Solar Control Glass for **Greater Energy Efficiency**

How policy-makers could save energy and significantly reduce CO_2 emissions to meet EU targets for 2020

A brochure from

GLASS FOR EUROPE
Europe's Manufacturers of Building, Automotive and Transport Glass

Key Facts about the EU's 2020 Targets

Fact: Greater use of solar control glass in residential and non-residential buildings in the EU could save between 15 and 85 million tonnes of CO_2 annually by 2020 (depending on the way Europeans install and use air-conditioning systems between now and then).

Fact: This is good news because the EU has committed to cutting around 300 million tonnes of needless CO_2 emissions annually in the same time frame by saving energy wasted in residential and non-residential buildings. Therefore, using solar control glass could save anywhere between 5% and 25% of the EU's emissions reduction targets for buildings.

Fact: EU leaders want to save 20% of the EU's overall energy requirement by 2020, cutting CO_2 emissions in the process. If successful, the EU's overall energy saving would be 390 million tonnes of oil equivalent and a cut of 780 million tonnes* of CO_2 emissions.

Fact: The EU's overall inability to use energy efficiently across all activities will needlessly cost hundreds of billions of euros by 2020. So greater use of solar control glass will also save money.

Fact: For comfort and productivity, more and more Europeans understandably wish to work and live in air-conditioned environments. More air-conditioning means more energy demand. Solar control glass helps minimise the amount of air-conditioning required and sometimes even eliminates the need for it.

Fact: Solar control glass technology exists today and is ready to use. Energy savings from installation of solar control glass by far outweigh the energy consumed in manufacturing the glass.

Sources: General facts from **"Action Plan for Energy Efficiency: Realising the Potential"** (Communication from the Commission, COM(2006)545 final of 19.10.2006) and, for facts about solar control glass, **"Impact of Solar Control Glazing on energy and CO_2 savings in Europe"** (TNO Report 2007-D-R0576/B by TNO Built Environment and Geosciences, Delft, The Netherlands).

* This figure refers to the target for the EU25.

Solar Control Glass Saves Energy. Policy Makers Should Promote its Use to Cut CO_2 Emissions.

Residential and non-residential buildings that use more energy than necessary to stay cool are a major source of unnecessary CO_2 emissions.

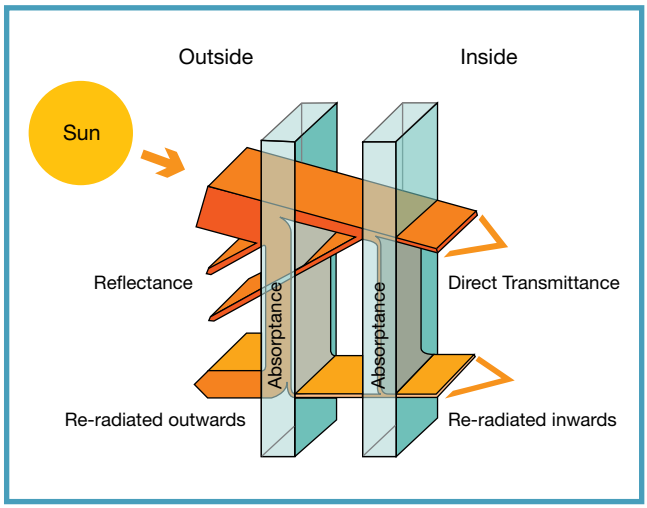
In March 2007, EU heads of state and government confirmed the need to save annually around 300 million tonnes of CO_2 from buildings by 2020.

Policy makers could achieve between 5% and 25% of that target by promoting greater use of solar control glass in existing and new buildings in Europe – ensuring that less energy is required to keep the interiors cool.

This technology exists today. The EU and its Member States can use it to help achieve their own targets, by acting to ensure that more solar control glass is installed.

The Energy Performance of Buildings Directive requires all Member States of the EU to improve their building regulations every five years. Encouraging greater use of solar control glass should be a top priority.

The potential for solar control glass to cut CO_2 emissions from buildings has been analysed by the Dutch scientific institute, TNO, in a study that is technically rigorous and conservative. The results are presented in this brochure. The study concludes that between 15 and 85 million tonnes of CO_2 emissions could be avoided annually by the year 2020 if solar control glass were used optimally.



Solar control glass

Solar control glass is a hi-tech product developed by the glass industry to allow sunlight to pass through a window or façade while radiating and reflecting away a large degree of the sun's heat. The indoor space stays bright and much cooler than would be the case if normal glass were used.

