Understanding U-factor, window insulation and energy savings

1. What is Uw?

The thermal transmittance of a window Uw, is the flow of heat through the window, in W/m^2K. The closer the U is to zero the better the insulating performance of the window. On the other hand, the bigger the U, the larger the heat loss through the window and the more the energy needed to heat or cool the interior.

2. How much heat is transferred through the window?

The heat transferred through a window or the required energy to keep the same temperature inside is E(Watts)= Uw x A x ΔT, where E is the heat transferred or the energy input, Uw the thermal transmittance of the window and ΔT the difference between the outside and the desired inside temperature.

Example:

An aluminum window, with WxH=1.0mx1.0m and single glass has Uw=$6.1W/m^2K$. Let us say that the outside temperature 6^oC and the desired inside temperature is 22^oC.
Then heat transferred through that window or the required energy input to keep the interior temperature is E(Watts)= U x A x ΔT, or

E = 6.1 x 1.0 x (22-6) or E=98W or 2.4KW in 24hrs.
When the livingbetter passive house W4900 tilt and turn window is used, the heat lost is only 0.30KW!! instead.

3. What is the cost of the window heat loss?

Using the above example, If the difference in temperature is the same for the whole month, the total windows area in the house 18 m^2, and the cost of electricity at ￥31.74/KWh, then the cost of heating due to the heat lost from the windows is ￥41,135/month.

When the livingbetter passive house W4900 tilt&turn window is used, the cost of heating is only ￥5,141/month for savings of ￥35,994/month!!

For the insulating livingbetter aluminum W4750 tilt&turn window the cost of heating is ￥5,702/month for savings of ￥35,433/month!!

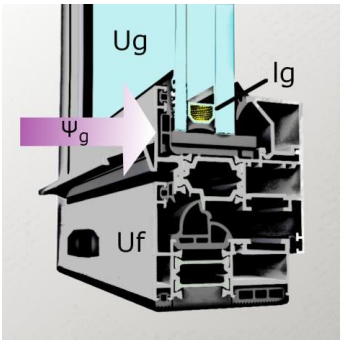
For the excellent livingbetter aluminum W450 tilt&turn window the cost of heating is ￥9,255/month for savings of ￥31,880/month!!

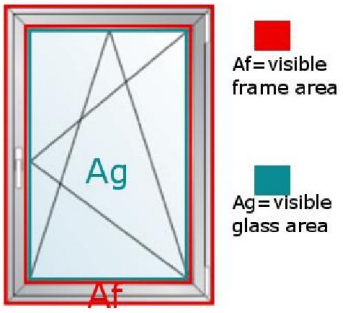
4. How is the window thermal transmittance Uw, calculated?

The thermal transmittance of the window Uw is a function of the thermal transmittance of the window frame, Uf, of the glass Ug and that of the glass spacer ψ_g. The window thermal transmittance equals:

$$U_w = \frac{A_f \cdot U_f + A_g \cdot U_g + l_g \cdot \Psi_g}{A_f + A_g}$$

Where,
Uw = thermal transmittance of window
Uf=thermal transmittance of the frame
Af=visible area of the frame
Ug=thermal transmittance of the glass
Ag=visible area of the glass
Ψg=the linear thermal transmittance of the glass (spacer)
Lg=the perimeter of the glass

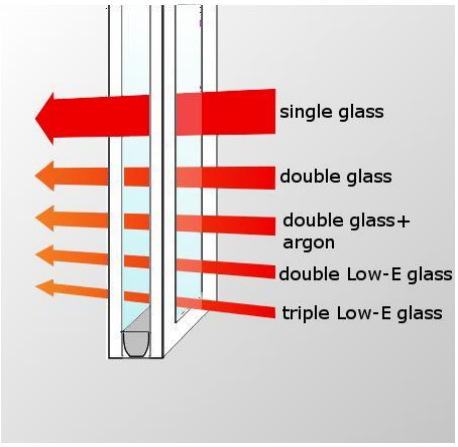




5. What type of glass is the best?

As glass comprises the highest percentage of the window overall area, the choice of glass is the No.1 energy decision. The best type is Low-E glass.

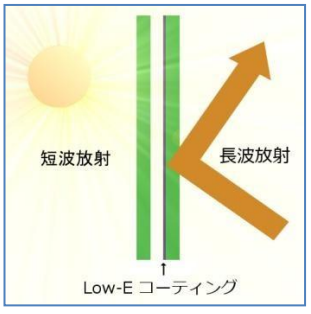
The more the glass panes the better the thermal insulation. In addition, more panes and thicker or laminated glass provide better sound insulation. All livingbetter windows come with Low-E glass.



