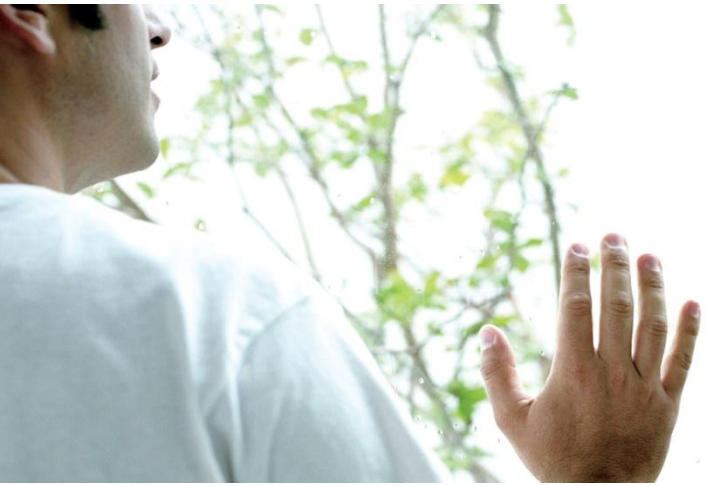

Windows and glazed area technologies and materials in Europe

Bertrand Cazes

GLASS FOR EUROPE
Building, Automotive, Solar-Energy Glass

IEA - Building Envelope Technologies and *Policies Workshop – 17 Nov 2011*

GLASS FOR EUROPE

About Glass for Europe

- 4 member companies and 1associate:
  - Run 58 of the 67 float lines based in the EU & EU candidate countries
  - Above 90% of the EU production

In association with:

- Flat glass:
  - Primarily building, automotive & solar-energy glass
  - Also furnitures, electronics, appliances

- Supporter of building energy-efficiency

GLASS FOR EUROPE

The myths to abandon

‘Windows are weak points in the building envelopes’

→ No longer true!

‘This is the house of the future’

→ Really efficient? Really the comfortable living space expected?

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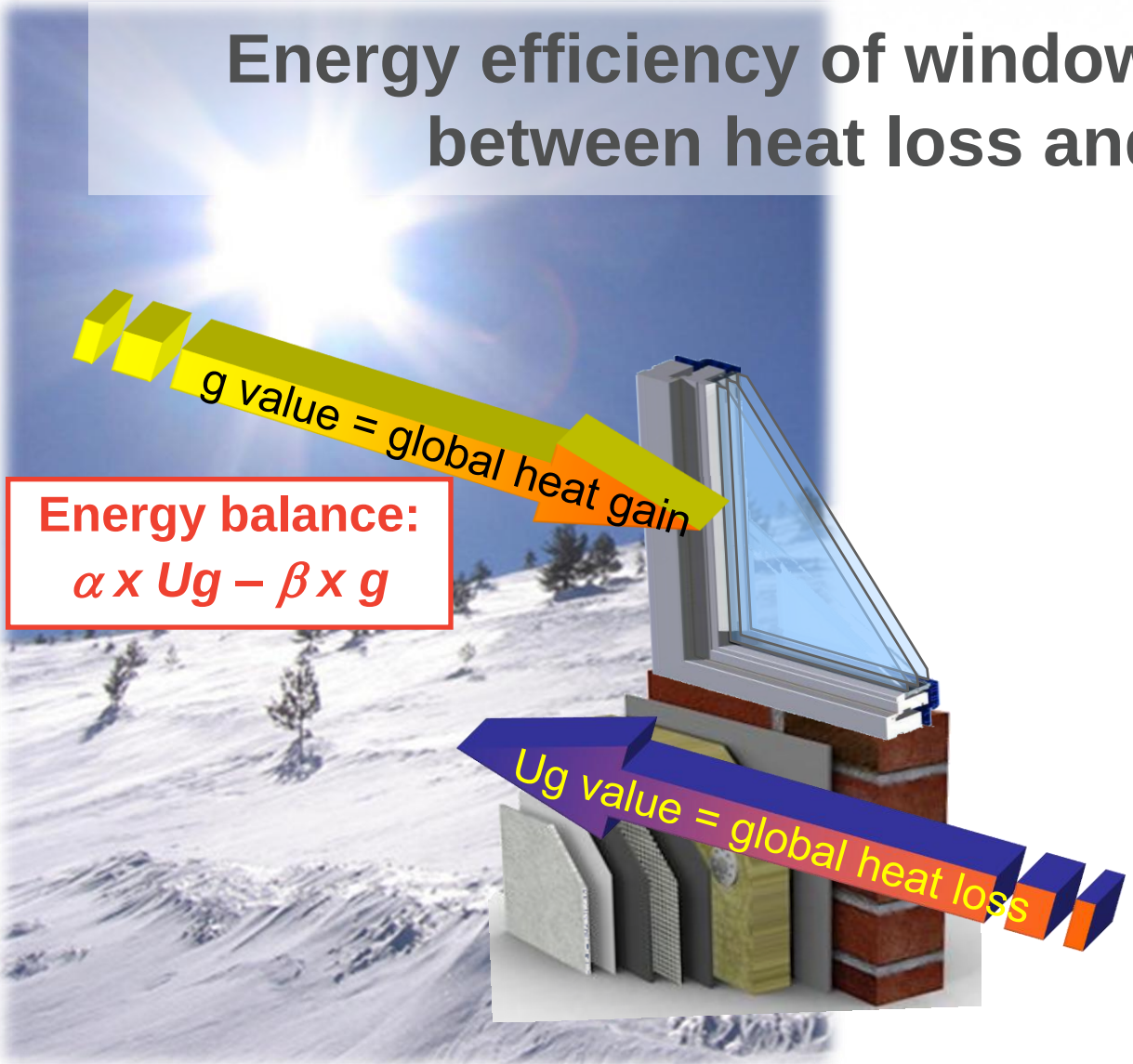
Properties of windows

