

Energy Efficiency in Buildings (I)



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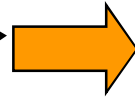


Energy Policy and Codes

- 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
 - Attributes include
 - Legislation, international treaties, incentives to investment, guidelines for energy conservation, taxation and other public policy techniques
 - National energy policy, such as: USA and China

Energy Policy and Codes

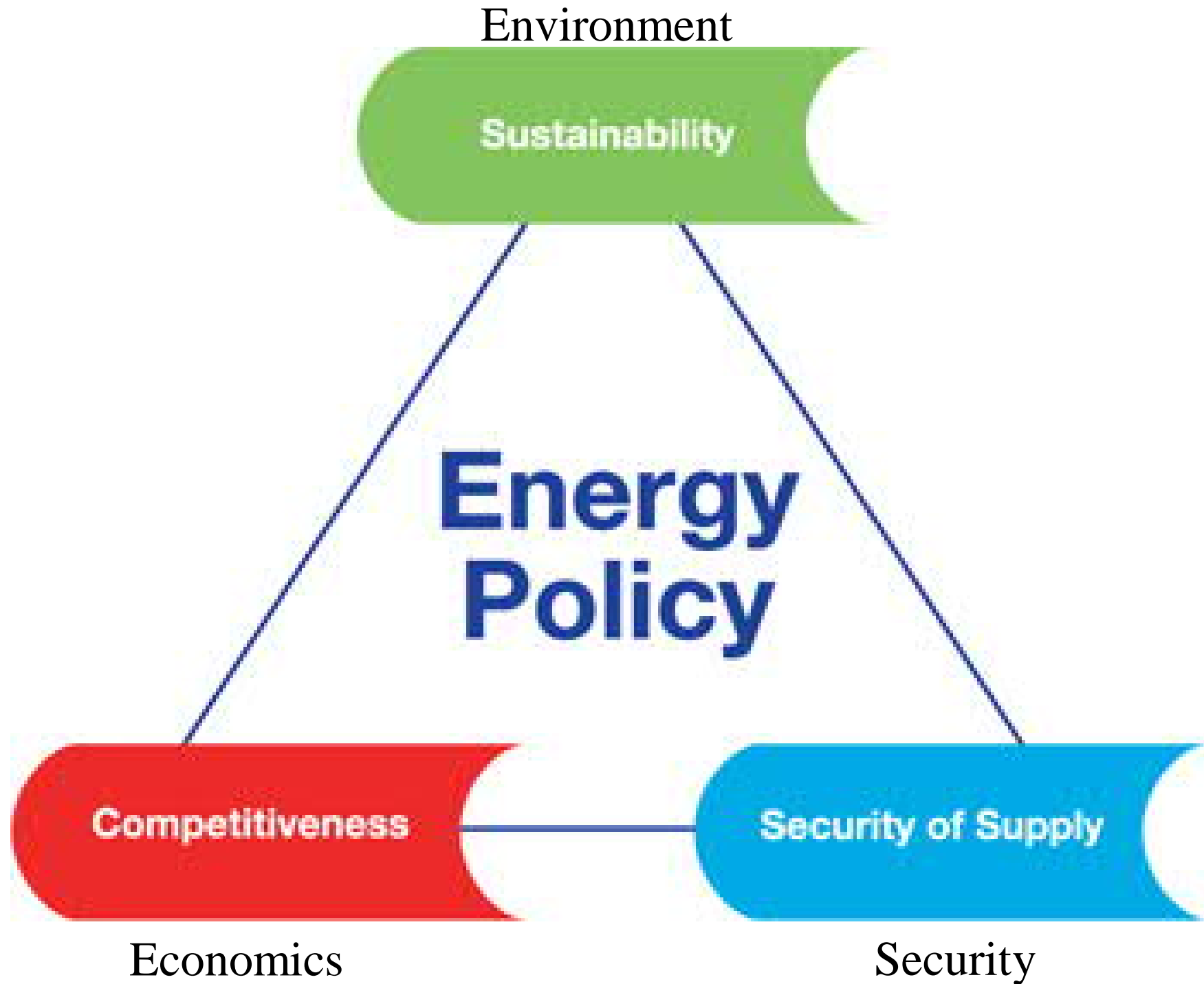


- *Energy Policy of USA**
 - Three Energy Policy Acts have been passed, in 1992, 2005, and 2007
 - Key issues:
 - Energy independence
 - Energy consumption (buildings, transport, industry)
 - Energy sources (oil, coal, natural gas, nuclear, renewable energy)
 - Energy efficiency
 - Energy budget, initiatives and incentives
 - Greenhouse gas emissions



(*See also http://en.wikipedia.org/wiki/Energy_policy_of_the_United_States)

Triple bottom line approach to US National Energy Policy



Energy Policy and Codes



- *Energy Policy of China**

- Basic contents:

- Give priority to conservation, rely on domestic resources, encourage diverse development, protect the environment, promote scientific and technological innovation, deepen reform, expand international cooperation, and improve the people's livelihood

- Key issues:

- Fossil fuels (coal, oil, natural gas)
- Electricity generation & rural electrification
- Renewable energy sources (biofuels, solar, wind)
- Energy conservation



(*See also http://en.wikipedia.org/wiki/Energy_policy_of_China)

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

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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
 - 1. Building energy standards/codes
 - For building design & operation
 - 2. Appliance energy standards/codes
 - For equipment & household/office appliances
 - 3. Energy audit codes/requirements

Energy efficiency and conservation measures in Asian countries

MEASURES	SECTORS	BURNEI	INDONESIA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	VIETNAM
EQUIPMENT/ APPLIANCE LABELLING	<i>Industrial</i>	Planned	under development	voluntary	na	voluntary	partly mandatory	Planned
	<i>Commercial</i>	Planned	under development	voluntary	partly mandatory	voluntary	partly mandatory	Planned
	<i>Residential</i>	Planned	under development	voluntary	partly mandatory	voluntary	partly mandatory	Planned
BUILDING STANDARDS	<i>Industrial</i>	Voluntary	na	voluntary	mandatory	mandatory	partly mandatory	partly mandatory
	<i>Commercial</i>	Voluntary	voluntary	voluntary	mandatory	mandatory	partly mandatory	partly mandatory
	<i>Residential</i>	na	na	voluntary	mandatory	mandatory	partly mandatory	partly mandatory
ENERGY AUDITS	<i>Industrial</i>	partly mandatory	voluntary	voluntary	na	voluntary	voluntary	voluntary
	<i>Commercial</i>	partly mandatory	voluntary	voluntary	na	voluntary	voluntary	voluntary
	<i>Residential</i>	Voluntary	na	voluntary	na	na	na	voluntary
FINANCIAL INCENTIVES AND SUPPORT	<i>Industrial</i>	Available	under development	Available	Available	Available	Available	Available
	<i>Commercial</i>	Available	under development	Available	Available	Available	Available	Available
	<i>Residential</i>	Available	na	Available	Available	na	na	Available

(Source: United Nations Environment Program (UNEP), 2010)



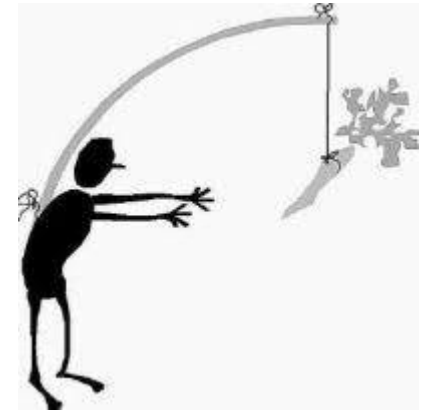
Energy Policy and Codes

- 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

Current Situation in HK



- Energy policy of Hong Kong
 - 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)
 - The current environmental and energy policy*

Current Situation in HK



- 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

Timeline of building energy efficiency regulations in Hong Kong

1991-1995

- 1991 Feasibility study on introduction of OTTV control in Hong Kong
- 1995 **Building (Energy Efficiency) Regulations (Cap. 123 sub. Leg. M)**; HK OTTV Code of Practice

1996-2000

- 1998 Lighting Code and AC Code; launch of the Energy Efficiency Registration Scheme for Buildings (voluntary)
- 1999 Electrical Code
- 2000 Lift and Escalator Code; Revised OTTV limits

2001-2005

- 2004 Performance-based Code; Guidelines on Energy Audit
- 2005 Updated edition of the five codes

2006-2010

- 2007 Updated edition of the five codes; Updated Guidelines on Energy Audit
- 2010 **Buildings Energy Efficiency Ordinance (Cap. 610)** (mandatory)

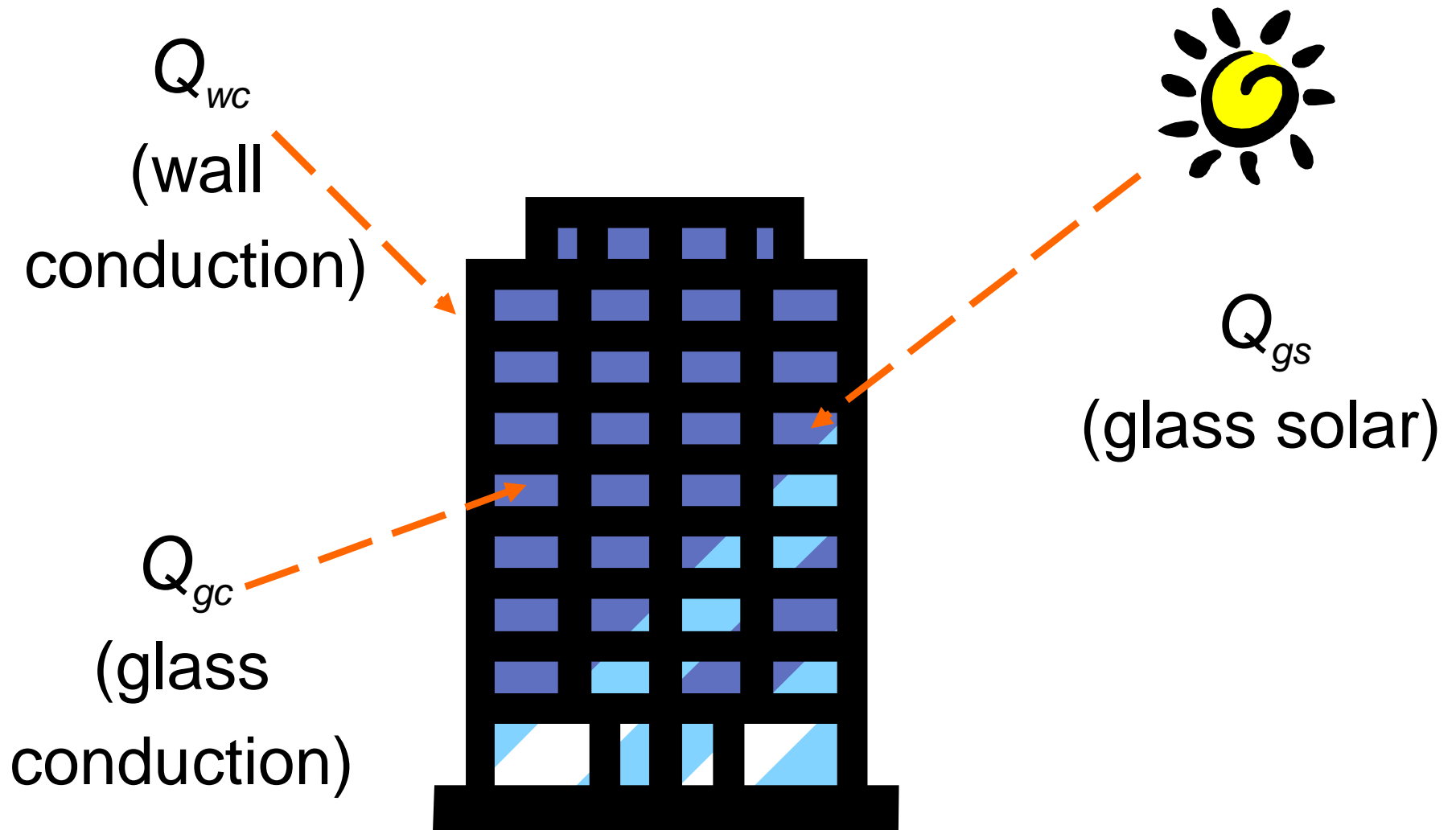
2011-Now

- 2011 Revised OTTV limits
- 2012 Full operation of the Buildings Energy Efficiency Ordinance (including Building Energy Code and Energy Audit Code)

Current Situation in HK



- 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: $OTTV \leq 56 \text{ W/m}^2$



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

Current Situation in HK



- 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

Current Situation in HK



- HK Building Energy Codes (BEC)



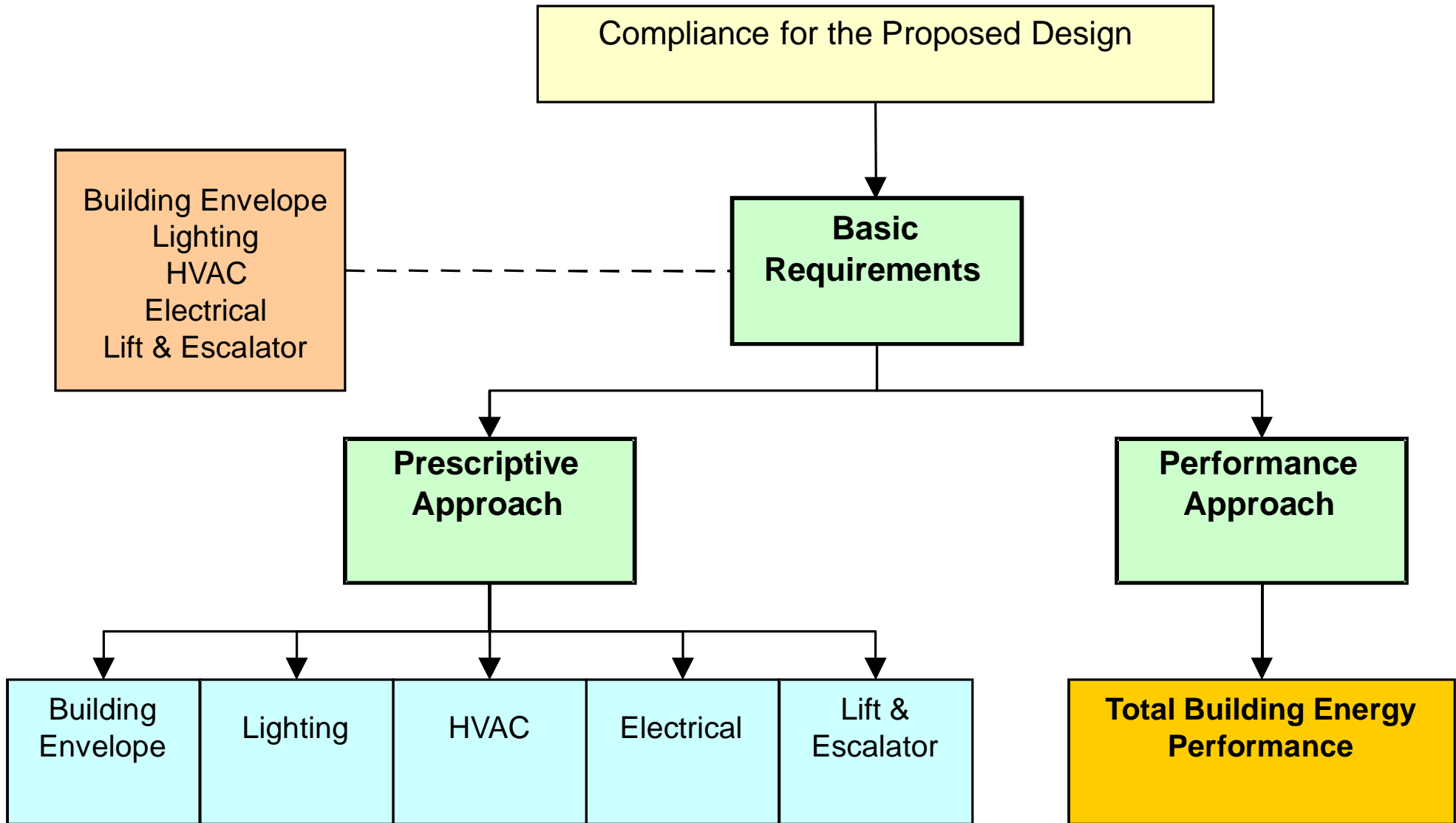
- Lighting
- Air-conditioning
- Electrical
- Lifts & escalators
- Performance-based code

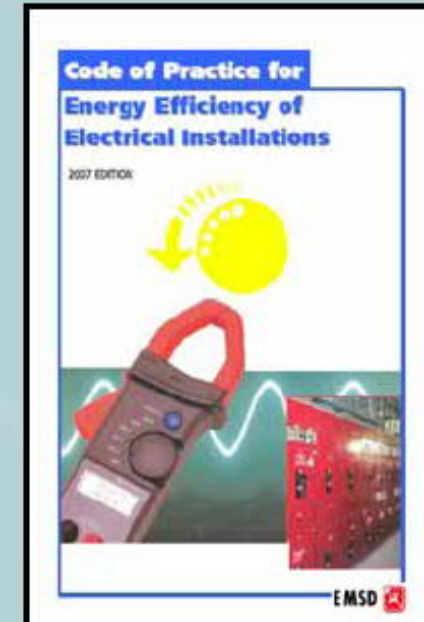
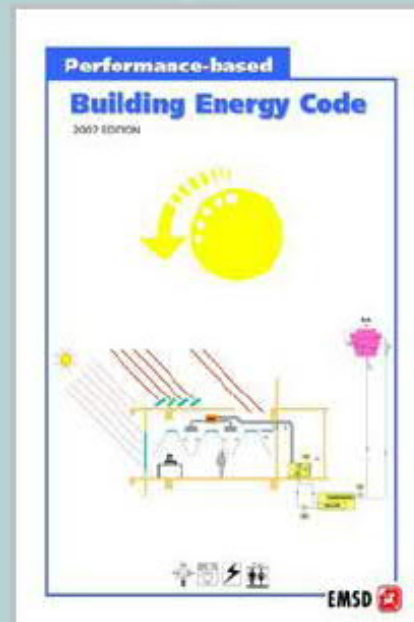
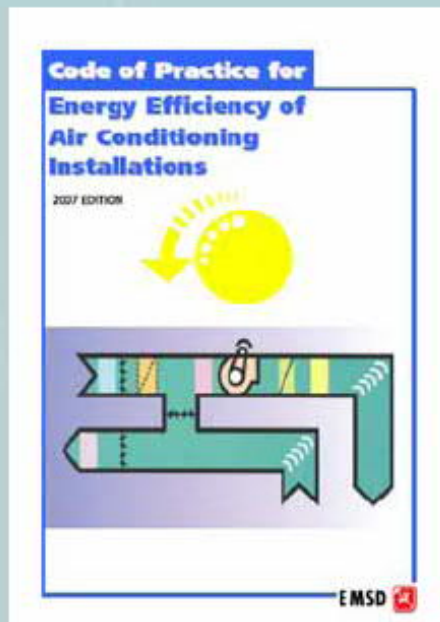
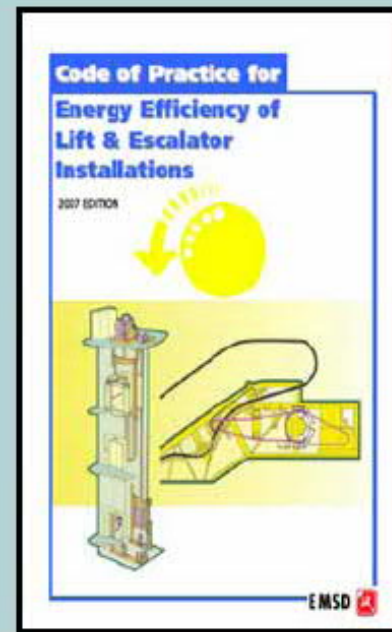
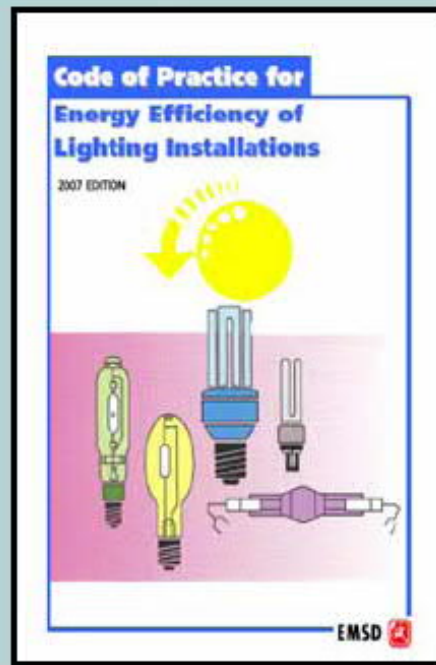


- Previously under Hong Kong Energy Efficient Building Registration Scheme (HKEEBRS)

- Become mandatory in 2011

Proposed framework of the comprehensive BECs in Hong Kong





Building Energy Codes in Hong Kong (2007 edition)

(Source: www.emsd.gov.hk)

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

* Combined and become mandatory in 2010 under the *Buildings Energy Efficiency Ordinance*. (See <http://www.beeo.emsd.gov.hk> for details)

Current Situation in HK



- The [Buildings Energy Efficiency Ordinance \(BEEO\)](#) (Cap. 610) had been enacted in November 2010 and had come into full operation on 21 September 2012
 - Mandatory implementation of [Building Energy Code \(BEC\)](#) in prescribed buildings
 - Mandatory implementation of energy audit according to the [Energy Audit Code \(EAC\)](#) in commercial buildings and portions of composite buildings that are for commercial use

See also <http://www.beeo.emsd.gov.hk>



機電工程署
EMSD



ENG

繁體

简体

《建築物能源效益條例》 The Buildings Energy Efficiency Ordinance



空調裝置
Air-conditioning installation



電力裝置
Electrical installation



升降機及自動梯裝置
Lift & escalator installation



照明裝置
Lighting installation



Current Situation in HK



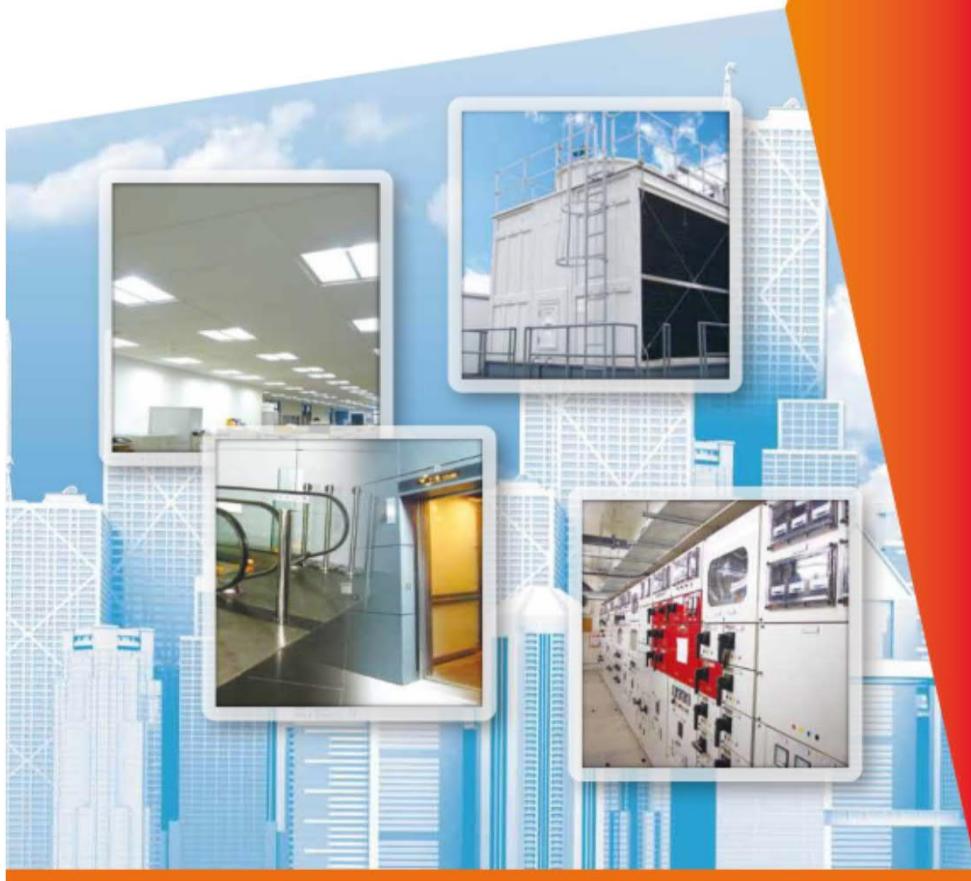
- Building Energy Code (BEC)
 - For newly constructed buildings & major retrofitting works
 - Minimum energy efficiency design standards for 4 key types of building services installations (air-conditioning, electrical, lighting and lift & escalator installations)
 - Requirements:
 - Declaration at design and occupation approval stages
 - Certificate of compliance registration (CoCR)

Current Situation in HK



- Energy Audit Code (EAC)
 - For commercial buildings (including the commercial portions of composite buildings)
 - Minimum technical requirements of energy audit for 4 key types of central building services installations (air-conditioning, electrical, lighting and lift & escalator installations)
 - Energy audit requirement (renew every 10 years)
 - According to the occupation permit of the building (>1988, >1978, >1970, <=1969), the first energy audit must be carried out in 2013, 2014, 2015, 2016

Code of Practice for Energy Efficiency of Building Services Installation



2012

EMSD 

Code of Practice for Building Energy Audit



2012

EMSD 

Current Situation in HK



- Two subsidiary regulations under the BEEO:
 - Buildings Energy Efficiency (Fees) Regulation (Cap. 610A)
 - Buildings Energy Efficiency (**Registered Energy Assessors**) Regulation (Cap. 610B)
 - REA = Registered Energy Assessors*
- Effects of the BEEO:
 - Enhance building energy efficiency in Hong Kong
 - Provide many opportunities for building energy professionals (e.g. Building Services Engineers)

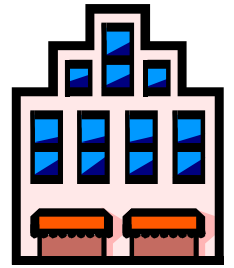
(* See also http://www.beeo.emsd.gov.hk/en/rea/search_rea.php)

Current Situation in HK



- What's Next in HK?
 - Guidelines for the BEC (coming soon)
 - Update of BEC requirements (e.g. for LED)
 - Full implementation of EAC (2012-2016)
 - Application of EAC to different types of buildings
 - Development of building energy labels & rating
- Other related developments
 - Green building: energy performance assessment
 - Zero and low carbon/energy buildings
 - Community energy systems (e.g. for renewables)

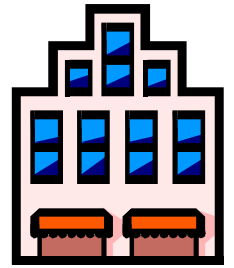
Assessment of Performance



- 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



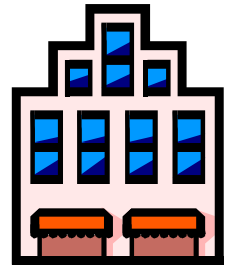
(Such as fuel efficiency)

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 ○倍）

床の遮音性（ランク○）

省エネルギー性（ランク○）

Energy efficiency

Daylight, ventilation

採光・換気性（開口率○%）

壁の遮音性（ランク○）

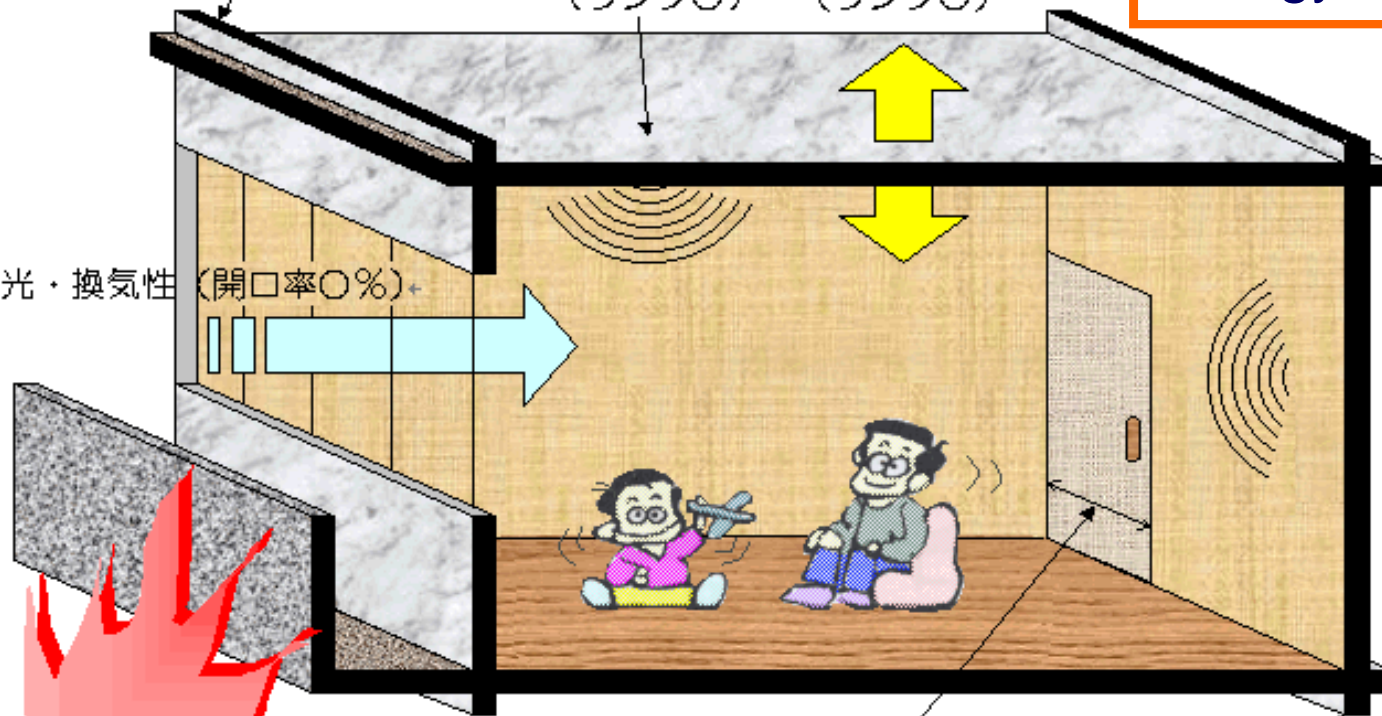
Sound insulation

Fire resistance

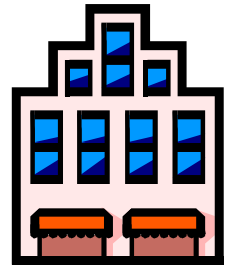
防・耐火性（耐火時間○時間／法定耐火時間○時間）

長寿社会対応性（ランク○）
Design for the aged

耐久性（ランク○）
Durability

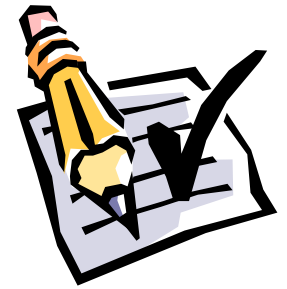


Assessment of Performance



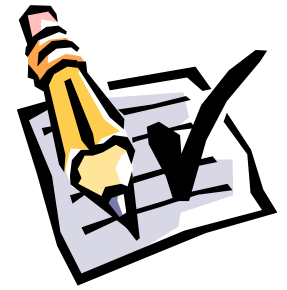
- Energy performance
 - Not well-defined, every building is unique
 - Energy consumption as index (e.g. $\text{kWh/m}^2/\text{year}$)
 - For the whole building or its components
- Other performance indices
 - Thermal performance - cooling and heating
 - Environmental performance - cover all other environmental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

Assessment of Performance



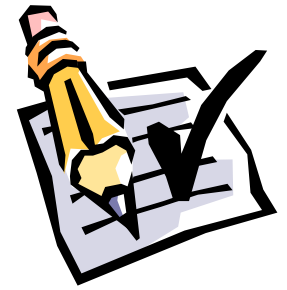
- Building energy performance depends on:
 - 1) Environmental requirements of occupants
 - Thermal comfort, ventilation, and lighting conditions
 - 2) Design of building fabric
 - Architectural design, building envelope
 - 3) Energy-consuming building services systems
 - e.g. air-conditioning, lighting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

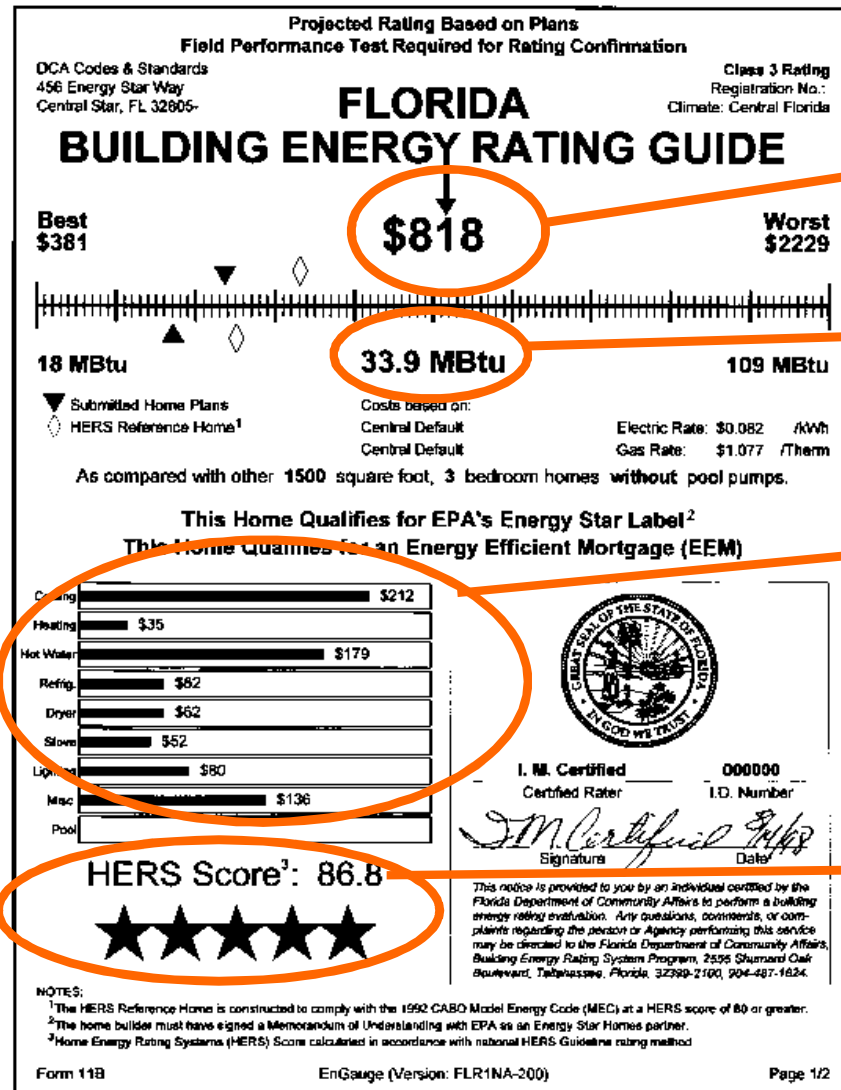
Energy Star Label for Buildings



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/en/consumer/buildings/homes/ratings/how.htm>

EU Directive on Energy Performance of Buildings (EPB) or Energy Performance of Building Directive (EPBD)





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

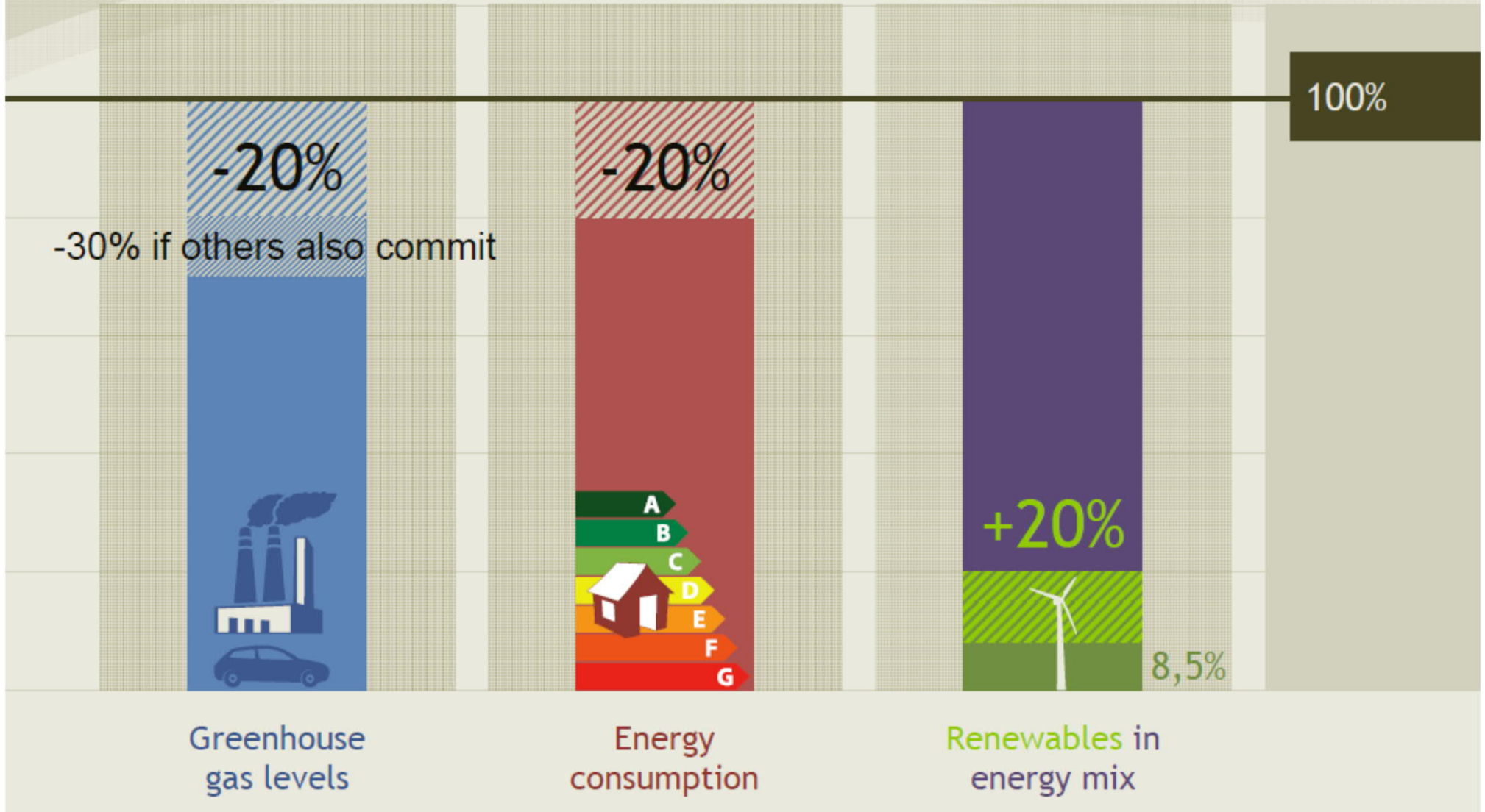




EU Directive on EPB

- 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

The 20-20-20 EU policy by 2020



(Source: <http://ec.europa.eu/energy/>)



EU Directive on EPB

- *EU Directive on the Energy Performance of Buildings*, 2002/91/EC, 16 December 2002*
 - European Commission's Action Plan on Energy Efficiency (2000) proposed it
 - 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



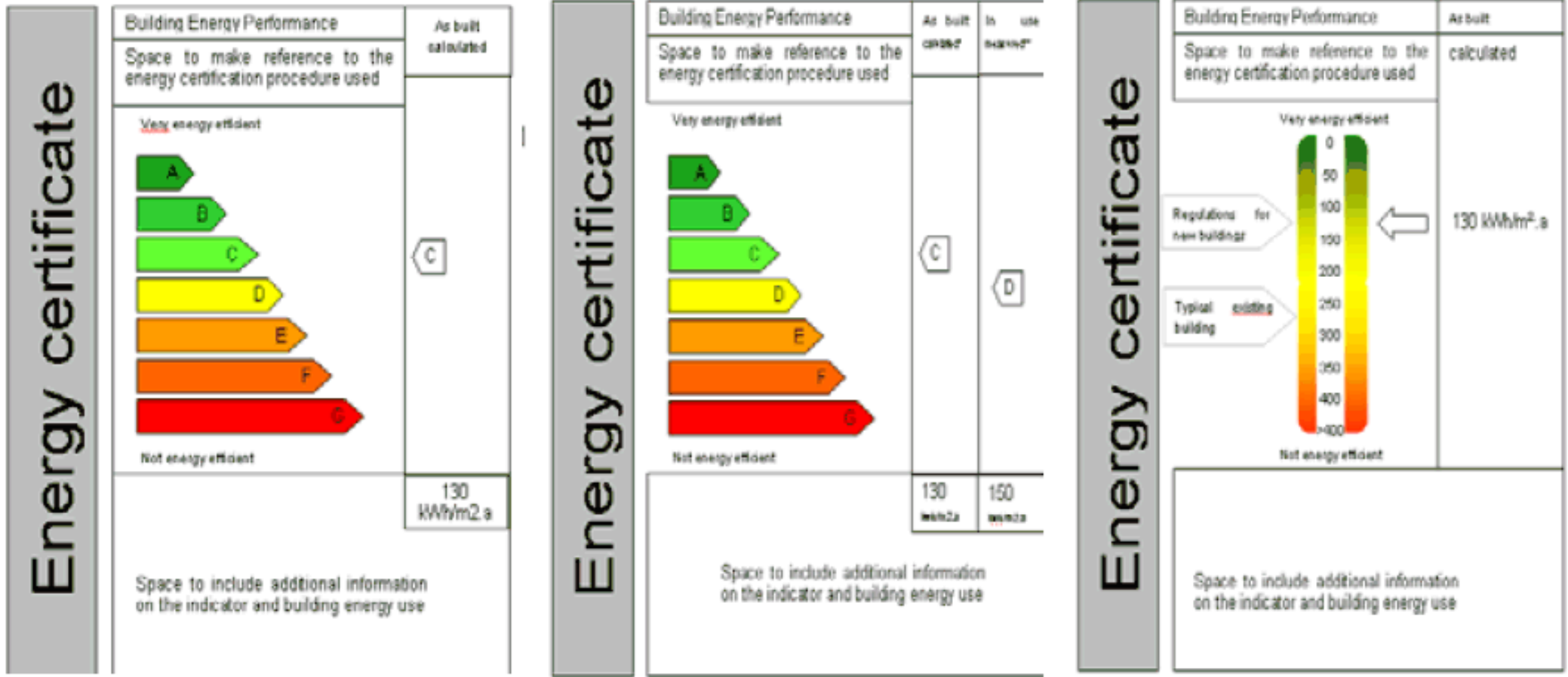
- 2. Minimum standards for all buildings
 - New buildings
 - Application of the minimum energy performance standards to:
 - New residential and tertiary sector buildings
 - Existing buildings
 - Application of minimum energy performance standards to existing buildings greater than 1,000 m² with larger 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)			ABCDEFG
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)

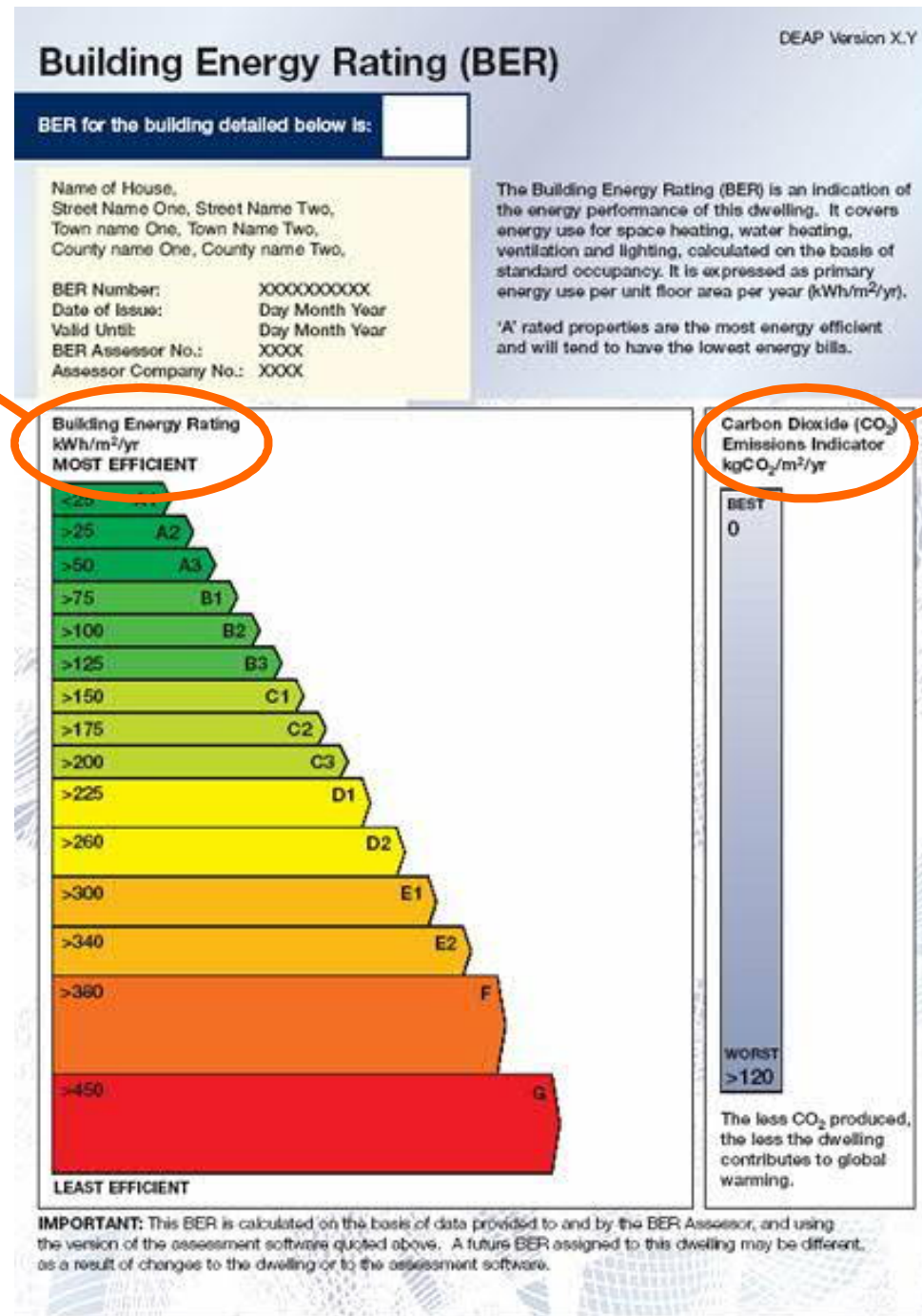
- ← Rating method & units
- ← Occupancy level
- ← Heating performance
- ← HVAC performance
- ← Lighting performance
- ← Management rating
- ← Internal environ. quality

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

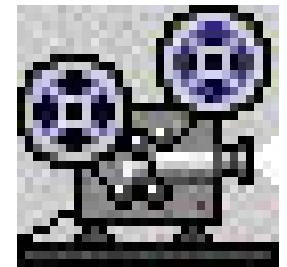


- EPBD recast (2010): key changes
 - Cost-optimal levels of minimum energy performance requirements for buildings and building elements
 - Eliminate the 1000 m² threshold for existing buildings
 - All new buildings to be nearly zero energy level by Dec 2020 (Dec 2018 for public authority buildings)
 - Require Member States to list financial incentives
 - Mandatory energy certification for all properties constructed, sold or rented out
 - Enhanced heating and cooling system inspections and reporting requirements
 - Require States to establish penalties for non-compliance

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



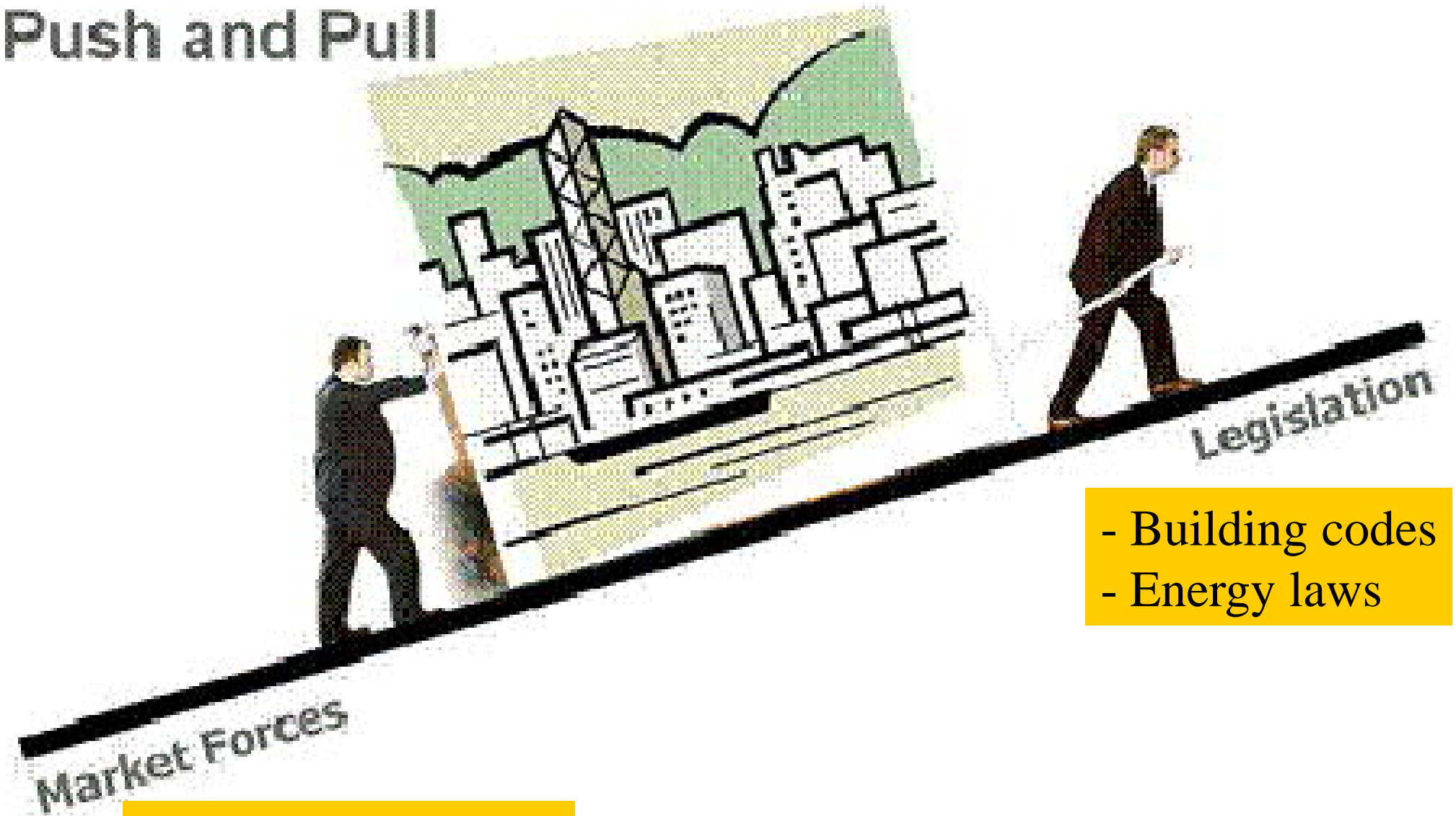


EU Directive on EPB

- **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

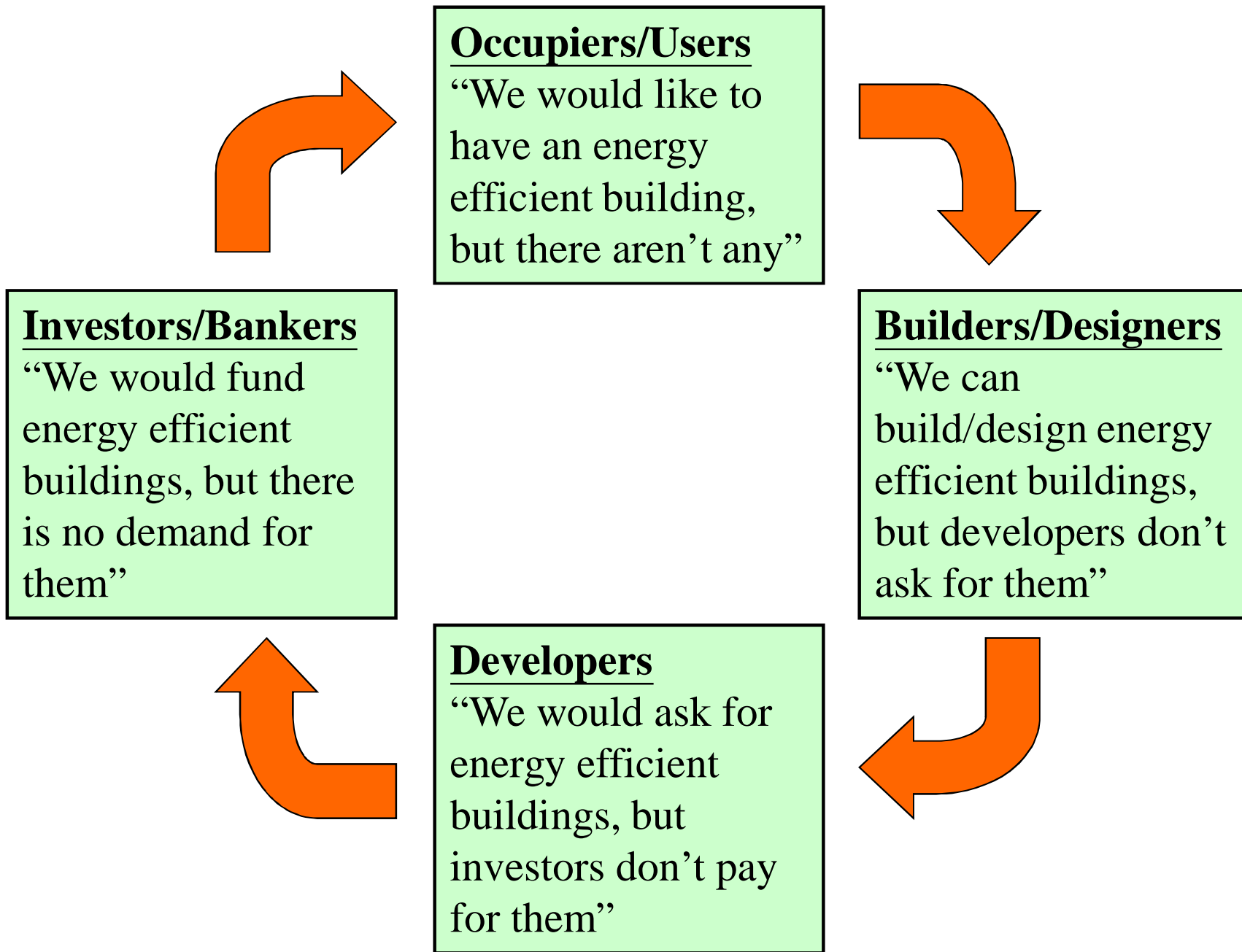
Strategy for promoting energy efficiency in buildings

Push and Pull

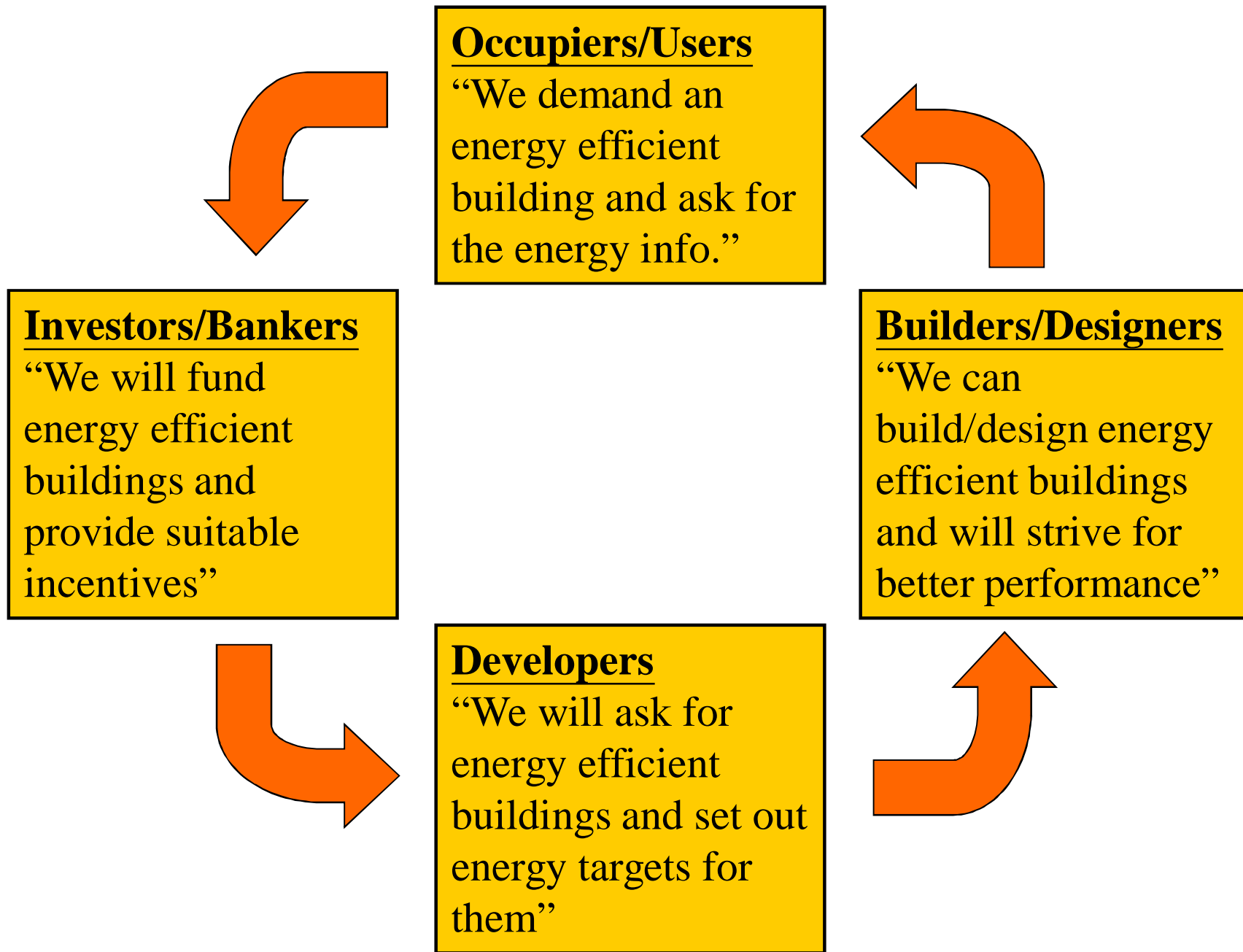


- Energy labels
- Voluntary schemes

- Building codes
- Energy laws



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



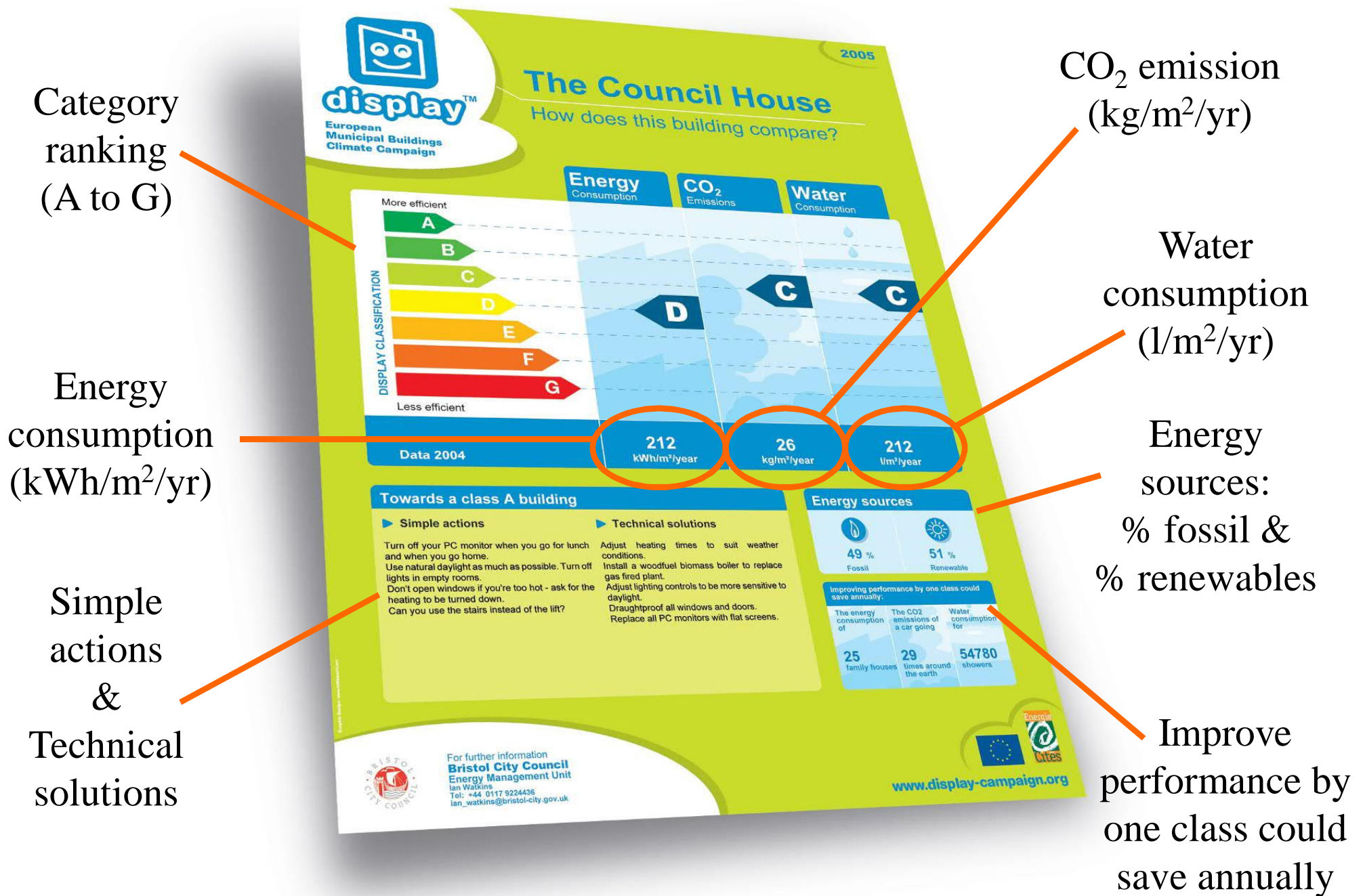
Reverse the viscous circle and overcome market barriers



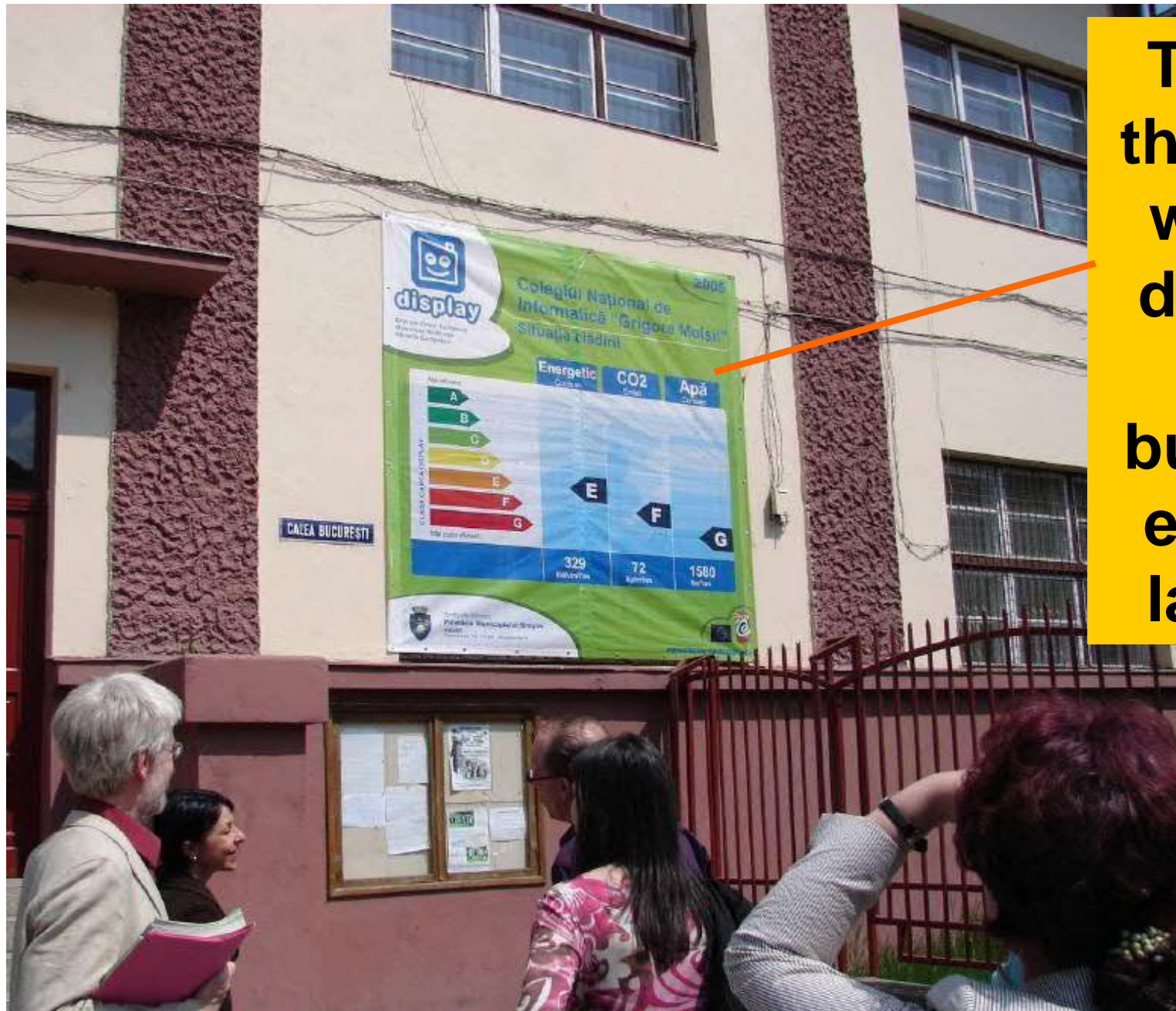
EU Directive on EPB

- **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



Display them in a prominent place



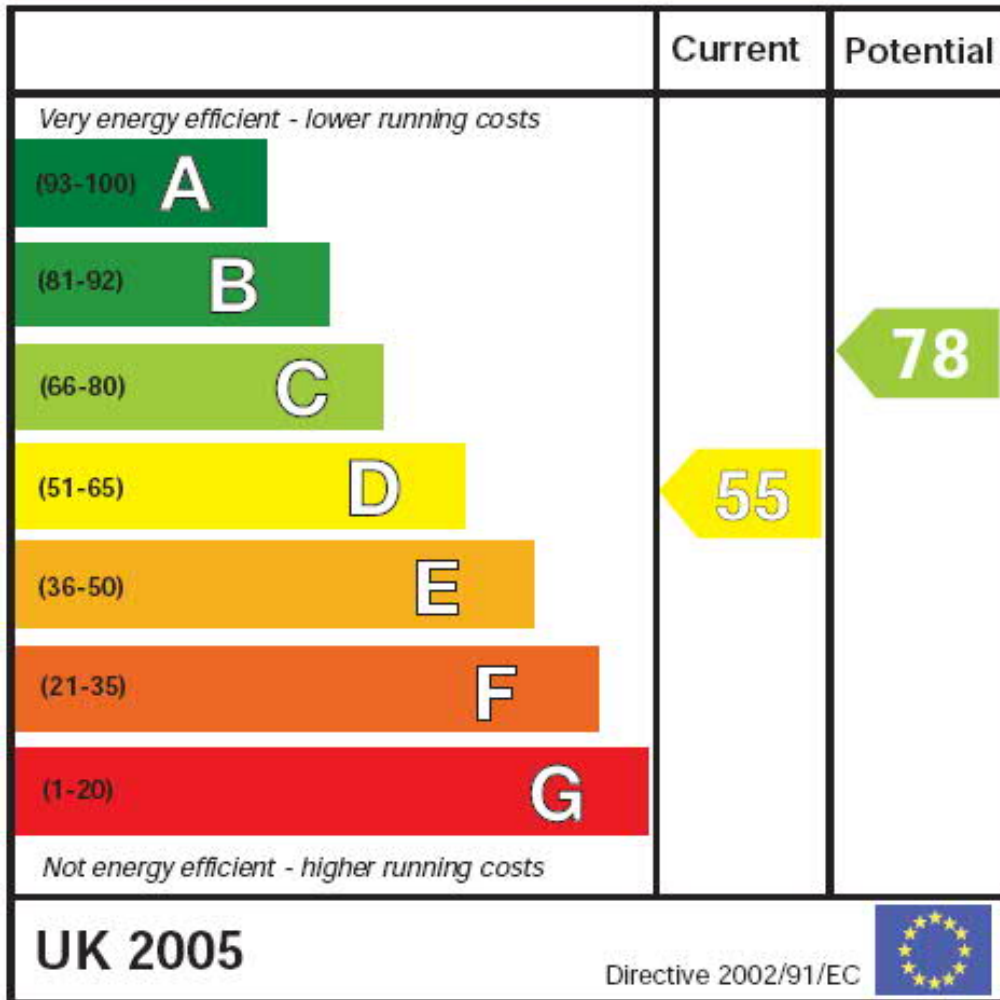
This is the right way to display the building energy label !!



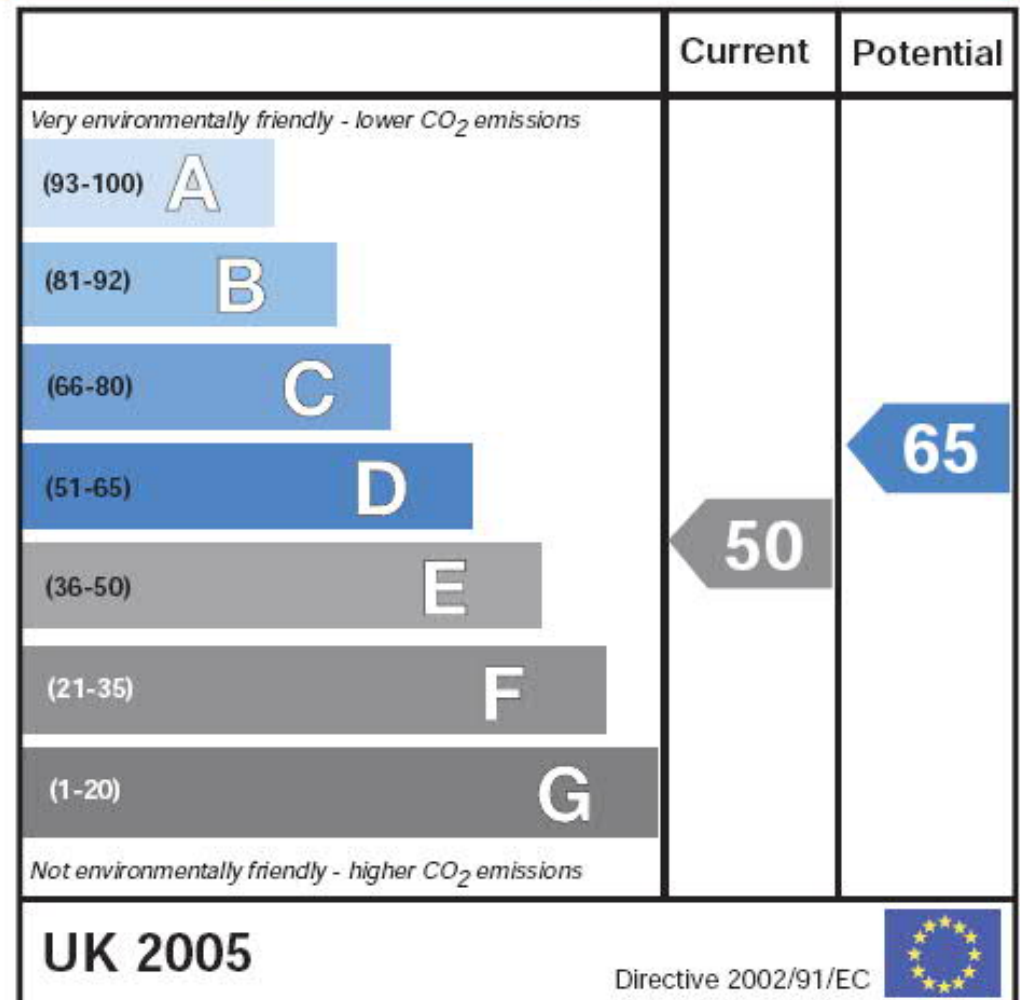
EU Directive on EPB

- 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. EBR nummer Reg. nr. Dato, start og afslutning

Adresse

Postnummer: By

Anvendelse: Areal Opvarmningstypen

Konsulentens bemærkning:

Opførelsesår: Konsulent nr.

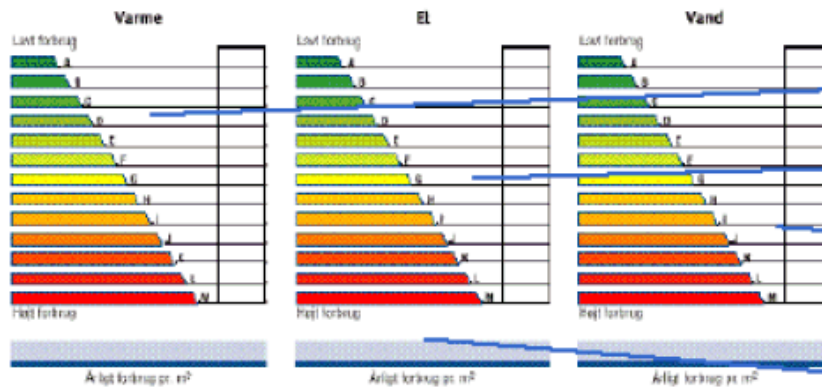
Date

Identification of building

Identification of consultant

Signature

Ejendommens registrerede årlige forbrug pr. m²



Labelling of Heating

Labelling of Electricity

Labelling of Water

Consumption pr. m²

Mærketegns på ekterne viser ejendommens registrerede varme-, el- og vandforbrug sammenlignet med forbrug i ejendomme med tilsvarende anvendelse og forbrug. Varmeforbruget er kilmekilogram.

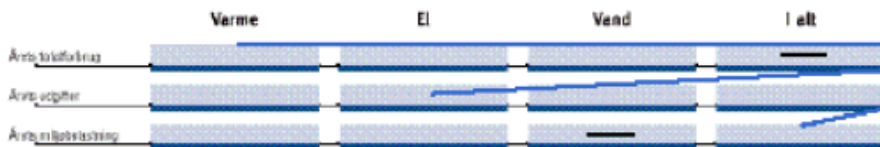
Energiforbrugets miljøbelastning pr. m²



Environmental Impact

Varme- og elforbrugets miljøbelastning udtrykkes ved den årlige CO₂-udledning. Mærketegnet på skælen viser ejendommens CO₂-udledning pr. m² sammenlignet med udledningen fra ejendomme med tilsvarende anvendelse. Varmeforbrugets bidrag er kilmekilogram.

Samlet forbrug og miljøbelastning



Consumption

Energimærketegnet er udarbejdet på grundlag af det registrerede forbrug. I ejendommens energipålys gives forbrug til hvidevarer, køleskab, tv, vind og varme belysningens forbrug og -plan er udarbejdet i henhold til lov om fremme af energi- og vandbesparelser i bygninger.



Energy certificate or label for buildings in Denmark

Implications for HK



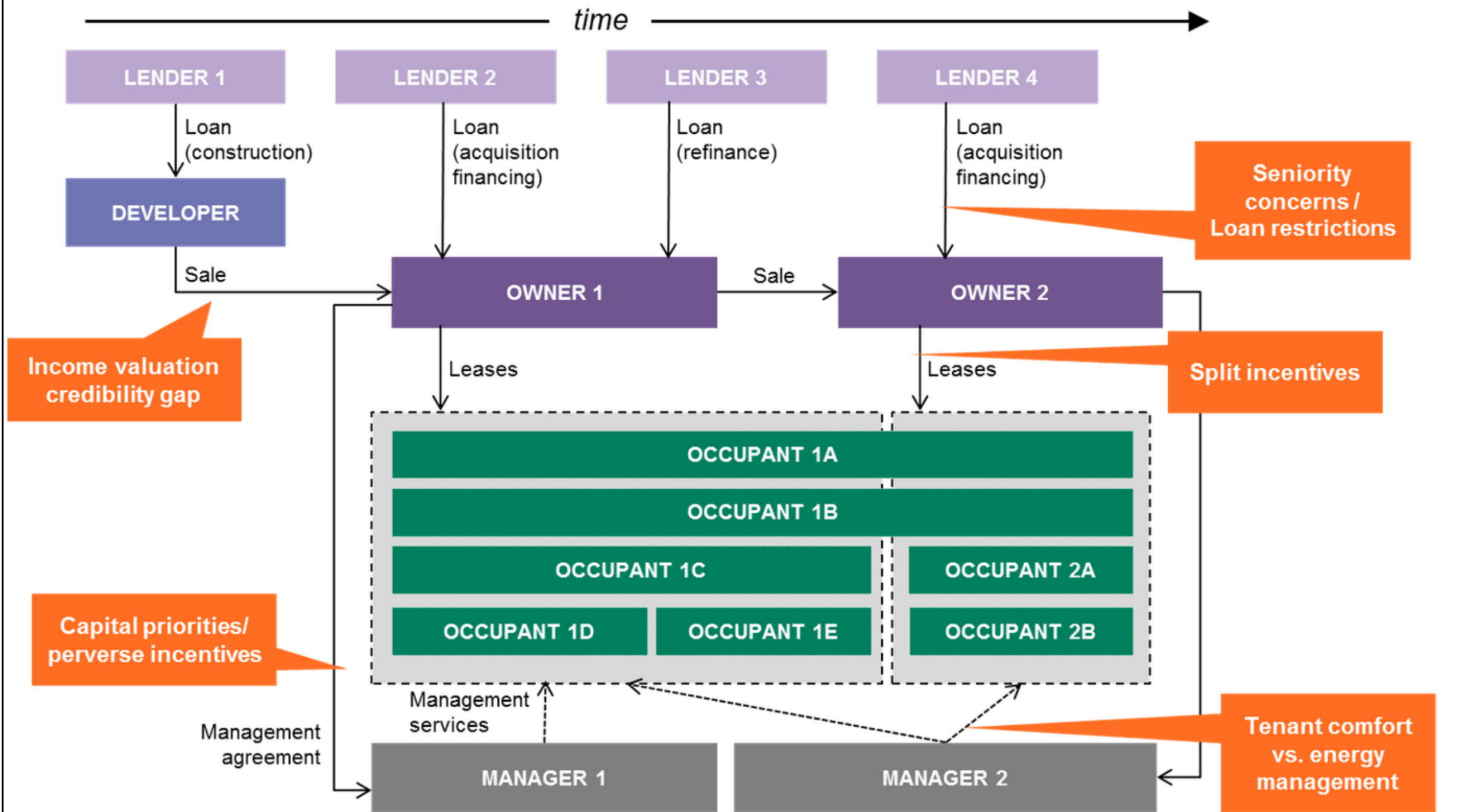
- Analysis of market factors
 - Lack of clear info. on bldg. energy performance
 - Market and institutional barriers
 - Developers are not interested in energy efficiency
 - Building owners/tenants pay for running costs
- The “*Push*” strategy: enhance information on building energy performance
 - Building energy labels, energy audits, awards
 - Policy to promote market forces and education

Implications for HK



- An interesting article for your study:
 - Why Energy Efficiency and Buildings Don't Mix
 - <http://www.consumerenergyreport.com/2012/09/20/why-energy-efficiency-and-buildings-dont-mix/>
 - 5 friction points:
 - Income valuation & credibility gap (developer-owner)
 - Seniority concerns/loan restrictions (owner-lender)
 - Split incentives (owner-occupant)
 - Capital priorities/perverse incentives (owner-manager)
 - Tenant comfort vs. energy management (occupant-manager)

Real estate industry interfaces and energy efficiency ‘friction points’



Source: Bloomberg New Energy Finance

Implications for HK



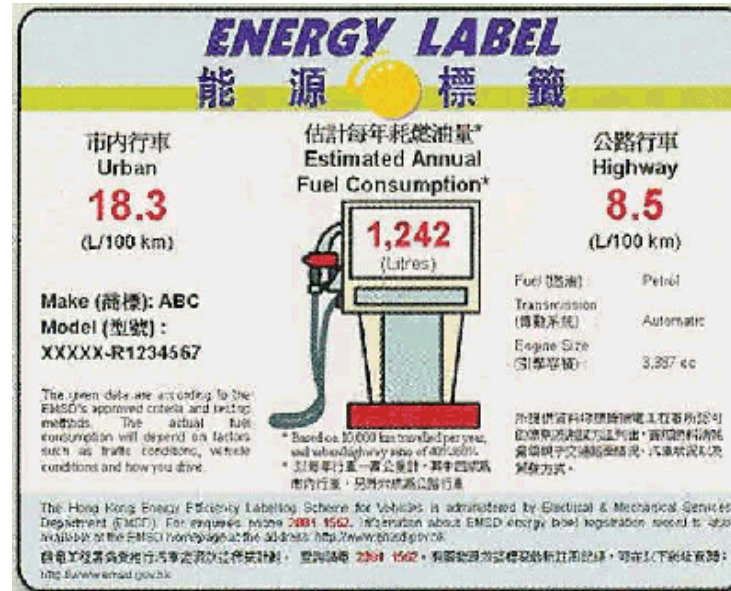
- Energy label & certification of buildings
 - For new buildings: specify energy performance baseline (allow people to know & compare)
 - For existing buildings: upgrade to meet the building energy codes (during retrofits)
- **Energy rating scheme** (grade A, B, C, D, E)
 - Possible links with mortgage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

Comparison of energy label methods

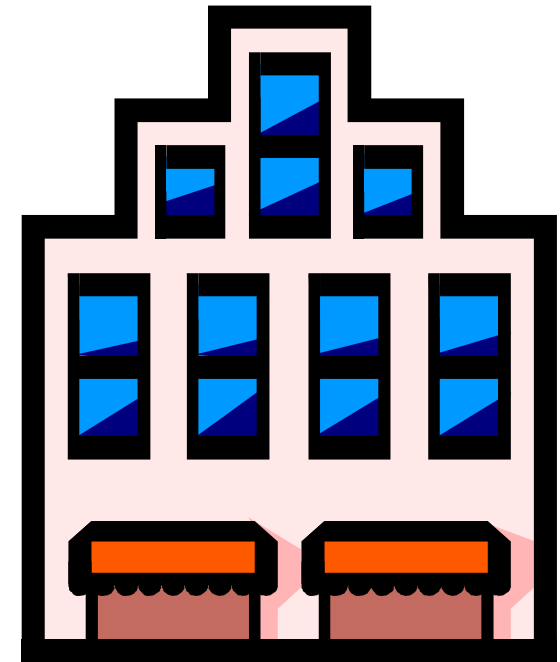
Energy label for appliance



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

- Buildings Energy Efficiency Ordinance (Cap 610)
 - www.beeo.emsd.gov.hk
 - Building Energy Code (BEC) and Energy Audit Code (EAC)
- CIBSE Briefing 6: The Energy Performance of Buildings Directive
- Policy Overview: EPBD (from EuroACE)
 - www.euroace.org/Resources/PolicyOverview/EnergyPerformanceofBuildingsDirective.aspx
- Why Energy Efficiency and Buildings Don't Mix
 - <http://www.consumerenergyreport.com/2012/09/20/why-energy-efficiency-and-buildings-dont-mix/>