
Documentation

Special Show



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April 17–22 · Munich



Special Show

climate.safe. construction

with sustainable and
climate-resilient products

Heat records, heavy rain, storms and droughts endanger people and buildings - climate change is here, and the consequences are also affecting us in Europe. It is therefore important to protect ourselves from climate extremes. The building sector contributes significantly to climate change through fossil heating energy and CO₂ emissions in the production of buildings and building products (grey energy). Future-proof building products must therefore be energy-efficient, sustainable and resilient to climate extremes. In order for planners, manufacturers and builders to make a reliable decision on the appropriate building products, suitable and simple criteria for sustainability and climate safety are needed. In April 2023, ift Rosenheim will therefore present suitable technologies and assessment criteria at the world's leading trade fair BAU in Munich together with innovative co-exhibitors in Hall C4 (501/502) as part of the special show "climate.safe.construction with sustainable and climate-resilient building products".

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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, certification 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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Climate safe construction

Energy-efficient, sustainable and climate-resilient building products for new construction and energy-efficient modernisation

Climate change is here, and the consequences of climate extremes such as heat records, heavy rain and storms endanger people and buildings. It is therefore a matter of reducing the climate change risk through energy-efficient and sustainable building products, but also of protecting people and building better against climate extremes. Future-proof and climate-proof building products must therefore be energy-efficient, sustainable and resilient to climate extremes such as heat waves, heavy rain and storms. In addition to reducing energy consumption and CO₂ emissions in the using phase, greater attention must also be paid to resource consumption during production ("grey energy") and the recyclability of building materials in order to push the transition to a circular economy. In order for planners, manufacturers and builders to be able to make a reliable decision for the appropriate building products, the requirements and evaluation criteria must be adapted. For this, a simple and reliable classification

and labelling at product level is necessary in order to be able to make an informed decision for building products during planning and tendering.

The following ten aspects or technologies are necessary for the new construction and energy-efficient modernisation of buildings:

1. Energy-efficient building envelope with high thermal insulation so that energy-efficient heating technology based on renewable energies can be used.
2. Building products must be easily replaceable, the materials used (frames, glazing, sealing, fittings, etc.) must be fully recyclable and easily separable for this purpose (circular economy).
3. Lowest CO₂ emissions during production, use and deconstruction of building materials
4. The composition and properties of the materials should be easily available for the entire period of use (databases, QR code, transponder, etc.).
5. Sufficient transparent surfaces for good daylight quality and optimal use of free solar energy
6. Effective and adaptive solar protection (roller shutters, venetian blinds, blinds, switchable glazing, etc.) to make optimal use of solar gains during the heating period and to protect successfully against overheating.
7. Easy-to-use ventilation devices (openable windows) to supply the occupants with fresh air and to avoid overheating of the rooms through night cooling. In addition, sensors and actuators for protection/warning in case of rain and wind are useful for windows.
8. Connection to the heating or building services (windows open – heating off)

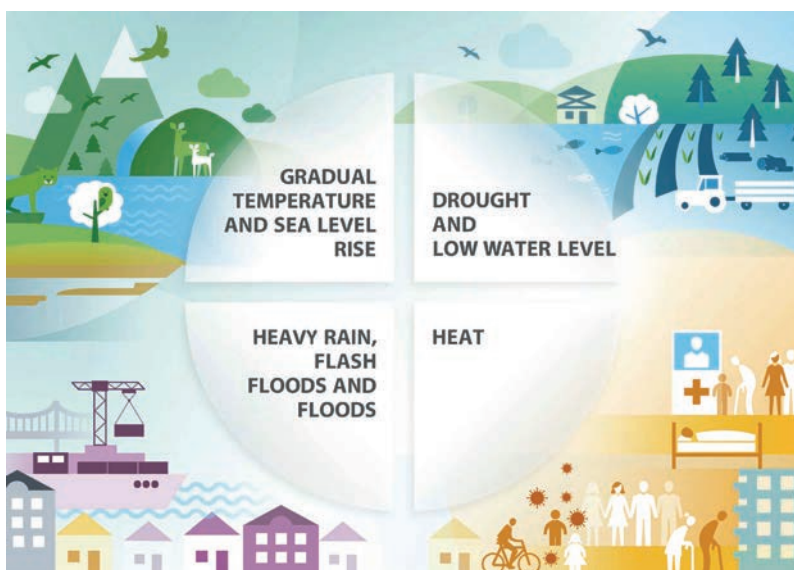


Fig. 1 Buildings and cities must be energy-optimised and climate-resilient in order to reduce climate change risks and withstand the consequences of extreme weather. (Source: Federal Environment Agency 2022, <https://www.umweltbundesamt.de/deutschland-im-klimawandel-risiken>)

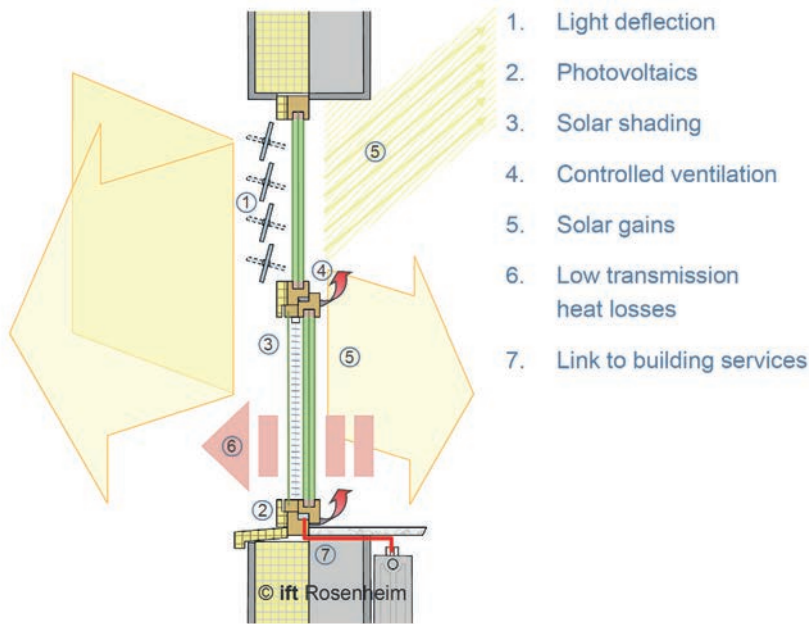


Fig. 2 The window as a regenerative "energy producer" for buildings

9. 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 (flood resistance).
10. 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

1 Climate change calls for energy-optimised buildings

The necessary reduction of CO₂ emissions in the building sector can only be achieved through radical savings in energy consumption and the increased use of renewable energies for heating (and partly for cooling). The necessary measures must focus much more strongly than before on the existing building stock. For it is here that the majority of CO₂ emissions are caused by a large building stock of energy efficiency class E to H, which at 250 kWh/m² consume 800% more energy than a modern class A building at 30 to 50 kWh/m² (equivalent to KfW Efficiency House 55 od class A). The big lever is therefore to increase the energy modernisation rate 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 could heat the building in the heating period, because the solar gains on the east, west and south sides exceed the energy losses via these surfaces. This makes modern thermal insulation windows a regenerative heat source without any heating system technology at all.

Particularly in the case of building renovation, installation has a very great influence on thermal insulation, function and serviceability of building elements and must therefore be well planned. A lot of detailed information can be found in the installation guide [23]. The following aspects must be taken into account for a successful installation:

- Re-evaluation of the building physics equilibrium, since 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 $U_{AW} > 1.0 \text{ W}/(\text{m}^2\text{K})$.
- 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 the requirements (GEG 2023 + GEG 2025)

In order to achieve the national and European climate targets, the requirements for the building sector must be adapted. The minimum energy requirements must be based on the EPBD (European Performance of Buildings Directive), which already called for increased energy requirements for buildings in 2018. Therefore, the German government is amending the Building Energy Act (GEG) in two steps (2023 and 2025). In the first step (2023), the

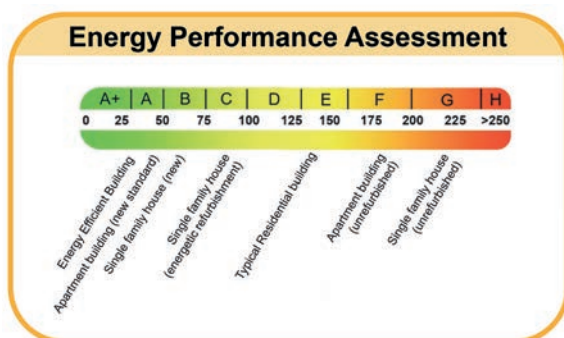


Fig. 3 German energy certificate with energy efficiency class A+ to H for buildings (Image: BMWK, Second Ordinance Amending the Energy Saving Ordinance)

requirements for the renovation of existing buildings have remained unchanged and tightened requirements have only been introduced for new buildings. In the second step (2025), a fundamental revision is planned, in which the solar gains of transparent building components are also to be taken into account.

According to the amendment of the GEG that will be effective from 1 January 2023, the following aspects are relevant for the planning and use of windows, doors and glazing.

- Reduction of the primary energy demand of the **reference building** from 75 % to 55 % (GEG § 15 para. 1 with Annex 1 "Reference building"). This corresponds

to a reduction of approx. 26 %. A further reduction to the EH40 standard is then planned for 2025 (further reduction of 27 %).

- Adaptation of the **simplified verification procedure (GEG-easy)** for residential buildings according to 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 hot water preparation) and the use of a ventilation system. In addition, specific requirements are formulated for building components, for example for windows and other transparent building components $U_w \leq 0.90 \text{ W}/(\text{m}^2\cdot\text{K})$, roof windows $U_w \leq 1.0 \text{ W}/(\text{m}^2\cdot\text{K})$, doors

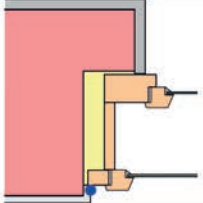
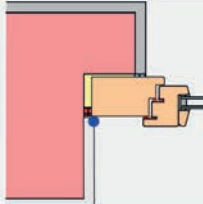
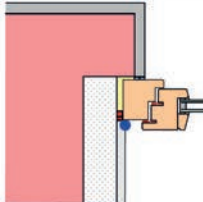
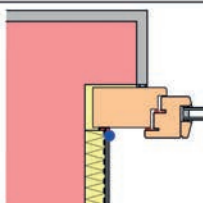
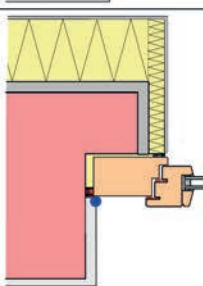
No.	Description	Representation	θ_{si} in °C (• Image)	$f_{0.25/0.13}$	Requirement is met	
1	Initial situation prior to refurbishment		13.1	0.72	yes	
2	Refurbishment with adapted window frame		11.3	$0.65 < f_{min}$	no	
3	Refurbishment with masonry lining to the reveal made of aerated concrete, 65 mm thick,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

Fig. 4 Optimisation options for window renovation ([23])

(basement and exterior doors) $U_D \leq 1.2 \text{ W}/(\text{m}^2\text{K})$, skylight domes and similar building components $U \leq 1.5 \text{ W}/(\text{m}^2\text{K})$, special window doors with hinged, folding, sliding or lifting mechanism) $U_W \leq 1.4 \text{ W}/(\text{m}^2\text{K})$, exterior walls, storey ceilings downwards against outside air $U \leq 0.20 \text{ W}/(\text{m}^2\text{K})$, other opaque building components (basement ceilings, walls and ceilings to unheated rooms, wall and floor surfaces against the ground, etc.) with $U \leq 0.25 \text{ W}/(\text{m}^2\text{K})$.) and the avoidance of thermal bridges $\Delta U_{WB} \leq 0.035 \text{ W}/(\text{m}^2\text{K})$.

- **Thermal bridge surcharges** with verification and compliance with equivalence may now only be determined in accordance with DIN V 18599-2:2018-09 or DIN V 4108-6:2003-06, as amended by DIN V 4108-6 Corrigendum 1:2004-3. Alternatively, designs according to DIN 4108 Supplement 2:2019-06 with the flat-rate thermal bridge surcharges according to Category A or Category B may be used.

