COST EFFECTIVENESS OF PASSIVE WINDOW MADE OF THERMALLY MODIFIED SPRUCE (*PICEA ABIES*)

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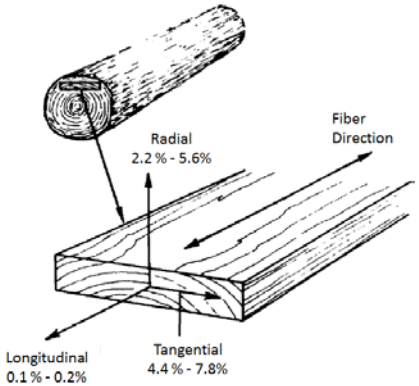
Thermal conductivity (λ)

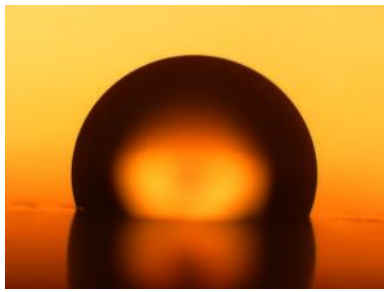
$\lambda_{larch} = 0,13\ W/mK$
$\lambda_{meranti} = 0,15\ W/mK$
$\lambda_{oak} = 0,18\ W/mK$

$\lambda_{glass} = 1,0\ W/mK$
$\lambda_{Al} = 160\ W/mK$
$\lambda_{PU\ foam} = 0,04\ W/mK$

