Low Exergy Systems for High Performance Communities

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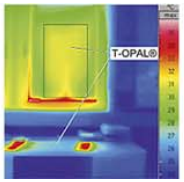
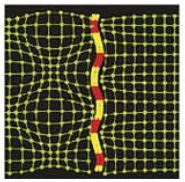







Objectives

Energy savings and reduction of CO_2-emissions:

By facilitating and accelerating the use of

low valued and environmentally sustainable energy **sources**

for heating and cooling of buildings.

Through the utilization of the EXERGY concept

Approach: Exergy concept

matching the Quantity AND Quality levels of supply and demand

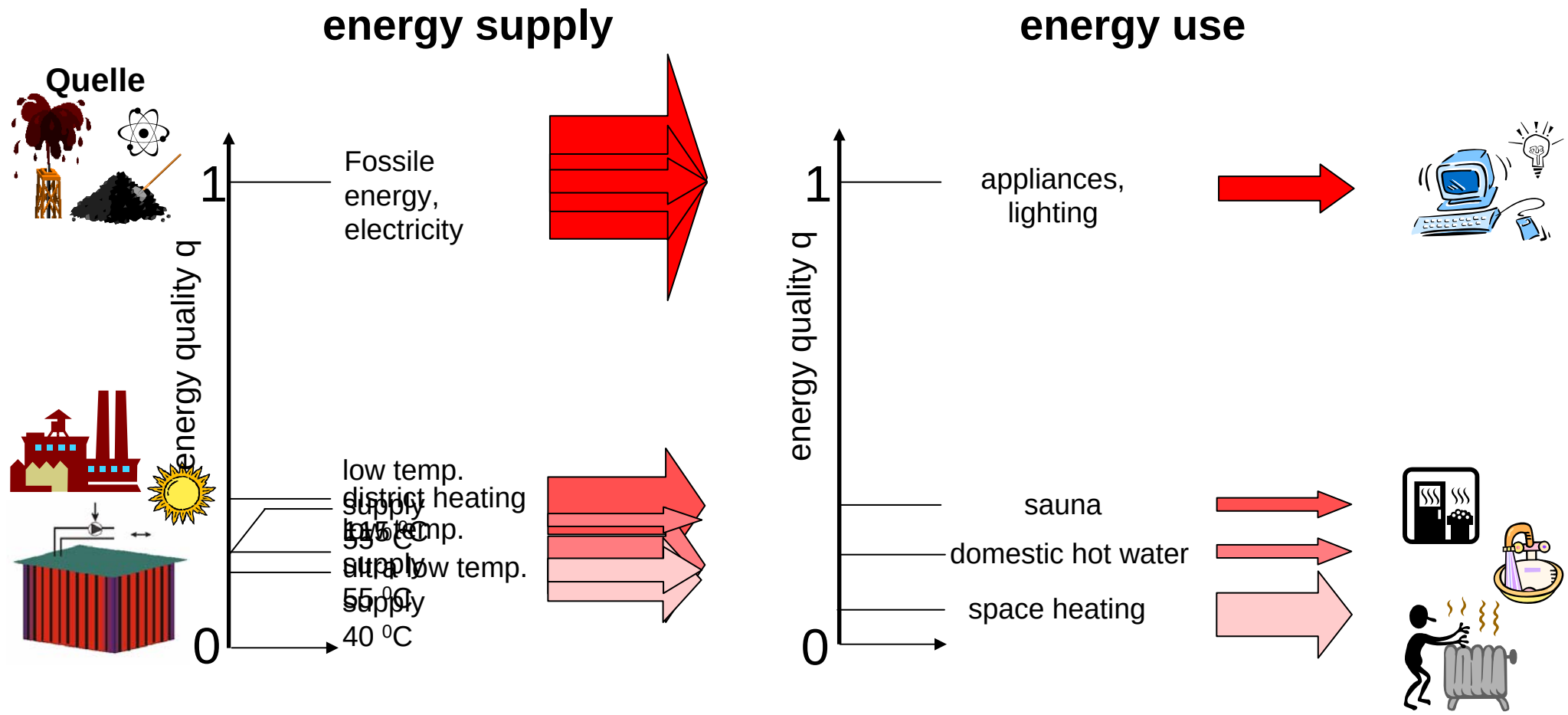
Quantity ⇒ Energy savings

Quality ⇒ use of low quality sources

e.g. solar thermal heat, ground/air heat

Matching of the energy quality of demand and supply

Source: VTT

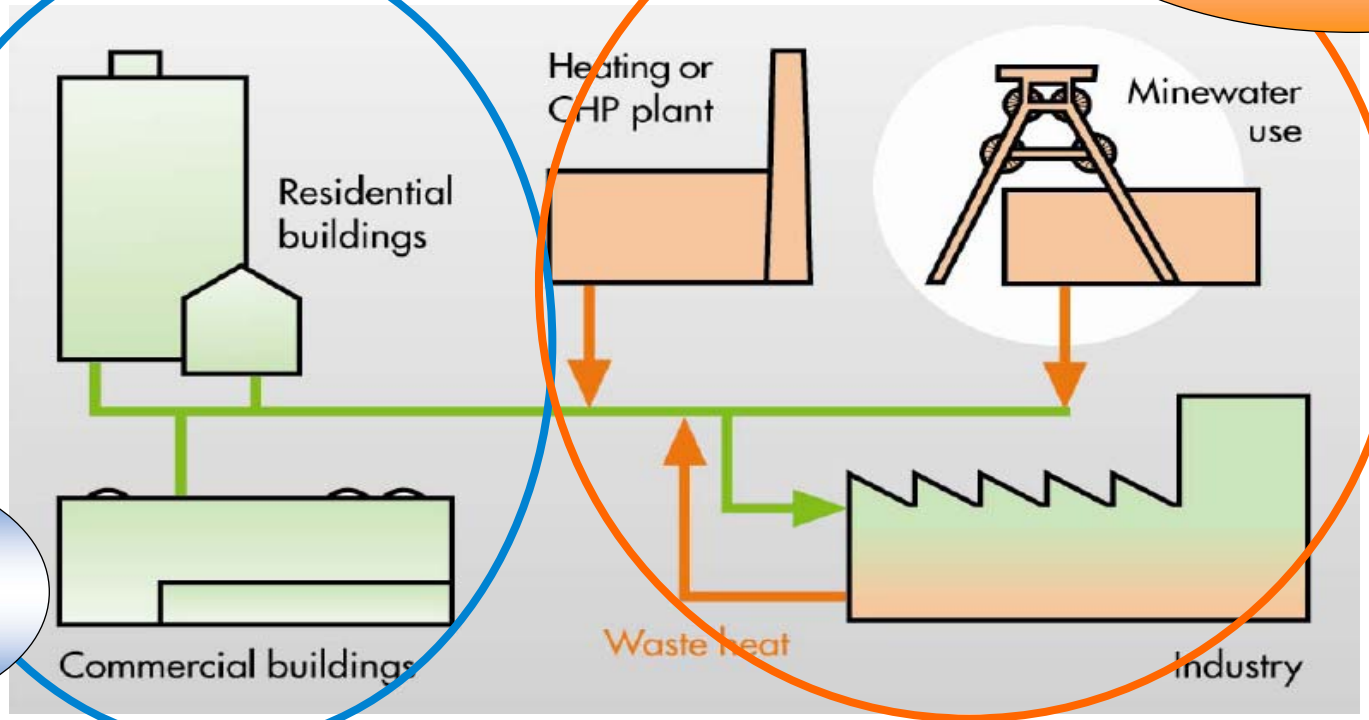


Scope LowEx Activities

Sustainable community systems

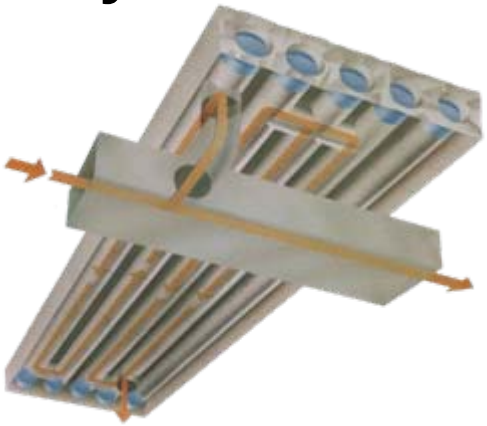
Supply systems

Building systems

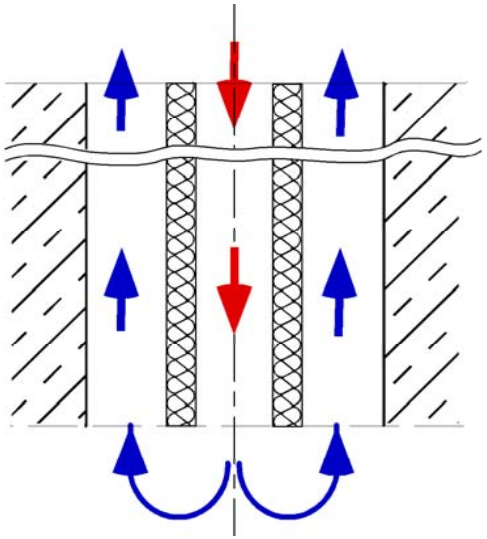


LowEx Building Systems:

Development of innovative system solutions



Heating/cooling systems and storages

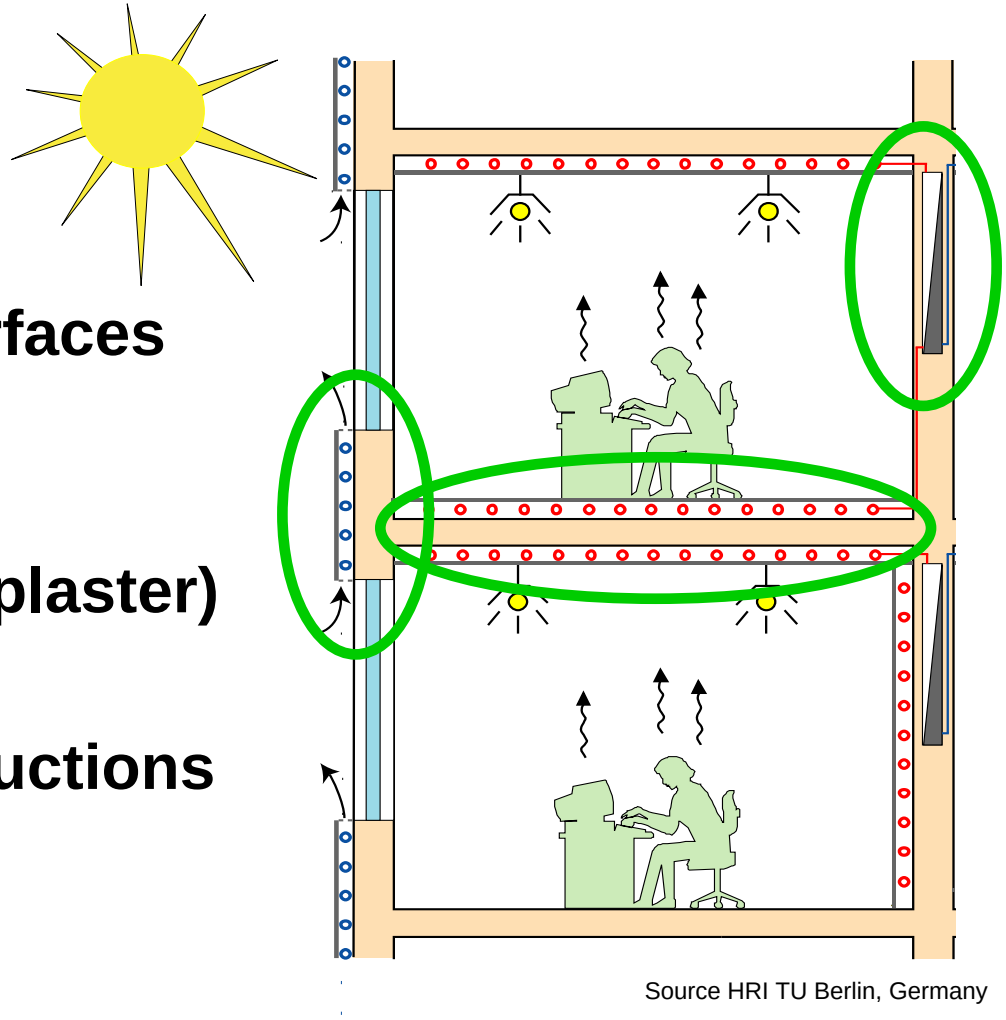


Example: Thermally activated surfaces

Thermally activated room surfaces

PCM storages
(macro scale or inside the plaster)

Active exterior facade constructions
(active night cooling)



