

IEA HPP Annex 32

Economical heating and cooling systems for low energy houses

Introduction to low energy houses and building systems

Carsten Wemhöner, Operating Agent IEA HPP Annex 32
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Outline of the presentation

- **Introduction to low energy houses**
 - Principles
 - Markets
- **Technical building systems in low energy houses**
 - Ventilation
 - Heating systems
 - Markets
- **Workshop Schedule**

Introduction to low energy houses - Advantages

- **Better indoor comfort**

- Higher indoor wall temperatures => reduction of temperature asymmetries
- More homogeneous temperature distribution
- Controlled ventilation: Reduced air draught by infiltration
- Higher air quality => Air filtering: reduction of pollutants, pollen etc.

- **Environmentally-sound**

- Low energy consumption, low emissions
- Lower temperature requirements promote use of renewable energy systems and environmental heat

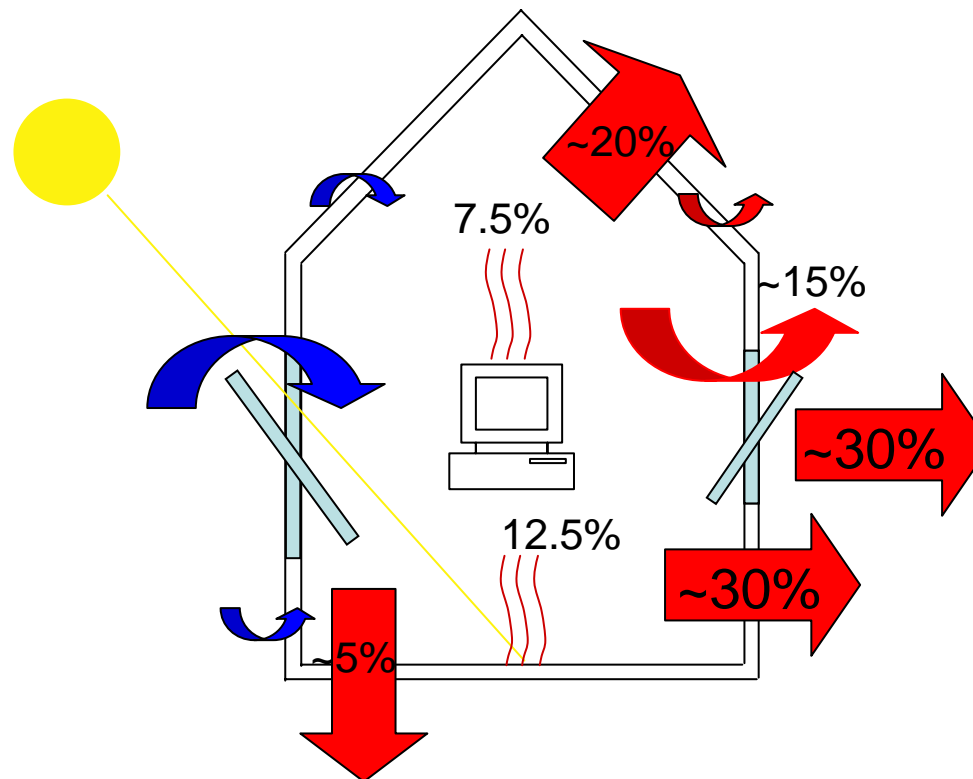
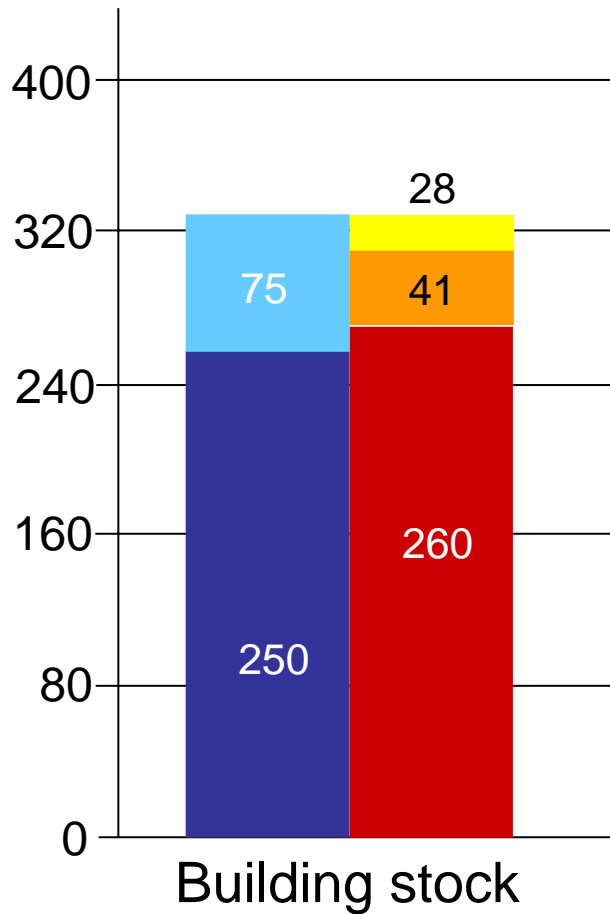
- **Economy**

- Limited additional investment costs, reduced operation cost
- High-quality building, value conservation

