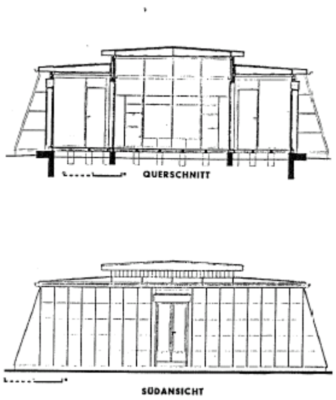
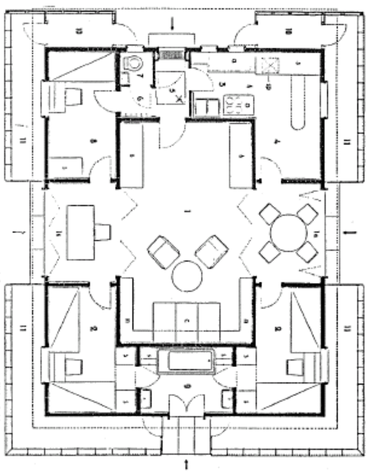
Competition „The Growing House“, Berlin 1931

1000 Participants: from 24 award-winning projects 13 houses with wintergarden

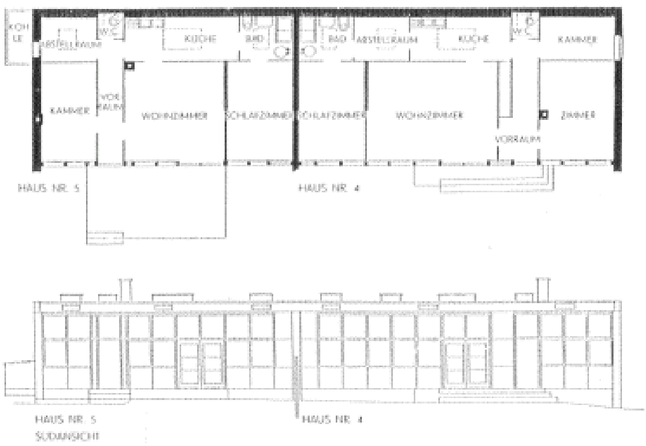
Project Martin Wagner, Onionskin principle - House with three thermal areas:

1. „Protecting Glass Walls “ as „Suncatcher“ and „Topcoat“ = unheated buffer
2. Bedrooms = tempered
3. Living space = highest heat zone



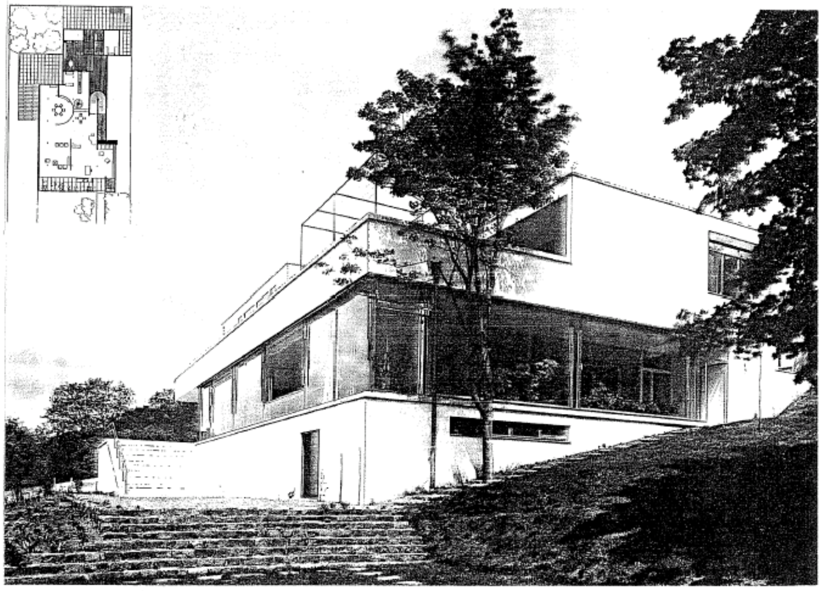


Martin Wagner – Competition project, “The growing House”

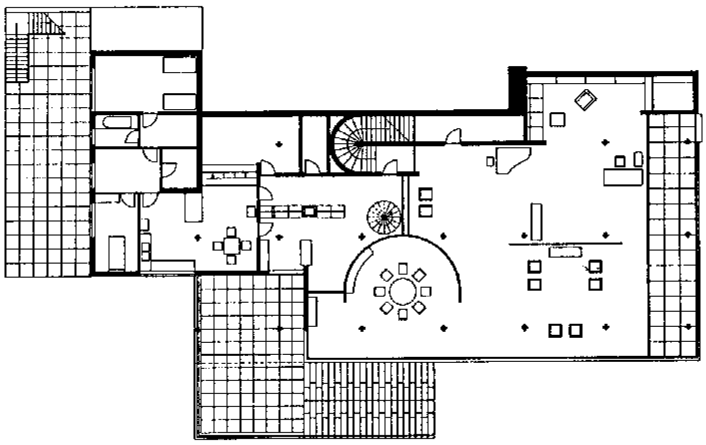


Hugo Häring – model house

Villa Tugendhat, Brno, 1928 – 1930,
Ludwig Mies van der Rohe



Villa Tugendhat, Brno, 1928 – 1930, Ludwig Mies van der Rohe



Villa Tugendhat in Brünn, 1928 – 1930, Ludwig Mies van der Rohe

„Solar Hemicycle“

Frank Loyd Wright planned in 1944 for the journalist couple Jacobs their 2nd house under the name „Solar Memicycle“ in Middleton, Wisconsin

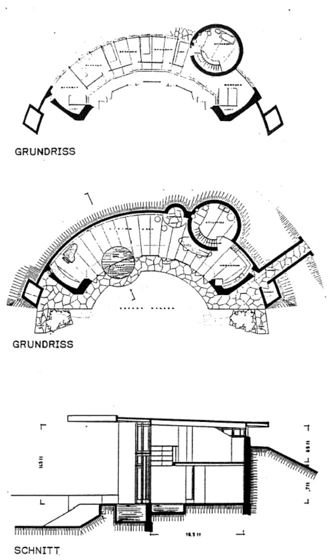
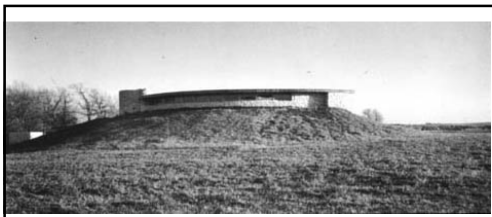


