Documentation

Special Show

„Green Deal"

CO_2 efficiency and protection against climate consequences with sustainable windows and building elements

FENSTERBAU FRONTALE

12 – 15 July 2022, Nuremberg

Special Show Green Deal

CO_2 efficiency and protection against climate consequences with sustainable windows and building elements

Climate change is here, and the building sector is bringing up the rear in terms of achieving Germany's climate targets. Politicians are also aware of this, so building components and materials will have to meet higher energy efficiency and sustainability requirements in the future. Otherwise, there is a threat of penalty payments to the EU amounting to billions. It is no longer just a matter of reducing CO_2 emissions through energy-efficient and sustainable building products and construction technology and thus limiting climate change, but also protecting against future climate extremes. At the world's leading trade fair FENSTERBAU FRONTALE in Nuremberg, ift Rosenheim and 12 co-exhibitors will be presenting innovative technologies in Hall 1 as part of the special show "Green Deal – CO_2 efficiency and protection against climate consequences with sustainable windows and building elements".

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About ift Rosenheim

You need skills, technology and experience for good structures, and this is especially applicable to windows, facades and doors. Since 1996, ift Rosenheim has been supporting the industry as a neutral scientific institute with technical services and more than 230 employees. These include conducting tests and research, certifica-tion and quality management as well as standardisation, advanced education and technical information. In this manner, ift Rosenheim is promoting the development of quality products that are suitable for use, environment-friendly and efficient, and which make life more comfortable, more secure and safer, and healthier.

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Green Deal

Energy efficiency, CO_2 avoidance, sustainability and protection against climate extremes for new construction and energy refurbishment

Climate change is real, and the consequences affect us all – as the disasters of the past few years show. Heat records with temperatures of up to 47° Celsius, heavy rain with flooding, but also unexpected cold spells with large masses of snow endanger people and buildings. Therefore, it is no longer just a matter of slowing down climate change through energy-efficient and sustainable building products, but also of protecting against future climate extremes. In addition to the reduction of CO_2 emissions, the consumption of resources during production (grey energy) and the recyclability of building products at the end of their life cycle must also be taken into account in order to force the change to a circular economy.

Fig. 1 Buildings and cities need to be energy-optimised and climate-resilient to slow climate change and withstand the impacts of climate extremes. (Image Kwest - stock.adobe.com)

For new construction and modernisation, buildings therefore need the following technologies:

- energy-efficient building envelope with high thermal insulation and, in the case of transparent components, adaptive solar protection (roller shutters, venetian blinds, blinds, switchable glazing, etc.) to utilise solar gains and protect against overheating,
- • easy-to-use ventilation devices (windows) to supply the occupants with fresh air and to avoid overheating of the rooms through night cooling. In addition, sensors and control elements for protection/warning in case of rain and wind are therefore also useful for windows.
- Connection to the heating or building services (windows open – heating off).
- Windows and doors in the basement and ground floor must provide sufficient protection against flooding caused by local heavy rain and water under pressure in critical installation positions.
- The constructions and materials must become more resistant to higher wind loads (storms) and surface temperatures (up to 70 °C during intense sunlight and heat periods), especially with dark surfaces.
- The building elements must be easily replaceable, the materials used (frame, glazing, seal, fittings, etc.) must be fully recyclable and easily separable for this purpose. The declaration of the materials should be easily available for the entire period of use.

1 Climate change calls for energy-optimised buildings

The necessary reduction of CO_2 emissions in the building sector can only be achieved through radical savings in energy consumption and the increased use of renewable energies. The necessary measures must focus much more strongly than before on existing buildings. After all, this is where the majority of CO_2 emissions originate. The big lever is therefore to increase the rate of energy-efficient renovation with energy-efficient building elements that make the use of regenerative heat sources such as heat pumps sensible in the first place.

Today, modern windows, façades and glazing have already reached a level where the solar gains during the heating period on the east, west and south sides exceed the energy losses via these surfaces and heat the building. This makes modern thermal insulation windows a regenerative heat source without any additional system technology at all. Especially in building renovation, installation has a very large influence on thermal insulation, function and serviceability and must therefore be well planned. A lot of detailed information can be found in the installation guide [17]. The following aspects must be taken into account for a professional installation

- Re-evaluation of the building physics equilibrium, as new windows change the air tightness and the surface temperatures on the building component and the reveal.
- Identify and optimise critical thermal bridges by insulating the reveal if the U-value of the exterior wall U_{AW} > 1.0 W/(m²K).
- Consideration of possible changes to the structural conditions (window sills, reveal, roller shutters), taking into account monument protection, effort/cost, avoidance of dirt, etc.
- If more than 1/3 of the windows in a building or a residential unit are replaced, a ventilation concept must be prepared in accordance with DIN 1946-6.

1.1 Tightening of requirements (German building law „GEG" 2023)

In order to achieve the national and European climate targets, the requirements and regulations must be adapted. The minimum energy requirements must be oriented towards the EPBD (European Performance of Buildings Directive), which already called for increased energy requirements for buildings in 2018. For this reason, the traffic light government also wants to amend the Building Energy Act (GEG). In the draft bill of 29.04.2022 [11] the requirements for the refurbishment of existing buildings were not tightened – this is done via amended funding programs. However, the following tightenings are planned for the building envelope of new buildings:

- Increase of the insulation standard to the "Efficiency House 55" (EH55) standard by reducing the primary energy demand of the reference building from 75 % to 55 % (GEG § 15 + § 16 with Annex 1 "Reference Building"). This corresponds to a reduction of approx. 26 %. A further reduction to the EH40 standard is then planned for 2024 (further reduction of 27 %).
- Tightening of the envelope requirements for residential buildings "HT'" from 1 to 0.7, i.e. a reduction of the transmission heat loss by 30 % (GEG § 16). For non-residential buildings, the permissible average U-values of the component groups are tightened (Annex 3a GEG).
- Adaptation of the simplified verification procedure GEG-easy for residential buildings (Annex 5). This verification can now only be used for regenerative heating systems (heat pumps, district heating and central biomass heating system in combination with a central exhaust air system and solar thermal system for domestic

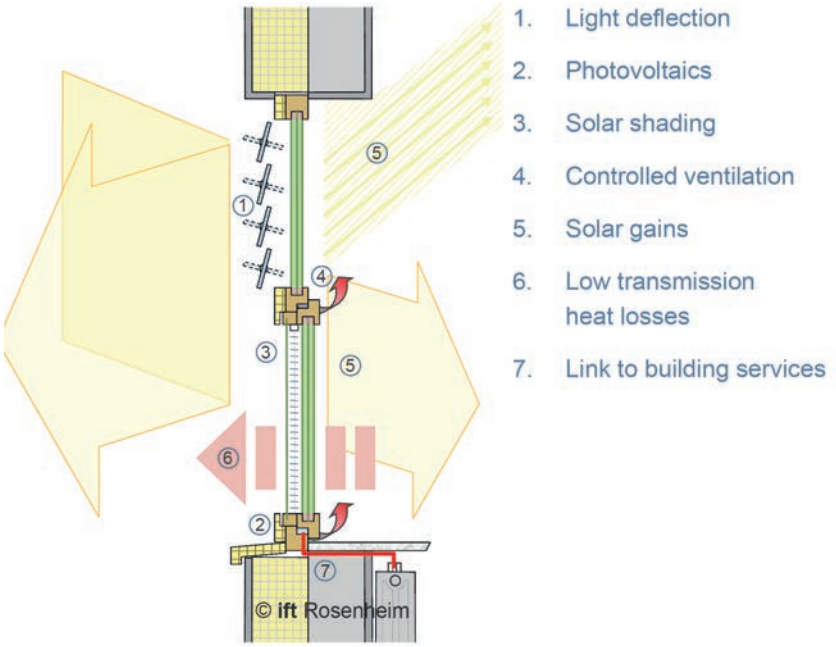


Fig. 2 The window as a regenerative "energy generator" for buildings

Table 4.8 Surface temperatures θ_{si} and temperature factor $f_{0.25/0.13}$ for different approaches to solutions (excamples) for window replacement. In line 2, a simple replacement without additional measures on the building structure is shown, with which the requirements for minimum thermal insulation are not met

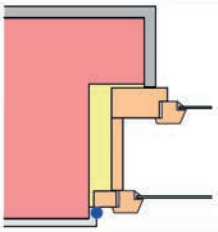
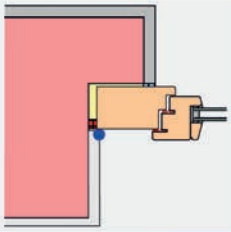
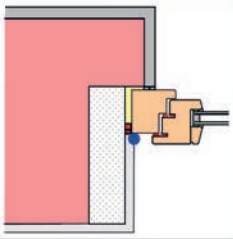
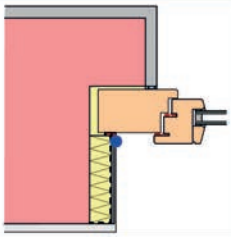
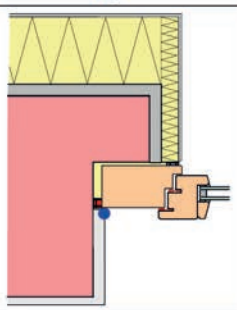
No.	Description	Representation	θ_{si} in °C (● Image)	$f_{0.25/0.13}$	Requirement is met	
1	Initial situation prior to refurbishment		13.1	0.72	yes	
2	Refurbishment with adapted window frame		11.3	0.65 < f_{min}	no	
3	Refurbishment with masonry lining to the reveal made of aerated concrete, 65 mm thick, λ_R = 0.16 W/(m·K)		12.7	0.71	yes	
4	Refurbishment with adapted window frame and insulation of the reveal on the room side, d = 40 mm, λ_R = 0.04 W/(m·K)		14.5	0.78	yes	
5	Refurbishment with adapted window frame and ETICS, thermal insulation thickness 120 mm, reveal 30 mm, λ_R = 0.04 W/(m·K)		17.1	0.88	yes	

Fig. 3 Optimisation options for window renovation [17]

hot water preparation) and the use of a ventilation system. In addition, detailed requirements are formulated for building components, for example for windows and other transparent building components $U_w \leq 0.90$ W/(m²-K), roof windows $U_w \leq 1.0$ W/(m²K), doors (basement and exterior doors) $U_D \leq 1{,}2$ W/(m²K), skylight domes and similar components $U \leq 1.5$ W/(m²K), special window doors with hinged, folding, sliding or lifting mechanism) $U_W \leq 1.4$ W/(m²K) and the avoidance of thermal bridges $\Delta U_{WB} \leq 0.035$ W/(m²K).

The opportunities for reducing energy consumption through building automation (sun protection, ventilation, window opening, lighting, etc.) are unfortunately not ex-

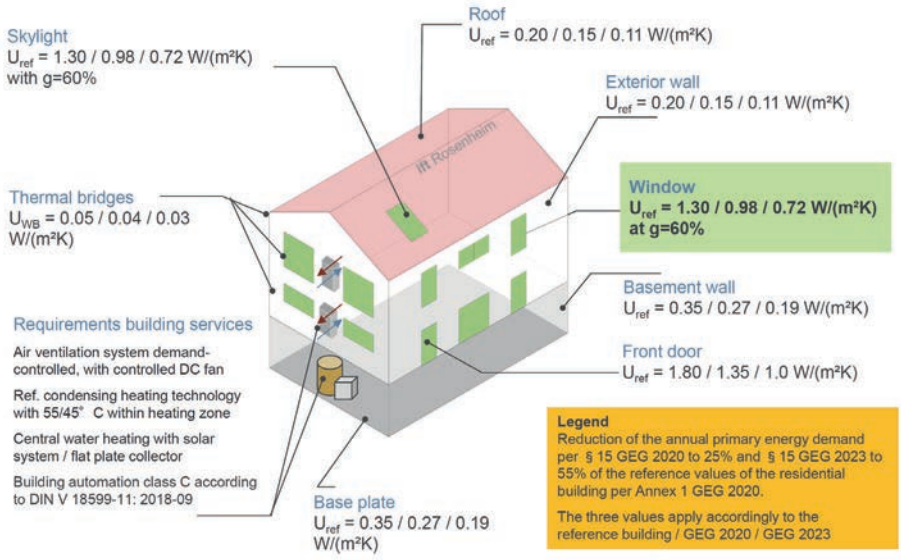


Fig. 4 Values of the reference building n. Annex 1 of the Building Energy Act 2020 (GEG) with the reduced values according to § 15 GEG 2020 and GEG 2023

plicitly formulated in the GEG, unlike in the EPBD, which "rewards" an increased degree of digitalisation, monitoring as well as building automation. In the funding programs of the BEG (Federal Funding for Efficient Buildings with processing via KfW and BAFA), investments in building automation can be funded as individual measures (section 3.5.1 for residential buildings), for example components for the automation of shading, ventilation and lighting (i.e. also, among others, air quality sensors, window contacts, presence and lighting sensors, etc.).

