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Intelligent Hybrid Thermo-Chemical District Networks

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KU LEUVEN

watergy water and energy solutions

berlin

Zurich University of Applied Sciences
zh aw School of Engineering
IEFE Institute of Energy Systems and Fluid Engineering

Sir Joseph Swan Centre for energy research

Aurubis

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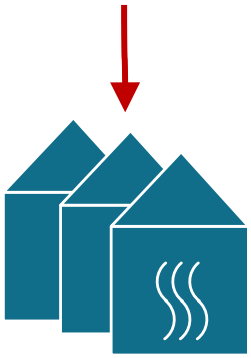
Excess heat and heat demand

Excess heat from industry 11,274 PJ / a



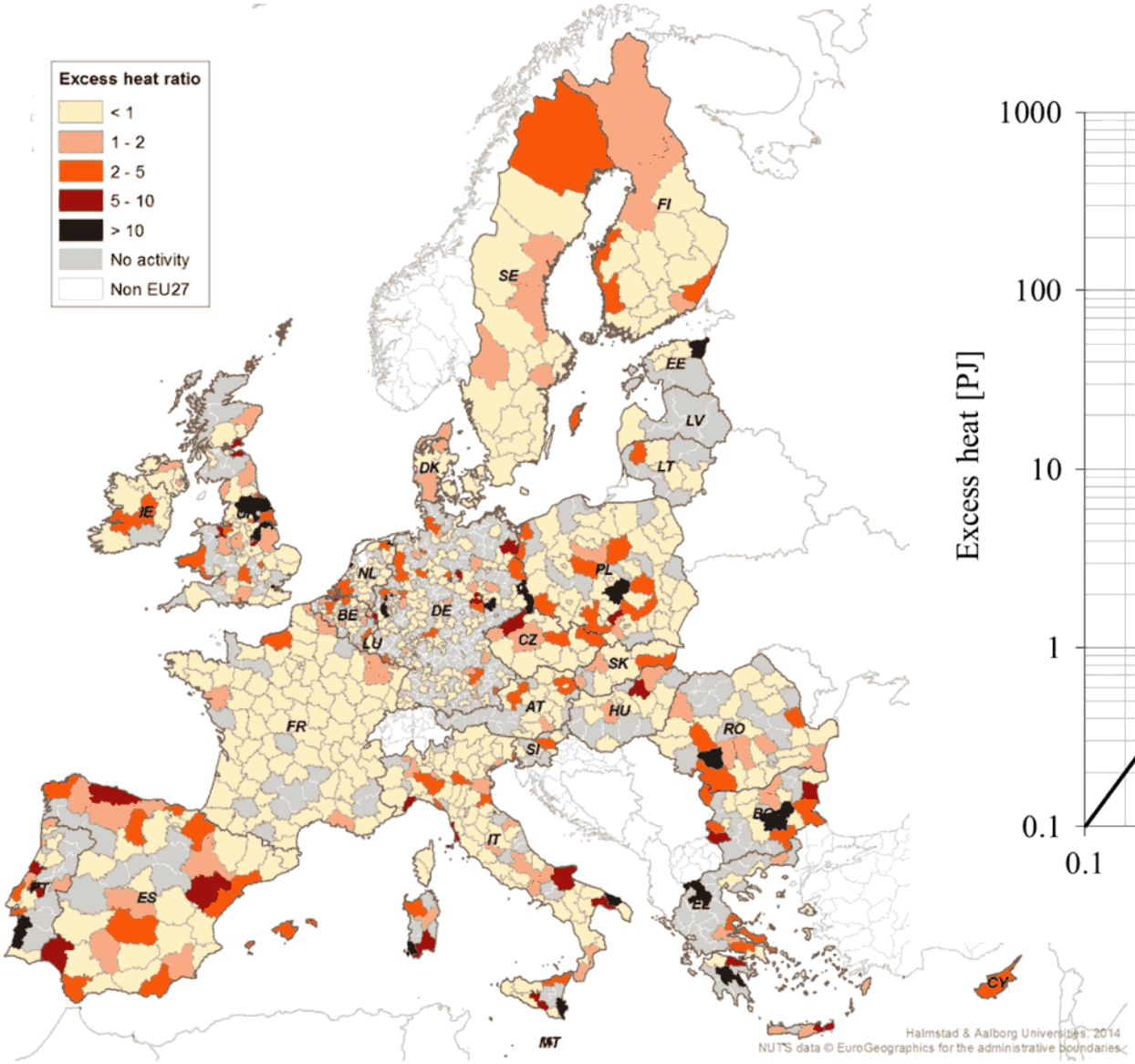
Heat demand in buildings 11,724 PJ / a

