

Geothermal Development and Activities in Germany

Veli Losinj, Croatia 27.08.2014

Dr. Eckehard Büscher
IGO - Geothermie International





**Bochum University
of Applied Sciences
(Hochschule Bochum)**



Bochum School of Geothermal Technology

GZB

German Universities

Associated International Universities



Bochum University Appl.Sc.

Host of the International Geothermal Center

Central R&D Department of Bochum University


Administration of IGL

Academic Education Ba / Ma Sc. Programs

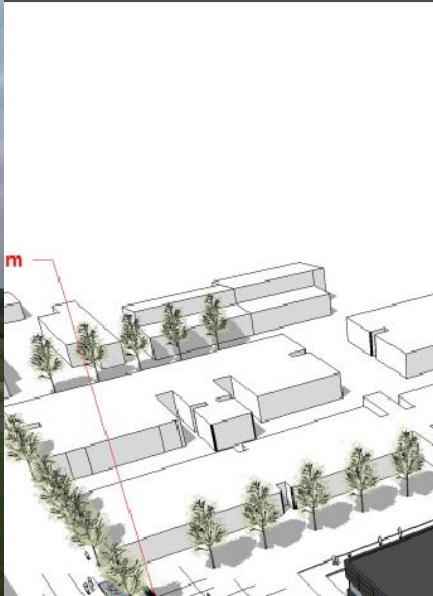
Public Bodies, Universities, Administr., Governmental Org., Chambers

Non-profit Association of Public Institutions

Scientific Management of the IGL, Networking, Communication

Bochum School of Geothermal Technology	GZB	Geothermal Economy Association	Energetikum	International Geotechnology Laboratories (IGT)	Geothermie. Ruhr	Energy Agency. NRW Geothermal Network	 International Geothermal Association	GtV-BV International
Bochum University AS	Public Bodies, Universities, Administr., Governmental Org., Chambers	Companies	Construction Industry, Technology-Providers, Chamber of Crafts	Research-Institute national & international	Science-to-Business Transfer	State of Northrhine-Westfalia	International Association	National Geothermal Association
Central R&D Department of Bochum University Academic Education Ba / Ma Sc. Programs	Non-profit Association of Public Institutions Management of the IGT, Networking, Communication	Profit-oriented; Construction Drilling, Utilities, Consultants Financing of the Branch Office; Marketing; Sponsoring	Educational Institution financed by the Economy / Companies	13 Mio. EUR Invest by GER/EU University-Industry Joint Research Labs for Geotechnologies	Technology-and Knowledge Transfer, Business-Development	Network-management Cluster of Excellence of the Energy Economy in NRW	Secretariate Executive Director	International Office of the Geothermische Vereinigung / Bundesverband Geothermie

