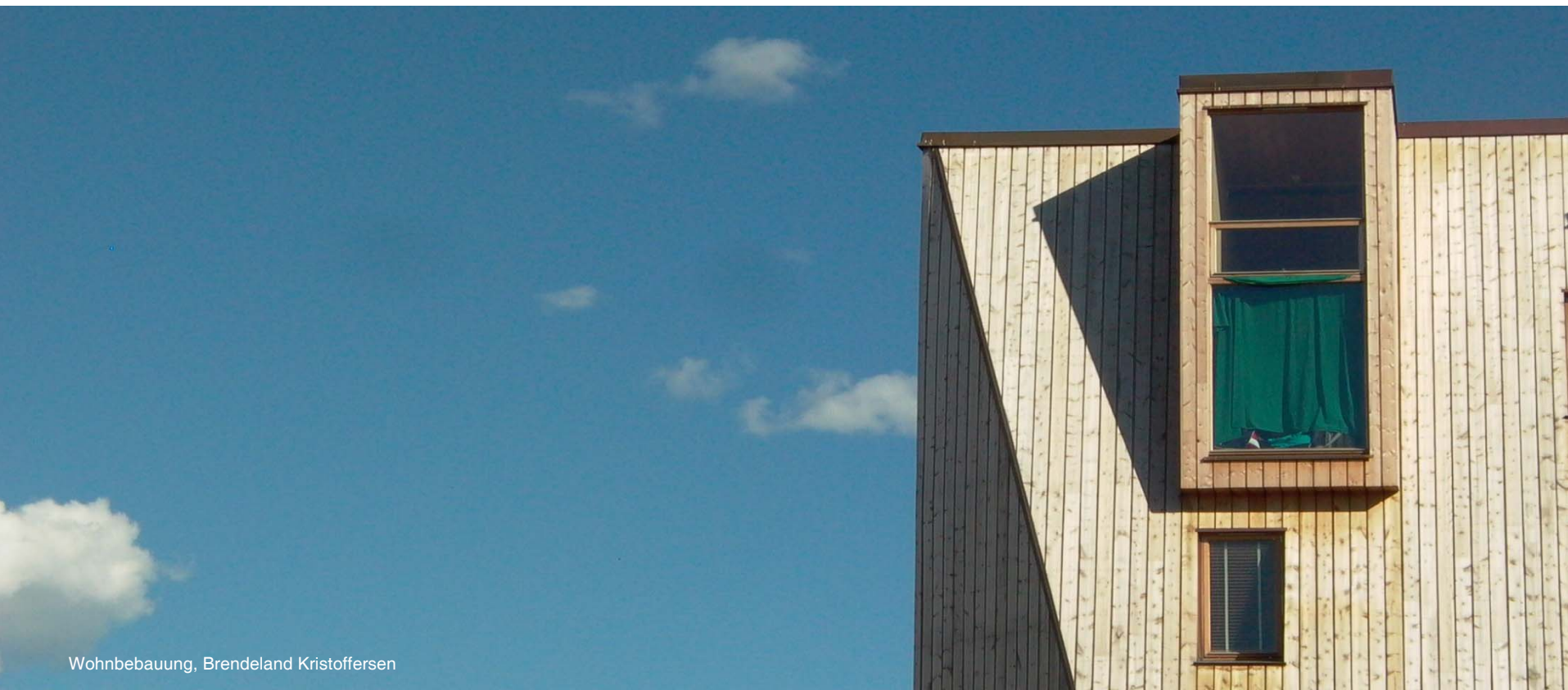


Energy-Efficient Building Design– Future Benchmarks



Wohnbebauung, Brendeland Kristoffersen

01 Background + Potentials

02 Energy Efficient Design

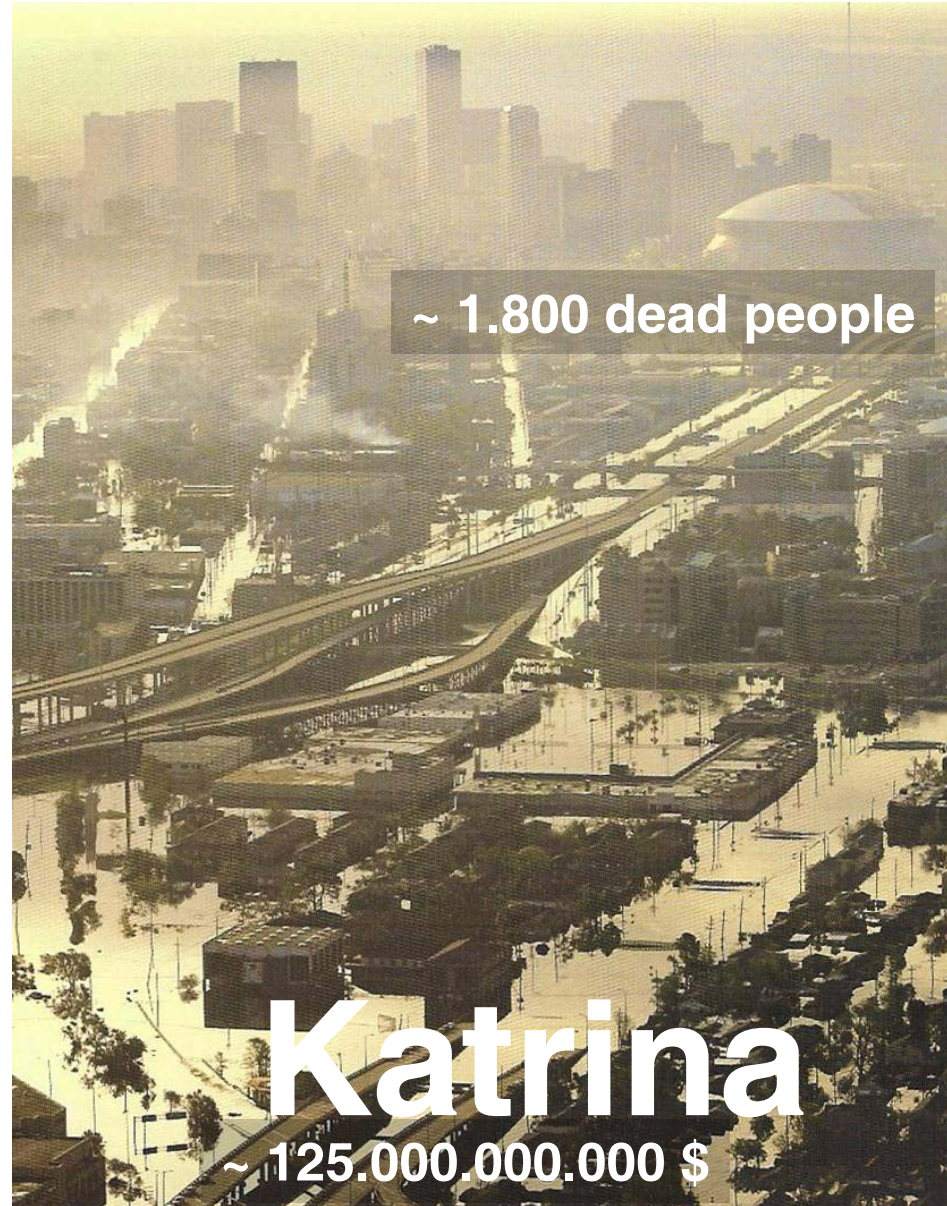
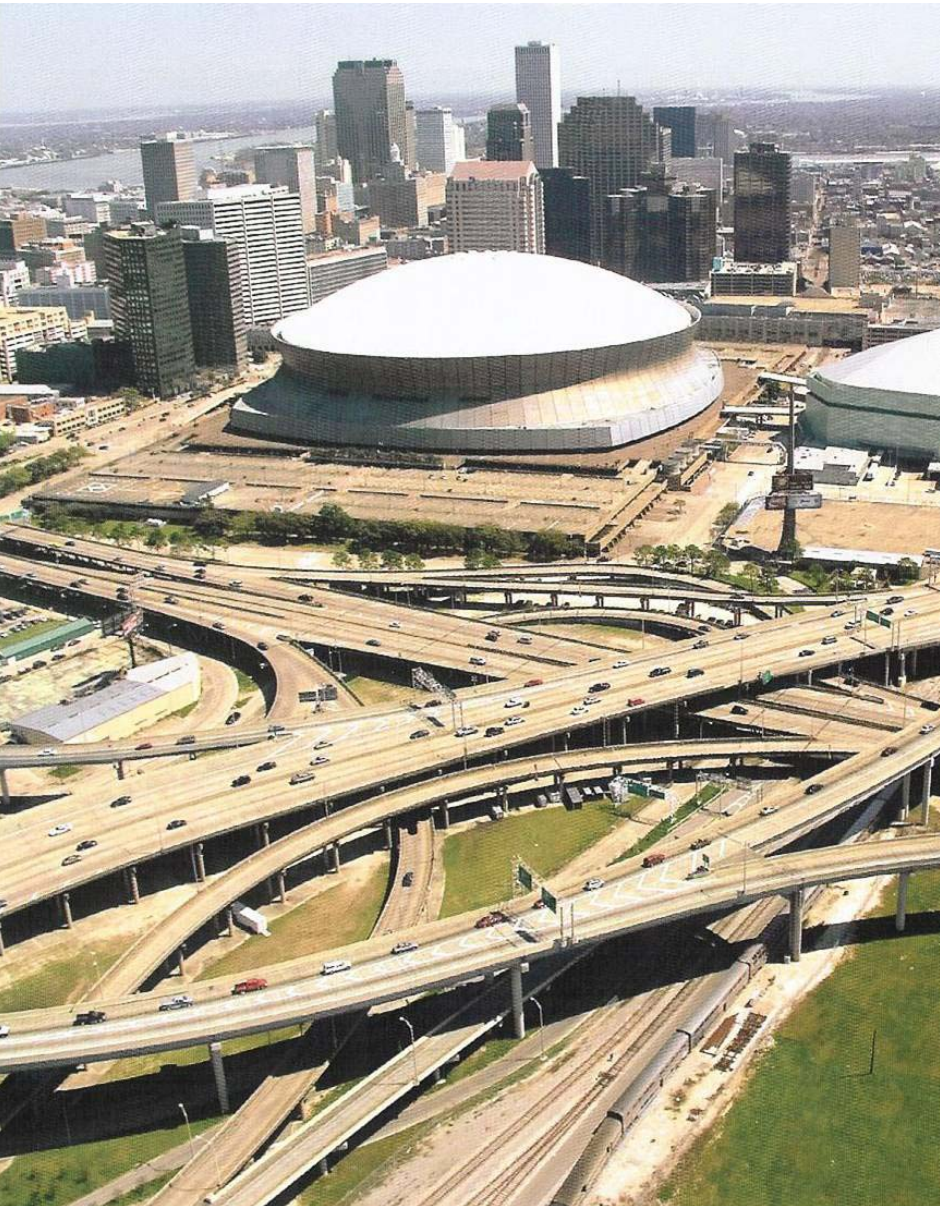
03 State Of The Art - Example Projects

