Building Regulations on Energy Efficiency after the EPBD

Past, Present and Future

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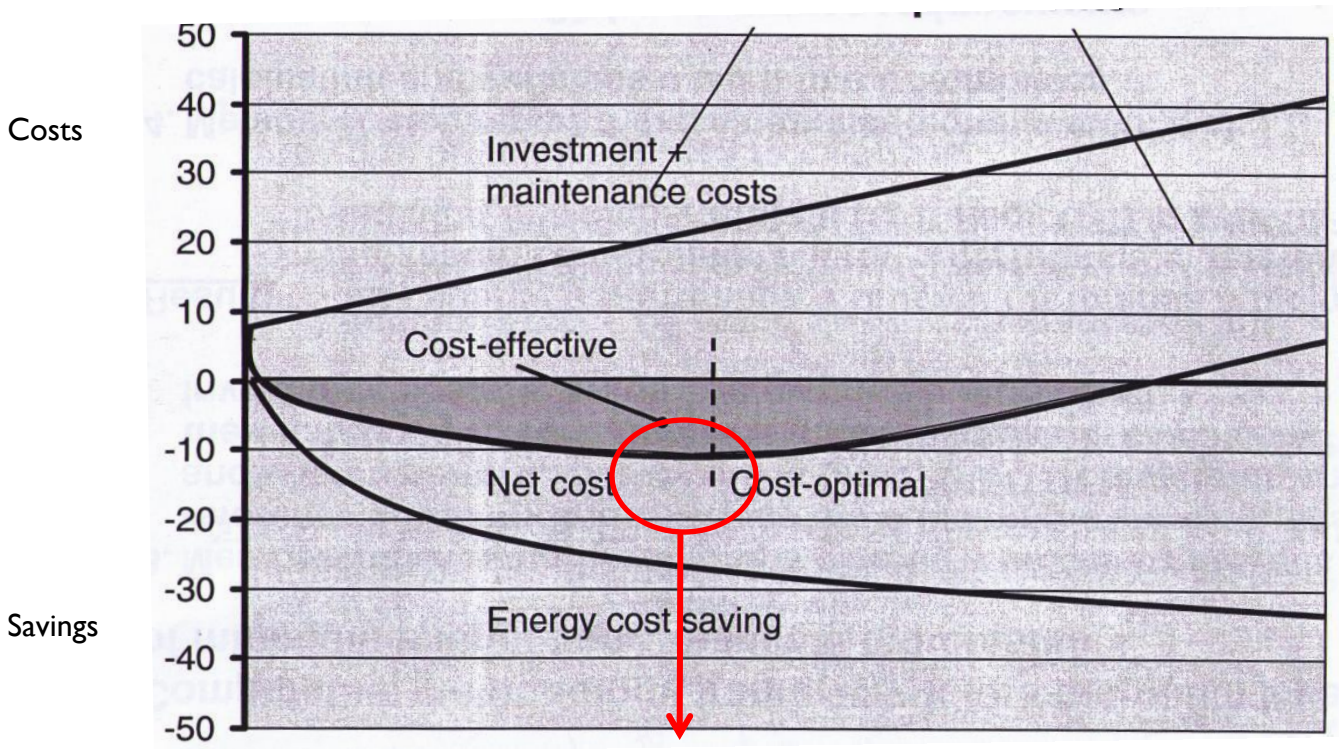
Policy Instruments for Buildings

- In 2002, the EU quickly adopted the first Directive on Energy Performance of Buildings (EPBD), requiring:
  - Minimum performance requirements for new buildings, major renovations and (construction) components;

Every MS established more demanding requirements.
But some MS were more ambitious than others…
And implementation ranged from 2006 until 2009 or even later.

How to set Minimum Requirements seen as equivalent over the whole EU?

- MS required to set minimum requirements with a cost-optimal methodology framework on a long-term life-cycle cost (building envelope and technical systems) in the new recast EPBD (Directive 2010/31/EU).



(E.g., thickness, or efficiency)

The new EPBD

(Directive 2010/31/EU - just published 18 June 2010)

Learning from the past experience: set more ambitious mandatory goals for MS.

By 2020, every new building in the EU must be a "nearly-zero" energy building.

Buildings with very low envelope loads and the remaining needs supplied by renewables as far as possible and cost-effective.

Public Buildings as a Leading Example, already included in the 2002 EPBD requirements, were largely ignored by MS.
By 2018, every newly occupied Public Building in the EU must be a "nearly-zero" energy building.

EPBD Requirements – Renewable Energy Systems

- The original EPBD encouraged MS to adopt more renewables, including mandatory cost-effectiveness studies prior to construction in larger buildings (>1000 m^2);
- MS largely ignored this requirement: only a handful of MS implemented it, and most in a very "mild" form;
- More Renewables and other energy-efficient solutions (urban networks, heat pumps, etc.) are urgently needed;
- The "nearly-zero energy" requirement in the new EPBD should help move faster towards this goal.

