EnOB
Forschung für Energieoptimiertes Bauen

Karlsruher Institut für Technologie

From Buildings to Neighbourhoods and Cities
Research on Building Energy Efficiency in Germany

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with acknowledgement to

all contributions of researchers from the different universities and research institutions involved in the research programs to be presented here

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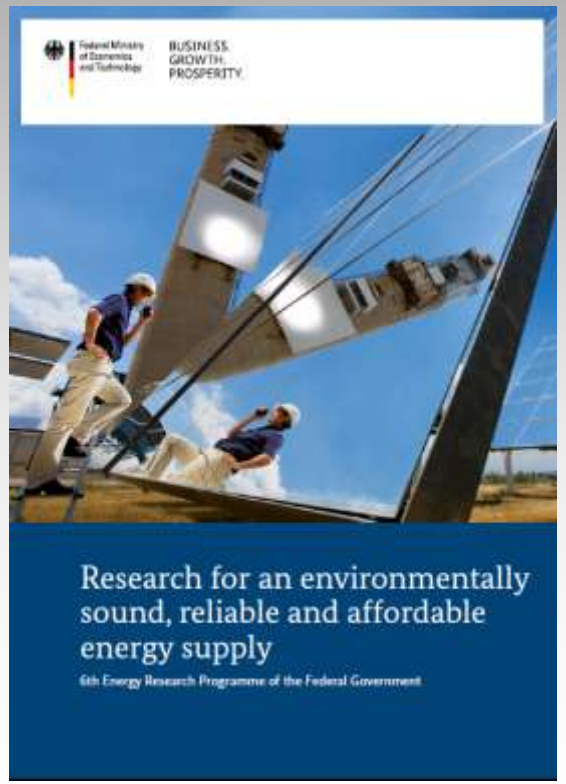
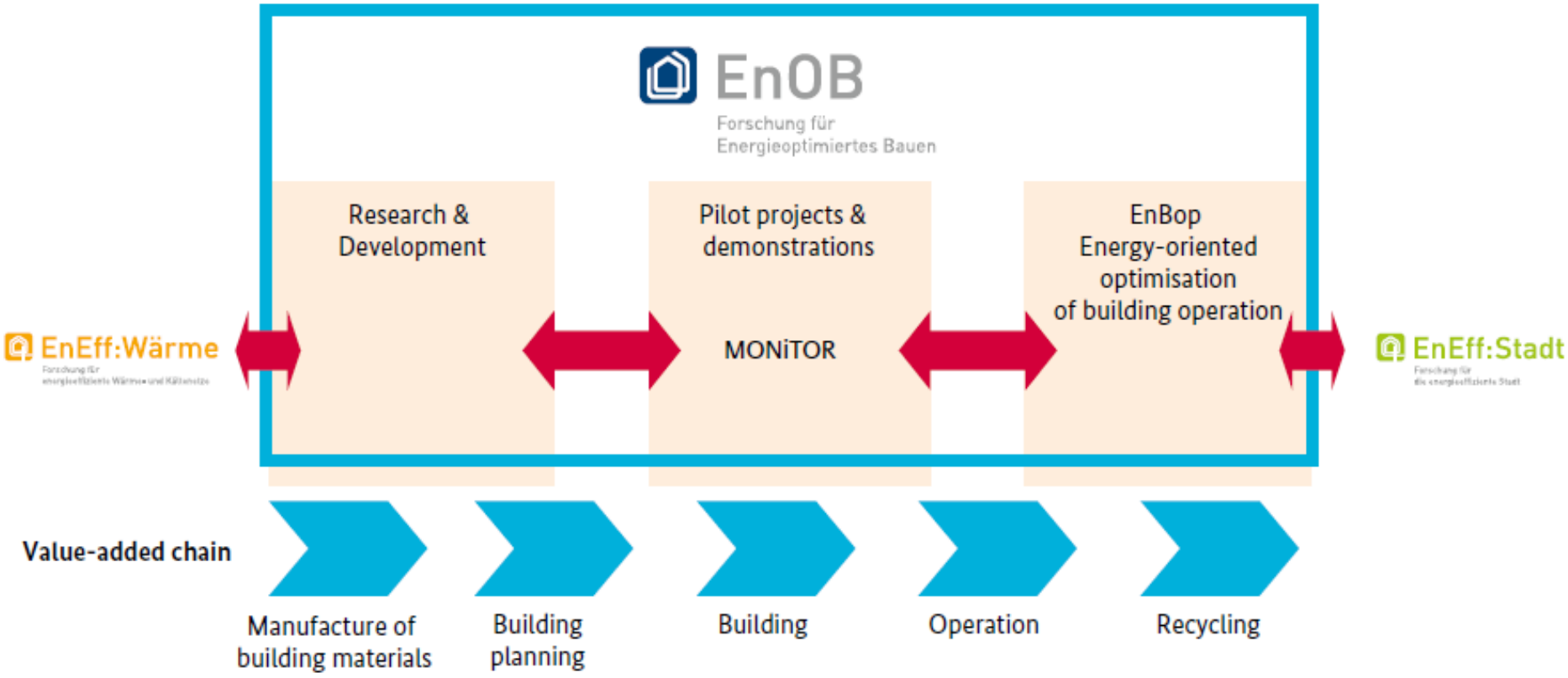
Content

- German research programs on building energy efficiency
- Innovative building technologies and performance of demonstration buildings
- Energy efficiency on the urban scale – actors and process implementation
- Pilot projects in EnEff:Stadt
- Conclusions and outlook



