

MEBS6016 Energy Performance of Buildings

<http://www.hku.hk/bse/MEBS6016/>



Energy Efficiency in Buildings (I)



Dr. Sam C. M. Hui

Department of Mechanical Engineering

The University of Hong Kong

E-mail: cmhui@hku.hk

Jan 2012

Contents



- Energy Policy and Codes
- Assessment of Performance
- EU Directive on Energy Performance of Buildings
- Implications for HK

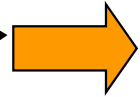


Energy Policy and Codes

- Energy efficiency matters is affected by policy and regulatory issues
 - Thus, we need to understand the social, economic and political context of them
- Government's role is important for stimulating the market and promoting long-term benefits
 - Legislative control (by codes) and guidelines
 - Financial and tax incentives
 - Administrative measures and information



Building
Energy
Codes



Energy Efficiency

- Buildings
- Industries
- Transport
- Appliance
- Utilities
- Energy management

Important energy sector

Energy Supply

- Coal
- Oil
- Natural gas
- Nuclear
- Electricity
- Renewable energy

Energy Resources

- Coal
- Oil
- Natural gas
- Nuclear energy
- Renewable energy

Other Issues

- Energy security
- Energy and environment
- Energy economics

Building sector in the overall energy policy



Energy Policy and Codes

- *Energy policy* - a big picture
 - Address many aspects and sectors of energy development including
 - Energy production, supply, distribution and use
 - A national energy policy is important for ensuring social and economic well-being
 - Examples:
 - *Energy Policy Act of 2005 (USA)*
 - *China's National Energy Conservation Law 1997*



Energy Policy and Codes

- *Energy Policy Act (EPAct) of 2005 (USA)*
 - http://en.wikipedia.org/wiki/Energy_Policy_Act_of_2005
 - Passed by US Congress and signed by President George W. Bush in Aug 2005
 - Attempt to combat growing energy problems, provides tax incentives and loan guarantees for energy production of various types
 - Various provisions for energy efficient building improvements; set out US\$1.3 billion for conservation and energy efficiency
- EPAct of 1992 was signed by old President Bush

China's National Energy Conservation Law 1997

(http://www.gov.cn/banshi/2005-08/31/content_68768.htm)



www.GOV.cn

中华人民共和国中央人民政府

The Central People's Government of the People's Republic of China

网站首页 | 今日中国 | 中国概况 | 法律法规 | 公文公报 | 政务互动 | 政府建设 | 政务要闻 | 人事任免 | 新闻发布

当前位置：企业>> 法律法规库

中华人民共和国节约能源法

中国政府门户网站 www.gov.cn 2005年08月31日 来源：全国人大法规库

中华人民共和国节约能源法

(1997年11月1日第八届全国人民代表大会常务委员会第二十八次会议通过
1997年11月1日中华人民共和国主席令第九十号公布 自1998年1月1日
起施行)

第一章 总 则	Chapter 1: General
第二章 节能管理	Chapter 2: Energy Management
第三章 合理使用能源	Chapter 3: Rational Use of Energy
第四章 节能技术进步	Chapter 4: Advance in Energy Conservation Technology
第五章 法律责任	Chapter 5: Legal Responsibility
第六章 附 则	Chapter 6: Appendices



Energy Policy and Codes

- Legal framework and guidelines
 - Energy laws and related legislation
 - Technical guidelines and codes
- Three types of energy standards or codes
 - Building energy standards/codes
 - For building design & operation
 - Appliance energy standards/codes
 - For equipment & household/office appliances
 - Energy audit codes/requirements

Energy efficiency measures in Asian countries (2000)

Country	Building codes		Appliance standards		Energy audits	
	Comm.	Resident.	Comm.	Resident.	Comm.	Resident.
Indonesia	Mandatory	---	---	---	Voluntary	---
Malaysia	Voluntary	Voluntary	Voluntary	Voluntary	Voluntary	---
Philippines	Mandatory	---	Mandatory	Mandatory	Voluntary	---
Singapore	Mandatory	Mandatory	Voluntary	Voluntary	Voluntary	---
Thailand	Partly Mand.	Partly Mand.	Partly Mand.	Partly Mand.	Voluntary	---
Vietnam	Voluntary	Voluntary	Voluntary	Voluntary	Mandatory	Mandatory



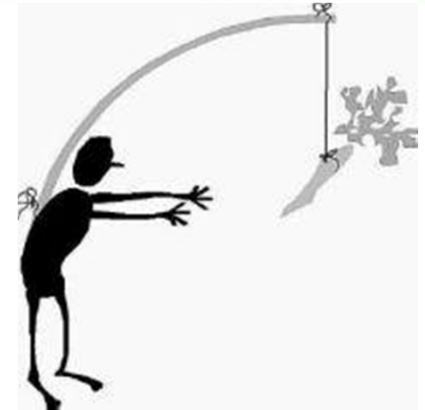
Energy Policy and Codes

- Building Energy Codes (*BEC*)
 - Set out energy consumption objectives
 - Form part of the energy policy
 - Control building design and/or operation
- Energy audit requirements (in some countries)
 - Essential for existing buildings
- Energy management programmes
 - Promote good practices in design and operation

Energy Policy and Codes



- Code implementation issues
 - Mandatory vs Voluntary
 - “Stick and carrot” approach
 - Strategy for promoting and enforcing the codes
 - Regulations, incentives, information, education, etc.
 - Energy professionals (e.g. Registered Energy Assessor)
- Code requirement issues
 - Prescriptive vs Performance approach
 - Prescriptive requirements: used in most existing codes
 - Performance requirements: being adopted in new codes





Energy Policy and Codes

- Prescriptive approach
 - Specifies for each building component the minimum requirements to satisfy the code
 - Advantages:
 - Simple to use & follow
 - Easy to check & enforce
 - Drawbacks:
 - Rather restrictive
 - Barrier to innovation & performance optimisation
 - Hinder cross-country product trading



Energy Policy and Codes

- Performance approach
 - State the goal(s) and allows the use of any solution to demonstrate compliance
 - Advantages:
 - More clearly explains what the code intends
 - Permits innovation & alternative solutions
 - More flexible regulatory environment, easily updated
 - Encourage building/technology research
 - Drawbacks:
 - Often more efforts are needed for analysis/compliance
 - Can be very complex & require more expertise

Energy Policy and Codes



- Energy policy of Hong Kong
 - Indicated by the Economic Services Bureau
 - Main objectives:
 - To ensure the *energy needs* of the community are met efficiently, safely and at reasonable prices;
 - To minimise the *environmental impact* of energy production and promote efficient use and conservation of energy
 - Free market philosophy is adopted
 - Proactive and non-intervening (積極不干預)



Energy Policy and Codes



- Energy policy of Hong Kong (cont'd)



- By Environmental Bureau (www.enb.gov.hk)

- To support Hong Kong's economic development, we aim to provide reliable supplies of energy at reasonable prices, promote its economical and safe use, and at the same time minimise the environmental impact in the production and use of energy

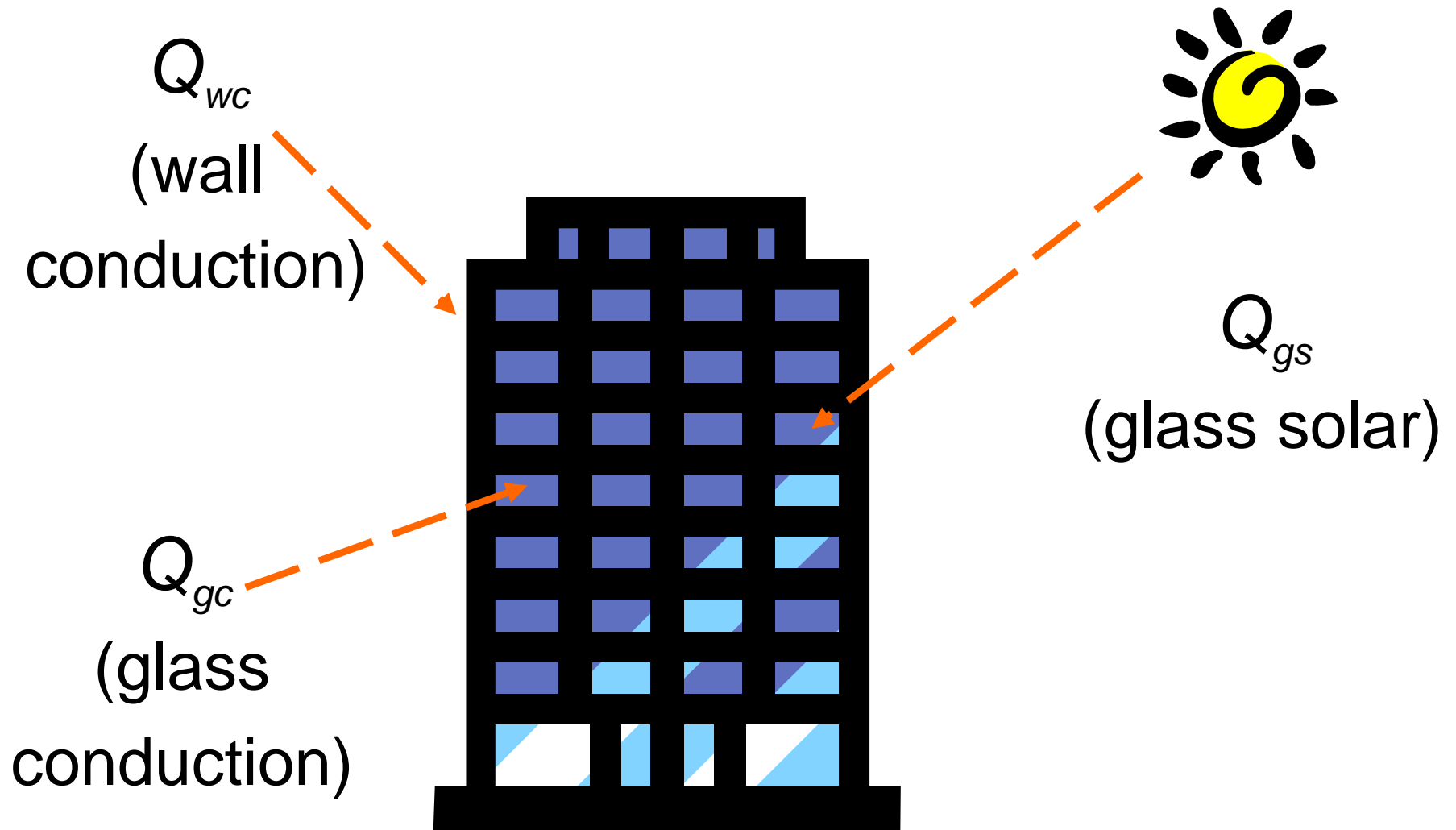
- Energy Efficiency and Conservation Policy

