



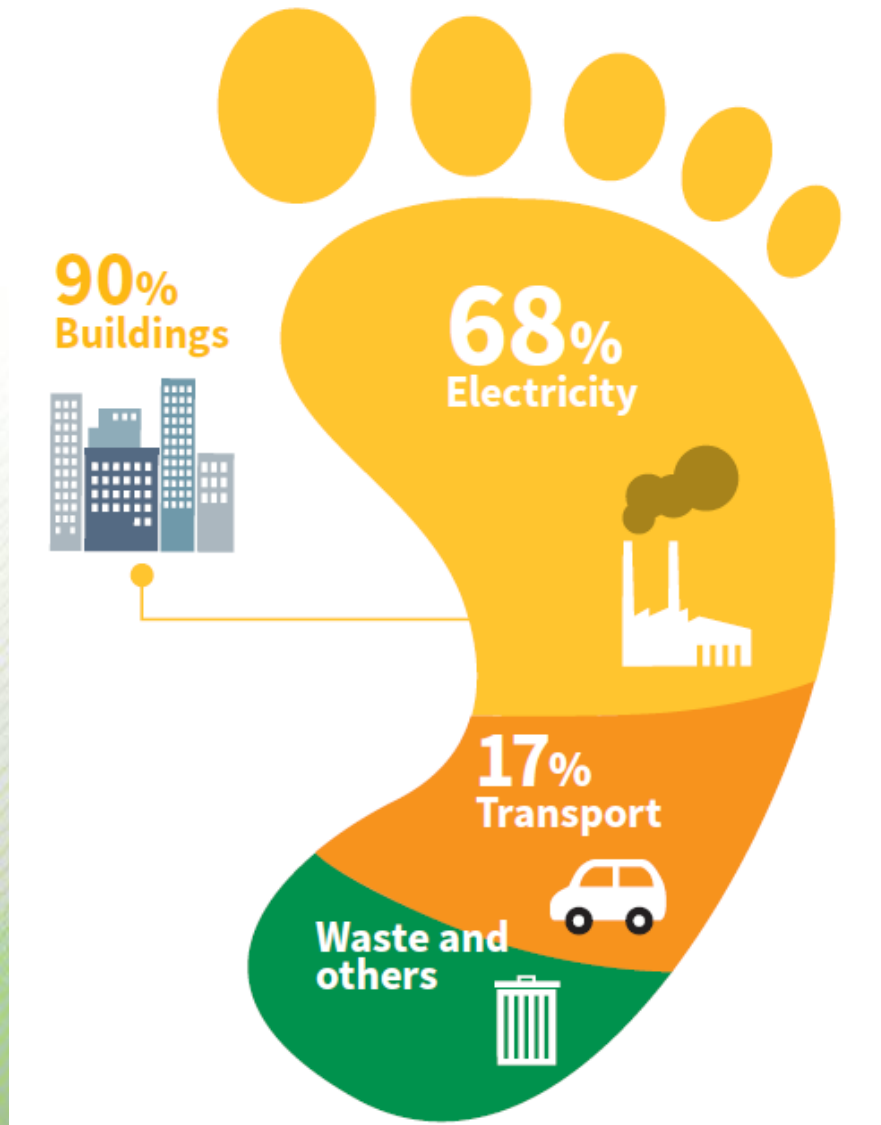
# Low-Carbon Building Management



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FIEAust, CEng, MIET  
Carbon Auditor Professional**

# 1. Hong Kong's Carbon Footprint



In 2012, Hong Kong's total Carbon Emission was 43.1 Million Tonnes of CO<sub>2</sub>-e.





Lighting

**8,000+**  
government  
buildings/  
facilities



**42,000+**  
buildings in  
private sector



**50+**  
buildings over  
200 m (656 ft)



Elevators

lifts  
62,000+  
escalators  
8,700+

**270+**  
buildings over  
150 m (492 ft)



# ENERGY SAVING PLAN

For Hong Kong's Built Environment  
2015~2025+



Environment Bureau in collaboration with  
Development Bureau  
Transport and Housing Bureau

May 2015

# SUMMARY OF ENERGY SAVING PLAN FOR HONG KONG 2015~2025+

## TARGET

Year  
2025

### ENERGY INTENSITY

Hong Kong to achieve energy intensity reduction by 40 % by 2025 using 2005 as the base

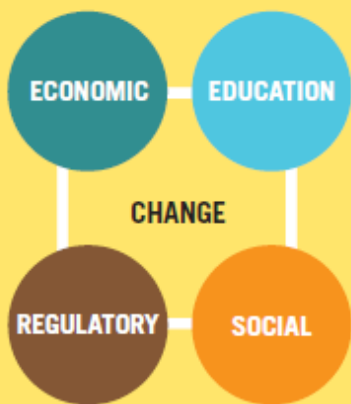


Be "Energy Aware"  
and "Energy Wise"



## POLICY

To drive energy saving through a combination of educational, social, economic and regulatory means, especially for buildings and inhabitants to become highly energy efficient by 2025



## STRATEGY

### PUBLIC SECTOR

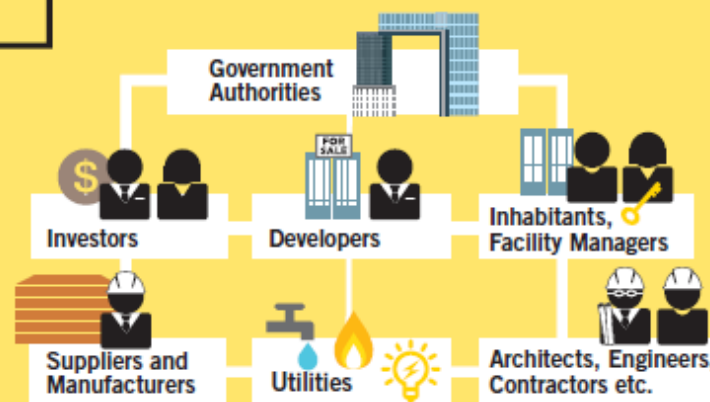
Government and public sector development agencies to lead by example and accelerate conditions for change