Abb. 2.27.: Frank Lloyd Wright, Haus Jacobs, Middleton, Wisconsin



Open-air school in Cloistraat, Amsterdam, Jan Duiker, 1932

Constructor: Vereenigung voor Openluchtscholen voor het gezonde Kind

Solar-oven from Odeillo, 1970

Southern France, Pyrenäen

Professor Felix Trombé

3.800 °C – 1.600 W / cm²

At 600 W/m² of direct radiation - 1.000 kW performance

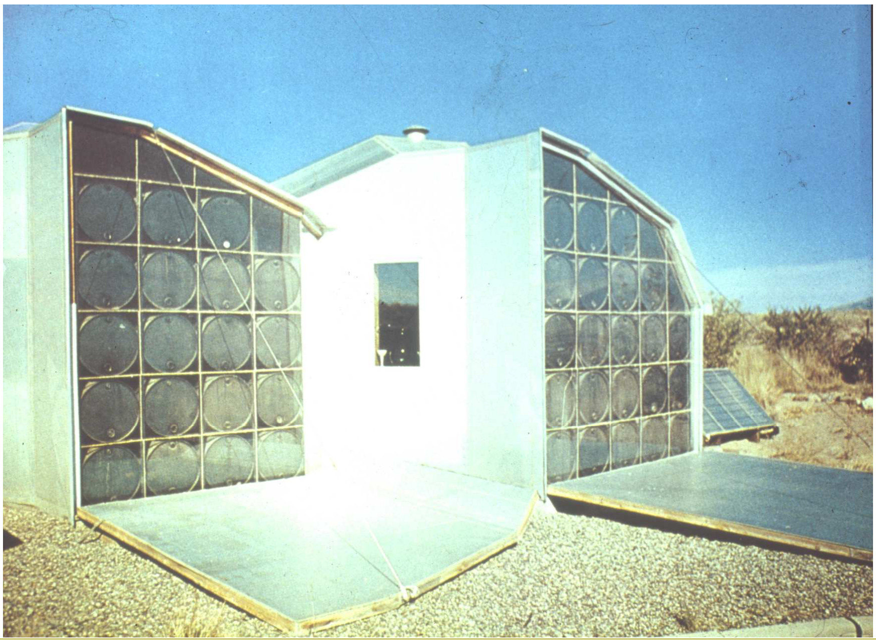
Research building around the Mirror, 45m high 54 m width

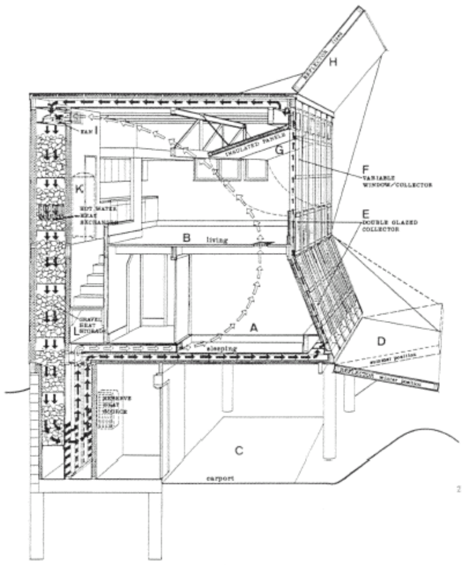
Parabolic reflector with 2.000 m² mirror surface from 9.500 hardglassfacets (45 x 45 cm)

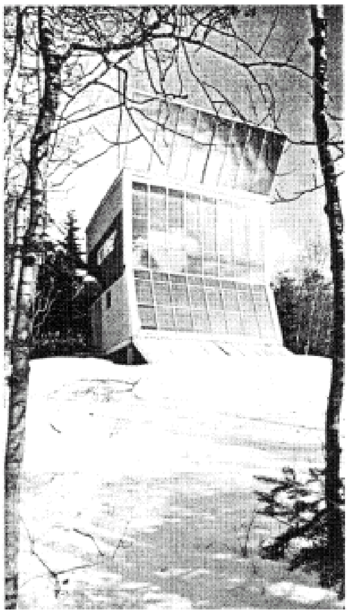
Steve Baer Haus, Corrales – New Mexico, 1972, Drumwall (oildrums filled with water)

Hippie-culture the 60´s as countermovement to consumerism, escape from Vietnam-war military duty, dropouters and consume deniers in the desert, pacifism and extensive energy self-sufficient housings

Geodetic domes, Houseboats, Shelters, idiosyncratic building forms

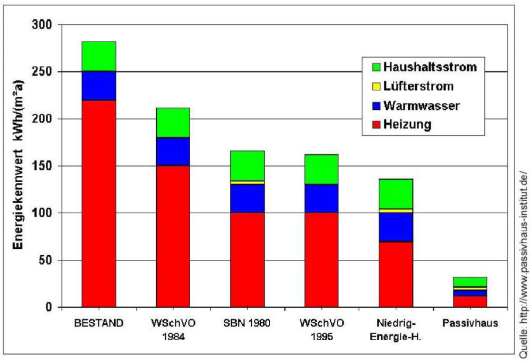



H
INSULATED PANELS
G
F
VARIABLE WINDOW/COLLECTOR
E
DOUBLE GLAZED COLLECTOR
FAN I
K
HOT WATER HEAT EXCHANGER
B living
GRAVEL HEAT STORAGE
L
A
sleeping
D
RESERVE HEAT SOURCE
C
carport
2



History of passive sun-energy utilisation since 1973 in Europe

• At the beginning, Europe was far behind the development of passive of sun-energy usage in USA
•1981: Austria, „Directive for increased heat insulation in national building constructions. “
• 1995: Germany „German Heat Insulation Ordinance“: Calculation of energy consumption
• 1990: In Austrian Energy report: In addition to the savings capacity for space heating
• - increased heat insulation
• - Solararchitecture and site selection
- buffering of temperature variations through technical constructions and architectural procedures



Passive solar-technical components

Passive sun-energy utilisation,Sun-windows, Windows-glazings

Definition

Precondition: positive energy balance

Passive sun-technical components: more energy is lead through their capturing (glazed) solar-collection-surface into the interior as the energy lost through heat-transmition via the entire component.

3 types:

-Sun-windows, glazes façade elements
-Sun-energy winning wallsystems, Trombé walls, walls with transparent heat-insulation
-Wintergardens, glazed buffer rooms, glazed areas

Cooperation of 5 Elements

-Collector (south-orientated solar collecting surfaces, e.g. windows, solar wall, wintergarden, sun-patio,…)

-Absorber (surface, where the radiation is tranformed into the heat, e.g. interior wall, floor,…)

-Heat accumulator (z.B. walls, floor,…)

-Heat distribution (through conduction, radiation and convection)

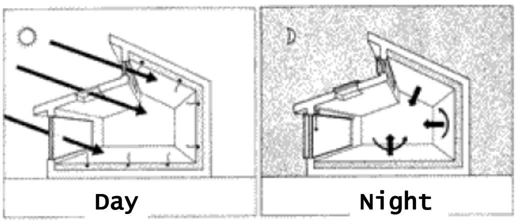
-Regulation (ventilation opening, sun-protection, ventilators, mobile sun-protection…)

Passive use of the sun-energy

Direct gain of heat

Solar radiation falling direct through the glass surface is absorbed by the interior surface, transformed into heat and time-delayed delivered in the night and in the morning.

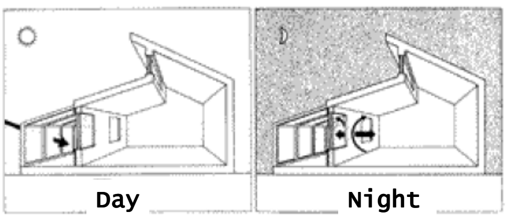
On cold sunny days, no heating is required = 100% solar coverage.



Passive use of the sun-energy

Indirect gain of heat

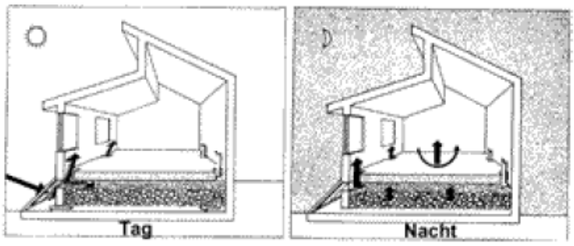
Through sun radiation, heated accumulation mass (e.g. 40-60°C on a black accumulation wall) releases at lower temperatures (e.g. 25-30°C at the inner wall) time-delayed the stored heat.



