A NEW VISION ON SOLAR SHADING

Solar and daylight management as an essential concept in the energy performance of buildings

EUROPEAN SOLAR-SHADING ORGANIZATION

Energy Savings & Comfort

The European Solar-Shading Organization, ES-SO, was established in December 2004 to bring together the professional associations of the solar shading industry in the EU.

ES-SO's ambition is to
realize energy savings in buildings;
• reduce CO_2 emissions;
• provide better indoor liveability by optimising natural daylight; and
• develop specialized local employment in the EU member states.

www.es-so.com

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Energy Savings & Comfort

Importance of buildings in reducing energy consumption and CO_2

Reducing energy consumption and CO_2 in Europe

The EU is committed to transforming itself into a highly efficient, competitive, low-carbon economy. To achieve this, national governments are implementing the EU Climate and Energy Package, also known as the 20-20-20 targets for 2020 and beyond.
The 20-20-20 targets are:

- 20% improvement in energy efficiency;
- 20% CO_2 reduction (followed by 40% CO_2 reduction by 2030, 80% by 2050) compared to 1990 levels;
- 20% of EU energy consumption from renewable energy sources.

Buildings account for 40% of all energy consumption and 36% of CO_2 in the EU

32%
of all energy in EU is used for transport

28%
of all energy in EU is used by industry

40%
of all energy in EU is used by buildings

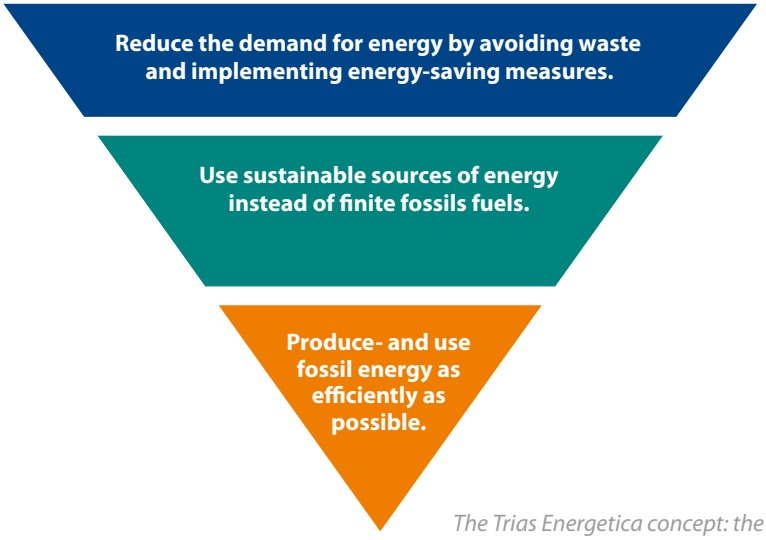
2/3 of energy consumption in buildings is used for heating and cooling

80% of energy consumption is used in small buildings < 1000 m²

Energy Performance Buildings Directive (EPBD)

The EPBD from 2010 states that from 2020 all new buildings have to be "nearly-zero energy buildings" (nZEB) with energy performance levels set at a cost-optimal level for the estimated economic lifespan. Attention should be paid due to these energy efficient buildings being highly insulated and air-tight.

The most sustainable energy is saved energy



The Trias Energetica concept: the most sustainable energy is saved energy.

The importance of solar shading for our future

Why do we need a building envelope?

"The building envelope - the parts of a building that form the primary thermal barrier between interior and exterior - plays a key role in determining levels of comfort, natural lighting and ventilation, and how much energy is required to heat and cool a building."

(OECD / IEA 2013 Technology Road Map – energy efficient building envelopes)

Progression of building envelopes from old stock to future technology

The IEA Technology Roadmap emphasizes the importance of dynamic solar control in transforming construction to zero-energy buildings.

Nearly-zero energy buildings imply both dynamic solar control and natural daylight

Inefficient - still common and old stock	Typical building code in advanced regions	Zero-energy buildings
• Single pane windows. • No insulation. • High air leakage.	• Low-e double glaze windows. • High levels of insulation. • Low air leakage.	• Highly insulated windows and dynamic solar control. • Optimised designs and orientations. • Daylighting.