Source HRI TU Berlin, Germany

Example: Simple exterior wall activation

Test building

Prototype setup

Source ETH Zurich, Switzerland

Example: Ground heat exchanger

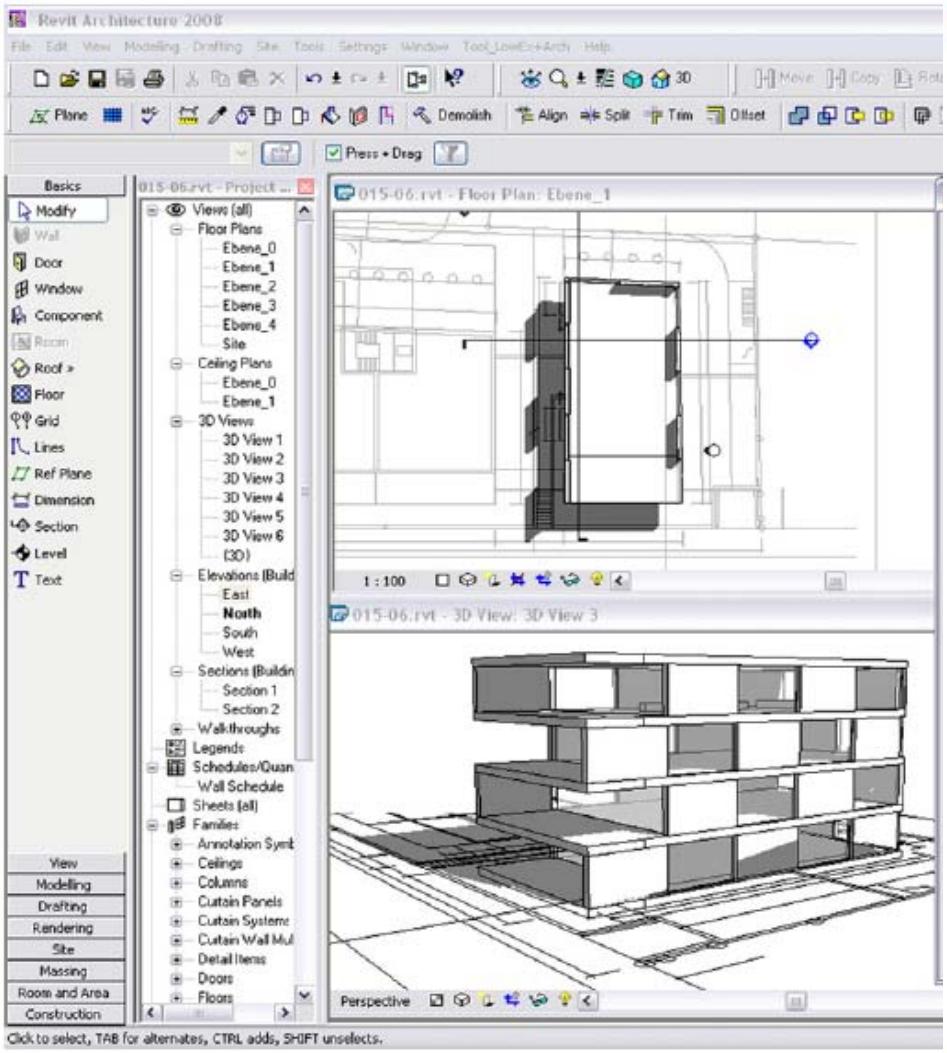
Source WH Zwickau, Germany

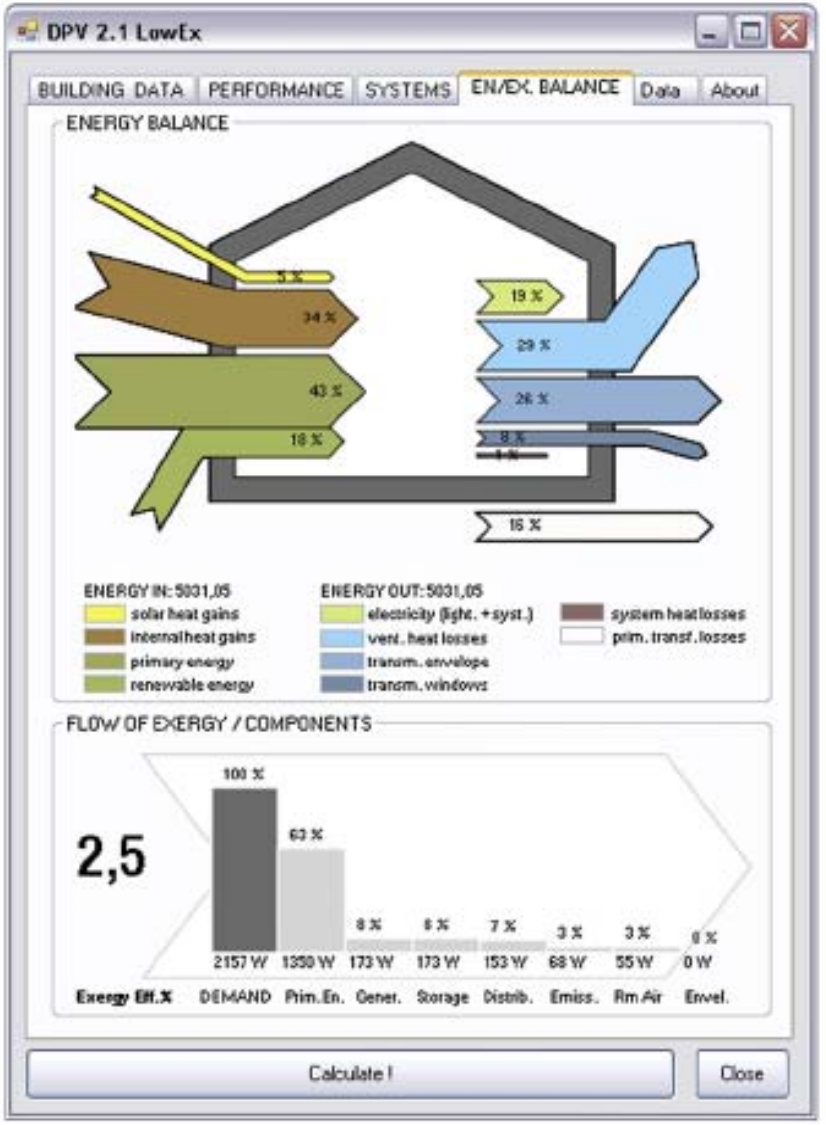
Use the ground as a energy source (mainly for cooling)

- **Energy poles**
- **Bore holes**
- **Horizontal heat exchanger**
- **Horizontal heat exchanger with capillary tubes**