PV façades

Solar Thermal Systems for Hot Water

The new EPBD

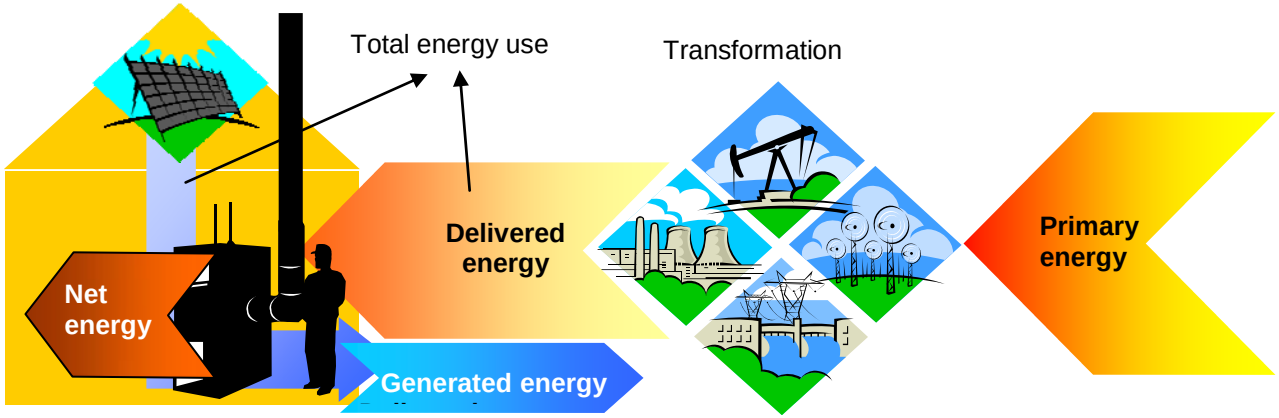
(Directive 2010/31/EU - just published 18 June 2010)

- Learning from the past experience:
  - In the EU, most buildings are small. Every renovation now carries mandatory energy efficiency requirements (envelope and technical systems) – the 1000 m^2 threshold is removed from 2012.

  - **We should always use every cost-effective opportunity for saving energy, no matter how small the building or the technical system – Regulations will need to include these new goals**.

Calculation Methodology

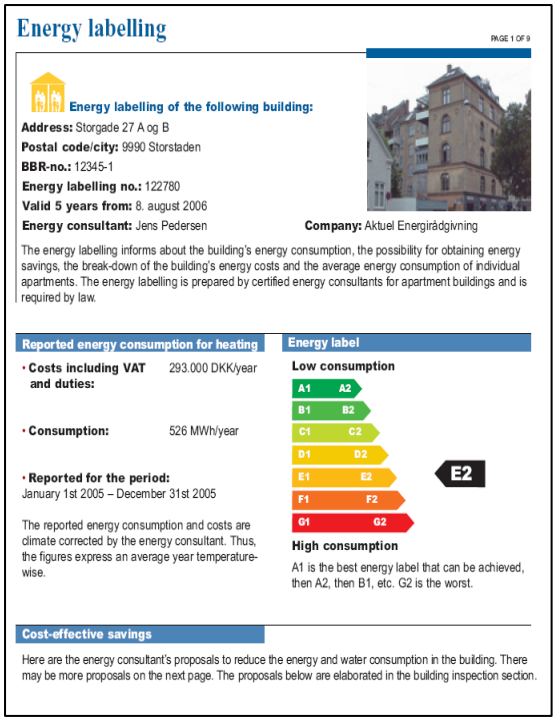
Energy use calculations are now made using a common methodology based on quantification of primary energy use and actual systems used, including own-production at the building site.



CEN standards are presently rather complex and not very well suited for implementation by MS. The existing pack will be reformulated with a 2015 goal for delivery, followed by implementation by MS

EPBD Requirements

- Building Certificates for every new building, as well as for every existing building when sold or rented.



Energy labelling

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Energy labelling of the following building:

Address: Storgade 27 A og B
Postal code/city: 9990 Storstaden
BBR-no.: 12345-1
Energy labelling no.: 122780
Valid 5 years from: 8. august 2006
Energy consultant: Jens Pedersen
Company: Aktuel Energirådgivning

The energy labelling informs about the building's energy consumption, the possibility for obtaining energy savings, the break-down of the building's energy costs and the average energy consumption of individual apartments. The energy labelling is prepared by certified energy consultants for apartment buildings and is required by law.

Reported energy consumption for heating

- **Costs including VAT and duties:** 293.000 DKK/year
- **Consumption:** 526 MWh/year
- **Reported for the period:** January 1st 2005 – December 31st 2005

The reported energy consumption and costs are climate corrected by the energy consultant. Thus, the figures express an average year temperature-wise.

Energy label

Low consumption

A1 A2 B1 B2 C1 C2 D1 D2 E1 E2 F1 F2 G1 G2

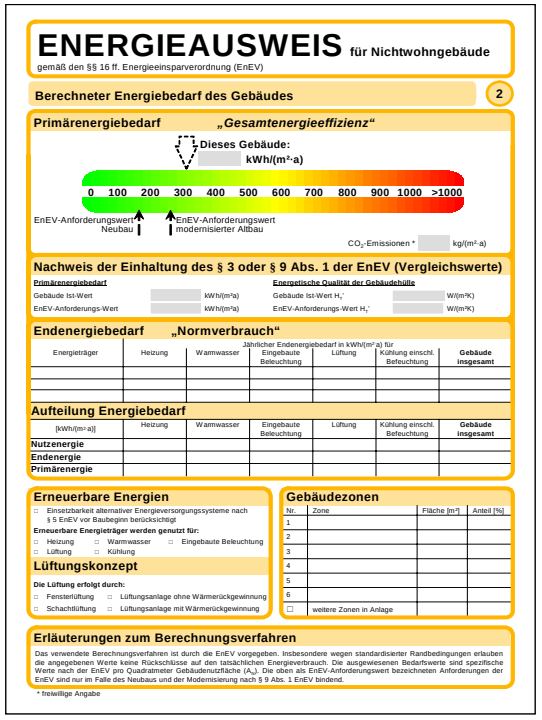
E2

High consumption

A1 is the best energy label that can be achieved, then A2, then B1, etc. G2 is the worst.

Cost-effective savings

Here are the energy consultant's proposals to reduce the energy and water consumption in the building. There may be more proposals on the next page. The proposals below are elaborated in the building inspection section.



