
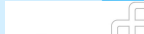


Green energy and Cooling

Get the best comfort with pure energy !

Warmte Netwerk


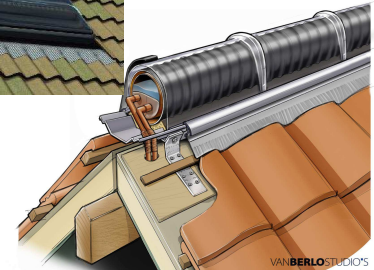



Who is De Beijer RTB ?

- In business since **1985**
- **Specialized in:**
 - Business development
 - Feasibility studies
 - Product development.

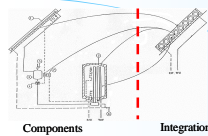
Major projects:

- **Evaluation studies** for the Dutch government on Solar, Heatpumps and Energy storage
- **Feasibility studies** and implementation for the Utilities on heatpumps in houses.
- **Product development:**
 - Heatpump boiler
 - Heatpump for housheating and hotwater production
 - Solar integrated colector storage system
 - Ridge collector
 - Solid absorption heatpump/cooling

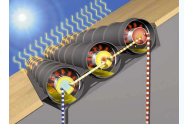




VANBERLOSTUDIO'S



Integration



Components **Integration**


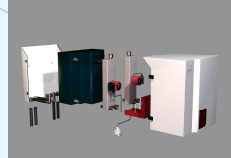



Ridge Collector







Electrical Heatpumps


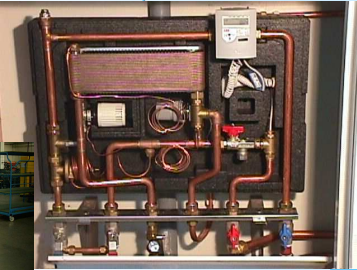

Geotherm

Energion ©

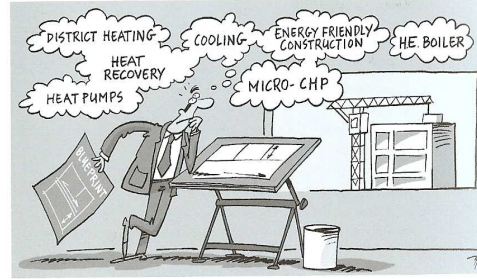
District Heating Units

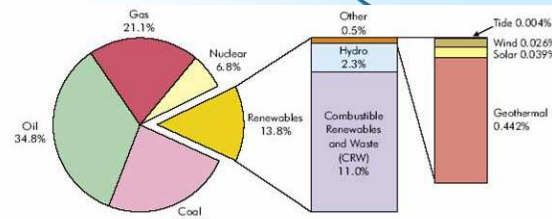
Energy /CO₂ targets in the EU/Netherlands

- reduction of greenhouse gases **30%** in 2020 compared to 1990.
- energy saving increased from 1% to **2%** every year
- renewable energy increased from **3%** (NL) / **6%** (EU) to **20%** in 2020.

What kind of action we expect from the Markets or the Governments?



World Energy and Renewables



Source: IEA

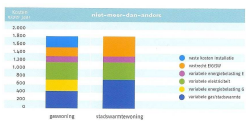


Kosten Stadsverwarming

Kostenvergelijking gas - stadswaarme, inclusief elektriciteit 2005

Verbruik a.b.w. marktonderzoek (woning / jaar)	
Stadswaarme	35,00 GJ
Elektriciteit stadswaarme	4,200 kWh
Gasverbruik	1,480 m ³
Elektriciteit bij gas	4,20 kWh

Darleen (inclusief BTW)	
aanpak per m ³	€ 3,200
Energiebesparing (NEB) aardgas per m ³	€ 0,278
Elektriciteit per kWh	€ 0,203
Energiebesparing (NEB) elektriciteit per kWh	€ 0,203
Stadswaarmegris per GJ	€ 24,7
Verbruik gas per jaar	€ 166,65
Verbruik elektriciteit per jaar	€ 85,67
Verbruik stadswaarme per jaar	€ 252,32
Verbruik warm kraanwater per jaar	€ 92,40
MIP-losting per jaar	€ 25,00
Algemene terugloop energiebesparing per jaar	€ -250,86