(OECD / IEA 2013 Technology Road Map – energy efficient building envelopes)

Dynamic solar control avoids overheating

Nearly-zero energy buildings have an increased **need for cooling to combat overheating**, even in low seasons, due to high insulation and airtightness. Climate change reports and EPBD recommend solar shading as one of the most energy efficient solutions available.

(Sources: Overheating in low energy buildings; the influence on solar shading by Per Heiselberg, Aalborg University, Denmark – Knowledge for climate, climate proof cities, Knowledge for climate research programme – EPBD Recast, EU Directive 2010/31/EU)

Capturing natural light saves energy

30-40% of electric energy in a typical office building is spent on lighting. Solar control management, using blinds and shutters, can **use natural light to reduce the requirement for artificial lighting** by up to 80% and ensure solar gains for passive room heating.

(Sources: GLES (Guide to low energy saving) BBSA report 2013 – Keep Cool Project, report on summer comfort, 2010)

Daylight has a major effect on productivity, health and wellbeing

People now spend nearly 90% of their day inside, compared to 50 years ago when many people spent 90% of their day outside.

OUTSIDE VIEWS

Mental Function & Memory	Call Processing	Hospital Stays
10 - 25 % BETTER	**6 - 12 % FASTER**	**8,5 % SHORTER**

DAYLIGHT

Students achieve	Workers are	
5 - 14 % HIGHER TEST SCORES and learn **20 - 26 % FASTER**	**18 % MORE PRODUCTIVE**	**15-40 % INCREASE** in Retail Sales

SYSTEMS

Productivity increased by
23 %
from better lighting
11 %
from better ventilation
3 %
from individual temperature control

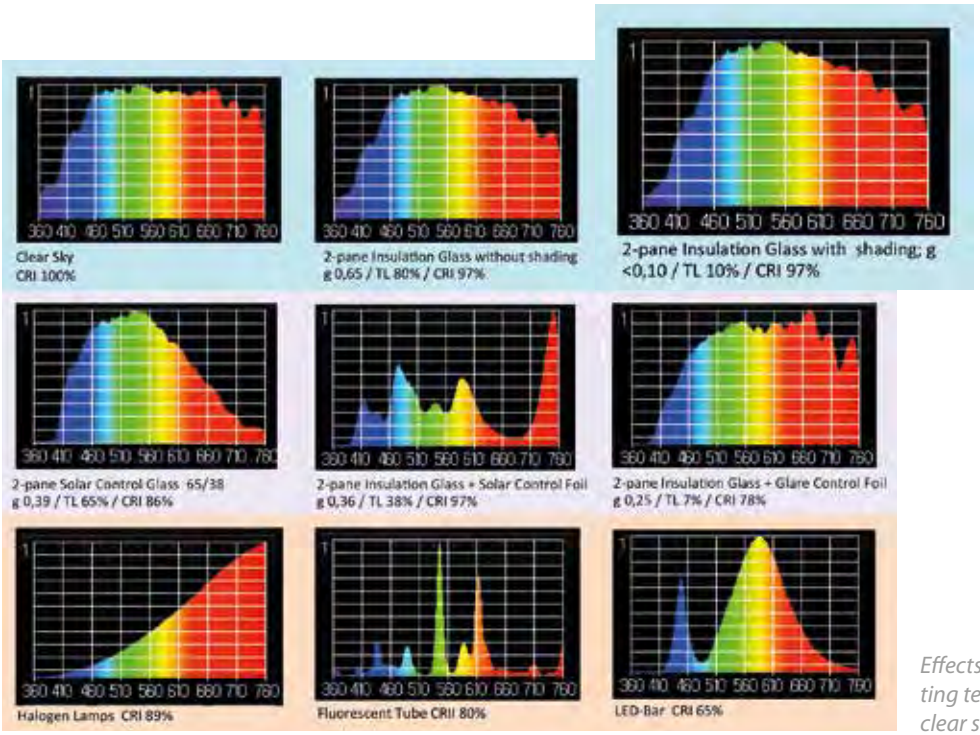
(A business case for green building, WGBC report 2013)

"Maximum colour spectrum daylight" – not just daylight – is essential for general wellbeing

Solar shading combined with clear glazing ensures the quality of daylight, only changing it to diffuse light, by guaranteeing **the full spectrum of visual daylight** and the best Colour Rendering Index (CRI) (see figure below). CRI measures how faithfully the appearance of visual colours is revealed in comparison with ideal or natural light. The graphs below compare the spectra of glazing and shading together with the spectrum of natural light.