ENERGIEAUSWEIS für Nichtwohngebäude

gemäß den §§ 16 ff. Energieeinsparverordnung (EnEV)

Berechneter Energiebedarf des Gebäudes 2

Primärenergiebedarf „Gesamtenergieeffizienz"

Dieses Gebäude: kWh/(m²·a)

0 100 200 300 400 500 600 700 800 900 1000 >1000

EnEV-Anforderungswert Neubau

EnEV-Anforderungswert modernisierter Altbau

CO_2-Emissionen * kg/(m²·a)

Nachweis der Einhaltung des § 3 oder § 9 Abs. 1 der EnEV (Vergleichswerte)

Primärenergiebedarf

Gebäude Ist-Wert kWh/(m²a)

EnEV-Anforderungs-Wert kWh/(m²a)

Energetische Qualität der Gebäudehülle

Gebäude Ist-Wert H_T' W/(m²K)

EnEV-Anforderungs-Wert H_T' W/(m²K)

Endenergiebedarf „Normverbrauch"

Jährlicher Endenergiebedarf in kWh/(m² a) für

Energieträger	Heizung	Warmwasser	Eingebaute Beleuchtung	Lüftung	Kühlung einschl. Befeuchtung	Gebäude insgesamt

Aufteilung Energiebedarf

[kWh/(m²·a)]	Heizung	Warmwasser	Eingebaute Beleuchtung	Lüftung	Kühlung einschl. Befeuchtung	Gebäude insgesamt
Nutzenergie						
Endenergie						
Primärenergie						

Erneuerbare Energien

☐ Einsetzbarkeit alternativer Energieversorgungssysteme nach § 5 EnEV vor Baubeginn berücksichtigt

Erneuerbare Energieträger werden genutzt für:

☐ Heizung ☐ Warmwasser ☐ Eingebaute Beleuchtung
☐ Lüftung ☐ Kühlung

Lüftungskonzept

Die Lüftung erfolgt durch:

☐ Fensterlüftung ☐ Lüftungsanlage ohne Wärmerückgewinnung
☐ Schachtlüftung ☐ Lüftungsanlage mit Wärmerückgewinnung

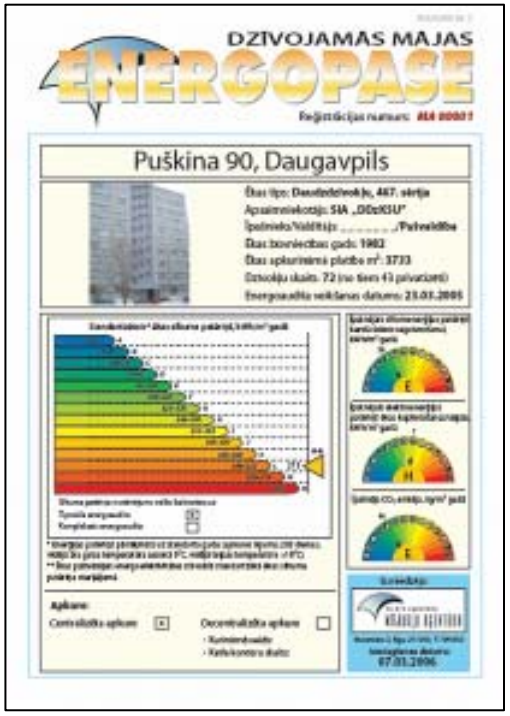
Gebäudezonen

Nr.	Zone	Fläche [m²]	Anteil [%]
1			
2			
3			
4			
5			
6			
☐	weitere Zonen in Anlage		

Erläuterungen zum Berechnungsverfahren

Das verwendete Berechnungsverfahren ist durch die EnEV vorgegeben. Insbesondere wegen standardisierter Randbedingungen erlauben die angegebenen Werte keine Rückschlüsse auf den tatsächlichen Energieverbrauch. Die ausgewiesenen Bedarfswerte sind spezifische Werte nach der EnEV pro Quadratmeter Gebäudenutzfläche (A_N). Die oben als EnEV-Anforderungswert bezeichneten Anforderungen der EnEV sind nur im Falle des Neubaus und der Modernisierung nach § 9 Abs. 1 EnEV bindend.