The draft of the GEG is now being voted on by the ministries and is to be passed this year with the so-called "summer package". Further approaches such as an obligation for 65 % renewable heat in new heating systems, a solar roof obligation or the conversion of the assessment from primary energy to greenhouse gas emissions are then to be realised in a subsequent amendment (2024).

1.2 Consequences for the insulation of windows and glazing

The planned tightening of the Building Energy Act (GEG) (reduction of the new building level to the Efficiency House 55 (EH55) standard corresponds to a tightening by 26 %. This raises the question of which U-values for windows, glazing and façades make sense in order to meet the higher requirements for the building envelope. A simple analogous reduction of the U-values according to the reference house is not expedient.

The basis for the insulation standards mentioned is the reference model of the GEG 2020 in conjunction with the flat-rate reductions by the GEG 2020 of 25% as well as 2023 to EH55. For windows and french doors in residential and non-residential buildings (with room temperature ≥ 19 °C), the "nominal" reference value is U_W = 1.3 W/(m² K). For the reduction of 25%, a linear transfer would result in a U_W = 0.98 W/(m² K) and for EH55 a U_W = 0.72 W/(m² K). This makes no sense, especially in the case of EH55, as these "theoretical" values for the window constructions would only be realisable with special constructions and special glazing. Windows with special glazing, such as for sound insulation, burglar resistance or safety barrier, would no longer be possible at all.

Ultimately, however, the maximum value of the annual primary energy demand of the building must not be exceeded. If building components (windows, doors, etc.) with a higher UW value than the reference value are installed, the higher heat losses must be compensated for, e.g. by improved building service technology or by lower U values of other building components (roof, wall, floor, etc.). However, the objective of the GEG is to develop a suitable and economical mix of all measures for each building task. If a building has an ideal roof surface and orientation for the use of PV systems or obtains renewable district heating, the thermal insulation may be somewhat poorer or vice versa.

The requirements of the GEG 2020 with U_W = 0.98 W/(m² K) can be easily achieved by using a triple-pane insulating glass with a U_g value of 0.6 W/(m² K) and a thermally improved frame profile (Uf value). At the EH55 level, however, there is a "theoretical" calculated requirement for the window of approx. U_W = 0.72 W/(m² K). This value could be achieved with considerable effort and cost through a combination of various energy optimisations (improved spacers and frame profiles, triple-pane insulating glass unit with a U_g value of 0.5 W/(m² K) etc.). The use of vacuum insulating glazing (VIG) with U_g values of 0.4 - 0.8 W/(m² K) is another option for reducing the U_w value. However, this also requires considerable adaptation of the window profiles and constructions.

However, achieving these low U_W values would cause significant additional costs and bears no sustainable and economic relation to the possible savings in CO_2 emissions. The highly insulating windows with a Uw value of ≈ 0.8 that are already available today have been used successfully for many years in low-energy, passive or energy-

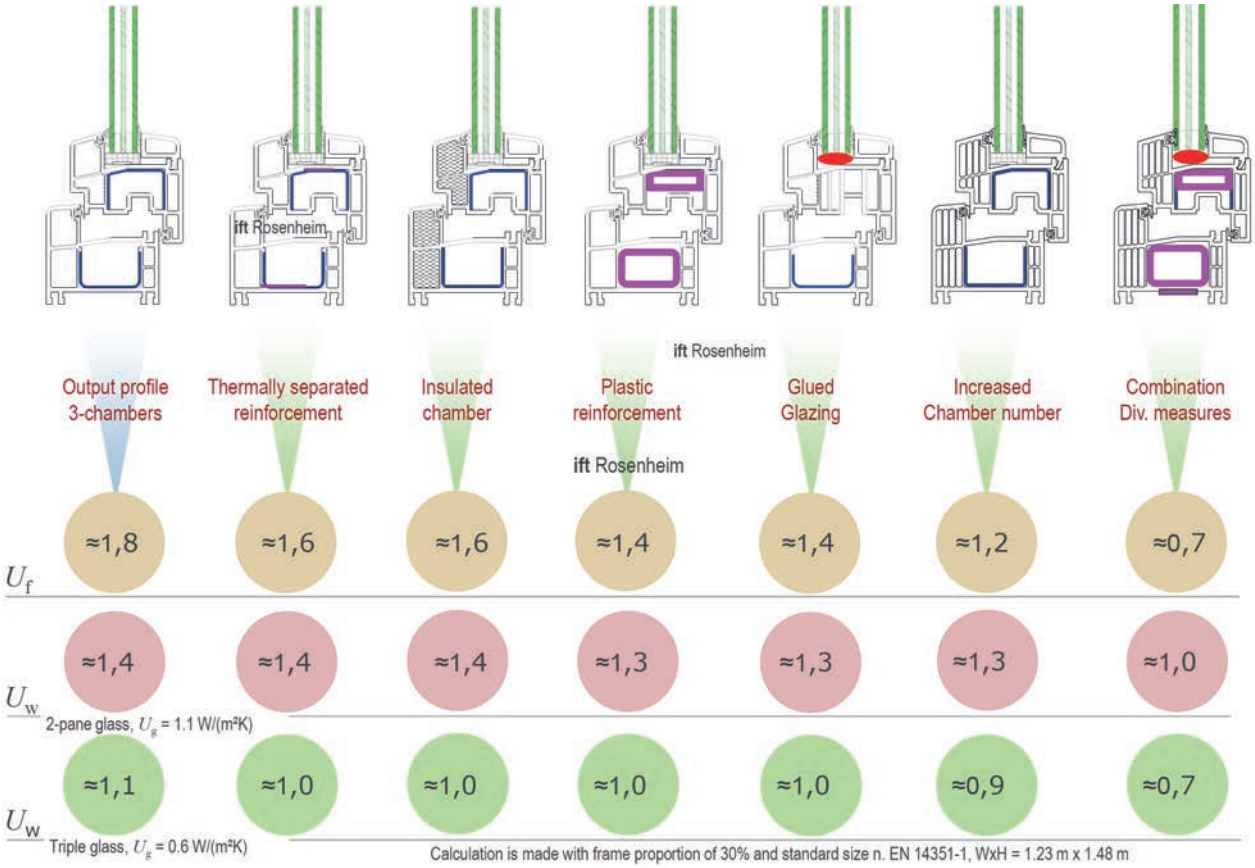


Fig. 5 Energy optimisation potential for windows using the example of the market-leading frame material PVC

plus houses. Due to the achievable solar gains (mainly on the west/east and south sides of buildings), modern windows with efficient triple glazing make an important contribution to saving CO_2 emissions in the building sector. This applies equally to new buildings and energy-efficient renovations.

2 Protection against climate extremes (resilience)

Even the realisation of ambitious CO_2 avoidance targets can no longer prevent the massive effects of climate change on the weather. The increase in climate extremes is already in full swing. A tornado in Kiel, the flood in the Ahr valley, heat waves in the southwest, drought, dryness and forest fires in the east of Germany, hailstorms and snow chaos in Upper Bavaria – it is frightening how frequently such events are now hitting us. Floods and heat waves are the greatest dangers to life and limb as well as to buildings. For windows, doors and façades, the requirements are therefore becoming more "extreme" and the constructions must become more "robust" in order to be suitable for the future. This requires materials with sufficient temperature resistance as well as suitable constructions with higher resistance to heavy rainfall events with floods or hail and storms. There are many ways to make the components and the building fit for climate change. However, architects also need to rethink sizes, window divisions, opening types and the arrangement of windows.

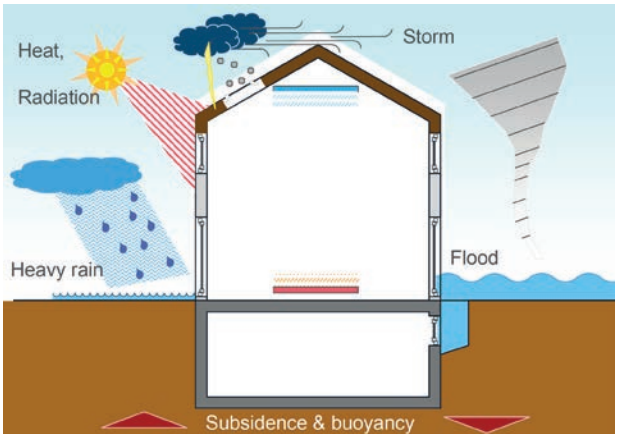
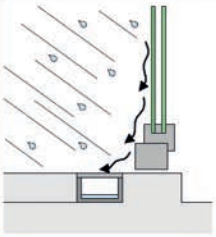
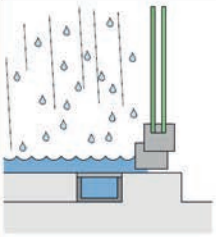
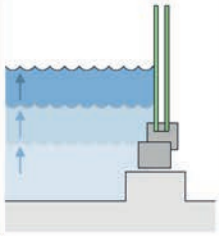
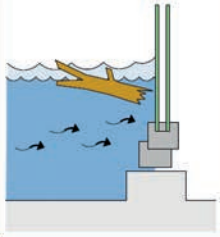
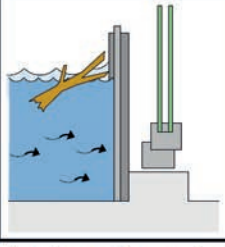


Fig. 6 Times are getting "rougher" for buildings and residents

2.1 Flood protection

Floods have been occurring for years not only in the direct vicinity of rivers and streams. This is because surface water during local heavy rain events often already leads to flooding – this can affect almost any building in Germany or Europe; all it needs is an unfavourable slope to the house. The stresses during a flood are manifold. Moderate mechanical stresses occur due to the water pressure when the water is rising slowly (cellar shaft). In the case of flowing water or flotsam (building materials, vehicles, floating debris, etc.), the loads are significantly higher and require the use of massive protective devices.

No.	Figure (schematic)	Description of the load	Normal constructed element	Flood-resistant element*)	Protective wall
1		**Driving rain** Overlay of normal to heavy rain and wind	Suitable Driving rain impermeability of element and connections. Regulated classes according to DIN EN 12208	(Suitable) Driving rain tightness of element and connections is given accordingly	Not required The use of a protective wall is not necessary.
2		**Heavy rain** Storm-like rain, possibly with high wind loads with accumulating surface water.	(Suitable) Depending on the height of the surface water, the tightness may be limited, water penetrating into the structure connection is possible.	Suitable Tightness of element and connections is given	Possible Short-term use of protective walls is conceivable.
3		**Accumulated water** Slowly rising water level without direct inflow (e.g. full-flowing cellar shaft).	Unsuitable Tightness and damage-free element and connections no longer given.	Suitable Low leakage permissible (flood resistant) or watertight.	Suitable Watertight shielding possible.
4.1		**Inflowing water** Flood flows against the elements.	Unsuitable Tightness and freedom from damage of element and connections no longer given.	Unsuitable Tightness and freedom from damage of element and connections no longer given.	See 4.2 Watertight shielding possible.
4.2		**Inflowing water** Flood flows against the shielding by protective wall.	Suitable Flood protection through watertight shielding.	Suitable Watertight shielding and/or shielding from flow and flotsam possible.	Suitable Watertight shielding possible.

*) Flood resistance is tested and classified according to ift guideline FE-07/1. Such windows are special constructions whose characteristics usually prevent a wide use in architecture.

Fig. 7 Exposure to water and possible protective measures

"Normal" windows in the house can prevent or limit the entry of water into the house in the event of driving rain. However, flood-resistant windows are necessary in the event of backwater. [1]. However, flood events do not only lead to water ingress, but also have a variety of damage patterns. Even building materials that are not sensitive to moisture show damage. In particular, moisture that has penetrated into the cavities of window constructions and contamination of the water by faeces or heating oil leads to impairments through odours, mould and other emissions into the room air. Windows can quickly become unusable as a result. Despite drying, cleaning and repairing building elements, renovation is then often no longer possible. This applies to the same extent to the building structure. When renovating a building and retrofitting it with flood-resistant constructions, expert planning is required, which often also necessitates adjustments to the building.

In addition to special glazing for aquariums and marine glazing, there are flood-resistant windows. These are special constructions that take on extended protective functions in addition to the usual requirements for function or thermal/sound insulation and are available primarily as small-format basement windows. The development of large-format constructions for flood-resistant windows and French windows that can be used like "normal" window or door on the ground floor is only just beginning. Effective combination systems of windows and temporary protective elements that are activated in case of danger are also conceivable. Due to the increasing demand from people who want to protect their buildings against a flood disaster, a dynamic market development can be expected. Insurers and their willingness to insure buildings without protective elements against natural hazard damage have a major influence on market developments.

2.2 Heat protection

Current forecasts show a significant increase in heat waves with temperatures of 30 °C and more. It becomes critical when buildings heat up quickly due to insufficient sun protection and lack of night ventilation, and people can no longer recover sufficiently (especially at night). [4]. This is especially true for heat-vulnerable groups (small children, infants, old/sick people, people with disabilities and homeless people). In Germany, no official statistics are collected, but on the very hot days between 23 July and 9 August 2018, the excess mortality rate was 8,000 people, according to figures from 15 state statistical offices in Germany. The German Meteorological Service (DWD) has therefore developed a two-stage warning system (severe heat stress with perceived temperature above 32 °C for two days in a row and extreme heat stress above 38 °C). Relevant for the health risk is not only the measured air temperature, but the "perceived temperature" ("climate Michel model"), which also takes into account the level of movement, clothing and humidity (sultriness).