Structure of the German research program EnOB



Source: BMWi

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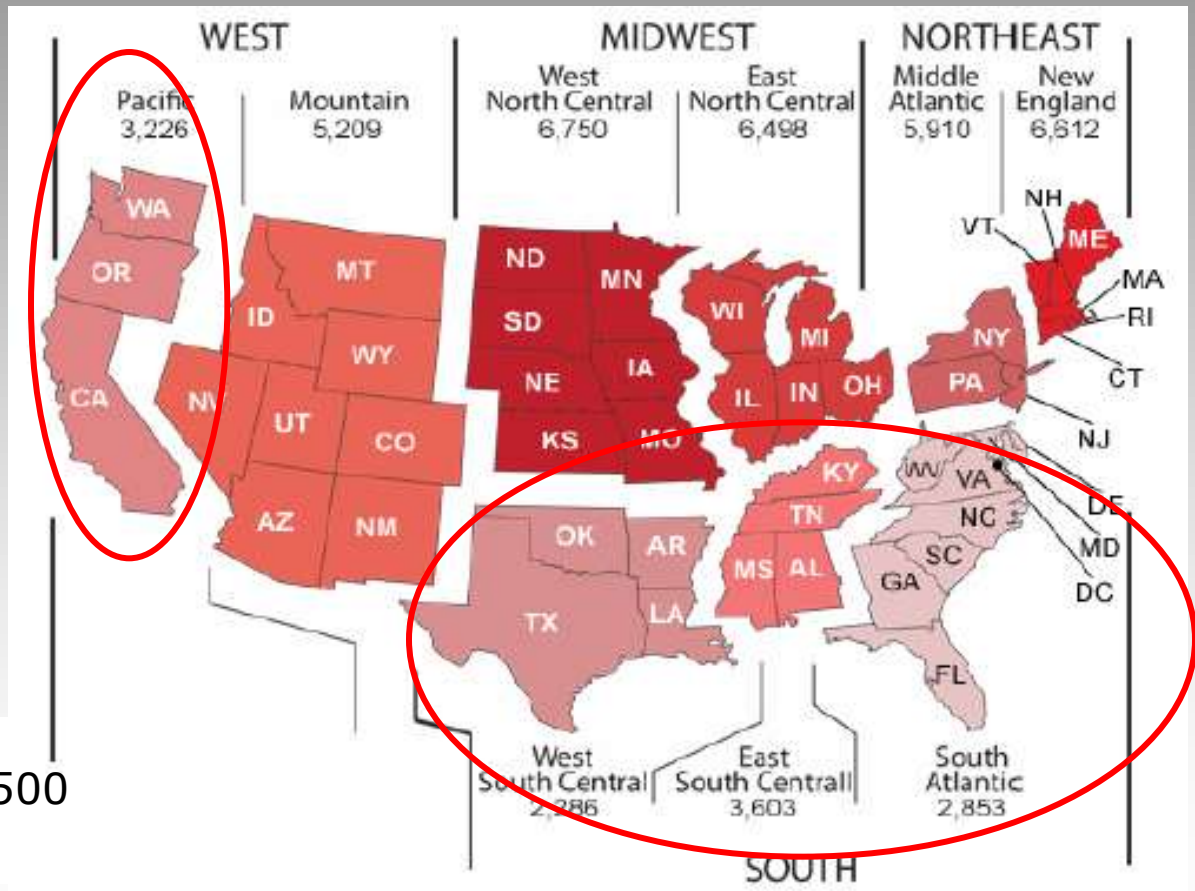
Energy performance analysis of demo buildings: Comparison of German and US climate

Heating degree days
by census region

based on 65°F (18.3°C)



Germany:
approx. 2300 < HDD18 < 3500

Source: Energy Information Administration (2008)

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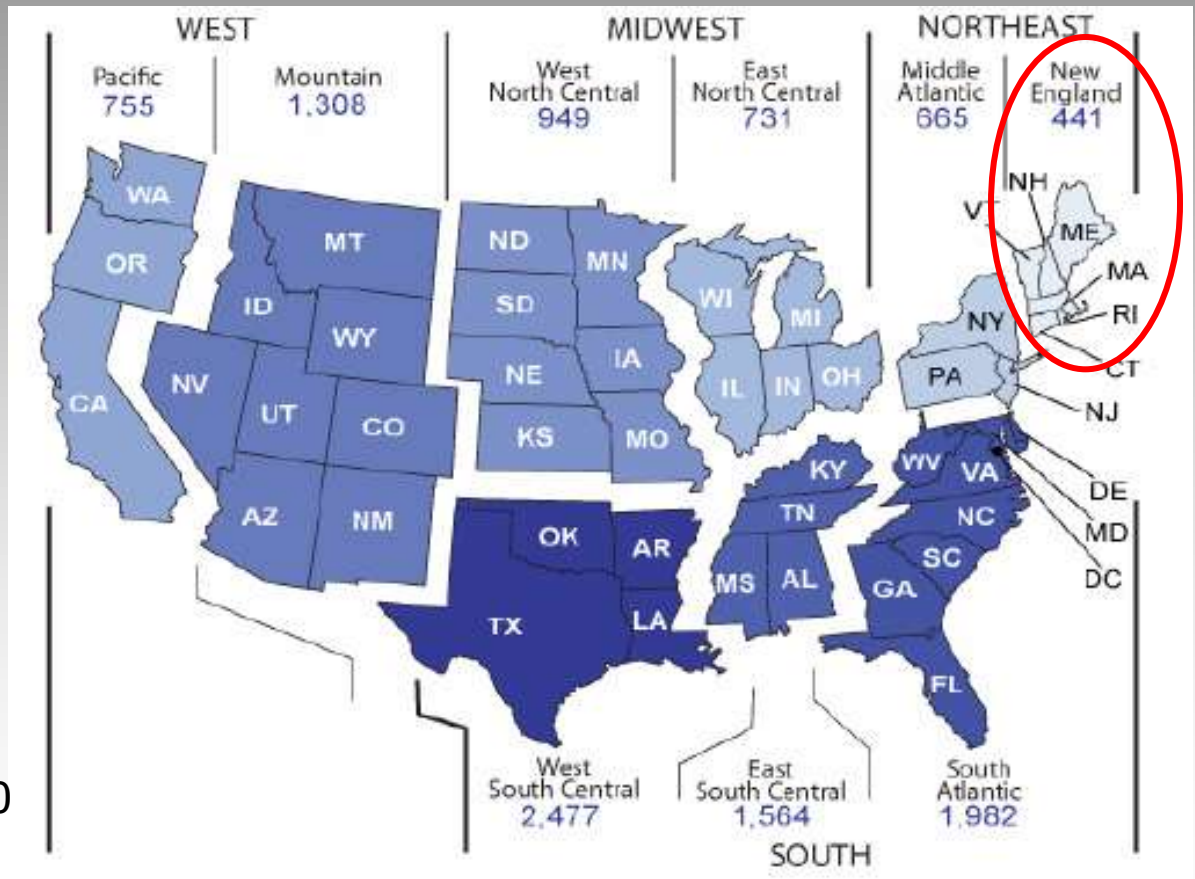
Comparison of German and US climate

