INTERNATIONAL ENERGY AGENCY

District Heating and Cooling, including the integration of CHP

District Heating Futures Seminar/Workshop

31.8.–1.9.2009 Gustavelund, Tuusula, Finland

Storage systems and DH

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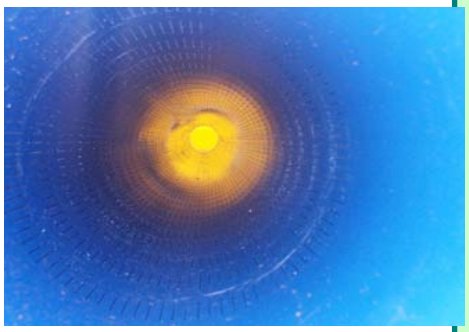
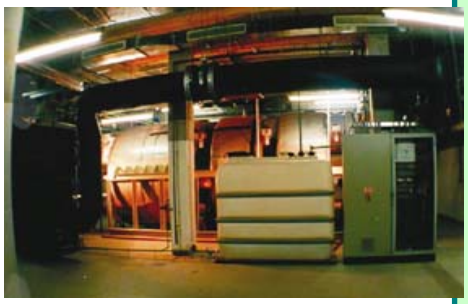
International Energy Agency

Energy Conservation through Energy Storage Programme

The Implementing Agreement ECES was established in 1978

Internet homepage www.iea-eces.org





Participating countries and corresponding organizations

1. **Belgium**, Ministry of Economical Affairs
2. **Canada**, Public Works and Government Services Canada
3. **Finland**, Technology Development Centre TEKES
4. **France**, TREFLE/CNRS
5. **Germany**, Forschungszentrum Jülich GmbH
6. **Japan**, Heat Pump & Thermal Storage Technology Center of Japan
7. **Korea**, Korean Institute of Science and Technology
8. **Norway**, Geological Survey of Norway
9. **Sweden**, FORMAS
10. **Turkey**, Çukurova University
11. **United States of America**, Department of Energy
12. **IF Technology** (The Netherlands), as a sponsor
13. **Institute of Heat Engineering** of the University of Technology Warsaw (Poland), as a sponsor

Ongoing Annexes

- Annex 18 **„Transportation of Thermal Energy Utilizing Thermal Energy Storage Technology“**, 2006 – 2009, member countries: **Sweden**, Germany, Japan

  http://www.webforum.com/annex18/home/index.asp?sid=3741&mid=1

  Operating Agent: Dr. Viktoria Martin, KTH -- Royal Institute of Technology, E-mail: vmartin@kth.se

- Annex 19 **„Optimised Industrial Process Heat and Power Generation with Thermal Energy Storage“**, 2006 – 2009, member countries: **Germany**, France

  Operating Agent: rainer.tamme@dlr.de

Ongoing Annexes

- Annex 20 **„Sustainable Cooling with Thermal Energy Storage“**, 2005 – 2008, member countries: **Japan**, Canada, Germany, Sweden,Turkey

  http://www.hptcj.or.jp/annex20/index.html

  Operating Agent: surakha@eng.hokudai.ac.jp <surakha@eng.hokudai.ac.jp>

- Annex 21 **„Thermal Response Test for Underground Thermal Energy Storage“**, 2007 – 2010, member countries: **Germany**, Sweden, Japan and Turkey

New Annexes

- **Annex 22 „ Thermal Energy Storage Applications in Closed Greenhouses “**

  Contact: Frank.Cruickshanks@ec.gc.ca

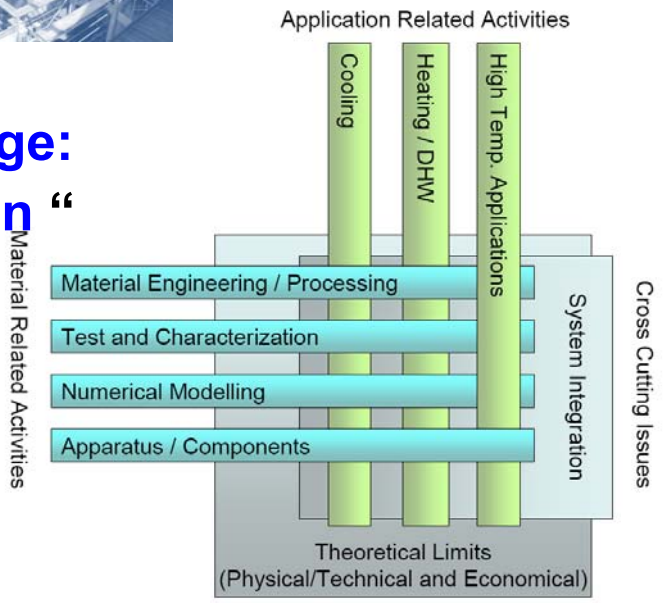
- **Annex 23 „ Applying Energy Storage in the Buildings of the Future“**