A suitable combination of good insulation standards, shading and ventilation (night ventilation) can significantly reduce the heat risk. In combination with passive cooling (cooling ceiling/floor), this means that in moderate climates (Germany/Central Europe) active cooling systems (air conditioning) can be dispensed with in most cases. [12]

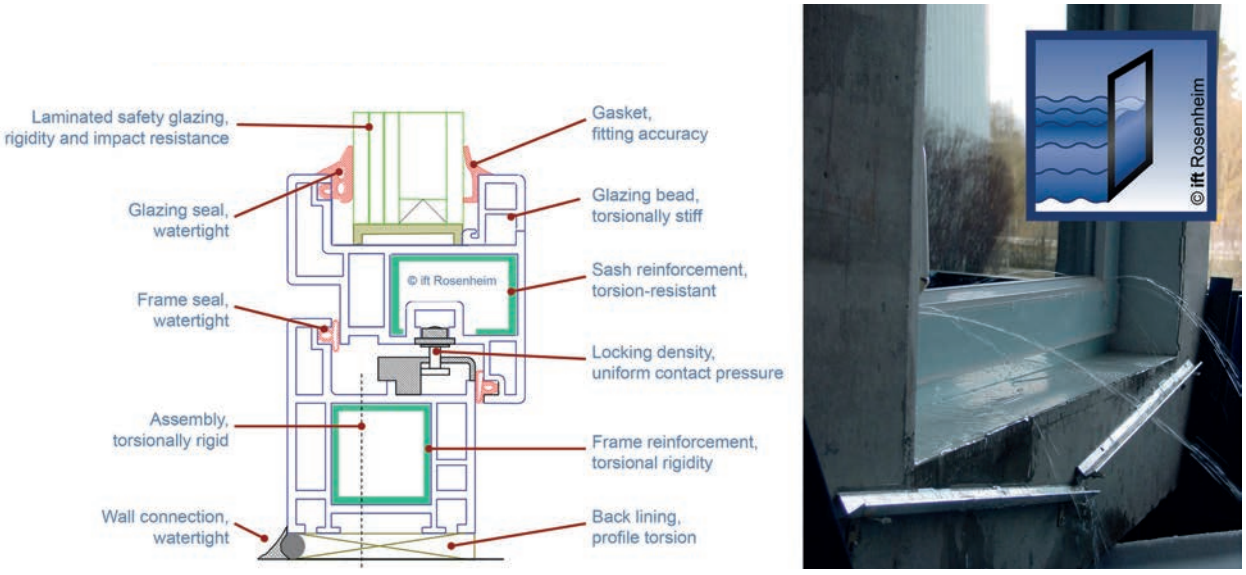


Fig. 8 Design principles and testing of flood-resistant windows [1]

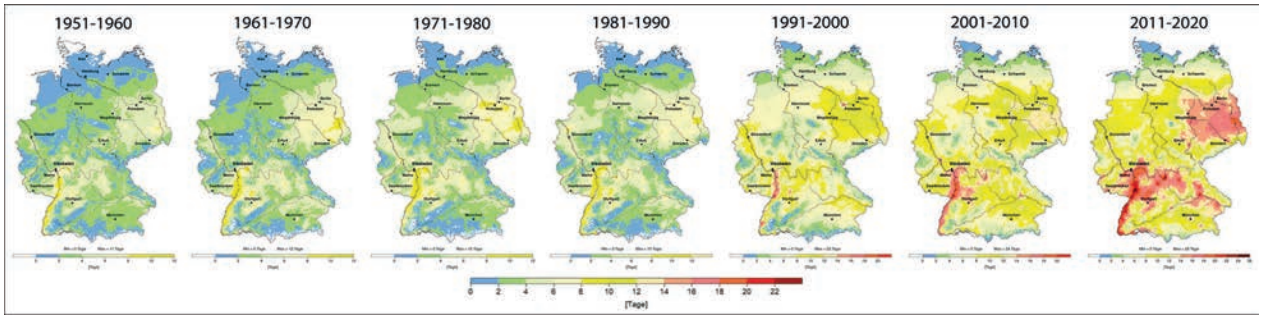


Fig. 9 Mean annual number of hot days in Germany (days with a maximum temperature of at least 30 °C). Source: DWD & EWK 2020

2.2.1 Sun protection

The relevant parameter for solar shading is the gtotal value, which represents the insulating properties of the glazing in combination with the shading and thus realistically describes the building-physical relationships. The F_c value for solar shading, which is often used in practice, only describes the technical quality to a limited extent. To meet the higher future loads, gtotal should be very low in the summer months. In winter, however, a high gtotal value is desirable in order to achieve solar gains.

Rigid solar shading is no longer sufficient for the current challenges. Adaptive systems are needed that flexibly adjust to the position of the sun and the solar radiation, for example switchable glazing with variable g-values or angle-selective shading. But "classic" shading devices such as external venetian blinds or roller shutters can also be optimally adapted to the situation in the building with automation. Solar shading devices must meet the following requirements:

- Control of solar radiation to ensure comfortable indoor temperatures,
- Good use of daylight to reduce artificial lighting and improve health,
- Glare protection and avoidance of direct sunlight, especially at VDU workstations,
- Privacy screen and avoidance of light pollution at night,
- Avoid high surface temperatures on the room side,
- Sufficient stability in wind, snow and ice formation.

The selection of solar shading must therefore not only be based on design aspects, but must also focus on energy, lighting and mechanical properties, including usability.

Dark shading should be avoided, as it can heat up to over 80 °C. In the case of strong solar radiation, complete shading should be possible in order to reduce the energy input through the transparent surfaces as much as possible.

For summer thermal insulation, a calculated verification for new buildings is required by building law. For residential buildings with a small proportion of windows, the simplified verification of the solar factor according to DIN 4108-2 is still sufficient. But for larger glass areas, more precise calculations should be carried out according to EN 13363. [2] The aim of planning must be to make optimum use of solar gains during the heating period and to avoid overheating in summer. A planner must always pay attention to the interaction of glass and solar shading. Here, the gtotal value according to EN 52022-1 or EN 52022-3 should be used.

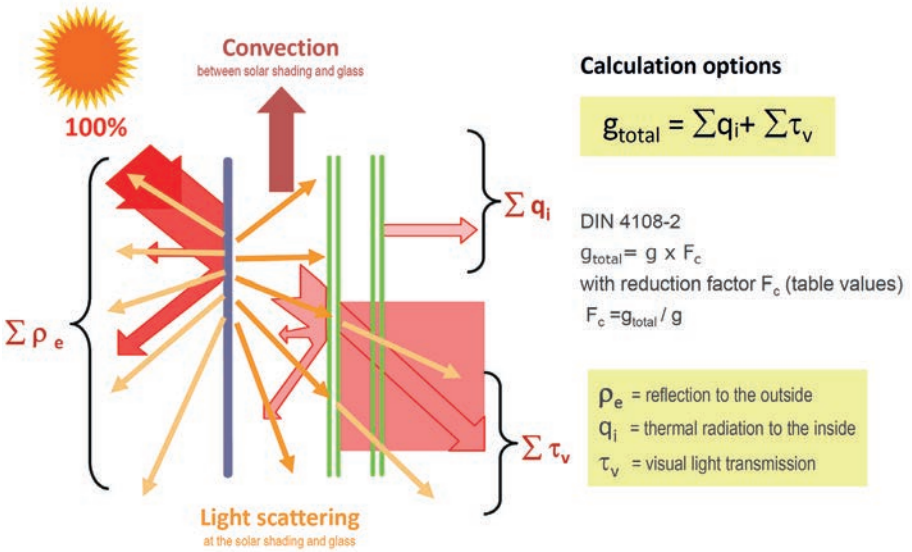


Fig. 10 Total energy transmittance g_{total} as a relevant parameter for calculating solar protection

2.2.1 Night cooling

The second possibility to reduce indoor temperatures is night cooling, for example without any system technology at all by window ventilation. This is possible in Germany and Central Europe, especially in rural areas, because the night temperatures are low enough due to a green habitat (forest, trees, meadows, lakes, etc.). For night ventilation, high air exchange rates (n approx. 2-5) are necessary by means of cross-ventilation through open windows or mechanical ventilators. In multi-stored flats, the air exchange is additionally supported by the "chimney effect". To improve comfort and security, windows can be equipped with warning sensors or as an automatic system that closes the windows when storms and rain occur. But structural measures in cities also make sense to improve the microclimate and reduce night temperatures. Mannheim is one of the pioneers here and has developed concrete measures in a "climate impact adaptation concept" and heat action plan. [3].

The third, naturally effective cooling follows the principle of evaporative cooling, which was already used in "pre-electric" times in the Orient, Africa and Asia. Here, larger surfaces are moistened (walls, textile fabrics, floors, wells, etc.). Through the evaporation of water, heat is extracted from the ambient air and the moist surfaces cool down. But this also requires an increased exchange of air to remove the humidity. Greening of roof surfaces and interior and exterior walls has a similar effect, demonstrably contributing to cooling and improving the microclimate. Even if these measures do not always avoid the use of electric air condition units, the high energy consumption when using them can be significantly reduced.

2.3 Protection against storms, tornadoes and strong wind events

In Germany and Europe, wind loads are designed according to Eurocode 1. [14] which essentially takes into account the wind loads, the shape of the building, the position of the building and the topography of the surroundings. When determining the wind loads, characteristic basic wind speeds are used with an annual probability of exceedance of 2 %, which corresponds to an average return period for high storms of 50 years. Due to climate change, however, we must assume more frequent occurrence and more violent storms in the future. The danger of locally occurring tornadoes due to strong temperature differences is also increasing.

The greatest danger in strong storms comes from high and rapidly changing air pressures (pressure/ suction loads) and

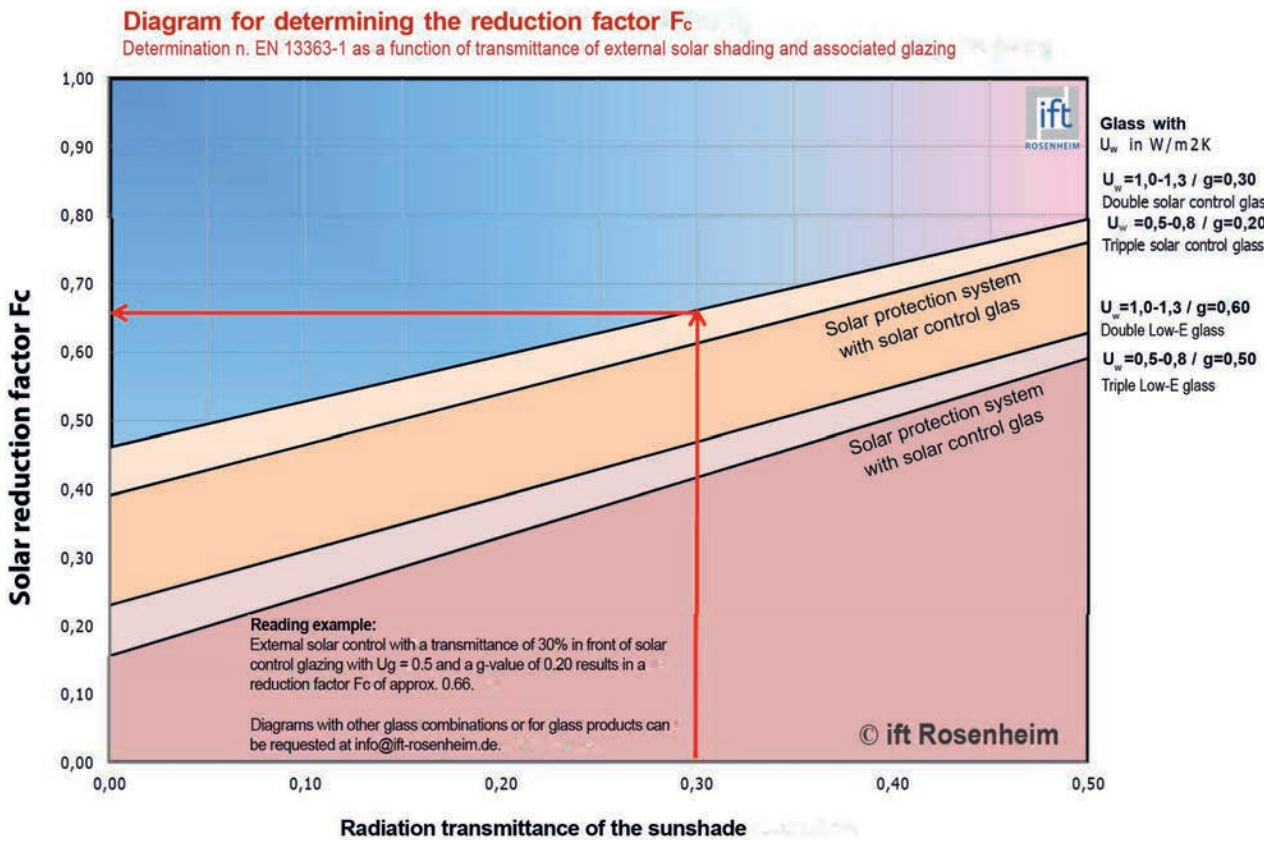


Fig. 11 Simplified estimation of the F_c value for external solar shading as a function of the glazing and the solar transmittance of the solar shading system

Fig. 12 Testing of hurricane-proof construction elements at ift Rosenheim in accordance with [16]

flying objects (roof tiles, cladding sheets, stones, small parts, etc.), which quickly destroy the float glass when they hit windows and facades. As a result, overpressure quickly builds up in the building/room, leading to explosive destruction of the building. Roofs are lifted off, glass or windows are forced out of their fixings, so that the structure of the building is significantly damaged or destroyed. In the USA, therefore, there is also a "hurricane test" [16] in which wooden components (roof battens and structural timbers with small cross-sections) are "shot" at a window/glass to test whether the windows and facades will hold up. Unlike in the USA, however, there are no requirements for this hazard potential in currently applicable standards and building laws in Germany or in EU standards. The standardisation bodies have now recognised the problem and have initiated the drafting of an ISO standard [15] standard, in which ift Rosenheim is involved. However, in contrast to the USA, the new EU standard also bullets the windows and facades with steel parts. The background to this is the difference between the American lightweight and the European solid construction method, in which the majority of solid building materials (roof tiles, bricks, brick cladding, etc.) are used and then also "fly around" during storms.

