



# Overview of Building Energy Efficiency in China and the Upcoming Trend

From Principle-based Approach to Data-based

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Organisers:

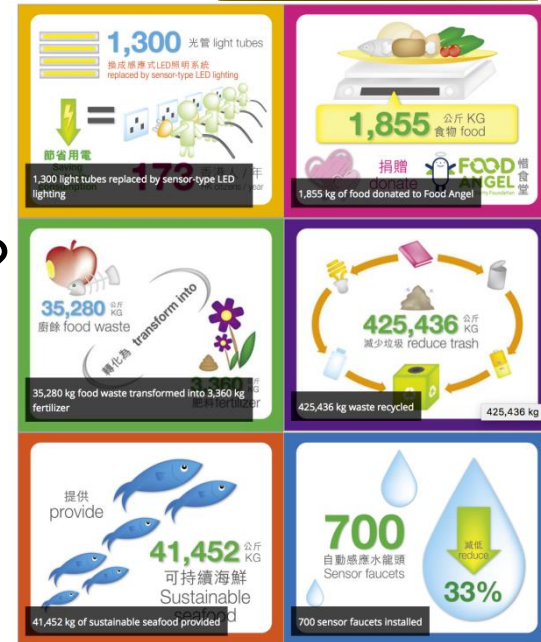


International Co-owners:



# Start From a Question

- How much CO2 were emitted by operating this gorgeous building for one year (i.e. in FY2016)
  - Get information from the website
  - Certificate, commitment, initiatives
- Electricity, gas, water consumption?
- Cooling or chilled water consumption?
- Energy system efficiency?
- CO2 emission?
- Indoor Environment?



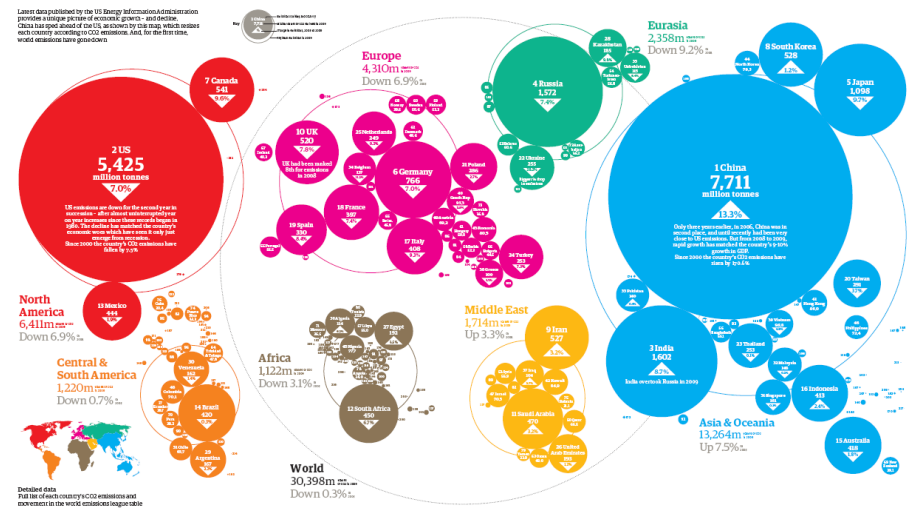
Organisers:



International Co-owners:

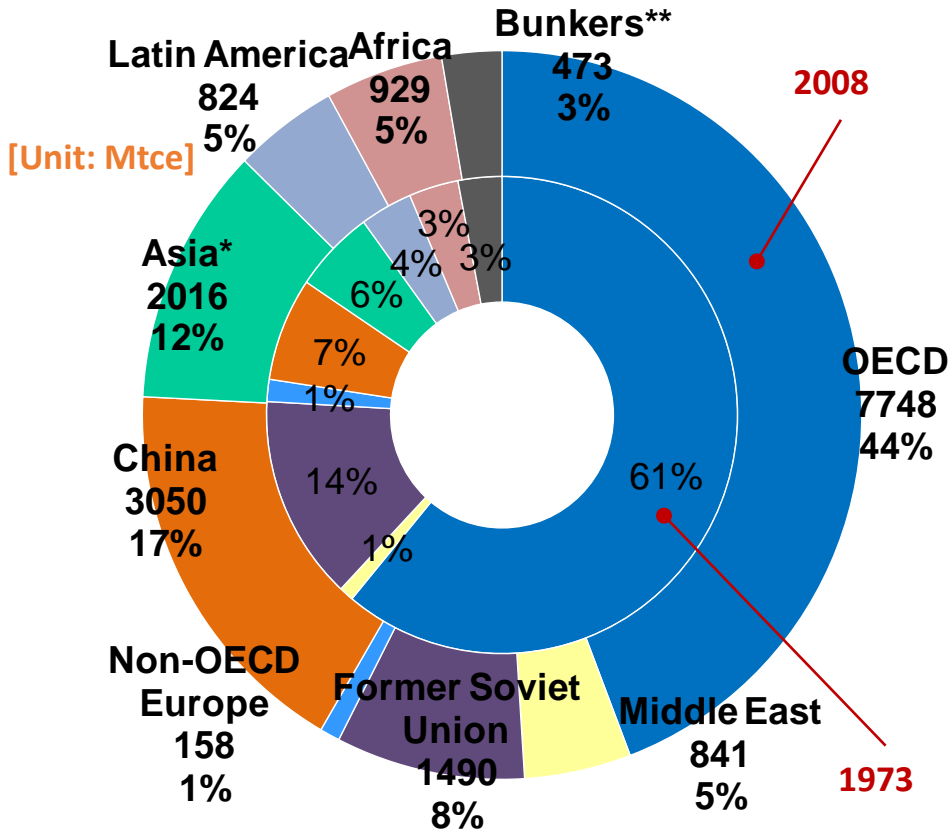


# Sharing Data From Macro Perspective

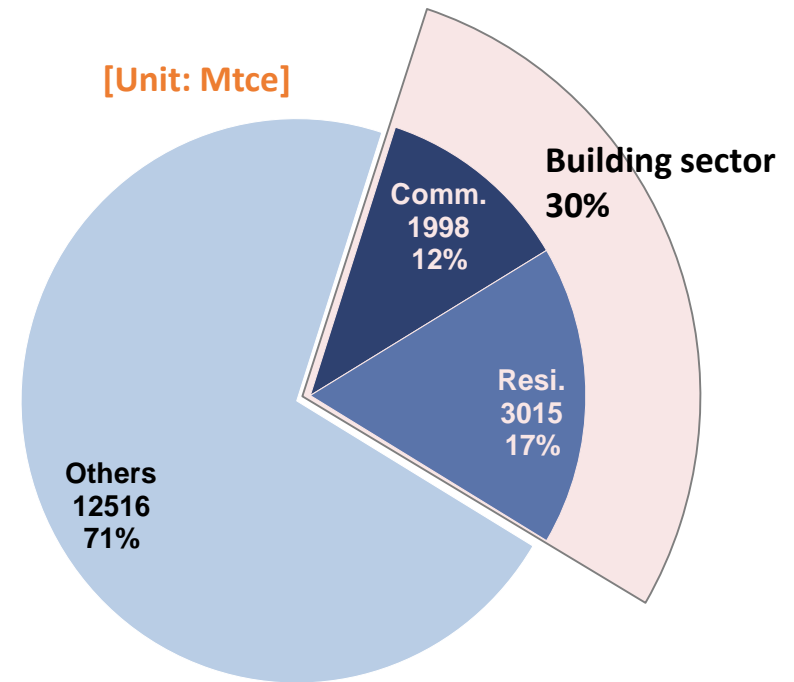


# Globally: Energy Use by Nations and Sectors

1973 and 2008 regional shares of Total Energy Use



2008 building shares of Total Energy Use



Energy use related to building operation: 30% of total energy use

\* Asia excludes China. \*\* Includes intl. aviation and intl. marine bunkers.

Data source: International Energy Agency. Key World Energy Statistics. 2010, compiled



Organisers:

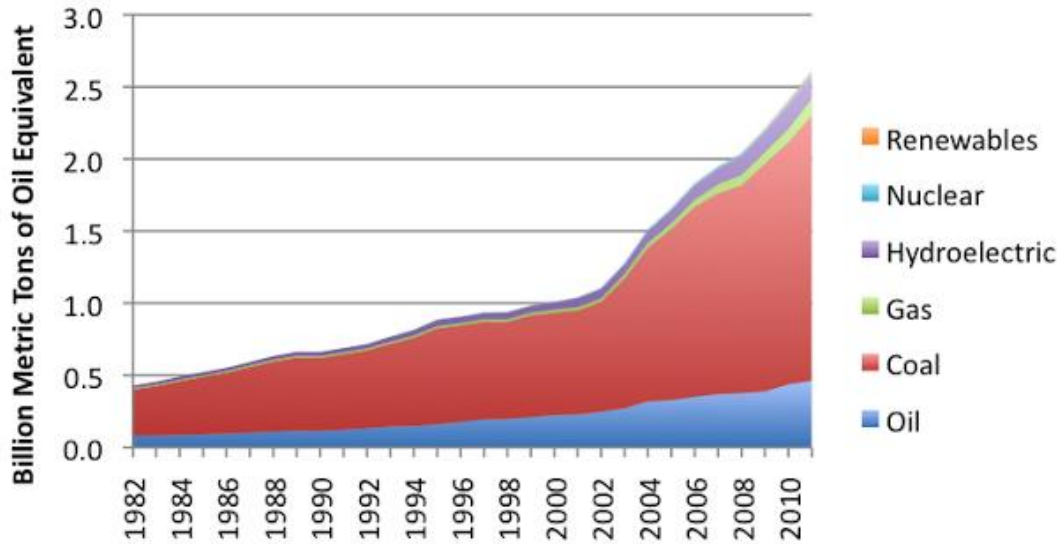


International Co-owners:



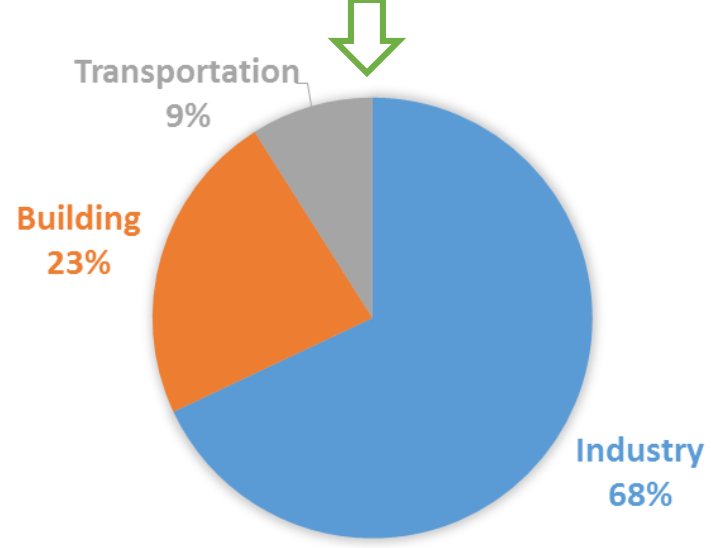
# China: Sources and End Users

China's Energy Consumption by Source



Industry still dominates energy use; energy use in **building sector** will be more and more important in the future

**Coal dominates** energy sources; environmental issues related to coal-burned are extremely serious



# We All Agree That

Energy efficiency in buildings can contribute greatly to sustainability in cities



But the question is:  
how to realize “truly” energy efficiency in buildings



Organisers:



International Co-owners:



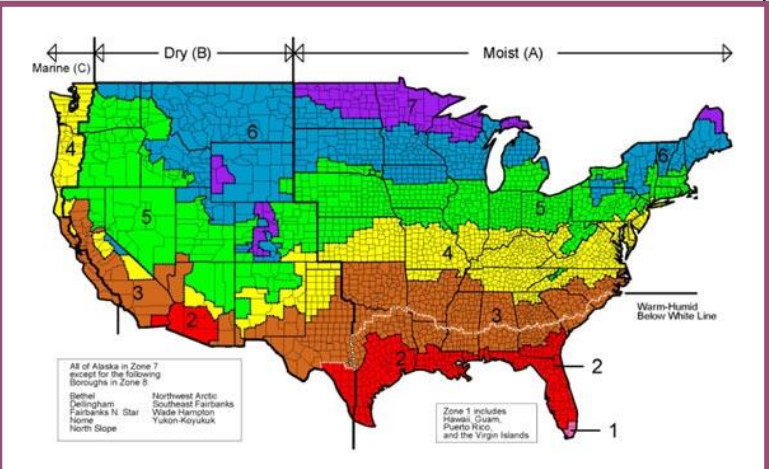
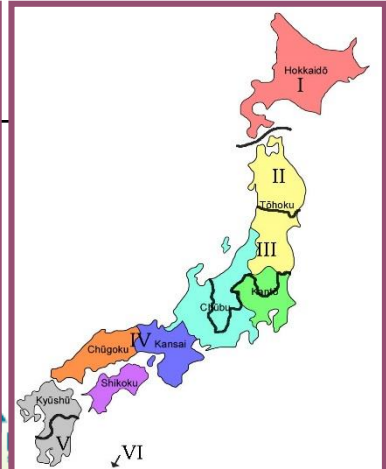
# Features of Building Energy Use in China

- Space Heating in Buildings: Totally **DIFFERENT**
  - Northern China / Yangtze River Basin (HSCW)
  - Urban / Rural
- Energy Use Excluding Space Heating
  - In Urban Residential Buildings
  - in Commercial Buildings
  - In Rural Buildings
- Various Building Energy Efficiency Standards are required



