

# GLAZING POTENTIAL

ENERGY SAVINGS &  
CO<sub>2</sub> EMISSION REDUCTION

GLASS  
FOR • EUROPE

# GLAZING ENERGY SAVING POTENTIAL



**75.5**  
MTOE

GLAZING SAVING  
POTENTIAL IN 2030



**-29%**

REDUCED ENERGY  
CONSUMPTION IN 2030



**42%**

CONTRIBUTION TO ENERGY  
EFFICIENCY TARGET

**NEARLY  
50% OF  
THESE  
SAVINGS  
CAN BE  
REALISED  
IN 10 YEARS.**



BY DOUBLING  
THE WINDOW  
REPLACEMENT RATE



BY INSTALLING  
HIGH-PERFORMANCE  
GLAZING

# 1

## HOW MUCH ENERGY AND CO<sub>2</sub> EMISSIONS COULD BE SAVED THANKS TO HIGH-PERFORMANCE GLAZING ?

Two scenarios presented in the study illustrate the amount of energy and related CO<sub>2</sub> emissions that could be saved annually in 2030 and 2050, if all EU buildings were equipped with high-performance glazing.

These two scenarios show that windows equipped with high-performance glazing have the potential **to deliver up to 75.5 Mtoe of energy savings in 2030 and 67.3 Mtoe in 2050.** This correspond to annual CO<sub>2</sub> emission avoidance of up to

94.2 Million tonnes and 68.5 Million tonnes in 2030 and 2050 respectively.

SCENARIO	TOTAL ANNUAL ENERGY SAVINGS	TOTAL ANNUAL CO <sub>2</sub> EMISSION SAVINGS
ALL WINDOWS ARE CHANGED IN 2030 WITH READILY AVAILABLE HIGH-PERFORMANCE GLAZING	75.5 Mtoe (-29%)	94.3 MtCO <sub>2</sub> (-28%)
ALL WINDOWS ARE CHANGED IN 2050 WITH IMPROVED HIGH-PERFORMANCE GLAZING	67.3 Mtoe (-37%)	68.5 MtCO <sub>2</sub> (-37%)

# 2

## WHY IS GLAZING OFFERING SUCH A HIGH ENERGY SAVING POTENTIAL ?

The study shows an energy saving potential in 2030 equivalent to a reduction of 30% in the energy consumption of buildings. This illustrates that windows are a key component to the energy performance of a building.

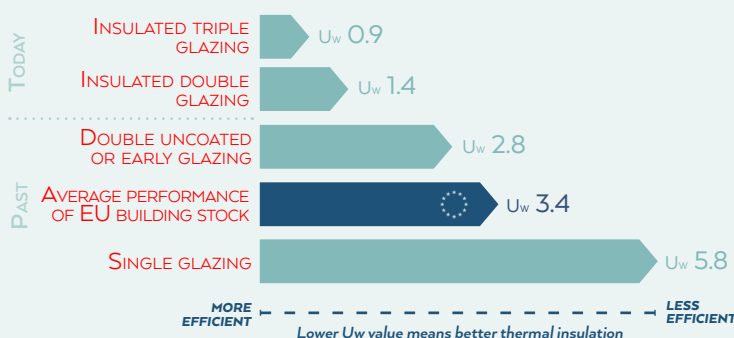
This massive potential is due to the fact that **today's buildings in Europe are mostly equipped with dated inefficient glazing**, as shown in several scientific studies and data reported to the European Commission<sup>1</sup>. Glazing performance has considerably increased over the last decades and high-energy performance products are available.

**Glazing can now be selected to offer the best energy balance** between thermal insulation properties (U<sub>w</sub> value) and ability to capture or repeal solar heat gains (g value). With the adequate type of glazing energy savings are maximised in all building types and under all climatic conditions.

### WINDOWS INSULATION PERFORMANCE

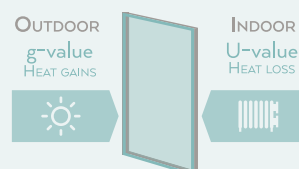
Typical U<sub>w</sub> value and average EU building stock

Source: Glass for Europe; European Commission.



### ENERGY BALANCE

With today's products, the **g-value** of glazing can be selected to offer the best **energy balance**.



