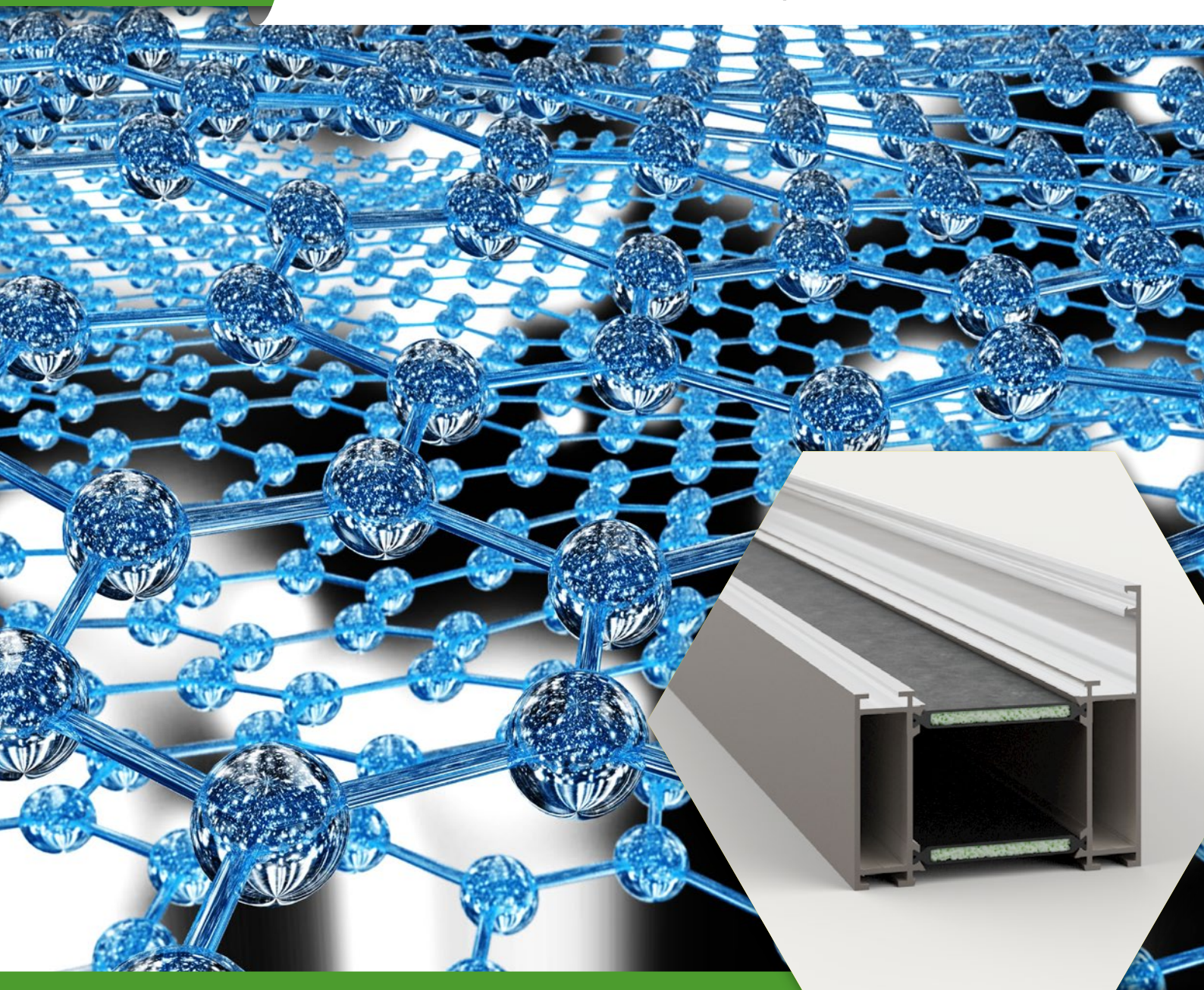


# *hochuli advanced*

Composite Extrusion



## The ALPET® insulating bar

Made from recycled PET bottles at the core

- Sustainable insulation profiles for window, door and facade construction (aluminium, wood-metal, plastic)
- POWER with lowest thermal conductivity
- Ecologically sustainable made of PET
- Retrofittable for all profiles

*engineering*  
by **hochuli + Empa**

## Hochuli Advanced AG - Progress thanks to technology

Hochuli Advanced AG is a spin-off of Hochuli Metallbau AG. Our specialists develop advanced, novel high-performance composites for the window, door, and facade industry as well as structural profiles for lightweight construction. The possibilities are unlimited. Together with your specialists we design custom-fit solutions for individual applications.



## We contribute to progress

Our insulation solution is made of 100% recycled old drink bottles.



## The power bar for your windows - the ALPET® insulation bar

Insulation bars are inserted inside aluminium, wood-metal and PVC windows or facade glazing - as thermal separators between the outside and inside, because otherwise heat would flow uncontrolled through the profile. The insulating bar becomes even more important with the need to reduce CO<sub>2</sub> emissions.

Our ALPET® insulating bar is revolutionising the market. The highlight of this development: Inside the glass fibre reinforced plastic is a foam core made of recycled PET bottles. The many air pores in this layer insulate efficiently: the thermal conductivity is far lower than with a standard insulating bar made of conventional materials and significantly lower than that of common high-end products.

## From old to new: "Upcycling" of PET bottles

The ALPET® foam core is made from used PET bottles - with up to 3x lower thermal conductivity values!

In close cooperation with scientists from the Swiss Federal Laboratories for Materials Science and Technology (Empa), we at Hochuli Advanced AG developed the innovative ALPET® insulating core. Innosuisse also supported this project.

As a composition with the aluminium, the ALPET® insulating web withstands wet paint, anodising and powder coating processes up to 200°C. The service life of the new material was scientifically tested and extrapolated over decades (stepped isostress tests).



# Innovative applications

The ALPET® insulation bar for high-end windows is a radical innovation. ALPET® offers much lower thermal conductivity compared to conventional plastic bars while meeting all thermo-mechanical requirements. In terms of price, conventional and ALPET® bars are comparable.

The changeover to ALPET® takes place without any restrictions, the cross-section can be designed differently. The choice of the standardised roll-in head also allows the existing roll-in process to be retained. The aluminium window frame profiles are produced with the existing process.

The profiles can be processed with the existing wood or metal construction tools. Fittings etc. can be screwed directly into our ALPET® profile.

ALPET® is resistant to a wide range of chemicals, cleaning, and processing agents. Therefore, the material is ideal for powder coating or anodising.

The requirements of the most common industrial standards were easily met and, in most cases, exceeded. Hochuli Advanced AG therefore went one step further. Extended scientific tests were carried out and types of failure not shown in the common standards were investigated and documented.



Fig. 3: ALPET® cavity filled. No insulating inserts must be installed, which means that work steps can be saved. Different profile widths can be realised with the same ALPET®.

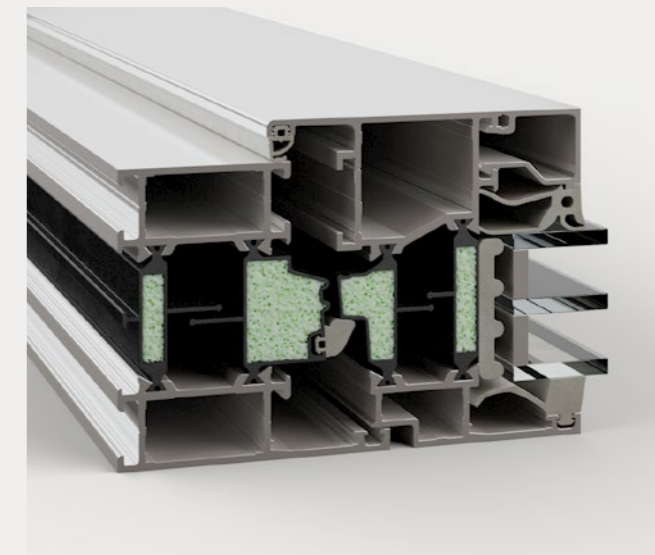


Fig. 4: ALPET® without classic vulcanised centre seal, thus faster and therefore cheaper production. Possibility of very individual cross-section.

