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GROUP



How glass is meeting the global energy efficiency challenge

*The benefit of 2S to create an eco-
friendly earth*

Phil Brown

November 2011



Global context

- The Kyoto Protocol set legally binding limits on greenhouse gas emissions from industrialised countries
- Post-Kyoto negotiations continue, but agreement reached on many elements
- Recognition that both developing and developed countries need to take action
- Current scientific evidence indicates that effects of climate change will only remain manageable if global temperatures rise by no more than 2°C (above pre-industrial levels)

The Energy Challenge



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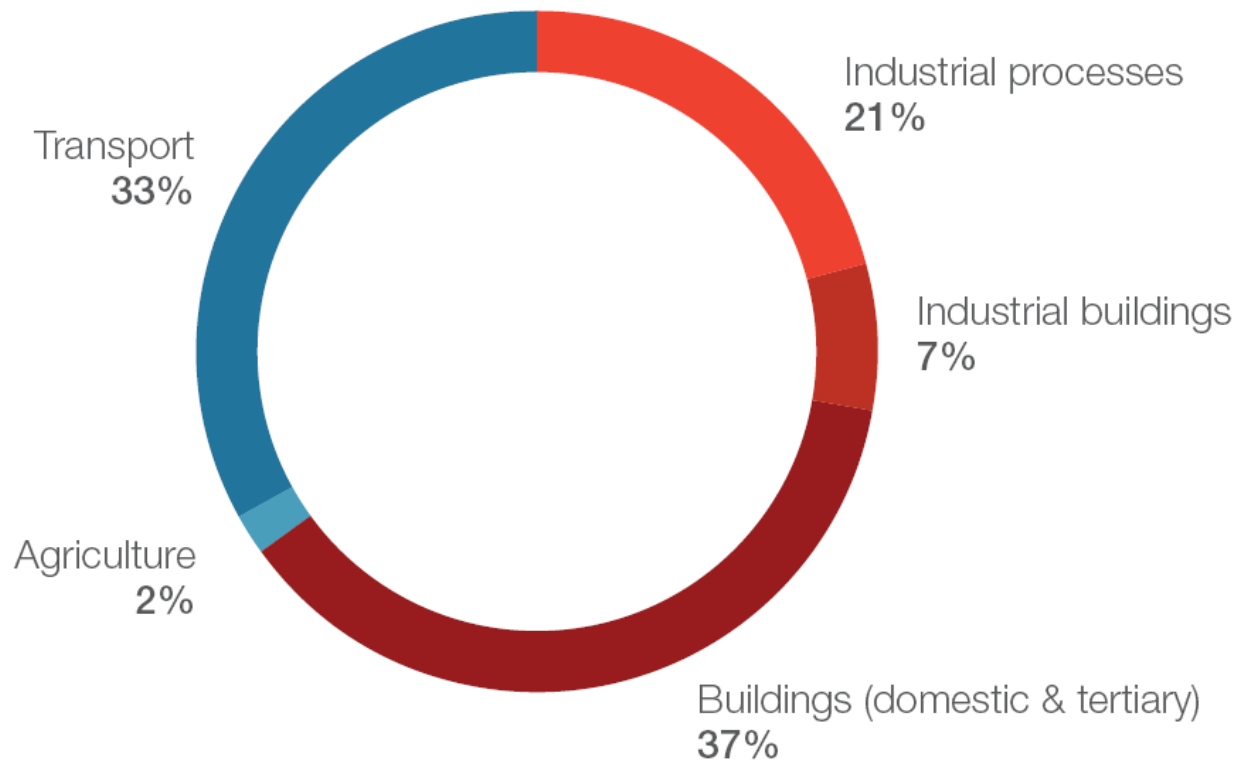
- Security of energy supply
- Addressing climate change
 - The 10 warmest years in global meteorological history have all occurred in past 15 years
 - Predicted rise in sea level
 - probable increase in the frequency of some extreme weather events
- Increased energy costs
- **The most secure energy is saved energy!**