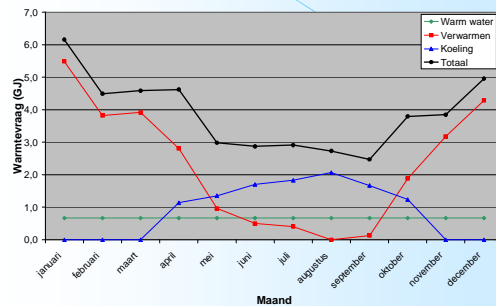


Voorbereiding gas	
Kosten aardgas	€ 495,60
Kosten energiebesparing aardgas	€ 306,50
Verbruik aardgas	€ 166,65
Stadswaarmegris	€ 85,68 (incl. energiebesparing)
Verspreidingskosten co-katal	€ 44,75 (incl. energiebesparing)
Vermeden investering warm kraanwater voor huishoudelijk gebruik	€ 93,45 (incl. energiebesparing)
Kosten elektriciteit	€ 82,40
Kosten energiebesparing elektriciteit	€ 362,29
Verbruik elektriciteit	€ 82,47
MIP-losting	€ 25,00
Algemene terugloop energiebesparing	€ -252,86
MIP-losting	€ 1,896,26

Voorbereiding stadswaarme	
Kosten stadswaarme	€ 760,06
Verbruik stadswaarme	€ 294,48
Verbruik warm kraanwater	€ 92,40
Kosten elektriciteit	€ 82,47
Kosten energiebesparing elektriciteit	€ 362,29
Verbruik elektriciteit	€ 82,47
MIP-losting	€ 25,00
Algemene terugloop energiebesparing	€ -250,86
MIP-losting	€ 1,896,26

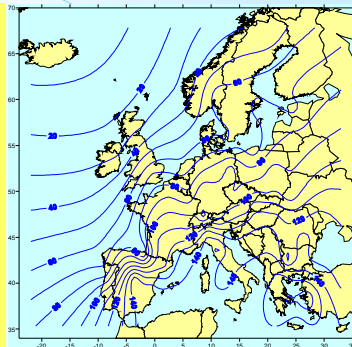
Bron: Samen en Slimmer voor Marketing Analyse NV

District Heating and Cooling



The European Cooling Index (ECI)

European cooling index (ECI) in a contour map computed from information from 80 urban locations in Europe. The average space cooling demand should be proportional to this index.



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Cooling is a must

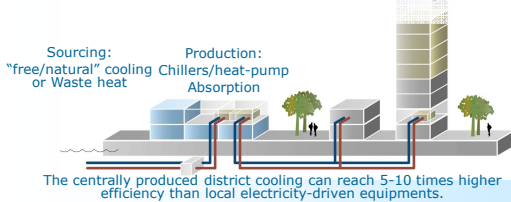
- Shifts in comfort culture, behavioural patterns, affordability and consumer expectation
- Perception that comfort cooling contributes to higher productivity
- Direct impact on rental value of commercial buildings
- Increase in internal loads (computers etc.)

Cooling is also business

- **10%** of electricity used for cooling (global) and 16% in US /Caribbean
- **> 80%** of commercial and institutional buildings in USA and Japan has air conditioning
- **< 40%** in EU, but expanding rapidly, **60%** is expected by 2018

Fundamental idea of district cooling

“The main idea of district cooling is to use local sources for cooling that otherwise would be wasted or not used, in order to offer the local market a competitive and high-efficient alternative to the traditional cooling solutions.”



Ecoheatcool

- Cooling demand is growing faster than expected and has a growing impact on (peak) electricity demand in summer
- DC is a solution of choice due to highest efficiency and use of renewable sources
- 25% market share of DC by 2020 is feasible and would significantly contribute to reducing fossil primary energy, investment needs in new electricity capacity and CO2

Performance of different cooling solutions

Solution	SSEER	PRF
Conventional building bound solutions		
Conventional RAC and CAC	1,5-3,5	1,7-0,7
Conventional chillers combined with aquifers	3-6	0,8-0,4
District cooling solutions		
Industrial chillers with efficient condenser cooling and/or recovered heat to DH	5-8	0,5-0,3
Free cooling / industrial chillers	8-25	0,3-0,1
Free cooling	25-40	0,1-0,08
Absorption chiller driven from heat from waste or renewable source	20-35	0,13-0,07

SSEER = Seasonal System Energy Efficiency Ratio. This states the output of yearly useful cooling energy per unit of yearly electrical energy input in the system. (base for financial calculations)

PRF = Primary Resource Factor (base for environmental impact analysis), see work package 3

For this study the SSEER of 2,5 is used as the average level of performance

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Benefits for the society

- Environment
 - CO2
 - Phase out of refrigerants, HCFC
 - local environment/legionella
- Security of supply
 - Avoid summer electricity peak
 - Higher local reliability
 - Higher energy utilisation and reduced energy consumption
- Competitiveness
 - A new energy service that competes freely with the conventional alternatives and can be introduced without subsidies

Expenses

District Cooling

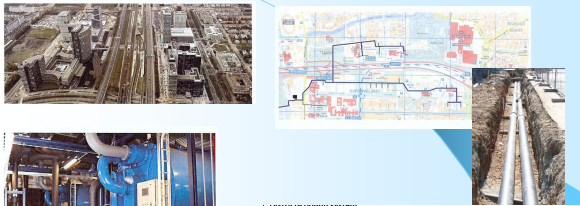
Customers alternative



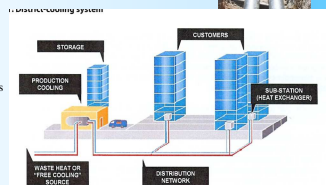
Production of Electricity and District Heating



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



Approach to meet customer's needs



Geothermal or District Heating

Geothermal in Nevis – Options in Saba, Dominica, Guadeloupe etc.