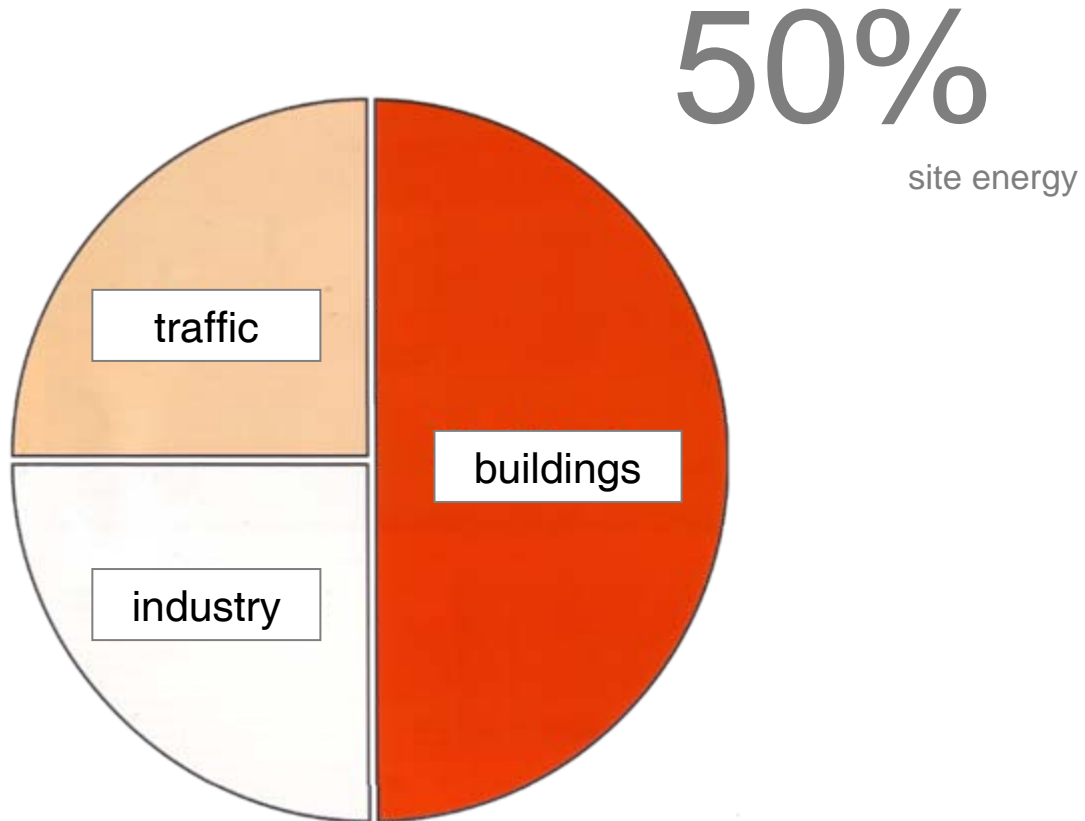
Plusenergy Home – Solar Decathlon 2007

Minimum Impact House

04 Résumé

> Background +
Potentials







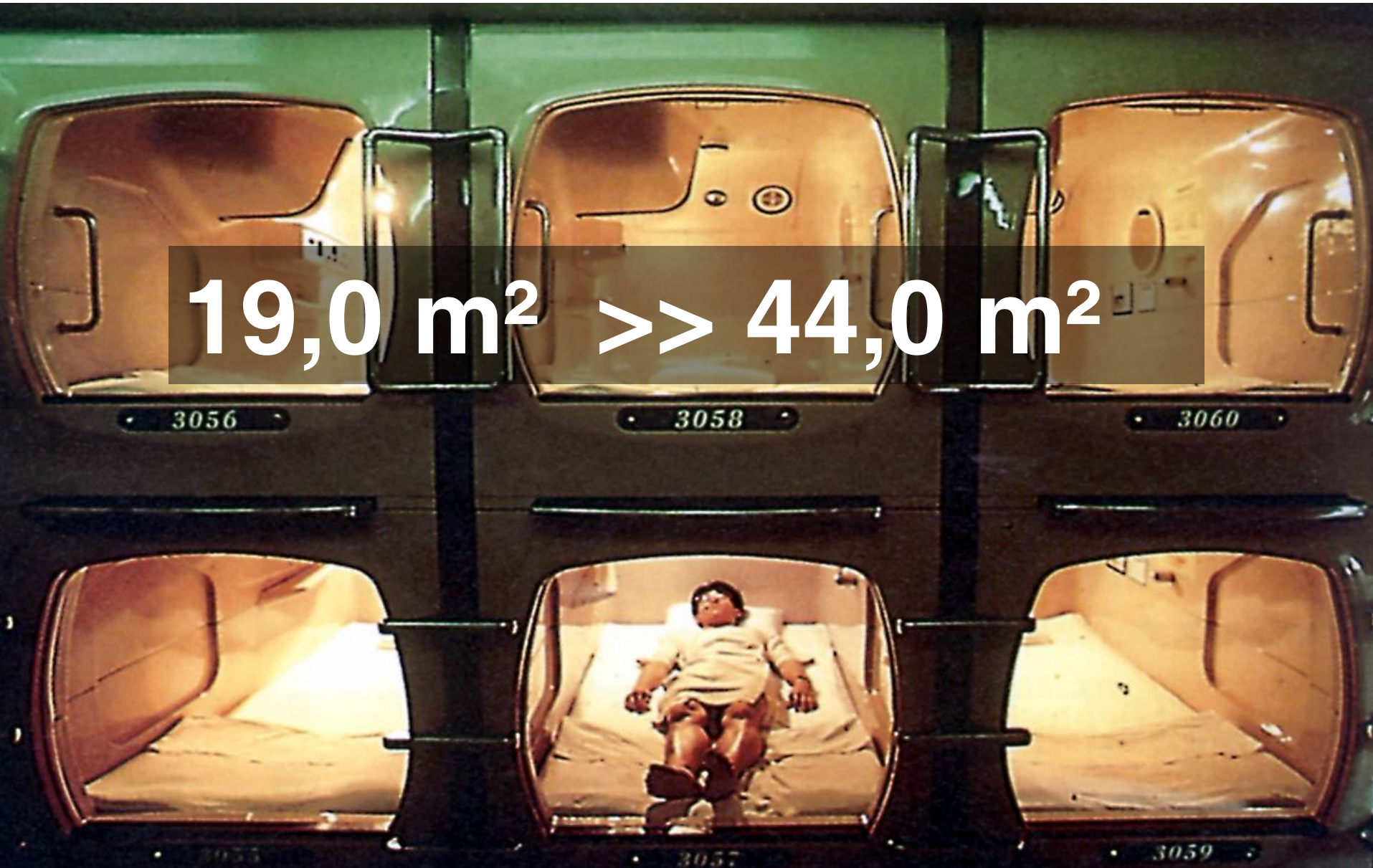
+ 60%
(2030)



50 %



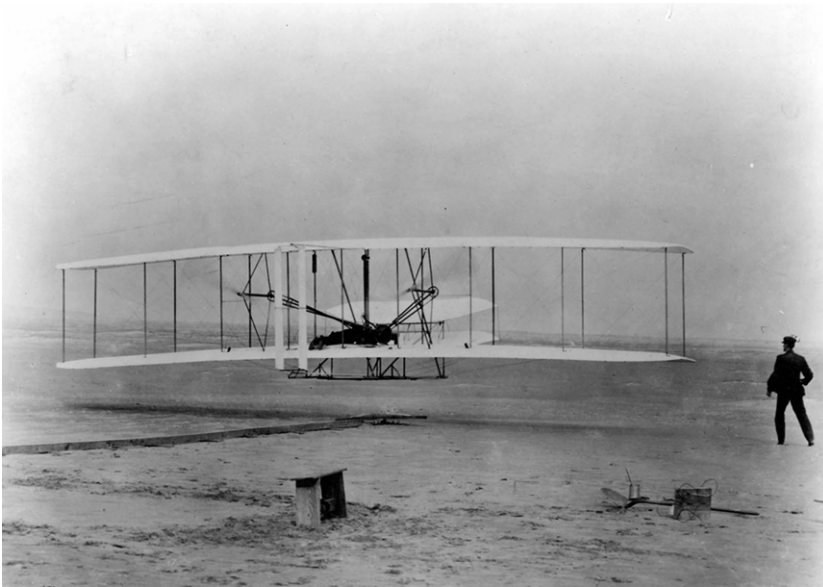
60%





129 ha/d

66a

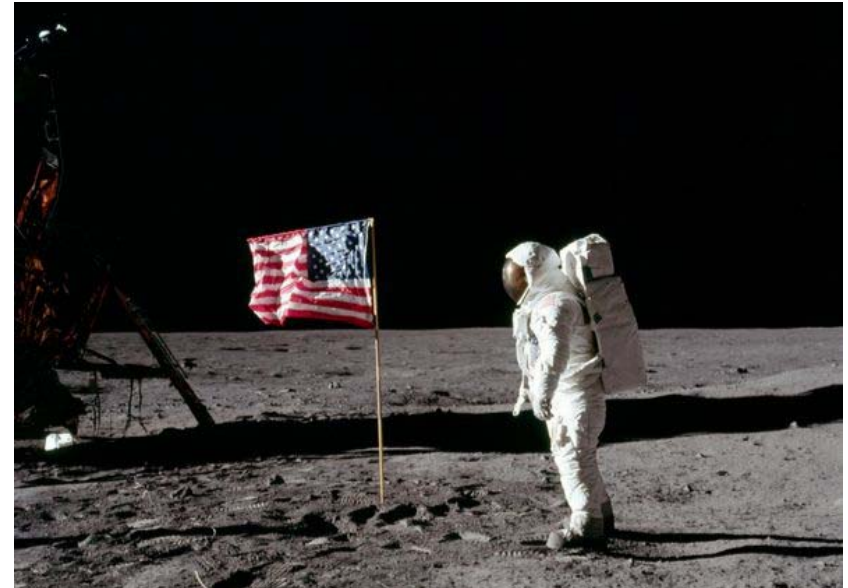


1903

first controlled engine powered flight

Orville Wright spent 12 seconds in the air and covered a distance of 37m.

Speed: 10,8 km/h.



1969

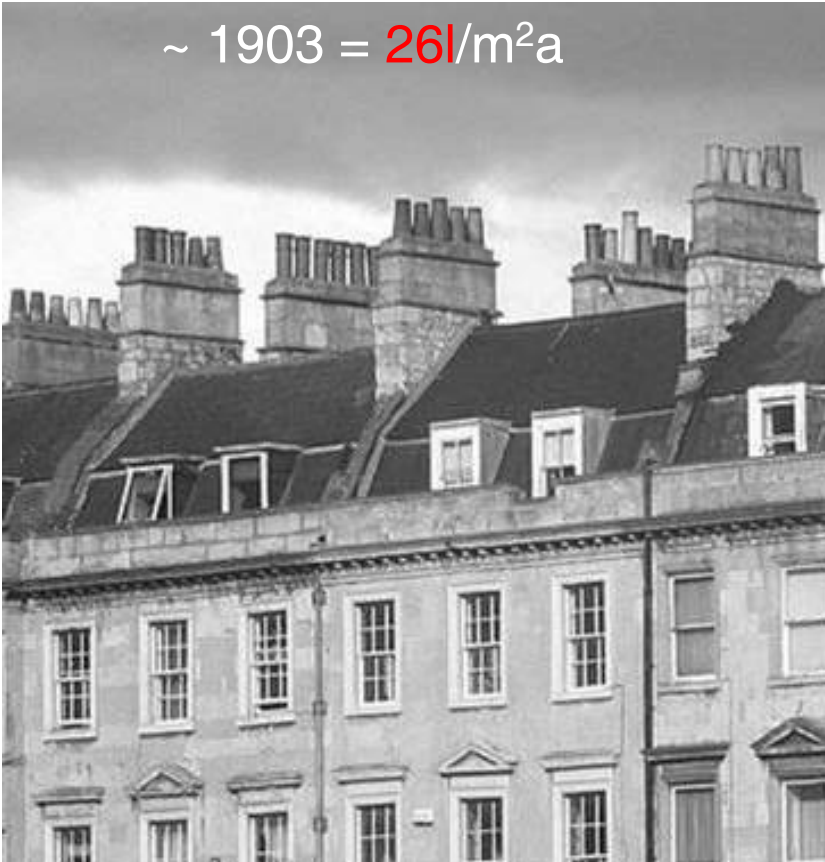
first manned moon landing

The Apollo-11-Mission circled in 8 days and 3 hours 30 times around the moon and covered the distance from earth to moon with 10,8 km per second.

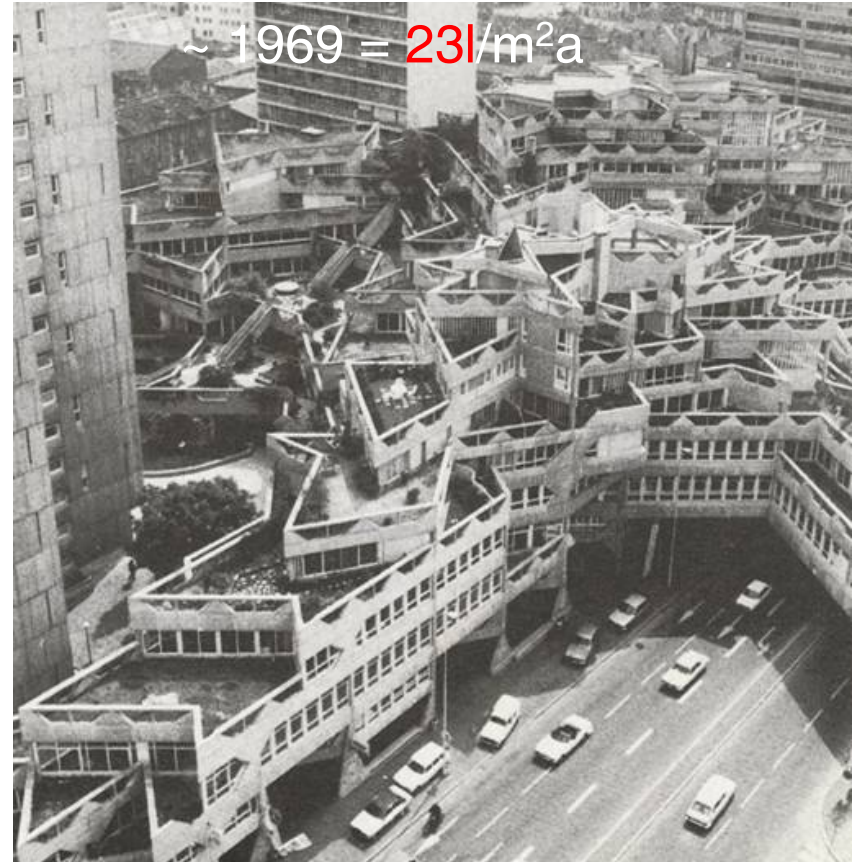
Speed: 38.880 km/h.

