WP 4 Energy Supply

Baltic Sea Region Programme 2007-2013

Part-financed by the European Union (European Regional Development Fund and European Neighbourhood and Partnership Instrument)

URB Energy

Energy Efficient and Integrated Urban Development Action

A tool to evaluate the energy consumption of entire housing areas and their potentials towards better energy efficiency

Hans Jörg Duvigneau
Centre of Competence for Major Housing Estates, Berlin, Germany

2 December 2011 – Final Conference „Energy Efficiency and Urban Future“

A tool to calculate the energy consumption and the energy saving potential of buildings

- This simple tool in the form of a matrix has been particularly developed during the URB-Energy project for the Berlin target area (Frankfurter Allee Süd and Kaskelkietz) by Henryk Hönow and his colleagues at BBP Bauconsulting, Berlin.
- For more details, look at the proceedings of the URB-Energy Conference at Berlin, Oct. 2010.
- Containing elements of the BEEN Manual, Nov.2007 (www.been-online.net), this tool has been refined by the BBP engineers for the purpose to evaluate energy saving potentials of entire housing areas in our cities.

Project part-financed by the European Union.
Baltic Sea Region Programme 2007–2013

Main elements of the matrix

- From top to bottom:
  - The types of buildings in a given urban area with their characteristic thermal features;
  - The types of heating systems used in the area's buildings
    - Decentralized heating by individual room or flat heaters, stoves
    - Central heating for single multi-storey buildings
    - District heating for all (or most of) buildings of an urban area
  - The energy sources used for heating / heat production
    - Fossil fuel, like coal, lignite, oil, natural gas etc.
    - Electrical energy
    - Renewable energy, like wood pellets, biomass, solar heat
    - Employed energy saving technologies for heat production, like CHP - Cogeneration of heat and power, others

Project part-financed by the European Union.
Baltic Sea Region Programme 2007–2013

Main elements of the matrix

- From left to right:
  - Building type
  - Roomspace (m²) in flat or building to be heated
  - Employed heat technology and energy sources
  - Energy demand (kWh/²a) according to the specific type of building and to the characteristics of heating technology
  - Total demand (Energy demand x floorspace, MWh/a)
  - Energy expenditure factor
  - Final energy demand (MWh/a)
  - Primary energy factor
  - Primary energy demand (MWh/a)

Project part-financed by the European Union.

Calculation of CO2-Emission (kg / MWh), according to the employed energy sources

Energy source (type of fuel)	Energy factor	Specific CO^2 emission
– Lignite / Braunkohle	1.200	350,0
– Light fuel oil	1.100	266,0
– Natural gas	1.100	211,0
– District heating 1990	0.700	300,0
– District heating 2010	0.567	149,0
– Electrical energy 1990	2.700	728,0
– Electrical energy 2010	2.600	575,0
– CHP Cogeneration		
Heat & Power Block	0.800	54,2
– Wood pellets, biomass	0.200	58,1
– Solar heating	0.000	0.0

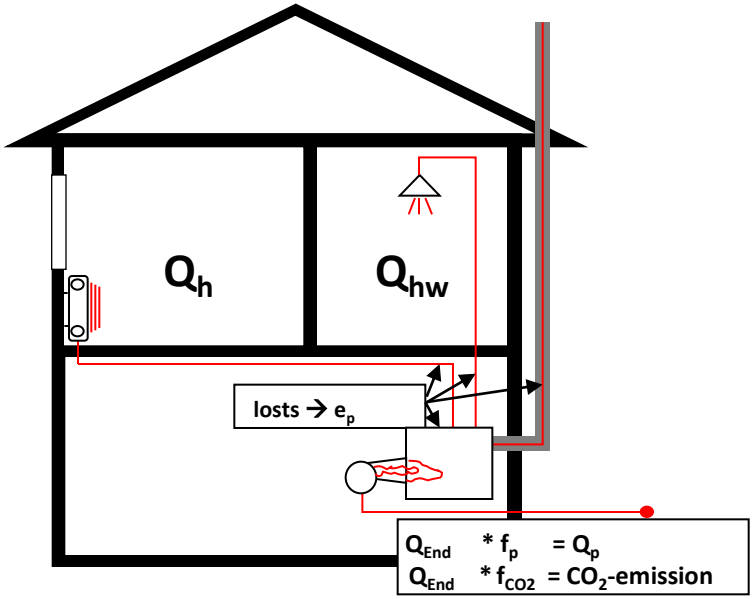
Project part-financed by the European Union.
Baltic Sea Region Programme 2007–2013

Calculation of energy consumption and energy saving potentials of prefab housing areas

- **Calculation system is just more simple because of reduced number of elements to be considered:**
  - None or few old buildings with special features
  - Little number of prefabricated building types with well-known energy-related performances
  - Generally, district heating has been installed in the area
- **Taking into account:**
  - The state of the heat production plant
  - The type of fuel and technology for heat production used
  - The state of the heat distribution net
  - Avoidable losses of heat energy in the distribution net
  - The state of the secondary stations in the buildings