### PRIVATE SECTOR

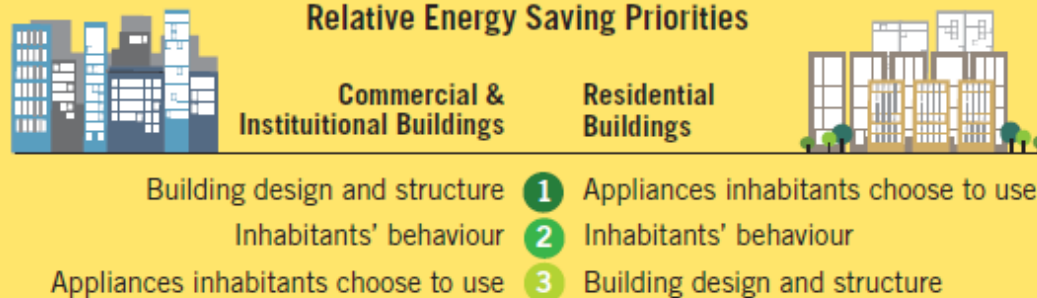
Focus on energy saving in new and existing private sector buildings to capture potential gains

### PARTNERSHIP

Collaborate with energy and built environment stakeholders to enable the 'Energy Wise' transformation

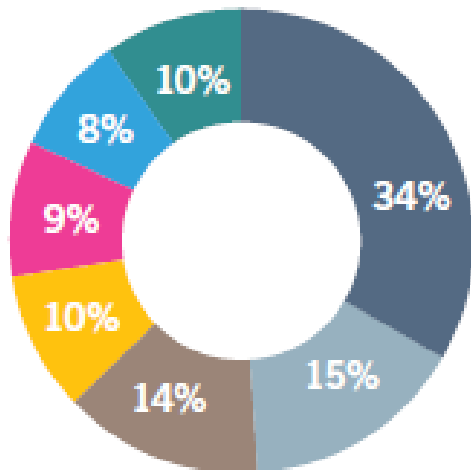


### Relative Energy Saving Priorities





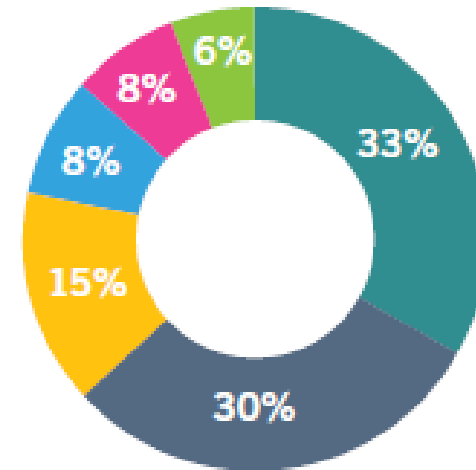
How the residential sector uses electricity, 2012



- Space conditioning
- Computer and audio/visual equipment
- Refrigeration
- Lighting
- Cooking
- Hot water
- Others

(Sources: Hong Kong Energy End-use Data, EMSD and C&SD)

How the commercial sector uses electricity, 2012



- Space conditioning
- Lighting
- Hot water and refrigeration
- Cooking
- Office equipment
- Others

(Sources: Hong Kong Energy End-use Data, EMSD and C&SD)



# Office + Arcade

	Carbon Emissions (in tones of CO <sub>2</sub> -equivalent)	
Operational Boundaries	Baseline Year 2010	Carbon reduction Year 2013
<b>Scope 1 Direct Emissions</b>		
Stationary Combustion Sources	1.047	1.047
Mobile Combustion Sources	N/A	N/A
Fugitive Emissions	531.7	N/A
Other Direct Emissions	N/A	N/A
<b>Scope 1 Direct Removals</b>		
Planting of additional trees	N/A	N/A
Other Direct Removals	N/A	N/A
<b>Scope 1 Emissions Total:</b>	<b>532.747</b>	<b>1.047</b>
<b>Scope 2 Energy Indirect Emissions</b>		
Electricity Purchased	13667.188	11922.000
Towngas Purchased	N/A	N/A
<b>Scope 2 Emissions Total:</b>	<b>13667.188</b>	<b>11922.000</b>
<b>Scope 3 Other Indirect Emissions</b>		
Disposal of Paper Waste	N/A	N/A
Electricity for Processing Fresh Water	10.77	9.103
Electricity for Processing Sewage	4.527	3.693
Others	N/A	N/A
<b>Scope 3 Emissions Total:</b>	<b>15.297</b>	<b>12.796</b>
<b>TOTAL GHG Emissions:</b>	<b>14,215.232</b>	<b>11,935.843</b>
	<b>Saving</b>	<b>16.03%</b>





# Shopping Centre

		Carbon Emissions (in tones of CO <sub>2</sub> -equivalent)	
Operational Boundaries	Baseline Year 2010	Carbon Reduction Year 2013	
<b>Scope 1 Direct Emissions</b>			
Stationary Combustion Sources	0.942	0.655	
Mobile Combustion Sources	N/A	N/A	
Fugitive Emissions	N/A	N/A	
Other Direct Emissions	N/A	N/A	
<b>Scope 1 Direct Removals</b>			
Planting of additional trees	N/A	N/A	
Other Direct Removals	N/A	N/A	
<b>Scope 1 Emissions Total:</b>	<b>0.942</b>	<b>0.655</b>	
<b>Scope 2 Energy Indirect Emissions</b>			
Electricity Purchased	6,906.433	5,890.092	
Towngas Purchased	N/A	N/A	
<b>Scope 2 Emissions Total:</b>	<b>6,906.433</b>	<b>5,890.092</b>	
<b>Scope 3 Other Indirect Emissions</b>			
Disposal of Paper Waste	5.904	5.923	
Electricity for Processing Fresh Water	28.419	33.428	
Electricity for Processing Sewage	11.529	13.56	
Others	N/A	N/A	
<b>Scope 3 Emissions Total:</b>	<b>45.852</b>	<b>52.911</b>	
<b>TOTAL GHG Emissions:</b>	<b>6,953.227</b>	<b>5,943.658</b>	
	<b>Saving</b>	<b>14.52%</b>	