λ = 0,09 W/mK

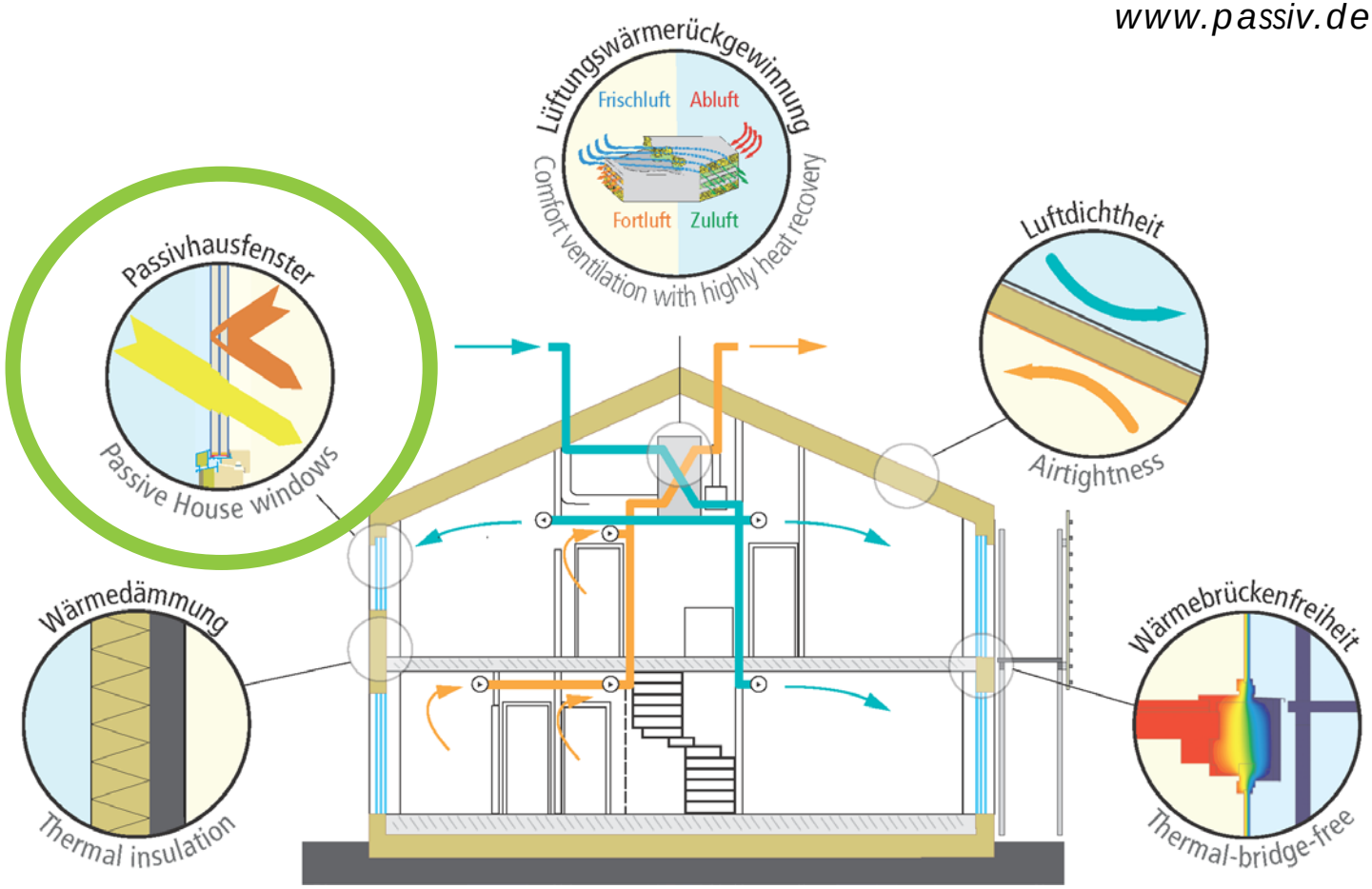
λ = 0,11 W/mK



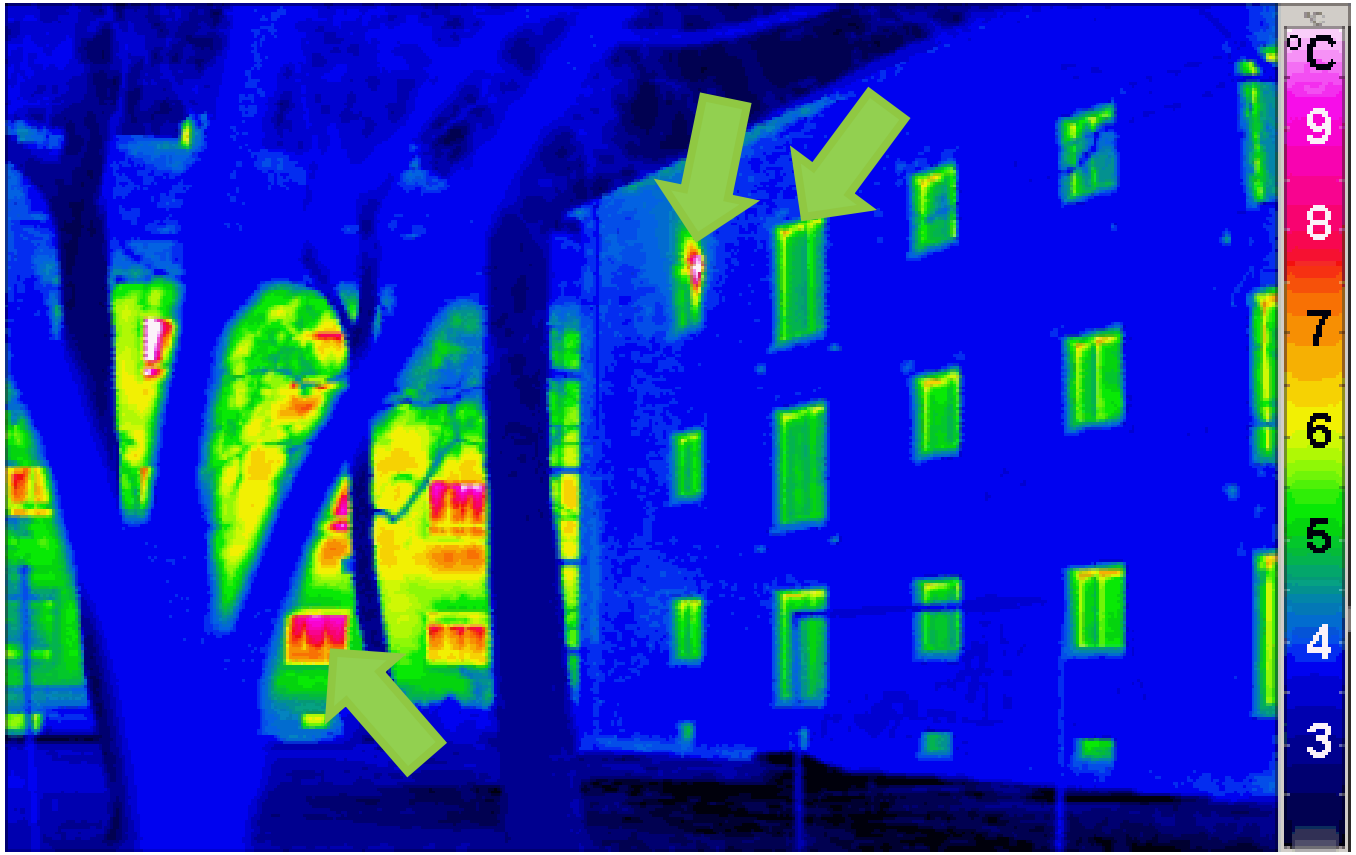


PASSIVE BUILDING

www.passiv.de



PASSIVE BUILDING



http://en.wikipedia.org/wiki/Passive_house

PASSIVE WINDOW?

U_f – thermal transmittance of frame

U_g – thermal transmittance of glazing

Ψ_g – linear thermal transmittance

U_w – thermal transmitance of window

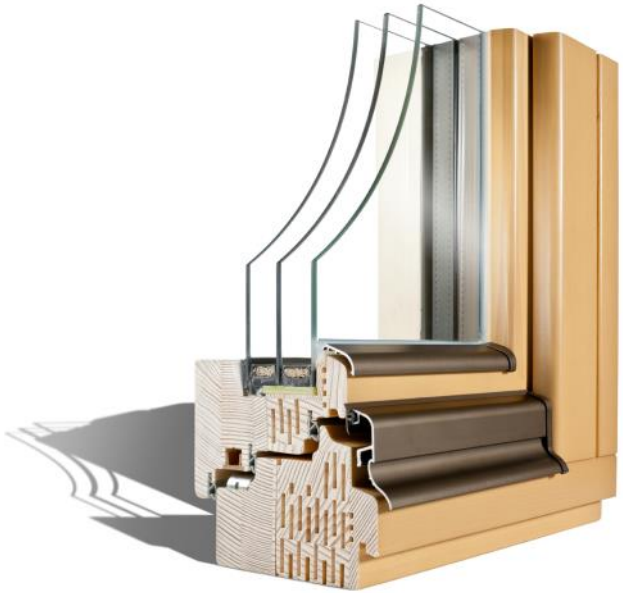
$$U_w = \frac{U_g \cdot A_g + U_f \cdot A_f + \Psi_g \cdot l}{A_w}$$

PASSIVE WINDOW?