Solar control glass is not necessarily coloured or mirrored glass, although such finishes can be applied for aesthetic purposes if desired. It incorporates invisible layers of special materials on the glass which have the dual effect of allowing sunlight in, while repelling solar heat. Solar control glass units are typically double-glazed, which means they also insulate well.

Architect Natal Enka specified Sunergy Azur solar control glass from **AGC Flat Glass Europe** in panels that also provide enhanced thermal insulation for Moscow-City Business Center.

Cooling Buildings **without** Warming the Planet

Air-conditioning in large buildings is a necessity today. The demand for it will increase into the future, due not only to the increasing numbers of people working in large buildings, but also because of rising external temperatures and higher expectations of comfort.

Air-conditioning makes a positive contribution to the working conditions experienced by Europe's workforce, to the economy, and to quality of life. The trick is to keep its overall CO_2 output to a minimum.

This can be achieved by increasing the efficiency of air-conditioning systems. Manufacturers are investing in this with admirable results.

The other important thing we can do is make sure that air-conditioning systems don't work overtime fighting the sun's natural heat when this can be avoided.

This is where solar control glass comes in. It lets in the sunlight but keeps out much of the heat. Use of such glass saves huge amounts of energy, as the study we present in this brochure demonstrates.

What can governments do to cut CO_2 emissions?

- Encourage and, where necessary, require the use of solar control glass in national building regulations for new construction.
- Encourage or require retrofitting of existing buildings with solar control glass by fiscal or legislative means.
- Provide economic and fiscal incentives to both users and manufacturers of solar control glass to promote better market uptake of these energy-saving products.
- Ensure that all relevant public buildings are fitted with solar control glass.
- Organise information and communication campaigns on the benefits of using solar control glass.

ClimaGuard Premium solar control glass by **Guardian** gives high optical transparency in this German house. Argon gas-filled panels provide optimum thermal insulation.

The Fight Against Climate Change **Unites Society**

Few dispute that human economic activity is altering the global climate, with a trend of increasing temperatures. The challenge now is to find every available way to stop the process.

Citizens play a role by willingly changing their behaviour; industry plays a role by willingly improving its products and processes to become more energy-efficient; and governments play a role by establishing policy for society and setting requirements that will lead to change benefitting the environment.

Policy makers are giving increasing attention to the role of buildings in energy consumption and CO_2 emissions. This is a welcome focus, as most buildings today are less energy-efficient than they should be and, therefore, contribute unnecessarily to climate change.

This brochure describes how an existing technology – solar control glass – offers policy-makers a way to increase the efficiency of Europe's building stock.

Increasing temperatures outside, increasing workforce inside to be kept cool

One of the challenges of fighting climate change is maintaining comfortable interior environments without contributing still further to total CO_2 output. The changing nature of the workplace environment in Europe - from manual to sedentary activity - means an increasing number of office buildings will need to be cooled inside. This effect will be multiplied further by the overall trend of increasing external temperatures, as the climate change process that has already begun continues to have its effect. How can the desirable evolution of Europe's economy be made compatible with the fight against climate change?

Staying comfortable at home

At home too, Europeans are increasingly turning to air-conditioning solutions to keep their living spaces comfortable. In busy cities, opening windows to try to cool an apartment also brings unwanted noise and dust from outside into the home. Many people are keeping the windows closed and installing equipment to condition and cool the air inside.

Solar control glass can be used very effectively to reduce the heat that builds up in private houses and apartments, reducing, and in many cases eliminating, the need for air-conditioning.

A Rigorous Study

A scientific determination of the potential benefit of solar control glass

Glass for Europe commissioned TNO to perform a study of the potential impact on energy and CO_2 savings in Europe of an increased use of solar control glass, which also has low-emissivity properties (see page 10). The report of the study is available on request from Glass for Europe or at www.glassforeurope.com.