HALES GEOTHERMIEZEN
AL GEOTHERMAL CEN



Institutsgebäude

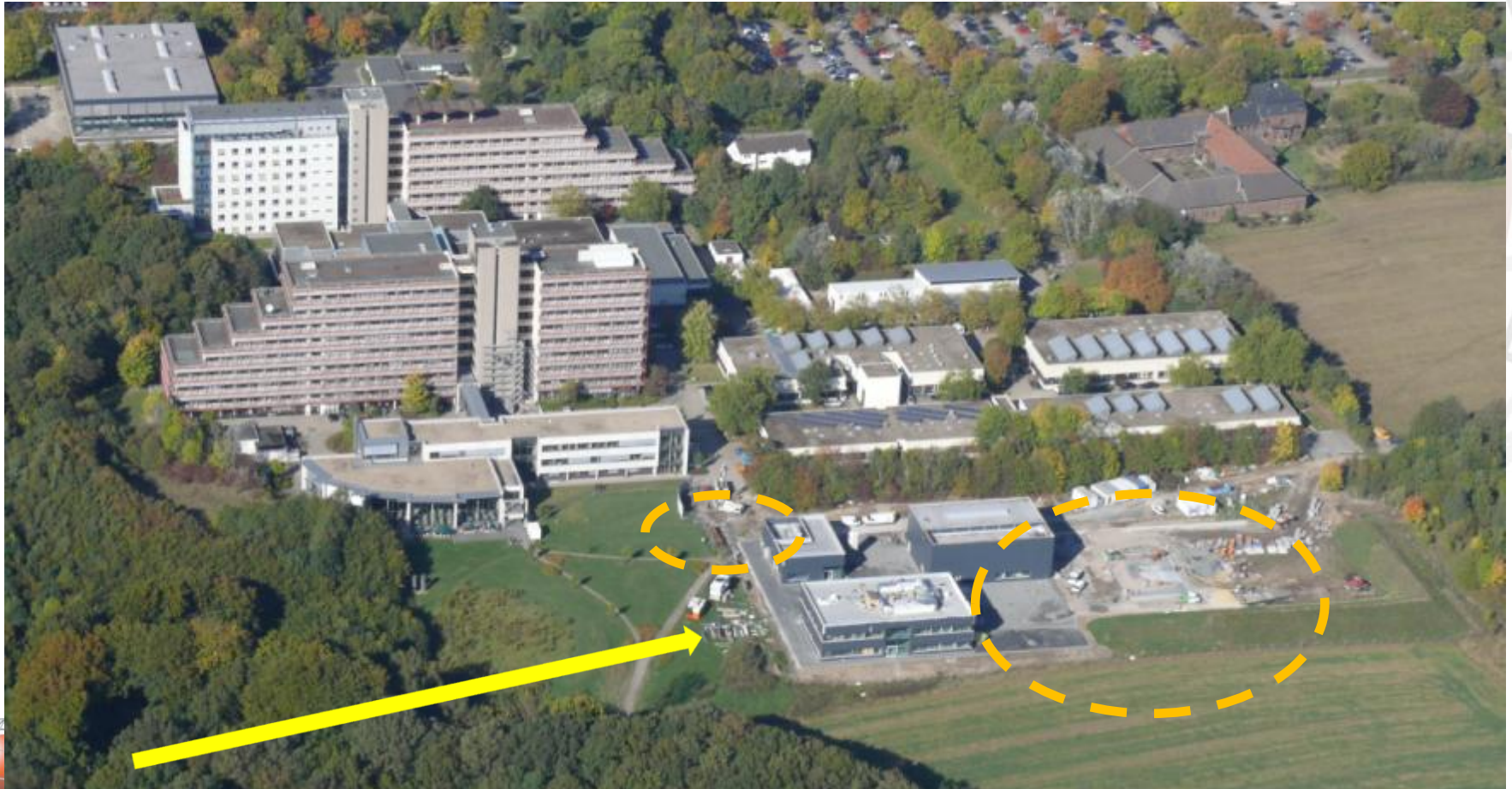
Geothermische Versuchsanlage

Host of IGA

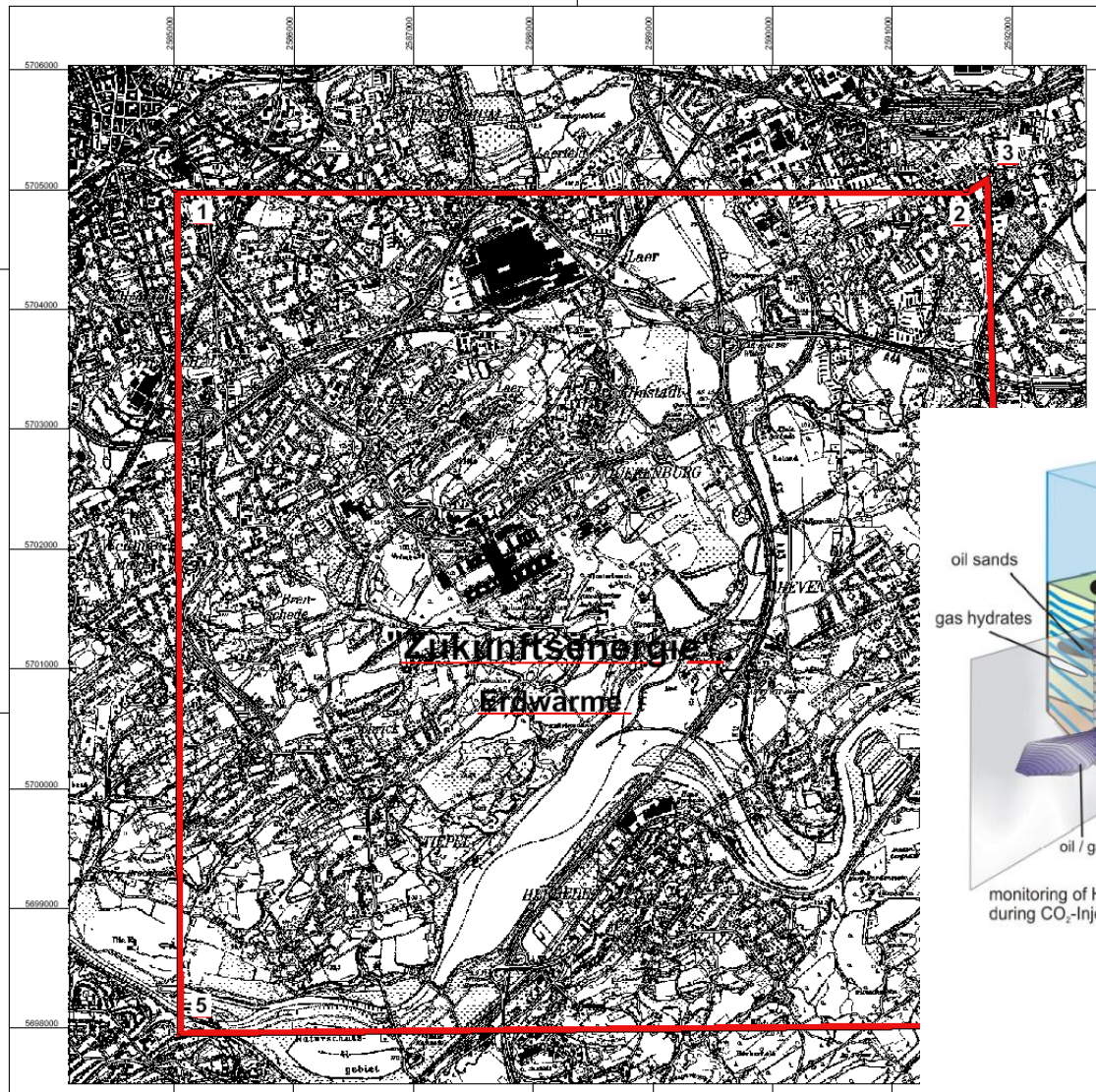
li Losinj, Croatia 27.08.2014
Dr. Eckehard Büscher

International Geothermal Centre - GZB**Internationales Geothermie Zentrum - GZB**

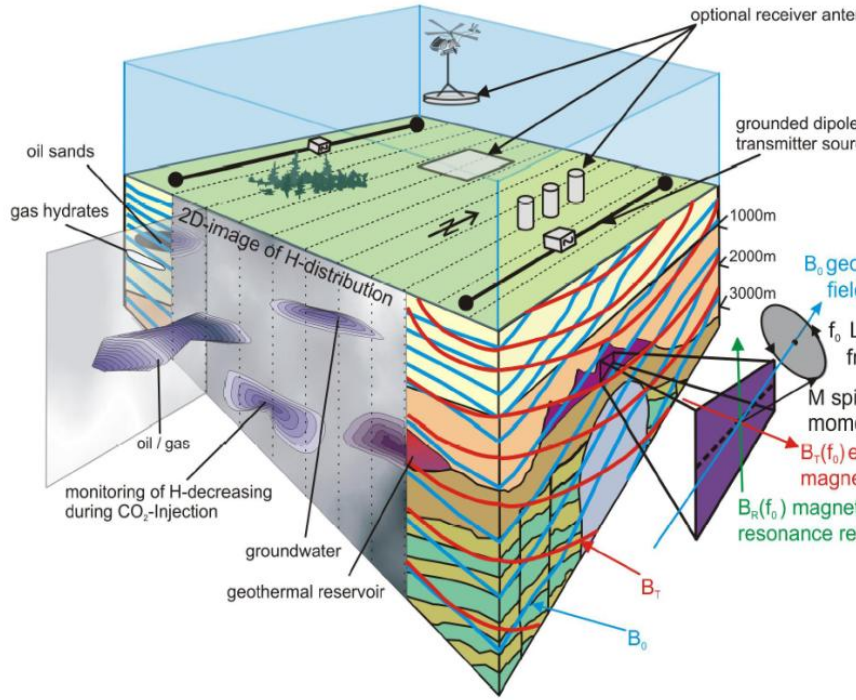
c/o Hochschule Bochum, Lennerhofstraße 140, 44801 Bochum