  Contact: Ed.Morofsky@PWGSC.GC.CA

- **Annex 24 „ Compact Thermal Energy Storage: Material Development for System Integration “**

  17 countries. **(Joint Activity with the SHC IA Task 42)**

  Operating Agents: ECES: Andreas Hauer, ZAE Bayern (DE) and SHC: Wim van Henden, ECN (NL)

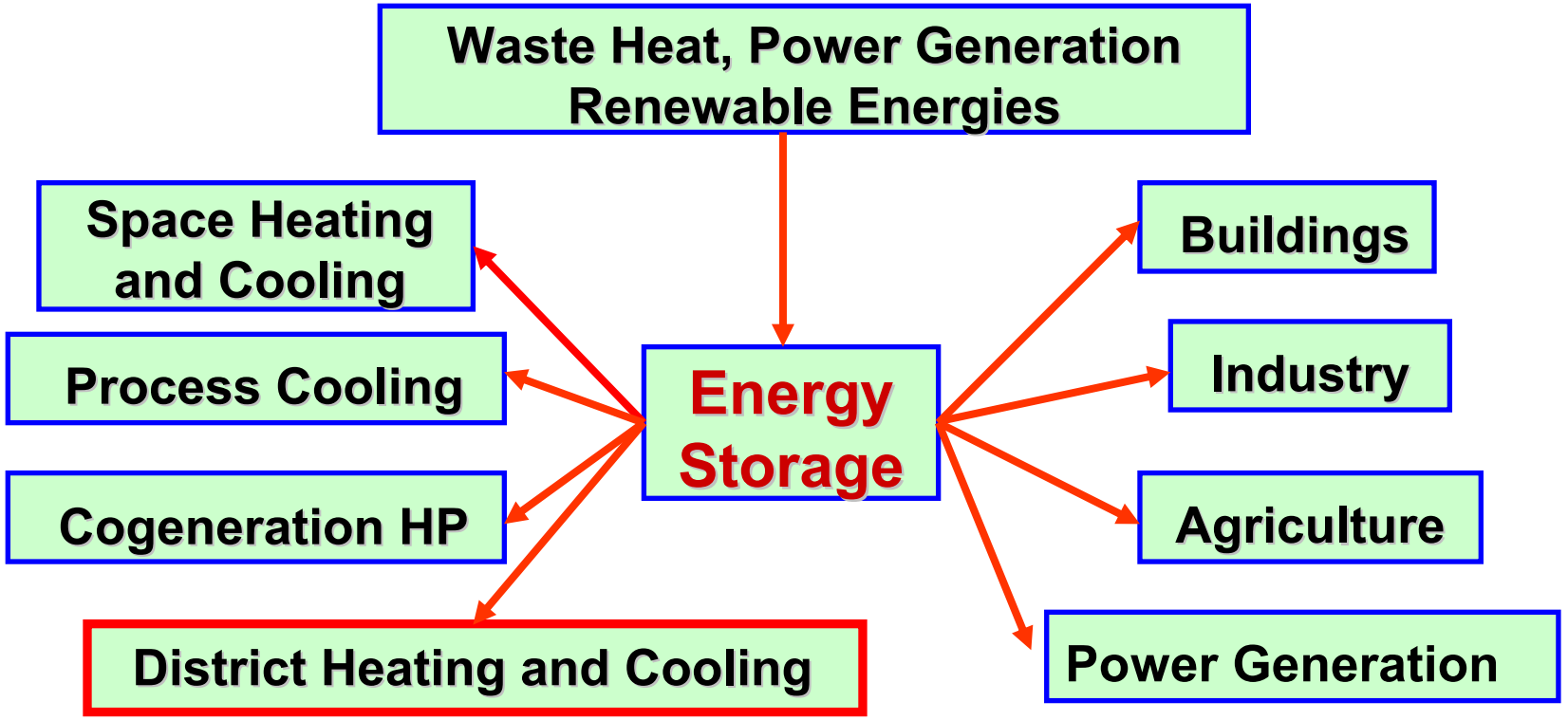


Matrix approach

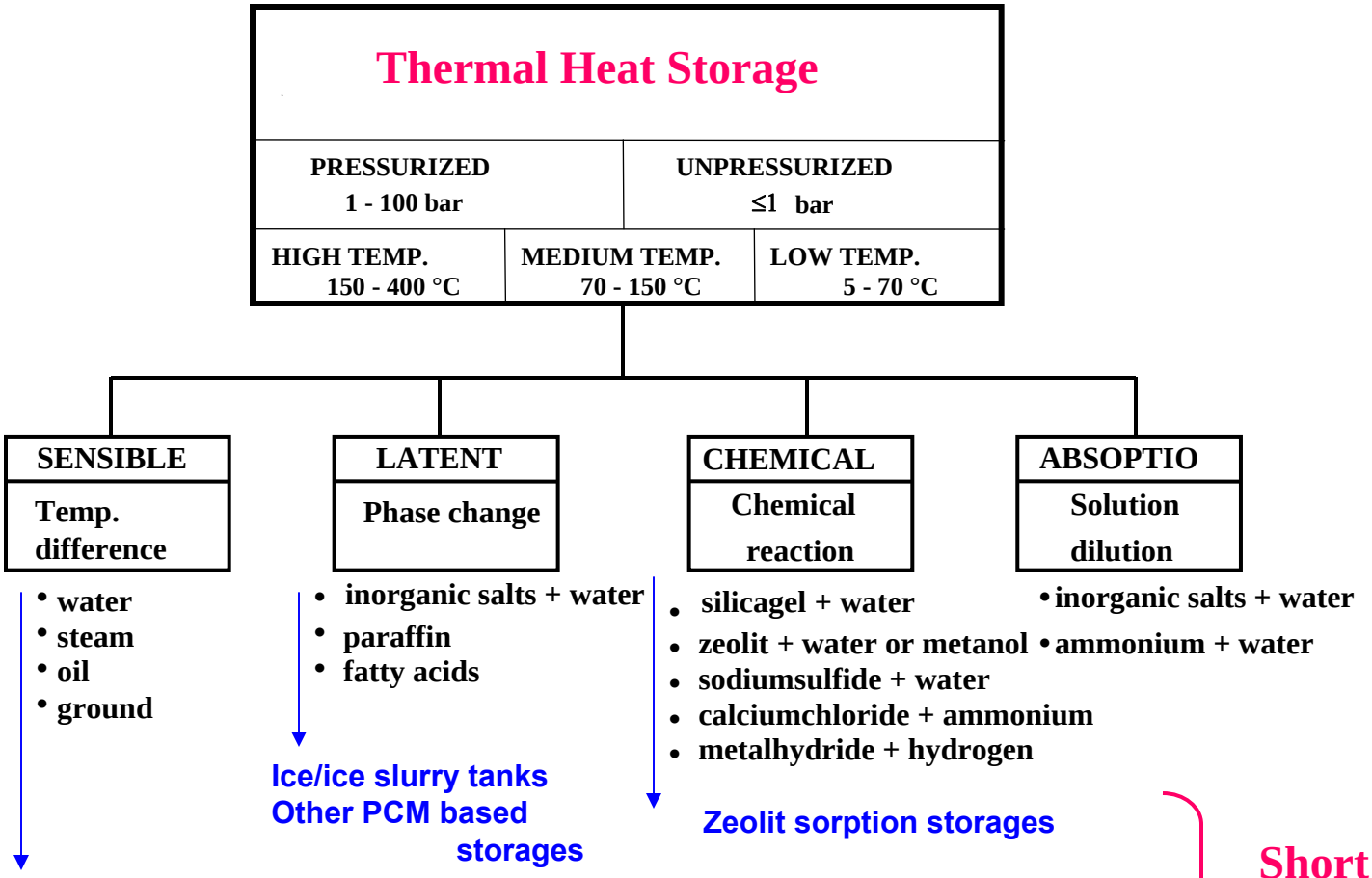
Activity areas:

- Storage of thermal energy (heat and cold)
- Storage of electrical energy (batteries, CAES…)
- Seasonal storage (ice, renewable energies)
- Energy Transport (container, slurry…)