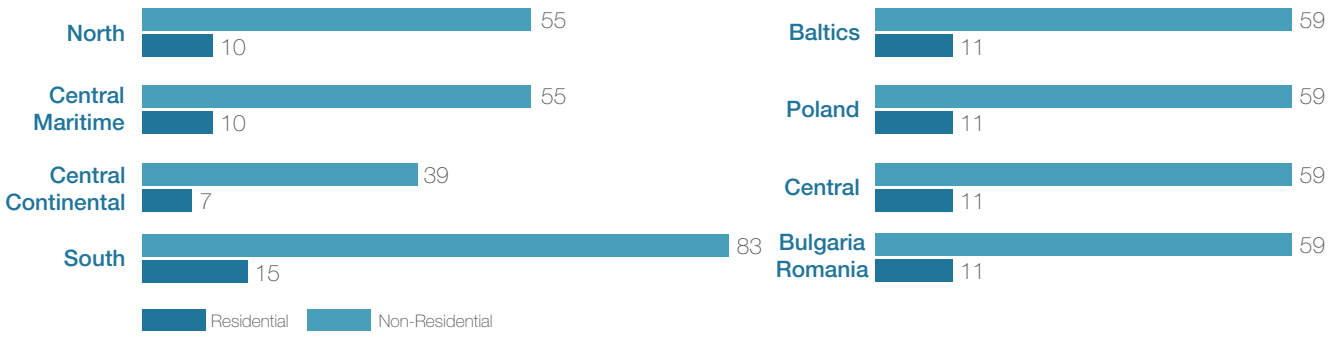
The study stands out for being exceptionally rigorous in its methodology and controls, and for the conservative and cautious approach adopted when making the assumptions built into the models. This has produced results that are serious, solid and credible.

The study is forward-looking, evaluating the likely impact of certain policy options in the future. It was, therefore, necessary to base it on certain sets of assumptions – or scenarios – regarding important variables, notably the use of air-conditioning.

The study envisaged four possible future scenarios within which to evaluate the potential impact of greater use of solar control glass, and then did a complete analysis for each.

Glass for Europe believes that the scenarios most likely to emerge in reality are those which anticipate a significant growth of air-conditioned buildings in Europe. In these scenarios, the study shows that consistent use of solar control glass could account for between 5% and 25% of the building-efficiency goals already set by European policy-makers for 2020.

Figure 1. Percentage of new buildings by region* constructed in the period 2007-2020 assumed to be air-conditioned**



Key factors considered

The calculation of the potential benefit of solar control glass in the 27 EU Member States took various key factors into account. Direct or extrapolated data were used for local climatic conditions; the mix of energy sources in use (CO_2 output per terajoule (TJ)*** varies depending on whether, for example, electricity is generated from coal, gas or nuclear); and the nature of the building stock (categorised by, for example, age, construction materials, whether residential or not, air-conditioned or not). Eight distinct groupings were identified on this basis. Figure 1 shows the assumptions that were made regarding air-conditioning in both residential and non-residential buildings in these eight regional groupings.

* Please see Table 2 (page 8) for the countries included in each region.

** It is assumed that the percentage of new buildings that are air-conditioned will be approximately twice as high in the period 2007 to 2020 as in the stock of buildings in existence in 2006.

*** A terajoule is 10^{12} joules. A joule is the amount of energy needed to produce power of one watt continuously for one second, or heat one gramme of dry, cool air by 1 degree Celsius.

Insulight Sun solar control glass from **Pilkington** keeps people cool inside the "Cockpit", the futurist headquarters of the Hessing Motor Company in the Netherlands.

27 countries, 8 regions, 4 scenarios

For purposes of the study, the EU Member States were grouped into eight regions that share similar climatic characteristics. The groupings of countries can be seen in Tables 2 and 3.

The scenarios for modelling future energy use with and without certain patterns of application of solar control glass are as follows:

Scenario 1:

- Use of solar control glass in all new buildings (2007-2020) that are air-conditioned; and,
- It is assumed that the percentage of new buildings that are air-conditioned will be approximately twice as high in the period 2007-2020 as in the stock of buildings in existence in 2006.

Scenario 2:

- Use of solar control glass to help eliminate the need for air-conditioning installations in all new buildings (2007-2020) in all regions except southern Europe;
- In southern Europe, even with solar control glass, air-conditioning continues to grow as in scenario 1.

Scenario 3:

- Use of solar control glass in all new buildings (2007-2020) that are air-conditioned; and,
- Replacing all non-solar control glass in existing air-conditioned buildings with solar control glass.

Scenario 4:

- As in scenario 3, but assuming also an increase in the use of air-conditioning to the levels currently seen in the USA, of 65% for residential and 80% for non-residential buildings in regions other than the South, and 65% for residential and 100% for non-residential buildings in southern Europe.

Table 1. An overview of the annual energy and CO_2 savings that can be predicted under each of the four scenarios.