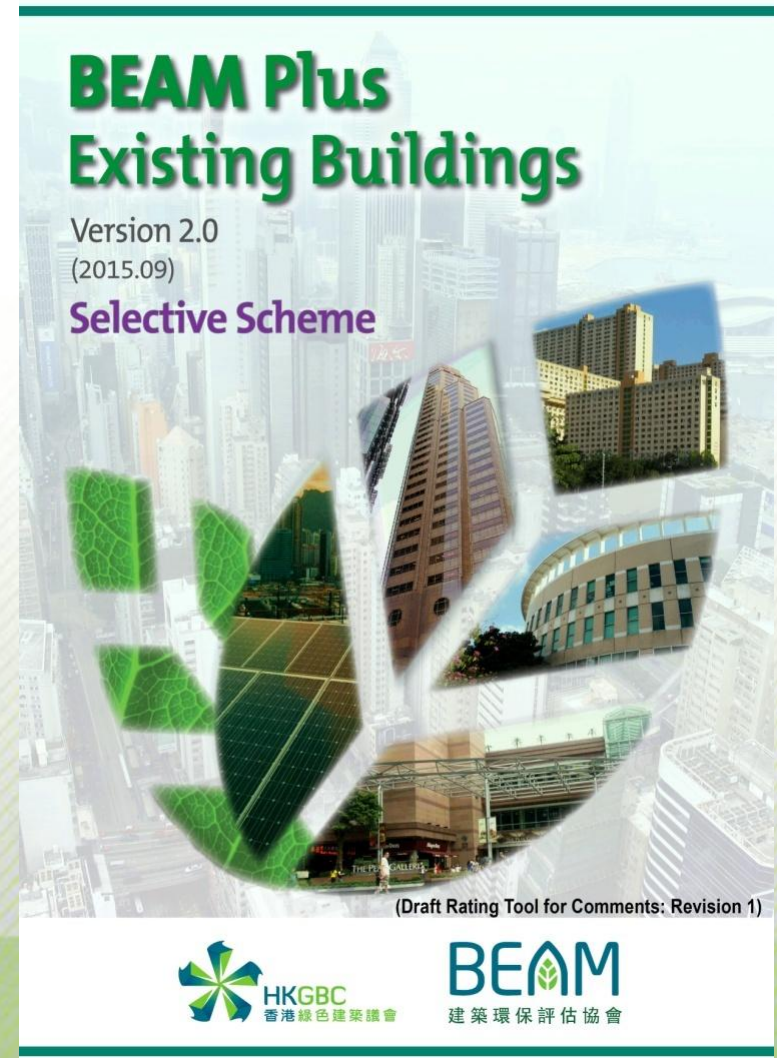
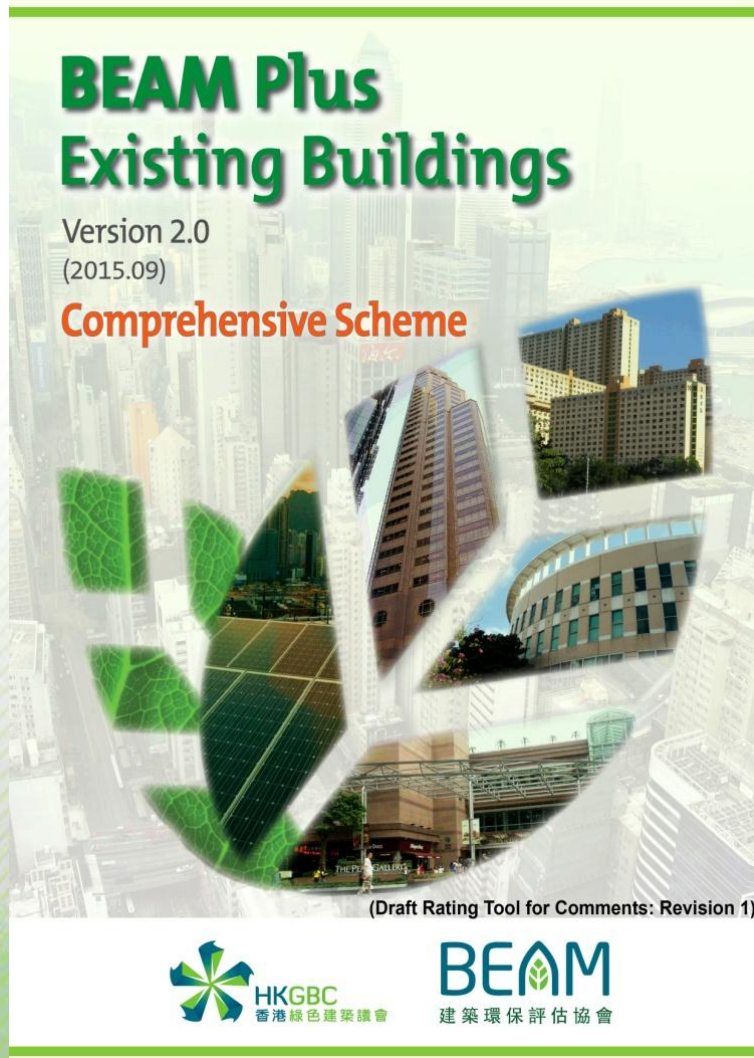


# Residential

	Carbon Emissions (in tones of CO <sub>2</sub> -equivalent)	
Operational Boundaries	Baseline Year 2008	Carbon Reduction Year 2010
<b>Scope 1 Direct Emissions</b>		
Stationary Combustion Sources	2.511	2.511
Mobile Combustion Sources	N/A	N/A
Fugitive Emissions	170	170
Other Direct Emissions	N/A	N/A
<b>Scope 1 Direct Removals</b>		
Planting of additional trees	-0.23	-0.23
Other Direct Removals	N/A	N/A
<b>Scope 1 Emissions Total:</b>	<b>172.279</b>	<b>172.279</b>
<b>Scope 2 Energy Indirect Emissions</b>		
Electricity Purchased	6,241.278	5,631.059
Towngas Purchased	5.578	5.555
<b>Scope 2 Emissions Total:</b>	<b>6,246.857</b>	<b>5,636.614</b>
<b>Scope 3 Other Indirect Emissions</b>		
Disposal of Paper Waste	15.36	16.08
Electricity for Processing Fresh Water	15.734	15.734
Electricity for Processing Sewage	5.227	6.542
Others	N/A	N/A
<b>Scope 3 Emissions Total:</b>	<b>36.321</b>	<b>38.356</b>
<b>TOTAL GHG Emissions:</b>	<b>6,455.459</b>	<b>5,797.251</b>
	<b>Saving</b>	<b>10.2%</b>