<sup>1</sup> European Commission, Clean Planet for all, COM(2018)773, and European Commission, EU Building Stock Observatory, viewed 17 December 2018, <<https://ec.europa.eu/energy/en/eubuildings>>

# 3

## WHAT IS THE IMPACT OF ENHANCED RENOVATION OF WINDOWS ?

Nearly half of the maximum saving potential identified for 2030 could be realised in 10 years by doubling the window renovation rate with high-performance glazing. This represents annual savings of 36,4 Mtoe in 2030 for the European Union.

To quantify these savings, a conservative 2% window replacement rate across Europe is assumed as a business as usual scenario. A doubling of building renovation, as contemplated by European institutions, means that the window replacement rate would reach 4% per year, all things being equal, and that

the worst performing windows are prioritised for renovation. For this potential to materialise, **more renovation must go hand in hand with the installation of glazing whose performance are optimized** for building types and locations.

Nearly **half of the maximum saving potential** identified for 2030 could be realised in **10 years**.

# 4

## CAN WINDOWS MITIGATE THE NEED FOR COOLING IN BUILDINGS ?

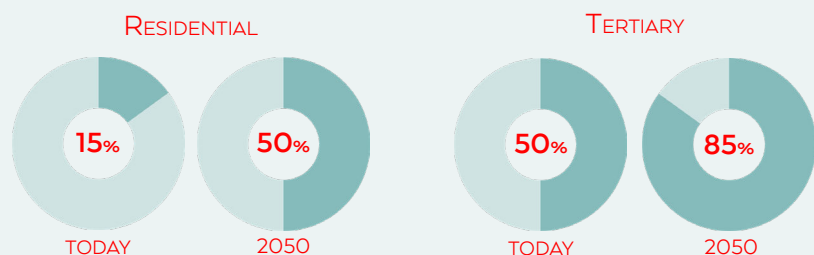
Although most energy savings are realised by reducing heating needs in buildings, high-performance glazing also contributes to reducing cooling demand. For instance, the study shows that **energy consumption used to cool buildings could be reduced by over 27%** all across Europe in 2050 by adequately using high-performance solar-control glazing.

Taking into account glazing's contribution to moderate heat loads in buildings is important in the southern regions of Europe as well as all across the continent. In commercial buildings with large glazed façades and residential windows facing south, **high-performance solar-control glass increases comfort and minimizes the heat load and need of air-conditioning**. This is important to

take into account at time of replacing windows, considering that studies forecast a high increase in the installation of cooling equipment in Europe's buildings in the next decades.

### FORECAST: EU BUILDINGS EQUIPPED WITH AIR-CONDITIONING

Source: IEA, 2018



# 5

## HOW DO SAVINGS EVOLVE OVER TIME ?

Windows are long-lasting products as they stay in buildings for over 40 years on average. Once properly installed and maintained, they offer stable energy performance throughout their lifetimes thus **energy savings will be realized for several decades**. It is therefore important that when windows are replaced in buildings,

high **energy efficiency glazing is chosen to maximize savings and to avoid lock-in effects** for several decades.

Between 2020 and 2030, cumulated energy savings could reach 200 Mtoe thanks to a doubling of the window replacement rate with the installation of high-performance glazing.

That also means avoiding the release of above 240 million tonnes of CO<sub>2</sub> emissions in the atmosphere in 10 years.

Policy actions to support upgrade in glazing is urgently needed to maximise energy savings and to help combat climate change!

Cumulated energy savings could reach **200 Mtoe in 10 years.**

# 6

## HOW CAN HIGH-PERFORMANCE GLAZING CONTRIBUTE TO ACHIEVING A CLIMATE NEUTRAL EU ?

The European Union contemplates the objective to become the first climate neutral economy by 2050. To achieve this ambitious goal, reducing drastically energy consumption from buildings is a necessity even if Europe succeeds in decarbonising its energy production.

The study by TNO allows the quantification of CO<sub>2</sub> avoided thanks to high-performance glazing. For instance, **in 2030, the use of advanced glazing could save annually almost a third of the EU CO<sub>2</sub> emissions in buildings**. In the year 2050, although the share of

renewable sources increases in the energy mix, 37.4% of CO<sub>2</sub> emissions from buildings could be saved thanks to high-performance glazing.