Investition

+

Savings













SORA
Okno je več kot pogled

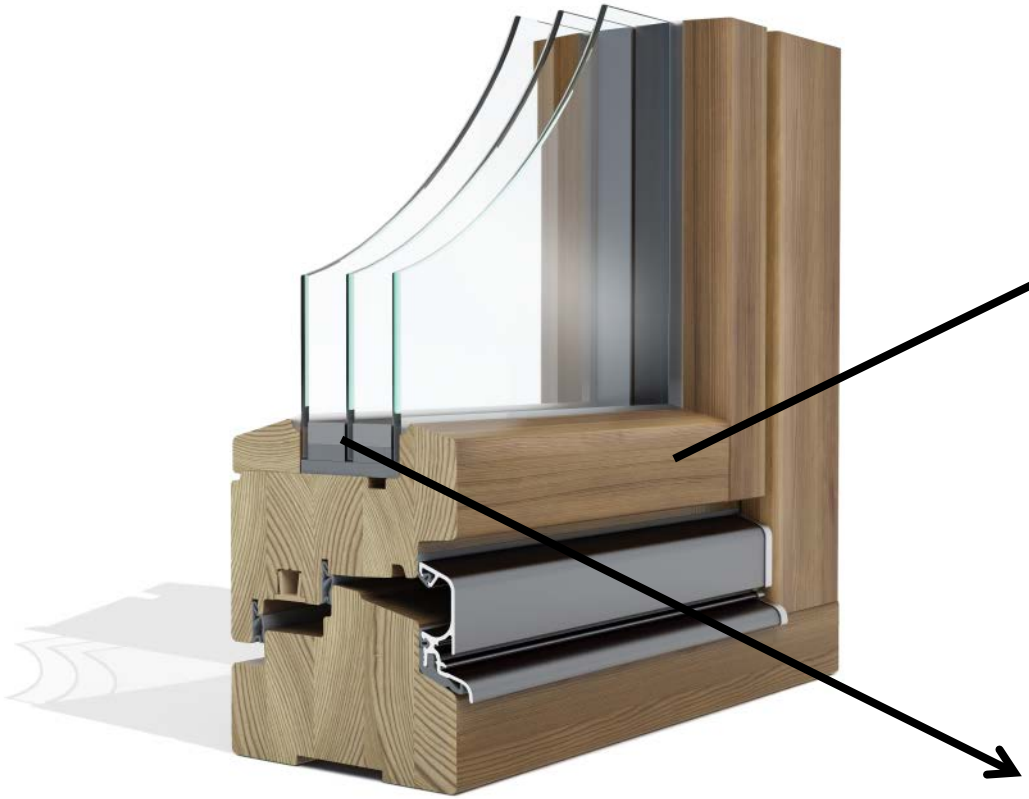
MATERIAL & METHODS

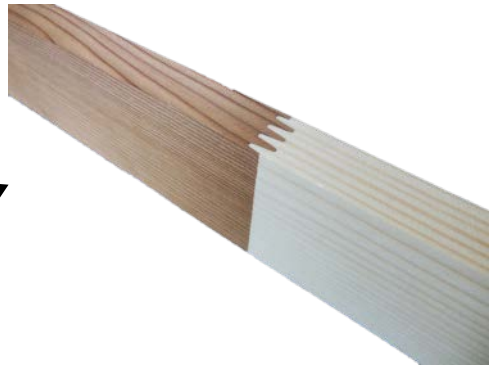
„Non – passive“

Passive

Wood:

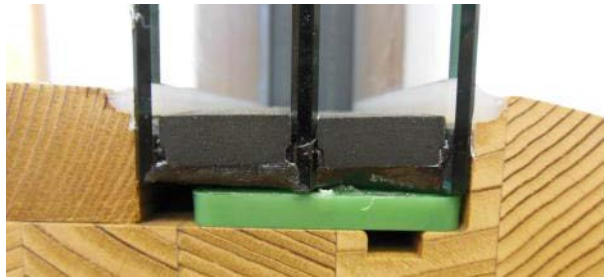
Thermally modified spruce (*Picea abies*)





Spacer:

Super spacer



PHPP calculation

Passive
House
Planning
Package

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Passivhaus Nachweis

Objekt:	Einfamilienhaus Langensendelbach - Bräuningshof				
Straße:					
PLZ/Ort:					
Land:					
Objekt-Typ:					
Klima:	Frankfurt/Main	Höhe Gebäudestandort (m ü. NN):	-		
Bauherrschaft:					
Straße:					
PLZ/Ort:					
Architektur:	Architekturbüro bucher + hüttinger				
Straße:	Gleiwitzer Str. 22				
PLZ/Ort:	91074 Herzogenaurch				
Haustechnik:	Ingenieurbüro Sabaczuk				
Straße:	Flözweg 14a				
PLZ/Ort:	08056 Zwickau				
Baujahr:	2008	Innentemperatur Winter:	20,0 °C	Umbautes Vol. V_e m³:	713,1
Zahl WE:	1	Innentemperatur Sommer:	25,0 °C	Mechanische Kühlung:	
Personenzahl:	6,0	Interne Wärmequellen Winter:	2,1 W/m²		
spez. Kapazität:	60 Wh/K pro m² WFL	dito Sommer:	2,9 W/m²		

Gebäudekennwerte mit Bezug auf Energiebezugsfläche und Jahr

				Anforderungen	Erfüllt?*
	Energiebezugsfläche	155,3	m²		
Heizen	Heizwärmebedarf	15	kWh/(m²a)	15 kWh/(m²a)	ja
	Heizlast	10	W/m²	10 W/m²	ja
	Übertemperaturhäufigkeit (> 25 °C)	5,8	%	-	-
Primärenergie	Heizen, Kühlen, Entfeuchten, WW, Hilfsstrom, Licht, elektr. Geräte	73	kWh/(m²a)	120 kWh/(m²a)	ja
	WW, Heizung und Hilfsstrom	22	kWh/(m²a)	-	-
	PE-Einsparung durch solar erzeugten Strom		kWh/(m²a)	-	-
Luftdichtheit	Drucktest-Luftwechsel n_{50}	0,2	1/h	0,6 1/h	ja

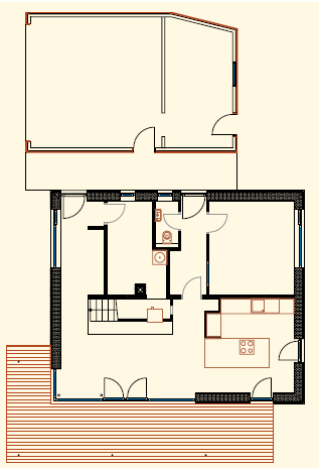
* leeres Feld: Daten fehlen; '-': keine Anforderung