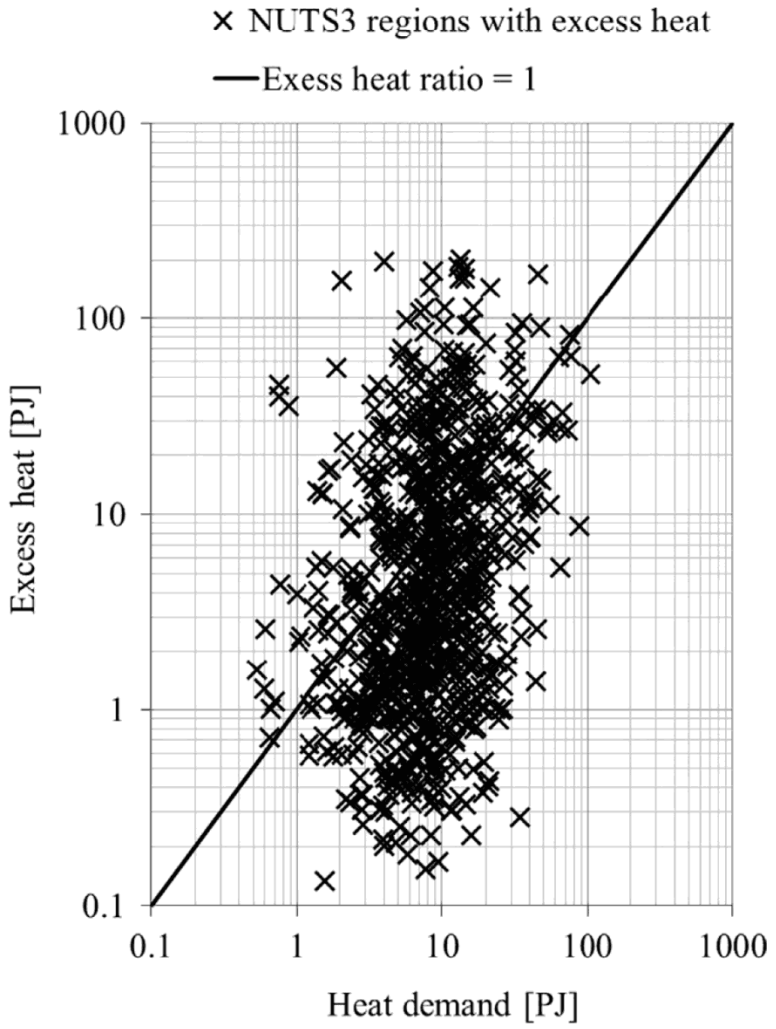
“Too much energy is being wasted: the amount of heat produced from industrial processes and wasted in the atmosphere or into water in the EU is estimated to be enough to cover the EU's entire heating needs in residential and tertiary buildings”

EU Heating and cooling strategy, Press release, Feb 2016

Data source: Persson et al. 2014

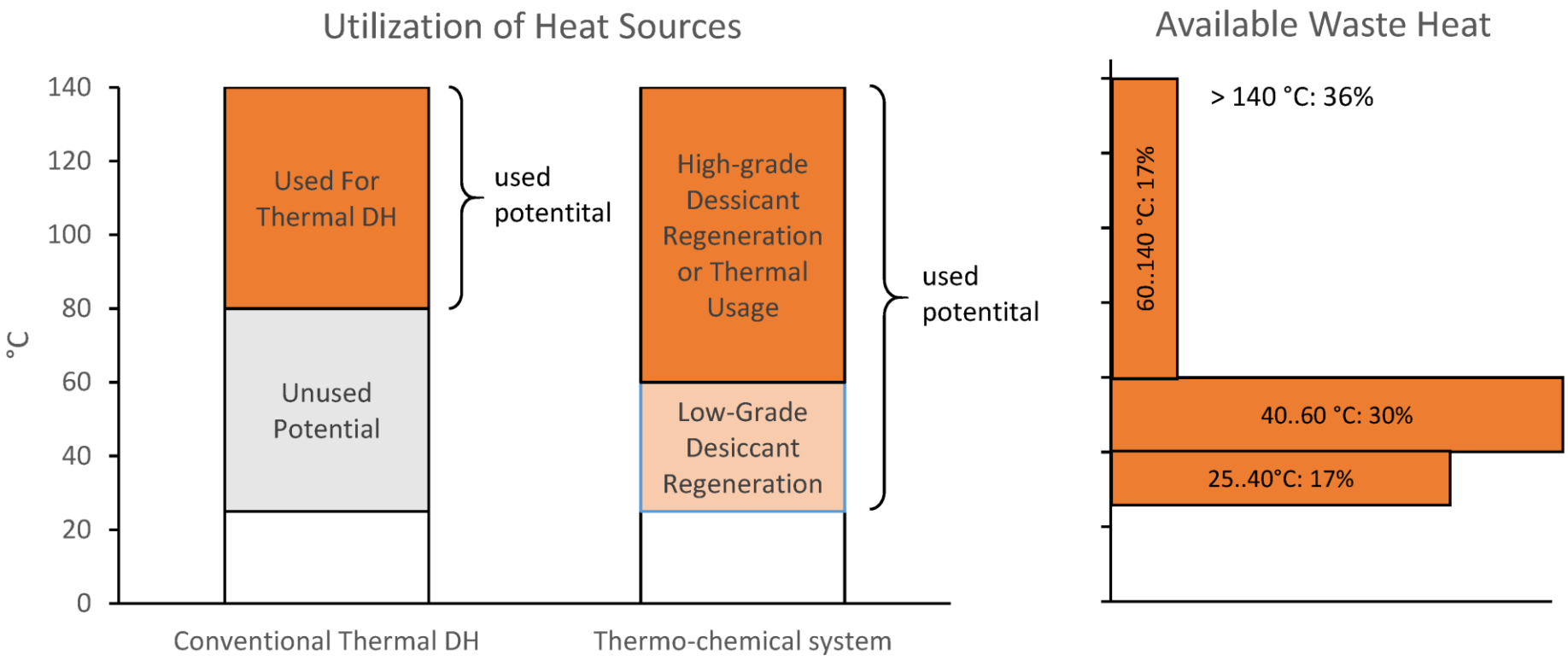
Excess heat vs. heat demand





Source: Persson et al. 2014

Excess heat temperature levels



Data source: Enova, Utnyttelse av spillvarme fra norsk industri - en potensialstudie, 2009.