Type of glass	U, W/m²K
single glass 4mm	5.75
double glass 4-14-4mm	2.8
double glass with argon 4-14-4mm	2.6
livingbetter Low-E with argon double glass 5-16-4mm	1.0
livingbetter Low-E with argon triple glass 4-12-4-12-4mm	0.7

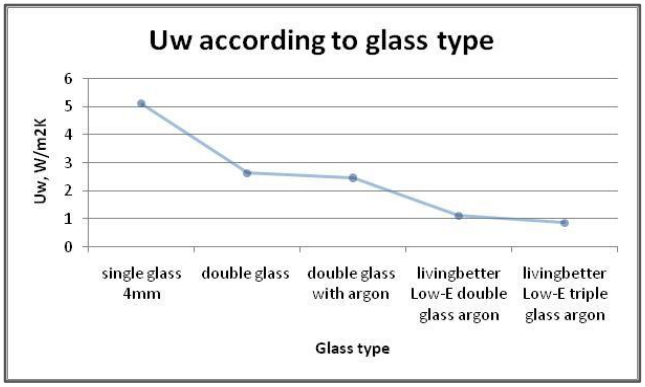
6. What is Low-E glass?

Low-E or Low emissivity glass is a coating applied in the glass that allows the heat from the sun rays (short wave radiation) to enter the house but reflects back the heat from the house that hits the window (long wave radiation). When Low-E coating is applied to a double glass window the outide glass is heated from escaping energy and the rik of condensation is also reduced.



7. How does glass affect the overall thermal transmittance of the window?

Let us take a 1.5mx1.5m aluminum W4750 tilt and turn window and evaluate the overall Uw for the different type of glass shown above: the triple Low-E glass window is 40% more efficient thanthat with the double glass.

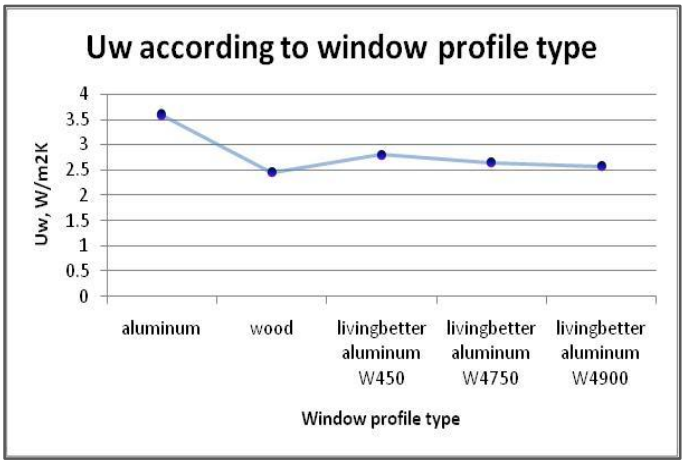


8. How does the choice of frame affect the window insulation?

We are going to examine how several different frames affect the overall window insulation using the window size from the previous example, WxH=1.5mx1.5m and a standard double glass with Ug=2.8m^2/K. The thermal transmittance values for the different frames are:

Type of frame	U, W/m^{2}K
aluminum	7.0
wood	1.7
livingbetter aluminum W450	2.2
livingbetter aluminum W4750	1.2
livingbetter aluminum W4900	0.76

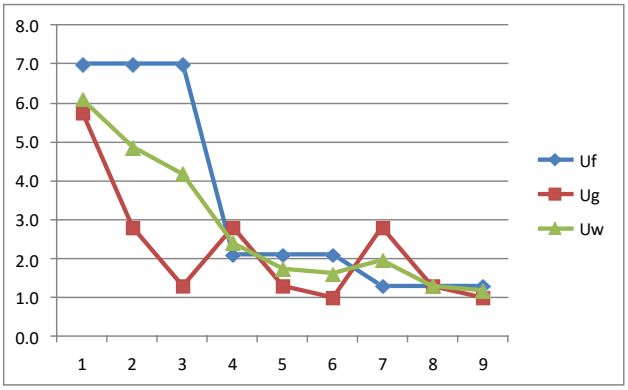
The effect of the frame material to the window U is not as dramatic as that of the glass due to the smaller area.



Note that the Uf values for the frame are evaluated in reputed laboratories. All livingbetter windows have certificates from the most reputed laboratory in Europe the German ift Rosenheim. You must insist that your window provider shares with you the Uf of the frame as tested by a recognized laboratory. If the thermal transmittance of the glass is not known it can be found from the glass company literature or from the internet.

9. Conclusion

The chart shows several combinations of frame and glasses. Due to the impact of the glass area to that of the window we can see that the overall Uw varies similar to Ug.



10. Thermal transmittance of Japanese windows vs European windows

All European cities have more efficient windows than the same climate Japanese cities because of stricter regulations. All livingbetter tilt & turn windows have Uw<2.0W/m^{2}K