Reference building

Area: 155 m^2

Passive standard – 15 kWh/(m^2a)

Clima: Frankfurt (Germany)



POSITION	WINDOW TYPE	WINDTH	HEIGHT	ORIENTATION	AREA
1	single casement window	65	65	N	0,42
1a	single casement window	65	65	N	0,42
2	single casement window	65	110	E	0,72
2a	fixed window	185	110	E	2,04
3	single casement balcony doors	100	234,5	E	2,35
3a	single casement balcony doors	100	234,5	S	2,35
4a	fixed window	197	234,5	S	4,62
4b	double casement balcony doors	100	234,5	S	2,35
4c	double casement balcony doors	100	234,5	S	2,35
4d	fixed window	205,5	234,5	S	4,82
4e	fixed window	133,5	234,5	W	3,13
5	single casement window	65	110	W	0,72
5a	fixed window	185	110	W	2,04
6	single casement window	100	100	N	1,00
7	single casement balcony doors	100	234,5	E	2,35
8	single casement balcony doors	70	234,5	E	1,64
9a	single casement window	100	110	S	1,10
9b	fixed window	150	110	S	1,65
9c	fixed window	150	110	S	1,65
9d	single casement window	100	110	S	1,10
10	single casement balcony doors	70	234,5	W	1,64
11	single casement balcony doors	100	234,5	W	2,35
12	single casement (reference) window	123	148	/	1,82

Windows area:

42,77 m^2

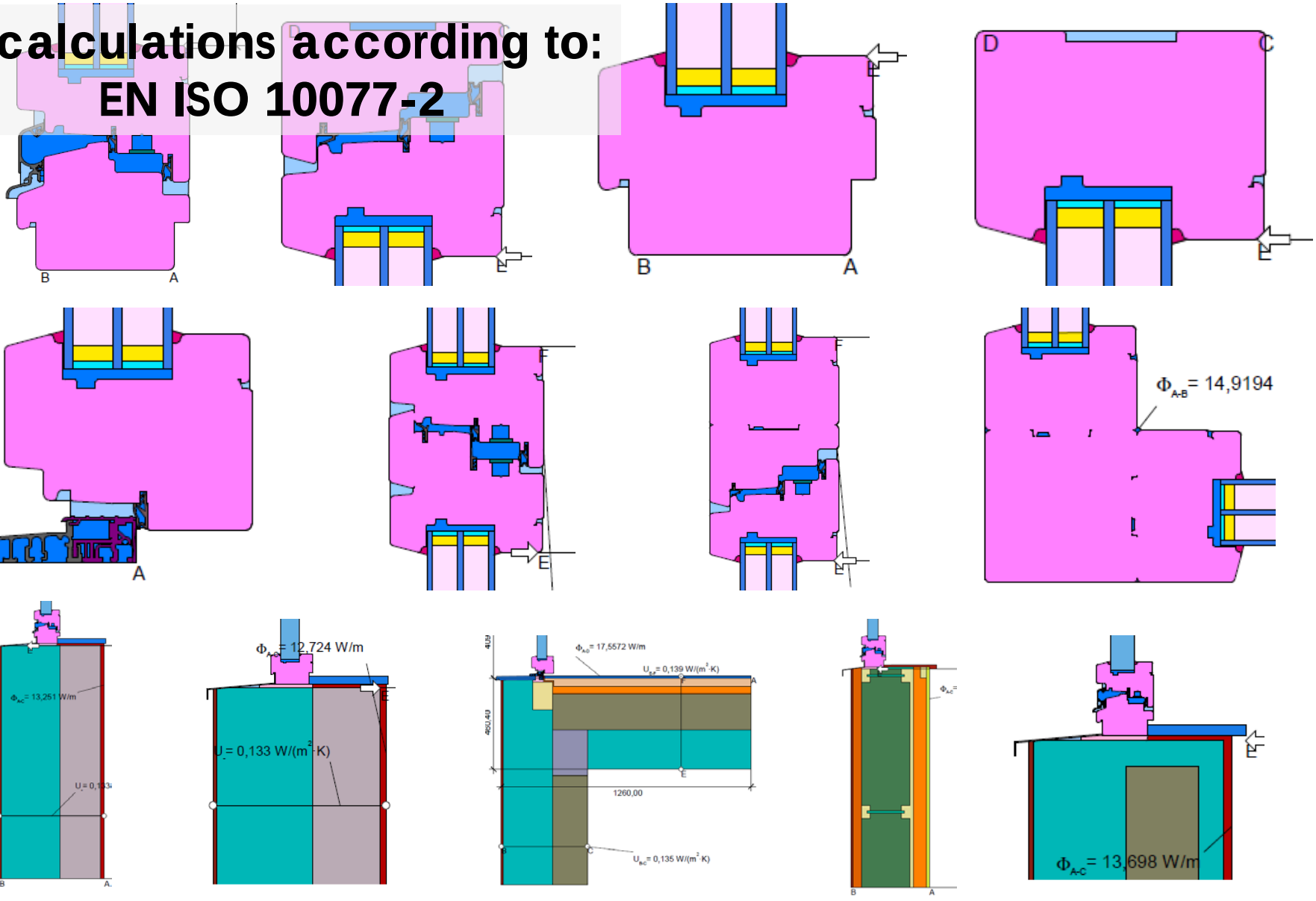
N: 1,85 m^2 (4,3 %)

E: 9,08 m^2 (21,2 %)

S: 21,97 m^2 (51,4 %)

W: 9,87 m^2 (23,1 %)