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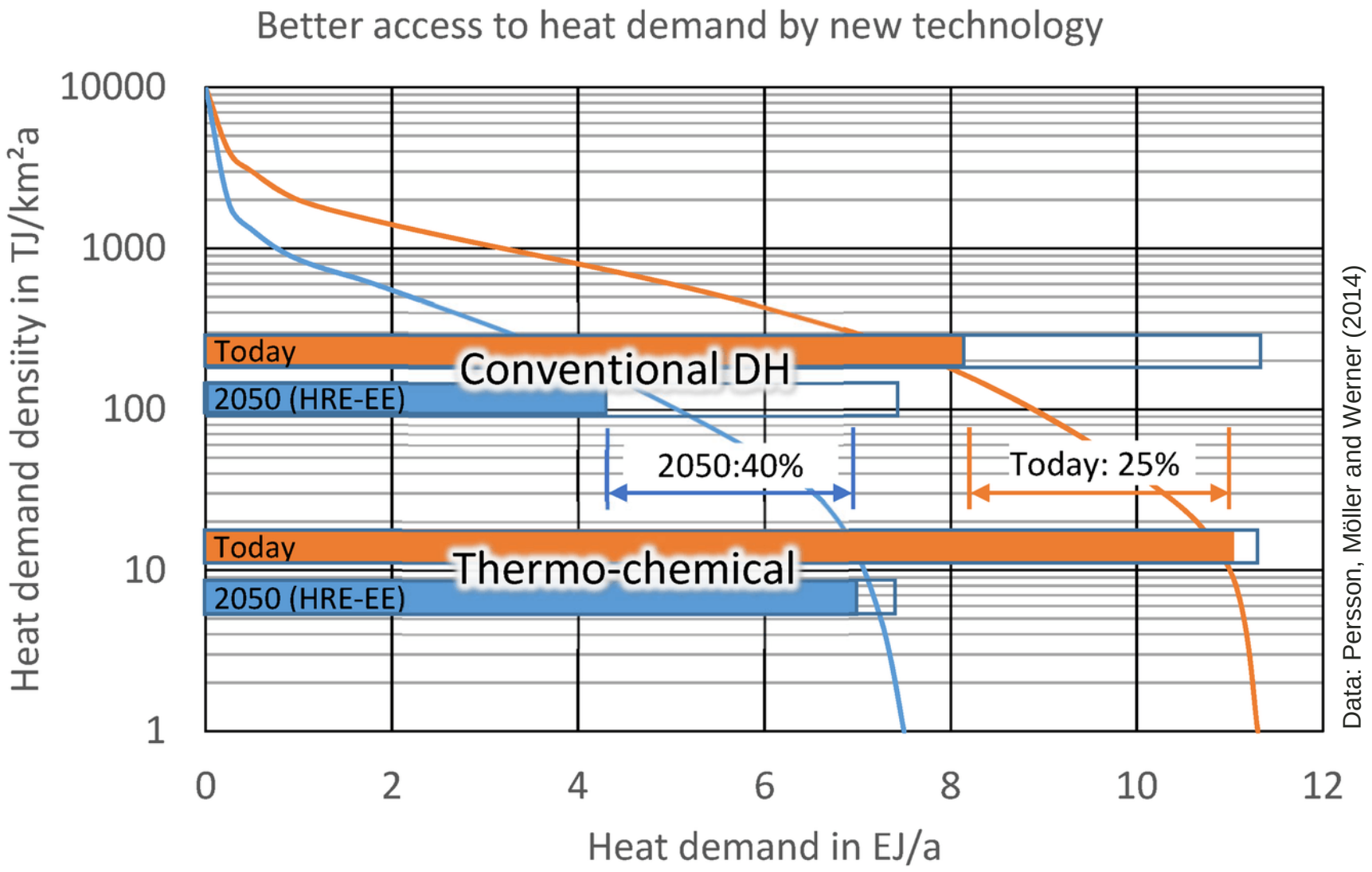
Demand density: Accessing Low-Demand Areas