Scenario	Energy savings for heating in 2020 [TJ]	Energy savings for cooling in 2020 [TJ]	CO_2 reduction in 2020 [kt]	Contribution to EU target for CO_2 reduction for buildings in 2020
1	-3,333	69,990	4,583	1.5%
2	-3,333	107,919	6,831	2.3%
3	20,484	208,025	16,552	5.5%
4	169,249	1,001,536	86,040	28.7%

The most likely scenario for 2020

Glass for Europe believes that the most likely outcome will lie somewhere between Scenario 3 and Scenario 4. What this means is that consistent use of solar control glass – wherever air-conditioning systems are working inside of buildings to fight solar heat – could achieve anywhere between 5% and 25% of the EU's targets for reducing CO_2 emissions from buildings (see Table 1). Of course, the use of solar control glass in some locations could eliminate the need for air-conditioning.

Diners enjoy views of Heilbronn, Germany, while Suncool™ HP Neutral solar control glass by **Pilkington** ensures that air-conditioning is minimal.

Solar Control Glazing in all Existing and Future Air-Conditioned Buildings

About 5% of residential and 27% of non-residential buildings in Europe are air-conditioned. Assuming this doubles in new buildings (2007-2020), Scenario 3 considers the effect of installing solar control glass in all new and existing air-conditioned buildings.

Table 2: Annual energy and CO_2 savings in 2020 for Scenario 3

Region, Country 2020	Energy savings [TJ]	CO_2 reduction [kt]	Contribution (%) to total CO_2 reduction*
North	**5,050**	**104**	**0.6**
Finland	1,854	70	0.4
Sweden	3,196	33	0.2
Central Maritime	**37,938**	**2,282**	**13.8**
Belgium	2,487	137	0.8
Denmark	1,306	96	0.6
Ireland	973	96	0.6
Luxembourg	114	9	0.1
The Netherlands	3,951	345	2.1
UK	14,522	1,097	6.6
France	14,586	502	3.0
Central Continental	**18,936**	**1,527**	**9.6**
Austria	1,712	92	0.6
Germany	17,224	1,435	8.7
South	**138,514**	**9,894**	**59.8**
Cyprus	916	122	0.7
Greece	12,232	1,626	9.8
Italy	66,534	4,523	27.3
Malta	458	46	0.3
Portugal	12,139	866	5.2
Spain	46,236	2,712	16.4
Baltic republics**	**2,413**	**235**	**1.4**
Poland	**9,997**	**1,169**	**7.1**
Central***	**7,566**	**703**	**4.2**
Bulgaria & Romania	**8,095**	**638**	**3.9**
EU 27	**228,509**	**16,552**	**100.0%**

CO_2 from glass manufacture is a fraction of what can be saved through use of solar control glass.

The energy consumed and the CO_2 emissions generated from glass manufacturing, even with increased levels of production, are a tiny fraction of what could be saved if solar control glass were used more extensively to let in the light, but keep out the heat of the sun.

Even as glass production volumes have continued to rise, the volume of CO_2 emitted per tonne of glass produced has been falling since the 1970s because of better process techniques and technologies and better-quality fuel resources. With architectural glass industry emissions in Europe estimated to be in the region of 4 to 5 million tonnes of CO_2 per year, the potential savings from the increased use of solar control glass far outweigh the manufacturing emissions.

* National share (with regional subtotals) of the total EU-27 CO_2 savings achievable with solar control glass.
** Estonia, Lithuania, Latvia
*** Czech Republic, Hungary, Slovakia, Slovenia

SGG COOL-LITE® solar control glass by **Saint-Gobain Glass** used by architects Pitz & Hoh in this roof application in the Technische Universität Berlin, Germany (photo by Esch).

An Increase in Air-Conditioning in Europe Towards US Levels

It is not inconceivable that use of air-conditioning in Europe will grow to approach US levels. Scenario 4 considers the impact that solar control glass would have if air conditioning were to increase in this way.

