BSMC
Dr. Bernd Steinmüller
Sustainability Management Consulting

Aggressive Residential Efficiency for Greenhouse Gas Reduction: What is possible, What will it take?

BSMC

Dr. Bernd Steinmüller

Sustainability Management Consulting

www.bsmc.de

ACI – Home Performance Conference

Cleveland, Ohio, April 2007

Sustainability Limit

BSMC
Dr. Bernd Steinmüller
Sustainability Management Consulting

for Energy Related CO_2-Emissions

Global limit:

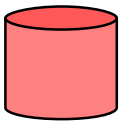
10 billion tons per year

Population 2050:

10 billion people

means

max. 1 ton

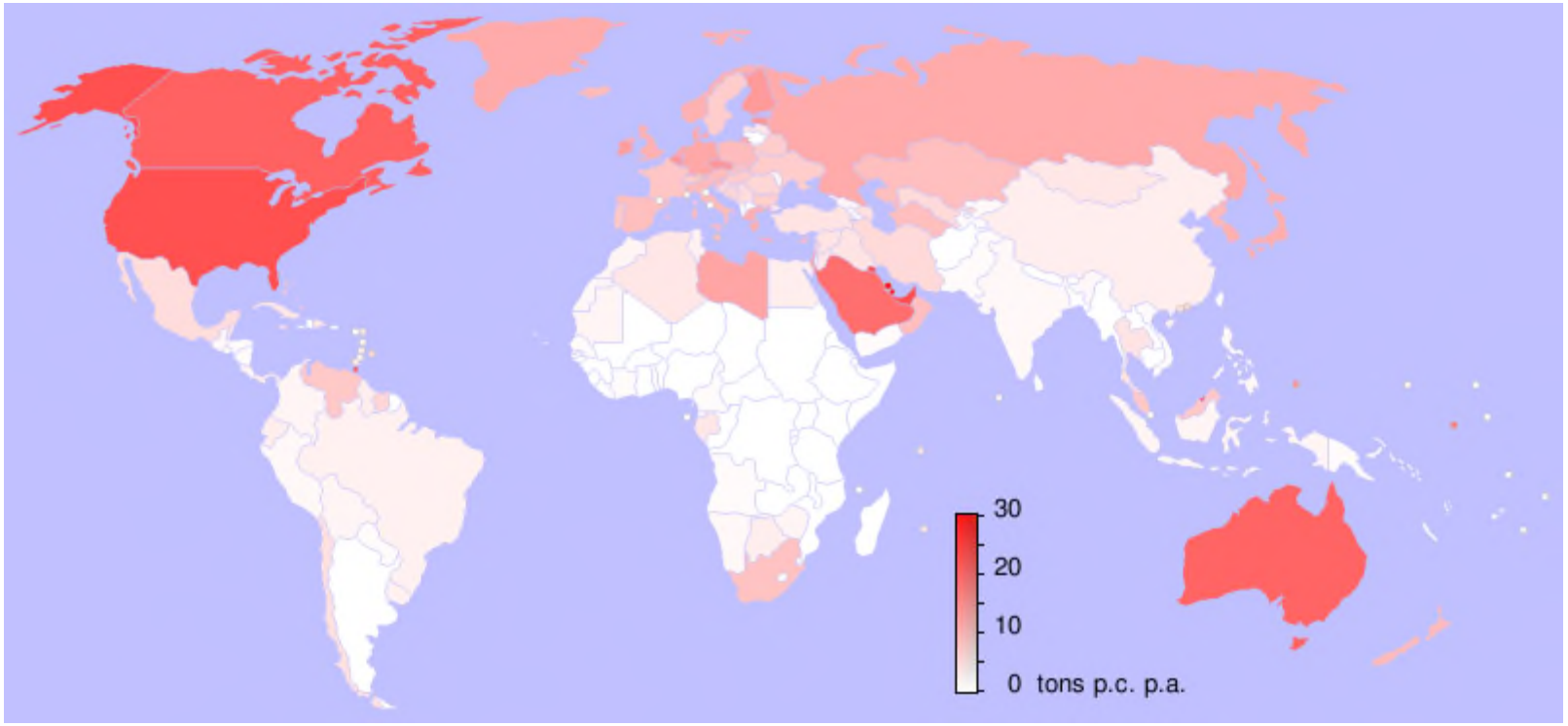


per capita and year

The Situation

Dr. Bernd Steinmüller
Sustainability Management Consulting

CO_2-Emissions in tons p. p. and yr. across the world



The Implication

Energy-related CO_2-emissions have to be reduced

by at least a factor of 10 in the western world!