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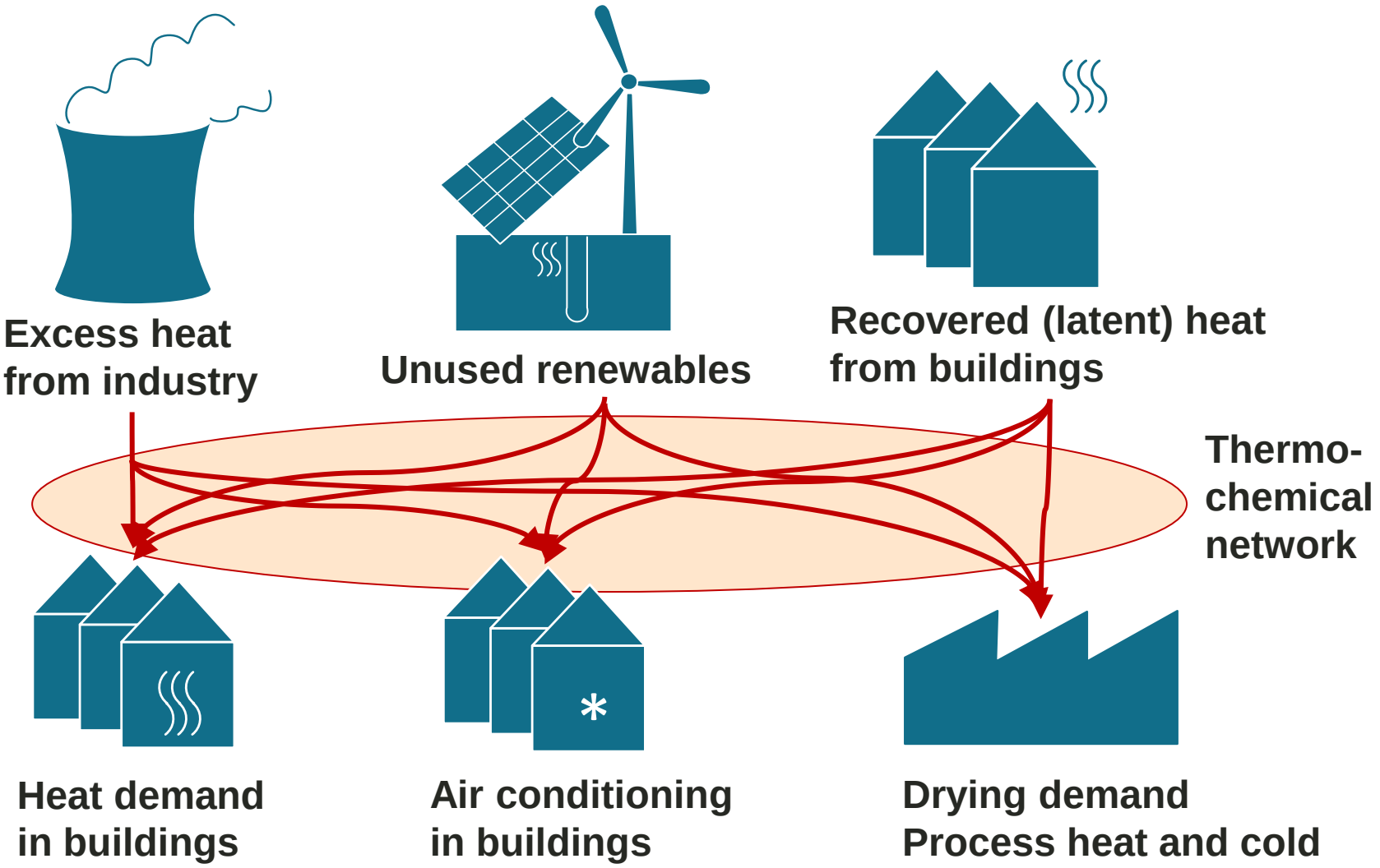
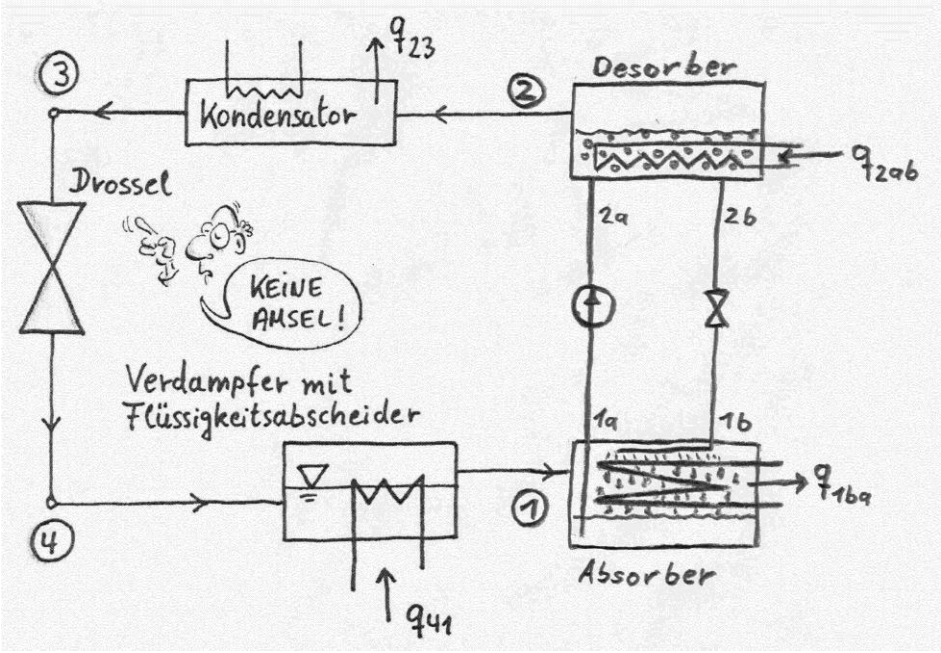
Thermo-chemical district networks