- To increase and sustain conservation of energy in order to reduce the growing trend of energy use

Energy Policy and Codes



- First energy efficiency regulation in HK
 - *Building (Energy Efficiency) Regulation*, Cap. 123 sub. Leg. M [implemented in July 1995]
 - <http://arch.hku.hk/research/BEER/bee-reg.htm>
 - Using Overall Thermal Transfer Value (OTTV) method for building envelope design control
 - www.bd.gov.hk/english/documents/code/e_ottv.htm
 - Applied mainly to commercial buildings and hotels; requirements revised in 2000 and 2011
 - Building tower: $OTTV \leq 24 \text{ W/m}^2$; podium: $OTTV \leq 56 \text{ W/m}^2$



$$\begin{aligned}
 OTTV_i &= \frac{Q_{wc} + Q_{gc} + Q_{gs}}{A_i} \\
 &= \frac{(A_w \cdot U_w \cdot TD_{eq}) + (A_f \cdot U_f \cdot DT) + (A_f \cdot SC \cdot SF)}{A_i}
 \end{aligned}$$



Energy Policy and Codes

- OTTV equation for Hong Kong:

$$OTTV_i = \frac{(A_w \cdot U_w \cdot \alpha \cdot TD_{eq}) + (A_f \cdot SC \cdot ESM \cdot SF)}{A_i}$$

- Two major differences from the general form:
 - Glass conduction term was omitted
 - Solar absorptivity and external shading multiplier were introduced

Energy Policy and Codes



- HK Building Energy Codes (BEC)

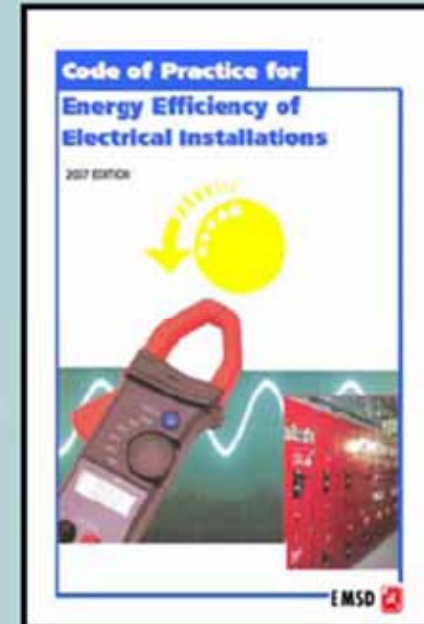
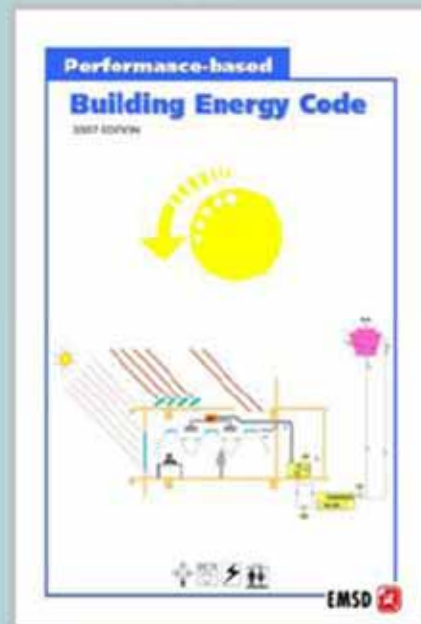
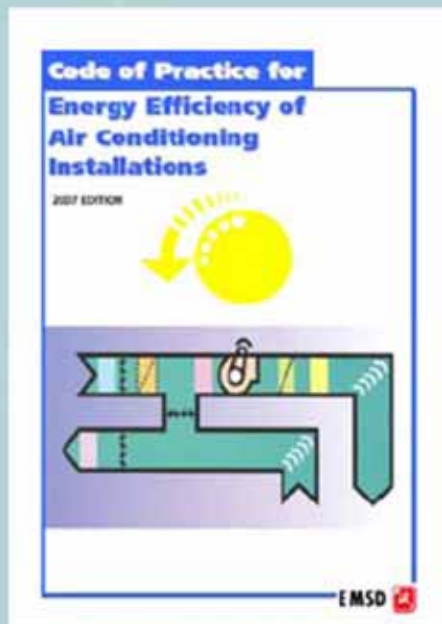
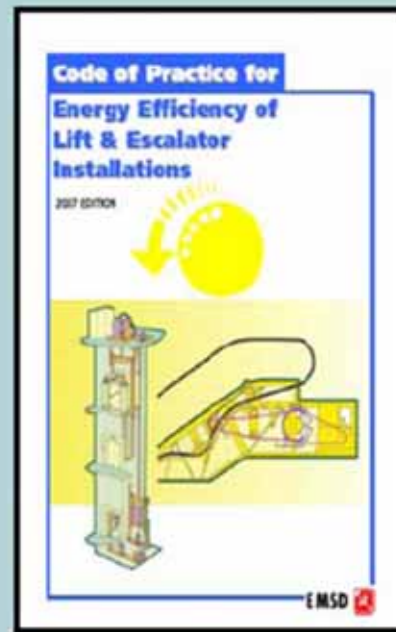
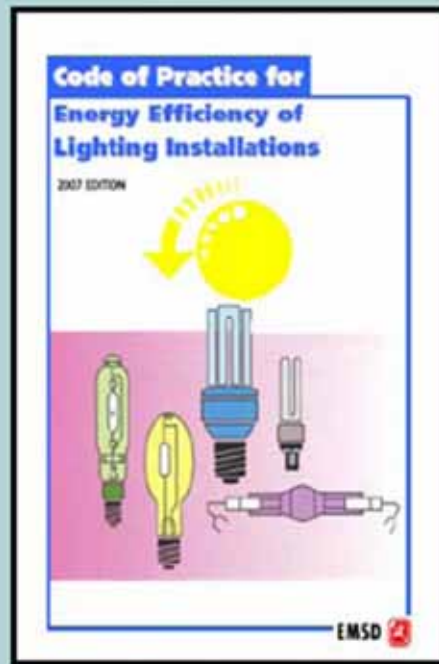


- Lighting
- Air-conditioning
- Electrical
- Lifts & escalators
- Performance-based code



- Previously under Hong Kong Energy Efficient Building Registration Scheme (HKEEBRS)

- Become mandatory in 2011



Building Energy Codes in Hong Kong

Building energy codes in Hong Kong

Energy Code	Date Implemented	Scope
OTTV	Jul 1995 (Mandatory)	Comm bldgs & hotels
Lighting	Jul 1998 (Voluntary)*	All bldgs except domestic, indust. & medical
Air conditioning	Jul 1998 (Voluntary)*	All bldgs except domestic, indust. & medical
Electrical	Feb 1999 (Voluntary)*	All buildings
Lifts & escalators	Dec 1999 (Voluntary)*	All buildings
Performance-based code	2004 (Voluntary)*	Comm bldgs & hotels

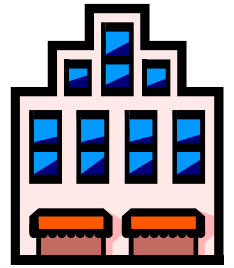
* Become mandatory in 2011 under the *Buildings Energy Efficiency Ordinance*.
 (See www.emsd.gov.hk/emsd/eng/pee/mibec.shtml for details)

Energy Policy and Codes



- Buildings Energy Efficiency Ordinance in HK
 - Mandatory implementation of Building Energy Code (BEC) and Energy Audit Code (EAC)
 - BEC:
 - Declaration at design and occupation approval stages
 - Certificate of compliance registration
 - Compliance for major retrofitting works
 - EAC:
 - Energy audit requirement (renew every 10 years)
 - Registered Energy Assessors

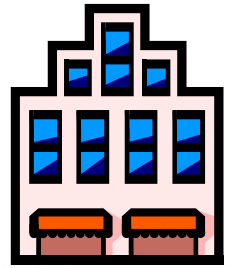
Assessment of Performance



- What is “Performance” ?
 - Performance is meeting expectations
- CIB definition *:
 - “The objectively identifiable qualitative or quantitative characteristics of the building which help determine its aptitude to fulfil the different functions for which it was designed.”
- How to study & measure it?

