



**COMPONENT  
AWARD  
2019**

Passive House Institute

## **Windows for the Future**

**Comfortable**

**Sustainable**

**Affordable**

**Documentation**



## Affordable Zero Energy Buildings



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### Impressum

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Figure 1: The Jury (PHI 2019)

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Author:

Dr. Ing. Benjamin Krick, Passive House Institute Darmstadt, October 2019

## 2 | The Award

### 2.1 Aim: Thermally improved windows for all.

In recent years, excellent progress has been made with reference to the thermal quality of windows. In order to make a significant contribution to climate protection, these further improved windows must enter the global mainstream. To create an impetus and contribute to the accelerated uptake of windows that represent the cutting edge in terms of thermal efficiency, the Passive House Institute has conducted this award as part of the AZEB-Project, supported by the European Union.

### 2.2 Method: Comparison with a baseline window.

Participants had to provide a certified Passive House window solution, including installation and shading, in the category “tilt & turn” window and in addition in the category “window combination”. Each window was compared by its life cycle costs and CO2 savings with a baseline window, which is standard at the participant’s location. A specialist jury evaluated the topics innovation, practicability, aesthetics and made the final decision regarding categories and winners. Members of the jury were:

- Prof. Dipl.-Ing. Ludwig Rongen, ROA
- Prof. Dr.-Ing. Harald Krause, b-tec
- M.Arch Dawid Michilec, Neubau best energy
- M.Sc. Sichen Sheng, Passive House Institute
- M.Arch. Edward Lowes, Passive House Institute
  - Dr.-Ing. Benjamin Krick, Passive House Institute
  - M.Arch Soraya Lopez, Passive House Institute

### 2.3 Participants: Windows from all over the world.

In sum, 23 companies from 12 countries took part in the competition with 31 products and variants. Among the products were 21 Timber Aluminium, 6 Aluminium, 3 Timber and 1 Plastic windows. For the arctic climate zone, one window was entered, 6 for cold, 14 for cool, temperate, 8 for warm, temperate and 2 warm windows. The jury awarded 10 regular prizes and 3 special prizes.



Figure 2: Award Ceremony: Arctic and cold climates (PHI 2019)



Figure 3: Award Ceremony: cool, temperate climates (PHI 2019)



Figure 4: Award Ceremony: Warm, temperate and warm climates (PHI 2019)

## 3 | Findings

### 3.1 Life cycle analysis: Investment- and operation costs

Due to different price levels of building costs all over the world in general, for passive house windows in particular, as well as the high variation of the proposed baseline windows, the jury found it hard to decide according to make decisions based on the life-cycle costs. In some cases this lead to questionable results. For instance in New Zealand, timber aluminium windows are not common. So, the baseline window to compare with the passive house window might be a timber or an aluminium window. In the case of comparing the passive house window with a traditional timber window, the passive house window turns out to be very affordable while comparing with a mass-produced aluminium window, the differences of the life cycle costs are much closer. In China, the labour- and thus the construction costs are, compared to North America or Europe, relatively low. So the costs of both, reference- as well as passive house windows and their installation are also low. The energy costs on the other hand were set as equal all over the world. That leads to a relatively high influence of the energy costs in markets with low window prices; passive house windows seemed to be much more beneficial in those markets. In such cases, the jury took the liberty to carefully interpret the results.

The choice of the heating system has a strong effect on the life cycle costs, too, as well as on the CO<sub>2</sub> emissions. For the award, an oil-fired boiler was taken into account for the life cycle analysis and to estimate the CO<sub>2</sub> emissions. The costs per kWh of heating energy were assumed as 9.8 €Cent per kWh, including 2.4 €Cent CO<sub>2</sub> compensation costs. However, for instance in New Zealand (south island near Christ Church, no cooling required), in the majority of cases electricity is used rather than oil-fired boiler is used for heating, either direct or via a heat pump. Figure 6 shows the life cycle costs and CO<sub>2</sub> savings of ThermaDura NatureLine (winner of the Special Prize Economy) in combination with different heating systems.

It can be seen that, in case of a direct electric heater and a poor heat pump, the life cycle costs are higher than as with the awards scenario. But if good heat pumps are used, the life cycle costs are lower than for the awards scenario. It should be noted, that no CO<sub>2</sub> compensation costs were taken into account in the price for electricity, nor the different investment costs for the heaters.

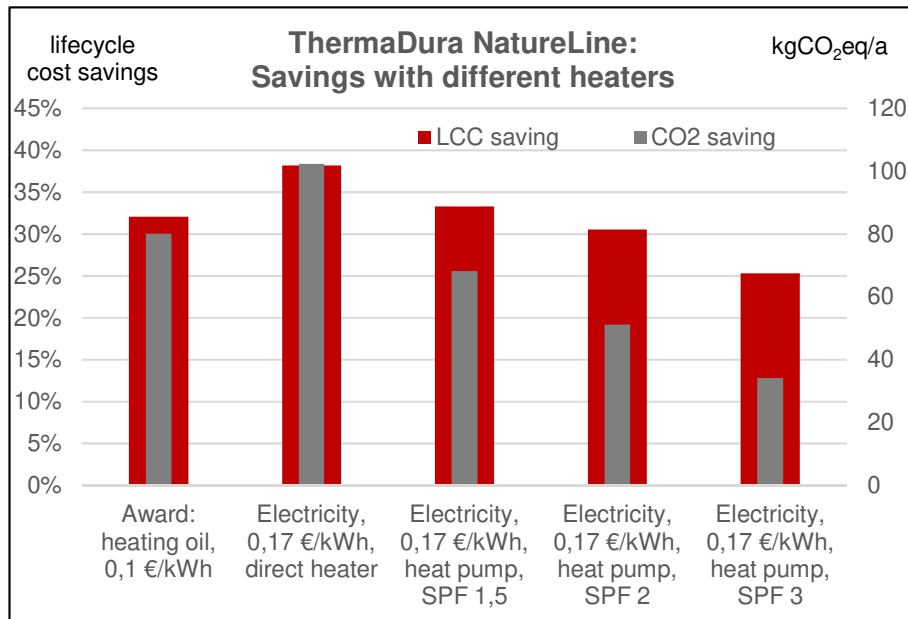


Figure 5: Life cycle cost and CO<sub>2</sub> savings for ThermaDura NatureLine with different heaters. Price of electricity: 17 €Cent/kWh, 450 gCO<sub>2</sub>eq/kWh. ©PHI 2019

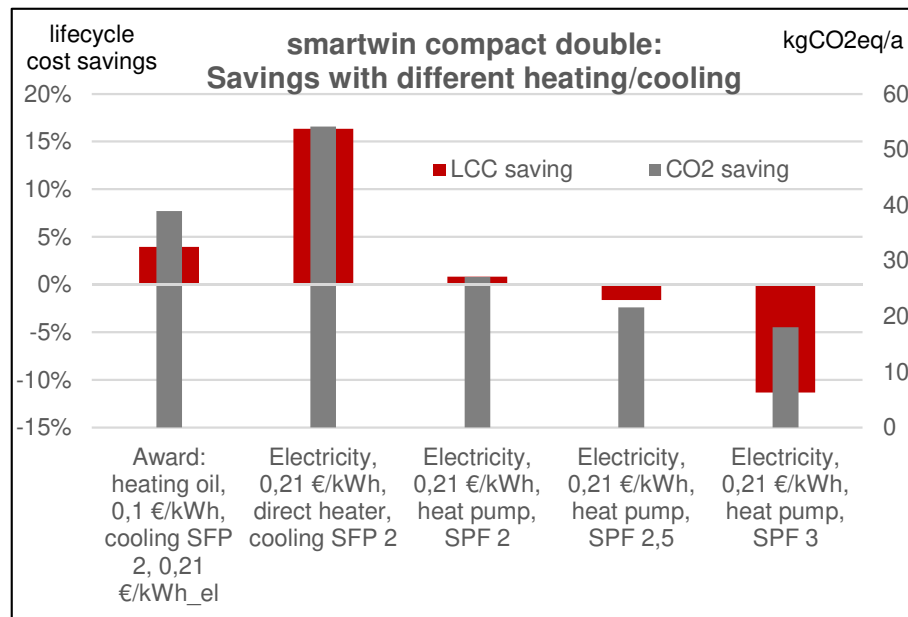


Figure 6: Life cycle cost and CO<sub>2</sub> savings for smartwin compact by Daimaru Kogyo LTD, Japan with different heaters/chillers. ©PHI 2019

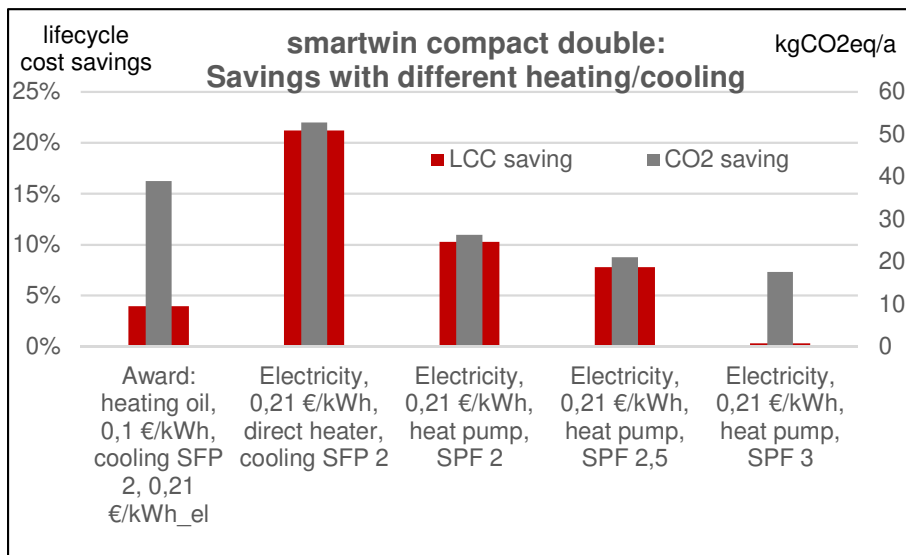


Figure 7: Life cycle cost and CO<sub>2</sub> savings for smartwin compact by Daimaru Kogyo Ltd., Japan with different heaters/chillers, adjusted window size and U-value optimized glazing. ©PHI 2019

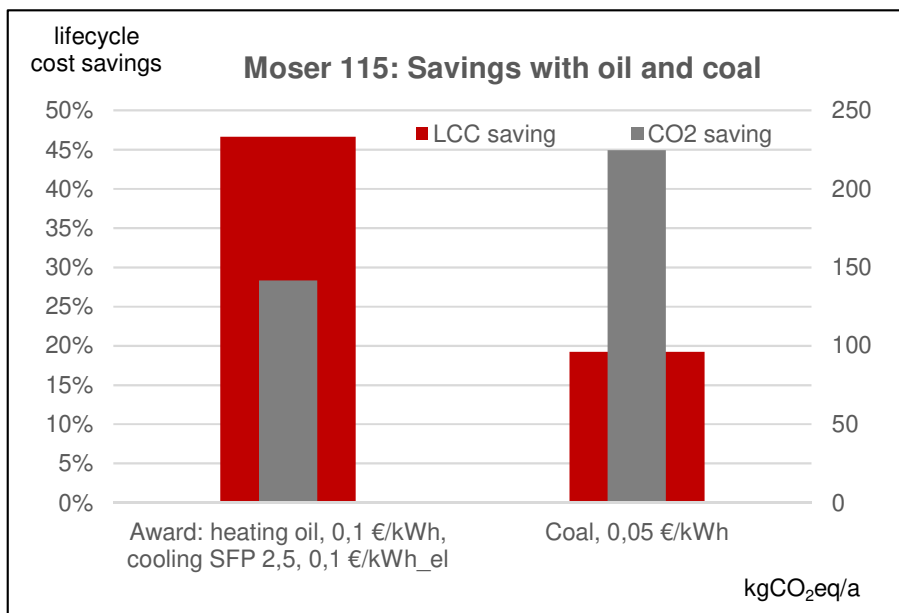


Figure 8: Life cycle cost and CO<sub>2</sub> savings for Moser 115 with awards boundary conditions and standard used coal heating. ©PHI 2019

Cooling was taken into account with both a very low energy price (10 €Cent/kWh) and low CO<sub>2</sub> emissions (63 gCO<sub>2</sub>eq/kWh), as it was assumed that a relatively efficient heat pump (SPF 2.5), powered by PV panels was used. Figure 6 shows the savings for smartwin compact double by Daimaru Kogyo Ltd., Japan with different cooling- and heating systems. Here too, no CO<sub>2</sub> compensation costs were taken into account for the real electricity price in Japan (for heating and cooling) of 21 €Cent/kWh. The CO<sub>2</sub> emissions of Japan's electricity were taken into account with 520 gCO<sub>2</sub>eq/kWh.

It can be observed that, with the exception of the direct heating with a relatively poor performing heat pump for cooling, there are only few or even negative life cycle cost savings. Furthermore, it appears that the cooling costs are higher for the smartwin than for the standard window. This is due to the higher glass fraction of the smartwin and glazing with a higher g-value.

Figure 7 shows a variation where the size of the smartwin window is reduced to match the glazing area of the baseline window; the investment costs are equally reduced and the glazing is U-value optimized: 1.04 W/(m<sup>2</sup>K), g = 45%. Now, only with the very good heat pump are the life cycle cost savings lower than in the award scenario and even then, there is a life-cycle benefit for the customer.

In China the situation is different. Here, coal at a cost of only 700 Yuan/tonne is used. With the CO<sub>2</sub> compensation cost used in the award, this results in 75 €/tonne and an efficiency factor of the heating system of 1.25, in a heat price of 5.3 €Cent/kWh. So, the achievable CO<sub>2</sub> savings are reduced. Because of the higher CO<sub>2</sub>-factor of coal compared to heating oil, the CO<sub>2</sub> savings are increasing at the same time, see Figure 8 which is showing at the example of Moser 115 by Hebei Orient Sundar, the winner of the first prize in the category Aluminium cool, temperate climate.

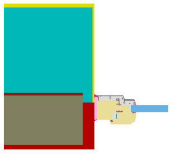
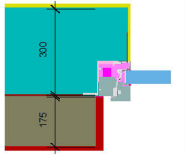
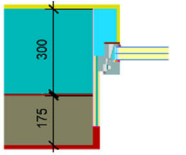
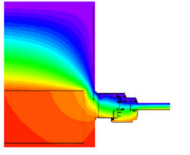
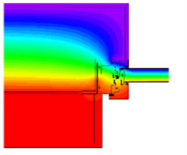
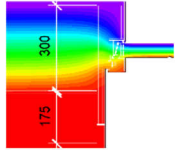
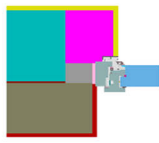
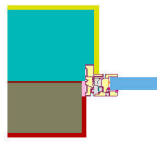
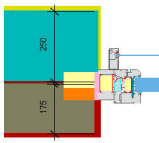
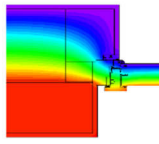
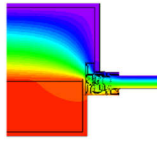
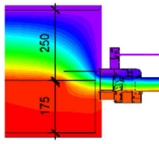
Case	Typical baseline	Steel brackets	Plywood board
	Double alu, China	Pazen120, China	smartwin, USA, Latvia
Model			
Isothermal map			
$\Psi$ [W/(m <sup>2</sup> K)]	0,170	0,007	-0,002
Energy costs [€/m <sup>2</sup> a]*	1,29 €	0,05 €	- 0,02 €
Life-cycle energy costs [€/window]**	162 €	7 €	- 2 €
Share of installation costs [%]	10%	12%	5%
Additional installation costs, [€/window]	- €	55 €	22 €
Life-cycle costs [€]	162 €	62 €	20 €
*0.10 €/kWh, 76 kWh/a. **Service life 40a, 3% real interest rate. Window size 1,23*1,48, all sides assumed with the same thermal bridge. The thermal bridge of installation depends also on the frame and on other factors. Because of that, the here presented values are not comparable.			

Figure 10: Different installation strategies with their respective thermal bridge coefficients and resulting heating- and life-cycle costs. ©PHI 2019

## 3.2 Installation

While the installation of the baseline windows shows in nearly every case extremely high level of thermal bridging (installed in the load-bearing layer with no reveal insulation), most of the Passive House windows show very good results, thus installed in or partially in the insulation layer with the frame covered by the insulation of the wall. It must be noted that the installation situation has a significant effect on both, the windows' energy balance as well as their economic success. This highlights the need for a very well designed installation and a high quality craftsmanship, not only in terms of thermal bridges but also in principle 5 different solutions for window installation were presented:

1. Installation by steel brackets: steel angles were screwed to the concrete wall, as well as to the window frame. Due to the high conductivity of steel, the angles can lead to high level of thermal bridging. In addition, it is necessary to fit the insulation well to the angles to avoid gaps caused by the angles and screws between insulation, wall and frame. If the angles are placed in the glue layer, if they do not penetrate the insulation layer of the window frame and countersink screws are used, the additional thermal losses will be in an acceptable range. In some cases, the windows bottom section is supported by a timber beam.
2. Installation by plywood boards: plywood boards are connected to the frame and fastened to the load bearing layer, becoming the window sill as well as reveal cladding. In this way, the frame can be positioned in the insulation layer, causing only neglect able thermal bridges. As the plywood is visible, it has to be installed very carefully. Without further measures, the screws are visible. Reinforcing elements might have to be used in bigger windows. This method can also be used in replacing old windows with new ones.
3. Installation by blind frame: a blind frame, for instance from highly rigid EPS foam is glued and screwed in the insulation layer, to the construction layer. The blind frame acts as clean surface on which the window can be mounted and to which the airtightness layer can be connected. The window can be easily replaced by a new one when time comes. In addition, the high density EPS foam presents a level of additional sound protection. Reinforcing elements might have to be used in bigger windows.

Case	Blind frame	Partially in constr. layer	Block-out in constr. layer
	Timm, Germany	Cascadia, Canada	Rocky110s, China
Model			
Isothermal map			
$\Psi$ [W/(m <sup>2</sup> K)]	0,013	0,033	0,023
Energy costs [€/m <sup>2</sup> a]*	0,10 €	0,25 €	0,17 €
Life-cycle energy costs [€/window]**	12 €	31 €	22 €
Share of installation costs [%]	17%	11%	6%
Additional installation costs, [€/window]	106 €	- €	18 €
Life-cycle costs [€]	118 €	31 €	4 €
*0.10 €/kWh, 76 kWh/a. **Service life 40a, 3% real interest rate. Window size 1,23*1,48, all sides assumed with the same thermal bridge. The thermal bridge of installation depends also on the frame and on other factors. Because of that, the here presented values are not comparable.			

- Installation partially in the construction layer: if the frame is deep and outside insulated it is possible to install it partially in the load bearing layer with. The frame can then be directly fitted in the load bearing layer without additional elements, which makes the installation easy and cheap. It is important that the insulation layers of the frame and wall overlap as much as possible.
- Block-out in the construction layer: to further improve the installation (partly) in the load bearing layer, Qingdao Rocky Window Ltd. has presented a practical solution: a bar, combined of resolic foam and timber blocks is used as part of the concrete formwork to make an insulating frame all around the window opening to which the window is connected. This solution represents an opportunity to install the window in the load bearing without a high level of thermal bridging. It is to be noted however, that the window will be further shaded by the deeper reveal and overhang.

Figure 10 and Figure 11 are showing the different approaches with the respective thermal bridge coefficients and heating costs. It can be seen that, the more the isothermal lines deviate, the greater the thermal bridge. The share of installation costs, additional installation costs as well as life cycle costs can also be seen, but it is important to note, that these data points are not fully comparable due to the different contexts. For instance with Rocky 110, the installation of a shutter housing is included in the installation costs of the baseline window, but Rocky 110s has an integrated shading with lower installation costs, which results in negative additional installation costs.

Figure 11: Different installation strategies with their respective thermal bridge coefficients and resulting heating- and life-cycle costs. ©PHI 2019

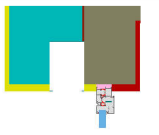
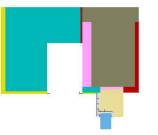

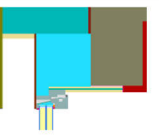
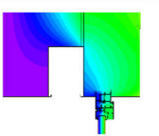
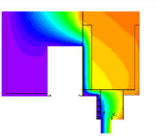
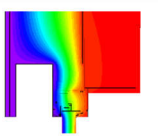
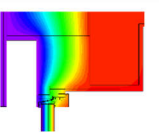
Case	Venetian blind			
	Baseline with- out insulation	Baseline with insulation	Exemplary solution	Exemplary solution
	Aluminium, China	Timber al., Germany	ENERsign primus	smartwin solar by i2
Model				
Isothermal map				
$\Psi$ [W/(m <sup>2</sup> K)]	1,094	0,278	0,024	0,025
Energy costs [€/m <sup>2</sup> a]*	8,31 €	2,11 €	0,18 €	0,19 €
Life-cycle energy costs [€/window]**	236 €	60 €	5 €	5 €
Share of instal- lation costs [%]	51%	29%	28%	26%
Costs for shading [€/window]	275 €	518 €	518 €	342 €
Wall with same loss as thermal bridge*** [m <sup>2</sup> ]	9,0 @U <sub>wall</sub> = 0,15 W/(m <sup>2</sup> K)	2,3 @U <sub>wall</sub> = 0,15 W/(m <sup>2</sup> K)	0,2 @U <sub>wall</sub> = 0,15 W/(m <sup>2</sup> K)	0,3 @U <sub>wall</sub> = 0,12 W/(m <sup>2</sup> K)
*0.10 €/kWh, 76 kWh/a. **Service life 40a, 3% real interest rate. *** The equivalent area of a wall with the displayed U-value is shown. The thermal bridge of installation depends also on the frame and on other factors. Because of that, the here presented values are not comparable.				

Figure 12: Shading solutions for venetian blinds (left side baseline, right side exemplary solutions presented within the Award) with their respective thermal bridge coefficients and resulting heating- and life cycle costs. ©PHI 2019

### 3.3 Shading

The following shading solutions were used:

- In arctic/cold climate: venetian blinds (7), fabric screen (1)
- In cool, temperate climate: venetian blinds (8), fabric screen (3), roller blind (2), integrated shading (1)
- In warm, temperate climate: fabric screen (6), roller blind (1), integrated shading (2), classic blinds (1)

In the arctic, cold and cool, temperate climates, venetian blinds are predominant. In the case of direct attachment of the shutter housing to the wall, the thermal bridges are extremely high. The heat loss is more than 1 W/(mK), equivalent to 9 m<sup>2</sup> of undisturbed wall, resulting in life-cycle heating costs more than 200 € per window as figure 6 shows. With thermal separation, the situation can be improved to 0.28 W/(mK), equivalent to 2.3 m<sup>2</sup> wall and life cycle energy costs of 60 €. But as very good examples from the award show, the thermal bridge can be ten times smaller and thereby not much higher than without shutter housing.

