

# Plus-Energy-House

## - The standard of the future

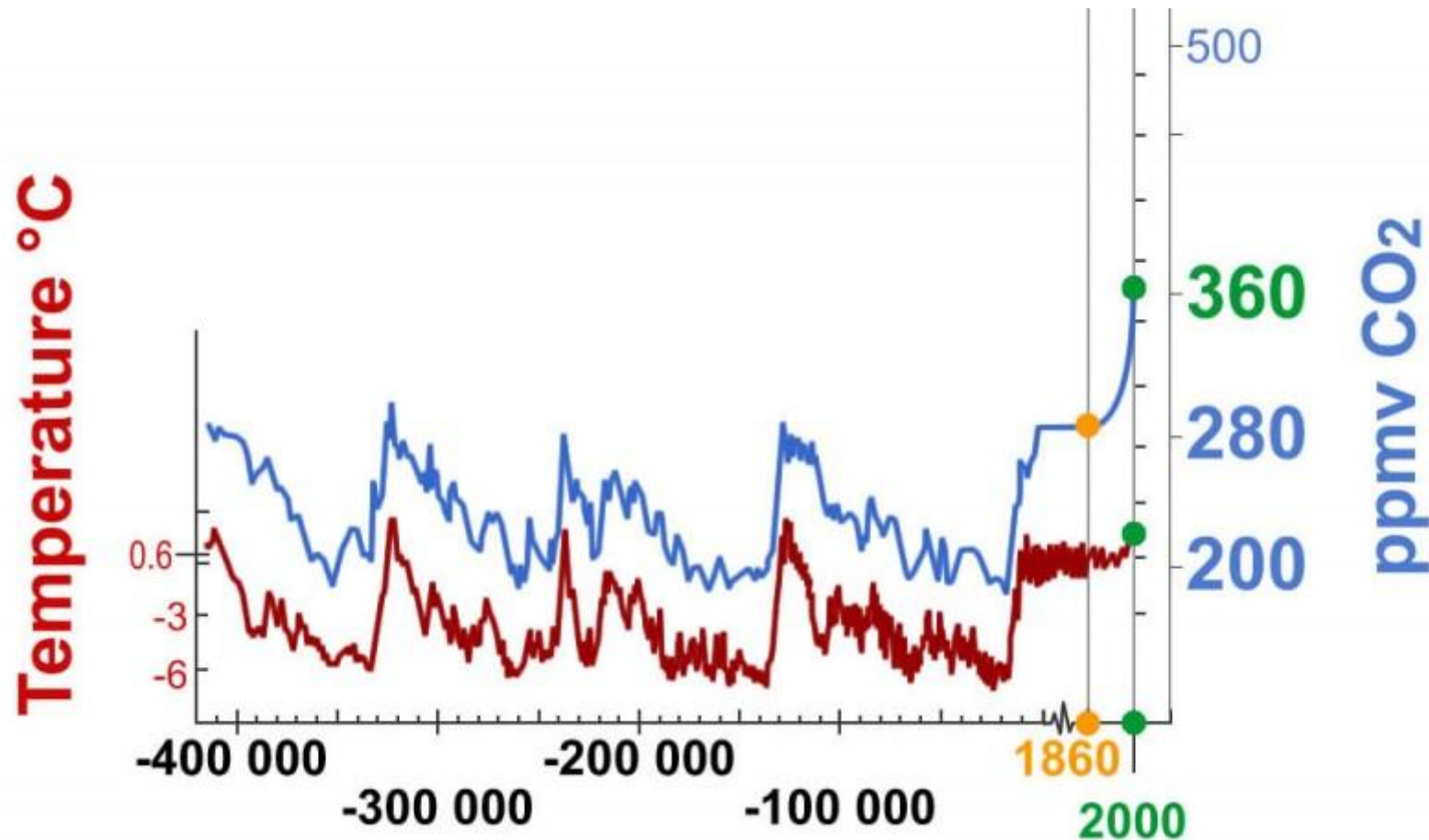
3rd EnercitEE Component Seminar  
23-24 October 2012 in Leipzig, Germany

Speaker: Stefan Vetter



## Main Problem

- the climate change due to rising concentration of CO<sub>2</sub>

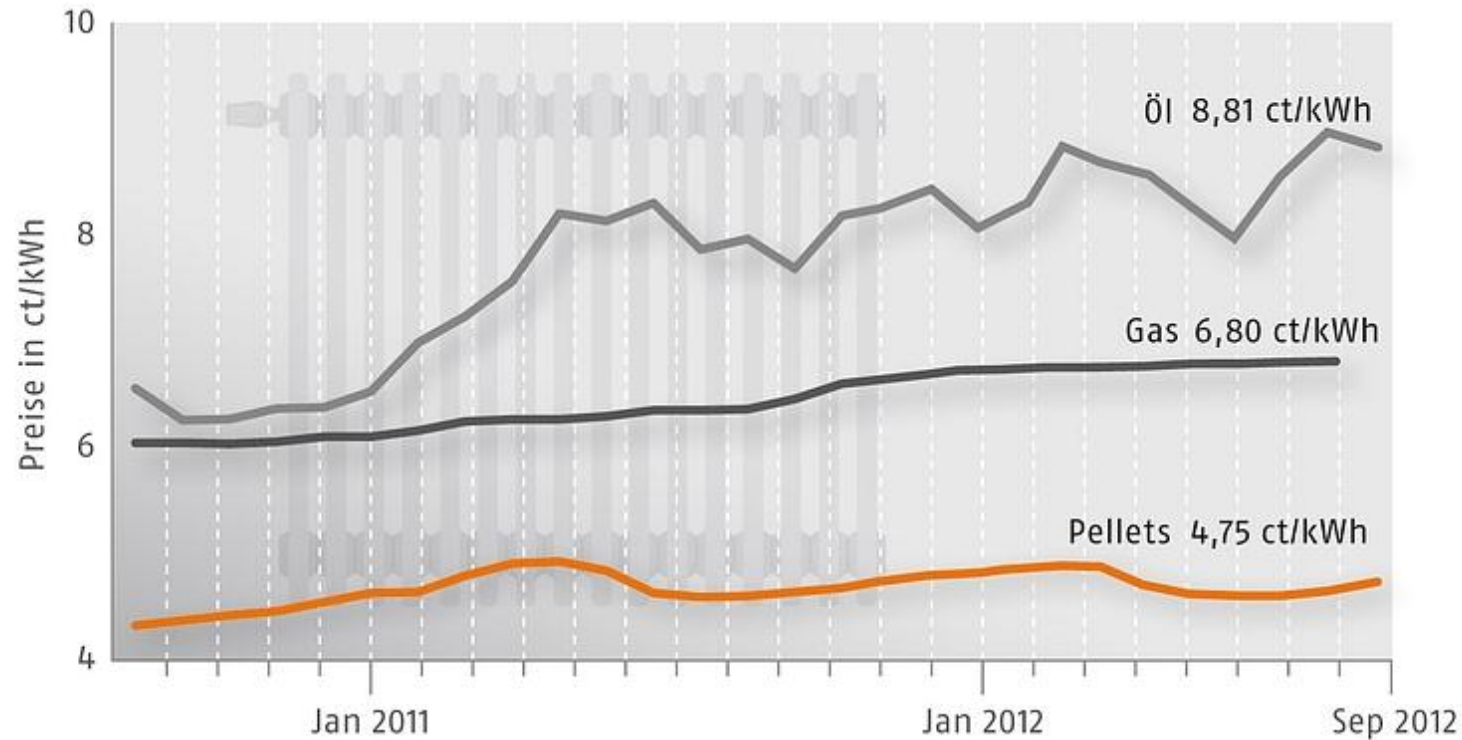


Source: [www.sciencepoles.org](http://www.sciencepoles.org)