(* CIB = International Council for Research and Innovation in Building & Construction)

Assessment of Performance



- Building performance
 - Functionality
 - Serviceability
 - Building-occupant comfort
- Trends
 - Use it as the major criteria for building design
 - The need to study, measure, and predict the level of building performance (to quantify)

Performance of a car



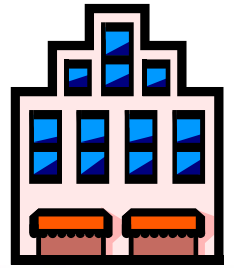
(Such as fuel efficiency)

Performance of a building/flat



We get info. about performance of a car, what about buildings?

Assessment of Performance



- Parameters of building performance
 - Structural
 - Fire and life safety
 - Accessibility
 - Durability
 - Sound insulation (acoustic)
 - Environmental
 - **Energy efficiency**



Index of Building (Houses) Performance (Japan)

住宅性能表示のイメージ

※これはあくまでも平成11年5月現在で検討中の資料をもとに構成したものであり、今後、変更・追加される場合があります。

Structure strength

構造耐力（建築基準法の求める構造強度との比較 〇倍）

床の遮音性（ランク〇）

省エネルギー性（ランク〇）

Energy efficiency

Daylight, ventilation

採光・換気性（開口率〇%）

壁の遮音性（ランク〇）

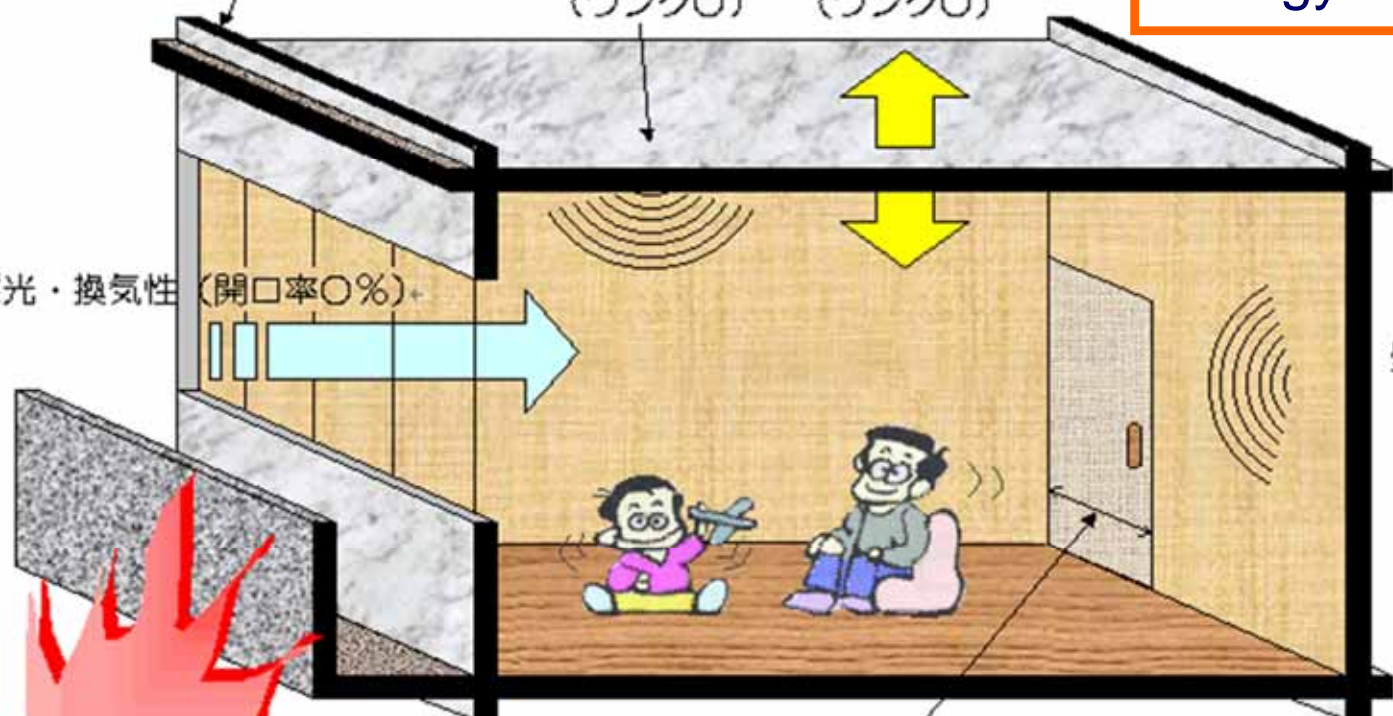
Sound insulation

Fire resistance

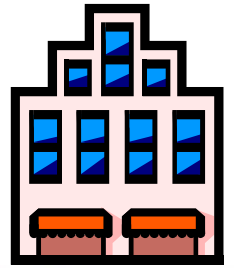
防・耐火性（耐火時間〇時間／法定耐火時間〇時間）

長寿社会対応性（ランク〇）
Design for the aged

耐久性（ランク〇）
Durability

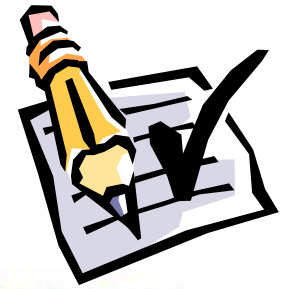


Assessment of Performance



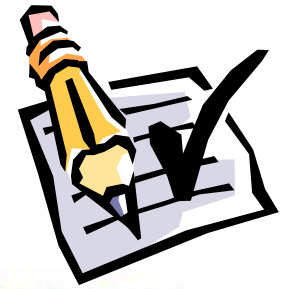
- Energy performance
 - Not well-defined, every building is unique
 - Energy consumption as index (e.g. $\text{kWh/m}^2/\text{year}$)
 - For the whole building or its components
- Other performance indices
 - Thermal performance - cooling and heating
 - Environmental performance - cover all other environmental impacts

Assessment of Performance



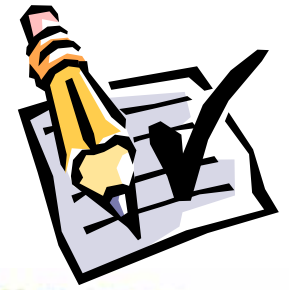
- Building energy performance depends on:
 - 1) Environmental requirements of occupants
 - Thermal comfort, ventilation, and lighting conditions
 - 2) Design of building fabric
 - Architectural design, building envelope
 - 3) Energy-consuming building services systems
 - e.g. air-conditioning, lighting
 - 4) Activity and occupancy patterns
 - Behaviour of occupants and operators

Assessment of Performance



- Methods to assess the performance
 - Component by component method
 - Simple to understand and easy to implement
 - Such as HK building energy codes (prescriptive 5 sets)
 - Whole building performance method
 - In kWh/m²/year or energy cost budget
 - Flexible but complicated in compliance
 - Such as HK's performance-based building energy code

Assessment of Performance



- Benchmarking energy performance
 - Determine how efficient the building is
 - e.g. “Statement of Energy Performance”
 - Set targets for increased efficiency
 - Also important for energy performance contracting to quantify savings
- Examples:
 - Energy Star Label for buildings
 - Building Energy Rating