What is most outstanding is that because windows stay on buildings for decades, CO<sub>2</sub> avoided over several years grow exponentially. For instance, between 2020 and 2030, a doubling of window renovation rates would **avoid the release of above 240 million tonnes of CO<sub>2</sub>**. This is more CO<sub>2</sub> saved that was emitted in 2016 by all the Baltic States, Finland, Sweden and Denmark together<sup>2</sup>!

**The contribution of glazing to a climate neutral Europe could be potentially higher.** New glazing products, such as switchable/electrochromic glazing, glazing-integrated photovoltaics or other novel technologies, have not been considered in the TNO study while their uptake could generate additional CO<sub>2</sub> savings.

Advanced glazing will be a major contributor to **CO<sub>2</sub> emission savings** needed to decarbonise Europe.

# SAVINGS IN BUILDINGS ALL OVER EUROPE

## NATIONAL DATA

The study conducted by TNO integrates buildings and energy sources information per country. It stems from this detailed work that it provides national figures on the amount of energy and related CO<sub>2</sub> emissions that could be saved annually in 2030 and 2050, if all buildings from a selected Member State were equipped with high-performance glazing.

Scenario	2030			2050		
	TOTAL ANNUAL ENERGY SAVINGS		TOTAL ANNUAL CO <sub>2</sub> EMISSION SAVINGS	TOTAL ANNUAL ENERGY SAVINGS		TOTAL ANNUAL CO <sub>2</sub> EMISSION SAVINGS
	ktoe <sup>3</sup>	% <sup>4</sup>	ktCO <sub>2</sub>	ktoe <sup>3</sup>	% <sup>4</sup>	ktCO <sub>2</sub>
Austria	1789	-29%	1439	1579	-37%	1116
Belgium	1664	-32%	2868	1518	-42%	2397
Bulgaria	1180	-27%	411	1066	-35%	237
Croatia	655	-34%	690	534	-40%	536
Cyprus	57	-19%	88	54	-26%	82
Czech rep	1622	-34%	1870	1323	-40%	1190
Denmark	874	-32%	486	797	-42%	404
Estonia	390	-39%	156	316	-45%	106
Finland	1363	-34%	420	1197	-43%	268
France	9758	-32%	9594	8901	-42%	7580
Germany	17998	-29%	26240	15888	-37%	20175
Greece	760	-19%	1655	725	-26%	546
Hungary	1608	-34%	2145	1312	-40%	1573
Ireland	651	-32%	1193	594	-42%	829
Italy	4134	-19%	8234	3946	-26%	4929
Latvia	675	-39%	340	547	-45%	267
Lithuania	1026	-39%	498	832	-45%	314
Luxembourg	76	-32%	126	69	-42%	102
Malta	28	-19%	51	27	-26%	60
Netherlands	2643	-32%	4019	2411	-42%	3279
Poland	6073	-34%	8525	4953	-40%	5045
Portugal	754	-19%	413	720	-26%	265
Romania	3630	-27%	3652	3280	-35%	2946
Slovakia	852	-34%	1015	695	-40%	754
Slovenia	317	-34%	230	259	-40%	153
Spain	2873	-19%	3274	2742	-26%	1739
Sweden	2350	-34%	222	2063	-43%	159
United Kingdom	9715	-32%	14376	8862	-42%	11462
<b>EU28</b>	<b>75514</b>	<b>-29%</b>	<b>94230</b>	<b>67210</b>	<b>-37%</b>	<b>68512</b>

3. One kilotonne of oil equivalent (ktoe) is equal to 11.6 GWh.

4. Percentage of energy consumption for heating and cooling buildings.

# POLICY RECOMMENDATIONS

Be it at EU level or across European countries, several policy measures can be designed to grasp this massive potential for energy savings and CO<sub>2</sub> avoidance, thanks to high-performance glazing. The building glass sector stands ready to support the design of these measures together with energy and climate-conscious policy makers.

## PUT ENERGY EFFICIENCY FIRST IN THE BUILDING SECTOR

**The decarbonisation of Europe by 2050 requires to cut CO<sub>2</sub> emissions in the building sector.** Actions to moderate buildings' energy consumption is a must to achieve the CO<sub>2</sub> emission savings needed and to increase the share of renewables in the energy mix. The increased share of renewables in the energy mix over the next decades, as computed in the study based on the European Commission's own projections, will not be sufficient to meet the carbon-neutral EU objective alone, hence the need to keep acting on increased energy performance.