U_f calculations according to: EN ISO 10077-2



COMPARISON

- **Reference timber window**

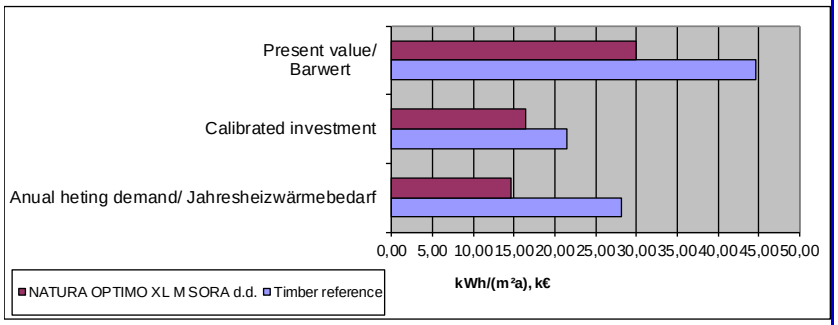
U_f = 1,2 W/m²K
$U_{f,sp}$ = 1,3 W/m²K
U_g = 1,2 W/m²K (g = 60 %)
Ψ = 0,035 W/mK
$\Psi_{vgr.}$ = 0,06 W/mK
U_w = 1,3 W/m²K

- **Passive window Natura Optimo XLT**

U_f = 0,78 W/m²K
$U_{f,sp}$ = 0,87 W/m²K
U_g = 0,6 W/m²K (g = 62 %)
Ψ = 0,023 W/mK
$\Psi_{vgr.}$ = 0,018 W/mK
U_w = 0,72 W/m²K

Section/ Schnitt	U_f [W/(m²K)]	b_f [m]	Ψ_g [W/(mK)]	$\Psi_{install}$² [W/(mK)]
Bottom TT/ Unten DK	0,87	0,143	0,023	0,018
Bottom fixed/ Unten fest	0,83	0,079	0,023	0,017
Bottom, terrace door/ Unten, Terrassentür	1,41	0,101	0,024	0,099
Side, top TT/ Seitlich, oben DK	0,78	0,116	0,023	-0,004
Side, top fixed/ Seitlich, oben fest	0,78	0,079	0,023	-0,003
Section/ Schnitt **2-2a**	0,77	0,191	0,023	
Section/ Schnitt **4a-4b**	0,77	0,191	0,023	
Section/ Schnitt **4b-4c**	0,80	0,148	0,023	
Section/ Schnitt **4c-4d**	0,77	0,191	0,023	
Section/ Schnitt **4d-4e**	0,41	0,370	0,023	
Section/ Schnitt **5-5a**	0,77	0,191	0,023	
Section/ Schnitt **9a-9b**	0,77	0,191	0,023	
Section/ Schnitt **9b-9c**	0,77	0,154	0,023	
Section/ Schnitt **9c-9d**	0,77	0,191	0,023	

Is the building a Passive House?/ Ist das Gebäude ein Passivhaus?	Annual heating demand/ Jahres-heizwär-mebedarf	Trans-mission losses/ Trans-missions-verluste	Solar gains/ Solare Gewinne	Calibrated invest-ment	Present value/ Barwert
yes / ja	[kWh/(m²a)]	[kWh/a]	[kWh/a]	[€]	[€]
Timber reference	28,2	4757	2918	21384	44595
NATURA OPTIMO XL M SORA d.	**14,7**	2489	3124	**16417**	**29907**



Savings/ Einsparung [€] **14688**

RESULTS

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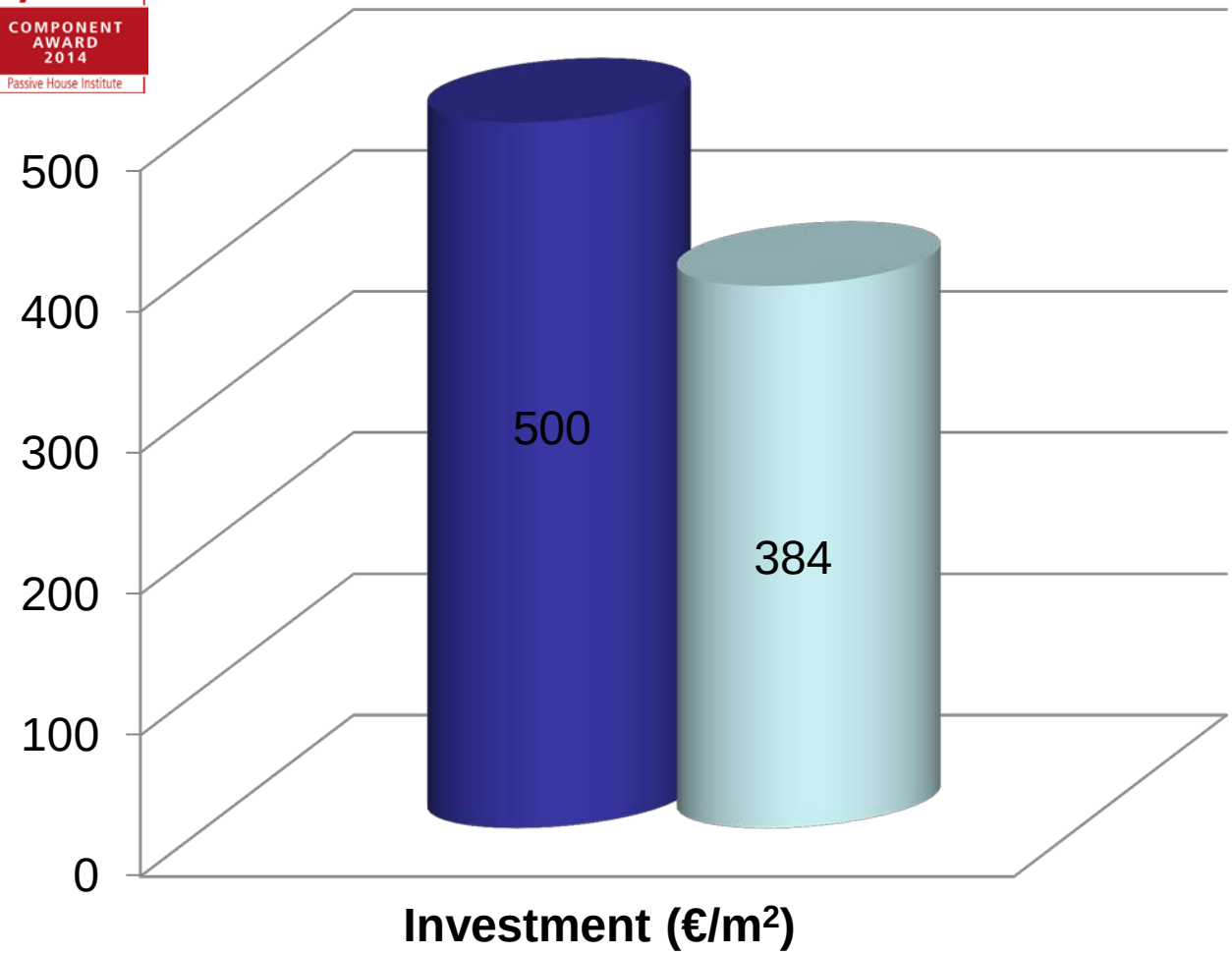