The aim of the standard is to develop suitable requirements, test methods and classifications in order to subsequently evaluate constructions that withstand the loads during storms in order to protect life and limb better than with previous windows and façades. The test procedure involves first subjecting the construction elements to a continuous load (up to 3,500 load cycles) with high pressure/suction loads corresponding to a wind speed of up to 230 km/h (wind force 12). Defined metal parts and wooden profiles are then "shot" onto the component at different speeds and then subsequently tested to pressure/suction loads again. A construction is only suitable if windows/facades (incl. the glass surface) are not destroyed during this test in order to prevent the feared overpressure in the building. For this, windows and façades need suitable glazing (laminated safety glass/LSG), sufficiently stable profiles, a reinforced glass connection by bonding or reinforced hardware technology as well as careful fastening.

The ift Rosenheim is already able to test according to the American hurricane standard and the future ISO standard. [16] and thus evaluate windows and façades that also offer protection during hurricanes, strong storms or tornadoes.

3 Sustainability and circular economy

The construction and real estate sector has a major impact on the environment due to the large amount of energy and raw materials consumed in the production and use of buildings. Sustainable buildings must be energy-efficient, but should also make living and working more social, healthier and more comfortable. Therefore, it is important to minimise the consumption of resources over all phases of the life cycle, i.e. for the production of building products, the construction stage, the use and ends up with the deconstruction.

The building envelope has a major influence on the entire building, as the living climate, the supply of daylight and natural ventilation are essentially determined by windows, façades and glass. In the amendment of the Construction Products Regulation (BauPVO) [10] the sustainable use of natural resources was consequently defined as an "essential requirement". *"[...] It must be possible to recycle the structure, its building materials and parts after demolition" [...] Environmentally friendly raw materials and secondary building materials must be used for the structure."*

Up to now, the focus for windows and façades has been predominantly on reducing energy consumption during use through better insulation (U-value) and use of solar energy (g-value). However, the emissions caused by the production and transport of building materials, the construction of buildings and the subsequent use (demolition or replacement of building components) are often still "ignored".

The new German government is now rightly calling for a holistic assessment of emissions over the entire life cycle. In future, greater focus will be placed on simple, resource-saving installation and removal, low maintenance and care requirements, a long service life, for example through easy reparability, as well as the possibility of separating the

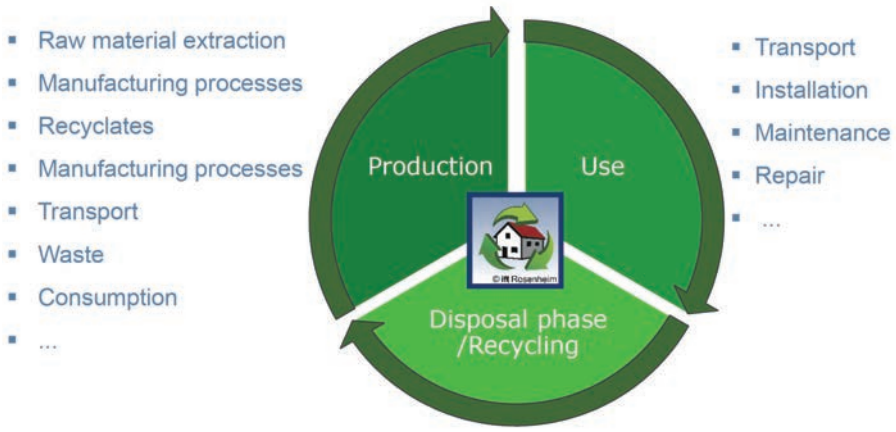


Fig. 13 A holistic analysis of the entire product life cycle reveals all environmental impacts and CO2 emissions. (Picture ift Rosenheim)

materials used by type, or even the reusability of entire building products or individual components at the end of the life cycle.

The BauPVO provides for an assessment by means of a life cycle assessment and EPD (environmental product declaration). Manufacturers of building elements must provide the necessary data and product information in it so that planners can take it into account when planning the building. This information is particularly important if a sustainability certification of the building is planned (BNB, DGNB, LEED etc.).

With the many parameters of a life cycle assessment, it is difficult to compare products, and the CO_2 footprint as a simple measure of the climate friendliness of a product is therefore increasingly in demand. The ift Rosenheim is therefore developing an assessment procedure that enables the comparison of the environmental impacts of windows and doors and provides recommendations for sustainable and climate-smart building elements. Detailed information can be found in the ift technical information FI-NA02/4 – "Green Envelope - Sustainability for Building Products" [13].

4 Sustainability assessment

The German dictionary "Duden" describes sustainable action in the ecological sense as "a use only to the extent that nature can tolerate". In practice, one aims at the equal implementation of environmental, economic and social goals, which are also referred to as the three pillars of sustainability. The Construction Products Regulation (CPD) as the EU basis for the trade and assessment of construction products therefore also provides for an assessment of sustainable aspects through an EPD (Environmental Product Declaration). The Renewable Energy Sources Act, the Environmental Impact Assessment Act, the Federal Soil Protection Act, the Closed Substance Cycle Waste Management Act, the Building Code and also the Directive for the Implementation of Construction Projects can be mentioned as further legislative influencing factors.

All these legal standards demand that construction projects be planned and built in a way that is as environmentally friendly and resource-conserving as possible. Likewise, the importance of certification systems for sustainable construction (LEED, BREEAM as well as BNB, DGNB) continues to grow. The sustainability certification systems for buildings require manufacturers to provide product information that describes important sustainability criteria over the entire product life cycle.

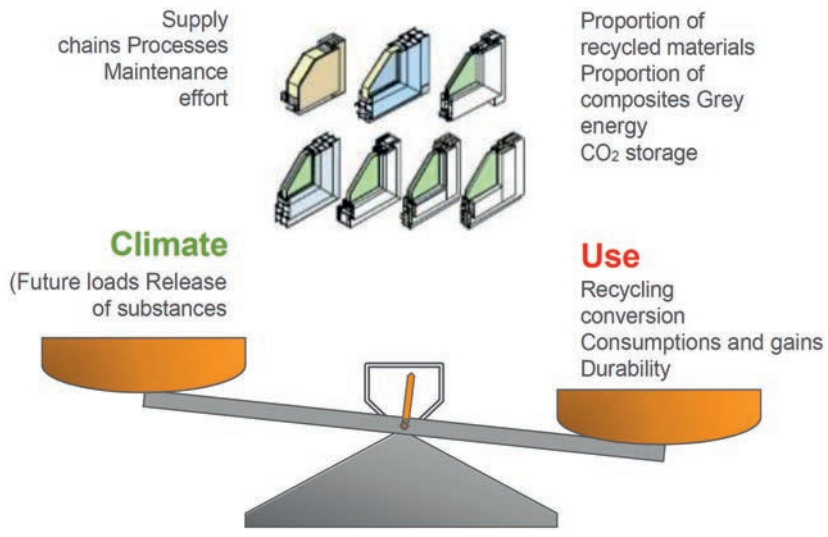


Fig. 14 All product areas play a role in a holistic balance

Therefore, not only planners, auditors and tendering bodies, but also the manufacturers of building elements are well advised to know the necessary data and product information, to create it and to hand it over to the building user who needs this data for use, conversions or dismantling. The importance of subsequent use and recycling is shown by the asbestos problem or the intensive discussion about the final storage of building materials from nuclear power plants. For transparent building components, the use phase is of great importance, as efficient use of solar gains can actively contribute to heating a building and thus reduce heating energy. The determination of environmental impacts, e.g. for building certification systems, is carried out within the framework of an EPD according to EN ISO 14025 as well as EN 15804. In order to be able to create corresponding EPDs, both a product category rule (PCR) and a life cycle assessment (LCA) are necessary. The PCR defines reasonable framework conditions and procedures for the product groups, whereas the LCA records and analyses product-related material and energy flows over the entire life cycle and ultimately quantifies the environmental impacts. Detailed information can be found in the ift technical information FI NA-02/4 – "Green Envelope – Sustainability for Building Products". [13] All documents published so far by ift Rosenheim are available on the website www.ift-rosenheim.de.

4.1 Product Category Rules (PCR)

A PCR provides general rules for the preparation of an EPD based on EN ISO 14025 and EN 15804. Calculation and assessment procedures are presented in order to be able to analyse and describe the environmental impacts of building products over their life cycle. PCRs are structured like regulations or guidelines. Mandatory statements are required within the framework of an EPD for manufacture, disposal and for benefits and impacts outside the system boundaries. The remaining life cycle phases can be considered optionally. Since all certification systems require information from different product life cycle phases, it makes sense to identify all necessary data when preparing an EPD.

4.2 Life Cycle Assessment (LCA)

The LCA (Life Cycle Assessment) according to EN ISO 14040 and EN ISO 14044 is a scientific method for recording and determining the environmental impacts of a product over its entire life cycle (from cradle to grave/cradle) and is the basis for developing the EPD. An LCA consists of four interlinked steps: target definition, life cycle inventory, impact assessment and finally evaluation and interpretation. In the first step, essential conditions are defined as part of the target definition. For example, the target group, the intended use, the selection of the products to be examined, spatial, technical and temporal system boundaries and the assessment methodology.

In accordance with normative requirements, the life cycle of products is divided into life cycle phases (manufacture, construction, use, disposal, benefits and burdens outside the system boundaries). The respective life cycle phases

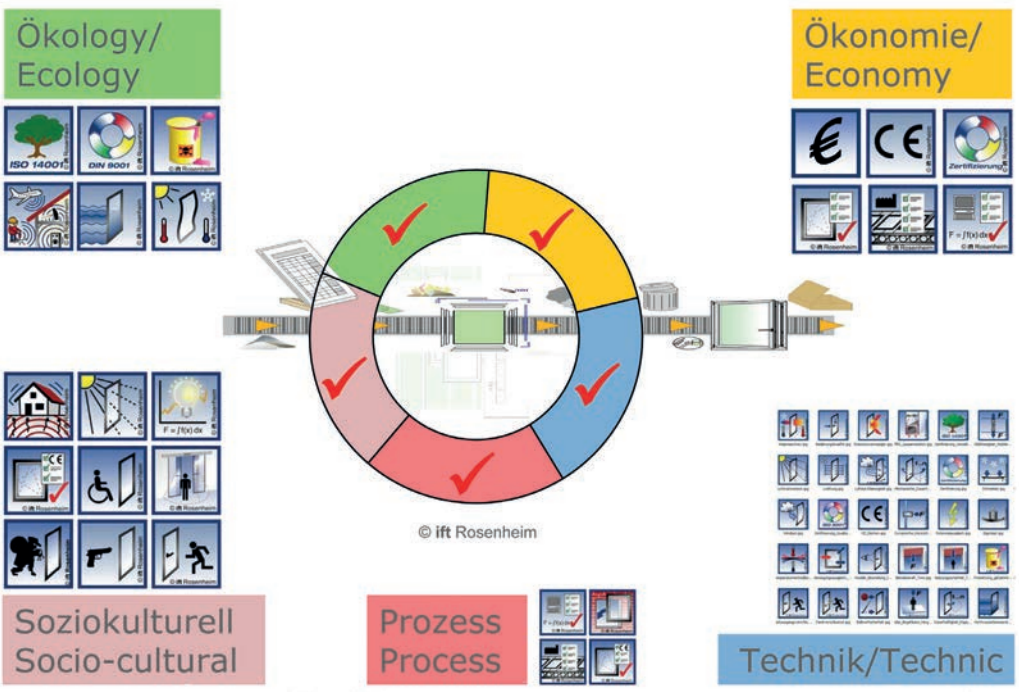


Fig. 15 Criteria and qualities for sustainable building based on the Sustainable Building Rating System – BNB

are further subdivided, e.g. into transport, assembly, repair or removal. In an LCA over the entire life cycle of the products (cradle-to-grave), the stages of raw material extraction, manufacturing/production, use and after-use, including transport and energy consumption, are considered. The data is collected from the manufacturer as part of a data collection process using data entry forms.

