Cooling with “Geothermal, Waste or Solar” Heat

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**Introduction De Beijer RTB:**

**Profile:**
- Engineering company with 30 years of experience in renewable energy solutions and products.
- Many international cooperation’s with institutes and universities.
- Various renewable energy products successfully launched to the market in the past.

**Main activity:**
De Beijer RTB is mainly active in the field of Solar, thermo-chemical-energy storage and thermo-chemical conversion technology.

**Main projects:**
Problems with building cooling?
Comfort spectrum

Eine bestmögliche thermische Behaglichkeit ergibt sich im inneren blauen Feld (3), also bei einer Raumtemperatur von etwa 20 bis 25 °C (Winter/Sommer) und einer relativen Raumluftfeuchte von 30 bis zirka 60 % (Winter/Sommer).
Growing Demand for air conditioning

Trend of World Demand for Air Conditioners

- World Total
- China
- Asia (excl. Japan & China)
- Europe
- North America

JRAIA
Key players and market drivers

- Consumer Building manager
- Heat generating company
- District heating company
- Property developer Housing company
- Excess of heat summer

Growing demand for cooling driven by improved insulation
Demand for improved living comfort
Legislation reduction F-gases

Declining demand for heat
Less heat sales summer
Growing demand for cooling

Legislation Europe: EPBD, EED
National government

EPC requirements
Growing demand for houses equipped with cooling
GIW: Compulsory guarantee energy installation
Requirements local authorities district heating
**Cooling is a must**
- Shifts in comfort culture, behavioural patterns, affordability and consumer expectation
- Perception that comfort cooling contributes to higher productivity
- Direct impact on rental value of commercial buildings
- Increase in internal loads (computers etc.)

**Cooling is also business**
- 10% of electricity used for cooling (global) and 16% in US
- > 80% of commercial and institutional buildings in USA and Japan has air conditioning
- < 40% in EU, but expanding rapidly, 60% is expected by 2020
District heating: excess heat in summer
Geothermal & Cooling
Soultz, Alsace, Fr.

Production 5 km depth at 200°C & Organic Rankine Cycle (ORC) -> 2 MWe -> re-injected temp 70°C
Geothermal in the world

Geothermal Power Plants

Hottest Known Geothermal Regions
Geothermal in Nevis
Geothermal in the Netherlands

<table>
<thead>
<tr>
<th>Nr</th>
<th>Locatie</th>
<th>Toevoeging</th>
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<tbody>
<tr>
<td>1</td>
<td>Aalsmeer e.o.</td>
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<td>2</td>
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IEA Task 28 Arnhem Netherlands energy storage & geothermal
Concentrating solar energy for electricity or heat

A power of tower near Seville

Bright Source Energy California

Electric Power Research based in Palo Alto
Solar island District heating ‘Almere’

Flat Plate Collectors 7000 m² Production 10,000 GJ/y at 75 C
Energy storage and conversion
Heat-driven cooling

Zonne-energie

Warmtenet

Warmtekracht-koppeling

SolabCool
The best comfort with pure energy
SolabCool product range

SolabChiller

SolabCascade
Cooling office incineration plant AVR Duiven
Residential
Absorption Chiller fed with heat from a district heating network

Two 3.5 MW absorption chillers for district cooling network making use of the heat delivered by the district heating system of the city of Helsinki. These units are installed in a rock cavern under the ground.

Chilling Capacity: 2 x 3,500 kW
Driving Heat: 80°C / 69°C
District Cooling in Europe cities

Amsterdam 76 MW Freecooling/Absorption chillers
Barcelona 66 MW
Helsinki 60 MW
Lisbon 40 MW
Stockholm 188 MW
Paris
Berlin
Cooling on District level
# Energy density of the materials

<table>
<thead>
<tr>
<th>Storage density</th>
<th>Hot water</th>
<th>Phase change materials</th>
<th>Thermochemical</th>
<th>Electrical Batteries</th>
<th>Chemical Looping</th>
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<tr>
<td>&lt; 0.2 GJ/m³ (&lt;dT= 50°C)</td>
<td>&lt; 0.3 GJ/m³</td>
<td>~ 1 GJ/m³</td>
<td>~ 1 GJ/m³</td>
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<th>minutes-months</th>
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<th>Electrical</th>
<th>Electrical &gt; thermal</th>
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| Cycling efficiency       | ~ 70%            | ~ 90%                  | ~ 90%          | 75%                  | 70%                 |
Chemical Looping Combustion for Energy Storage Applications
Solar/Heat /Cold storage distribution system
Company ‘Principles’

- Spirit
- Reliability
- Flexibility
- Innovation
- Fun

It’s our Competence that makes the difference
District Heating Units
Electrical Heatpump boiler

Inclusie mechanische ventilatie
Storage and conversion 1st generation

District heating

Automotive airco
Product characteristics

Sunridge > 3 tubes system:
Performance: 2,5 GJ/yr
Ridge integrated solution
No use of space indoors
Optimal irradiation
Independent of orientation
Electrical Heatpumps

Geotherm

Energion ®
Heatpipe for renovating electrical boilers to Solarboiler