* freiwillige Angabe



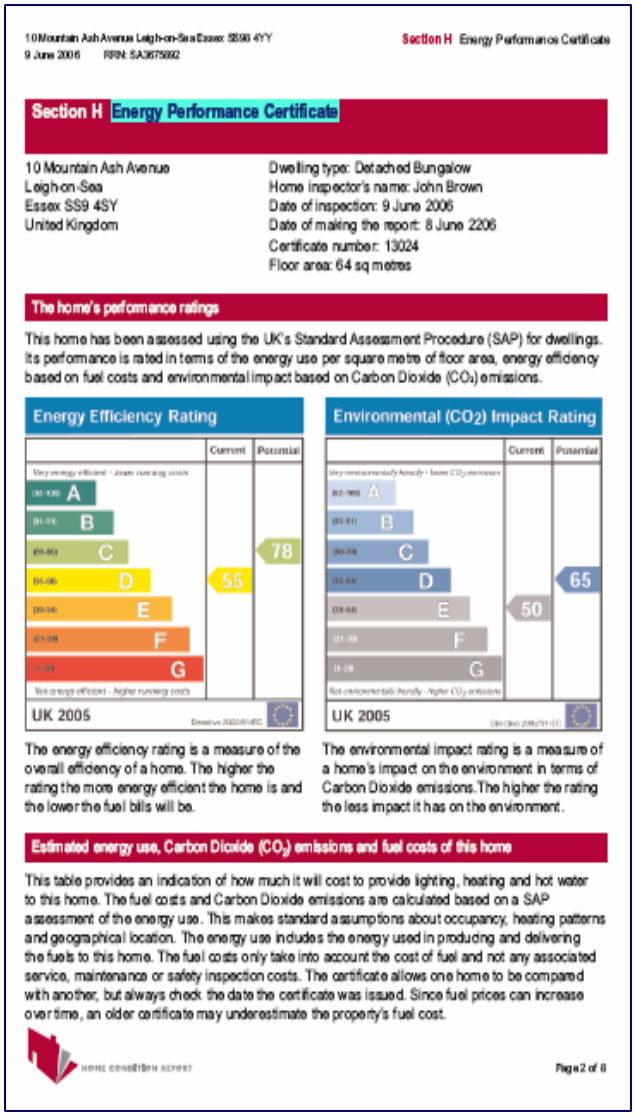
DZIVOJAMĀS MĀJAS

ENERGOPASE

Puškina 90, Daugavpils

Energy Performance Certificates

- The most visible aspect of the EPBD.
- But the quality of the certificates varies widely, rules change from MS by MS, intercomparisons are impossible across borders.
- Even the basis of the certificates varies:
  - Some countries use measured values
  - Others use calculated values
  - And a few, both…



10 Mountain Ash Avenue Leigh-on-Sea Essex SS9 4YY
9 June 2006 RRN: SA3675882

Section H Energy Performance Certificate

Section H Energy Performance Certificate

10 Mountain Ash Avenue
Leigh-on-Sea
Essex SS9 4SY
United Kingdom

Dwelling type: Detached Bungalow
Home inspector's name: John Brown
Date of inspection: 9 June 2006
Date of making the report: 8 June 2206
Certificate number: 13024
Floor area: 64 sq metres

The home's performance ratings

This home has been assessed using the UK's Standard Assessment Procedure (SAP) for dwellings. Its performance is rated in terms of the energy use per square metre of floor area, energy efficiency based on fuel costs and environmental impact based on Carbon Dioxide (CO_2) emissions.

Energy Efficiency Rating

Current: 55 (D)
Potential: 78 (C)

UK 2005

The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills will be.

Environmental (CO_2) Impact Rating

Current: 50 (E)
Potential: 65 (D)

UK 2005

The environmental impact rating is a measure of a home's impact on the environment in terms of Carbon Dioxide emissions. The higher the rating the less impact it has on the environment.

Estimated energy use, Carbon Dioxide (CO_2) emissions and fuel costs of this home

This table provides an indication of how much it will cost to provide lighting, heating and hot water to this home. The fuel costs and Carbon Dioxide emissions are calculated based on a SAP assessment of the energy use. This makes standard assumptions about occupancy, heating patterns and geographical location. The energy use includes the energy used in producing and delivering the fuels to this home. The fuel costs only take into account the cost of fuel and not any associated service, maintenance or safety inspection costs. The certificate allows one home to be compared with another, but always check the date the certificate was issued. Since fuel prices can increase over time, an older certificate may underestimate the property's fuel cost.

HOME CONDITION REPORT

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Benchmarks for Complex Buildings in Regulations

- **The EPBD lists a few indicative building typologies that MS can adopt for setting requirements for certificates;**
- **But there are huge differences possible within each typology, e.g.:**
  - **2 or 3 * hotels**
  - **5 * hotels**
  - **City "business" hotels**
  - **Holiday beach hotels**
  - **Hotels with or w/o swimming pool**
  - **…**
- **Benchmarks must be well suited for the intended building or certificates will be almost useless;**
- **EU MS today set up systems with just a few benchmarks up to more than 50…**

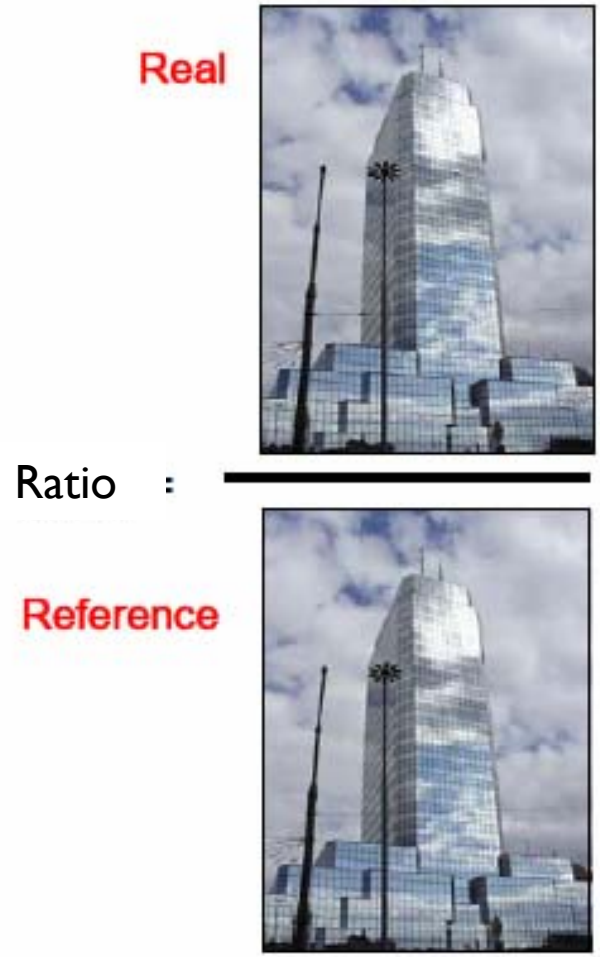
This list remains unchanged in the new EPBD

(a) single-family houses of different types;
(b) apartment blocks;
(c) offices;
(d) education buildings;
(e) hospitals;
(f) hotels and restaurants;
(g) sports facilities;
(h) wholesale and retail trade services buildings;
(i) other types of energy-consuming buildings.