The opportunities to reduce energy consumption through solar gains and building automation (sun protection, ventilation, window opening, lighting, etc.) are not taken into account in the current GEG. The EPBD already goes further here and "rewards" an increased degree of digitalisation, monitoring and building automation. In the funding programmes of the BEG (Federal Funding for Efficient Buildings), investments in building automation can also be funded as individual measures, for example components for the automation of shading, ventilation and lighting (e.g. air quality sensors, window contacts, presence and lighting sensors, etc.).

For political reasons, a fundamental revision of the GEG is not planned until 2025 in order to achieve an effective reduction of greenhouse gas emissions (GHG) for existing and new buildings during operation and construction. In order to achieve a GHG-neutral building stock as well as an efficient use of renewable energies (EE) by 2045, the building envelope must be optimisable as cost-efficiently as possible so that energy retrofits do not fail due to costs. This should also take adequate account of solar gains, the positive effect of which has been confirmed in passive, low-energy or zero-energy houses. The second aspect is a more sustainable use of the buildings over the entire life cycle by assessing the "grey energy" during construction, ensuring easy maintenance and replacement of "wear parts", and a very high recycling or reuse of the products. For this reason, the German Federal Ministry of Economics and Climate Protection (BMWK) has commissioned a short expert report [3], in order to determine suitable requirements and parameters for the planned revision of the GEG 2025. The final energy demand and heating demand $q_{h,b,0}$ (useful energy demand for heating before iteration, $Q_{h,b,0}$) is proposed as an efficiency requirement for reducing GHG emissions. The use of solar heat input is also taken into account in order to adequately assess the energy performance of transparent building components. Added to this is the recording of ventilation efficiency, which allows flexibility for the design of the building envelope. For example, the installation of a ventilation system with heat recovery (WRG) could moderately degrade the U-values of the building components. The report also made suggestions for sensible characteristic values for the reference building.

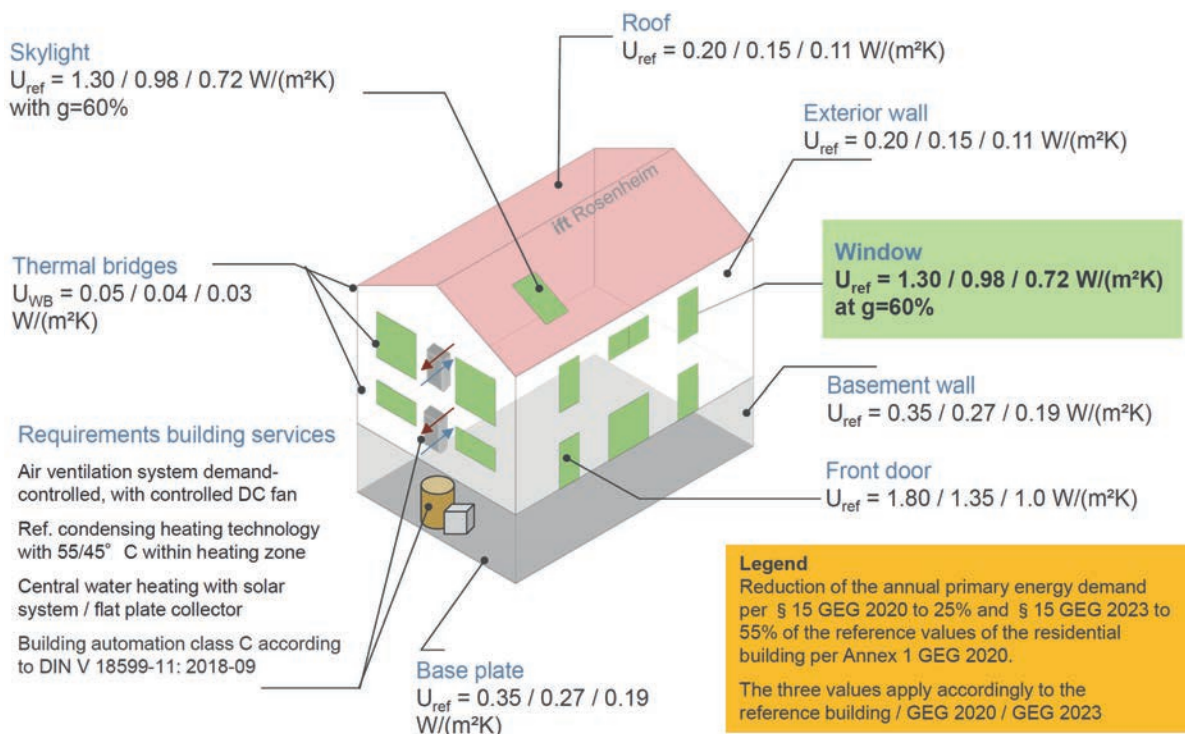


Fig. 5 Values of the reference building according to Annex 1 of the Building Energy Act 2020 (GEG) and planned values for GEG 2025 (as of 11/2022)

1.2 Consequences for the insulation of windows and glazing

The objective of the GEG 2020/2023/2025 is to limit the maximum value of the annual primary energy demand of a building in order to save energy. If building components (windows, doors, façades, etc.) with a worse U_W value than the reference value are installed, the higher heat losses must be compensated for e.g. by improved system technology or by lower U values of other building components (roof, wall, floor, etc.). The objective of the GEG is therefore to enable a suitable and economic 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. However, it is problematic that solar energy gains during the heating period are not taken into account in the GEG yet. An evaluation of windows, façades and glazing only according to the U -value can therefore quickly lead to an energetically incorrect planning of buildings because the window areas are reduced.

Due to the tightening of the Building Energy Act (GEG) for all new buildings to the Efficiency House 55 standard (EH55), which will apply from 1.1.2023, the question arises as to which U -values for windows, glazing and façades are sensible or necessary in order to meet the higher requirements for a new building. The basis for the insulation standards is the reference building procedure according to the GEG. From January 2023, the annual primary energy requirement of new buildings is reduced to 55% of the reference building across the board. For windows and

french doors in residential and non-residential buildings (with room temperature $\geq 19^\circ\text{C}$), a U_W of $1.3 \text{ W}/(\text{m}^2\text{K})$ applies for the "nominal" reference value. A proportional reduction of the U_W values for windows analogous to the annual primary energy demand would lead to constructions that are technically very difficult to realise and completely uneconomical.

At the EH55 level, a proportional reduction of the U -values would result in a "theoretical" requirement for the window of $U_W = 0.72 \text{ W}/(\text{m}^2\text{K})$. With today's standard frame profiles and glazing, this value is difficult and costly to achieve. For windows with special glazing, e.g. for sound insulation, burglary resistance or fall protection, these U -values are no longer possible in most cases.

These extremely low U_W values cause significant additional costs that bear no economic relation to the possible savings in energy and CO_2 emissions. The highly insulating windows already available today with a U value of $\approx 0.8 \text{ W}/(\text{m}^2\text{K})$ have been used successfully for many years in low-energy, passive or energy-plus houses. Due to the achievable solar gains (mainly on the west/east and south sides of buildings), modern windows with efficient triple glazing therefore make an important contribution to saving CO_2 emissions in the building sector. This applies equally to new buildings and energy-efficient renovations. The H'T requirement of the GEG 2023 does not take usable solar heat input into account. Especially in the case of regenerative heat generation, the H'T requirement is the "reference value" for the design of the building envelope, so that the identification of an energetically optimal

Major amendment to the Building Energy Act - formulation of a new reference building

ibh INGENIEURBÜRO
Prof. Dr. Hauser GmbH

Building envelope - thermal insulation for essential components (work status 10/2022!)

Components		Reference EFH/ZFH	Reference MFH
Exterior walls, floor slabs downwards against outside air	U_{AW}	$0.16 \text{ W}/(\text{m}^2\text{K})$	$0.18 \text{ W}/(\text{m}^2\text{K})$
Windows and other transparent components	$U_{W,i}$; g	$0.90 \text{ W}/(\text{m}^2\text{K})$; 0.50	$0.90 \text{ W}/(\text{m}^2\text{K})$; 0.50
Skylight	$U_{W,i}$; g	$1.0 \text{ W}/(\text{m}^2\text{K})$; 0.50	$1.0 \text{ W}/(\text{m}^2\text{K})$; 0.50
Doors (basement and exterior doors)	U_{AT}	$1.0 \text{ W}/(\text{m}^2\text{K})$	$1.0 \text{ W}/(\text{m}^2\text{K})$
Pitched roof surfaces, top floor ceiling, Dormer windows	U_D	$0.12 \text{ W}/(\text{m}^2\text{K})$	$0.14 \text{ W}/(\text{m}^2\text{K})$
Flat roof	U_D	$0.11 \text{ W}/(\text{m}^2\text{K})$	$0.11 \text{ W}/(\text{m}^2\text{K})$
Other opaque components (basement ceilings, wall and floor surfaces against unheated/earth etc.)	U_{Op}	$0.2 \text{ W}/(\text{m}^2\text{K})$	$0.24 \text{ W}/(\text{m}^2\text{K})$
Thermal bridges	ΔU_{WB}	$0.03 \text{ W}/(\text{m}^2\text{K})$	$0.03 \text{ W}/(\text{m}^2\text{K})$
Air tightness of the building envelope	n_{50}	0.6 h^{-1}	0.6 h^{-1}

* The designation "GEG neu" is an abbreviation for a perspective amendment to the upcoming amendment to the Building Energy Act.



Source: Brief expert opinion on the revision of the GEG/2022

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Fig. 6 Proposals for the characteristic values of the reference building in the GEG 2025 (Fig.: Dr Stephan Schlitzberger [2])

solution is not possible with it - at worst, window areas are reduced (H_T value "improves"), and the energy demand is increased as a result (reduction of solar gains). Therefore, the proportionally reduced reference design according to the GEG 2023 does not offer a sensible buildable solution for meeting the energy requirements. In practical use, modern thermal insulation windows in south, west and east installation positions with a U_W value of 0.80 – 1.0 W/(m²K) are mostly energy neutral due to the solar gains in the heating period (October – March) – that is, the heat losses are compensated for or exceeded by the solar energy gains, so that the heating energy demand is even reduced.

2 Protection against climate extremes (resilience)

Even the realisation of ambitious CO₂ 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 of Germany and southern Europe, drought, dryness and forest fires all over Europe, 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, façades and building products 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, hail and storms. There are many ways to make the components and the building fit for climate change. However, architects also need to rethink when it comes to sizes, window divisions, types of opening, arrangement of windows and sun protection in general.

2.1 Flood protection

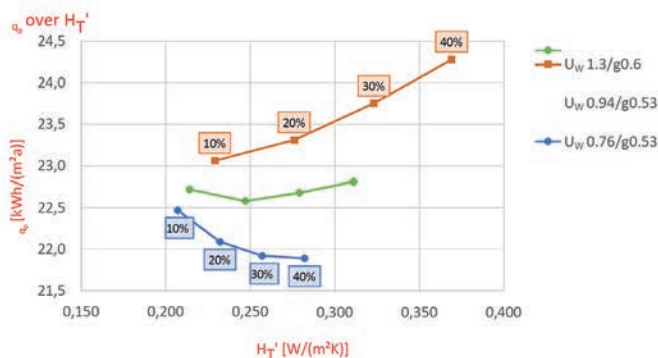
Floods have been occurring for years not only in the direct vicinity of rivers and streams. This is because surface water during local heavy rain events often already leads to flooding - this can affect almost any building in Germany; it only needs an unfavourable slope to the house. The stresses during 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.