## Use of ALPET® in the aluminium window profile independent of the installation parts



Fig. 1: Standard window without ALPET®

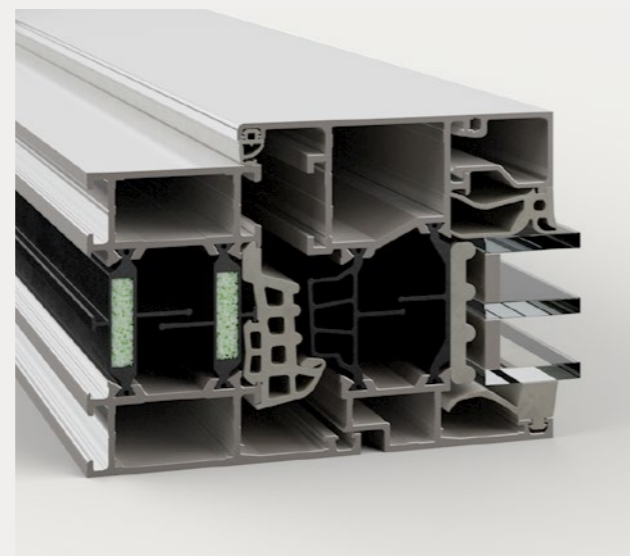


Fig. 2: ALPET® with a flag and T. The flag divides the cavity and reduces air convection, which leads to energy savings and lower heating costs.

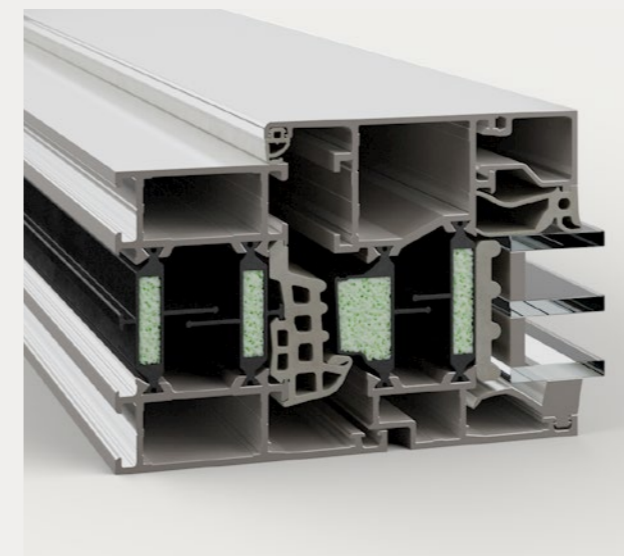


Fig. 5: ALPET® with classic vulcanised centre seal. This means that existing insulation bars can be replaced without any problems. With improved U-value.

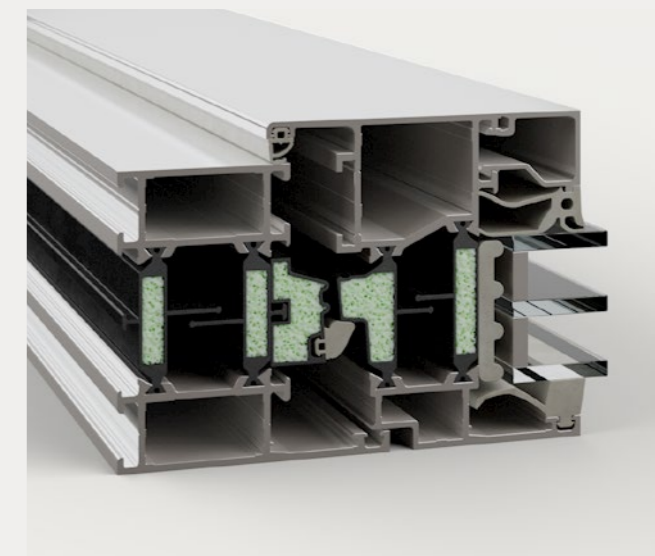


Fig. 6: ALPET® with flag, T and top profile without classic vulcanised centre seal.



# Innovative applications

**hochuli advanced**  
Composite Extrusion

Use of ALPET® in the aluminium integral window with large installation depth

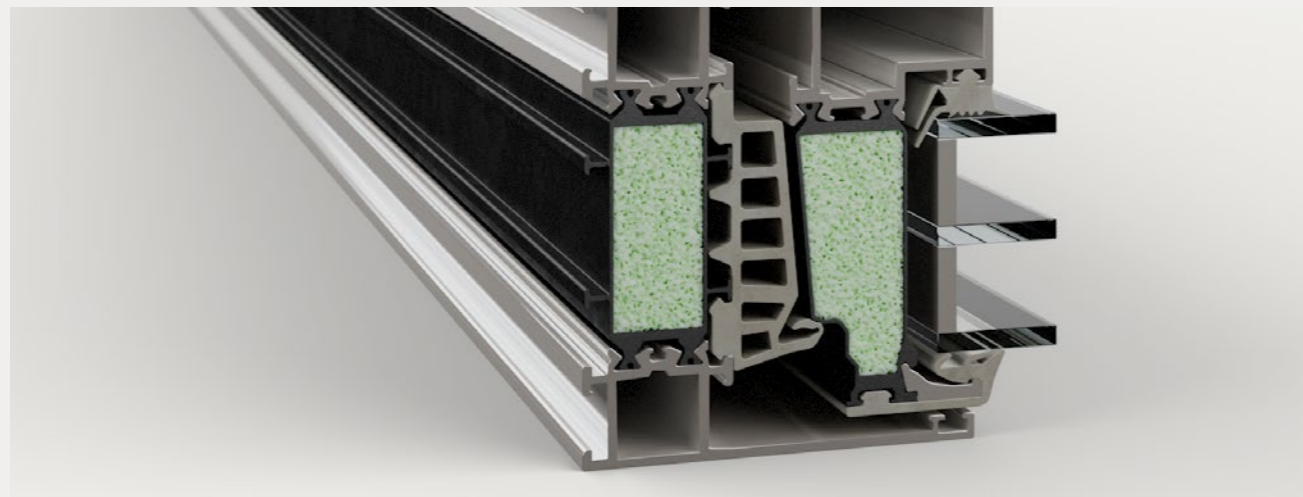


Fig. 7: ALPET® filled with double dovetail / cavity, resulting in uniform thermal conductivity.

Use of ALPET® in the exchangeable profile

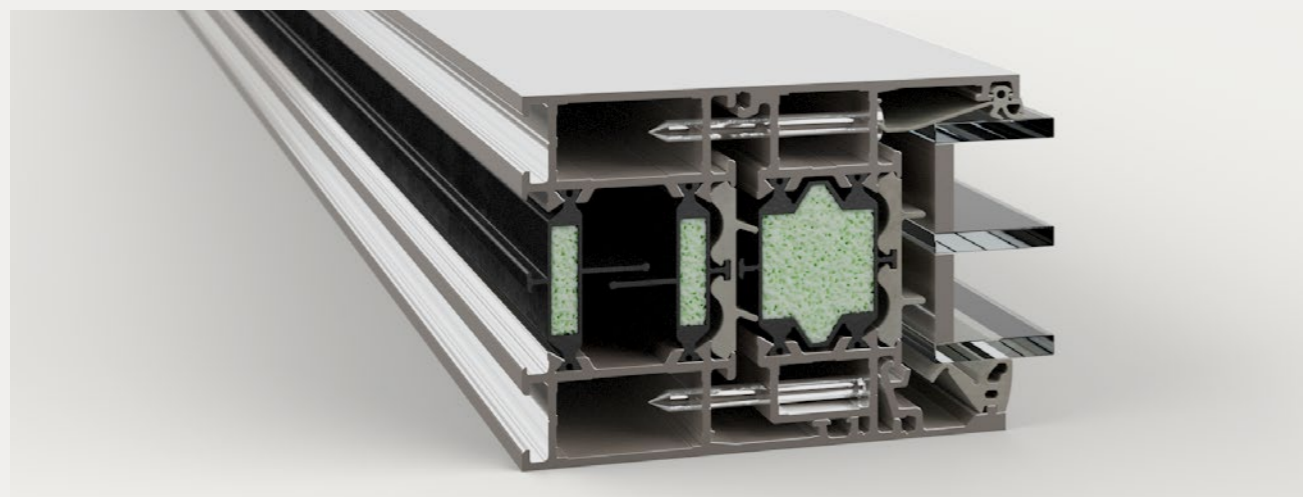


Fig. 8: ALPET® with T and double dovetail / cavity filled. This can improve the U-value when using the interchangeable profile.