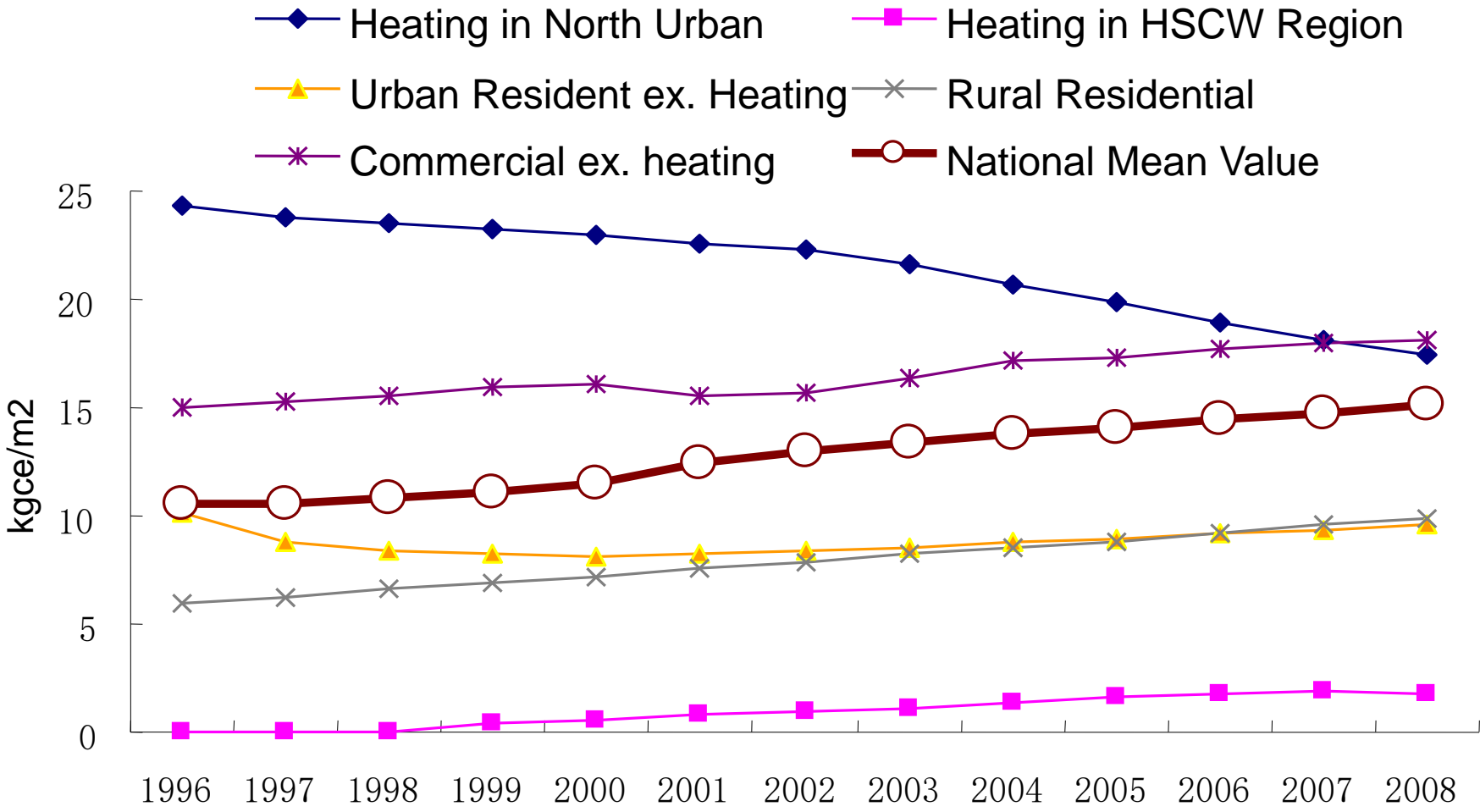
# Standards of BEE in China: Component Focused

住宅 Residential, for urban	1986年 (已废止) Abolished	《民用建筑节能设计标准 (采暖居住建筑部分)》 (JGJ26-86) Space Heating for Buildings in North China
	1996年7月	《民用建筑节能设计标准 (采暖居住建筑部分)》 (JGJ26-95) Space Heating for Buildings in North China
	2001年10月	《夏热冬冷地区居住建筑节能设计标准》 (JGJ134-2001) Space Heating and Cooling for Buildings in HSCW
	2003年10月	夏热冬暖地区居住建筑节能设计标准 (JGJ75-2003) Space Cooling and Heating for Buildings in HSCW
公建 Commercial	1993年 (已废止) Abolished	《旅游旅馆建筑热工与空气调节节能设计标准》 (GB50189-93)
	2005年7月	《公共建筑节能设计标准》 (GB50189-2005) HVAC, lighting, etc.





# Building Energy Use Intensity (EUI) Trend



Note: 1 kgce = 29.27 MJ



International Co-owners:



# Reasons for Heating Energy Use Reduction

- BEE standards are effective
  - More than 90% of new construction meet the BEE standards
  - Some new buildings have even better performance of space heating: i.e.  $<60 \text{ kWh}_h/\text{m}^2\cdot\text{a}$
- Retrofitting on Existing Buildings
  - Huge amount of buildings have been reinsulated during the last 5 years
- Improvement on Heat Sources Efficiency
  - Abolishing Small-scale coal-burned boilers
  - Implementation of heat pumps, CHP etc.



Organisers:



International Co-owners:



# However, on the other hand

- Other usages of building energy (except heating in north urban) kept increasing
- Residential Building
  - Energy use for lighting, home appliances, DHW, Air-conditioners (AC), etc. increased along with living standard rising
- Non-residential (Commercial)
  - Large number of new glass boxes and skyscrapers appear in every city
- What happens in actually operated buildings?