# 2. BEAM Plus Existing Building V2.0





# BEAM Plus Existing Buildings Assessment (Comprehensive)

- Management
- Energy Use
- Site Aspects
- Indoor Environmental Quality
- Materials and Waste Aspects
- Water Use
- Innovations

**Figure 19** BEAM Plus NB and EB Assessment Scope

- Low Energy Passive Design
- Energy Benchmarking
- Commissioning
- Energy Management

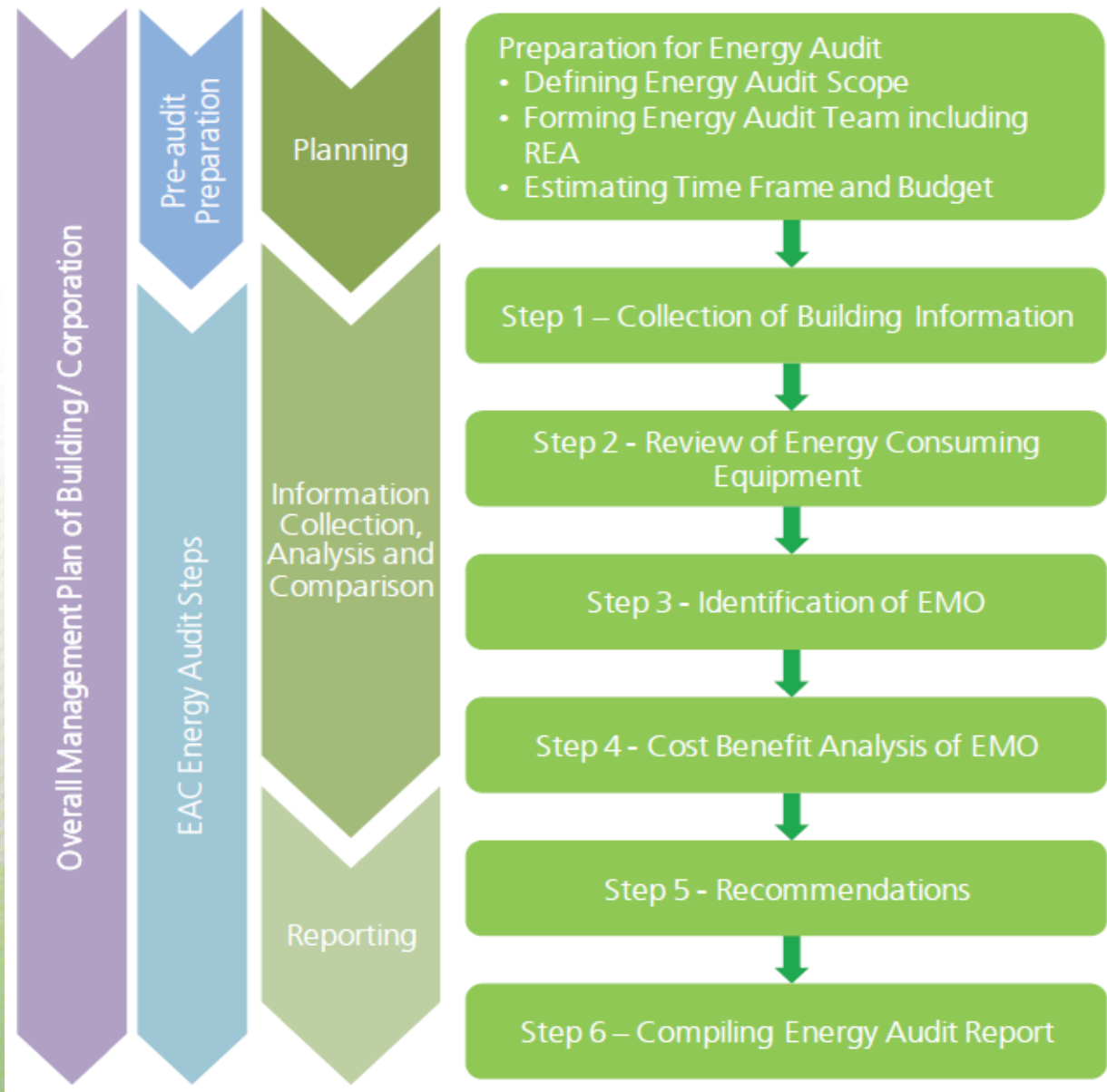
- Location and Amenities
- Planning and Design
- Site Emissions
- Site Management

- Indoor Air Quality
- Health, Hygiene, Amenities
- Visual, Aural and Thermal Comfort

- Material Selection
- Building Adaptability
- Waste Management

- Water Economy and Quality

# 3. Energy Audit



# Energy management Opportunities (EMO)

類別 Category	描述 Description	例子 Examples
第一類 Category I	涉及內務管理，所推行的改善措施無需任何投資成本，並且不會妨礙建築物的運作 Involving housekeeping measures which are improvements with practically no cost investment and no disruption to building operation	當房間無人使用時，關掉冷氣機或電燈、調高室內溫度等 Turning off A/C or lights when not in use, revising A/C temperature set-points, etc.
第二類 Category II	涉及更改操作方法，投資成本相對較低 Involving changes in operation measures with relatively low cost investment	安裝時間掣來關掉設備、將T8螢光燈管更換為T5燈管等 Installing timers to turn off equipment, replacing T8 fluorescent tubes with T5 fluorescent tubes, etc.
第三類 Category III	涉及相對較高的投資成本，以達致善用能源的目的 Involving relatively higher capital cost investment to attain efficient use of energy	加裝可變速驅動器、安裝功率因數修正器、更換冷水機等 Adding variable speed drives, installing power factor correction equipment, replacing chillers, etc.