The ability to vary both solar gain and thermal loss through the positioning of solar shading clearly demonstrates the extent to which dynamic shading systems can **outperform static glazing systems** whose optical properties are fixed. The full dynamic range of solar transmittance is very high for shading (CRI 97 compared to CRI 86 for solar control glass).

Extremely low g-values can be achieved by using dynamic shading devices *without adverse colour rendering of transmitted light* or an adverse effect on the glazing temperature.



Effects of solar control and lighting technologies on clear sky spectrum.

Solar shading in energy efficient buildings

As an integral part of the building envelope in energy performance buildings, solar shading has evolved from a "component" to a "concept of solar and daylight management".

Solar and daylight management	
For saving energy and costs	**For increasing comfort, health, productivity and wellbeing**
Cooling • Keeps out the heat in "summer" conditions • Risk of overheating in high performance buildings due to high insulation and air-tight buildings • Costs for heating will shift towards cooling, even in colder climates **Heating** • Captures solar energy in "winter" conditions • Improves insulation at night in "winter" conditions **Artificial lighting** • Large glazing areas are needed to capture enough daylight to reduce lighting costs	**Maximize natural daylight** **Keep full colour rendering of transmitted light** **Reduce glare and filter daylight** **Reduce overheating**

Performance Shading Solutions should be integrated by the architect/builder as an essential concept in the design of sustainable buildings.

Solar shading in refurbished buildings

New buildings make up only 1-1.5% of the housing stock. It will take 50 years for all energy-inefficient windows in old housing stock to be replaced.

There are currently nearly 2 billion energy-inefficient window units in the EU and over 3 billion across Europe. Of the window units in the EU, 44% are single glazing and 42% are uncoated double-glazing.

(Source: Eurowindoor survey based on Window market in Europe, study VFF-Verband Fenster+ Facade 2013. GlassforEurope, Competitive low carbon economy report, 2012)

To meet the 20-20-20 targets, the industry needs to focus on refurbishment to replace inefficient glazing with dynamic solar shading solutions. This will deliver cooling energy savings of around 40% and heating savings of 18%.

Solar shading and its CO_2 footprint

Shading is cost efficient delivering *energy savings of up to 60 times its CO_2 footprint over its 20-year lifespan.*

The Würzburg Schweinfurt Institute in Germany calculated the CO_2 footprint (carbon footprint) on behalf of the Greenhouse Gas Protocol of the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD). The calculations were based on a motorised, standard external venetian blind with 80mm slats, 1.2m x 2.0m big.

The results show that 86% of CO_2 emissions come from the extraction of raw materials and the production of primary products. Only 0.5% is created during manufacturing. Assuming a lifespan of 20 years, up to 11% is created during the operational phase, while transport and disposal accounts for 2.4%.

In the course of its lifespan, a venetian blind creates approximately 150kg of CO_2 emissions. However, the external shading it produces saves over 8,500kg of CO_2, a 57-fold improvement. Other types of external shading, in particular external roller blinds and screens with various types of solar shading fabrics, will have a better energy saving and carbon footprint record, as they usually generate much less CO_2 during their production process.

ES-SO 2014 Study: "Dynamic shading solutions for energy efficient buildings"

Cooling energy savings

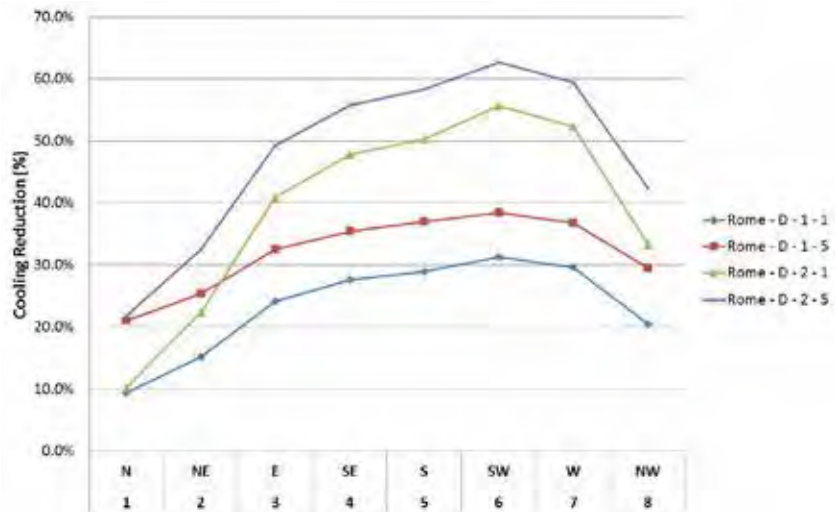
Dynamic solar shading leads to **mean cooling energy savings of more than 36%** when averaged across all glazing types and climate conditions in Europe.