"Normal" windows in the house can prevent or limit the entry of water into the house in the event of driving rain. However, in the case of backwater, flood-resistant windows are necessary. [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

Windows in the energy balance - interplay of the main and secondary requirements



EFH as efficiency house 55 with regenerative heat generation, variation windows



Sketch EFH from ZUB model building typology

H_T' increases from 0.229 to 0.369 W/(m²K): + 61 %
 q_p increases from 23.1 to 24.3 kWh/(m²a): + 5 %

H_T' increases from 0.214 to 0.311 W/(m²K): + 45 %
 q_p increases from 22.7 to 22.8 kWh/(m²a): + << 1%

H_T' increases from 0.207 to 0.282 W/(m²K): + 36 %
 q_p decreases from 22.5 to 21.9 kWh/(m²a): - 3 %

- The requirement variable H_T' can lead to **incorrect optimisations!**
- This "danger" exists with regenerative heat generation. Here, for example, with use of a heat pump far exceeds the q_p requirement and the H_T' -requirement becomes the guiding variable for the design of the building envelope

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Fig. 7 Energetic incorrect planning of windows and glazing due to requirements of the GEG 2023 (Fig.: Dr. Stephan Schlitzberger, Ingenieurbüro Prof. Dr. Hauser GmbH [2])

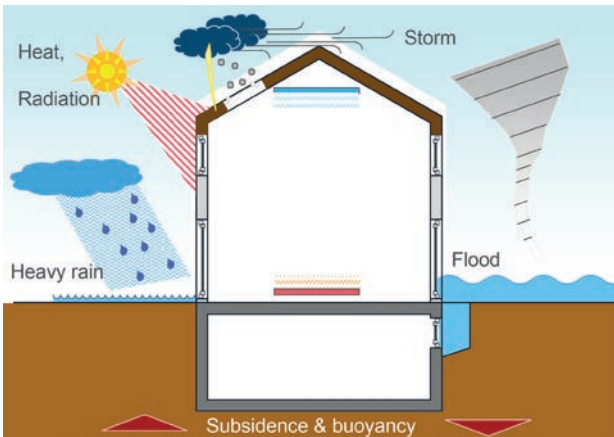


Fig. 8 Times are getting "rougher" for buildings and residents

to moisture show damage. In particular, moisture that has penetrated into the cavities of PVC or aluminium window constructions and contamination of the water by faeces or gasoline lead to impairments through odours, mould and other emissions into the room air. Windows can quickly become complete 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 also highly water-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 mo-

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	(Suitable)	Not required
			Driving rain impermeability of element and connections. Regulated classes according to DIN EN 12208	Driving rain tightness of element and connections is given accordingly	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)	Suitable	Possible
			Depending on the height of the surface water, the tightness may be limited, water penetrating into the structure connection is possible.	Tightness of element and connections is given	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	Suitable	Suitable
			Tightness and damage-free element and connections no longer given.	Low leakage permissible (flood resistant) or watertight.	Watertight shielding possible.
4.1		Inflowing water Flood flows against the elements.	Unsuitable	Unsuitable	See 4.2
			Tightness and freedom from damage of element and connections no longer given.	Tightness and freedom from damage of element and connections no longer given.	Watertight shielding possible.
4.2		Inflowing water Flood flows against the shielding by protective wall.	Suitable	Suitable	Suitable
			Flood protection through watertight shielding.	Watertight shielding and/or shielding from flow and flotsam possible.	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. 9 Exposure to water and possible protective measures

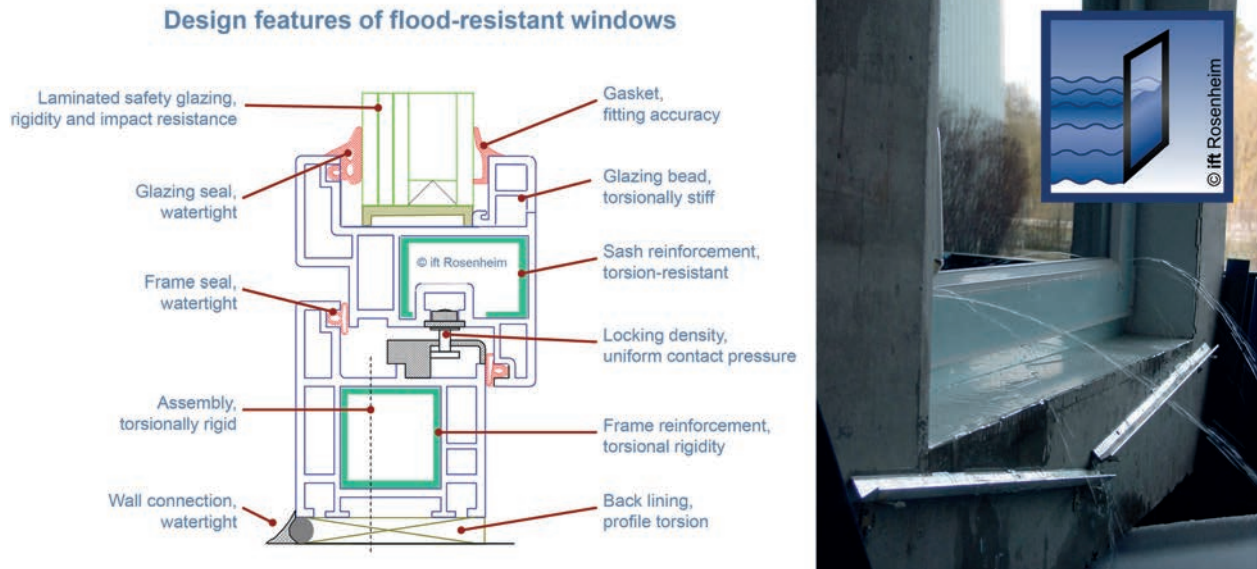


Fig. 10 Construction principles and testing of flood-resistant windows [1]

stly as small-format basement windows. The development of large-format constructions for flood-resistant windows and French windows that can be used like "normal" windows on the ground floor is in progress. 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 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) [10]. 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. 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 (intense ventilation at night) can significantly reduce the heat risk. In combination with passive cooling (cooling ceiling/floor), this means that in moderate climates (central Europe) it is possible to do without active cooling systems (air conditioning) in most cases. [18].

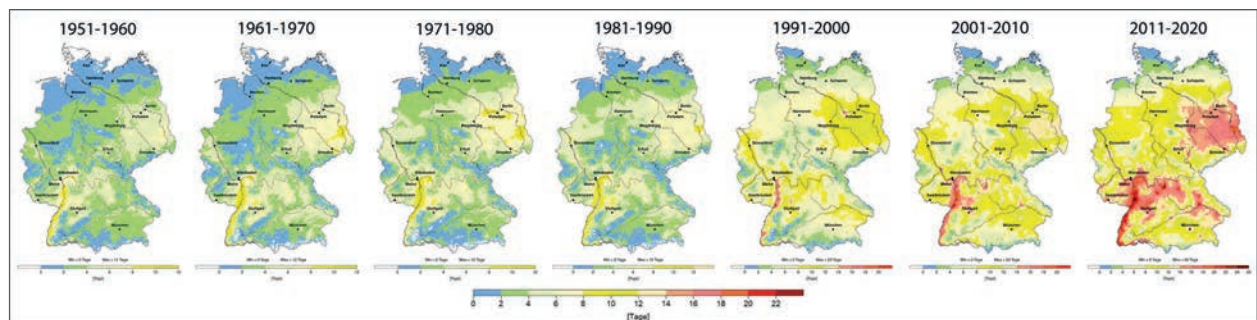


Fig. 11 Mean annual number of hot days in Germany (days with a maximum temperature of at least 30 °C). (Source: DWD & EWK 2020)

2.2.1 Sun protection

The relevant parameter for solar shading is the g_{total} 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, g_{total} should be very low in the summer months. In winter, however, a high g_{total} 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 therefore meet the following requirements:

- Control of solar radiation to ensure comfortable indoor temperatures,
- Good use of daylight to reduce artificial lighting and for health,
- Glare protection and avoidance of direct sunlight, especially at VDU workstations,
- Privacy screen at night,
- Reduction of light pollution,
- 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 the material surface 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 (near zero).

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. [8]. 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 g_{total} value according to EN 52022-1 or EN 52022-3 should be used.

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 moderate climate such as central and eastern 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-storey flats, the air exchange is additionally supported by the "chimney effect". To improve comfort and safety, windows can be equipped with warning sensors or as an automatic system that closes the windows when storms

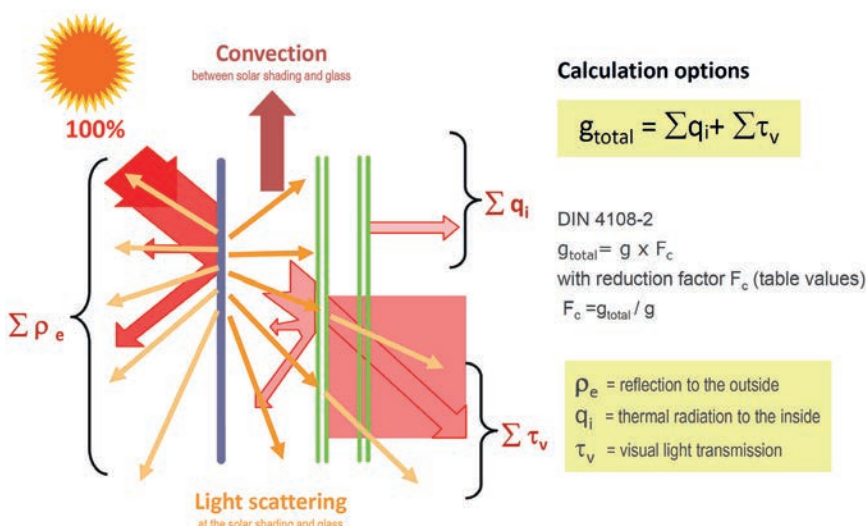


Fig. 12 Total energy transmittance g_{total} as the relevant parameter for calculating of the solar protection

and rain occur. But structural measures also make sense in cities 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 [9].

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 surrounding 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 air condition/cooling 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 [20] which essentially takes into account the wind loads, the shape of the building, the building location and the topography of the surroundings.

When determining the wind loads, characteristic basic wind speeds with an annual exceedance probability of 2 % are used, which corresponds to an average return period 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 and a higher evaporation rate of water on oceans is also increasing.

The greatest danger in strong storms comes from high and rapidly changing air pressures (pressure/ suction loads) and 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 there is therefore also a "hurricane test" [22], 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 can withstand. Unlike in the USA, however, there are no requirements for this potential hazard in currently applicable standards and building laws in Germany. The standardisation committees have now recognised the problem and have initiated the development of an ISO standard. [21] which ift Rosenheim is also involved in. In contrast to the

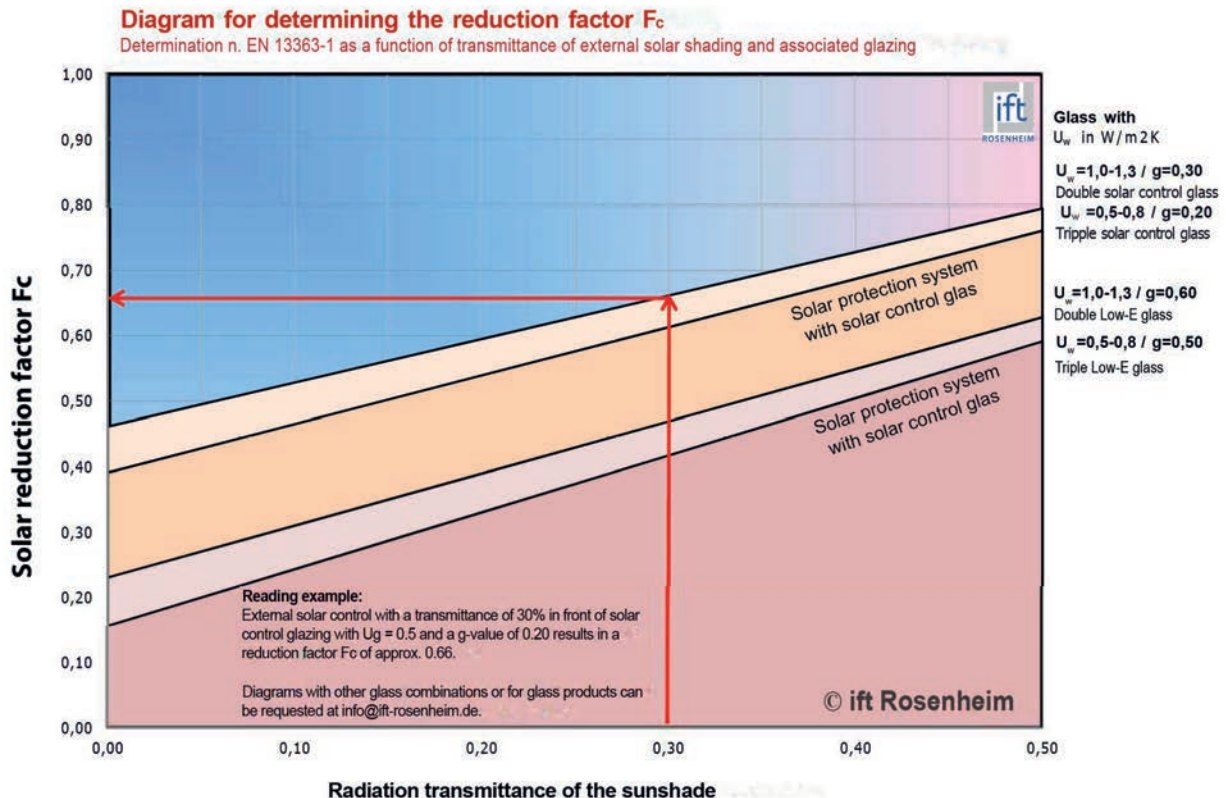


Fig. 13 Simplified estimation of the F_c value for external solar shading depending on the glazing and the solar transmittance of the solar shading system



Fig. 14 Testing of hurricane-proof building elements at ift Rosenheim according to [22]

USA, however, the new standard also covers windows and façades with steel parts. The background to this is the difference between the American lightweight construction method 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 subjected 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 (VSG), 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 perform tests according to the American hurricane standard [22] and the fu-

ture ISO standard 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 required for 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 up to 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 European Construction Products Regulation (BauPVO) [16] the sustainable use of natural resources was consequently defined as an "essential requirement". "[...] *The structure, its building materials and parts must be recyclable after demolition*" [...] *Environmentally friendly raw materials and secondary building materials must be used for the structure.*"

So far, the focus for windows and façades has been predominantly on reducing the building's 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 "faded out". The new German government is now rightly calling for a holistic assessment of emissions over the entire life cycle. A 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 materials used by type or even the reusability of entire building products or individual components at the end of the life cycle should be given greater focus in the future.