Energy consumption in the EU

Share of total EU energy consumption

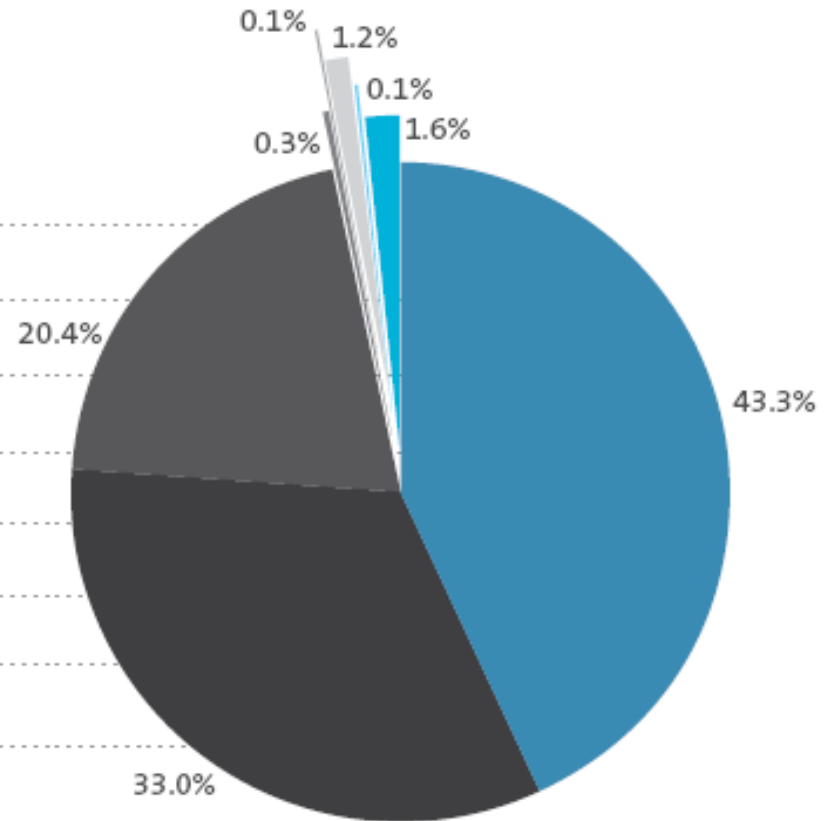




Energy consumption in Malaysia

SALES OF ELECTRICITY (GWh) (GROUP)

- INDUSTRIAL
- COMMERCIAL
- DOMESTIC
- AGRICULTURE
- MINING
- PUBLIC LIGHTING
- EXPORT
- OTHERS (TNB LPL)



Tenaga Nasional Berhad Annual Report 2010



Increasing legislation

- Focus on energy efficiency and sustainability
- Recast of EU Directive on Energy Performance of Buildings (EPBD) in Europe
- Energy Conservation Building Code (India)
- Building Energy Conservation Code 2012 (USA)
- Increased focus on sustainable buildings
 - LEED¹ (North America)
 - BREEAM² and Code for Sustainable Homes (UK)
 - Green Building Index, GBI (Malaysia)
 - Green Star (Australia)
 - Green Mark (Singapore)