Passive use of the sun-energy

Isolated gain of heat

Sun energy is captured through indirect system, heat accumulator and room to heat are detached.



isolierter Wärmegewinn

Passive use of the sun-energy

Hybrid systems

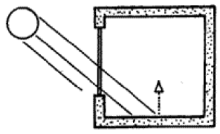
Combination between active and passive systems.

Definition of active solar system:
Facility utilizing sun energy, where the energy transport between energy converter (e.g. sun collector), heat accumulator and heat consumer is carried out with help of additional mechanical devices.

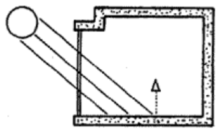
(ÖN M7700)

Components for pasive use of the sun-energy

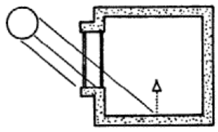
Glased facade elements / sun-windows



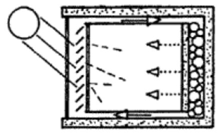
Sonnenfenster II



Erker



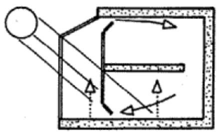
Blumenfenster



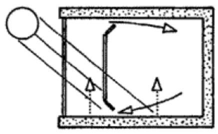
Fensterkollektor II

Components for pasive use of the sun-energy

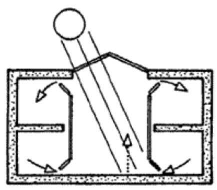
Glased buffer-rooms/ sun patios/ Verglaste Pufferräume/Sonnenveranda/glased areas, passages



Wintergarten, vorgesetzt



Wintergarten, eingebaut



glasüberdeckter Bereich II

Examples for combined systems

Project name: Wohnhausanlage Csokorgasse
Planning: Treberspurg
Location: Csokorgasse Wien
Constructor: GEWOG, Gemeinnützige Wohnungsbauges.mbH
Finished: 1999

Apartment complex Csokorgasse III

Examples for combined systems

Apartment complex ‚Am Hirschenfeld' II

Project name: Wha am Hirschenfeld
Planning: ARGE Reinberg, Treberspurg, Raith
Location: Wien 21, Brünnerstraße, Empergergasse
Constructor: GESIBA
Finished: 1996

Examples for combined systems

Apartment complex Stadlau II

Project name:
Wohnhausanlage
Stadlau
Planning:
Arge Reinberg -
Treberspurg - Raith
Location:
Wien 22
Constructor: Neues
Leben -
Gemeinnützige Bau-,
Wohn- und
Siedlungsgenossen-
schaft
Finished: 1991

Examples for combined systems

Apartment complex Stadlau I

Examples for combined systems

Project name:
Wohnhausanlage
"Naturnahes Wohnen"
Planning:
Treberspurg
Location:
Wien 22
Constructor:
Demonstrativprojekt
Naturnahes Wohnen
der Gemeinde Wien
Finished: 1996

Apartment complex ‚Naturnahes Wohnen‘ II

Examples for combined systems

Project name:
Haus Reznicek
Planning:
Treberspurg
Location:
St.Andrä-Wördern
Constructor:
Privat
Finished: 1992

Reconstruction Family house Reznicek I

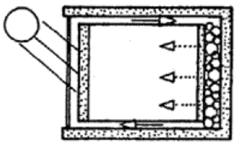
Examples for combined systems

Project name:
Haus Reznicek
Planning:
Treberspurg
Location:
St.Andrä-Wördern
Constructor:
Privat
Finished: 1992

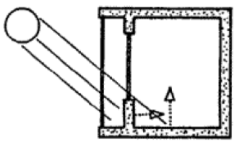
Reconstruction Family house Reznicek I

Components for pasive use of the sun-energy

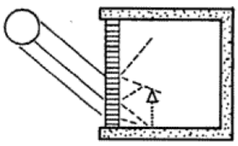
Sunenergy gaining wall systems / sun-wands



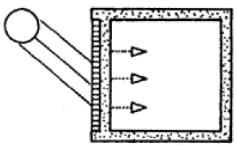
Luftkollektor/Trombéwand



doppelte Fassadenhaut I

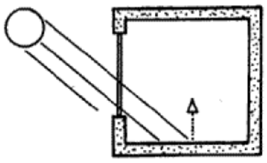


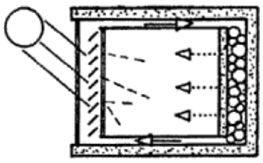
TWD zwischen Glas



TWD vor Mauerwerk

Sun-windows + glazes facade elements





Examples for sun gazebo

Apartment complex Osramgründe II

Project name: Wohnhausanlage Osramgründe
Planning: Treberspurg, Atelier 4, E.Steiner
Location: Wohnhausanlage Wien 23, Osramgründe
Constructor: WIEN SÜD,Gemeinnützige Bau- und Wohnungsgenossenschaft
Finished: 1999

Design rules

-Orientation preferably to south, 10% loss when orientated till 20° to east and till 30° to west

-no shadowing in wintertime

-sunscreen in summertime

-adequate size to be coordinated with the inner-mass-accumulator of the building. (Danger of overheating also in the transition time; planning mistakes, liability, optionally consult building physics + simulation)

-total surface of the sun-window: 25-50% of the inner space which is in the influence of the sun-window

Dimensioning rules

-appropriate heat insulation of the glazing

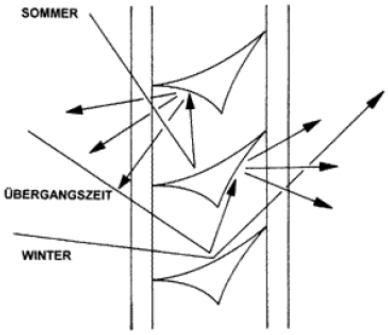
-flexible heat insulation through mobile heat absorbing shutters for the night-time (by bad glazing insulation)

-appropriate heat insulation of the framework

-possibly large, contiguous glasplanes due to thermal bridges of the border junctions