Four measures are necessary for such a good result: 1. Use narrow shutter housings. 2. Move the shutter housing as far as possible to the outside. 3. Use a very good insulation between the wall and shutter housing. 4. Put the window in line with this insulation.

As we have seen, it is possible to get to low thermal bridge values in cool, temperate, cold and arctic climates. This is mainly because the insulation layer is thick enough to contain the shutter housing as described. In warm- or warm, temperate climates however, the insulation is thinner and therefore it is more difficult to insulate between the shutter housing and the wall.

To overcome this issue, several strategies were used in the award. The use of fabric screens instead of venetian blinds is one option, because the housing of a fabric screen is smaller. That might be the reason why fabric screens are predominant in warm, temperate and warm climates.

ThermaDura connected a partially exterior housing directly to the frame, which reduces both thermal bridges and installation costs. The jury saw this solution as critical in terms of durability (water could drain between housing and plaster leading to moisture damages) and from an aesthetic perspective.



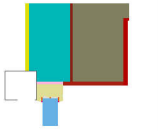
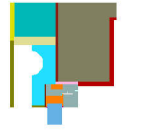
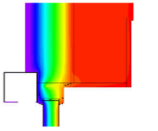
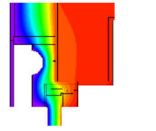
Case	Fabric screen	
	Exterior housing	Housing in insulation
	ThermaDura	smartwin
Model		
Isothermal map		
$\Psi$ [W/(m <sup>2</sup> K)]	0,063	0,055
Energy costs [€/m <sup>2</sup> a]*	0,48 €	0,42 €
Life-cycle energy costs [€/window]**	14 €	12 €
Share of installation costs [%]	38%	18%
Costs for shading [€/window]	897 €	216 €
Wall with same loss as thermal bridge*** [m <sup>2</sup> ]	0,3 @U <sub>wall</sub> = 0,25 W/(m <sup>2</sup> K)	0,3 @U <sub>wall</sub> = 0,25 W/(m <sup>2</sup> K)
*0.10 €/kWh, 76 kWh/a. **Service life 40a, 3% real interest rate. *** The equivalent area of a wall with the displayed U-value is shown. The thermal bridge of installation depends also on the frame and on other factors. Because of that, the here presented values are not comparable.		

Figure 13: Exemplary shading solutions for fabric screens presented within the Award) with their respective thermal bridge coefficients and resulting heating- and life cycle costs. ©PHI 2019

Smartwin's solution is to simply turn the screen around, so that it rolls to the outside, creating the possibility of a thicker insulation between the roll and the wall. In this way, the thermal bridge can be reduced to around 0.06 W/(m<sup>2</sup>K), equivalent to 0.3 m<sup>2</sup> undisturbed wall in warm, temperate climate, see figure 6. Further improvements could be made by putting a piece of insulation in the lintel area of the concrete formwork.

Three manufacturers used integrated shading in different forms. This solution is very affordable, protect the shading device from weather and improves the U-value of the window. However, the cleaning of an additional pane, a higher level of winter time shading (by the lamella when not in use) and a lower summer time shading (due to less efficiency caused by overheating of the air gap in which the blind is hosted) are taken into account. Furthermore, fixed glazing has to be shaded inside with reduced efficiency.

One manufacturer used a traditional blind for shading, which seems to be a very good solution as it is relatively cheap and thermal bridges are insignificant.

# 4 | Overview of the results

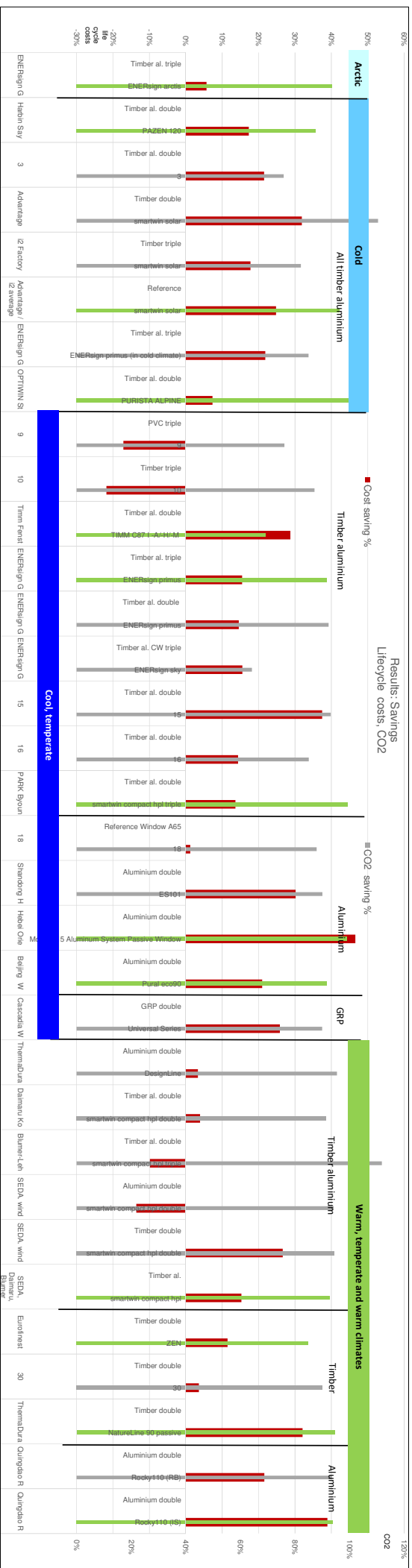
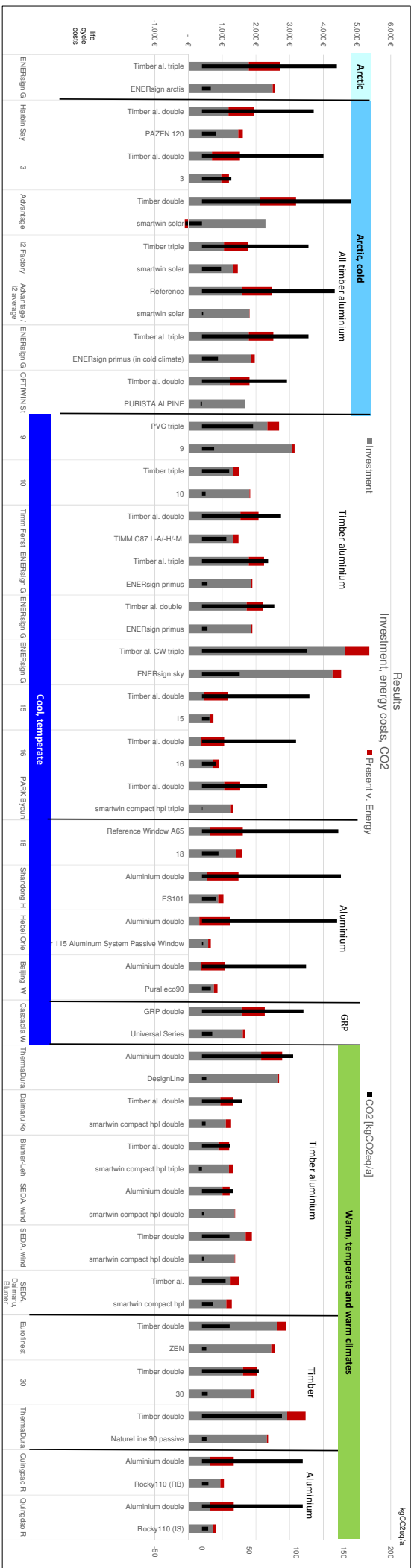


Figure 14: Overview of the results. Winners are highlighted in green in the bottom graph. Top graph: Investment- and energy costs as well as CO<sub>2</sub>-emissions. Bottom graph: Savings of life cycle costs and CO<sub>2</sub> emissions compared to the specific reference windows. It can be seen that in most cases, life cycle cost savings are possible. Please see also the following figures zooming for the various climate zones. © PHI 2019

## 5 | Participants

In sum, 23 companies from 12 countries took part in the competition with 31 products and variants.

Among the products were

- 21 Timber Aluminium,
- 6 Aluminium,
- 3 Timber and
- 1 Plastic windows.

For the arctic climate zone, one window was entered, 6 for cold, 14 for cool, temperate, 8 for warm, temperate and 2 warm windows.

The jury awarded 10 regular prizes and 3 special prizes.

For each product and product variant, a poster was presented to the jury, along with detailed reports.

On the following pages, all participating products and product variants are shown with the mentioned poster on the left side.

On the right hand side, the jury protocol including the jury's decision is shown.

All winners are shown with the companies- and products name. As well as all other applicants on request. The other applicants are only indicated with numbers.

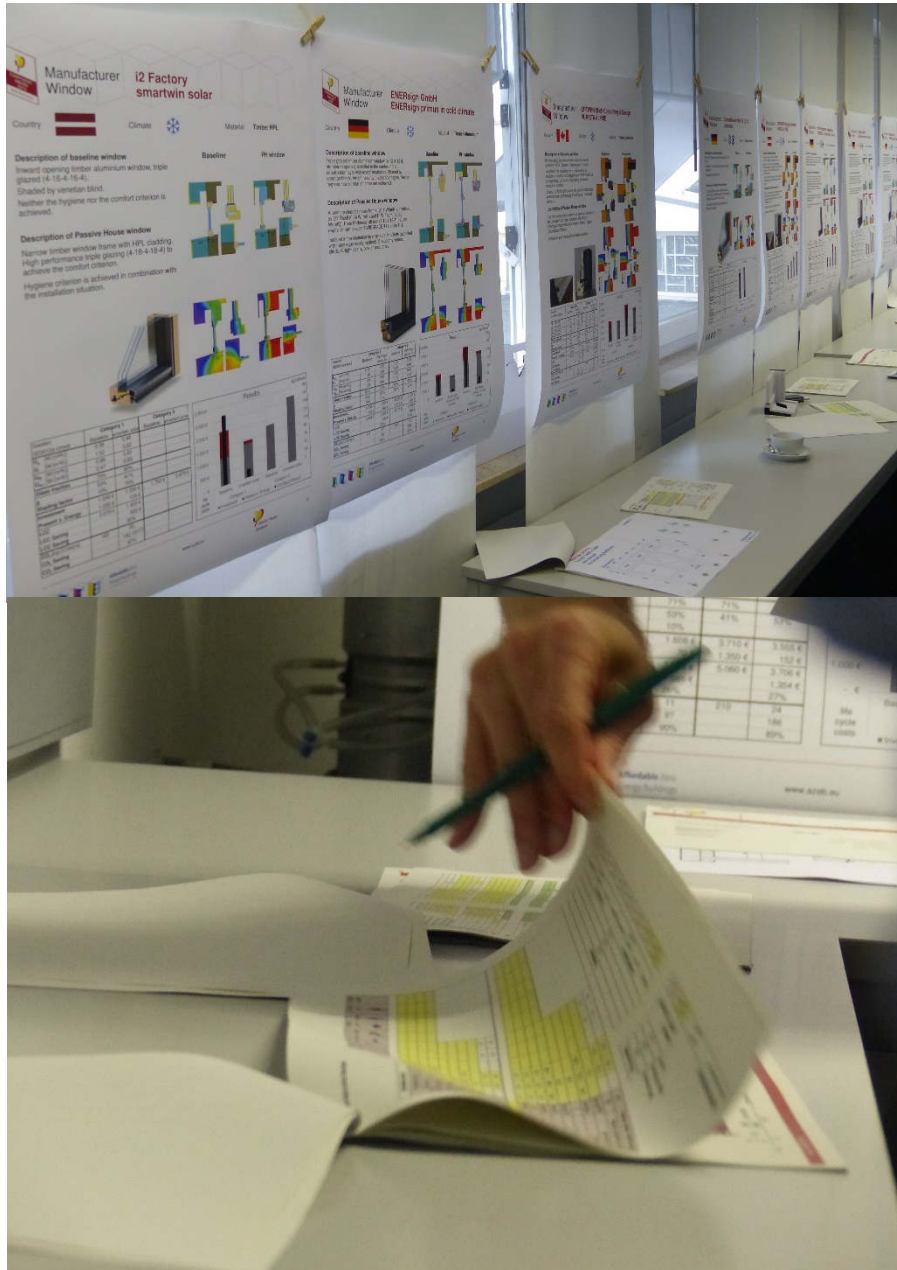
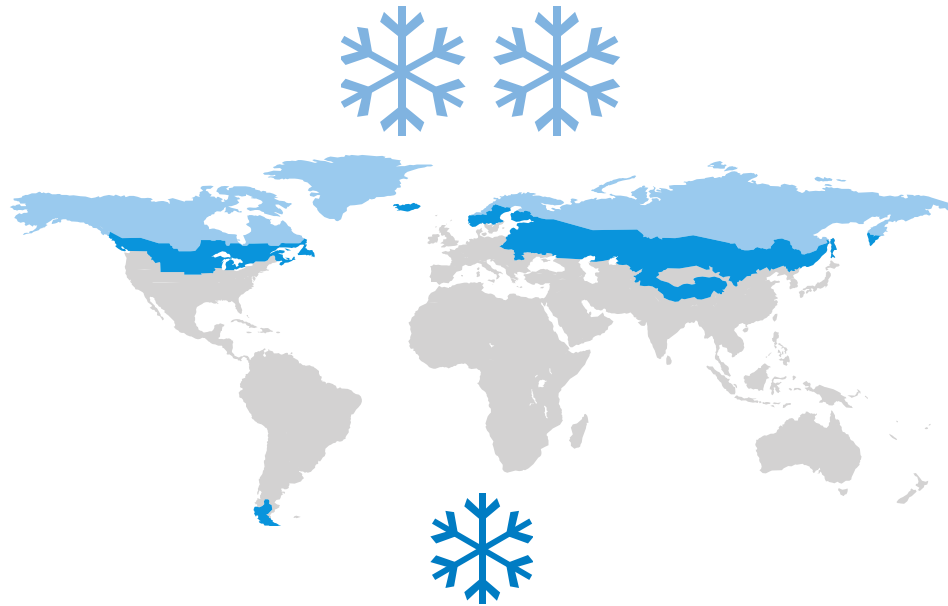


Figure 15: Posters and reports presented to the jury. (PHI 2019)

## 6 | Arctic and cold climates



For the arctic climate, ENERsign GmbH from Germany applied with the quadruple glazed window ENERsign arctis in the category Timber Aluminium.

For the cold climate zone, six windows were applied, all in the category Timber Aluminium:

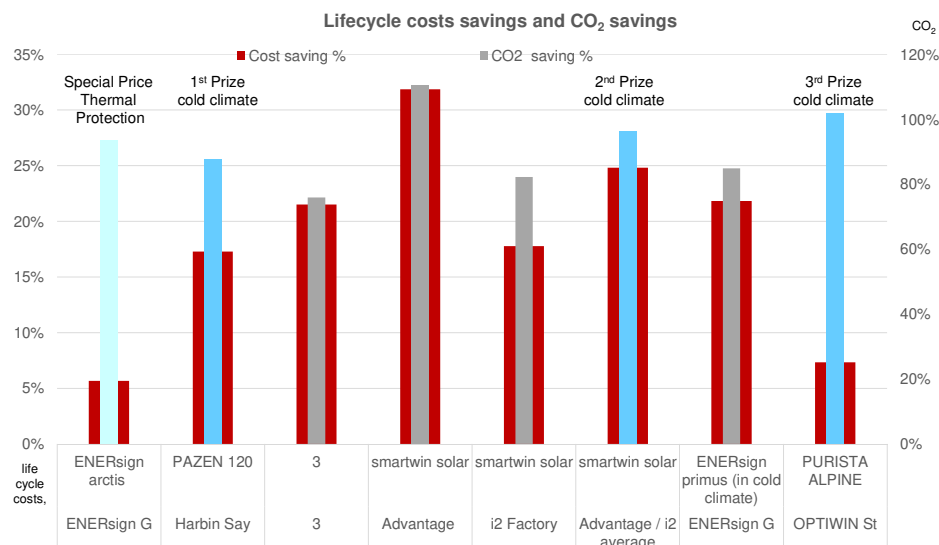
- Sayyas, China with PAZEN 120
- ENERsign, Germany with ENERsign primus
- OPTIWIN: Stich consulting from Canada with PURISTA ALPINE
- Advantage Architectural Woodworks from the USA with smartwin solar
- I2 factory from Latvia with smartwin solar
- 3

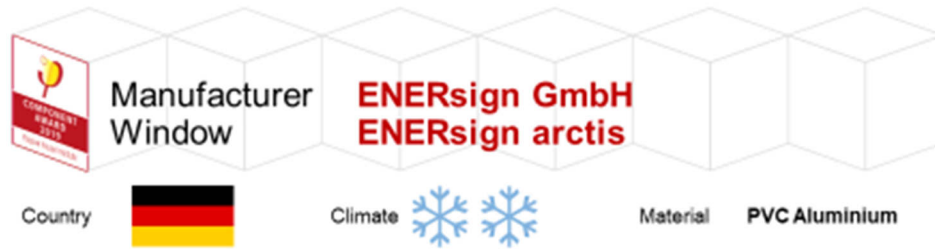
According to the rules of the Component Award, prizes could only be given for a category with three or more participants.

Because in the arctic climate zone only one participant had applied, it was not possible to award a regular prize. But ENERsign arctis convinced the jury by its high aesthetic quality and maximum thermal protection, so the jury granted the Special Prize for thermal protection to ENERsign arctis.

The assessment of the award allows the giving of prizes to three of the six participants in the category cold climate | Timber Aluminium. The jury decided as follows:

- 1<sup>st</sup> Prize to PAZEN 120 from SAYYAS, China
- 2<sup>nd</sup> Prize to smartwin solar from Advantage Architectural Woodworks, USA and i2 factory, Latvia
- 3<sup>rd</sup> Prize to PURISTA ALPINE from OPTIWIN: Stich consulting, Canada





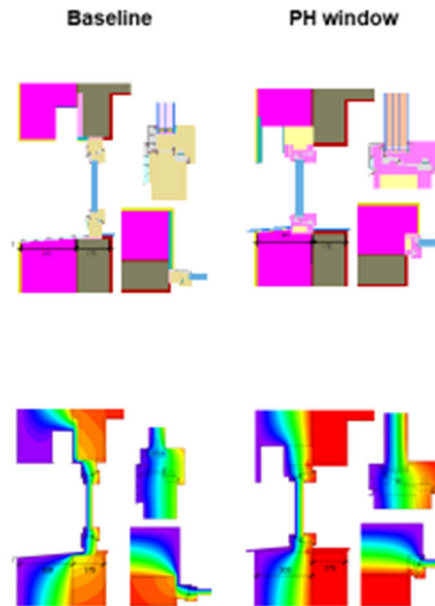
### Description of baseline window

Triple glazed timber aluminium window (4-12-4-12-4, aluminium spacer), installed in the center of the construction layer with reveal insulation. Shaded by venetian blinds. Airtightness by plasterable tapes. Neither hygiene, nor comfort criterion are achieved.

### Description of Passive House window

Aluminium clad ENERcell frame (0,06 W/(mK)), insulated by resolic foam (0,023 W/(mK)) with quadruple glazing (49 mm 4/12/3/12/3/12/3), rebate depth: 20 mm, spacer: MULTITECH G with DOWSIL 3364 warm edge sealant.

Installed in the insulation layer by steel brackets (modelled with mass equivalency method). Shaded by venetian blinds. Airtightness by plasterable tapes.



## 6.1 ENERsign GmbH, Germany: ENERsign arctis

ENERsign arctis is a variant to the timber aluminium window ENERsign primus. To date, ENERsign arctis is the only known window that is suitable for the arctic climate zone.

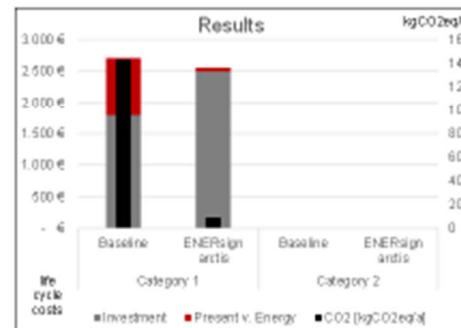
This is achieved by a quadruple glazing combined with the improved primus frame, which is in the applied variant completely constructed from ENERcell, a PVC foam. So, strictly speaking, the presented window is a PVC aluminium window, but because of its origin and its method of production, it was entered into the category Timber Aluminium.

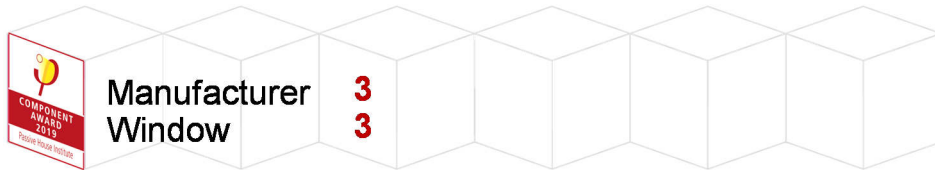
The jury praised the high aesthetic standard in combination with the extraordinary thermal protection, which is leading to CO2 savings of 94% and the achievement of the hygiene as well as the comfort criterion - even in the arctic climate of Kiruna/Sweden.

Because in the arctic climate zone only one participant had applied, it was not possible to award a regular prize. But ENERsign arctis convinced the jury by its high aesthetic quality and maximum thermal protection, so the jury granted the

**Special Prize for thermal protection to ENERsign arctis.**

Sweden SE0007a-Kiruna	Category 1		Category 2	
	Baseline	ENERsign arctis	Baseline	ENERsign arctis
U <sub>f</sub> [W/(m <sup>2</sup> K)]	0,72	0,30		
U <sub>w</sub> [W/(m <sup>2</sup> K)]	1,26	0,45		
U <sub>gl</sub> [W/(m <sup>2</sup> K)]	1,13	0,38		
U <sub>wa</sub> [W/(m <sup>2</sup> K)]	1,78	0,41		
Glass fraction	63%	72%		
g	53%	50%		
Shading factor	10%	10%		
Investment	1.790 €	2.495 €		
Present v. Energy	919 €	92 €		
LCC	2.709 €	2.555 €		
LCC Saving		154 €		
LCC Saving		6%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	143	9		
CO <sub>2</sub> Saving		134		
CO <sub>2</sub> Saving		94%		





Country Climate Material **Timber Aluminium**

**Description of baseline window**

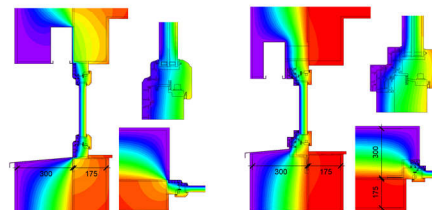
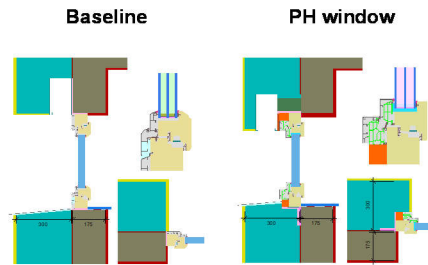
68 mm timber aluminium window, triple glazed (5/12/5/12/5), aluminium spacer.