Cooling degree days by census region

based on 65°F (18.3°C)



Germany:
approx. 170 < CDD18 < 450

Source: Energy Information Administration (2008)

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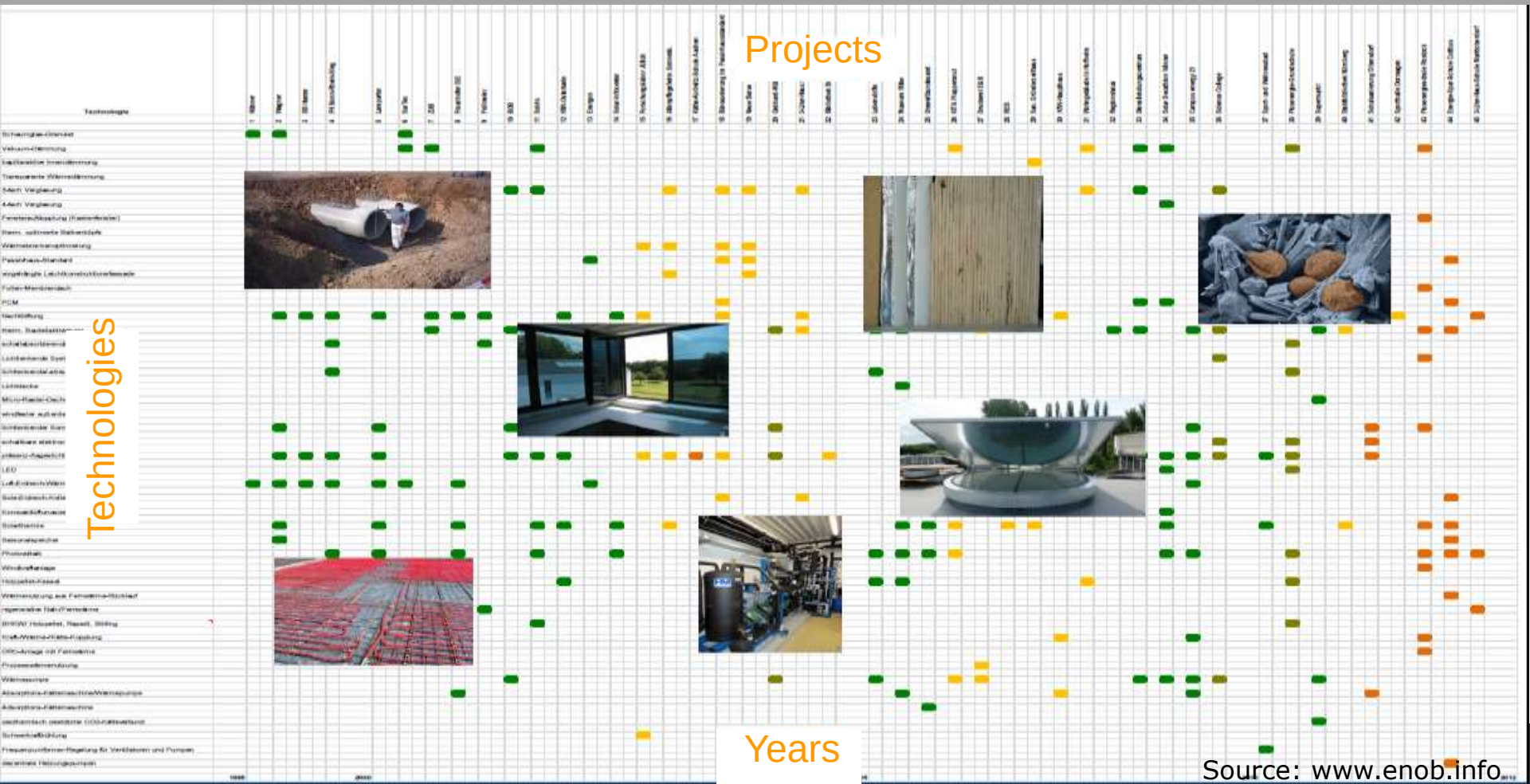
Applied building technologies