Energy efficiency of windows is the balance between heat loss and solar heat gain



Low E coatings are transparent to solar radiation:

→ *Increase of solar Heat gain: g value*

Low E coatings stop exchange by radiation:

→ *Reduction of Heat Loss: Ug value*

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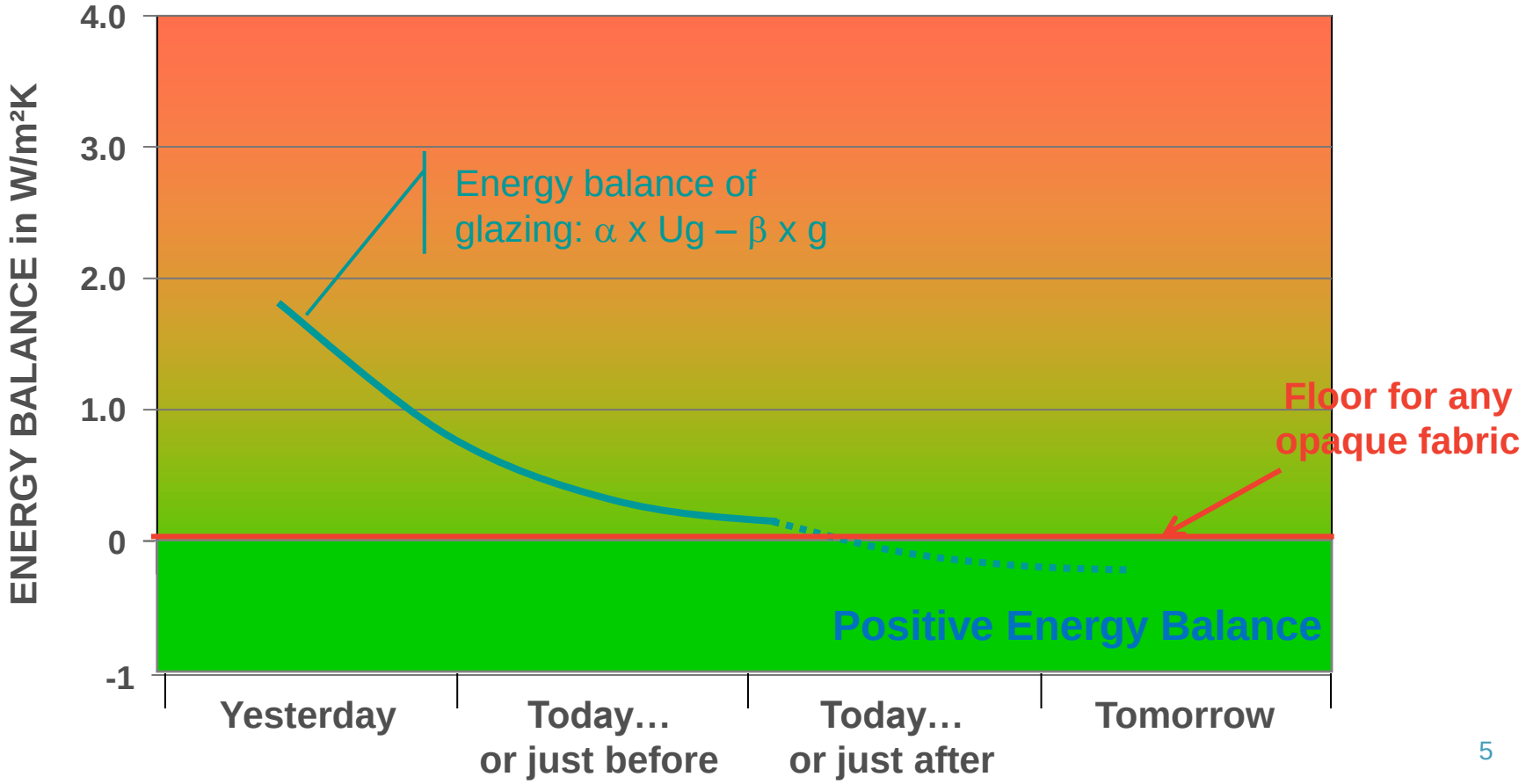
A new energy-efficiency picture

Ability to capture free solar heat gain is **unique**
High performance windows could soon become **energy positive**



The sound policy basis

UK – Window Energy Rating scheme

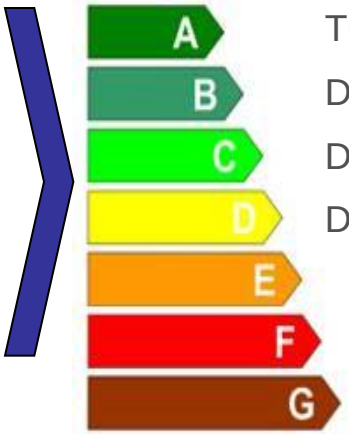
→ ***Providing easily understandable information to consumers on the energy performance of products, expressed by way of labeling.***

From Insulation focus

Uw	gw	
1.17	0.32	TGU #1
1.25	0.40	TGU #2
1.39	0.32	DGU #1
1.46	0.40	DGU #2
1.53	0.45	DGU #3

to

Labels valuing Energy efficiency



TGU #2
DGU #3
DGU #2 or TGU #1
DGU #1

WERs in UK:

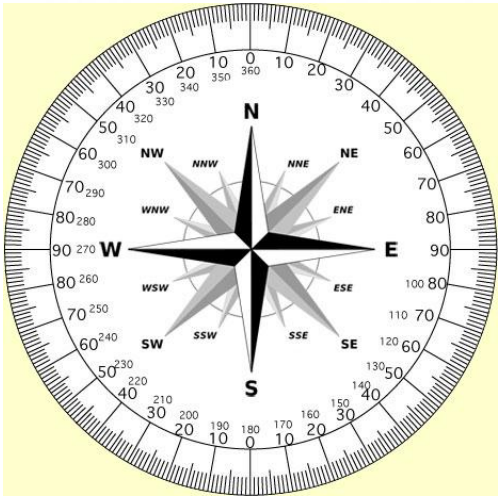
Uw	gw	WERs
1.25	0.40	A
1.53	0.45	B
1.17 1.46	0.32 0.40	C
1.39	0.32	D

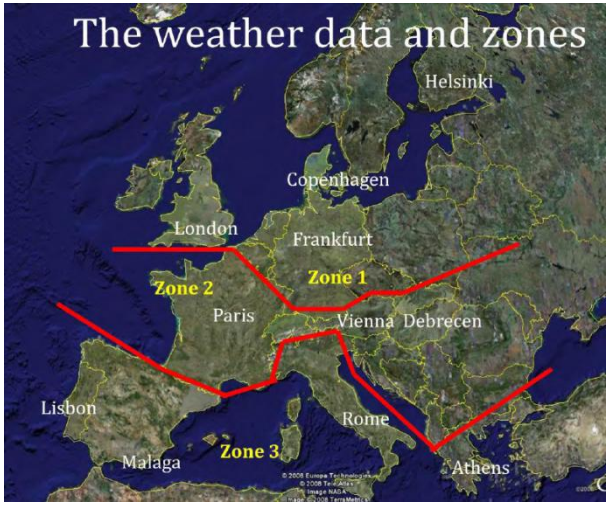
…by shifting strongly focus from insulation to energy balance

No longer about the sole U value but the energy balance

→ ***Same principles in Denmark, Finland, Czech Republic and Slovakia***

Different parameters to consider





POLICY MAKING

New Build or

Renovation ?

Residential or **Commercial ?**

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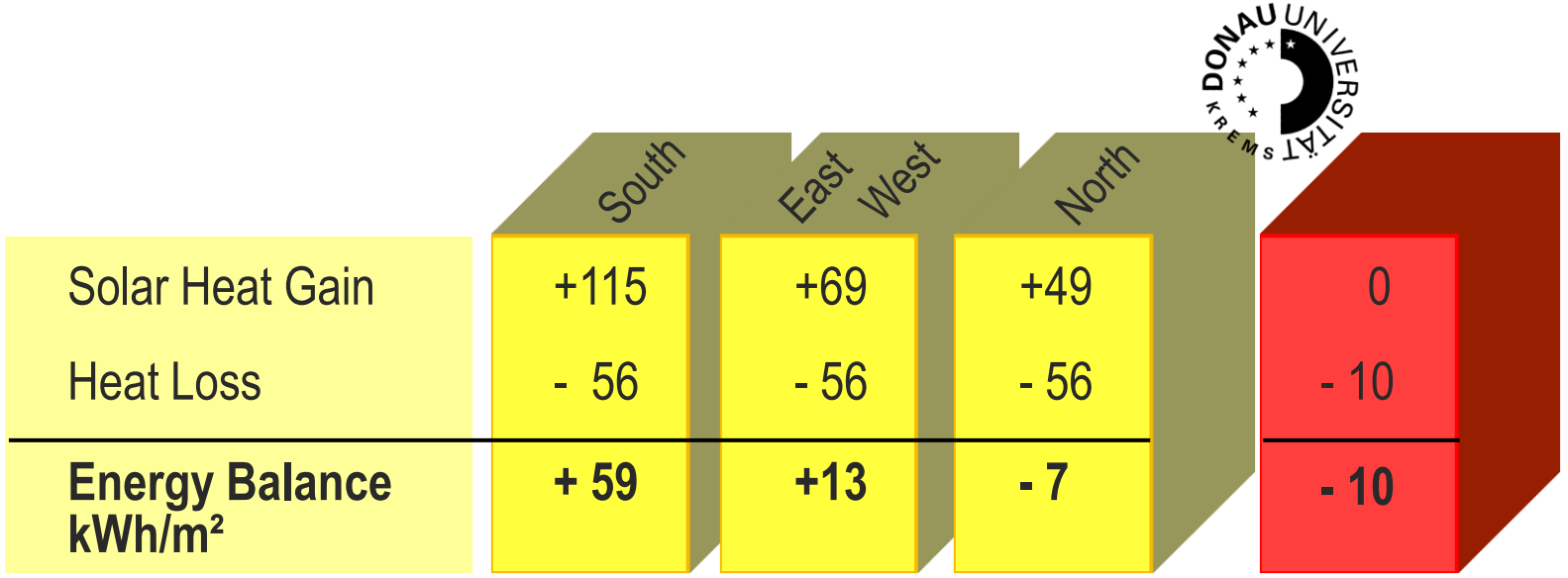
Impact of the orientation

- Orientation primarily impact solar heat gains
- Triple Glazed units with high solar factor can be more energy efficient than walls, even in the North orientations



Triple glazed Unit in **Salzbourg**

Ug = 0.6W/m²K & g = 0,60

Wall:

U = 0.12W/m²K

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Climates in the equation

UK Rating Method based on energy balance between losses and gains:

Energy Index = 218.6 gw – 68.5 (Uw + L50)

Energy index: energy saved or lost by the window

gw: solar factor of the window (glass fraction * glass solar factor)

Uw: U value of the window calculated by BFRC Certified Simulators (EN 10077-2)

L50: effective heat loss due to air penetration.