## Main Problem

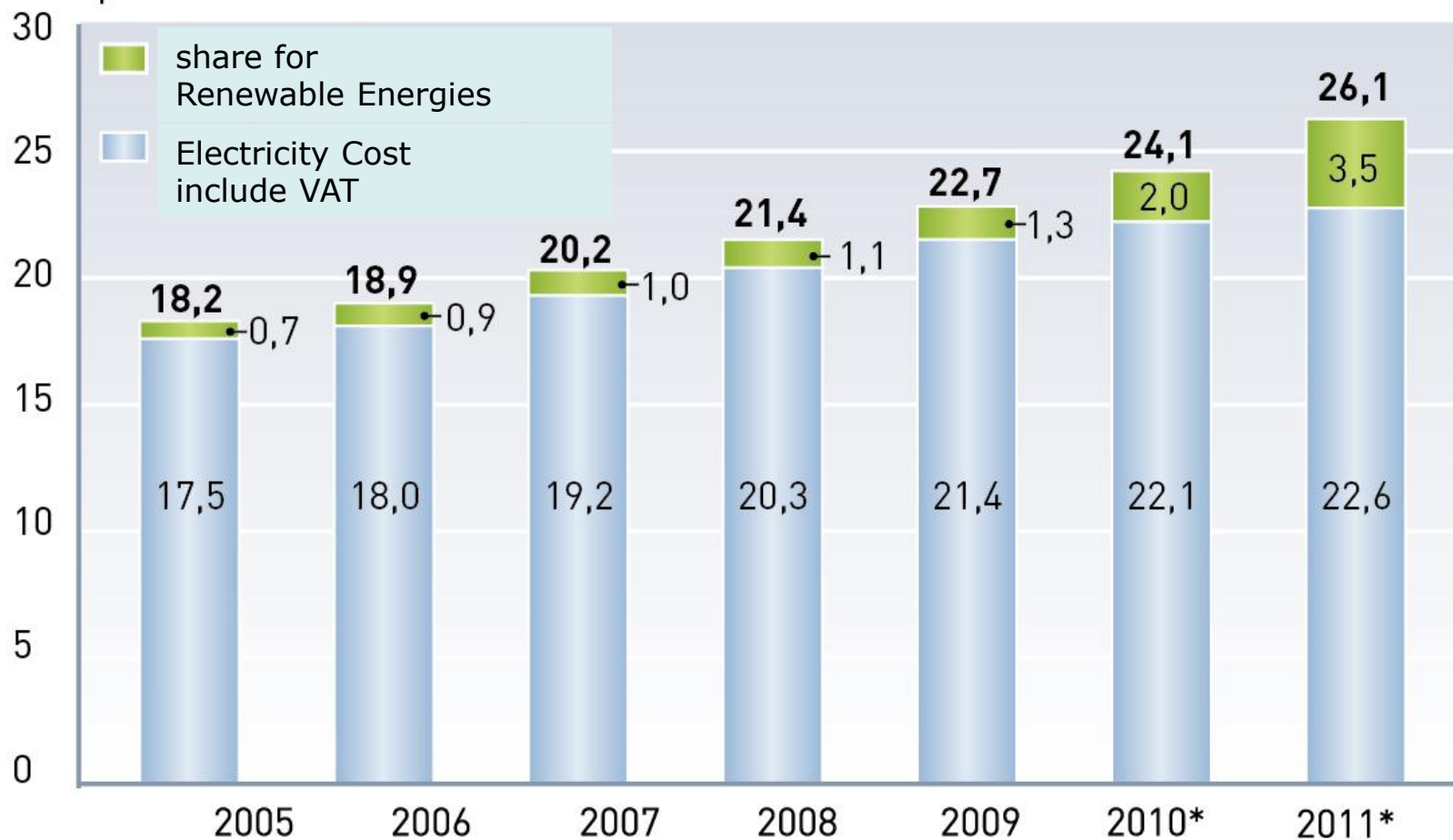
- Energy Prices constantly rising

### Heating cost development in Germany [Cent per kilowatt hour]



Source: [www.depv.de](http://www.depv.de)

## Household Electricity Prices 2005-2011 in Germany [Cent per kilowatt hour]

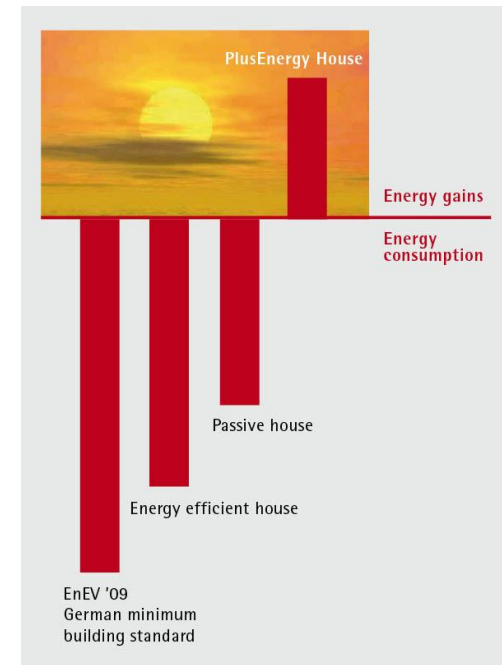


Source: [www.unendlich-viel-energie.de](http://www.unendlich-viel-energie.de)

