



Europe's flat glass industry in a competitive low carbon economy

Performance, Sustainability, Capacity
to help deliver Europe's low carbon future

GLASS
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Foreword by the Secretary General

'As of now, Europe's flat glass industry sets itself on a path to maximize its contributions to the European 2050 ambitions. (...) Our industry intends to deliver Performance, Sustainability and the Production Capacities needed for Europe's low carbon future.'

'The flat glass industry, through its products, its research and manufacturing activities, and its sustainability policy, has an active role to play in shaping Europe's future of a competitive low carbon economy.'



In March 2011, the European Commission presented its communication on “a Roadmap for moving to a competitive low carbon economy in 2050”. This Commission roadmap provides scenarios and targets on how sectors such as industry, power generation, transport, buildings, agriculture, etc. should undertake a transition towards a low carbon economy in the coming years to achieve defined goals by 2050.

Much talk has surrounded this so-called low carbon roadmap. What is already clear is that it provides direction for Europe. It defines a horizon for Europe's industry, decision-makers and society at large to embrace. Achieving the objective of a competitive low carbon economy requires the mobilization of all stakeholders.

Europe's flat glass industry hears that message and, as of now, sets itself on a path to maximize its contributions to the European 2050 ambitions. This is the purpose of this flat glass industry's contribution to a competitive low carbon economy. It presents not only our industry's vision for 2050 but it most importantly highlights how our industry will deliver **Performance, Sustainability and the Production Capacities needed for Europe's low carbon future.**

The purpose of this contribution is neither to discuss the content of the Commission's communication nor to define detailed positions on pieces of EU legislation. Rather, it sets out an industry vision which can be achieved if supported by the right regulatory environment.

We look forward to working with all interested parties who share our belief that the flat glass industry, through its products, its research and manufacturing activities and its sustainability policy, has an active role to play in shaping Europe's future of a competitive low carbon economy.

Bertrand Cazes,
Secretary General of Glass for Europe



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The flat glass industry's vision of a low carbon economy



1. A nearly-zero-energy building stock

A 90% reduction in CO₂ emissions by 2050 should be achieved

Today, buildings account for over 40% of primary energy consumption and 36% of Europe's CO₂ emissions.² As such they are the largest total emitters of CO₂ but they also form the sector in which most savings can be realised. The EC road map suggests that a cut of 90% in CO₂ emissions from buildings is necessary to achieve the EU's low carbon objective. Studies have already demonstrated that this is achievable as the required technologies, including highly insulating glass that offers a positive energy balance, already exist. The BPIE study 'Europe's buildings under the microscope'³ even defined the pathway to reach this objective at the lowest upfront cost for Society and with the highest return on investment.

The competitive low carbon economy will never be achieved if Europe does not invest heavily in the deep renovation of the existing building stock necessary to reach 'nearly-zero' energy levels by 2050.

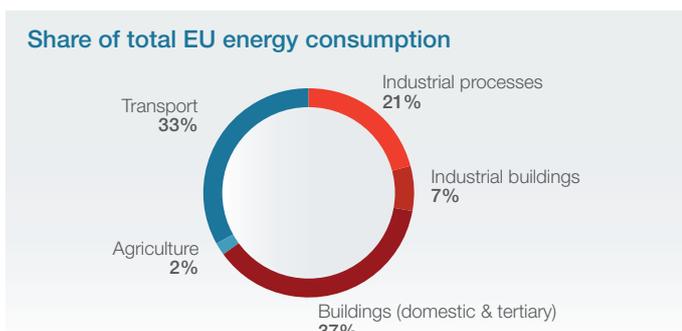
The competitive low carbon economy will never be achieved if Europe does not invest heavily in the deep renovation of the existing building stock

2. Greener vehicles

Faster deployment of technology must drive sustainable mobility

Transport and road vehicles in particular are a major source of CO₂ emissions. It is therefore imperative that the automotive industry embraces all new technological developments that make vehicles more energy efficient. In addition to improvements in the efficiency of engines, new technologies in materials, such as glass, can also help contribute to greener vehicles. Research and development in these fields should be prioritised and the uptake of new products needs to be supported. Over the longer term, and as the deployment of electric vehicles increases, integrating renewable energy sources into vehicles may offer new opportunities, as illustrated by the gradual introduction of photovoltaic cells on glass roof surfaces of some hybrid vehicles.

New technologies in materials, such as glass, can also help contribute to greener vehicles



The flat glass industry supports the objective of making Europe a competitive and low carbon economy as soon as possible. In fact, it believes that all sectors of the economy must contribute to achieving CO₂ emission reductions by the horizon 2050. Based on the EU roadmap for a competitive and low carbon economy,¹ the flat glass industry has a vision for the four sectors of the economy where it is active. This vision requires a high-level of ambition and industry mobilization.



3. Renewable energy to power Europe

Nearly all of Europe's electricity should come from low carbon sources in 2050

The low carbon objective implies a gradual electrification of Europe's economy, with a move away from fossil fuel wherever technology allows it. Only if electricity comes from low carbon sources, and renewable sources in particular, will this lead to decarbonisation. Photovoltaic technology has a central role to play in this transition. It can be implemented on a large scale in concentrated solar power stations, and of course in smaller units, such as photovoltaic panels on roofs and, increasingly, in building integrated photovoltaic facades, which can feed surplus electricity back into the grid. In all these applications, glass offers an ideal substrate to help generate and conduct electricity in the modules.

Thanks to the deployment of smart grids and technology advances in battery storage, it is possible for nearly all of Europe's electricity to come from low carbon and renewable sources by 2050.

Glass offers an ideal substrate to help generate and conduct electricity in photovoltaic modules

4. An environmentally-friendly manufacturing base

Europe deserves the most energy efficient industrial processes

The low carbon economy will only materialize if a strong and competitive industrial base in Europe supports the objective by delivering the new products needed to renovate buildings, generate energy or to manufacture new types of vehicles. These products must be manufactured in Europe:

- to avoid carbon and energy embodied in imported products,
- to ensure that Europe's industries remain at the forefront of green technology development
- to provide jobs, manufacturing and economic growth.

How big a cut in industrial CO₂ emissions is achievable ultimately depends on the type of industry, the state of technological progress and the products manufactured. Unlike in the other sectors where energy savings can serve as a useful indicator, energy efficiency, which considers energy per output unit, must be placed at the core of the EU's approach to industry to avoid impeding manufacturing growth. Ensuring that Europe profits from the most energy efficient manufacturing processes, which deliver the advanced glass products that the low carbon economy requires, is not only a vision but a commitment of the flat glass industry.

A strong and competitive industrial base in Europe supports the objective by delivering the new products needed

¹ European Commission - A Roadmap for moving to a competitive low carbon economy in 2050 - COM(2011) 112 final – 8 March 2011

² Sources : Eurostat

³ BPIE – 'Europe's buildings under the microscope' – October 2011.

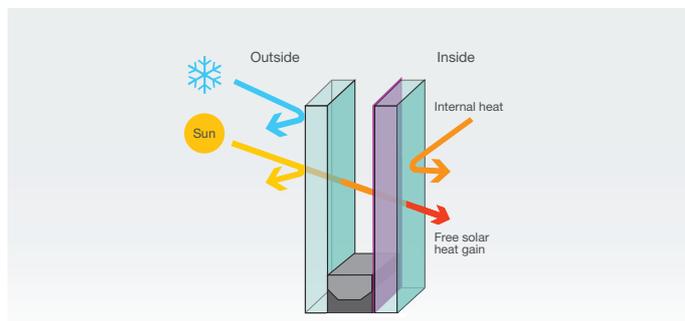
Flat glass products provide energy efficient solutions

Europe's flat glass industry is ready to provide solutions to enable Europe to achieve its objective of a competitive low carbon economy. These solutions lie in glass products themselves, which in their different applications are essential to reduce energy use and CO₂ emissions.