66a?

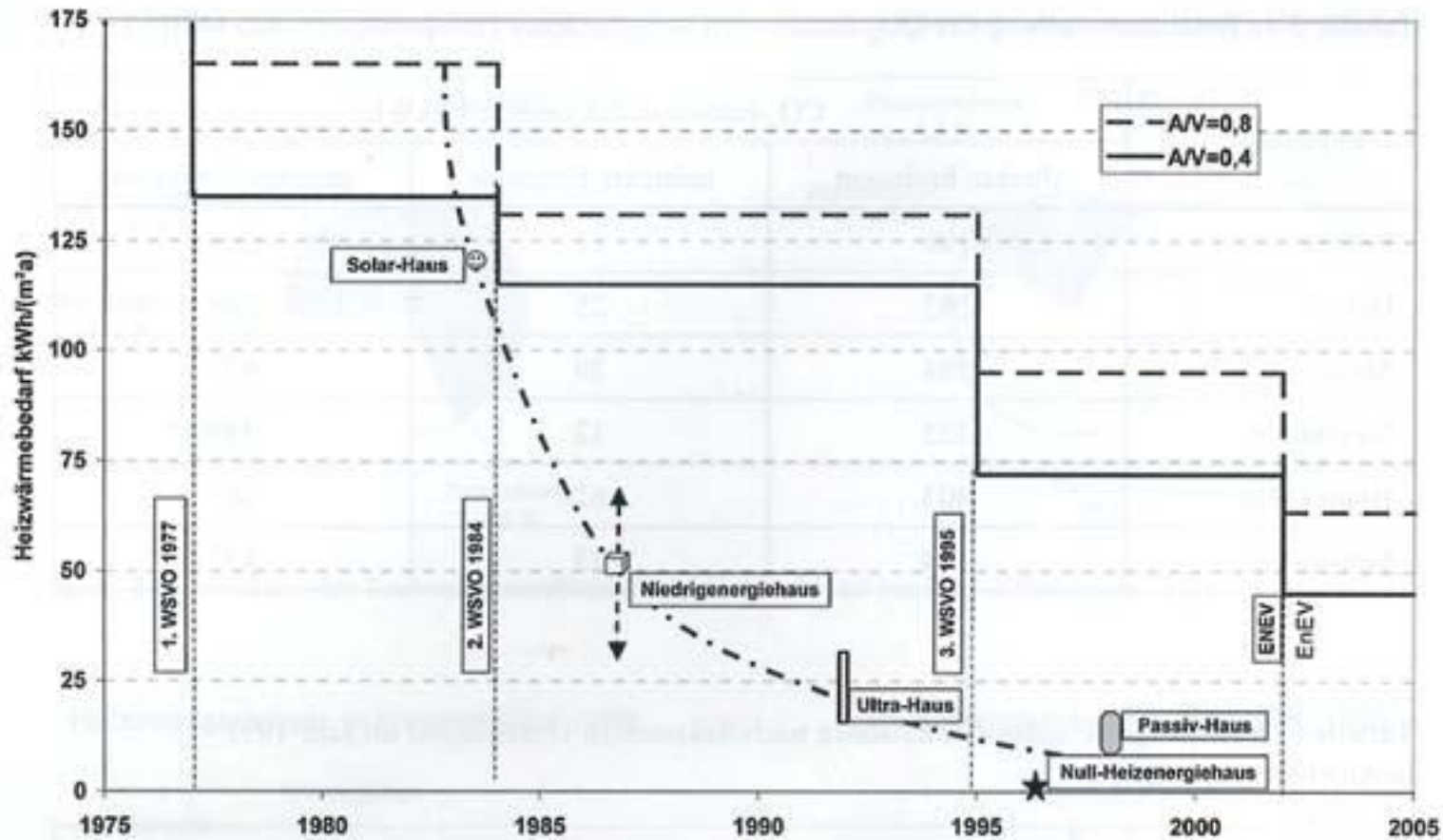
~ 1903 = 26l/m²a



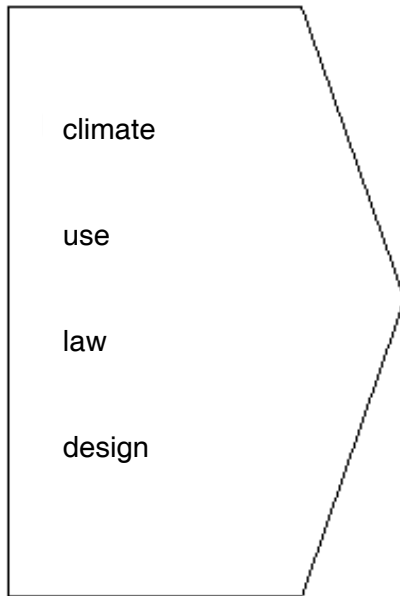
~ 1969 = 23l/m²a



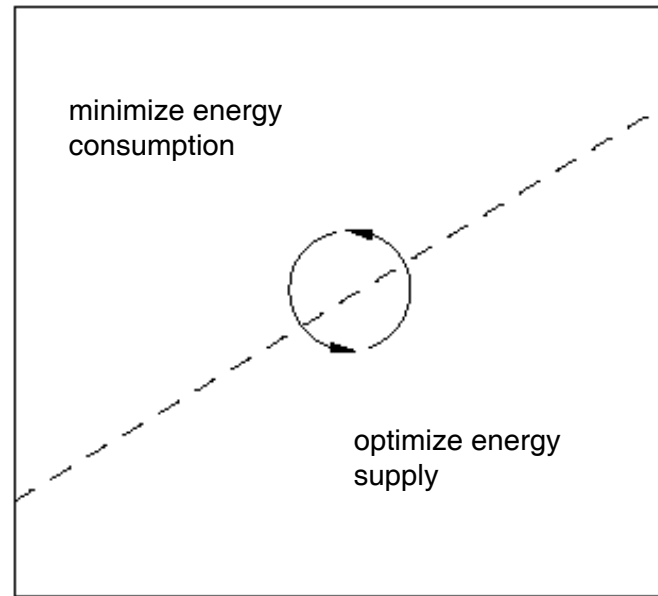
> Energy-Efficient
Design



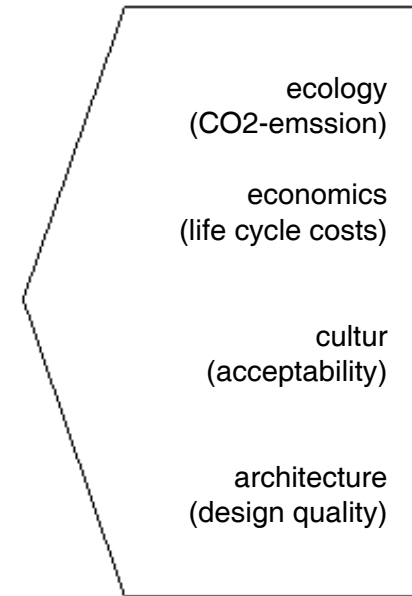
boundary conditions



energy optimized building concept



evaluation



	minimize energy consumption (building shell)	optimize energy supply (tech. equipment)
heating	conserve thermal energy	efficiently gain and storage thermal energy
cooling	avoid overheating	use efficient cooling
lighting	use natural lighting	optimize artificial lighting
ventilation	use natural ventilation	use efficient mechanical ventilation
energy	conserve electric energy	decentralize energy production use renewable energy

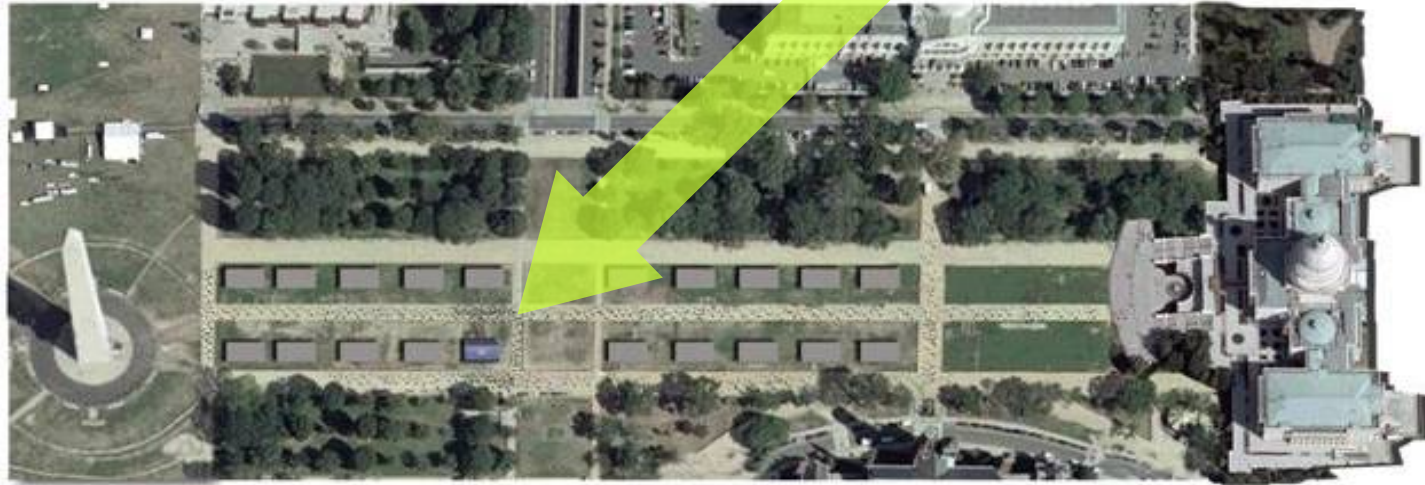
energy efficiency

renewable energy

> State Of The Art -
Example Projects

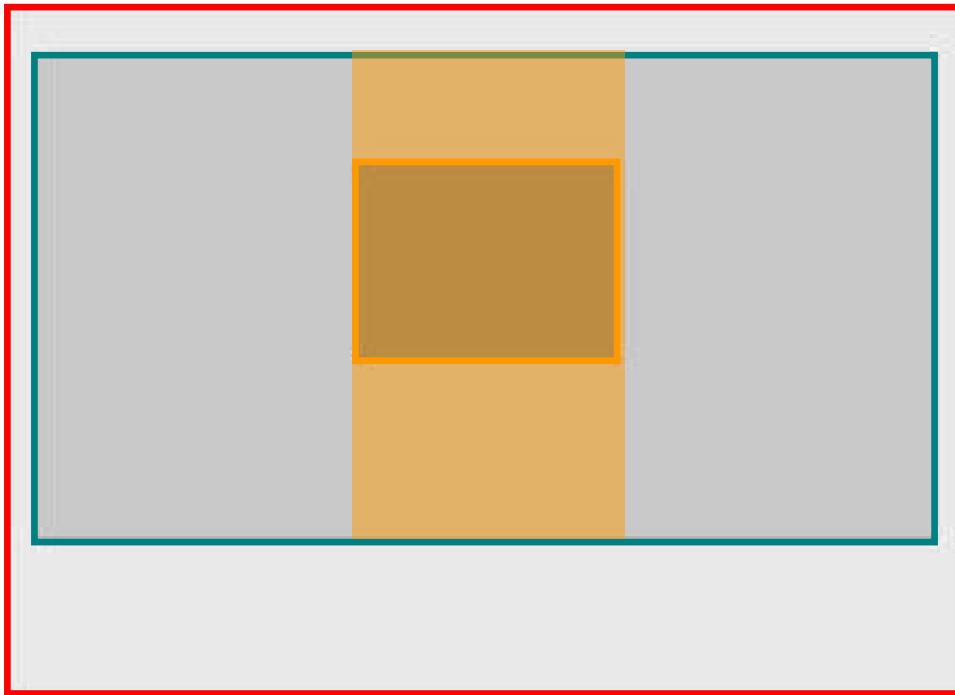
**> Plusenery Home
Solar Decathlon 2007**