## Best alternative is the “Plus-Energy-house”

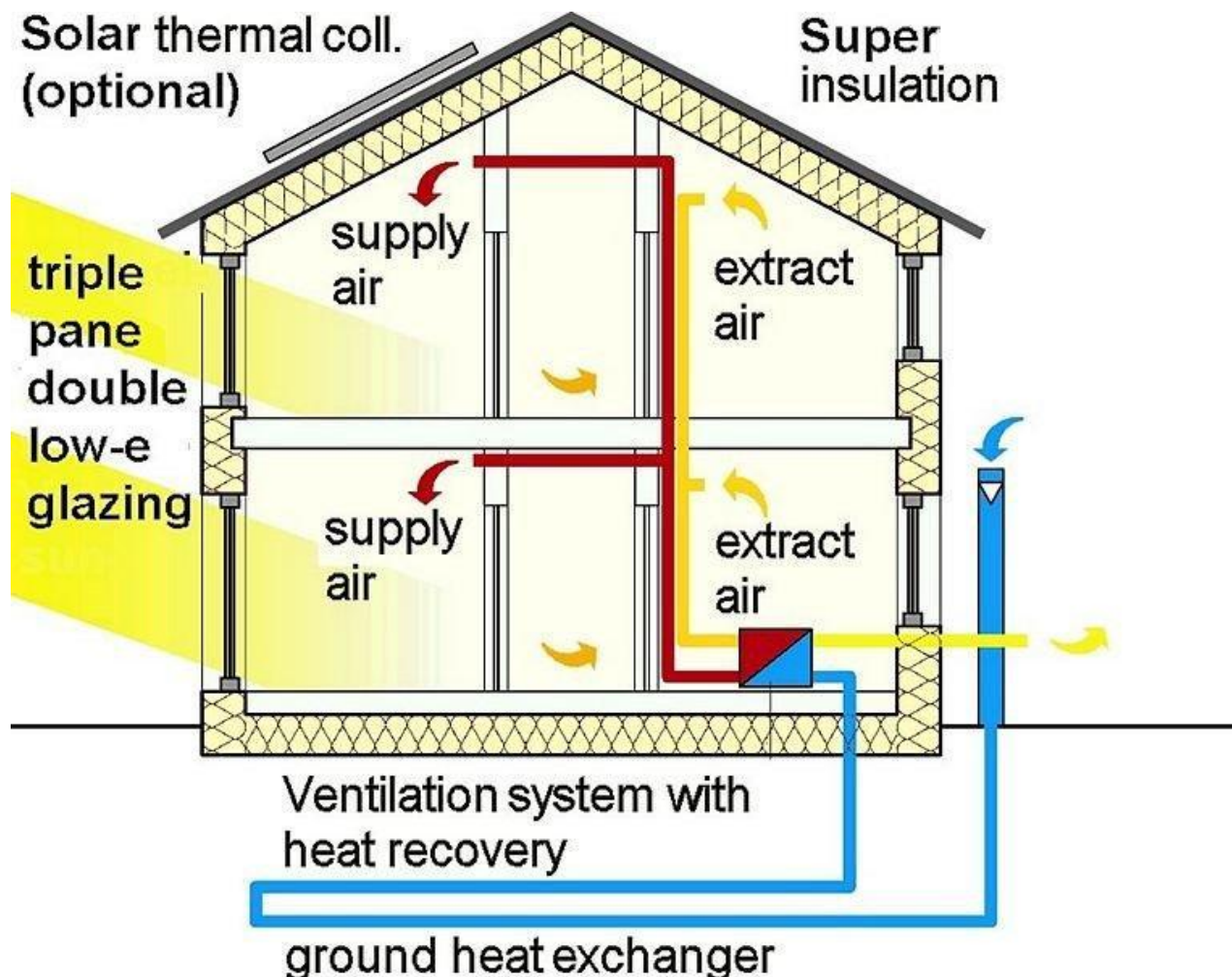
= produces more energy from renewable energy sources, over the course of a year, than it imports from external sources

- a technical building standard more better than current legal requirements
- **based on the passive house concept**
- best opportunity for the use of renewable energies
- no or very low CO<sub>2</sub> emission
- no or very low energy costs
- realizable with all buildings and insulation materials
- best indoor air quality the whole year
- no increased humidity, free of mould
- high living comfort, constant room and wall temperature





## The Passive House... What's that ?



Source: Passivhaus-Institut

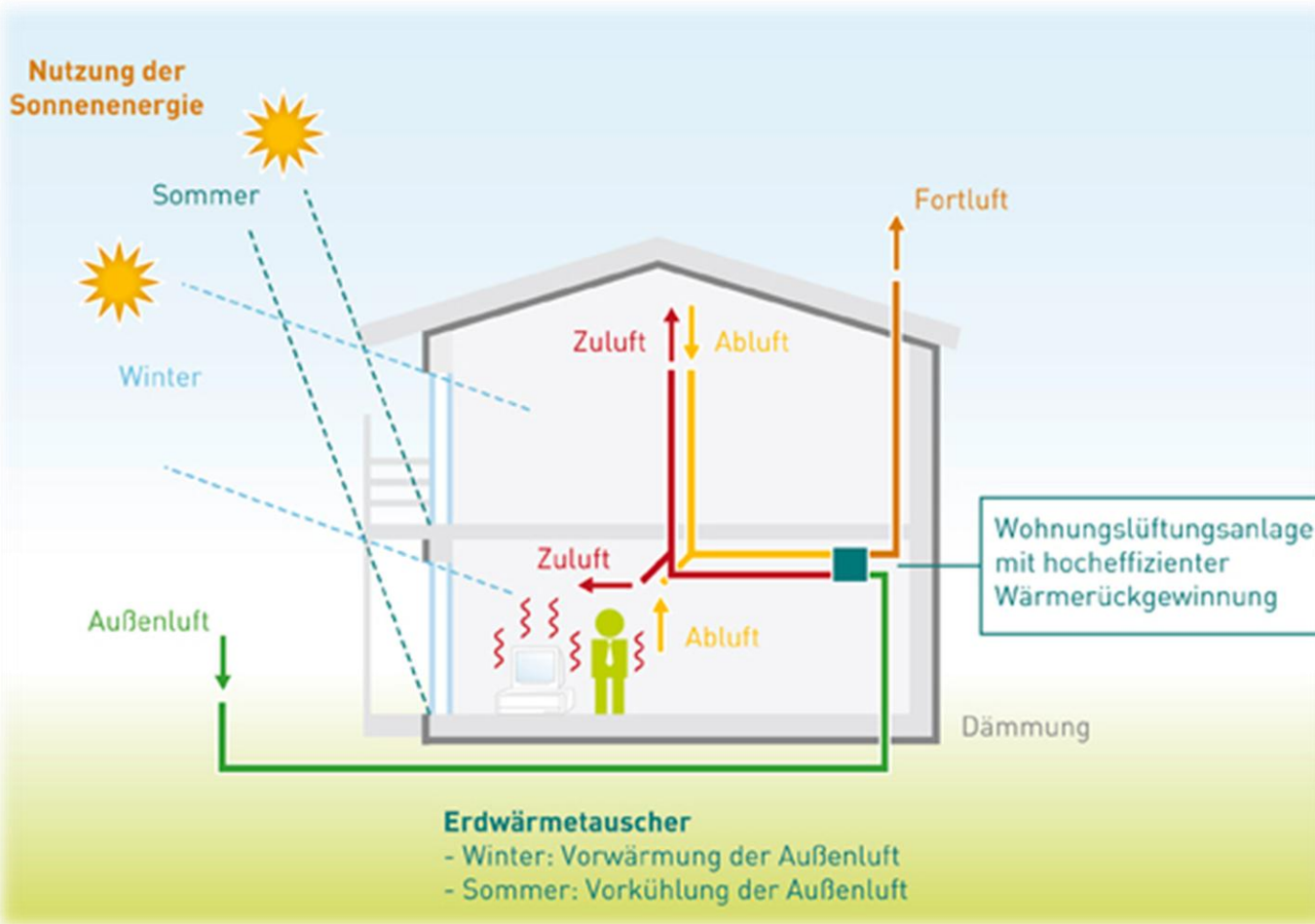
- high level of thermal insulation
- well-insulated window frames with triple low energy glazing (pane)
- solar heat gains higher than heat losses
- thermal-bridge-free construction
- high Airtight building envelope
- comfort ventilation with highly efficient heat recovery
- the heat recovery has an average of 90%

## Why so called Passiv House ?

→ because the use of passive heat sources = **internal winnings**



- The heat emission of the residents (about 80 watt/hour)
- the solar energy entering through the windows
- the waste heat of the electrical appliances (lightning, stove, clothes dryer)



## The main Passive House criteria (1)

### Energetic Requirements:

- heat load  $\leq 10 \text{ W/ m}^2$
- heating demand  $\leq 15 \text{ kWh/ (m}^2\text{a)}$
- Primary energy demand  $\leq 120 \text{ kWh/ (m}^2\text{a)}$

15 kWh per m<sup>2</sup> living area  
= 1.5 l heating oil /m<sup>2</sup>  
or  
1.5 m<sup>3</sup> natural gas /m<sup>2</sup>.