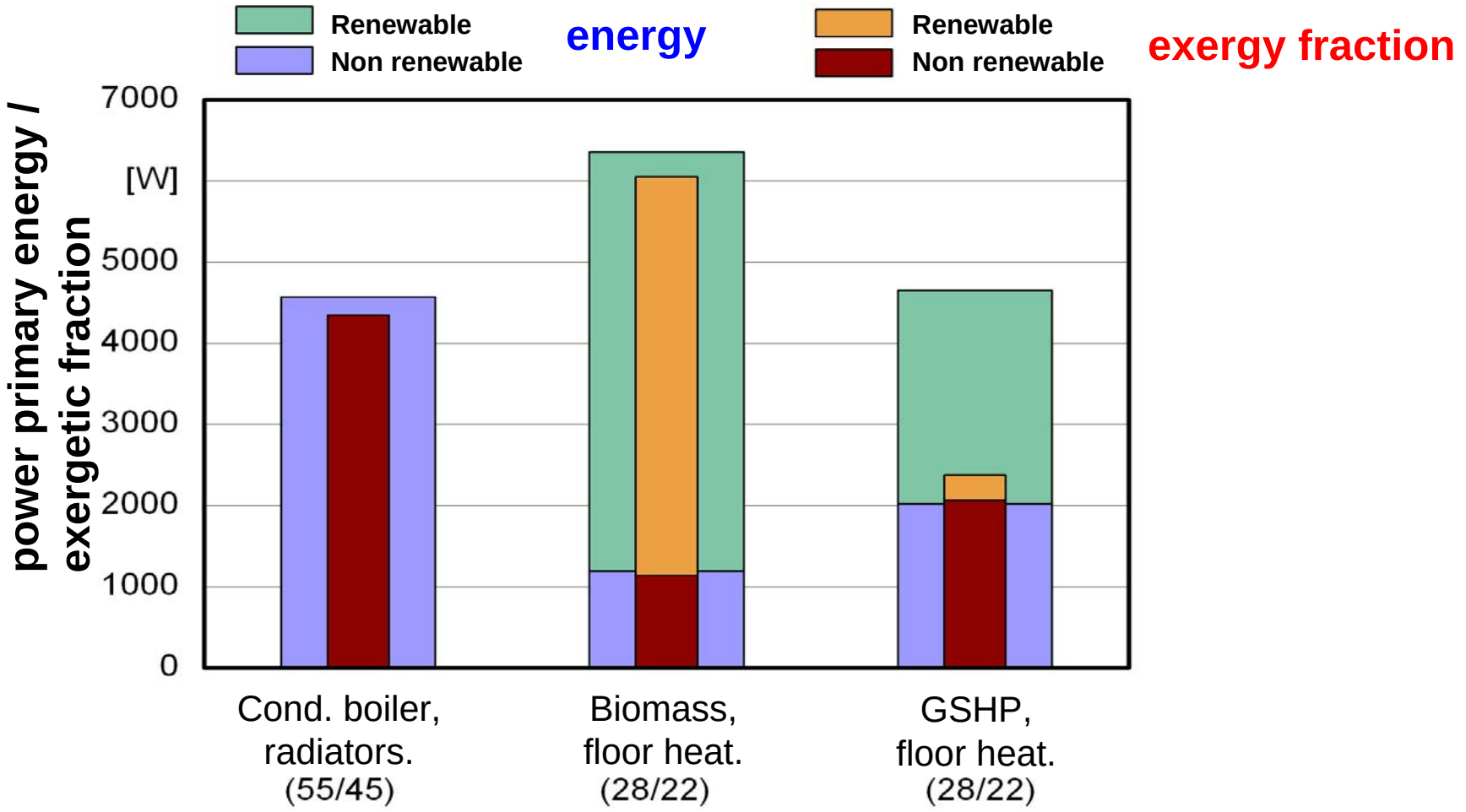
Source City of Kassel, Germany

Analyses tools for LowEx systems

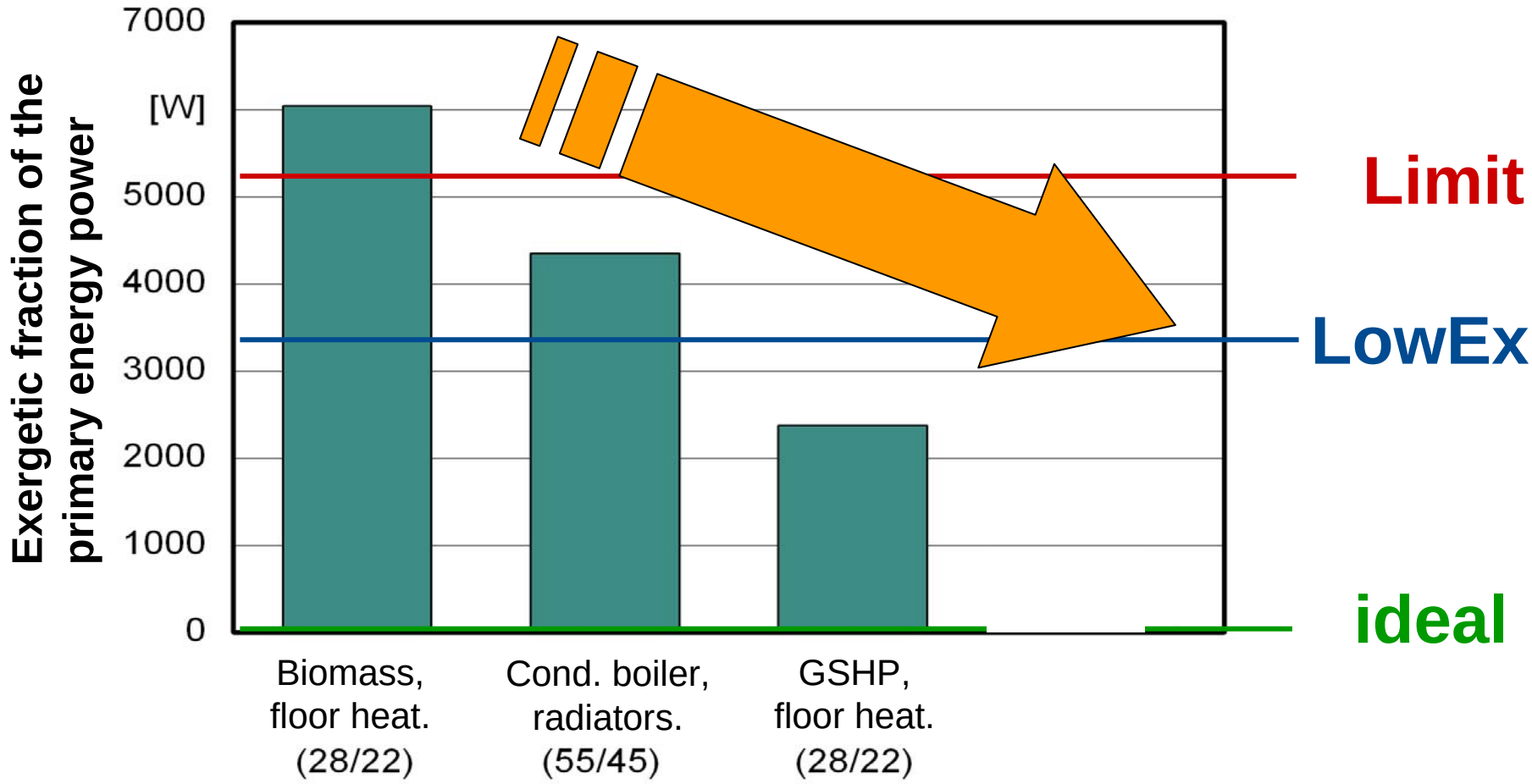




Analyses of buildings

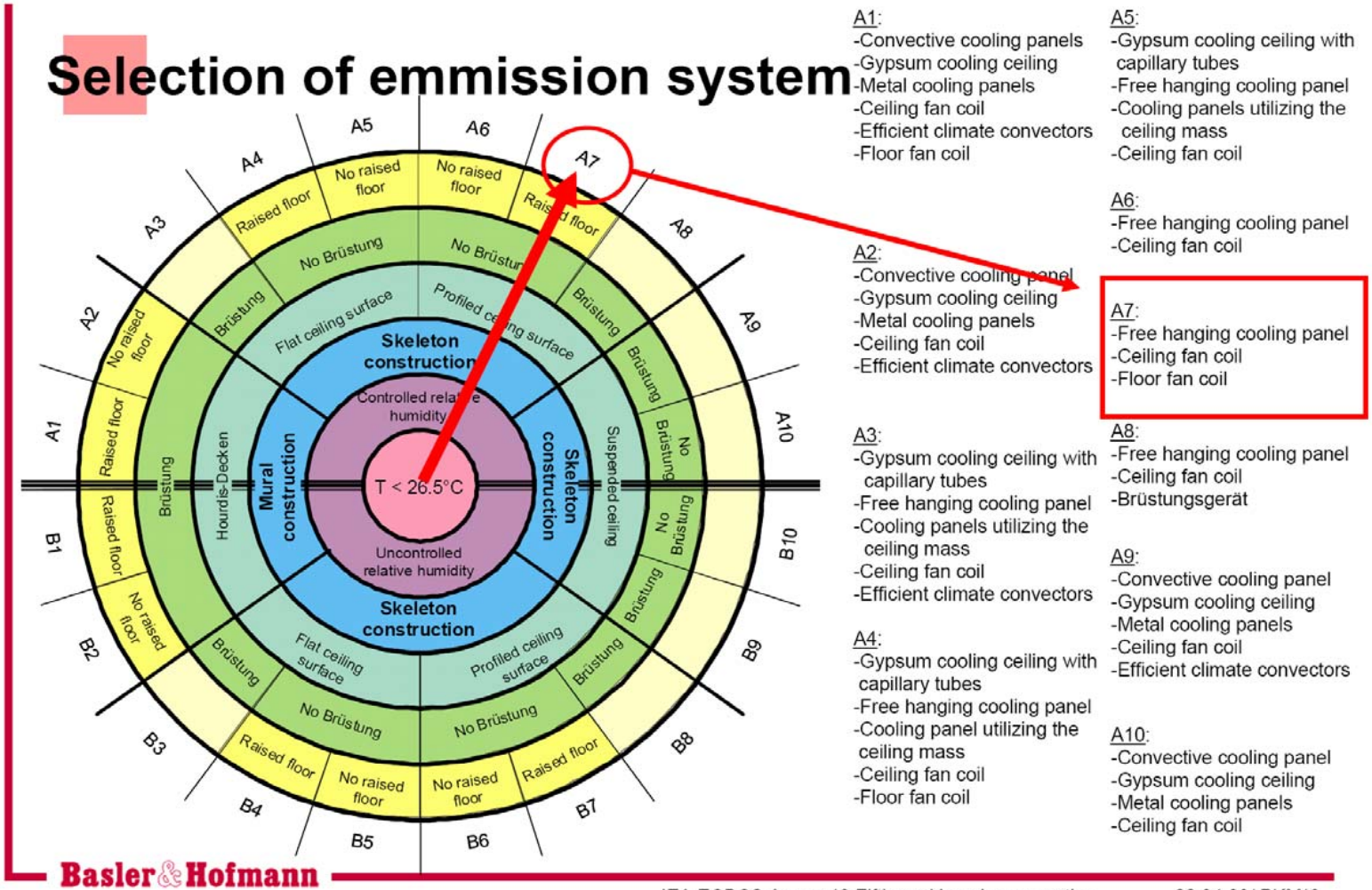


Benchmarking of system solutions



Decision tool for system configuration

Deliverable C 4.2 Decision tool for energy efficient cooling



A1:
-Convective cooling panels
-Gypsum cooling ceiling
-Metal cooling panels
-Ceiling fan coil
-Efficient climate convectors
-Floor fan coil

A2:
-Convective cooling panel
-Gypsum cooling ceiling
-Metal cooling panels
-Ceiling fan coil
-Efficient climate convectors

A3:
-Gypsum cooling ceiling with capillary tubes
-Free hanging cooling panel
-Cooling panels utilizing the ceiling mass
-Ceiling fan coil
-Efficient climate convectors

A4:
-Gypsum cooling ceiling with capillary tubes
-Free hanging cooling panel
-Cooling panel utilizing the ceiling mass
-Ceiling fan coil
-Floor fan coil

A5:
-Gypsum cooling ceiling with capillary tubes
-Free hanging cooling panel
-Cooling panels utilizing the ceiling mass
-Ceiling fan coil