Can Renewable Energies solve the problem? …

Global Perspective – European Approaches

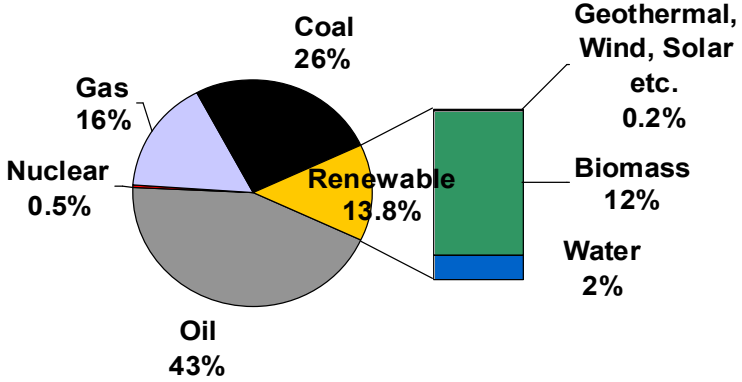
Global Primary Energy Consumption

Dr. Bernd Steinmüller
Sustainability Management Consulting

doubled since 1971... share renewables constant < 15%

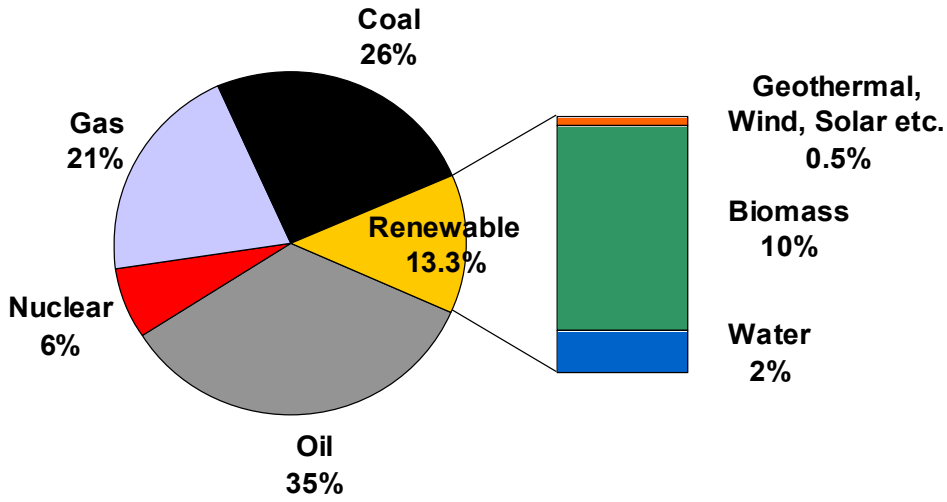
1971:

Total: 234 000 PJ (220 btu 10^{15})



2004:

Total: 463 000 PJ (440 btu 10^{15})



Source: BMU, IEA

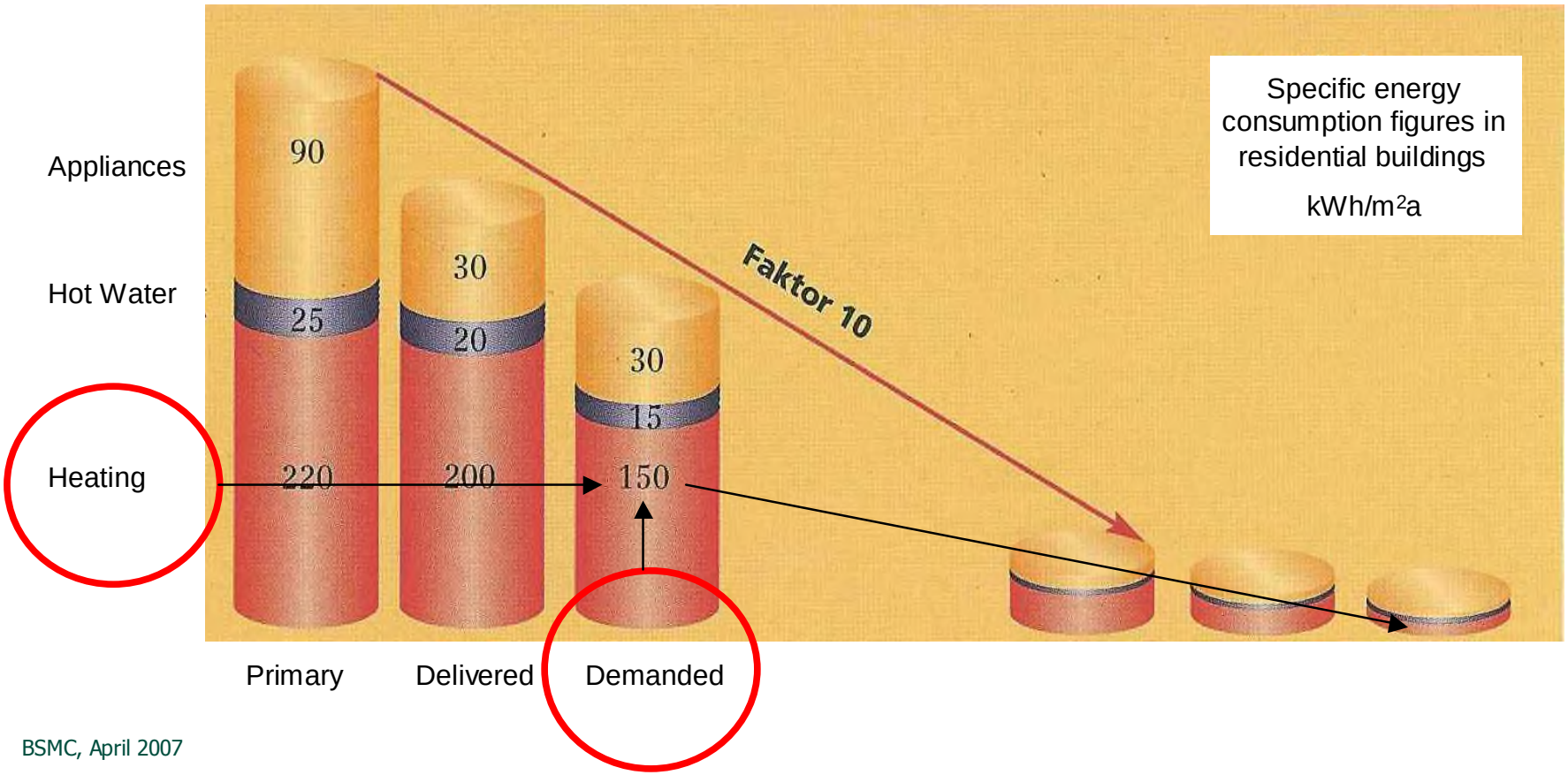
Housing

Overall boundary conditions imply:

Dr. Bernd Steinmüller
Sustainability Management Consulting

We have to improve energy performance of houses by a factor of 10 … with a focus on heating demand

Energy consumption today (Germany) ... tomorrow



Passive Houses – Formal Definition

Central Requirement:

- Maximum Heating Load at Climate Extreme <= 10 W/m² (~ 1 W/ft²)
  - allows omission of traditional heating system

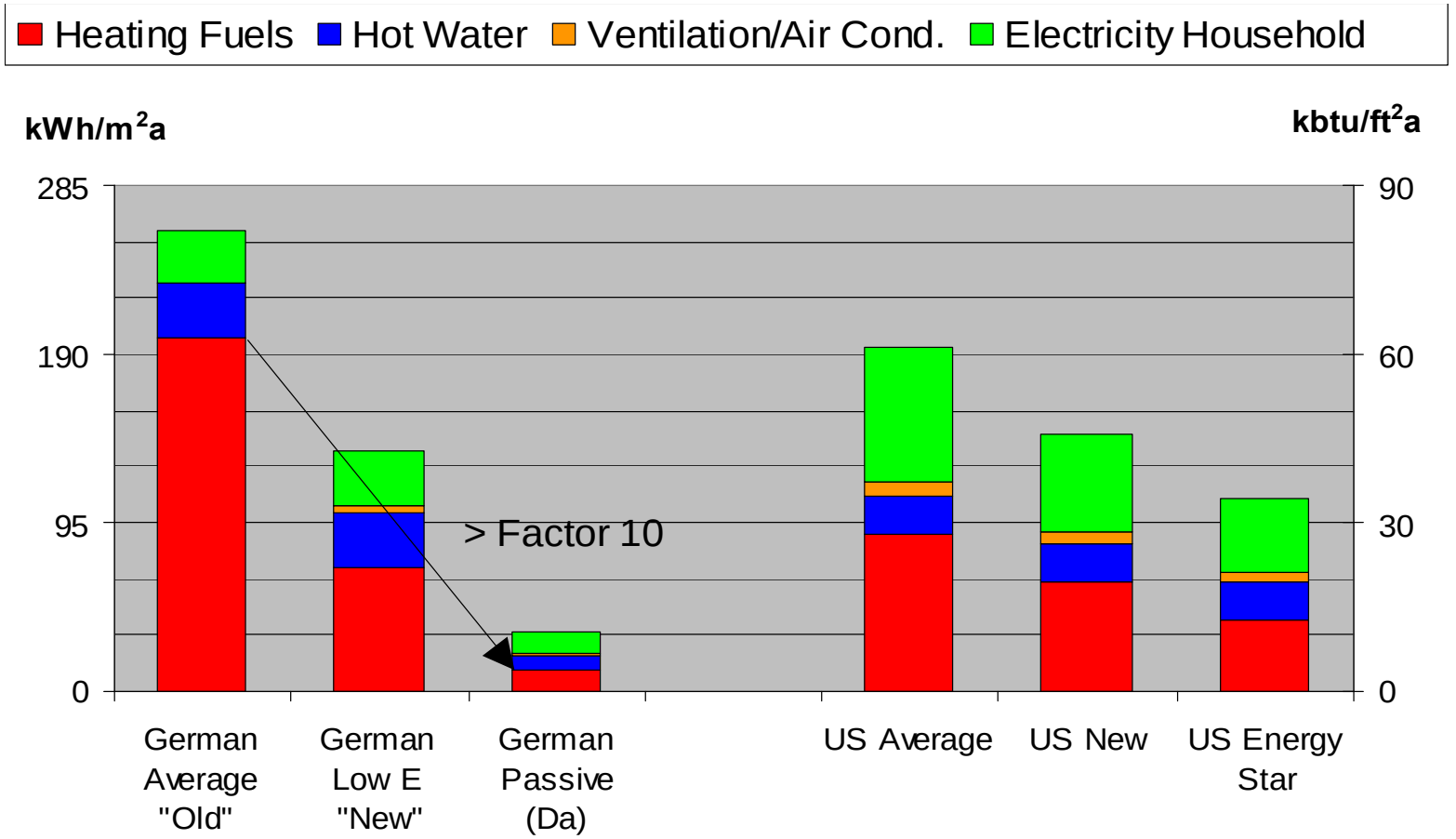
Secondary Requirements:

- Maximum Annual Heating Demand <= 15 kWh/m²a (~ 5 kBtu/ft²a)
  - for south oriented buildings in Central Europe

- Overall Primary Energy Consumption <= 120 kWh/m²a (~ 40 kBtu/ft²a)
  - Including household appliances
  - To be lowered in the future

