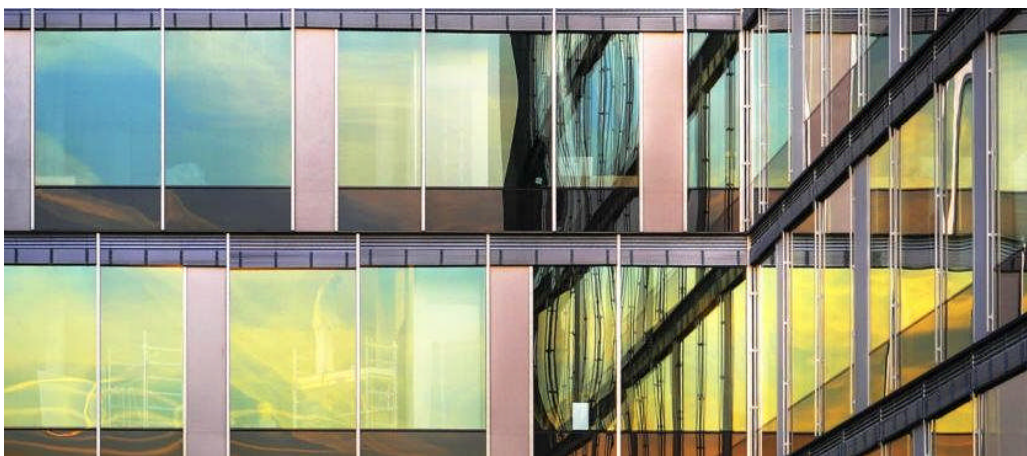




Energy saving through window sealants

Worldwide, the increasing demand for energy efficiency influences the development of façades and windows. Modern international market requirements for greater transparency and higher functionality demand innovative and economically convincing solutions. Especially in the North of Europe, windows are one of the most important factors when considering the overall energy efficiency of a house. Insulating glass units are the heart of every façade and window. For long service life they need proper sealants that are compatible with all other components with which they come in contact.



Advancements in window profile technology over the past few years have created windows with better insulation to prevent water leakage and moisture penetration between the windows and into building, and to avoid energy loss. Sealants are used to seal the glass from the window frame (glazing sealant) to avoid water penetration but also to seal the space between window frame and the building façade to avoid both water penetration and air leakage into the building. They are also both used as adhesive and sealant in insulated glass to prevent moisture penetration between the glass panes, to prevent argon gas leakage and to provide structural integrity to the assembly. In the last years, they also started to be used to bond the glass to the window frame, which allows to increase the glass surface and to improve the energy efficiency of windows. This technology allows the omission of steel reinforcements in plastic windows, enabling a thinner frame design. Besides an improved material efficiency and a brighter room ambience, up to 20% energy savings can be achieved this way.

The embodied energy of sealants, the energy used to produce the sealant, corresponds to about 10% of the embodied energy of the window and is lower than a non-bonded window. This energy is being recuperated few days after placing the window with the sealant where it may stay up to 50 years. The bonding technology allows removing the steel in the PVC frame to decreasing its thickness. The glass area is being increased allowing more daylight into the house. The overall benefits result is saving energy up to 20%. A sealant with a higher embodied energy such as a perimeter sealant will, if installed correctly, result in even higher energy savings and therefore recuperate its embodied energy several times over.



ANNEX – technical explanation

The embodied energy of sealants and adhesives used in windows are put in balance with the energy gain provided in a standard building. For the embodied energies, average values (table 1) were taken from the ICE report[1]. Energy use calculations (table 2) have been carried out using the EFEN..... with following assumptions: a 30mx35m Building with 15 (1.5m x 1.2m) PVC windows per side was used. The analyses were carried out using a UK type climate, comparing the use of single glass panes, double insulated glass, bonded windows and the introduction of air leakage.

Table 1: Embodied energy of sealants/adhesives and window elements

Material	Use	Embodied energy (MJ/kg)	Amount used/ window kg	Embodied energy/ window MJ	Embodied energy in building GJ
Sealant	Glazing	100	0.05	5	0.3
Sealant/adhesive	Insulated Glass	100	0.5	50	3
Sealant	Perimeter	100	0.6	60	3.6
Adhesive	Bonding	100	0.15	15	0.9
Glass	Glass	16	20	320	19.2
Steel	Frame	25	10-20	250-500	15-30
PVC	Frame	80	5-10	400-800	24-48
PVC Window		1000-2000		1000-2000	60-120



Table 2: Energy used with different window configurations (two different climates)

Type	Type of window	U (W/m2.K)	SHG	Energy (GJ/yr)*	Energy gain (GJ/yr)
1	Single glass pane (6mm glass)	4.4	0.54	1808	/
2	Low E Ar filled insulated glass (4mm glass)	1.6	0.33	1548	260
3	Same as (2) but bonded	1.5	0.36	1541	267
4	Same as (3) with introduction of air leakage of 5.5m3/m2.h	1.5	0.36	1601	215

**total energy: includes heating, cooling, water heating, electrical equipments*

Analysis of table 1 shows that the embodied energy of sealants and adhesives corresponds to about 10% of the embodied energy of the window and provides multiple benefits.

In table 2, we can see that 3 GJ are needed to produce the sealant/adhesive used to make the insulated glass, leading to an energy gain of 260GJ/yr (type 1 vs 2). Thus the energy needed to produce the sealant/adhesive is recovered in a few days.

Less than 1 GJ (0.9GJ) was needed to produce the adhesive whilst the energy gain is 7 GJ (per year?). Whilst the embodied energy of the bonded window is already lower compared to the non-bonded window (type 3 vs 2), the sealant/adhesive also allows omission of the steel in the PVC frame, thereby decreasing the frame thickness and increasing the glass area. More daylight enters into the building which improves the overall energy efficiency of the window (reduced U-value).

These calculations were carried out using a perimeter sealant. Using a different type of sealant/adhesive would lead to higher air leakage than in the simulation (5.5m3/m2.hr). Therefore, calculations were made assuming bad sealing of the space between the window frame and the building façade. Using this assumption, we can see that the embodied energy of the perimeter sealant although higher than that of other types of sealants (3.6GJ) is much lower than the energy gain (52GJ/yr) through the correct sealing of the building (type 4 vs 3).