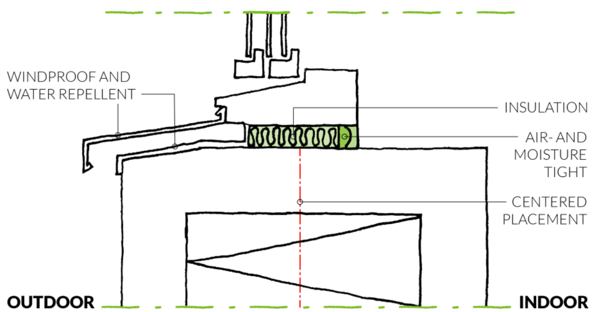
Advice:

There are several factors during the installation that can affect the insulation ability of the window:

- *Centred placement*
  - Thermal bridges can be reduced if the window is placed depth-wise centred to the insulation in the wall
- *Insulation around the window*
  - The space between the frame and the window must be carefully insulated
- *Air and moisture tightness*
  - The space between the frame and the window must also be air- and moisture tight from the inside, as well as windproof and water repellent from the outside



About DREEAM

DREEAM (Demonstration of an integrated Renovation approach for Energy Efficiency At the Multi building scale) aims to show that renovating at a larger scale opens the opportunity for better integration of renewable energy and is generally more cost-effective. The project demonstrates a multi-building and single owner renovation approach that can achieve a 75% reduction of total energy demand.

The DREEAM approach is implemented on pilot sites in the UK, Germany and Italy. These demonstration sites are to validate the DREEAM method in different climate, cultural and institutional configurations.

dreeam
scaling energy renovation

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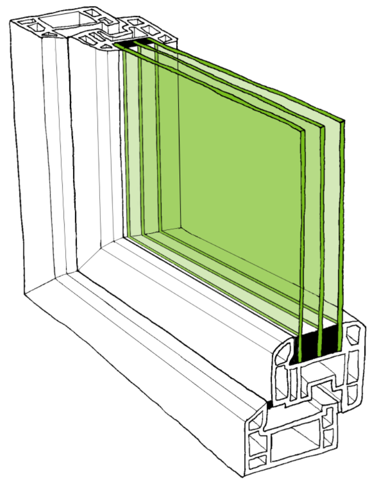
WINDOWS



Benefits of window improvements

The savings in renovation projects can be substantial and the energy emissions can be decreased by up to 40 % by the improvements of old windows. Older windows have a high heat transfer coefficient (U-value) that creates heating loads in cold climate and cooling loads in warm climate. Newer windows have a higher insulation ability, leaks less air and reduce the solar heat gain, which all affects the energy use negatively.

Additional benefits associated with window updating are the increase in thermal and acoustic comfort. A downside is the high investment cost.

Thermal transmittance (U-value, W/m^{2}K)

The heat transmission through a building part, e.g. a wall or a window, can be compared using their U-value. The U-value expresses how much energy a material emits per unit area and temperature difference (°K/C) between the in- and outside. However, what is included in the calculations varies from country to country, some include only the glass while others take the complete window into consideration.

Solar heat gain

Solar heat gain occurs when solar radiation perpetuates the window. The effects of which can be either positive or negative, depending on the external climate.

Different kinds of windows

When it comes to windows there are lots of different kinds, they vary in appearance and characteristics e.g. when it comes to thermal transmittance. Three of the most significant features when it comes to energy efficiency are the frame, the filling between the panes (e.g. gas) and its operating type (e.g. fixed, sliding or casement).

Adaptations

To optimize a window there are several parameters to take under consideration:

- *Location*: The climate and weather condition in which the building is located effects the demands on the window.
- *Facing direction*: A window which is frequently exposed to sunlight (facing south) should not let much solar heat in. In contrast, a window facing north should have a higher U-value to prevent heat emissions.

STATE OF THE ART

Low emissivity coatings TRL 9*

The low emissivity (low-e) coating can be applied to any window with insulated glazing. The coating lowers the emissivity *i.e.* a materials ability to radiate, so that less heat can enter through the window.

A normal window emits about 84 % of the long-waved (infrared) light and only reflects 16 %. With a low-e coating, the emittance can be as low as 4 % and reflect up to 96 % of long-waved light. The emittance rating is usually not listed in the product information for windows since the effect is incorporated into the U-value.

Electrochromic glazing TRL 7

Electrochromic glazing, also known as smart or dynamic glass, shuts the heat out by tinting the glass. The window reduces cooling needs and glare but is still transparent.

The tinting of the electrochromic glazing can be controlled automatically or manually to all or sections of the glass.

Vacuum insulated windows TRL6

A vacuum insulated window is comparable with a flat and transparent thermos bottle. When two sealed airtight panes of glass are separated with small spacers, it is possible to create a vacuum in between. The vacuum will eliminate the heat loss by conduction and convection make the window surface almost as warm as the wall. To achieve the highest possible result, the technology takes advantage of the low-e technique to prevent heat loss through radiation.

Aerogel glazing TRL 6

Aerogels are among the lightest solid materials in the world with a density 1000 times less than glass. Most aerogels are based on *silicon dioxide* and consists of up to 99.8% air.

The aerogel glazing has a high insulation ability and diffuses the light without glare. It can be used as a filling between the panes in the window and is suitable in both hot and cold climate zones to prevent heat transmissions.

Dynamically responsive infrared coatings TRL 5

The dynamically responsive infrared (IR) window coating has two states. In the first state, the window coating is transparent. As the temperature rises, it changes into the second state, which reflects the IR light.

Hierarchical porous silica insulation TRL 4

This technique involves insulating windows using a layer of a newly produced material called Hierarchical Porous Silica, that has a low U-value. It is also free from haziness and has improved mechanical strengths. Compared to aerogel, hierarchical porous silica is predicted to be both cheaper and more transparent.

**TRL = Technology Readiness Level, a scale from 1-9 to assess the maturity level of a technology. 1 is the lowest and 9 is the highest.*