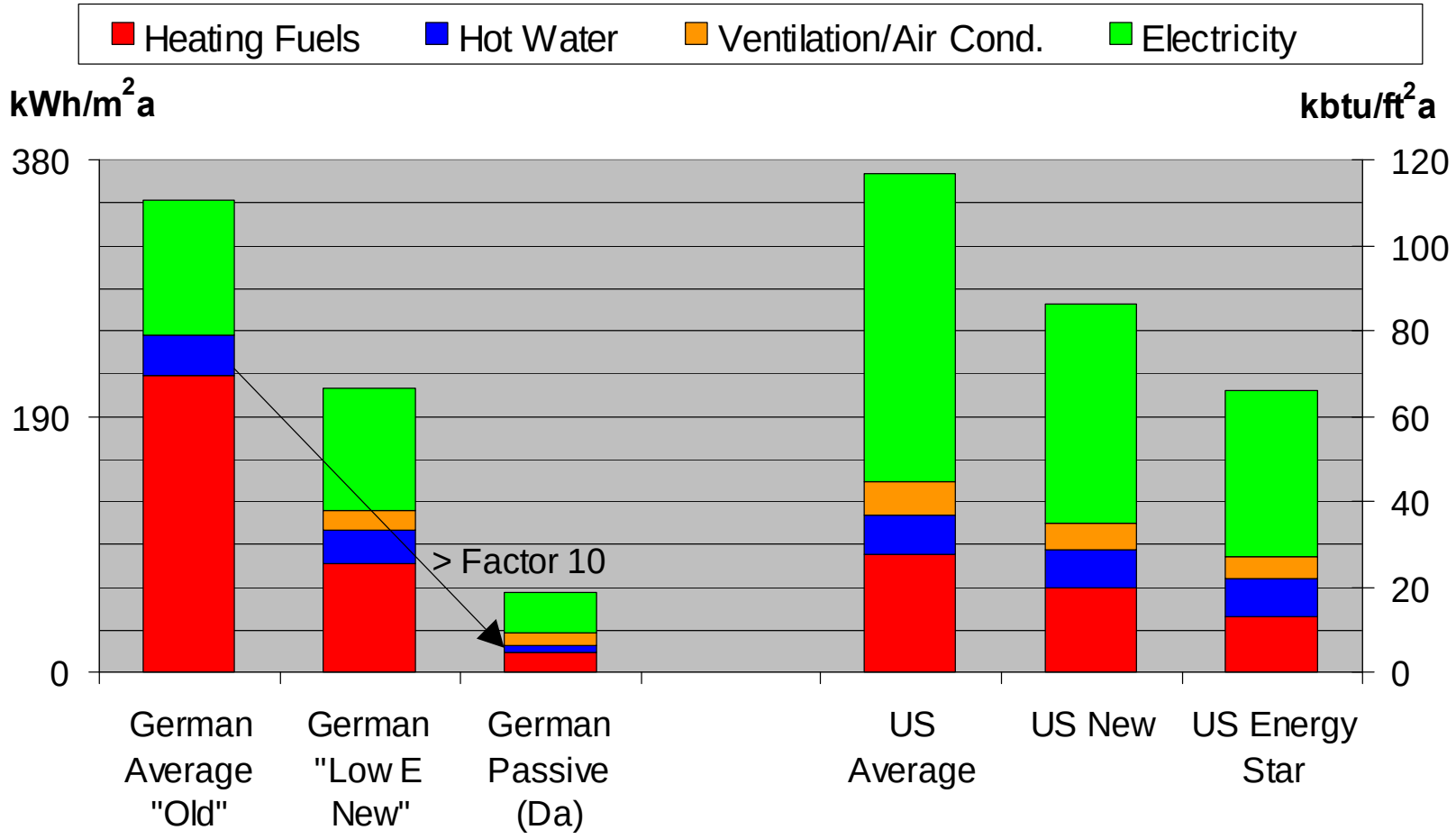
Source: PHI

Passive House – Site Energy Usage
Comparison to Existing and New Buildings in Europe and the US



Source: PHI, J. Krigger ..

Passive House - Primary Energy per Floor Area – Comparison with European and US Residential Building Types



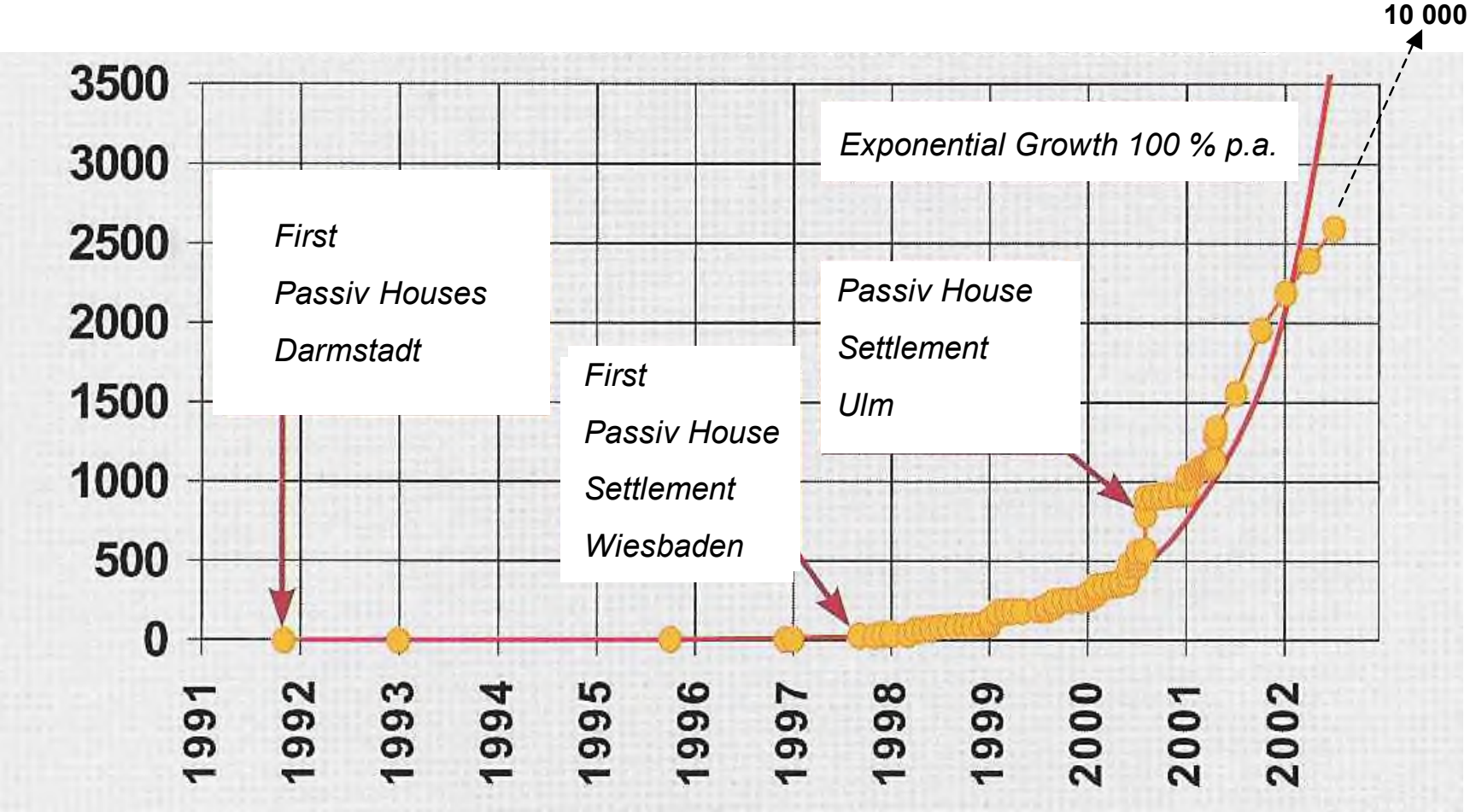
Source: PHI, J. Krigger (converted site data)