Level	E index
A	>0
B	-10 TO <0
C	-20 to < -10
D	-30 to < -20
E	-50 to < -30
F	-70 to < -50
G	< -70

218.6: fractions to reflect the solar heat gains based on climatic conditions

68.5: fractions to reflect the heat losses based on climatic conditions

Fomulae adapted to countries' climatic conditions

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WER systems in Europe

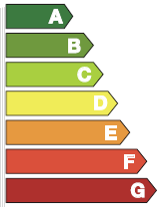
SWEDEN
Based on Uw values only
A if Uw = 0.9W/m²K
G if Uw = 1.5W/m²K

DENMARK
E_{ref}= 196,4 * g_w – 90,36 * U_w
A if E_{ref} > 0 kWh/m²
C if -17 > E_{ref} ≥ -34 kWh/m²
MINI Band C compulsory

UK
E_{ref}= 218 * g_w – 68.5 * (U_w + L_{50})
A if E_{ref} > 0 kWh/m²
G if E_{ref} < -70 kWh/m²
MINI Band C compulsory

FRANCE
Under development

3 zones based on energy consumption of the building



FINLAND
E_{ref} = 140 * u_w – 160 * g_w + 50 * L
A if E_{ref} < 85 kWh/m²
G if E_{ref} ≥ 185 kWh/m²

CZECH REP.
E_{ref}= 282.4 * g_w – 98.7 * (U_w +L_w)
A if E_{ref} > 0 kWh/m²
G if E_{ref} < -100 kWh/m²

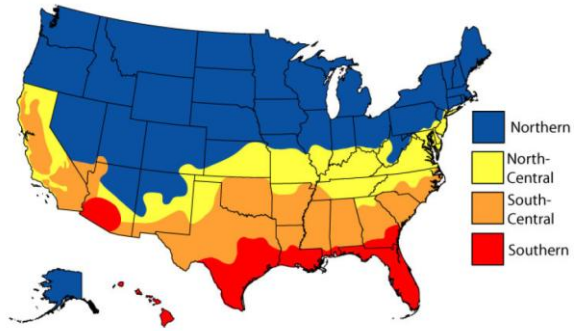
SLOVAKIA
E_{ref}= 266.6 * g_w – 96.6 * (U_w +L_w)
A if E_{ref} > 0 kWh/m²
G if E_{ref} < -100 kWh/m²

SPAIN
Under development
Takes into account energy for heating and cooling

ITALY
Under development
Will be the first with limitation on solar factor

When WER is developped based on energy balance, it is adapted to local realities!

GLASS FOR EUROPE Variances & refinement possible



ENERGY STAR Program Requirements for Windows, Doors, and Skylights: Version 5.0 (April 7, 2009)

NFRC certification of the U-Factor & Solar Heat Gain Coefficient (SHGC)

→ Levels must meet or exceed the minimum qualification criteria

Windows

Climate Zone	U-Factor[1]	SHGC[2]	
Northern	≤ 0.30	Any	Prescriptive
	=0.31	≥ 0.35	Equivalent Energy Performance
	=0.32	≥ 0.40	
North-Central	≤ 0.32	≤ 0.40	
South-Central	≤ 0.35	≤ 0.30	
Southern	≤ 0.60	≤ 0.27	

[1] Btu/h.ft².°F

[2] Fraction of incident solar radiation

Proposal for a labeling of windows

- Based on the global energy consumption of the building (both U and g values for windows)
- Three climatic zones
- Indication of summer comfort (prevention of over-heating).

Labeling under development

- Likely to include limitation on solar factor to avoid heat build-up in summer
- Solar-control glass may provide the best energy balance.