Glazing ID	Glazing	Rome		Brussels		Stockholm		Budapest	
		Int	Ext	Int	Ext	Int	Ext	Int	Ext
A	Single Clear	36%	71%	31%	64%	33%	66%	32%	65%
B	Double Clear	33%	70%	25%	59%	29%	65%	27%	62%
C	Heat Control	35%	67%	24%	53%	29%	61%	27%	57%
D	Solar Control	31%	63%	24%	51%	25%	58%	26%	54%
E	Triple Clear	32%	68%	24%	56%	28%	63%	26%	59%
F	Double Clear Low-e	33%	69%	25%	55%	29%	63%	27%	59%

Comparison of relative percentage cooling energy savings of best performing dynamic internal and external shaded glazings by unshaded glazing: Rome, Brussels, Stockholm and Budapest.

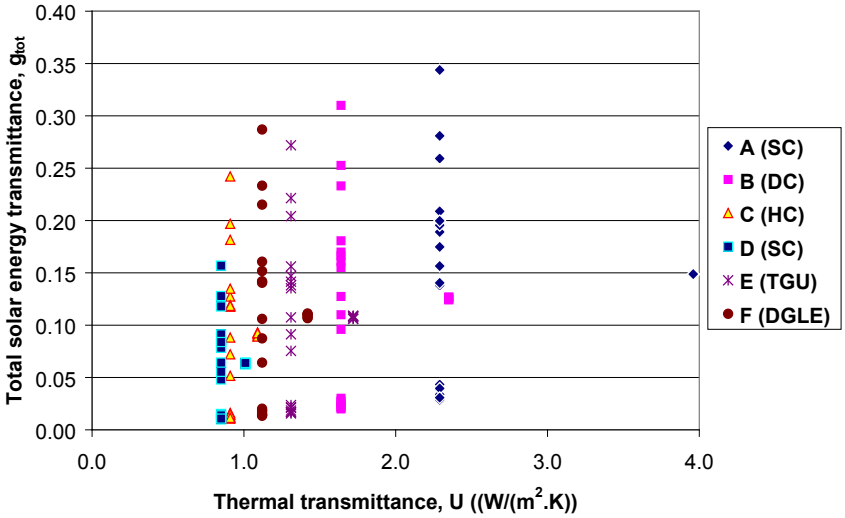
Cooling energy savings are higher for facades orientated between south east and west, with mean cooling energy savings rising to 59%. The highest cooling energy savings of 65-70% are achieveable on south west facades.

The table below illustrates the cooling energy savings for shades combined with the highest performing solar control glazing (D) in Rome, Italy.



Cooling Energy Savings: Shaded solar control glazing (D) in Rome

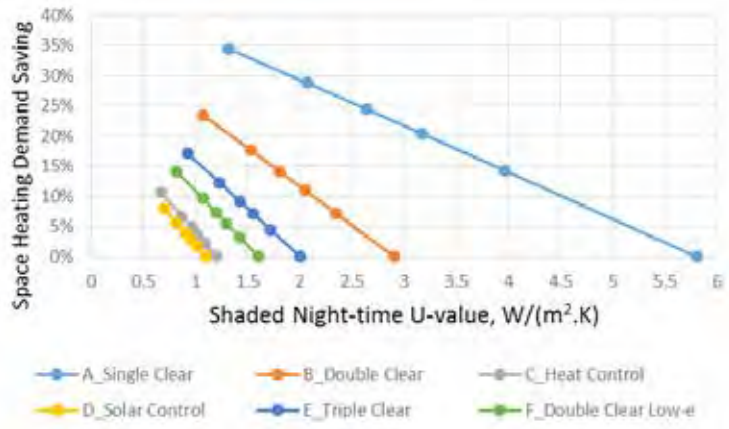
With the best performing external shading products, solar energy or g-values can be reduced to values as low as 0.02 for all types of glazing. The figure below shows **the impact of different shading products on the total solar energy transmittance** of the 6 EN reference glazing types.