Glazing needs to be optimised to provide the best energy balance to buildings

Adequate use of highly insulating glazing is essential to energy efficient buildings

Glass is unique amongst building materials because of its ability to provide natural light and solar heat. Glass therefore reduces the need for artificial lighting. It also transmits free solar heat gains into buildings to the extent that **windows can be net contributors of energy**. For these reasons, many architects specialising in low energy buildings incorporate large glazed areas in their designs. Such daylight interiors also result in increased comfort, productivity, health and wellbeing for the occupants.



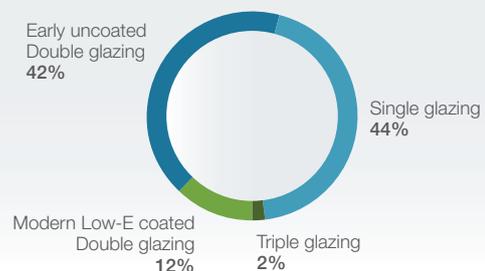
It is thanks to **the development of coated glass technologies** that glazed surfaces and windows have developed these unique properties. In either double or triple glazing, modern insulating glass units contain at least one pane having a thin transparent coating, which increases insulation properties. These "Low-Emissivity" coatings help keep the warmth inside when it is cold outside, while capturing the benefit of any solar heat. In warm climates, or where a building is air-conditioned, these coatings can also be given "solar control" properties, which allow the daylight to pass through a window or façade while radiating and reflecting away a large degree of the sun's heat so that the indoor space stays bright and much cooler than with normal glass.

85% of the glazed surfaces in Europe's buildings contain inefficient glazing.⁴ The Dutch scientific institute TNO quantified that **over 100 million tonnes of CO₂ could be saved annually if this were replaced with advanced glazing**.⁵ This represents more than a third of the EU's 20% energy saving commitment for 2020. It illustrates how vital it is for Europe to upgrade the glazing of its building stock to achieve its low carbon objectives.

Be it in new construction or at the time of deep renovation of buildings and homes, glazing needs to be optimised to provide the best energy balance to buildings.

In building glass, the solution has already been largely provided: the high-performing glazing products that will make Europe's buildings nearly zero-energy are already available. The challenge for 2050 is to ensure that Society embraces these products and that they are properly used to deliver their full potential.

Glazing type distribution in the EU



⁴ TNO Built Environment and Geosciences – Glazing type distribution in the EU building stock – TNO report TNO-60-DTM-2011-00338 – February 2011.

⁵ TNO Built Environment and Geosciences – Potential impact of Low-Emissivity glazing on energy and CO₂ savings in Europe – TNO report 2008-D-R1240/B – November 2008.

Glass technologies are constantly being developed to continue improving solar energy's efficiency.



Glass technologies offer new opportunities for solar energy

Glass already plays an important role in the generation of solar power. It is already used in both photovoltaic modules and solar thermal panels to generate respectively electricity and hot water. So far, glass covers have primarily been used to protect panels and modules from outside conditions while letting the sunlight through to heat thermal collectors or to activate photovoltaic cells.

Glass technologies are constantly being developed to continue improving solar energy's efficiency. For instance, extra-clear glass coupled with anti-reflective coatings allows more sunlight into the module. The coated glass component of modules can also now serve to conduct the generated electricity outside of the modules. In addition, different shapes and colours are developed to allow more flexibility for design integration, particularly into buildings.

Flat glass manufacturers make sure to constantly respond and exceed **the performance requirements of the solar energy industry**. They also utilize all their expertise from the construction industry to deliver durable solutions for the deployment of building integrated photovoltaic.



Contributing to innovative, green and safe transport solutions

Glass already contributes in different ways to the development of greener vehicles. With **the development of lighter glass components for windshields, sidelights and backlights**, the energy use and CO₂ emissions of vehicles can be reduced.⁶ However for the glass industry, the challenge is to succeed in reducing further the weight of these components while ensuring the highest levels of safety and security for passengers and while making sure that reduced glass weight does not imply recourse to heavier materials elsewhere to guarantee the structural integrity of vehicles. Thanks to new glass technologies, the average glass content of a passenger car has decreased to below 3% by mass while the glazed surfaces have increased in size to accommodate new aerodynamic designs.

Automotive glass also uses coating technologies to further contribute to reducing fuel consumption. Solar control glazing helps minimize solar heat ingress into vehicles exposed to the sun and therefore considerably reduces the load on any air conditioning required to maintain a comfortable cabin temperature. Since air-conditioning equipment is a large energy consumer in road transport, this glazing technology allows for reduced fuel consumption.

In electric cars, glazing can play an even more important role. Reducing the power consumption of the comfort equipment which does not serve to power the vehicle itself helps in improving the range of electric vehicles. Furthermore the limitations of batteries in extreme conditions and the intense power needed to heat or cool down cabins, means light-weight glazing solutions with advanced thermal properties can make substantial differences to the range of vehicles between battery charges. As electric and hybrid vehicles become more common, the glass component of vehicles is likely to incorporate more solar cell technologies.

Sustainable mobility is technology intensive and requires many small improvements in all areas without waiting for "blue sky developments". Flat glass manufacturers have solutions ready to be implemented now to contribute to greener automobiles and beyond, to greener transport modes such as trains, trams and buses which use glass. By 2050, the use of automotive glass to generate motive power could become a normal fact of everyday life.

⁶ In fact, it is assumed that a reduction of 10kg of an average family car reduces the vehicle's CO₂ emissions by 0,8 g/km.

The contributions of the flat glass industry to a **competitive low carbon economy**

Glass products provide a wealth of ways to reduce CO₂ emissions but it is essential for our industry to capitalize on these benefits to fully realize the potential of a competitive low carbon economy. To that end, the flat glass industry intends to deliver **Performance, Sustainability and the Production Capacities needed for Europe's low carbon future.**

This is much more than a motto. These are three essential contributions from the flat glass industry which act as guiding principles for the industry to take its part in realizing Europe's 2050 ambitions. It goes beyond the glass products themselves and covers the manufacturing process. **It illustrates the manufacturers' will to responsibly produce in Europe the products that will shape Europe's future.**

Delivering on these promises is an industrial challenge; that of the flat glass industry. It is clear however that the regulatory environment will heavily influence the feasibility and timeliness of the achievement of these goals. Therefore we hope that European authorities will support these efforts with adequate concrete policy measures.

GLASS
F O R • E U R O P E

Glass for Europe and its member companies are committed to pursuing the following contributions to help shape Europe's competitive low carbon economy:

Delivering **performance**

- To provide Europe with net Energy and CO₂ saving products
- To guarantee that our products meet the highest performance in terms of safety, comfort, technology and aesthetics
- To maintain a lead in Research & Development

Placing **sustainability** first in all activities and products

- To produce responsibly and in harmony with the environment
- To recycle and contribute to a resource efficient Europe
- To build sustainability awareness along the value chain

Investing in state-of-the-art **production capacity** to meet Europe's demand

- To ensure that Europe's glass market is principally supplied by European manufacturers
- To invest in upgrading all European plants to best available techniques
- To ensure the competitiveness of our European operations to generate growth and employment in the EU

Delivering performance



Our industry is proud that glass products, throughout their life-cycle, are net energy savers.

1. To provide Europe with net energy and CO₂ saving products

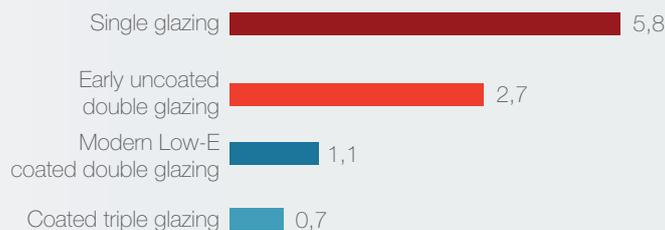
Products made from flat glass are essential to the achievement of Europe's low carbon objectives. This is due to the fact that in most of their applications, glass products help save energy and their contributions are increasingly being recognized by decision-makers.