Darmstadt-Kranichstein
First Passive House in Europe/Germany 1991

- Super insulated House in a Row
  - Insulation: 10 - 18 inches, U-Value 0.1 bis 0.14 W/(m²K) → R40 to R60
  - Optimized triple panes windows with insulated frames, south oriented
  - Ventilation with heat recovery
- Rest Energy Demand
  - Heating: 12 kWh/(m²a)
  - Hot water: 8 kWh/(m²a)
  - Household appliances: 11 kWh/(m²a)
- Covered by
  - Vacuum collectors
  - Gas condensing furnace

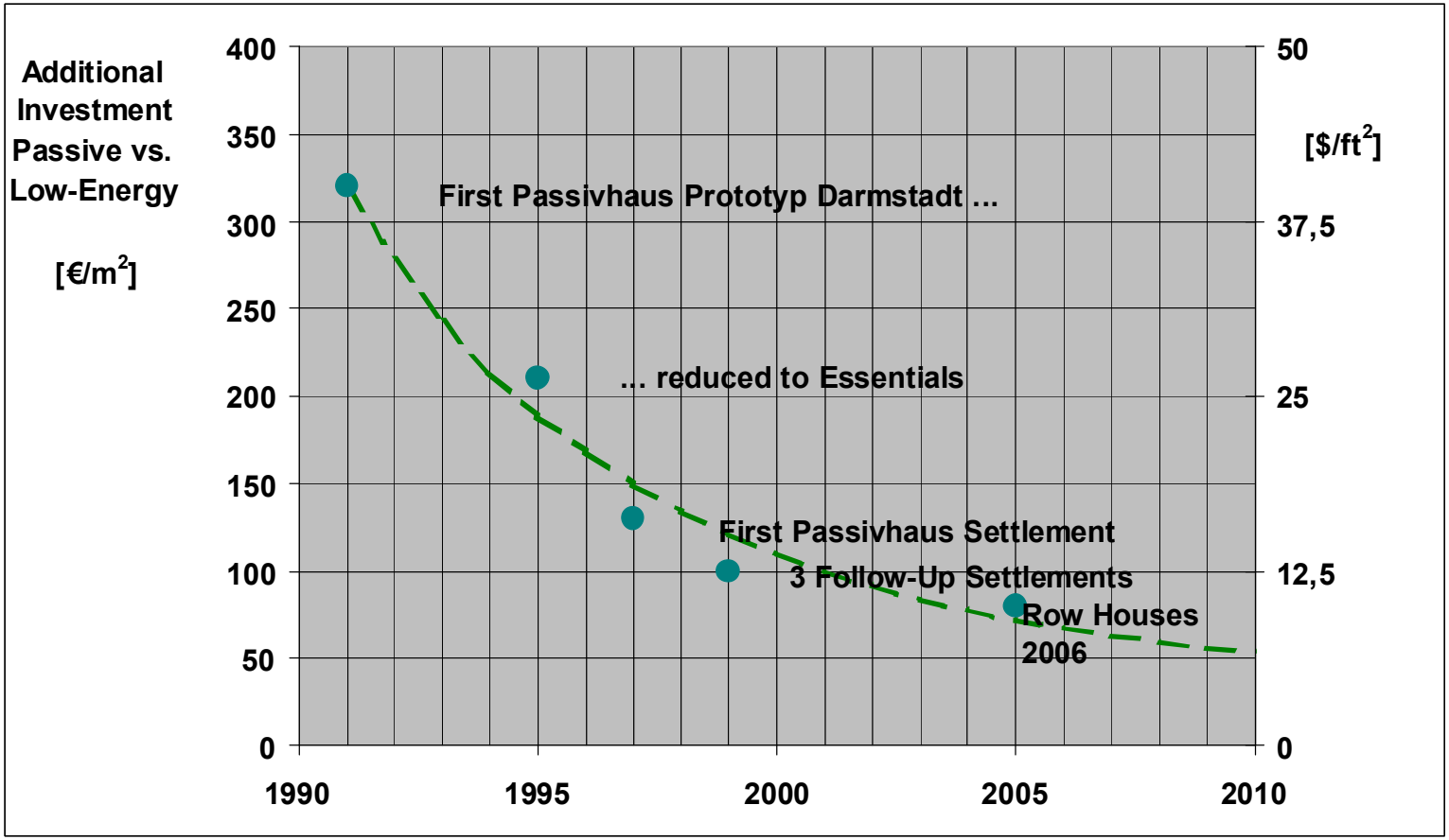
Source: Feist (IWU, PHI)