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 a building. This information is particularly important if a sustainability certification of the building is planned (BNB, DGNB, LEED, BREEAM etc.).

With the many parameters of a life cycle assessment or EPD, it is difficult to compare products, and the CO₂ footprint or another 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-resilient building elements. Detailed information can be found in the ift Technical Information NA-02/4 "Green Envelope – Sustainability for Building Products" [19].

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 or 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 in US, BREEAM in UK or BNB and DGNB in Germany) 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.

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 for reuse or recycling. 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.

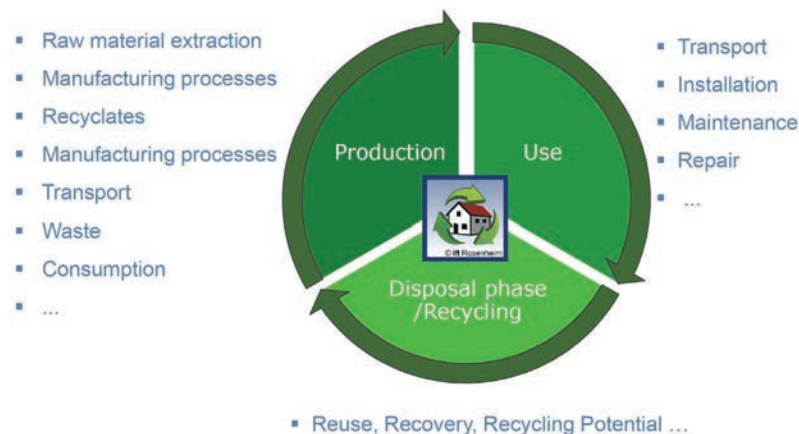


Fig. 15 A holistic analysis of the entire product life cycle reveals all environmental impacts and CO₂ emissions. (Fig.: ift Rosenheim)

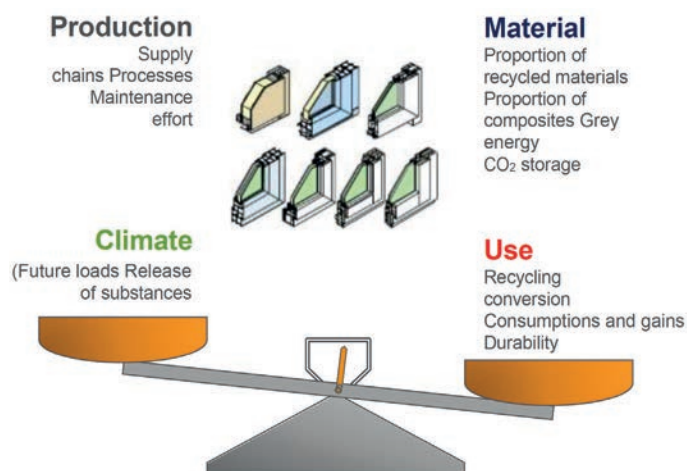


Fig. 16 All product areas are important in a holistic assessment

The determination of environmental impacts, e.g. for building certification systems, takes place within the framework of an EPD according to DIN EN ISO 14025 as well as DIN 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

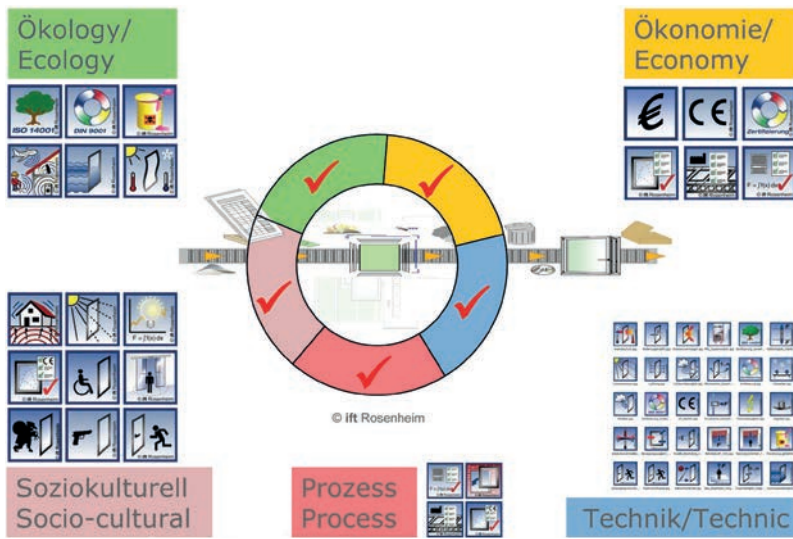


Fig. 17 Criteria and qualities for sustainable building based on the German Sustainable Building Rating System – BNB

information NA-02/4 – "Green Envelope – Sustainability for Building Products" [19]. All documents published by ift Rosenheim to date are available on the website www.ift-rosenheim.de.

4.1 Life Cycle Assessment (LCA)

The LCA (Life Cycle Assessment) according to DIN EN ISO 14040 and DIN 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") and 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.

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.

4.2 Environmental Product Declaration (EPD)

An environmental product declaration is made on the basis of the standards DIN EN ISO 14025 and DIN EN 15804. In an EPD, the environmental impacts of a product must be documented on a mandatory basis for the manufacturing process and 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, facades and glazing, the impact of the use phase (30 to 50 years of use) on the environment is mostly significantly greater than that of the manufacturing process – quite in contrast to short-lived building products such as carpeted floors 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 nine 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

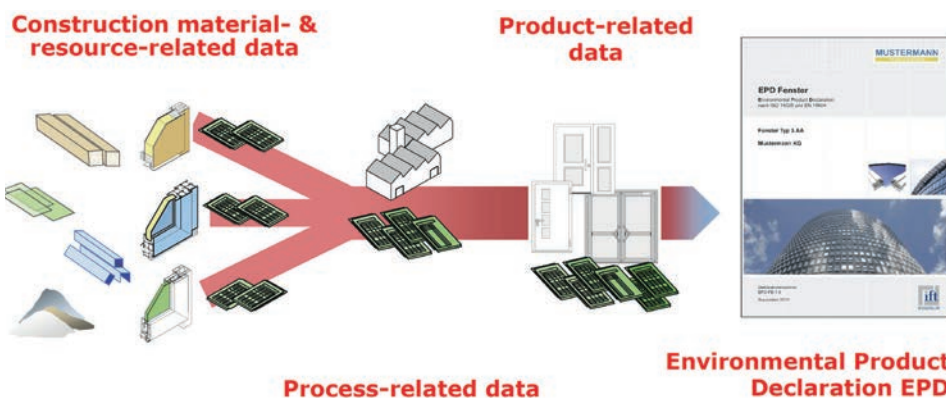


Fig. 18 Data determination for an EPD, optionally with average, company-specific or product-specific data

Table 1 Description of the life cycle phases according to DIN 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)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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)

and quality of the product. The data obtained also provides important information for the establishment of an environmental management system.

If an EPD has been prepared in accordance with DIN 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.

4.2.1 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 (Table 2). 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 developed EPDs for windows made of wood, aluminium and plastic [24] as well as for flat glass, in which sensible boundary conditions and procedures for all life cycle phases were defined.

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 and 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.

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.

4.2.2 Product-specific EPD

The creation of a product-specific, individual EPD is necessary, among other things, if there is no model 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 power plant, a particularly economical or electrical driven vehicle fleet or local raw material extraction, can represent increased resource efficiency.

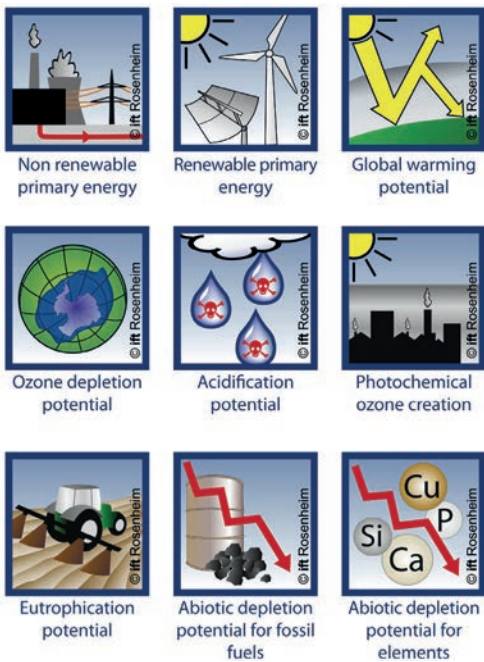


Fig. 19 9 core indicators of an EPD (Environmental Product Declaration)

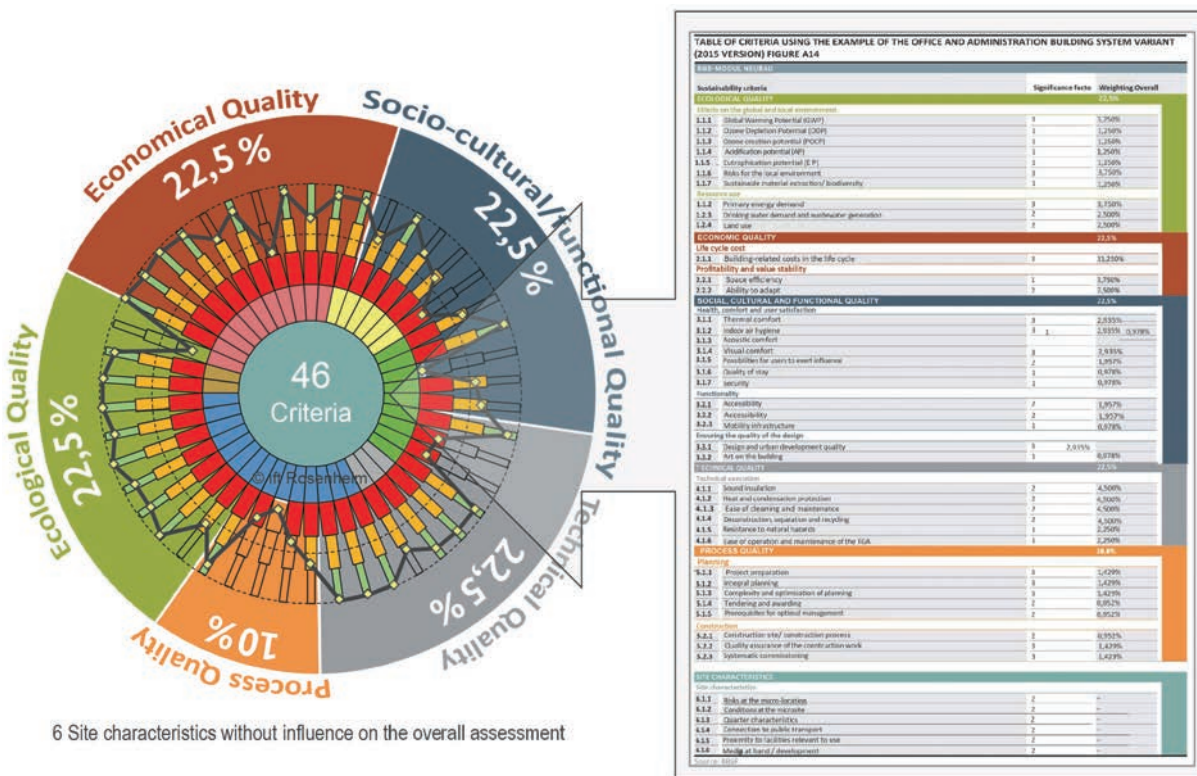


Fig. 20 Sustainable Building Rating System (BNB), Example of Office and Administration Buildings