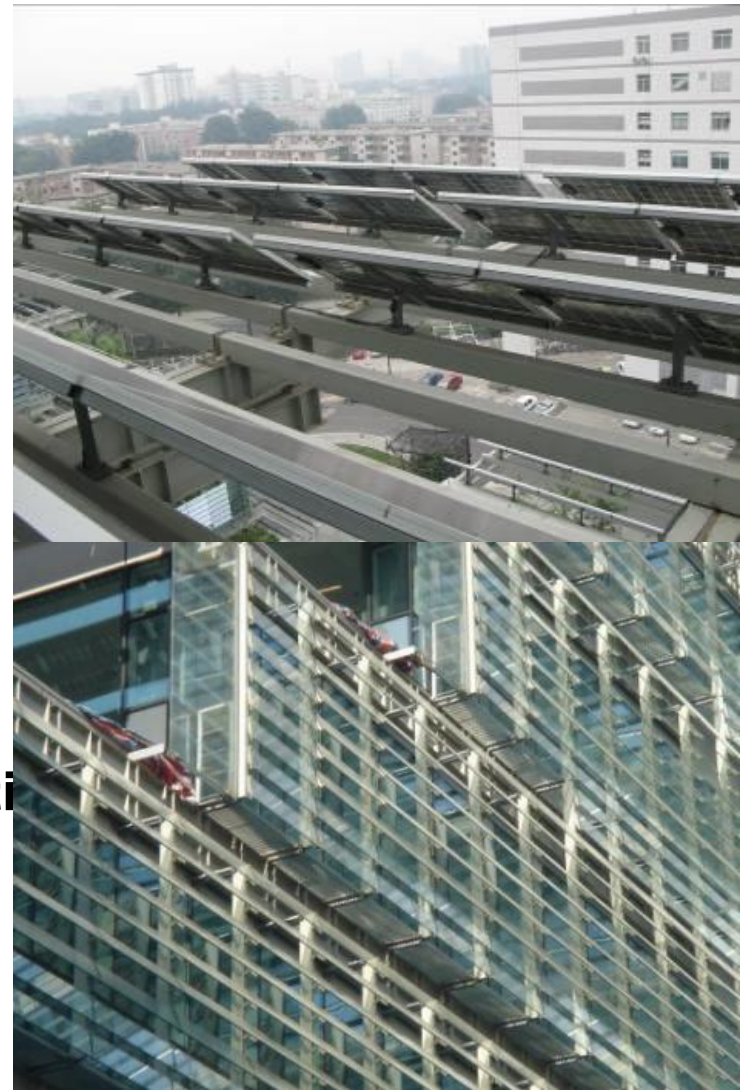
Organisers:



International Co-owners:



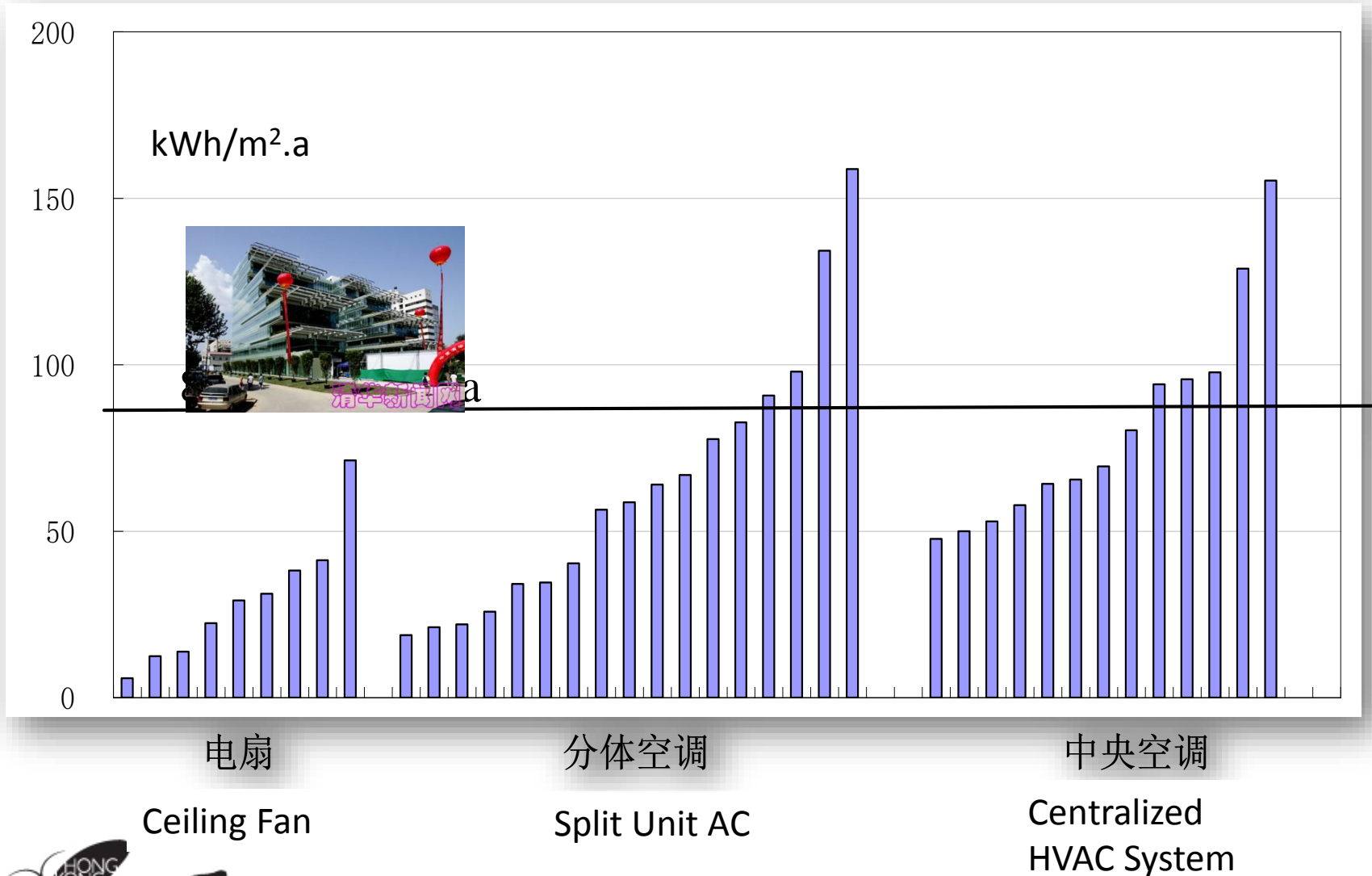
# A Low Energy Demo Building in the Campus