The European Commission for instance, in its recent Energy efficiency plan noted that '*measures should be put in place to support the market uptake of efficient building components, for example... windows*'.⁷ Throughout Europe, under the impetus of European authorities, measures are being put in place or designed to support the uptake of energy efficient technologies and all these measures have the direct or indirect impact of encouraging the use of energy efficient building glass:

- The Recast energy performance of building directive will require all new constructions to achieve nearly-zero energy standards by 2020 and all renovation should achieve cost-optimal requirements, thus requiring energy efficient glazing.
- A European energy labelling scheme for windows is being considered following the extension of the Energy labelling directive to cover energy related products.
- Many national energy efficiency action plans (NEEAPS) include economic and fiscal incentives to consumers to replace standard glazing with energy efficient glazing.
- The Energy efficiency directive introduces energy saving obligations for utilities and public building renovation requirements for Member States.

This is only logical considering the high level of performance already achieved by the flat glass industry in developing innovative products that meet our modern society's needs. But what is all the more important for our industry is **our ability to provide Europe with products that, throughout their life-cycle, are net energy savers.**

Glazing insulation performances: U_g value



⁷ European Commission – Energy Efficiency Plan - COM(2011) 109 final – 8 March 2011.

CO₂ savings are between 30 to 120 times greater than their embodied CO₂

Ideal performance is achieved when a product saves far more CO₂ during its lifetime in use than it creates during its manufacture.

Based on life-cycle inventory studies, the carbon content of energy efficient glazing units has been quantified. It can be correlated with the CO₂ savings resulting from the replacement of old glazing units with energy efficient double glazed units to provide outstanding evidence that building glass products are net CO₂ saving products.

For instance, calculations suggest that across Europe the total CO₂ equivalent generated by an energy efficient double glazing unit throughout its life-cycle is offset on average between 3 to 10 months only by the energy savings realised compared to the same build-

ing equipped with single glazing (in the shorter payback range) or early uncoated double glazing (in the higher range). It must be noted that the payback period depends, among other factors, on the energetic mix of countries and of the heating needs. It is usually longer (up to 15 or 20 months) when the product is installed in a building located in a warm climate like that of the very south of Europe. By using triple glazing, even more CO₂ emissions can be avoided. For instance, if it was used in all new constructions in Central and Northern Europe, CO₂ emissions generated by the built environment would be reduced by an extra 10 million tonnes a year as of 2020.⁸ These additional savings significantly outweigh the extra CO₂ emissions created by the production of triple glazing.

Such CO₂ payback times are extremely short when one considers that the full life-cycle is taken into account and that windows stay on average 30 years in a residential dwelling. When looking at the overall CO₂ impact of replacing old and inefficient glazing units with energy efficient double glazing, CO₂ savings are between 30 to 120 times greater than their embodied CO₂.

The above figures provide orders of magnitude for the residential sector only for the sole reason that many different parameters affect precise data. For this reasons, Glass for Europe prefers providing an order of magnitude knowing that the majority of calculations based on alternative data and assumptions will fall within this range. The above figure have been calculated on the basis of average and conservative assumptions.⁹

The total CO₂ equivalent generated by an energy efficient double glazing unit throughout its life-cycle is offset on average between 3 to 10 months only.

Europe's flat glass industry will use life-cycle thinking to deliver net energy and CO₂ saving products. To do so, it will pursue both the challenge of further improving products' performances and that of bringing down the product carbon footprint. The same considerations will continue to drive product development in other flat glass applications, be it in automotive and transport and even more so in solar energy glass used to provide a renewable source of energy.

⁸ TNO Built Environment and Geosciences – Glazing type distribution in the EU building stock – TNO report TNO-60-DTM-2011-00338 – February 2011.

⁹ Among parameters affecting these calculations, is the figure on embodied CO₂. Many LCA studies on insulating glass units provide different figures for embodied CO₂. Glass for Europe tested its calculations on a range of data, some available in LCA databases, some based on Environmental Performance Declarations existing in some countries. The energy and CO₂ savings linked to energy-efficiency gains can also vary depending on climate, reference building, building usage, glazing orientation, previous glazing equipment in the building (i.e. single glazing or early uncoated double glazing), space heating energy mix, CO₂ conversion factors, calculations methods, etc. Glass for Europe has done its calculations on the basis of a reference apartment block with typical glazing area and orientations. Six climatic zones in the EU were computed and tested. Space heating energy mixes are based on information available in the literature and national CO₂ conversion factors were used when available (if not the ELCD data was used). Some cross-checks with different assumptions (e.g. different building design, different reference climate, etc.) were carried.

2. To guarantee that our products meet the highest performance in terms of safety, comfort, technology and aesthetics

Europe's flat glass industry 'vision of a competitive low carbon economy' is not limited to energy and climate considerations. The 2050 European society will continue requesting the highest levels of performance in terms of safety, comfort but also technology and aesthetics.

Flat glass products are part of everyday life. We see, and see through them, all the time and they are part of the environment we live in and move within. Safety, security and comfort will remain primary markers of performance for our industry, be it in the area of building or automotive and transport.

Our industry believes the competitive low carbon economy can be the driver of a new technological era. Functional integration in flat glass products is likely to continue as we have already seen in the integration of photovoltaic cells in both building and automotive glass.

Looking forward **flat glass products offer a range of new possibilities thanks to the development of touch screen technologies** and progress in information technologies. The scope for Europe's innovators is huge.

Safety and security are paramount to automotive glass

Automotive glass is designed to last for the lifetime of a car – enduring all weather conditions, wear and tear, wiper usage without excess of haze and scratches – and maintaining all its safety and quality requirements in the event of accident or assault.

Today safety is ensured by two types of glazing: toughened or laminated glass. Both toughened glass and laminated glass can be used in particular in side windows of cars to provide increased levels of security and passenger comfort by increasing impact resistance and

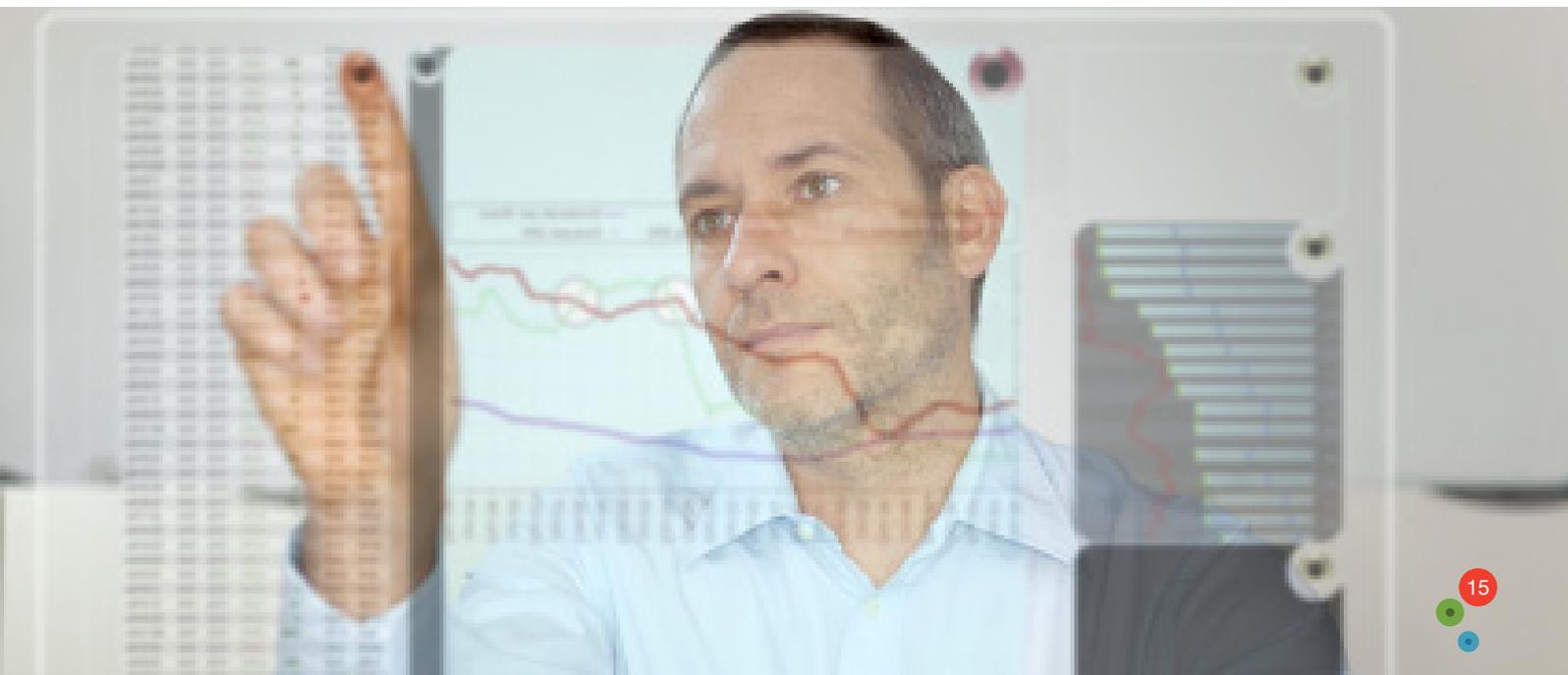
defence against theft. With the use of laminated glass, in the case of impact in an accident, the glass will crack while absorbing a large part of the energy from the impacting body. Since the glass remains adhered to the plastic interlayer, the window stays in the frame acting as a safety net and keeping fragments away from the passengers. Glass also allows people injured in an accident to be easily freed.