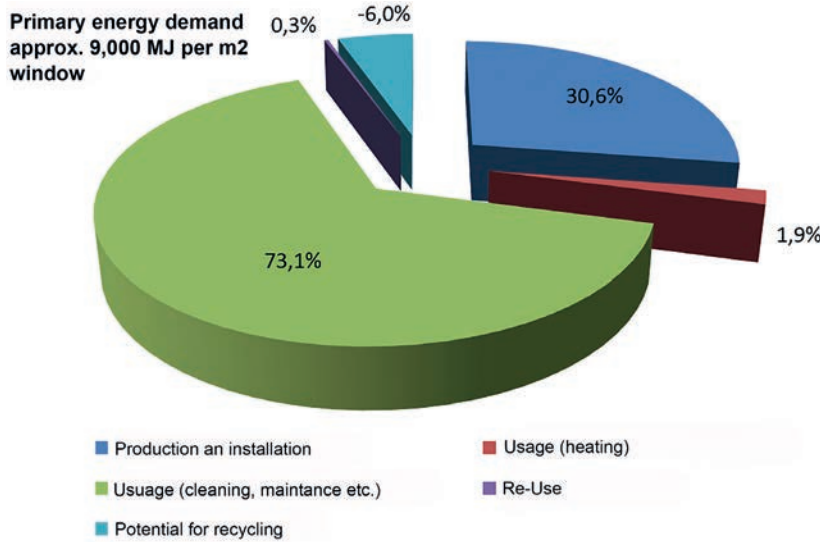


Fig. 21 Estimation of primary energy consumption per m² steel window (source: ift Rosenheim)



Fig. 22
ift-EPD logo

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.

4.3 Product passport sustainability

To make it easier for planners, builders and investors to evaluate sustainability-relevant criteria, ift Rosenheim has developed a 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, a management certification or CSR reports (Corporate Social Responsibility). As an accredited programme 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 and dates.

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.

4.4 CO₂ footprint

The CO₂ footprint (CO₂ balance or carbon footprint) represents the CO₂ emissions for products or services over a specific life cycle. It takes into account the resources and energy consumed in the production, use and disposal of a product or service. A CO₂ footprint can be calculated at the product level (Product Carbon Footprint) or at the companies level (Corporate Carbon Footprint).

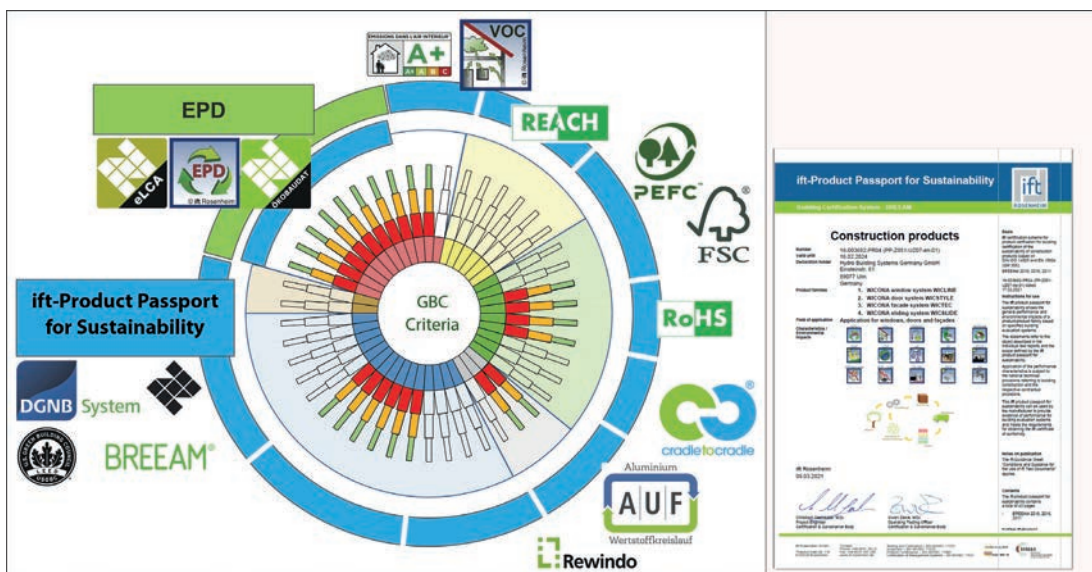
Since not only CO₂ contributes to anthropogenic climate change, but also other climate-relevant greenhouse gases such as methane (CH₄) or nitrous oxide (N₂O) are emitted, so-called CO₂ equivalents serve as a unit of measurement for the CO₂ footprint. These enable the comparison of different greenhouse gases on the basis of their impact on climate change over a defined period of time. The effect of one kilogram of CO₂ serves as the base value. According to the UBA, a kilogram of CH₄ is about 25 times more harmful to the climate than a kilogram of CO₂, and N₂O is almost 300 times more harmful.

4.4.1 Product Carbon 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 way according to DIN 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

Table 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

**Fig. 23** Information on the evaluation of sustainable criteria of different certification systems is clearly summarised in the ift Product Passport Sustainability

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 profound 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.

4.4.2 CO₂ for company assessment (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 CO₂ footprint for companies in the form of various standards. Standardisation has also taken up the issue 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 CO₂ 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 of activities in companies.

Table 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 m ² 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 m ² multi-pane insulating glass (2-fold)	24,41
1 year telephone and internet connection	89,60
1 m ² Roller shutter	90,78
1 m ² sliding gate	132,52
1 m ² Aluminium front door	144,93
1 m ² stainless steel window	365,54
1 m ² Fire door (T90)	954,05

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

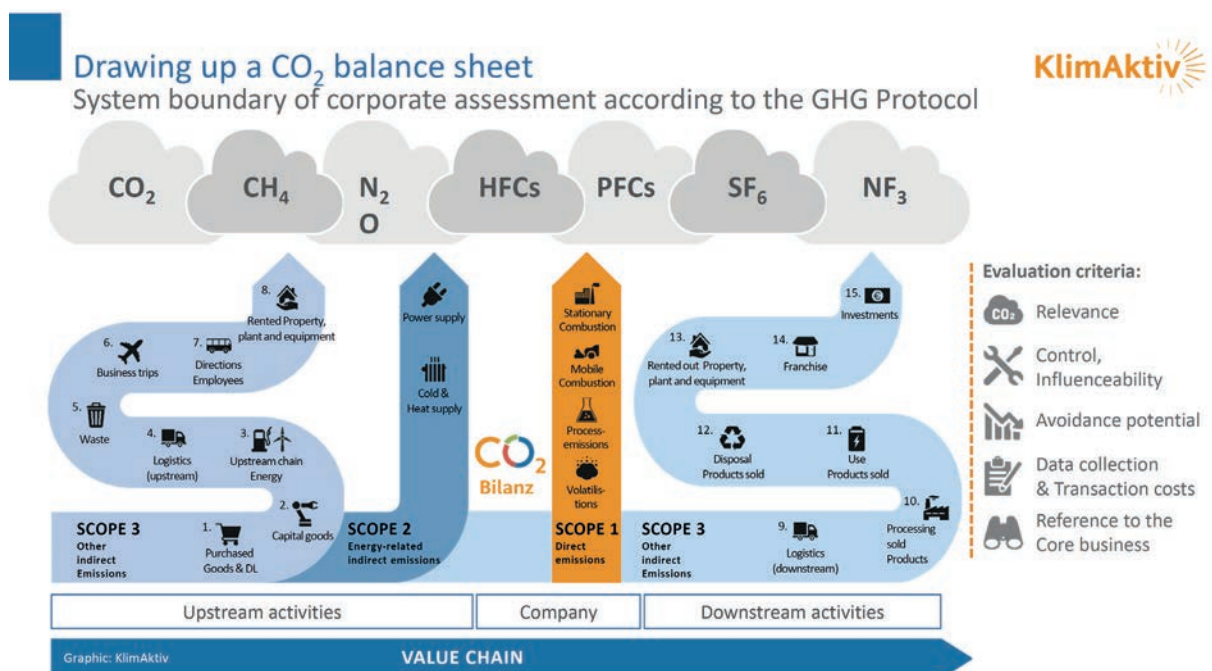


Fig. 24 Overview of scopes and emissions along the value chain (Source: KlimaAktiv)

5 Climate-safe construction with sustainable and climate-resilient building products



Climate change and its consequences call for consistent and holistic action to ensure that new buildings and energy modernisation are sustainable – that is, to reduce CO₂ emissions as much as possible and to effectively protect people and buildings against climate extremes. Future-proof and

climate-proof building products must therefore be energy-efficient, resilient to climate extremes and sustainable. However, the entire topic is very extensive and complex, and comprehensive building certification (DGNB, BNB, etc.) is often too time-consuming and cost-intensive for smaller buildings and the gradual modernisation of existing buildings. Nevertheless, building owners and planners naturally want or need to assess which building products and building elements are suitable for a climate-safe and sustainable building. An online survey [25] has shown that planners, manufacturers, retailers and builders consider a neutral assessment of sustainability, greenhouse gas (GHG) reductions and climate safety at product level to be necessary. For this reason, ift Rosenheim is developing suitable requirements and evaluation criteria in order to be able to make a reliable decision for the appropriate building products. In the

process, both the companies and the products are evaluated. It makes no sense to produce an energy-efficient and climate-safe product in an environmentally harmful way.

Building products are currently traded and placed on the market without reference to the building, so that labelling of building products with statements on sustainability and climate resilience is necessary. An appropriate assessment of building products must therefore meet requirements for both the product and the company in order to ensure or promote the most sustainable development of the entire value chain. The assessment includes the energy and resource consumption and the improvement of environmental impacts as well as the properties regarding the improvement of climate resilience of buildings – i.e. the resistance against floods, heat waves and storms. This assessment must be objective, transparent and easy to understand in order to enable a quick product selection and comparison. All properties/characteristics are condensed into a key figure to make it easy for planners, investors, manufacturers, the trade and end users (building owners). Important product features that are necessary for the individual planning and certification of a building must also be available. The assessment methodology is transparent and is carried out objectively on the basis of recognised standards and regulations (harmonised DIN, EN or ISO standards or generally recognised rules of technology).