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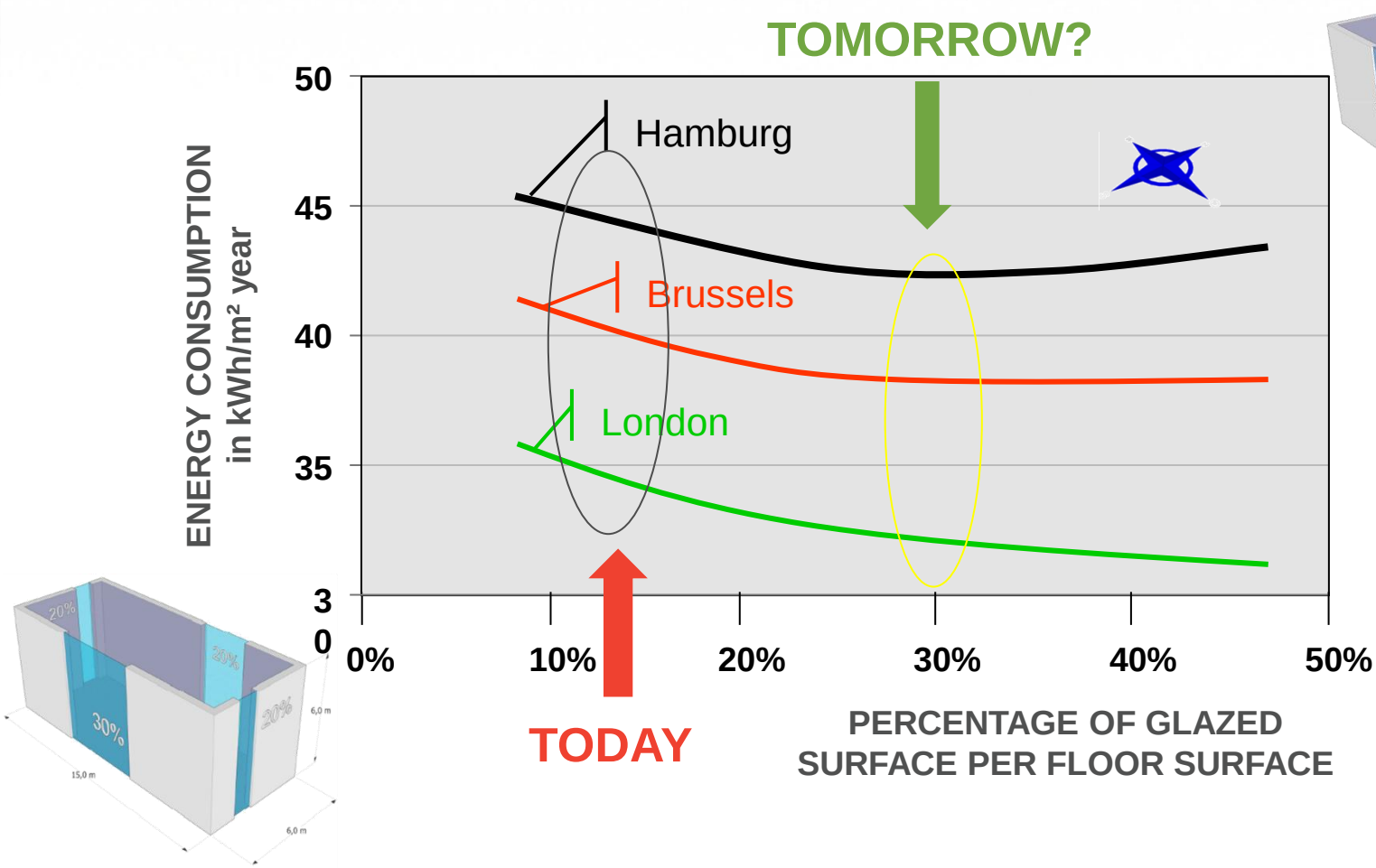
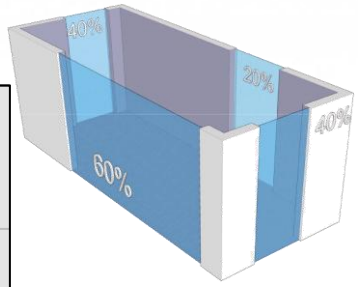
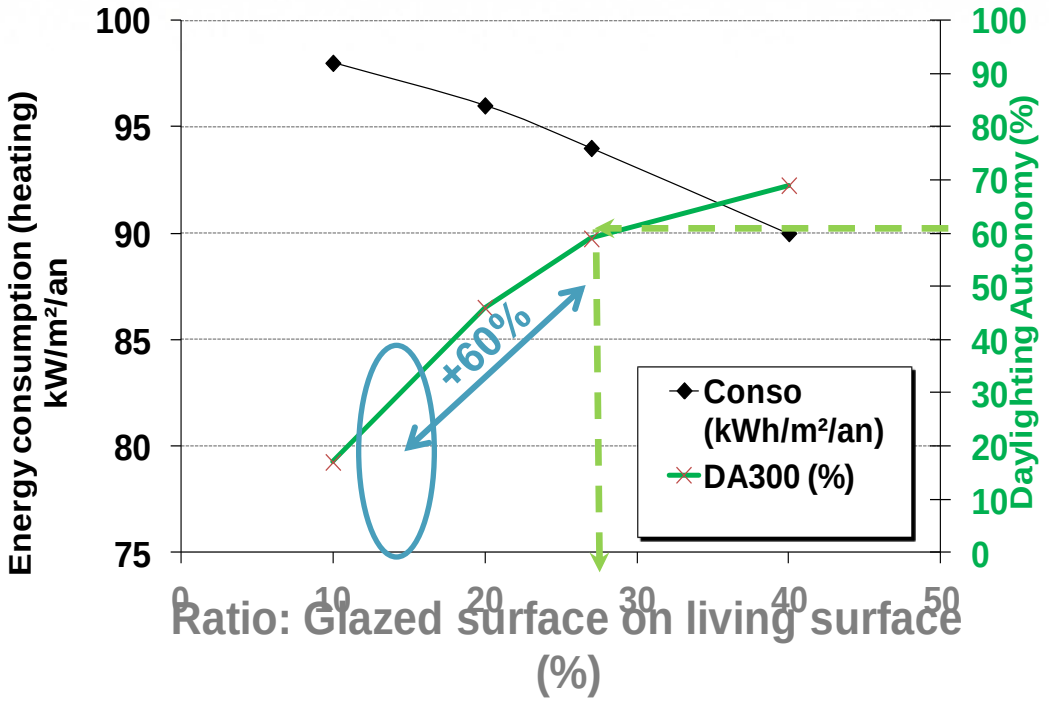
Solar heat gains to be optimized





In most climates enlarging size of performing windows helps to reduce energy consumption

Glazing areas can be increased



DA = % of the day (8-18h), during which the natural light in the house is higher than 300 LUX.

For indication, in France, new residential buildings must have a minimum glazed surface of 18%.

This is still very far below the optimum for energy efficiency AND natural daylight!