New Products for Sun-windows

Insulated Glass with fix arranged mirror profiles in the interspace

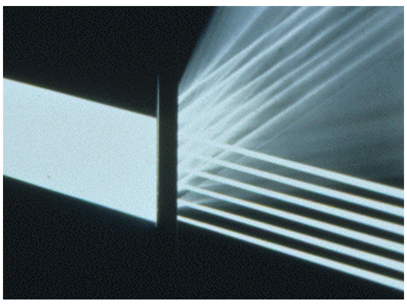


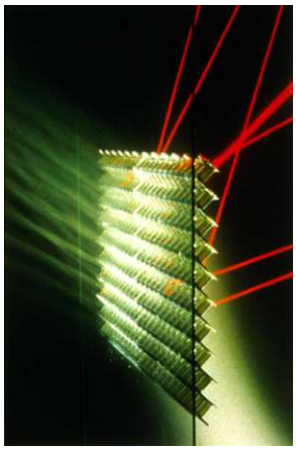
Okasolar-Grafik

Okasolar-Bild

New Products for Sun-windows

Insulated Glass with fix arranged mirror profiles in the interspace





Example of Sun-window

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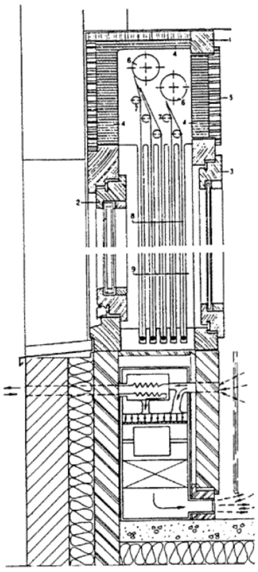
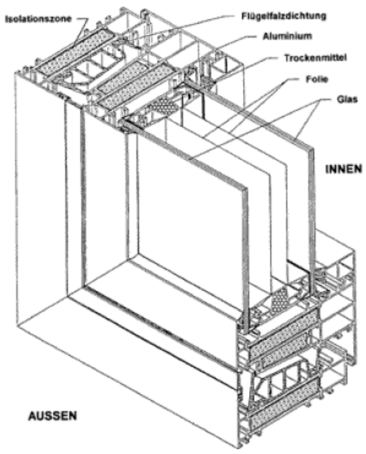
Planning:
Treberspurg
Location:
Wien 22
Constructor:
Demonstrativprojekt
Naturnahes Wohnen
der Gemeinde Wien
Finished: 1996

High-performance Window

Toptherm window



High-performance Window



HIT-Fenster

Definition of modern Architecture

Abstract Architecture Sculpture

Formalism

Structural body

Spatial Concept

Modern Architecture

Functional design

Construction

Utilitarianism

attainment of an aim

New Builging and abandonment

Impact on Enviroment

Ecological construction concept

Life Cycle Assessment

Resource Concept, Solar-energy Concept,

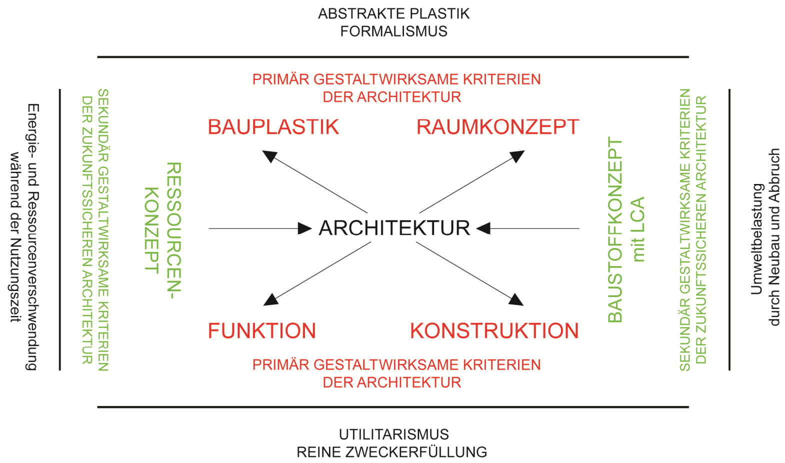
Low Energy/Passive

Water Concept

Waste of Energy and Resources during the Time of Usage

"In my opinion, the goal of a fully developed modern architecture has to be the unity of the spatial concept on the one hand and the structural body on the other hand. Both qualities have to be compiled out of the completion of a building's functional needs and its construction. The essential quality of such a developed architecture is the tension between the spatial concept and a building's functional needs on the one hand and as well as the tension between the structural body and the construction on the other hand. Construction transforms into the structural body. Only through this tension a building becomes lively and leads to an ability to feel its own architectural composition. A lack of this tension would lead to pure utilitarianism or an abstract architectural sculpture." (Ernst Plischke, 1963)

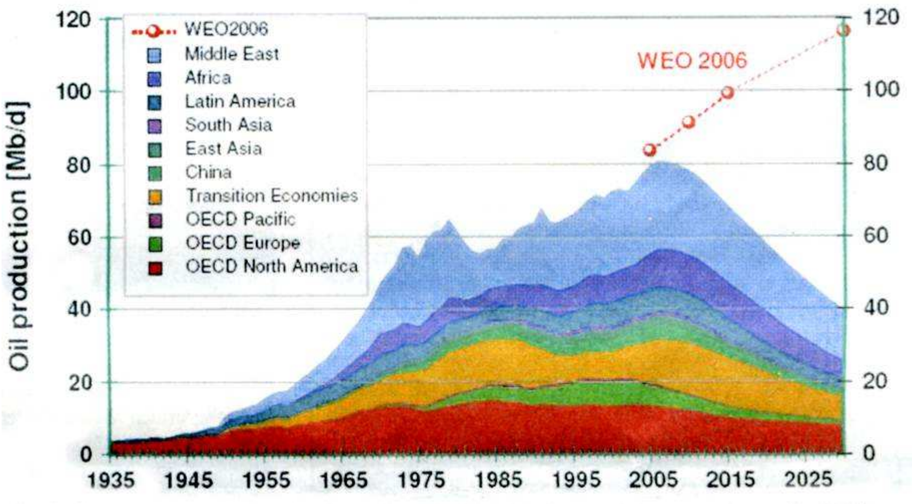
Definition „Moderne Architektur“



„Das Ziel einer voll entwickelten modernen Architektur muss meiner Ansicht nach eine Einheit sein zwischen einem räumlichen Konzept einerseits und einer Bauplastik andererseits. Diese beiden Qualitäten müssen aber aus der Erfüllung der Funktion des Bauwerkes und seiner Konstruktion erarbeitet werden. Die wesentliche Qualität einer solchen voll entwickelten Architektur liegt in der Spannung zwischen dem Raumkonzept und der Funktion einerseits und zwischen der Vision einer Bauplastik und der Konstruktion andererseits. Konstruktion wird zur Bauplastik. Es ist erst diese Spannung, welche einen Bau lebendig macht und zu einem Spürbarwerden seiner Architektonik führen kann. Ohne diese Spannung haben wir entweder einen reinen Utilitarismus oder eine abstrakte Bauplastik.“

(Zitat: Ernst Plischke,1963)

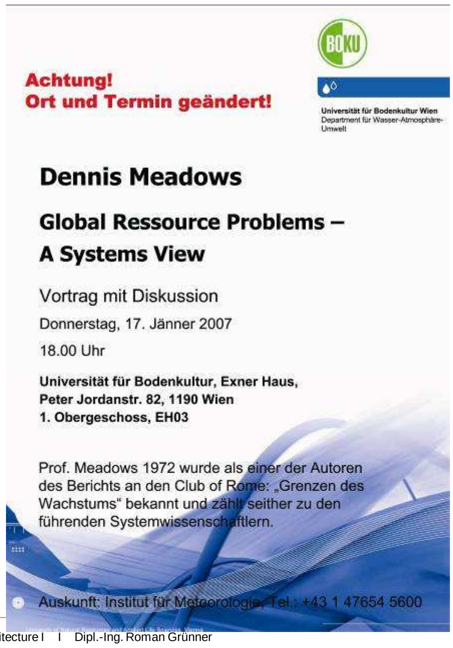
„Peak Oil“ was already in 2006



World oil production [Mb/d] seit 1935 – 2030. „Peak Oil“ stated around 2006.