Kartgrundlage: Topographische Karte 1: 25000, Blatt 4509, Bochum	© Geobasisdaten: Landesvermessung NRW, Bonn	Maßstab: 1 : 25 000
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Karte
für das Erlaubnisfeld
"Zukunftsenergie"
zur Aufhebung von Erdwärme

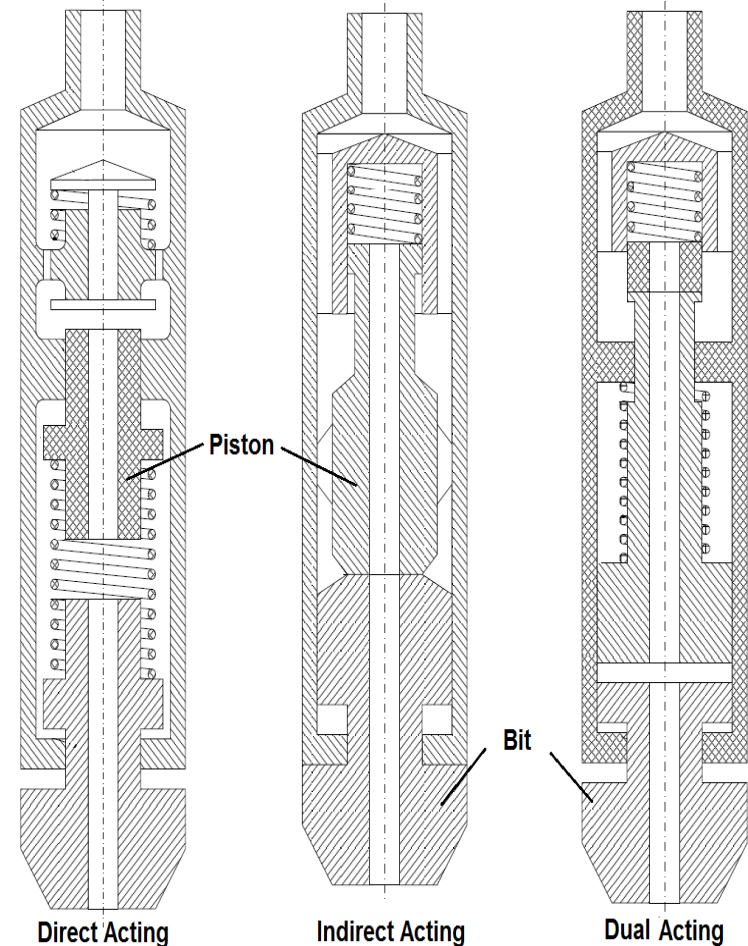


Advanced drilling technology

Percussion Drilling

Percussion Drilling is suited for geothermal drilling due to the rigidity of hard, fractured formations, which have little or no plastic deformation of the rock, like igneous or volcanic rocks or metamorphous sediments.

*Reduces the overall well costs up to **15%** by drastically increasing the **penetration rate**.*



> 100 year old technology to break hard rock (much like diesel / combustion engine in cars)

introduction of **tricone bit** beginning of 20th century



PDC bits have brought some improvement, but only in favorable, homogenous, „softer“ geology



- **TODAY :**
- **better drilling technology needed like DTH fluid / mud hammer to greatly improve ROP, drilling efficiency and return of cuttings**



GZB Approach

Hard Rock Drilling

-DTH fluid hammer
→ Geostar project-

-GeoJetting

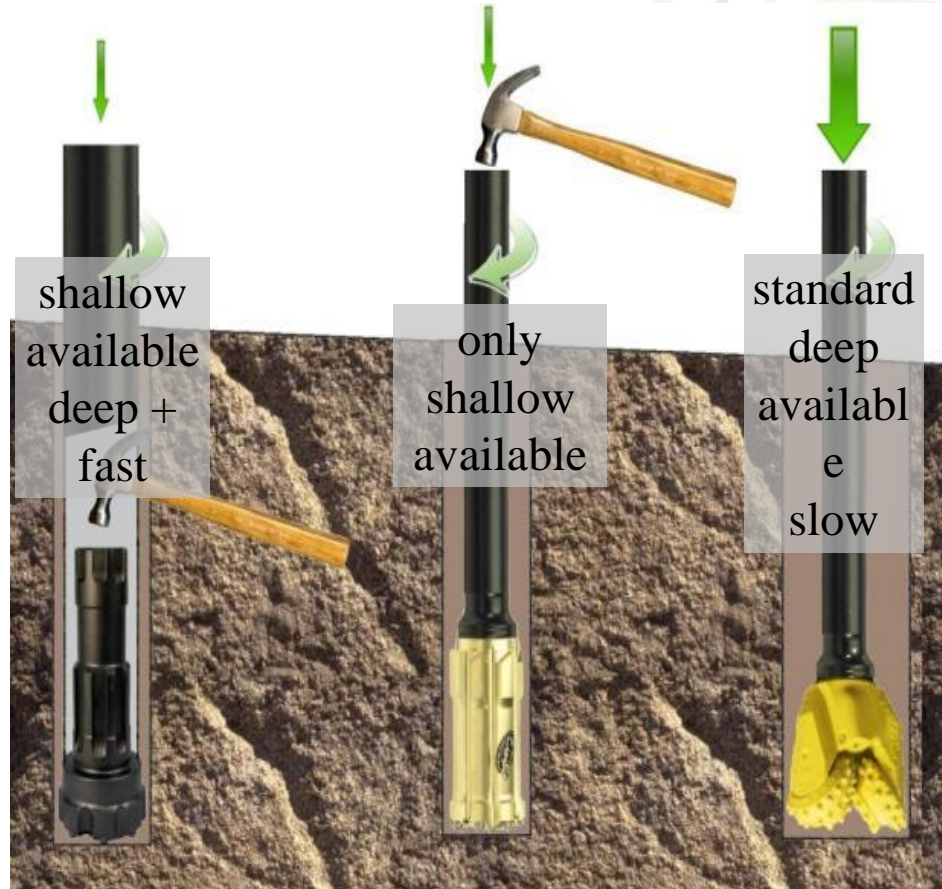
- CT drilling

-Heat project-

storage

DTH hammer
Rotary

Top hammer



shallow
available
deep +
fast

only
shallow
available

standard
deep
available
slow

R&D only
very fast
future

high
pressure
"GeoJetting"