Energy label and rating systems for buildings in USA

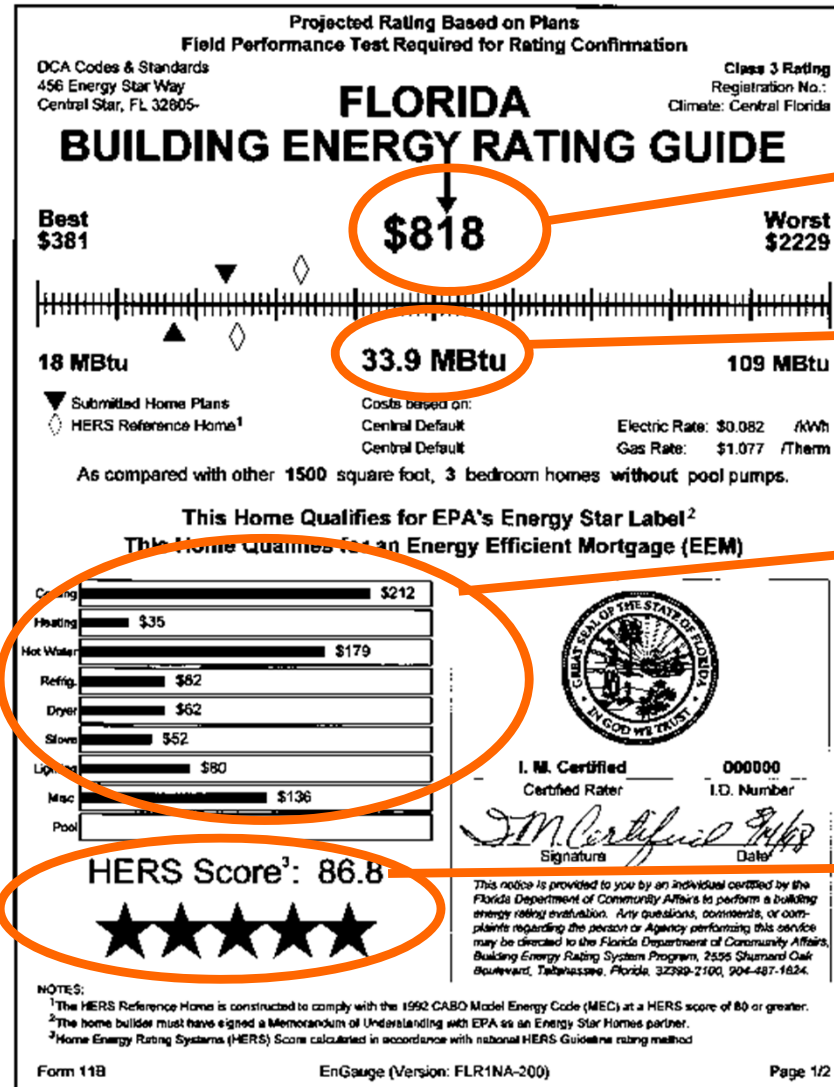
Energy Star Label for Buildings



Buildings that rate in the top 25% of energy-efficient buildings in USA

<http://www.energystar.gov/>

Building Energy Rating System (Florida)



Energy cost

Energy consumption

Breakdown of energy use

Overall score

<http://www.fsec.ucf.edu/ratings/>

EU Directive on Energy Performance of Buildings (EPB)





EU Directive on EPB

- In Europe, buildings uses ~40% of final energy
- The European Union (EU) needs to promote energy savings because:
 - Security of supply
 - Import dependence 70% by 2030
 - Environment
 - Energy sector emits 94% of CO₂
 - Supply side (reserve) limited
 - EU must promote end use efficiency





EU Directive on EPB

- Research showed that by improving energy efficiency, carbon emissions from buildings could be reduced by 22% by 2010
 - Help EU to meet its climate change objectives under the [Kyoto Protocol commitments](#) (reduce 8% greenhouse gas)
 - Also improve the energy performance of new and existing buildings (save money \$ or €)
- Among the EU countries: large differences in standards and application at present



EU Directive on EPB

- European Commission's Action Plan on Energy Efficiency (2000) proposed it
- *EU Directive on the Energy Performance of Buildings*, 2002/91/EC, 16 December 2002
 - Become European Law on 4 Jan 2003
 - In each EU country, legislation must be in place by 4 Jan 2006 and will affect all buildings
 - Will set out a trend for promotion & assessment of building energy performance in the world





EU Directive on EPB

- Principal objectives of the Directive:
 - To promote the improvement of the energy performance of buildings within the EU through cost effective measures
 - To promote the convergence of building standards towards those of Member States which already have ambitious levels
- EU countries must develop suitable energy rating systems and certification schemes for buildings by 2009



EU Directive on EPB

- How does the directive work? -- It facilitates requirements to measure energy use in buildings by:
 - Introducing agreed measurements of relative energy performance
 - Regular inspections and re-evaluations
 - Requiring higher standards for upgrading larger buildings
 - Improving standards for new buildings





EU Directive on EPB

- The Directive aims to improve the energy performance of buildings by requiring:
 - 1. Methodology for integrated buildings energy performance standards
 - 2. Application of these standards on new and existing buildings
 - 3. Certification schemes for all buildings
 - 4. Inspection & assessment of boilers/heating and cooling installations



EU Directive on EPB

- 1. Methodology for integrated building energy performance standards that:
 - Integrate thermal insulation, heating, hot water, cooling, ventilation, lighting, renewable energy installations, passive/active solar, combined heat & power (CHP)/district heating, bldg. position and orientation
 - Give flexibility to designers to meet energy standards in most cost-effective way (e.g. using performance approach)
 - Can be expressed in simple energy indicators
 - Are adopted by Member States for different categories of buildings taking into account climatic differences

EU Directive on EPB



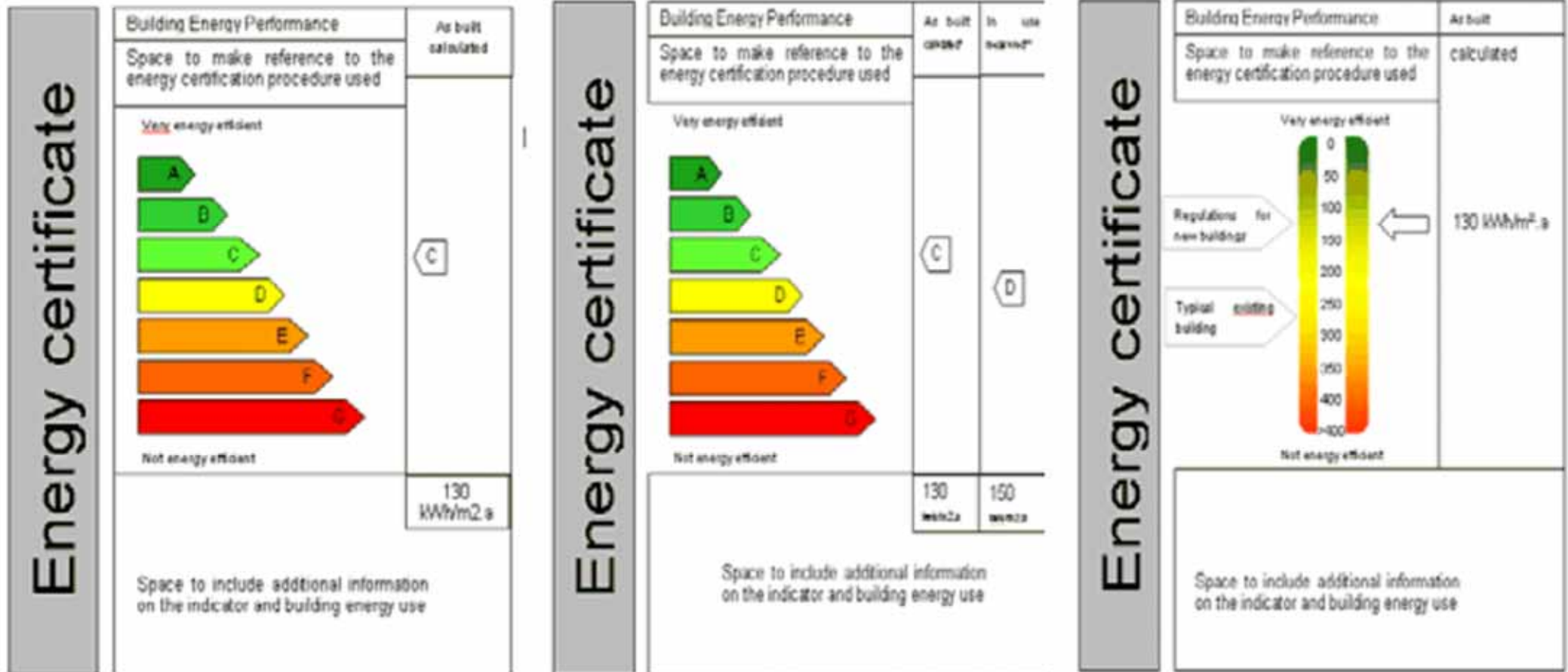
- 2. Minimum standards for all buildings
 - New buildings
 - Application of the minimum energy performance standards to:
 - New residential and tertiary sector buildings
 - Existing buildings
 - Application of minimum energy performance standards to existing buildings greater than 1,000 m² with larger renovations, when technologically/economically feasible



EU Directive on EPB

- 3. Certification schemes for all buildings
 - Why?
 - To facilitate the transfer of clear and reliable information on the energy performance of buildings
 - To make energy efficiency more attractive
 - Energy performance certificates for new and existing buildings should be available when they are constructed, sold or rented out


Just like academic results (成績表) for a building!
Grade A – B – C – D – E ...