Introduction to low energy houses – Energy balance

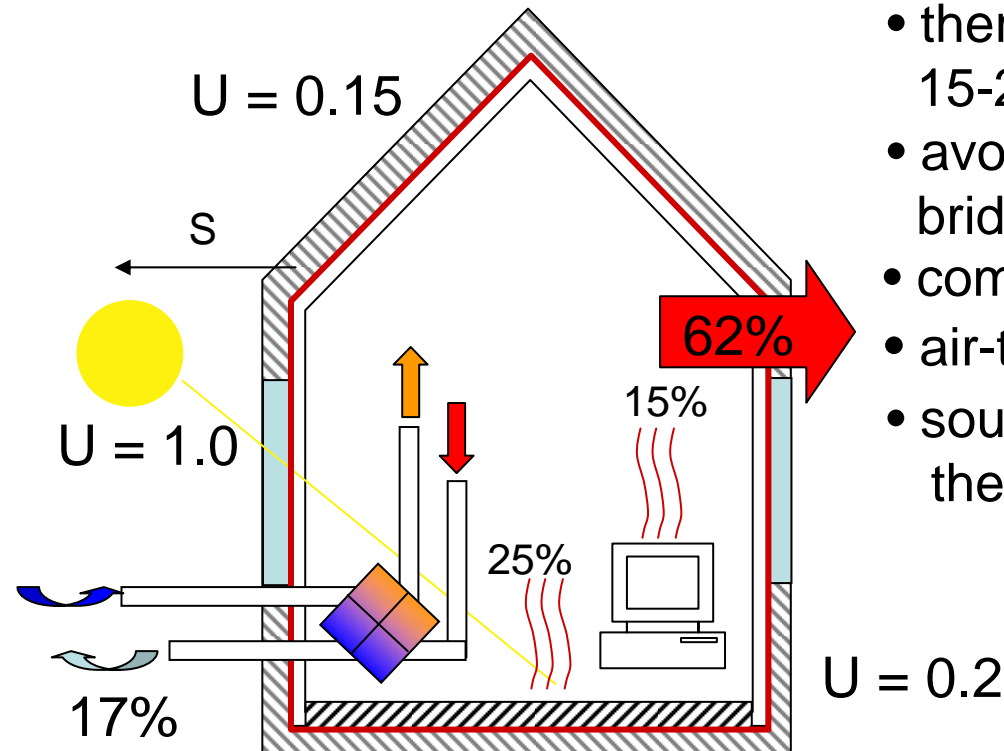
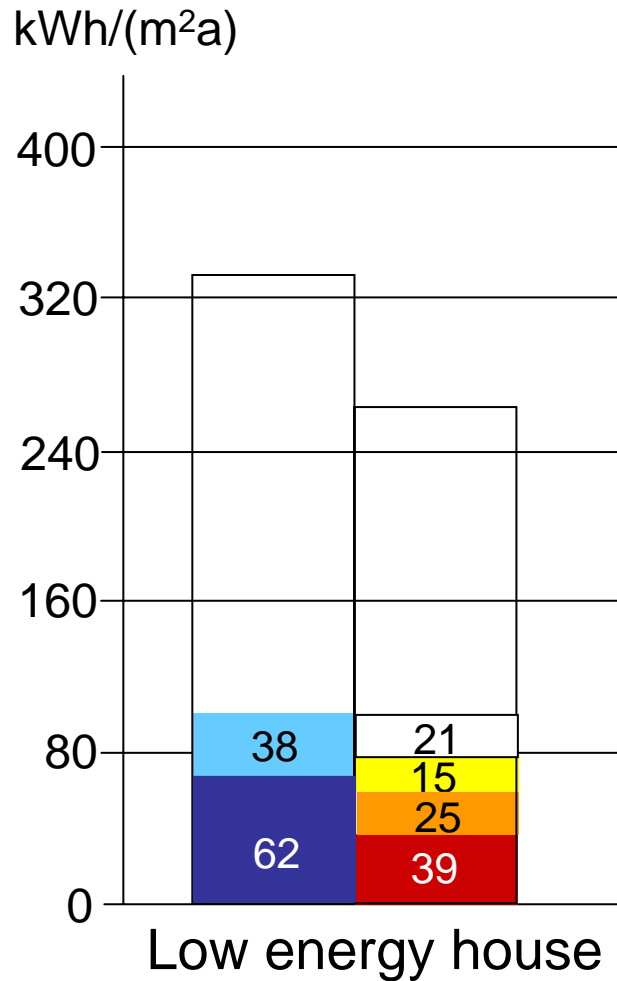
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kWh/(m²a)



Introduction to low energy houses – Energy balance

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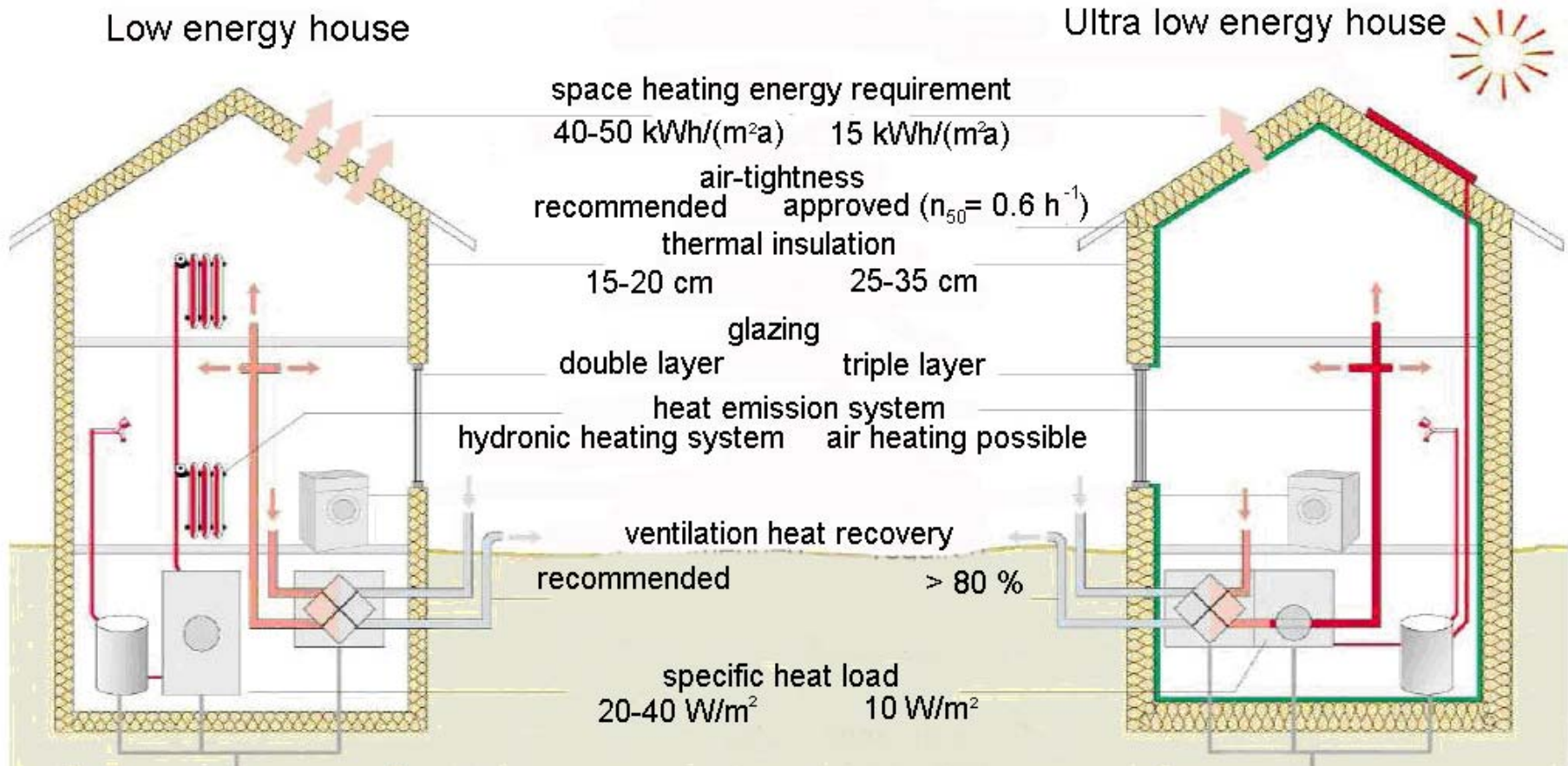