=>Energy Storage : <u>Central component in energy efficient systems</u>



Thermal Heat Storage (TES)



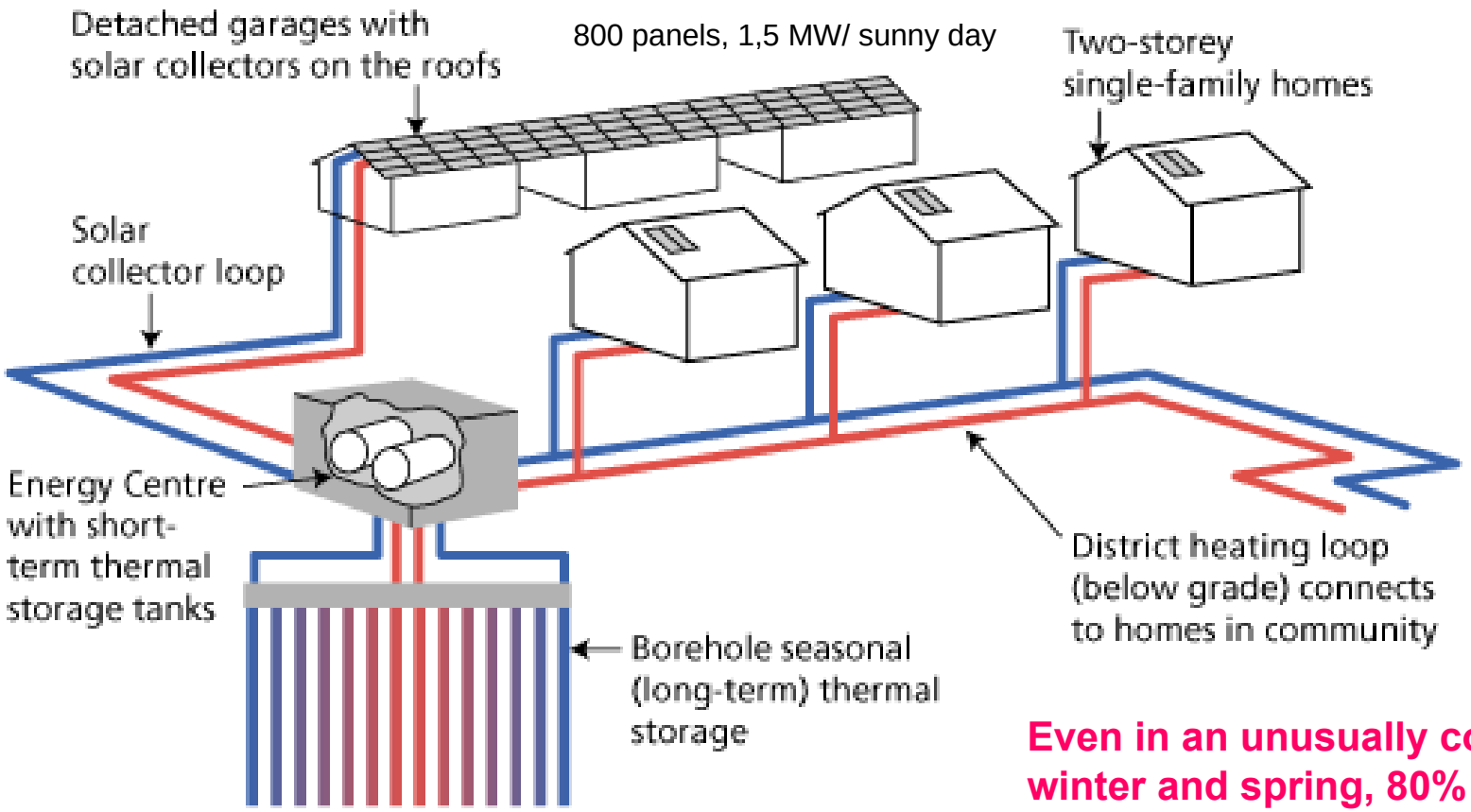
Short term and long term storages for district heating and cooling applications !