Installed at the edge of the construction layer, shaded by venetian blinds.

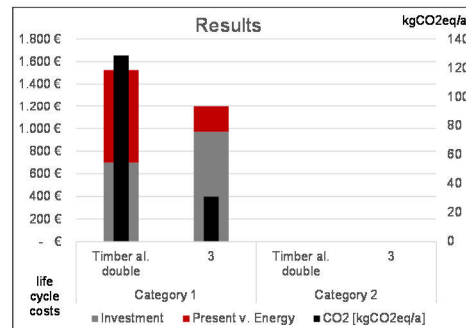
**Description of Passive House window**

Timber aluminium frame (timber 0.13 W/(mK)) with insulation (XPS 0.029 W/(mK)); Pane thickness: 45 mm (5/15/5/15/5), rebate depth: 21 mm, spacer: SWISSPACER Ultimate.

Installed in the insulation layer, supported by thermally separated steel brackets (mass equivalency method) and high rigid EPS-foam. Shaded by venetian blinds.



China CN0005a-Harbin	Category 1		Category 2	
	Timber al. double	3	Timber al. double	3
U <sub>g</sub> [W/(m <sup>2</sup> K)]	1,00	0,60		
U <sub>t</sub> [W/(m <sup>2</sup> K)]	1,05	0,79		
U <sub>w</sub> [W/(m <sup>2</sup> K)]	1,26	0,74		
U <sub>w,j</sub> [W/(m <sup>2</sup> K)]	2,22	0,80		
Glass fraction	66%	64%		
g	60%	52%		
Shading factor	10%	10%		
Investment	698 €	970 €		
Present v. Energy	827 €	228 €		
LCC	1.526 €	1.197 €		
LCC Saving		328 €		
LCC Saving		22%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	129	31		
CO <sub>2</sub> Saving		98		
CO <sub>2</sub> Saving		76%		



6.2 – 3 –

This timber aluminium window is installed by steel brackets in the insulation layer of the wall. The housing for the shading blinds is mounted by a high rigid EPS foam block, which is a good idea. However, the use of steel brackets leads to avoidable high thermal bridging values.

The jury praised the high energy CO<sub>2</sub> savings of this window.

In the harsh climate of Harbin, the comfort criterion is not met.



Country  Climate  Material Timber Aluminium

#### Description of baseline window

Aluminium cladded timber frame (0,13 W/(mK)).  
 Pane thickness: 25mm(5/15/5), rebate depth: 15 mm, spacer: Stainless steel with polyurethane as secondary seal.

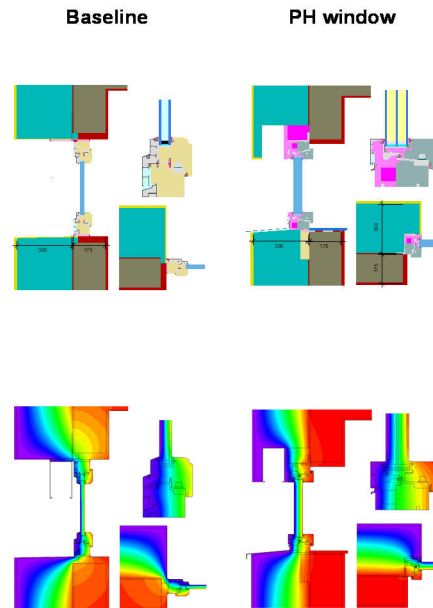
Installed in the constructive layer. Airtightness by silicone. Shades by venetian blinds.

#### Description of Passive House window

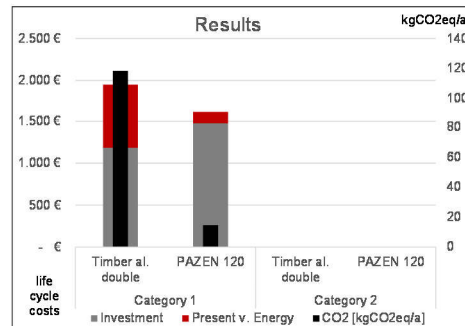
Aluminium cladded timber frame (0,11 W/(mK)), insulated by ENERcell (0,06 W/(mK)) and EPS-Foam). Pane thickness: 48 mm (4/18/4/18/4), rebate depth: 15 mm, spacer: MULTITECH with polyurethane as secondary seal.

Installed in the insulation layer. Fastened by timber beam (bottom) and steel angles (lateral, top). Shaded by venetian blinds.

Air tightness by plaster able tapes.



China CN0005a-Harbin	Category 1		Category 2	
	mber al. dou	PAZEN 120	mber al. dou	PAZEN 120
$U_g$ [W/(m <sup>2</sup> K)]	1,12	0,53		
$U_r$ [W/(m <sup>2</sup> K)]	1,40	0,64		
$U_w$ [W/(m <sup>2</sup> K)]	1,36	0,61		
$U_{w,z}$ [W/(m <sup>2</sup> K)]	2,07	0,65		
Glass fraction	65%	72%		
g	63%	53%		
Shading factor	10%	10%		
Investment	1.184 €	1.475 €		
Present v. Energy	765 €	136 €		
LCC	1.948 €	1.611 €		
LCC Saving		337 €		
LCC Saving		17%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	118	15		
CO <sub>2</sub> Saving		104		
CO <sub>2</sub> Saving		88%		



### 6.3 Harbin Sayyas Windows Stock Co., Ltd., PAZEN120

Harbin Sayyas Windows Stock Co., Ltd. currently holds 8 window certificates, 2 certificates for curtain walls, 2 for entrance doors and one for a frame for fixed glazing.

PAZEN 120 is a timber aluminium window, installed in the insulation layer. The housing for the venetian blind is attached directly to the frame, which results in low thermal bridging values for installation. The frame is connected to the wall by a timber beam at the sill and steel brackets on side and top.

The jury praised the high aesthetic standard in combination with high levels of thermal protection, which leads to CO<sub>2</sub> savings of 88% and to the achievement of the hygiene as well as the comfort criterion, even in the harsh climate of Harbin.

For PAZEN120, the jury awarded the

**1<sup>st</sup> Prize in the category Cold Climate.**



Country

Climate



Material

Timber HPL

#### Description of baseline window

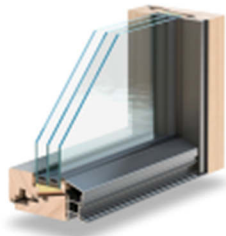
Inward opening timber aluminium window, double glazed (3-13-3) with aluminium spacer  
Shaded by venetian blind.

Neither the hygiene nor the comfort criterion is achieved.

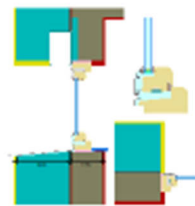
#### Description of Passive House window

Narrow timber window frame with HPL cladding. High performance, solar optimized triple glazing ECLAZ (4-18-4-18-4 - imported from Europe) for optimum energy balance.

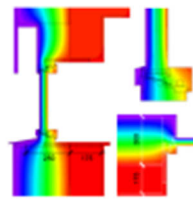
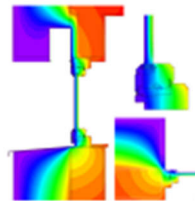
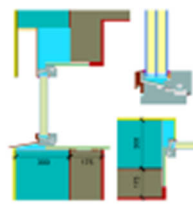
Hygiene criterion is achieved in combination with the installation situation.



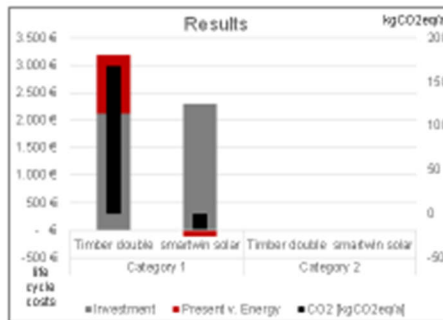
#### Baseline



#### PH window



United States of Amer UB0094a_Gumison	Category 1		Category 2	
	Timber double	smartwin solar	Timber double	smartwin solar
U <sub>f</sub> [W/m <sup>2</sup> K]	1.42	0.55		
U <sub>i</sub> [W/m <sup>2</sup> K]	1.68	0.82		
U <sub>e</sub> [W/m <sup>2</sup> K]	1.67	0.56		
U <sub>wa</sub> [W/m <sup>2</sup> K]	2.56	0.58		
Glass fraction	73%	80%		
g <sub>g</sub>	41%	60%		
Shading factor	10%	10%		
Investment	2.111 €	2.285 €		
Present v. Energy	1.082 €	- 109 €		
LCC	3.193 €	2.176 €		
LCC Saving		1.017 €		
LCC Saving		32%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	958	-18		
CO <sub>2</sub> Saving		186		
CO <sub>2</sub> Saving		110%		



## 6.4 Advantage Architectural Woodwork: smartwin solar

Smartwin solar is a very thin timber window with weather protection cladding from high pressure laminate, installed in the insulation layer using a plywood frame connector. This frame connector enables installation of the window in the middle of the insulation layer without additional load-bearing elements, thereby avoiding additional losses via thermal bridging. The narrow shutter housing and rails are made by the window manufacturer themselves and become an integral part of the window, which is both cost-efficient and nearly thermal bridge free. The decision to use HPL instead of aluminium for the cladding allows the manufacturer to offer various designs and a high grade of individualization. The window sill is also from HPL and is directly inserted into the frame.

In this case, the smartwin is compared with a double glazed outward opening timber aluminium window. The high performance glazing is imported from Europe and has shorter delivery times and lower costs than a regionally available double glazing of moderate thermal quality.

The jury praised the high aesthetic and innovative standard in combination with high thermal protection, which is leading to astonishing CO<sub>2</sub> savings of 110% - this is possible because the window gains more heat than it loses.

For smartwin solar, the jury awarded the

**2<sup>nd</sup> Prize in the category Cold Climate.**

Advantage Architectural Woodworks shares the prize with i2 Factory, participating with the same window.



## 6.5 i2 Factory: smartwin solar



### Description of baseline window

Inward opening timber aluminium window, triple glazed (4-16-4-16-4).

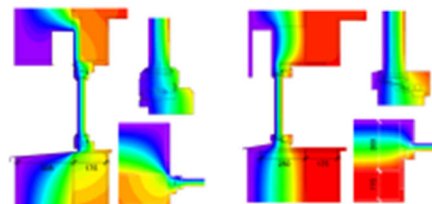
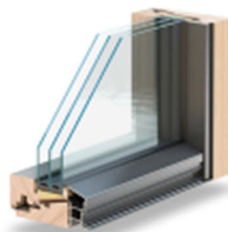
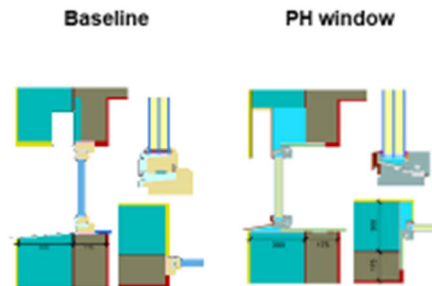
Shaded by venetian blind.

Neither the hygiene nor the comfort criterion is achieved.

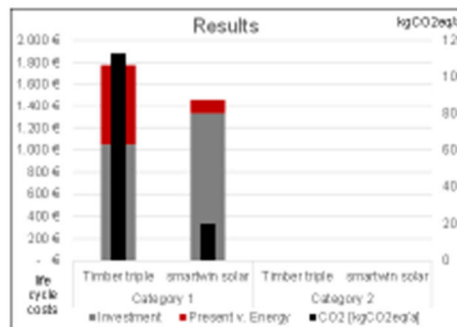
### Description of Passive House window

Narrow timber window frame with HPL cladding. High performance triple glazing (4-18-4-18-4) to achieve the comfort criterion.

Hygiene criterion is achieved in combination with the installation situation.



Sweden SE0012a-Umeå	Category 1		Category 2	
	Timber triple	smartwin solar	Timber triple	smartwin solar
U <sub>g</sub> [W/(m <sup>2</sup> K)]	0.58	0.48		
U <sub>f</sub> [W/(m <sup>2</sup> K)]	1.52	0.82		
U <sub>hw</sub> [W/(m <sup>2</sup> K)]	0.98	0.50		
U <sub>hw</sub> [W/(m <sup>2</sup> K)]	1.87	0.53		
Glass fraction	73%	80%		
g	53%	41%		
Shading factor	93%	93%		
Investment	1.048 €	1.330 €	1.793 €	2.679 €
Present v. Energy	726 €	129 €		
LCC	1.775 €	1.459 €		
LCC Saving		316 €		
LCC Saving		93%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	113	20		
CO <sub>2</sub> Saving		93		
CO <sub>2</sub> Saving		82%		



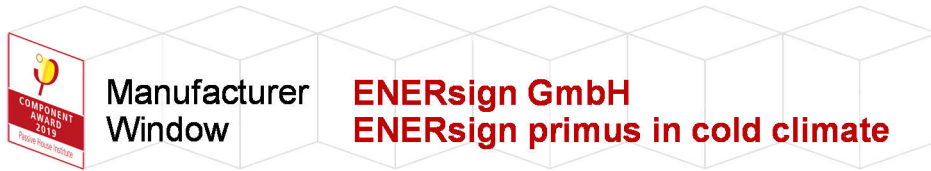
Smartwin solar is a very thin timber window with weather protection cladding from high pressure laminate, installed in the insulation layer using a plywood frame connector. This frame connector enables installation of the window in the middle of the insulation layer without additional load-bearing elements, thereby avoiding additional losses via thermal bridging. The narrow shutter housing and rails are made by the window manufacturer themselves and become an integral part of the window, which is both cost-efficient and nearly thermal bridge free. The decision to use HPL instead of aluminium for the cladding allows the manufacturer to offer various designs and a high grade of individualization. The window sill is also from HPL and is directly inserted into the frame.

In this case, the smartwin is compared with a triple glazed outward opening timber aluminium window. The harsh climate of Umea requires a U-value optimized glazing with  $U_g = 0,48 \text{ W}/(\text{m}^2\text{K})$  to achieve the comfort criterion.

The jury praised the high aesthetic and innovative standard in combination with high levels of thermal protection. The narrow frame allows a glass fraction of 80%, the highest in the whole competition for category 1.

For smartwin solar, the jury awarded the 2<sup>nd</sup> Prize in the category Cold Climate.

i2 Factory shares the prize with Advantage Architectural Woodwork, which applied with the same window.



Country  Climate  Material Timber Aluminium

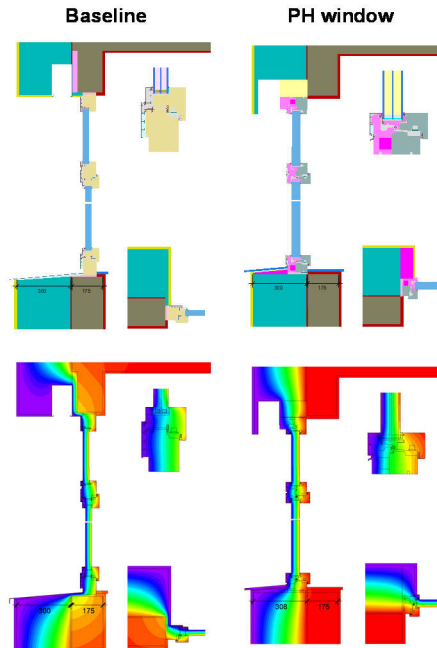
**Description of baseline window**

Triple glazed timber aluminium window (4-12-4-12-4, aluminium spacer), installed in the center of the construction layer with reveal insulation. Shaded by venetian blinds. Airtightness by plasterable tapes. Neither hygiene, nor comfort criterion are achieved.

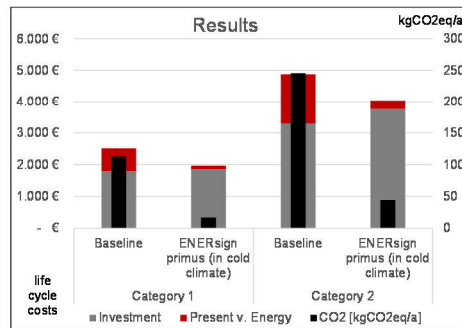
**Description of Passive House window**

Aluminium cladged timber frame (0,11 W/(mK)), insulated by ENERcell (0,06 W/(mK)) and EPS-Foam (0,032 W/(mK)). Pane thickness: 48 mm (4/18/4/18/4), rebate depth: 15 mm, spacer: SWISSPACER Ultimate PU.

Installed in the insulation layer by steel brackets (modeled with mass equivalency method). Shaded by venetian blinds. Airtightness by plaster able tapes.



Sweden SE0012a-Umeå	Category 1		Category 2	
	Baseline	ENERsign primus (in)	Baseline	ENERsign primus (in)
U <sub>g</sub> [W/(m²K)]	0,72	0,53	0,72	0,53
U <sub>i</sub> [W/(m²K)]	1,26	0,64	1,29	0,61
U <sub>w</sub> [W/(m²K)]	1,13	0,61	1,29	0,64
U <sub>w,i</sub> [W/(m²K)]	1,78	0,62	1,78	0,65
Glass fraction	63%	72%	61%	66%
g	53%	53%	53%	53%
Shading factor	10%	10%		
Investment	1.790 €	1.856 €	3.297 €	3.751 €
Present v. Energy	725 €	109 €	1.578 €	287 €
LCC	2.514 €	1.966 €	4.876 €	4.038 €
LCC Saving		549 €		838 €
LCC Saving		22%		17%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	113	17	246	45
CO <sub>2</sub> Saving		96		201
CO <sub>2</sub> Saving		85%		82%



**6.6 ENERsign GmbH: ENERsign primus in cold climate**

ENERsign GmbH applied with ENERsign primus for the cold and cool temperate climate zones.

ENERsign primus is a timber aluminium window, insulated by ENERcell, a PVC foam and EPS foam. The ENERcell material is not only insulation, it also carries the loads of the glazing, resulting in both low thermal losses and high interior surface temperatures. The shutter housing is directly applied to the frame and insulated by resolic foam against the wall. This results in an installation thermal bridge of only 0.007 W/(m²K) including the shutter housing. The rails for the shutter are directly attached to the frame, giving both a high-quality aesthetic impression and low thermal bridging values. The window is fixed by metal brackets into the wall.

The window is compared to a triple glazed timber aluminium window, installed in the construction layer with reveal insulation.

The jury praised the high aesthetic standard, in combination with the high level of thermal protection.

ENERsign primus is certainly worthy of a prize. The jury decided to grant one for the climate region cool, temperate. For more information, see there.



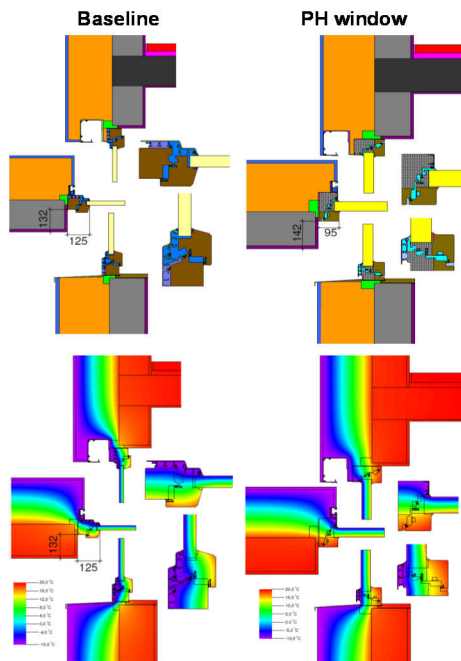
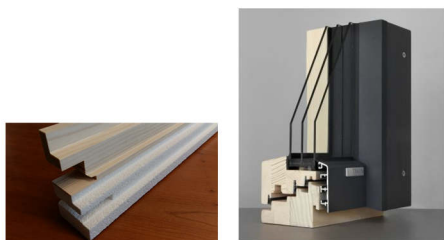
Country  Climate  Material Timber Aluminium

#### Description of baseline window

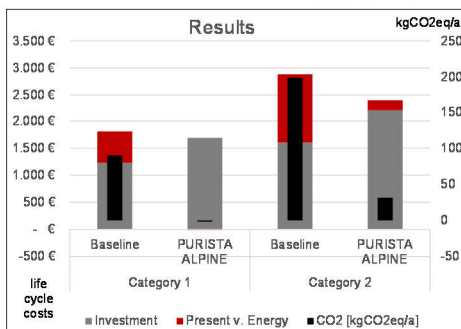
85 mm strong aluminium timber window, double glazed (4/16/4); Spacer – Superspacer Tri Seal. Installed in the insulation layer, fully covered by insulation. Installed in CompacFoam PREFRAME as an expensive, but clean, long lasting and noise protective solution. Shaded by Roma ZIP screen, rail guided, electrically powered and automatically driven by sun and wind sensors.

#### Description of Passive House window

149 mm strong timber aluminium window, insulated by CompacFoam, triple glazed (4/18/4/18/4); Glazing constantly bonded with the Frame; Spacer – Superspacer Tri Seal. Installation and shading like baseline window.



Canada CA0005b-Calgary	Category 1		Category 2	
	Baseline	PURISTA ALPINE	Baseline	PURISTA ALPINE
$U_g$ [W/(m <sup>2</sup> K)]	1,40	0,52	1,40	0,52
$U_f$ [W/(m <sup>2</sup> K)]	1,30	0,50	1,27	0,52
$U_{w1}$ [W/(m <sup>2</sup> K)]	1,46	0,58	1,50	0,62
$U_{w2}$ [W/(m <sup>2</sup> K)]	1,63	0,60	1,63	0,65
Glass fraction	67%	74%	64%	63%
g	41%	50%	41%	50%
Shading factor	10%	10%	10%	10%
Investment	1.231 €	1.688 €	1.603 €	2.199 €
Present v. Energy	579 €	11 €	1.279 €	203 €
LCC	1.810 €	1.677 €	2.882 €	2.401 €
LCC Saving		133 €		481 €
LCC Saving		7%		17%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	90	-2	199	32
CO <sub>2</sub> Saving		92		167
CO <sub>2</sub> Saving		102%		84%



## 6.7 OPTIWIN Stich Consulting & Design: PURISTA ALPINE

Optiwin is a group of Passive House Window manufacturers, holding Passive House window certificates since 1998. Stich Consulting and Design is the Canadian Partner.