Measures:

- thermal insulation
15-20 cm
- avoidance of thermal bridges
- compact design (A/V)
- air-tight construction
- south-orientation,
thermal mass

Introduction to low energy houses – ultra-low energy houses

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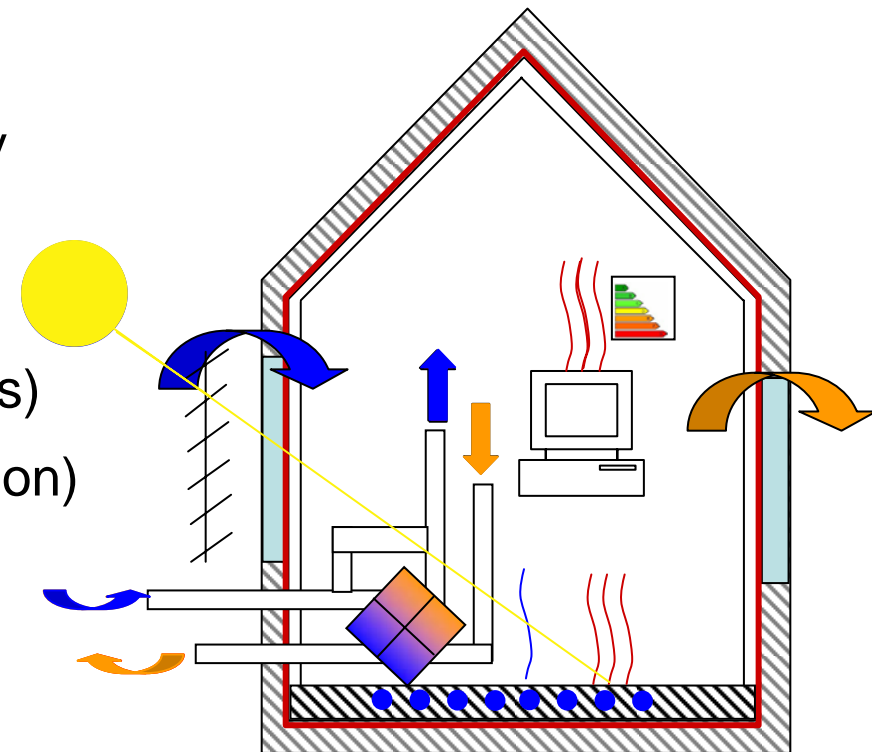
Source: modified of MINERGIE®

Step from low energy house to ultra low energy house

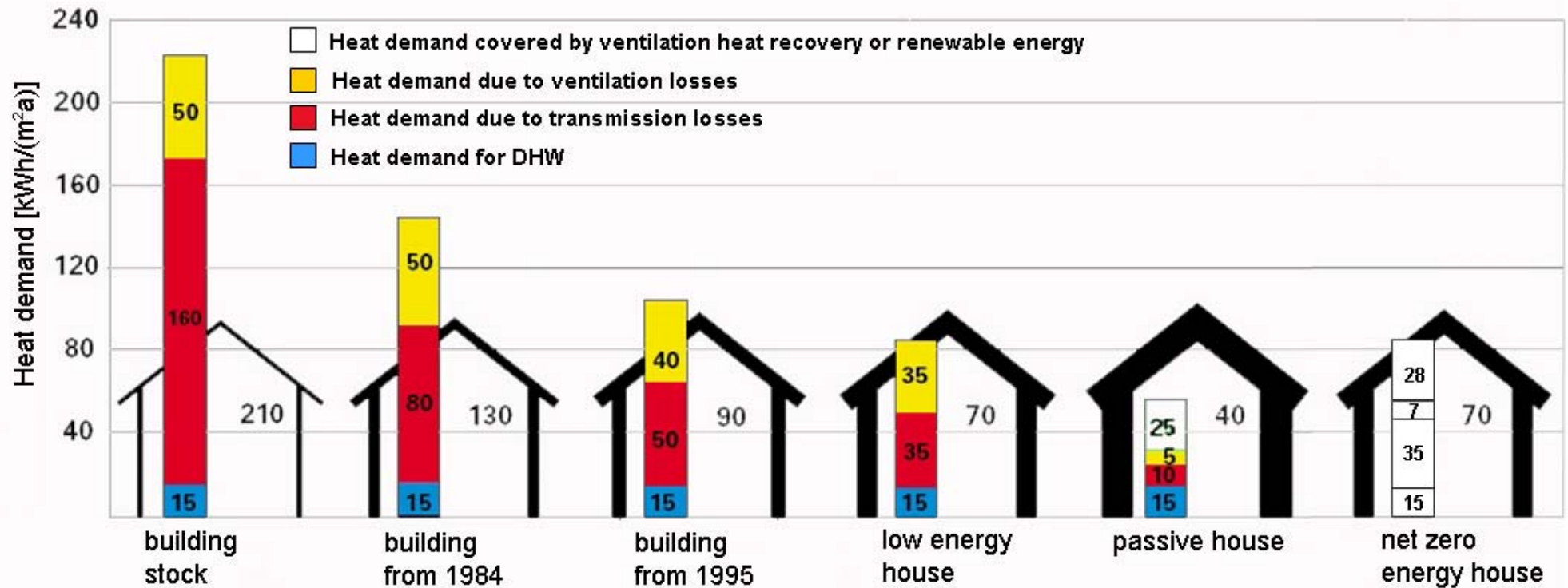
Introduction to low energy houses – Summer strategies

Summer operation: Reduction of heat gains

- High thermal insulation, air tightness
- Reduced air exchange to hygienic necessary
- Bypass heat recovery
- Reductions of external load (Shading)
- Reduction of internal load (A-label appliances)
- Capacity of thermal mass (nighttime ventilation)
- Additional comfort cooling