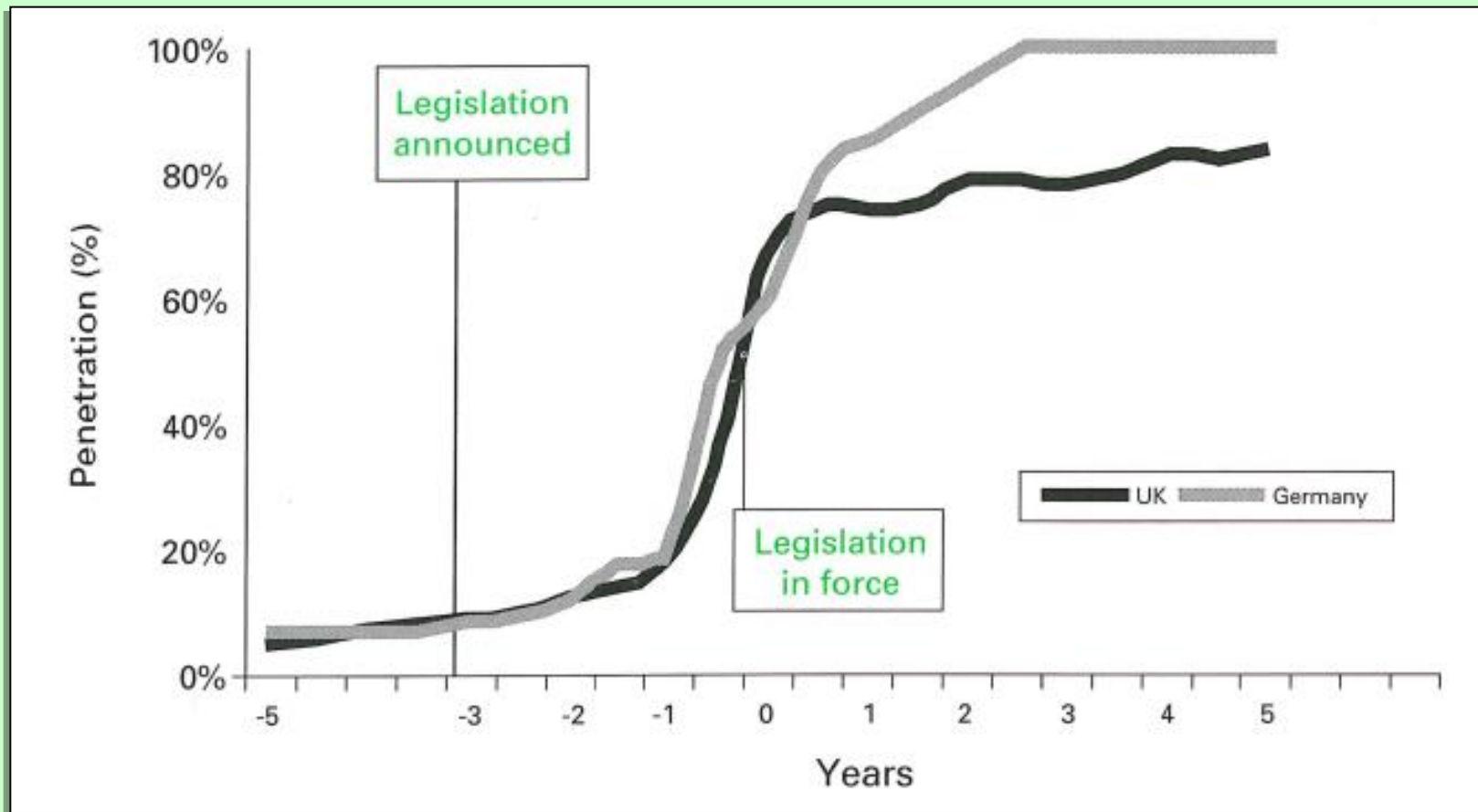
¹Leadership in Energy and Environmental Design

²Building Research Establishment Environmental Assessment Method

Impact of legislation on low-e penetration



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Source: Pilkington and the Flat Glass Industry 2008



Malaysia

- Increasing focus on energy efficiency, renewable energy and sustainability
- Programs implemented to promote energy efficiency and renewable energy
- Revision of MS 1525 (Code of practice on energy efficiency)
- Income tax exemptions for building owners obtaining GBI Certificates
- Stamp duty exemptions for buyers purchasing buildings with GBI Certificates