Particular attention must be paid to defining the system boundaries, as a variety of raw materials and preliminary products are used. In the case of aluminium window profiles, for example, it is necessary to consider the production of aluminium from bauxite extraction in open-cast mines to the finished aluminium profile, or the significantly lower resource consumption for recycled aluminium. Generic data are available for common materials used in industry and the construction sector. The quality of an EPD therefore depends heavily on how thoroughly the raw materials and preliminary products are considered. The goal should be a life cycle inventory that is as complete as possible and, accordingly, an adequate quantification of all energy and material flows.

Subsequently, in the impact assessment phase, the collected data can be analysed and calculated with software to quantify the environmental impacts of the building product. This makes it possible to make statements regarding the environmental impacts of a product. These findings are in turn required for the preparation of an EPD. The results of the LCA are not comparatively evaluated or classified due to the possible different reference frames or delimitations.

By considering the entire life cycle, an LCA can provide information about the actual quality of a product. Accordingly, LCA can contribute to increasing resource efficiency and be used as a methodological tool in product development and the decision-making process. In this way, building products can be designed more ecologically and monetary benefits can be reaped.

4.3 Environmental Product Declaration (EPD)

An environmental product declaration is made on the basis of the standards EN 14025 and EN 15804. In an EPD, the environmental impacts of a product must be documented on a mandatory basis for the manufacturing processand subsequent use. Examples of this are the effects on the ozone layer (ozone depletion potential) and the climate (global warming potential) or the acidification of soil and water. In the case of exterior building components such as windows, façades and glazing, the impact of the use phase (30 to 50 years of use) on the environment is significantly greater than that of the manufacturing process – quite in contrast to short-lived building products such as carpeting or the interior.

Therefore, the impacts over the entire product life cycle should be specified. This offers opportunities for high-quality products with lower energy, maintenance and cleaning costs, which are rewarded by certification and have better chances in future tenders. For the preparation of an EPD, PCR and LCA serve as a basis. In an EPD, statements must be made on 9 core indicators as a "mandatory part".

In addition to the mandatory information, voluntary information on the environmental impacts of the further life cycles can be provided in the EPD. This should also be used, as this information is required by most certification systems for buildings. Furthermore, a "cradle to grave" approach contributes to an increase in the innovative capacity and quality of the product. The data obtained also

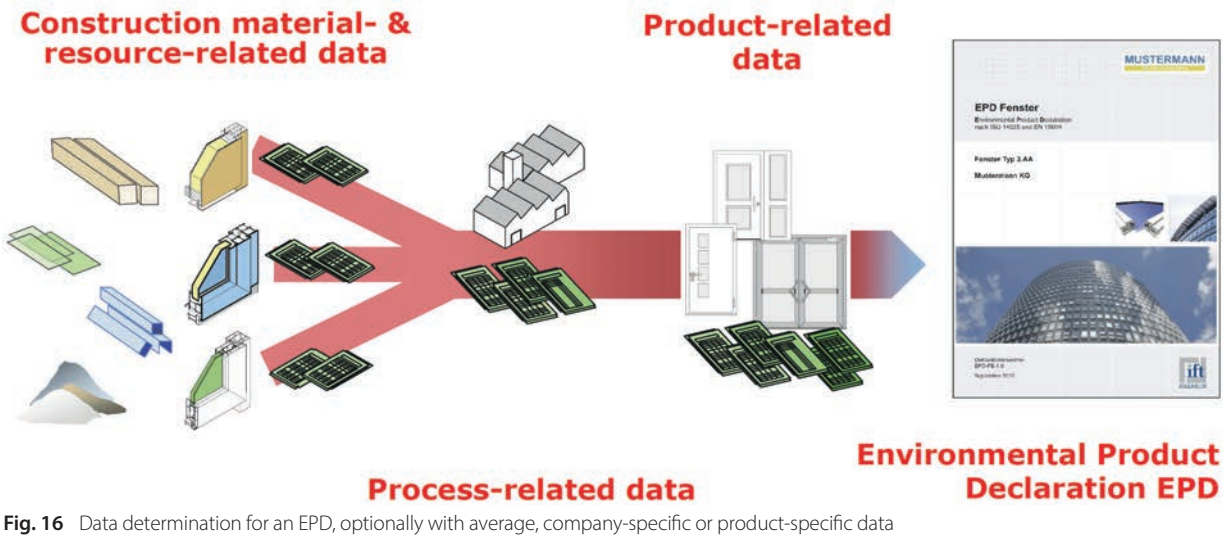


Fig. 16 Data determination for an EPD, optionally with average, company-specific or product-specific data

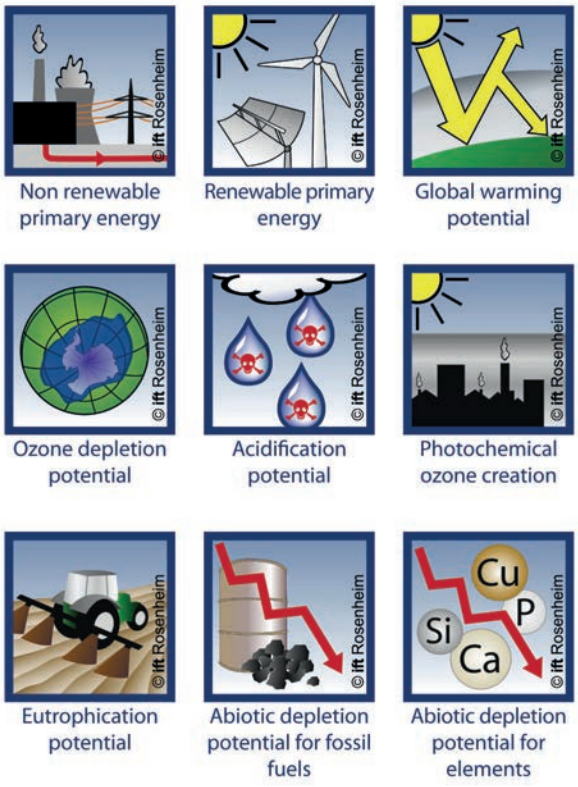


Fig. 17 9 Core indicators of an EPD (Environmental Product Declaration)

provides important information for the establishment of an environmental management system.

If an EPD has been prepared in accordance with EN 15804 and externally verified, it can be entered into the online database "ÖKOBAUDAT" and serve as the exclusive basis for the BNB and DGNB building certification systems.

4.3.1 Sample EPD

In a sample EPD, data from different companies are determined and used as average values in a common "data pool". They reflect an industry average and are therefore representative within the defined reference limits. The manufacturer can define different scenarios for production, use and after-use for his product or company. The respective environmental impacts are determined for the different scenarios using suitable software. As a rule, simple input data are sufficient for this. For example, defining the means of transport and specifying the distance travelled are sufficient for a transport scenario.

Within the framework of a research project, the ift Rosenheim has produced EPDs for windows made of wood, aluminium and plastic as well as for flat glass, in which reasonable boundary conditions and procedures for all life cycle phases were defined [18].

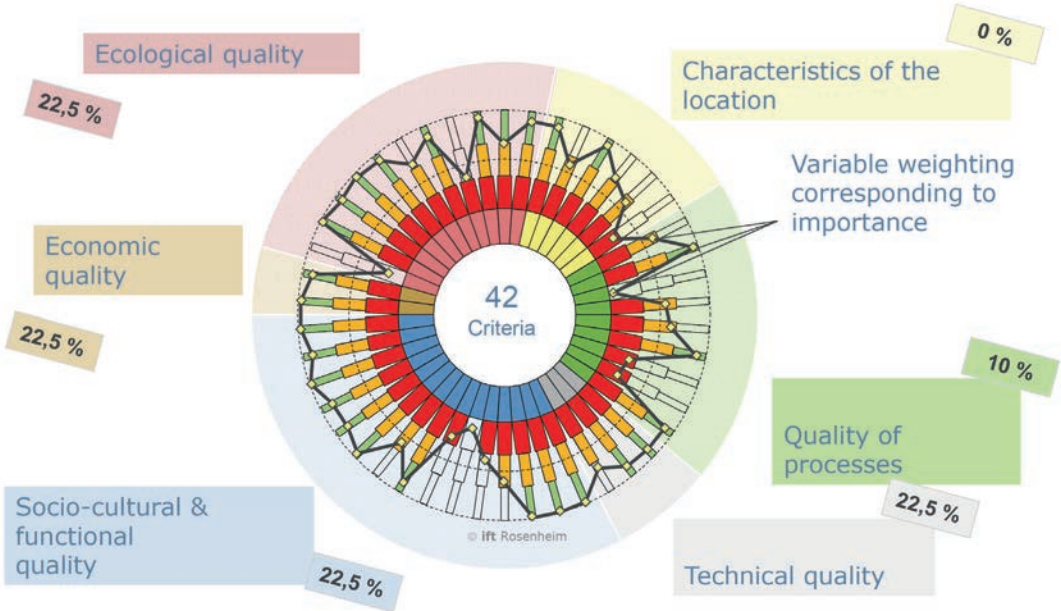


Fig. 18 Criteria for building elements during the use phase that can be identified and stated as optional information in the EPD.

In addition, sample EPDs are available for multi-pane insulating glass, flat, single-pane safety and laminated safety glass, electrical drives and control centres, steel façades or gates. In this way, manufacturers can have an EPD drawn up simply and inexpensively on the basis of just a few data via www.ift-rosenheim.de/environmental-product-declaration. EPDs are generated automatically using the sample EPDs by confirming various framework conditions. This system is particularly suitable for craft and medium-sized companies.

Tab. 1 Description of the life cycle phases according to EN 15804

Manufacturing phase			Construction phase		Use phase							Disposal phase				Advantages + loads outside system limits
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Production	Transport	Construction/Installation	Use	Maintenance	Repair	Replacement	Conversion/renewal	Operational energy use	Operational water use	Expansion	Transport	Waste management	Landfill	Reuse-Recovery-Recycling Potential

Phase	Exemplary aspects / criteria
Production phase (A1 - A3)	▪ Raw material production (e.g. ore extraction, aluminium production, forestry) ▪ Reuse and recycling of materials for product manufacture ▪ Electricity, heat, steam and energy consumption ▪ Reuse of energy and other processes (e.g. waste heat) ▪ Raw material transports (national and international transport routes) ▪ Production of auxiliary materials and other preliminary products ▪ Production and packaging processes ▪ Production and packaging waste
Construction phase (A4 - A5)	▪ Transport (factory gate to construction site or to intermediary) ▪ Storage of products and the necessary cooling, heating, humidity control, etc. ▪ Installation (incl. auxiliary materials) and waste
Use phase (B1 - B7)	▪ Use of the installed product and emissions to the environment (VOC, ...) ▪ Maintenance - care and repair (cleaning, painting, lubricating, replacing damaged spare parts, ...) ▪ Replacement (glazing, ...) ▪ Conversion / renewal (thermal refurbishment, ...) ▪ Energy / water consumption during use ▪ Waste
Disposal phase (C1 - C4)	▪ Expansion ▪ Transport to collection point / waste incineration plant / landfill site ▪ Reuse / Recover / Recycle ▪ Disposal / final storage (construction waste or hazardous waste)
Advantages + load Outside the system boundaries (D)	▪ Possibilities to recycle the building products / building materials (e.g. melting of glass, metal or PVC or thermal use in a combined heat and power plant). ▪ Consideration as an energetic "credit" on energy consumption (reduction of energy consumption)

Tab. 2 Creation of different usage scenarios using the example of transport

No.	Use scenario	Description
	Development of representative usage scenarios with information on the vehicle and average information on utilisation and distance travelled.	
A4.1	Small series Direct marketing	7.5 t truck, 40 % load, 50 km there and back empty
A4.2	Small series via local manufacturers	7.5 t truck, fully loaded, 50 km there and back empty
A4.3	Small series via dealers	40 t truck, fully loaded, 150 km there and back empty and 7.5 t truck, 40 % load, 50 km there and back empty
A4.4	Major project	40 t truck, fully loaded (Germany-wide), 250 km there and back empty

However, no specific qualities of the building product can be highlighted in a sample EPD that are suitable for differentiation in competition, as the input data are only based on average data.