Project part-financed by the European Union.
Baltic Sea Region Programme 2007–2013

Methods



Heat requirement

Q_H

- **Wall insulation** /Roof/basement / ceiling
- **Thermal insulation windows**
- Ventilation/heat recovery
- A/V-Ratio

Input factor e_p
- Technical systems
- Losses during distribution, conversion, storage

Final heating energy consumption

$Q_{End} = Q_H * e_p$

Primary energy factor f_p
- Used energy sources
- Renewable energy content
- CHP use

CO_2- emissionfactor f_{CO2}
- Energy sources
- Renewable resources
- CHP credit

Primary energy demand

$Q_P = Q_{End} * f_p$

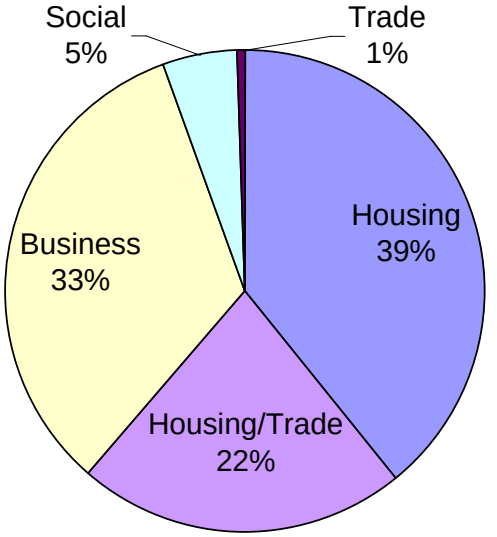
CO_2 - emissions

$Q_P = Q_{End} * f_{CO2tr}$

Project part-financed by the European Union.
Baltic Sea Region Programme 2007–2013

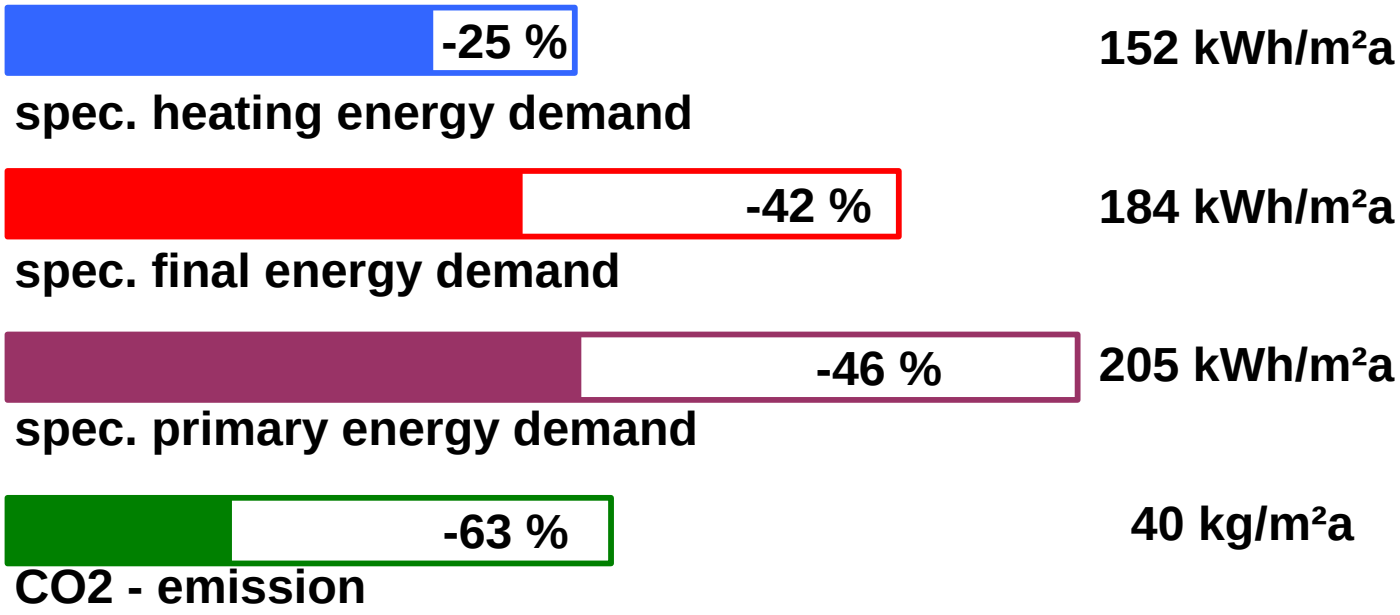
Description *Kaskelkiez (KAS) 1991/92*

- Buildings mainly masonry structure
  (brick walls, construction period 1875-1920),
  lower part for trade and social institutions
  Industry / business in western part of area (e.g. Knorr Co.)
- Block development with war-related gaps
- Total living / usable area: ca. 187.450 m²
- Average of overall specific primary energy demand: **383 kWh/m² a**



Project part-financed by the European Union.
Baltic Sea Region Programme 2007–2013