The Competition

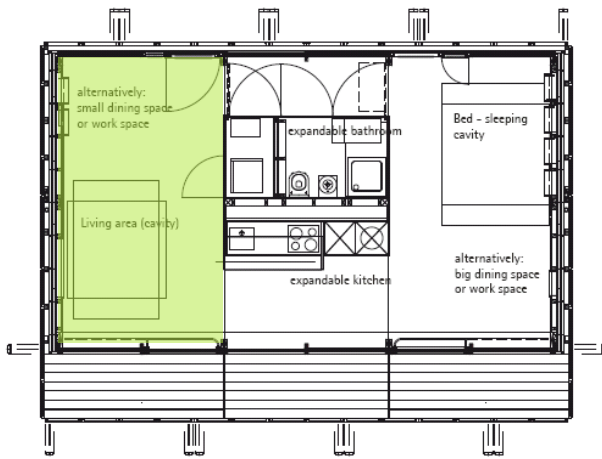


- ... International University Competition
- ... U.S.Department of Energy
- ... 3rd time after 2005 and 2002
- ... „Year 2015 Prototype Home“

- ... German Innovation, Research and Design
- ... National Mall, Washington D.C.
- ... 150.000 visitors



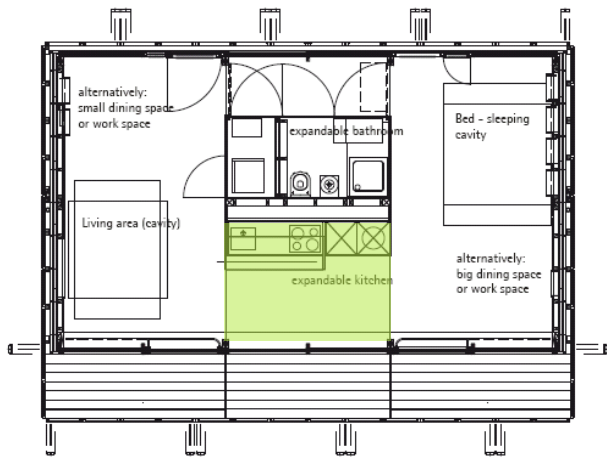
- principle of layers
- core
- platform



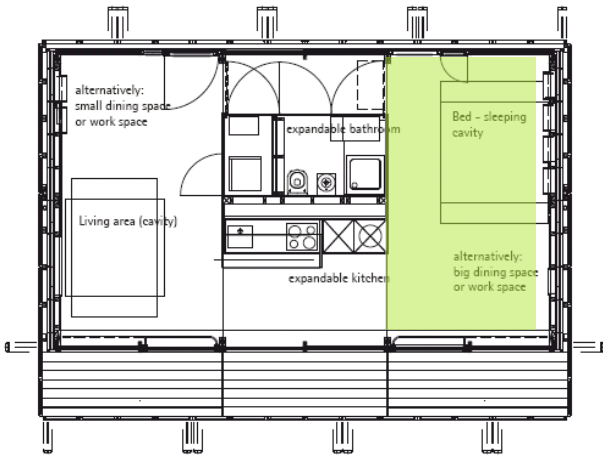
working space



living area



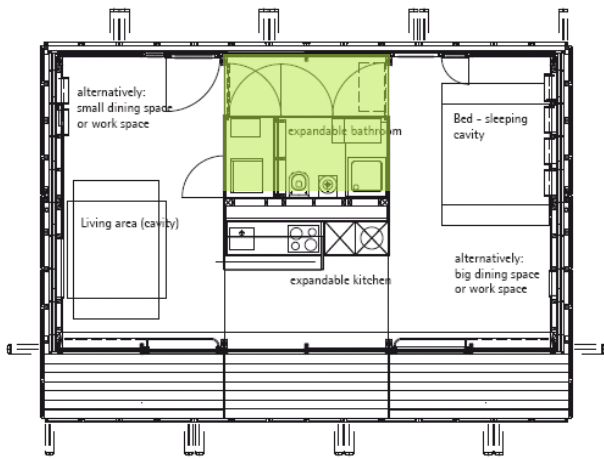
kitchen



bed

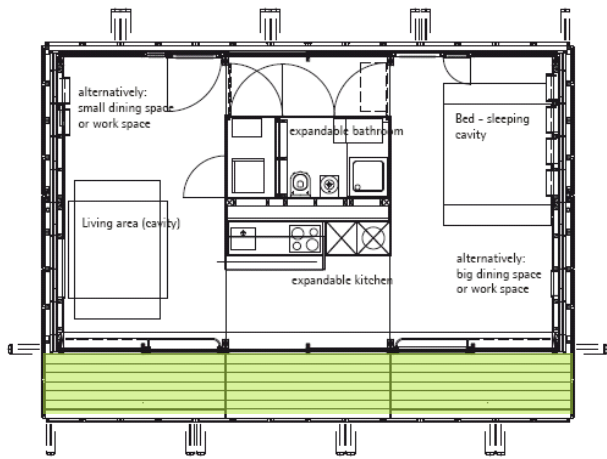


dinner table



barroom





porch

Passive Technologies



Active Systems

Passive Technologies





Passive Technologies

. compact building





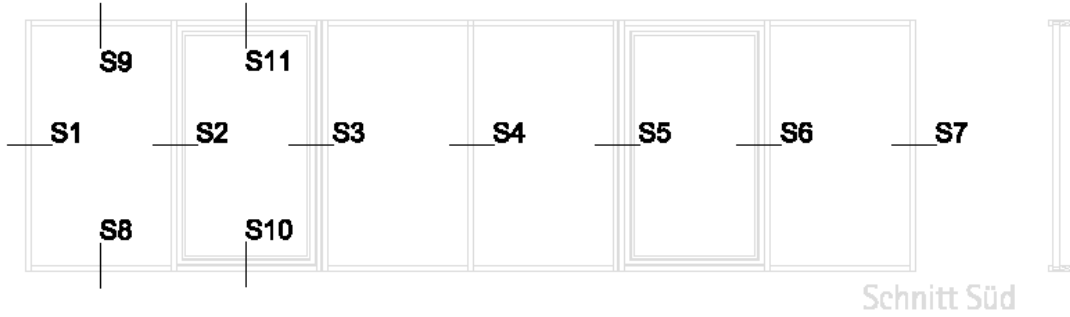
Passive Technologies

- . compact building
- . highly insulated shell



Außenansicht Süd

triple glazing – U-value: 0,5 W/m2K

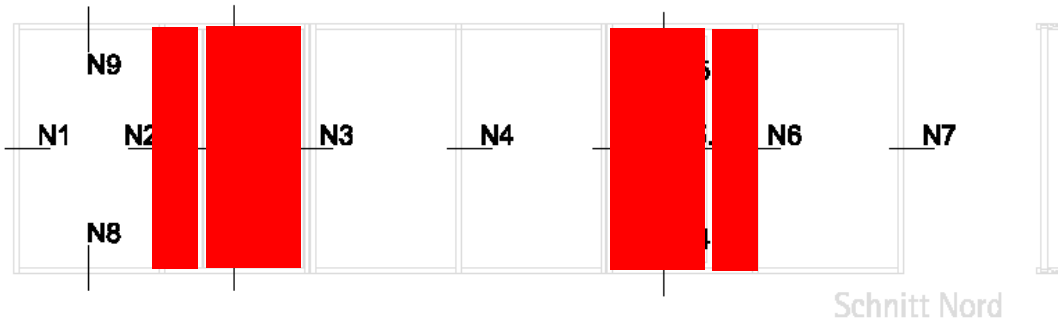


Grundriss Süd



Außenansicht Nord

quadruple glazing – U-value: 0,3 W/m2K



Grundriss Nord

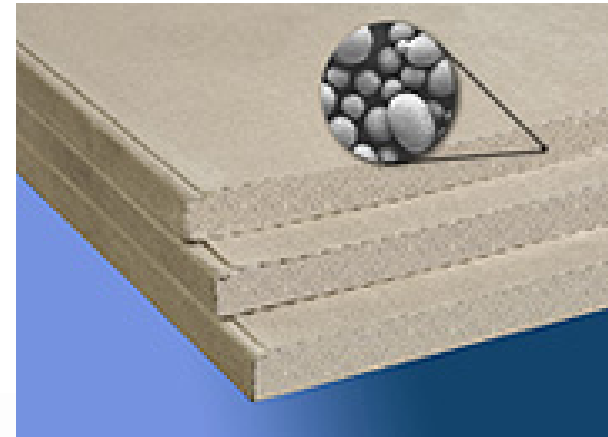




Passive Technologies

- . compact building
- . highly insulated shell
- . **Overheating protection, passive solar gains**





Passive Technologies

- . compact building
- . highly insulated shell
- . Overheating protection, passive solar gains
- . **thermal mass through Phase Changing Materials**

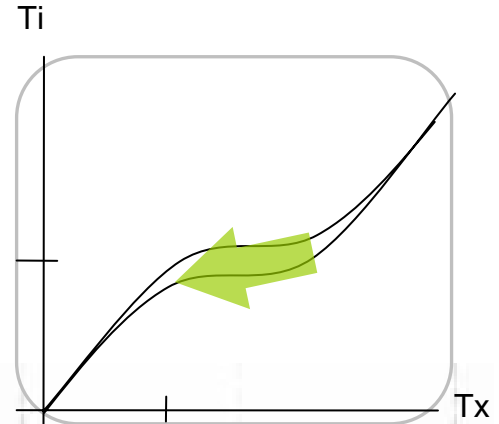




Passive Technologies

- . compact building
- . highly insulated shell
- . Overheating protection, passive solar gains
- . thermal mass through Phase Changing Materials
- . **nightly cross ventilation**



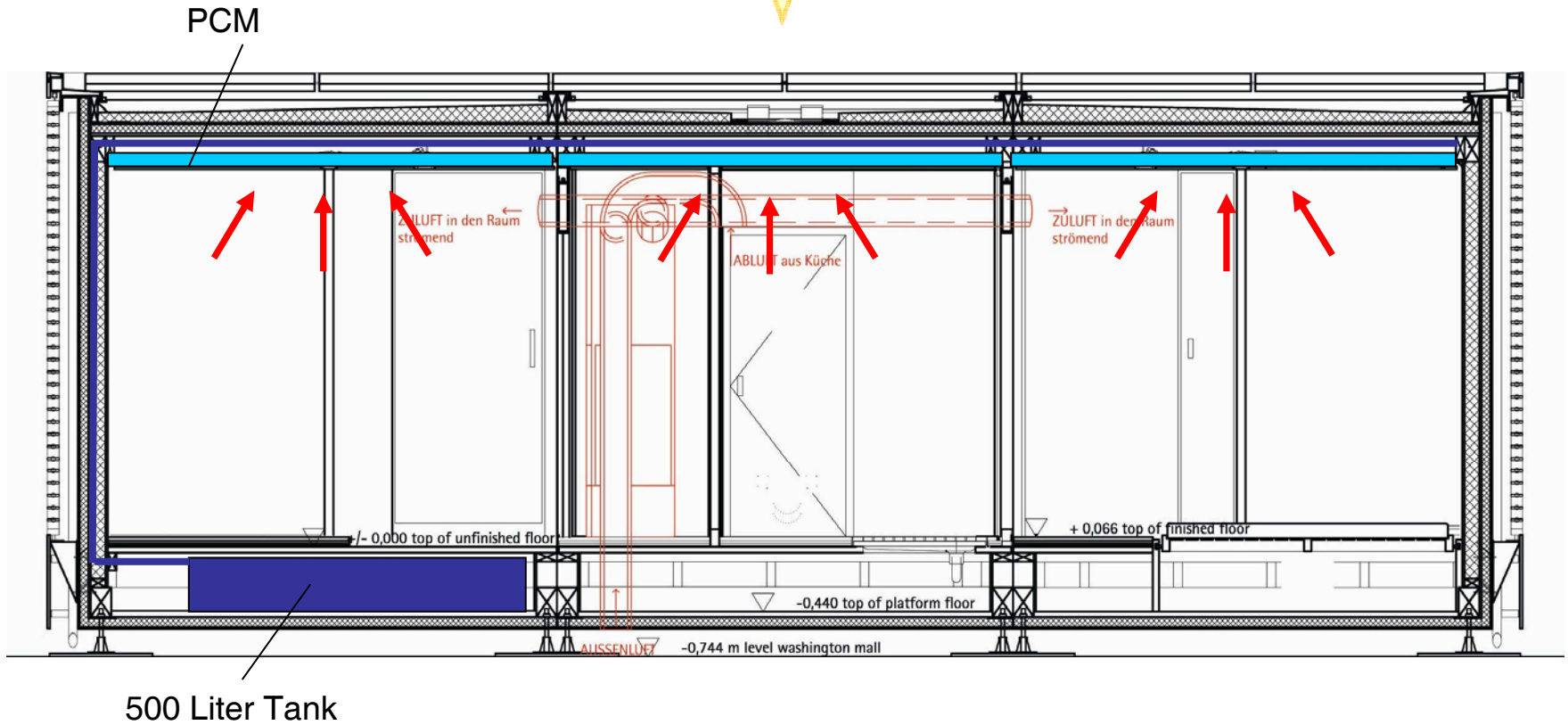
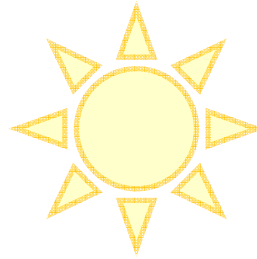