Thermal Heat Storage (TES)
Large long term storages

	Concrete or steel tank	Basin with total insulation	Basin with top insulation	Rock cavern	Aquifer	Earth bed	Vertical tubes in clay	Drilled wells
Specific thermal capacity kWh/m3K	1.16	1.16	1.16	1.16	0.75	0.70	0.80	0.63
Reference ΔT /°C	55	55	55	55	55	55	15	55
Typical storage efficiency	0.90	0.85	0.70	0.80	0.75	0.60	0.70	0.70
Size range /m3	0-100 000	0-75 000	0-50 000	50 000-300 000	50 000-500 000	0-100 000	50 000-300 000	50 000-400 000

ATES using heat pumps!

Examples of storages and DH&C: Solar Seasonal Storage and District Loop



Even in an unusually cold winter and spring, 80% of the required heat is expected to come from the sun!

Source: www.dlsc.ca

District heating system in Drake Landing Solar Community, Alberta, Canada

Examples of storages and DH&C: Geothermal

Geothermal District Heating

Geothermal district heating for the historic city Ferrara in Italy
Combination with heat from municipal waste incineration plant

Pump house and warm water storage tanks

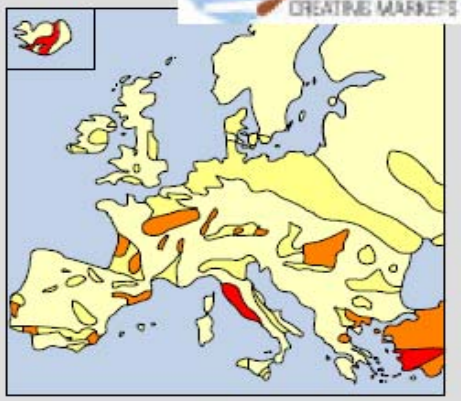
Geothermal district heating for Zakopane, Poland
Pumps and heat exchangers

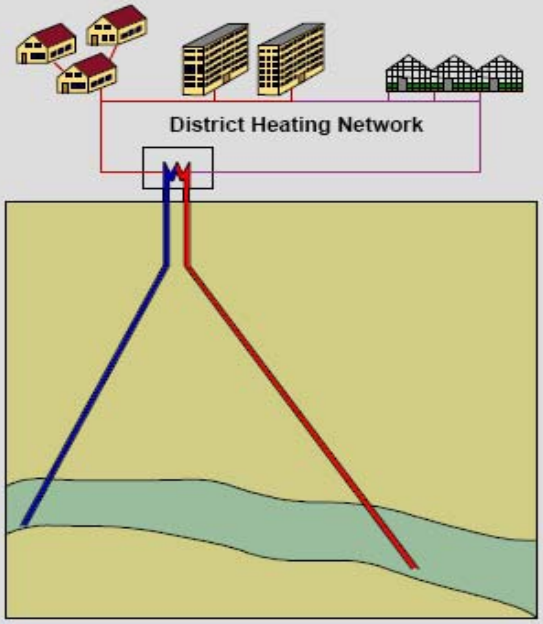
European Geothermal Energy Council

Examples of storages and DH&C: Geothermal

Geothermal District Heating

doublet systems, used since the late 1970s in France and since 1984 in (Eastern) Germany