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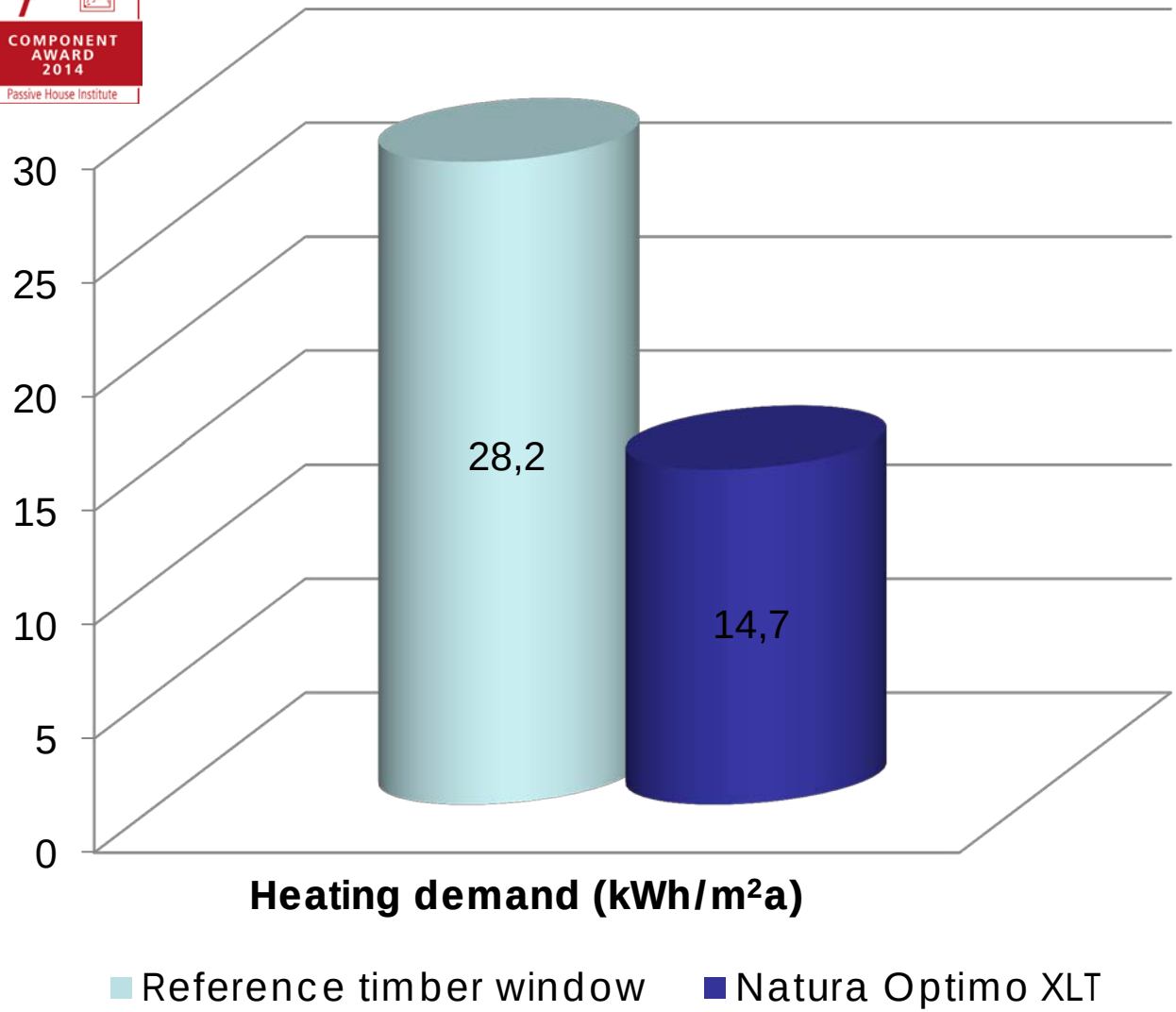