Passive Technologies

- . compact building
- . highly insulated shell
- . Overheating protection, passive solar gains
- . thermal mass through Phase Changing Materials
- . nightly cross ventilation
- . **passive cooling system**







Active Systems

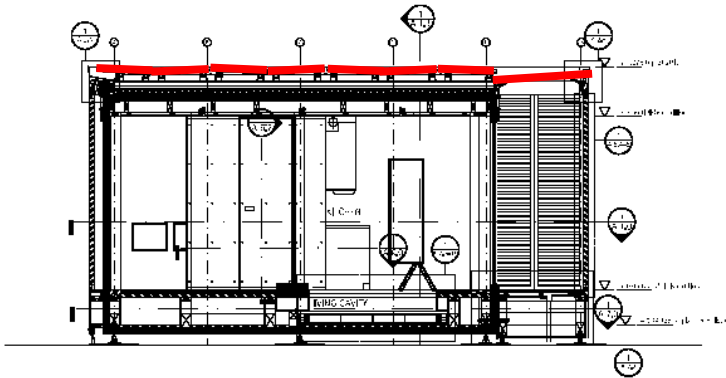




Active Systems

. photovoltaic-modules





Roof:

40 Sunpower SPR-215 moduls
3° angle – flat roof integration

performance: 9kWp

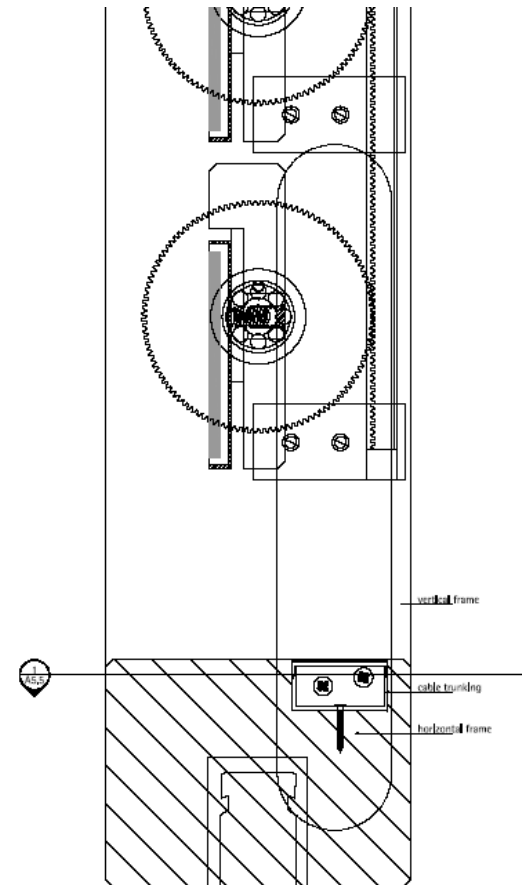
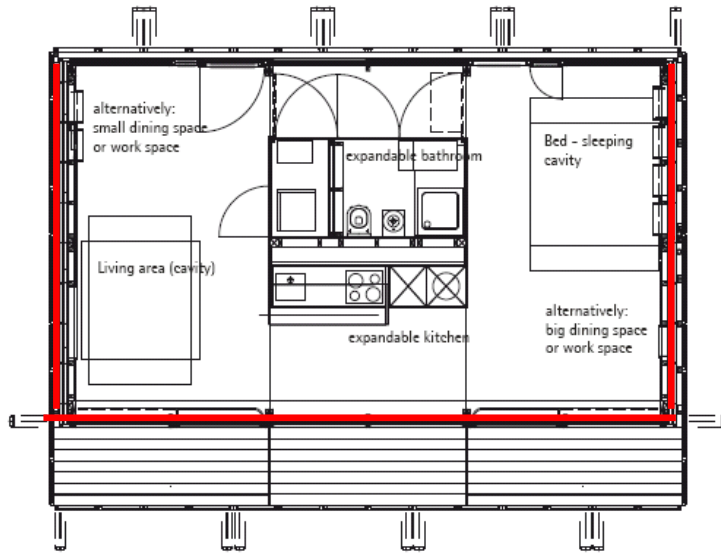


Porch:

6 Scheuten glas-glas-moduls with
transparent PV-Cells

Sunscreen, weather protection & energy gain

performance: 2kWp



- total: 48 frame elements / 1488 lamellae
- with PV: 34 frame elements / 1054 lamellae
- performance: east/west: 0,5 kWp, south 1kWp

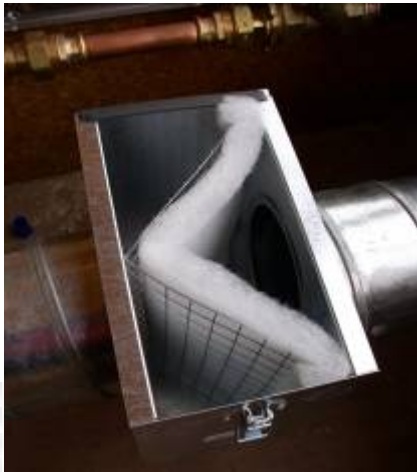


Active Systems

. photovoltaic-modules

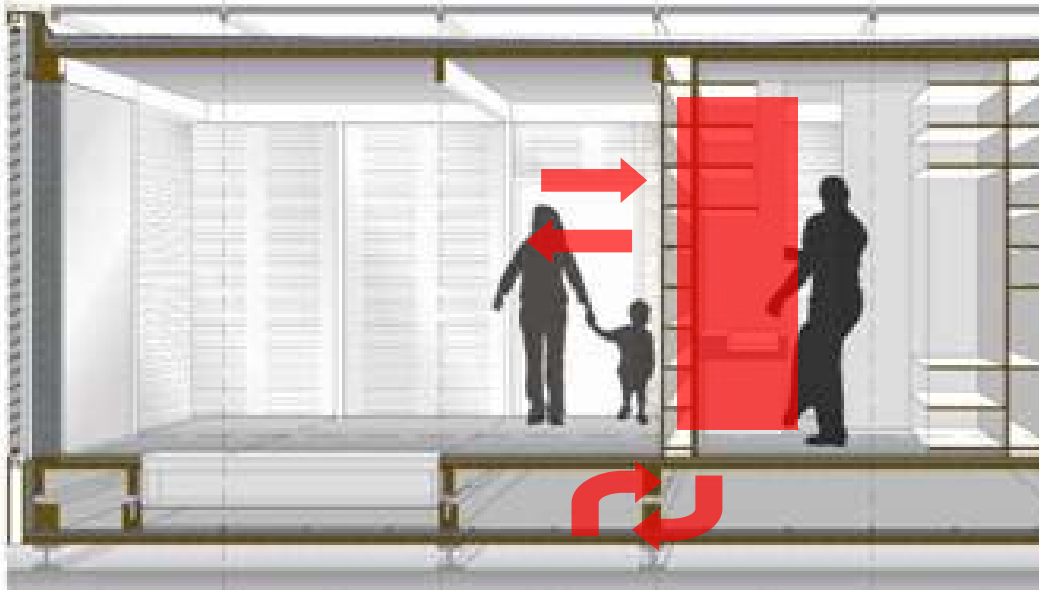
. solarthermal collectors





Active Systems

- . photovoltaic-modules
- . solarthermal collectors
- . compact device, heat pump, heat storage tank, heat recovery





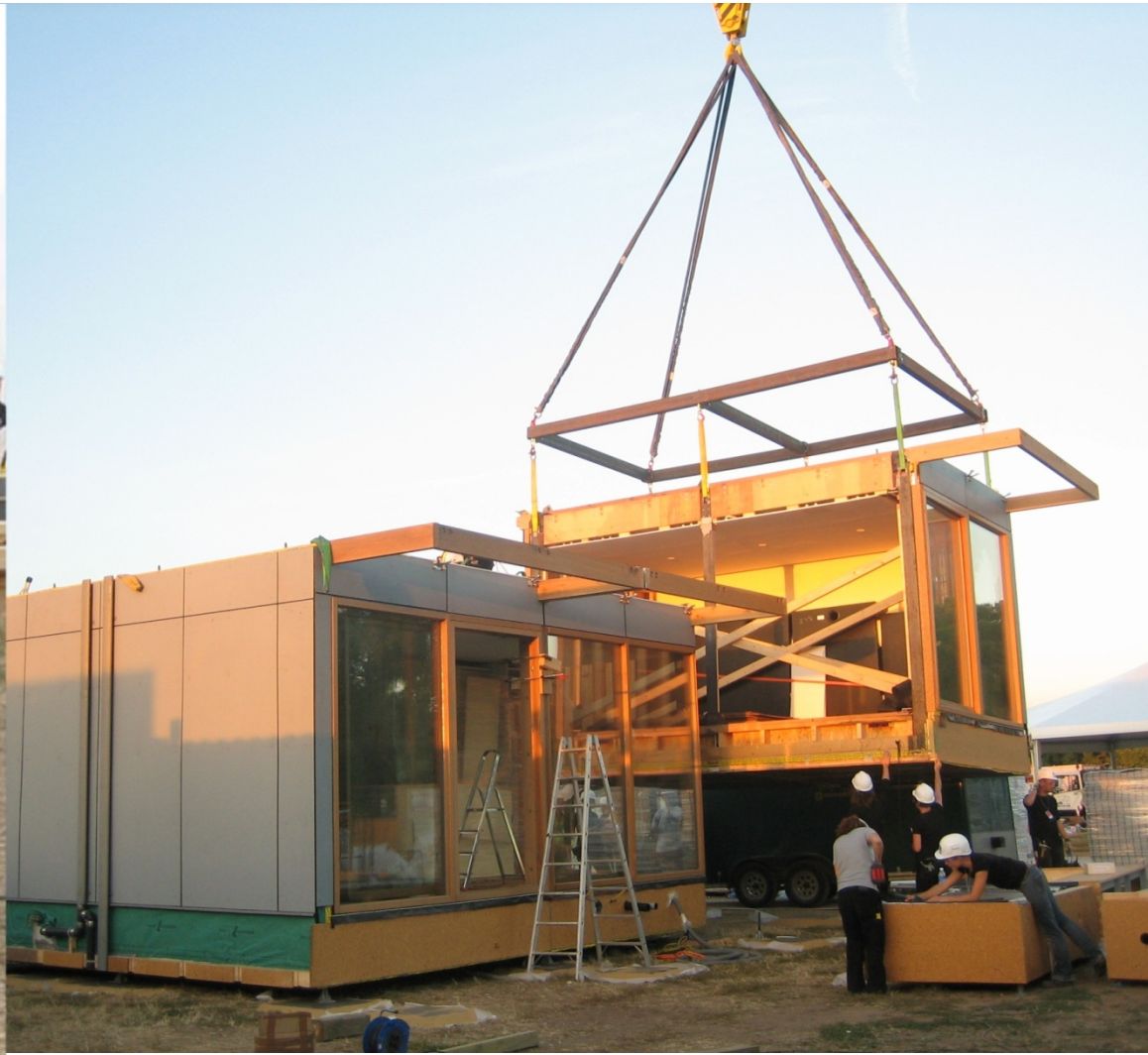
Active Systems

- . photovoltaic-modules
- . solarthermal collectors
- . compact device, heat pump, heat storage tank, heat recovery
- . energy-efficient appliances



Active Systems

- . photovoltaic-modules
- . solarthermal collectors
- . compact device, heat pump, heat storage tank, heat recovery
- . energy-efficient appliances
- . **energy-efficient lighting**







> Minimum Impact House



DREXLER GUINAND JAUSLIN ARCHITEKTEN

INTRO NACHHALTIGKEIT

PROTOTYPE BUILDING PROJECT TARGETS:

Urban Densification

- reduce land use
- safe natural environments
- reducing investments for infrastructure
- reinforcing social structure in the cities