Labels	Ref	IN 1	IN 2	BK 1	BK 2	BK 3	C 2	C 4	BK 4	C 1	C5	C 3	C 6	C 7	C 8
Gymnastiekzaal	G	G	G	G	G	E	E	E	E	D	D	C	C	A	A
Sporthal	G	G	G	G	F	E	E	E	E	D	D	C	C	A	A
Zwembad	G	G	G	G	G	E	E	E	D	D	D	C	C	A	A
Kantoor groot	G	G	G	G	G	D	D	D	C	C	C	C	B	A	A
Kantoor middel	G	G	G	G	G	E	E	E	D	D	D	C	C	A	A
Kantoor klein	G	G	G	G	G	E	F	E	E	E	D	D	C	A	A
Groepspraktijk	G	G	G	G	G	D	D	D	D	D	C	C	B	A	A
Verpleegtehuis	G	G	G	G	G	F	D	D	E	E	C	B	B	A	A
Ziekenhuis	G	G	F	G	G	E	C	C	D	D	B	B	B	A	A
Hotel	G	G	G	G	G	F	F	F	E	E	E	E	D	B	A
Basisschool	G	G	G	G	G	F	D	D	E	E	C	C	B	A	A
VO school	G	G	G	G	G	D	C	C	D	D	B	B	B	A	A
HBO	G	G	G	G	G	D	C	C	C	C	B	B	A	A	A
Cafe restaurant	G	G	G	G	G	E	D	D	D	D	C	B	B	A	A
Buurthuis	G	G	G	G	F	C	C	B	B	C	A	A	A	A	A
Theater	G	G	G	D	B	B	A	A	A	A	A	A	A	A	A
Museum	G	F	F	E	B	A	A	A	A	A	A	A	A	A	A
Gevangenis	G	G	G	F	D	B	C	C	B	B	B	B	A	A	A
Kleine winkel	G	G	G	G	C	B	B	B	B	B	A	A	A	A	A
Warenhuis	G	G	G	D	B	B	B	A	A	A	A	A	A	A	A
Supermarkt	G	F	F	C	B	A	A	A	A	A	A	A	A	A	A

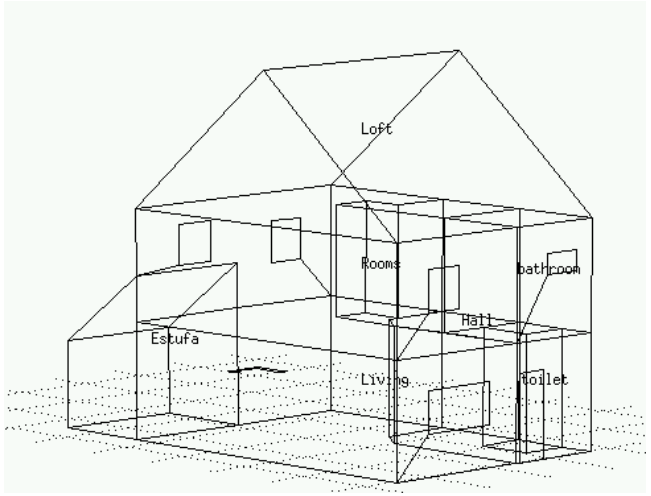
Benchmarks

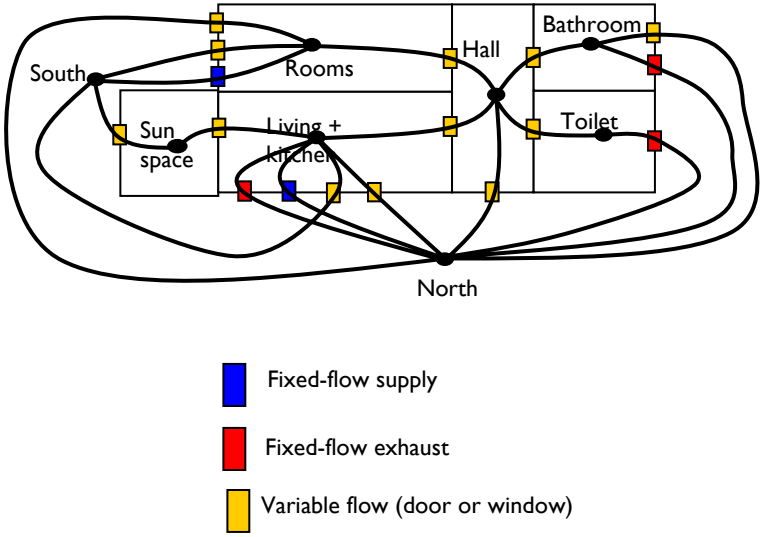
- **There are two main options:**
  - **Using the notion of reference building – an identical building, at the same location, with standard set of characteristics (envelope, systems, etc.);**
  - **Setting up absolute performance targets (e.g kWh/m^2.year);**
- **The reference building approach has many advantages, but it neglects the f of the building, an important factor in energy performance – e.g., the shape factor;**
- **The absolute scale approach requires well-tuned typologies – usually, they re from large-scale surveys of the existing building stock, together with simulatic studies.**



Calculated Energy Rating

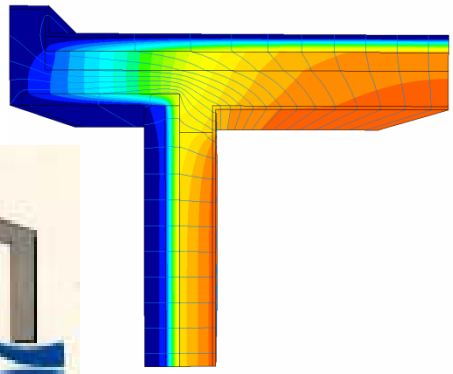
- It is based on a simulation or a simpler calculation under nominal conditions, with a standard occupant use pattern;
- For small single-zone buildings (e.g., a residence), it is relatively simple, reliable and cheap to produce the rating but, for complex buildings, it may become very complex and expensive to perform the required simulation;
- It is difficult for authorities to check the accuracy of complex simulations, and any good software programmer can easily perform "miracles"…
- The skill of the author of the simulations or the regulations (simplifications) are critical.

