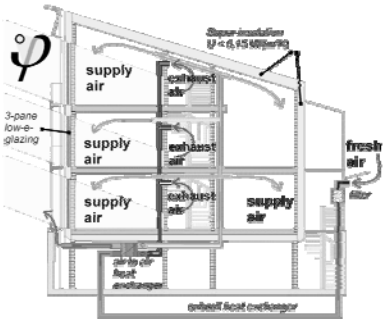
Konceptet bag passivhuse



Jürgen Schnieders
Passivhaus Institut
Darmstadt

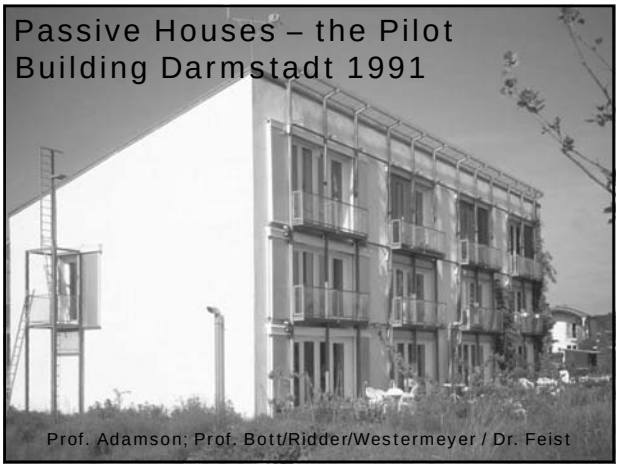
History of low energy buildings

William Shurcliff 1981
Superinsulated and Double Envelope Houses

Amory Lovins 1984
Rocky Mountain Institute

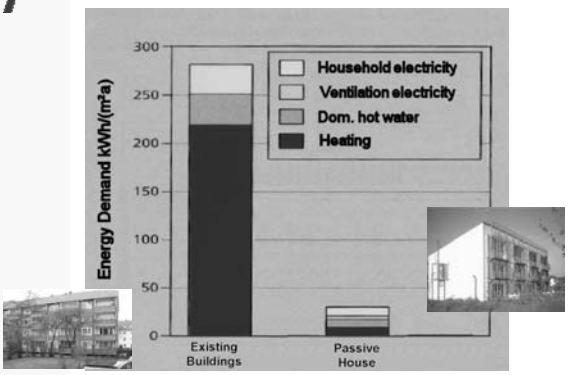
Wolfgang Feist et al 1987
Schrecksbach low energy house

Passive Houses – the Pilot Building Darmstadt 1991



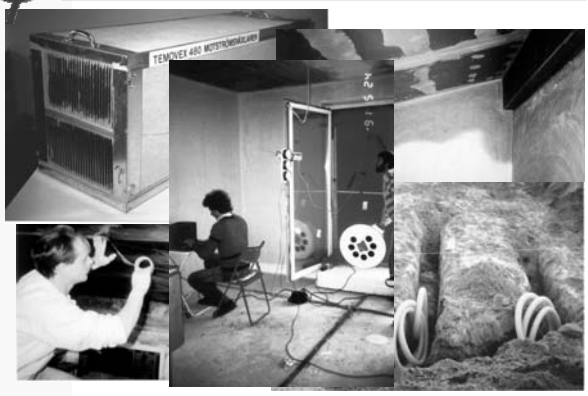
Prof. Adamson; Prof. Bott/Ridder/Westermeyer / Dr. Feist