Number of Passive House Units Grow …



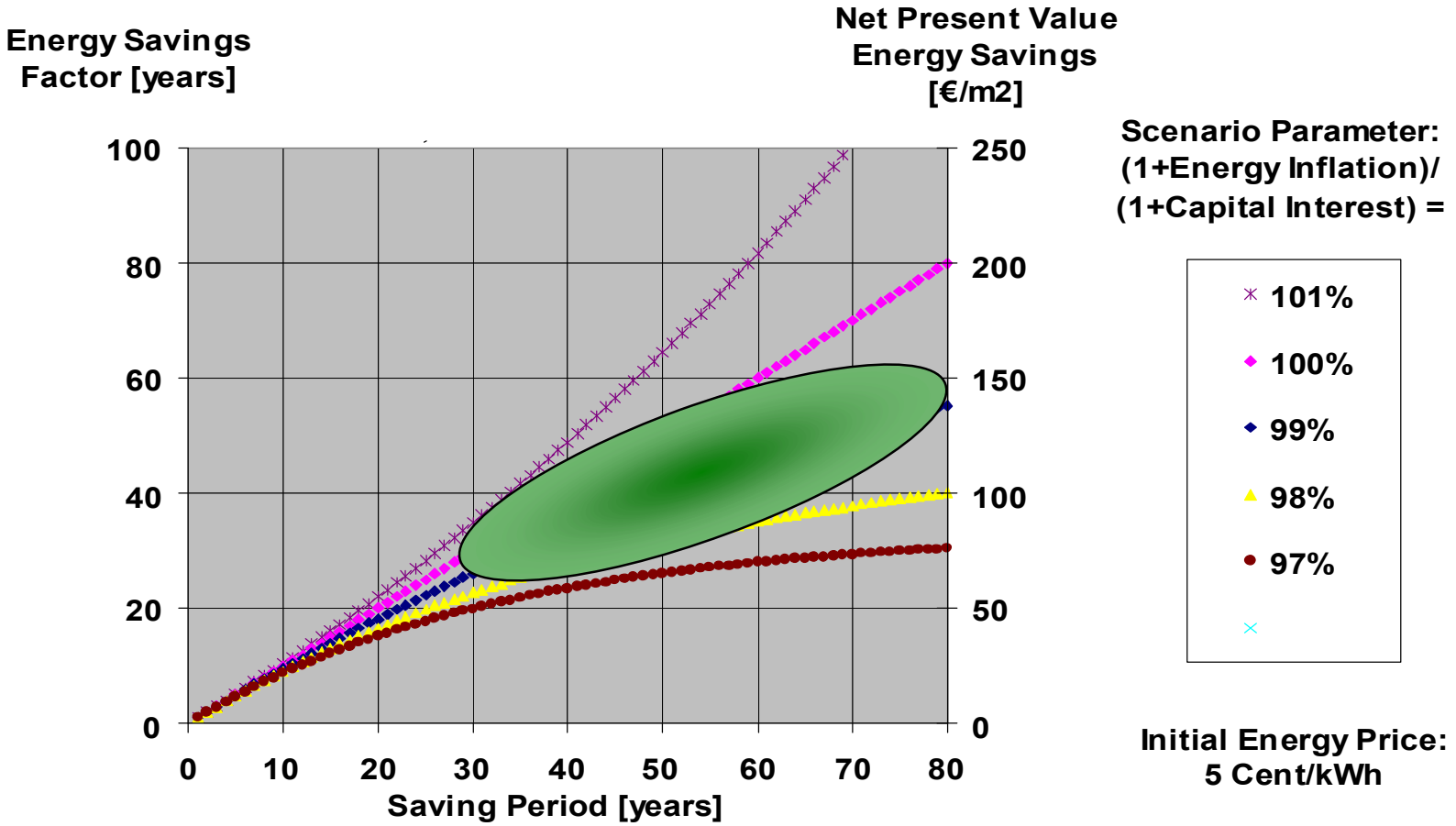
Source: PHI

.... Additional Investment Drops → 50 €/m² (6 $/ft2)



Source: W. Feist PHI

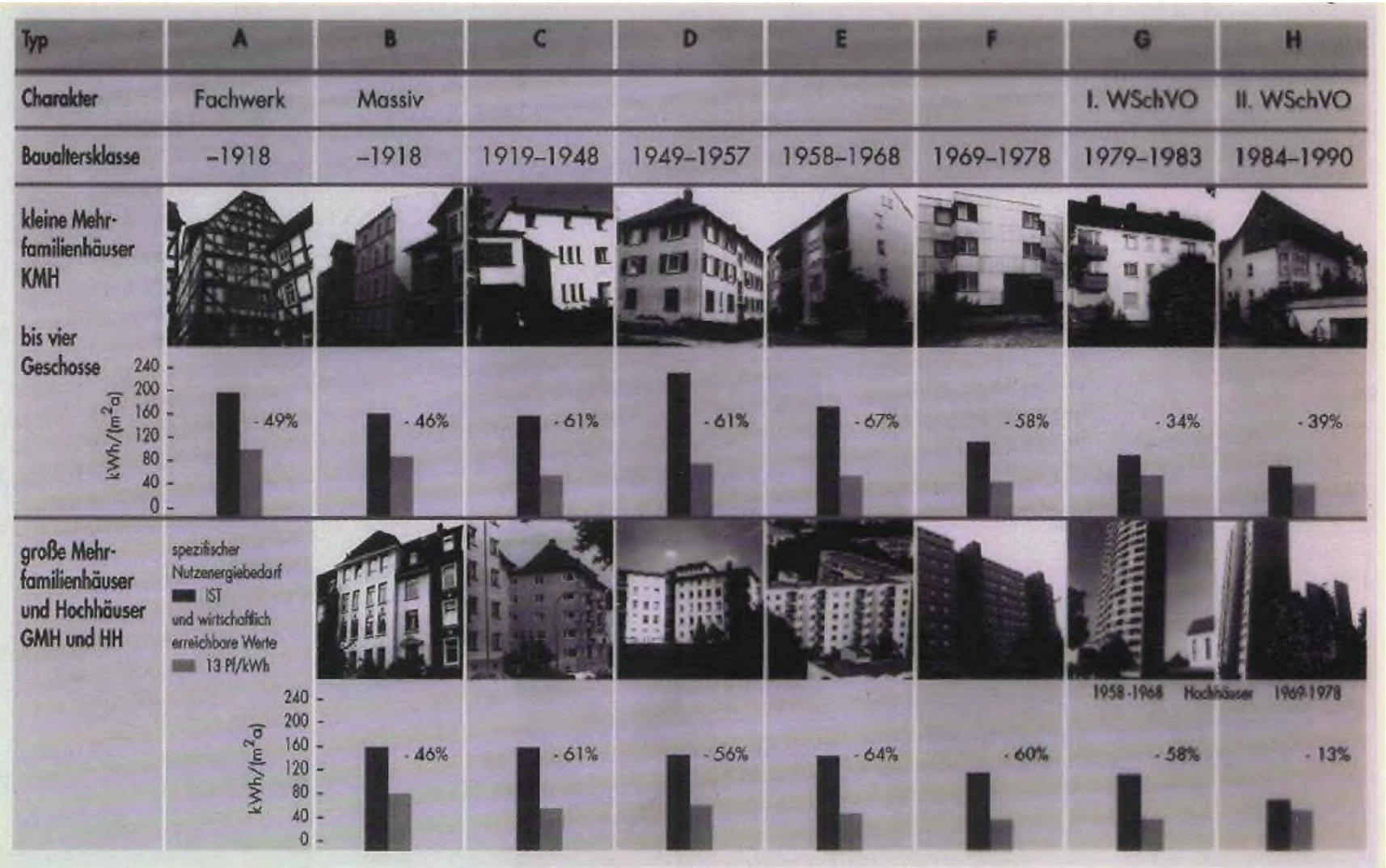
Energy Savings > 50 €/m² (6$/ft2) ... dependent on scenario