PURISTA ALPINE was entered into the cool, temperate climate category by Freisinger Fensterbau and into the cold climate category by Stich Consulting.

PURISTA ALPINE is the most advanced window of the Optiwin group, designed for cold climates like in the high Alps or in Canada and Sweden. The frame consists partly of high rigid EPS-foam, by which very good frame U-values of only 0.47 W/(m<sup>2</sup>K) are achieved.

The window is mounted by a blind frame of highly rigid EPS-foam, which provides a clean and fast fixing solution. The window is shaded by an automatically driven ZIP screen. The screen housing is attached to the frame for a low thermal bridge effect.

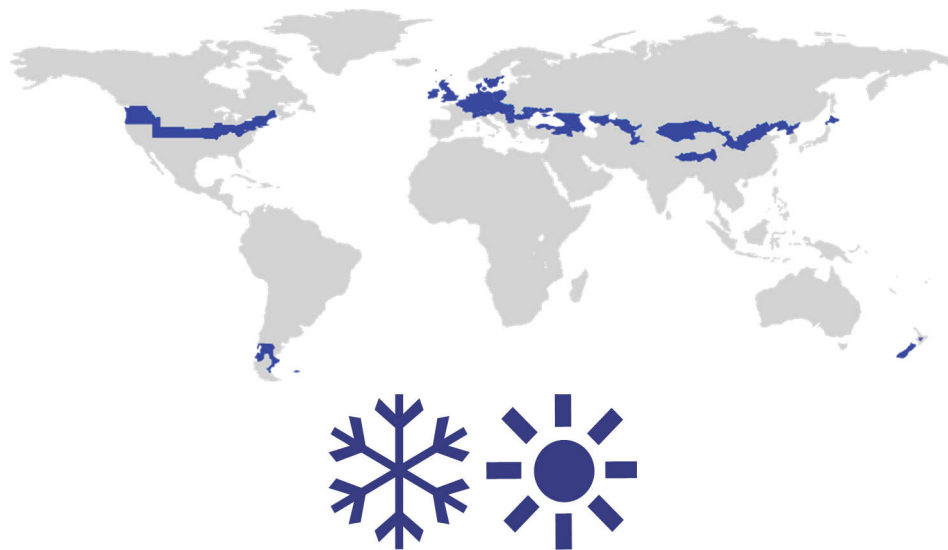
Surprisingly, the double glazed reference window is installed in the same way, which is not typical for Canada. This improves the reference variant vs. the PURISTA ALPINE, leading to relatively low life cycle benefits.

The jury praised the high standard and clean installation situation in combination with the high level of thermal protection, energy and CO<sub>2</sub> savings.

For PURISTA ALPINE, the jury awarded the

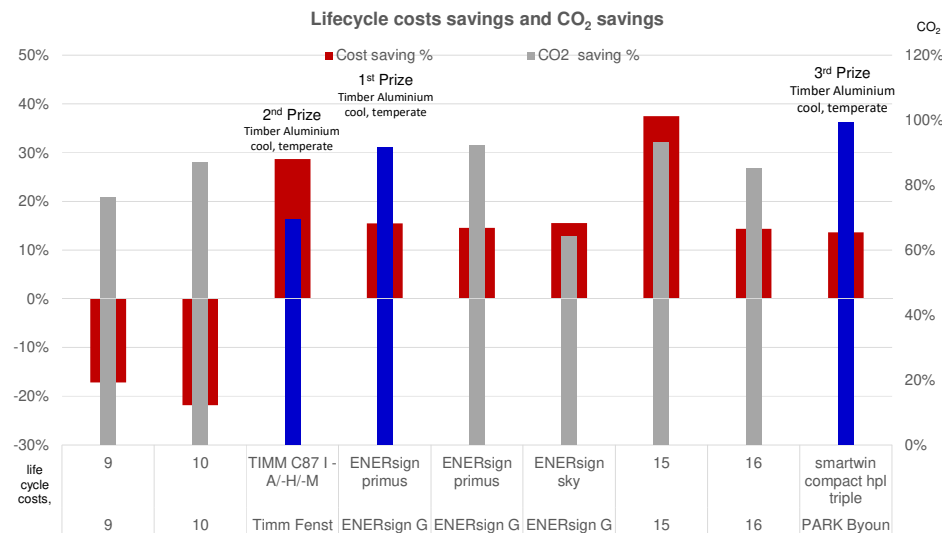
**3<sup>rd</sup> Prize in the category Cold Climate.**

# 7 | Timber Aluminium windows in cool, temperate climates



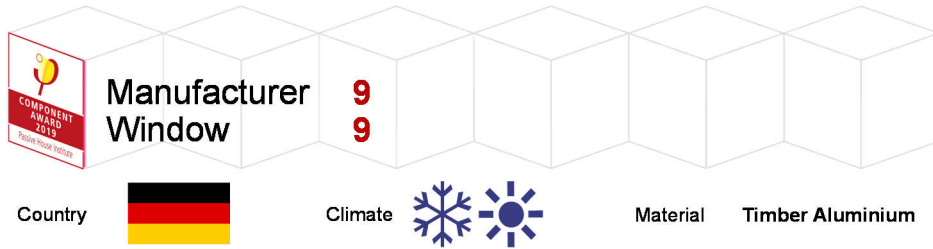
For the cool, temperate climate zone, nine windows and variants were entered into the category Timber Aluminium:

- 9
- 10
- Timm Fensterbau /Mesenburg, Germany with TIMM C87 I –A/-H/-M + W87 –A/-H/-M
- ENERsign GmbH, Germany with ENERsign primus vs a double- and a triple glazed baseline window
- 14
- 15
- 16
- PARK Byoungyoeol, Architecture studio Time, Human and Space, Korea with smartwin compact hpl triple



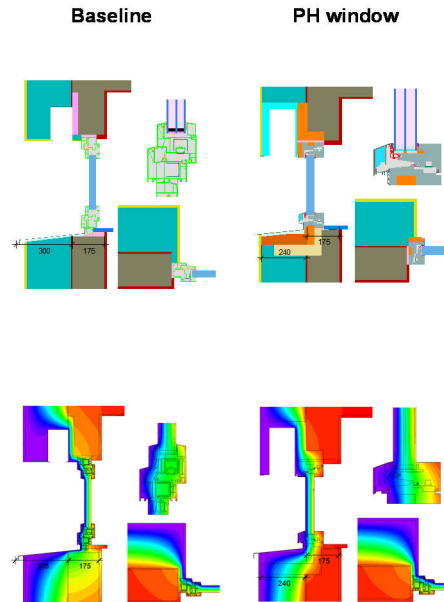
The assessment of the award allows the giving of prizes to three of the nine participants in the category cool, temperate climate | Timber Aluminium. The jury decided as follows:

- 1<sup>st</sup> prize to ENERsign primus from ENERsign GmbH, Germany
- 2<sup>nd</sup> prize to TIMM C87 ... + W87 ... from Timm Fensterbau / Meesenburg, Germany
- 3<sup>rd</sup> prize to smartwin compact triple from PARK Byoungyoeol, Korea

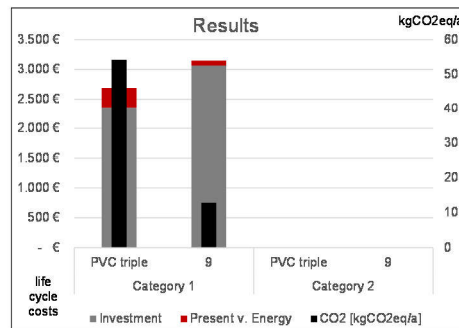


**Description of baseline window**  
 82 mm PVC window with triple glazing (4-14-4-14-4).  
 Installed in the construction layer with reveal insulation.  
 Shaded by venetian blinds.

**Description of Passive House window**  
 Timber aluminium window with triple glazing (4/18/4/18/4), installed partially in the insulation layer by special kind of blind frame.  
 Shaded by venetian blinds, airtightness by plaster able tapes.



Deutschland DE0036a-München	Category 1		Category 2	
	PVC triple	9	PVC triple	9
$U_g$ [W/(m <sup>2</sup> K)]	0,64	0,53		
$U_f$ [W/(m <sup>2</sup> K)]	0,37	0,73		
$U_w$ [W/(m <sup>2</sup> K)]	0,65	0,60		
$U_{w,f}$ [W/(m <sup>2</sup> K)]	1,37	0,77		
Glass fraction	65%	76%		
g	53%	53%		
Shading factor	10%	10%		
Investment	2.340 €	3.067 €		
Present v. Energy	349 €	83 €		
LCC	2.689 €	3.150 €		
LCC Saving	-	481 €		
LCC Saving		-17%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	54	13		
CO <sub>2</sub> Saving		41		
CO <sub>2</sub> Saving		76%		



The window is compared to a triple glazed PVC window, which is a hard choice, because the investment costs of Timber Aluminium windows are about 2 times the price of a PVC window.  
 The window is installed with a special blind frame, which has an integrated solution for a water tight window sill.

The jury praised the high aesthetic standard of the window and clean installation situation, as well as the innovative idea of the water tight sealing of the window sill. Unfortunately it turns out that this solution is expensive.

The jury indicated some improvements of the installation situation like moving the window to the outside of the insulation layer, using a slimmer shutter housing and less timber in the bottom part of the blind frame.



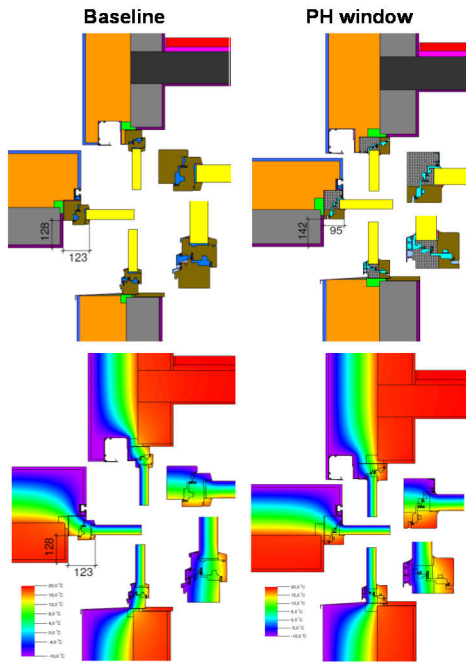
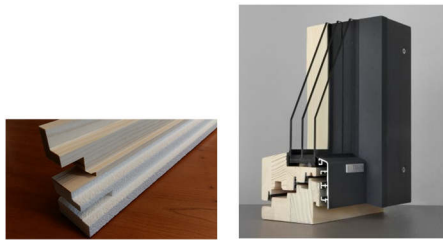
Country Climate Material **Timber Aluminium**

**Description of baseline window**

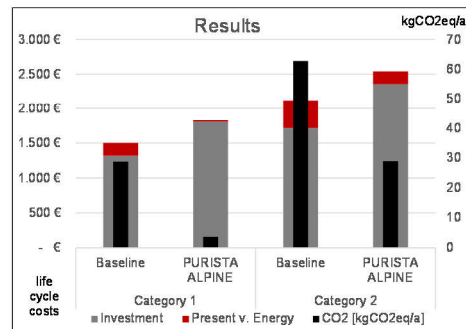
92 mm strong timber window, triple glazed (4/16/4/16/4); Spacer – Superspacer Triseal. Installed in the insulation layer, fully covered by insulation. Installed in CompacFoam PREFRAME as an expensive, but clean, long lasting and noise protective solution. Shaded by Roma ZIP screen, rail guided, electrically powered and automatically driven by sun and wind sensors.

**Description of Passive House window**

149 mm strong timber aluminium window, installed by CompacFoam, triple glazed (4/18/4/18/4); Glazing constantly bonded with the Frame; Spacer – Superspacer Triseal. Installation and shading like baseline window. Glazing imported from Europe.



Austria AT0037a-Wörgel	Category 1		Category 2	
	Baseline	PURISTA ALPINE	Baseline	PURISTA ALPINE
U <sub>g</sub> [W/(m²K)]	0,60	0,52	0,60	0,52
U <sub>t</sub> [W/(m²K)]	1,01	0,50	1,00	0,52
U <sub>w</sub> [W/(m²K)]	0,80	0,58	0,84	0,62
U <sub>w,j</sub> [W/(m²K)]	1,02	0,60	1,00	0,65
Glass fraction	67%	74%	67%	63%
g	50%	50%	50%	50%
Shading factor	10%	10%	10%	10%
Investment	1.319 €	1.808 €	1.717 €	2.356 €
Present v. Energy	185 €	24 €	404 €	186 €
LCC	1.504 €	1.832 €	2.121 €	2.542 €
LCC Saving		- 328 €		- 421 €
LCC Saving		-22%		-20%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	29	4	63	29
CO <sub>2</sub> Saving		25		34
CO <sub>2</sub> Saving		87%		54%



7.2 6.2 – 10 –

The window is designed for cold climates like in the high Alps or in Canada and Sweden. The frame consists partly out of high rigid EPS-foam, by which very good frame U-values of only 0.47 W/(m²K) are achieved.

The window is mounted by a blind frame of high rigid EPS-foam, which provides a clean and fast fixing solution. The window is shaded by an automatically driven ZIP screen. The screen housing is attached to the frame for a low thermal bridge effect.

Surprisingly, the triple glazed reference window is installed in the same way, which is said to be typical for all Freisinger products. This improves the reference variant vs. the PURISTA ALPINE, leading to negative life cycle benefits.

The jury praised the high standard and clean installation situation in combination with the high levels of thermal protection, energy and CO<sub>2</sub> savings.

**Manufacturer Window**  
**Timm Fensterbau / Meesenburg**  
**TIMM C87 I -A/-H/-M + W87 -A/-H/-M**

Country  Climate  Material **Timber Aluminium**

**Description of baseline window**

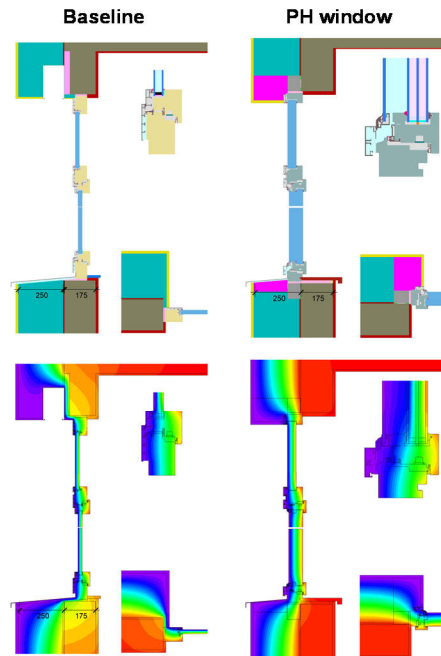
Triple glazed timber aluminium window (4-16-4, stainless steel spacer), installed in the center of the construction layer with reveal insulation. Shaded by venetian blinds. Airtightness by plaster able tapes.

**Description of Passive House window**

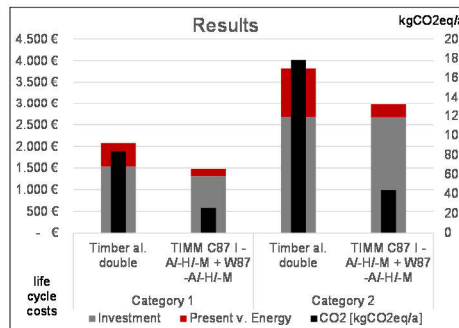
Coupled timber aluminium window with venetian blind shading in the air gap Glazing: 5-40 air-4-12-4-12-4 for the sash) 4-18-4-18-4 for the fixed elements. fixed elements shaded by interior blinds. Installed by Blaugelb Triotherm+ in the insulation layer. Airtightness by compression tapes. Edge bond: Multitech with Butyl secondary seal.

The air-gap integrated shading is causing additional shading in its opened state also. This is included in the additional shading factor.

The window is installed by use of Blaugelb Triotherm+ by Meesenburg.



Germany DE0008a-Polsdam	Category 1		Category 2	
	Timber al. double	TIMM C87 I -A/-H/-M + W87 -A/-H/-M	Timber al. double	TIMM C87 I -A/-H/-M + W87 -A/-H/-M
U <sub>g</sub> [W/(m <sup>2</sup> K)]	1,12	0,60	1,12	0,55
U <sub>f</sub> [W/(m <sup>2</sup> K)]	1,41	1,10	1,44	0,76
U <sub>wp</sub> [W/(m <sup>2</sup> K)]	1,35	0,79	1,46	0,70
U <sub>wd</sub> [W/(m <sup>2</sup> K)]	1,97	0,83	1,92	0,74
Glass fraction	63%	73%	61%	69%
g	64%	49%	64%	52%
Shading factor	10%	15%	10%	30%
Investment	1.537 €	1.315 €	2.672 €	2.688 €
Present v. Energy	539 €	165 €	1.147 €	307 €
LCC	2.076 €	1.480 €	3.819 €	2.975 €
LCC Saving		596 €		844 €
LCC Saving		29%		22%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	84	26	178	44
CO <sub>2</sub> Saving		58 €		134 €
CO <sub>2</sub> Saving		69%		75%



**7.3 Timm Fensterbau /Meesenburg, Germany with TIMM C87 I –A/-H/-M + W87 –A/-H/-M**

Timm Fensterbau is a window manufacturer from Berlin, Germany. In cooperation with Meesenburg, a supplier of accessories, the window TIMM C87 I –A/-H/-M + W87 –A/-H/-M was entered.

C87 I –A/-H/-M is a coupled, 3+1 window. A venetian blind, integrated into the air gap between the inner triple and the outer single pane, is able to shade the window for its whole service life nearly without maintenance.

W87 –A/-H/-M is the window with fixed glazing used in combination with the coupled window for category 2. The fixed elements are shaded by internal blinds. The outside parts of the frame can be flexibly clad with aluminium, timber or other metallic claddings.

The window is installed by Meesenburgs mounting frame blaugelb Triotherm+ in the installation layer, which turns out as a method for clean and low-thermal bridge-causing installation.

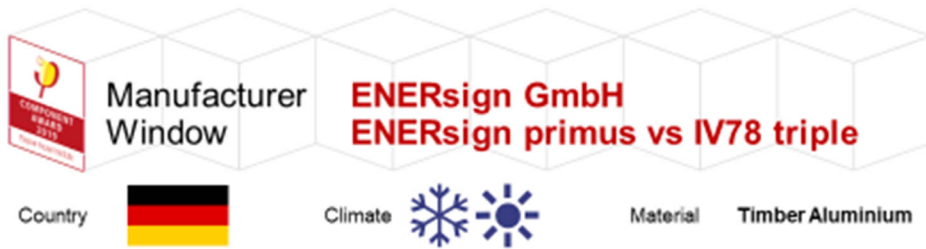
The window was compared with a double glazed Timber Aluminium window in the center of the construction layer.

The jury praised the cost-efficient and low-maintenance shading system as well as the high standard and clean installation situation.

For Germany, the jury indicated, that a triple glazed window should have been used as baseline.

For TIMM C87 I –A/-H/-M + W87 –A/-H/-M in combination with the installation system blaugelb Triotherm by Meesenburg, the jury awarded the

**2<sup>nd</sup> Prize in the category Timber Aluminium in cool, temperate Climate.**



Country



Climate



Material

Timber Aluminium

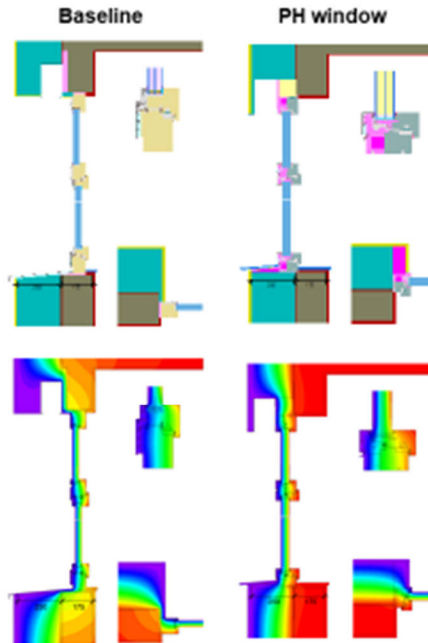
**Description of baseline window**

Triple glazed timber aluminium window (4-12-4-12-4, aluminium spacer), installed in the center of the construction layer with reveal insulation. Shaded by venetian blinds. Airtightness by plasterable tapes. Neither hygiene, nor comfort criterion are achieved.

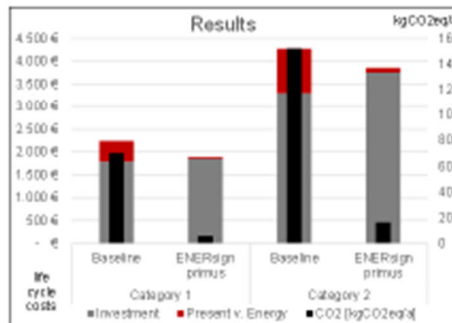
**Description of Passive House window**

Aluminium clad timber frame (0.11 W/(mK)), insulated by ENERcell (0.06 W/(mK)) and EPS-Foam (0.032 W/(mK)). Pane thickness: 48 mm (4/18/4/18/4 ECLAZ), rebate depth: 15 mm, spacer: SWISSPACER Ultimate PU.

Installed in the insulation layer by steel brackets (modeled with mass equivalency method). Shaded by venetian blinds. Airtightness by plasterable tapes.



Germany DE0022a-Trier	Category 1		Category 2	
	Baseline	ENERsign primus	Baseline	ENERsign primus
U <sub>g</sub> [W/(m <sup>2</sup> K)]	0.72	0.55	0.72	0.55
U <sub>w</sub> [W/(m <sup>2</sup> K)]	1.26	0.84	1.29	0.81
U <sub>ext</sub> [W/(m <sup>2</sup> K)]	1.13	0.53	1.29	0.55
U <sub>ext</sub> [W/(m <sup>2</sup> K)]	1.76	0.55	1.76	0.57
Glass fraction g	63%	72%	61%	66%
Shading factor s	53%	60%	53%	60%
Investment	1.700 €	1.856 €	3.297 €	3.751 €
Present v. Energy	451 €	38 €	979 €	106 €
LCC	2.241 €	1.894 €	4.277 €	3.857 €
LCC Saving		347 €		420 €
LCC Saving		15%		10%
CO <sub>2</sub> [kgCO <sub>2</sub> e/g]	70	6	152	16
CO <sub>2</sub> Saving		64		136
CO <sub>2</sub> Saving		92%		89%



**7.4 ENERsign GmbH: ENERsign primus vs. triple glazed window**

ENERsign GmbH applied with ENERsign primus for cold and cool temperate climate. In cool, temperate climate, ENERsign primus was shown against a triple and a double glazing.

Windows from ENERsign's developer Günter Pazen were amongst the first certified Passive House windows, dating back to the late 1990s.

