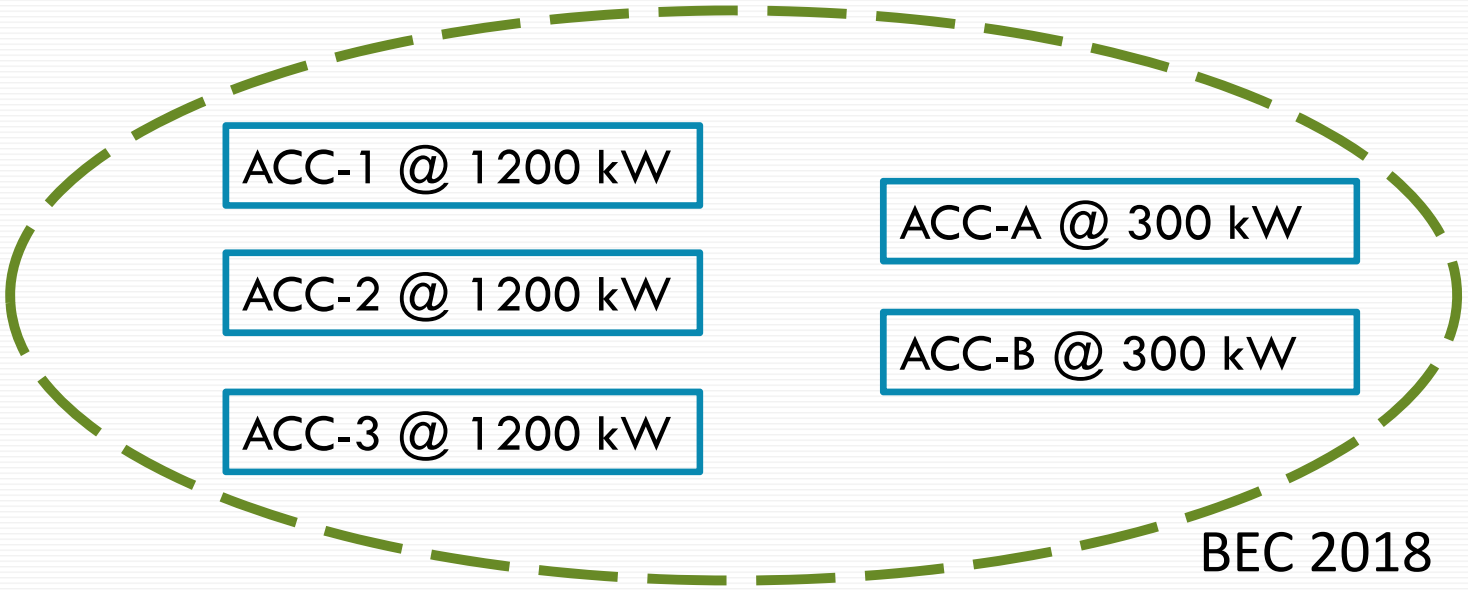
350 kW C/H Cap.
U-A/C, CH
+ HP

+ CT

60kW C/H Cap.
AHU
+ U-A/C
+ VRF System
+ HP
+ CH

Changes in BEC Table 10.1 (b) [CBSI]

Replacement of 5no. of Air-cooled Chillers



FOC covers ACC-1 to 3 plus ACC-A & B

- ACC-1 to 3 over 350 kW → MRW (CBSI main component)
- ACC-A & B over 60 kW each → part of the MRW under Table 10.1 (b) (ii)

BEC 2018 – Potential Energy Saving

Around **18%** improvement compared with the 2012 edition

By the end of the coming decade,

- energy saving of some **27 billion kWh** from both new buildings and existing buildings in Hong Kong,
- Equivalent to
  - the total annual electricity consumption of about **5.8 million households**
  - a reduction in carbon dioxide emissions of about **19 million tonnes.**

Changes - EAC 2018

- Clause 7.4 – Identification of EMO
- Clause 7.5 – Cost Benefit Analysis of EMO
- Clause 7.6 – Recommendations

EMO Identification

Clause No.	EAC 2015	EAC 2018
7.4.1	Derive energy performance (W per l/s, W/m^2 etc.)	Same
7.4.2	Comparison: original design, well known international standard	Same
7.4.3	Involving occupant of building units – behavior change reducing CBSI energy consumption	Same

EMO Identification

Clause No.	EAC 2015	EAC 2018
7.4.4	-	Study viable: • Replacing or addition of equipment/ system with more efficient models; • Energy recovery system; • On-site renewable energy
		TG-EAC Clause 7.4.4

EMO Identification

Clause No.	EAC 2015	EAC 2018
7.4.5	-	List out obvious EMO(s) during site walk • Match equipment operating schedule with space operation needs • Needs of maintenance works • Avoid excessive provision (e.g. lighting level, temp. set point)
		TG-EAC Clause 7.4.1.1

EMO Identification

Clause No.	EAC 2015	EAC 2018
7.4.6	-	Equipment/System Energy Consumption pattern: • Automatic control enhancement, improvement of system operating efficiency; • Conduct system balancing; • Matching equipment capacity with load profile (Avoid oversizing)
		TG-EAC Clause 7.4.1.1

Clause 7.5 – Cost Benefit Analysis of EMO
Clause 7.6 – Recommendations

- Enhancement on M&V related matters
- Robustness of measured or collected energy data
- Facilitate verification/evaluation
- Reference: **IPMVP** *(International Performance Measurement and Verification Protocol)*

Cost Benefit Analysis

Clause No.	EAC 2015	EAC 2018
7.5.1	Estimate energy saving; Cost benefit analysis	Same
7.5.2	-	Elaborate “energy saving”
7.5.3	-	Record of the **conditions** under which the measured energy use took place (Allow adjustment for change of the conditions)
7.5.4	-	EMO’s energy performance **degradation** over the service life time

Cost Benefit Analysis

Clause No.	EAC 2015	EAC 2018
7.5.5	-	Energy price
7.5.6	-	Measurement period (preferable of complete operating cycle) (record projection methodology)
7.5.7	-	Metering details (e.g. metering points, measurement interval)

Recommendations

Clause No.	EAC 2015	EAC 2018
7.6.1	Based on energy saving & cost benefit	Same + robust data for implementation stage evaluation
7.6.2	-	EMO intent/description; Any special requirement to generate expected saving; Functional testing, data trending analysis.
7.6.3	-	Metering point, measurement devices, involved parameter, interval of measurement.

Thank you

謝謝