EN Reference Glazings with External Shading: Dynamic impact of shading on solar gain values.

Heating energy savings

Reducing night u-values by closing shading devices has a positive impact on space heating requirements for all European climate types. The figure below shows the percentage of annual space heating energy savings through shaded night u-values.



Space Heating Demand Savings, Glazings A - F

The reduction in u-values is 55% for single and 40% for uncoated double glazing (assuming low permeability closed shades for EN 13125 Class 3 and 3/4).

	Single Clear	Double Clear	Heat Control	Solar Control	Triple Clear	Double Clear Low-e
	A_cUn W/(m2.K)	B_cUn W/(m2.K)	C_cUn W/(m2.K)	D_cUn W/(m2.K)	E_cUn W/(m2.K)	F_cUn W/(m2.K)
Unshaded	5.80	2.90	1.20	1.10	2.00	1.60
Class 1	3.96	2.35	1.09	1.01	1.72	1.42
Class 2	3.17	2.05	1.02	0.95	1.55	1.30
Class 3	2.64	1.81	0.96	0.90	1.42	1.20
Class 3/4	2.07	1.53	0.87	0.82	1.23	1.07
Class 5	1.32	1.07	0.67	0.70	0.92	0.82

Night-time U-values, Un, of the fully shaded reference glazings by air permeability (EN13125).

Conclusions and implications for the solar shading industry

Energy savings and CO_2 reduction figures updated
Figures are based on energy inefficient glazing still on the European market.
If 75% install dynamic solar shading, savings include:

Heating savings	**18.15 Mtoe/year**	**Cooling savings**	**39.81 Mtoe/year**
Heating CO_2 savings	**43.07 $MtCO_2$/year**	**Cooling CO_2 savings**	**94.46 $MtCO_2$/year**

Overall (new build and refurbishment) energy savings for cooling and heating by dynamic solar shading solutions can exceed 13%.

Cfr ESCORP-EU 25 report of 2005:
CO_2 savings for heating 31 MtCO2/year and CO_2 savings for cooling 80 $MtCO_2$ based on 50% take up of shading. The energy savings reached by using shading were estimated to be up to 10% of the total building energy consumption.
Mtoe: million tonnes of oil equivalent

The **ES-SO 2014 study** clearly demonstrates the **impact solar shading solutions can have on energy savings**, plus the **size of old window stock is much higher** than previously assumed. Solar shading refurbishment can achieve reductions of 17 Mtoe energy savings and 40 Mtoe CO_2 for heating; these figures are 35 Mtoe energy savings and 85 Mtoe CO_2 for cooling.

Shading is a mature technology engrained in local building culture and habits where it is often a present and visible part of buildings all over Europe. A wide variety of solutions and combinations are readily available for energy efficient refurbishment.

Dynamic solar shading solutions are an essential concept in energy performance buildings, in order to avoid the risks of overheating due to the evolutions in building construction and climate change. The situation will worsen if dynamic solar shading doesn't become an integral part of the building concept.

The combination of external and internal dynamic solar shading is essential for energy savings and healthy indoor comfort for both refurbishment and new buildings. Shading is cost efficient delivering energy savings of up to 60 times its CO_2 footprint over its 20-year lifespan.

The challenge faced by the building sector in order to achieve the target of 40% CO_2 savings by 2030 and 80% CO_2 savings by 2050 is the development of innovative smart control systems which will effectively regulate the operation of integrated solar shading, glazing, natural ventilation, HVAC and lighting systems within a common framework.