GLASS FOR EUROPE

Way to reduce artificial lighting

- As buildings become more efficient, **lighting becomes the most important consumer of energy** in buildings
- Electricity remains one of the most **carbon intensive** form of energy
- **Regulatory requirements and standards:**
  - EU EPBD directive: Nearly Zero Energy Buildings - *to become the norm as of 2020* - lighting included in energy demand (office buildings).
  - Passive Haus: electricity for lighting and appliances have to be minimised (German standard)
  - Proposal for a criterion on 'daylight availability' for the EU Ecolabel for office buildings
  - Active House: daylight factor > 5% on average
  - Need to envisage criterion on daylight autonomy

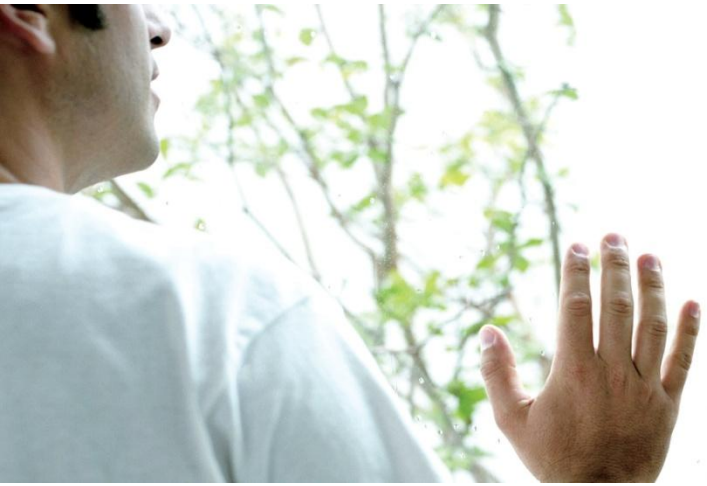
→ Easiest answer is Daylight thanks to glazed areas

Comfort
Well-being
Health
Productivity
Aesthetics

Conclusion

Hopefully, the myths are dead!
It's time to build differently with a holistic energy balance approach

- Energy efficiency of windows must take into account thermal losses AND solar heat gains
  - Calculation should be based on a robust methodology
  - Different climatic conditions with direct impact on energy consumption of the building.
  - Artificial lighting through Daylighting autonomy should be part of the energetic performance of the window
  - NEXT STEP: properly take account of the orientation and size of windows in addition to the location



Thank you!

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www.glassforeurope.com

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Building, Automotive, Solar-Energy Glass

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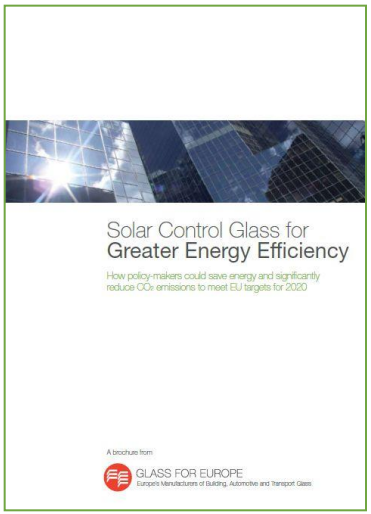
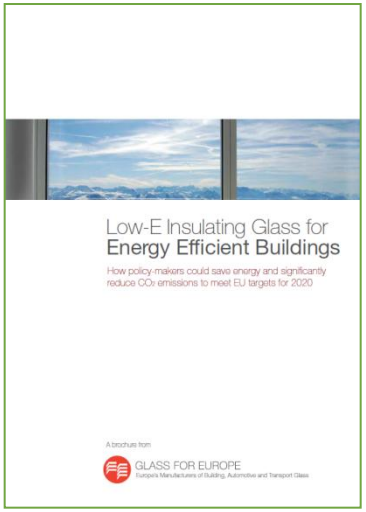
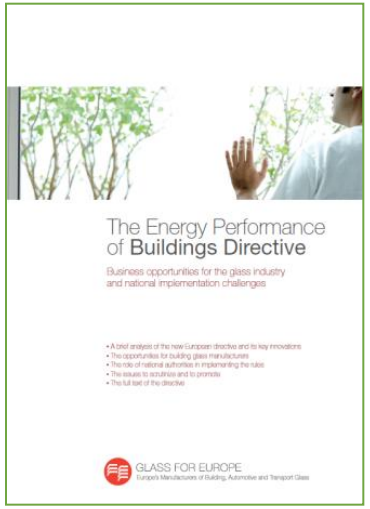
More information available