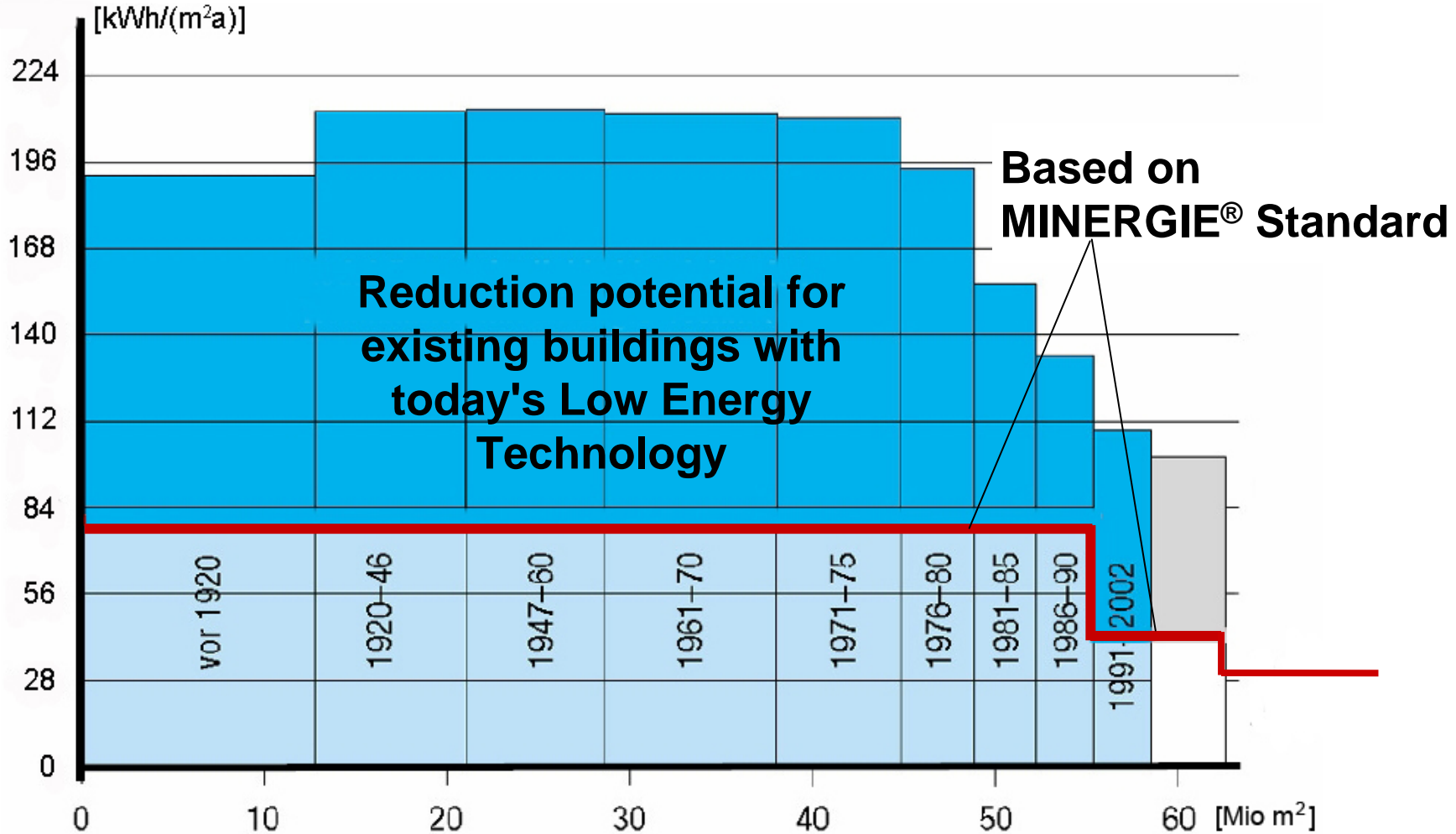
Introduction to low energy houses – Energy balance and building types



Source: modified from Viessmann

Introduction to low energy houses – Energy saving potentials

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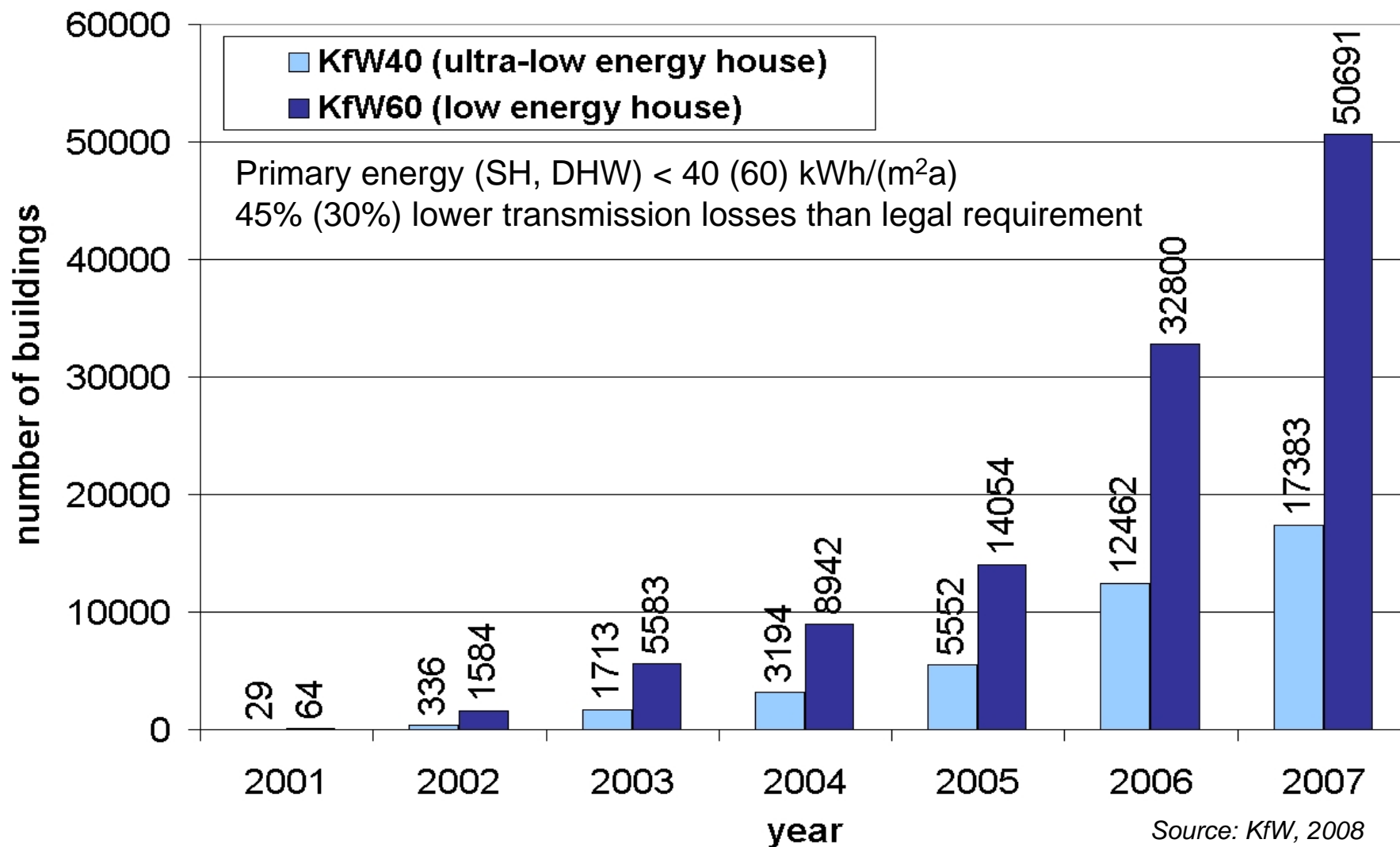