# Annual EUI from Energy Audits

Central AC System	Type of Building	EUI (kWhr/m <sup>2</sup> /annum)
Yes	Office	95-170
	Shopping Mall	150-310
	Office + Retail (mixed development)	100-250
No	Office	30-70
	Shopping Mall	20-100
	Office + Retail (mixed development)	25-50

Energy Utilization Index (EUI): 
$$\frac{\text{Total Energy Consumption (MJ or KWh)}}{\text{Total Internal Floor Area (m}^2\text{)}}$$

# 4. Re-Commissioning

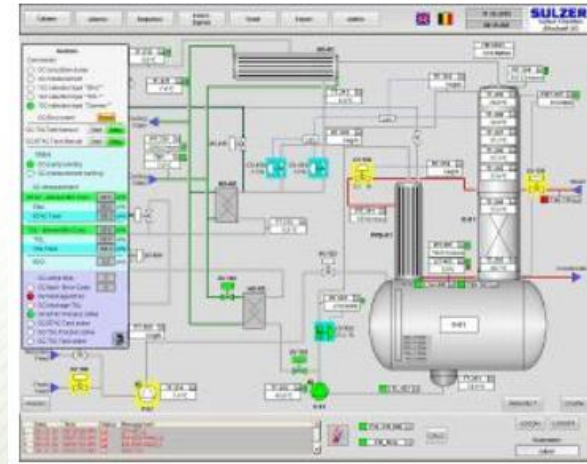
- A quality assurance process for improving and optimizing a building's energy performance.
- O&M tune-up activities and diagnostic testing are used to optimize the building systems.
- Meeting building's operational needs:
  - System functionality;
  - Integrated functionality (how systems function together);
- Preparing O&M documentation
- Training O&M personnel





# Re-Commissioning

- **Retro-commissioning :**
  - After Changes to Major Systems
  - Electrical Services Systems
  - Plumbing and Drainage Systems
  - Lifts and Escalators
  - HVAC System
- **Ongoing Commissioning:**
  - Yearly for HVAC and Electrical Systems
  - Power Quality Management, 5 years interval
    - Power Factor monitoring & correction
    - 3 phase load balancing
    - Demand side Management (DSM)
    - Total harmonic distortion (THD)
    - Thermal scan on electrical distribution system

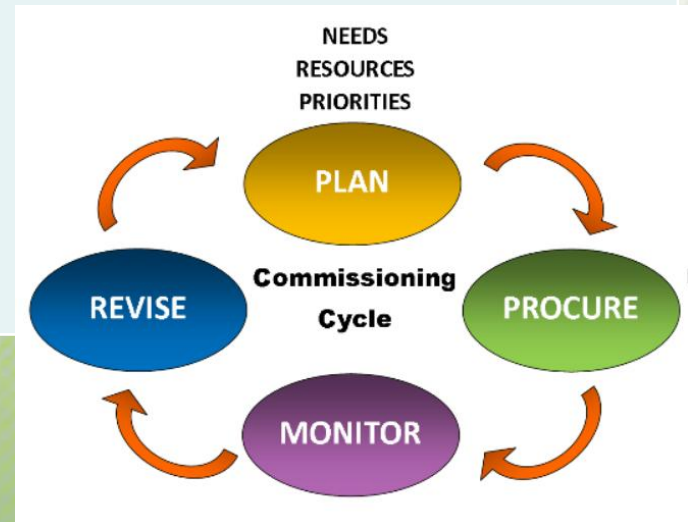




# Re-Commissioning Process

## 1. Planning phase

- Develop commissioning objectives
- Hire commissioning provider
- Review documentation and obtain historical data
- Develop re-commissioning plan



# Re-Commissioning Process

## 2. Investigation phase

- Perform site assessment
- Develop and execute diagnostic, monitoring and test plans
- Analyze results
- Develop Master List of deficiencies
- Recommend cost-effective improvements for implementation



# Re-Commissioning Process

## 3. Implementation phase

- Implement repairs and improvements
- Retest and re-monitor for results
- Fine-tune improvements if needed
- Verify energy savings estimates





# Re-Commissioning Process

## 4. Project Hand-off and integration phase

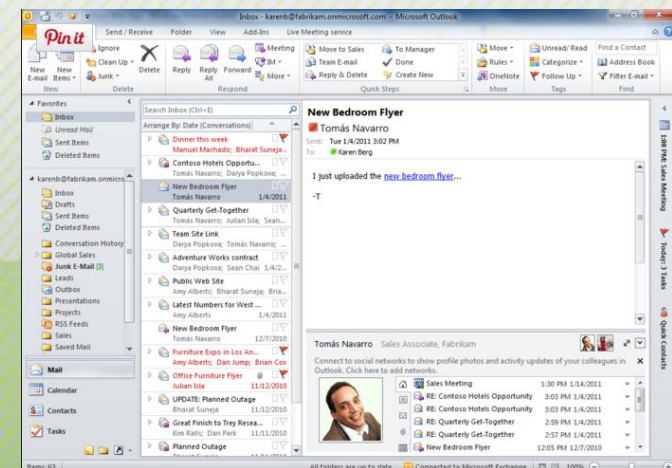
- Prepare and submit final report
- Perform deferred tests (if needed)
- Develop next re-commissioning schedule
- Documentation



# 5. Electronic O&M Platform

## Current Issues

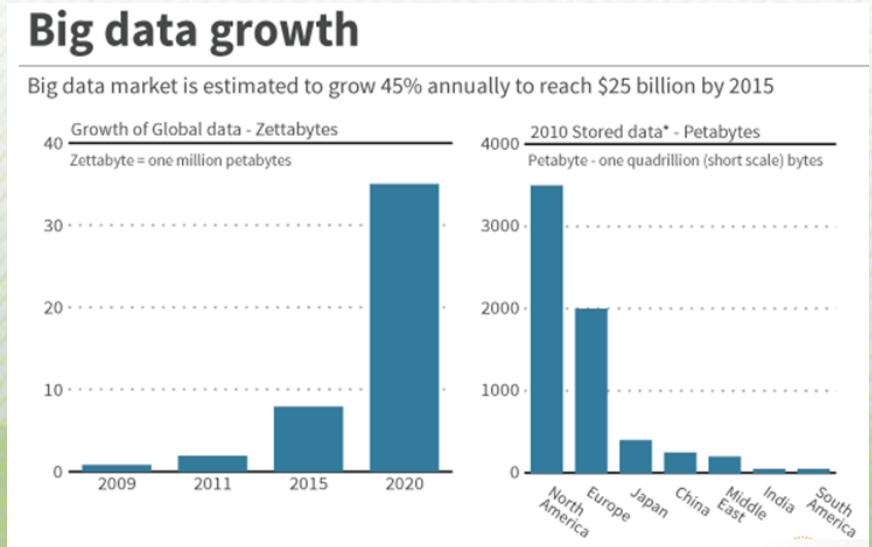
- **Paper document**
  - ✓ Require large storage space
  - ✓ Time consumption to search for required info
  - ✓ Easy to lose and damage
- **Storing large amount of data**
  - ✓ Large data in a single file
  - ✓ Difficult to find information req'd
  - ✓ Inconvenient for further analysis
- **Difficult to communicate / interact**
  - ✓ Email sorting is time consuming