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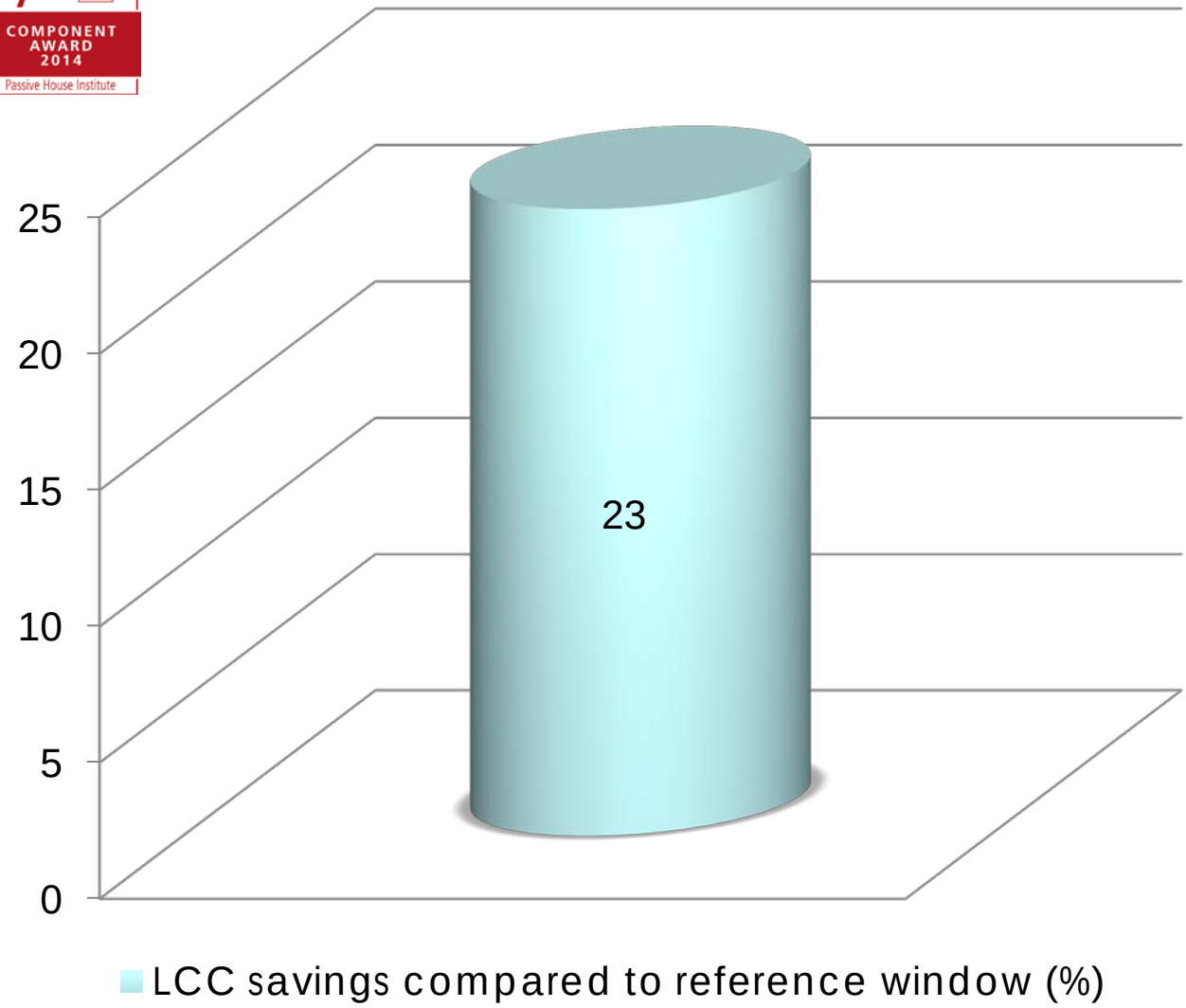

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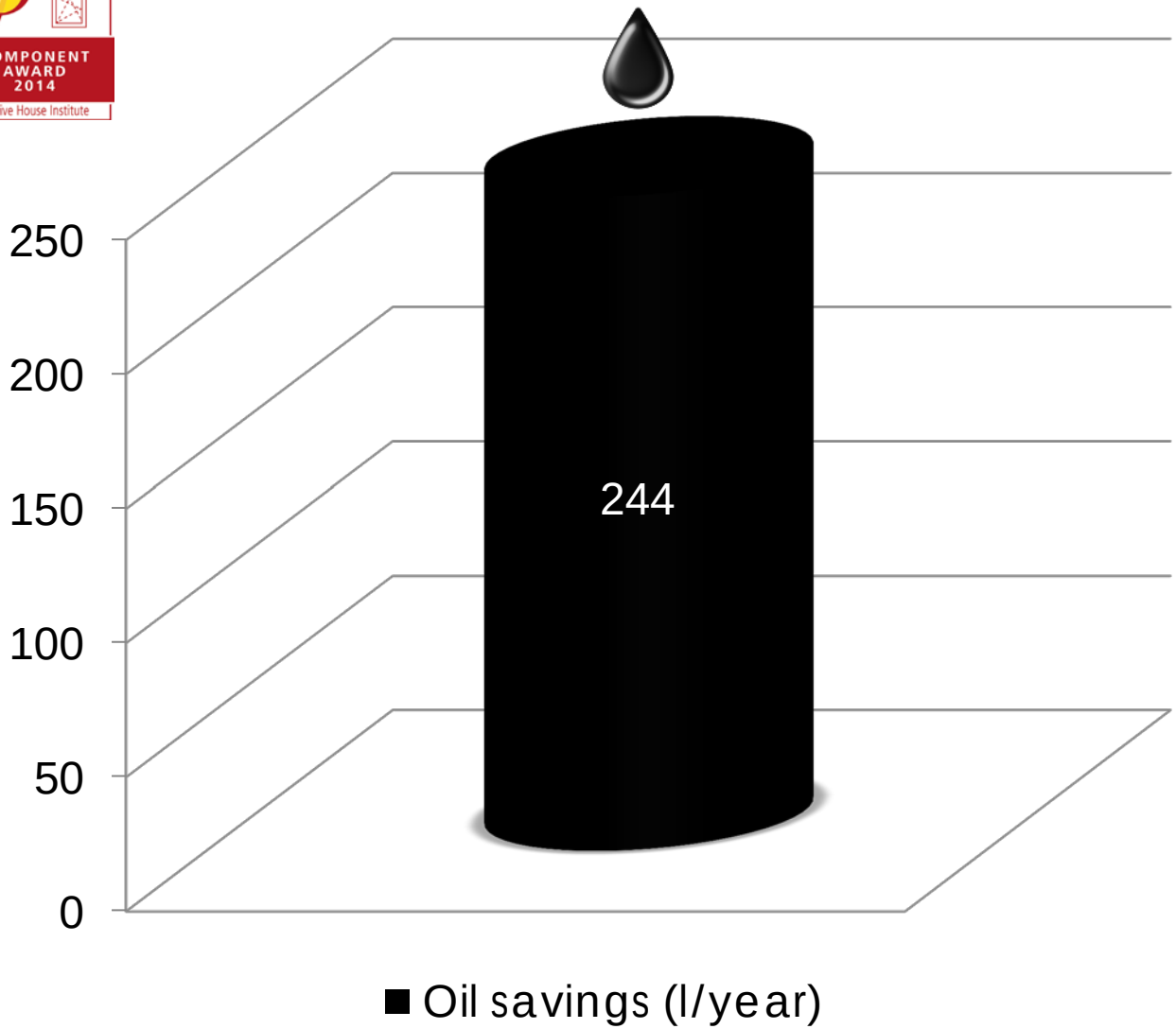