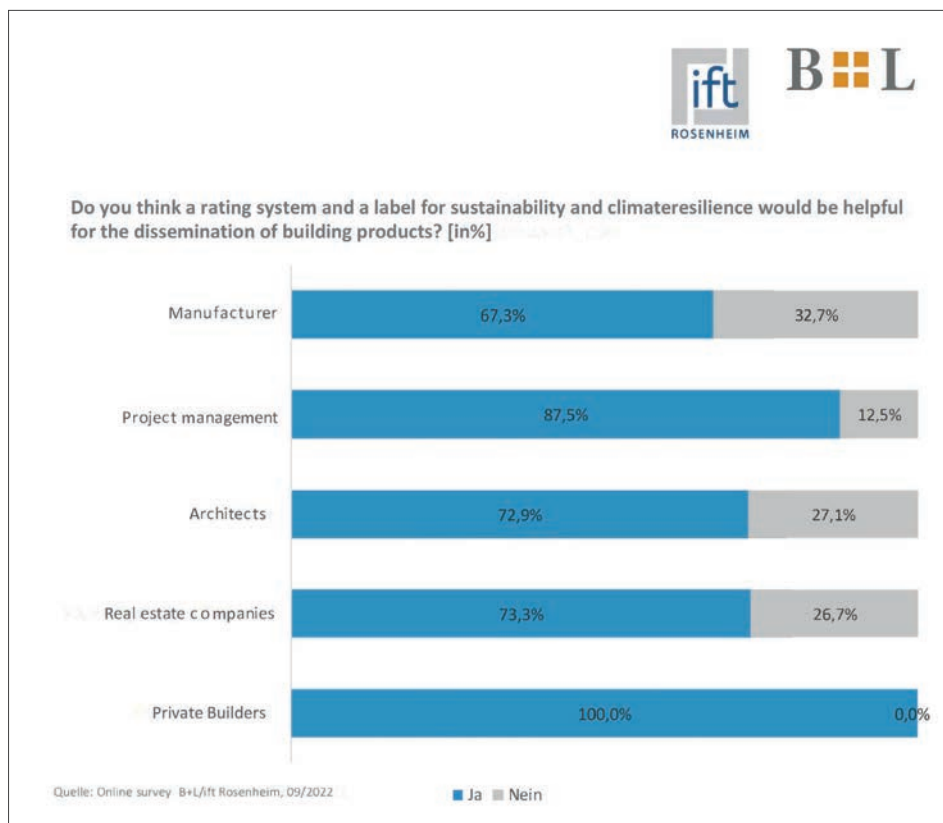


Fig. 25

Online survey shows the need for a simple assessment of building products in terms of sustainability and climate resilience

6 Conclusion

The dangerous consequences of climate change can only be stopped if we now achieve a rapid and consistent reduction of greenhouse gas emissions through appropriate measures. The necessary technologies are available and competitive at current energy prices. [15]. 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 professional product decision. For this reason, ift Rosenheim is developing guidelines and practical system

boundaries for the evaluation of sustainability, in order to enable a simple comparison of products. Therefore, the following aspects must be the focus for the development and successful distribution 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,

Table 4 Overview of relevant criteria for assessing the sustainability and climate resilience of building products and their manufacture

Criteria	
A	Rating of Product Energy efficiency, climate resilience, material use, service life/repairability, recycling, etc.
A1	Product Design Type and purpose of product (consumption, basic needs such as food/housing/culture, investment for/against reduction of environmental impacts)
A2	Product Features Product quality and assessment of technical properties regarding energy efficiency, climate resilience, GHG potential mitigation, durability, and recycling
A3	Product emissions utilisation phase Evidence for environmental impacts (EPD), air pollutants (VOC) or toxic substances (REACH)
A4	Materials/Resources Material content and reduction of substances of concern (toxins/REACH) or increase of positive materials (renewable raw materials, recycling/reuse)
A5	Mechanical durability Maintenance, cleaning, disposal
A6	Repairability Dismountability (screws instead of glue), availability of spare/wear parts, instructions, repair service, etc.
B	Rating of Companies Management, production, purchasing, employees, etc.
B1	Corporate philosophy and communication Description (internal/external) of sustainable behavior with goals, measures and controlling as well as awards/evidence or memberships in associations/institutions
B2	Control and management Sustainability as a decision criterion for material purchasing, equipment and evaluation of business partners (stakeholders)
B3	Certification Existence of guidelines/certification/management systems for sustainable working/management
B4	Energy consumption Documentation + measures to reduce all energy consumption and use of renewable energies (production, administration, distribution, travel, employees, etc.)
B5	Resources Documentation and measures to reduce all resources used (water, raw materials, packaging, operating materials, etc.)
B6	Emissions Documentation and measures to reduce all emissions (GHG, compliance with/exceedance of legal limits)



- Reusable (recyclable) materials as the basis for a circular economy,
- Sustainable processes, production methods and forms of enterprise.

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

7 Literature

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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 professional window builder, he completed a degree in wood technology and held leading positions at a system house, window and façade manufacturers, as well as 14 years at ift Rosenheim in the areas of research, testing, standardisation and certification. For the last six years, he was head of the "Building Envelope" department 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 Deputy Head of Inhouse, responsible for the ift Academy's Inhouse 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.



Christoph Seehauser, MSc.

MSc. has been at ift Rosenheim since 2018 and is responsible for sustainability certification, CO₂ footprints and environmental product declarations, among other things. Previously, he completed a degree in environmental, process and energy engineering at the Management Center Innsbruck. He worked at "Wasser Tirol" (a subsidiary of Tiroler Wasserkraft AG), among other things, as an advisor to the Tyrolean provincial government on energy issues/energy monitoring.

Product

Decentralised ventilation system LAD select EPP with heat recovery



Company

Aereco GmbH

Robert-Bosch-Straße 9
65719 Hofheim-Wallau, Germany

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info@aereco.de

www.aereco.de

Product description

With the decentralized ventilation LAD select EPP with heat recovery, an almost invisible intake opening on the facade is achieved thanks to well thought-out measures and the use of high-quality components. This ensures the best air quality for the living area with simultaneous heat recovery, without having to accept a visual impairment of the facade. Due to the possibility of flexible positioning of the core hole and numerous accessories, a wide variety of installation situations can be realized.

Apart from the outer grille in the window reveal, no component is visible on the outer facade. The EPP flat ducts are available in two designs (L-shape/standard shape). Both flat duct shapes are installed in the facade insulation. The strengths of the EPP flat duct lie in its simple and safe handling as well as the modular expansion option. In addition, the reveal channels are supplied with practical plaster protection covers as standard.



Product benefits

1. Demand-controlled ventilation:

Thanks to the combination of demand control and heat recovery, Aereco ventilation systems make it possible to achieve excellent energy efficiency.

Demand control, while ensuring permanent optimization of indoor air quality, allows to reduce the average air exchange rate. Heat recovery makes most of the energy contained in the exhaust air usable again to heat the supply air. This is not only easy on the purse, but also ensures the best possible living comfort.

2. Easy installation:

When using a shortenable EPP wall sleeve (DN 160 - Expanded Polypropylene), there is no need to drill an additional slope. This optional accessory for the LAD select series wall sleeve replaces a more complex core drilling



through the outer wall. The outer hood and inner screen are attached by screwing these components to the outer wall accordingly.

3. Inconspicuous integration:

Apart from the external grille in the window reveal, no component is visible on the external facade.

Product

energeto® neo – flush-mounted balcony door

Company

aluplast GmbH

Auf der Breit 2
76227 Karlsruhe, Germany

☎ +49 (0) 721 47171-0

✉ info.de@aluplast.net

www.aluplast.net



Product description

Clear structures, simple design and resource-efficient: this is what the new system platform energeto® neo – Design meets Sustainability by aluplast stands for. In developing the new system, the pvc profile manufacturer focused on resource conservation and CO₂ avoidance. Another important point was the reduction of complexity, i.e. the energeto neo portfolio is very slim. Fabricators thus have the possibility to build many different variants of windows and doors on one platform.

The new aludec/woodec colour concept, which is oriented towards modern wood/aluminium surfaces, and the proven aluplast technologies (bonding inside, safetec inside, Multifals and powerdur) round off the system. At the trade fair, aluplast will be showing a flush-mounted version of an energeto® neo balcony door in the colour Jet Black 1130 x 2280 mm.

Product benefits

Fabricator:

- Windows and doors can be built on one platform
- energeto neo has a 15 percent lower carbon footprint, compared to conventional, steel-reinforced windows
- energeto neo windows are bonded, so steel can be eliminated or minimised up to a certain size
- Installation: windows are lighter without steel
- Glued windows need to be readjusted less often, there is no need for aftercare, significantly less maintenance-intensive
- Adhesive technology: machine production possible

End customer:

- More environmentally friendly in production than other window systems.
- Sustainability: energeto® is 100% recyclable
- Timeless design: flush and recessed versions



- Durable surface: haptics and appearance are based on modern wood/aluminium surfaces
- Surfaces are particularly scratch-resistant, easy to clean and heat-resistant
- Long-term high operating comfort
- Optimum thermal insulation
- High burglar resistance

Product

athmer Technical Center (test laboratory)

Company

athmer oHG

Sophienhammer
59757 Arnsberg, Germany

+49 (0) 2932 477500

info@athmer.com

www.athmer.com

Product description

athmer has set up an ift-Lab together with the ift at its headquarters in Arnsberg, North Rhine-Westphalia. In this test laboratory, preliminary tests can be carried out by the testers from athmer's technical center, as well as building code tests by the ift test engineers. The lab is equipped with testing devices from ift Mess-Tec for testing sound, air-wind-water, continuous function, smoke protection and burglar resistance. "The ift Lab is a win-win situation because athmer and ift Rosenheim share the same quality and customer philosophy," explains Dr. Jochen Peichl, ift managing director.

With this cooperation, athmer and the ift are accommodating all companies from the region. For many ift customers, a visit to Rosenheim often means a two-day trip. The ift-Lab Arnsberg, on the other hand, is only a 50-minute drive from the ift West office base.

In contrast to the ift "in-house test" concept, there are no restrictions in the new lab with regard to requests from a wide variety of companies. "For us, the cooperation with ift Rosenheim is another important step towards more testing competence, customer service and the expansion of the international network," commented Holger Pertz, Managing Director of athmer, on the new development.



Product

Promotion of the disposal and recycling of construction components and profiles, such as aluminum windows, doors and facades for the purpose of reuse the materials in a closed recycling cycle



Company

A|U|F e.V.

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

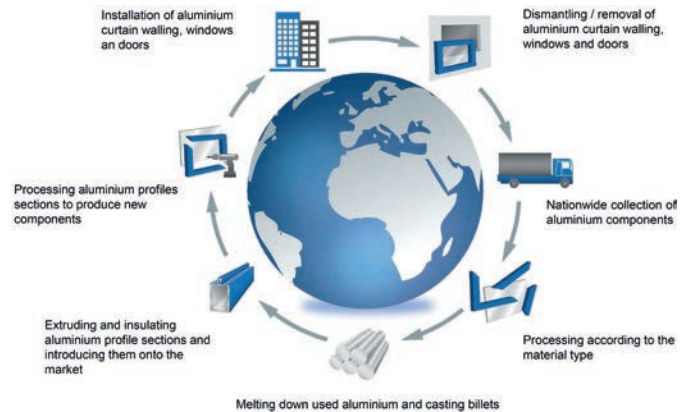
☎ +49 (0) 69 955 054-35

✉ info@a-u-f.com

www.a-u-f.com

Product description

The aim is, in cooperation with the A|U|F members, to achieve a closed recycling cycle in which the aluminum components processed by our members are completely withdrawn at the end of their life cycle via the circuit organized by A|U|F. The material remains within the European Community and its circulatory system; there is no export outside of Europe. From a dismantled aluminum window, door or facade part a new aluminum profile is created with only 5% of the needed energy for primary aluminum. This protects the environment, the population as well as the costs and contributes to the strengthening of the economic area of Europe. The A|U|F stands for sustainability and taken responsibility.



Product benefits

1. Our members receive a renewed certificate each year, to qualify for tenders.
2. Our members are part of an optimized closed loop recycling process and can offer it for windows, doors and facades in sustainable buildings.
3. Our members strengthen the European economic because the material remains within the European Community.
4. Our members work economically with their companies and ensure sustainable environmental protection.

Product

Testing + Certification

Company

BSI Assurance UK Limited

Kitemark House, Maylands Avenue
Hemel Hempstead, HP2 4SQ. UK

+44 (0) 345 086 9001

product.certification@bsigroup.com

www.bsigroup.com



Product description

Market Access

Whether exporting to global markets or importing into the UK, our dedicated team of fenestration professionals support your certification process from concept to completion. With in-depth regulatory knowledge and product expertise we can assist you every step of the way.

Our team of experts includes Certification Managers regional Business Development Managers, Client Managers and Customer Care Advisors, not to mention our Test Engineers. We take care to test your products and assess your factory production controls with accuracy, providing a premium service and certification you can build on.

Our current team holds over 205 years of certification and industry experience, with 161 years dedicated specifically to fenestration testing and certification. We are ideally equipped to work with you from the design stage through to the testing and compliance process, helping you to get your products into the desired



Product benefits

UKCA Marking

The UKCA (UK Conformity Assessment) mark is the new UK conformity mark that came into force for construction products, including windows and doorsets, that are placed on the market in Great Britain (England, Wales and Scotland) after BREXIT. It covers most products that previously required the CE marking and will become mandatory from 30 June 2025. As a UK Approved Body (0086) for UKCA marking we can provide this service, so contact us to find out more.

CE Marking

The Construction Products Regulation, via CE marking continues to be a visible declaration from the manufacturer or importer that the product meets the minimum

legal requirements for supply of construction products, including windows and doorsets placed on the market within the EU. We can offer CE marking services from our Netherlands (Notified Body No. 2797) Centre of Excellence.