### Construction Requirements:

heat transition coefficient for Wall, Roof, Floor

$$U < 0,15 \text{ W / (m}^2\text{K)}$$

heat transition coefficient for windows

$$U_w \leq 0,8 \text{ W / (m}^2\text{K)}$$

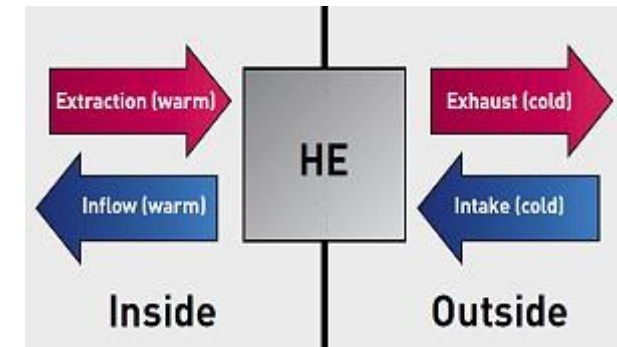
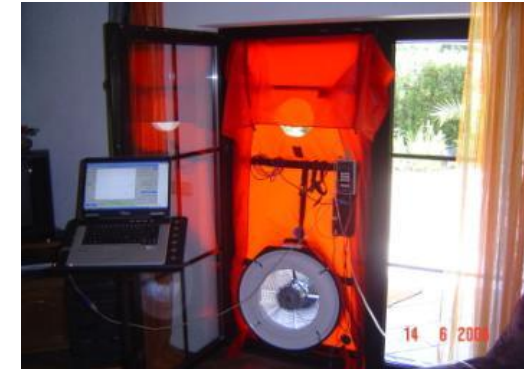


Source: [www.lieblinger.de](http://www.lieblinger.de)



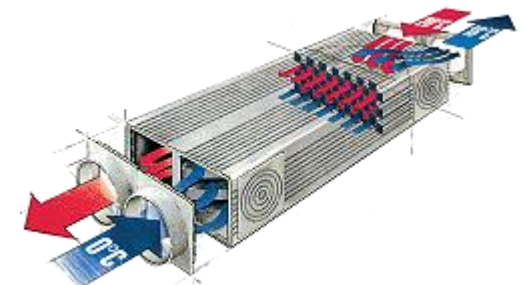
## The main Passive House criteria (2)

- **Airtightness:**  $n_{50} \leq 0,6 \text{ h}^{-1}$   
(max. 0,6-times air changes per hour, 50 Pa pressure difference – Airtightness measurement)
- **ventilation system with heat recovery**  
Heat Recovery Efficiency:  $h_{\text{WRG, eff}} \geq 75\%$   
electricity efficiency:  $p_{\text{el}} < 0,45 \text{ Wh/ m}^3$
- **Calculated with Passive House Planning Package**



Kennwerte mit Bezug auf Energiebezugsfläche				
Energiebezugsfläche:	136,1	m²		
Verwendet:	Jahresverfahren	PH-Zertifikat:	Erfüllt?	
<b>Energiekennwert Heizwärme:</b>	<b>15</b>	<b>kWh/(m²a)</b>	<b>15 kWh/(m²a)</b>	<b>ja</b>
<b>Drucktest-Ergebnis:</b>	<b>0,4</b>	<b>h⁻¹</b>	<b>0,6 h⁻¹</b>	<b>ja</b>
<b>Primärenergie-Kennwert (WW, Heizung, Kühlung, Hilfs- u. Haushalts-Strom):</b>	<b>82</b>	<b>kWh/(m²a)</b>	<b>120 kWh/(m²a)</b>	<b>ja</b>
<b>Primärenergie-Kennwert (WW, Heizung und Hilfsstrom):</b>	<b>45</b>	<b>kWh/(m²a)</b>		
<b>Primärenergie-Kennwert Einsparung durch solar erzeugten Strom:</b>		<b>kWh/(m²a)</b>		
<b>Heizlast:</b>	<b>13</b>	<b>W/m²</b>		
<b>Übertemperaturhäufigkeit:</b>	<b>0</b>	<b>%</b>	über <b>25</b> °C	
<b>Energiekennwert Nutzkälte:</b>		<b>kWh/(m²a)</b>	<b>15 kWh/(m²a)</b>	
<b>Kühllast:</b>	<b>2</b>	<b>W/m²</b>		

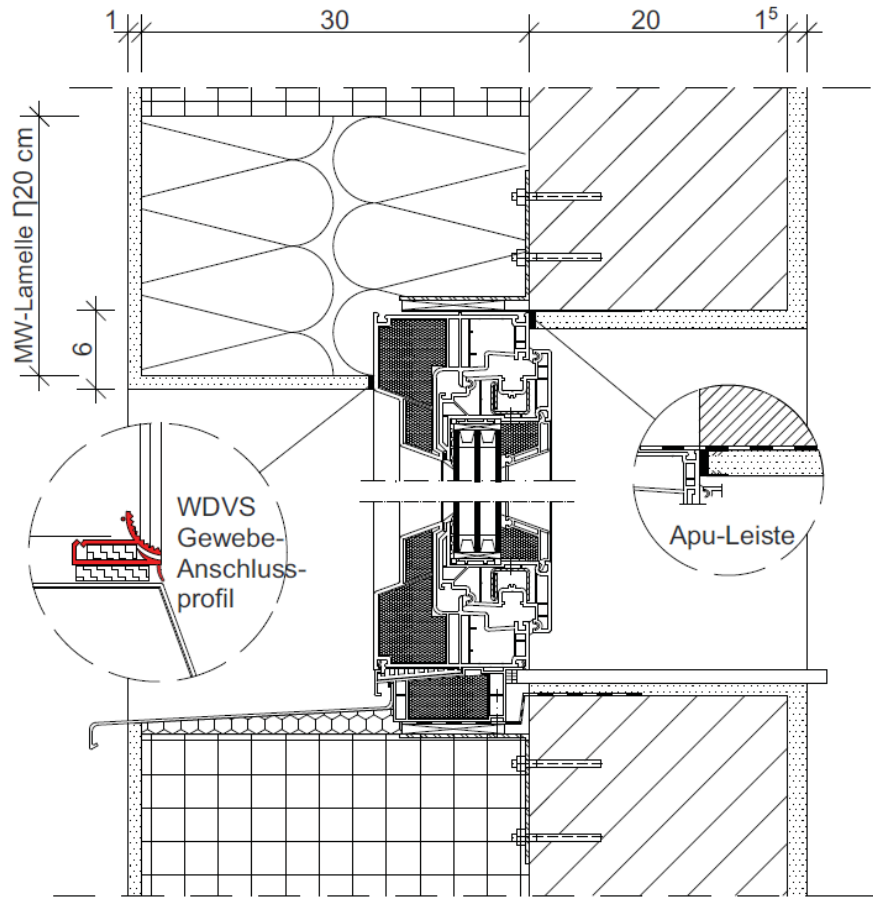
Kennwert mit Bezug auf Nutzfläche nach EnEV				
Nutzfläche nach EnEV:	198,0	m²	Nachweis EnEV erfolgte in separater Berechnung	
<b>Primärenergie-Kennwert (WW, Heizung und Hilfsstrom):</b>	<b>31</b>	<b>kWh/(m²a)</b>	<b>Anforderung: 40 kWh/(m²a)</b>	<b>Erfüllt? ja</b>