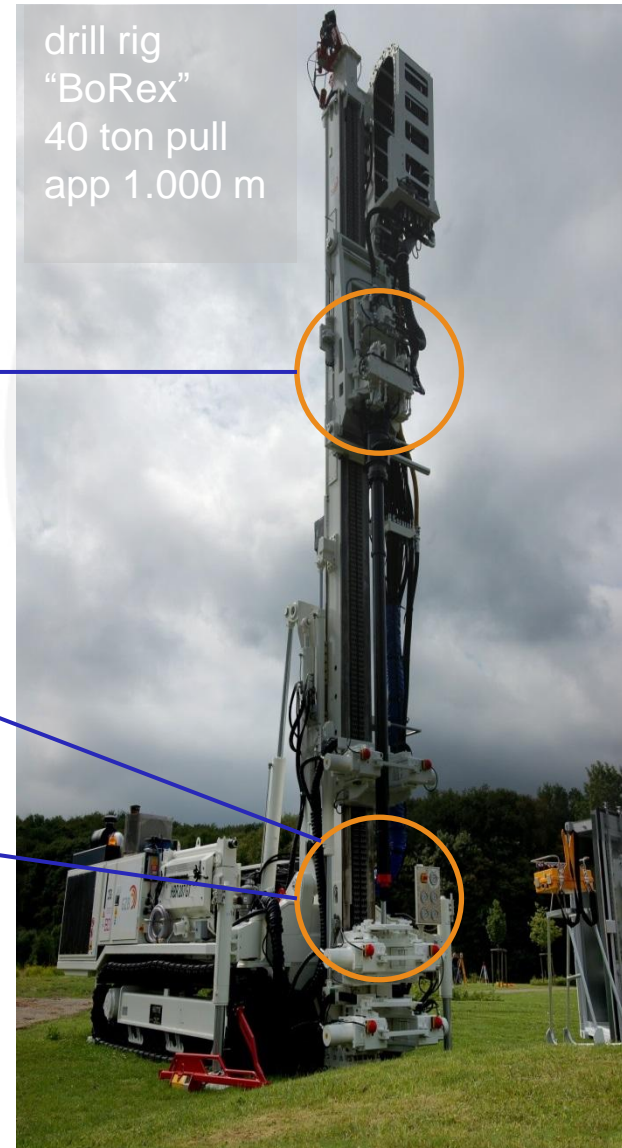


GZB Approach

Drilling

-Research shallow drill rig “BoRex” (40 ton < 1.000 m)-

- Casing Drilling (CWD)
 - Dual Rotary Head system
 - Applicable for rotary/ percussion/jet drilling
- DTH fluid / mud hammer
 - Wassara DTH for rotary/ casing drilling
 - Kamat pump for HP/ HV
- GeoJetting
 - Retrievable High Pressure Jet bit for CWD
 - High Pressure Jet swivel
- Coiled Tubing Drilling (tender process)
 - Running with DTH / jetting system