Build energy reference area in canton Zurich

Source: AWEL Zürich

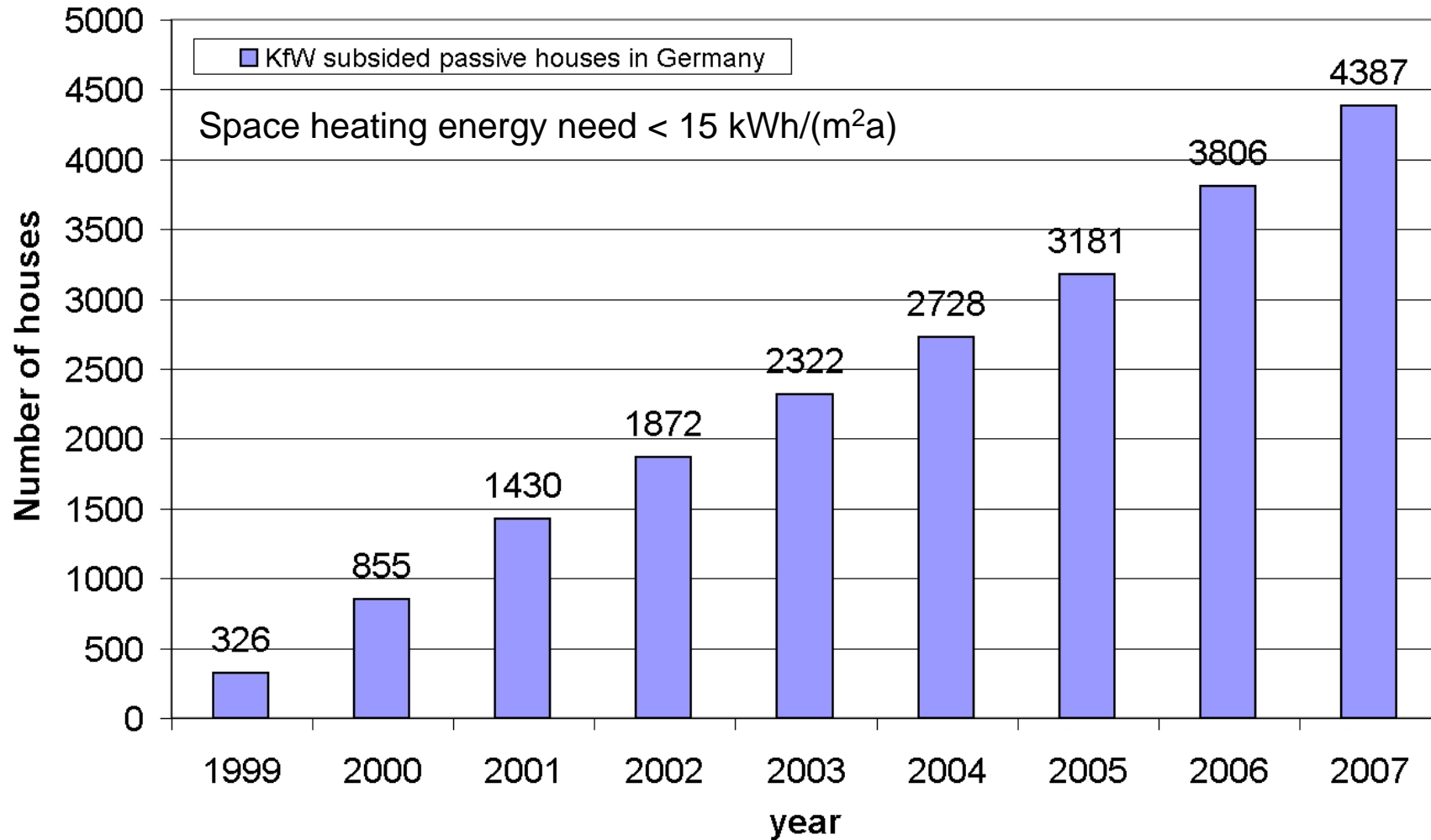
Markets low energy houses – Markets KfW40 and KfW60 houses Germany

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Markets low energy houses – KfW subsidized passive houses Germany

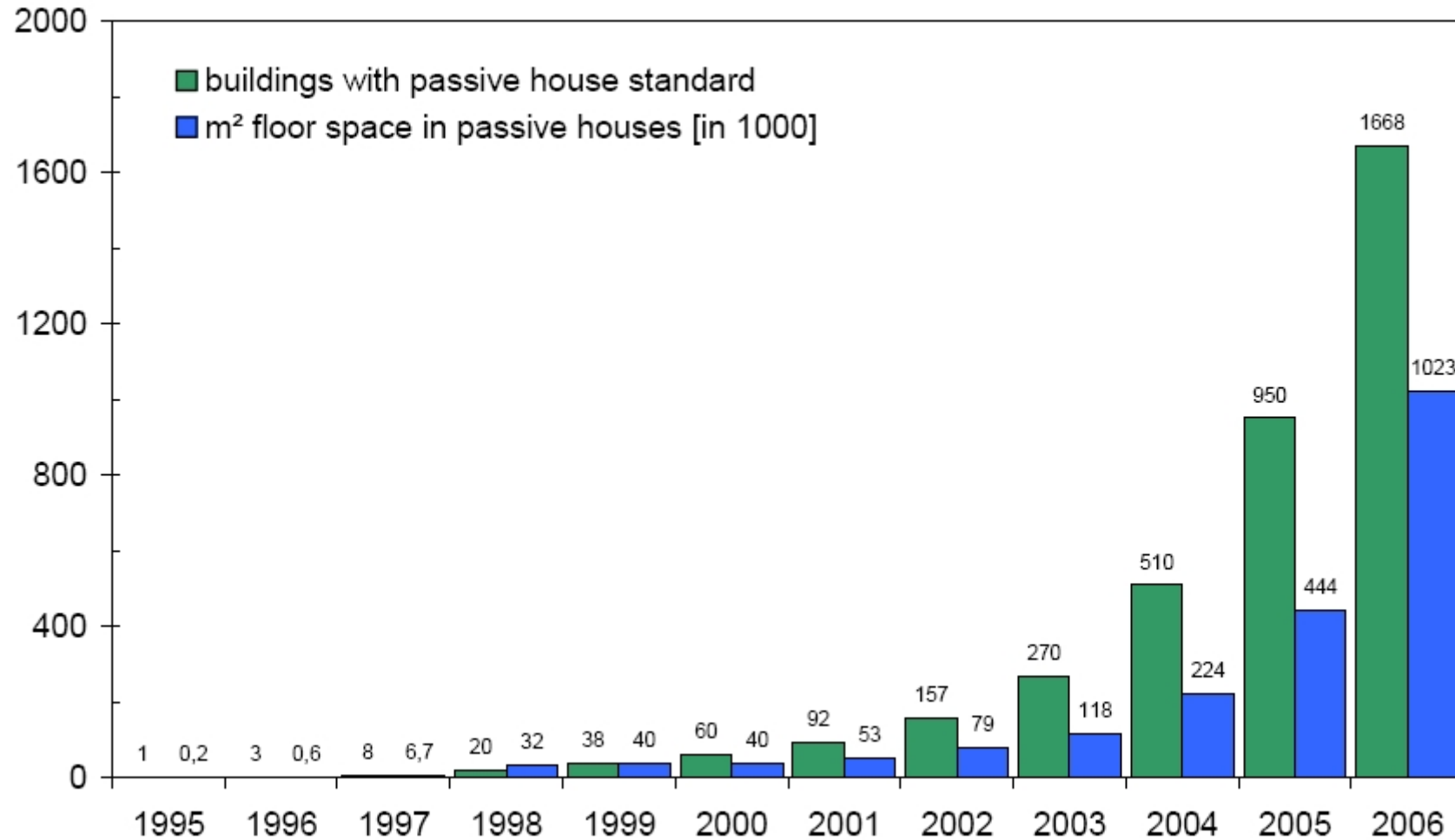
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Source: KfW, 2008