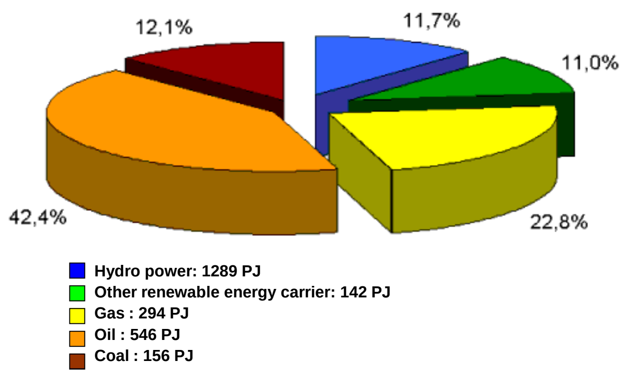
[Source: Ludwig-Bölkow-Systemtechnik (2007) „Crude Oil – The Supply Outlook“. Energy Watch Group (Hrsg.)]

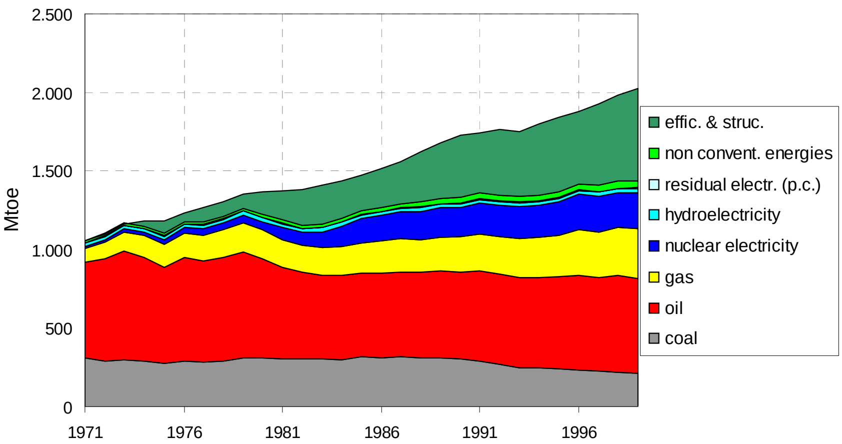
OIL PRICE [US-$ pro Barrel]		
03.01.2008	100 $/b	
OIL PRICE FORECAST [US-$ pro Barrel] ab 2010		
	Dennis Meadows	OMV
2010	ca. 200 $/b	ca. 60 $/b
2018	ca. 300 $/b	?



Primary-energy in Austria, 2010

Total energy assignment: 1289 PJ





EUROPEAN UNION (15): *Development of the primar energy consumption related to 1971. Source: ENERDATA / World Energy Database*

BIERMAYER, P., HEINDLER, M., HAAS, R., SEBESTA, B. (2004): Perspektive. In: Kernenergie, Klimaschutz und Nachhaltigkeit. Argumentarium zur Vorbereitung der UNFCCC COP 2004. Forum für Atomfragen, Vienna.

Passive houses

- Basic Principles of the Passive House
- Projects from Austria from Treberspurg & Partner Architects ZT GmbH
- The Design of the Austria House

Principles of the Passive House Concept

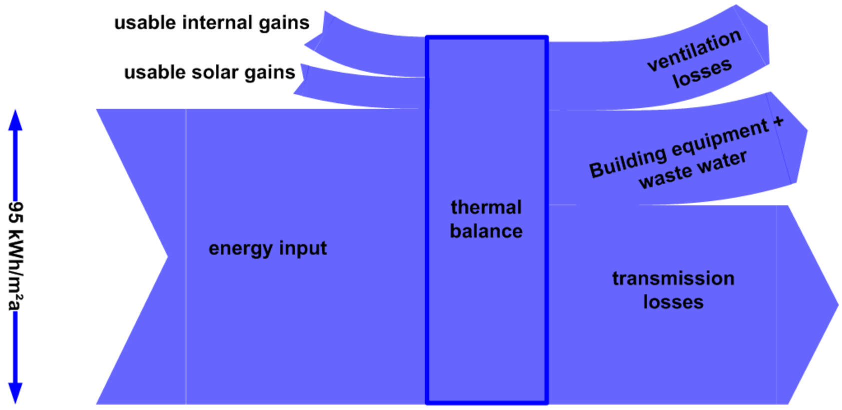
Definition (Passivhouse Institute Darmstadt - Dr. Feist):

A Passive House is a building, for which thermal comfort can be achived solely by postheating or postcooling of the fresh air mass, which is required to fullfill sufficient indoor air quality conditions - without a need for recirculated air.

- ► Optimizing the building shell
- ► Loss minimizing before Profit Maximizing

Comparison of PH with conventional buildings

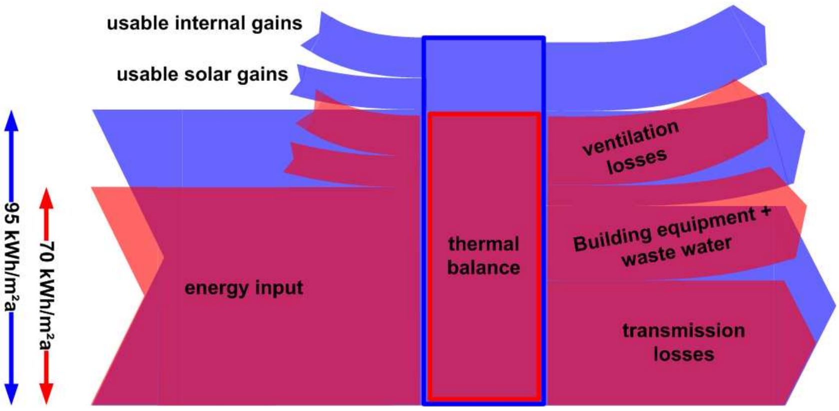
Net final energy for space heating and hot water



20.10.2011, SB11-Helsinki, Roman Smutny, Christoph Neururer BOKU Vienna

Comparison of PH with conventional buildings

Net final energy for space heating and hot water



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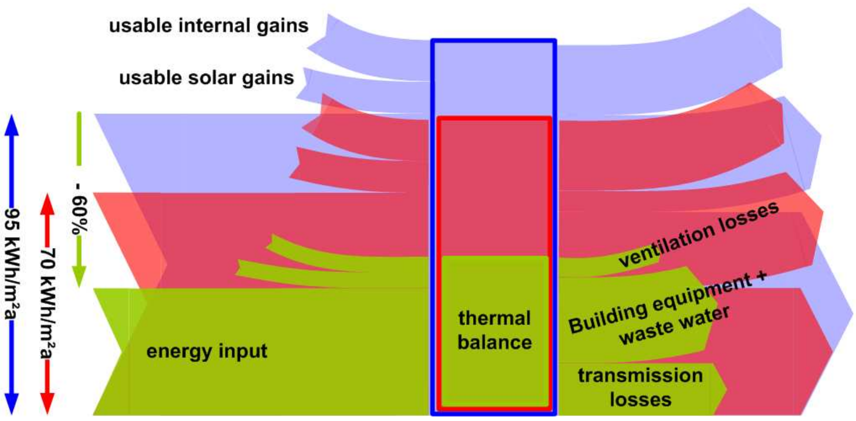
Comparison of PH with conventional buildings