GZB Approach

Drilling

-Kamat Triplex Pump-

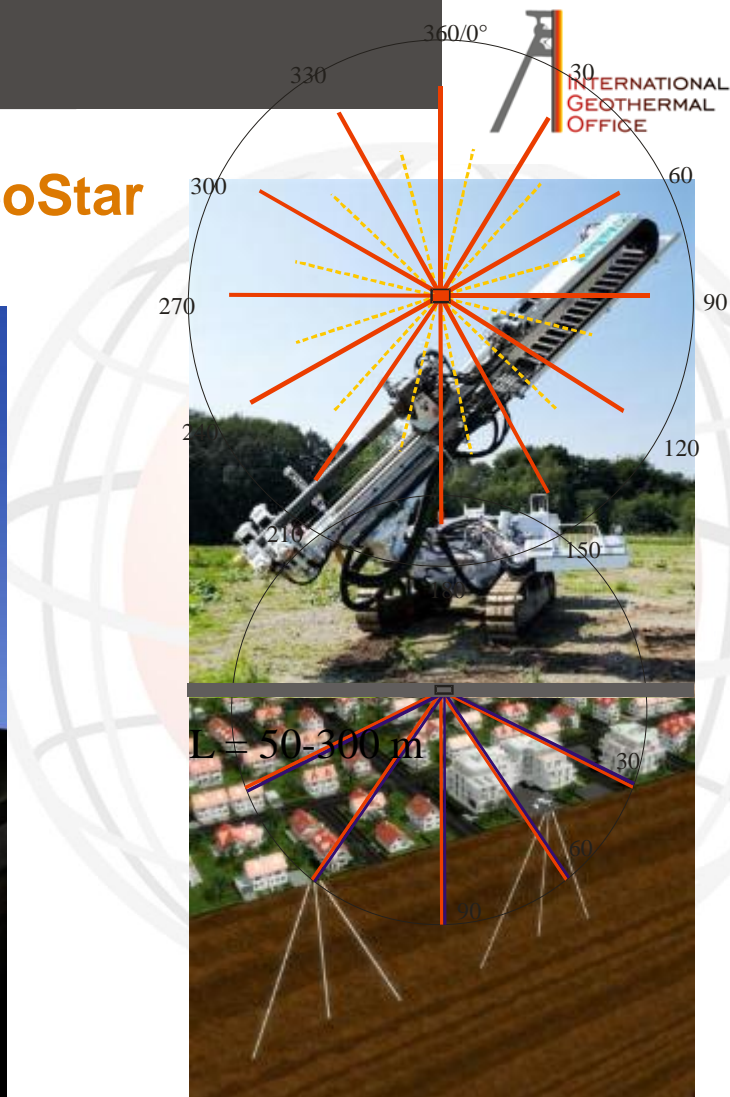
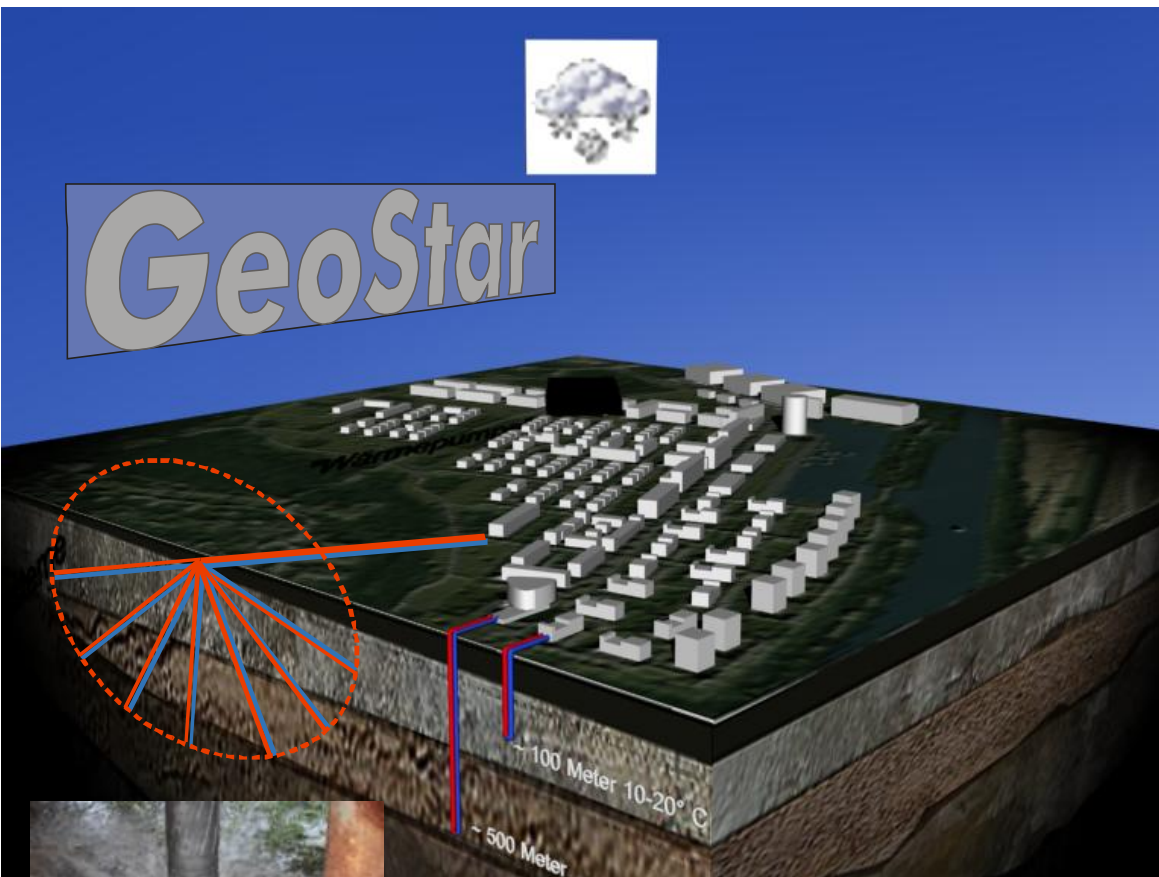
- > 160 kW hydraulic power
- 250 kW Diesel engine @ max. 2100 RPM
- High pressure / high flow operations possible
- up to 1.500 bar or 1.050 L / min

-Downhole Mud Hammer-

- DTH water for rotary/ casing drilling
- used during the GeoStar project
- currently fastest tool for (deep) hard rock drilling



GZB approach : radial geothermal system **GeoStar**



GEFÖRDERT VOM



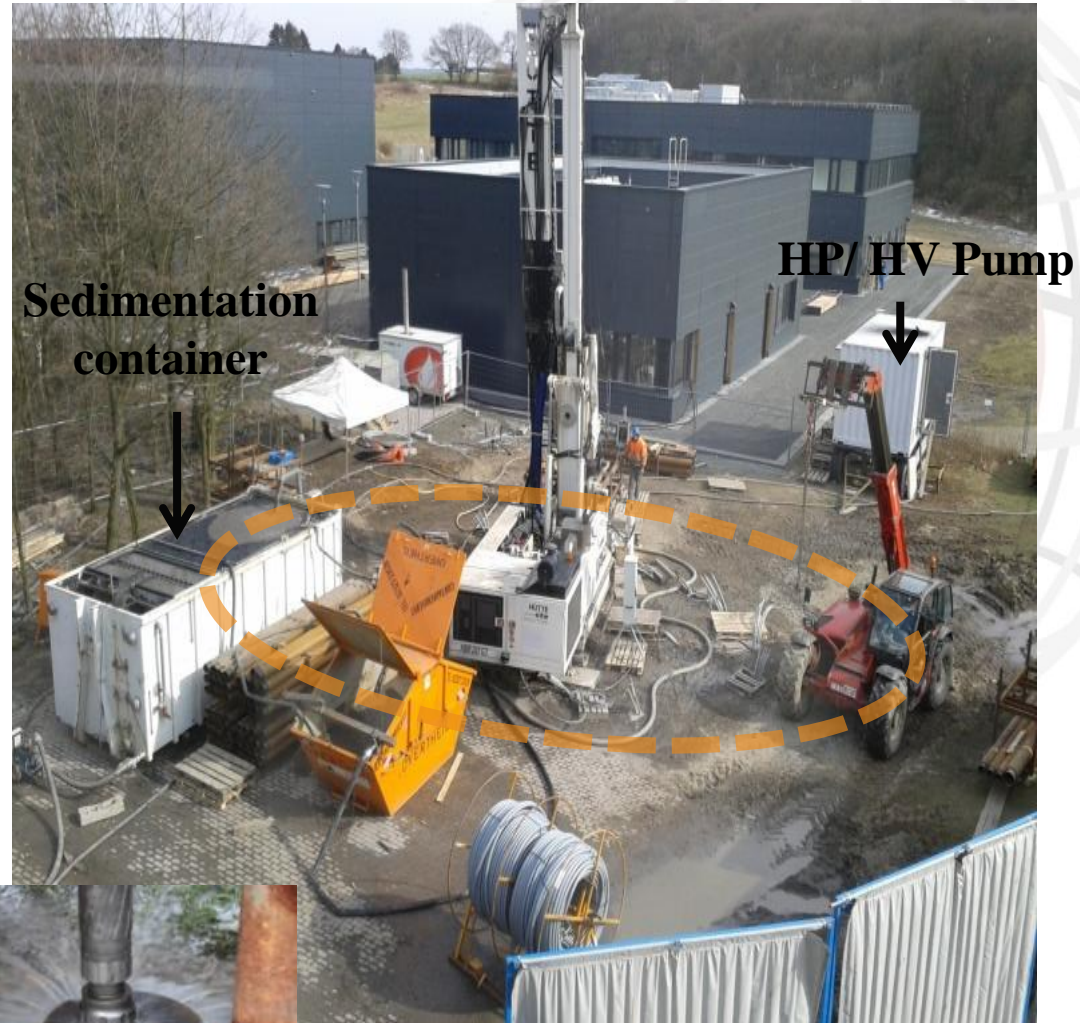
Bundesministerium
für Bildung
und Forschung