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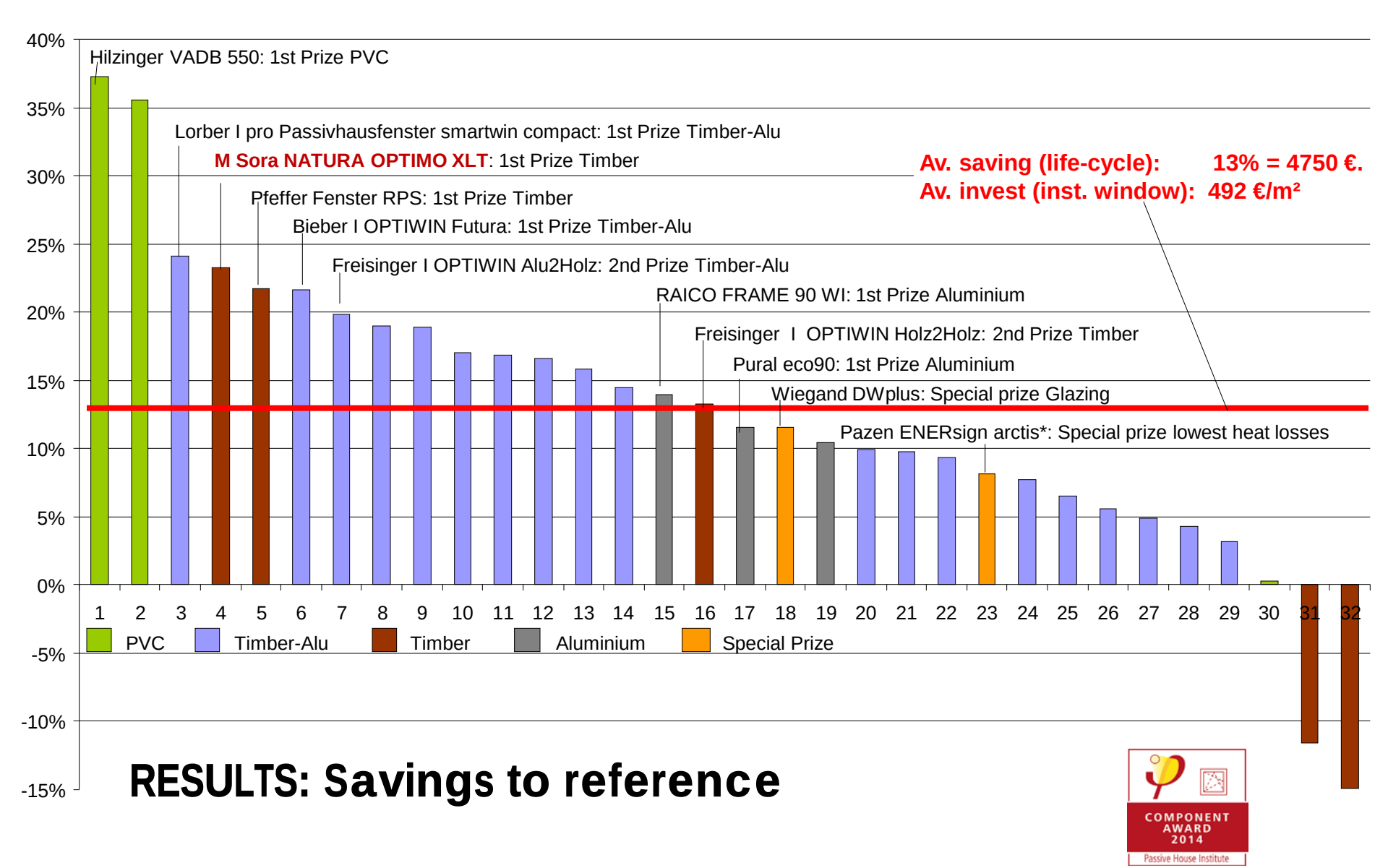
Savings in life-time of 40 years

14.688 €

(*calibrated investition 16.417 €)

** factor 1,226 according to Slovenia/Germany economy situation*



RESULTS: Savings to reference

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TAKE HOME MESSAGES

- Thermally modified spruce is due to cca. 20 % **better thermal insulation** appropriate material for passive windows

- **Simple solutions** result in cost-effectiveness

- **LCA** is of importance for more appropriate comparison of timber to PVC windows


Thank
You
Merci
Gracias
Spacibo
Danke
KamSahHamnida
Arigatô
Hvala
TerimaKasih
NajisTuke
Mèsi
Xièxie
Takk
aDank
BarakAllahuFiik
Grazie
Chokrane
Kiitos
Dziakuju
GratiasAgimus
GratiasAgo
Motashakkeram
TänanVäga
Tak
Dankie
KopKhunKha
Gràcie
CámOn
Multumesc
Saha
Salamat
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Mauruuru
Barkal
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Grazzi
KhobChaiDeu


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