4.3.2 Product-specific EPD

The creation of a product-specific, individual EPD is necessary, among other things, if there is no sample EPD for the corresponding product. For manufacturers, a specific EPD is more time-consuming, as extensive data must be determined and evaluated. However, the specific EPD enables a detailed and representative description of the product. Special qualities can be described for the entire life cycle and used as a differentiating feature or to increase opportunities in tenders. The use of specific data on production, transport or assembly, for example an increased share of renewable energies in production through an own block heating or hydroelectric or solar power plant, a particularly economical vehicle fleet or local raw material extraction, can represent increased resource efficiency.

Fig. 19 Sample EPDs of ift Rosenheim

All ift-EPDs created can be viewed at www.ift-epd.de. An individual EPD logo is issued for each EPD. This can be used by the declaration holder for promotional purposes for the product. The user can check the validity of the EPDs at any time via the unique declaration number.

4.4 Product passport for sustainability

To make it easier for planners, builders and investors to evaluate sustainability-relevant criteria, ift Rosenheim has developed the Sustainability Product Passport. This contains the necessary characteristic values for certification systems such as DGNB, BNB, LEED or BREEAM. This includes a life cycle assessment report, an environmental product declaration (EPD), valid REACH manufacturer's declarations, health-relevant evidence (e.g. VOC evidence), evidence of sustainability (e.g. PEFC, FSC or cradle-to-cradle), declaration of the recycling proportion, management certification or CSR reports (corporate social responsibility). As an accredited program holder for EPDs, ift Rosenheim can produce these necessary verifications. The Sustainability Product Passport of ift Rosenheim supports "stakeholders" such as building owners, investors, building users, architects, planners and building certifiers, customers, suppliers or employees with a clear presentation of the ecological, social and economic parameters.

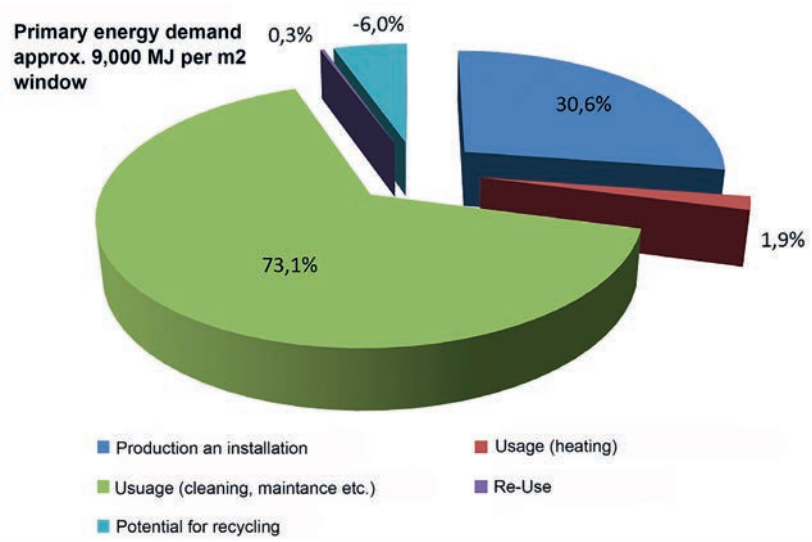


Fig. 20 Estimation of primary energy consumption per m^2 of steel windows (source: ift Rosenheim)

Fig. 21 Product-specific EPDs of ift Rosenheim

Fig. 22 ift-EPD logo

The necessary characteristic values for different building certification systems (DGNB, BNB, LEED and BREEAM) are clearly compiled and can easily be used as a basis for an environmental management system or the ecological optimisation of products and production.

4.5 CO_2 footprint

The CO_2 footprint (CO_2 balance or carbon footprint) represents the CO_2 emissions for products or services over a specific life cycle. It takes into account the resources and energy consumed in the production, use time and disposal of a product or service. A CO_2 footprint can be calculated at the product level (Product Carbon Footprint) or at the corporate level (Corporate Carbon Footprint).

Since not only CO_2 contributes to anthropogenic climate change, but also other climate-relevant greenhouse gases such as methane (CH_4) or nitrous oxide (N_2O) are emitted, so-called CO_2 equivalents serve as a unit of measurement for the CO_2 footprint. These enable the comparison of different greenhouse gases on the basis of their influence on climate change over a defined period of time. The effect of one kilogram of CO_2 serves as the base value. According to the German Federal Environmental Agency (UBA), a kilogram of CH_4 is about 25 times more harmful to the climate than a kilogram of CO_2 , and N_2O is almost 300 times more harmful.

4.5.1 Product CO_2 footprint (PCF)

The Federal Ministry for the Environment (BMU) and the Federation of German Industries (BDI) have developed a guideline for companies that describes in detail the purpose, goal and systematics of this indicator. The carbon footprint can be determined in a standardised manner according to EN ISO 14067 and can also be used in the context of sustainability management and promote the discovery of undiscovered savings potential.

However, direct product comparisons based on the PCF currently have more of an orientational character and are not suitable for a comprehensive sustainability assessment because accuracy and reproducibility are insufficient. This is a consequence of varying data quality, inconsistent definitions and reference boundaries of the life cycle phases as well as different databases as a basis for calculation. LCAs, eco-efficiency

and sustainability analyses are therefore better suited for a solid assessment of sustainable economic activity because the relevant environmental categories are analysed more comprehensively. However, this makes the assessment more complex again, so that the PCF is often used by companies in their communication.

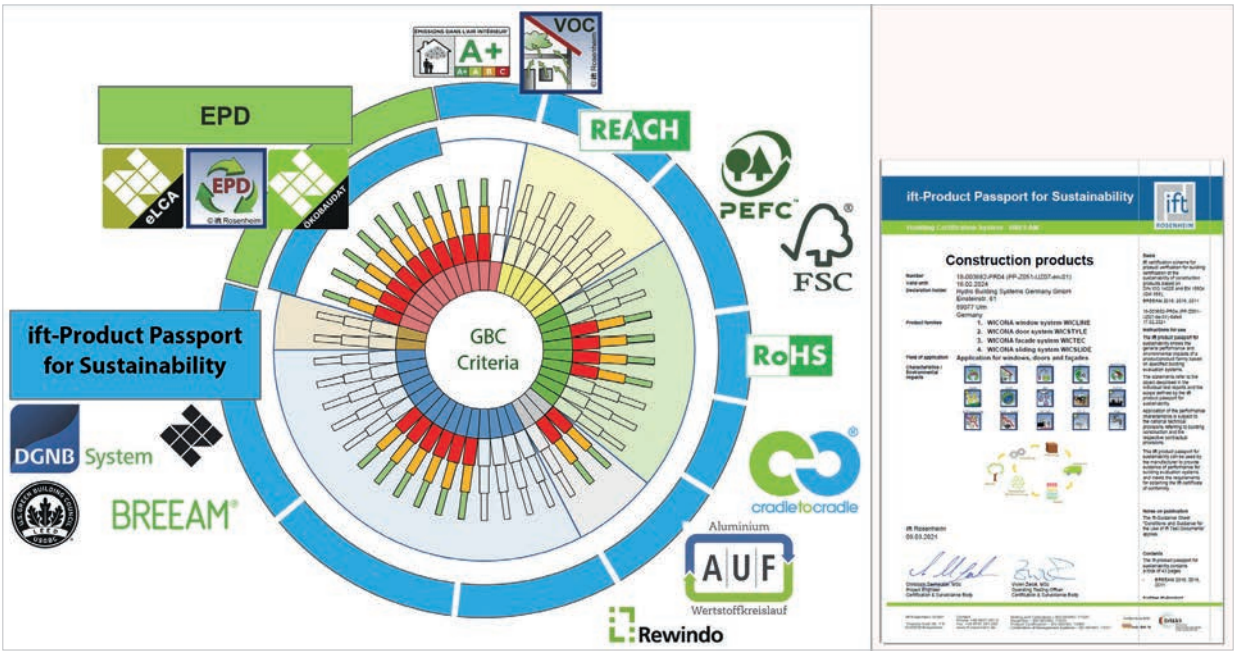


Fig. 23 Information on the evaluation of sustainable criteria of different certification systems (Image: ift-Produktpass-Nachhaltigkeit)

Tab. 3 PCF of selected consumer goods

Product / Service (Selection)	PCF in kg CO_2 equivalent over all life cycle phases
1 coffee cup	0,06
600 g frozen vegetable mix	0,11
100 g fish fingers	0,34
1 wash with Persil detergent	0,70
6 pieces organic free-range eggs	1,10
500 g chicken cutlets	1,35
1 m² flat glass	2,18
10 rolls of toilet paper	2,50
1 running metre spacer	9,81
1 kg beef	13,00
1 running metre aluminium window frame	15,18
1 m² multi-pane insulating glass (2-fold)	24,41
1 year telephone and internet connection	89,60
1 m² Roller shutter	90,78
1 m² sliding gate	132,52
1 m² Aluminium front door	144,93
1 m² stainless steel window	365,54
1 m² Fire door (T90)	954,05

Sources: PCF Pilot Project Germany; Grießhammer R., Hochfeld, C., ift Rosenheim

4.5.2 CO_2 Corporate Carbon Footprint (CCF)

The Greenhouse Gas Protocol (GHG Protocol), founded by the World Resource Institute and the World Business Council for Sustainable Development, provides the basis for calculating a CO_2 footprint for companies in the form of various standards. Standardisation has also taken up the topic and developed the ISO 14064 series of standards, Parts 1 to 3, which is largely based on the standards of the Greenhouse Gas Protocol.

The difference to the product CO_2 footprint lies in the reference value. While the PCF refers to a unit of product, the CCF deals with entire companies. The structure of the CCF is therefore not divided into life cycle stages, but into so-called scopes, which cover the different areas in companies.

5 Conclusion

The dangerous consequences of climate change can only be stopped if we now achieve a rapid and consistent reduction in greenhouse gas emissions through appropriate measures. The necessary technologies are available and competitive at current energy prices. [9]. Companies that invest and take action now will also be able to convince the future buyers and users of buildings, construction elements and construction technology, who are now referred worldwide as the "Fridays for Future" generation. Future-proof and climate-proof building elements must be energy-efficient, resilient to climate extremes and sustainable. Planners, investors and builders must also be able to compare products in terms of sustainability in order to make a serious product decision. For this reason, ift Rosenheim will work together with the industry to create guidelines and suitable system boundaries for assessing sustainability in order to enable product comparisons.

Therefore, the following aspects must be the focus for the development and successful sales of windows and façades:

- Minimisation of energy losses via building components, including ventilation losses,
- Optimal use of solar gains with simultaneous protection against overheating in summer,
- Resilience to floods, storms, hail and heat,
- Low energy consumption in production, maintenance and operation,
- Reusable (recyclable) materials as the basis for a circular economy,
- Sustainable processes, production methods and forms of enterprise.

These aspects must be communicated to the end consumer in an easily understandable form for the selection of suitable products. For an industry whose biggest driver in recent decades has already been the optimisation of energy losses, the chances of mastering this future are de-

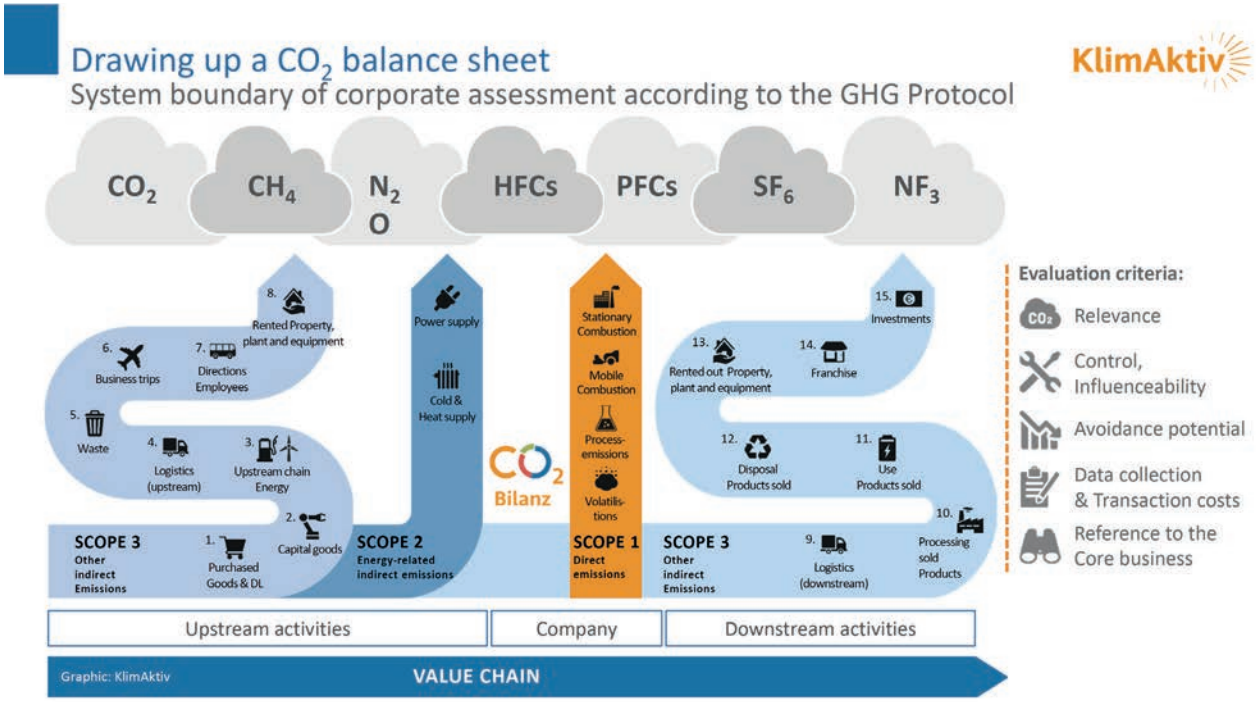


Fig. 24 Overview of scopes and emissions along the value chain (KlimAktiv)

finitely good. The ift Rosenheim will actively support the companies and the industry with appropriate research projects, test procedures and verifications to enable fair competition and to convince consumers and politicians of the value of modern building elements by providing objective information.