GZB approach

DTH water hammer drilling

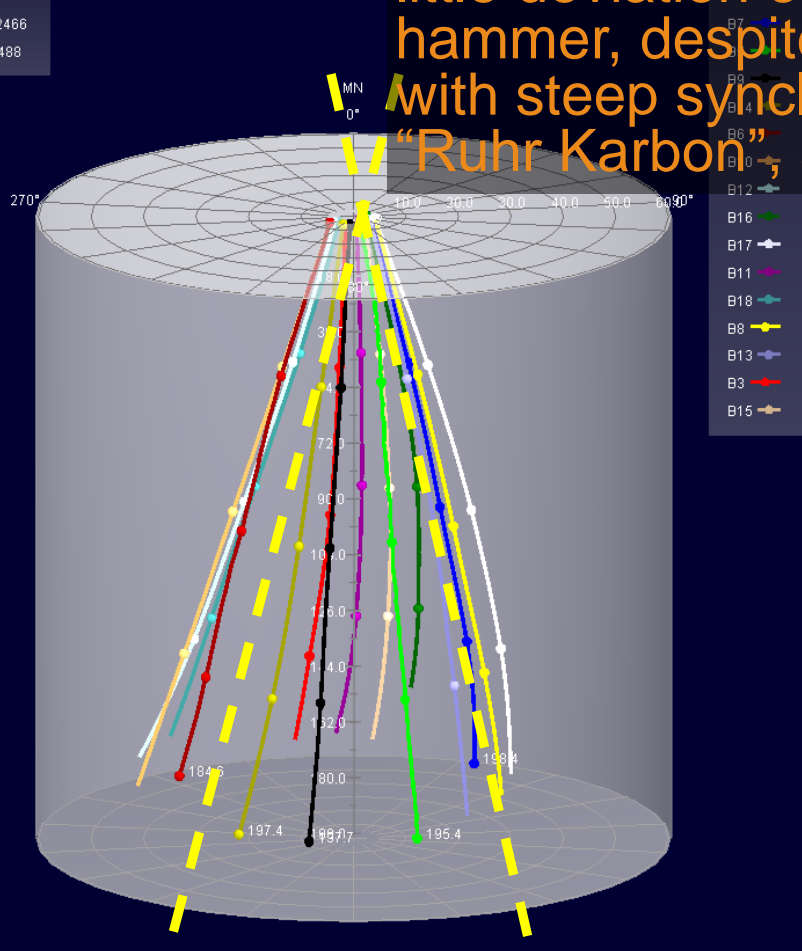
-GeoStar Project -

- 20 wells à 200 m
- 10° Inclination
- Elliptical drilling pad (7 m x 10 m)
- 6" DTH with 7 ¼" PDC bit
- 6" Drill pipe ($\varnothing = 152,4$ mm)
- Research drill rig "BoRex"
- Casing while Drilling (\rightarrow dual head)
- avg. ROP at appr. 1 m / min in sedimentary rock



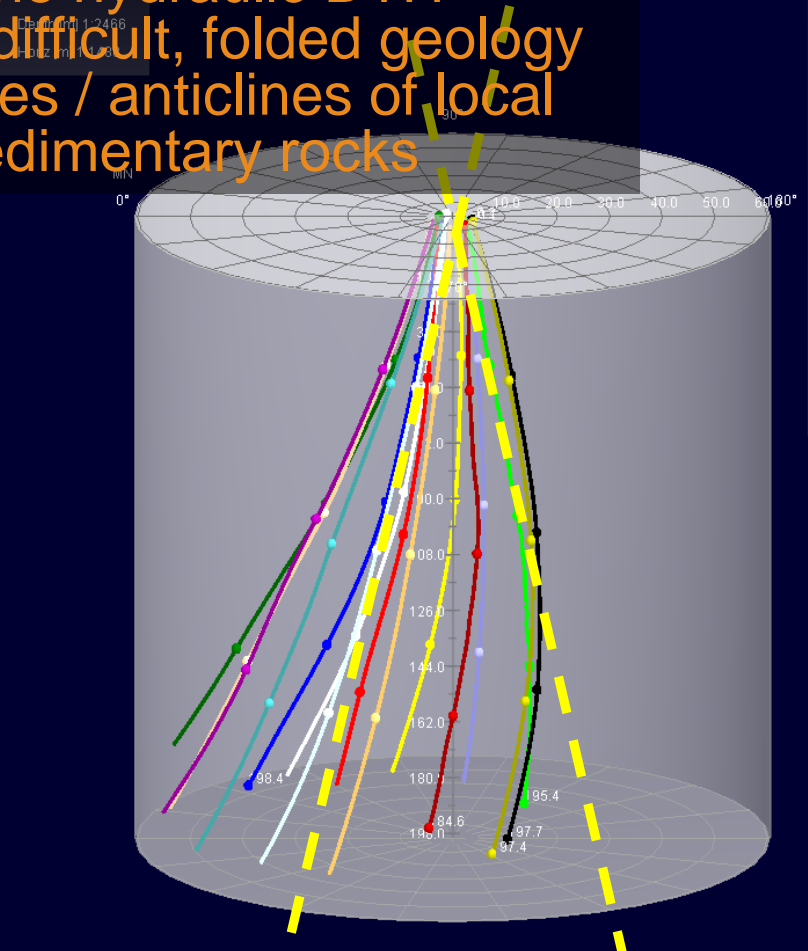
little deviation of the hydraulic DTH hammer, despite difficult, folded geology with steep synclines / anticlines of local "Ruhr Karbon", sedimentary rocks