Three examples of energy certificate proposed in Europe

Energy Certificate

As built:
Asset rating
(calculated)

Building Energy Performance >		As built:	In use:
Certificate type	FULL	Asset Rating	Operational Rating
Building Type	Office		
Whole or part of building	Whole building		
<i>Very energy efficient</i>			
A			
B		B	
C			
D			D
E			
F			
G			
<i>Not energy efficient</i>			
Asset rating method:	UK National Standard 2004	Calculated	Actual
Operational rating method:	UK Office Tailored Benchmarks 2002		
Units used:	kg CO ₂ per sq m of net area per annum >	48	83
Occupancy level:	Square metres net lettable area per person	14	12
Equipment heat gain level:	Watts per square metre net	12	12
Weekly occupancy hours:	Hours per week	55	58
Heating performance ratings		ABCDEFG	ABCDEFG
HVAC performance ratings (cooling, fans and pumps)		ABCDEFG	ABCDEFG
Lighting performance ratings		ABCDEFG	ABCDEFG
Management rating (for in-use performance only)			ABCDEF
Internal Environmental Quality			Not assessed
Risk level			Not assessed
Further information can be found in the Energy Log Book			
GB 2005		 Directive 2002/91/EC	

In use:
Operational
rating
(actual)

Proposed energy
certificate of
buildings in Europe
(source: ww.eplabel.org)

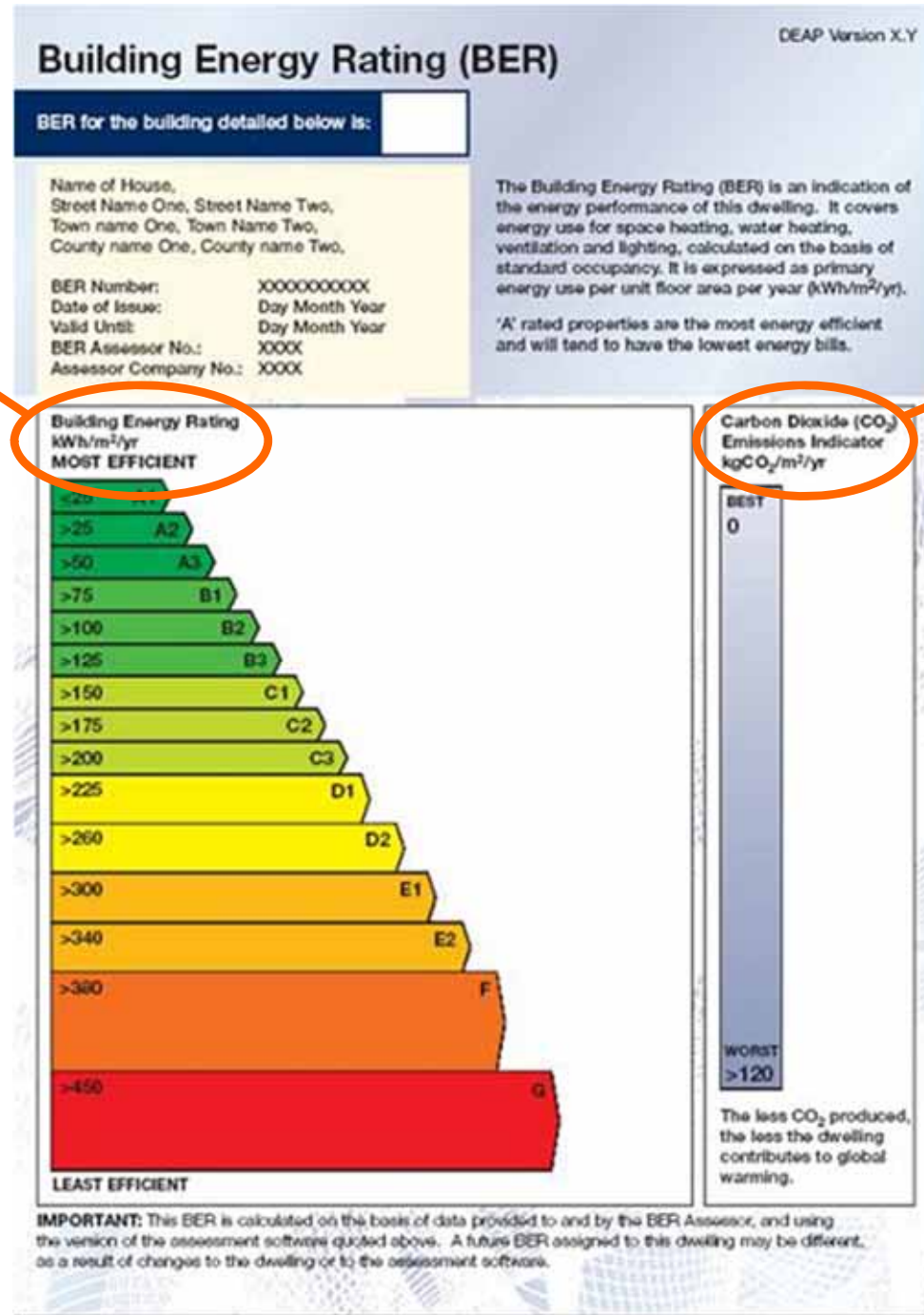
- ← Rating method & units
- ← Occupancy level
- ← Heating performance
- ← HVAC performance
- ← Lighting performance
- ← Management rating
- ← Internal environ. quality

Certifying organisation	Building name
Street	Organisation
PO Box	Street
City	City
Contact	Contact
Tel	Tel
email	email

Example of building energy rating (Ireland)

Building energy rating (kWh/m²/yr)

CO₂ emission indicator (kgCO₂/m²/yr)



EU Directive on EPB



- 4. Inspection & assessment of boilers/heating and cooling installations
 - Heating systems
 - Boilers with output 20-100 kW: regular inspection
 - Boilers over 100 kW (except gas -4 yrs): inspected every 2 years
 - Boilers larger than 10 kW & older than 15 years: entire installation to be inspected & advice given on alternative solutions
 - Cooling systems
 - Similar measures need to be taken as regards cooling systems, in particular in larger buildings

EU Directive on EPB



- Video presentation: Energy use in buildings: use it better, use it less [15 min.] (HKU Library [EDCC 343.407869 E56])
 - Provide an overview of the EU Directive
 - Practical issues in Europe
 - Illustrate by examples in three EU countries
 - Upper Austria, Czech Republic and Portugal (Lisbon)
- Energy, let's save it! (3:40)
 - www.youtube.com/watch?v=1-g73ty9v04



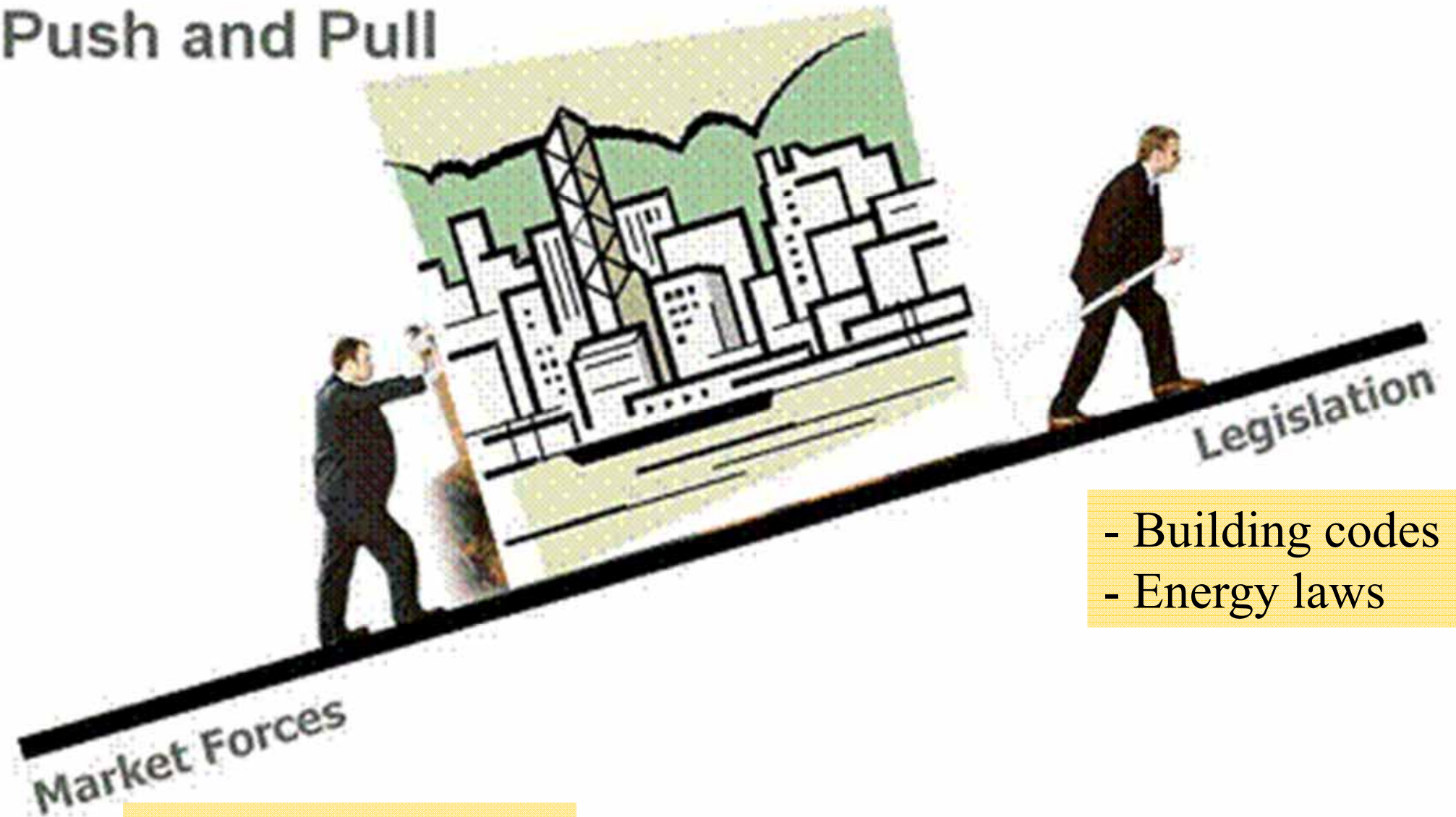


EU Directive on EPB

- **Strategy for promoting energy efficiency**
 - Legislation (**PULL**)
 - Building codes, energy laws
 - Market forces (**PUSH**)
 - Improve awareness & information
- Reverse the vicious circle
 - Change market behaviour & overcome barriers
 - Increase investments in energy efficiency measures among the stakeholders