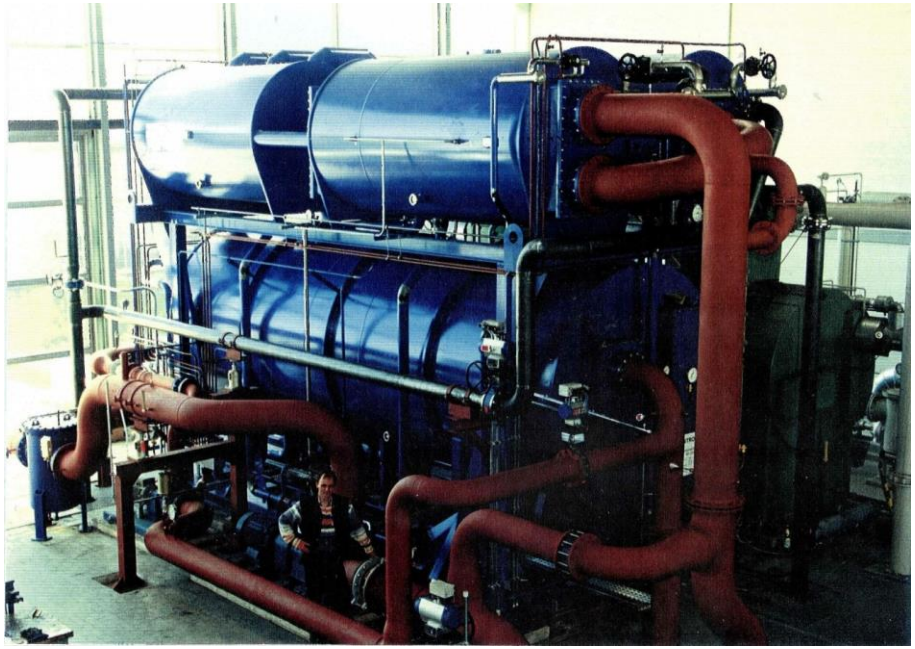


Thermo-chemical networks

Absorption heat pump / chiller — Closed process

- Work medium in TC network: Water
- Absorbent: Hygroscopic salt solution





Absorption chiller airpoort München

Thermo-chemical networks

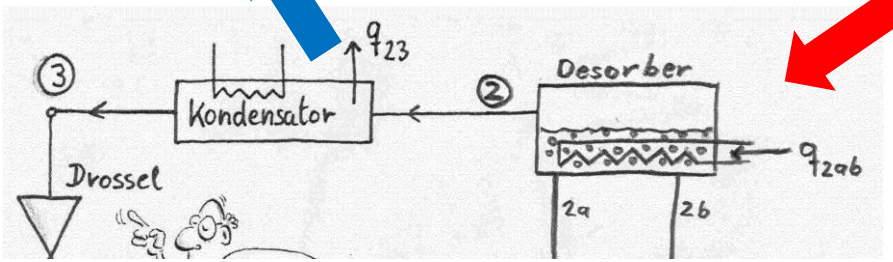
Cutup of the process

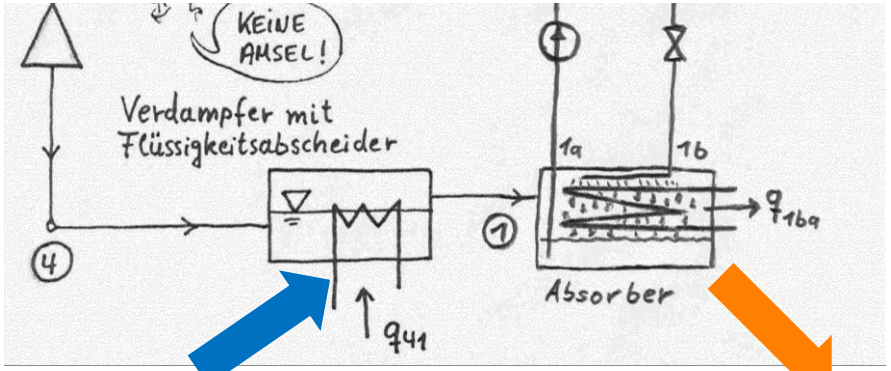
=> Process at different location and time => Lossless transport and storage


Residual heat from regeneration (lower temperature)

Driving heat (high temperature)

Regeneration





Services

Environmental heat

Useful heat

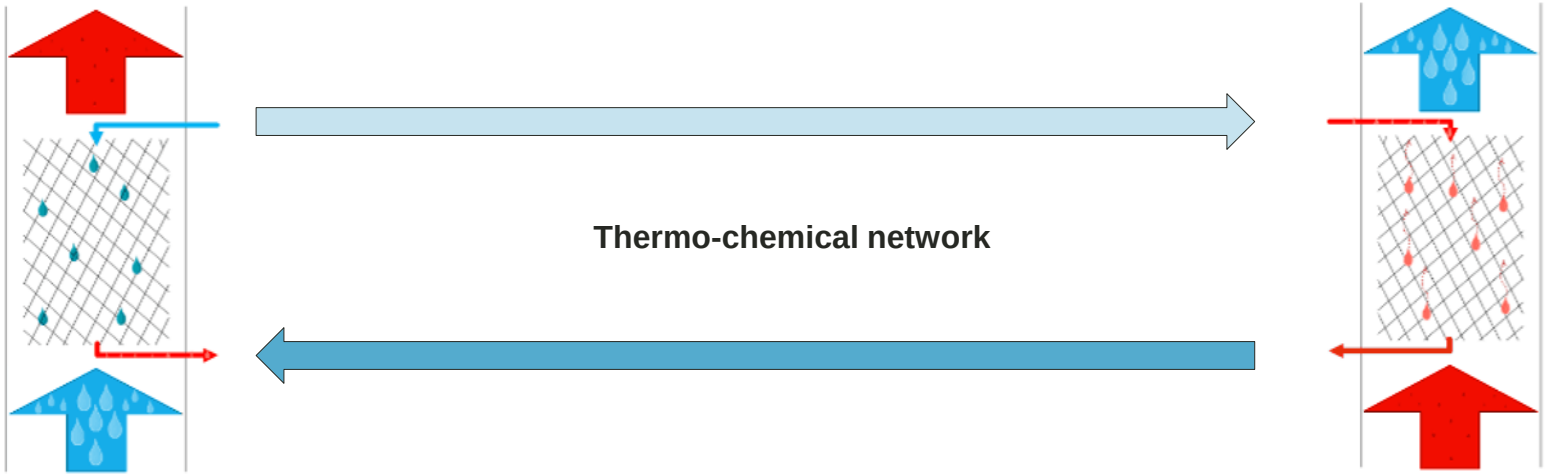
Thermo-chemical technology: Absorption / Desorption