## Key tech:

- BCCHP
- High performance windows
- Cool ceiling + displacement ventilation
- Auto-lightings (dimming system)
- Advanced BAS
- 300m<sup>2</sup> PV
- Heat recovery

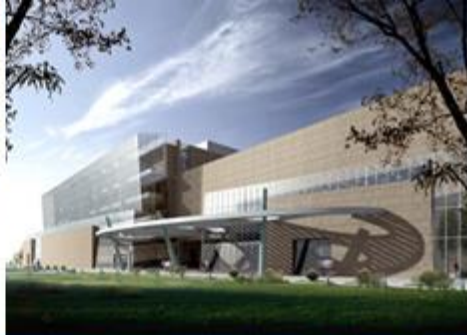
# Measured Total Electricity Use (EUI)



# Case Study: Actual Electricity Use Intensity



**Tsinghua School**  
4650m<sup>2</sup>, 34kWh/m<sup>2</sup>-a



**Tsinghua Art School**  
64k m<sup>2</sup>, 65.7kWh/m<sup>2</sup>-a



**Government office A**  
16k m<sup>2</sup>, 70.1kWh/m<sup>2</sup>-a



**Government office B**  
37k m<sup>2</sup>, 113kWh/m<sup>2</sup>-a



**Tower in Shanghai**  
287k m<sup>2</sup>, 215kWh/m<sup>2</sup>-a



**Office building A, USA**  
6425m<sup>2</sup>, 364kWh/m<sup>2</sup>-a



**Office building B, USA**  
30k m<sup>2</sup>, 356kWh/m<sup>2</sup>-a



**Office building, Lyon**  
17k m<sup>2</sup>, 165kWh/m<sup>2</sup>-a

Note: Excluding energy for space heating.



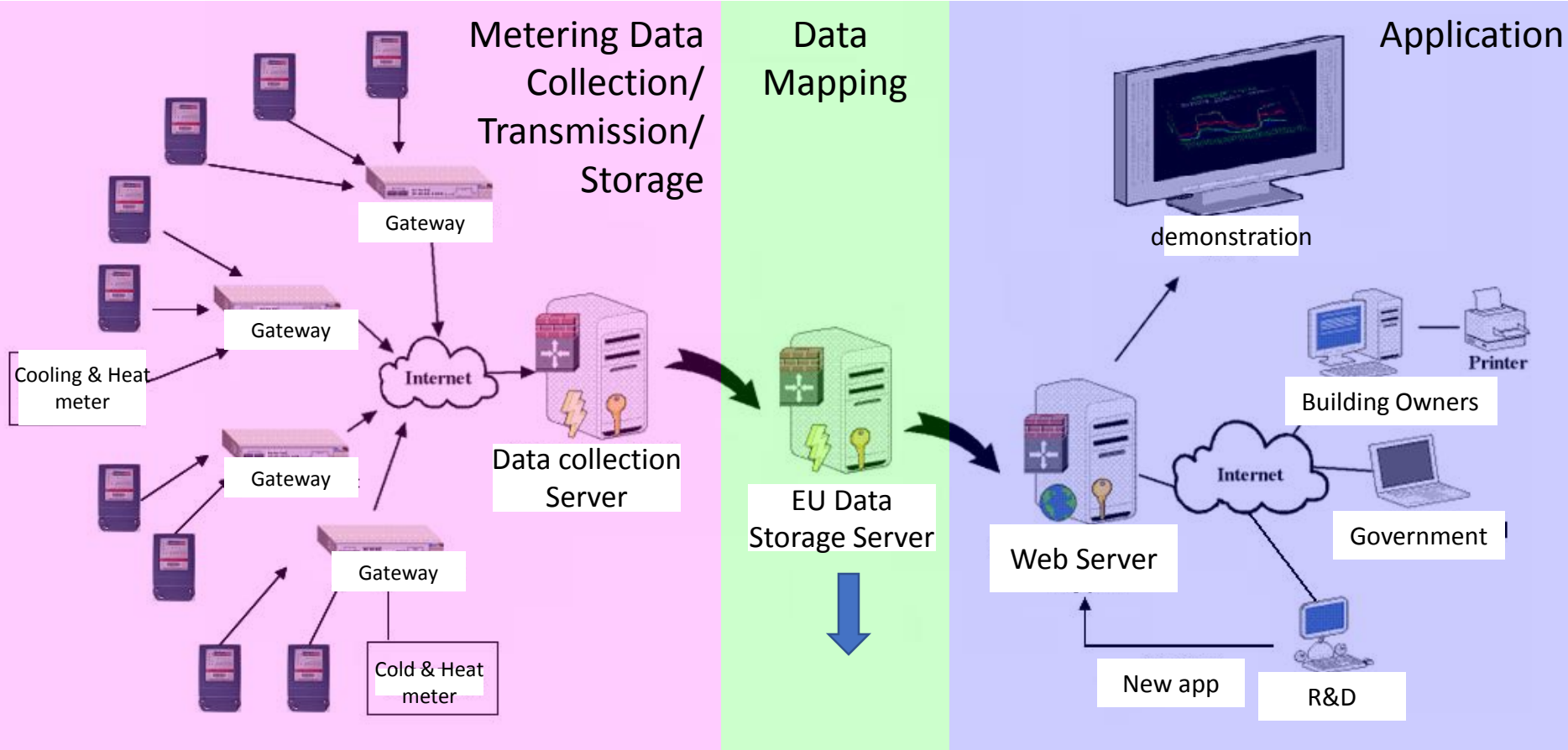
Organisers:



International Co-owners:

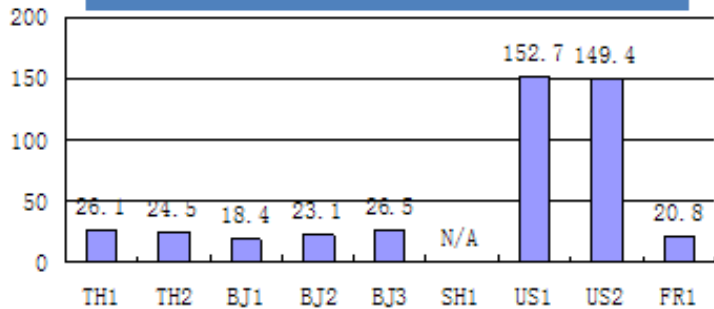


# Essential BMS: Sub-metering with ICT

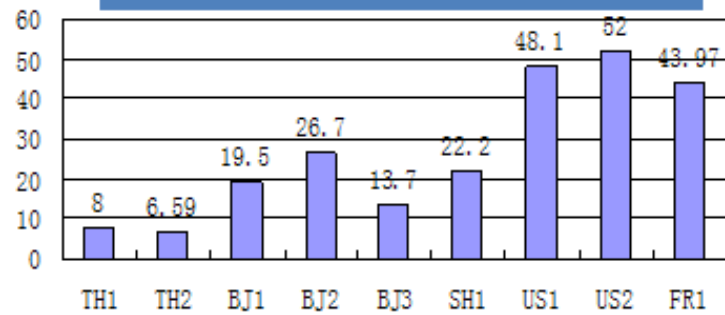


# Measured EUI for End-Users in Buildings

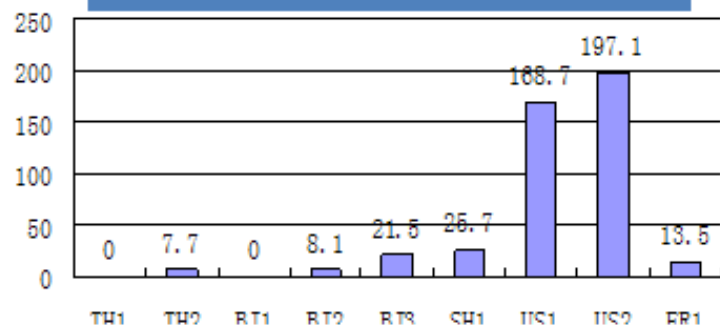
### Lighting & Appliances (kWh/m<sup>2</sup>-a)



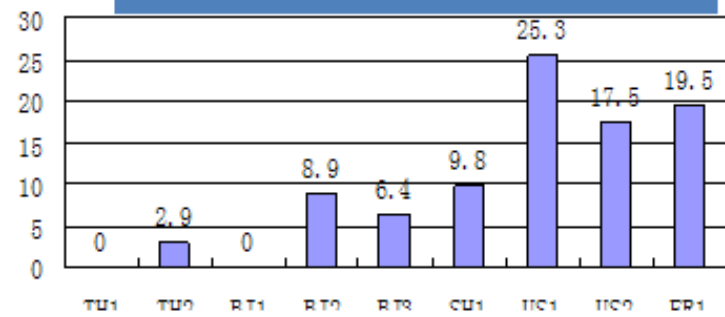
### Chiller (kWh/m<sup>2</sup>-a)



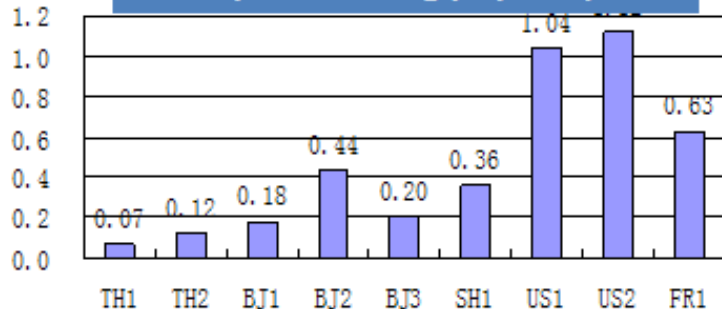
### Fan for AC system (kWh/m<sup>2</sup>-a)