Depth [m] 1.2466
Horiz [m] 1.1488



looking North

yellow dotted lines show planned 10° inclination



looking East





**20 m³ Sedimentation Container
cleaning of cuttings / mud return
< 40 m³ / hr capacity**



Hochschule Bochum
Bochum University
of Applied Sciences 



cleaning and recirculation of drilling fluids
/ muds while drilling with DTH fluid
hammer @ GZB



Filter cage

Flocculation reservoir



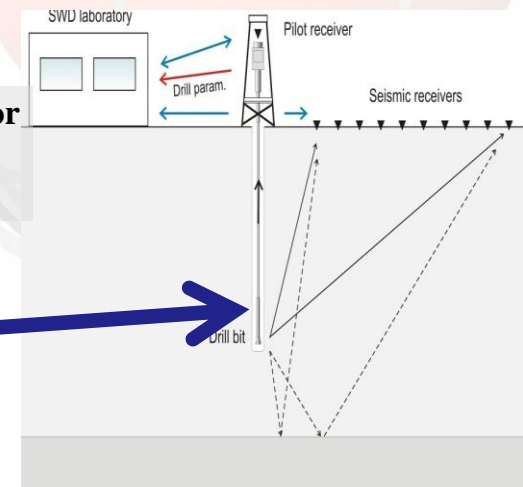
GZB Approach (together with OGS in Trieste, Italy)

Seismic-while-drilling (SWD)

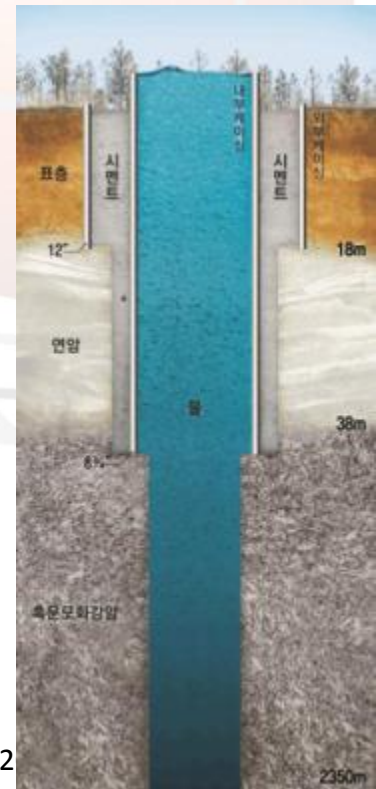
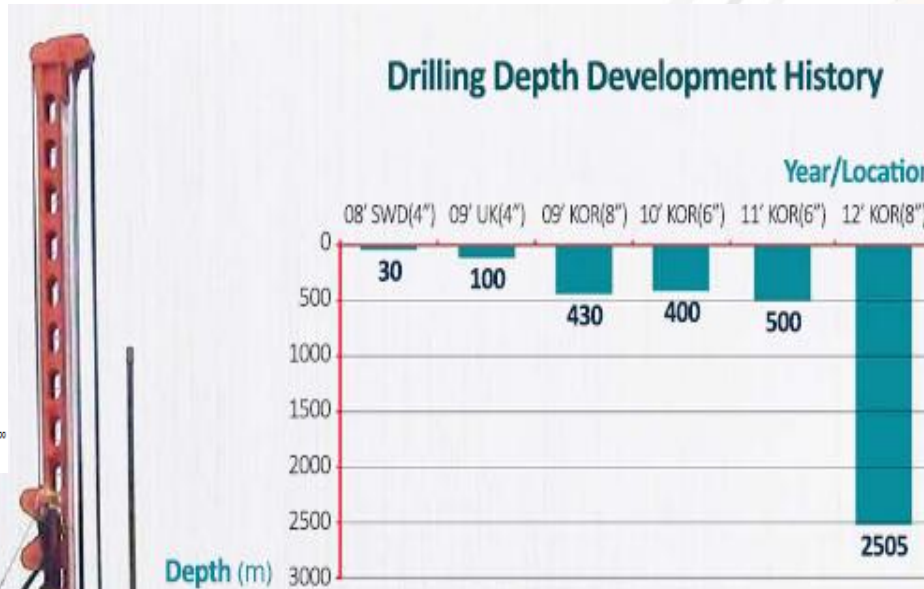
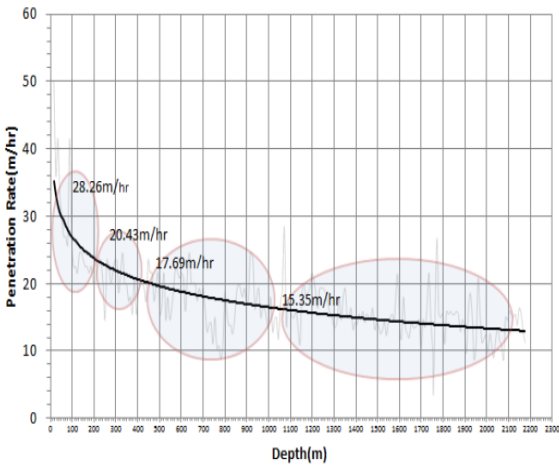
- pilot project at GZB together with OGS
- seismic while drilling data for reservoir and drilling prediction
- use of DTH water / fluid hammer
- high rate of penetration - ROP
- excellent seismic data for geology analysis and prediction
- economic drilling
- little borehole deviation & high quality
- water recirculation possible
- DTH mud hammer in production stage



DTH water hammer makes for very fast drilling and excellent seismic noise source



Today : deep drilling with DTH Water hammer systems up to 4.000 m; ROP 16 m / hr in Granite; 7" open hole



3.2

Advanced drilling technologies : coiled tubing CT

Prospecting / Exploration Drilling

Coiled Tubing Drilling is suited for prospecting drilling due to its small footprint, higher ROP and ability to drill easily underbalanced. Additionally, it may be used as stimulation tool, and production rates may be measured insitu while drilling.

Exploration drilling will be able to reduce high prospecting risk and high equity financing.