The BSI Mark of Trust

Organizations who achieve third party certification (for their products or services) can display the BSI Mark of Trust on their products. BSI certification goes beyond the minimum requirements, and the Mark of Trust is unique to BSI. As a result, it is not only acknowledged by consumers but also accepted by specifiers, architects and procurement professionals as a method of demonstrating 'best in class' around the globe.

Product

eyrise® s350 liquid crystal glazing



Company

eyrise®

De Run 5432
5504 DE Veldhoven, Netherlands

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✉ eyrise@merckgroup.com

www.eyrise.com

Product description

eyrise® is a dynamic glass system based on liquid crystal technology. The glass instantly controls incoming thermal radiation and sunlight. This reduces energy consumption for building cooling and heating without the high maintenance requirements of external blinds or a complex façade structure.

eyrise® s350 glazing allows you to instantly adjust the quality of daylight to your individual needs while maintaining the view to the outside. It does so by switching smoothly and seamlessly between light and dark in one second. eyrise® is the only dynamic glass that responds instantly to user input via sensors or an app, for example

eyrise® s350 is color neutral. The natural colors of skin tones, food or artwork are preserved and not disturbed.

Available in sizes up to 3500 mm x 1600 mm, it fits any façade system and allows creative design of a unique architectural appearance.

Product benefits

Installing eyrise® in a building allows it to earn more points in the most used green building certifications. By doing so, we support society/people by providing uninterrupted access to daylight and outdoor views, and by increasing thermal and visual comfort so that people can work comfortably and undisturbed. On an economic level, eyrise® increases tenant income and building stock value, reduces maintenance costs and overhead, and creates local jobs by producing in Europe. Environmental benefits include reduced CO₂ emissions through less cooling, heating, and artificial lighting (reducing operational carbon emissions) and short delivery routes from factory to site.

Compared to alternative solutions such as blinds or fixed shading systems, we offer other benefits: continuous views to the outside and daylight, lower carbon footprint (reduc-



tion of embedded carbon), and less complex façade designs at similar lifecycle costs.

Thus, eyrise® helps companies achieve their ESG (sustainability) goals and creates a work environment that retains talent and promotes productivity.

So put all these benefits together and eyrise® is a sustainable and financially durable solution for corporate and investment real estate.

Product

IMB glass railing BG 015 mounted with Fix Max® fastening system BS 100 installed in the heroyal W 77 window system



Company

FeBaTec Fenster- und Bauelementetechnik GmbH

Theodor-Gietl-Str. 5
83026 Rosenheim, Germany

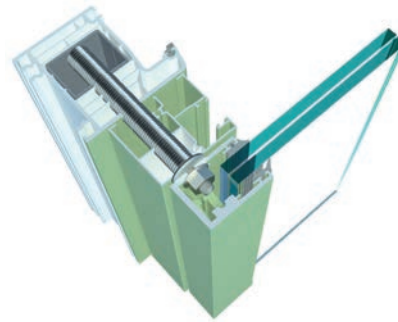
+49 (0) 8031 268043

info@febatec.com

www.febatec.com

Product description

- The Fix Max® fastening system can be used for the installation of guardrails on all commercially available window frame profiles. With a general building authority approval (abZ/aBG Z-14.4-88), the system meets the building authority requirements and thus guarantees action and planning security.
- The IMB glass railing BG015 for floor-to-ceiling windows with concealed fastening is mounted as a prefabricated element via suspension grabs and fastened in a concealed manner. Available from 300 mm glass height to 2500 mm glass width with general building authority test certificate according to DIN 18008-4. Also tested according to Ö-Norm.
- The W77 thermally broken aluminum window from heroyal achieves a U_f value of $0.95 \text{ W}/(\text{m}^2\text{K})$ at passive house level with a basic depth of 77 mm.
- heroyal Ready RS 41 SW (slim winding) is a prefabricated, slim winding prefabricated roller shutter from heroyal, suitable for particularly small roller shutter boxes and retrofitting.



Product benefits

1. Thanks to the innovative fastening method, the IMB glass railing can be installed quickly and easily as a ready-glazed complete system in conjunction with the approved Fix Max® fastening system. Assembly on site is therefore no longer necessary. Revision of the complete railing is possible at any time without damaging the window frame.
2. The Fix Max® fastening system is an efficient solution due to its easy handling during assembly and the low number of fasteners required. Pre-assembly at the factory also helps to avoid errors and complaints. The requirements of the ETB guideline are met by every fastening point of the Fix Max® fastening systems. All systems have been approved by the building authorities precisely for this application. In addition, use with frame overhang is possible, e.g. for a design with roller shutter guide rails or other special designs.
3. Due to the combination of geometry and material, the heroyal W 77 window system achieves a U_f -value of $0.95 \text{ W}/(\text{m}^2\text{K})$ with a construction depth of only 77 mm. In the long term, the thermally broken aluminum window is designed not only to meet the requirements of today, but also the demands of tomorrow.
4. The heroyal Ready RS 41 SW front-mounted roller shutter is installed in front of the window and is suitable for retrofitting. The particularly narrow winding roller shutter slats allow correspondingly small box sizes.

Product

Slide-in installation

Company

Finstral AG

Gastererweg 1
39054 Unterinn/Ritten (BZ), Italy

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finstral@finstral.com

www.finstral.com

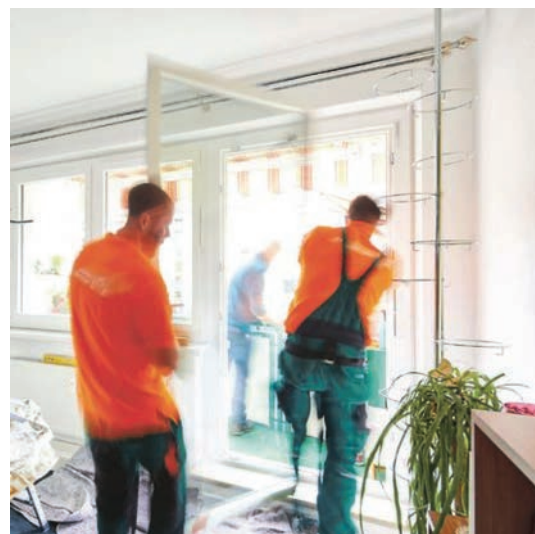
Product description

High-quality window refurbishment in just 30 minutes.

Slide-in assembly simplifies the replacement of PVC or aluminium windows in buildings dating from the 1970s, 80s and 90s without any noise, dirt, scaffolding or evacuation of tenants - and with an ift-approved structural joint and unlimited design options for the new windows, as the Nova-line sashes with or without Venetian blinds between the panes are suitable for the slide-in installation technique.

Product benefits

1. Ideal solution for refurbishing PVC and aluminium windows from the 1970s, 80s and 90s
2. Quick: windows can be replaced in as little as 30 minutes per window
3. Clean and quiet: no construction site needed and hardly any noise produced as only drilling is necessary
4. Resource-saving: structural joint and old window frame remain in place
5. Attractive: the view outside is preserved while the inside gets a new look
6. Uncomplicated: only one specialist is required, windows can be replaced during business hours
7. Perfectly easy to plan: low coordination effort required, few unforeseen expenses, costs easy to calculate





Product

Sustainable, turnkey and cost-effective residential buildings

Company

GROPYUS AG

Barichgasse 38/2/4
1030 vienna, Austria

+49 (0) 30 700101201

development@gropyus.com

www.gropyus.com/de



Product description

GROPYUS creates sustainable and affordable living. The complete digitalisation of the entire scalable value chain – from planning to automated production to operation – enables affordable and sustainable living. GROPYUS modernizes and transforms the housing market and thus establishes living as a service-oriented product ("Living as a Service").

GROPYUS thinks and delivers buildings as turnkey products that are continuously improved over time. GROPYUS focuses on people and their needs. Affordability, sustainability, and inclusion are combined with high standards of design, comfort and functionality.

The life cycle optimized buildings are standard compliant (ESG a. 8 & 9 / KfW / BEG 40 eligible) and equipped with its in-house developed Building Operating System (BOS). It gives a complete overview and control over the life cycle of the building – with extreme granularity.

Product benefits

1. GROPYUS takes a holistic approach and delivers buildings as turnkey products for sustainable, affordable and smart living. According to the principles of "universal design", living spaces are created for people with a wide range of backgrounds – barrier-free and adaptable to wishes and requirements.
2. GROPYUS uses sustainable materials such as PEFC certified wood. The use of resource-saving and healthy materials has a positive effect on the eco-balance of the building and the health of residents.
3. The digital end-to-end integration along the entire value chain – from planning to production to the operation of the building – ensures efficiency.
4. The digitalization of the value chain enables GROPYUS to know every part of the product across the whole life-cycle of the building. Digitized resource documentation offers transparency that has a positive impact on the



5. circularity and also on climate and costs. The buildings are climate positive in operation.
5. Optimized production, development and technology processes such as automated manufacturing and modular elements allow GROPYUS to scale quickly on an industrial level. This guarantees a product that is affordable without compromising on the quality of the building.
6. The proprietary Building Operating System (BOS) gives GROPYUS full control over the life cycle of the building. It enables an efficient operation of the building for asset managers and it is the basis for a truly connected smart home for tenants.

Product

Front door blank type Öko Passiv 78 mm with integrated cable duct



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 is optimal with a door thickness of 78, 88 and 98 mm. 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. Thus 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 cabling of the motor lock, fingerprint, control units, cable transitions, etc.

Between 73 mm and 108 mm, we can manufacture the Öko Passive blank in any door leaf thickness you need. The center layer depends on the technical requirements regarding thermal insulation or sound insulation.



Product benefits

1. Integrated cable duct
2. Climatic 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

Joint permeability, driving rain, wind load test rig for determining air permeability, water tightness and wind load resistance on exterior building components



Company

ift MessTec GmbH

Theodor-Gietl-Str. 7-9
83026 Rosenheim, Germany

+49 (0) 8031 261 2550

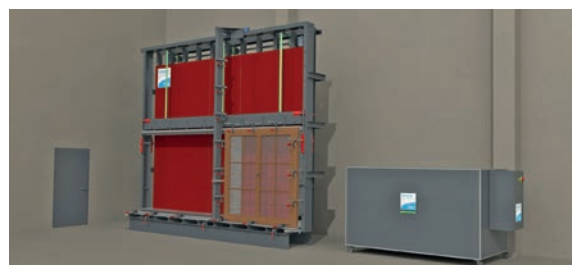
info@ift-messtec.de

www.ift-messtec.de

Product description

The LWW test rigs consist of a test wall for tight clamping of the test specimens. Test chambers can be constructed in any size from a small window to a large gate or facade. The standard chamber depth of 400 mm can be increased and designed with access at the customer's request. Depending on the national or international test standard, spray rows or spray grids with different spray nozzles are installed in the test chamber. A suitable measuring and supply unit is connected to the test wall. These are available in various sizes and designs. With the comprehensive ift MessTec testing software, the tests can be carried out very easily and conveniently. Documentation by means of a standard-compliant test protocol is also possible.

Depending on the application, we offer factory calibrations for development tests or factory production control or so-called DAkkS calibrations for official tests with accredited and/or notified testing bodies. We can offer the measurands pressure, air and water flow, displacement and temperature measurement in the accredited area with DAkkS calibration protocol.