Use of ALPET® in the aluminium window profile with reduced outer or inner shell

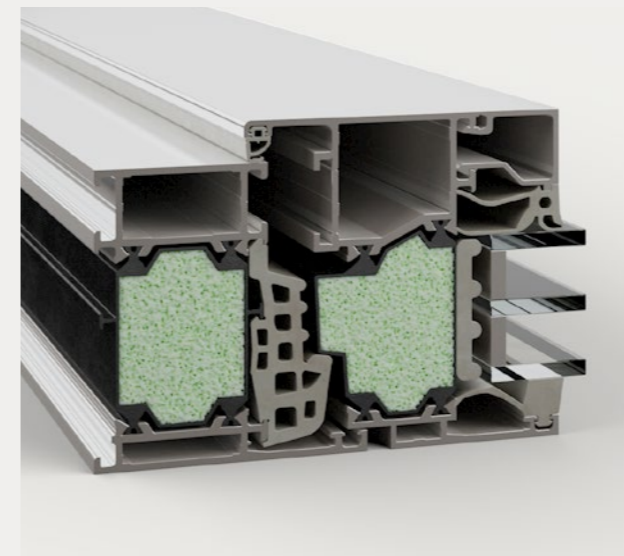


Fig. 9: ALPET® filled with T and double dovetail / cavity. The aluminium content has been reduced and thus energy can be saved.

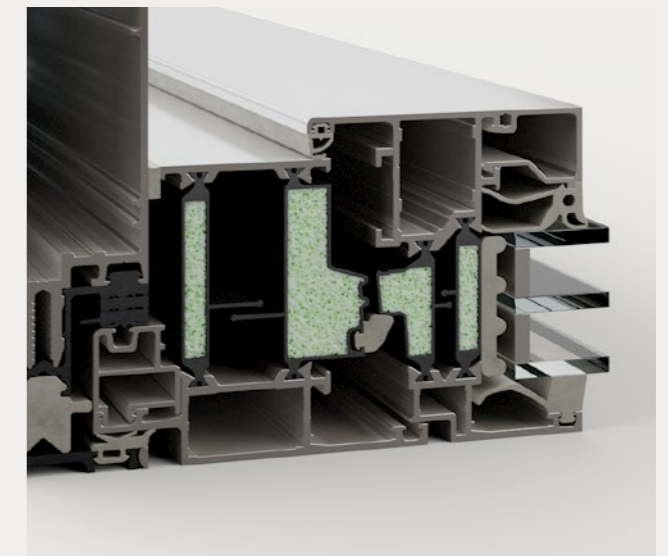


Fig. 10: ALPET® for insert windows with flag / without vulcanised centre seal. The aluminium content of the inner chamber has been reduced to a minimum.

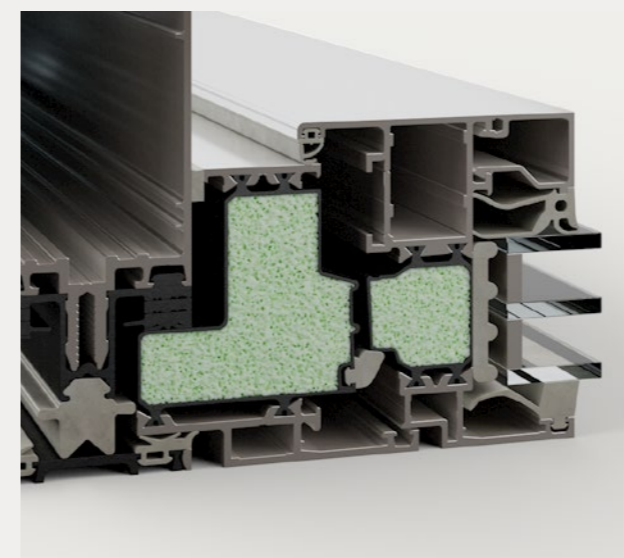


Fig. 11: ALPET® for insert windows with double dovetail / without vulcanised centre seal. The aluminium content of the inner chamber has been reduced to a minimum. Without additional clamping profile. Fewer components are required and at the same time energy loss is minimised.

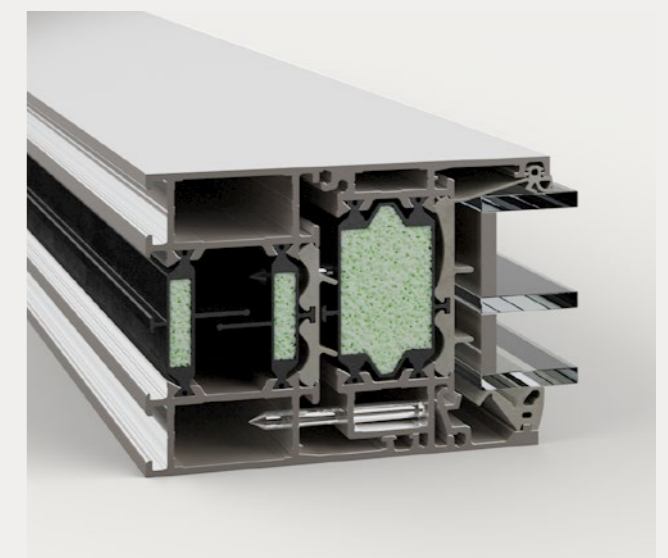


Fig. 12: ALPET® for exchangeable profile with T and double dovetail / cavity filled. The aluminium content of the inner chamber was reduced to a minimum.



## Frame widening with composite profile and very good insulation value

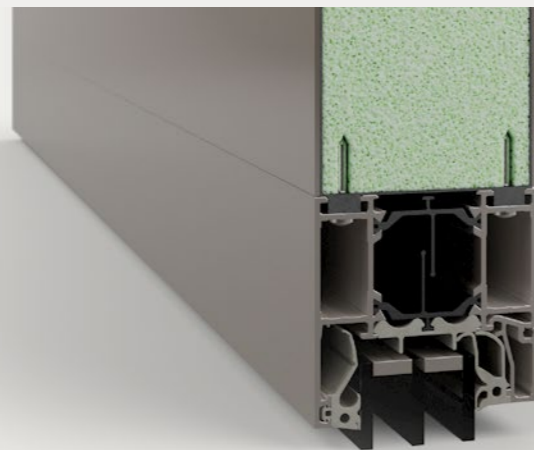


Fig. 13: Frame widenings adapted to the geometry of the profiles with a U-value of 0.60 W/m<sup>2</sup>K at a thickness of 70 mm.

Thanks to the composite construction, a flexible cross-section can be practically implemented. The new profile geometries allow the reduction of aluminium (improved thermal insulation).

Thanks to the enlarged cross-sections, our customers can carry out bonding and sealing on windows and sash frames in a more controlled manner and thus achieve a new, better final quality.

The hollow chambers of the profiles are filled with the ALPET® insulating bar. The use of inserts becomes unnecessary. Quality assurance is increased, work steps are eliminated and thus production costs are also reduced.

New geometries reinterpret the classic, vulcanised centre seal. This is replaced by an EPDM seal, sold by the metre. The delivery time is reduced, and the production costs decrease.

The lambda values of the materials are clearly specified, and the U<sub>f</sub>-calculations can be carried out uniformly using the radiosity method.

The new ALPET® insulating bar revolutionises the market and opens new possibilities:

- New profile systems
- Greater choice for object profiles
- Profile extensions with very good insulation values
- Interchangeable profiles with better insulation values
- Insert profiles with lower aluminium content

## Use of ALPET® in wood-metal windows

The ALPET® insulating web can also be used with this system to improve the insulation values.



Fig. 14: ALPET® wood-metal windows. ALPET® can also improve the U-value of wood-metal constructions.

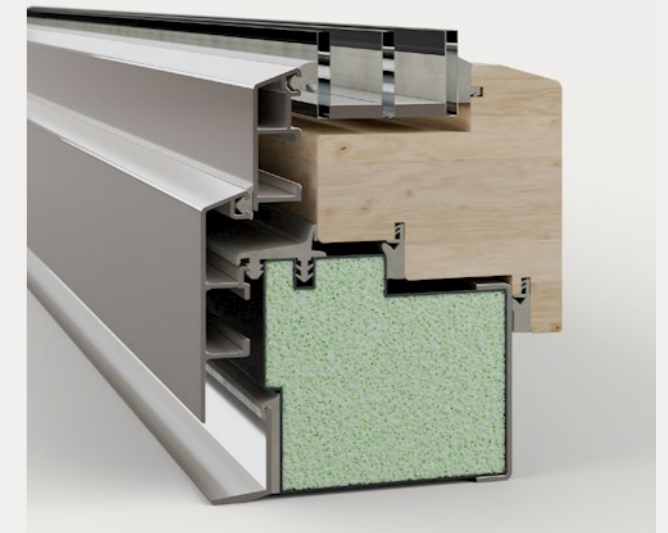


Fig. 15: Wood-metal window. Bottom profile made of ALPET®. It is rot-resistant and at the same time offers improved insulation.