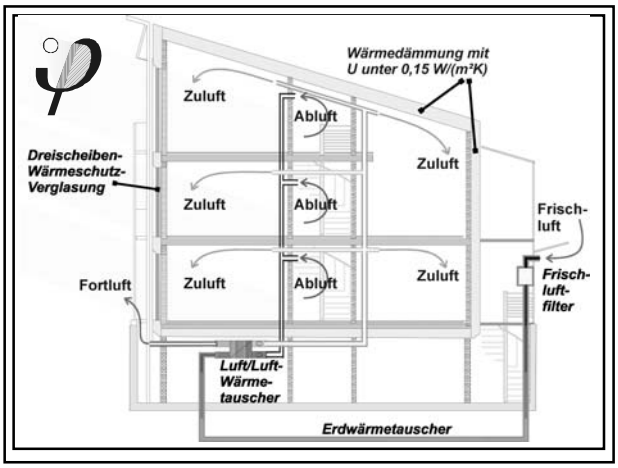
The Initial Goal: Demonstration



Insulation

Airtightness and Ventilation





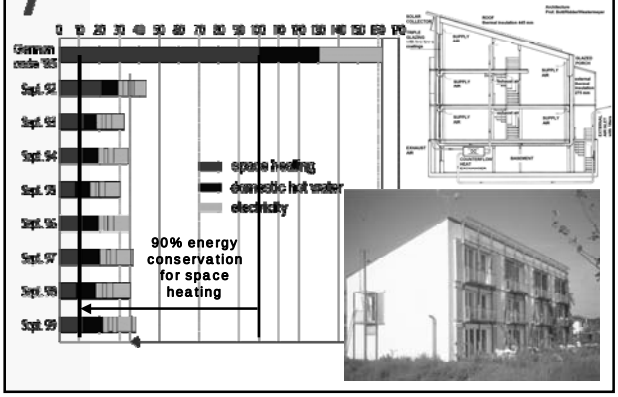
DHW and Distribution

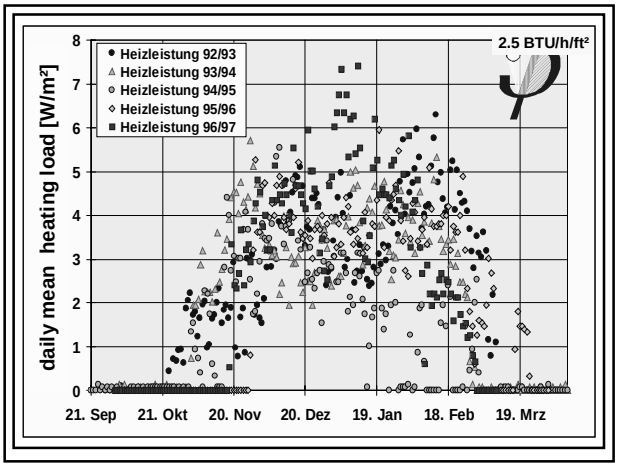
Solar thermal collector as seen from the back

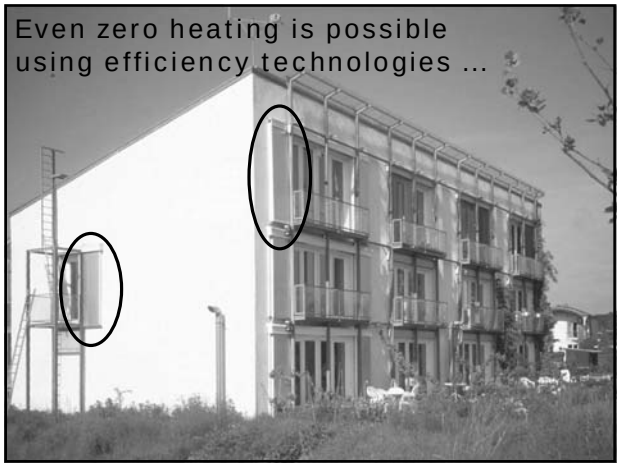
DHW distribution: Highly insulated & within the thermal envelope

Efficient Electricity Use

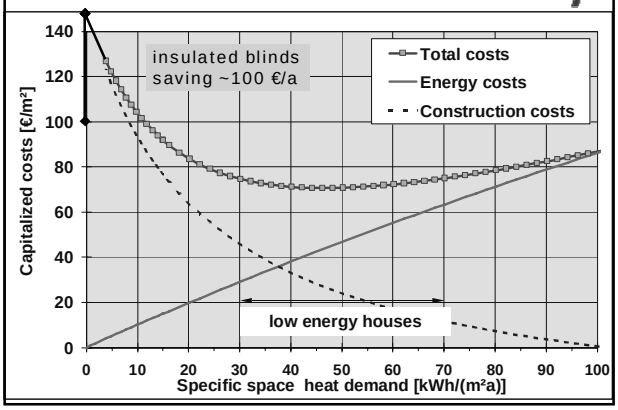
Measurement Results and Overview







... but it is expensive!