Absorption

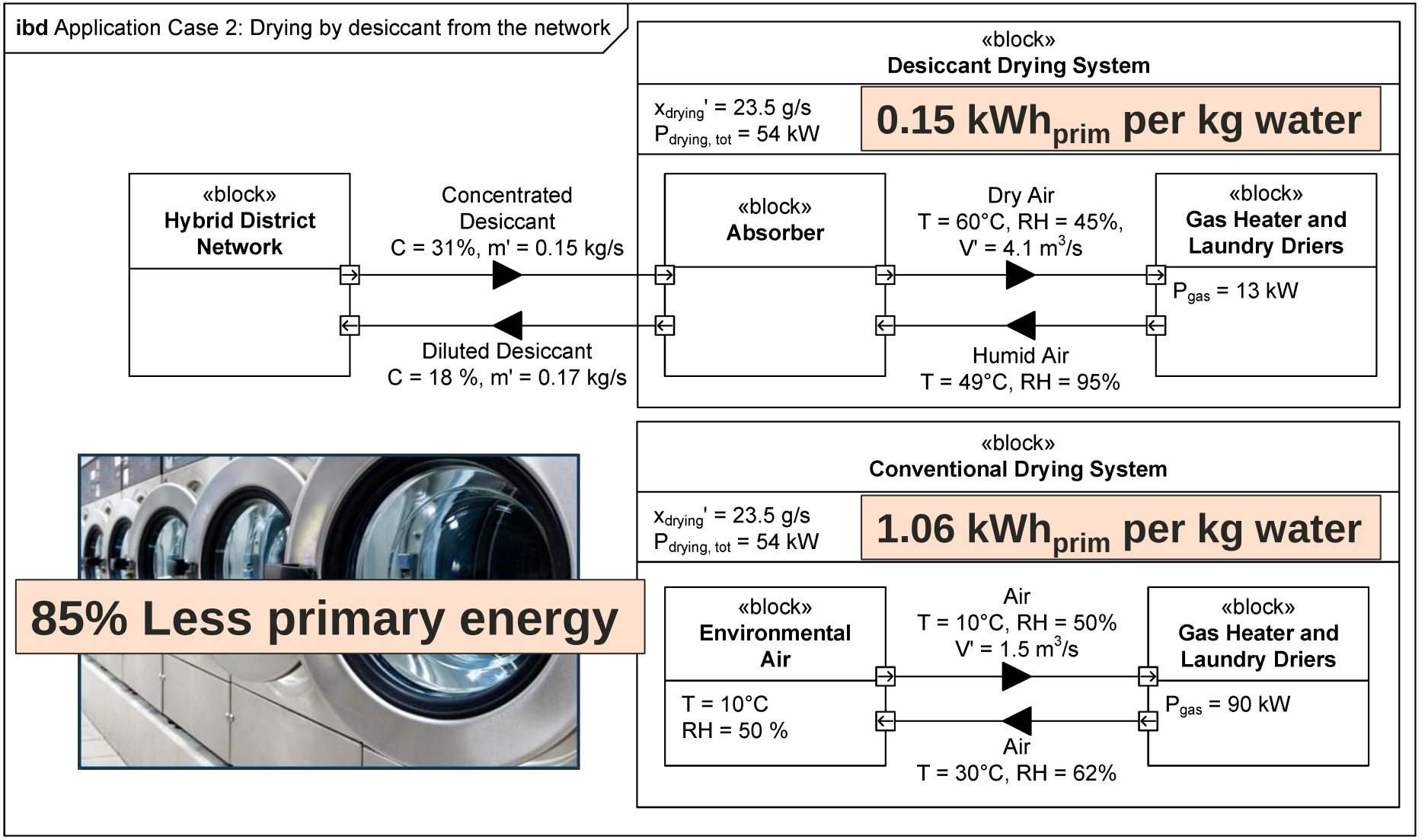
- Humidity uptake
- Heat generation
- Dehumidification
- Cooling supply
- Heat recovery / latent energy recovery