Low Energy Consumption

- reducing global warming
- improve comfort for inhabitants
- energy efficiency
- renewable energy

New Typology of Residential Houses

- spatial efficiency
(make small spaces feel great)
- flexibility
- vertical organisations

Design

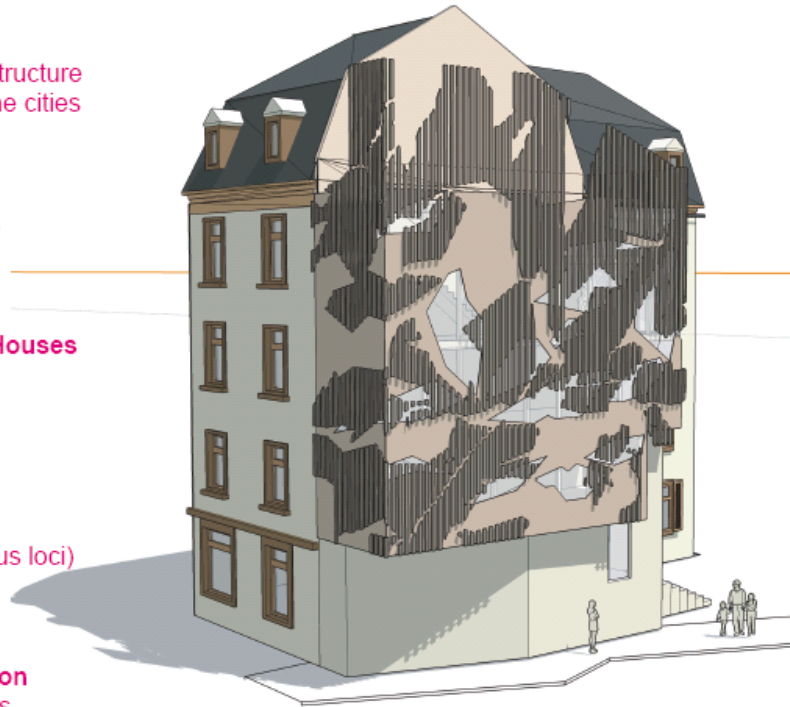
- creating a spatial identity (genius loci)
- telling the story of the place
- giving sustainability a new look

Innovative Building Construction

- fire resistant timber constructions
- renewable primary products
- reduce energy content of building
- recycling
- water management
- supporting local economy
- supporting forestry
- protection of forests

Waste Water Free House

- reducing water consumption
- stabilizing hydrological cycle
- improving micro and macro climate



RESEARCH AND DEVELOPMENT SCIENTIFIC EVALUATION:

Urban Studies

- estimates for potential land savings
- potential for redensification
- comparing urban infrastructure

Life Cycle Analysis

- energy consumption of construction
- optimizing construction project

Energetic Simulation

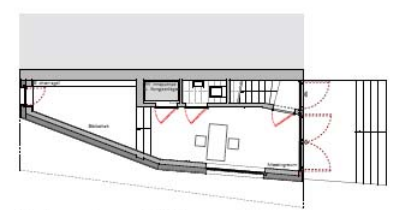
- analysis of energy consumption
- energy efficiency: design by simulations
- passive solar design
- monitoring operation:
 - heating system
 - warm water
 - electric appliances
 - passive energy

Comparative Studies

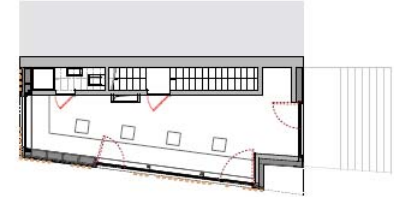
- comparison with conventional techniques
- comparison of energy content
- comparative simulation

Development of Building Technology

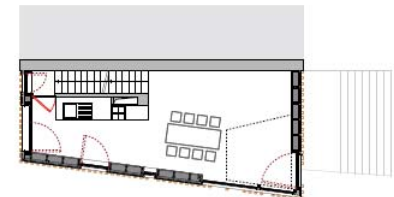
- fire protection concepts for building
- fire resistant timber
- long lasting timber constructions



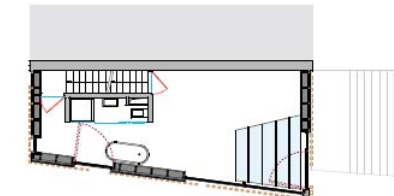
Erdgeschoss: Minihaus



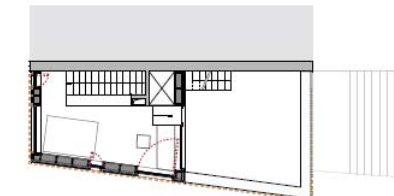
1.OG: Büro



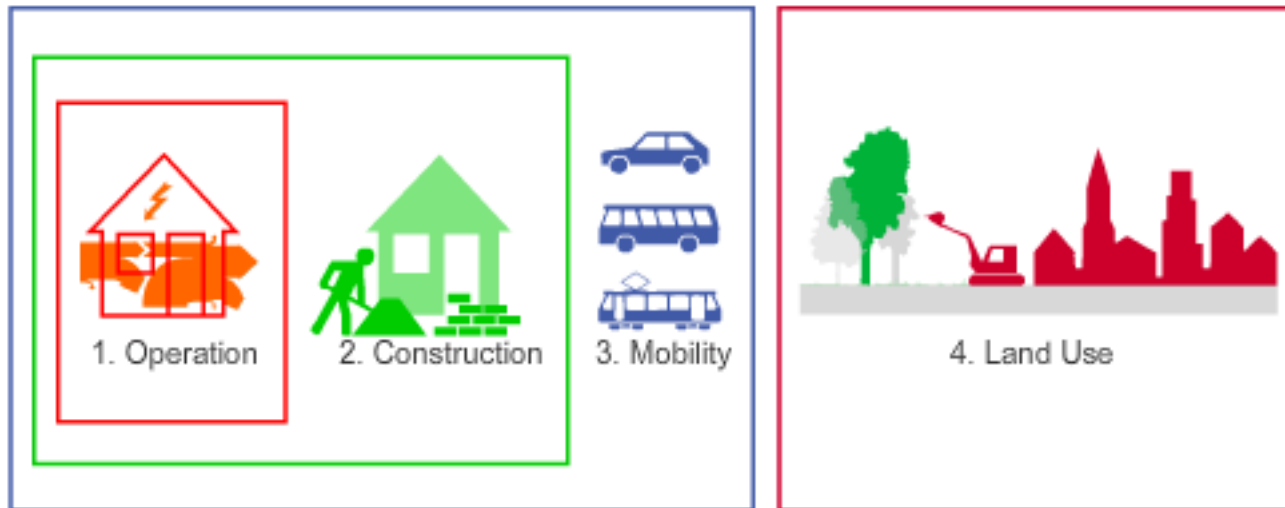
2.OG: Küche und Wohnen



3.OG: Bad und Schlafen



4.OG: Schlafen



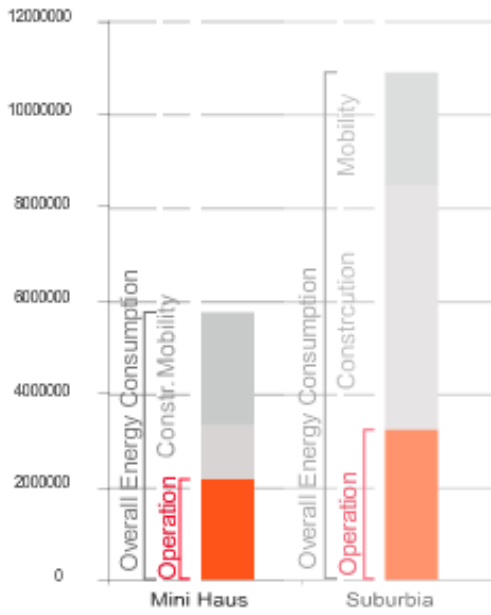
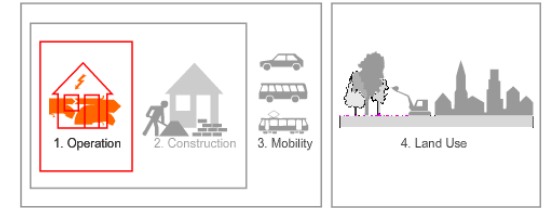
369'000,-*



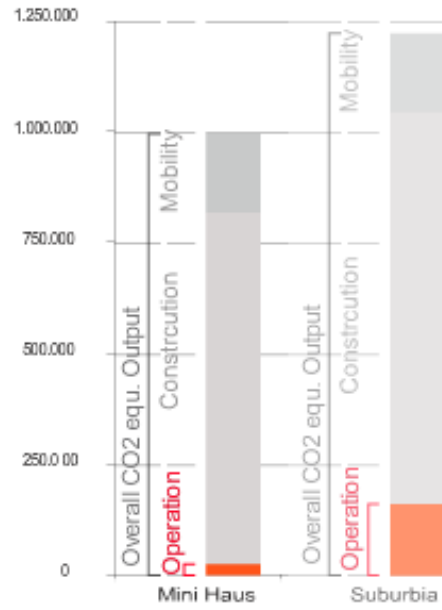
Minihaus Sachsenhausen *inkl. MWST und Grundstück



Sabina Riedberg *inkl. MWST und Grundstück



ENERGY [MJ]



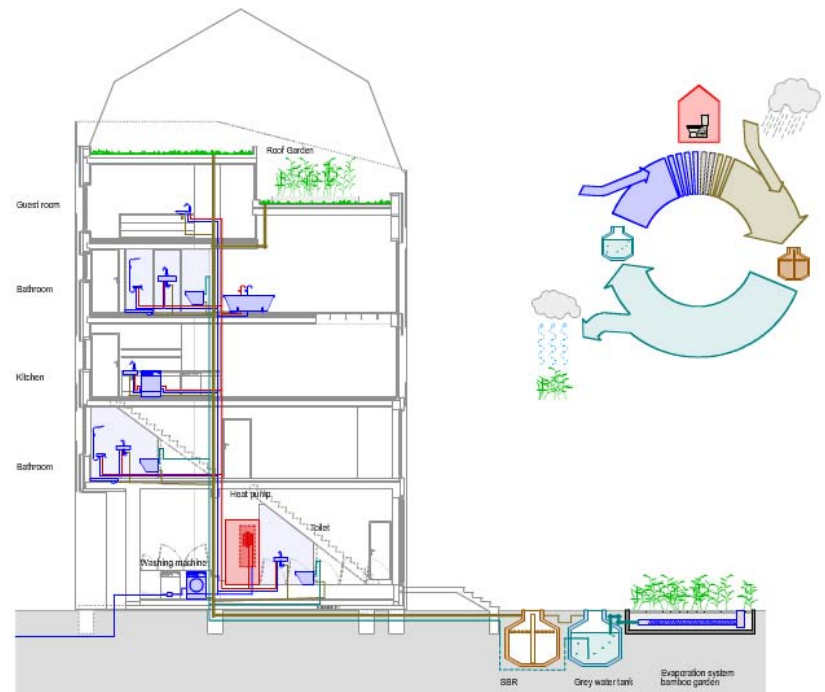
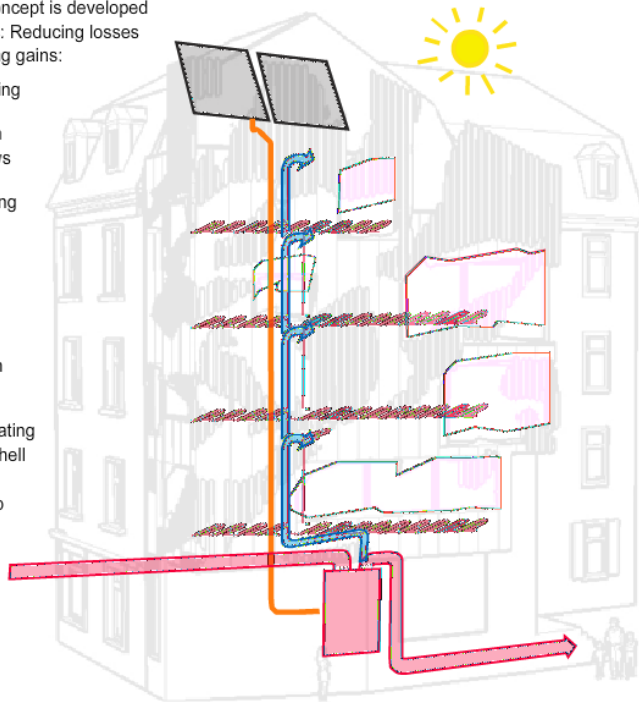
CO2-Output GWP [kgCO2eq]