Why "Zero"...
... some candles could be enough

1 candle ≈ 30 W

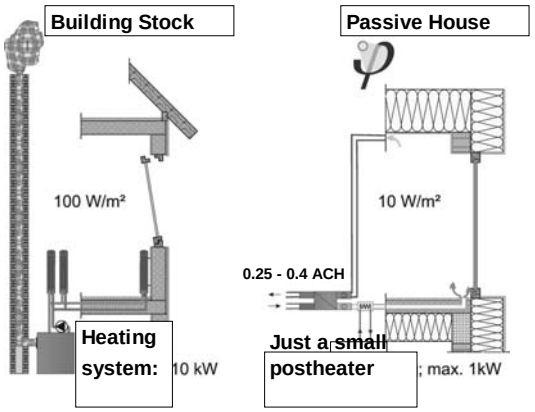
1 incandescent lamp ≈ 100 W

1 person ≈ 100 W

You always need fresh air

- indoor air pollutants:
  - humidity
  - CO_2
  - VOC
  - Radon
- "natural ventilation": difficult, high thermal losses
- ventilation system required for IAQ – infiltration is not sufficient, and modern buildings are too tight for infiltration alone to provide fresh air
- minimum ventilation rate 30 m³/h/pers for IAQ ventilation rate of approx. 0.4 ach for IAQ

Use the IAQ ventilation system for heating



Passive Houses - Definition

... heating (cooling...) with the ventilation system

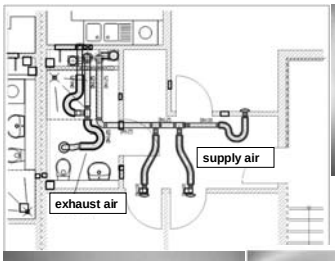
how it works:

- minimum ventilation rate of 0.4 ac/h for IAQ
- that gives at least 1 m³/(m²h)
- maximum temperature postheater 50°C
- simple calculation:

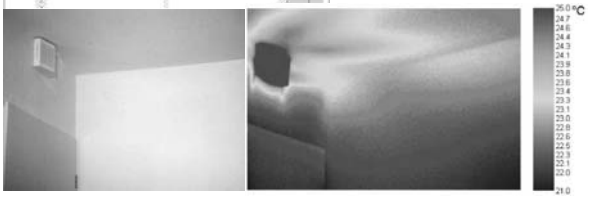
$1\ m^3/(m^2h) \cdot (50\ °C - 20\ °C) \cdot 0{,}33\ Wh/(m^3K)$

$= 10\ W/m^2$

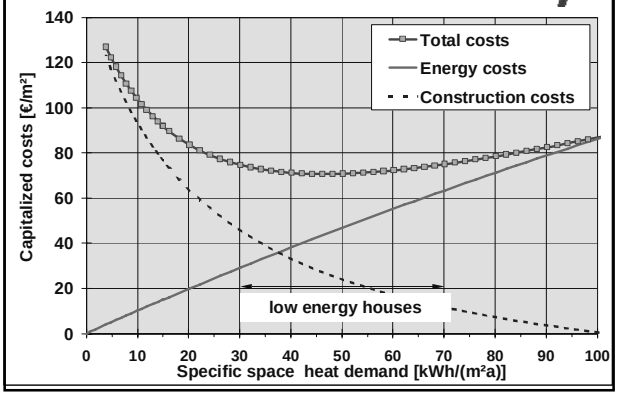
This power can be distributed by heating the supply air. The result holds for all residential buildings; it does no depend on the climate (but the specific solution will).



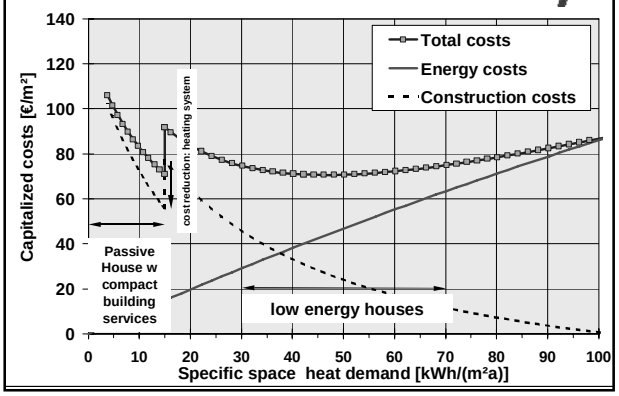
Example: **Kassel Marbachshöhe**
Design: **innovatec / Otte**
Monitoring: **PHI Pfluger**