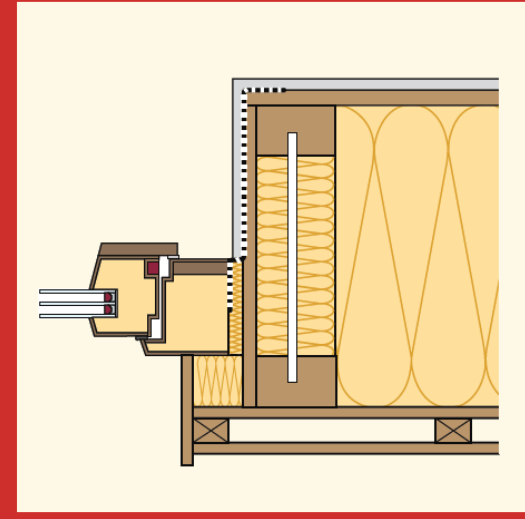
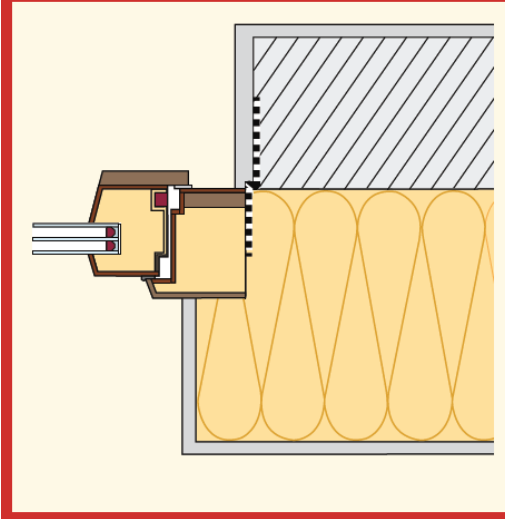
Source: [www.paul-lueftung.net](http://www.paul-lueftung.net)