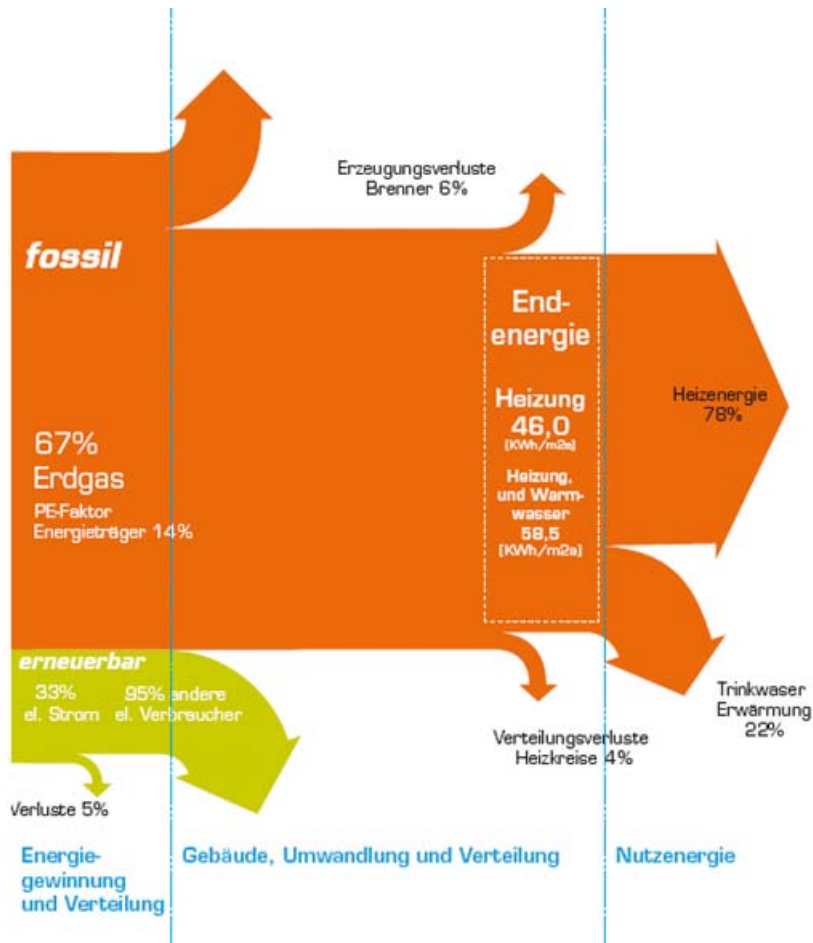
- M: Mobility
- M: Construction
- M: Running

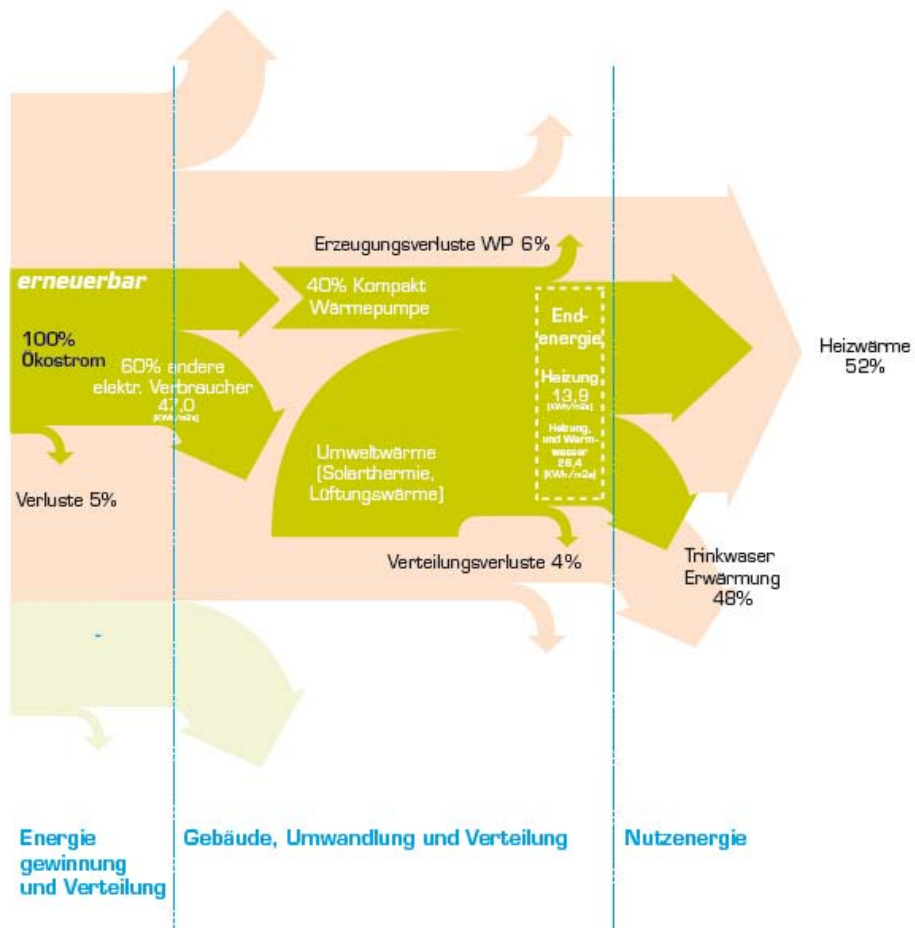
ENERGY CONCEPT: ENERGY SUPPLY SYSTEM

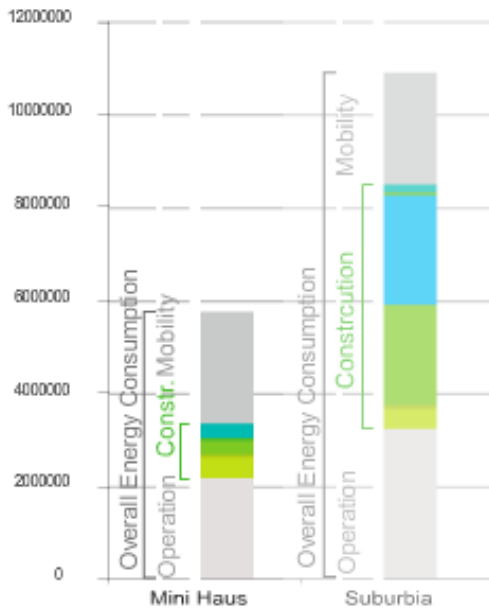
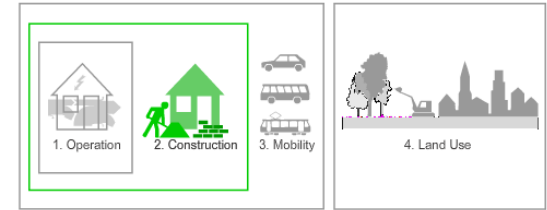
The energy concept is developed along two axis: Reducing losses and maximising gains:

- solar heating
- orientation of windows
- floor heating
- controlled ventilation
- highly isolating building shell
- heat-pump

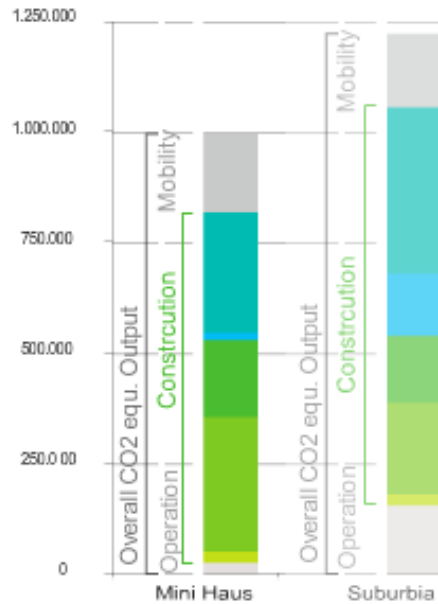






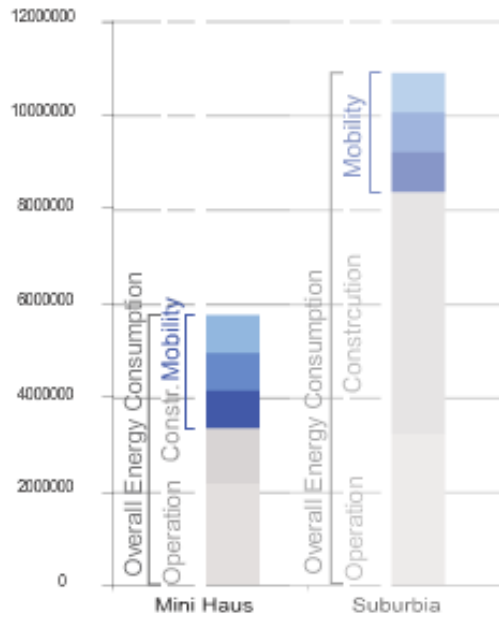
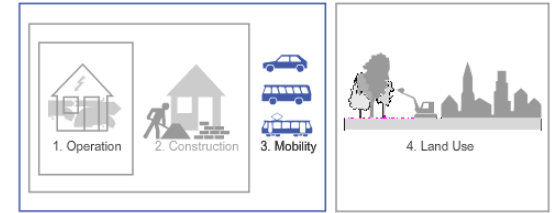


ENERGY [MJ]

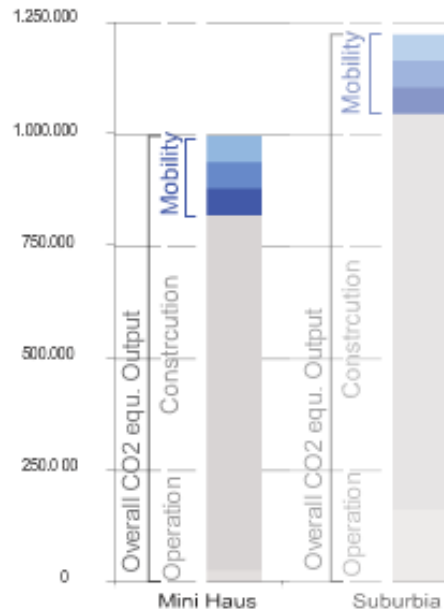


CO2-Output GWP [kgCO2eq]

- Module 3: Mobility
- Exterior walls
- Inner walls
- Foundation
- Ceilings
- Roof
- Technical equipment
- Module 1: Running



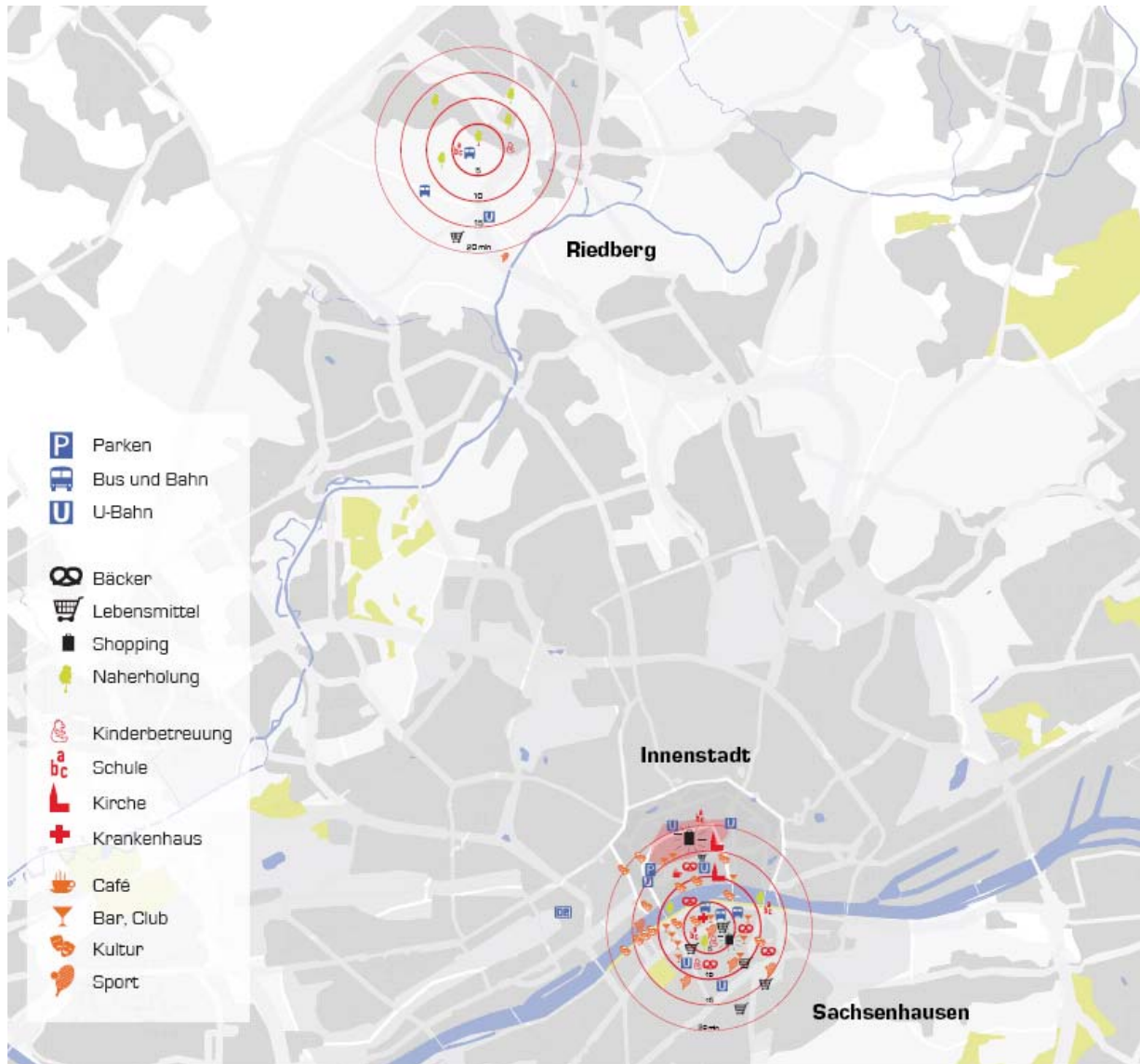
ENERGY [MJ]