Energy Efficient Buildings: The Problem



Passive Houses: The Solution

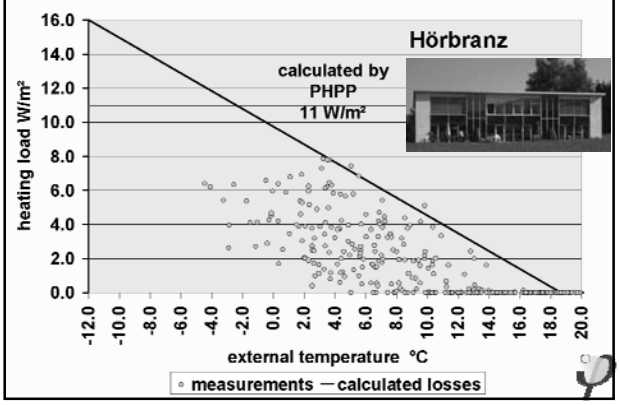


... It really works

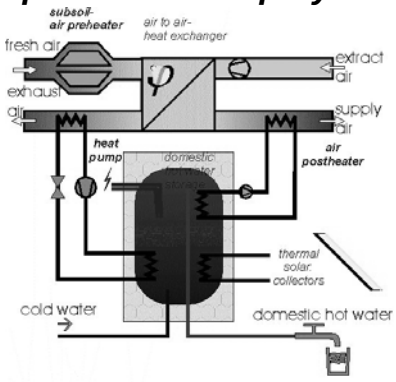
3 Row Houses at Hörbranz, Austria

A CEPHEUS - Project,
Architect: Caldonazzi

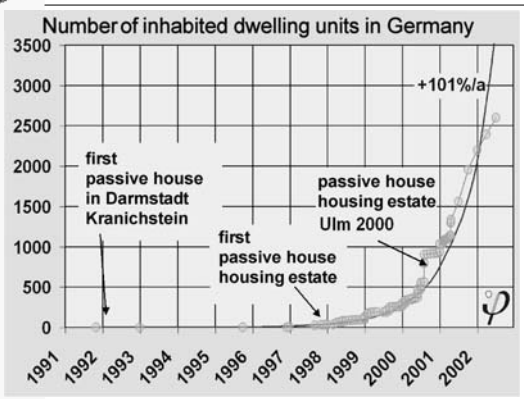
... It really works

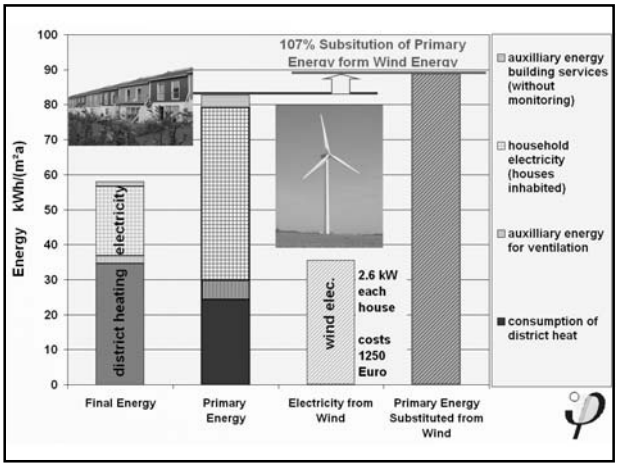


Compact Heat Pump Systems



Exponential Growth? A Success Story





Single-family Detached Passive House in Bretten

architecture: oehler + arch kom
year of construction: 1998
living area: 165 m²

construction:
wooden construction with first Pfosten-Riegel-Fassade suitable for Passive Houses

heating system:
supply air heating, energy source for postheating: natural gas

ventilation:
ventilation system with high-efficient heat recovery, efficiency 83%, subsoil heat exchanger

annual heat requirement:
q_h: 12,3 kWh/(m²a),
calculated with PHPP

spec. construction costs:
280 €/m³ (solar construction, garage, balcony, porch roof)

Semi-detached Houses in Bühl-Rittersbach

architect: Dipl.-Ing. Günter Früh / Lichtenau
year of construction: 2001
living area: 198 m²

construction:
polystyrene concrete form blocks

heating system:
compact ventilation unit

ventilation:
ventilation system with heat recovery, efficiency 60 %, subsoil heat exchanger

annual heat requirement:
q_h: appr. 12 kWh/(m²a),
calculated with PHPP

32 Terraced Houses in Hannover-Kronsberg

Rasch & Partner
year of construction: 1998
living area: 97 - 118 m²

construction: mixed
loadbearing structure made of prefabricated concrete elements exterior wall and roof: wooden lightweight element

heating system: postheating supply air + bath radiator, district heating supply

ventilation:
ventilation system with high-efficient heat recovery, efficiency 80 %

annual heat requirement:
q_h: appr. 15 kWh/(m²a),
calculated with PHPP

spec. construction costs:
each unit 950 - 1.090 €/m² (living area)