Markets of low energy houses – Development passive houses in Austria

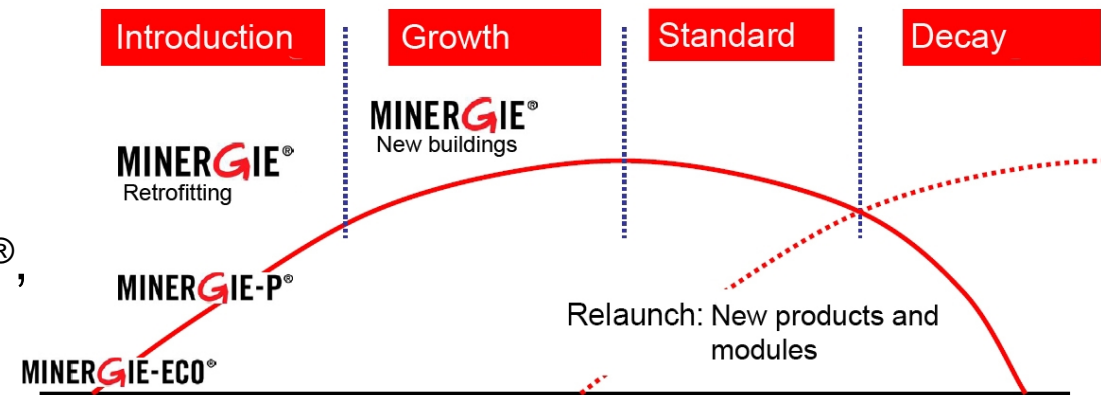
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source: IG Passivhaus (AT)

Markets low energy houses – MINERGIE® houses Switzerland

- **MINERGIE® (1998, ~4-liter house)**
 - ~9000 new buildings in total
 - 15% of new buildings certified
 - 15% further comply to MINERGIE®, but are not certified



source: MINERGIE®

- **MINERGIE® Retrofit (1998, ~8-liter house)**
 - ~900 certified retrofitted houses
- **MINERGIE-P® (2002, ~3-liter house)**
 - ~200 houses
- **MINERGIE-Eco® (2006, ~4-liter house, add. criteria: resources, health, comfort)**
 - 15 houses

Markets of low energy houses

- **Norway: Strong growth**

-  2006: 2000 houses, 2007: 10000 houses in planning, construction
Husbanken

- **Netherlands, Sweden: market introduction**

- Netherlands push-market, small project developers active, pilot houses
- Sweden first pilot plants of passive house (e.g. Lindås)

- **USA: target net zero energy houses**

-  Energy star houses (>15% reduced needs) 10% market share in 2005,
Target DOE 2020 spread of Net Zero Energy Houses (NZEH)

- **Japan, Canada: market introduction and strategies**

- Single pilot plants of NZEH in Japan and Canada (EQuilibrium initiative)



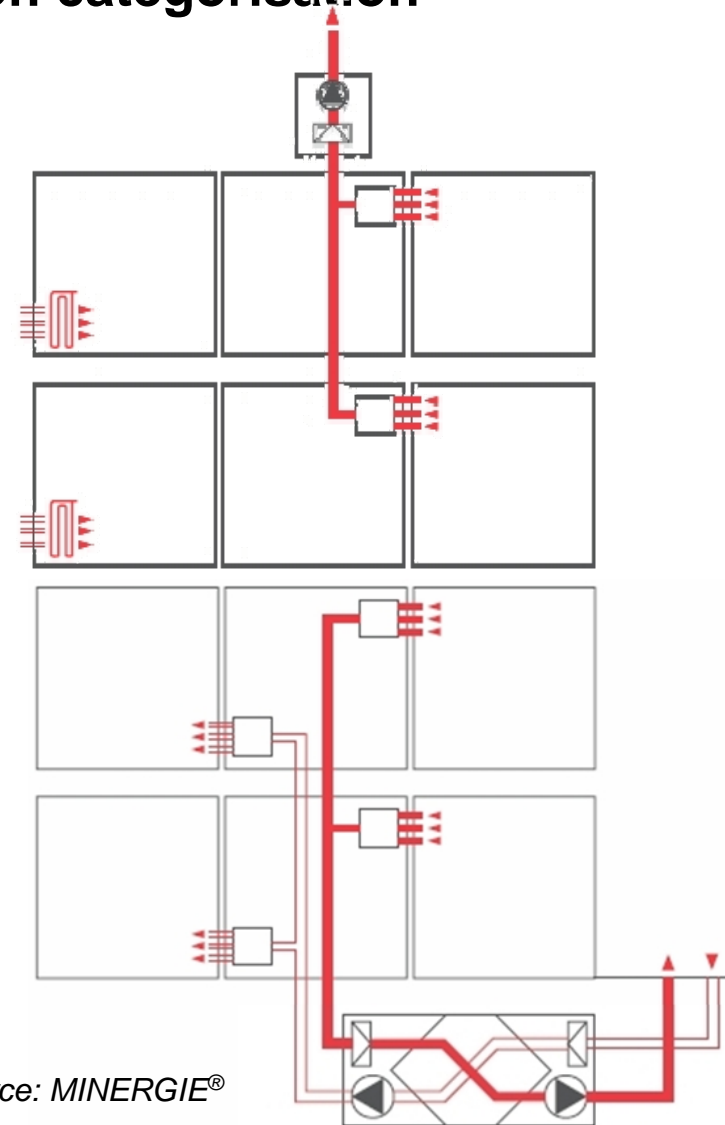
Initiatives for energy-efficient housing (R-2000, Novoclimat)