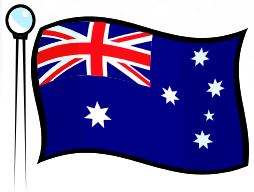




Many tools are available

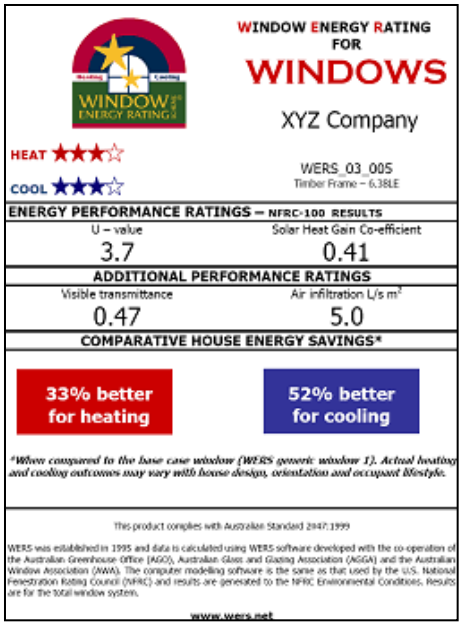
www.glassforeurope.com

Australia's WER scheme



Also based on Uw and gw for heating and cooling

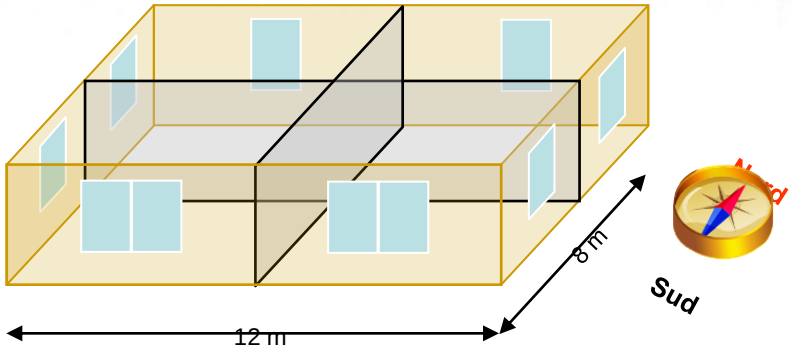
- Energy consumption modelling of three different size houses equipped with 17 windows using Accurate software
- Energy performance of the window is expressed using a 5 stars scales rating for heating and cooling
- Indicative percentage of improvements compared to reference 'model' house
- WERS ratings are designed to 'plug in' to NatHERS, Australia's Nationwide House Energy Rating Software.



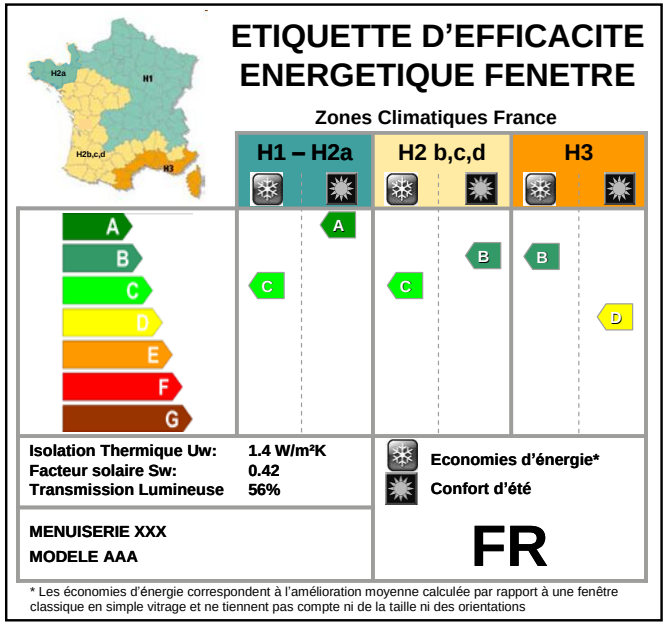
AWA
AUSTRALIAN WINDOW ASSOCIATION

GLASS FOR EUROPE

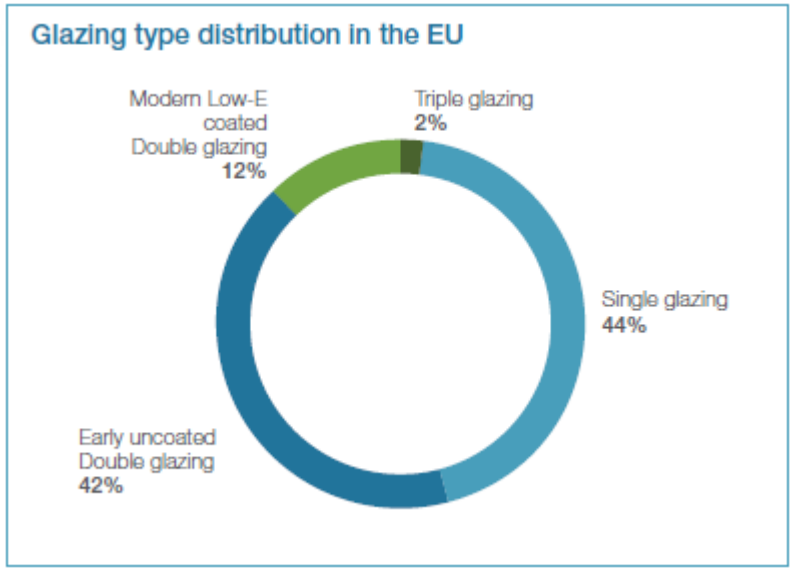
France's labeling under preparation

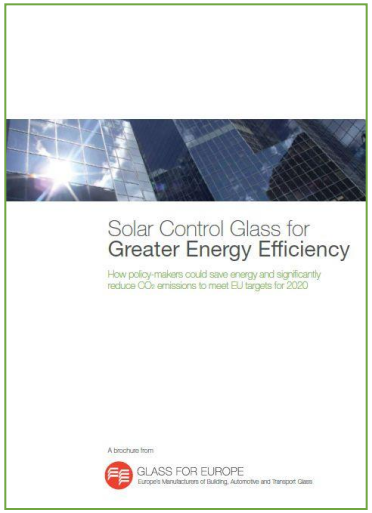


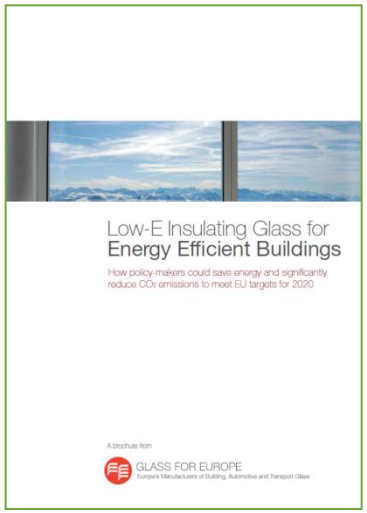
- Energy consumption is calculated with TRNSYS software using 96 different types of windows
- Multi-linear regression are used to evaluate energy consumption of building only using window parameters: Uw and gw
- Energy ranking is based on improvement compared to a single glazed window
- Summer comfort is related to potential air-conditioning consumption



Scale of the challenge in EU







- Over 85% of inefficient glazing surfaces in Europe's buildings
- Over 100 million tonnes of CO_2 to be saved annually.