The role of glass



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Puteri Sentral ↓



↑ Yong Lung building



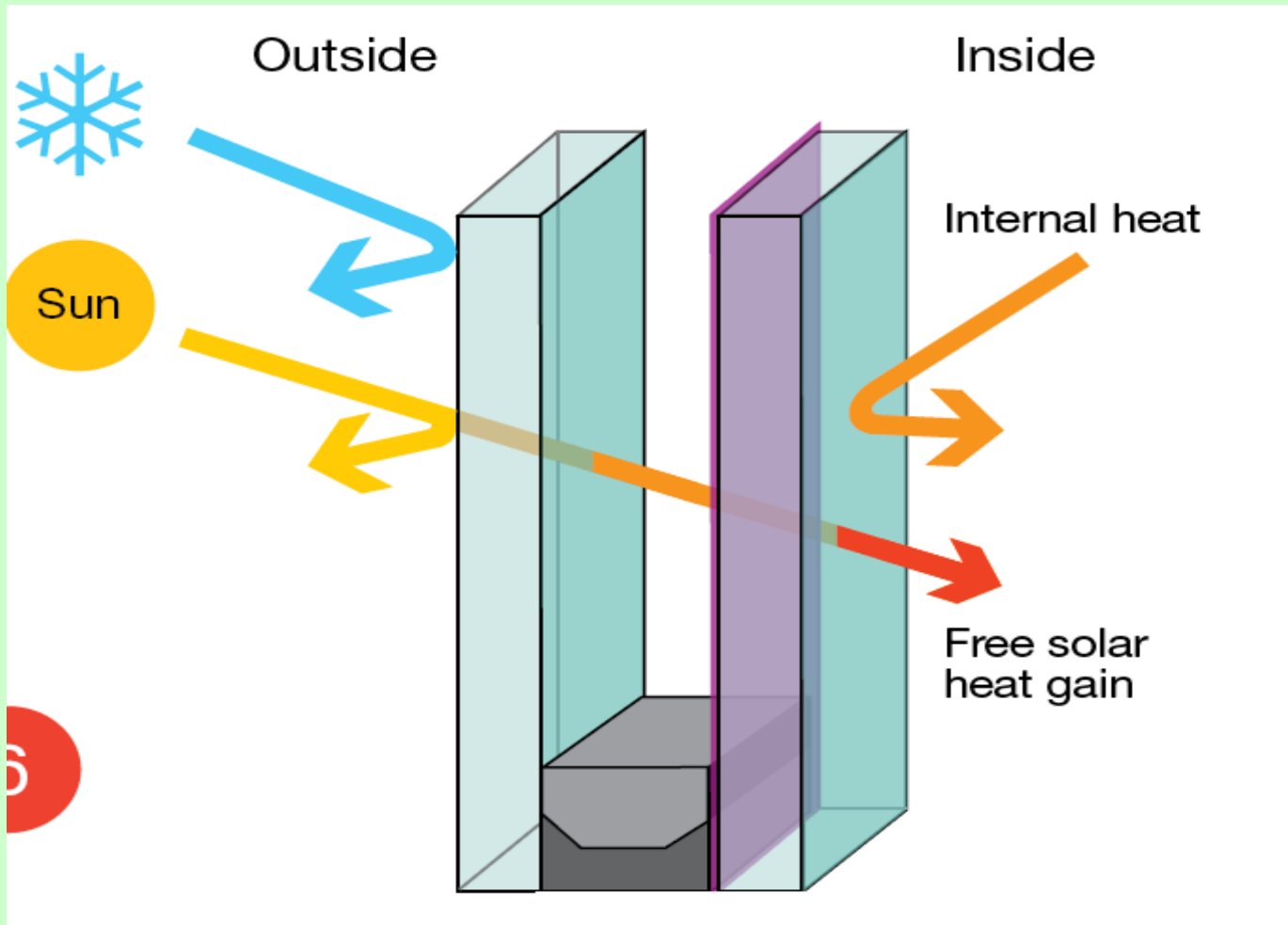


Thermal Insulation

- Advances in low emissivity (low-e) technology have made windows an essential contributor to energy conservation in buildings
- Significantly reduces heat loss through windows
- Also helps to maximize passive solar gain (free solar energy from the sun) in colder climates
- Can help even in warmer climates by reducing:
 - Conduction gains through the glass
 - Heat gains from direct solar radiation (when combined with solar control glass)
- Important parameter is U value (*low U value = good thermal insulation*)
- Products readily available
 - Pilkington **Energy Advantage**TM (in conjunction with solar control)
 - Pilkington **Solar-E**TM (thermal insulation + solar control)