Source: www.enob.info

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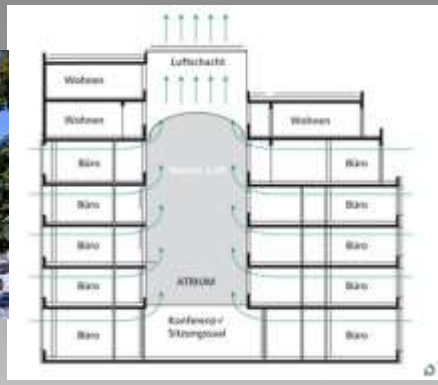
Insulation standard

- Introduction of passive house standard in non-residential buildings between 1995 – 2000 (new facade technologies), new buildings and refurbishment

- Vacuum insulation from single elements to pre-fabricated systems

Source: www.enob.info

Passive cooling



Different heat sinks:

- between 1995 and 2005 cooling with (natural) night ventilation …

- … then increased application of thermally activated concrete slabs connected to boreholes, earth piles or ground water
  also use of PCM technology

- until 2000 application of ground-to-air heat exchangers

Source: www.enob.info

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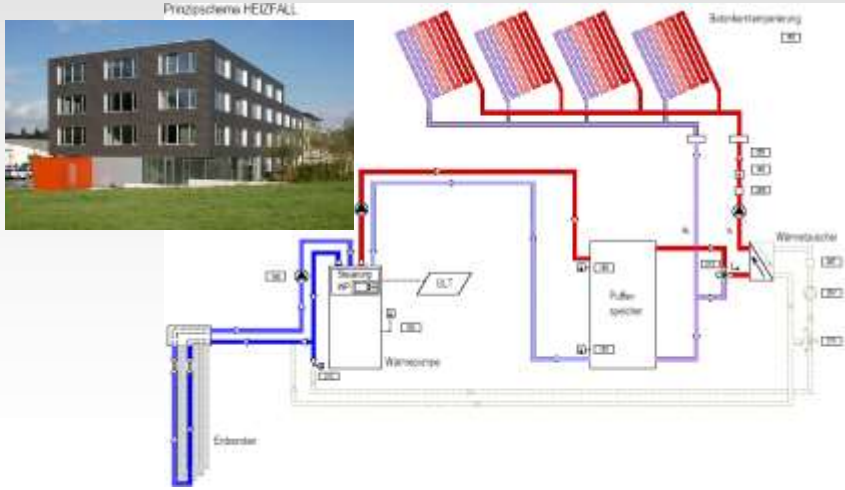
Lighting

- Application of shading systems with daylighting option
- Very often application of lighting control systems wirh presence detection and daylight-dependence

Energy Supply

- From 2005 on more heat pumps (synergy: ground as heat source and sink)
  → all-electricity buildings?