## Installation of a passive house window without thermal bridges

Detail: Window in insulation layer



Cross section: solid construction | timber-frame construction



air-tight connection with special tapes

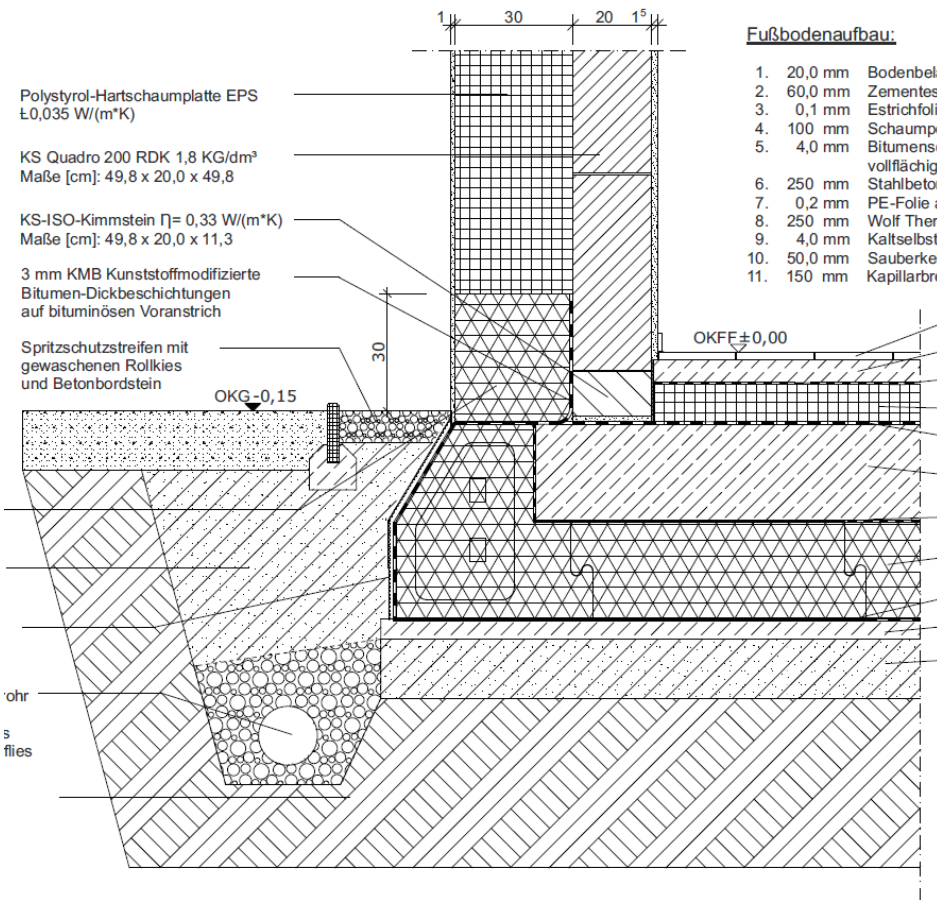
source: iPHA



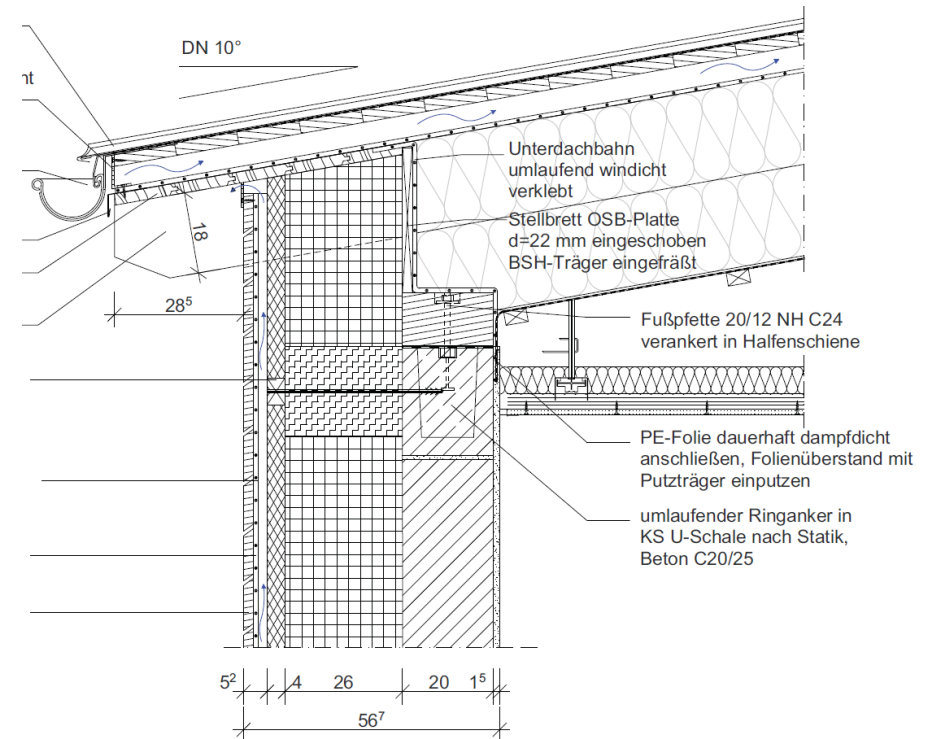
source: BauPraxis Home

# Installation of a passive house window without thermal bridges

## Detail: wall - base plate

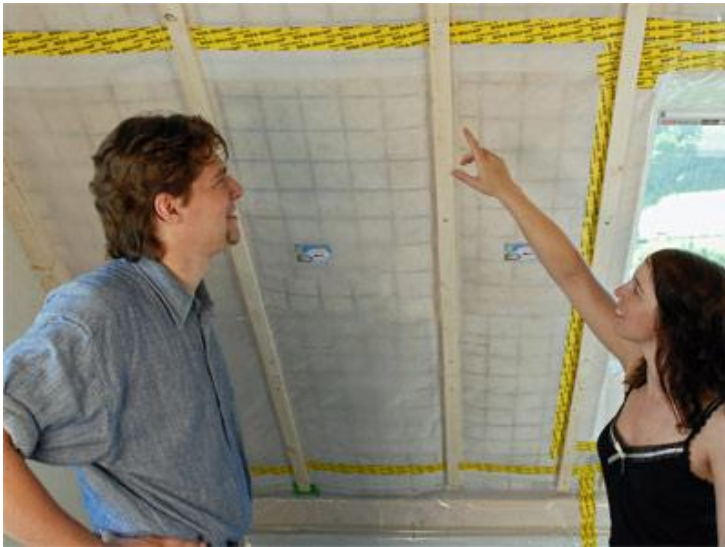


## Detail: wall - roof

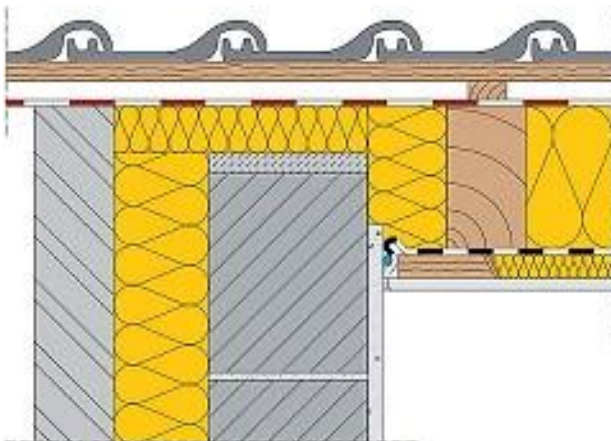




## Important! Airtightness

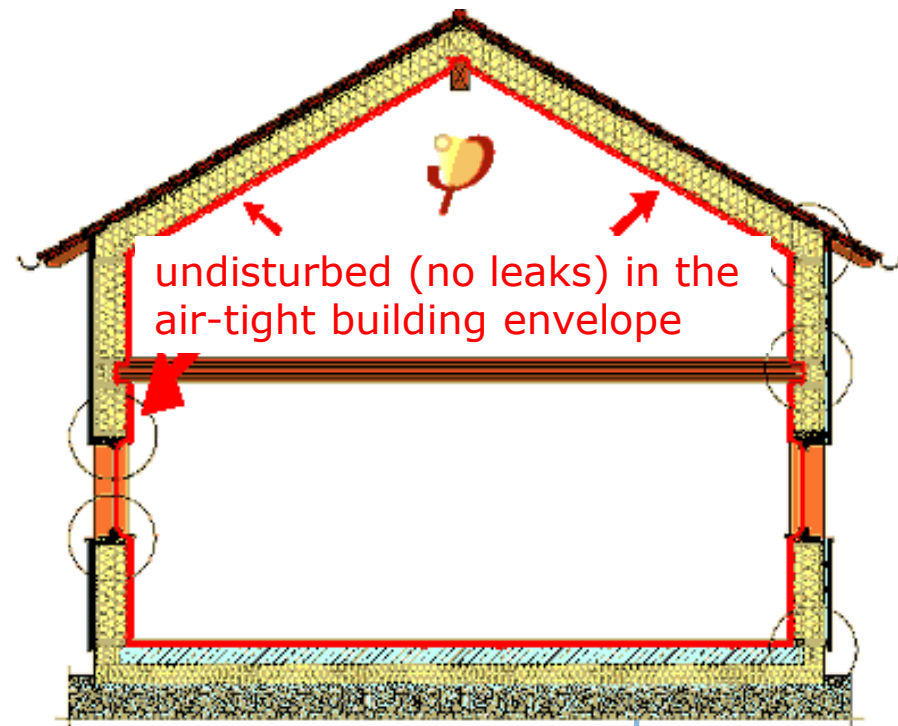


Quelle: [www.baulinks.de](http://www.baulinks.de)



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- Prevent condensation in construction
- Reducing heating losses
- Prevent the entry of air pollutants
- Avoid cold floors on the ground floor
- Ensure the permanent insulation effect



## Energetic Concepts of Plus-Energy-Houses in Germany

### SonnenEnergieHaus® (sun energy house)



Single-family house

Source: Weberhaus/Paradigma

### Plusenergiehaus®



Solar Settlement in Freiburg

Source: [www.rolfdisch.de](http://www.rolfdisch.de)