6 Terraced Houses in Batschuns
(Vorarlberg/ Austria)

architect:
Walter Unterrainer

services:
IBN-Ing.-Büro Naßwetter

year of construction:
1998

living area:
totally 780 m²

construction: solid
18 cm expanded clay and wooden elements with 18 cm PUR-insulation

heating system:
supply air heating with air to air heat pump, each 5 m² solar collectors, 500 l hot water storage with additional electr. heating

ventilation:
ventilation system with high-efficient heat recovery, efficiency appr. 85%, subsoil heat exchanger

annual heat requirement:
q_h: 8 - 9,6 kWh/(m²a),
simulated with Helios

spec. construction costs:
appr. 1.400 €/m² (WNF)

***Single-family Passive House Frastanz-Amerlügen** (Vorarlberg / Austria)*

planning: Baumeister Richard Caldonazzi

services: Ing. Chr. Drexel

year of construction: 1997

living area: 180 m²

construction: solid
18 cm brick, thermal compound insulation system made of cork (35 cm), interior walls made of clay

heating system: supply air heating
17 m² collector, 3000 l storage, 500 l hot water tank

ventilation:
ventilation system with high-efficient heat recovery, efficiency more than 75% (counterflow), subsoil heat exchanger

annual heat requirement:
q_H: appr. 10 kWh/(m²a), simulated with TRNSYS

spec. construction costs:
appr. 1.430 €/m² (living area)

Multi-story passive houses in Kassel

Architekturbeispiel: Wohnen bei St. Jakob

Bauherrin: ABG Frankfurt Holding
Architekten: P. Grenz, F. Rasch, faktor10, Darmstadt
Foto: Fotostudio Michels, Darmstadt.

Passive House - Office Buildung in Cölbe (Hessen)

architect: Christian Stamm/Stadtallendorf
services: IGH GmbH/ Marburg
building physics: PHI; measurement: Uni Marburg.
supported by SolarBau / BMBF
year of construction: 1997/98
useful area: 2180 m²

construction: mixed
loadbearing structure made of reinforced concrete skeleton,exterior walls: wooden lightweight elements, roof: prefabricated wooden lightweight elements on glulam timber beam

heating system: supply air heating
solar plant, additional heating: combined heating and power station

ventilation:
ventilation system with high-efficient heat recovery, efficiency more than 80%, subsoil heat exchanger

annual heat requirement:
q_H: appr. 14 kWh/(m²a), calculated with PHPP, measured result appr. 10 kWh/(m²a)

spec. construction costs:
appr. 1.227 €/m² (useful area)

Passivhaus Dienstleistung GmbH
www.passivhaus-info.de

Montessori Volksschule mit Turnhalle

ca. 3.275 m² Nutzfläche

Architektur:
Wallbrunn, Grotz, Vallentin, Loibl, Bockhorn

Haustechnik:
IB Lackenbauer, Traunstein

zertifiziertes Passivhaus

Konstruktion:
Grund: Stb.-Bodenplatte auf XPS + PS innen
Wände: innen Stb. + Holzleichtbauelemente
Dach: Holzleichtbauelemente

Technik:
Lüftungsanlage mit Gegenstrom-WÜ
Restwärme ggf. aus Gaskessel
Heizwärmeverteilung: Zuluft + Heizkörper

Projekt Montessori Volksschule D-85445 Aufkirchen

More offices & schools ...

Ulm: Office Building Energon Stefan Oehler

Steyr: Industr. Schloßgangl/Unterrainer

Waldshut:

passive school-building Harter + Kanzler

Weiß/Stahl

Hagen:

students homes

Ralph Wortmann

Office: Lu-teco

ca. 10 000 m²
Building owner: GAG Ludwigshafen
Architect: Lutz Laier, Ludwigshafen

Gymnasium in Munich

Building owner:
Landkreis München und
Stadt Unterschleißheim
Architect:
Pfletscher und Steffan, München

Results from the CEPHEUS project