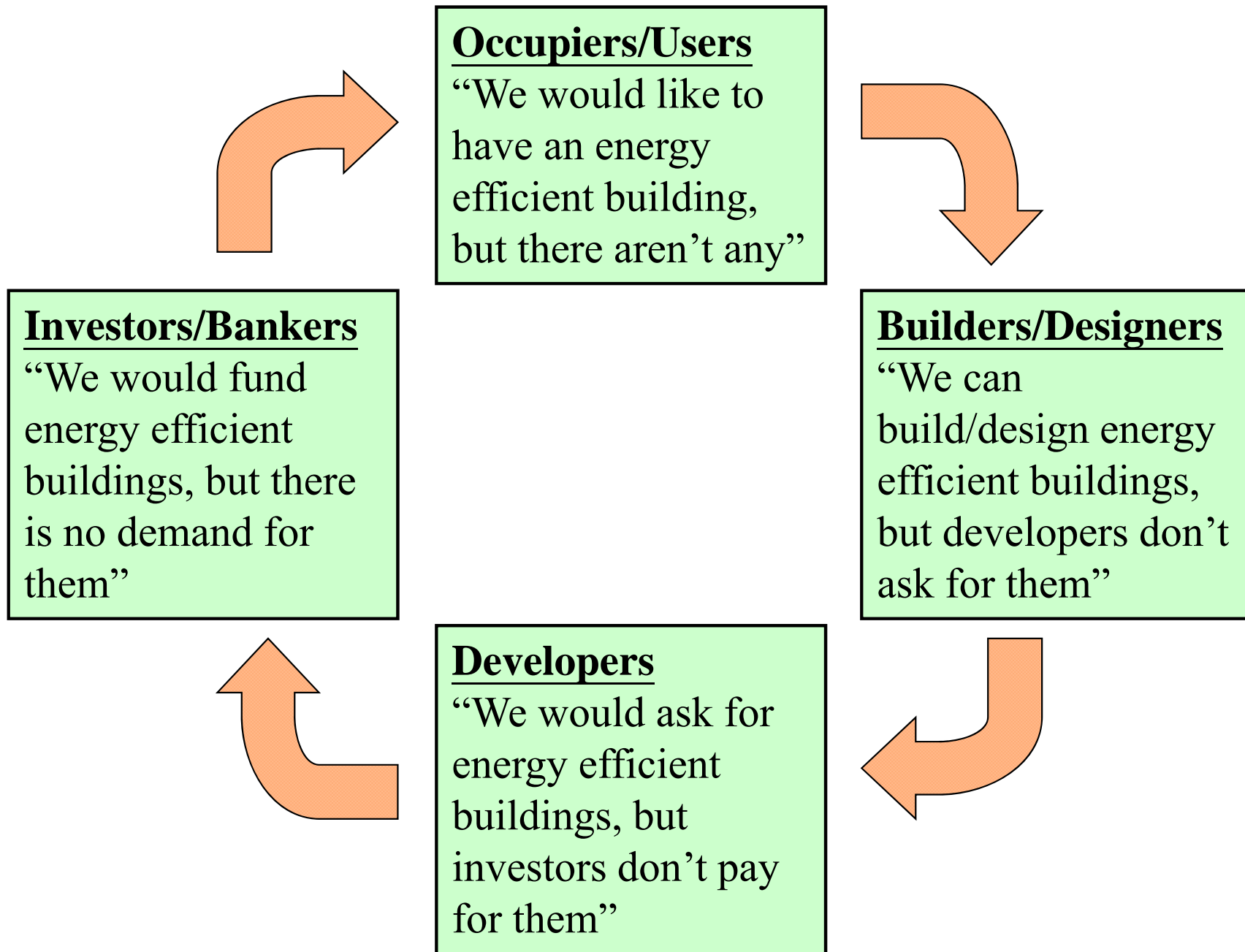
Strategy for promoting energy efficiency in buildings

Push and Pull

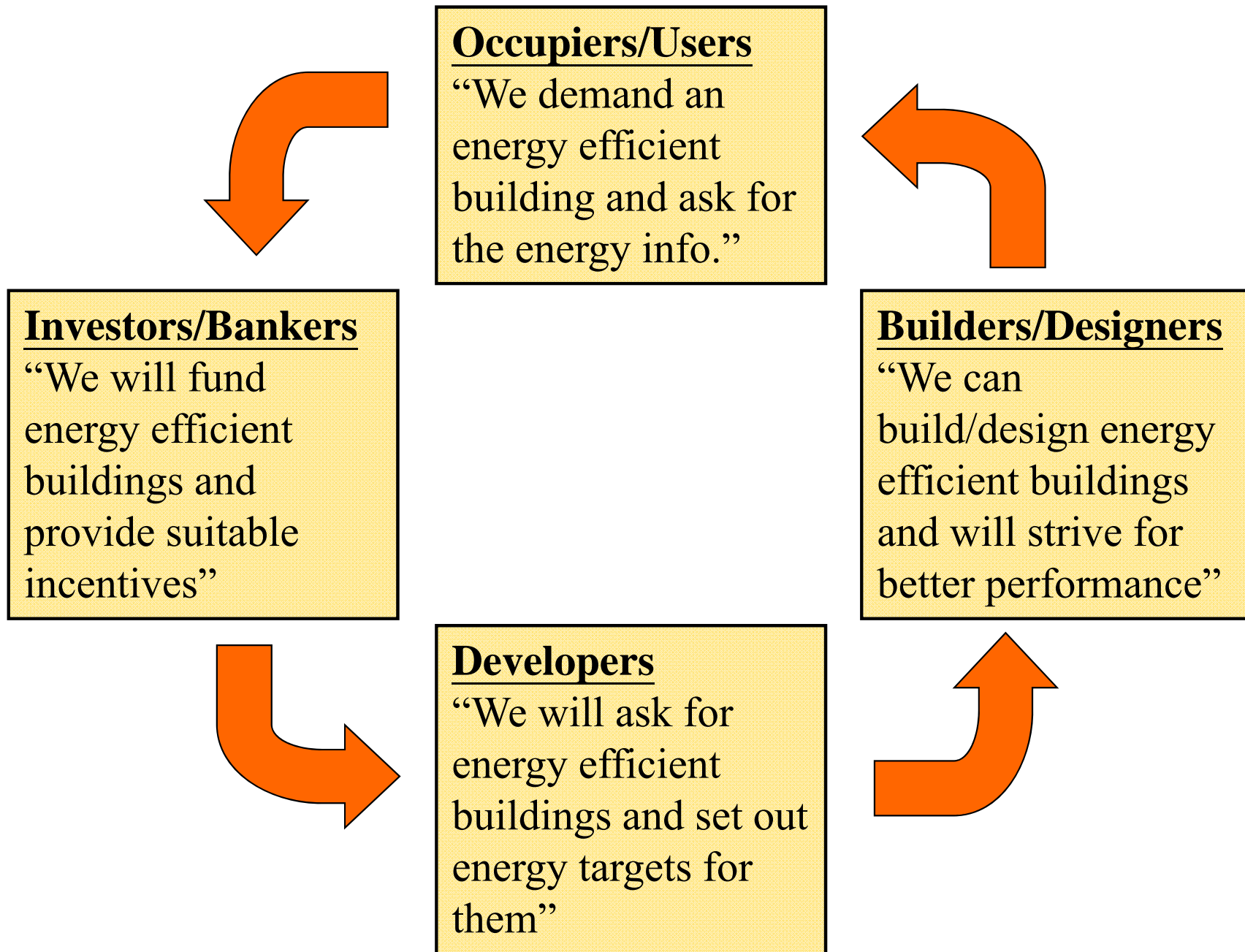


- Energy labels
- Voluntary schemes

- Building codes
- Energy laws



The **vicious circle** of energy efficient buildings
(From EU studies)