Source: www.enob.info

Residential care home for the elderly, Stuttgart

Source: www.enob.info

Architecture: Heckmann, Kristel, Jung, Stuttgart

Energy concept: ebök, Tübingen

Monitoring: Fraunhofer IBP, Stuttgart

Historical building „Kleine Freiheit“, Hamburg

Source: www.enob.info

Architecture: Dittert & Reumschüssel, Hamburg

Energy concept: innovaTec Energiesysteme, Ahnatal

Monitoring: Fraunhofer IBP

Plus-Energy School, Hohen Neuendorf

Architecture: IBUS Architekten und Ingenieure, Bremen

Energy concept: BLS Energieplan, Berlin

Monitoring: Hochschule für Technik, Berlin

ENERGON office building, Ulm

Source: www.enob.info

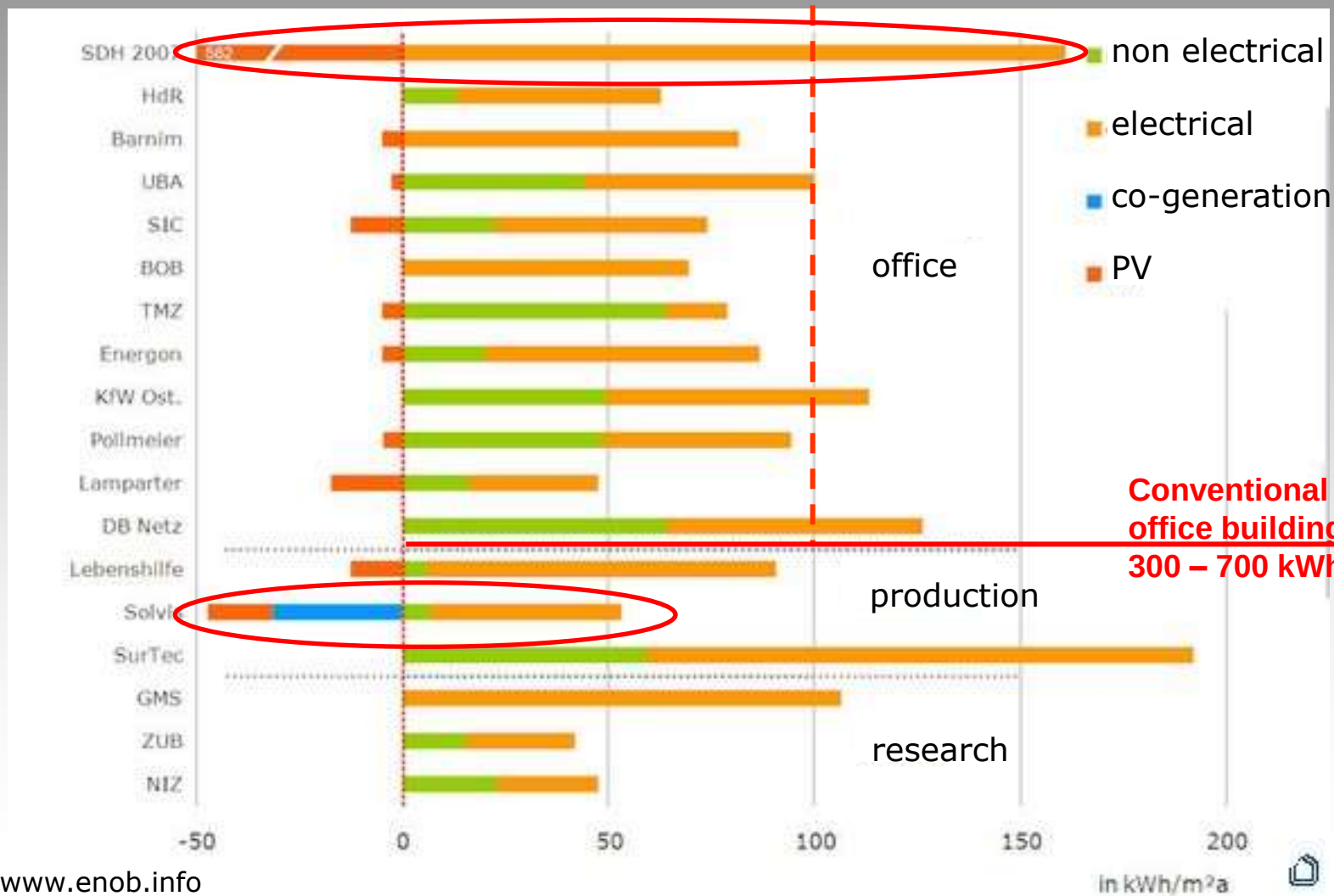
© Software AG Stiftung, Steinbeis-Transferzentrum Energietechnik

Architecture: oehler faigle archkom solar architektur, Bretten

Energy concept: ebök Ingenieurbüro, Tübingen

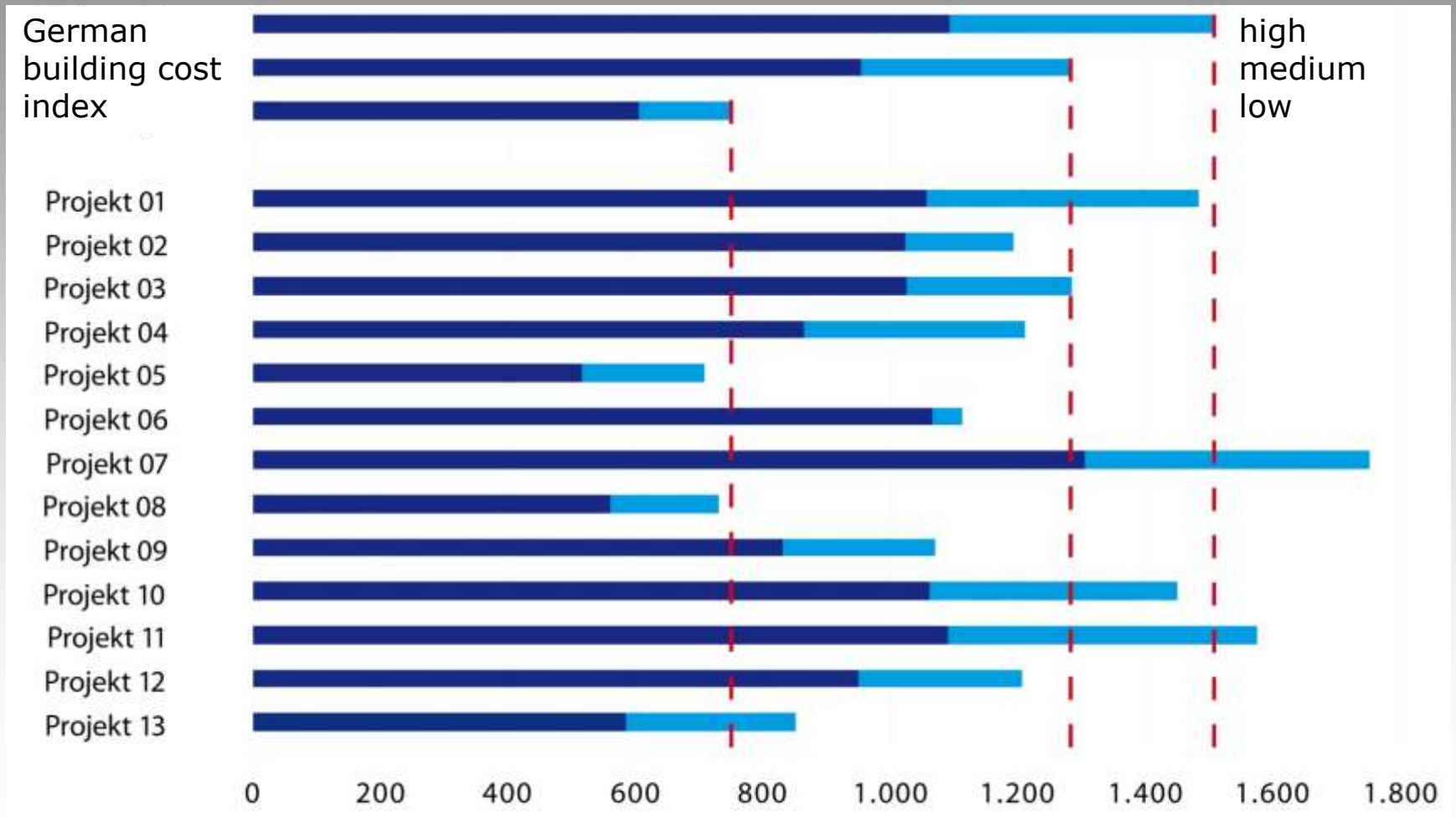
Monitoring: Steinbeis-Transferzentrum FH Ulm