Laminated glass responds not only to the main safety concerns in cars but it also helps reduce vehicle weight and improves thermal conditions within vehicles to reduce their energy consumption.



On the eve of a new technological era, Europe's flat glass industry will seek to guarantee the highest level of performance of its products for all their relevant characteristics.

It will investigate new applications for glass which meet Society's needs and will ensure that these are not developed at the expense of energy and CO₂ saving inherent performances of glass products.



3. To maintain a lead in Research & Development

Research and development of new glass products that meet the needs of a low carbon society is a priority for the flat glass industry. In fact, **Glass for Europe member companies spend annually hundreds of million Euros in R&D**. These R&D efforts cover all aspects of glass technologies from the development of new products and new functionalities to minimizing the environmental impacts of manufacturing facilities.

Striving to **develop cutting-edge flat glass products** for the building, automotive and solar energy sectors, means principally looking for ways to further improve the basic performances of flat glass products. Research fields therefore cover topics as diverse as:

- increasing the insulation and solar control properties of building and automotive glass;
- enhancing the performance of glass products for fire resistance and protection;
- improving the comfort, aesthetic and noise pollution prevention qualities of glass;
- reducing the weight of automotive glass while raising the safety and security standards
- developing glass solutions that integrate PV cells to help power electric vehicles;
- strengthening the anti-reflective properties of high-light transmission glass to generate more solar electricity

Flat glass manufacturers are dedicated to bringing useful innovative solutions to the European market and that is why **new functionalities and applications** for flat glass products are also researched, such as OLEDs lighting technologies.

For these industrial efforts to pay-back for companies, and to create added-value in Europe, **it is fundamentally important that new innovative products can quickly enter markets**. Because energy efficiency and sustainability will be critical success factors for innovations, the flat glass industry is ready to work with European authorities to ensure that the adequate policy instruments such as energy labelling, eco-labelling or eco-design, are used intelligently and more rapidly to reward R&D efforts by providing a market stimulus for high-performance products.

Minimising the environmental impacts of production and products translates into the research and development field as well. For instance, in the automotive glass sector, millions of Euros are being spent to develop alternatives to lead-based soldering of antennae to glass in vehicles. Special care is constantly given to product development so that the recyclability of products is ensured. Last but not least, thanks to R&D efforts, every newly built float glass installation is made ever more environmentally friendly and new furnace designs will continue to be developed.

OLEDs & glass substrates: a new form of lighting

Organic Light Emitting Diodes, OLEDs, emit light due to electroluminescence and offer increased energy efficiency over today's lighting technologies. OLEDs can easily be fabricated on a glass substrate, which offers the benefits of a fully recyclable support material that can be integrated into building designs and maximises the lifetime of the OLED device.

This technology, which is being further developed into final products, will offer a new way of providing artificial light into buildings when the natural light allowed into the interior by glazed surfaces is falling. In addition, any glass surface could become a source of artificial light of a very pure and warm nature, whilst consuming less energy than with current technology.



Performance in the field of research and development is a pre-requisite for the flat glass industry to deliver solutions for Europe's transition to a competitive low carbon economy. Europe, thanks to its skilled workforce, its tradition and centres of excellence, is and will continue to remain on the flat glass industry's map for R&D centres and investments.

A Supportive European Policy Framework

- In order to give substance to the 2050 competitive low carbon economy roadmap, interim energy efficiency targets for the building and automotive sectors, and robust monitoring systems, must be put in place for 2020, 2030 and 2040. This is essential to provide a long term framework for industry to plan and invest with confidence, and to mobilize society at large.
- Beyond support for R&D projects, Europe needs to ensure that its innovative industries can be rewarded for their research investments and active contributions to the competitive low carbon economy objective.
- Be it in transport, building or solar energy, the European Union should ensure that its product policy is developed more rapidly and updated more often to ensure that measures always benefit state of the art products. It is essential that policy instruments such as energy labelling, eco-labelling, green public procurement criteria, etc. become more reactive to ensure that innovation is rewarded.
- The concept of energy and resources embodied in products in isolation must be abandoned and replaced by real life-cycle analysis of products. Robust and reliable methodologies need to be created and guidelines must be developed to adequately take account of the saving potential of products during their use phase.
- Europe should strengthen its policy to support the renovation of Europe's building stock with concrete legislative tools and more robust implementation of existing instruments, such as the Energy performance of buildings directive. Much greater EU funds must be mobilized to triple the rate at which Europe's buildings undergo deep renovation whilst preserving our cultural heritage.
- Europe needs to ensure a proper functioning of the single market to avoid market access delays generated by eventual national obstructions. To that end, European authorities need to ensure that they maintain and enforce stringent European and/or international glass product standards.

Placing sustainability first
in all activities and products



For Europe's flat glass industry, sustainability goes way beyond concentrating on climate considerations. Producing in a sustainable manner also means minimising all environmental impacts, by way of reducing the use of primary raw materials and substituting the use of hazardous substances, for example. It also requires efforts to ensure the highest levels of health and safety for workers and to educate customers down the supply chain to use our products responsibly.

1. To produce responsibly and in harmony with the environment

One of the main environmental impacts of flat glass manufacturing is linked to the use of energy. This impact is discussed separately on page 28. However, the flat glass industry is committed to reducing all environmental impacts of its products and production facilities. In fact, if most of the other environmental impacts are relatively limited, it is thanks to all efforts already undertaken by flat glass manufacturers.

Today, nearly all float glass manufacturing installations in Europe are certified to ISO-14001 and/or EMAS, the EU Eco-Management Audit Scheme, which illustrates the robustness of the environmental management systems put in place by the industry. They cover a wide variety of aspects as illustrated below.

The use of hazardous substances and in particular of substances classified as substances of very high concern (SVHC) is a priority focus of care in the industry. For certain specific glass products, hazardous substances may sometimes be used in the production process. Despite intensive research, it might not always be possible to completely rule these substances out, as may be the case for specific applications in solar energy glass.

The flat glass industry is committed to reducing all environmental impacts of its products and production facilities.

Examples of environmental impact reduction efforts in glass manufacturing

- **Air emissions:** Beyond CO₂, the further reduction of NO_x, SO_x and HCl is a primary objective of glass manufacturers. The challenge for the industry is to achieve greater reduction while avoiding adverse effects since certain techniques may impact on other pollutants. When it comes to dust, the introduction of dust filters in plants in the last twenty years and other abatement techniques have already helped reduce drastically most of these emissions.
- **Water consumption:** In the flat glass industry, water usage is limited and mostly directed at the cooling of installations. For this reason, water is often used in close loop. Reducing and reusing water remains an objective for the industry. In the few applications which require that water is in contact with possible pollutants, the installation of water treatment installations is considered as a best practice which is effectively implemented.
- **Waste management:** In flat glass manufacturing, 90% of the waste generated is of a non-hazardous nature and levels of waste are relatively low. Much effort is placed in further reducing quantities and ensuring that all remaining waste is recycled.
- **Transport:** Whenever possible, flat glass manufacturers favour the local supply of raw materials and alternative solutions to road transport, such as water and rail transport.
- **Packaging:** Transporting flat glass requires specially-designed equipment. Steel stillages, which can be reused, now predominate in the EU flat glass industry and when wood packaging is necessary, flat glass companies try to favour wood coming from certified sources.