A6:
-Free hanging cooling panel
-Ceiling fan coil

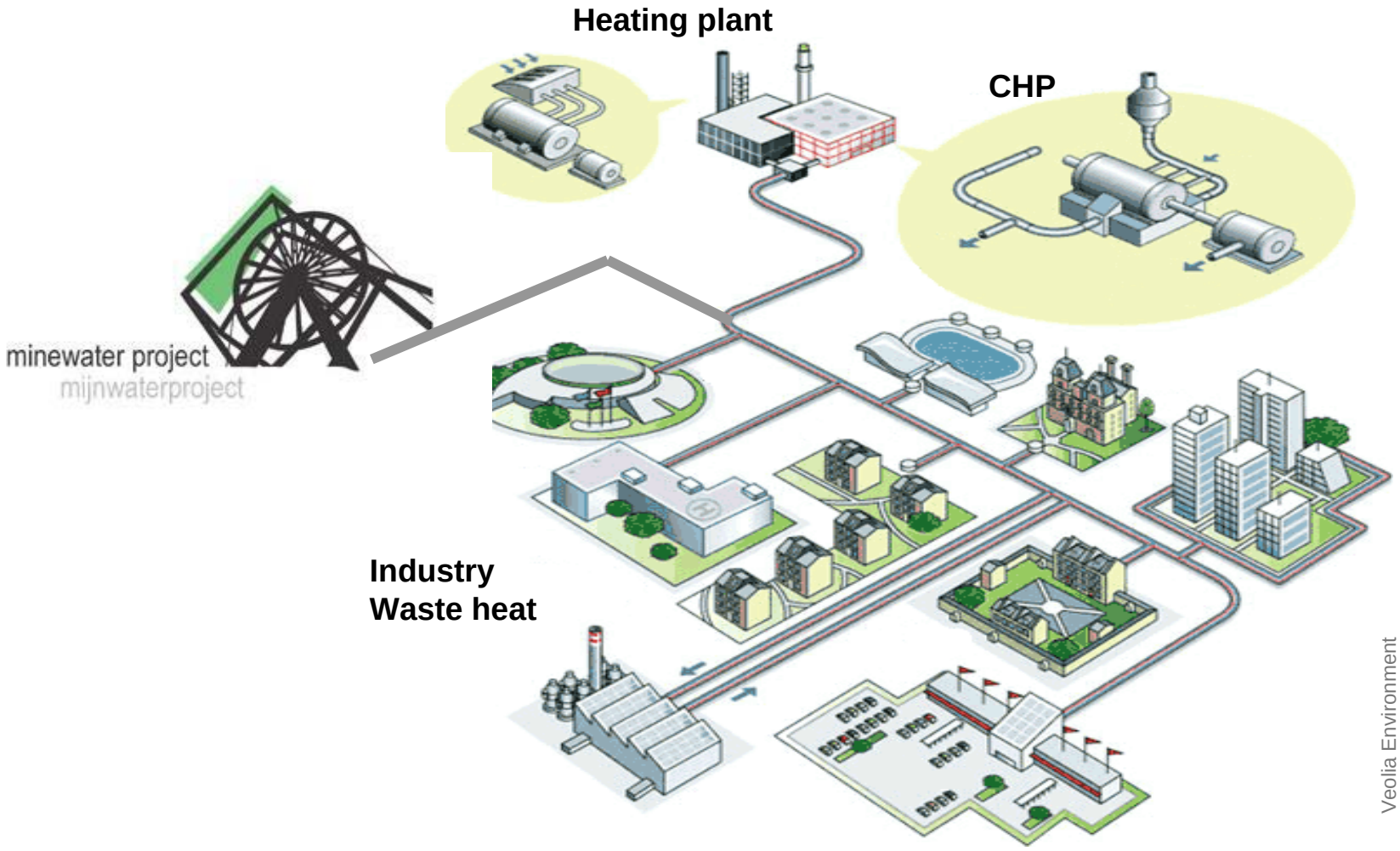
A7:
-Free hanging cooling panel
-Ceiling fan coil
-Floor fan coil

A8:
-Free hanging cooling panel
-Ceiling fan coil
-Brüstungsgerät

A9:
-Convective cooling panel
-Gypsum cooling ceiling
-Metal cooling panels
-Ceiling fan coil
-Efficient climate convectors

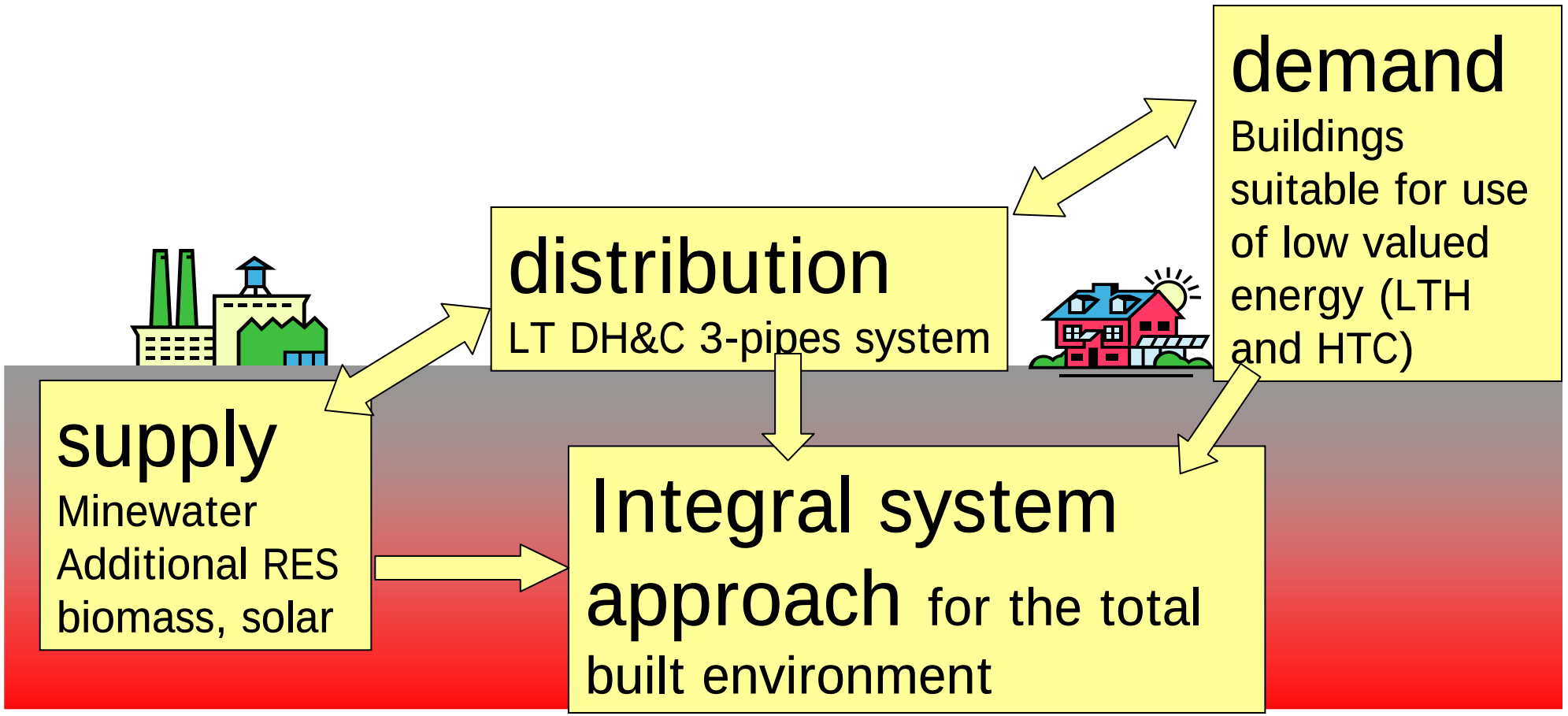
A10:
-Convective cooling panel
-Gypsum cooling ceiling
-Metal cooling panels
-Ceiling fan coil

Seeking Low-Exergy Supply Structure for a Community



Veolia Environment

LowEx approach for the Mine Water Project Heerlen:



Heerlerheide
phase 1

Buildings Heerlerheide Centre

H C R

35…40⁰C 17⁰C 20…23⁰C

Energy station Heerlerheide Centre

HP HP

2 Warm Wells

25…35⁰C

Intermediate Well

17…20⁰C

2 Cold Wells

Heerlen SON
phase 2

Energy st bu

Energy st bu

Energy stations buildings

Energy station Maankwartier

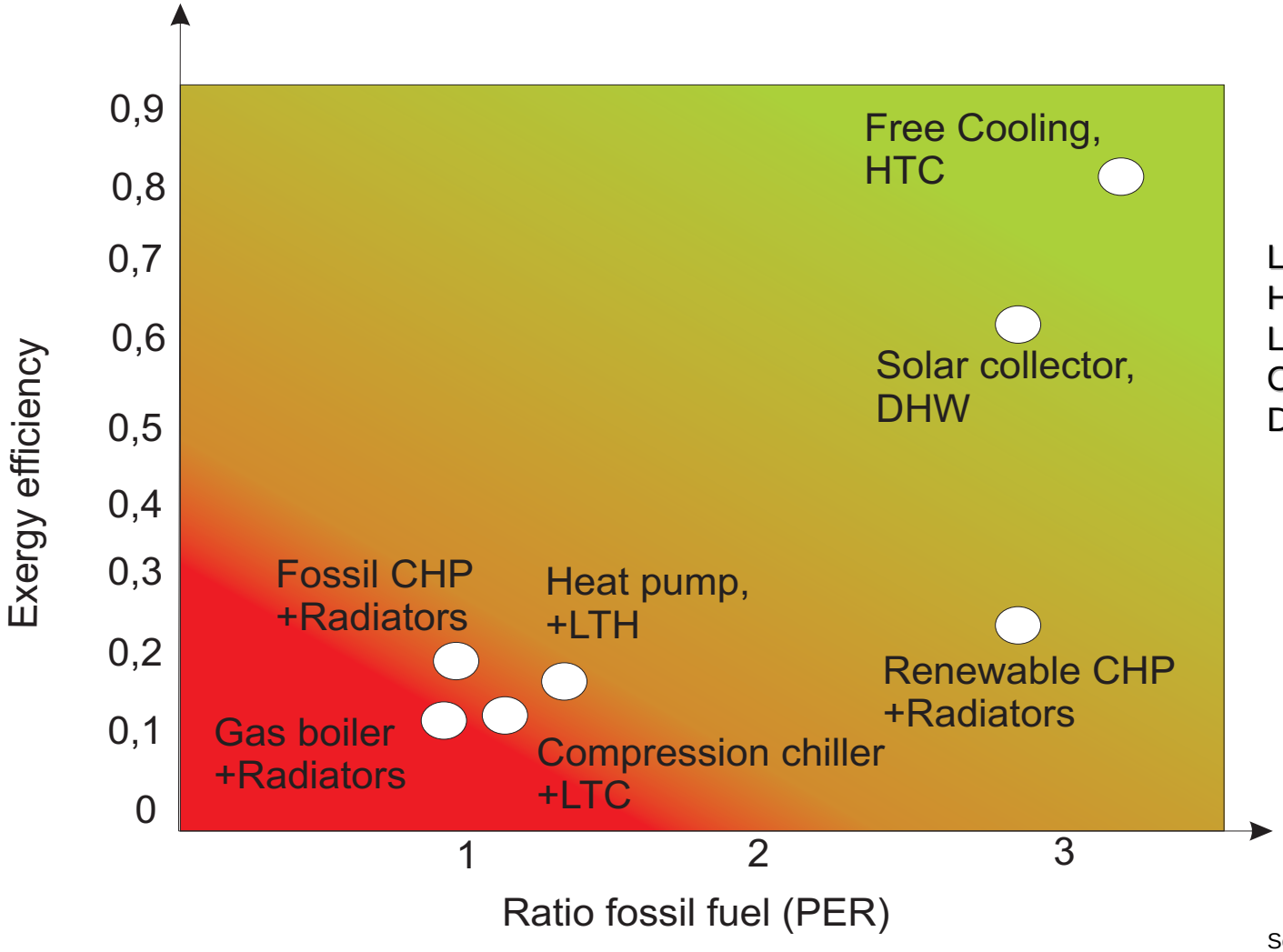
HP HP

From a schematic approach to a LT H&C grid in practice

Design constraints:

- **Chemical quality of the mine water**
- **Sediments and sludge's**
- **Scaling**
- **Corrosion (bacterial)**
- **Gases (CH_4 and CO_2)**
- **Transport energy (pumps)**

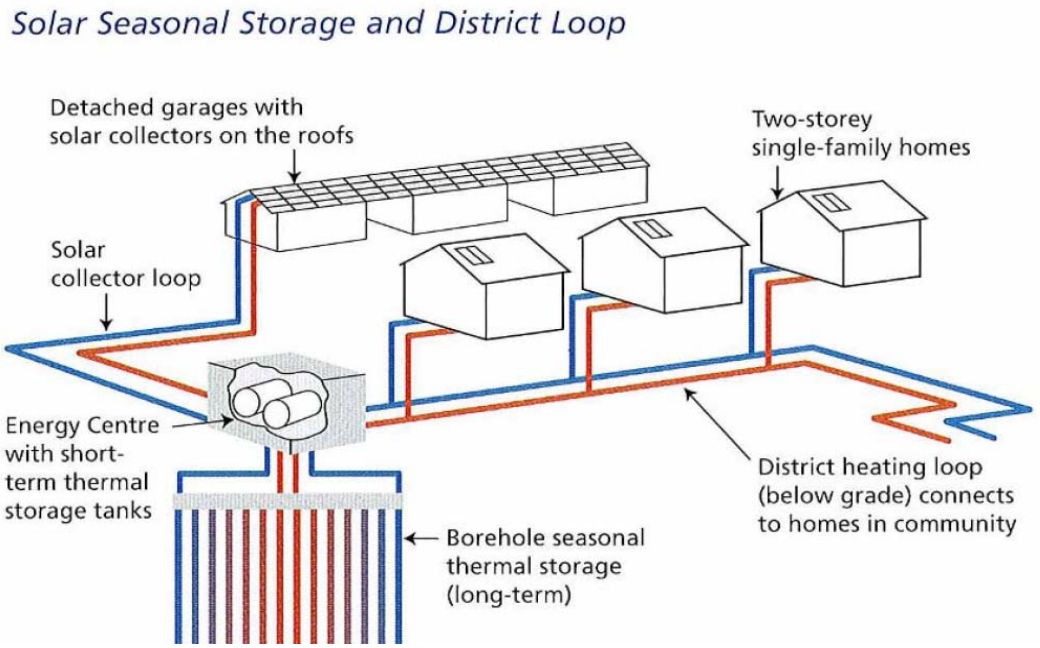
Assessment of different options



LTC: Low temperature cooling
HTC: High temperature cooling
LTH: Low temperature heating
CHP: Combined heat and power
DHW: Domestic hot water

Source: Op't Veld, CHRI, The Netherlands

Community case: Okotoks, Canada



Okotoks, Canada

52 single family homes (140m^2)

120m^3 short term storage (water)

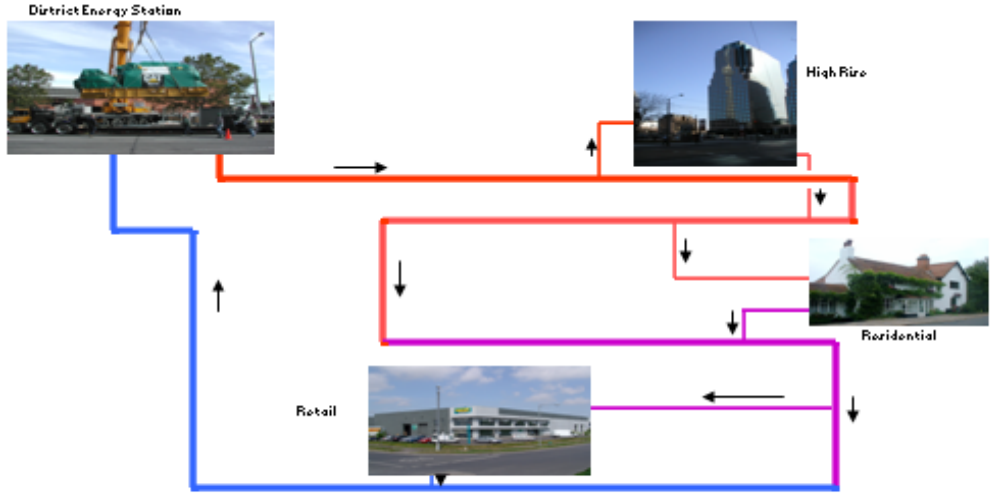
144 boreholes (35m deep, 15cm ø)

Quelle: Church, NRC Canada

CASCADIA - THE CALCULATION TOOL FOR CASCADED BUILDINGS

Based upon the Pre-Design Heating & Cooling Tool developed as part of IEA ECBCS Annex 37 - *Low Exergy Systems for Heating and Cooling of Buildings* and on input from IEA ECBCS Annex 49 - *Low Exergy Systems for High Performance Buildings and Communities*

Annex 49
Low Exergy Systems for High-Performance Buildings and Communities



	High rise		Residential		Retail / Commercial	
Building Floor Plate Area	**303**	square metres	**99**	square metres	**14000**	square metres
Number floors per building	**5**		**2**		**1**	
Floor Height	**3**	m	**3**	m	**6**	m
Number of buildings	**20**		**75**		**12**	
Volume	90900	cubic metre	44550	cubic metre	1008000	cubic metre
Floor plates	30300	square metres	14850	square metres	168000	square metres
losses	**2300**	watts/deg C	**1400**	watts/deg C	**3000**	watts/deg C
indoor temperature	**20**	C	**20**	C	**20**	C
Design Temperature	**-29**	C	**-29**	C	**-29**	C
Transmission Losses	2254000	watts	5145000	watts	1764000	watts