## Use of ALPET® in the PVC window as a static insertion

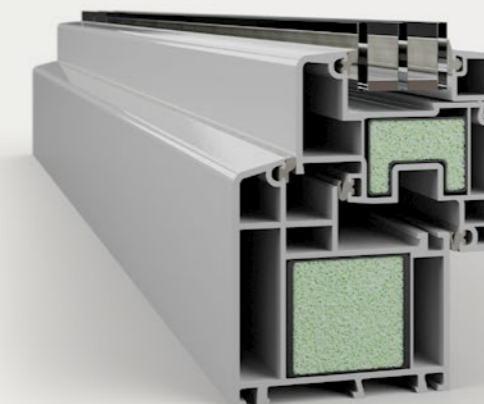


Fig. 16: Static reinforcement. This allows for larger constructions with lower thermal conductivity with PVC windows.

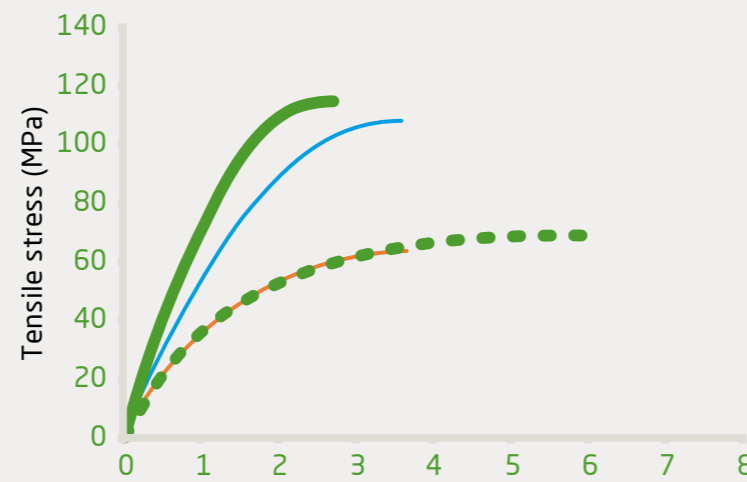


## Thermal behaviour checked

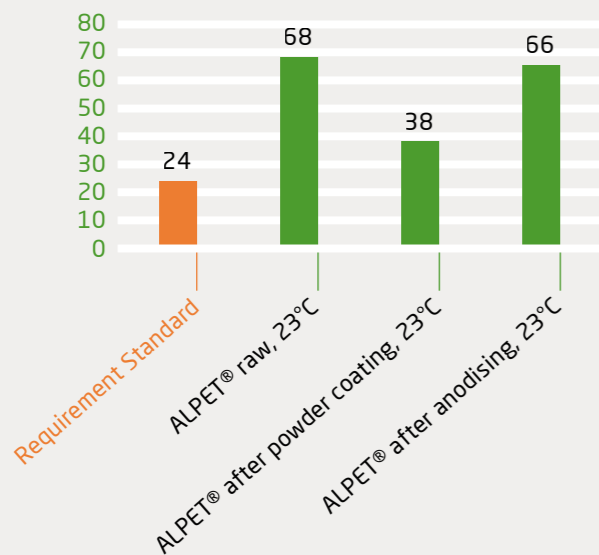
The thermal effects were checked with the FEM programme. The occurring stresses are below the permissible value, the requirement according to the standard is fulfilled by far.

## Material comparison

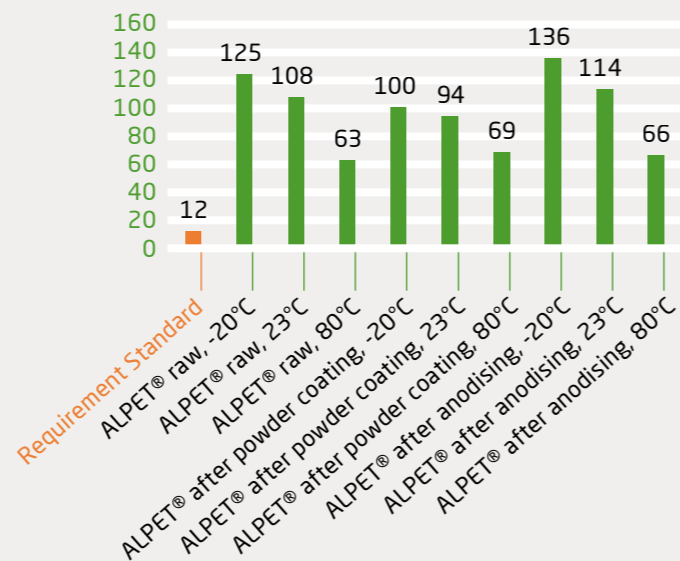
- PA66-GF 23°C (campus, humidity)
- PA66-GF 80°C (campus, air dry)
- ALPET®-GF 23°C (measurement, normal climate)
- ALPET®-GF 80°C (measurement, normal climate)



## Shear strength ALPET® (EN 14024)



## Transverse tensile strength ALPET® (EN 14024)



## Effects in case of shear load (Fig. 17 / 18 / 19 / 20)

The following figures show the investigation of stresses in different ALPET® cross-sections. They are below the values specified in the standard. Figure 20 shows the occurring stress according to Mises under tension.