Primary energy balance for HVAC+L (EnBau)



Source: www.enob.info

Investment costs (construction and technical services)



Source: www.enob.info

But:

How can we reach the EC targets for green house gases (-80% by the year of 2050)?

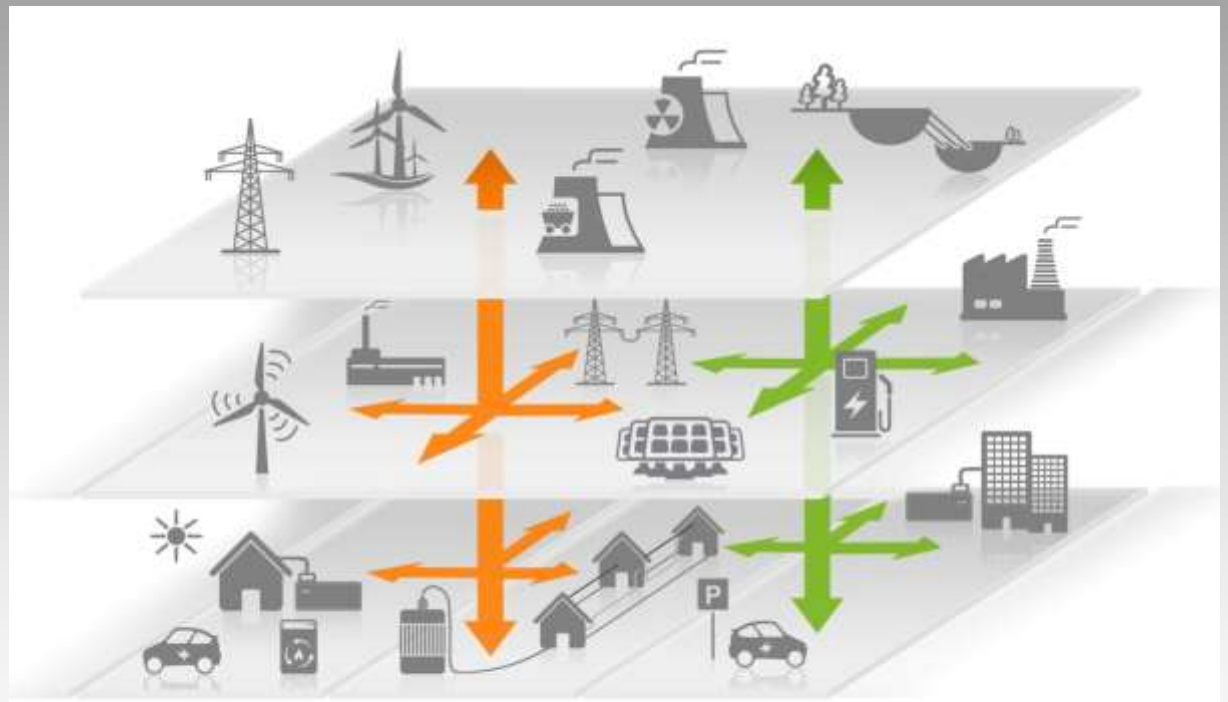
- Ambitious standards introduced for buildings and performance demonstrated
- Building sector responsible for 40% of primary energy consumption and 80% of all buildings are in cities!
- How can energy performance of whole existing building stock be improved within given time frame?