## DON'T DELAY MEASURES, CHOOSE TO MAXIMISE SAVINGS

The carbon budget left is limited and swift actions are needed today in the building sector to mitigate global warming. The present study demonstrates that the products offered by the glass industry can deliver vast amounts of energy savings and avoid releasing CO<sub>2</sub> in the atmosphere. Once a window is replaced, it will continue delivering savings over decades, which has **an exponential effect on the cumulated amounts of CO<sub>2</sub> that can be avoided. The earlier actions are taken, the better for the climate!**

## INCREASE BUILDING RENOVATION RATE

An increase in the renovation rate of buildings needs to be supported. The average energy performance of windows in the EU building stock is extraordinarily poor. The average thermal transmittance value of 3.4 U<sub>w</sub> is that of a mix of products from the late 1960s and 70s, when incomparably better performance products are readily available in Europe. **Pro-active policy measures need to be implemented to make building renovation attractive to consumers.**

## TAKE MARKETS TO UPPER ENERGY EFFICIENCY LEVELS

**Important savings can be achieved in the building sector provided policy actions steer markets towards high-performance glazing.** The energy performance of buildings directive provides that building components with a very strong influence on the energy performance of the whole structure, such as windows, shall be subject to prescriptive energy requirements. These **Member States' minimum performance requirements should be updated** to take into consideration the increased energy performance of products in all their aspects, including the moderation of cooling needs by way of the energy balance. Other policy instruments, such as financial incentives, information campaigns and improved guidance to building owners should be used **to guide consumers towards most efficient glazing solutions.**

GLASS FOR EUROPE

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# A ROBUST STUDY

## HOW WERE ENERGY SAVINGS AND CO<sub>2</sub> AVOIDANCE POTENTIAL CALCULATED?

Glass for Europe commissioned a study on energy savings and CO<sub>2</sub> emission avoidance of high-performance glazing to the **independent research institute TNO**.

This study is a quantification of both energy and CO<sub>2</sub> savings that can be realised thanks to high-performance glazing across the 28 EU

Member States in both horizons 2030 and 2050. In addition to full potentials, whereby all windows are equipped with high-performance glazing across all EU buildings, it also simulates the impacts of several window replacement rates, all compared to a baseline scenario.

**The study draws on recent scientific sources to define input parameters** such as today's Europe building stock and performance, the evolution in the energy mix, the penetration of high-performance heating and cooling equipment, etc.

## WHAT ARE THE ENERGY PERFORMANCE CHARACTERISTICS OF GLAZING COMPUTED IN THE STUDY BY TNO?

The energy performance characteristics of products computed in the study had to be defined by an ad-hoc expert group within Glass for Europe, for two distinct periods: 2020-2030 and 2030-2050.

In the first period, **windows installed are based on a mix of high-performance glazing products readily available on the EU market**. By contrast, the windows installed in the second period (2030-2050) are not yet available products and are based on an expert

judgment on the potential evolution of glazing energy performance over the next decades.

**Glazing has been selected to offer optimal energy performance to different building types, in seven climatic zones and taking into account façades' orientations.**

For the 2020-2030 period, performances are based on five different types of Low-E glazing and five different types of solar-control glazing.

For **non-residential buildings** with large glazing façades, different types of solar control glazing are applied on all buildings' façades across all climatic zones. For **dwellings** in the Southern regions of Europe, solar control glazing is applied on all buildings' orientations. For dwellings in the other regions of Europe, several different low-e glazing are used on the North, West and East façades, while solar control glazing is applied on the South orientation.

## WHAT WINDOW RENOVATION RATES ARE ASSUMED?

Based on window lifetime and available scientific literature, the average EU replacement rate of windows is estimated between 2 and 2.5%/y. It was decided to adopt a conservative approach by considering

an average EU window renovation rate of 2% in the baseline scenario. The doubling of the building renovation rate, as contemplated by the European Commission, therefore uses a 4% rate on average across the

EU between 2020 and 2030.

Thanks to the breakdown of data per country and the 1% rate provided in the study, more refined calculations can be realised per country.