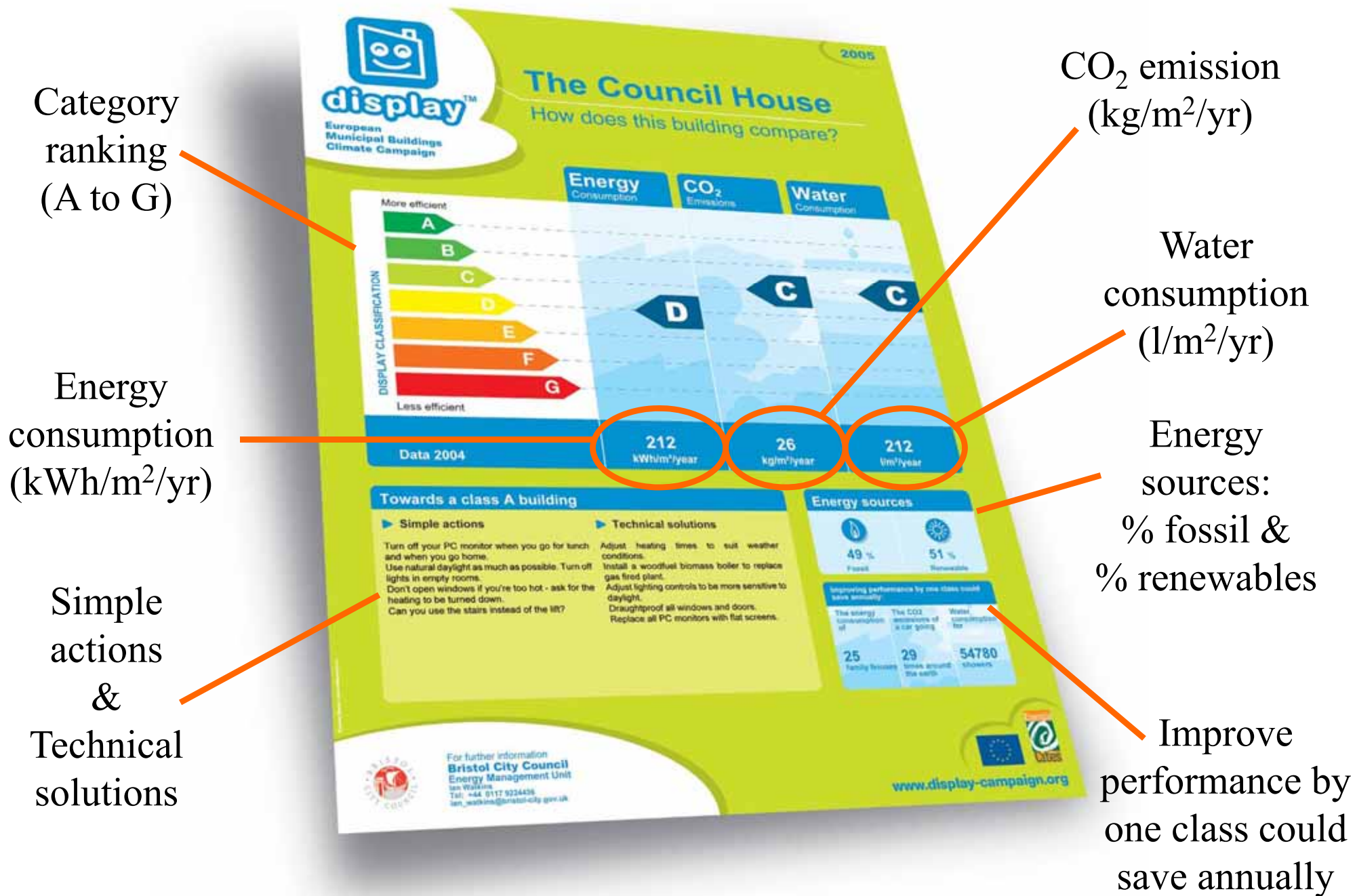
Reverse the viscous circle and overcome market barriers



EU Directive on EPB

- **EU's energy performance certificates**
 - Should not be more than 10 years old
 - Be accompanied with advice on how to improve the energy performance
 - Be carried out by independent and qualified experts
- **Publicising the certificates**
 - Display them in a prominent place
 - Form the basis for building energy rating or label

Building energy label from Display Campaign in Europe



Category ranking (A to G)

CO₂ emission (kg/m²/yr)

Water consumption (l/m²/yr)

Energy consumption (kWh/m²/yr)

Energy sources: % fossil & % renewables

Simple actions & Technical solutions

Improve performance by one class could save annually

Display them in a prominent place



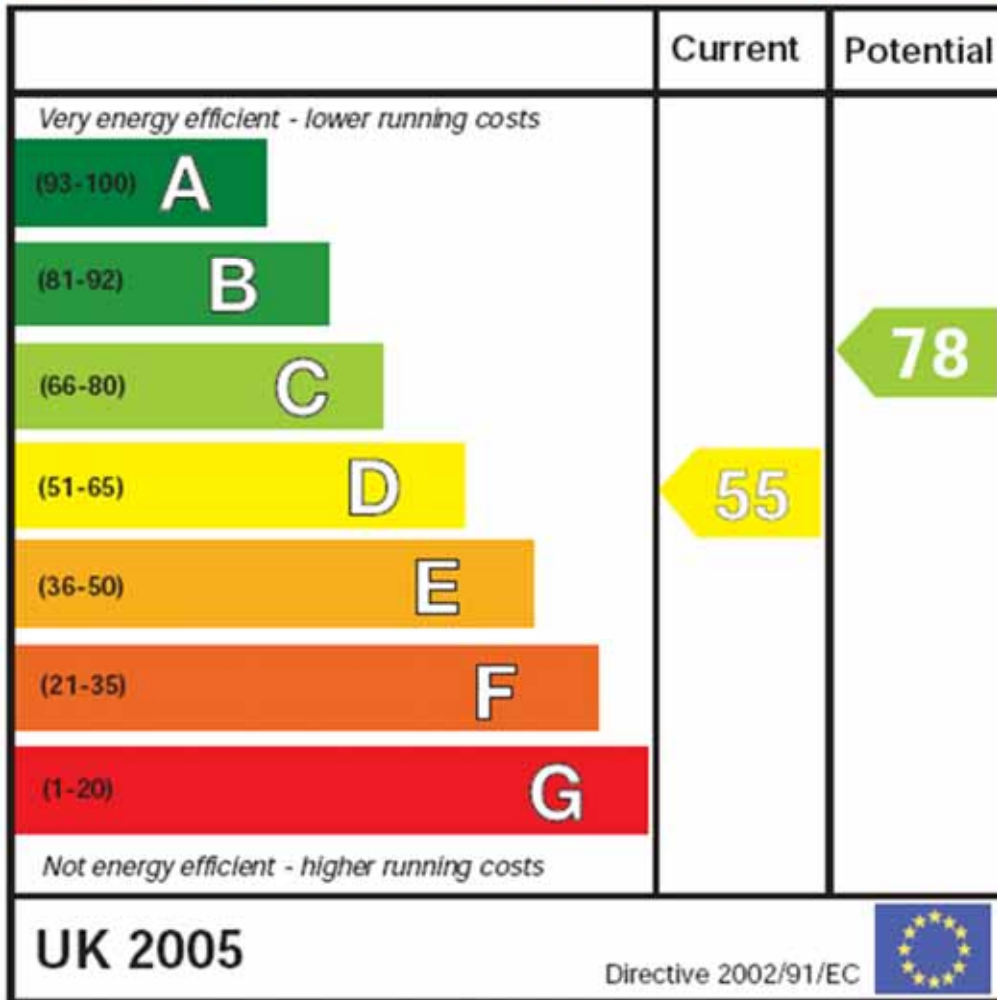
This is the right way to display the building energy label !!



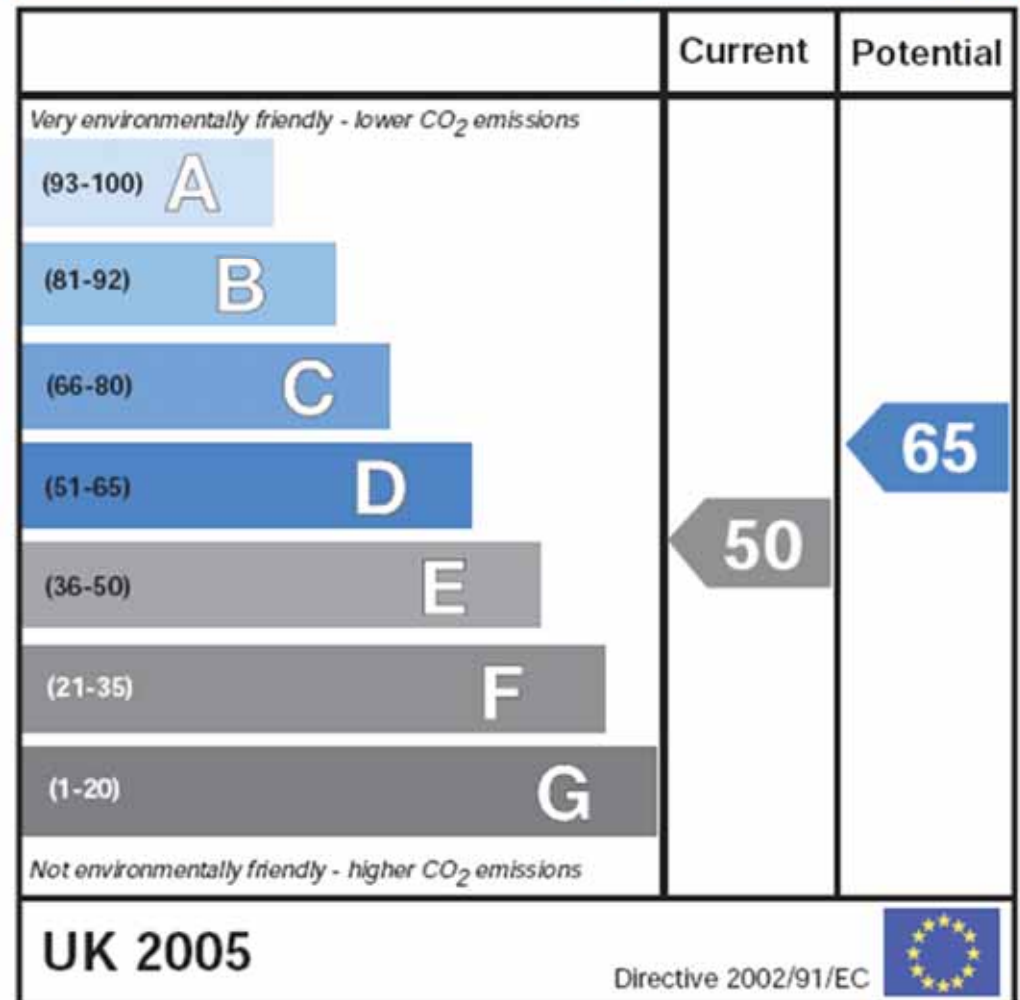
EU Directive on EPB

- The certificates apply to public buildings, homes, offices, etc.
- Some EU countries develop it further to include environmental impact rating
 - Such as UK and Denmark
 - Energy efficiency rating based on fuel cost
 - Environmental impact rating based on CO₂ emissions
- Future trends: connected to mortgage (\$\$) & tenancy agreement

Energy Efficiency Rating



Environmental Impact Rating



Energy efficiency rating and environmental impact rating in UK

Certificate number: XXXX
 Date issued: XXXX
 Name of inspector: XXXX

Section H: Energy Performance Certificate

Summary of this home's energy performance related features

The table shows the current performance of each element of this home on the following scale:
 Extremely poor/ Very poor/ Poor/ Average/ Good/ Very good/ Excellent

Element	Description	Current performance
Main walls	Uninsulated cavity wall	Poor
Main roof	Pitched, 100mm loft insulation	Average
Main floor	Uninsulated solid concrete (assumed)	Average
Windows	Single glazed throughout	Extremely poor
Main heating	Mains gas back boiler	Poor
Main heating controls	No controls	Extremely poor
Secondary heating	Flame effect fire	Extremely poor
Hot water	From main heating system; uninsulated cylinder	Extremely poor
Lighting	Low energy lighting throughout	Excellent
Current energy efficiency rating		D 55
Current environmental impact rating		E 50

Example of how the performance of each element is indicated

Measures to improve this home's performance ratings

The improved performance ratings are cumulative, that is they assume the improvements have been installed in the order that they appear in the table.

Lower cost measures	Typical savings	Performance ratings after improvement	
		Energy efficiency	Environmental impact
Cavity wall insulation	£xx per year	D 65	D 56
Loft insulation top up to 250mm	£xx per year	C 68	D 57
Hot water tank and pipe work insulation	£xx per year	C 69	D 58
	Sub Total £xx per year		
Higher cost measures			
Condensing boiler	£xx per year	C 75	D 63
Installation of a full heating controls package	£xx per year	C 78	D 65
	Sub Total £xx per year		
Potential energy efficiency rating		C 78	
Potential environmental impact rating		D 65	
Further measures to achieve even higher standards			
Double glazing	£xx per year	C 80	C 67
Solar water heating	£xx per year	B 85	C 72
Enhanced energy efficiency rating		B 85	
Enhanced environmental impact rating		C 72	

Example of improvement measures suggested

Energimærke

Store ejendomme

Status over ejendommens energi- og vandforbrug



Måle nr. _____ EEF-nummer _____ Regio: _____ Data, beregning, udstillt _____

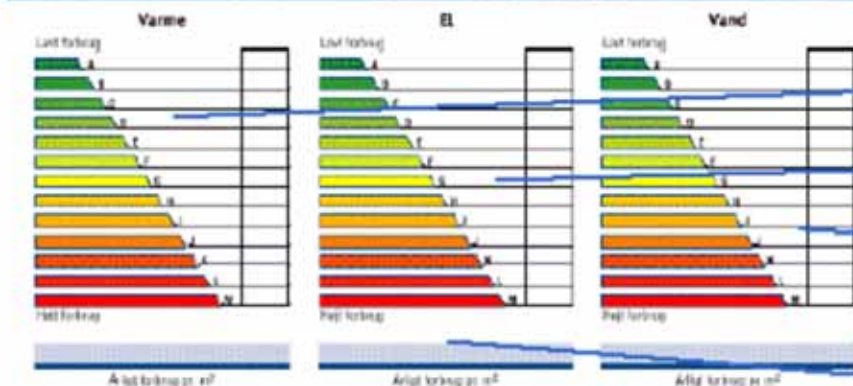
Adresse _____

Postnummer: _____ By _____

Arbejdsnr. _____ Amt _____

Udsteders kontaktoplysninger _____

Ejendommens registrerede årlige forbrug pr. m²



Målesystemet er afsluttet med ejendommens registrerede forbrug. De og udstillingen af energimærket skal være i overensstemmelse med de tekniske specifikationer og forklaring af målesystemet og beregningerne.

Energiforbrugets miljøbelastning pr. m²



Varme- og elforbrugets miljøbelastning er beregnet ud fra den årlige CO₂-udledning. Målesystemet er afsluttet med ejendommens CO₂-udledning pr. m² sammenlignet med den gennemsnitlige CO₂-udledning for tilsvarende bygninger. Sammenligningsbetragtning er beregnet ud fra.

Samlet forbrug og miljøbelastning



Energimærket er afsluttet på grundlag af det registrerede forbrug. I overensstemmelse med de tekniske specifikationer og forklaring af målesystemet og beregningerne.



Date

Identification of building

Identification of consultant

Signature

Labelling of Heating

Labelling of Electricity

Labelling of Water

Consumption pr. m²

Environmental Impact

Consumption



Energy certificate or label for buildings in Denmark

Implications for HK



- Current problems
 - Voluntary scheme cannot attract the private sector to participate
 - Lack of clear information on energy performance of buildings
 - Market and institutional barriers to energy efficiency improvement
- The “*Pull and Push*” strategy is needed to resolve them

Implications for HK



- Analysis of market factors
 - Developers are not interested in energy efficiency
 - Building owners/tenants pay for running costs
 - Need for better information & awareness
- The “*Push*” strategy: enhance information on building energy performance
 - Building energy labels, energy audits, awards
 - Policy to promote market forces and education

Implications for HK



- Energy label & certification of buildings
 - For new buildings: specify energy performance baseline (allow people to know & compare)
 - For existing buildings: upgrade to meet the building energy codes (during retrofits)
- **Energy rating scheme** (grade A, B, C, D, E)
 - Possible links with mortgage and rates
 - Can create market forces to differentiate good/bad
 - Provide suggestions for improvement

Comparison of energy label methods

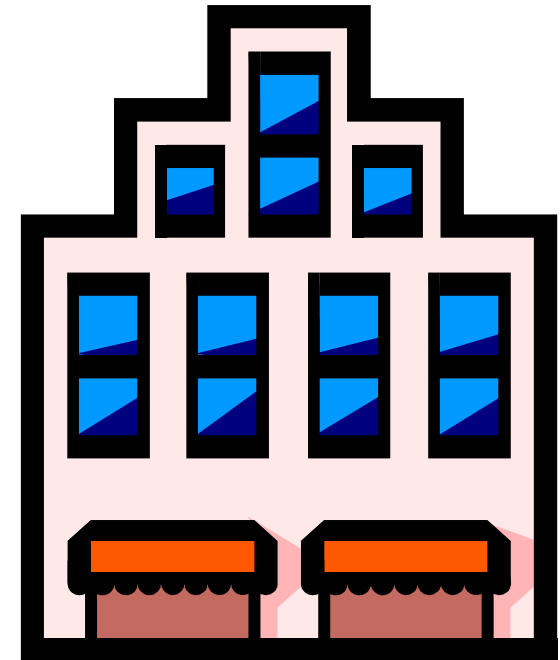
Energy label for appliance



Energy label for passenger car



Energy label for buildings??



In Hong Kong, we pay a lot of money for housing and workplace. But we do not receive any info about their energy performance.

Hong Kong Building Energy Label

Type: residential building	Current	Potential
<i>Very energy efficient - lower running costs</i>		
(93-100) A		
(81-92) B		
(66-80) C		78
(51-65) D	55	
(36-50) E		
(21-35) F		
(1-20) G		
<i>Not energy efficient - higher running costs</i>		
* See notes for measures to improve the performance.		

Imagine what effect if we have this when buying or renting a flat?

Would you like to have this?



Further Reading

- CIBSE Briefing 6: The Energy Performance of Buildings Directive
 - Available at www.cibse.org
- EU Directive on the Energy Performance of Buildings, 2002/91/EC (original document & other reports)
 - Available at www.buildingsplatform.org
- Reports from European Alliance of Companies for Energy Efficiency in Buildings (EuroACE)
 - Available at www.euroace.org



References

- Buildings Energy Efficiency Ordinance (Cap 610)
 - www.emsd.gov.hk/emsd/eng/pee/mibec_beeo.shtml
 - Draft Building Energy Code (BEC) and Energy Audit Code (EAC)
- Building Energy Codes (2007 version)
- Guidelines for Energy Efficiency (2007 version)
- Guidelines on Energy Audit, 2007 Edition
- Code of Practice for Overall Thermal Transfer Value in Buildings 1995
 - Revised OTTV limits (Aug 2011): APP67 - Energy Efficiency of Buildings -- Building (Energy Efficiency) Regulation