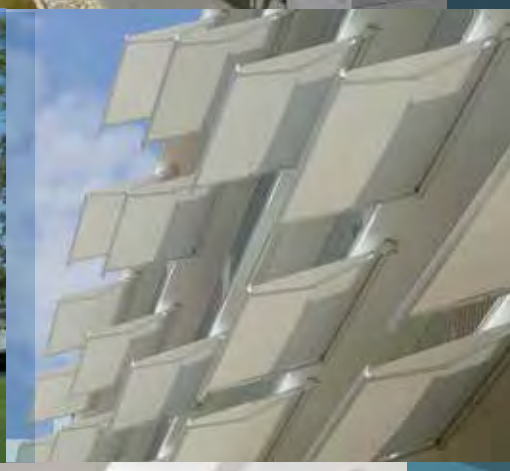
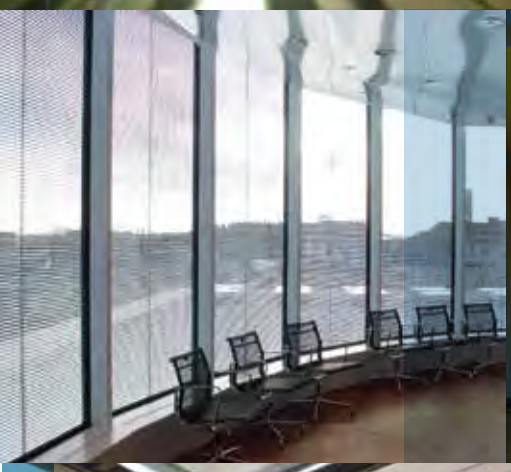
The industry needs to undertake the mission of user education: raising awareness of the correct way to use energy-efficient building solutions while delivering the desired indoor environment.

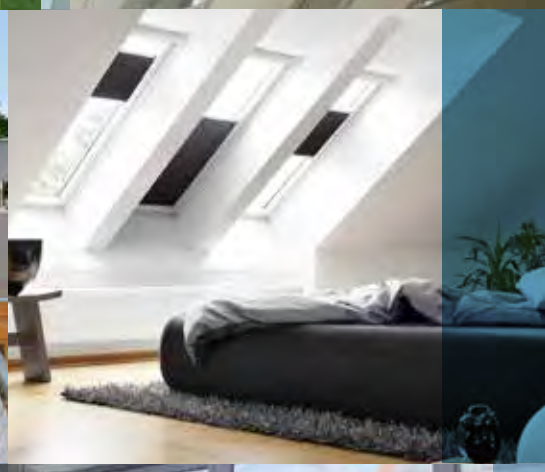
Solar shading is much more than a component. A performance shading solution is a *concept that combines solar and daylight management*. Architects and builders should integrate it as standard in all designs for both new sustainable buildings as well as refurbishments.
By doing so, we will have a major impact on the 20-20-20 targets and help our planet.