KAS 2010 - Energy efficiency / CO_2-emission

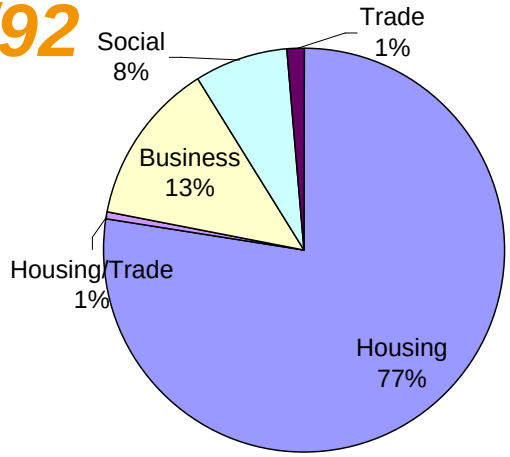


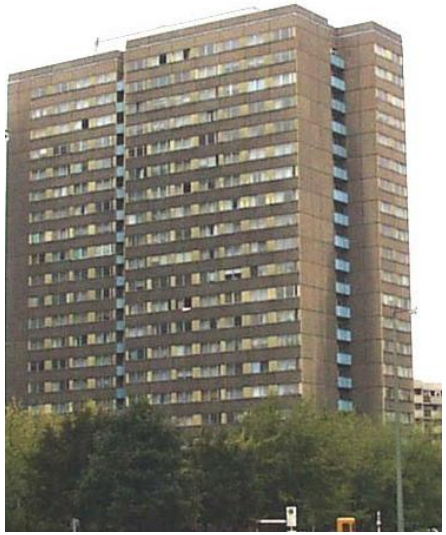
- realised through
  - renovation on different levels
  - new heating systems (central), mostly based on natural gas
  - replacement of coal as primary energy source

Project part-financed by the European Union.
Baltic Sea Region Programme 2007–2013

Description *Frankf.-Allee-Süd 1991/92*

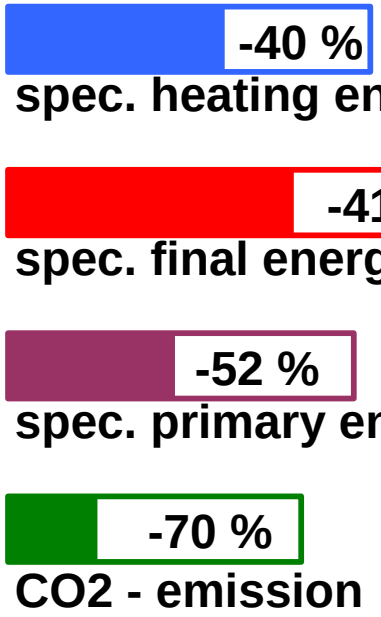
- **Mainly residential area (prefabricated building type), social institutions e.g. schools, day-care-facilities as well as industry / trade / business**
- **Specific primary energy demand 125 kWh/m²a**





Project part-financed by the European Union.
Baltic Sea Region Programme 2007–2013

FAS 2010 – Energy efficiency / CO_2-emission



- realised through
  - complete reconstruction
  - renewal of building equipment (heating / hot water / ventilation)
  - district heating generation with combined heat and power process (CHP)

Project part-financed by the European Union.
Baltic Sea Region Programme 2007–2013

Perspectives

Achieved energy efficiency status (heating + warm water)		
	Final energy	**Primary energy**
Kaskelkiez	**184** kWh/m²a	**205** kWh/m²a
Frankfurter Allee-Süd	**103** kWh/m²a	**60** kWh/m²a

Potential for further actions:

Kaskelkiez

- more insulation measures
- more efficient use of primary energy

Frankfurter Allee-Süd

- classical EEM-potential implemented
- long term objectives:
  district heating shift to renewable energies

Project part-financed by the European Union.
Baltic Sea Region Programme 2007–2013

A simple way to evaluate energy saving potentials of whole urban areas

- Seizing the groundspace of buildings of the area by using aerial views by Google Earth or others
- Multiplying the groundspace with the number of storeys and adequate factors to get the floorspace.
- Evaluating the heat energy demand by using data of the building type's specific heat requirements.
- With simple operations like this, engineers would be able to evaluate the actual energy consumption, possible savings by step-wise realised improvements and to survey the progress towards more energy efficiency.

Project part-financed by the European Union.
Baltic Sea Region Programme 2007–2013

Just to remind you:

- **The annual average demand of energy for heating and hot-water supply differs, depending of the type of housing (data from the German housing sector, 2007):**
  - **Old buildings (construction until 1920) >300 kWh/m²**
  - **Post-war buildings (1950-1980) 150 – 180 kWh/m²**
    (incl. prefab. housing buildings 1960-90)
  - **Overall average of the total housing stock 185 - 220 kWh/m²**
- **Comparative data concerning the housing stock in the Baltic Sea Region are fairly similar.**
- **Agreed objectives of all EU-member States: reduction of energy consumption and CO2 emission by 20% until 2020**

Project part-financed by the European Union.

Thank you for your attention!

Project part-financed by the European Union.
Baltic Sea Region Programme 2007–2013