Thermal insulation



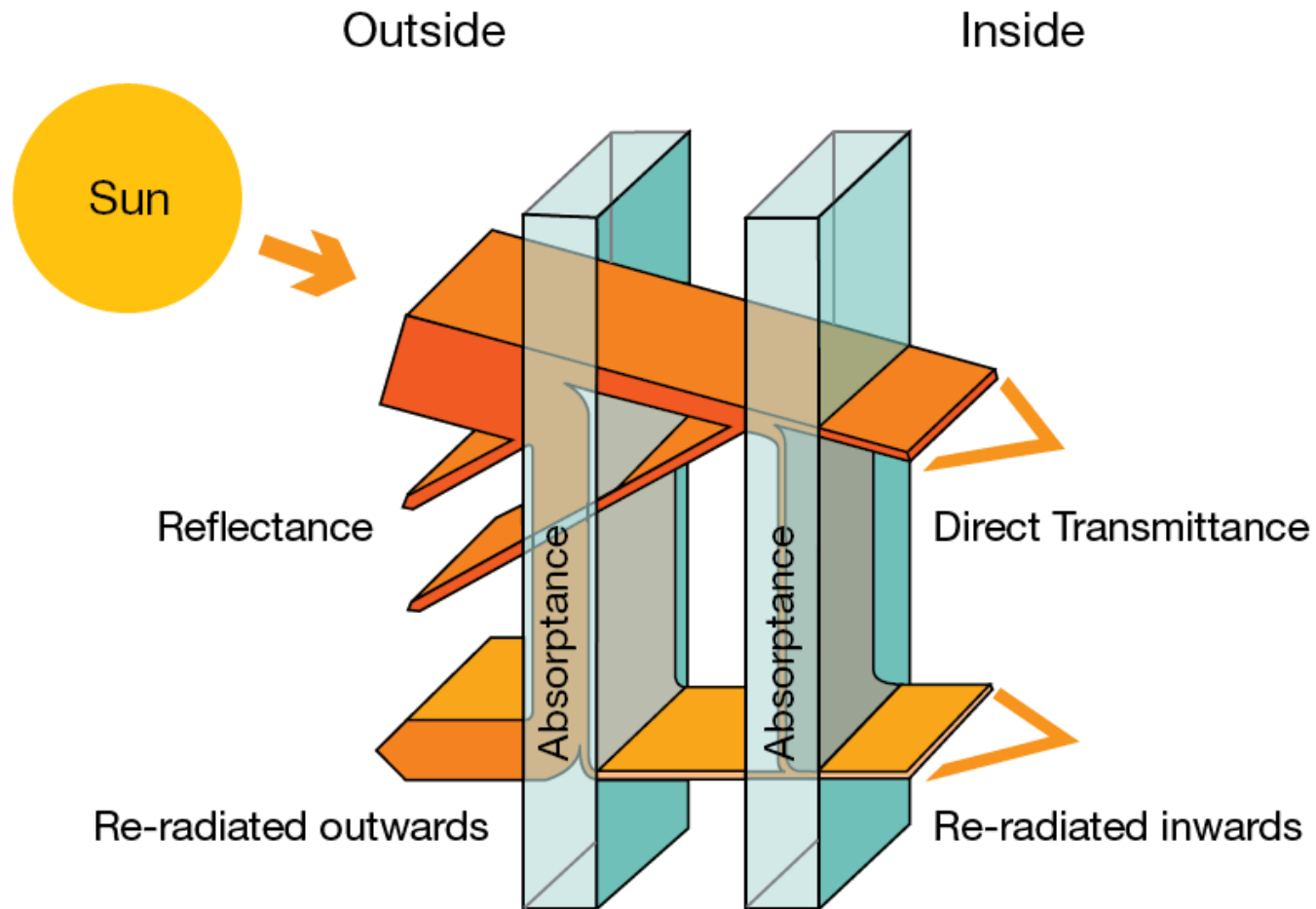


Solar control

- Minimizes solar gains into buildings by reflecting and/or absorbing energy from the sun
- Can help to reduce the air-conditioning loads in buildings
- Important parameter is Solar Heat Gain Coefficient (SHGC) or g value (*low value = good solar control*)
- Products readily available with range of performance and appearance
 - Pilkington **Emerald Green™**, Pilkington **Arctic Blue™**, Pilkington **Dark Grey™**, Pilkington **Optifloat™** Green
 - Pilkington **Reflite™**
 - Pilkington **Suncool™**
- Solar control and low e properties can be combined
 - Pilkington **Solar-E™** Clear and Tinted versions
 - Insulating glass unit (Pilkington **Emerald Green™** + Pilkington **Energy Advantage™**)
 - Laminated glass (Pilkington **Emerald Green™** + Pilkington **Solar-E™**)



Solar control





Performance data

	SHGC	SC
<u>Monolithic</u>		
6mm Pilkington Optifloat TM Clear	0.85	0.98
6mm Pilkington Solar-E TM EverGreen	0.34	0.40
<u>Laminated</u>		
13.1mm Pilkington Reflite TM Emerald Green (laminated) #4	0.35	0.41
<u>IGU</u>		
6mm Pilkington Solar-E TM EverGreen <i>outer pane</i> (#2) 12mm airspace 6mm Pilkington Optifloat TM Clear <i>inner pane</i>	0.26	0.30
6mm Pilkington Eclipse Advantage TM Arctic Blue <i>outer pane</i> (#2) 12mm airspace 6mm Pilkington Energy Advantage TM Clear <i>inner pane</i> (#3)	0.27	0.31