ENERsign primus is a timber aluminium window, insulated by ENERcell, a PVC foam and EPS foam. The ENERcell material is not only insulation, it carries also the loads of the glazing, which results in both low thermal losses and high interior surface temperatures. The shutter housing is directly applied to the frame and insulated by resolic foam against the wall. This results in an installation thermal bridge of only 0.024 W/(m<sup>2</sup>K) including the shutter case. The rails for the shutter are directly attached to the frame, giving both a highly aesthetic impression and low thermal bridging values. The window is fixed by metal brackets into the wall.

The window is compared to a triple glazed Timber Aluminium window installed in the construction layer with reveal insulation.

The jury praised the high aesthetic standard in combination with the high level of thermal protection. Favourably judged was also the aesthetically pleasing integration of the shading and its assembly in the overall concept. According to the opinion of the jury, a triple glazed window is the correct choice as baseline window for Germany.

For ENERsign Primus, the jury awarded the

**1<sup>st</sup> Prize in the category Timber Aluminium in cool, temperate climate**

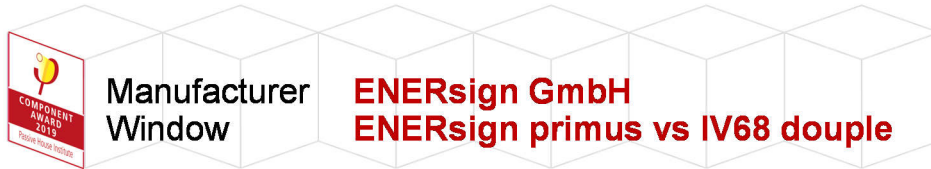


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18





Country  Climate  Material Timber Aluminium

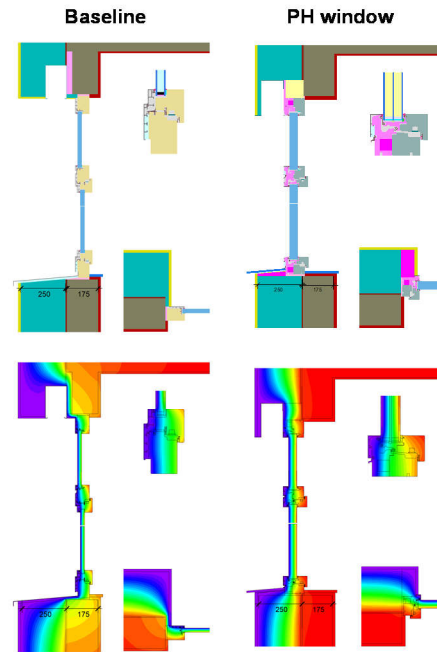
### Description of baseline window

Triple glazed timber aluminium window (4-16-4, stainless steel spacer), installed in the center of the construction layer with reveal insulation. Shaded by venetian blinds. Airtightness by plaster able tapes. Neither hygiene, nor comfort criterion are achieved,

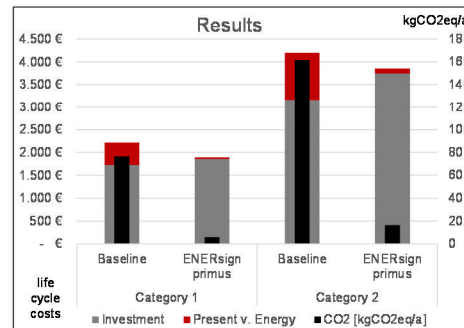
### Description of Passive House window

Aluminium clad timber frame (0,11 W/(mK)), insulated by ENERcell (0,06 W/(mK)) and EPS-Foam (0,032 W/(mK)). Pane thickness: 48 mm (4/18/4/18/4 ECLAZ), rebate depth: 15 mm, spacer: SWISSPACER Ultimate PU.

Installed in the insulation layer by steel brackets (modeled with mass equivalency method). Shaded by venetian blinds. Airtightness by plaster able tapes.



Germany DE0022a-Trier	Category 1		Category 2	
	Baseline	ENERsign primus	Baseline	ENERsign primus
$U_g$ [W/(m <sup>2</sup> K)]	1,12	0,55	1,12	0,55
$U_t$ [W/(m <sup>2</sup> K)]	1,41	0,64	1,44	0,61
$U_w$ [W/(m <sup>2</sup> K)]	1,35	0,63	1,46	0,65
$U_{w,j}$ [W/(m <sup>2</sup> K)]	1,97	0,65	1,92	0,67
Glass fraction	63%	72%	61%	66%
g	64%	60%	64%	60%
Shading factor	10%	10%		
Investment	1.724 €	1.856 €	3.181 €	3.751 €
Present v. Energy	493 €	38 €	1.039 €	106 €
LCC	2.217 €	1.894 €	4.200 €	3.857 €
LCC Saving		323 €		343 €
LCC Saving		15%		8%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	77	6	162	16
CO <sub>2</sub> Saving		71		145
CO <sub>2</sub> Saving		92%		90%



## 7.5 ENERsign GmbH: ENERsign primus vs. double glazed window

ENERsign GmbH applied with ENERsign primus for cold and cool, temperate climate. In the cool, temperate climate, ENERsign primus was compared to a triple and a double glazing.

ENERsign primus is definitely worthy of a prize. According to the opinion of the jury, a triple glazed window is the correct choice as baseline window for Germany.

The jury decided to grant the prize for the climate ENERsign Primus vs. triple glazed window. For more information, see there.

**Manufacturer Window** **ENERsign GmbH**  
**ENERsign sky vs curtain wall triple**

Country  Climate  Material **Timber Aluminium**

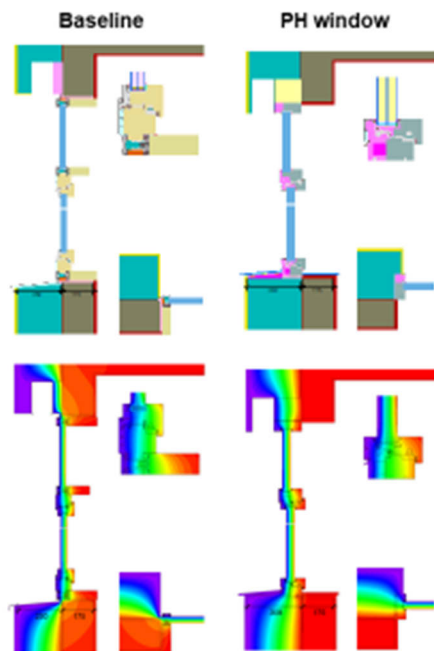
**Description of baseline window**

Triple glazed (4-12-4-12-4, aluminium spacer) timber aluminium curtain wall with IV78 timber aluminium opening element, installed at the edge of the construction layer. Shaded by venetian blinds. Airtightness by plasterable tapes.

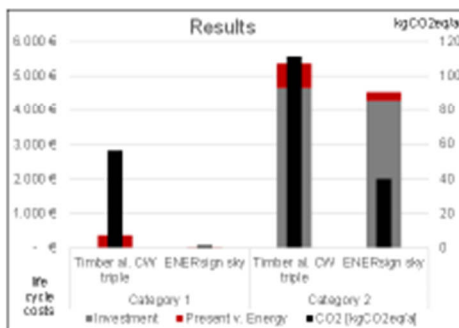
**Description of Passive House window**

Aluminium clad timber frame (0,11 W/(mK)), insulated by ENERcell (0,06 W/(mK)) and EPS-Foam (0,032 W/(mK)). Glazed from the outside as special kind of curtain wall facade. Pane thickness: 48 mm (4/18/4/18/4), rebate depth: 15 mm, spacer: SWISSPACER Ultimate PU.

Installed in the insulation layer by steel brackets (modeled with mass equivalency method). Shaded by venetian blinds. Airtightness by plasterable tapes.



Germany DE 0022a-Trier	Category 1		Category 2	
	Timber al. CW triple	ENERsign sky	Timber al. CW triple	ENERsign sky
U <sub>w</sub> [W/(mK)]	0,72	0,55	0,72	0,55
U <sub>f</sub> [W/(mK)]	1,19	0,64	1,19	0,76
U <sub>w</sub> [W/(mK)]	1,11	0,62	1,29	0,72
U <sub>f</sub> [W/(mK)]	1,49	0,63	1,52	0,72
Glass fraction g	59%	72%	60%	49%
Shading factor s	53%	60%	53%	60%
Investment	- €	- €	4.649 €	4.274 €
Present v. Energy	393 €	13 €	716 €	256 €
LCC	393 €	13 €	5.365 €	4.531 €
LCC Saving		349 €		834 €
LCC Saving		96%		18%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/m <sup>2</sup> ]	56	2	111	40
CO <sub>2</sub> Saving		55		71
CO <sub>2</sub> Saving		97%		64%



**7.6 ENERsign GmbH: ENERsign sky vs. triple glazed window**

ENERsign GmbH applied also with ENERsign sky vs. a triple glazed curtain wall construction for cold and cool temperate climate.

ENERsign sky is a variant without visible frames in development, which shall be placed in the market of curtain wall facades.

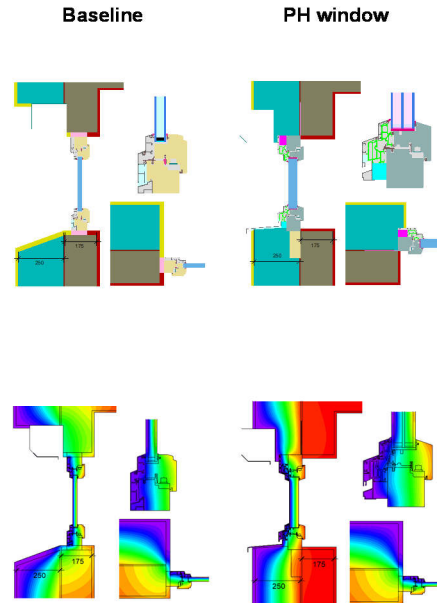
The jury praised the narrow, high esthetic frames as well as the cutting edge vision and emphasis ENERsign GmbH to further develop ENERsign sky.



Country  Climate  Material **Timber Aluminium**

**Description of baseline window**  
 Aluminium cladged timber frame (0,13 W/(mK)).  
 Pane thickness:25mm(5/15/5),rebate depth: 15 mm, spacer: Stainless steel with polyurethane as secondary seal.  
 Installed in the constructive layer. Airtightness by silicone. Shades by roller blinds.

**Description of Passive House window**  
 Timber - PVC profile with aluminium facing shell. SEPS insulation (0.039 W/mK) in the jamb, XPS (0.032 W/mK) in the head and sill profile. Pane thickness: 48 mm (4/18/4/18/4), Swisspaver Ultimate. Rebate depth: 17 mm. Installed by steel brackets (modled by mass equivalency method) in the insulation layer. Shaded by roller blinds. Airtightness by plaster able tapes.

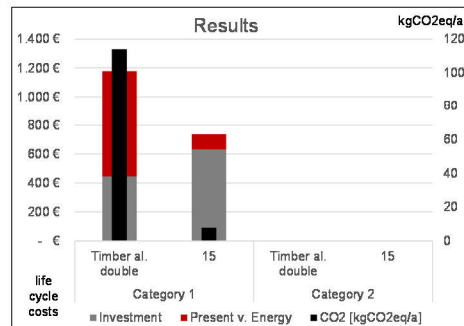


7.7 – 15 –

15 is a Timber Aluminium window, installed in the insulation layer. The window is supported at the bottom by a timber beam and at the sides and top by steel brackets. It is shaded by a roller blind and compared with a double glazed window frame installed at the edge of the construction layer. The baseline window's shutter housing is not insulated against the concrete causing very high levels of thermal bridging.

The jury praised the energy and cost efficiency of this window. Care should be taken regarding the connection of the roller case and the plaster. This connection might cause high maintenance efforts.

China CN0002a-Beijing	Category 1		Category 2	
	Timber al. double	15	Timber al. double	15
U <sub>g</sub> [W/(m²K)]	1,12	0,53		
U <sub>f</sub> [W/(m²K)]	1,40	0,77		
U <sub>w</sub> [W/(m²K)]	1,35	0,68		
U <sub>w,i</sub> [W/(m²K)]	3,18	0,75		
Glass fraction	67%	62%		
g	63%	53%		
Shading factor	10%	10%		
Investment	445 €	629 €		
Present v. Energy	732 €	107 €		
LCC	1.177 €	736 €		
LCC Saving		441 €		
LCC Saving		37%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	114	8		
CO <sub>2</sub> Saving		106		
CO <sub>2</sub> Saving		93%		





Country



Climate



Material

Timber Aluminium

**Description of baseline window**

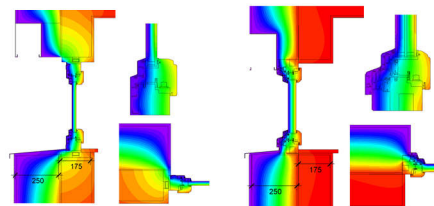
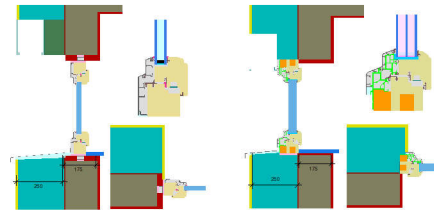
68mm width timber frame , two pane glasses

**Description of Passive House window**

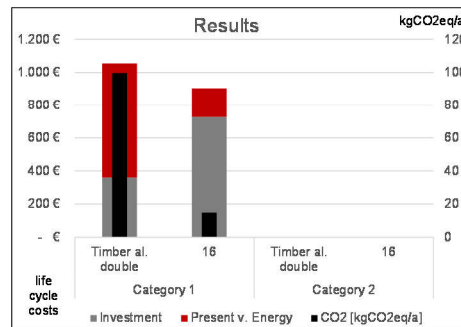
Timber frame with external PVC-aluminium shell and insulation (XPS Q35); Pane thickness: 45 mm (5/15/5/15/5), rebate depth: 13 mm. Spacer: SWISSPACER Ultimate.

Baseline

PH window



China CN0013a-Tianjin	Category 1		Category 2	
	Timber al. double	16	Timber al. double	16
U <sub>g</sub> [W/(m²K)]	1,80	0,70		
U <sub>f</sub> [W/(m²K)]	1,37	0,80		
U <sub>w</sub> [W/(m²K)]	1,80	0,81		
U <sub>wj</sub> [W/(m²K)]	3,06	0,91		
Glass fraction	67%	65%		
g	80%	60%		
Shading factor	10%	10%		
Investment	359 €	727 €		
Present v. Energy	695 €	176 €		
LCC	1.055 €	903 €		
LCC Saving		152 €		
LCC Saving		14%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	100	15		
CO <sub>2</sub> Saving		85		
CO <sub>2</sub> Saving		85%		



7.8 – 16 --

Timber Aluminium window, installed in the insulation layer, supported by steel brackets. It is shaded by a venetian blind and compared with a double glazed window frame installed at the edge of the construction layer. The baseline window's shutter housing is insulated by a highly rigid EPS block against the concrete, causing relatively low levels of thermal bridging.

The jury praised the high energy and CO<sub>2</sub> savings of this window.

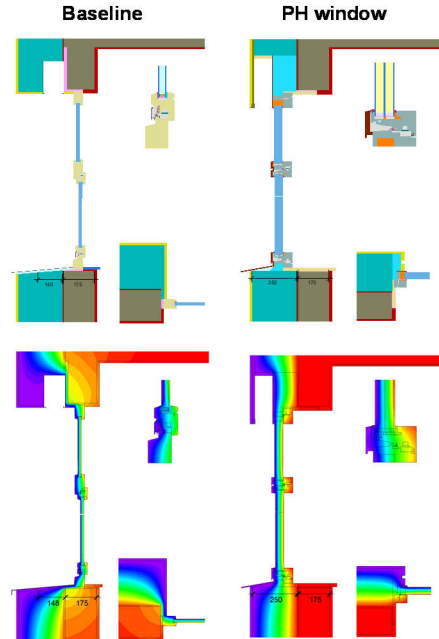
The prices given for the shading is not plausible (75 € for a venetian blind)

**COMPONENT AWARD 2019**  
**Manufacturer Window**  
**PARK Byoungyeol, Architecture studio Time, Human and Space smartwin compact hpl triple**

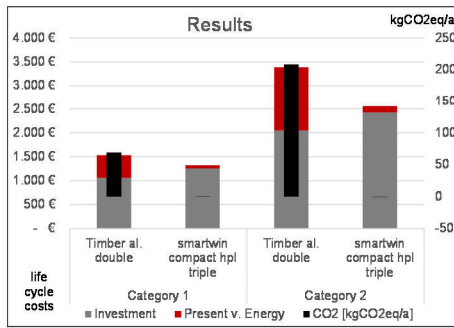
Country  Climate  Material **Timber HPL**

**Description of baseline window**  
 Double glazed (3/14/3) Timber window with aluminium Spacer. Shaded by venetian Blinds.  
 Installed in the construction layer with reveal insulation.

**Description of Passive House window**  
 HPL clad version of smartwin compact: Timber frame (Spruce/Fir, 0.11 W/(mK)), insulated by low dense timber-fiber board (0,04 W/(mK)). Glazing: 4/18/4/18/4, Glass intersection: 15 mm. Spacer: SWISSPACER Ultimate.  
 Shaded by venetian blind in narrow case built by the window manufacturer to minimize the thermal bridge.  
 Installed in the insulation layer by wooden frame connector. Airtightness by plaster able tape.



Korea KR0002a-Jeonju	Category 1		Category 2	
	Timber al. double	smartwin compact hpl triple	Timber al. double	smartwin compact hpl triple
U <sub>n</sub> [W/(m²K)]	1,36	0,60	1,36	0,60
U <sub>f</sub> [W/(m²K)]	1,76	0,86	1,66	0,78
U <sub>w</sub> [W/(m²K)]	1,66	0,73	1,74	0,75
U <sub>hw</sub> [W/(m²K)]	2,40	0,74	2,31	0,77
Glass fraction	69%	76%	6%	71%
g	64%	54%	64%	54%
Shading factor	10%	10%	10%	10%
Investment	1.056 €	1.254 €	2.046 €	2.420 €
Present v. Energy	475 €	68 €	1.341 €	135 €
LCC	1.531 €	1.322 €	3.387 €	2.555 €
LCC Saving		209 €		832 €
LCC Saving		14%		25%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	69	0	209	-1
CO <sub>2</sub> Saving		69		209
CO <sub>2</sub> Saving		99%		100%



**7.9 PARK Byoungyeol, Architecture studio Time, Human and Space, Korea with smartwin compact hpl triple**

Smartwin compact hpl is a timber window with weather protection cladding constructed from high pressure laminate and a very narrow frame. It is installed in the insulation layer using a plywood frame connector. This frame connector enables installation of the window right in the middle of the insulation layer without additional load-bearing elements, thereby avoiding additional thermal bridge losses.

The narrow shutter housing, as well as the rails is made by the window manufacturer themselves and becomes an integral part of the window, which is both cost-efficient and nearly thermal bridge free. The choice to use HPL instead of aluminium for the cladding allows the manufacturer to offer various designs and a high grade of individualization. The window sill is also from HPL and is directly inserted into the frame.

The smartwin is compared with a double glazed 56 mm timber window. The high performance glazing is imported from Europe.

The jury praised the high aesthetic and innovative standard in combination with high levels of thermal protection.

For smartwin compact hpl, the jury awarded the

**3<sup>rd</sup> Prize in the category Timber Aluminium in cool, temperate climate**



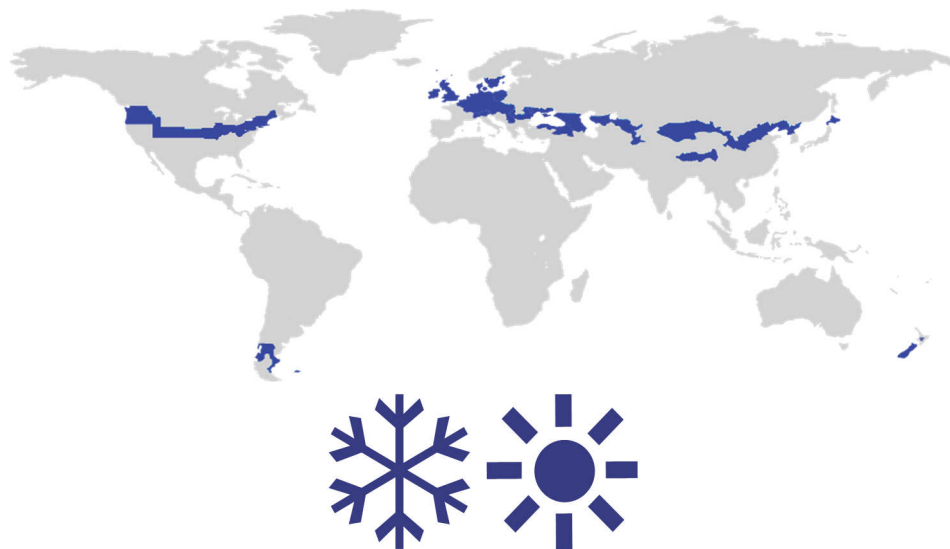
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## 8 | Aluminium & GRP windows in cool, temperate climates

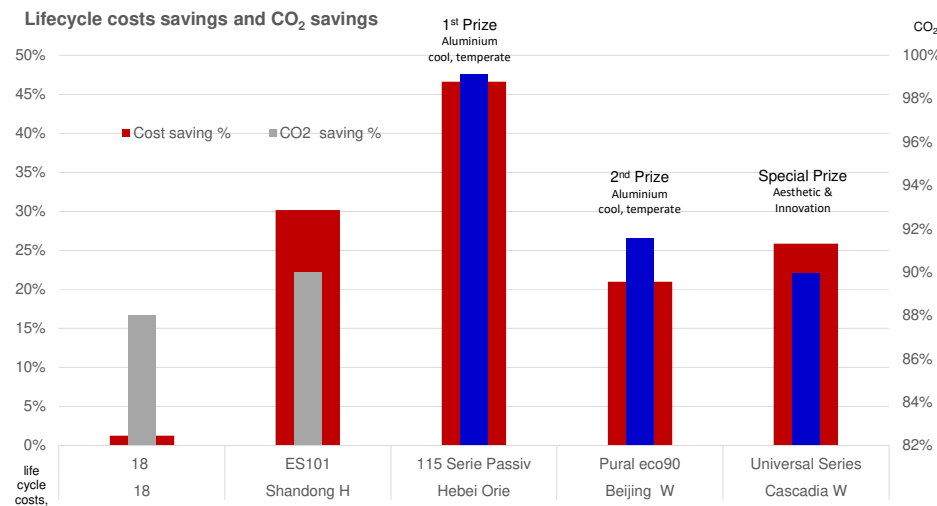


For the cool, temperate climate zone, four windows were entered into the category Aluminium:

- 18
- Shandong Huajian Aluminium Group, China with ES101
- Hebei Orient Sundar Window Co. Ltd., China with 115 Serie Passiv
- Beijing Wuddy Building Technology, China with Pural eco 90

The assessment of the award allows the giving of prizes to two of the four participants in the category cool, temperate climate | Aluminium. The jury decided as follows:

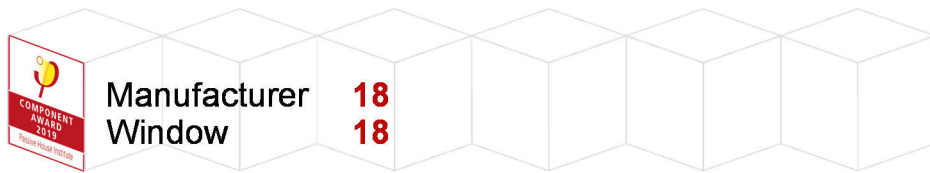
- 1<sup>st</sup> prize to Hebei Orient Sundar Window Co. Ltd., China with 115 Serie Passiv
- 2<sup>nd</sup> prize to Beijing Wuddy Building Technology, China with Pural eco 90



Only one window was entered into the category GRP windows, so according to the award rules it is not possible to grant a regular prize. But the Cascadia Universal Series entered by Cascadia, Canada convinced the jury by its high aesthetic quality, slim frames, high levels of energy savings and very reasonable investment costs.