Table 3: Annual energy and CO_2 savings in 2020 for Scenario 4

Region, Country 2020	Energy savings [TJ]	CO_2 reduction [kt]	Contribution (%) to total CO_2 reduction*
North	**29,957**	**681**	**0.8**
Finland	10,999	437	0.5
Sweden	18,959	243	0.3
Central Maritime	**232,331**	**14,636**	**17.0**
Belgium	15,229	888	1.0
Denmark	7,998	602	0.7
Ireland	5,960	592	0.7
Luxembourg	695	56	0.1
The Netherlands	24,197	2,137	2.5
UK	88,913	6,882	8.0
France	89,322	3,479	4.0
Central Continental	**161,478**	**13,180**	**15.3**
Austria	14,600	816	0.9
Germany	146,878	12,363	14.4
South	**575,040**	**40,781**	**47.4**
Cyprus	3,801	508	0.6
Greece	50,783	6,790	7.9
Italy	276,217	18,617	21.6
Malta	1,901	191	0.2
Portugal	50,393	3,568	4.1
Spain	191,946	11,107	12.9
Baltics**	**15,416**	**1,503**	**1.7**
Poland	**59,259**	**6,841**	**8.0**
Central***	**47,008**	**4,409**	**5.1**
Bulgaria & Romania	**50,295**	**4,009**	**4.7**
EU 27	**1,170,785**	**86,040**	**100.0%**

* National share (with regional subtotals) of the total EU-27 CO_2 savings achievable with solar control glass.
** Estonia, Lithuania, Latvia
*** Czech Republic, Hungary, Slovakia, Slovenia

Low-emissivity glass

For colder and less sunny climates, "Low-E" glass can be the more energy-efficient choice. Instead of keeping the sun's heat out, Low-E glass is specially treated to keep heat in. Most solar control glass is also "Low-E" glass, keeping warmth in during cooler periods of the year. This is another way in which the glass industry has innovated to provide solutions relevant to today's needs.

Savings Everywhere, **Especially in the Sunny South**

All across Europe, solar control glass can generate energy savings and reduce emissions of CO_2.

The percentage of buildings that use air-conditioning is much higher in the south of Europe than anywhere because it is hotter (see Figure 1, page 6). The same factors that lead to this higher use of air-conditioning – more and "hotter" sunshine – should also lead to greater use of solar control glass. Indeed, 50% - 75% of the total potential CO_2 reductions that could be obtained through consistent use of solar control glass across the EU would come from the South. Nonetheless, in cooler northern zones, solar control glass has a place and could sometimes eliminate the need for air-conditioning. Solar control glass is usually also low-emissivity glass designed to insulate so that the heat you want to keep inside stays there.

Scenario 3 reflects the current rate of growth of air-conditioning levels in Europe. In practice we can expect the use of air-conditioning to rise all across Europe, in which case the energy consumption of Europe's buildings will climb significantly. Scenario 4 assumes that Europe adapts its use of air-conditioning to something close to current US practice. It would not be unreasonable to expect reality to be somewhere in between scenarios 3 and 4.

The key message for policy makers is, therefore, that between 15 and 85 million tonnes of CO_2 emissions could be cut each year depending on the rate at which solar control glass is installed or retrofitted in new and existing buildings, respectively, and the speed at which Europeans install air-conditioning in homes and workspaces.

What can the policy-maker do?

There is no instant solution. Energy savings must be found across all sectors and activities; modest incremental savings add up to the overall goals we wish to achieve.

Many energy-efficient technologies exist already but are not adequately exploited. Solar control glass is a perfect example of a proven way to increase efficiency that can and should play a greater role. Use of solar control glass provides a "win-win-win scenario": keeping buildings cool inside and occupants comfortable and productive; reducing unnecessary CO_2 emissions and helping keep the planet cool; and, reducing energy needs and cutting costs.

Policy-makers should actively examine ways to promote greater use of solar control glass in building projects. This could be achieved by legislative means. For example, national building regulations could require use of solar control glass, especially in sunny countries, or use economic and fiscal instruments to favour energy-efficient choices, or a mix of both.

Europe's leading glass manufacturers have a Vision...

- To be forward-looking, innovative providers of state-of-the art products and technologies.
- To provide solutions to the major needs and challenges of our times, now and in the future.
- To be admired and valued for our products, which enhance people's lives and environment.
- To be a valued partner in promoting safety, security, comfort, and sustainability - recognised as responsible and responsive.
- To be an industrial manufacturing sector in which our employees will always be proud to work.

Glass for Europe is the trade association representing these companies...

- AGC Flat Glass Europe.
- Pilkington.
- Saint-Gobain Glass.
- The TNO study was also supported financially by Guardian.

Glass for Europe has a clear Mission...

- To explain and promote the Vision of the glass industry.
- To explain and promote the value and contribution of the glass industry and its products.
- To represent the interests of our members in the policy-making process.
- To contribute to worldwide initiatives on product policy.

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