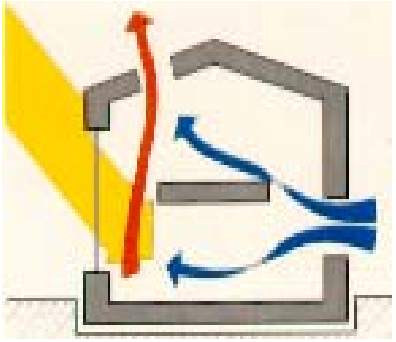




Difficult Issues for Simulation

- **Although there are special software packages that specialize in modeling a single particular complex issue, no commercial package normally addresses in detail every single issue:**
  - **Natural or hybrid ventilation**
  - **Daylighting and optimal use of artificial lighting**
  - **Thermal bridges**
  - **Innovative (not typified) HVAC components**
  - **Advanced Controls**
  - **Dynamic performance of HVAC equipment (rather than using average seasonal efficiencies)**
  - **Integration of renewables, including active and passive solar energy**
  - **High inertia construction**
  - **….**



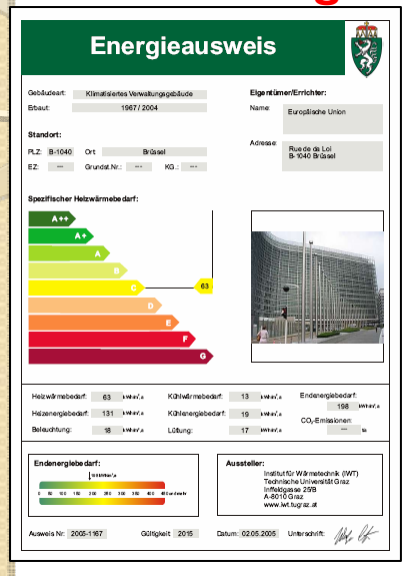


The Berlaymont Building
EC Headquarters

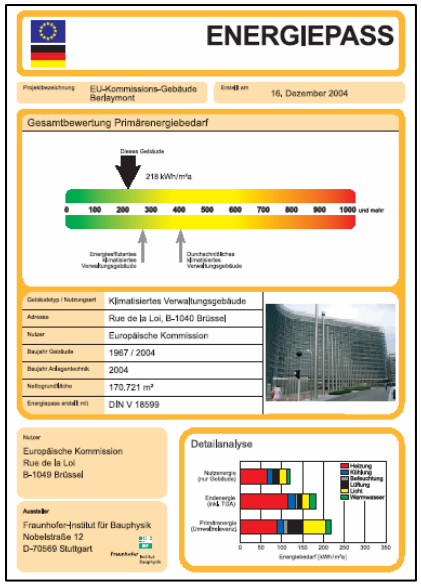
180,000 m²

The Berlaymont Building – Issued Certificates

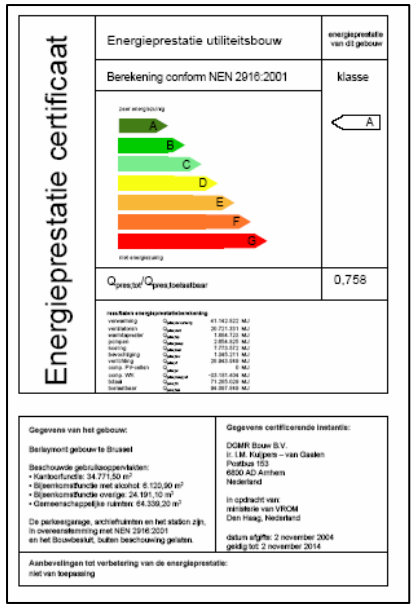
Building rated as placed in the capital of each country, using own regulations

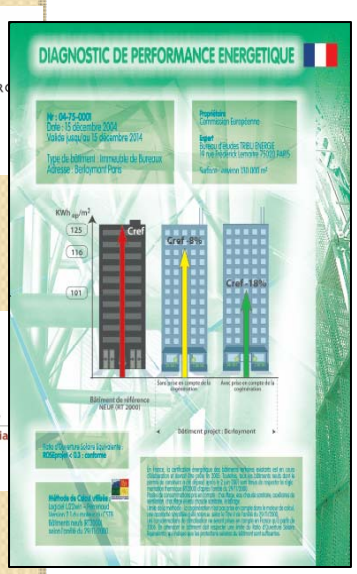


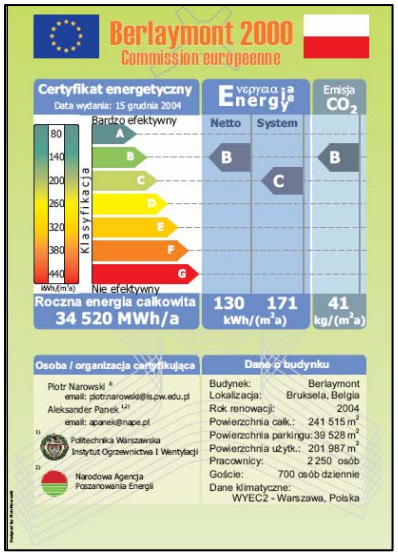
A few "A" Certificates



And a few "not so good" Certificates…

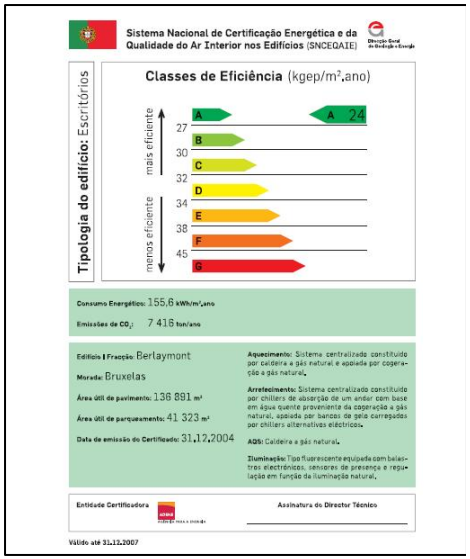






Looking at the details:

- **Huge differences between heating and cooling needs between certificates, even with similar climates…**
- **Some calculations only with heating needs…**
- **Models with between 1 and 60 zones…**



The Call for a Uniform Certification System for Commercial Buildings

- **Faced with very different criteria in EU Certificates, there has been a Call from various stakeholders, including REHVA, for a common EU Certification scheme for non-residential buildings – international organizations would like to be able to compare the relative quality of buildings across borders;**
- **The new revision of the EPBD, soon to be published (June 2010) calls on the EU Commission to develop such a common methodology, but it will be up to each individual country to adopt it or not;**

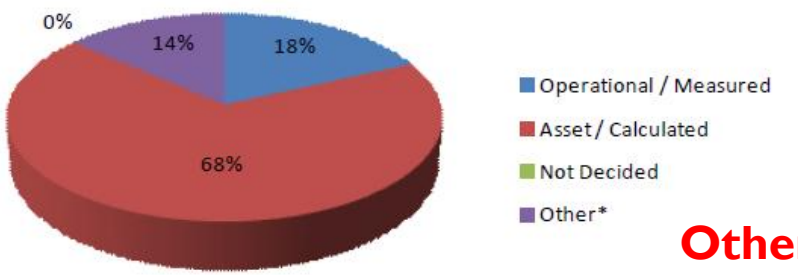
Article 11, point 9:

The Commission shall, by 2011, in consultation with the relevant sectors, adopt a voluntary common European Union certification scheme for the energy performance of non-residential buildings. That measure shall be adopted in accordance with the advisory procedure referred to in Article 26(2). Member States are encouraged to recognise or use the scheme, or use part thereof by adapting it to national circumstances.

The Call for a Uniform Certification System for Commercial Buildings

- **It still rests to be seen which model will be adopted by the EC, among so many alternatives, and to which degree the different countries will accept the common method to issue Energy Certificates… They cannot even agree on calculated or measured energy rating… but there is a good tendency:**

  - **It depends on negotiation with the expert…**
  - **An asset (calculated) rating certificate is required as a first step. After 5 years, an operational (measured) rating certificate is displayed alongside the initial asset rating certificate…**
  - **operational/measured data is used for existing buildings and asset/calculated data is used for new build.**



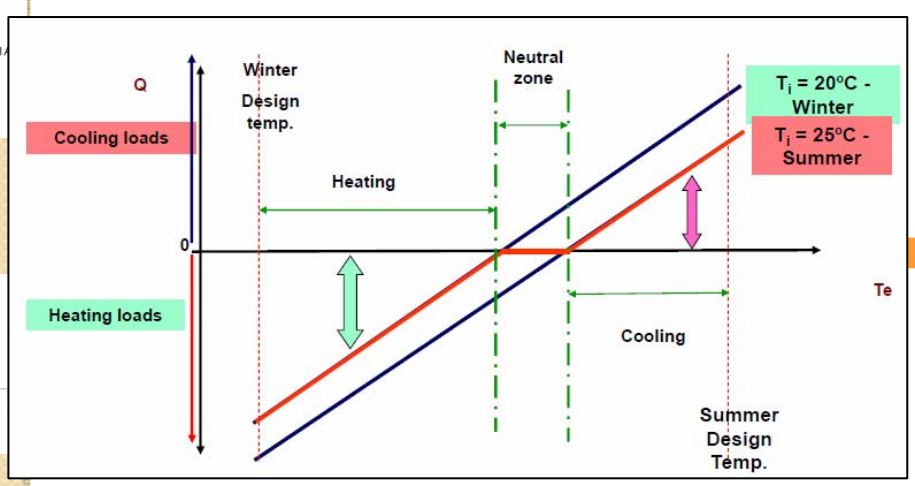
Other?

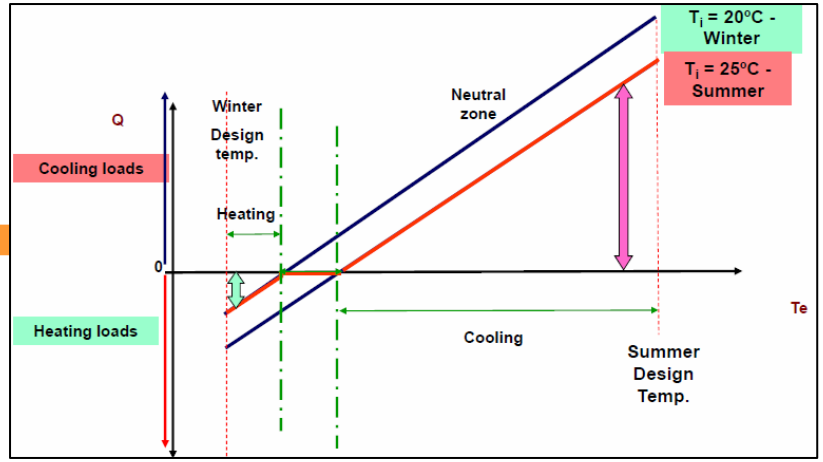
Climatic Correction

- **How can we compare two identical buildings in two different climates?**
  - **Heating and cooling loads will be totally different…**
- **Heating loads are easy to adjust (heating degree days) if the building is dominated by envelope loads (including ventilation);**
- **But cooling loads are not correctly adjusted even in buildings dominated by the envelope – cooling degree days do not work when solar radiation is strong.**
- **And, worse, most non-residential buildings are dominated by internal loads, not by the envelope…**