Systems in low energy houses – Characterisation of loads

- **Reduced space heating requirement**
 - Lower temperature requirements of the heating system
 - DHW energy need has a higher fraction (up to 50% of total space heating requirement)
- **Ventilation system required**
 - Hygienically necessary air exchange has to be guaranteed
 - Enhancement of air-quality (comfort)
 - Reduction of ventilation loss > 80% possible
- **Space cooling**
 - With good concept, summer comfort with passive measures possible
 - Increasing market interest in cooling in low and ultra-low energy houses

Systems in low energy houses – Ventilation categorisation

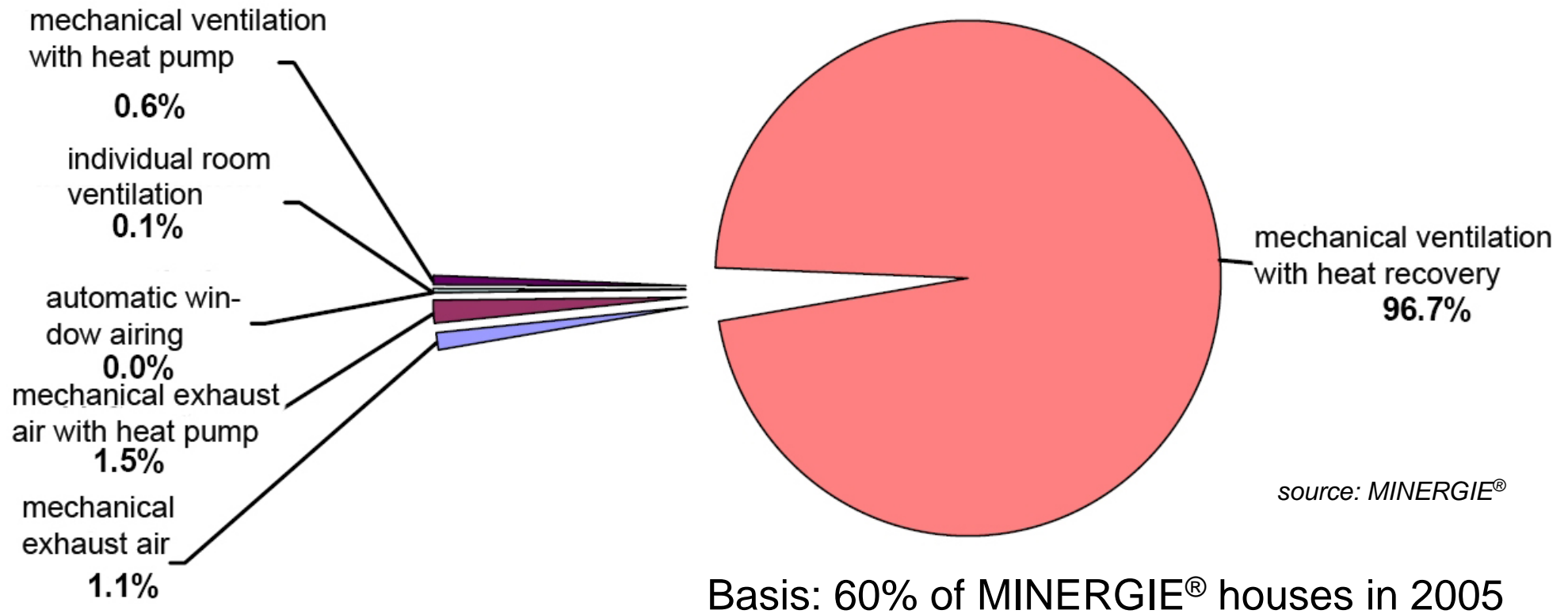
- **Central/decentral**
- **Exhaust air/balanced ventilation system**
 - Exhaust-air ventilation system
 - Extraction of odours, pollutants and moisture
 - Balanced ventilation system
 - Additional improvement of inlet air quality by filtering
- **With/without heat recovery**



source: MINERGIE®

Systems in low energy houses – Installed ventilation systems

Installed ventilation systems in MINERGIE® houses



Systems in low energy houses – Heat pumps

Specific advantages of heat pumps

- Highly-efficient with proper design of the system, use of ambient heat
- Available on the market down to very low capacity ranges
- Environmentally-sound technology, no dependency on fossil fuels
- Space heating and -cooling with one generator possible
- Simultaneous supply of different building services (e.g. space cooling and DHW)
- Further reduction of building losses possible (e.g. exhaust-air heat pumps)
- Depending on the boundary conditions economically favourable
=>rising oil and gas prices!

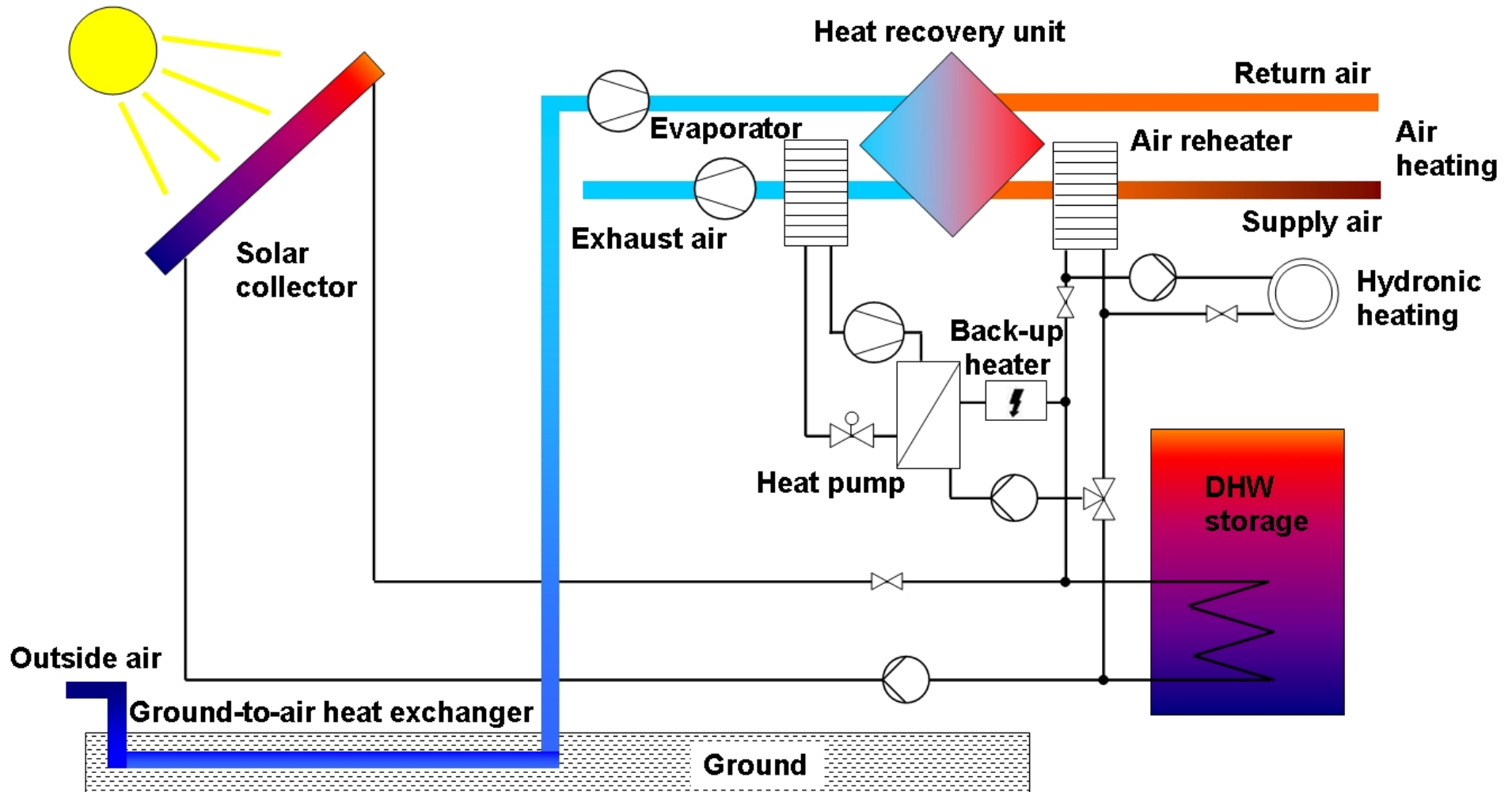
Systems in low energy houses – System integration options