Old Buildings

Old Buildings – Broad Spectrum of Types, Ages

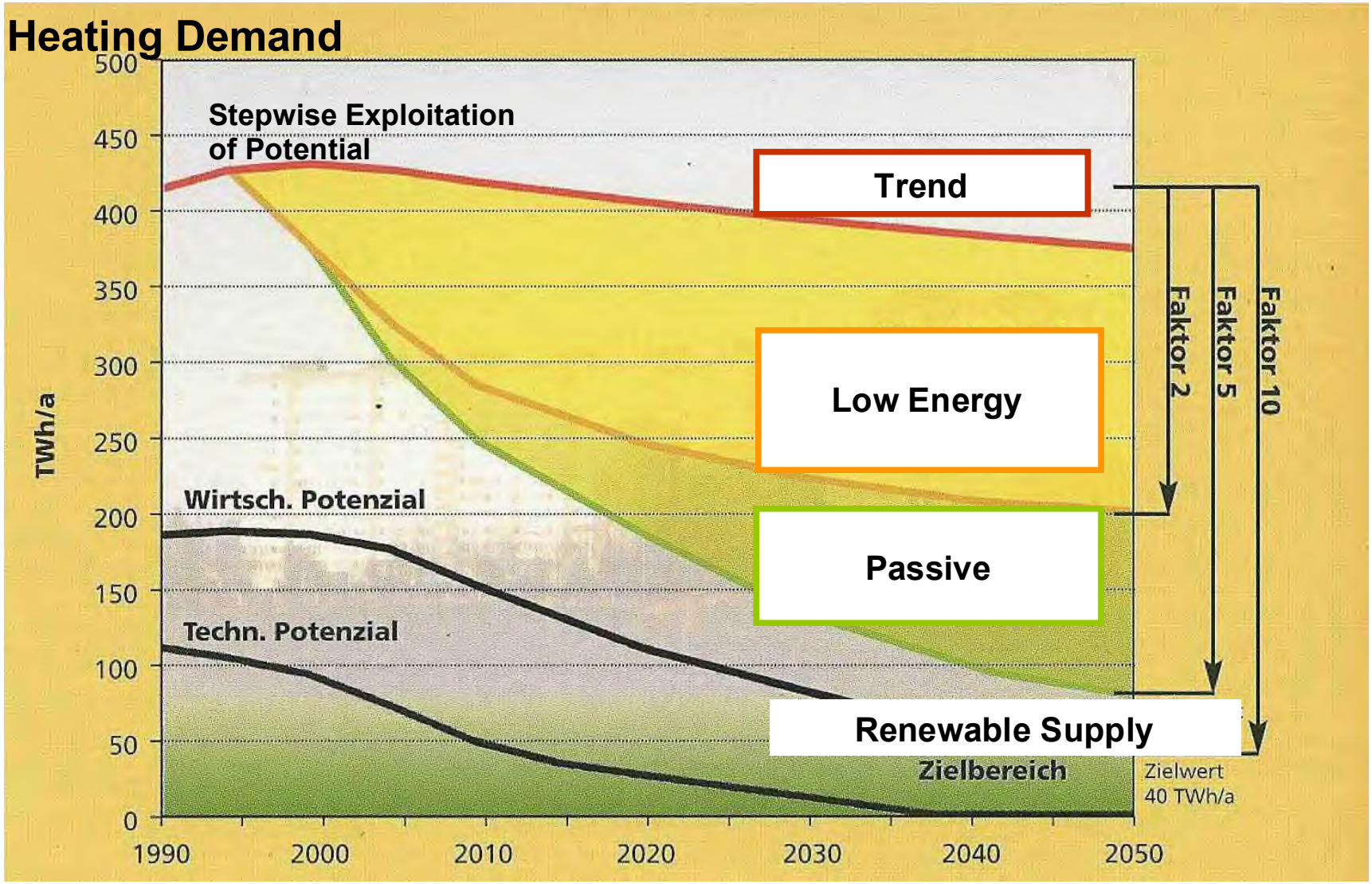
Dr. Bernd Steinmüller
Sustainability Management Consulting