Product benefits

1. Fast assembly and tight clamping with quick clamping system
2. Comprehensive and comfortable software with manual, semi-automatic or fully automatic test control
3. Low-cost versions for development tests or factory production control WPK
4. Standard-compliant design and outstanding measuring accuracy for official tests
5. Extensive accessories:
 - Measurement of operating forces with HMG 400 (force or torque)
 - Load with racking and torsion
 - Load with temperature, humidity, formwork rain in the cycle
 - Testing devices for facades
 - Dynamic wind load devices
6. Independent calibration by ift Rosenheim

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 CO₂ emissions



Company

ift Rosenheim

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✉ info@ift-rosenheim.de

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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

Holistic technical support

Company

ift Rosenheim ConTec GmbH

Theodor-Gietl-Str. 9
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www.ift-contec.de



Product description

Range of services:

- Support with national and EU approval procedures (e.g. ETA, abZ, etc.)
- Support in the preparation, implementation or adaptation of factory production control based on national or European regulations
- Standards research with direct access to standards relevant to the industry
- Individual training concepts on technical/organizational tasks in the window, facade and building products industry
- Assessment and optimization of wall connections and concepts for freedom from barriers, monument protection and fire protection

Product benefits

1. **Holistic Support:** ift Rosenheim ConTec GmbH sees itself as a full-service provider for technical services in the component industry and accompanies you throughout the entire process of your projects - e.g. for approvals or new developments. The holistic support during all stages of a project can lead to faster time-to-market for new developments as well as better cooperation with official bodies
2. **Industry Expertise:** Our employees are experts in the components industry and have extensive technical experience. This is how we warranty discussions at eye level with engineers and technicians. You also benefit from our expertise in the introduction of sustainability measures, so that we can address your company-specific requirements in a targeted manner. This distinguishes us from other consulting companies on the market that are not focused on the components industry.
3. **Bureaucracy Reduction:** A short time-to-market is crucial in the development of new products. Our ex-



perience and expertise help to reduce bureaucracy and handle methods faster and more efficiently: Approval procedures or new developments require cooperation with official bodies or authorities. Unfortunately, this is often a lengthy process that claims a lot of time and resources. Thanks to our experience, we know exactly how to make methods less complicated, faster and less bureaucratic. In this way, we minimize problems with official bodies such as DIBt, can clearly define deadlines and timelines, and optimize processes. We also bring our expertise to bear in areas that are not covered by standards.

Product

blaugelb Triotherm⁺ assembly frame “in Advance”



Company

Meeseburg Großhandel KG

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24944 Flensburg, Germany

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

Product description

The highly insulating, ductile profile bodies of the blaugelb Triotherm⁺ 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 façade before concluding the construction project in accordance with the construction schedule. They cannot be damaged by other trades.

The geometry of the blaugelb Triotherm⁺ 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 Triotherm⁺ 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 Triotherm⁺ 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

Fire protection – sectional door with liquid barrier



Company

Metacon-Next

Zuidbaan 450
2841 MD Moordrecht, Netherlands

+31 (0) 182 510777

info@metacon-next.com

www.metacon-next.com

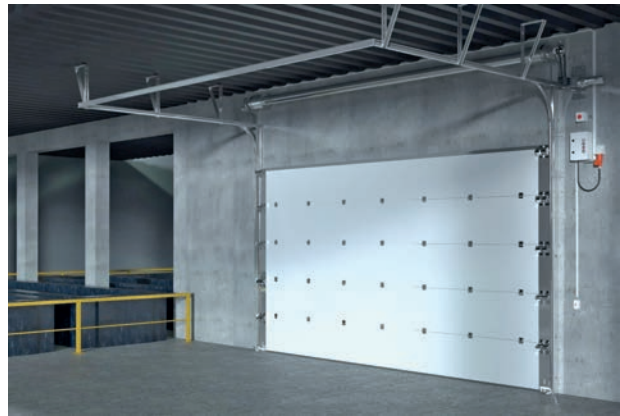
Product description

Combined fire protection – sectional door, including liquid barrier, tested on both sides up to 300 mm height and approved up to 500 mm for indoor use. Application for indoor and outdoor use possible. For outdoor use an approval must be applied for in individual cases.

All our products are tested according to the latest regulations of the European Union classified and marked accordingly. A leading product, which we manufacture for you on request to measure. Through individual installation options and a wide product portfolio, we also have a suitable solution for you. Thus, even construction projects with limited space can be realized. We manufacture the gate systems up to a maximum width of 5200 mm and a maximum height of 6967 mm. We will be glad to support you with our technicians.

Product benefits

1. 50 000 load cycles according to C3
2. Service life up to 120 minutes
3. Running speed up to 0.6 m sec.
4. Liquid barrier
5. Wind load 5 is possible
6. Burglary protection class RC 3
7. Smoke tight SA according to EN 1634-3
8. Wicket door centered possible
9. Approved for mounting on aerated concrete, concrete and fire-resistant steel structures



Product

Testing + Certification

Company

National Fenestration Rating Council (NFRC)

6305 Ivy Lane #410
Greenbelt, MD. 20770, USA

+1 301 589 1776

therron@nfr.org / danderson@nfr.org

www.nfrcommunity.org



Product description

National Fenestration Rating Council (NFRC) puts windows, doors, skylight, applied films through rigorous performance testing with our accredited laboratories and Inspection Agencies to provide fair, credible and accurate ratings so the public via a label can make a well-informed purchase decision.

The purchasing decisions are made helpful through NFRC's Efficient Window Collaborative Selection Tool. This searchable database helps you find energy-efficient options suited to your home and climate. You can find the link to the EWC database at the following URL:
<https://efficientwindows.org/window-selection-tool/>

You'll also find unbiased information from the NFRC on the technologies behind energy-efficient windows, and the benefits they offer.



**Largest independent
third-party rating and labeling
system for the energy
performance of windows,
doors, and skylights in the U.S.**

Product benefits

1. Helps ensure windows, doors, and skylights meet building codes.
2. Helps consumers compare windows, doors, and skylights so they can make a well-informed purchase decision.
3. Contributes to healthier and more energy-efficient buildings.
4. Our ratings accelerate sustainability in the built environment.

Product

ECOFUSION – balcony door (76 mm)



Company

OKNOPLAST Sp. Z o.o

Ochmanów 117
32-003 Ochmanów, Poland

+49 (0) 5451 545837-70

info@oknoplast.de

www.oknoplast.de

Product description

Balcony door in RAL A quality and exclusive OKNOPLAST design. ECOFUSION system (76 mm) for new buildings and renovation:

- Structurally reinforced profile with heat-reflecting foil on the outside to reduce thermal deformations.
- Integrated ventilation system (PAD fitting)
- controllable solar shading
- Glazing with titanium dioxide nanocoating (TiO₂), reduces harmful compounds in the air

Photocatalysis is the degradation of harmful organic & inorganic compounds under the influence of light. The basic component of photocatalytic coating is titanium dioxide (TiO₂), which is activated by UV radiation when deposited on the surface of a solid. TiO₂ converts the absorbed light energy into chemical energy, triggering the decomposition reaction of pollutants. These include formaldehyde, bacteria, viruses and other volatile organic compounds. Photocatalysis causes harmful compounds to decompose into completely neutral products.



Product benefits

1. 76 mm system suitable for new construction and renovation
2. Exclusive OKNOPLAST profile in joint development with VEKA
3. Up to 10 years OKNOPLAST warranty
4. Eligible for governmental BAFA subsidies for energy renovations
5. Reduction of thermal deformation due to heat-reflecting foil coating on the outside
6. Efficient ventilation through PAD fitting "effiAIR" (parallel opening)
7. Reduction of harmful organic and inorganic compounds in the air by titanium dioxide coating of the glazing
8. Self-cleaning glass
9. Controllable sun protection

Product

Nationwide recycling system for plastic windows, roller shutters and doors

Company

Rewindo GmbH Fenster-Recycling-Service

Am Hofgarten 1-2
53113 Bonn, Germany

+49 (0) 228 291283-0

info@rewindo.de

www.rewindo.de

Product description

Rewindo GmbH – Fenster-Recycling-Service, Bonn, which turned 20 in the summer of 2022, is the nationwide recycling Scheme of the leading German plastic window profile manufacturers. In addition to the nationwide collection system, the acquisition of further recycling and logistics partners, the establishment of more than 70 collection points and the establishment of a network along the value chain of PVC windows as supporters of Rewindo could be realized. Rewindo sees the window construction industry, demolition companies, private and public builders as well as the waste management industry as key target groups.





Product

WINISO®, **WINSLT®**, **GLASGLOBAL®**,
WINTHS



Company

Sommer Informatik GmbH

Sepp-Heindl-Straße 5
83026 Rosenheim, Germany

☎ +49 (0) 8031 24881

✉ vertrieb@sommer-informatik.de

www.sommer-informatik.com

Product description

WINISO® – U_f , Ψ , heat flows, isotherms, fR_{si} , 3D

Calculation of heat flows, thermal bridges, isotherms, U_f and Ψ values according to EN ISO 10077-2 as well as U_{fr} , U_{eg} and U_{cg} values according to ISO 15099 / NFRC 100 and 3D thermal bridge calculation.

WINSLT® – U_g , g , g_{tot} CE marking

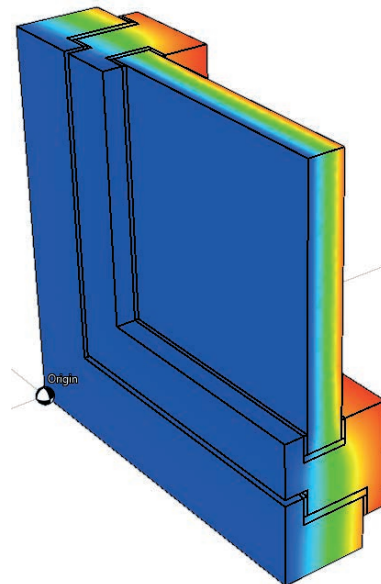
Calculation of photometric, solar and thermal parameters of glazing in combination with solar control. Declaration of performance and CE marking for each glazing.

GLASGLOBAL® – Glass statics according to DIN 18008 part 1-6

Powerful calculation machine with FEM part 1 / 2 horizontal and vertical glazing, 3 point fixing, 4 fall protection, 5 accessibility, 6 walkability, ASTM E1300-16, Switzerland SIA 2057, AGSB ÖNORM B 3716 and EN 16612.

WINTHS – Thermal Stress

Calculation of thermal stresses in glass panes due to solar radiation and partial shading during the day and year with real climate data.



Product benefits

1. Certified by independent testing institutes
2. Intuitive operation
3. Quick and easy processing
4. Internationally recognised results
5. Extensive product database
6. Graphic evaluation with false colours
7. Quality assured

Product

Testing + Certification

Company

UL Solutions

Am Oberfeld 19
83026 Rosenheim, Germany

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✉ EU.BuildingLifeSafety@ul.com

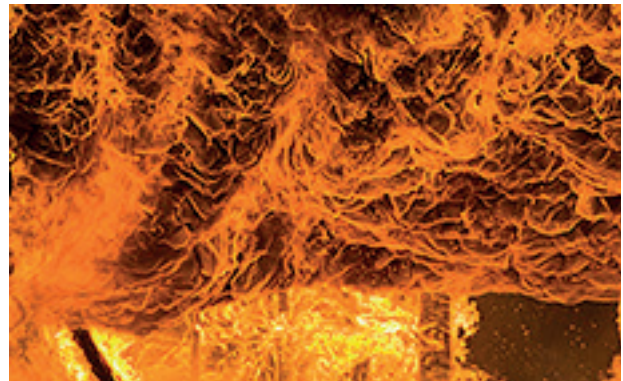
www.ul.com/fire



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.



Product

Trade association of the window and door industry

Company

Verband Fenster + Fassade (VFF)

Walter-Kolb-Straße 1
60594 Frankfurt, Germany

+49 (0) 69 955054 0
vff@window.de
www.window.de

Product description

The VFF is the publisher of more than 53 leaflets on all current technical topics of the window and facade industry. You can find the overview here: www.vff-wissen.de

The quality association is the publisher of the guidelines for the installation of windows and front doors as well as curtain walling. You can find the overview here: www.montage-wissen.de

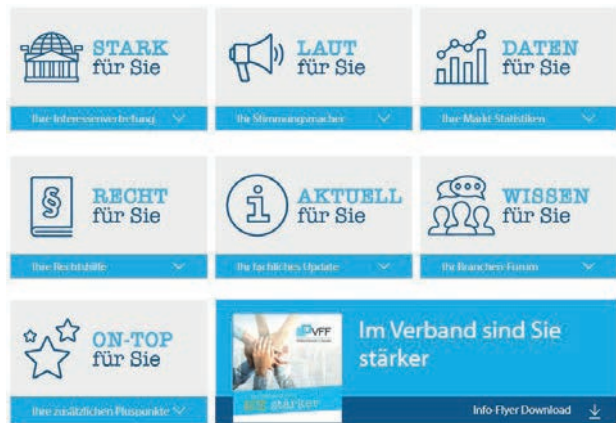
The new knowledge transfer of the Mekkblätter in the context of the blended learning is trend-setting developed. You find the overview to the offer here: www.vff-blended-learning.de

An overview of the many topics of the VFF and the current events can be found here: www.window.de

Product benefits

The leaflets of the Window+Facade Association available at www.vff-shop.de

The guidelines for the installation of windows and front doors as well as curtain walling as a book, digital or as a bundle (book+digital) can be obtained at: www.guete-shop.de



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