Net final energy for space heating and hot water

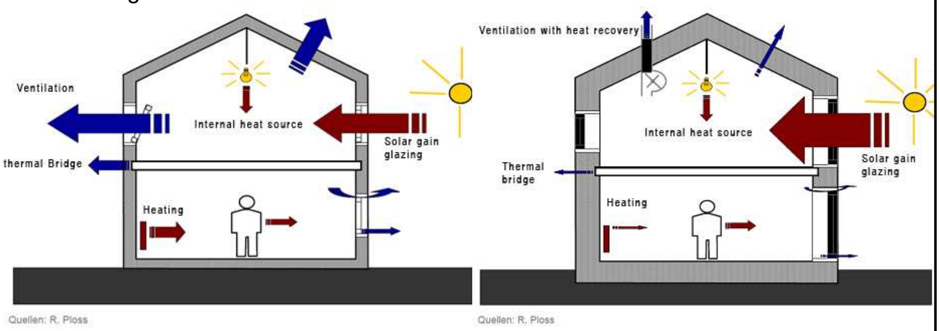


20.10.2011, SB11-Helsinki, Roman Smutny, Christoph Neururer BOKU Vienna

Conventional House VS Passive House

Building Standard

Passive House:

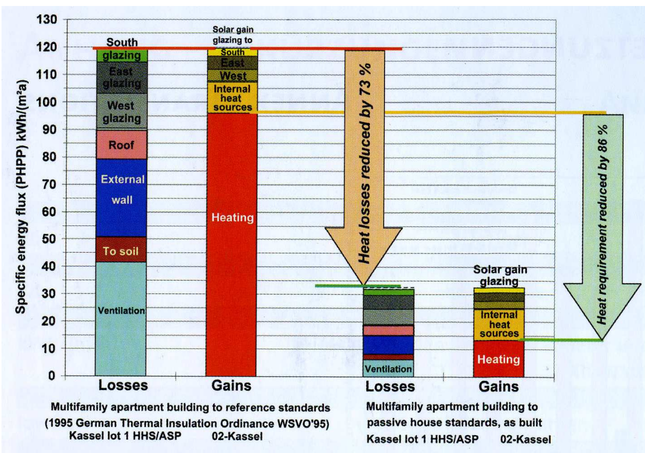


Losses – Gains

= Heating energy requirement

[source: HdZ - Passivhaus Schulungsunterlagen, 1.3 Ressourcenverbrauch im Gebäudebetrieb]

Energy Saving!



Energy saved on heating is 86% compared to conventional standards of new buildings.

[source: CEPHEUS]

Definition of kWh

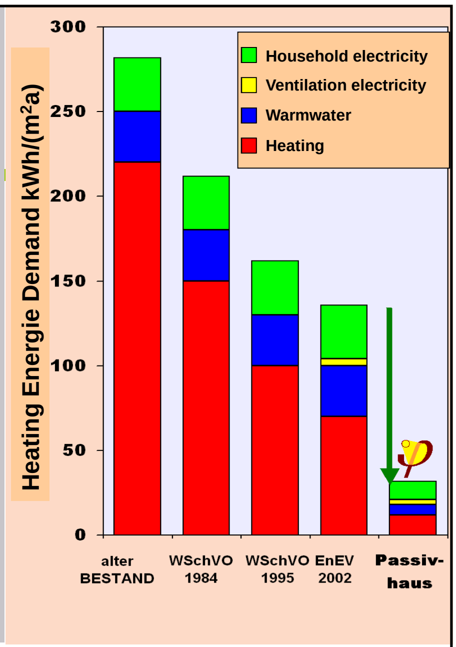
- 1l heating oil ≈ 10 kWh
- 1l gas ≈ 7 kWh

Definition of kWh

- **Conventional house** before year 1990
  -> 200 kWh / m2a
- 100 m2 -> 20 000 kWh -> 2000 liter oil

- **Passive house** -> max 15 kWh /m2a
- 100 m2 -> 1500 kWh -> 150 liter oil

Factor 10 is possible



Evolution

„1-Liter Car"

Over 80% Energy savings

„1-Liter House" = Passivhaus:

Since 1991

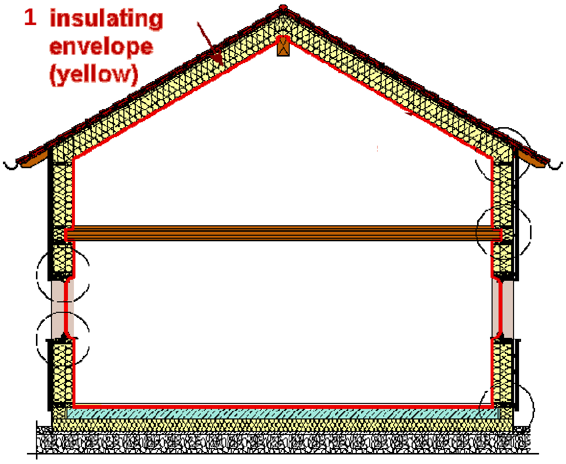
Over 90% Energy savings

Principles of the Passive House Concept

Passive Houses require superior design and components with respect to:

- Insulation
- Comfort windows
- Design without thermal bridges
- Air-thightness
- Ventilation with heat-recovery
- Innovative heating technology

Building Envelope: High Thermal Insulation

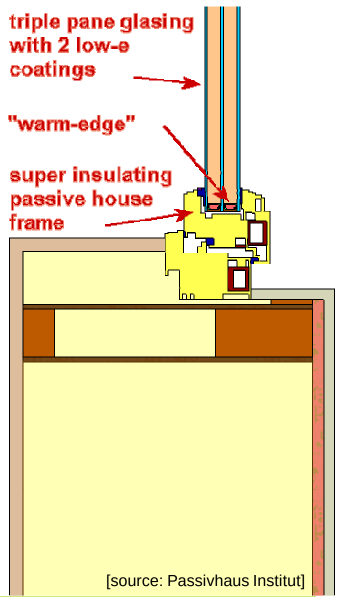


[source: Passivhaus Institut]

Building Envelope: Comfort Windows

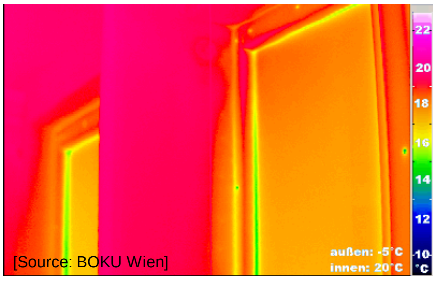
Example of triple pane glasing window

Window ≤ 0,8 W/(m²K) (R-7.1)



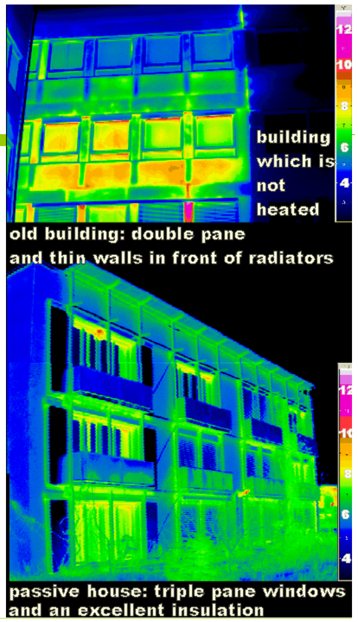
[source: Passivhaus Institut]