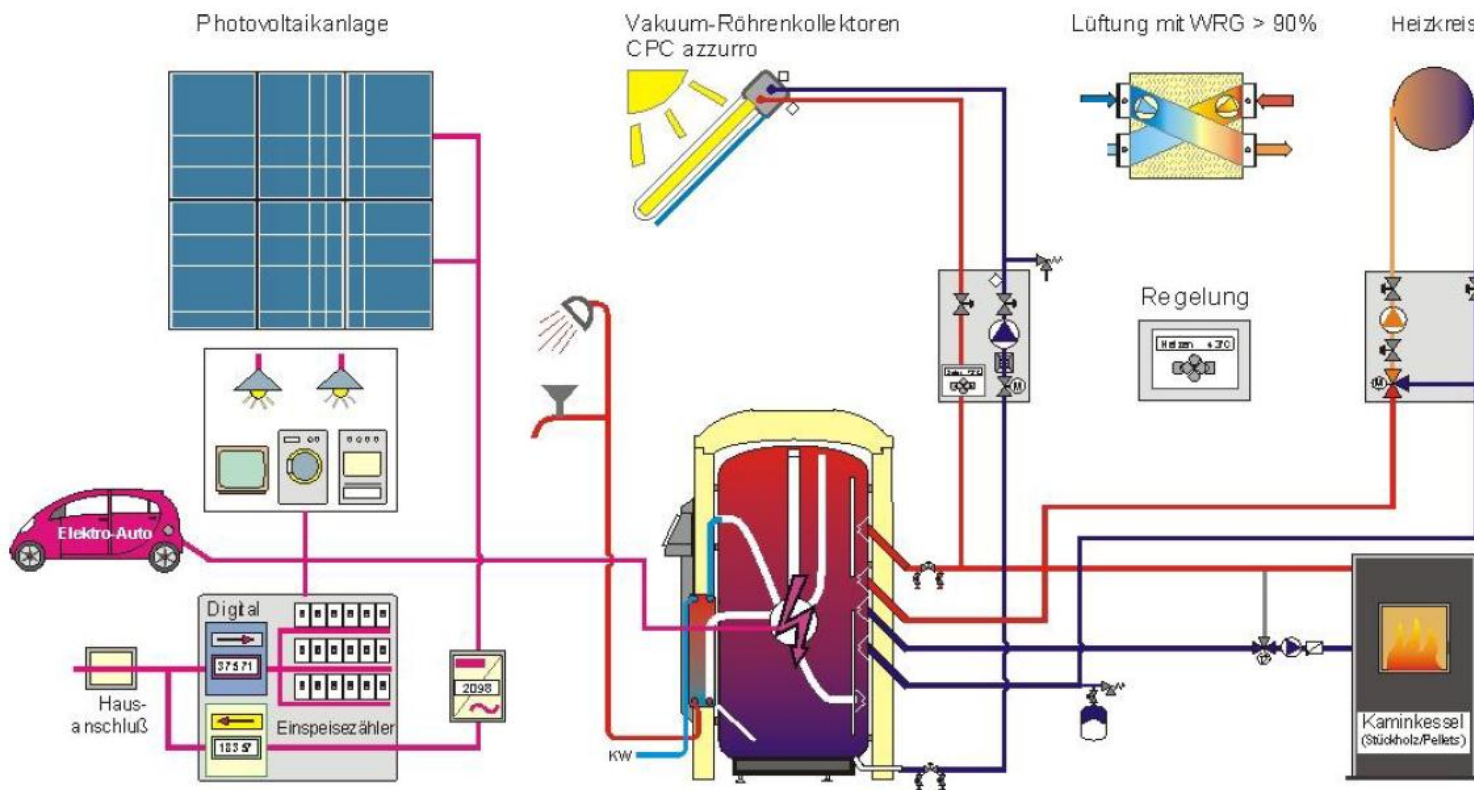


# SonnenEnergieHaus® (sun energy house)

## Technical Concept



Source: Weberhaus/Paradigma



## Energetic Concepts of Plus-Energy-Houses in Saxony



Single-Family House in wood construction

Source: Brunner Holz solarhaus



Single-Family House in solid construction

Source: Fam. Mahn, BMB GmbH Kettner-Haus



## Sample calculation of a single-family house – region Saxony

### General data

- single-family house for 4 persons
- two full storeys and heated attic
- living area: 214 m<sup>2</sup>

### Construction:

- external wall with sand lime bricks (17,5 cm) and insulation (28 cm Styrofoam  $\lambda=0,32$  W/m<sup>2</sup>K)
- ground and 1. floor slab reinforced concrete (2. floor slab wooden joist ceiling)
- gable roof in wood construction with 32 cm mineral wool insulation  $\lambda=0,32$  W/m<sup>2</sup>K
- ground slab insulation → 16 cm below and 20 cm above slab  $\lambda=0,32$  W/m<sup>2</sup>K



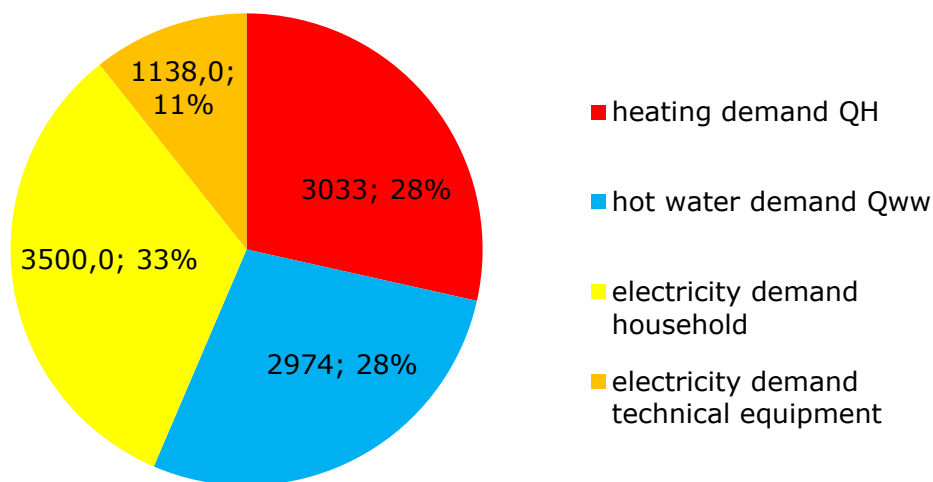
### Technical System:

- photovoltaic system 10 kWp (ca. 75 m<sup>2</sup>)
- wood burning and water-based fire place
- hot water storage ca. 1200 l for a water-based heating system
- wall or underfloor heating
- air heat pump only for hot water preparation
- ventilation system with 93 % heat recovery