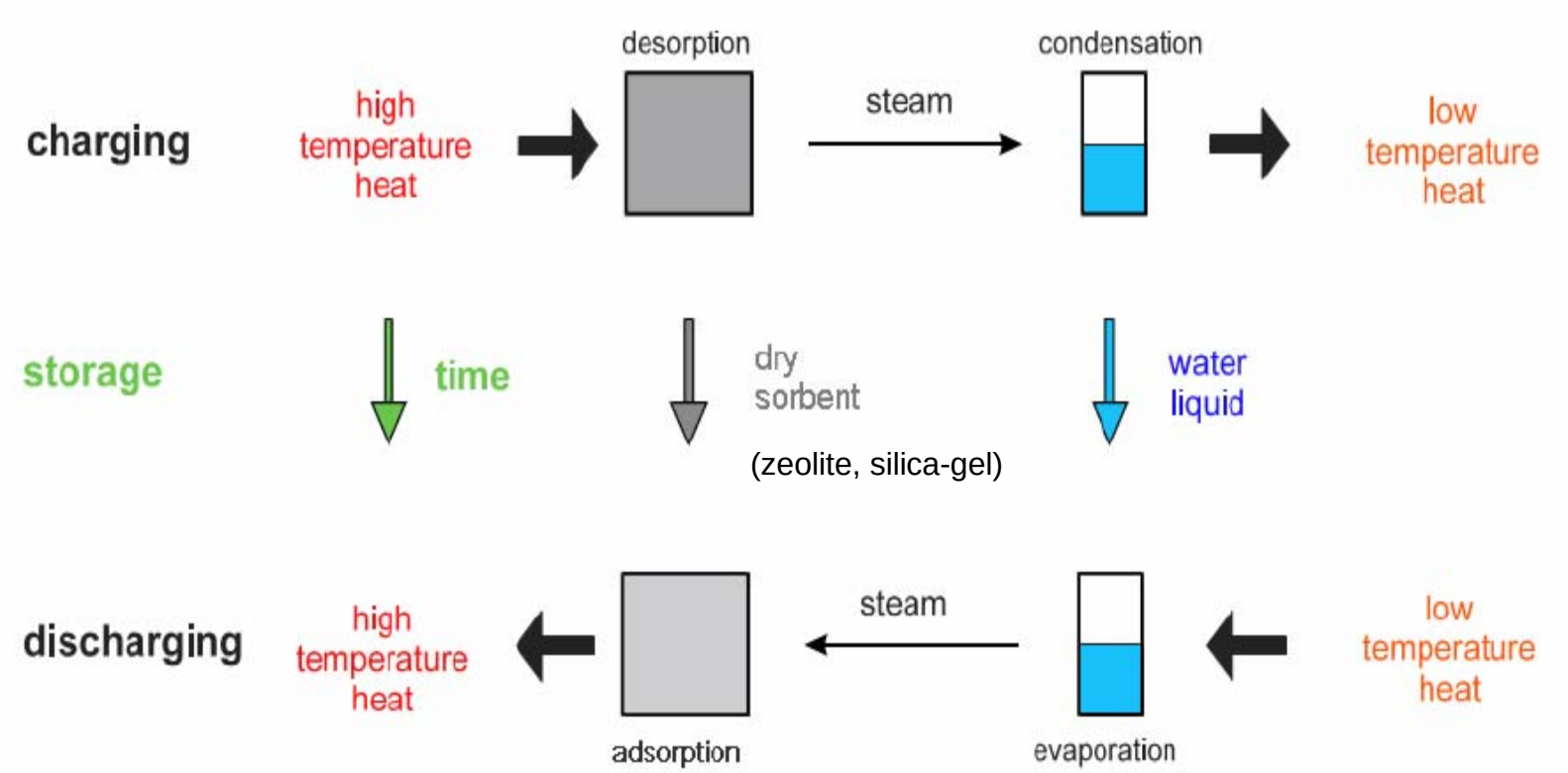




Geothermal heating plant Neustadt-Glewe photo O. Joswig

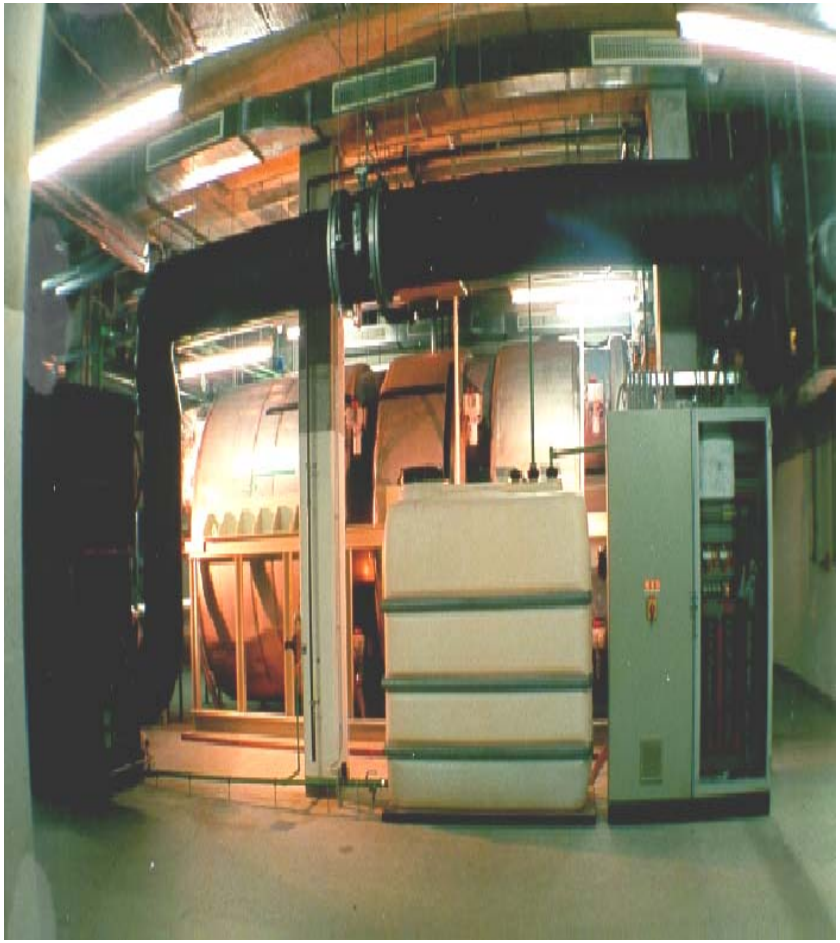
European Geothermal Energy Council

Examples of storages and DH&C:
Open Sorption Storage for Heating and Cooling



H. Müller-Steinhagen, 2008

Examples of storages and DH&C:
Open Sorption Storage for Heating and Cooling



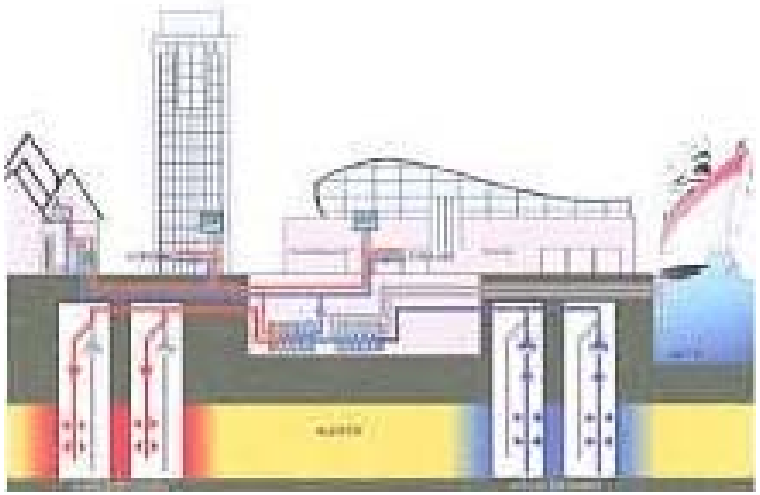
Mass of Zeolite	7000 kg
Max. air flow	6000 m³/h
Max. heating power	130 kW
Max. cooling power	50 kW
Energy density (heating)	up to 200 kWh/m³
Energy density (cooling)	up to 100 kWh/m³

Thermochemical Storage Pilot Plant for Heating and Cooling of School Building and a Jazz Club in the District Heating System of Munich

Examples of storages and DH&C: Aquifer Thermal Energy Storage (ATES) in Amsterdam

Sustainable heating and cooling for the Oostelijke Handelskade project

- **Passenger terminal, office buildings, hotel, arts centre and apartments**
- **Various energy demand patterns**
- **Heat and cold demand 8.2 MW and 8.3 MW respectively**



Examples of storages and DH&C: Aquifer Thermal Energy Storage (ATES) in Amsterdam

Centralized aquifer thermal energy storage system in combination with decentralized heat pumps.

- Balancing supply and demand of thermal energy:
  within each building / between the buildings / using aquifer storage
- Seasonal storage of surplus heat and cold
- Heat pump capacity 6.5 MW, two warm and two cold wells (total flow rate 500 m^3/h)
- Use of surface water to balance the system thermally.

Results

- Energy saving 50% as compared to conventional heating and cooling
- Reduction of energy losses due to low temperature heating and high temperature cooling
- Energy rates comparable to conventional system

Future DH and Energy Storages

Future challenges:

- ✓ More efficient systems!
- ✓ Combined DH and DC!
- ✓ Increased use of renewables!
- ✓ Decreased dependency on fluctuating fuel prices!

A solution:

Increased use of energy storages!

„The Role of Energy Storage in Future Energy Systems “

Workshop:
October 21-23 2009
Bad Tölz
Germany

Aim of the workshop is to find ways of better coordination between the different activities on energy storage within the IAs of the IEA.

Contact: hauer@muc.zae-bayern.de

Thank you very much for your attention!

Is that all you saved from last summer? Energy Storage helps to conserve Energy and to protect the environment!