→ **Holistic approach necessary on different scales**

→ **Energy concepts for neighbour-hoods and cities**

Stuttgart, Germany

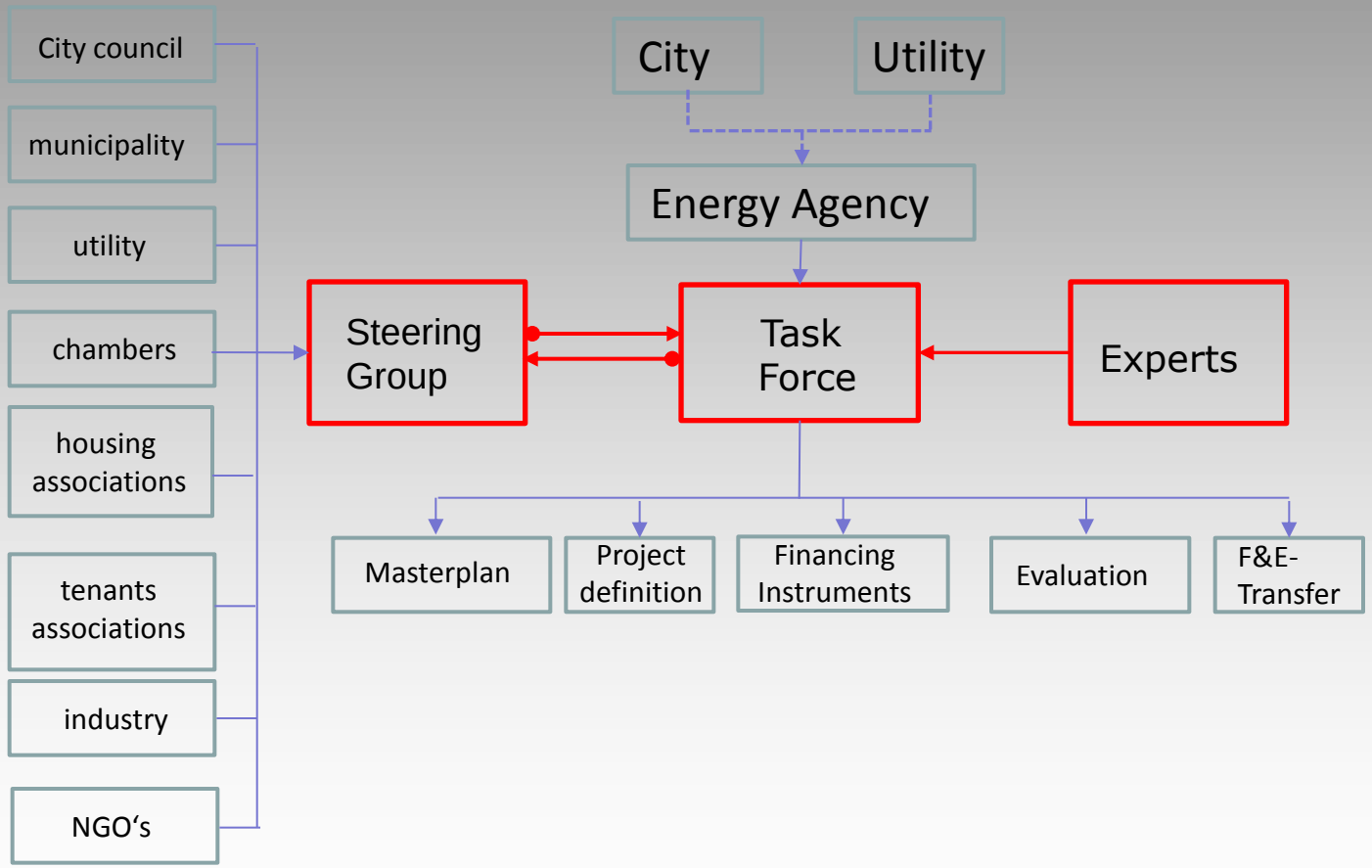
Integrated energy concepts with multi-directional energy and information flows



Buildings as active players in the grid: decentralized energy production and storage