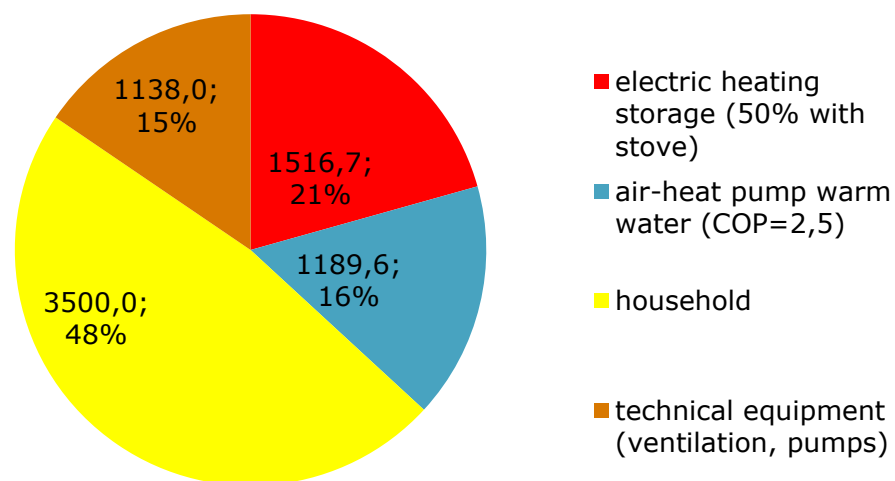
## Energetic Balance

**total energy demand [kWh/a]**



sum: 10.645 kWh

**electricity demand [kWh/a]**

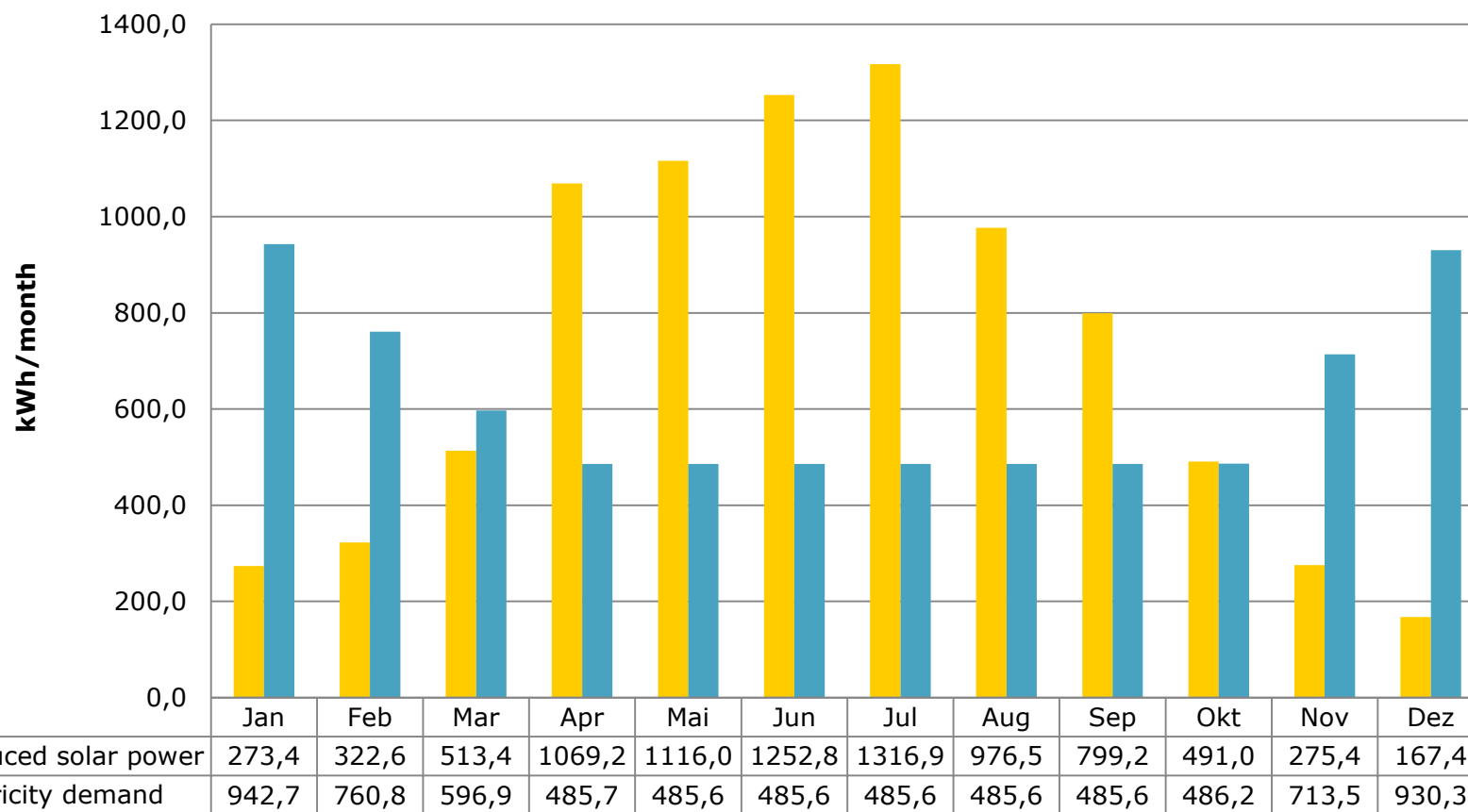


sum: 7.344 kWh

specific heating demand: 14,2 kWh/m<sup>2</sup>a  
specific hot water demand: 13,9 kWh/m<sup>2</sup>a  
specific primary demand: 30,0 kWh/m<sup>2</sup>a

## Solar Balancing Photovoltaic System

generated and the required electricity



total produced electricity per year: +8.574 kWh  
 total electricity demand: - 7.344 kWh  
 difference: +1.230 kWh



## Economy Calculation Photovoltaic System (PVS)

total produced electricity per year:	+8.574 kWh
total electricity demand:	<u>- 7.344 kWh</u>
difference:	+1.230 kWh

coverage electricity consumption for heating:	70 %
coverage total electricity consumption:	40 %
supply to the grid:	5.627 kWh
→ subsidy for PV electricity per year:	920 € (by 0,1635 €/kWh in 2014)
removal from grid:	2.392 kWh
→ cost electricity from net per year:	- 1.114 €

Difference = total energy cost per year:	<u>194 €</u>
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total energy cost without PVS:	1.820 €	0.5 % annual reduction of income or saving
service and insurance per year:	- 280 €	2 % electricity price increase
Cost of the PVS complete:	18.000 €	3% interest rate for financing

→ **amortisation after 12 years with funding by EEG**  
→ **amortisation after 23 years without funding by EEG**

## Special funding in Saxony for energy efficiency measures

### → funding policy „Energie und Klimaschutz“

- Measures to increase energy efficiency, renewable energy, reducing emissions from transport
- Implementation of the objectives of energy policy and climate protection in Saxony



## R.15 2a) new Passive houses construction, refurbishment with passive house components

### Conditions

- Fulfillment of the requirements for the construction of a passive house and the values for the refurbishment with passive house components
- Project; graphic depiction, cost calculation
- Calculating detection PHPP and national thermal regulation (EnEV)
- Economic evaluation
- after completion Blower-Door-Test (0,6 1/h)

### Level of support

new buildings: 100 Euro /m<sup>2</sup> treated floor area (PHPP)

refurbishments: 130 Euro /m<sup>2</sup> treated floor area (PHPP)



## Refurbishment **multi family house, Chemnitz**

- year of completion : 1911
- treated floor area:  $A_{EB} = 445,6 \text{ m}^2$

heat demand after -  $29 \text{ kWh} / \text{m}^2\text{a}$



Heat demand befor – ca.  $320 \text{ kWh} / \text{m}^2\text{a}$

### renovation measures:

- roof insulation : 16 cm WLG 040 + 8 cm on top
- wall: 20 cm WLG 035
- floor: 14 cm WLG 040
- ventilation with 83 % heat recovery
- heat pump
- solar system for water

Quelle Fotos: Taube, Chemnitz



# Thank you for your attention!

## The Saxon Energy Agency- SAENA GmbH:

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