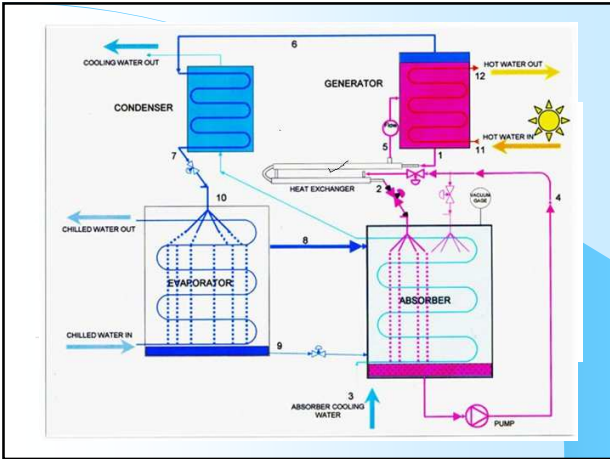
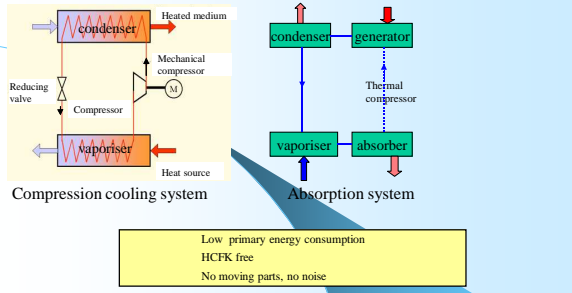
Concentrating solar energy for electricity or heat

Bright Source Energy/California



Electric Power Research based in Palo Alto

Absorption system vs. Compression Heat Pump



Adsorption Refrigeration Machine and Solar Thermal System

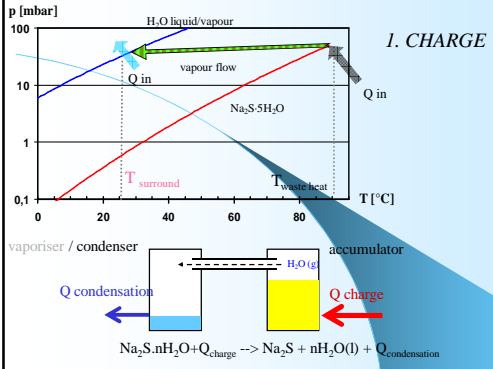
Air conditioning system on the rooftop of Chamber of Commerce and Industry in Freiburg, Germany. Temp. 95 C



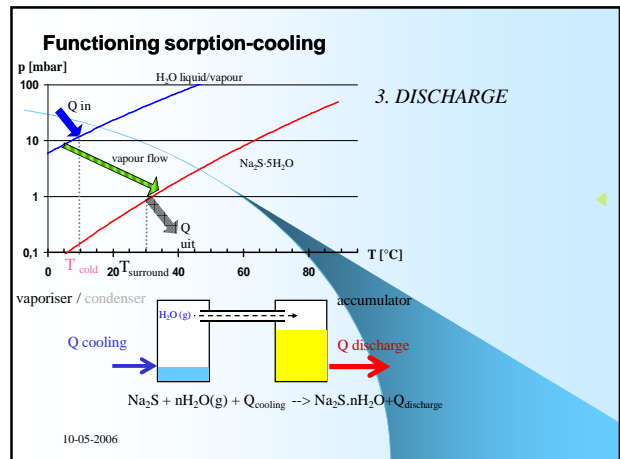
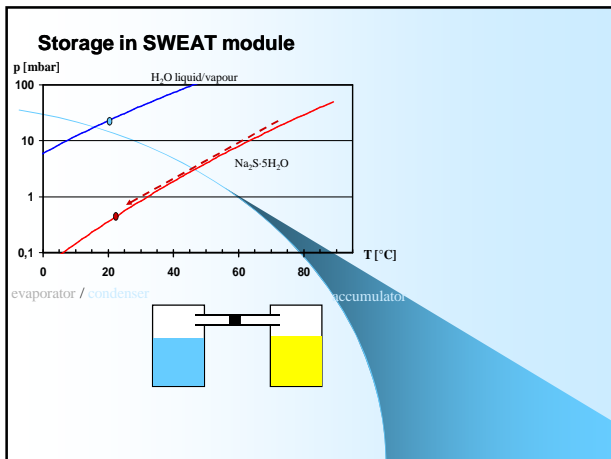
Alternative Solid absorption pair with a temperature < 100°C				
Absorber	Absorbent	Loading temperature °C	Reaction heat/ Storage capacity kJ/kg (Dry salt)	Power/kg Wh
Na2S	H2O (5-0.5)	80-90	3600	500-1500
BaCl2	NH3 (8-0)	70	1440	
CaCl2	NH3 (4-2)	80	960	
	NH3 (8-4)			1700
CaCl2	H2O (4-2)	80	1100	
SrCl2	NH3 (8-1)	100	1800	
Silica	H2O	70-90	700	350-750