Building Envelope: Comfort Windows

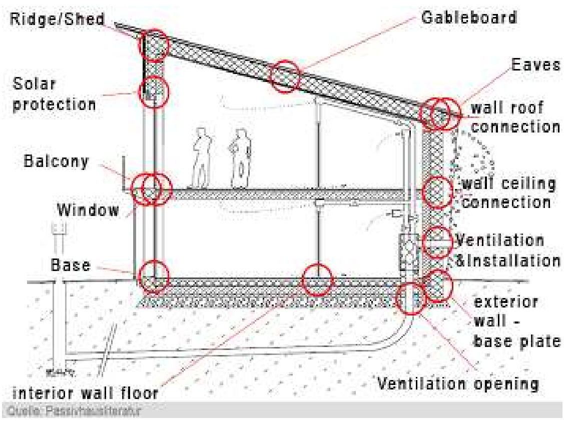


Passive House Window, Interior

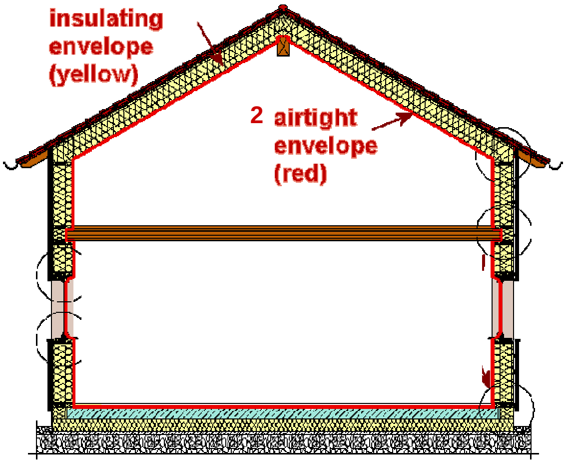
Infrared pictures of an old building and a passive house (at the bottom) for comparison (photos: PHI)



Building Envelope: Avoiding Thermal Bridges



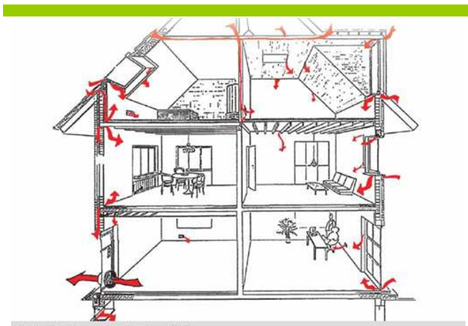
Building Envelope:
Airtight Construction



An envelope can be airtight only if its consists of ONE undisturbed airtight layer enwrapping the whole volume.

[source: Passivhaus Institut]

Building Envelope:
Airtight Construction

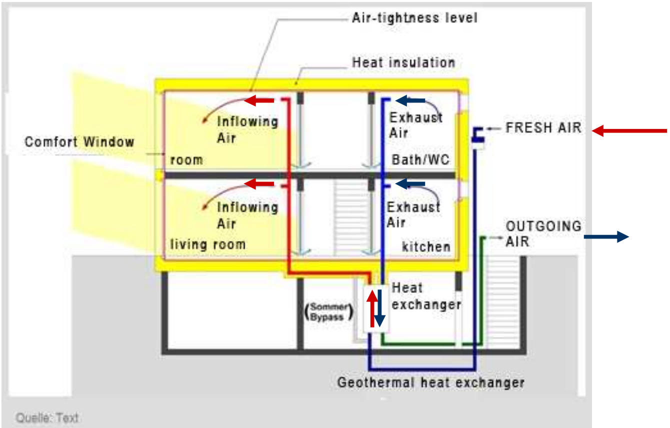


Quelle: Energie und Umweltzentrum (EUZ)

Quelle: Passivhaus Institut Darmstadt

- avoid damage caused by condensation of moist, room warm air penetrating the construction
- reduce losses through building envelope and ventilation

Innovative Heating Technology: Ventilation with heat recovery



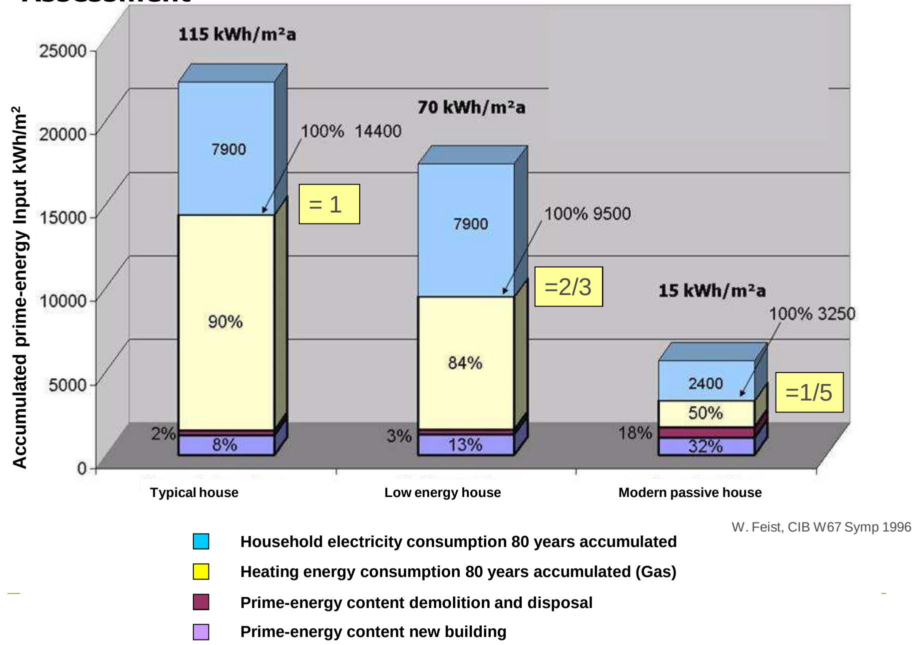
[source: CEPHEUS]

Basic Numbers for Passive houses

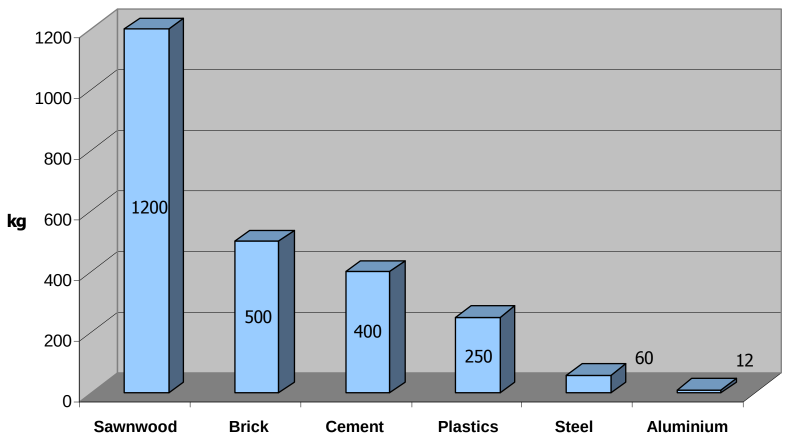
Values should be lower than:

- 120 kWh/m2a – primary energy demand, net floor area
- 15 kWh/m2a – heating energy demand, net floor area
- 10 W/m2 – maximum heating load (in case of heating with ventilation system)
- 0,85 W/m2K – U value of whole window
- 0,75 – heat recovery performance
- 0,60 – airtightness: max. 60% of room volume air change per hour at 50 Pascal underpressure
- 0,45 Wh/m2 – ventilation system electricity consumption
- 0,10 – to ensure the internal comfort in summer, max.10% of the year, temperatures can be higher than 25 °C

Life Cycle Assessment



Producible building materials from 1000 kWh thermic Energy



1200 kg Sawnwood - 1000 kWh - 12 kg Aluminium

Nach P. Sabady, Biologischer Sonnenhausbau 1989

Evaluation methode: Lifecycle analysis (LCA, Ökobilanz)

