Innovative and good practices of shallow geothermal energy across Europe and abroad

Shallow geothermal open loop systems in the Cologne-Bonn region

Burkhard Sanner
Geological Situation

Geological Map

Source: GEOportal.NRW, Geologischer Dienst NRW, 8.12.2020
Geological Situation

Geological Map

Groundwater availability

Source: GEOportal.NRW, Geologischer Dienst NRW, 8.12.2020
Geological Situation

Geological Map

Geothermal yield (BHE)

Source: GEOportal.NRW, Geologischer Dienst NRW, 8.12.2020
“Cold” District Heating Troisdorf

Local energy transition starts with the development plan

Bebauungspläne

„Die Energiewende vor Ort beginnt schon beim Bebauungsplan“

Local community information, photo Stadtwerke Troisdorf

Slide from a presentation by Stadtwerke Troisdorf
“Cold” District Heating Troisdorf

Concept:
• Groundwater is pumped from wells
• Heat in groundwater is transferred to heat pumps (7-10 kW) in the individual buildings
• The cooled groundwater is re-injected into the aquifer via wells

Start of operation in 2012, and continuous enlargement since then.

Graph and photo: Stadtwerke Troisdorf
“Cold” District Heating Troisdorf

Crucial for all open loop systems:

• Hydrochemical suitability of groundwater on site
• Exact planning of wells (location, diameter, type)
• Simulation of groundwater flow and temperature development

red: production wells  –  blue: injection wells
map: Stadtwerke Troisdorf

Graph: UBeG
“Cold” District Heating Troisdorf

Construction of a network with the following parameters:

Main conduit
• ca. 5 km supply and return pipe

Building connections
• ca. 100 when completed
• dimensions: DN 25 and DN 32

Installation, including components by Stadtwerke Troisdorf

Total cost ca. 200 K€

red: production wells   blue: injection wells
map: Stadtwerke Troisdorf
“Cold” District Heating Troisdorf

Drilling and well construction with large diameter:

Moselfeld area
- total production 225’000 m³/a
- max. production 72 m³/h

Fritz-Erler-Strasse area
- total production 110’000 m³/a
- max. production 57 m³/h

Total cost ca. 120 K€
“Cold” District Heating Troisdorf

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Operation experience (after information from Stadtwerke Troisdorf and UBeG GbR):

• during start-up phase pumping capacity might be too large (few initial connections)
• maximum load smaller than expected, but annual load within the planning range; daily distribution of load more favourable than anticipated
• no operating problems up to now

Costumers can opt for either just getting the groundwater, or have full energy service incl. heat pump.

Further networks for new residential areas are under construction in Troisdorf, and more projects in the region are considered.

28.2.2014, press information event
(photo Stadtwerke Troisdorf)
Bonner Bogen is a development area with office buildings, a hotel and restaurants at the eastern bank of the Rhine river.

The site is a conversion of a former industrial area (cement factory founded in the 1850s), started in 2002.
Heating / Cooling “Bonner Bogen”

Development stages of Bonner Bogen and location of groundwater wells

First stage 2002-2004, includes old building, 2 x 2 wells

Further stages, 3 x 3 wells
Heating / Cooling “Bonner Bogen”

Extensive hydrochemical and hydrogeological investigations and tests.

Simulations of groundwater flow while pumping had to include two neighbouring open loop installations in order to avoid interferences.

End of heating period

End of cooling period

Geological cross-section (BGU)

FE-simulation (BGU / UBeG GbR)
Heating / Cooling “Bonner Bogen”

Drilling and hydrogeological testing (pump test for permeability)

Well1 during pump test

Water level monitoring in well 3

Large diameter well construction

photos: UBeG GbR
Heating / Cooling “Bonner Bogen”

Characteristics of main stage (2009):

Groundwater wells for stage 2009  (graph Bonn Visio – Bonner Bogen, photos UBeG GbR)
Heating / Cooling “Bonner Bogen”

Characteristics of main stage (2009):

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Heat Pump</td>
<td>heating 919 KW, cooling 625 KW</td>
</tr>
<tr>
<td>2 peak boilers (gas)</td>
<td>1,0 MW and 1,9 MW</td>
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<tr>
<td>Groundwater wells</td>
<td>6 wells in total, up to 28 m deep</td>
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<tr>
<td>Groundwater production</td>
<td>50-60 l/s (180-216 m3/h)</td>
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Flow direction of wells is reversed for summer / winter mode

Groundwater heat exchanger and heat pump (photo Bonn Visio – Bonner Bogen)
Heating / Cooling “Bonner Bogen”

The geothermal wells are providing heat and cold invisibly!

Well 8 in 2009 (photo UBeG GbR)

Kameha Grand hotel today (photo Kameha Grand Bonn)
Thank you for your kind attention!