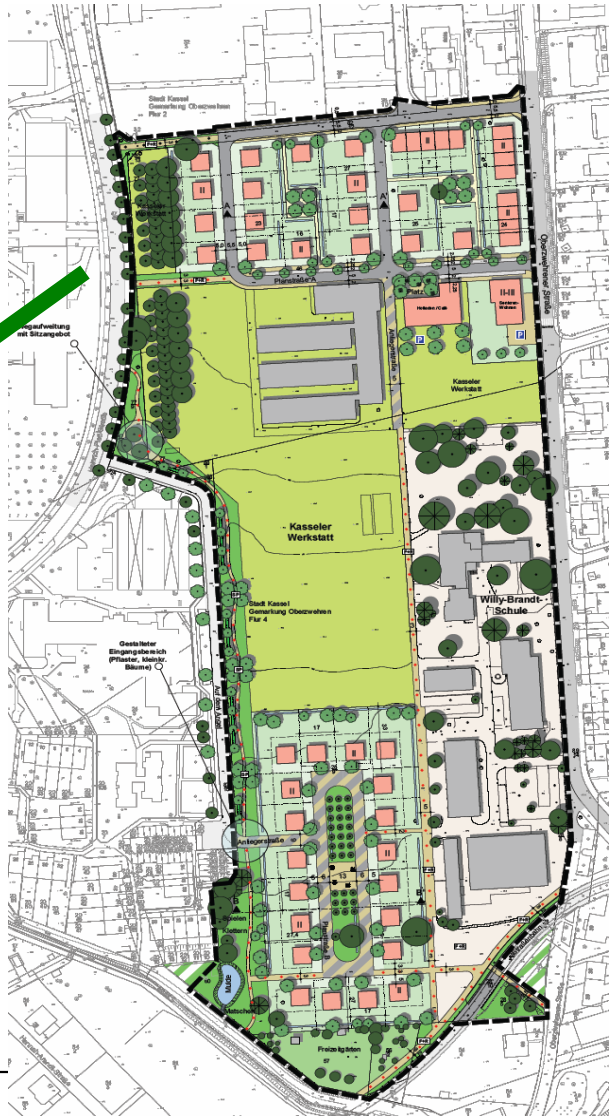
Community case: Oberzwehren (GER)

- CO_2-neutral heating (and cooling)
- optimised thermal insulation under ecological and economical aspects
- optimised urban structure from energy perspective
- development of a tailored supply system