„Lifecycle analysis is important with relevance to the realisation of sustainable developement in the construction sector as the basis for decision-making in the design and planning stage"

Prof. Graubner, TU Darmstadt, Inst. F. Massivbau

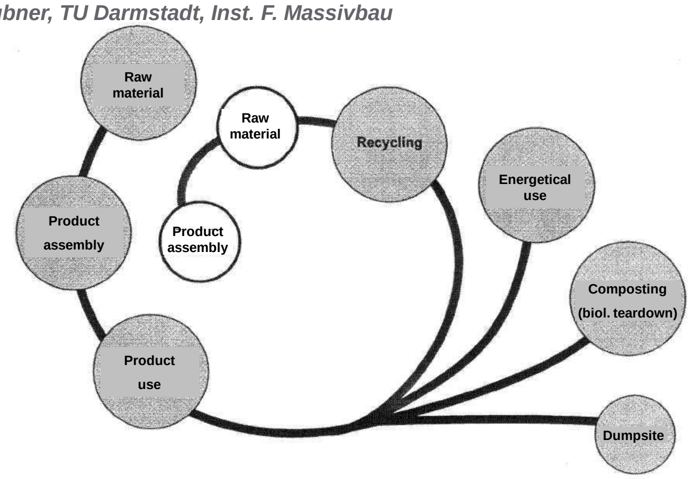
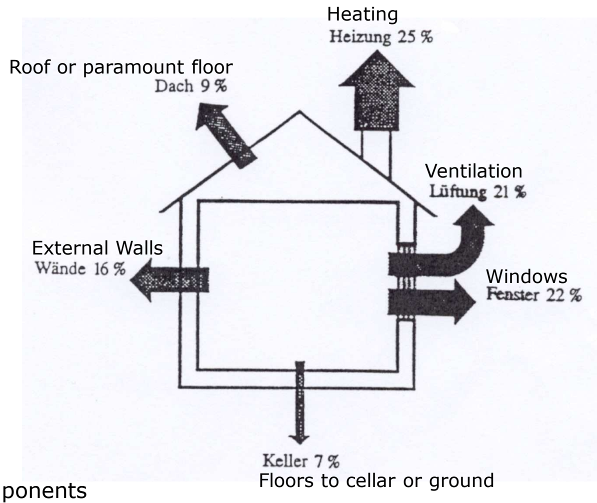


Fig 1 - The life-cycle of a product – "from the cradle to the grave".

THERMAL REFURBISHMENT

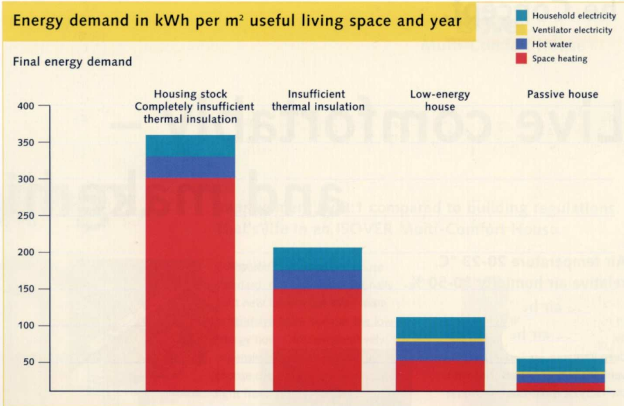
Where is the heat lost?



Heat losses of building components in contact with outer air

[Source: WUPPERTAL INTSITUT FÜR KLIMA, UMWELT, energy (1996) energygerechtes Bauen und Modernisieren. Basel: Verlag für Architectur]

THERMAL REFURBISHMENT



Heating energy demand of a typical one-family house	kWh/m²a 300-250	kWh/m²a 150-100	kWh/m²a 50-40	kWh/m²a ≤ 15
BUILDING STANDARD	**Completely insufficient thermal insulation** Structurally questionable, cost of heating no longer economical (typical of rural buildings, non-modernized old buildings).	**Insufficient thermal insulation** Thermal renovation is clearly worth the trouble (typical of residential houses built in the 50s to 70s of the last century).	Low-energy houses	Very low energy houses (passive houses need to meet this parameter as part of the requirement profile)

[Source: ISOVER (2007) Built for the future: The ISOVER Multi-Comfort House.]

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BUILDING ELEMENT	Typical U-values and insulation thicknesses			
External walls (massive wall of 25 cm) Insulation thickness	1.30 W/(m²K) 0 cm	0.40 W/(m²K) 6 cm	0.20 W/(m²K) 16 cm	0.13 W/(m²K) approx. 30 cm
Roof Insulation thickness	0.90 W/(m²K) 4 cm	0.22 W/(m²K) 22 cm	0.15 W/(m²K) 30 cm	0.10 W/(m²K) 40 cm
Floors to ground Insulation thickness	1.0 W/(m²K) 0 cm	0.40 W/(m²K) 6 cm	0.25 W/(m²K) 10 cm	0.15 W/(m²K) 26 cm
Windows	5.10 W/(m²K) Single glazing	2.80 W/(m²K) Double glazing, insulation glass (air-filled)	1.10 W/(m²K) Double glazing, thermal insulation glazing	0.80 W/(m²K) Triple glazing, thermal insulation glass, special frame
Ventilation	Leaky joints	Open the windows	Exhaust air unit	Comfort ventilation with heat recovery
CO_2 emission	60 kg/m²a	30 kg/m²a	10 kg/m²a	2 kg/m²a
Energy consumption in liters heating oil per m² living space and year	30-25 liters	15-10 liters	4-5 liters	1.5 liters

[Source: ISOVER (2007) Built for the future: The ISOVER Multi-Comfort House.]

THE DESIGN OF THE AUSTRIA HOUSE IN WHISTLER, CANADA

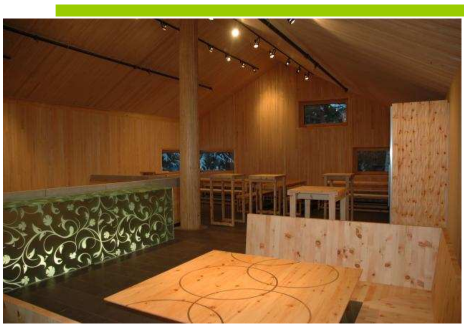
(credit:Ira Nicolai)

What´s the overvalue of the Olympic Austria House?

Symbol for Canada and the world, how the energy issue could be solved and how sustainable development could be realized

- Most energy efficient building in the Olympic history
- Ecological building materials
- Salubrious indoor climate: fresh air quality, natural light and other contributions to raise workplace productivity
- High quality of planning (coordinator Erich Reiner) and workmanship: Sohm Holzbau, Optiwin, drexel&weiss and others

THE DESIGN OF THE AUSTRIA HOUSE WHISTLER



(credit:Ira Nicolai)

THE DESIGN OF THE AUSTRIA HOUSE WHISTLER

(credit:Ira Nicolai)

THE DESIGN OF THE AUSTRIA HOUSE WHISTLER

From Austria …

… to Canada

THE DESIGN OF THE AUSTRIA HOUSE WHISTLER

Day 3

Day 5

THE DESIGN OF THE AUSTRIA HOUSE WHISTLER

Installing windows

Topping out ceremony

THE DESIGN OF THE AUSTRIA HOUSE WHISTLER

(credit: Ira Nicolai)

Floor Plan – First Floor