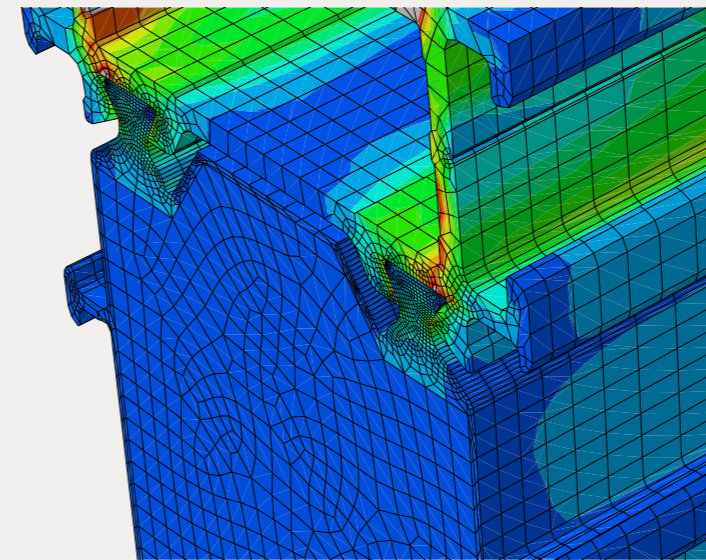


Fig. 17 FEM calculations cross-section 1

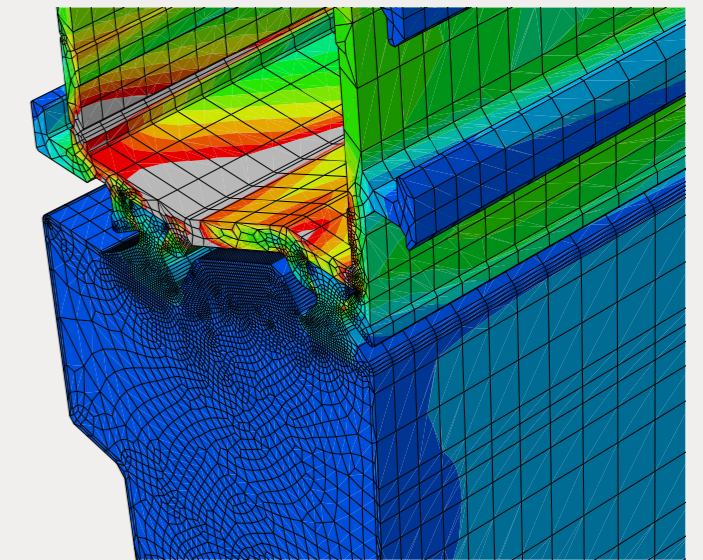


Fig. 18 FEM calculations cross-section 2

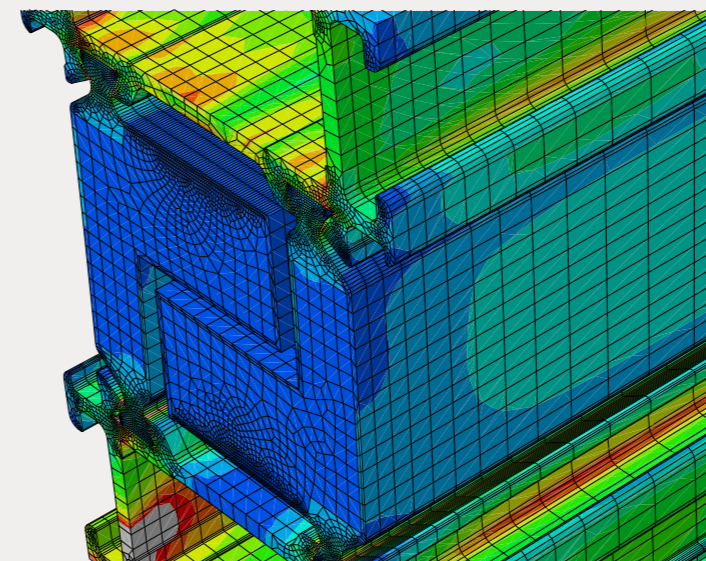


Fig. 19 FEM calculations cross-section 3

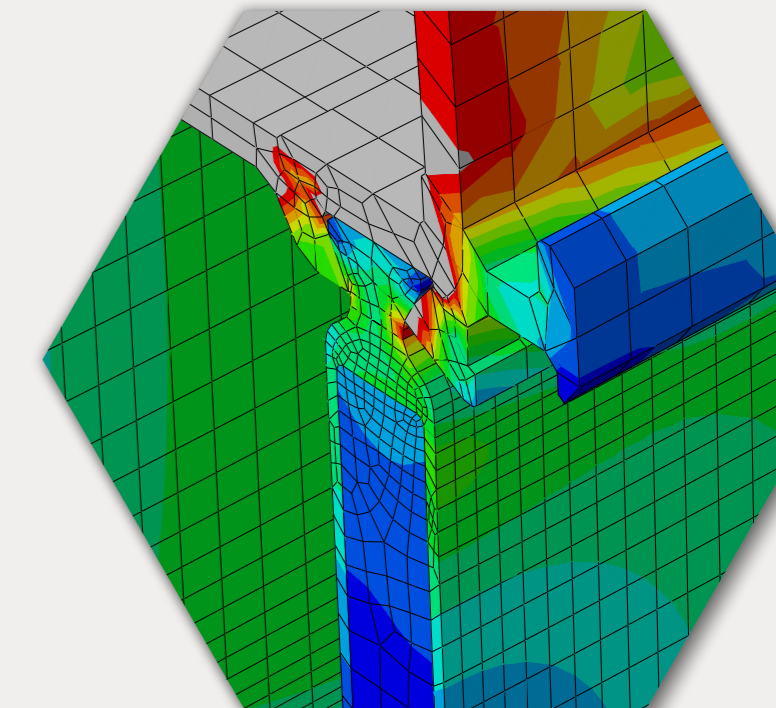
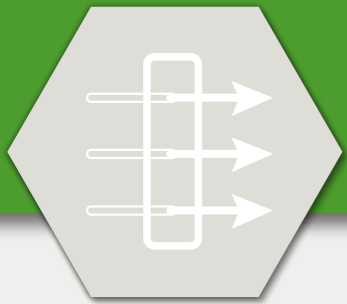


Fig. 20 FEM calculations cross-section 4



# Thermal conductivity value

## Improved heat flow through ALPET®

The following illustrations show how the heat flow is significantly improved by ALPET®. This leads to energy savings and lower heating costs.

Unmatched deep thermal insulation of standard windows with ALPET®

Standard window without ALPET®

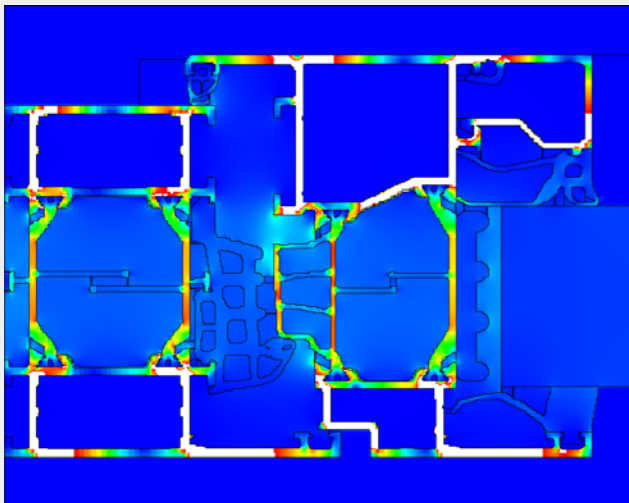


Fig. 21.1: Heat flow - aluminium window without ALPET®

Standard window with ALPET®

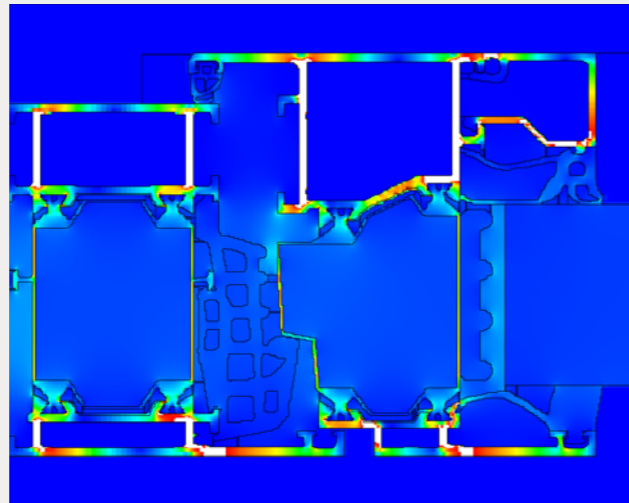


Fig. 21.2: Heat flow - aluminium window with ALPET®

Insert window without ALPET®



Fig. 22.1: Heat flow - insert window without ALPET®

Insert window with ALPET®

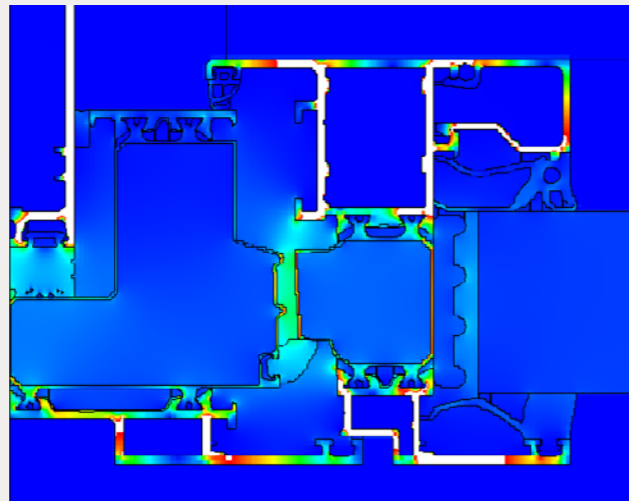


Fig. 22.2: Heat flow - insert window with ALPET®

## Improved isothermal curve due to ALPET®

In the following illustrations, you can see how the isothermal curve is significantly improved by ALPET®, which leads to an increase in the quality of the window.