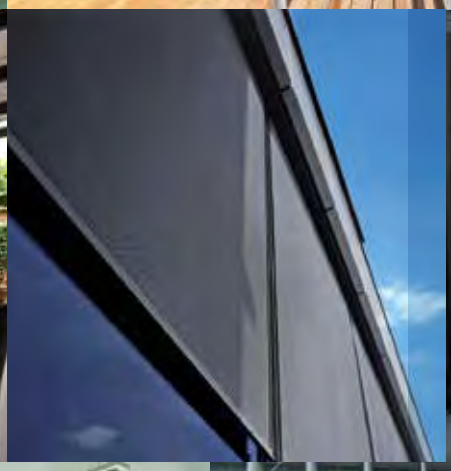
Selection of photos from ES-SO members

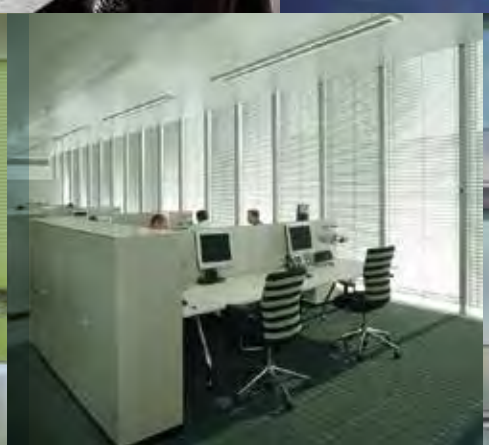




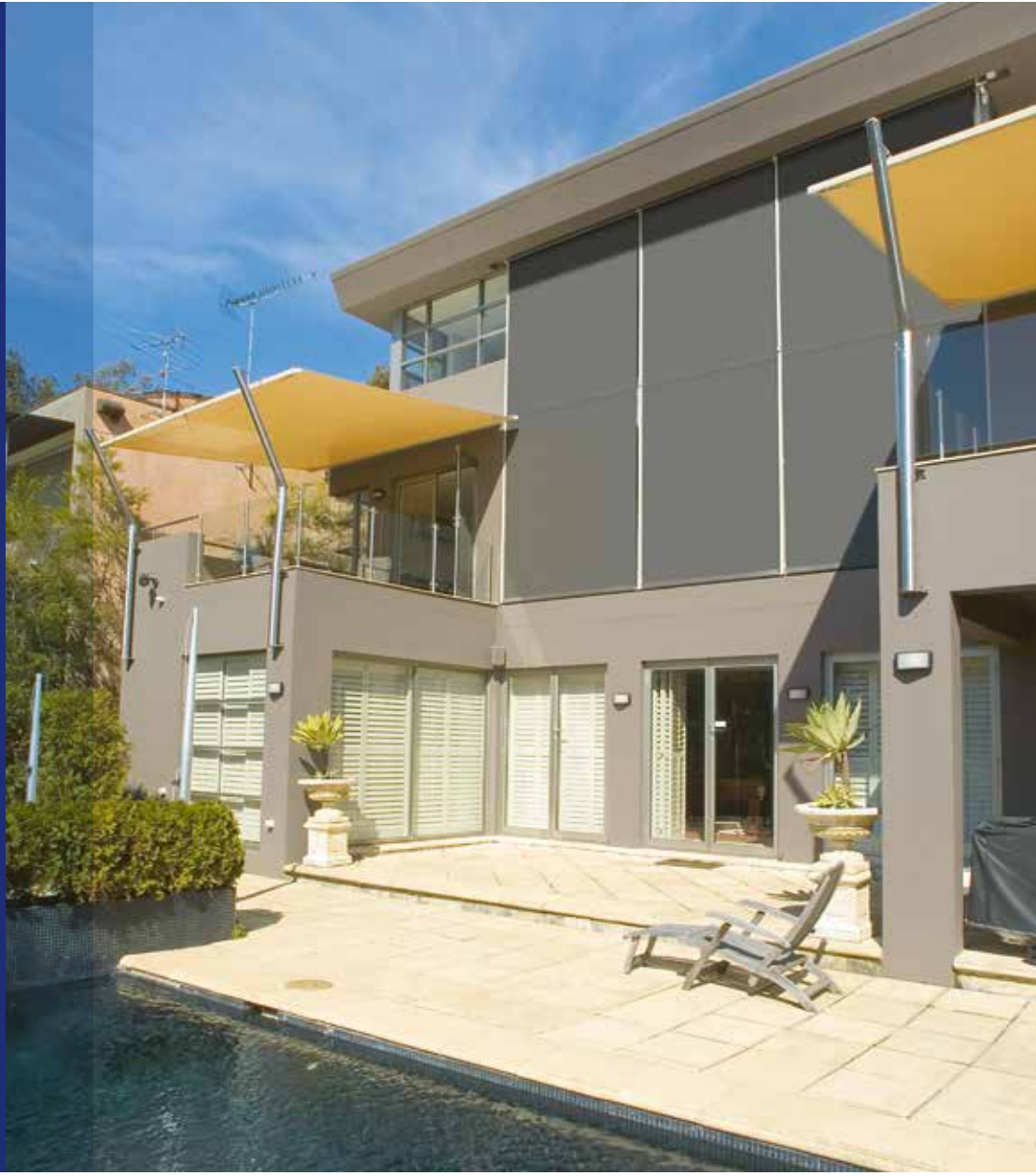








Solar and daylight management increases the indoor and visual comfort, health and productivity of inhabitants and users and is crucial to avoid overheating in nearly-zero energy buildings.
The ES-SO 2014 study demonstrates the impact external and internal solar shading can have on energy savings.
In order to achieve the 20-20-20 targets, solar shading solutions should be integrated as a concept by architects and builders in all designs for both new sustainable buildings as well as refurbishments.



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