Source: IWU

Heat Saving Potential in Old and New German Dwellings

Dr. Bernd Steinmüller
Sustainability Management Consulting



Source: IWU/BSMC

Systematic National Advances via DENA-Programs

Participants Phase I

- Means
  - Demanding targets exceeding new buildings
    - Quality of building envelope
    - Primary energy consumption
    - Sustainability measures
  - Upgraded government funds
    - special “cheap” loans
    - up to 20 % debt relief
- Phases
  1. 33 Buildings (2003 - 2005) multi-family
  2. > 100 Buildings (2005 - 2007) incl. single-fam.
  3. > 1000 Buildings … just started

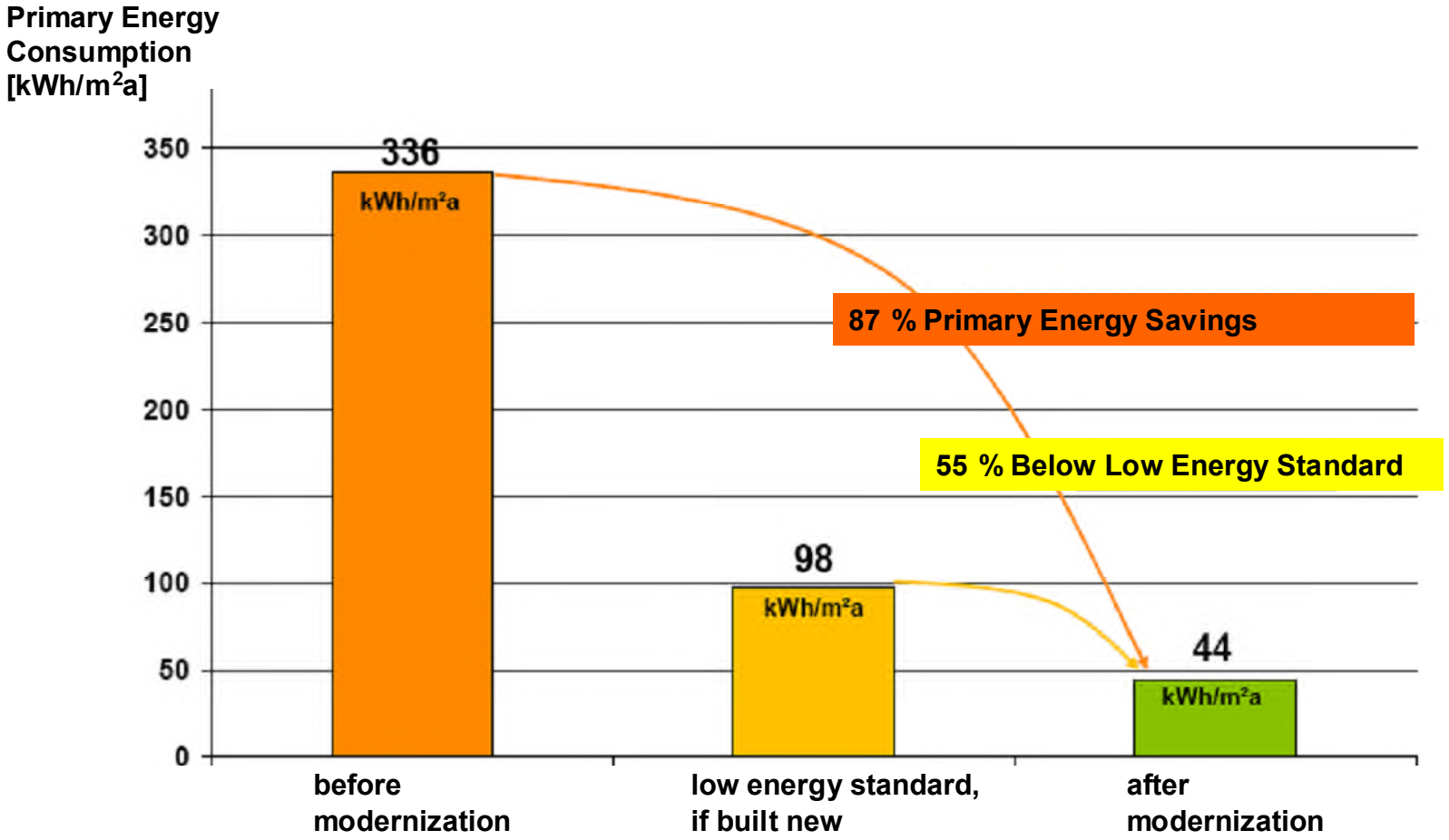
Source: DENA

Example:
Advanced Retrofit of 8-Family House in Bielefeld

- Sustainability Approach
  - Life-Cycle Optimization Energy and Economy
  - Long-term Usability, Adaptability
- Passive House Technologies
  - Roof 15, Wall 8, Cellar 4 inches additional high performance insulation
  - Reduction of Thermal Bridges
  - Passive House Windows
  - Ventilation 90% heat recovery
  - Solar assisted hot water
- Factor 10 Savings
  - In Energy & CO_2-Emissions
  - Economically “multipliable” and even optimum for most measures

Source: BSMC

Results Phase I: On the Average 87% Savings for all Buildings



Source: Dena

Conclusions

- Non-renewable energy consumption has to be reduced by a
  - factor of 2 world wide
  - factor of 10 in the western world …. at least
- This can only be achieved by combining
  - Drastic energy efficiency & saving measures (factor 5 and more)
  - Promotion of renewable energies (factor 2 at least)
  - In all sectors: industry, traffic and housing
- The housing & building sector is of special importance
  - Causing 40% of energy consumption in Europe and the US
  - Offering large “no-regret” saving potentials and huge quality of life with proven, promising technologies waiting for local application
- Sustainability starts at home …


Thank You!