10-05-2006

Functioning sorption-cooling



10-05-2006



Simulation model

Model developed based on Simulink (Matlab).

Components are coupled via vapor equilibrium.

System is driven thermally

Output:

10-05-2006

Theory

The useful equilibrium reactions in the $\text{Na}_2\text{S-H}_2\text{O}$ system are:

Reaction	$\Delta T_{\text{equilibrium}}[\text{K}]$	Heat of reaction[kJ/mol]
$\text{Na}_2\text{S} \cdot 5\text{H}_2\text{O} \leftrightarrow \text{Na}_2\text{S} \cdot 2\text{H}_2\text{O} + 3\text{H}_2\text{O}(\text{g})$	56	189
$\text{Na}_2\text{S} \cdot 2\text{H}_2\text{O} \leftrightarrow \text{Na}_2\text{S} \cdot \frac{1}{2}\text{H}_2\text{O} + 1\frac{1}{2}\text{H}_2\text{O}(\text{g})$	61	111

Heat storage 3.84 MJ/kg Na_2S (1.1 kWh/kg)
 Cold storage 2.54 MJ/kg Na_2S (0.70 kWh/kg)
 COP_{th, cooling} is 0.66.

Advantages of SWEAT system

- Small sized cooling system
- Heat and cold storage function with no losses
- Modular system
- Easy to install
- Driven by low-grade heat (residual heat)
- Constant power

Amount of salt: 3.2 kg

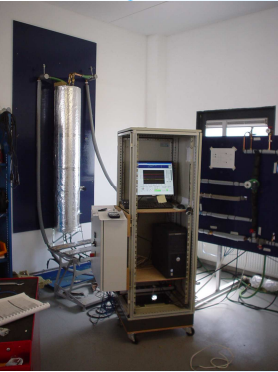
Heat storage capacity:
 Heat in 13.3 MJ (3.7 kWh)
 Heat out 11.5 MJ (3.2 kWh)
 Efficiency 0.84

Cold storage capacity: 7.6 MJ (2.1 kWh)
 COP_{cooling} 0.57

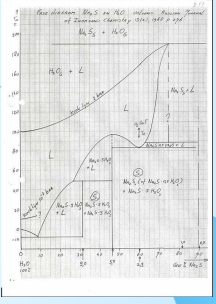
Solidcooling(SWEAT®)

District heating

Automotive airco




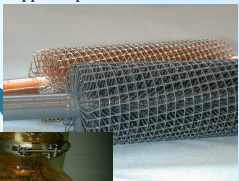

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Material research corrosion and coatings

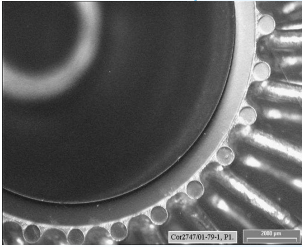

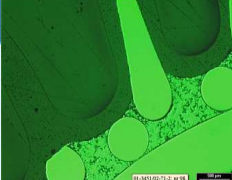
Quality check for defects in coating on heat exchanger:

- Electrical current measurement in copper sulphate solution

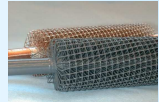
Material research corrosion and coatings


Detail of "wire-fin" heat exchanger








Production technology

- Wire-fin heat exchanger
- Container
- Na₂S carrier material
- Vaporizer/condenser

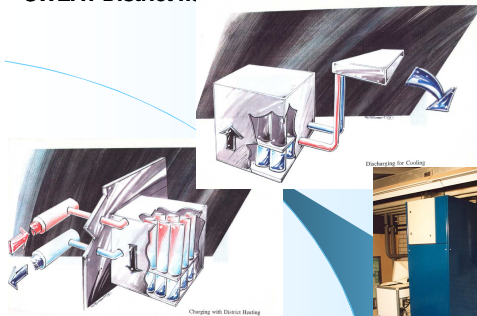




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SWEAT District heating



Discharge for Cooling

Charging with District Heating