# Growing Demand in Data

- “Digital Exhaust” data resulting from all kinds of activities :
  - ✓ Day-to-Day operation
  - ✓ Renovation / Regular maintenance
  - ✓ Recommissioning
- Big Data for Building Intelligency & Sustainability
- Traditional Approach is difficult to cater with growing data and demand for data analysis



Source: Nasscom – CRISIL GR&A analysis



# Easy Accessibility

- Web-Platform Document Management System :
  - ✓ Document Management
  - ✓ Defect Management
  - ✓ Energy Management
  - ✓ IEQ Management
  - ✓ Tenant Management
- Browser Requirement
  - ✓ PC / Tablet (iPAD / Android Tablets)
  - ✓ Smartphones
  - ✓ Allows paperless working environment at different locations



Google  
Chrome



Baidu  
Browser



Firefox  
Browser

# Design Concept



## Negawatt Building Operating System



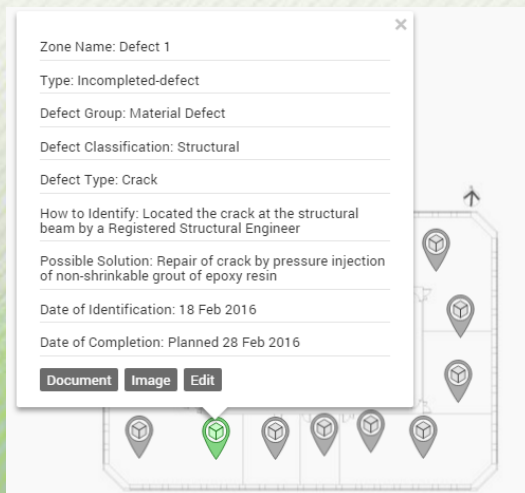
- Easy information storing / retrieval
- Hierarchical Design for good visual impact
  - Location
  - System
- Risk / Defect Management



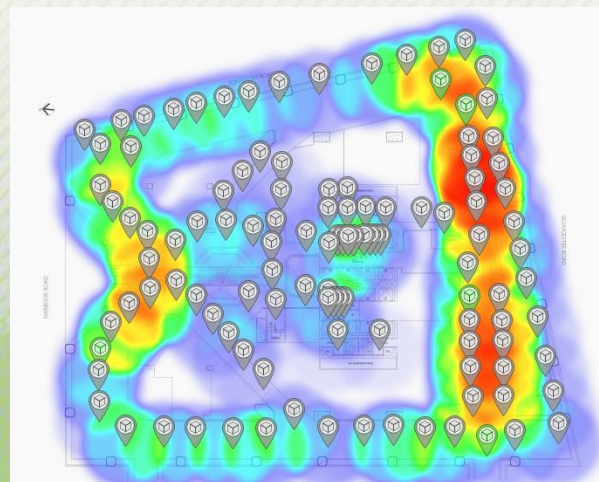
- Graphical display of metering info
- Energy evaluation with innovative “Thermal Line” technique
- Intensive energy evaluation with equipment optimization

# Location Hierarchy Marker/Zonal System

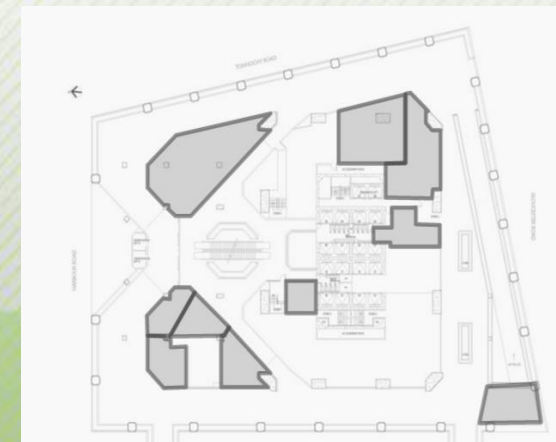
- Location and equipment specification
- Self-defining specific zone
  - ✓ Separating tenant and public area
- Remote monitoring of building operation data
- Time / Paper Reduction in repair / upgrade projects
- Graphical display of IEQ info
  - ✓ Temp / RH / Lux
  - ✓ Energy reduction evaluation