The flat glass industry will continue looking for suitable alternatives to hazardous substances. Under the REACH regulation, glass is a UVCB substance¹⁰ which is generally exempt from registration. For the products put on the market, i.e. 'articles', flat glass manufacturers will continue avoiding that any hazardous components are present.

Should it however become the case, the flat glass industry will always ensure that these components cannot be released to the soil, air or water environment and are therefore not available.

Producing responsibly also **requires that workers are guaranteed the highest level of health and safety in plants.**

Because glass is made with crystalline silica, a type of sand that is ubiquitous in nature, measures are put in place to ensure that workers do not inhale fine dust.

For instance, risk reduction measures and closed systems are developed to limit workers' exposure to dust. Additionally,

collective and individual protective measures can also be put in place and workers are submitted to regular health checks. The flat glass industry is a signatory of the NEPSI European social dialogue in order to share and continue applying best practices, in co-operation with employees unions.

¹⁰ According to the REACH regulation, Glass is a substance of 'unknown or variable composition, complex reaction products or biological materials'. Glass is not a "mixture". The raw materials are completely consumed during the manufacturing process in a set of chemical reactions so that they are no longer present in the newly formed glass substance.



Europe's flat glass industry will intensify its efforts to ensure that all its plants operate state-of-the-art environmental management systems that deliver continuous environmental improvements. In doing so, the industry will progressively apply best available technologies as described in the new BREF document for glass manufacturing, established in the framework of the Industrial emissions directive.



2. To recycle and contribute to a resource efficient Europe

One of the objectives of the 2050 competitive low carbon economy is to protect natural resources and ensure that these are used only when necessary. In this context, recycling will be of vital importance for industries. In the flat glass sector, recyclability and recycling is already a reality but the product's end-of-life management remains to be improved. **Glass products have long been recyclable** and the industry ensures that new products launched on the market maintain this fundamental characteristic.

Beyond recyclability, the flat glass industry is willing to increase the quantity of recycled glass, named 'cullet', in its production processes.

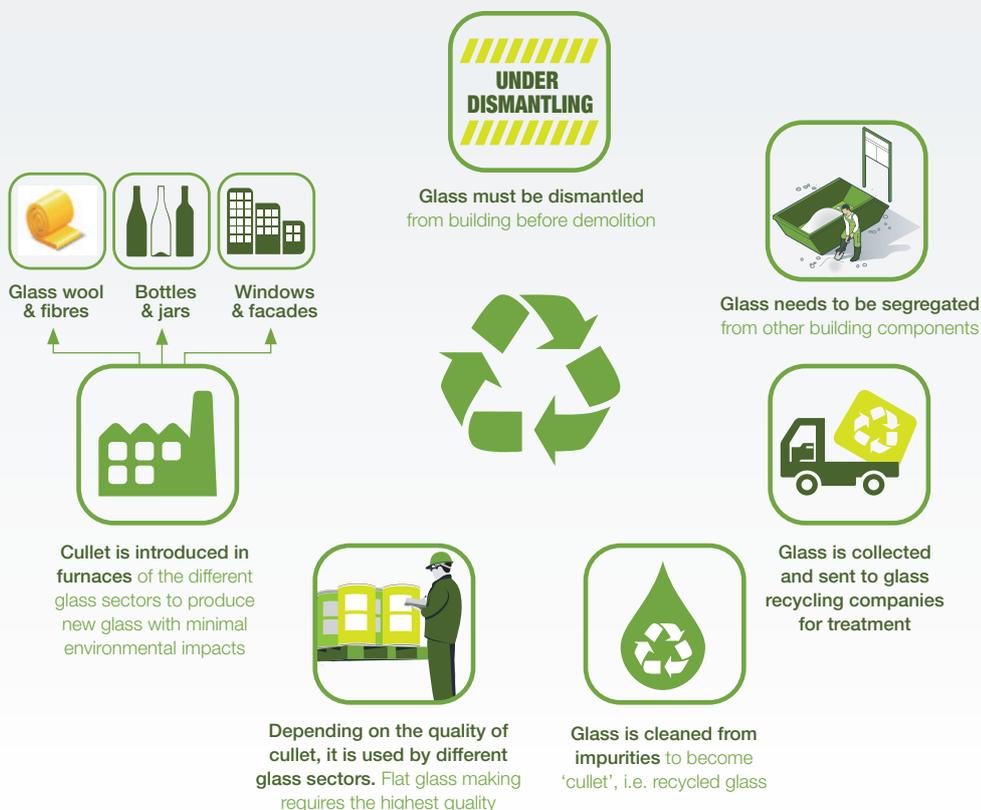
The use of cullet helps save natural resources but it also offers additional benefits. Because recycled glass requires less energy to melt, it also contributes to reducing energy consumption and CO₂ emissions from manufacturing plants. Today, **float glass usually contains at least 20% cullet, which represents more than 5 million tonnes of recycled glass used annually** in Europe's float glass operations.

Most of the cullet used in flat glass manufacturing usually originates from the glass production, processing or re-processing processes such as off-cuts, losses during laminating, bending, insulating glass unit fabrication, etc. These 'by-products' and/or waste usually have the required quality levels to be recycled to produce quality float glass.

Despite its recyclability, post-consumer / end-of-life waste flat glass is not recycled as much as desired. In many Member States, **most of the construction, renovation and demolition glass waste simply ends up in landfills** due to its low value, its

inert characteristic and a lack of properly organised collection systems. Europe's flat glass industry is **ready to work closely with European authorities to improve the situation**, which will require removing regulatory hurdles that jeopardise the renovation and demolition glass recycling route.

Building demolition waste glass: the recycling route



The industry is committed to playing its part in achieving **Europe's objective of recycling 70% of building demolition waste by 2020**.

For glass, this means in practice ensuring that throughout Europe and at any demolition or renovation site, glass waste is properly dismantled, separated, sorted and sent back to recyclers. Down the line, recyclers must clean waste glass of any impurity and be able to deliver cullet meeting the industry's quality specifications back to glass plants.

In a closed loop route, the most stringent standards must be met for cullet to be sent back to flat glass plants, due to the low tolerance to impurities of float glass making. Alternatively, cullet can be recycled into container glass, glass fibres and glass wool.

Float glass usually contains at least 20% recycled content.

For this promise to materialize, European authorities will also have a role to play. Indeed, such efforts will mean additional costs for Europe's flat glass industry and so it will be important to ensure that they do not jeo-

pardize the level playing field between EU-based and outside EU industries.

In the longer term, **the flat glass industry wishes to benefit from increased cullet availability**

for its manufacturing process. For this reason, European manufacturers are also actively looking for solutions to the main technical concern, which is that of increasing recycled content while safeguarding the production quality.

Impurities in glass cullet affect product quality and strength, thus potentially raising safety concerns for some products. Impurities in glass cullet can also seriously damage manufacturing installations.

In the flat glass sector, recyclability and recycling is already a reality but the product's end-of-life management remains to be improved.



Effective recycling of end-of-life glass products is a major priority of the flat glass industry, which wishes to increase the waste glass content of its products. The industry is actively looking for solutions to establish efficient collection and recycling schemes throughout Europe and will work hand in hand with authorities to establish the right legal and economic framework.

3. To build sustainability awareness along the value chain

The flat glass industry provides a wide range of products combining different properties, be it in terms of thermal insulation, solar control properties, safety features, technological integrations, aesthetics, noise prevention, fire prevention, etc. To maximize the sustainability potential of glass products, it is of utmost importance that they can be adequately used by glaziers, car makers and the solar energy module industry. **A lot of information and education on products and their application is therefore needed and the flat glass**

industry is willing to play an even more active role in this field.