Desorption

- Regeneration by excess heat / renewables
- Air humidification



Technology benefit: Drying



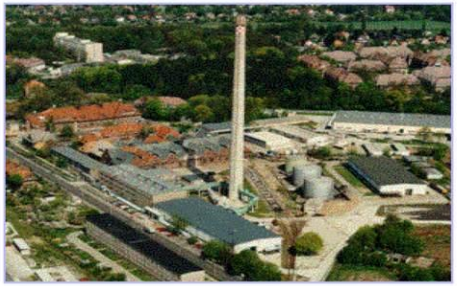
85% Less primary energy

watergy

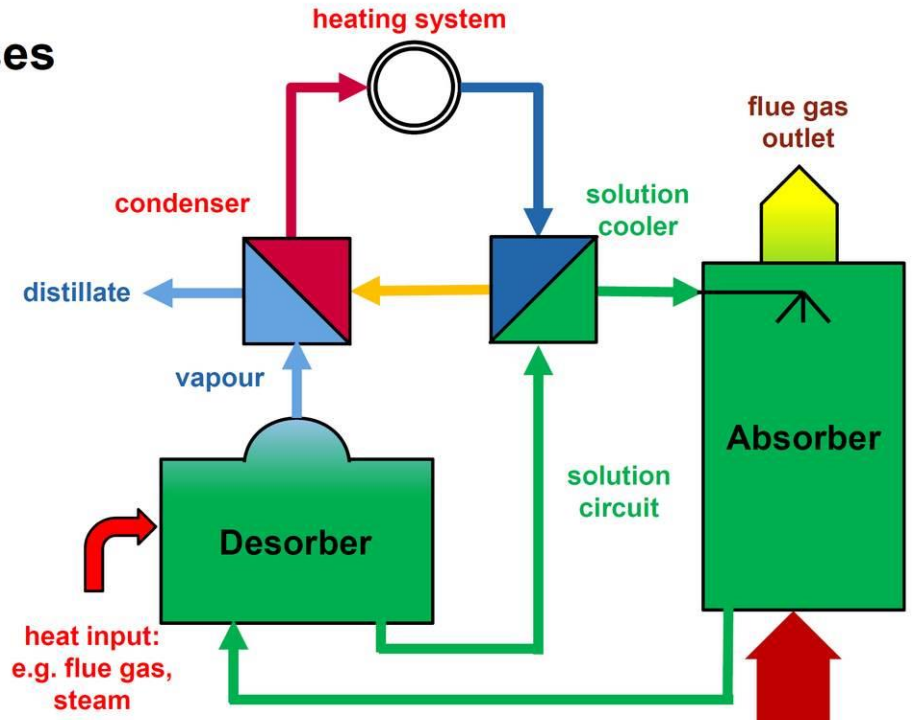
Experiences with absorption processes

Heat recovery with open sorption processes

German Sport
Univeristy, Cologne (D)



Heating plant
Buch-Berlin (D)



Absorption medium:
hygroscopic salt solution

Newcastle University

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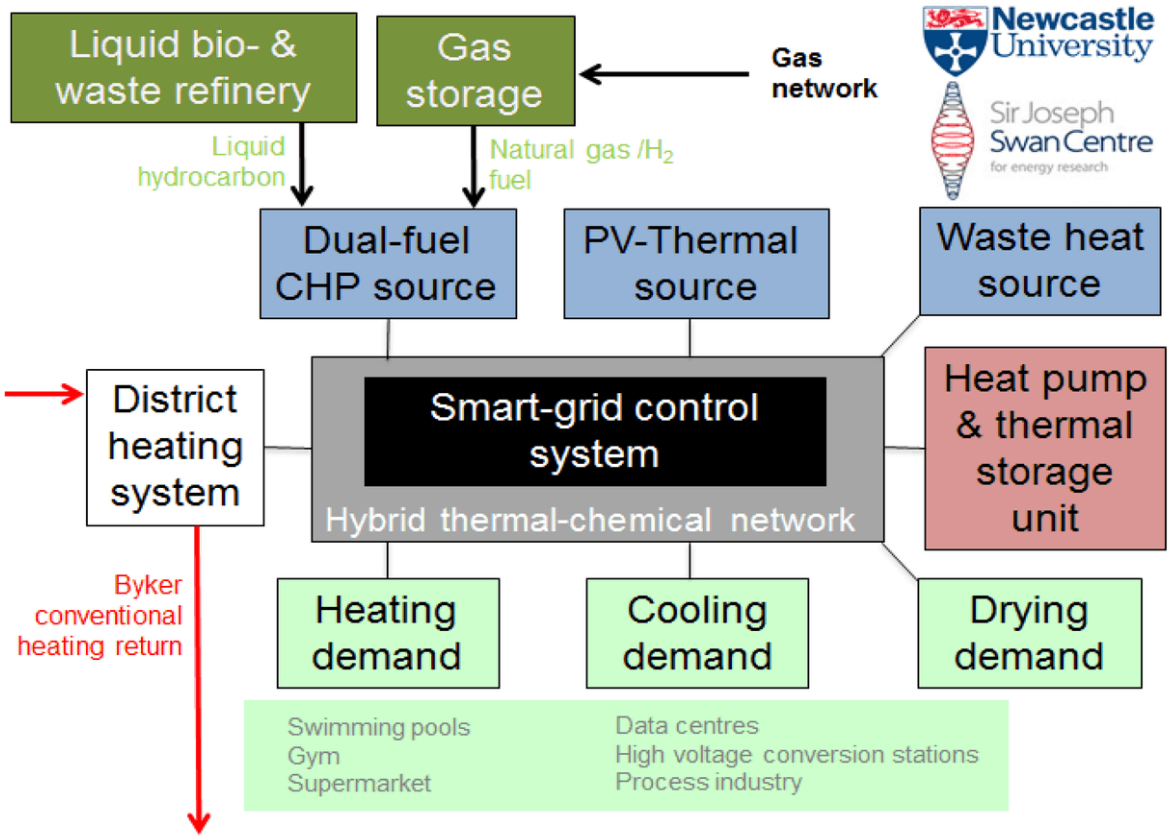
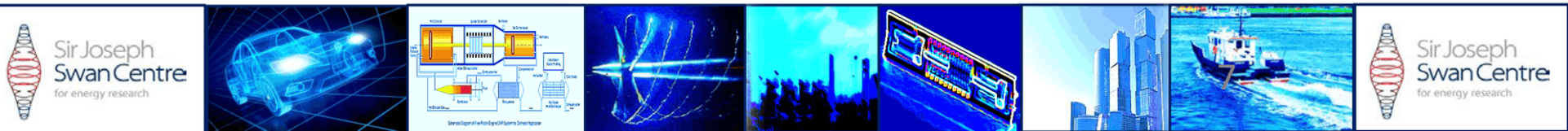
Laboratory demonstrator

"SMART"