Defect Inspection during  
rectification



Graphical Data Display

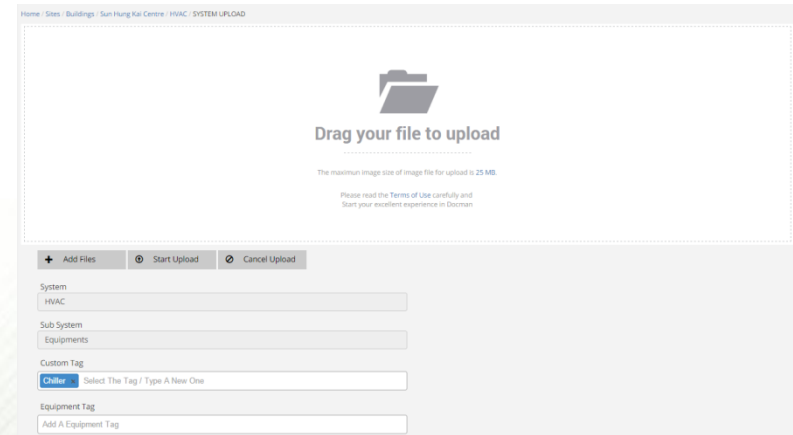


Self Defined Zone

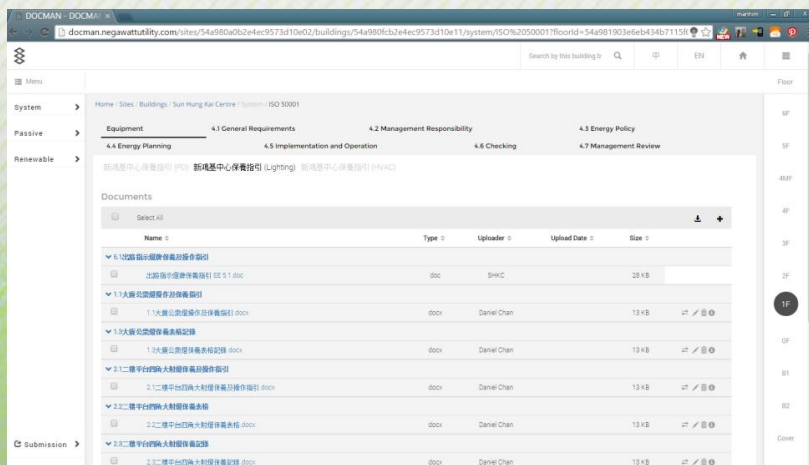


# System Hierarchy

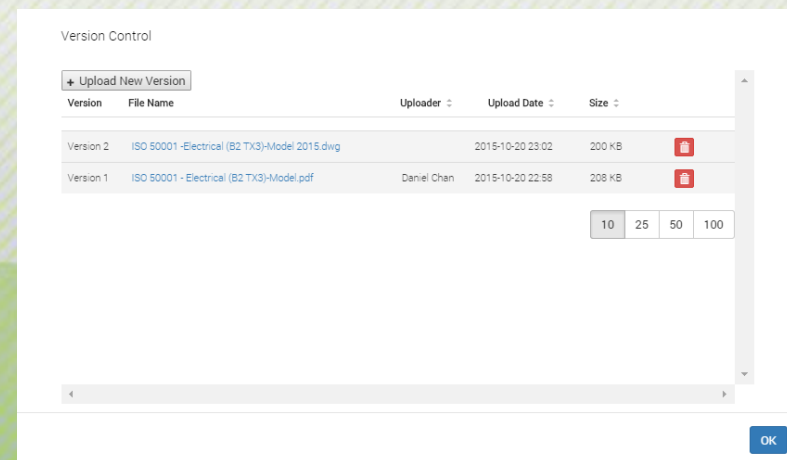
- Information sorting system
  - ✓ Reduce time on info searching
- User-friendly info storage / retrieval approach
- Document Versioning control
- Support Green Building Assessment
  - ✓ ISO50001 / BEAM Plus



File-Dragging Upload Approach



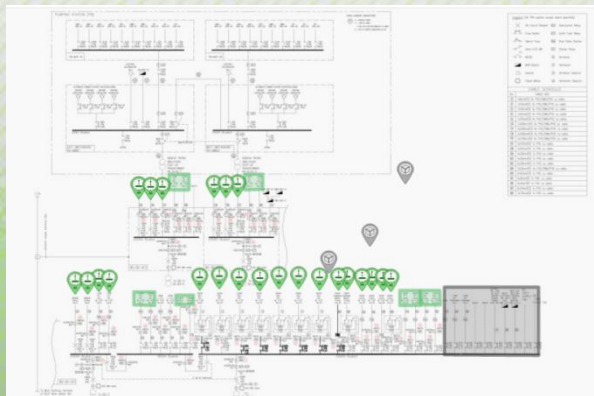
ISO50001 interface



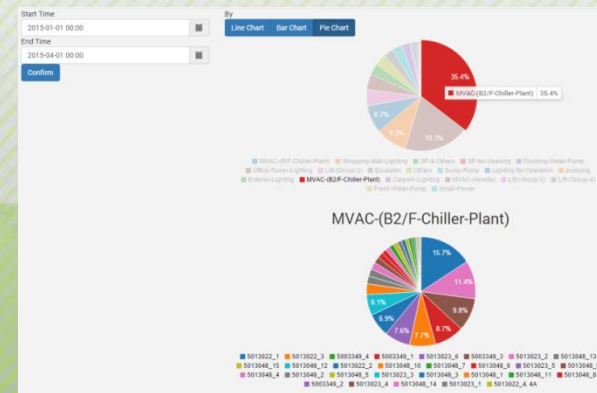
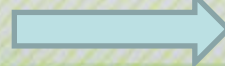
Versioning Control

# Energy Mapping and Evaluation

- Bridging documented info to energy consumption
- Evaluate annual energy usage
- Identify energy breakdown of building
- Recognize months with unusually high energy consumption
- Compare EUI of different projects



Info Retrieval

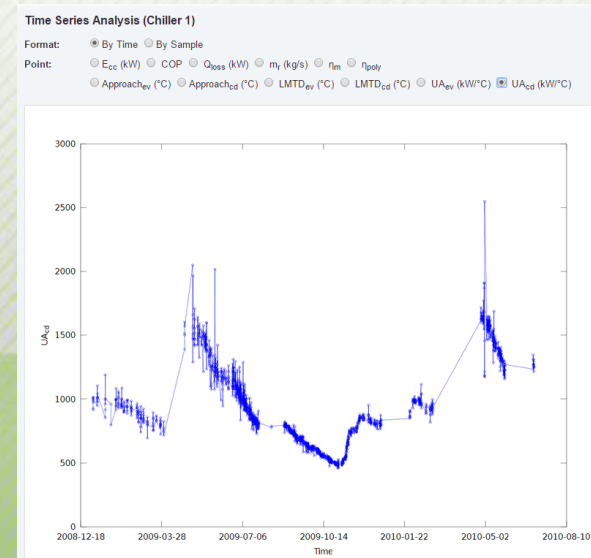
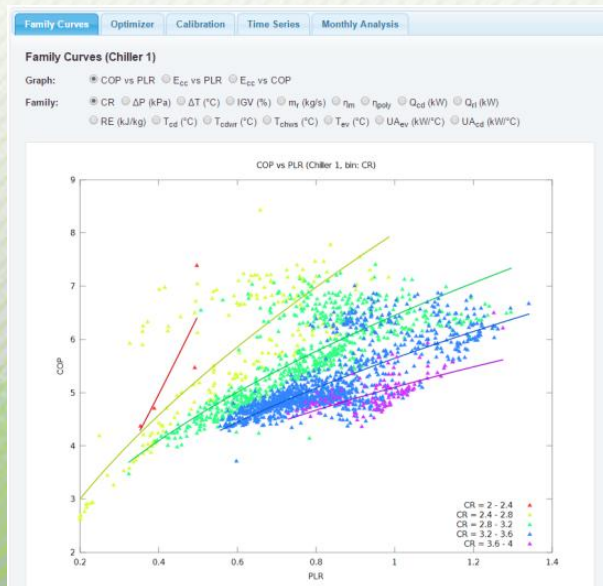