In the building sector for instance, more training on glass technologies, energy efficiency and nearly-zero energy buildings is needed. Today, too many pre-conceived ideas about glazed facades and their contribution to heat losses persist against all the evidence. Countless recent studies demonstrate that **glass is the only construction material which can have a positive energy balance** thanks to its unique ability to provide free solar heat

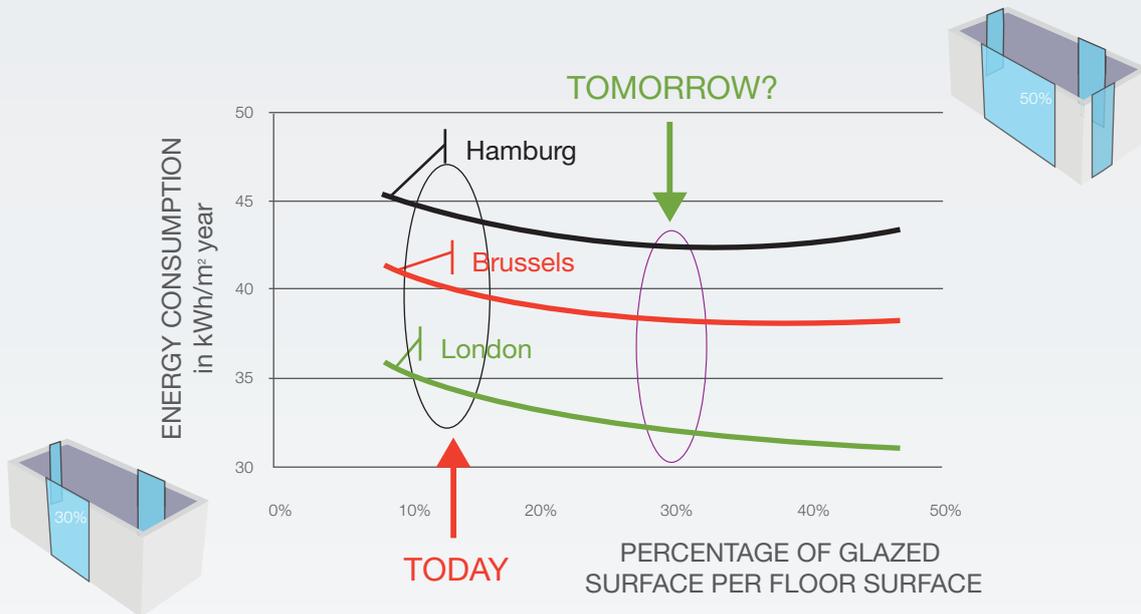
gains. This balance is even more positive when one considers that glazed surfaces let natural light enter buildings, thus saving considerable amounts of electricity used for artificial lighting.

For construction professionals, it is critically important to know how to best design buildings, to optimize glazed surfaces and use the different glazing types depending on climate, building orientations, building usage, etc. to conceive and increase the development of nearly-zero energy buildings.

Construction professionals must rediscover how to optimize glazed surfaces and use the different glazing products.

Glazed surfaces and energy consumption in buildings

- Residential:



In most climates enlarging size of high-performance windows helps to reduce energy consumption

- Office buildings:

Because of their use, office buildings require different strategies than residential housing. These buildings are often air-conditioned and artificial lighting is one of the biggest sources of energy consumption. Glazing plays a major role in reducing these sources of energy demand.

After modelling the energy consumption of a standard office building, a technical consortium led by CIRCE10 came to the conclusion that *'The increase of glazing percentage when including lighting control strategies brings in general environmental benefits because of the increase daylight'*.

This confirms the findings of other studies, which show that, provided that the right type of glazing is used, architects can freely use glazed areas to conceive their building designs while achieving the highest levels of energy efficiency.

Solar control glazing in automotive to curb fuel consumption

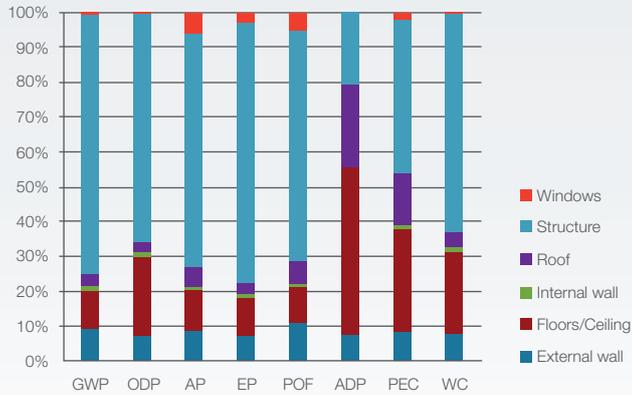


By minimizing heat entrance inside vehicles exposed to the sun, solar control glazing considerably lowers the need to air-condition vehicles' cabins or at least to reduce its load. In this way, this automotive glass technology helps save fuel consumption and extend the range of electric vehicles.

Nevertheless, these benefits of glazing are not accounted for in published fuel consumption figures. This regulatory loophole limits the deployment of this advanced glass technology, despite all quantifiable evidences of its benefits. Incentives must be put in place to incite car makers to equip new vehicles with this energy-saving glass technology.

Life-Cycle Inventory of the construction of 1m² of office area – JRC.

Cradle to delivery of a new office building: use and demolition phase not taken into account



Windows carry the smallest environmental burdens

Sustainability in the construction sector will require a **more thorough life-cycle approach to construction products and to buildings**. The flat glass industry will play its role in delivering life-cycle assessments of products and environmental performance declarations for its products but it must be borne in mind that buildings are complex systems whose sustainability must be assessed as a whole rather than as a sum of construction products. In this field, the flat glass industry supports and will contribute to the use of harmonised European life-cycle-analysis methodologies especially designed for buildings by CEN TC350.

Studies available so far usually limit themselves to a partial analysis but they nevertheless provide useful indications. For instance, a life-cycle inventory study of the construction of 1m² of office building is being finalized by a consortium of research institutes led by CIRCE for the purpose of developing of an EU ecolabel for office buildings.¹⁰

The provisional work confirms that **windows carry the smallest environmental burdens for all indicators compared to other parts of the building envelope up to the construction phase**. That being said, this type of work must be pursued to cover the benefits of glazed surfaces during the use, demolition and recycling phases.

Building sustainability awareness along the value chain also means for our industry providing responses to the social and economic challenges of our modern societies. In the transport sector for instance, our industry must guide its clients to take into account the benefits of glazing in terms of enhanced safety and comfort when laminated glazing is used. In the construction sector, **the 'qualitative benefits' of letting natural daylight flood into buildings, such as increased productivity, amplified sensations of well-being, improved health conditions, etc. need to be better appreciated and reflected in the way construction evolves.**



Flat glass products can shape Europe's competitive low carbon economy but these must be properly utilized to deliver their full benefits. Providing adequate information, contributing to professionals' training, working with institutions to ensure awareness of all sustainability aspects across the construction, solar energy and transport sectors are essential contributions that the flat glass industry will continue delivering in the coming years.

Glazed areas improve comfort, wellbeing and provide healthier indoor environments

A Supportive European Policy Framework

- Sustainability must be placed at the core of the EU strategy towards a competitive low carbon economy. It must be comprehensively understood, including its economic and social aspects in addition to the environmental ones, and it must be spread to all EU policies.
- Glass recycling must be encouraged and supported whenever possible. EU intervention may be needed to facilitate recycling and ensure that the right economic and legal conditions are in place throughout Europe.
- EU authorities need to pay particular attention to the growing problem of supply of critical raw materials. Beyond rare earths not available on the European continent, solutions need to be found for other materials whose supply will become critical due to the high demand for these products by other regions of the world.
- Authorities throughout Europe need to encourage the deployment of sustainability training for many professions and in particular in the construction industry and to support information and communication campaigns.
- The European Union needs to embrace a true life-cycle thinking approach for buildings, to complement today's environmental policy on individual construction materials. The LCA method for the assessment of buildings developed by CEN TC350 must be supported.