As a result, the jury granted the

Special Prize Aesthetic and Innovation to Cascadia Universal series.



Country  Climate  Material Aluminium

### Description of baseline window

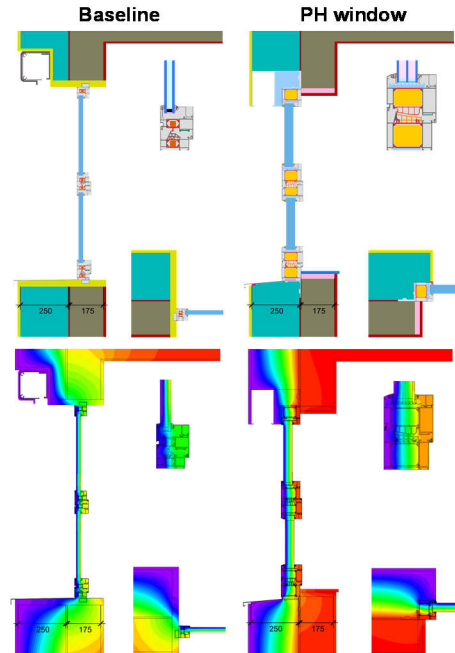
Thermally separated aluminium frame. Pane thickness: 24mm (6/12/6), rebate depth: 17 mm, spacer: stainless steel with polysulfide as secondary seal. Installed in the constructive layer. Airtightness by silicone. Shaded by roller shutter.

Comfort- as well as hygiene criterion are not achieved.

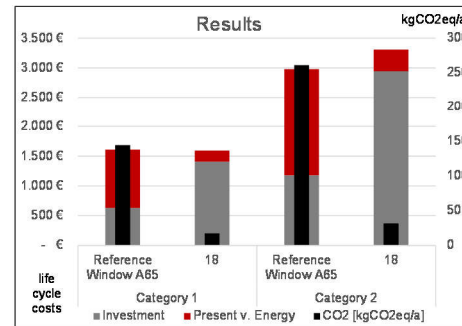
### Description of Passive House window

Thermally separated aluminium frame, insulated with PIR (0,022 W/(mK)). Pane thickness: 47 mm (5/16/5/16/5), rebate depth: 18 mm, spacer: SWISSPACER Ultimate with polyurethane as secondary seal. Installed in the insulation layer. Fastened by steel angles. Shaded by venetian blinds. Air tightness by way of specialist tapes.

Comfort- as well as hygiene criterion are achieved



China CN0002a-Beijing	Category 1		Category 2	
	Reference Window	18	Reference Window	18
$U_g$ [W/(m²K)]	1,27	0,58	1,27	0,58
$U_f$ [W/(m²K)]	2,77	0,78	2,68	0,73
$U_{w,gl}$ [W/(m²K)]	1,85	0,72	1,93	0,74
$U_{w,fr}$ [W/(m²K)]	3,84	0,84	3,34	0,84
Glass fraction	73%	56%	74%	58%
g	63%	52%	63%	52%
Shading factor	10%	10%	10%	10%
Investment	629 €	1.409 €	1.177 €	2.944 €
Present v. Energy	982 €	182 €	1.802 €	362 €
LCC	1.611 €	1.592 €	2.979 €	3.306 €
LCC Saving		20 €		- 327 €
LCC Saving		1%		-11%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	144	17	261	32
CO <sub>2</sub> Saving		127		229
CO <sub>2</sub> Saving		88%		88%



## 8.1 – 18 –

18 is a thermally separated and insulated Aluminium window, which is installed in the insulation layer using steel brackets. It is shaded by a venetian blind and compared with a thermally separated, non-insulated double glazed window frame installed in the center edge of the construction layer. The baseline window's roller shutter case is insulated by EPS-foam block against the concrete causing a relatively low level of thermal bridging.

The jury praised the high energy and CO<sub>2</sub> savings of this window.



Material Aluminium

**Description of baseline window**

Thermally separated, double IGU-glazed (6/12/6) aluminum window. Depth of frame: 52 mm. Spacer: Stainless steel.

Installed in the construction layer. Shaded by venetian blind.

Comfort- as well as hygiene criterion are not achieved.

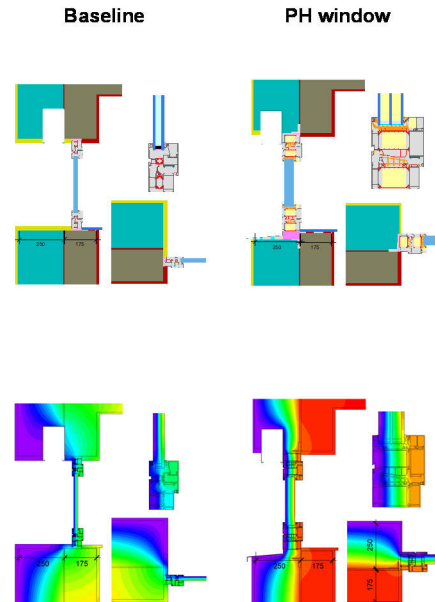
**Description of Passive House window**

Thermally separated aluminium frame; insulated with resolic foam (0.023W/(mK))

Pane thickness: 54 mm (6/18/6/18/6), rebate depth: 17 mm, spacer: SWISSPACER Ultimate with polyurethane as secondary seal.

Installed by steel angles in the insulation layer. Shaded by venetian blind.

Comfort- as well as hygiene criterion are achieved

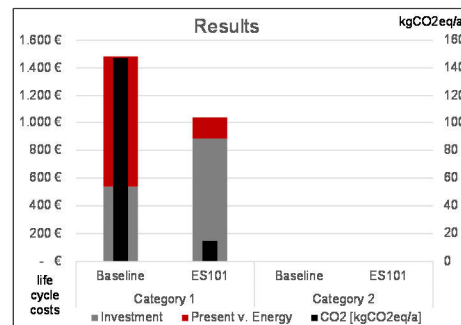


**8.2 Shadong Huajian Aluminium Group, China with ES101**

ES101 is a thermally separated and insulated Aluminium window, which is installed in the insulation layer using steel brackets. It is shaded by a venetian blind and compared with a thermally separated, not insulated double glazed window frame installed in the center edge of the construction layer. The baseline window's roller shutter housing is not insulated against the concrete, causing a very high level of thermal bridging.

The jury praised the high energy and CO<sub>2</sub> savings of this window.

China CN0031a-Weifang	Category 1		Category 2	
	Baseline	ES101	Baseline	ES101
U <sub>g</sub> [W/(m²K)]	1,27	0,53		
U <sub>f</sub> [W/(m²K)]	3,97	0,81		
U <sub>w</sub> [W/(m²K)]	2,16	0,69		
U <sub>w,i</sub> [W/(m²K)]	4,23	0,82		
Glass fraction	72%	60%		
g	63%	51%		
Shading factor	10%	10%		
Investment	537 €	884 €		
Present v. Energy	946 €	152 €		
LCC	1.484 €	1.036 €		
LCC Saving		448 €		
LCC Saving		30%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	147	15		
CO <sub>2</sub> Saving		132,45179		
CO <sub>2</sub> Saving		90%		



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Country  Climate  Material Aluminium

**Description of baseline window**

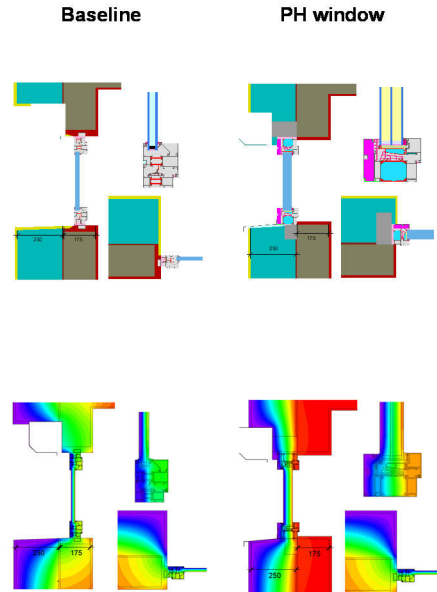
Thermally separated, double IGU-glazed (5/12/5) aluminum window. Depth of frame: 74 mm. Spacer: Stainless steel. Installed in the construction layer. Roller shutter.

**Description of Passive House window**

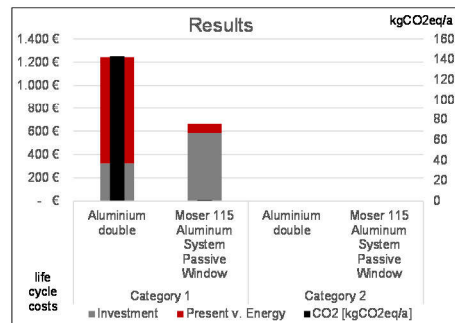
Narrow thermally broken aluminum integral window frame with PU- and EPS insulation thickness: 51 mm (5/18/5/18/5), rebate depth: 15 mm, spacer: SWISSPACER Ultimate.

Shaded by roller blind, installed in the insulation layer, supported by Blaugelb Triotherm+.

Airtightness by plaster able tapes.



China CN0002a-Beijing	Category 1		Category 2	
	Aluminium double	Moser 115 Aluminium	Aluminium double	Moser 115 Aluminium
U <sub>g</sub> [W/(m²K)]	1,44	0,53		
U <sub>f</sub> [W/(m²K)]	3,14	0,73		
U <sub>w</sub> [W/(m²K)]	2,01	0,66		
U <sub>wi</sub> [W/(m²K)]	4,07	0,74		
Glass fraction	74%	74%		
g	77%	53%		
Shading factor	10%	10%		
Investment	324 €	584 €		
Present v. Energy	920 €	80 €		
LCC	1.244 €	664 €		
LCC Saving		580 €		
LCC Saving		47%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	143	1		
CO <sub>2</sub> Saving		142		
CO <sub>2</sub> Saving		99%		



**8.3 Hebei Orient Sundar Window Co. Ltd., China with Moser 115 Aluminum System Passive Window**

Hebei Orient Sundar Window Co. Ltd. is currently holding 3 certificates for Passive House windows and for one Passive House entrance door, all for the cool, temperate climate. Another window is in the process of certification.

115 Serie Passiv is a brand new Aluminium window concept specially designed in cooperation with the Passive House Institute to achieve the efficiency class pA for passive house windows.

This target is achieved by a very slim frame and two layers of insulation. The window is installed in the insulation layer. Supported by Meesenburg blaugelb Triotherm installation system. It is shaded by a roller blind and compared with a double glazed, thermally separated aluminium window frame installed in the center of the construction layer. The baseline window's shutter housing is not insulated against the concrete causing a very high level of thermal bridging.

The jury praised the high aesthetic quality of the window concept with its slim frame as well as the energy and cost efficiency of this window. Care should be taken regarding the connection of the roller shutter housing and the plaster. This connection might cause high maintenance efforts.

For 115 Serie Passiv, the jury awarded the

**1<sup>st</sup> Prize in the category Aluminium in cool, temperate climate**



Country  Climate  Material **Aluminium**

**Description of baseline window**

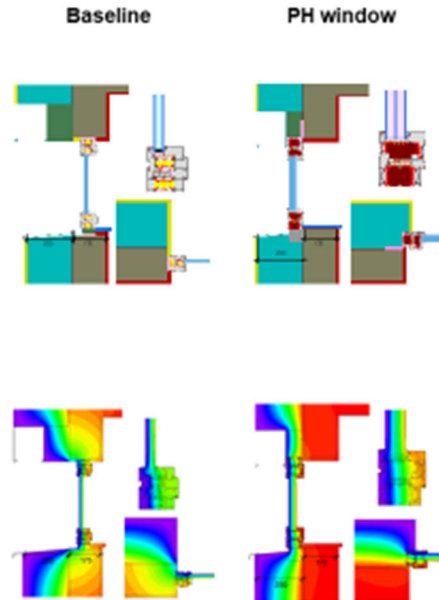
78mm wide, thermally separated and insulated aluminum frame with double glazing (5+16+5). Installed in the construction layer, shaded by venetian blinds.

**Description**

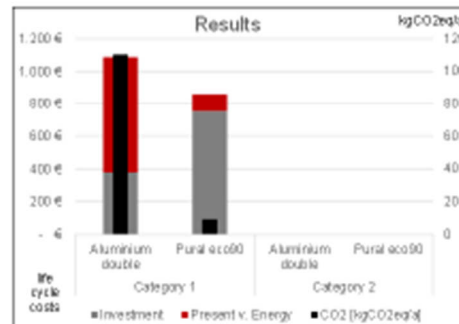
Thermally broken aluminum frame with PU-foam core (0,051 W/(mK)). Pane thickness: 44 mm (4/16/4/16/4), Rebate depth: 15/18 mm. Spacer: Swisspacer Ultimate.

Installed in the insulation layer, supported by high rigid EPS (bottom) and steel brackets (mass equivalency method) on side and top. Shaded by venetian blinds.

Airtightness by plaster able tapes. of Passive House window



China CH0002a-Beijing	Category 1		Category 2	
	Aluminium double	Pural eco90	Aluminium double	Pural eco90
U <sub>w</sub> [W/(m²K)]	1,20	0,70		
U <sub>g</sub> [W/(m²K)]	1,90	0,78		
U <sub>w,sh</sub> [W/(m²K)]	1,55	0,79		
U <sub>w,bl</sub> [W/(m²K)]	3,20	0,98		
Glass fraction	74%	93%		
g	80%	80%		
Shading factor	10%	10%		
Investment	378 €	753 €		
Present v. Energy	709 €	106 €		
LCC	1.087 €	859 €		
LCC Saving		228 €		
LCC Saving		21%		
CO <sub>2</sub> [kgCO <sub>2</sub> e/yr]	110	9		
CO <sub>2</sub> Saving		101,03167		
CO <sub>2</sub> Saving		92%		



**8.4 Beijing Wuddy Building Technology, China with Pural eco 90**

Pural eco 90 is a highly innovative and proven Aluminium window concept with a load bearing core of high rigid Polyurethane foam in its center.

The window is installed in the insulation layer, supported at its bottom by highly rigid EPS foam and steel brackets at the side and top. It is shaded by venetian blinds, the shutter case is thermally separated by highly rigid EPS foam.

Pural eco 90 is compared with a double glazed, thermally separated and insulated aluminium window frame installed in the center of the construction layer. The baseline window's shutter housing is insulated against the concrete causing a relatively low level of thermal bridging, and in combination with the insulated frame relatively low overall energy losses.

The jury praised the high aesthetic quality of the window concept, as well as its energy and cost efficiency. The jury suggested connecting the upper part of the frame with the highly rigid EPS block supporting the shutter housing to avoid the steel brackets and by that to decrease the thermal bridge of the installation at this point.

For Pural eco 90, the jury awarded the

**2<sup>st</sup> Prize in the category Aluminium in cool, temperate climate**



Material GRP

**Description of baseline window**

Cascadia Windows - 400 Series Fiberglass punched and strip window system with optional 300 or 325 Series operable vent inserts. Typically provided in double glazing.

Airtightness connection to wall by airtightness tape. Installation in the constructive layer.

No shading, because that is not common in the Vancouver area.

**Description of Passive House window**

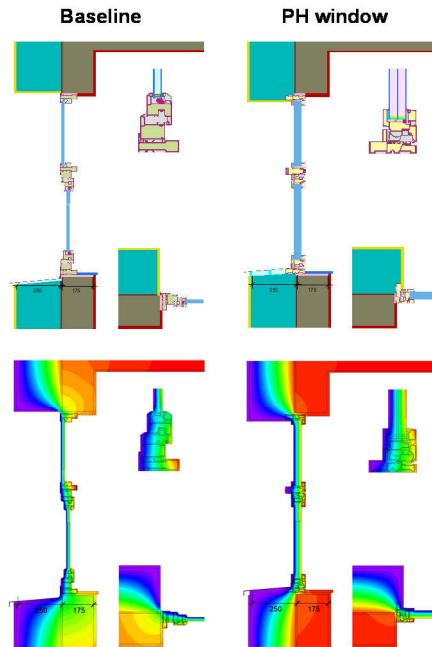
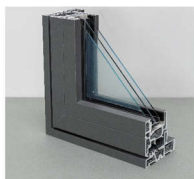
Cascadia Windows - Universal Series PH Fiberglass punched and strip window system. Triple glazed.

The series was developed to provide high thermal quality at low investment costs.

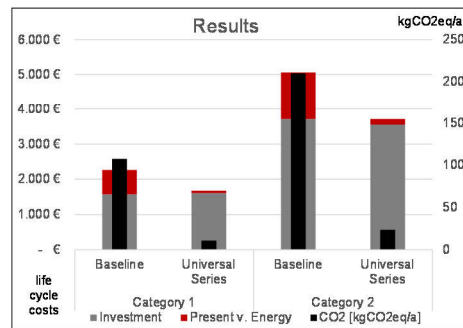
Airtightness connection to wall by airtightness tape.

Installation fixed in the construction layer, but overlapping with the insulation layer for both, low thermal bridges and low installation costs.

No shading, because that is not common in the Vancouver area.



Canada   CA0063a-Abbotsford	Category 1		Category 2	
	Baseline	Universal Series	Baseline	Universal Series
$U_g$ [W/(m²K)]	1,40	0,60	1,40	0,60
$U_f$ [W/(m²K)]	1,50	0,88	1,85	0,86
$U_w$ [W/(m²K)]	1,68	0,73	1,88	0,77
$U_{w,i}$ [W/(m²K)]	2,82	0,84	2,69	0,84
Glass fraction	62%	71%	71%	70%
g	41%	53%	41%	53%
Shading factor	10%	10%		
Investment	1.571 €	1.608 €	3.710 €	3.555 €
Present v. Energy	692 €	70 €	1.350 €	152 €
LCC	2.263 €	1.678 €	5.060 €	3.706 €
LCC Saving		585 €		1.354 €
LCC Saving		26%		27%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	108	11	210	24
CO <sub>2</sub> Saving		97		186
CO <sub>2</sub> Saving		90%		89%



**8.5 Cascadia Windows Ltd., Cascadia Universal Series**

Cascadia Universal Series 90 is a highly innovative frame constructed from glass fiber reinforced plastic composite (GRP) and insulated by resolic foam. The series was specially developed to meet the passive house standard, as well as to reduce production costs. With this system inside opening as well as outside opening windows can be assembled. As external shading is not common in the region where the manufacturer is located, the entry was accepted without shading.

The Universal Series is compared to the Cascadia 400 series, which is constructed from the same material, also insulated but double glazed. Astonishingly, the investment costs of the new Universal series are in the same range as the 400 series, but with far poorer thermal quality.

The Universal Series is installed partly in the construction layer to guarantee a safe, clean and fast installation. The 400 Series is installed at the edge of the insulation layer.

The jury praised the aesthetic and innovative qualities of this window concept, combined with very reasonable investment costs and its high energy and cost efficiency, especially compared to a relatively good baseline window.

In the category GRP windows, only one window was entered. So according to the assessment of the award it was not possible to grant a regular prize. But Cascadia Universal Series convinced the jury by its high aesthetic quality, slim frames, high energy savings and the very reasonable investment costs.