Standard window without ALPET®

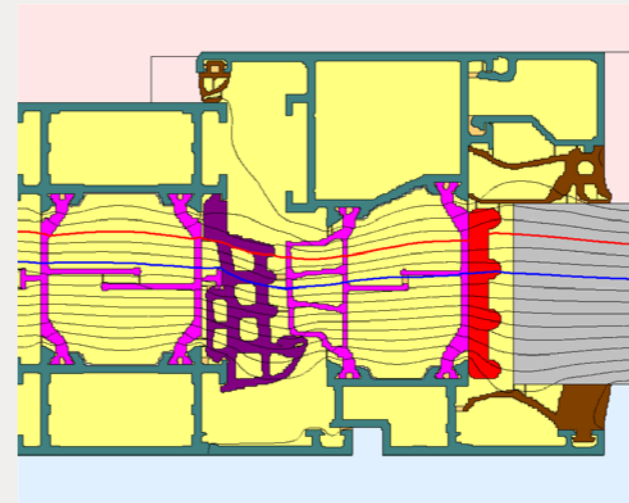


Fig. 23.1: Isotherm curve - aluminium window without ALPET®

Standard window with ALPET®

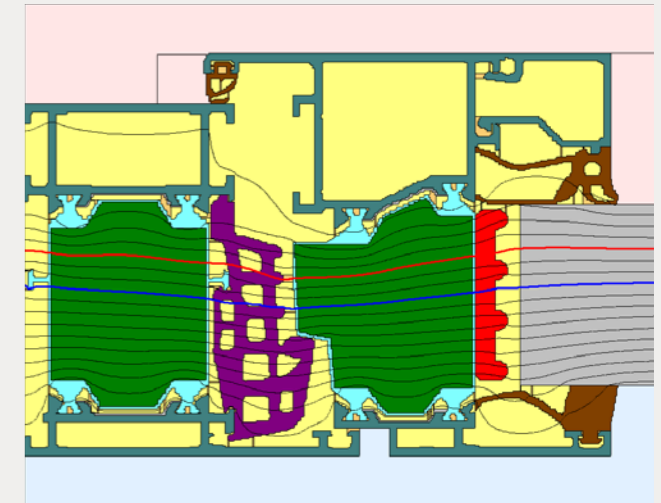


Fig. 23.2: Isothermal curve - aluminium window with ALPET®

Insert window without ALPET®

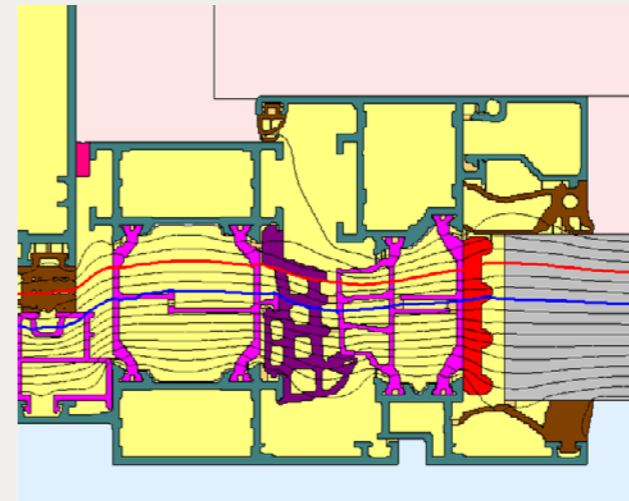


Fig. 24.1: Isothermal curve - insert window without ALPET®

Insert window with ALPET®

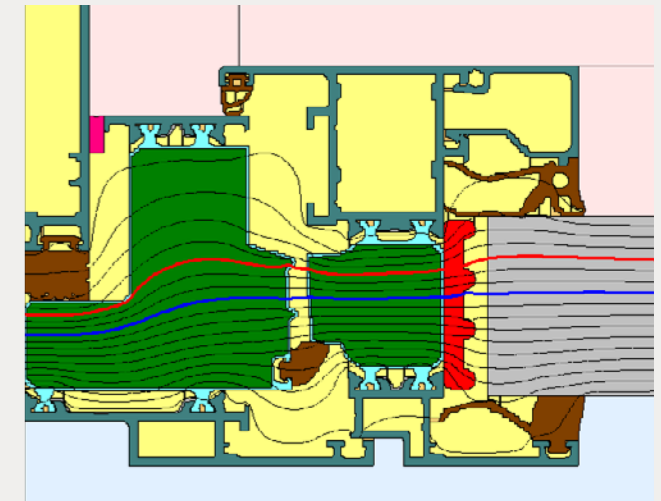
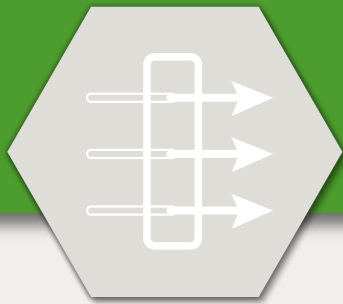


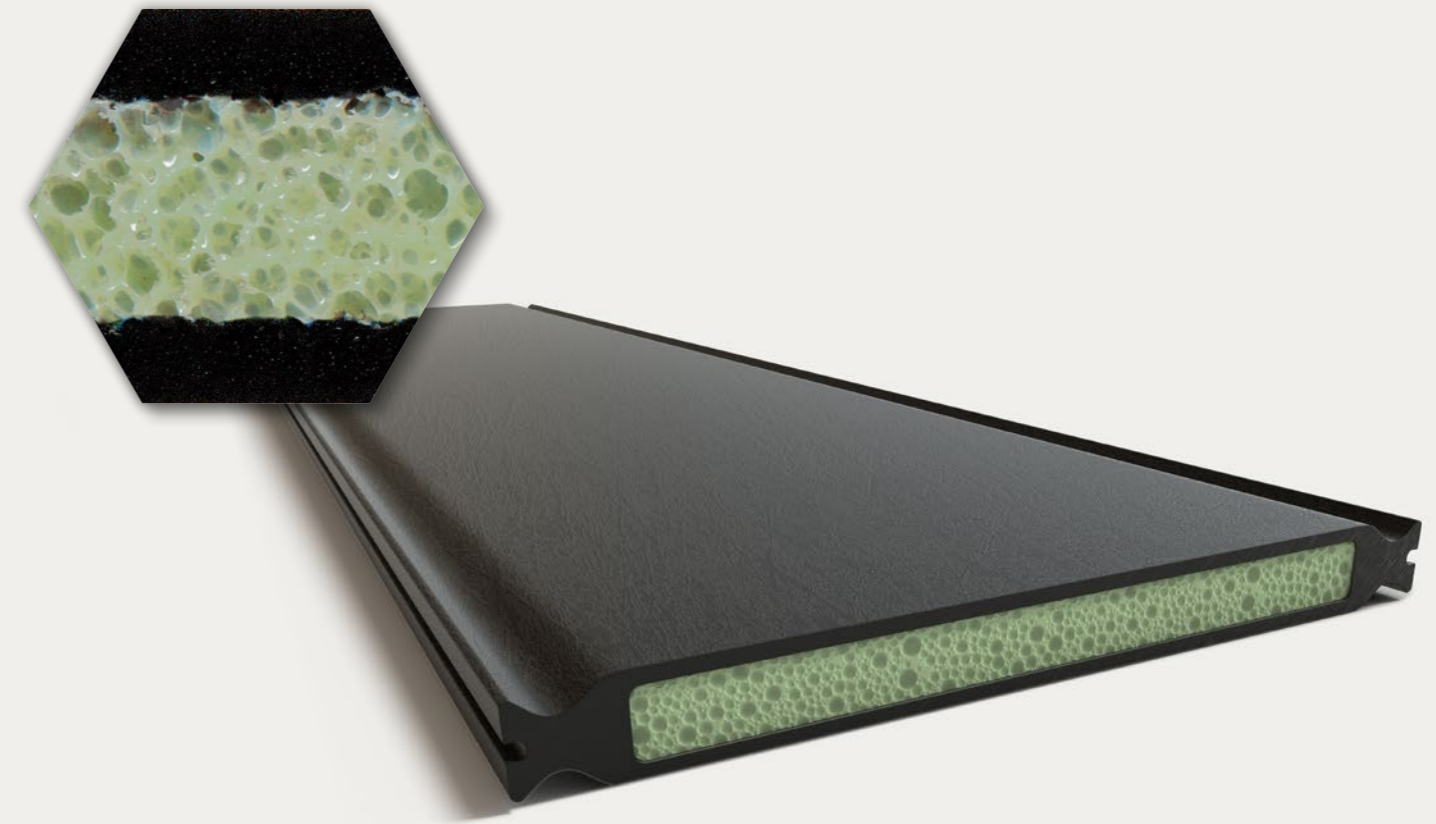
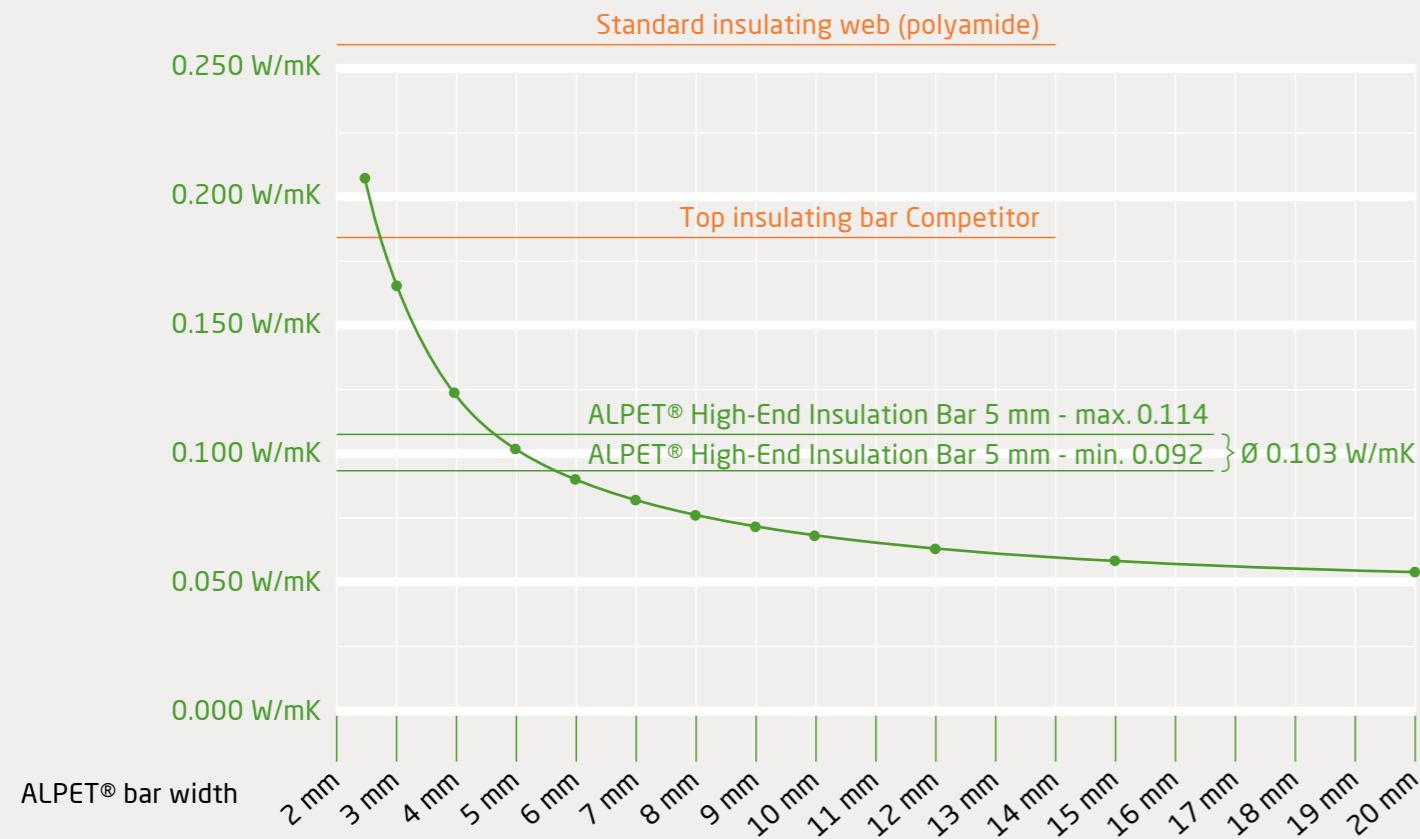
Fig. 24.2: Isotherm curve - insert window with ALPET®