Investing in state-of-the-art production capacity to meet Europe's demand



The manufacturing of flat glass in Europe is the only sustainable route towards a true low carbon economy

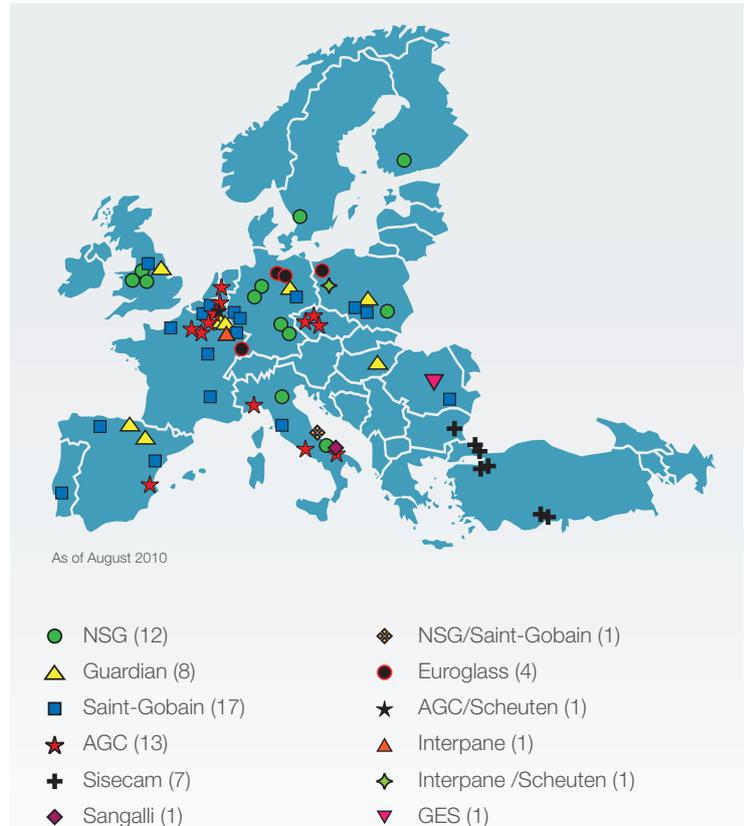
1. To ensure that Europe's glass market is principally supplied by European manufacturers

Until very recently, the European Union has been the world's largest producer of flat glass. This position is now held by China primarily because it alone accounts for over 50% of the world's flat glass demand due to the local boom in the construction and automotive sectors.

In 2011, there were 61 float glass lines in the European Union whose theoretical melt capacity reached nearly 15 million tonnes of float glass per year. These facilities are located throughout Europe, close to both sources of raw materials and markets to minimize transport at both ends. In addition to these EU based facilities, six other float glass lines exist in Turkey.

To Glass for Europe members, the manufacturing of flat glass in Europe is the only sustainable route towards a true low carbon economy. Since float glass is a relatively heavy material to transport, **importing glass from outside Europe inherently means importing glass with a higher CO₂ footprint**. In addition, larger shares of imported glass would mean that Europe's transition towards a low carbon economy would mostly profit other regions of the world instead of supporting Europe's industrial base.

It must nevertheless be noted that the flat glass industry needs to specialize its plants in certain types of products. This is due to the slow-moving nature of the production process itself which can imply two or three days of production and energy losses when colours or thickness of the produced glass is changed. For this reason, importing very specific glass products will always be required and supplied glass may not necessarily always come from the nearby factory.



The flat glass industry is deeply committed to remaining a positive contributor to global efforts to reduce overall energy consumption and CO₂ emissions from human economic activity. For these reasons and whenever possible, Glass for Europe member companies will prioritize the supply of glass products made in Europe to serve the EU markets.

Certainty and confidence is needed for flat glass manufacturers to plan investments. Once the long term vision of a low carbon economy is backed by robust policy measures that both support decarbonisation of the building, automotive and power sectors and step up flat glass demand, flat glass manufacturers will increase European production capacities to provide added-value and jobs to the European economy.

2. To invest in upgrading all European plants to best available techniques

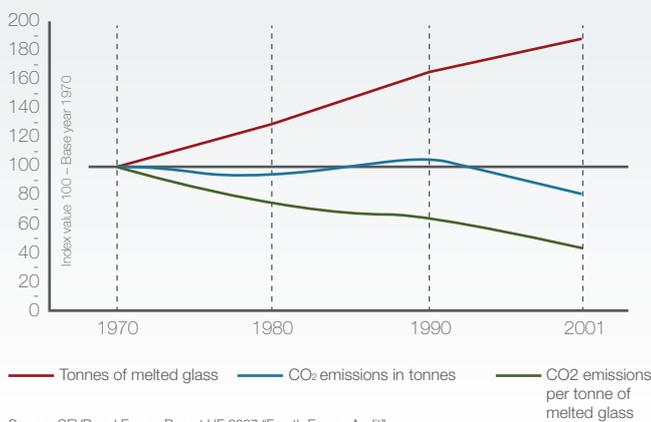
Glass manufacturing requires energy since glass furnaces need to be heated to temperatures of 1600°C at which point raw materials melt to become glass. Because of this law of material physics, **energy accounts for the largest share of manufacturing costs** and reducing energy

consumption is both an economic imperative and a constant objective of all glass manufacturers in order to remain competitive in the market place.

Europe's flat glass manufacturers invest to upgrade installations and will continue to apply best

available techniques. In doing so, the industry is guided by existing legislation such as the EU emissions trading scheme and the Industrial emissions directive but primarily driven by the economics of the sector.

Europe's flat glass industry's track record in energy efficiency



Studies have shown that the flat glass industry has been able to reduce energy consumption per unit of production by 55% between 1970 and 2000, thereby doubling output with no overall increase in CO₂ emissions.

The major challenge for our industry lies in the fact that, as recognized in numerous studies and by the European Economic and Social Committee, the flat glass industry has reached existing physical limits in the state of current knowledge, and best available techniques are already wide-spread in the industry.

Europe's flat glass manufacturers invest to upgrade installations and will continue to apply best available techniques.

CO₂ in glass manufacturing comes from two sources: the use of fossil fuel to fire furnaces (75% of CO₂ emissions) and the carbon contained within and released by raw materials during the melting process (remaining 25% of emissions).¹² This last source of CO₂ will never disappear: although the industry tries to increase the use of recycled glass and therefore uses fewer raw materials, glass melting without any raw material and with recycled glass only is not feasible for physical and quality reasons.

Regarding energy sources, **to date there is no technology available to efficiently operate large scale float glass furnaces using only electricity.**

In the state of current knowledge and research, best performing installations remain powered by a mix of fossil fuel and electrical boosts. Thanks to continuous improvements in furnace insulation, in the most efficient use of energy and in increased recycled glass use, the flat glass industry believes that it will be able to further reduce by 5 to 10% its CO₂ emissions per output unit by 2030.

Achieving an 80% decrease in CO₂ emission as set out in the EU roadmap for industrial operations is therefore impossible in the flat glass industry. Beyond the 5 to 10% mentioned above, further reduction would require major breakthrough in thermo-dynamic science and in raw material use,

the combination of greater recourse to electricity and the development of Carbon Capture and Storage. These last two options represent huge challenges for our sector in terms of industrial processes but also for authorities, particularly in the field of infrastructure development.

In this context, **the decarbonisation of the flat glass manufacturing industry is expected to follow a slow path** in the next 20 to 30 years as technologies and infrastructures are put in place and then rolled out to all installations. In the state of current knowledge, achieving the 80% objective remains unlikely and for our industry to make such a commitment would be dishonest.

¹² It must be noted that the quantity of CO₂ per tonne of flat glass is also impacted by economic conditions and the level of demand for our products. When demand is low, manufacturers must take measures, e.g. 'pull-reduction measures', to adjust production levels while maintaining float furnaces running. As the furnace still runs and fewer float glass is produced, the level of CO₂ per output unit increases. This is nevertheless more efficient than stopping a furnace, which is a heavy and lengthy process which would waste a lot more natural resources, energy and CO₂.