Climatic Correction

- **The energy balance of these buildings is decisively influenced by the internal and solar gains – energy needs for heating and cooling must account for the "location" of the neutral zone (i.e., the outdoor air temperature when no heating nor cooling is needed);**
- **Climate correction needs to take into account the holistic view, changing both heating and cooling needs in a concerted way.., not each one separately by itself!**

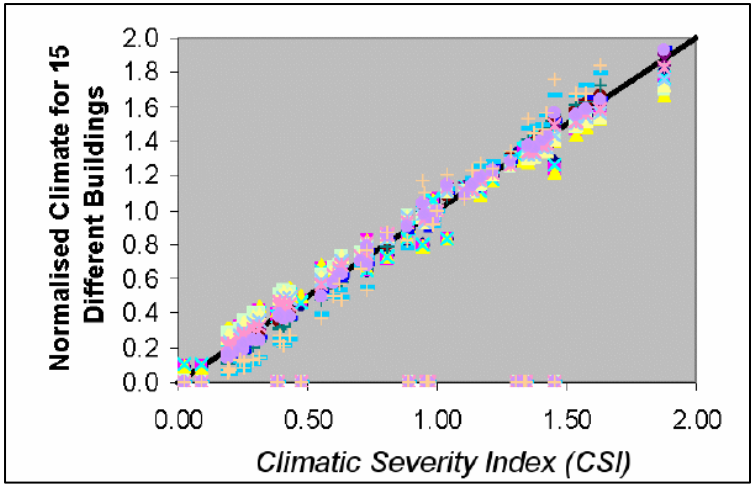




Climate Severity Index

- **A methodology developed and adopted in Spain:**
  - **Calculate heating and cooling needs for a reference building in two locations**
  - **The ratio of total energy needs is then used for climate correction;**
  - **Separate heating and cooling indices can be produced by the same simulation.**
- **Of course, this index depends on the reference building itself - to be more precise, it needs to be calculated for each building, and this is time consuming and expensive.**

Country	Net Energy Demand (Heating) kWh/m^2	Net Energy Demand (Cooling) kWh/m^2	CSI-H	CSI-C
Holland	55.56	0.15	0.93	0.0064
Germany	67.71	1.91	1.14	0.0821
Belgium	59.61	0.34	**1.00**	0.0148
Spain (Burgos)	49.22	2.66	0.83	0.1143
Finland	108.47	0.49	1.82	0.0212
Denmark	74.54	0.18	1.25	0.0078
Spain (Madrid)	22.85	15.93	0.38	0.6858
Norway	99.84	0.07	1.67	0.0031
France	51.22	2.01	0.86	0.0865
Czech Republic	70.89	0.83	1.19	0.0355
Italy	11.96	23.24	0.20	**1.0000**
Spain (Sevilla)	3.37	26.42	0.06	1.136
Poland	79.53	1.03	1.33	0.0441

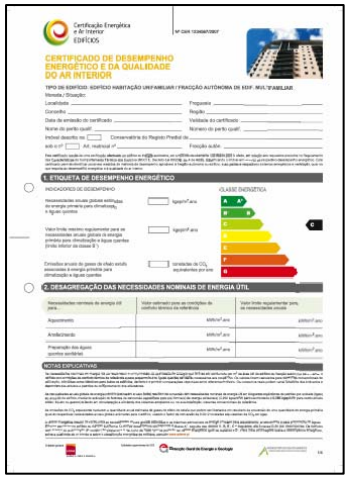


Lessons learned on Existing Buildings

- The original EPBD only included requirements for major renovations;
- Even with excellent "zero-energy" new buildings from now on, the building sector will continue to be inefficient if nothing is done to improve a large number of existing buildings – the renewal rate is too small (1-2%/year) to have a significant impact, even in the medium term;
- It is essential to act on existing buildings in a systematic way at large scale to reach the full potential of energy savings in the sector – recommendations in the certificates offer, just by themselves, excellent opportunities, but incentives and other major initiatives will be needed;
- Existing standards are not well suited for application to **existing buildings** – **simplified methodologies** (relative to new buildings), good default values, etc., are needed.

Conclusions

- **Europe laid out ambitious plans to improve new and existing buildings:**
  - **Improved energy-efficiency requirements;**
  - **Requirements for all technical building systems as well as envelope components;**
  - **Certificates for all buildings (calculation method …?);**
  - **More and more renewables and energy efficient systems;**
  - **Mandatory retrofitting of a significant portion of the existing buildings, based on appropriate regulations.**
- **Based on the experience of the last decade, requirements are tightened now:**
  - **Move towards zero-energy buildings by 2020 – New ground-breaking regulations needed.**
- **Energy-Efficiency Regulations for Buildings in EU MS must evolve to provide a legal framework for all these new objectives.**



For updated information from MS views, you are invited to visit regularly the CA-EPBD website

www.epbd-ca.eu

Directorate-General for Energy and Transport

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Concerted Action

Energy Performance of Buildings Directive

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AVAILABLE DOWNLOADS

1. Executive summary report Concerted Action 2005-2007
2. Detailed technical reports
3. Book of country reports 2008

Reducing energy consumption and eliminating wastage are among the main goals of the European Union (EU). EU support for improving energy efficiency will prove decisive for competitiveness, security of supply and for meeting the commitments on climate change made under the Kyoto protocol. There is significant potential for

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