Glare

- Glare can be a problem when using glass with high visible light transmittance in conditions of bright sunlight
- Balance the conflict between glare and useful light
- If glare is an anticipated problem, possible solutions include:
 - Moving windows out of the field of view, using deep reveals,
 - Shading systems, and other physical modifiers
- If such solutions to glare not possible, select glass with visible transmittance that is compromise between glare and light
- A visible light transmittance as low as 25% may still provide adequate daylight

- *Reference: TIPS FOR DAYLIGHTING WITH WINDOWS The Integrated Approach LBNL-39945 (Jennifer O'Connor, Eleanor Lee, Francis Rubinstein, Stephen Selkowitz) Ernest Orlando Lawrence Berkeley National Laboratory*



Renewable energy

- Glass plays an important role in generation of solar power
 - Photovoltaic
 - Solar thermal
- Photovoltaic technologies convert solar energy into electricity
 - Crystalline silicon solar cells use glass as protective cover whilst transmitting solar energy to the cells
 - ‘Thin film’ use transparent conductive coated glass to allow light to pass through
- Solar thermal collectors collect heat to supply hot water
- Range of glass products available to optimise efficiency of these technologies
 - NSG **TEC**TM





Life cycle impact

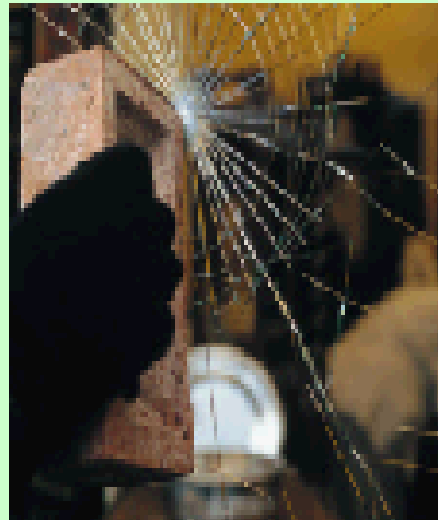
- Manufacturing flat glass is energy intensive
- CO₂ emitted during manufacture more than compensated for by CO₂ saved during use in building
- Study in EU showed that manufacture of 1m² of low e double glazing leads to emission of 25kg CO₂
- Replacing 1m² single glazing with 1m² low e double glazing
- Payback period only 3.5 months (in CO₂ terms)
- Glass is also recyclable
 - Recycled glass (cullet) melted again to produce new glass
 - Further reduces CO₂ emitted during manufacture





Influence of glass on buildings

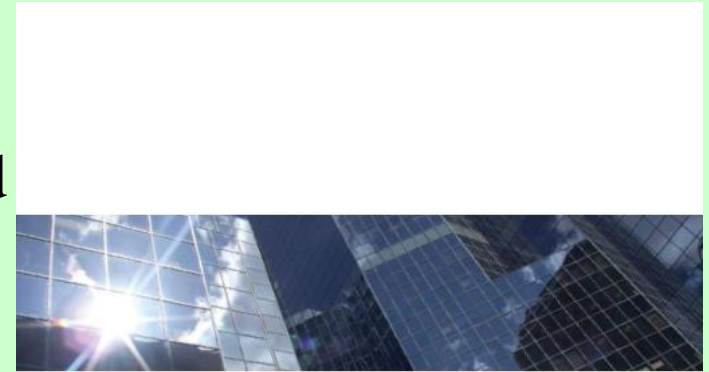
- Choice of glass has significant impact on energy performance of buildings
- In the past, glass seen as ‘weak point’ of building envelope
- With advances in glass technology and significant step changes in performance, this is no longer the case
- Glass can also offer many other benefits:
 - Noise control
 - Fire protection
 - Safety and security
 - Self-cleaning





Potential for solar control glass

- Studies carried out by TNO (Dutch scientific institute) to analyse potential for cutting CO₂ emissions from new and existing buildings by increased use of:
 - Solar control glass
- Up to 80 million tonnes of CO₂ emissions annually (5% and 25% of the EU's target) could be saved by 2020 by optimal use of solar control glass
- Even greater potential for warmer countries where air-conditioning is prevalent (e.g. Malaysia)



Solar Control Glass for Greater Energy Efficiency

How policy-makers could save energy and significantly reduce CO₂ emissions to meet EU targets for 2020