Documented Meter Info

Energy Breakdown

# Energy Accounting

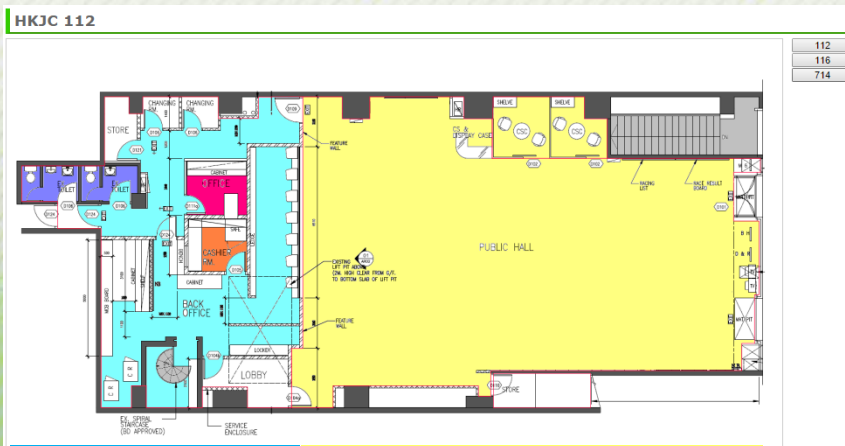
- Operating condition of each individual chiller
- Statistical approach to tune up chiller performance
- Optimizing operating & cleaning cost of equipment
  - ✓ How energy reduced over-time
  - ✓ When cleaning is necessary to increase equipment energy performance





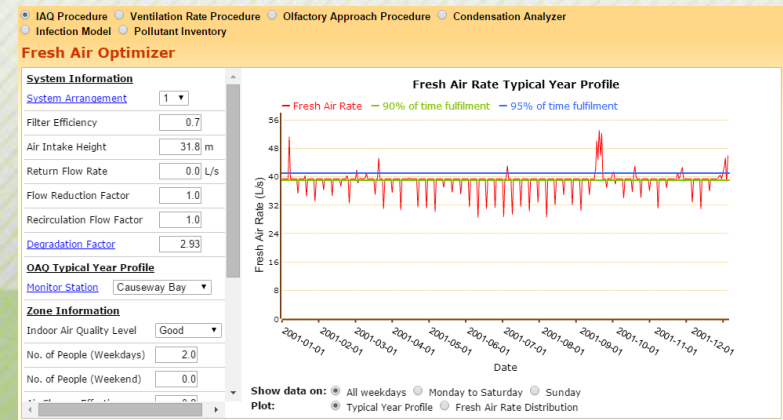
# IEQ / Energy Management

- Zone Separation
  - ✓ Controlled zone (constant occupancy)
  - ✓ Uncontrolled zone (varying occupancy)
- Monitoring & Adjustment in Fresh Air Rate for A/C Ventilation
  - ✓ Optimize Indoor Environmental Quality with Energy Consumption
  - ✓ Provide good infection & pollutant control



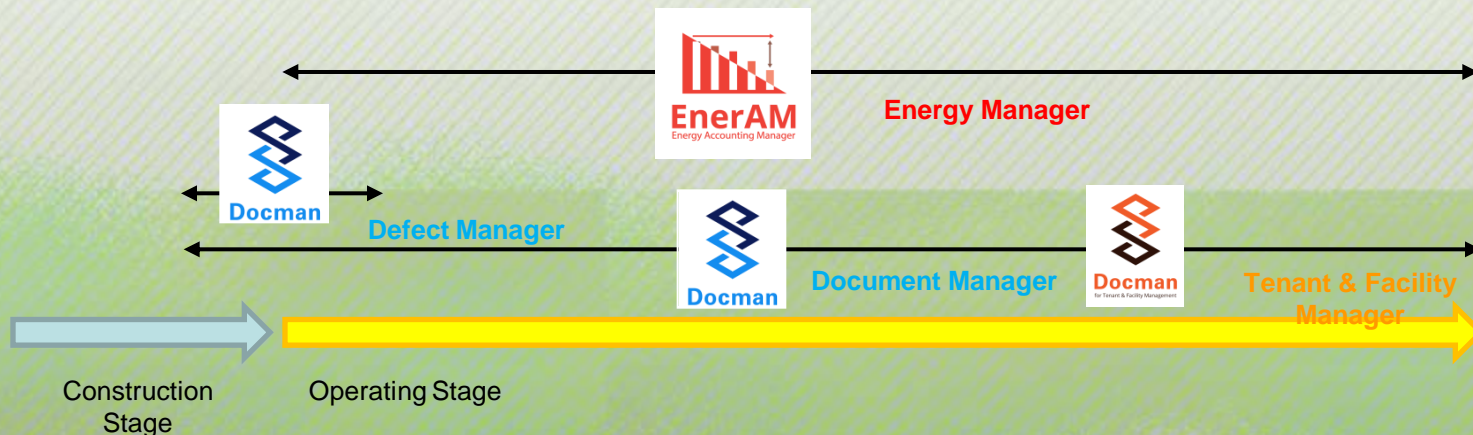
Controlled  
Zone

Uncontrolled Zone



# Leading For Low-Carbon Building Management

- Document Management
  - ✓ Documentation & Storage
  - ✓ Tracking defects
- Building Services Management / IEQ
  - ✓ Balance between energy with IEQ
  - ✓ ISO50001 / BEAM Plus
- Tenant Management
  - ✓ Communication between Building Management & Tenants
  - ✓ Energy consumption of tenants
- Energy Management
  - ✓ Building energy performance
  - ✓ Feasible EMOs



**Thank You**