Mitigating and adapting to climate change using groundwater

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2 april 2008
Thermal energy storage in aquifers
Aquifer Thermal Energy Storage (ATES)

- Also called:
  - Open loop systems (for heat pumps)
  - Shallow geothermal systems
- Closely related, but not discussed here:
  - Closed loop systems
  - Deep geothermal energy (for heating and electricity)
Number of projects with storage in NL

- 1989: 5
- 1991: 34
- 1993: 214
- 1995: 353
- 1997: 438
- 1999: 485
- 2001: 540
- 2003: 630

Number of projects with storage in NL from 1989 to 2007.
Example projects

Campus TU/e Eindhoven
Wavin Hardenberg
Kurhaus Scheveningen
Twee Steden hospital Tilburg
Queens Towers A’dam
Head office ING A’dam
Climate change: average daily temperatures in NL have gone up with approx. 2 C
Climate change: groundwater temperatures in cities are increasing.
Adaption to climate change

- The climate will be warmer so we need more cooling. Store the waste heat in summer for heating in winter. Using heat pumps will reduce the temperature of the groundwater.
- Climate change will cause higher rain fall intensities and longer periods of drought in summer. So we need more storage of water. New surface water can be used for the production of sustainable heat in summer and/or sustainable cold in winter time.
- The importance of proper groundwater management will increase due to the increasing demands on temperatures, quality and quantity
Using surface water for storing wintercold for cooling offices and apartments in summer: paleiskwartier Den Bosch (NL)
Using surface water in summer to abstract heat for use in winter
Cooling asphalt for heating in winter
Groundwater management

- Problem 1: high groundwater levels (reducing abstractions, partly because of drought in nature areas)
- Problem 2: groundwater pollution too expensive to remediate
- Problem 3: how to reduce energy consumption in a growing city?
- One solution: groundwater management
- Example case: Apeldoorn
Poluted sites in Apeldoorn
High groundwater levels in Apeldoorn

Zuid-West Apeldoorn, 1998
Energy storage with pumping/injection
= “bioactieve zone”  = geohydrologische beheersing
Examples of actions by local authorities

• Apeldoorn: combine groundwater remediation, reduction of high groundwater levels and renewable heating/cooling
• Nijmegen: make a map of potential for subsurface renewable energy and communicate
• Province Noord Brabant: survey the potential for geothermal heating/cooling in the province, translate the data to provincial policies
• Province North Holland: make masterplans for ATES for urban planning
Nijmegen: map of potential
Province Brabant: map of potential in Brabant
Last remarks

• Climate change will increase the cooling load, and reduce the heating demand. In countries with a higher heating demand then cooling demand (most of Europe) this implies a big opportunity to save energy.

• Local authorities have a significant impact on the succes (or lack of succes) of the implementation of this technology: through permitting, stimulation, communication, urban planning, etc.
Thank you