Fig. 25 Aspects for climate-proof building elements

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Authors

Prof. Jörn P. Lass is the institute director of ift Rosenheim and has been active in the window and façade industry for over 40 years. As a glazier and window builder, he completed a degree in wood technology and held leading positions at a system provider, window and façade manufacturers, as well as 14 years at ift Rosenheim in the areas of research, testing, quality monitoring, standardisation and certification. For the last six years, he was head of the "Building Envelope" field of study as a professor at the Rosenheim University of Applied Sciences and has been back at ift Rosenheim as Institute Director since January 2020.

Dipl.-Ing. **Jürgen Benitz-Wildenburg** is head of PR & Communication at ift Rosenheim. As a carpenter, timber construction engineer and marketing expert, he has been active in the timber and window industry in various functions for 38 years. He shares his experience as a lecturer, speaker and author.

Dipl.-Phys. **Michael Rossa** has been an employee at ift Rosenheim since 2000 and has held various positions at the institute. Since 2012, he has been Head for the ift Academy's in-house training division, and has been Head of the ift Academy since 2019. He is also a lecturer in physics at the Rosenheim University of Applied Sciences and works for ift as a speaker on the topics of glass, building physics and energy efficiency.

Xaver Hilz, MSc. has been expert for Life Cycle Assessment and Sustainability at ift Rosenheim since 2021 and is responsible, amongst others, for the topic of Environmental Product Declarations. Previously, he completed his studies in Management of Renewable Energies at the Weihenstephan University of Applied Sciences as well as Environmental Systems Sciences with focus on Sustainability Management at the Karl Franzens University in Graz and was active in the fields consultancy and product development regarding hard-to-digest input substrates for biogas plants.

Product

The A|U|F ensures sustainable environmental protection: the aluminium scrap from production and dismantled elements is reused in the cycle. Old aluminium products are turned into new products.

Company

A|U|F e.V.

Walter-Kolb-Straße 1-7
60594 Frankfurt, Germany

☎ +49 (0) 69 955 054-0
✉ info@a-u-f.com
www.a-u-f.com

Product description

The A|U|F ensures sustainable environmental protection: the aluminium scrap from the production and dismantled elements is reused in the same cycle An old aluminium window/door/facade is turned into a new product.

Product benefits

1. The A|U|F offers an **optimised recycling process**: metalworkers can offer this for windows, doors and façades in sustainable buildings and thus qualify product-specific recycling processes can be sustainably influenced.
2. The A|U|F enables a **"closed loop"**: The recycled content of aluminium products is thereby constantly increased.
3. The A|U|F provides **proof** of the requirements of the Recycling Management Act: These requirements also describe the product responsibility of manufacturers. Members can use this proof and develop the requirements for the future with the A|U|F.
4. The A|U|F ensures a **qualified recyclable material cycle** in Germany and Europe: The A|U|F guarantees that aluminium recyclables remain in Germany and Europe.

Product

Finstral FIN-Fix mounting frame for two-stage installation

Company

Finstral AG

Gastererweg 1
39054 Unterinn/Ritten (BZ), Italy

☎ +39 0471 296611
finstral@finstral.com
www.finstral.com

Product description

Finstral FIN-Fix mounting frame is a heat-insulating, all-round corner-welded frame made of recycled PVC with steel insert. It is installed into the masonry during the wet construction phase. The actual window or door element is installed in a second step during the dry construction phase. Thus, it remains undamaged during the construction site. In addition, the frame also reduces the workload on the construction site. Thanks to delivery times of 2-3 weeks, frames are already installed while windows are still being manufactured. Future replacement of windows installed with a mounting frame is only a matter of minutes.

Finstral offers with FIN-Fix an extensively developed frame system. Shading boxes, insulated window sills, etc. can be prepared in the factory with FIN-Fix instead of being assembled on site. This effectively saves time and minimizes errors made by the increasingly valuable installation specialists. All FIN-Fix construction connections are ift-tested.

Product benefits

1. **no damage during installation:** Construction moisture infestation, contamination and damage to the prefabricated elements is avoided by two-stage installation.
2. **unbundled construction process:** Coordination effort for the trades is simplified.
3. **fast delivery time:** Only 2-3 weeks delivery time for finished frames including all connecting profiles and equipment.
4. **recommended by ift Rosenheim:** Two-stage installation with frame is the best method for installation of windows and doors. All FIN-Fix construction connection details ift tested.
5. **always made of PVC:** Perfectly insulating PVC multi-chamber profiles made of 100% recycled, rot-free rigid PVC. Two anextruded seals for perfect sealing between frame and element.
6. **integrated shading:** Top box and guide rails pre-assembled on frame. Visible elements (panels for guide rails, hangings) are mounted only with window or door element.
7. **stable shading box:** Box made of PVC multi-chamber profiles: stable, flame-retardant. Provides perfect hold for fastening screws.
8. **motor fan integrated:** Integrated in the shading box for supply or also exhaust air with heat exchanger.
9. **glass railing integrated:** Almost concealed brackets on the side of the frame. Expert opinion from ift Rosenheim confirms usability as fall-proof component with fall-proof glazing.
10. **foil closure ex works:** Optional ex works: matching wooden frames with foil to close openings in wet construction phase.

Product

SECU-SMART-WINDOW

Company

F.R. Hauk Stahl- und Leichtmetallbau GmbH

Nithackstraße 6
10585 Berlin, Germany

☎ +49 (0) 30 34 79 23 0
✉ info@hauk.de
www.hauk.de

Product description

The SECU-SMART-WINDOW from Hauk brings security and the opportunities of the digital networking of Smart Home applications together. It is not only possible at any time to check the state of the windows from anywhere in the world but also to control it actively. The protection from burglars is not compromised.

The window can be tilted by the press of a button in an app from anywhere outside or inside the house. When tilted, the resistance class RC2 or RC3 can be selected. In closed state, the resistance classes RC2 to RC4 can be enabled. Of course, it is possible to open the side-hung window function manually. Integrated contacts prevent the simultaneous opening by app.

The window can find many different applications both in the private home and in public buildings. The control system ensures that it can be integrated in complex house control systems or work in a stand-alone environment. The Smart Home applications can be disabled completely at any time without any impairment of the functions inside the building.

Product benefits

1. Burglar-proof window, closed up to RC 4, tilted up to RC3
2. Bullet resistance up to FB4 possible
3. Simple control by app possible
4. Additional Smart Home applications can be integrated by the gateway.
5. Integration in complex house control systems possible
6. All functions can also be used without Smart Home applications

Product

Door blank type Öko Passiv 78 mm, with integrated cable duct tested for climate class c, d and e according to EN 1121

Company

Haustüren-Ring GmbH

Beckerstraße 2a
85049 Ingolstadt, Germany

☎ +49 (0) 841 954995
office@haustueren-ring.de
www.haustueren-ring.de

Product description

For passive houses and low-energy houses, this blank, with a door thickness of 78, 88 and 98 mm is optimal. Certified by the Passive House Institute Dr. Wolfgang Feist in Darmstadt.

We manufacture the front door blank type Öko Passiv with a circumferential U-steel frame, welded at the corners and additionally reinforced on the lock side.

The U-steel is encased in Purenit. This way we guarantee distortion stability even in the most extreme climates and installation situations. A cable duct runs in the U-steel on the lock side and on the hinge side, for protected wiring of motor lock, fingerprint, control units, cable transitions, etc.

Between 78 mm and 108 mm, we can manufacture any door leaf thickness you need. The middle layer depends on the technical requirements regarding thermal insulation or sound insulation. As an alternative from the price, we also manufacture the blank in 78 mm door leaf thickness with flat steel frame.

Product benefits

1. Integrated cable duct
2. Climate test c, d and e according to EN 1121 in class 3 according to EN 12219
3. Burglary resistance EN 1627 - 1630 - RC 2 and RC 3
4. Thermal insulation as tested element 1,0 W/(m²K)
5. Sound insulation as tested element Rw 43 dB
6. Fire and smoke protection EI2 30 - C5 -Sa/S200
7. Ability to release EN 179 emergency exit and EN 1125 panic

Product

Aluminium window system heroal W 72 with clamp-on sun protection heroal VS Z EM

Company

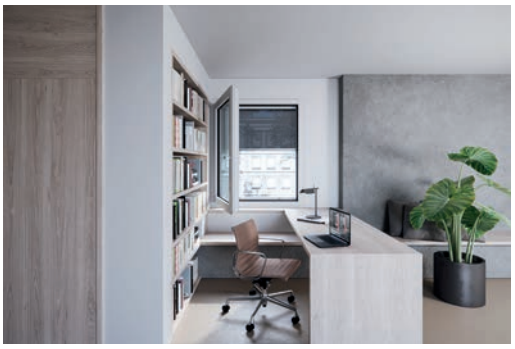
heroal – Johann Henkenjohann GmbH & Co. KG

Österwieher Straße 80
33415 Verl, Germany

☎ +49 (0) 5246 507-0
info@heroal.de
www.heroal.de

Product description

The sun protection system heroal VS Z EM is the clamp-on variant of the textile zip screen system heroal VS Z. It received the R+T Innovation Award 2021 Gold. It can be installed without drills and, if required, can be removed without leftover marking of the structure. Thanks to its integrated solar-powered drive, this system is particularly suited for a retrofit, and can be installed in listed buildings, rented property and existing buildings without much effort. With a range of different clip holders available, this system can be used for almost all conventional types of window made of aluminium, PVC or wood. The standard portfolio with more than 250 different textiles offers a **great freedom of design**.



Product benefits

Installation

The sun protection system can be fitted in the window frame **without** much effort and the **need for special tools**. The installation is done from inside the building. As no structural alterations become necessary, a permission from the landlord or the owners is not required.

Control

Thanks to the **integrated solar-powered drive**, the heroal VS Z EM does not require an additional power supply. If the sun doesn't shine sufficiently, the battery holds a charge to lift or lower the screen for approx. 10 times. The battery can also be **charged via an interface**. System operation at the push of a button on a remote control or via a manual switch on the wall.

Design

The aluminium parts of the heroal VS Z EM are coated with the heroal hwr powder coating – for **perfect colour uniformity** with heroal systems for windows, doors, sliding doors and curtain walls. The standard portfolio of more than 250 different textiles offers a **great freedom of design**. With the heroal VS Z EM, elements up to 2,200 mm high and 2,000 mm wide, with a maximum area of 4.4 m^2, can be created. heroal VS Z EM is also available with **integrated insect or pollen screens**.

Comfort

The heroal VS Z EM offers ideal **protection from glare, prying eyes, heat and UV radiation**. This clamp-on sun protection withstands **strong winds up to 60 km/h** (wind speed 7). If combined with heroal blackout textiles, **100% room darkening** can be achieved. The finished element heroal VS Z EM can be configured and ordered digitally.

Product

digiTEST – Die Zukunft für offizielle Prüfungen im Kundenlabor

Company

ift MessTec GmbH

Theodor Gietl-Straße 7-9
83026 Rosenheim, Germany

☎ +49 (0) 8031 261-2550
info@ift-messtec.de
www.ift-messtec.de

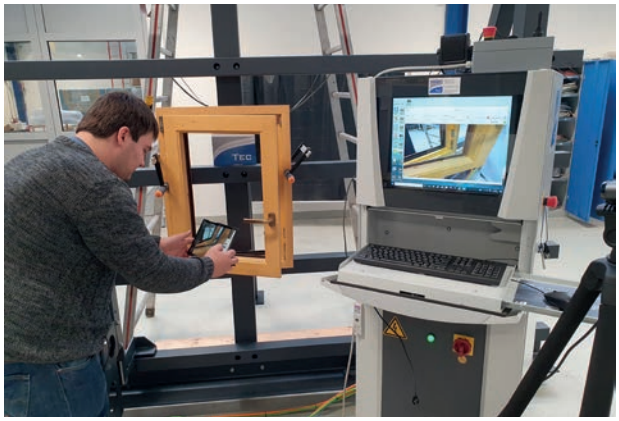
Product description

Test and measuring instruments with precise sensor and mechanical systems are set up for standard-compliant, reproducible, sufficiently accurate and economically efficient tests. With the modern devices, the test engineer is also supported in the inspection task by the software and relieved of tedious standard tasks

The high-quality test equipment of ift MessTec is designed not only to meet the requirements of a test rig for quality control or development tests, but also to meet the higher demands of an accredited and, if necessary, even notified laboratory. These test devices in combination with a calibration of an accredited calibration laboratory create the basis for official tests in the customer's laboratory. The ift Rosenheim has been accredited for this for several years. The many advantages of an official test in our own laboratory are very popular with customers and are in increasing demand.