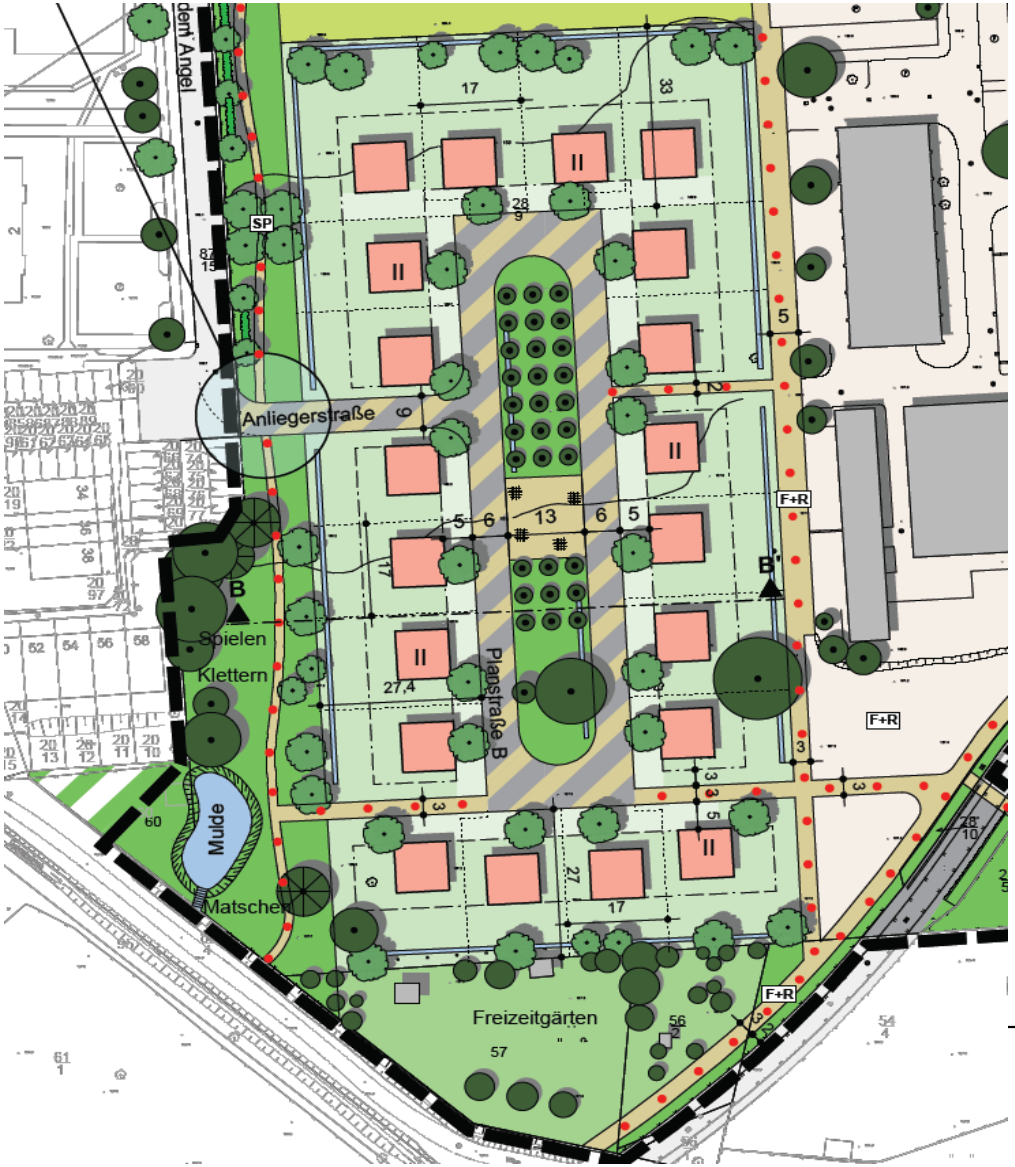
Building site 85.000 m²

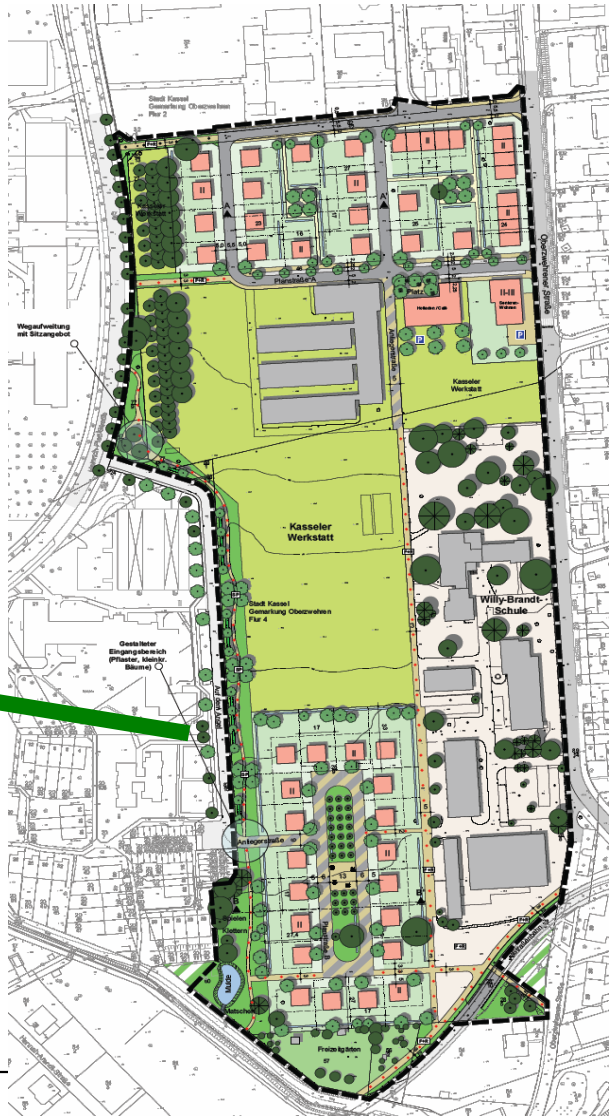
100 living-units total

Oberzwehren urban development plan - north



Oberzwehren urban development plan - south





Existing energy supply infrastructure

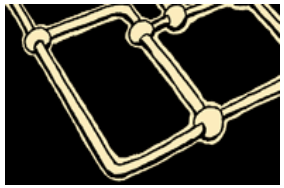
District Heating

Natural Gas

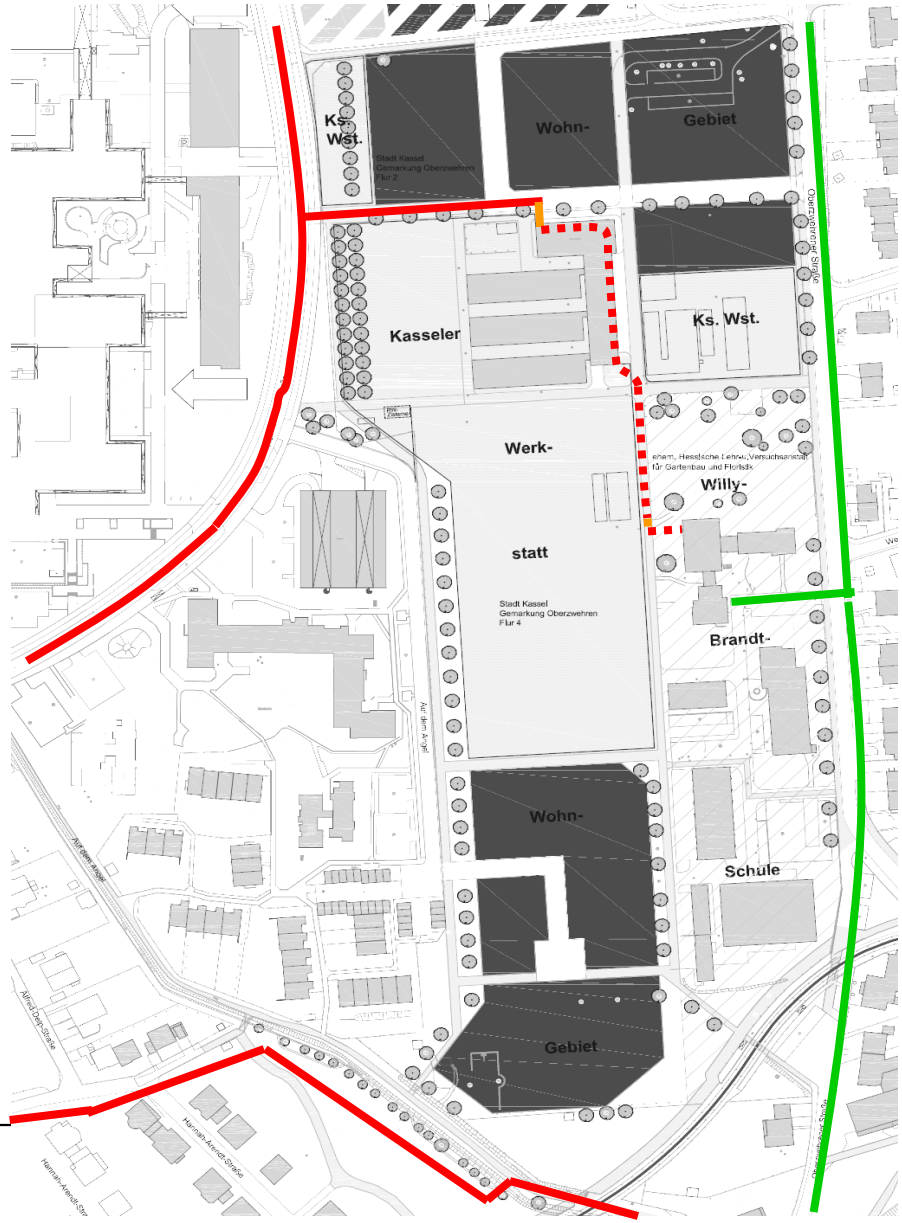
Highly energy-efficient buildings with LowEx emission systems

Solar energy for DHW and photovotaics for CO_2-balance

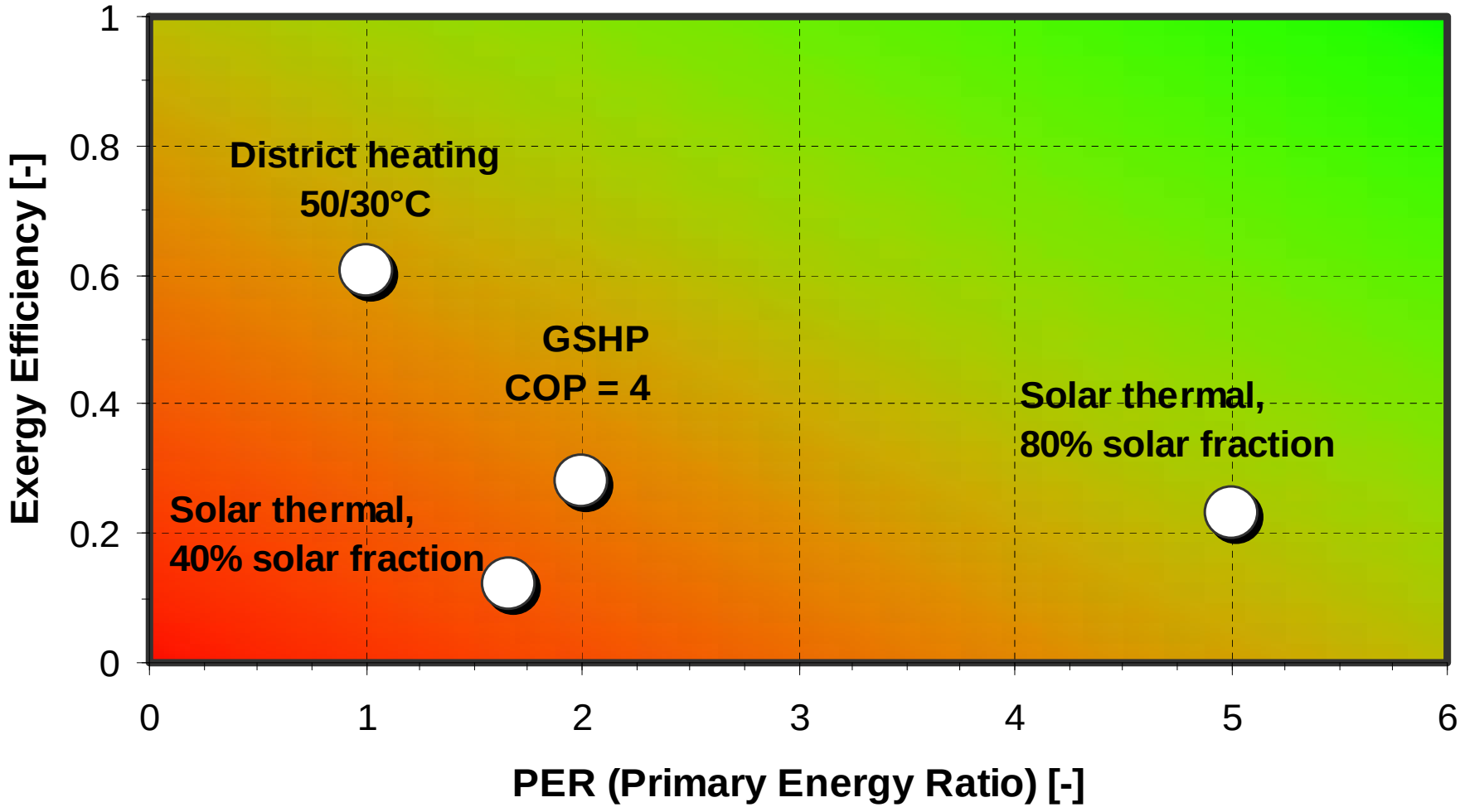
Use of District Heating return to supply buildings



Grid improvement for overall efficiency benefit



Community case: Oberzwehren (GER)



Concluding remarks

1. Exergy demands for heating/cooling are very small
   - Energy demands are high.
2. Supply as low exergy as possible to the room space.
3. Find suitable low-exergy sources in the immediate/local environment.
4. Development of system-components and their smart integration are necessary.

Rational exergy consumption patterns are possible.

This is our challenge!

Conference:

cost
Action C24: COSTeXergy

Energy Conservation In Buildings And Community Systems: Annex 49

THE FUTURE FOR SUSTAINABLE BUILT ENVIRONMENTS
-Integrating the Low Exergy Approach

April 21st 2009 **in Heerlen (The Netherlands)**

Annex 49

Low Exergy Systems for High-Performance Buildings and Communities

International Energy Agency

Energy Conservation in Buildings and Community Systems Programme