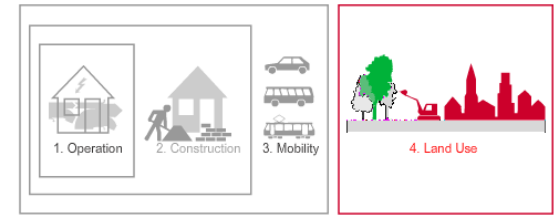


CO2-Output GWP [kgCO2eq]

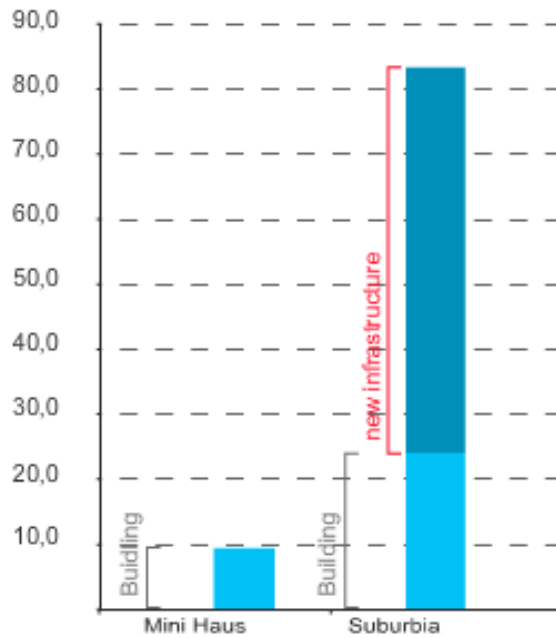
- M: Mobilität bei 5.000 km/a
- M: Mobilität bei 10.000 km/a
- M: Mobilität bei 15.000 km/a

- M: Herstellung
- M: Betrieb

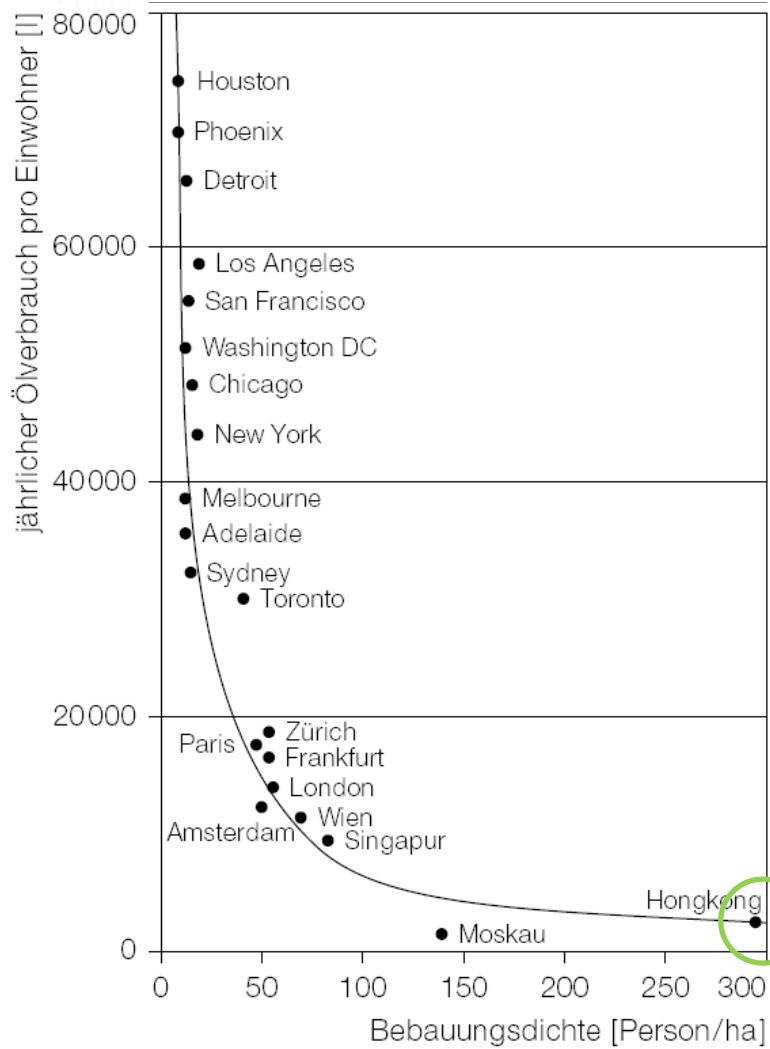




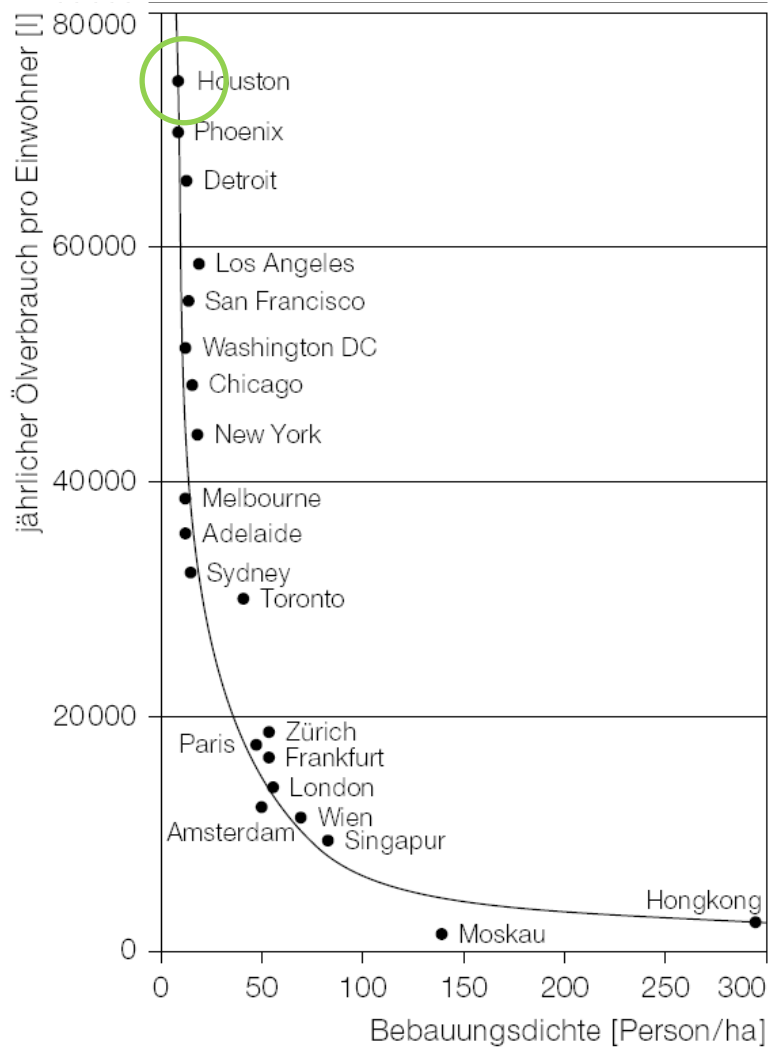
Land Use per head [m²]



- Land use for infrastructure
- Land use for building



Quelle: Energie Atlas; Hegger et. al.; 2007



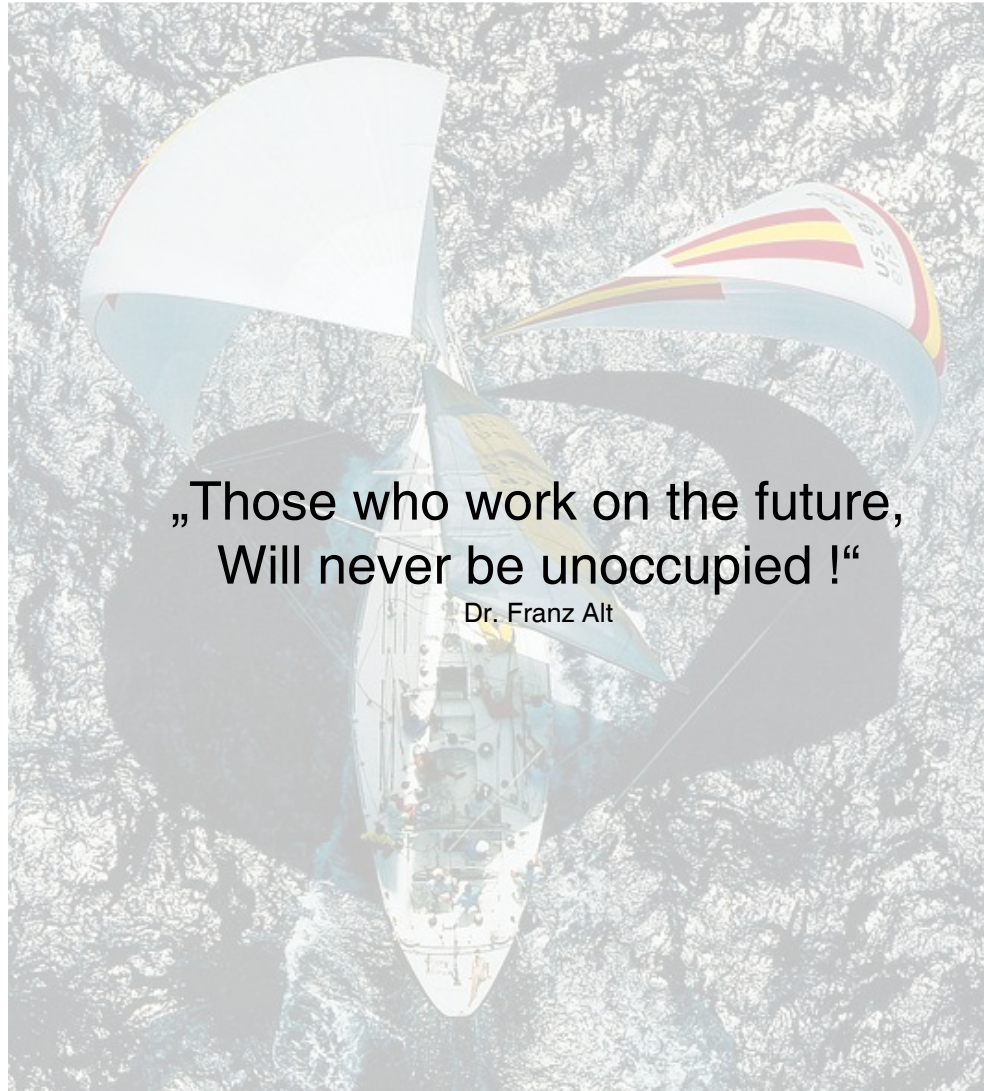
Quelle: Energie Atlas; Hegger et. al.; 2007





> **Résumé**





„Those who work on the future,
Will never be unoccupied !“

Dr. Franz Alt



Thank you for your attention.

Dipl.-Ing. Isabell Schäfer
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Fachbereich Architektur
Technische Universität Darmstadt
ischaefer@ee.tu-darmstadt.de