* According to three different scientific studies carried by the Dutch independant research institute TNO.

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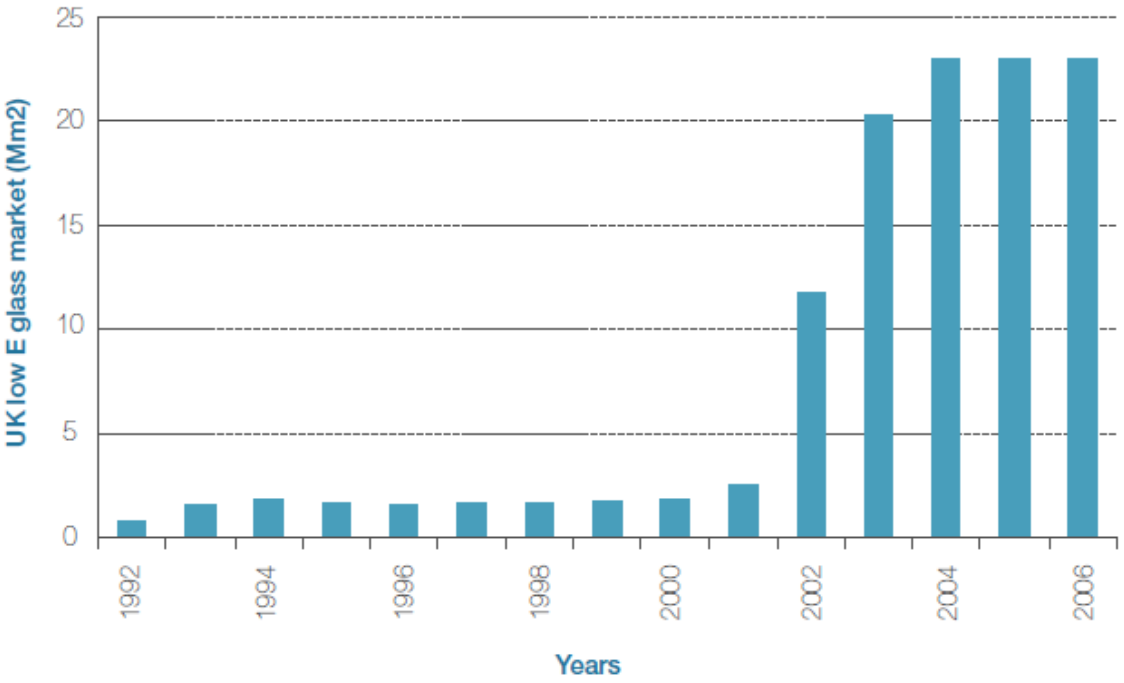
Legislations can help!

Graph showing impact of new UK Building Regulations for energy conservation, April 2002

Minimum mandatory requirements can have a dramatic affect on the market for added-value glass, as was shown in the UK when low E glass became mandatory for all replacement windows in 2002. The recast EPBD will require national governments to introduce legislation requiring "cost optimal" standards of replacement windows.



→ Importance of proper minimum energy performance requirements for components being replaced (i.e. Cost-optimality in EU recast EPBD)

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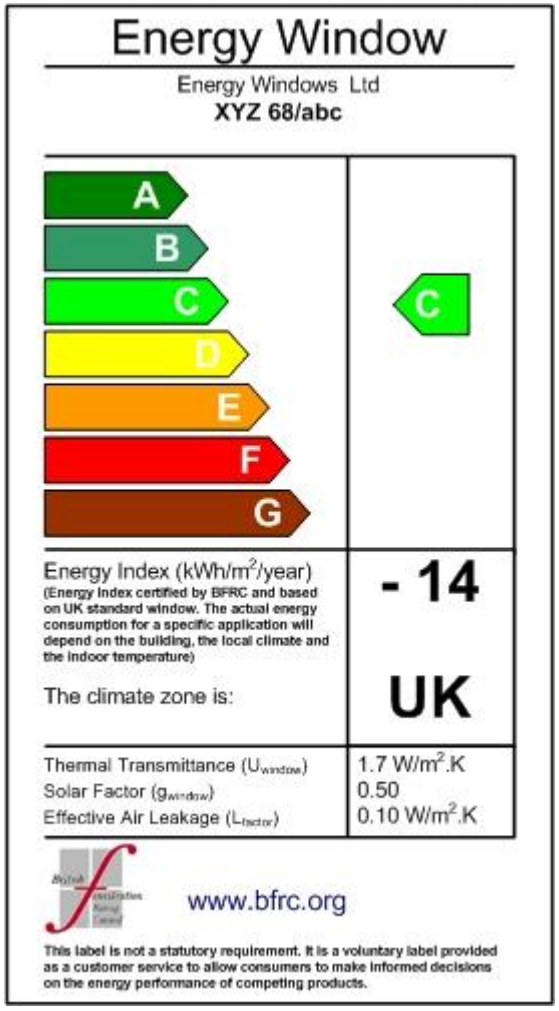
Labeling and more…



Information to consumer

+

Basis for minimum performance requirements in building regulations

+

Basis to grant financial incentives / tax returns