# Thermal conductivity value

## Thermal conductivity insulation bar

Reference values: ALPET® bar width 5 mm - 0.105 W/mK  
ALPET® bar width 8 mm - 0.080 W/mK



## Reduced thermal conductivity values

In aluminium glazing and aluminium facades, the new ALPET® insulating bar develops its full insulating power. The  $U_f$  values are significantly improved depending on the cross-section and reach values that are notably below the existing ones.

## The economical construction of ALPET®

With the sandwich construction method, we process the insulating structural foam core based on PET and encase it in glass-fibre reinforced, semi-crystalline thermoplastic.

Empty spaces are replaced by a foam with microscopically small air chambers.

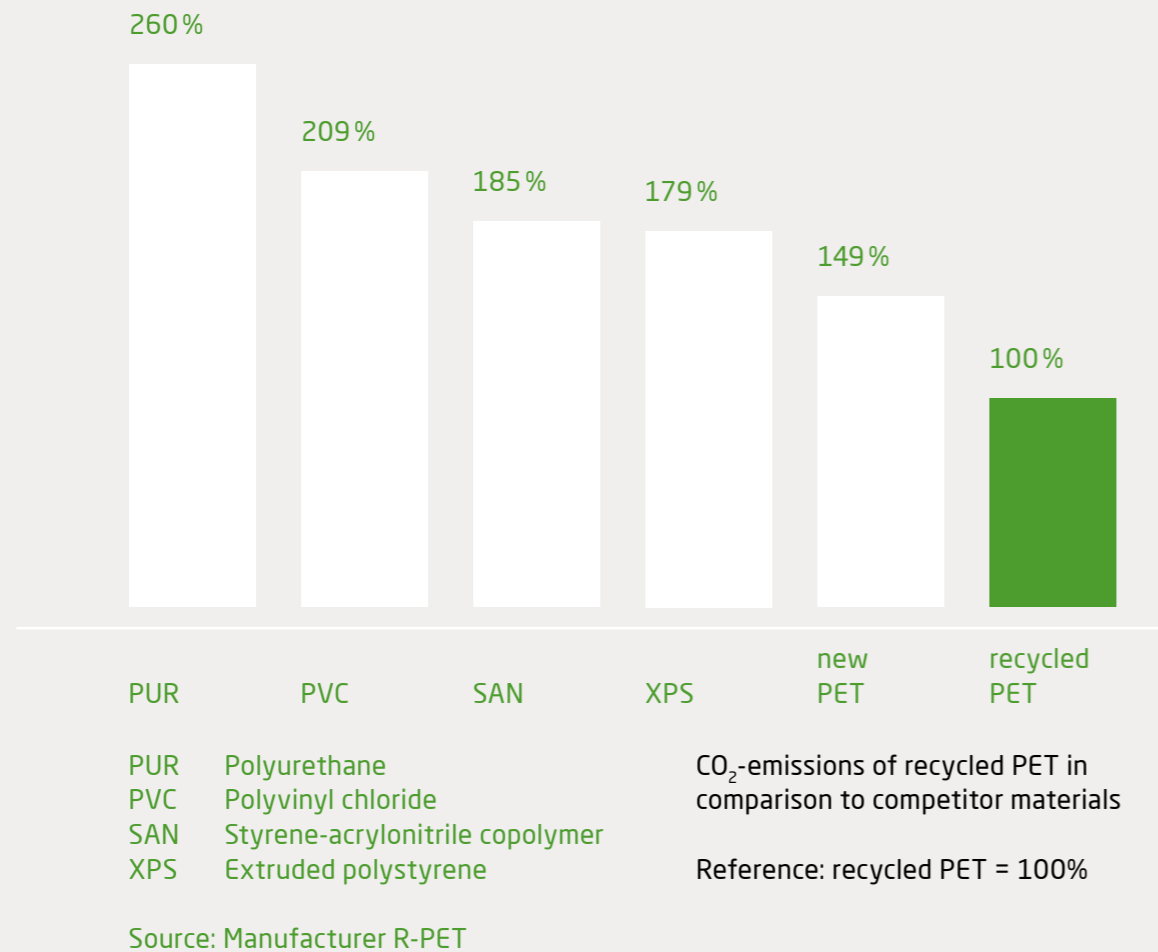
In a continuous manufacturing process, the sheathing, including dovetail connectors or grooves/flags are produced extremely economically around the foam core.





# Recycling

Recycled PET comes out on top in terms of CO<sub>2</sub>-emissions



## Patent process technology with lowest CO<sub>2</sub>-emissions

The use of 100% recycled PET as a raw material base for our foam products leads to significant savings in CO<sub>2</sub> emissions.

## Sustainability in values and philosophy

Upcycling (recycling with material upgrading) or urban mining (our region as a raw material mine) are not just great buzzwords for us, but we also implement the concepts behind them. We are in the process of obtaining Cradle to Cradle certification. Because it is not only the first use of the raw material in the foreground, but also the application afterwards.

## For the day after tomorrow

The shell and core material can be 100% recycled or reprocessed together.

The insulating foam core of ALPET® is made from 100% recycled PET as the starting raw material.





## Surface treatment

The composite profiles can be powder-coated vertically or horizontally in conventional processes.

The anodising process also remains unchanged in connection with ALPET®.

The effects of these coating methods on the material have also been scientifically tested and are unproblematic. The compatibility and resistance to chemicals are given.

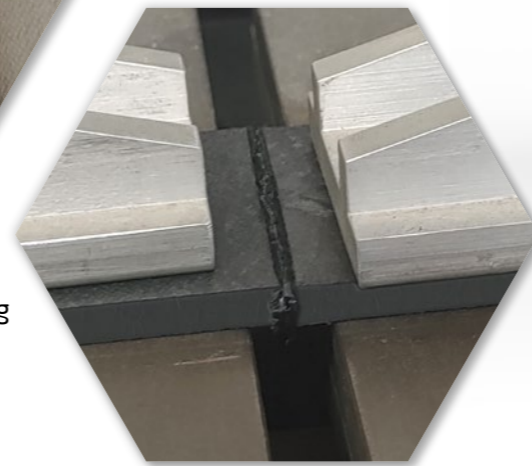


## Bonding/sealing

The bonding and sealing of ALPET® profiles is also state of the art and can be carried out very well (scientifically tested).