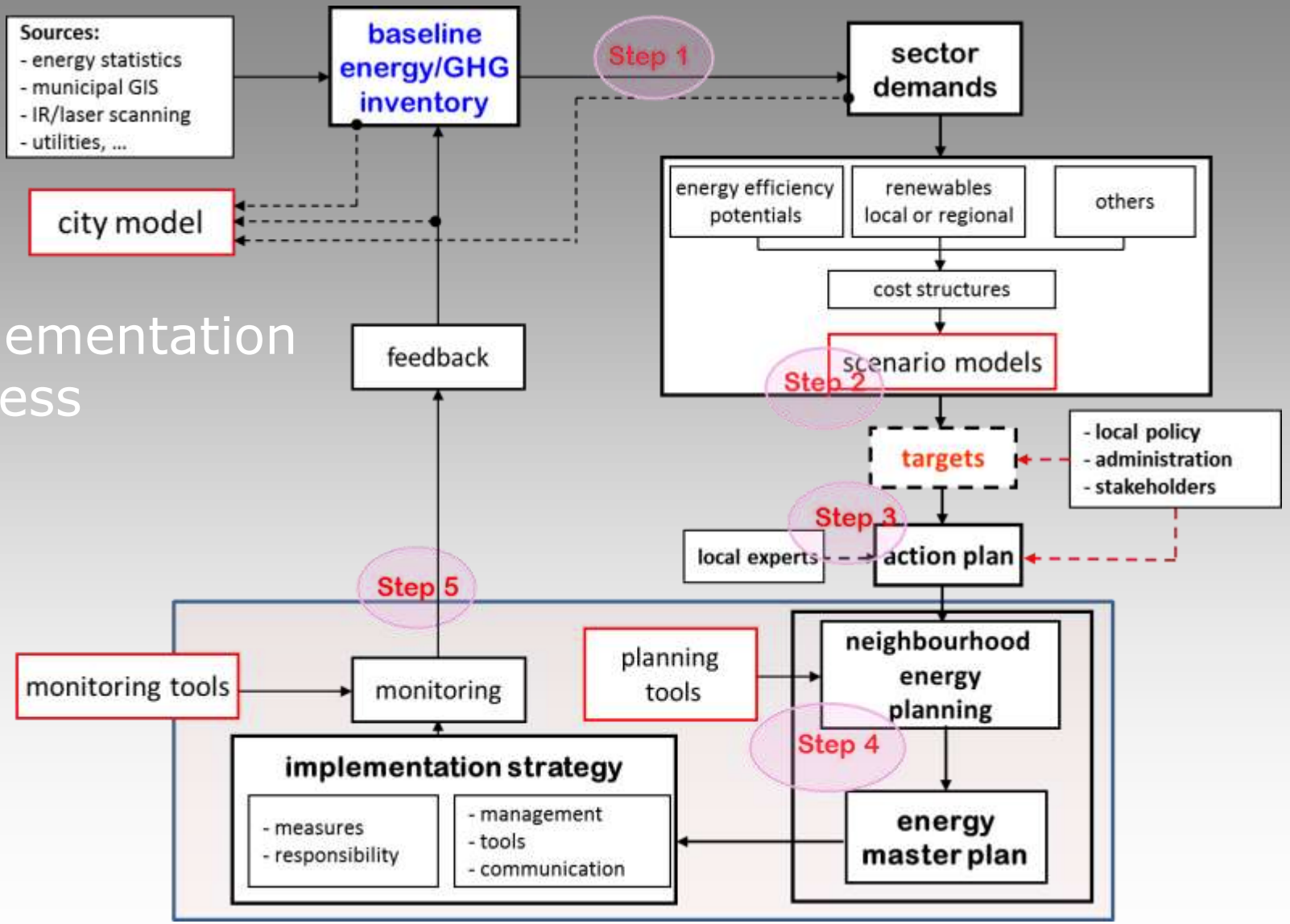
Source: KIT

Actors involved and strategy for co-operation



Source: R. Jank, Volkswohnung Karlsruhe

Implementation process



Source: R. Jank, Volkswohnung Karlsruhe

Focus of the programs EnEff:Stadt and EnEff:Wärme

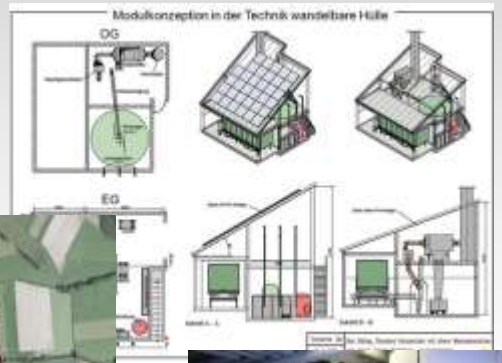
- R&D with regard to improved energy transformation and distribution, low exergy solutions for heat delivery, smart grid technology
- Demonstration projects on different scales – campuses, neighbourhoods, districts (7 projects in conceptual / planning phase, 4 projects under realization
- New planning and management methods, energy efficiency master plans, assessment criteria and strategies, planning tools for municipalities and other actors

Bad Aibling - a former military base on its way to a zero energy city

Conversion of total usable floor area of 72,000 m², divided among 52 building complexes or residential complexes

Improvement of buildings' energy quality by more than 50%

solar-powered local heating network with decentralized feed-in points, woodchip boiler, large-scale, ground-mounted PV system and PV roofs on aircraft hanger



Source: eneff-stadt.info

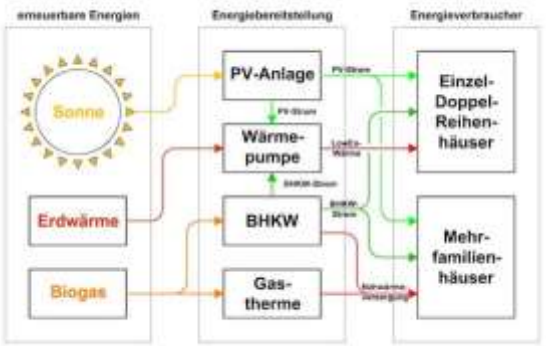
Ludmilla energy-plus housing estate, Landshut

New residential buildings with total usable floor area of 7,600 m²

High energy standard achieved with hollow clay bricks with integrated insulation

Heating network with co-generation for apartment buildings, fueled with biogas
Mini heat pumps for detached, semi-detached and terraced houses, use of shallow geothermal energy
Electricity for building services from PV systems on roofs

© Ludmilla-Wohnbau GmbH



Source: eneff-stadt.info

Integrated Neighbourhood Energy Concept, Karlsruhe-Rintheim

Refurbishment of residential buildings built in 1950 and 1960 with total usable floor area of 87,000 m²,
mixture of high-density linear apartment blocks and high-rise apartment complexes

Optimizing energy reduction costs by combination of building refurbishment and installation of a district heating network which connects to urban distribution system

Maintaining the overall cost level for tenants by compensating higher rents by lower energy bills

© Volkswohnung GmbH

Source: eneff-stadt.info

Conclusions and outlook (I)

- New building technologies have to be integrated smartly into whole building concept → integrated design, system integration (controls)
- Active role of buildings in overall energy system → load shifting and management in connection with grid (energy storage, PV, co-generation)
- Hugh potential for improving building operation – new tools required (data processing and visualization, automated fault detection, model based optimization), market for new services
- Ambitious European/national energy-saving goals require much stronger focus on existing building stock in the future; need for combinations of measures on different scales (building → city)

Conclusions and outlook (II)

Energy transition for cities needs

- integrated strategies (supply/demand)
- coordinated action over long time
- co-operation between stakeholders
- mix of public and private efforts (including grant systems)
- integration into overall planning framework
- holistic approach

Source: R. Jank

Conclusions and outlook (III)

Research issues: (*beyond individual buildings*)

- **Technology** (neighbourhood scale)
  - low exergy applications
  - monitoring and operation optimization
  - smart metering → smart homes → smart grids
- **Modelling** (city and neighbourhood scale)
  - 3D neighbourhood modeling with digital territory information systems and remote scanning methods
  - interface to building and energy system models
- **Transition process** (city scale)
  - management structures
  - urban planning framework integration
  - financing models (→ business cases?)
  - appropriate participation models
  - evaluation / learning

Source: R. Jank

Thank you for listening.

Dank u wel voor uw aandacht.

Merci pour votre attention.

Danke für Ihre Aufmerksamkeit.

More information: www.enob.info,
www.eneff-stadt.info

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