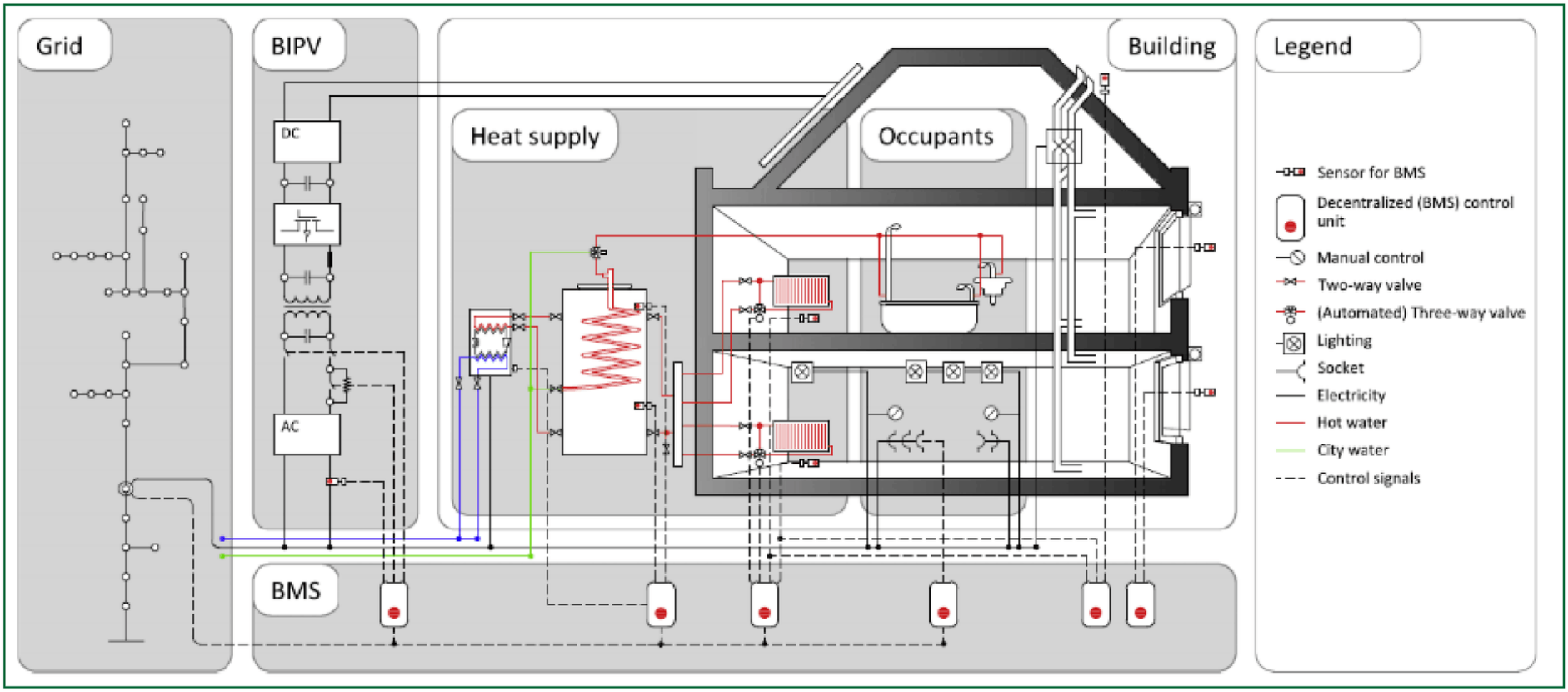
Siemens DEMS control





Example
Integrated District Energy Assessment by Simulation

- Modelica environment to assess PV integration in districts



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Primary copper production process

Aurubis

Making use of residual heat

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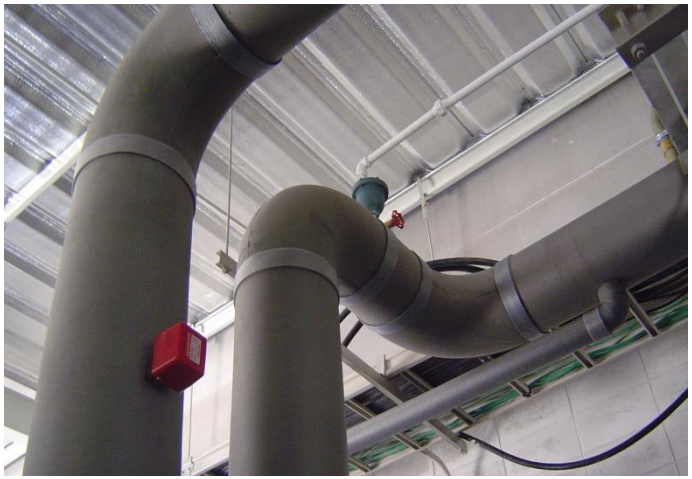
Corrosion free thermal networks

District Heating/Cooling

Indoor heating/cooling



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Conclusions: Thermo-chemical district networks

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Heat sources:
- **Residual heat from industry**
- **Unused renewables (e.g. excess solar thermal in summer or wind power)**
- **DH return flow**

Low temperature renewable energy

Storage for excess power

High temperature excess heat

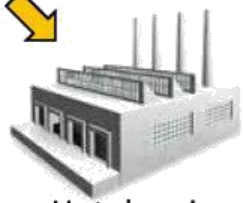
- **Multifunctional smart network**
- **Regeneration and service at different levels possible**
- **Low-grade heat (30 to 60 °C) → Heat cascading**
- **No thermal losses → Long-distance transport (> 50km) → Short and medium term storage**
- **Higher energy density**
- **Different temperature levels**

Medium temperature excess heat

Services:
- **Drying**
- **Space heating**
- **Space cooling**
- **Air conditioning and humidity control**

Low temperature excess heat

Warm air with humidity control



Hot dry air for drying process