## Welding

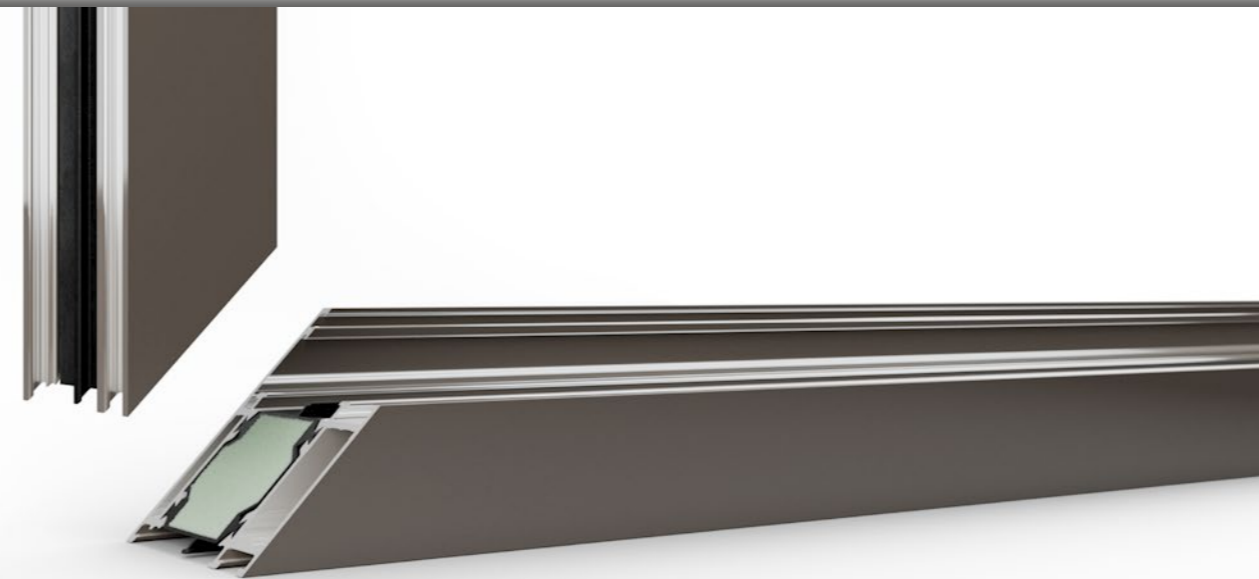


### Simply weldable ...

ALPET® profiles can be welded together very well and durably, by bead welding or heating mirror welding.

### ... and load-tested

Various lightweight constructions or frames for window construction can be realised by welding. The welded joints can withstand large loads without any problems.



### Bonding over a larger area

In many cases, filling the cavity with ALPET® creates an area for bonding the frame that is at least twice as large.

Advantages:

- Controlled execution of bonding and sealing
- Significant increase in quality

## With the use of ALPET® for improved energy balance

In Switzerland, the Energy Efficiency Ordinance (EnEV) applies nationwide. During global efforts to save energy and protect the climate, all European countries have formulated energy standards for their buildings and set certain U-values as limits in them.

With ALPET® we are reaching a new level of development and setting a new standard in terms of thermal performance.

We offer a wide range of cross-sections for different applications. With our product, the U-values are significantly improved, which has a direct effect on the energy balance.

- Product development with the support of material scientists, engineers, physicists, selected industrial partners and the scientific project partner Empa
- Engineering from conception to development
- Specialised personnel with many years of experience
- Innovative production of prototypes and series in own production
- Your competent partner



### We continue to develop!

- Further development of ALPET® as an insulating web in different cross-sections
- New sandwich construction method, protected by three patents
- Coextrusion of new profiles
- Cradle-to-Cradle certification of the insulation bars
- Optimisation of welding processes to increase economic efficiency



### Upcycling and upgrading

With our product, the existing shells/profiles receive a refreshment and thus an upgrade.

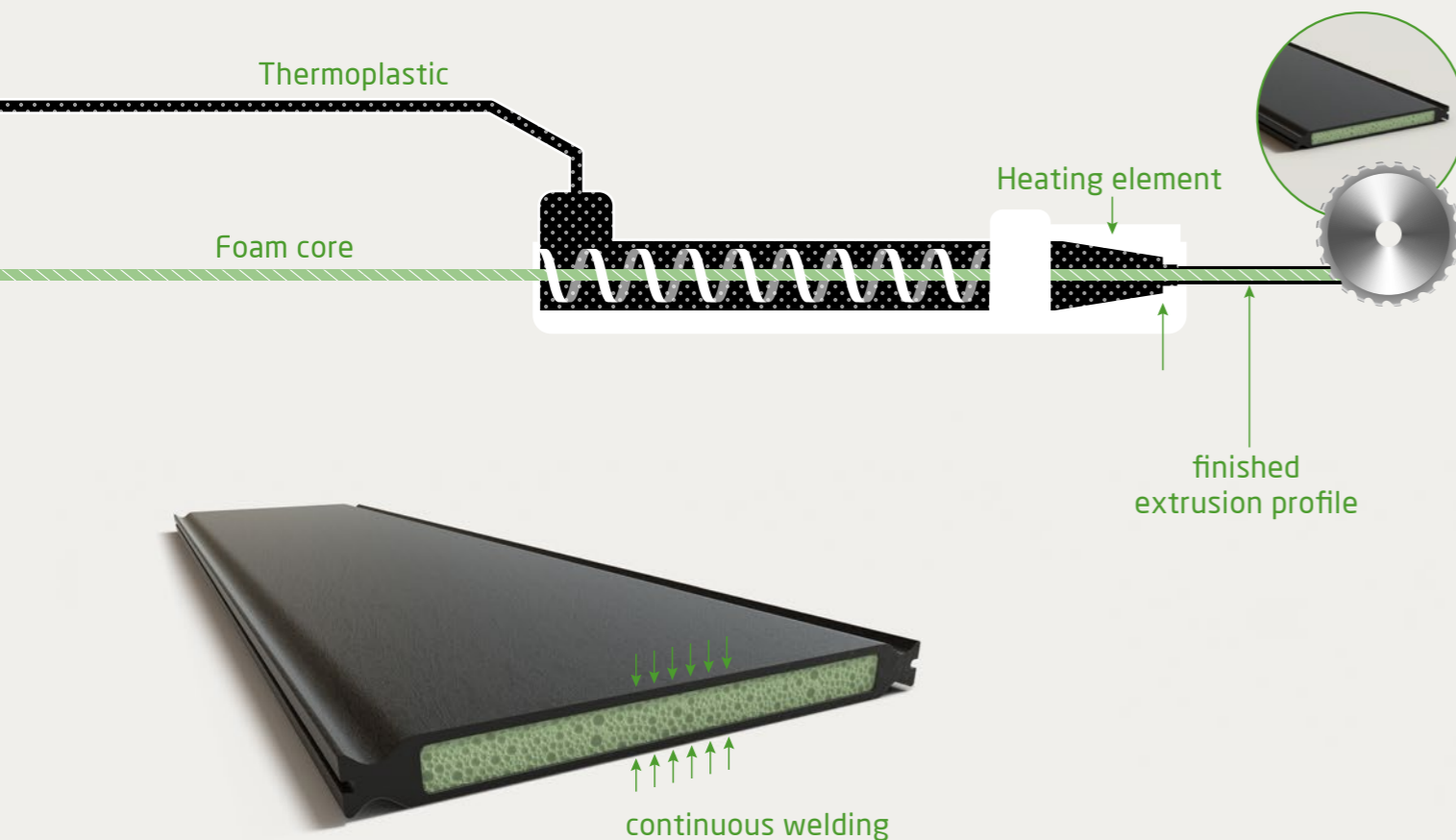
The ALPET® profiles can be easily recycled and returned to the cycle (urban mining).

## Production and Development

Scan the QR code. In a short video you will find an insight into the production process and individual development steps of ALPET®.



## The sheathing process



## Worth knowing

### Standards

Suitable for the new Building Energy Act GEG (as of 1 November 2020)  
 Suitable for Minergie (Swiss label for buildings with minimal heating-energy consumption)  
 Suitable for passive house (German label for buildings with no heating-energy requirement)

### Sound measurement

Our insulation bar in comparison with conventional insulation bar and profile systems:

ALPET®	Rw (C; C tr) = 46 (-2; -6) dB
Reference depth 80 mm	Rw (C; C tr) = 46 (-2; -6) dB (Noryl-bar)
Reference depth 70 mm	Rw (C; C tr) = 47 (-2; -6) dB (polyamide-bar)

### Fire behaviour

DIN EN 13505-1, Class E

### Mechanical performance

DIN EN 14024


Failure possibilities have been scientifically investigated.

### Ageing behaviour tested

The ageing behaviour was extrapolated according to advanced scientific methods. (stepped isostress tests)

ALPET® is tested according to the strictest standards

Innovation project supported by:

 Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

Innosuisse – Schweizerische Agentur für Innovationsförderung

Basic research and development by materials scientists at Empa:

 **Empa**  
Materials Science and Technology

 **ift**  
ROSENHEIM

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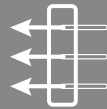


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Innovative applications



Thermal conductivity



Recycling



Surface treatment



Welding



Bonding/sealing



Prospects



Upgrade/Upcycling



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