The dynamics of investments in flat glass manufacturing plants

The flat glass production process is a capital intensive, high volume, continuous production process, meaning that a float glass installation operates 24 hours a day, 7 days a week for uninterrupted periods of 16 to 18 years. During this period, only limited upgrades can be carried on producing installations so as to keep the furnaces hot and therefore avoid wasting energy. Major energy efficiency improvements can only be undertaken when production is completely stopped, which requires waiting for the end of the 16 to 18 year production cycle.

The decision to rebuild a float glass line is mostly dependent on the projected demand for products. This is due to the fact that a modern energy efficient plant not only requires heavy investments that can only be recuperated over a certain number of uninterrupted years of production but it will melt an average 650 tonnes a day, meaning nearly 250 thousand tonnes of melted product a year. However, once the major repair or rebuild decision has been taken, there is a natural incentive to apply best available techniques in order to limit production costs for the next 16 to 18 years.



- The flat glass industry cannot rely on hypothetical solutions outside its control and so it will continue to take part in, and finance, extensive research programmes to develop and apply conventional solutions that progressively curb energy consumption and CO₂ emissions.

The flat glass industry hopes to be able to achieve a further reduction of 5 to 10% of its CO₂ emissions per output unit by 2030, provided that ongoing research & development deliver the desired outcomes.

3. To ensure the competitiveness of our European operations to generate growth and green jobs in the EU

As an industry with a solid European manufacturing base, it is our duty to ensure the competitiveness of our European operations. On a daily basis, we strive to achieve this objective, which becomes ever more challenging as the worldwide market for primary float glass becomes a commodity market. This means that our industry's competitiveness is mostly impacted by commodity prices and our ability to achieve the lowest production costs.

Europe's flat glass industry wishes to continue operating the most competitive, socially and environmentally sustainable production facilities

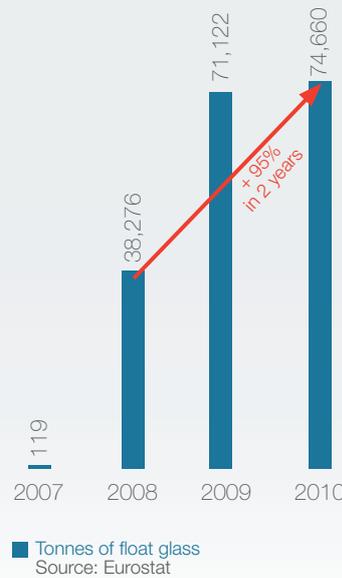
In this context, our ability to maintain a competitive lead whilst having to internalize costs not borne by our competitors, such as CO₂ allowances under the EU emissions trading scheme, higher employment costs, more stringent environmental standards set out in the Glass BREF document, etc. becomes an increasingly difficult challenge. Europe's flat glass industry accepts these realities and wishes to continue operating the most competitive, socially and environmentally sustainable production facilities in Europe.

To support this commitment of the flat glass industry, **European authorities have to seriously consider maintaining a level-playing field between EU and extra-EU manufacturers.** At the present time, roughly one fifth of Europe's float lines are idle as a consequence of the severe economic downturn, but imports of flat glass into the European Union are on the rise. Even more worrying is that there is only one concrete project for a new float line construction in the EU whereas

at least 12 projects of new lines exist in surrounding countries, mostly in North-Africa. Considering the limited size of North-African markets for float glass, the intention to target the EU market, is clear, as illustrated by the rise of Algeria's exports of float glass to the EU.

The flat glass industry is committed to reducing the CO₂ emissions from its operations but it needs to remain competitive. For these reasons, **CO₂ emission reduction objectives must reflect industry's respective technological ability to improve efficiency and must ensure that European based industries are not put at a competitive disadvantage.** As Europe evolves towards more stringent targets, efficient protection against carbon leakage must be ensured. Border adjustment mechanisms might prove necessary and recourse to Certified Emission Reductions (CERs) in the case of both imports and exports should not be a taboo. It deserves to be investigated.

Algeria exports of float glass to the EU



A new Algerian company called MFG was created in 2007 and quickly started operations of a new float line of a capacity of 600 tonnes of melted glass a day. On its website, this company prides itself on exporting a large share of its production to the European Union by way of weekly sea transport to its two logistics platforms in Italy and Spain.

Maintaining a level-playing field between EU and extra-EU manufacturers is an imperative.

Flat glass manufacturing under the EU Emissions Trading Scheme

In the context of the EU ETS, the exposure of flat glass manufacturing to external trade has been assessed by DG Enterprise of the European Commission. This assessment revealed that the industry's exposure to external trade equalled 21% during the period 2005 to 2007. This reality coupled with a high energy intensity ratio means that our industry is exposed to risks of carbon leakage. Flat glass manufacturers are therefore entitled to receive free CO₂ emission allowances up to the benchmark level. This benchmark has been set on the basis of the 10% least CO₂ emitting installations per quantity of float glass produced.

Even though this mechanism is meant to reward the least CO₂ emitting installations, it still raises a few concerns in terms of competitiveness. In practice, manufacturers will have to acquire allowances for nearly all installations and for a large part of their needs. In addition, the mechanism does not take into account the range of products produced on each site, whereas some sites may specialise in advanced glass types that will always require more energy than more basic products.

Without adequate protection mechanisms, Europe's flat glass sector will have to bear additional costs compared to its competitors that will likely translate in carbon leakage.



Europe's flat glass industry wishes to utilise the 2050 ambitions to be competitive and to help achieve Europe's green economy. Beyond its energy and CO₂ saving products, it intends to contribute to a solid manufacturing base in Europe that generates added-value, growth and green jobs.

A Supportive European Policy Framework

- The EU needs to rethink its approach to energy efficiency in industry and to give greater consideration to the 'output' and 'value added creation' when envisaging energy saving measures.
- Creating the economic conditions and confidence needed for industries to plan major investments and upgrades in European installations are imperatives to energy efficiency improvements. This requires that European environmental policies are developed over time according to clearly defined objectives that provide visibility and allow planning.
- Environmental legislation needs to differentiate between existing and new installations. Sufficient transition periods for industries operating continuous production flows to comply with new requirements in existing installations need to be realised.
- Due consideration should be given to the state of technological progress and possible innovations if and when industrial targets are set. It should be recognised that some sectors will inherently always require more energy than others and adequate differentiation should be envisaged.
- Maintaining a level playing field between European based industries and their competitors should be a pre-requisite of any European measure, unless that measure strengthens Europe's lead.
- Europe should avoid moving unilaterally in terms of binding commitments to reducing its manufacturing CO₂ emissions and should make sure that any international agreement covers its neighbours and that it is properly implemented.
- Border adjustment mechanisms should not be considered as a taboo and should be investigated to guarantee a level playing field between EU-based and extra EU industries in case additional commitments are taken.



About Glass for Europe



Glass for Europe is the trade association for Europe's manufacturers of flat glass. Flat glass is the material that goes into a variety of end-products and primarily in windows and façades for **buildings**, windscreens and windows for **automotive and transport** as well as glass covers, connectors and mirrors for **solar-energy** equipments. It is also used in smaller quantities for other applications such as furniture, appliances, electronics, etc.

Glass for Europe has four members: **AGC Glass Europe**, **NSG Group**, **Saint-Gobain Glass** and **Sisecam-Trakya Cam** and works in association with **Guardian**. Altogether, these five companies represent 90% of Europe's flat glass production.

Glass products not only provide light, comfort, style, security and safety, they are also **essential to energy-efficient buildings, houses and transport**. Windows containing high-performance glass such as low-e insulating glass, which helps keep warmth in, and solar-control glass, which reflects unwanted heat away, help reduce energy consumption. Solar-energy glass helps enhance the production of a renewable sources of energy. Better use of building glass alone could help reduce Europe's CO₂ – emissions by 100 million tonnes annually hence Glass for Europe's plea for an ambitious and robust European energy-efficiency policy.

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