- **Combined operation of heat pump for space heating and DHW**
 - DHW function has a higher share of the total heat consumption
- **Coupling of space heating/DHW function to the ventilation function**
 - Higher reduction of ventilation losses
 - Exhaust-air as heat source
 - In ultra-low energy houses, air-heating with hygienically necessary air flow possible
- **Use of the ground source in summer operation**
 - Ground-coupled heat pumps with direct free cooling option (natural cooling)
 - Ground-to-air heat exchangers in ventilation system

Integrated multi-functional heat pumps are very suited for LEH

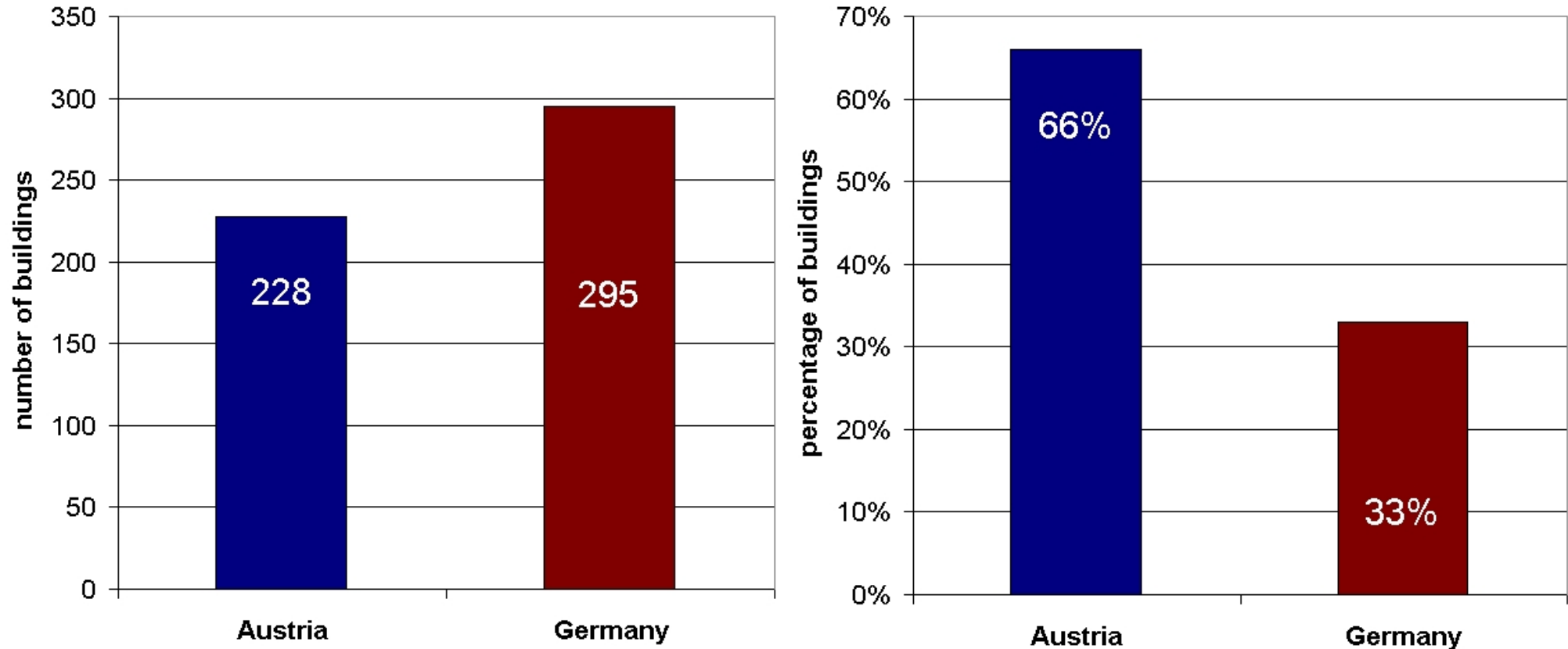
Systems in low energy houses – System integration ventilation compact units

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Systems in low energy houses – Market ventilation compact units

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Installed compact units in Austrian and German passive houses

Basis Austria: 345 of ~1700 passive house, Basis Germany 894 of ~5000 passive houses

ANNEX 32 WORKSHOP FLIGHT SCHEDULE 1905

BOARDING

- INTRODUCTION TO SYSTEM AND MARKETS

FLIGHT 1: NEW HP SYSTEM CONCEPTS

- DESIGN, PROTOTYPING, LAB-TEST RESULTS
- SYSTEMS WITH NATURAL REFRIGERANTS
- SYSTEM INTEGRATION

STOP-OVER: COFFEE BAR

FLIGHT 2: FIELD TESTING

- INTERIM RESULTS ON FIELD PERFORMANCE

LANDING

FLIGHT ATTENDANTS



READY FOR TAKE-OFF?
PLEASE TURN OFF MOBILE PHONES
DON'T LEAVE THE CABIN DURING THE FLIGHT
ENJOY YOUR FLIGHT