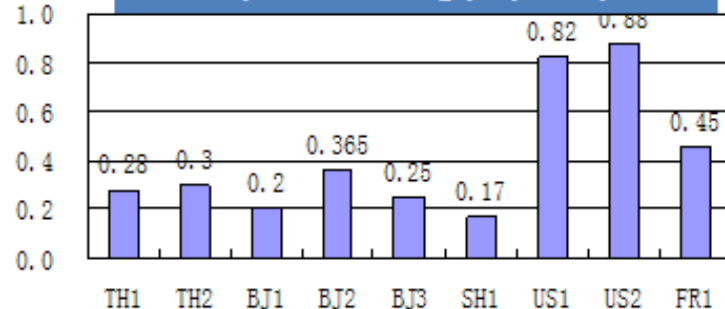
### Pump for AC system (kWh/m<sup>2</sup>-a)



### Space Cooling (GJ/m<sup>2</sup>-a)



### Space Heating (GJ/m<sup>2</sup>-a)



TH1



TH2



BJ1



BJ2



BJ3



SH1



US1



US2

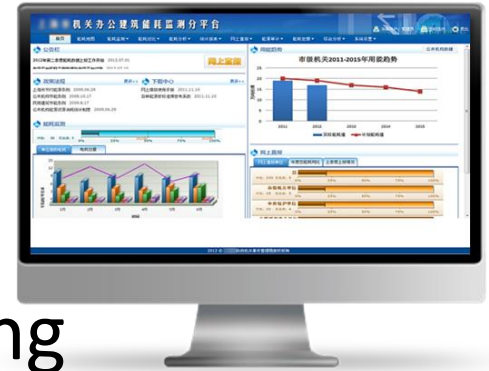


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# We All Agree That

Continuously measuring / monitoring actual building energy use and system efficiency is essential to sustainability



But the question is:  
how to make it in an affordable / reliable / effective way



Organisers:



International Co-owners:



# Start: Standard

- The First One on Building Energy Use Data

5.2.1 办公建筑能耗指标的约束值和引导值应符合表 5.2.1 的规定。

表 5.2.1 办公建筑能耗指标的约束值和引导值 单位: kWh/(m<sup>2</sup>.a)

建筑分类		严寒和寒冷地区		夏热冬冷地区		夏热冬暖地区		温和地区	
		约束值	引导值	约束值	引导值	约束值	引导值	约束值	引导值
A 类	党政机关办公建筑	55	45	70	55	65	50	50	40
	商业办公建筑	65	55	85	70	80	65	65	50
B 类	党政机关办公建筑	70	50	90	65	80	60	60	45
	商业办公建筑	80	60	110	80	100	75	70	55

?

民用建筑能耗标准

Standard for energy consumption of building

2016-04-15 发布

2016-12-01 实施

中华人民共和国住房和城乡建设部 联合发布  
中华人民共和国国家质量监督检验检疫总局



Organisers:



International Co-owners:



# Detailed in this Standard

5.2.2 宾馆酒店建筑能耗指标的约束值和引导值应符合表 5.2.2 的规定。

表 5.2.2 宾馆酒店建筑能耗指标的约束值和引导值 单位: kWh/(m<sup>2</sup>.a)

建筑分类		严寒和寒冷地区		夏热冬冷地区		夏热冬暖地区		温和地区	
		约束值	引导值	约束值	引导值	约束值	引导值	约束值	引导值
A 类	三星级及以下	70	50	110	90	100	80	55	45
	四星级	85	65	135	115	120	100	65	55
	五星级	100	80	160	135	130	110	80	60
B 类	三星级及以下	100	70	160	120	150	110	60	50
	四星级	120	85	200	150	190	140	75	60
	五星级	150	110	240	180	220	160	95	75

# Detailed in this Standard

5.2.3 商场建筑能耗指标的约束值和引导值应符合表 5.2.3 的规定。

表 5.2.3 宾馆酒店建筑能耗指标的约束值和引导值 单位: kWh/(m<sup>2</sup>.a)

建筑分类		严寒和寒冷地区		夏热冬冷地区		夏热冬暖地区		温和地区	
		约束值	引导值	约束值	引导值	约束值	引导值	约束值	引导值
A类	一般百货店	80	60	130	110	120	100	80	65
	一般购物中心	80	60	130	110	120	100	80	65
	一般超市	110	90	150	120	135	105	85	70
	餐饮店	60	45	90	70	85	65	55	40
	一般商铺	55	40	90	70	85	65	55	40
B类	大型百货店	140	100	200	170	245	190	90	70
	大型购物中心	175	135	260	210	300	245	90	70
	大型超市	170	120	225	180	290	240	100	80



Organisers:



International Co-owners:



# Summary

- Energy Efficiency in Buildings is Extremely Important to Sustainability in China
- Not Only Principles and Techniques Should Be Focused
- But
- The Data of Energy Use during Building Operation Should Be the Key to Future Works



Organisers:



International Co-owners:



Special Thanks to  
Swire Properties Ltd



# Thank you



Organisers:



International Co-owners:

