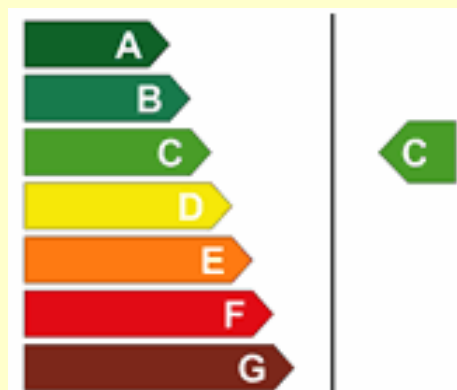
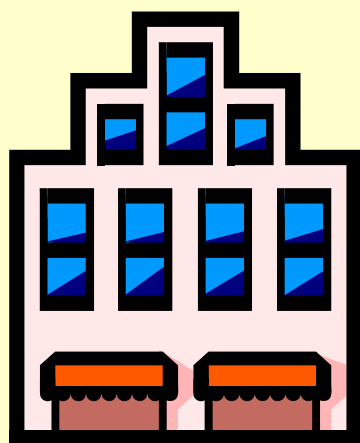


Asian Building Technologies 2008 / Asian Elenex 2008

Building Services Technical Seminars

4-5 June 2008



## Development of Building Energy Labels in Hong Kong



*Dr. Sam C M Hui*

Department of Mechanical Engineering

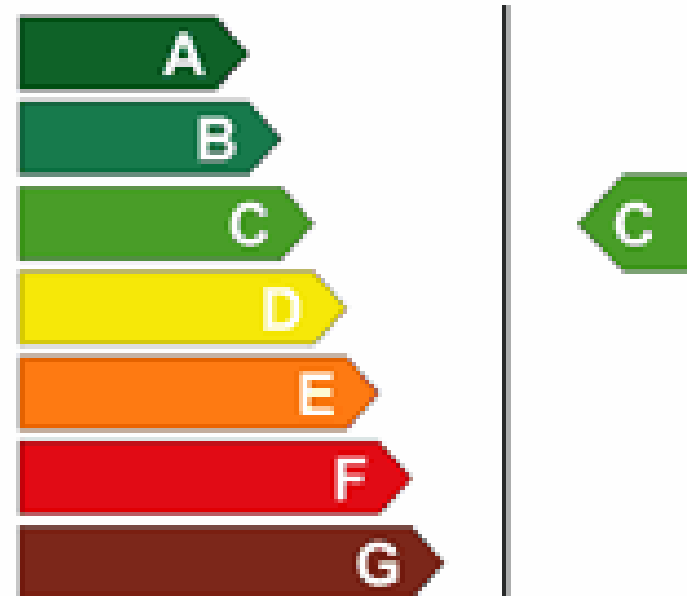
The University of Hong Kong

E-mail: [cmhui@hku.hk](mailto:cmhui@hku.hk)

# Contents



- Building Energy Use in HK
- Energy Efficiency Labels
- Experience in Europe
- Experience in USA
- Conclusions



# Building Energy Use in HK



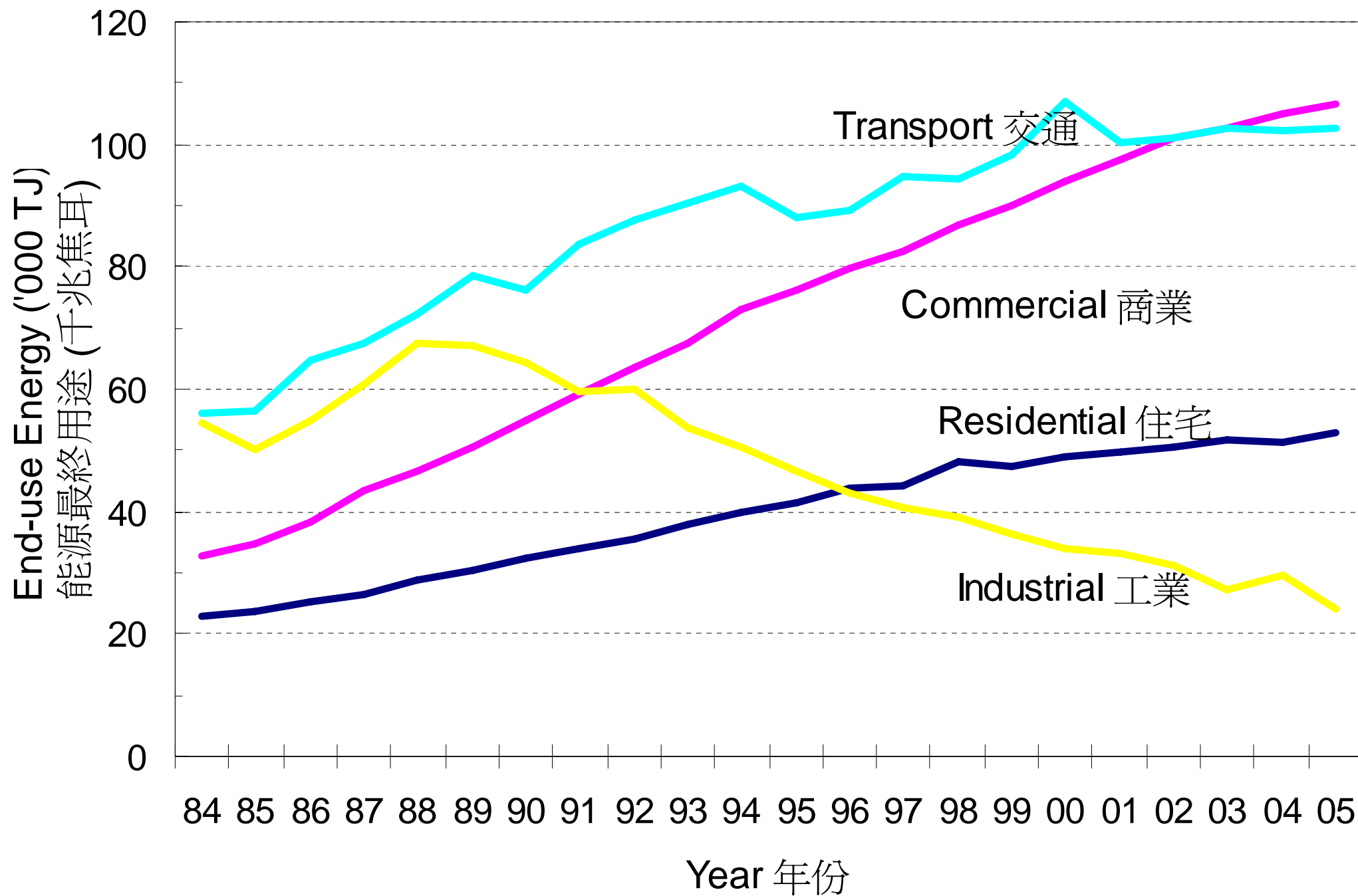
- **Energy** is important to every society
  - Economic, environmental & social impacts
  - It is also a key issue for *sustainable development*
- Use energy ...
  - Consume finite fossil fuels (oil, coal, natural gas)
  - Cause air pollution & environmental damage
  - Contribute to global warming
  - Cost money



# Building Energy Use in HK



- **Buildings** constitute 30-50% of energy needs
  - Residential + commercial + industrial
  - The potential for energy saving is large
- Possible benefits from energy efficiency:
  - Life-cycle cost savings
  - Reduced CO<sub>2</sub> emissions and consumption of fossil fuels
  - Improved building design and operation
  - Better working environments
  - Added market value of buildings
  - Reduced capital cost by better integration of building fabric and systems

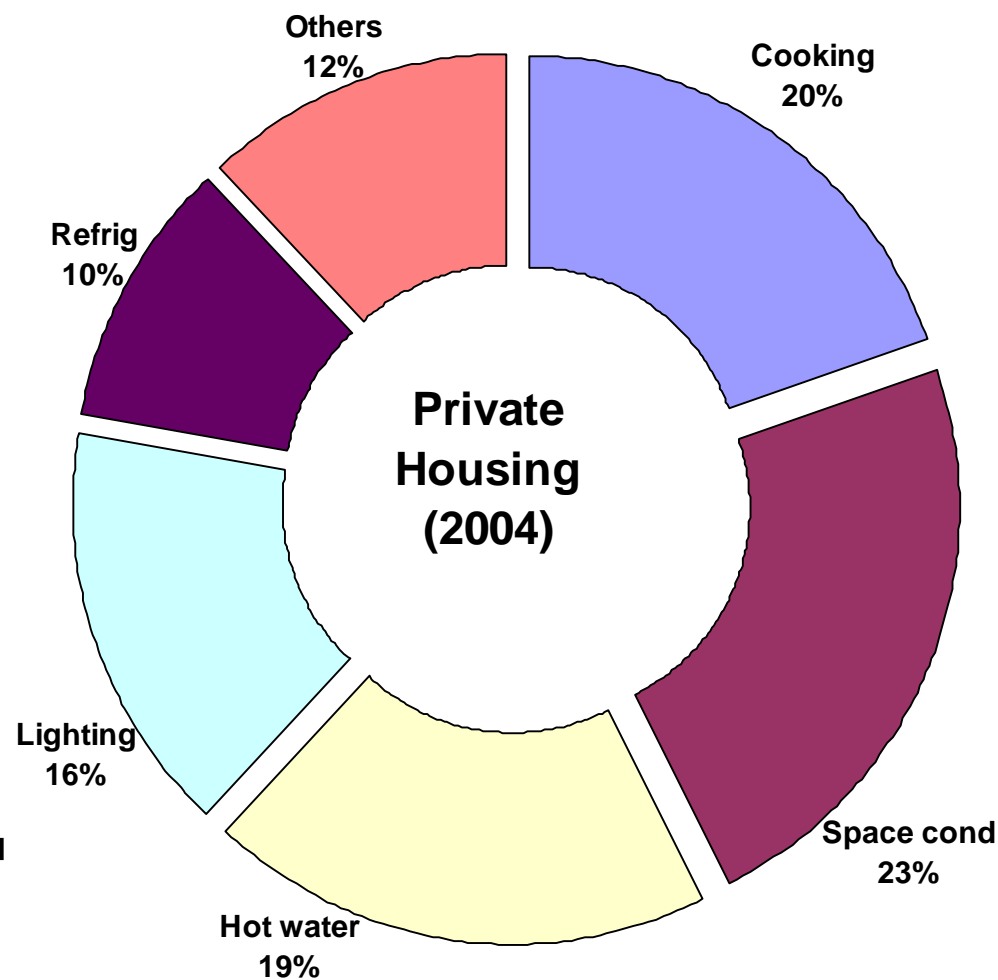
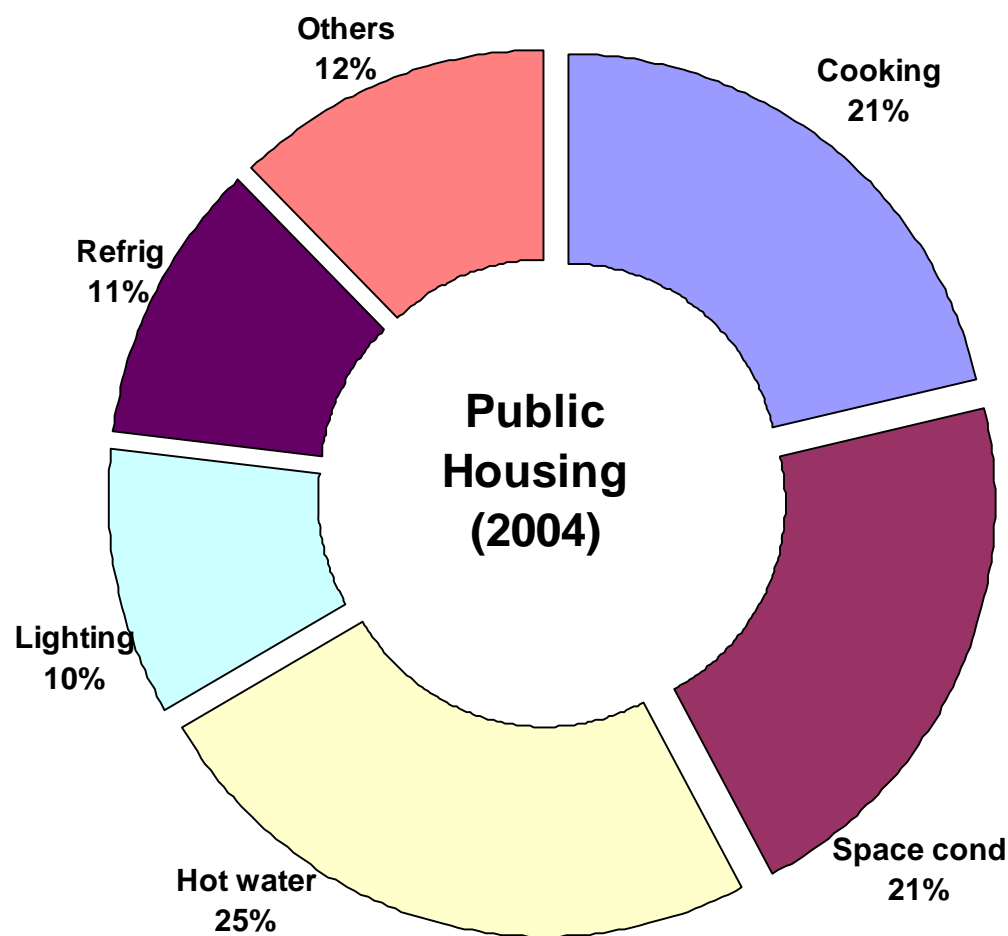


Energy end-use in Hong Kong by sectors, 1984-2005

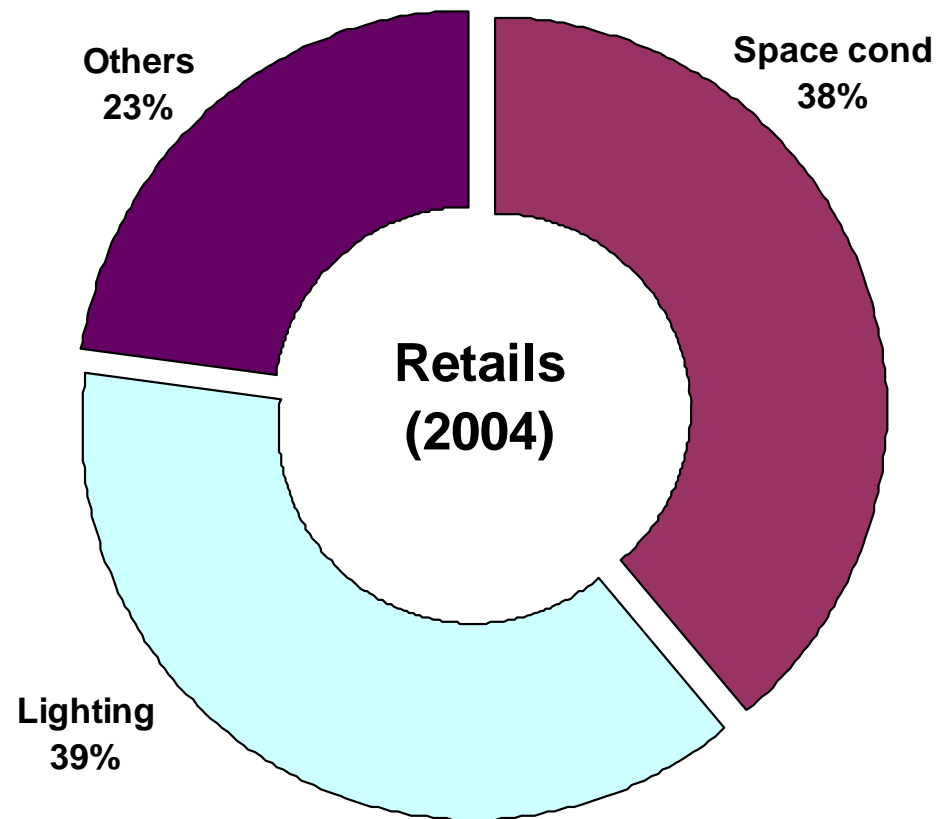
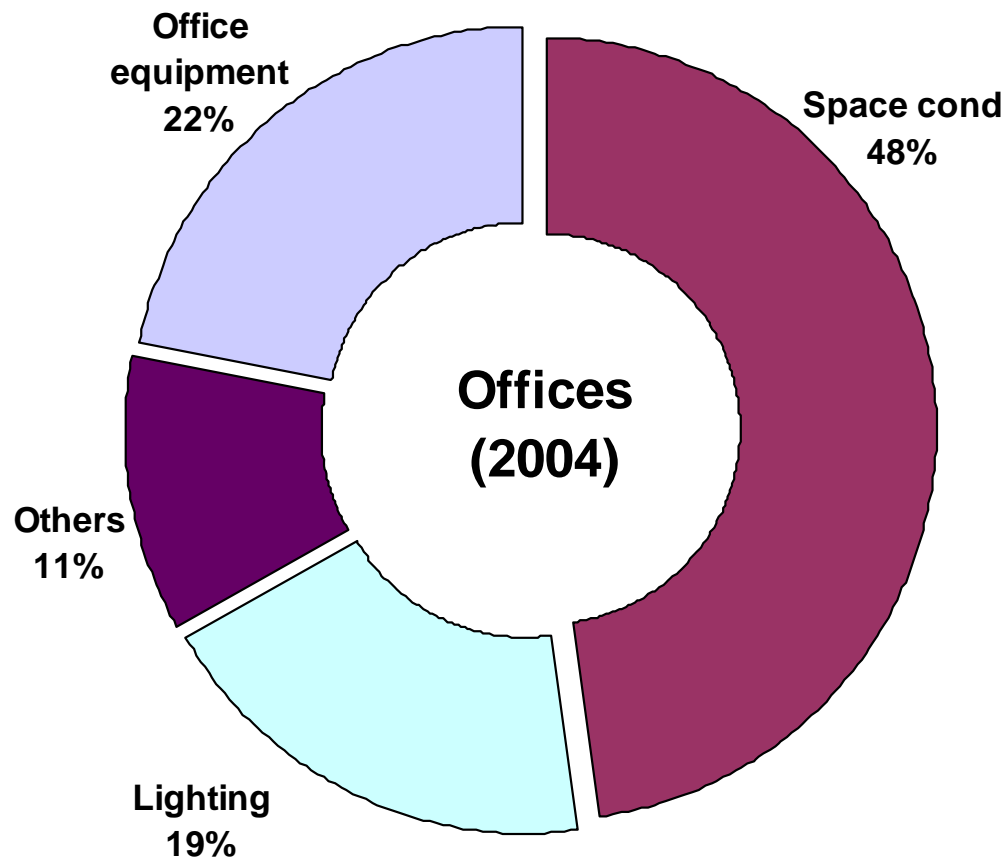
**Table 1 - Final energy requirements (FER)  
in Hong Kong (year 2005)**

Unit: MJ	Commercial	Residential	Industrial	Total
Electricity	93 724 (65%)	35 811 (25%)	14 636 (10%)	144 172 (100%)
Town gas	10 919 (40%)	15 444 (57%)	898 ( 3%)	27 261 (100%)
Elec. + town gas	104 643	51 255	15 534	171 433
% in total FER	31.5%	15.5%	4.7%	51.7%

(\* Source: *Hong Kong Energy Statistics 2005 Annual Report*)



Energy consumption patterns in residential buildings  
(Data source: Energy Efficiency Office, HK)



Energy consumption patterns in offices and retails  
(Data source: Energy Efficiency Office, HK)

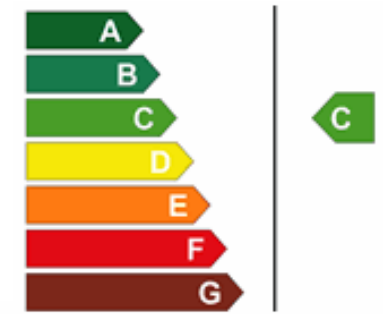


# Building Energy Use in HK



- Policy to promote building energy efficiency:  
HK building energy codes
  - Lighting
  - Air-conditioning
  - Electrical
  - Lifts & escalators
  - Performance-based code
- Put under the Hong Kong Energy Efficient Building Registration Scheme (voluntary)





# Energy Efficiency Labels

- **Energy efficiency labels**
  - *Informative* labels to describe the energy performance of a product or system
    - Indicate energy use, efficiency, or energy cost
  - Commonly used for appliances and equipment
    - Give consumers the data necessary to make *informed* purchases or decisions
  - Two types of labels:
    - Grading-type (comparative)
    - Recognition-type (endorsement)



# Examples of energy efficiency labels in Hong Kong

Energy label  
for appliance  
(grading-type)

Energy label  
for appliance  
(recognition-type)

Energy label for  
passenger car

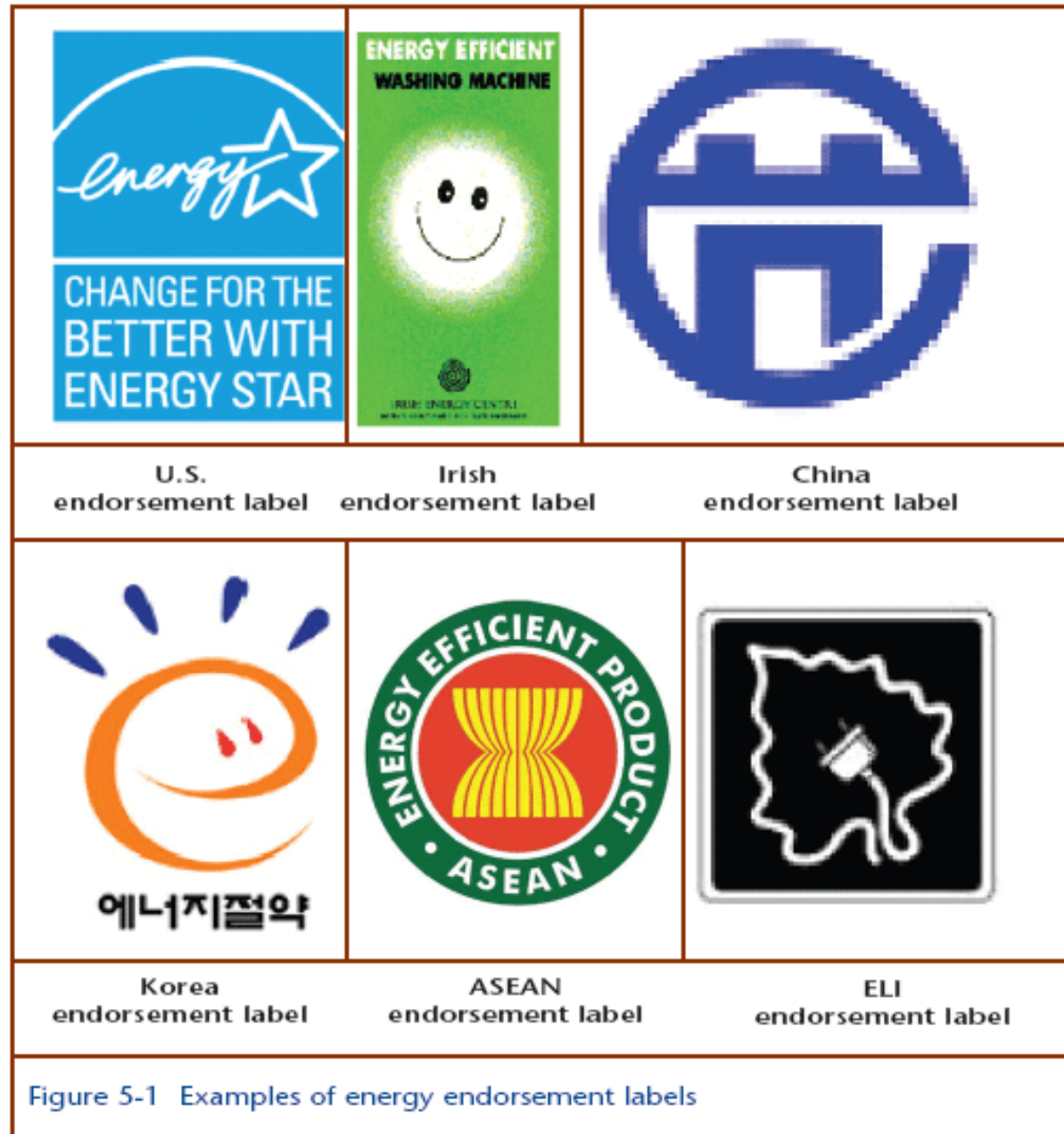
<b>ENERGY LABEL</b> <b>能源標籤</b>		
<b>Brand 牌子</b>	ABC 某某牌	
<b>Model 型號</b>	HK1234	
<b>Annual Energy Consumption* kWh/yr</b> <b>每年耗電量 單位: kWh</b> <small>Actual consumption depends on where the appliance is located and how it is used. Based on 1000-hour* operation.</small> 實際耗電量會根據安裝位置及用法而變。圖則顯示平均耗電量 1000小時。	<b>1000</b>	
<b>Energy Efficiency Grade*</b> <b>能源效率級別</b> <small>Among the five grades, Grade 1 is the most energy efficient.</small> <small>在效率級別中，第一級最為節能。</small>	<b>1</b>	
<b>Room Cooler Category*</b>	冷氣機類別	1
<b>Cooling Capacity (kW)</b>	製冷量	2.5
<b>Refrigerant</b>	製冷劑	HFC 123
<b>EEL Registration Number</b> 能源標籤登記號碼	C 96-0001	
<small>* The data are provided according to the Hong Kong Energy Efficiency Labelling Scheme for Room Coolers administered by the Electrical and Mechanical Services Department (EMSD), Government of the Hong Kong Special Administrative Region. The registration record can be found at the EMSD website at <a href="http://www.emsd.gov.hk">www.emsd.gov.hk</a>.</small> <small>圖則數據是根據由香港政府電機工程處(EMSD)管理的香港能源效率標籤計劃提供的。登記記錄可在電機工程處網頁 <a href="http://www.emsd.gov.hk">www.emsd.gov.hk</a> 查閱。</small>		



<b>ENERGY LABEL</b> <b>能源標籤</b>		
<b>市內行車</b> <b>Urban</b> <b>18.3</b> (L/100 km)	<b>估計每年耗燃油量*</b> <b>Estimated Annual Fuel Consumption*</b> <b>1,242</b> (Litres)	<b>公路行車</b> <b>Highway</b> <b>8.5</b> (L/100 km)
<b>Make (商標): ABC</b> <b>Model (型號): XXXXX-R1234567</b>		
<b>Fuel (燃油): Petrol</b> <b>Transmission (傳動系統): Automatic</b> <b>Engine Size (引擎容量): 3,957 cc</b>		
<small>The open data are according to the EMSD's approved criteria and testing methods. The actual fuel consumption will depend on factors such as traffic conditions, vehicle conditions and how you drive.</small> <small>* Based on 10,000 km travelled per year, and when driving at 90 km/h.</small> <small>* 以每年行車一萬公里計算，其中四成為市內行車，另六成為公路行車。</small>		
<small>The Hong Kong Energy Efficiency Labelling Scheme for Vehicles is administered by Electrical &amp; Mechanical Services Department (EMSD). For requests, please call 2361 1562. Information about EMSD energy label registration, need to be available at the EMSD homepage at <a href="http://www.emsd.gov.hk">http://www.emsd.gov.hk</a>.</small> <small>香港能源效率標籤計劃由電機工程處(EMSD)管理。查詢詳情，請電 2361 1562。有關能源效率標籤登記計劃詳情，可在以下網址查詢：<a href="http://www.emsd.gov.hk">http://www.emsd.gov.hk</a></small>		

# Examples of energy efficiency labels in the world (endorsement)

Endorsement labels provide a government stamp of approval.



# Examples of energy efficiency labels in the world (comparative)

Comparison labels use either categories or a continuous scale.

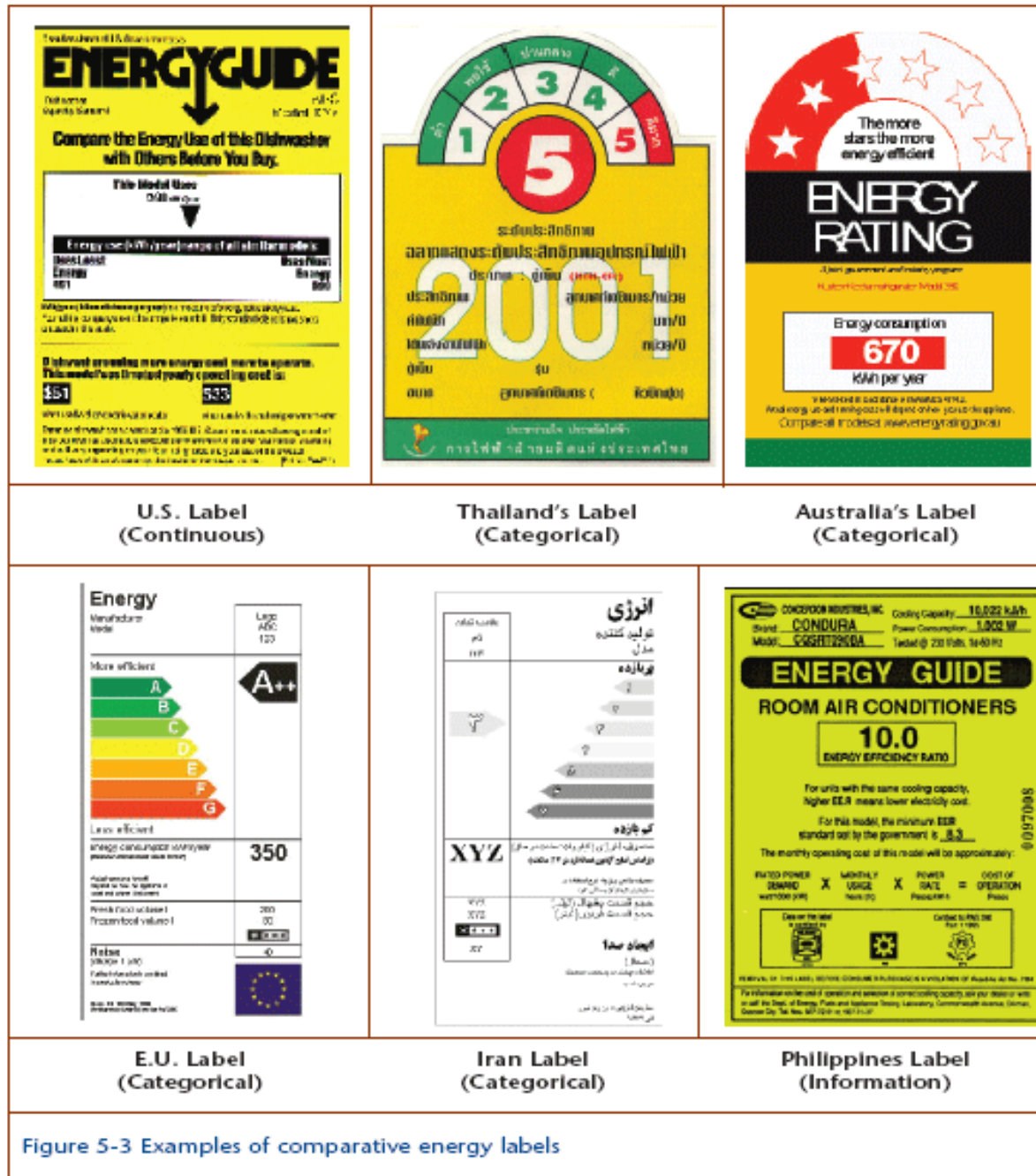
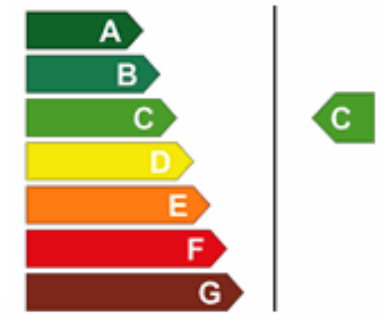


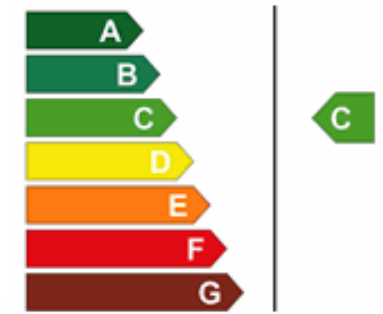
Figure 5-3 Examples of comparative energy labels



# Energy Efficiency Labels

- Energy labels can stand alone or complement energy codes or standards
- Major market impacts of energy labels:
  - Influence consumers to compare and choose more efficient products
  - Create competition among manufacturers and suppliers to market energy-efficient models
  - Provide a common benchmark for utility companies and government to design incentive programmes and policies





# Energy Efficiency Labels

- The effectiveness of energy labels is heavily dependent on:
  - How they present information to the consumer
    - Understand the information that labels communicate
  - How they are supported by:
    - Information campaigns
    - Financial incentives
    - Other related programmes
  - Whether it is voluntary or mandatory

# Energy labels as the tip of the iceberg

The energy label is just the tip of the program iceberg.

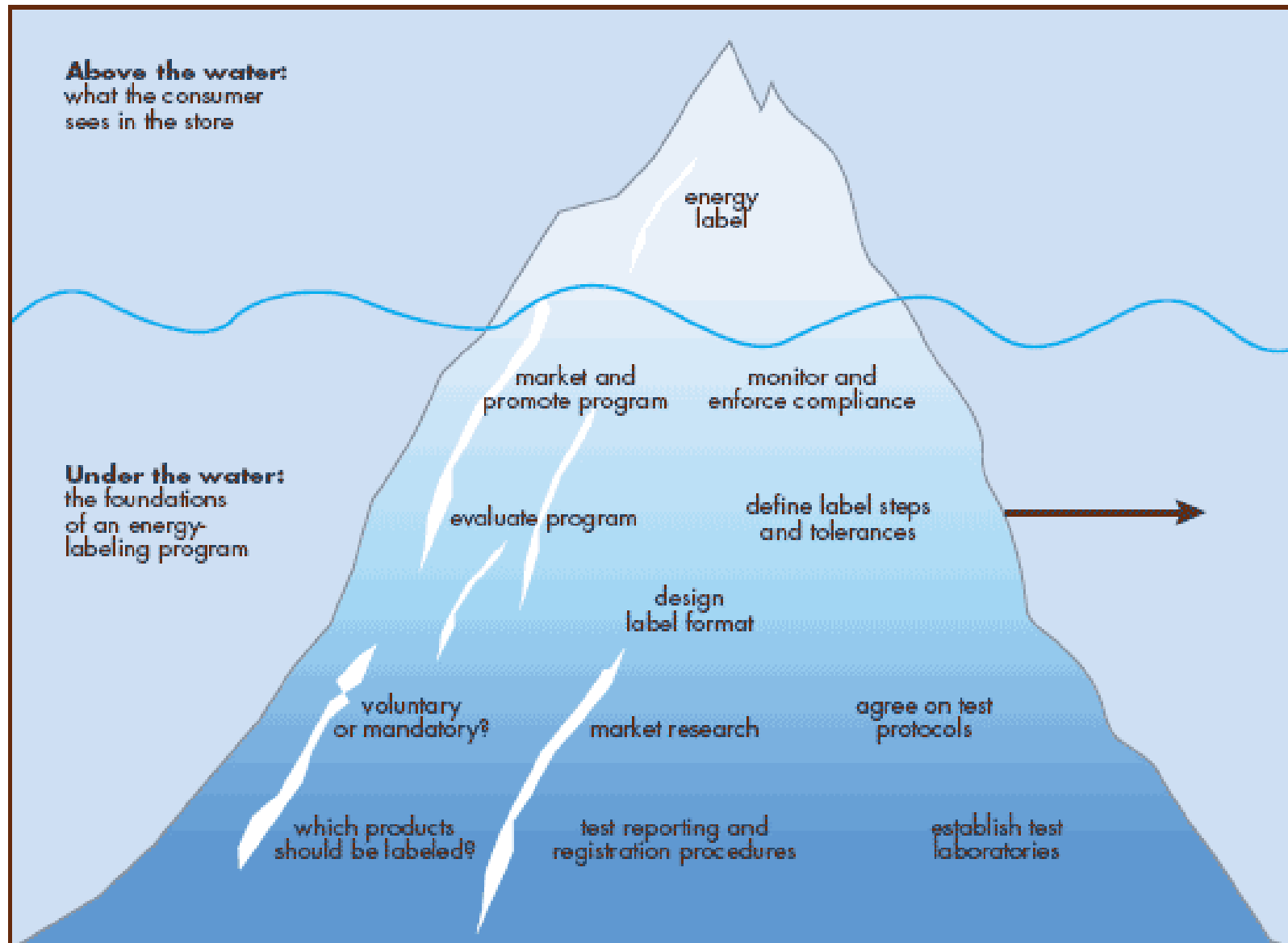
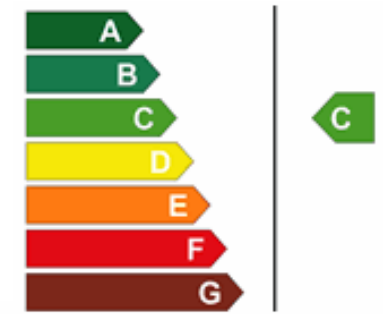


Figure 5-5 The "Iceberg" of energy labeling



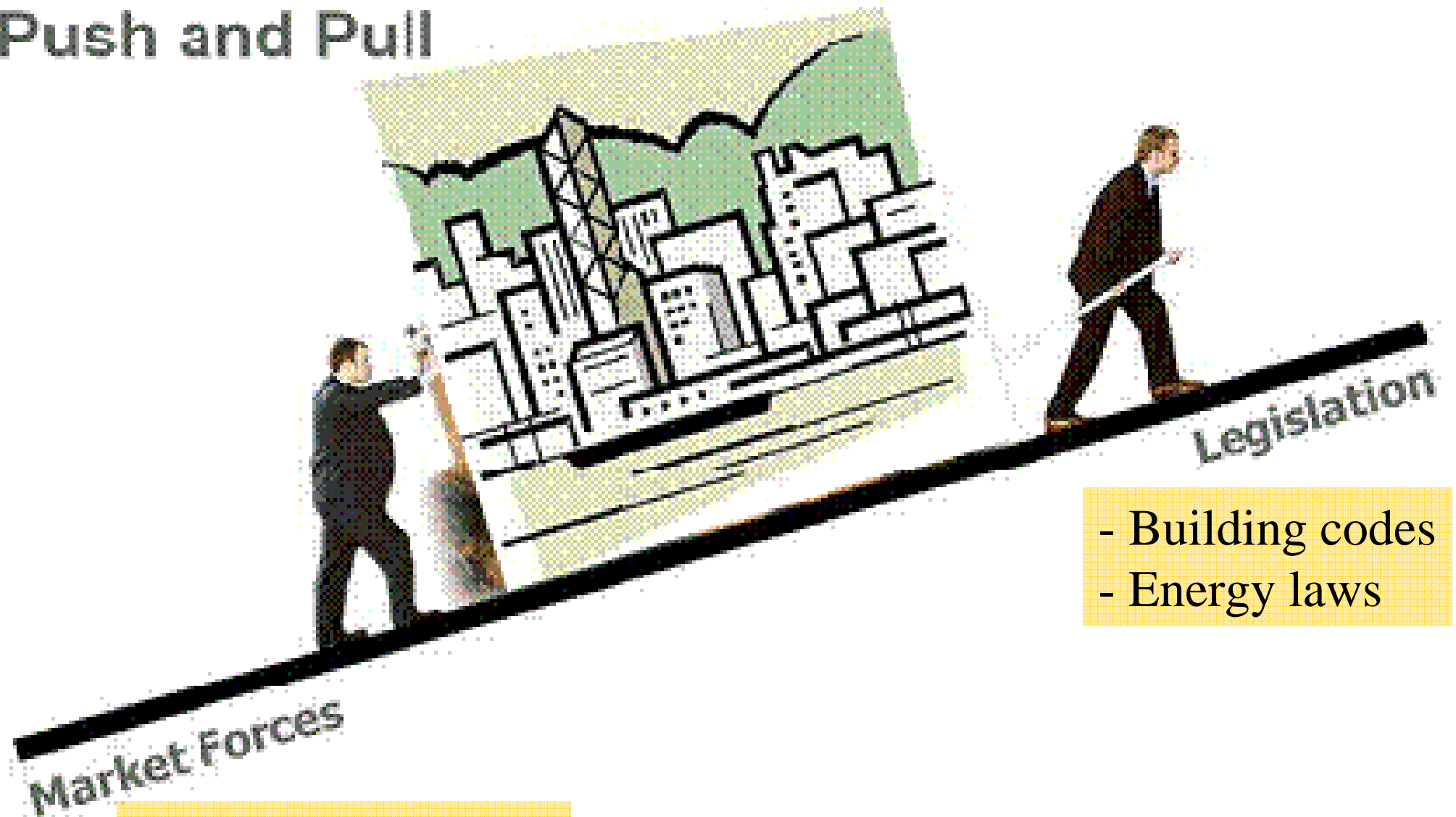


# Energy Efficiency Labels

- Building energy labels
  - More complicated than appliances or equipment
  - Must be considered in a holistic way
- Current problems and limitations
  - Low energy awareness of building owners & users
  - Not easy to define building energy performance
  - Lack of good info. & data on building energy use
  - Market and institutional barriers

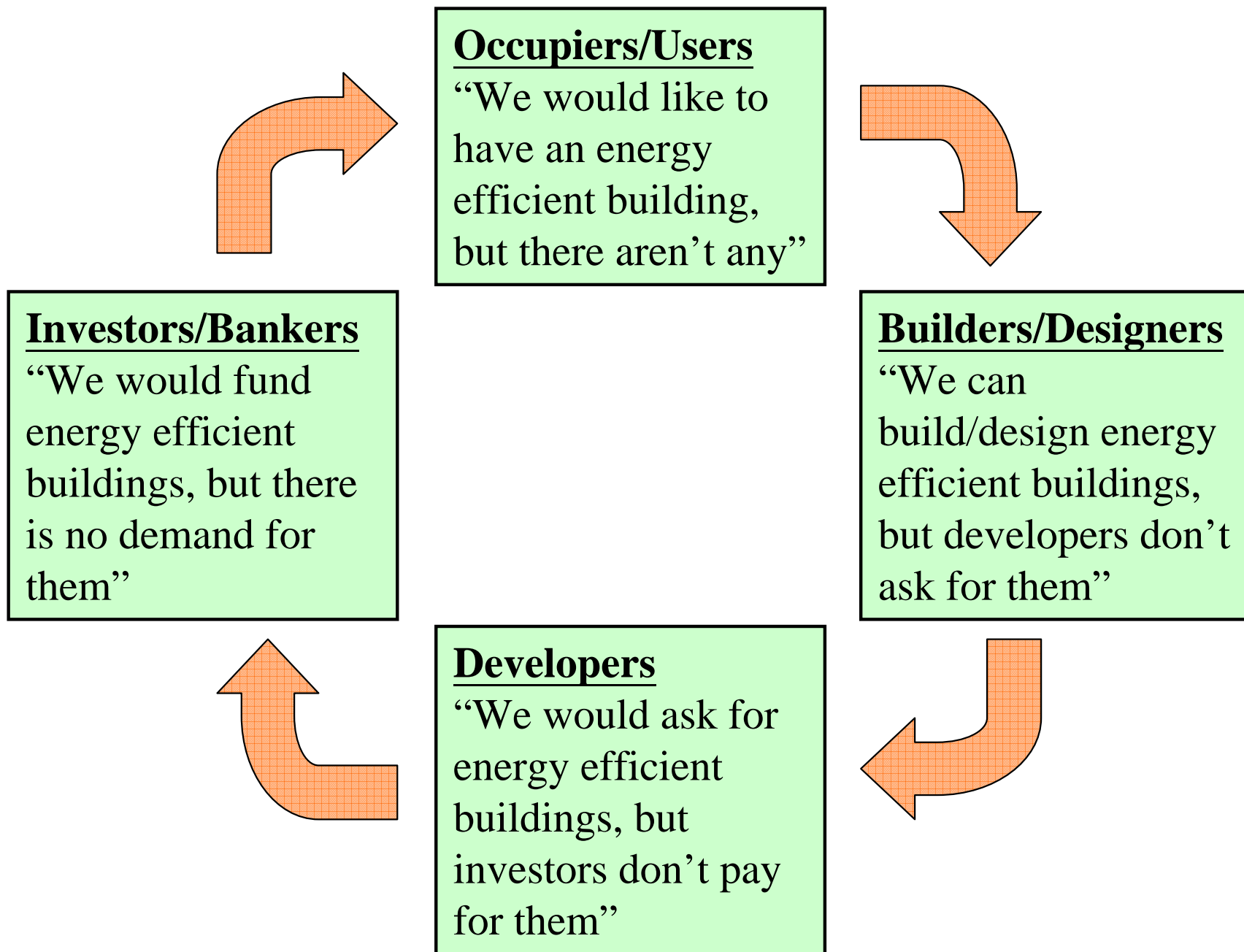
# Strategy for promoting energy efficiency in buildings

## Push and Pull



- Energy labels
- Voluntary schemes

- Building codes
- Energy laws



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



# Experience in Europe

- European Commission's Action Plan on Energy Efficiency (2000) proposed the *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
- EU countries must develop suitable energy rating systems and certification schemes by 2009



# Experience in Europe

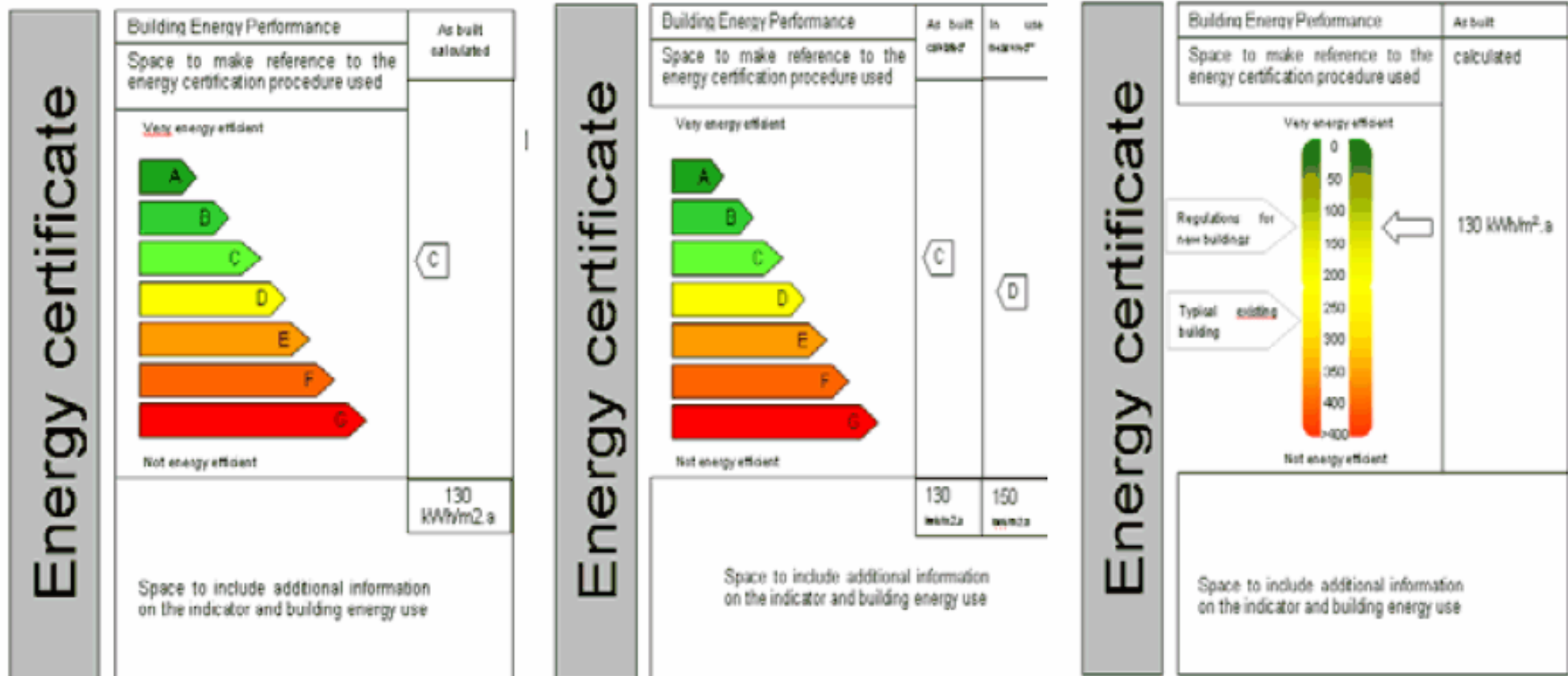
- Certification schemes for all buildings
  - To facilitate the transfer of clear and reliable *information* on energy performance of buildings
  - To make energy efficiency more attractive
- Energy performance certificates for new and existing buildings should be available when they are constructed, sold or rented out
  - Improve awareness & information
  - Increase investments in energy efficiency measures among the stakeholders



# Experience in Europe

- **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


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		
Very energy efficient			
A		B	D
B			
C			
D			
E			
F			
G			
Not energy efficient			
Asset rating method: UK National Standard 2004		Calculated	Actual
Operational rating method: UK Office Tailored Benchmarks 2002		48	83
Units used: kg CO <sub>2</sub> per sq m of net area per annum >		14	12
Occupancy level Square metres net lettable area per person		12	12
Equipment heat gain level Watts per square metre net		55	58
Weekly occupancy hours Hours per week		AB CDEFG	AB CDEFG
Heating performance ratings		AB CDEFG	AB CDEFG
HVAC performance ratings (cooling, fans and pumps)		AB CDEFG	AB CDEFG
Lighting performance ratings		AB CDEFG	AB CDEFG
Management rating (for in-use performance only)			AB CDEFG
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: [www.eplabel.org](http://www.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

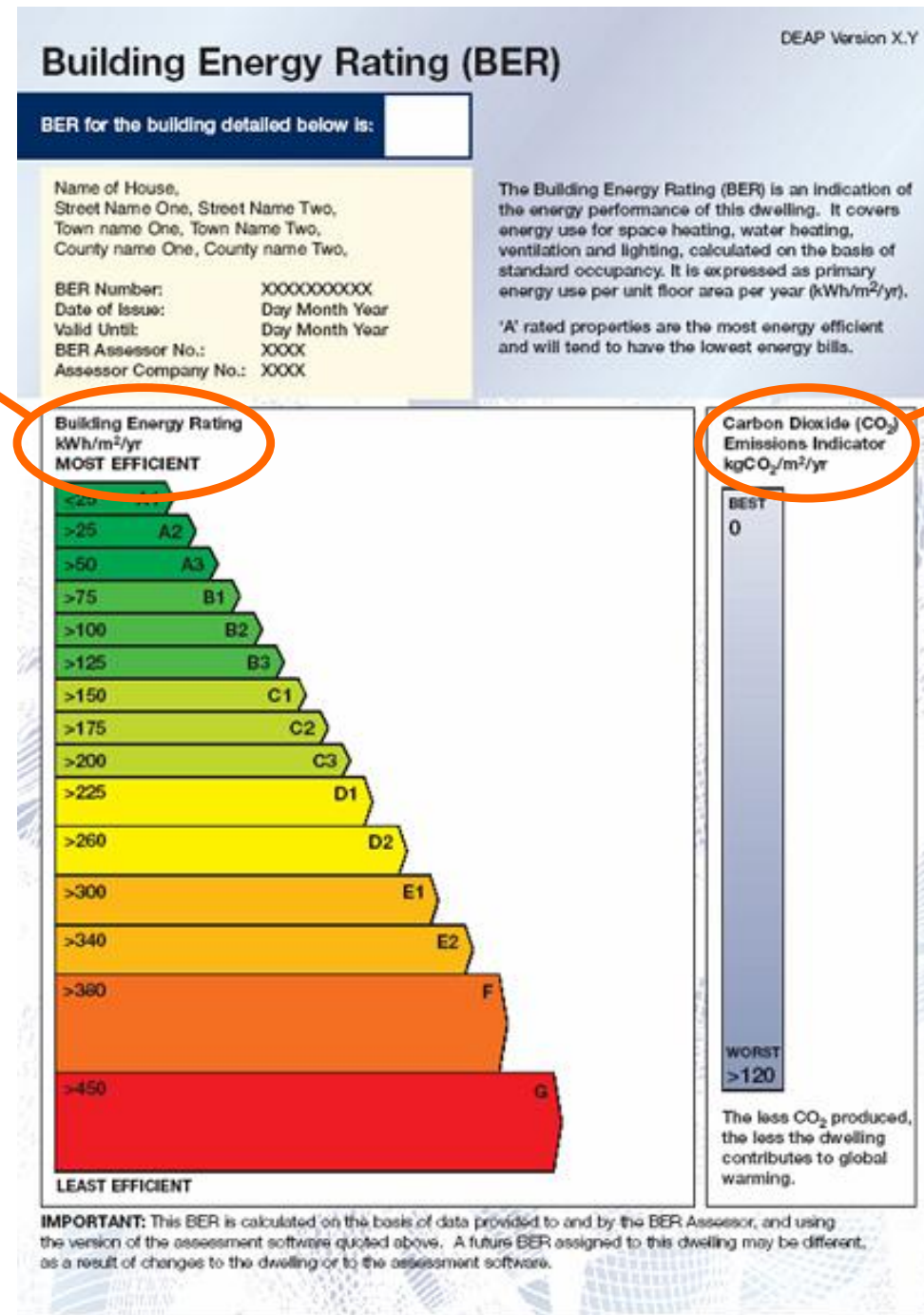
Building name  
Organisation  
Street  
City  
Contact  
Tel  
email



# Example of building energy rating (Ireland)

Building  
energy rating  
(kWh/m<sup>2</sup>/yr)

CO<sub>2</sub> emission  
indicator  
(kgCO<sub>2</sub>/m<sup>2</sup>/yr)



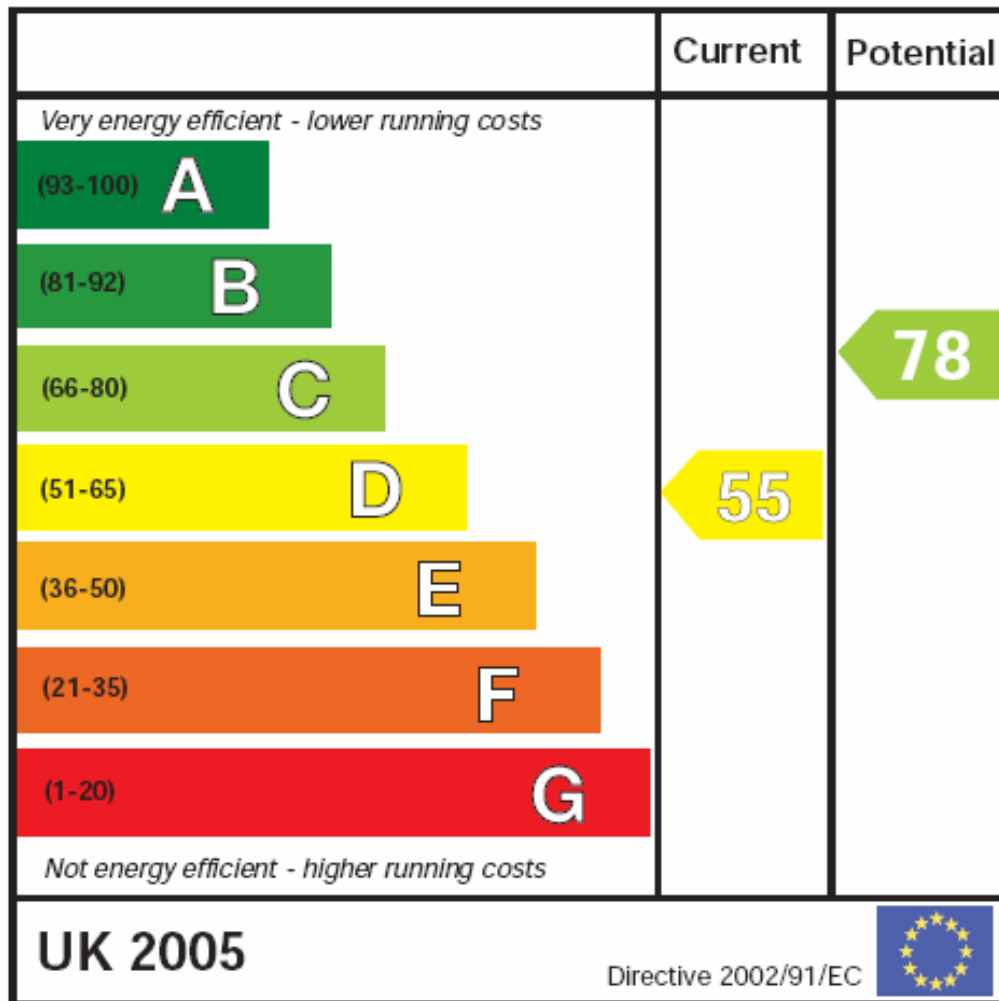
(source: Sustainable Energy Ireland, [www.sei.ie](http://www.sei.ie))



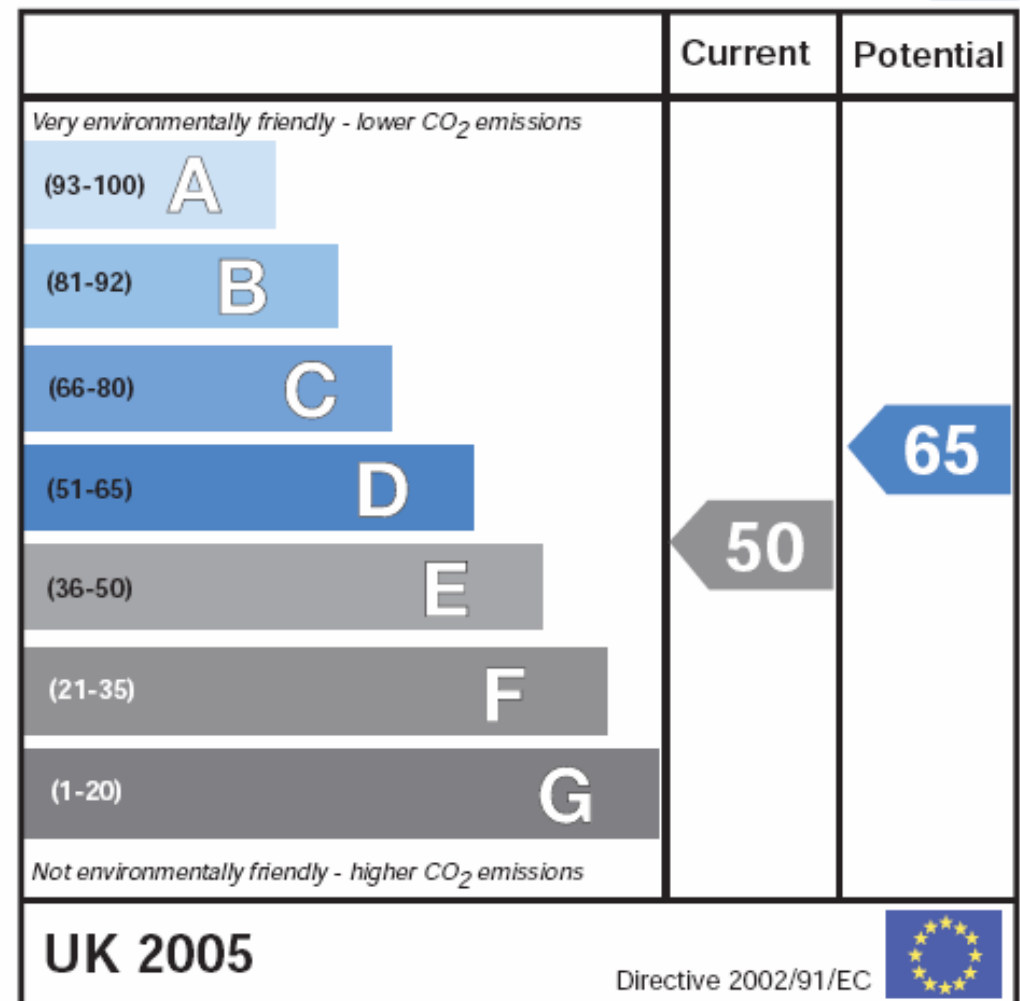
# Experience in Europe

- 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 CO<sub>2</sub> emissions
- Future trends: links with mortgage, rates & tenancy agreement (\$\$ incentives)

## 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



Markenr.: \_\_\_\_\_ EBR-nummer: \_\_\_\_\_ Regio: \_\_\_\_\_ Dato, udstedt og udsendt af:

Adresse: \_\_\_\_\_

Postnummer: \_\_\_\_\_ By: \_\_\_\_\_

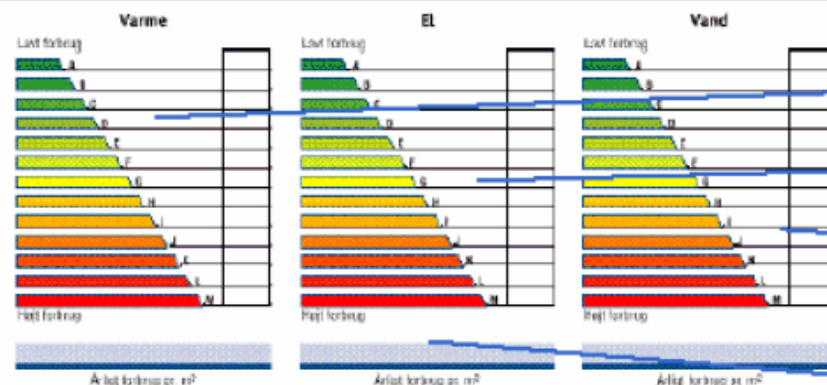
Ansøgelse: \_\_\_\_\_ Ansøgt: \_\_\_\_\_ Opsamlingsår: \_\_\_\_\_

Konsulentens bemærkning: \_\_\_\_\_

\_\_\_\_\_

Konsulent nr.: \_\_\_\_\_

## Ejendommens registrerede årlige forbrug pr. m<sup>2</sup>



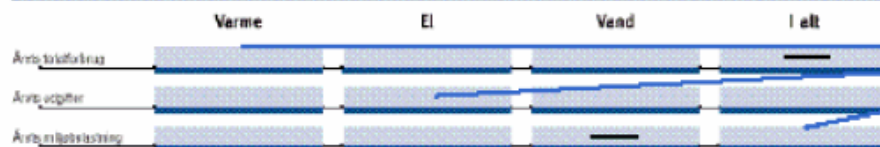
Markeringen på ejendommen viser ejendommens registrerede varme-, el- og vandforbrug sammenlignet med forbruget i ejendomme med tilsvarende areal og bygningstype. Varmeforbruget er korrigeret.

## Energiforbrugets miljøbelastning pr. m<sup>2</sup>



Varme- og elforbrugets miljøbelastning er beregnet ved den årlige CO<sub>2</sub>-udledning. Markeringen på skålen viser ejendommens CO<sub>2</sub>-udledning pr. m<sup>2</sup> sammenlignet med udfordringen fra ejendomme med tilsvarende areal og bygningstype. Varmeforbrugets bidrag er korrigeret.

## Samlet forbrug og miljøbelastning



Energimærket er udstedt på grundlag af det registrerede forbrug. I ejendommens areal og bygningstype er taget hensyn til, hvordan forbruget af el, vand og varme kan påvirkes. Energimærket og -plan er udstedt i henhold til lov om fremme af energie- og vandbesparelser i bygninger.



2. udgave

Date

Identification of building

Identification of consultant

Signature

Labelling of Heating

Labelling of Electricity

Labelling of Water

Consumption pr. m<sup>2</sup>

Environmental Impact

Consumption



Energy certificate or label for buildings in Denmark



# Experience in USA



- Energy Star Label for Buildings
  - [www.energystar.gov](http://www.energystar.gov)
  - For buildings (commercial & industrial)
  - For homes (residential)
- Building energy rating system in some States (e.g. Florida)
  - Categorical ranking (e.g. scale 1 to 5 or stars 1 to 5)
  - Continuous scale (a bar graph)
  - Information only (w/o comparing to others)



# Energy label and rating systems for buildings in USA

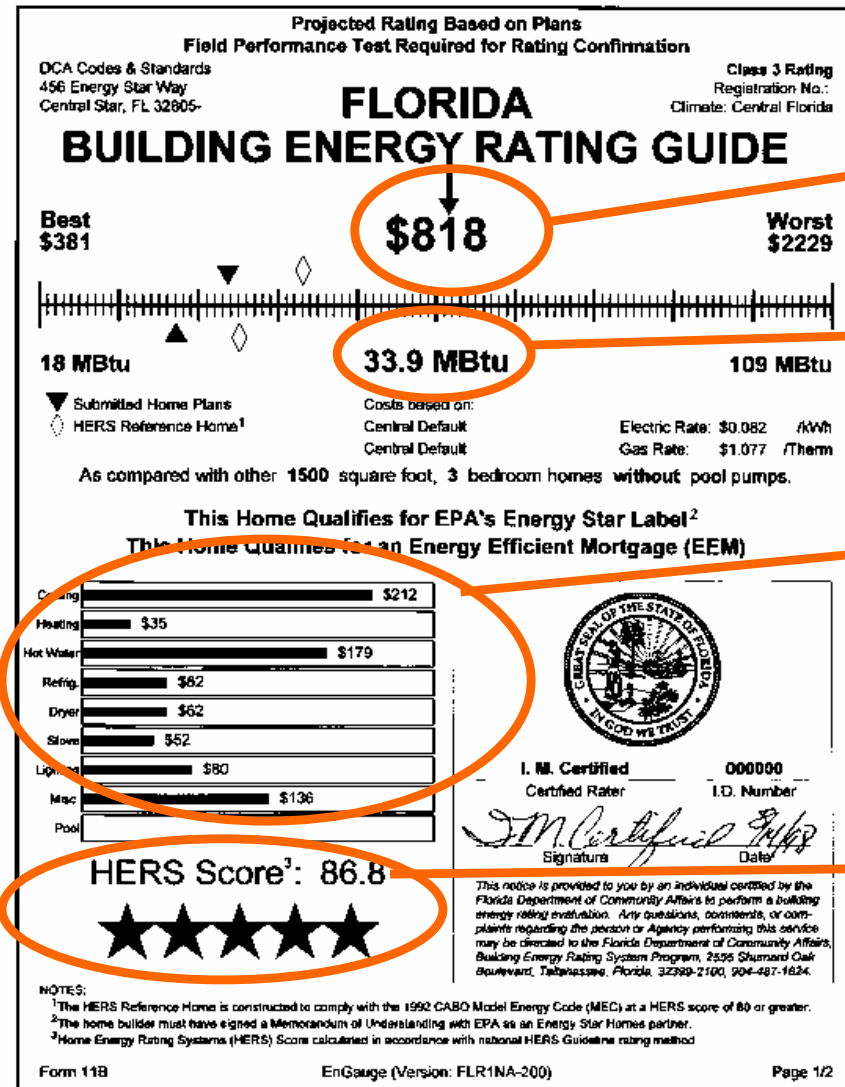
## Energy Star Label for Buildings



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/>



# Experience in USA



- 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 (measurement & verification, M&V)
- Energy Star Label
  - Voluntary by design; partnerships are critical
  - An *information* and *branding* campaign

# Experience in USA



- Energy Star for Buildings: tools & resources
  - Energy Star Challenge (publicity toolkit)
    - [www.energystar.gov/challenge](http://www.energystar.gov/challenge)
  - Energy Star Partnership (assistance)
  - Energy Star Leaders (portfolio)
  - Guidelines for Energy Management (information)
  - Building Upgrade Manual (information)
  - New Building Design Guidance (information)



# Conclusions



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

# Hong Kong Building Energy Label

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

How could we develop such a building energy label in Hong Kong?

# Conclusions



- Strategy to develop building energy labels
  - Labelling concept
    - Select measuring indicator & labelling method
  - Rating method (quite complicated)
    - Determine assessment tools & methods
    - Decide on calculation methodology
  - Certification process
    - Comparison & benchmarking
  - Publicity & displaying the labels

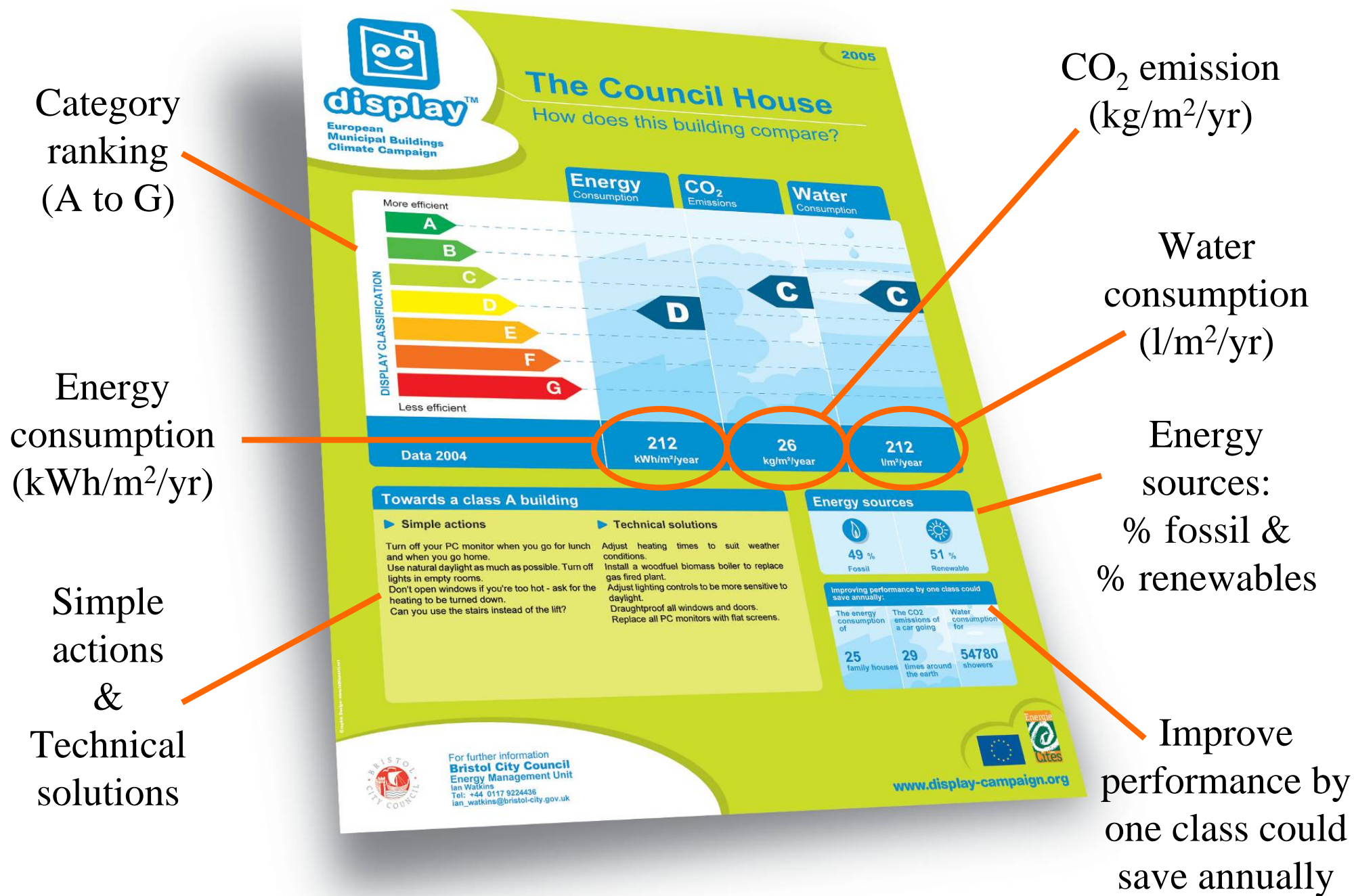


# Conclusions



- 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)
- More than a building energy label
  - Provide other related info (CO<sub>2</sub> emission, water consumption, % renewables)
  - Offer suggestions for improvement (simple actions, technical solutions)

# Building energy label from Display Campaign in Europe





# THANK YOU



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