Since the same requirements apply to tests in the customer's laboratory as in the laboratory of the test centre, a neutral, independent and official test at the customer's premises can only be carried out and guaranteed with ongoing checks or the constant presence of the independent expert from the test centre. The requirements for a customer laboratory for official testing are summarized in an iftTEST contract and agreed with ift Rosenheim.

The test rigs are equipped with appropriate technology, which digitally transmits all important details of the test to the test engineer. He can then remotely intervene in the tests and access the logged results and backup files at any time. The challenge here is to combine measurement, video technology and security monitoring. The most important partner of the neutral test centre becomes the testing and monitoring software. In close cooperation with ift Rosenheim, ift MessTec has developed the necessary extensions to the testing software and will offer them to iftTEST customers as an add-on module digiTEST in the future.



Manufacturers with their own testing facilities and technical experts can thus use their own tests to improve product quality sustainably, develop innovations quickly and have the product properties verified by a neutral body. As a result, they are faster on the market.

Product benefits

- Fast and flexible performance of tests recognised under building law by a notified body on company's in-house test rig
- Faster development times for new product developments and thus a shorter time to market
- Avoidance of time, costs and CO2 emissions due to the journey of a notified test engineer or the transport of test specimens as well as the journey of the manufacturer to the test facility
- Improved support for remote maintenance, troubleshooting and test support

Product

Testing technology and expert know-how for climate resilient building elements as well as, certifications for energy/environmental management (ISO 50001/14001), life cycle assessments and CO_2 emissions

Company

ift Rosenheim

Theodor Gietl-Straße 7-9
83026 Rosenheim, Germany

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www.ift-rosenheim.de

Product description

ift Rosenheim is a notified European testing, surveillance and certification body with international accreditation, according to DIN EN ISO/IEC 17025. The core activities at ift Rosenheim include practical, holistic and fast test-ing and assessment of all characteristics of windows, facades, doors, gates, glazing and construction materials as well as personal safety equipment PPE (breathing masks etc.). Its goals include sustainable improvement of product quality, design, and technology as well as work on standardisation and research. Certification by ift Rosenheim assures you of acceptance all over Europe. At ift, we are committed to providing knowledge and as an unbiased institution, ift Rosenheim enjoys a special status with the media – the publications document the current state-of-the-art technology.

Product benefits

- Testing individual performance characteristics as well as a holistic analysis and evaluation of construction materials and building elements
- Surveillance, quality assurance and certification of products as well as management systems
- Executing official and private research projects including the management of funds and the publication of the results
- Compilation of expertises and statements
- Assessment of tenders, construction and detailed solutions
- Calibration of measuring instruments as well as planning and construction of test devices or instruments
- Cooperation in standards committees and technical bodies of associations, authorities, institutions etc.
- Advanced training by seminars, conferences and congresses
- Transfer of knowledge via all forms of media (print, web, presentations, trade fairs, congresses, video, TV, ...)

Product

Education, training and consulting on modern building technology to improve energy efficiency, resource use, safety and comfort

Company

IGT – Institut für Gebäudetechnologie GmbH

Alte Landstraße 25
85521 Ottobrunn, Germany

☎ +49 (0) 89 66591973
info@igt-institut.de
www.igt-institut.de

Product description

Innovative consulting, planning and project management processes for modern building technology, especially "Smart Buildings" to improve energy efficiency, resource consumption, safety and comfort.

Energy consulting for the German BEG subsidy programs of KfW as well as BAFA with focus on individual measures of building automation.

Focal points with **Fact Sheets** to take away in each case:

- Trends of "Smart Buildings" incl. legal aspects as well as funding programs.
- Office buildings of the future (application scenarios and evaluation of complexity and benefits)
- Comparison of various wireless protocols
- Well-being and productivity in smart buildings
- 10 commandments of good smarthome planning

Product benefits

- Increase in consulting and planning competence in the "Smart Building" environment - both in terms of buildings and product developments.
- Knowledge of the energy law requirements for automation via the GEG (German Building Energy Act) or EPBD 2018.
- Qualification to determine or specify reasonable requirements both from the user's point of view and in terms of energy efficiency
- Ability to estimate the energetic savings potential through building automation
- Knowledge for the selection of suitable technologies or systems
- Formulation of manufacturer- and product-neutral functional descriptions (functional specifications)

Product

WinAlulok 100 Design

Company

LOKVE d.o.o.

Homer 39
51316 Lokve, Croatia

☎ +385 51 508 300
lokve@lokve.com
www.lokve.com

Product description

Wood Alu windows fully aligned sash shape on the inside and aluminum on the outside, they fit perfectly into modern architecture.

Wood – 4 layered lamellas; profile thickness – 100 mm; heat insulation – U_w = 0,75 W/(m²K) (U_g = 0,5 W/(m²K); glass – three-layered insulation glass 52 mm; gasket – 6; hardware – ROTO Designo (Hidden); safety – basic, RC1 or RC2.

The wood-aluminum windows represent the windows of finest quality and design. They are the best choice for the new generation of modern, low-energy and passive houses.

Product benefits

1. Three-layered insulation glass (the opportunity for various configurations of glass type and surface)
2. Aluminium mask for protection (modern design with aligned aluminium)
3. Glazing without silicone (the new generation of glazing with gasket)
4. Rectangular sash shape (without glass strip)
5. Six gaskets (the best heat and sound insulation)
6. Wood/aluminium windows saves energy and money
7. Environmental green production (contributes to the reduction of greeenhouse gases in the atmosphere, and mitigates climate change)
8. Wood/aluminium windows provided sense of comfort, create a healthy and a pleasant atmosphere in the space, raise the value your real estate
9. The products have a certificate of quality issued by ift Rosenheim

Product

blaugelb Triotherm+ assembly frame “in Advance”

Company

Meesenburg Großhandel KG

Westerallee 162
24944 Flensburg, Germany

☎ +49 (0) 461 5808 - 6030
m.yucel@meesenburg.de
www.meesenburg.com

Product description

The highly insulating, ductile profile bodies of the blaugelb Trio**therm**+ assembly frame are integrated into the overall wall structure according to concrete, object-specific specifications (installation planning/installation instructions). Together with the doors and windows to be installed later, they bear “dressing gauges” for the trades:

– Facade insulation/cladding/exterior plaster
– Interior work/interior plaster

The high-quality construction elements – windows and doors – are installed in the frame system as the last component of the overall facade before concluding the construction project in accordance with the construction schedule. They cannot be damaged by other trades.

The geometry of the blaugelb Trio**therm**+ assembly system “in Advance” is defined by the required position of the window in the complete wall section and the forces exerted by wind loads and dead weights from the construction elements.

Product benefits

Thanks to the installation position in the insulation layer of the blaugelb Trio**therm**+ assembly system “in Advance”, the thermal bridges are very limited and there are no energy losses by the elements when installed. There are virtually no thermal bridges thanks to not only the installation position, but also thanks to the low lambda value of 0.0375.

The elements are assembled at the end of the building phase, which has the advantage that the elements cannot be damaged during the building phase.

Laborious cleaning of the hardware is hereby prevented. The easy-to-transport, pluggable individual components enable prefabrication irrespective of the element size.

Architects can implement their ideas thanks to the individual profiling option for the blaugelb Trio**therm**+ assembly system “in Advance”. During installation, the elements simply have to be adjusted and screwed into the blaugelb Triotherm+ assembly system “in Advance” without complex alignment.

Product

Window system made of structurally reinforced PVC profiles

OKNOPLAST
Europas Fensterexperten

Company

Oknoplast Sp. z o.o.

Ochmanów 117
32-003 Ochmanów, Poland

☎ +49 (0) 5451 5458 37 70
info@oknoplast.de
www.oknoplast.de

Product description

Window system made of structurally reinforced PVC profiles with heat-reflective coating on the outside to reduce thermal deformation, integrated hardware ventilation, controllable solar shading, and nanocoating of titanium dioxide (TiO_2) on the glazing to reduce harmful organic and inorganic compounds in the outside air.

Photocatalysis is the degradation of many harmful organic and inorganic compounds under the influence of light. The basic component of the protective layer of photocatalytic coating is TiO_2, which, when deposited on the surface of a solid, is activated by UV radiation and generates reactive oxygen species. The titanium dioxide converts the absorbed light energy into chemical energy, triggering the decomposition reaction of pollutants. These include NO_x, formaldehyde, benzene, bacteria, viruses and other volatile organic compounds. For example, harmful nitrogen oxides are deposited on a surface coated with a nano titanium coating. Under the influence of sunlight, TiO_2 from the composition of the coating forms active oxygen species that combine with water vapor from the air and form hydroxyl radicals. Hydroxyl radicals activate the oxidation reactions of nitrogen oxides. This means that the dangerous NO_x decomposes into harmless nitrate ions and completely neutral water vapor. Together In summary, the phenomenon of photocatalysis causes harmful compounds to decompose into completely neutral products. In addition, it acquires self-cleaning properties.

Product benefits

1. Self-cleaning glass
2. Reduction of thermal deformation
3. Efficient ventilation due to PAD fitting
4. Reduction of harmful organic and inorganic compounds in the outside air

Product

rp fineline 70

Company

RP Technik GmbH Profilsysteme

Edisonstraße 4
59199 Bönen, Germany

☎ +49 (0) 2383 91 49-0
info@rp-technik.com
www.rp-technik.com

Product description

rp fineline 70 provides metalworkers and planners with a slender, thermally broken system with total face widths of just 45 mm (sash/frame combination) for high-quality residential construction and the renovation of listed buildings.

Product benefits

The highlights in terms of design are accompanied by efficient processing for the metalworking company. This results in significant time savings when it comes to production – for example, thanks to tool-free mounting of the glazing beads, which are simply hooked into place without the need for clamping studs.

Planners can choose from three different design variants for integrating the lock case: enclosed by either transoms or a mullion for a linear style or left without transoms or mullions and with a simple glass cut-out for a particularly minimalist look.

The elegant barrel hinges with a diameter of just 15 mm can be coated in any RAL colour and are therefore ideal for either accentuating or blending in with the colour concept.

With no fewer than three threshold solutions to choose from, rp fineline 70D also adapts to a variety of structural circumstances. In addition to the "normal threshold" with a height offset between inside and outside, the "zero threshold" can be used to ensure accessibility. The "old building threshold" is simply mounted on an existing floor and is therefore suitable for renovation and refurbishment projects.

Product

We bring clarity to the complexities of building science and code compliance. Our capabilities, insights, product and performance testing, and technical engineering support can help you design, build and manage smarter and sustainable products and buildings.

Company

UL

Am Oberfeld
83026 Rosenheim, Germany

☎ +44 (0) 1925 258876
EU.BuildingLifeSafety@ul.com
www.ul.com/european-fire-safety-product-and-system-services

Product description

Fire-rated doors, wall, floor and ceiling assemblies provide the necessary fire and smoke barriers to create compartmentalization during a fire, safeguarding against the spread of fire and smoke within a building or to and from a building. These assemblies need to meet fire and smoke safety and environmental sustainability requirements. We can help ensure that your materials, systems and assemblies are designed to meet these requirements by providing third-party certification of their safety and performance.

Our solutions also help confirm the safety, performance, reliability and security of your fire-resistant rated designs. Fire-resistance rated designs are used to achieve code compliant installations where the building codes require hourly rated designs. We test assemblies to international standards, establishing an hourly rating to provide evidence of compliance to code requirements.

Product benefits

1. We understand that meeting fire resistance safety requirements can be challenging, which is why we provide training, advisory, testing, verification, inspection and certification solutions for the fire resistance industry.
2. With a rich history of fire safety science behind us, we can provide third-party Verification that your products are in compliance with industry standards, helping them get to the market faster.
3. The UL Certification Mark on fire resistant products, systems and assemblies is relied on by code enforcement officials and buyers to provide confidence that products and systems meet regulatory and market requirements.
4. The UL Evaluation Report provides code authorities with added assurance that assemblies have been evaluated to the diverse code requirements to which they must comply.
5. Our testing services span across a broad spectrum of standards and evaluate product performance to all the critical attributes necessary to provide confidence in product performance.

Imprint

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„Green Deal“

Special Show

Organiser:

FENSTERBAU FRONTALE

ift ROSENHEIM

Co-exhibitors:

Aluminium AUF Wertstoffkreislauf

FINSTRAL

F.R. HAUK STAHL- UND LEICHTMETALLBAU GMBH

Stark durch Verstärkung – Haustüren-Ring

heroal

MESS TEC

ift ROSENHEIM

IGT INSTITUT FÜR GEBÄUDE-TECHNOLOGIE

LOKVE® QUALITY WINDOWS

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rp technik

UL