A brochure from



GLASS FOR EUROPE

Europe's Manufacturers of Building, Automotive and Transport Glass

Sustainability



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- Annual Sustainability Reports
- Sustainability targets in key areas:
 - Economic
 - Health & Safety
 - Energy
 - Product development
 - People
 - Suppliers
 - Recycling & waste
- Measurable KPIs to demonstrate improvements
- Looking inward (operations & suppliers) and outwards (customers and products)



Glass for energy efficiency



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Frequently Asked Questions

Energy saving glazing solutions and
a low carbon economy

How energy saving
glass and advanced
glass technologies
contribute can towards
a low carbon economy

www.glassforeurope.com



GLASS FOR EUROPE
Building, Automotive, Solar-Energy Glass

Product Directory



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<http://www.pilkington.com/Asia+and+Australasia/Malaysia/English/products/bp/default.htm>

The screenshot shows the Pilkington website's product directory page. At the top left is the Pilkington logo and the text "PILKINGTON NSG Group Flat Glass Business". To the right of the logo is a "Change Country" link and a search bar. Below the logo is a navigation menu with the following items: Home, Product Map, Product Benefits, Our Brand Names, and Literature & Tools. The main content area features a large image of a modern building with large glass windows. Below this image is the heading "Solar Control" and a paragraph of text: "Pilkington Solar-E™ is a range of good solar control performance on-line coated glasses offering low solar heat gain coefficient, low reflectivity, reduced glare and low-emissivity." followed by a "read more >" link. To the right of the main image are four smaller images with captions: "Solar Energy", "Solar Control", "Thermal Insulation", and "Special Applications". Below the main content area is a horizontal menu with four items: "Product Benefits" (with a small icon), "Glass in Building" (with a small icon), "Our Brand Names" (with a small icon), and "Literature & Tools" (with a small icon). Each item has a brief description. At the bottom of the page, there is a footer with contact information: "Nippon Sheet Glass Co., Ltd. Head Office - 3-5-27 Mita Minato-ku Tokyo t:+81 (0)3 5443 9477". On the right side of the footer, there are links for "Legal Notice", "Privacy Practices", "About this site", and "Accessibility". At the very bottom, there is a status bar with "Done" on the left, "Local intranet | Protected Mode: Off" in the center, and a zoom level of "100%" on the right.

Performance data



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www.pilkington.com/spectrum

Pilkington Spectrum On-line
Version 4.0.0

Language Override: English | U Value Decimal Places: 1 | Save | Open | Print | Copy | Disclaimer | Information | Noise Control

Glass 1: Pilkington Arctic Blue, Annealed, 6 mm | Cavity 1: 16 | Gas 1: Argon (90%)
 Glass 2: Pilkington K Glass, Annealed, 6 mm

Light: 9% | Energy: 7%

Light %: 44% | Energy %: 35%

Product Code	U Value	UV %	Light %			Energy %			Solar Factor	Shading Coeff.	
6ab-16Ar-K6	W/m ² K	T _{uv}	LT	LR out	LR in	ET	ER	EA	g	T 5C	S 5C
	1.5	10	44	9	15	27	7	66	0.35	0.40	0.31

Performance Code	Sound Reduction	Ra	Thickness	Weight	Selectivity	Date
U-value/Light/Energy	R _w dB (C ₂ C _{tr})	80	mm	kg/m ²	1.26	22/09/2011
1.5 / 44 / 35	31 (-1; -4)		28	30.00		

Additional Values (Hide Details...)

Bullet Resistance	Burglar Resistance	Explosion Resistance	External Fire Performance	Load Resistance (mm)
NPD	NPD	NPD	NPD	6+6

Pendulum Body Impact Resistance	Reaction to Fire	Resistance to Fire	Temperature Change Differential Resistance (K)
NPD+NPD	A1	NPD	40+40

Done | Local intranet | Protected Mode: Off | 100%



What can policymakers do?

- Make energy efficiency a priority
- Implement an ambitious energy efficiency policy, with a focus on buildings
- Work with industry to deliver standards and regulations that help to support that policy
- Encourage and require the use of energy efficient glazing for new buildings and refurbishments of existing buildings
- Provide economic and fiscal incentives to promote uptake of energy efficient glazing and create growth and jobs
- Carry out information and communication campaigns to raise awareness of the benefits of energy saving solutions

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