Due to that, the jury granted the

**Special prize Aesthetic and Innovation to Cascadia Universal series.**



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## 9 | Warm, temperate and warm climates

For the warm, temperate and warm climate zone applied:

### Timber Aluminium

- ThermaDura, New Zealand with DesignLine
- Daimaru Kogyo LTD, Japan with smartwin compact hpl double
- Blumer Lehmann, China with smartwin compact hpl triple
- SEDA. Windows&doors, New Zealand with smartwin compact hpl double

### Timber

- 30
- Pisetta Romano di Pisetta Diego e Marco snc, Italy with IDEA 85
- ThermaDura, New Zealand with NatureLine 90 passive

### Aluminium

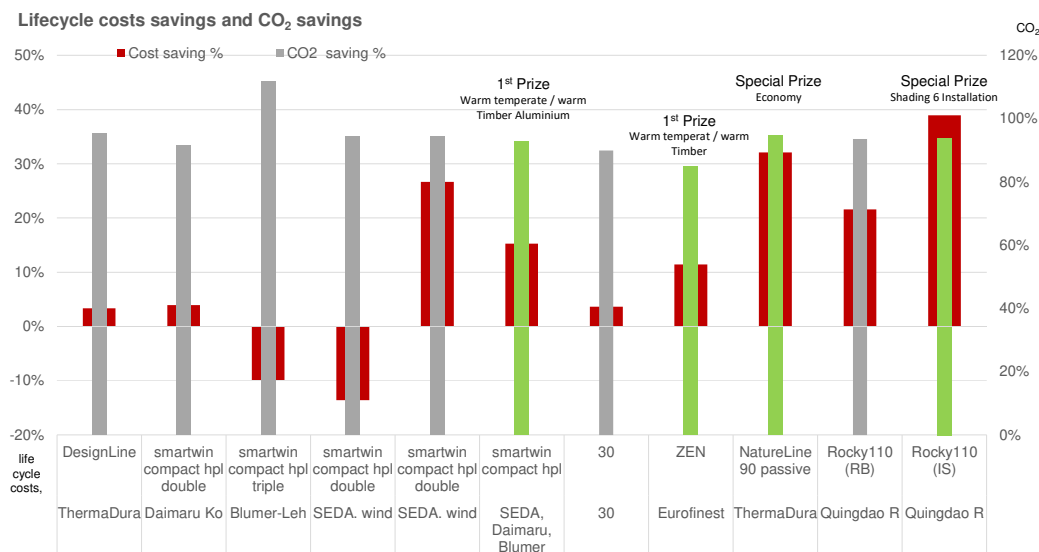
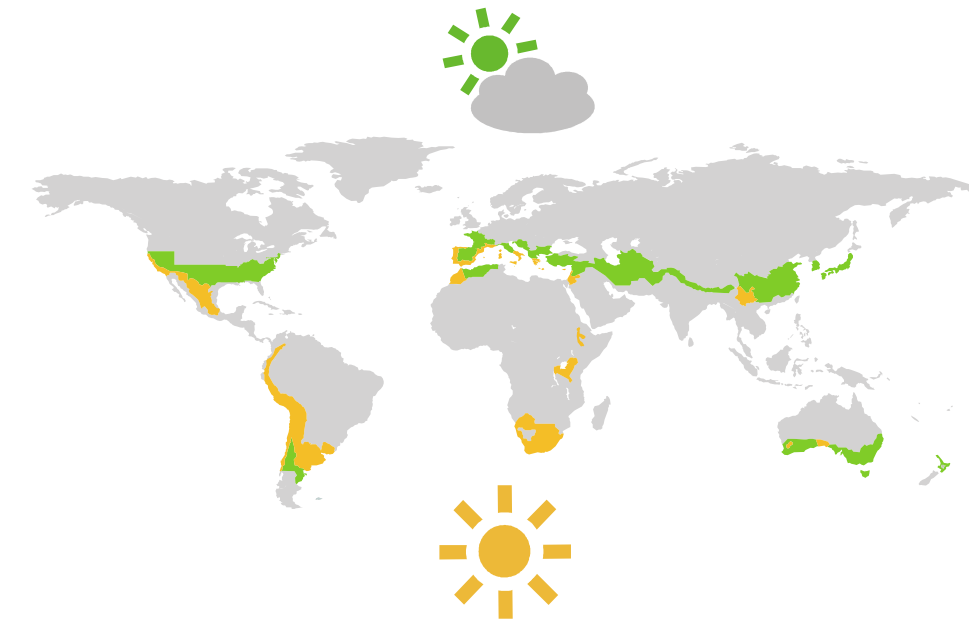
- Quingdao Rocky Window Co., Ltd., China with Rocky 110 Roller blind
- Quingdao Rocky Window Co., Ltd., China with Rocky 110 Integrated shading

For the category Timber Aluminium, the jury decided to award 1<sup>st</sup> prize to smartwin compact hpl to Daimaru Kogyo, Blumer Lehman and SEDA

For the category Timber the jury decided to award 1<sup>st</sup> prize ZEN by Eurofinestra

The jury dedicated also 2 special prizes

- Special Prize Economy to ThermaDura NatureLine 90 passive
- Special Prize Shading & Installation to Quingdao Rocky Window for Rocky 110





Country



Climate



Material

Timber-Aluminium

#### Description of baseline window

Thermally separated, double IGU-glazed (4/16air/4) aluminum window. Depth of frame: 46 mm. Spacer: Aluminium.

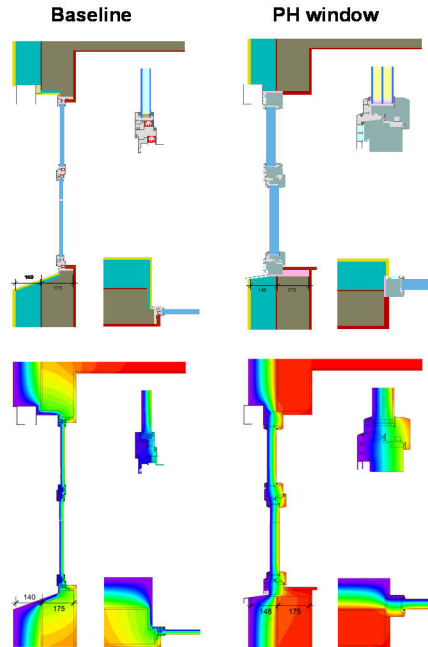
Installed in the construction layer with reveal insulation. Shaded by fabric screen.

Comfort- as well as hygiene criterion are not achieved.

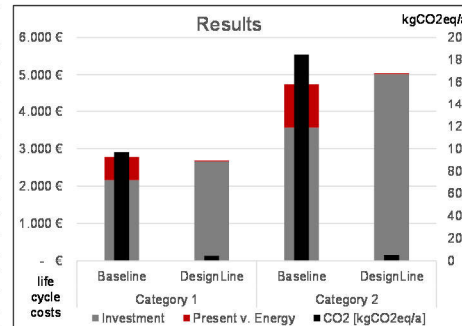
#### Description of Passive House window

Timber aluminium frame. High performance triple glazing (4-20-4-20-4). Spacer: Swisspacer Ultimate.

Installed at the edge of the construction layer. Shaded by fabric screen. Airtightness by plaster able tapes.



New Zealand NZ0013a-Dunedin	Category 1		Category 2	
	Baseline	DesignLine	Baseline	DesignLine
$U_g$ [W/(m <sup>2</sup> K)]	1,36	0,52	1,36	0,52
$U_f$ [W/(m <sup>2</sup> K)]	3,26	1,06	3,15	1,07
$U_w$ [W/(m <sup>2</sup> K)]	2,08	0,76	2,16	0,80
$U_{w,i}$ [W/(m <sup>2</sup> K)]	3,62	0,84	3,34	0,86
Glass fraction	73%	65%	76%	65%
g	64%	53%	64%	53%
Shading factor	12%	12%	12%	12%
Investment	2.157 €	2.656 €	3.557 €	5.016 €
Present v. Energy	621 €	28 €	1.187 €	33 €
LCC	2.779 €	2.685 €	4.744 €	5.048 €
LCC Saving		94 €		-304 €
LCC Saving		3%		-6%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	97	4	185	5
CO <sub>2</sub> Saving		92		180
CO <sub>2</sub> Saving		95%		97%



## 9.1 ThermoDura, New Zealand, DesignLine

ThermoDura is a small Timber and Timber Aluminium window manufacturer based close to Dunedin, NZ, who is producing European style windows. Hardware and glazing are imported from Europe. ThermoDura entered their Timber Aluminium PH window DesignLine and the Timber window NatureLine.

DesignLine is a Timber Aluminium window, installed partly in the insulation layer and shaded by a ZIP screen. The window is compared to a thermally separated, industrially produced Aluminium window. It is poorly installed, according to recommendations of a well-known producer of insulation material.

Despite the poor installation of the baseline window and due to the cheap industrial production of the same, it was not possible to achieve high economic benefits looking at the assessment of the award. But this changes for the real situation in New Zealand, where electricity is the main, expensive source of heating energy, often used directly, in other cases utilized in poor air-to-air heat pumps.

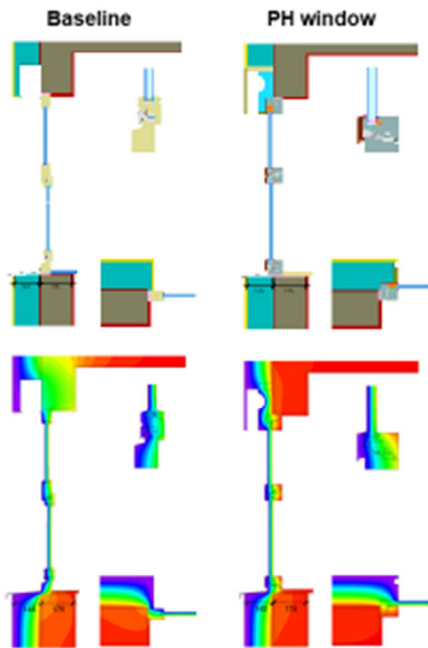
The jury praised the high energy and CO<sub>2</sub> savings of this window as well as the, relative to New-Zealand baselines, best practice standards of installation. Care should be taken regarding the connection of the roller shutter housing and the plaster. This connection might cause high maintenance efforts.



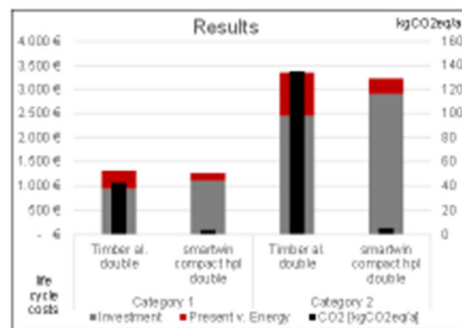
Country Climate Material **Timber HPL**

**Description of baseline window**  
 Double glazed (3/14/3) Timber window with aluminium Spacer. Shaded by venetian blind. In the region interior shading is common. For the reason of comparability, the screen was used.  
 Installed in the construction layer with insulated shutter box.

**Description of Passive House window**  
 HPL cladded version of smartwin compact: Timber frame (Spruce/Fir, 0.11 W/(mK)), insulated by low dense timber-fiber board (0.04 W/(mK)). Glazing: 4/16/4, glass intersection: 15 mm. Spacer: SWISSPACER Ultimate.  
 Shaded by fabric screen in narrow case built by the window manufacturer to minimize the thermal bridge.  
 Installed in the insulation layer by wooden frame connector. Airtightness by plaster able tape.



Japan JP004a-Takamatsu	Category 1		Category 2	
	Timber al double	smartwin compact hpl double	Timber al double	smartwin compact hpl double
U <sub>g</sub> [W/(mK)]	1.44	1.12	1.44	1.12
U <sub>f</sub> [W/(mK)]	1.76	1.15	1.66	1.06
U <sub>w</sub> [W/(mK)]	1.71	1.21	1.75	1.24
U <sub>wi</sub> [W/(mK)]	2.59	1.24	2.50	1.28
Glass fraction	57%	77%	57%	77%
g	57%	54%	57%	54%
Shading factor	10%	12%	10%	12%
Investment	935 €	1.107 €	2.441 €	2.935 €
Present v. Energy	371 €	166 €	935 €	339 €
LCC	1.316 €	1.263 €	3.396 €	3.234 €
LCC Saving		52 €		123 €
LCC Saving		4%		4%
CO <sub>2</sub> [kgCO <sub>2</sub> e/a]	43	4	130	5
CO <sub>2</sub> Saving		39		130
CO <sub>2</sub> Saving		91%		99%



## 9.2 Daimaru Kogyo LTD, Japan with smartwin compact hpl double

Smartwin compact hpl is a timber window with a weather protection cladding from high pressure laminate and a very narrow frame. At this specific location, even it is in warm, temperate climate, due to the narrow and well insulating frame, a double glazing is sufficient to achieve both, the hygiene- and the comfort criterion.

It is very interesting, that this window achieves the Passive House window-efficiency class pA even with its double glazing.

The smartwin is installed in the insulation layer by a plywood frame connector. This frame connector opens the possibility to install the window right in the middle of the insulation layer without additional load bearing elements avoiding additional thermal bridge losses.

A big issue with the relatively thin insulation in warm, temperate climates (here 14 mm) is to implement the case for the shading invisible to meet high aesthetic standards as well as with low thermal bridges for climate protection. The smartwin solution is a flipped ZIP screen, rolling at the outside. The case for the screen as well as the rails is made by the window manufacturer himself and becomes an integral part of the window, which is both cost efficient and nearly thermal bridge free. The choice to use HPL instead of aluminium for the cladding allows the manufacturer to have various designs and a high grade of individualization. The window sill is also from HPL and is directly inserted into the frame.

The smartwin is compared with a double glazed 56 mm timber window. The high performance glazing is imported from Europe.

The jury praised the high esthetic and innovative standard in combination with high thermal protection and the innovative shading.

For smartwin compact hpl, the jury awarded the

**1<sup>st</sup> Prize in the category Timber Aluminium in warm, temperate and warm climate**

Daimaru Kogyo LTD is sharing this prize with Blumer Lehmann and SEDA.



Country  Climate  Material Timber HPL

### Description of baseline window

Double glazed (4/16/4) Timber Aluminium window with aluminium Spacer. Shaded by fabric screen. In the region interior shading is common. For the reason of comparability, the screen was used.

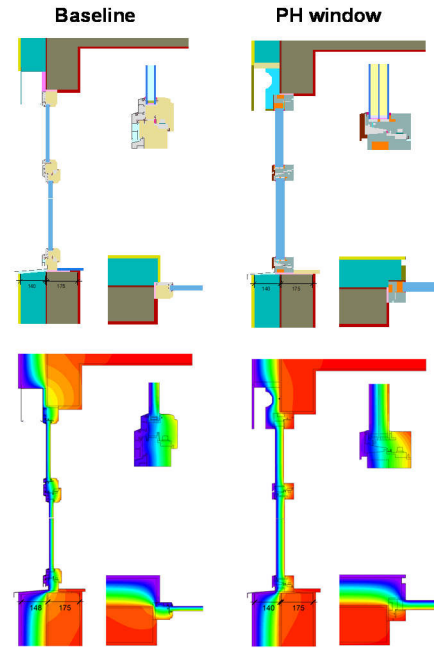
Installed at the edge of the construction layer with insulated shuttercase.

### Description of Passive House window

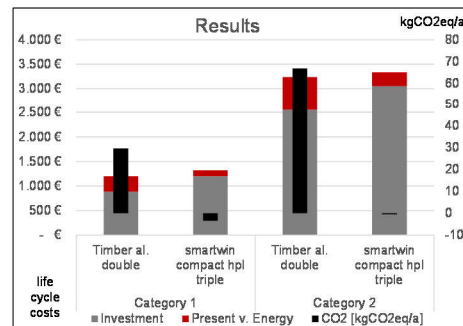
Timber frame (Spruce/Fir, 0.11 W/(mK)), insulated by low dense timber-fiber board (0.04 W/(mK)). Glazing: 4/18/4/18/4, Glass intersection: 15 mm. Spacer: SWISSPACER Ultimate.

Shaded by fabric screen in narrow case built by the window manufacturer to minimize the thermal bridge. Installed in the insulation layer by wooden frame connector. Airtightness by plaster able tape.

Window-production has not started yet.



China CN0001a-Shanghai	Category 1		Category 2	
	Timber al. double	smartwin compact hpl triple	Timber al. double	smartwin compact hpl triple
$U_g$ [W/(m²K)]	1,45	0,60	1,45	0,60
$U_{gl}$ [W/(m²K)]	1,40	0,86	1,42	0,78
$U_w$ [W/(m²K)]	1,64	0,73	1,76	0,75
$U_{wgl}$ [W/(m²K)]	2,06	0,79	2,09	0,82
Glass fraction	67%	76%	66%	71%
g	60%	60%	60%	60%
Shading factor	10%	12%	10%	12%
Investment	885 €	1.198 €	2.554 €	3.051 €
Present v. Energy	317 €	122 €	690 €	288 €
LCC	1.202 €	1.320 €	3.244 €	3.339 €
LCC Saving	-	-118 €	-	-95 €
LCC Saving	-	-10%	-	-3%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	30	-4	67	0
CO <sub>2</sub> Saving	-	33	-	67
CO <sub>2</sub> Saving	-	112%	-	101%



## 9.3 Blumer-Lehmann, Shanghai, China with smartwin compact hpl triple

Smartwin compact hpl is a timber window with weather protection cladding constructed from high pressure laminate and a very narrow frame. It is installed in the insulation layer using a plywood frame connector. At this specific location, triple glazing has to be used to achieve the hygiene- and the comfort criterion. This frame connector enables installation of the window right in the middle of the insulation layer without additional load-bearing elements, thereby avoiding additional thermal bridge losses.

A big issue with the relatively thin insulation in warm, temperate climates (here 14 mm) is the concealed installation of the shutter housing to meet high aesthetic standards, as well as with low thermal bridging values for climate protection. The smartwin solution is a flipped ZIP screen, rolling at the outside. The housing for the screen, as well as the rails is made by the window manufacturer themselves and becomes an integral part of the window, which is both cost efficient and nearly thermal bridge free. The choice to use HPL instead of aluminium for the cladding allows the manufacturer to offer various designs and a high grade of individualization. The window sill is also constructed from HPL and is directly inserted into the frame.

The smartwin is compared with a double glazed 56 mm timber aluminium window. The high performance glazing is imported from Europe.

The jury praised the high esthetic and innovative standard in combination with high thermal protection and the innovative shading.

For smartwin compact hpl, the jury awarded the

**1<sup>st</sup> Prize in the category Timber Aluminium in warm, temperate and warm climate**

Blumer Lehmann is sharing this prize with Daimaru Kogyo LTD and SEDA.

**Manufacturer Window** **SEDA. windows&doors smartwin compact hpl double**

Country  Climate  Material **Timber HPL**

**Description of baseline window**

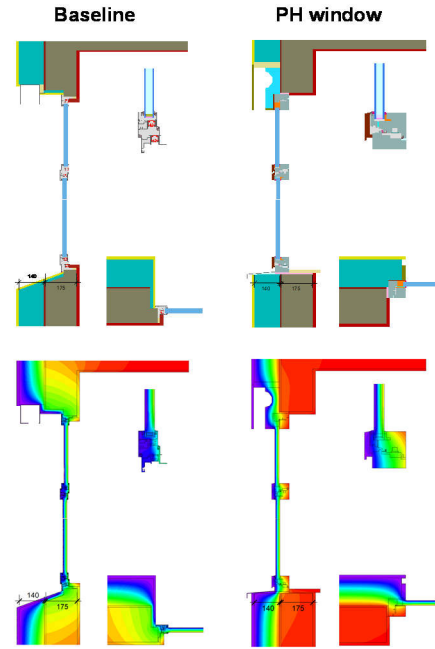
Thermally separated, double IGU-glazed (4/16air/4) aluminum window. Depth of frame: 46 mm. Spacer: Aluminium. Installed in the construction layer with reveal insulation. Shaded by fabric screen. Exterior shading is not common in the region. The screen was chosen for reasons of compatibility. Comfort- as well as hygiene criterion are not achieved.

**Description of Passive House window**

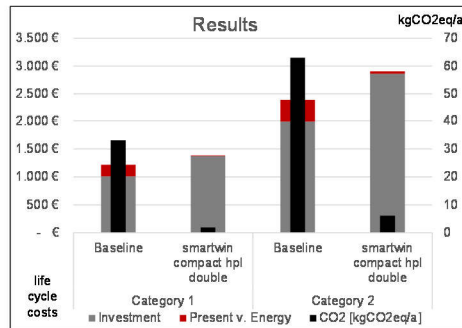
Timber frame (Spruce/Fir, 0.11 W/(mK)), insulated by low dense timber-fiber board (0.04 W/(mK)). Glazing: 4/16/4, glass intersection: 15 mm. Spacer: SWISSPACER Ultimate. Glazing, wood and hardware importet.

Shaded by venetian fabric screen in narrow case built by the window manufacturer to minimize the thermal bridge.

Installed in the insulation layer by wooden frame connector. Airtightness by plaster able tape.



New Zealand NZ0001a-Auckland	Category 1		Category 2	
	Baseline	smartwin compact hpl double	Baseline	smartwin compact hpl double
U <sub>g</sub> [W/(m²K)]	1,36	1,12	1,36	1,12
U <sub>f</sub> [W/(m²K)]	3,26	1,15	3,15	1,06
U <sub>w</sub> [W/(m²K)]	2,08	1,21	2,16	1,24
U <sub>ww</sub> [W/(m²K)]	3,62	1,24	3,34	1,28
Glass fraction	73%	76%	76%	71%
g	64%	64%	64%	64%
Shading factor	10%	12%	10%	12%
Investment	1.005 €	1.370 €	1.987 €	2.864 €
Present v. Energy	213 €	12 €	405 €	39 €
LCC	1.217 €	1.383 €	2.392 €	2.903 €
LCC Saving	-	-165 €	-	-512 €
LCC Saving	-	-14%	-	-21%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	33	2	63	6
CO <sub>2</sub> Saving	-	31	-	57
CO <sub>2</sub> Saving	-	94%	-	90%



**9.4 SEDA. windows&doors, New Zealand with smartwin compact hpl double**

Smartwin compact hpl is a timber window with weather protection cladding constructed from high pressure laminate and a very narrow frame. At this specific location in the warm, temperate climate, a double glazing is sufficient to achieve both, the hygiene- and the comfort criterion due to the narrow and well insulating frame.

It is very interesting, that this window achieves the Passive House Window-efficiency class phA even with its double glazing. The smartwin is installed in the insulation layer using a plywood frame connector. This frame connector enables installation of the window right in the middle of the insulation layer, without additional load bearing elements avoiding additional thermal bridge losses.

A big issue with the relatively thin insulation in warm, temperate climates (here 14 mm) is the concealed installation of the shutter housing to meet high aesthetic standards, as well as with low thermal bridging values for climate protection. The smartwin solution is a flipped ZIP screen, rolling at the outside. The housing for the screen, as well as the rails is made by the window manufacturer themselves and becomes an integral part of the window, which is both cost efficient and nearly thermal bridge free. The choice to use HPL instead of aluminium for the cladding allows the manufacturer to offer various designs and a high grade of individualization. The window sill is also constructed from HPL and is directly inserted into the frame.

The window is compared to a thermally separated, industrially produced Aluminium window. It is poorly installed, according to recommendations of a well-known producer of insulation material. Despite the poor installation of the baseline window and due to the cheap industrial production of the same, it was not possible to achieve high economic benefits looking at the assessment of the award. But this changes for the real situation in New Zealand, where electricity is the main, expensive source of heating energy, often used directly, in other cases utilized in poor air-to-air heat pumps. The jury praised the high aesthetic quality and innovative standard in combination with high levels of thermal protection and the innovative shading.

For smartwin compact hpl, the jury awarded the **1<sup>st</sup> Prize in the category Timber Aluminium in warm, temperate and warm climate**

SEDA is sharing this prize with Daimaru Kogyo and Blumer Lehmann.



COMPONENT AWARD 2019  
Power House Institute

# Manufacturer Window

## SEDA. windows&doors smartwin compact hpl double

Country  Climate  Material Timber HPL

### Description of baseline window

Double glazed traditional New Zealand wooden window with double (IGU-glazing (4/6air/4) and aluminium spacer. Depth of frame: 42 mm.

The frame is not painted in the factory, so for painting at the building site, 8% were added on the net window price. Installed in the construction layer with reveal insulation. Shaded by fabric screen. In the region interior shading is common. For the reason of comparability, the screen was used.

Installed in the construction layer with reveal insulation.

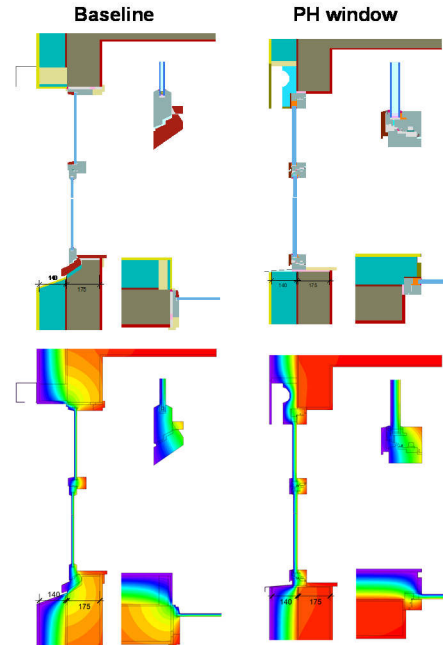
Comfort- as well as hygiene criterion are not achieved.

### Description of Passive House window

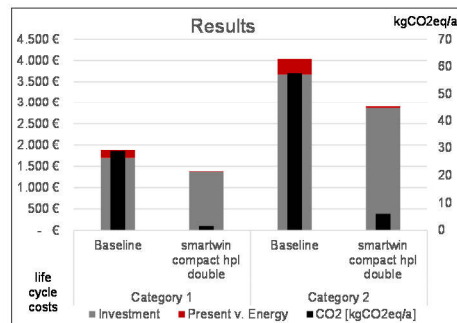
Timber frame (Spruce/Fir, 0.11 W/(mK)), insulated by low dense timber-fiber board (0.04 W/(mK)). Glazing: 4/16/4, glass intersection: 15 mm. Spacer: SWISSPACER Ultimate. Glazing, wood and hardware importet.

Shaded by venetian fabric screen in narrow case built by the window manufacturer to minimize the thermal bridge.

Installed in the insulation layer by wooden frame connector. Airtightness by plaster able tape.



New Zealand NZ0001a-Auckland	Category 1		Category 2	
	Baseline	smartwin compact hpl double	Baseline	smartwin compact hpl double
$U_g$ [W/(m²K)]	2,45	1,12	2,45	1,12
$U_i$ [W/(m²K)]	1,57	1,15	1,38	1,06
$U_w$ [W/(m²K)]	2,39	1,21	2,15	1,24
$U_{wz}$ [W/(m²K)]	3,36	1,24	2,86	1,28
Glass fraction	77%	76%	56%	71%
g	63%	64%	63%	64%
Shading factor	10%	12%	10%	12%
Investment	1.696 €	1.370 €	3.669 €	2.864 €
Present v. Energy	186 €	11 €	371 €	39 €
LCC	1.882 €	1.381 €	4.040 €	2.903 €
LCC Saving		502 €		1.136 €
LCC Saving		27%		28%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	29	2	58	6
CO <sub>2</sub> Saving		27		52
CO <sub>2</sub> Saving		94%		89%



## 9.5 SEDA. windows&doors, New Zealand with smartwin compact hpl double

Here, the smartwin compact hpl double is compared to a traditional outward opening New Zealand timber window, produced by a craftsman. It turns out that the smartwin can be produced and installed more cheaply than the poor quality traditional timber window.

In the warm climate of Auckland, the potential savings made by way of the better thermal performance of the passive house window are very small. So, the better quality, airtightness and overall concept as well as the investment costs are dominant.

For smartwin compact hpl, the jury awarded the

1<sup>st</sup> Prize in the category Timber Aluminium in warm, temperate and warm climate

SEDA is sharing this prize with Daimaru Kogyo and Blumer Lehmann.



Country  Climate  Material **Timber**

**Description of baseline window**

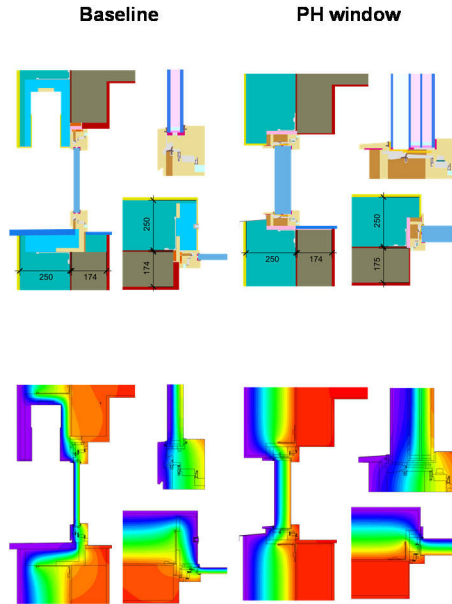
Solid timber frame (0,13 W/(mK)) with cork insulation (0,045 W/(mK)). Pane thickness: 30mm (6/18/6), rebate depth: 13 mm, spacer: Superspacer Triseal with polysulfide as secondary seal. Installed in the constructive layer. Airtightness by silicone. Shaded by venetian blinds.

Comfort- as well as hygiene criterion are not achieved.

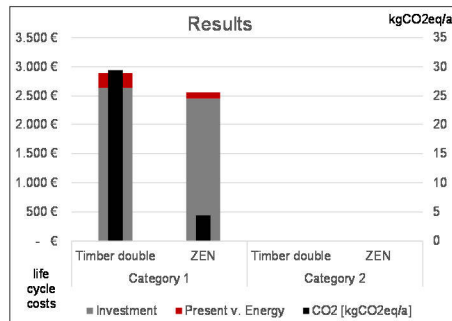
**Description of Passive House window**

Solid timber frame (0,13 W/(mK)) with cork insulation (0,045 W/(mK)) and bamboo reinforcement (0,18 W/(mK)). Pane thickness: 50 mm (4/18/4/18/6) with integral shading in 30 mm air cavity with additional glass pane to the exterior, rebate depth: 17 mm, spacer: Superspacer Triseal with polysulfide as secondary seal. Installed in the insulation layer using steel angles. Airtightness by way of specialist tapes.

Comfort- as well as hygiene criterion are achieved.



Italy IT0026a-Verona / Valeggio	Category 1		Category 2	
	Timber double	ZEN	Timber double	ZEN
U <sub>s</sub> [W/(m²K)]	1,12	0,52		
U <sub>i</sub> [W/(m²K)]	1,14	0,54		
U <sub>w</sub> [W/(m²K)]	1,23	0,61		
U <sub>wg</sub> [W/(m²K)]	1,51	0,67		
Glass fraction	74%	78%		
g	64%	49%		
Shading factor	10%	15%		
Investment	2.640 €	2.456 €		
Present v. Energy	255 €	107 €		
LCC	2.895 €	2.563 €		
LCC Saving		332 €		
LCC Saving		11%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	29	4		
CO <sub>2</sub> Saving		25		
CO <sub>2</sub> Saving		85%		



**9.6 Eurofinestra s.a.s, Italy with ZEN**

Eurofinestra s.a.s is a north Italian based window manufacturer, who currently holds 3 window certificates.

The window presented is the most recently certified ZEN window, which is a timber window for the cool, temperate climate. As the workshop of the manufacturer is in warm, temperate climate, this climate zone was chosen for the award.

Eurofinestra solved the issue of high thermal bridging values caused by the shutter case by using a coupled 3+1 window with shading integrated in the air gap between the interior triple pane and the exterior single pane.

The window is installed by steel brackets in the insulation layer. It is compared with an insulated and very well installed double glazed window, so this baseline is to be considered as remarkably good. Never the less, ZEN is able to create a life-cycle-cost benefit of 11% and is able to save 85% CO<sub>2</sub>.

The jury praised the highly innovative and aesthetic qualities of the window and shading concept. The jury underlined the exemplary life-cycle-cost savings in the warm, temperate climate zone compared to a very good baseline window.

For ZEN, the jury awarded the

**1<sup>st</sup> Prize in the category Timber in warm, temperate and warm climate**



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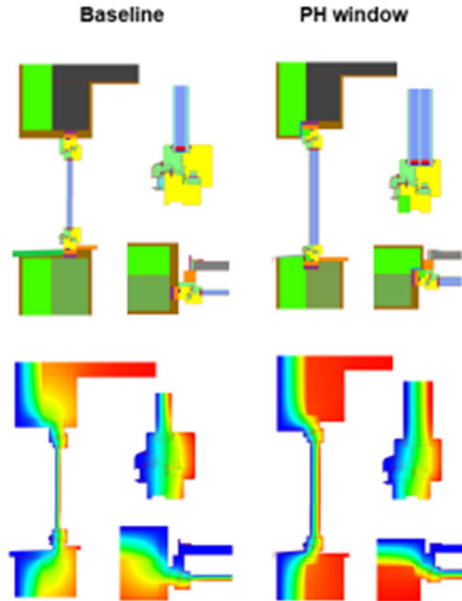
Country  Climate  Material **Timber**

**Description of baseline window**

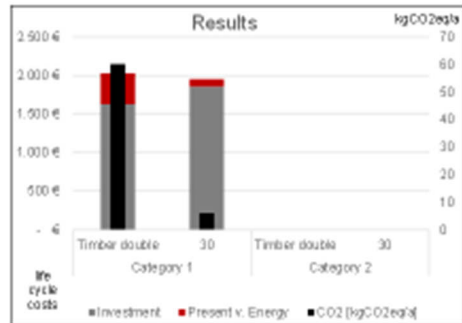
Timber Frame (Fir 0,11 W/mK, okumè 0,13 W/mK).  
 Frame width: 85 mm. Glazing: 4/18 SSP/33.1 EN2P  
 +ARGON 94%, Spacer: Chromatech.  
 Installed in the construction layer. Shaded by blind.  
 Comfort- as well as hygiene criterion are not achieved.

**Description of Passive House window**

Timber Frame (Fir 0,11 W/mK, Xps 0,035 W/mK, okumè 0,13 W/mK).  
 Frame width: 85 mm. Glazing: 33.1  
 EN2P/18 SSP/4/18 SSP/33.1 EN2P +ARGON 94%,  
 Spacer: SuperSpacer Tri-Seal  
 Installed between the construction layer and the  
 insulation layer. Shaded by blind.  
 Comfort- as well as hygiene criterion are achieved



Italy (T021a-Trento)	Category 1		Category 2	
	Timber double	30	Timber double	30
U <sub>g</sub> [W/m <sup>2</sup> K]	1,10	0,50		
U <sub>f</sub> [W/m <sup>2</sup> K]	1,11	0,93		
U <sub>w</sub> [W/m <sup>2</sup> K]	1,25	0,71		
U <sub>wi</sub> [W/m <sup>2</sup> K]	2,41	0,80		
Glass fraction	70%	70%		
g	5,8%	5,8%		
Shading factor	10%	12%		
Investment	1.621 €	1.859 €		
Present v. Energy	411 €	100 €		
LCC	2.032 €	1.959 €		
LCC Saving		74 €		
LCC Saving		4%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	60	6		
CO <sub>2</sub> Saving		54		
CO <sub>2</sub> Saving		90%		



9.7 – 30 --

The timber window presented, is for the warm, temperate climate zone and is made of fir and okume and insulated by a XPS block.

30 solved the issue of high thermal bridging values caused by the shutter housing by using a traditional blind.

The window is installed by a blind frame at the edge of the construction layer.

The jury praised the clean installation situation, especially the connection to the window sill, which allows to cover the bottom frame partly with insulation. The jury suggested moving the window more to the outside to reduce the thermal bridges of the installation.



Country

Climate



Material

Timber

**Description of baseline window**

Double glazed traditional New Zealand wooden window with double IGU-glazing (4/6air/4) and aluminium spacer. Depth of frame: 42 mm.

The frame is not painted in the factory, so for painting at the building site, 15% were added on the net window price.

Installed in the construction layer with reveal insulation. Shaded by fabric screen.

Comfort- as well as hygiene criterion are not achieved.

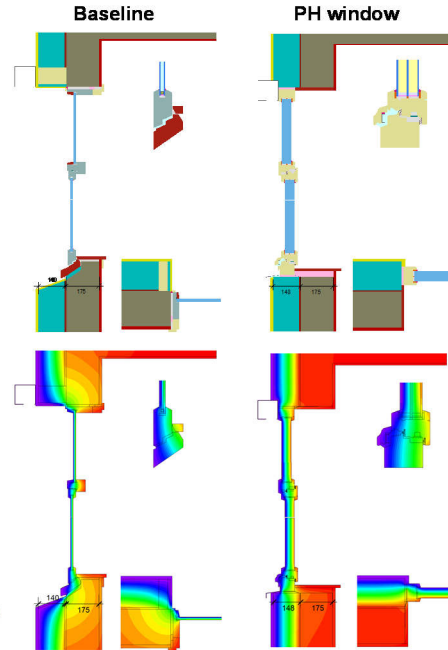
**Description of Passive House window**

Timber window frame with high performance triple glazing (4-20-4-20-4). Spacer: Swisspacer Ultimate.

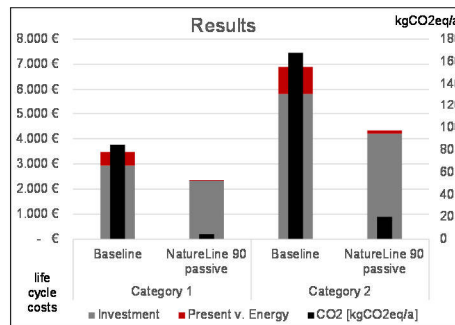
Installed in the center of the insulation layer by steel brackets. Mass equivalency method was used to model the brackets.

Airtightnes by plaster able tapes.

Shades by fabric screen.



New Zealand NZ0013a-Dunedin	Category 1		Category 2	
	Baseline	NatureLine 90 passive	Baseline	NatureLine 90 passive
$U_g$ [W/(m <sup>2</sup> K)]	2,45	0,52	2,45	0,52
$U_f$ [W/(m <sup>2</sup> K)]	1,57	1,06	1,36	1,01
$U_{w,gl}$ [W/(m <sup>2</sup> K)]	2,39	0,74	2,15	1,03
$U_{w,f}$ [W/(m <sup>2</sup> K)]	3,36	0,92	2,86	1,16
Glass fraction	77%	70%	56%	71%
g	63%	53%	63%	53%
Shading factor	12%	12%	12%	12%
Investment	2.929 €	2.329 €	5.819 €	4.201 €
Present v. Energy	544 €	30 €	1.079 €	129 €
LCC	3.473 €	2.359 €	6.898 €	4.330 €
LCC Saving		1.114 €		2.567 €
LCC Saving		32%		37%
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	85	5	168	20
CO <sub>2</sub> Saving		80		148
CO <sub>2</sub> Saving		95%		88%



**9.8 ThermaDura, New Zealand, NatureLine 90 passive**

ThermaDura is a small Timber and Timber Aluminium window manufacturer, based close to Dunedin, NZ, who is producing European style windows. Hardware and glazing is imported from Europe.

Thermadura entered the award with the Timber Aluminium window DesignLine and the Timber window NatureLine.

NatureLine is a Timber window, installed in the insulation layer by steel strips and shaded by a ZIP screen.

The window is compared to a traditional outward opening New Zealand timber window, produced by a craftsman. It is poorly installed according to recommendations of a well known producer of insulation material. It turns out, that NatureLine can be produced and installed more cheaply than the poor quality traditional timber window.

The jury outlined the high craftsmanship quality and practicability of window and window installation. Care should be taken regarding the connection of the roller shutter housing and the plaster. This connection might cause high maintenance efforts.

What looks like a standard window in the eyes of a European window expert is for New Zealand a very big step forward towards a greater degree of economy and climate protection.

Because that, the jury granted the

**Special Prize Economy to NatureLine 90 passive.**



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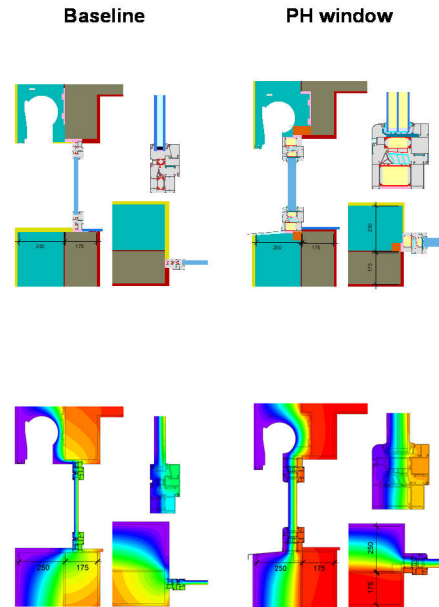
Country  Climate  Material **Aluminium**

**Description of baseline window**

Thermally separated, double IGU-glazed (6/12/6) aluminium window. Depth of frame: 52 mm. Spacer: Stainless steel.  
 Installed in the construction layer. Shaded by insulated roller blind.  
 Comfort- as well as hygiene criterion are not achieved.

**Description of Passive House window**

Thermally broken aluminium window frame with resol-foam insulation (0,023 W/(mK)). Pane thickness: 48 mm (4/18/4/18/4), rebate depth: 18 mm, spacer: SWISSPACER Ultimate with PU secondary seal.  
 Shaded by roller blind, installed in the insulation layer, supported by high rigid EPS.  
 Airtightness by plaster able tapes.



**9.9 Qingdao Rocky Window Co., Ltd., China with Rocky 110 Roller blind**

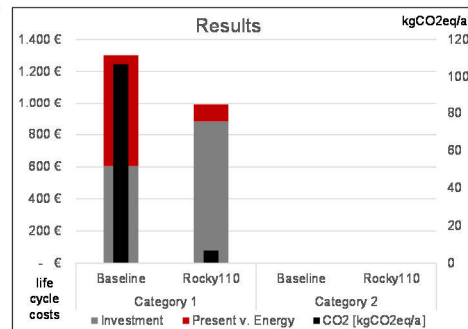
Qingdao Rocky Window is an innovative producer of Aluminium windows, doors and curtain walls. The company currently holds four Passive House Component certificates.

Rocky 110 is a relatively slim Aluminium window, achieving Passive House efficiency class pHB, wich is remarkable for an Aluminium window. Qingdao Rocky Window entered the component in two variants, one shaded by roller blind, one with integrated shading.

The roller blind shaded variant is installed with the support of highly rigid EPS foam in the insulation layer. It is compared to a thermally separated Aluminium window, installed in the construction layer causing high thermal bridging values.

The jury rated highly the energy and CO<sub>2</sub> savings of this window and the aesthetics of the window due to the relatively slim frame construction.

China CN0027a-Qingdao	Category 1		Category 2	
	Baseline	Rocky110	Baseline	Rocky110
U <sub>g</sub> [W/(m²K)]	1,27	0,53		
U <sub>f</sub> [W/(m²K)]	3,97	0,89		
U <sub>w</sub> [W/(m²K)]	2,16	0,71		
U <sub>wa</sub> [W/(m²K)]	3,69	0,80		
Glass fraction	72%	64%		
g	63%	53%		
Shading factor	10%	10%		
Investment	605 €	883 €		
Present v. Energy	697 €	111 €		
LCC	1.302 €	994 €		
LCC Saving		308 €		
LCC Saving		24%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	107	7		
CO <sub>2</sub> Saving		100		
CO <sub>2</sub> Saving		94%		



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Country



Climate



Material

Aluminium

#### Description of baseline window

Thermally separated, double IGU-glazed (6/12/6) aluminum window. Depth of frame: 52 mm. Spacer: Stainless steel.

Installed in the construction layer. Shaded by insulated roller blind.

Comfort- as well as hygiene criterion are not achieved.

#### Description of Passive House window

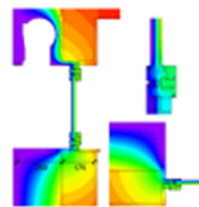
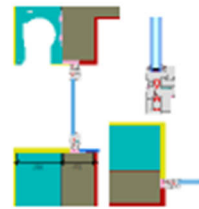
Thermally broken aluminum window frame with resol-foam insulation (0.023 W/(mK)). Pane thickness: 48 mm (4/18/4/18/4), rebate depth: 18 mm, spacer: SWISSPACER Ultimate with PU secondary seal.

Shaded by integrated shading between triple glazing and additional exterior pane. Gap is ventilated by openings all around the cavity.

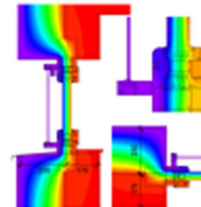
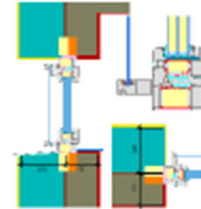
Installed in the construction layer, but thermally separated from the concrete by an element of resolcic foam with glued in timber blocks where necessary for static function.

Airtightness by plaster able tapes.

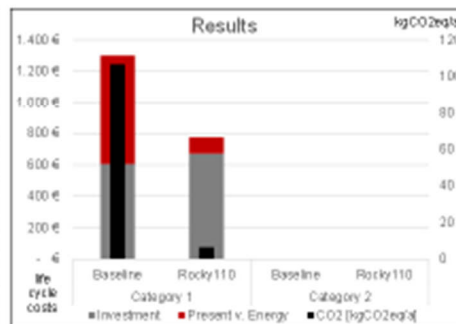
#### Baseline



#### PH window



China (CN)(27a-Qingdao)	Category 1		Category 2	
	Baseline	Rocky110	Baseline	Rocky110
U <sub>g</sub> [W/(m²K)]	1.27	0.49		
U <sub>t</sub> [W/(m²K)]	3.97	0.80		
U <sub>w</sub> [W/(m²K)]	2.16	0.67		
U <sub>av</sub> [W/(m²K)]	3.69	0.73		
Glass fraction	72%	54%		
g	63%	48%		
Shading factor	10%	10%		
Investment	605 €	671 €		
Present v. Energy	697 €	104 €		
LCC	1.302 €	775 €		
LCC Saving		526 €		
LCC Saving		40%		
CO <sub>2</sub> [kgCO <sub>2</sub> eq/a]	107	7		
CO <sub>2</sub> Saving		100		
CO <sub>2</sub> Saving		94%		



## 9.10 Qingdao Rocky Window Co., Ltd., China with Rocky 110 Integrated shading

Qingdao Rocky Window is an innovative producer of Aluminium windows, doors and curtain walls. The company currently holds four Passive House Component certificates.

Rocky 110 is a relatively slim Aluminium window, achieving Passive House efficiency class pHB, which is remarkable for an Aluminium window. Qingdao Rocky Window entered the component in two variants, one shaded by roller blind, one with integrated shading.

The variant with integrated shading is installed partially in the construction layer, mounted on an integrated blind frame from wood and resolcic foam. This installation strategy, developed in cooperation with the Passive House Institute turns out to be far easier to apply and thus less expensive than installation completely in the insulation layer.

An inoperable fourth pane is added to the outside of the window. The gap between this pane and the triple glazing is slightly ventilated and contains the venetian blind, which is protected from the weather and, as a result, less expensive. Because a avoided shutter housing is avoided, the installation thermal bridge value is much lower and further costs are avoided.

As Rocky 110 was the only participant entered into the warm, temperate category, Aluminium, it was not possible to give a regular prize. But Rocky 110 along with the innovative shading and installation concept convinced the jury to grant the

**Special Prize Shading & Installation to Qingdao Rocky Window for Rocky 110**



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