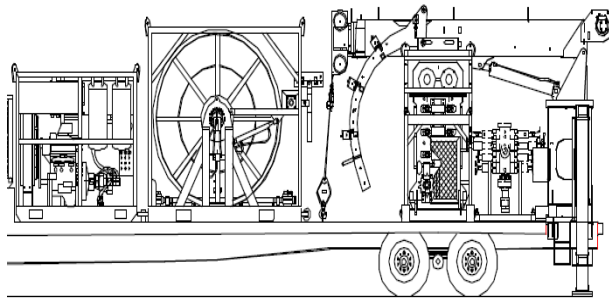
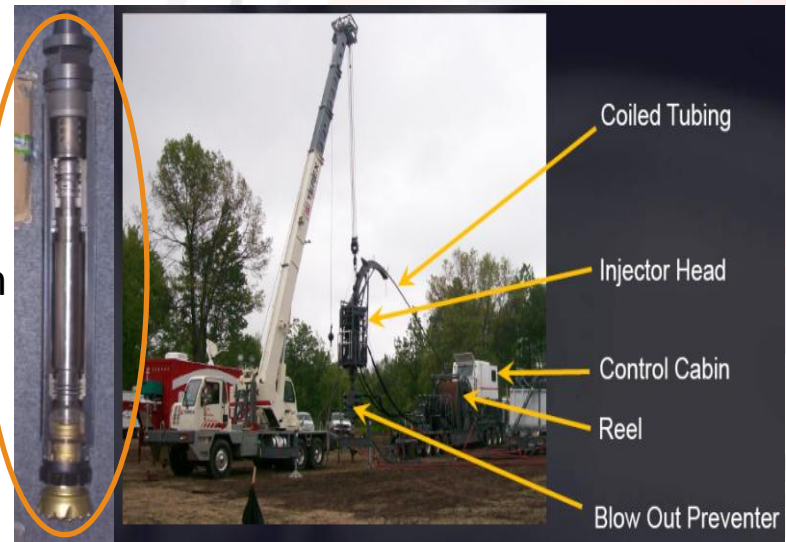


Coiled Tubing drilling demonstrator rig @ GZB

exploration drilling with Coiled Tubing (CT)

-Coiled Tubing Drilling Demonstrator @ GZB

- Prospecting drilling
- Running with DTH hammers
- Running with retrievable jetting system
- Mechanical / Hydraulic Stimulation
- test and use of non-metal, composite coils

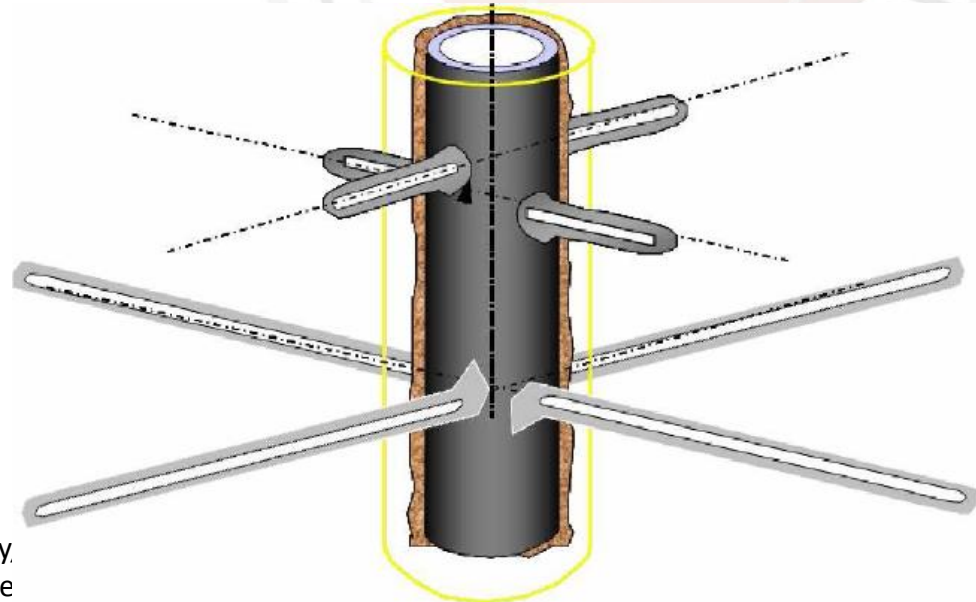
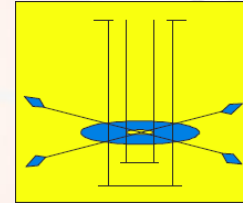


CT demonstration drill rig for R&D
up to 2 ton pull < 1.000 m depth

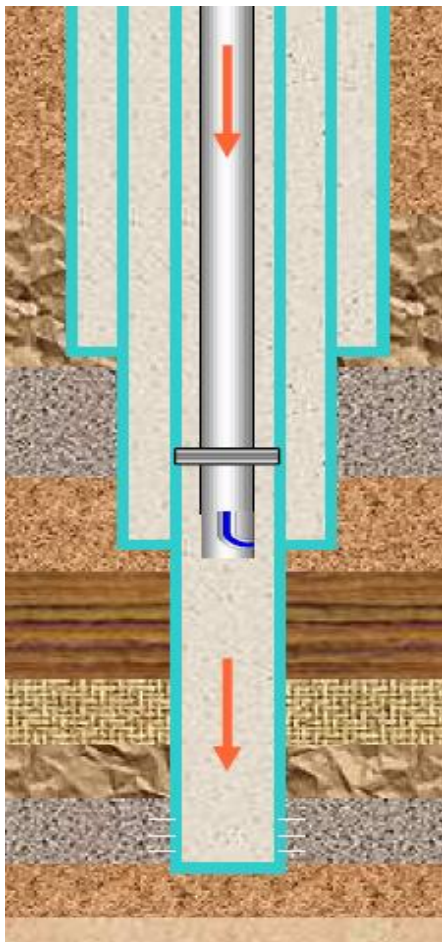
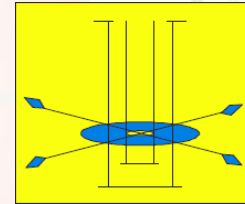


CT GeoJetting / radial drilling to create pathways / increasing hydraulic conductivity → stimulation for EGS

- ◆ Jet Drilling / GeoJetting extends lateral reach + operations
- ◆ Horizontal reach up to 100 meter with 2" (50 mm) ID
- ◆ Controllable / steerable and proven performance
- ◆ Field tested for numerous wells
- ◆ Enhanced Geothermal Systems (EGS)
- ◆ Fast operation with very small footprint



CT GeoJetting : radial (abrasive) drilling to create pathways →
increase hydraulic conductivity → stimulation for EGS



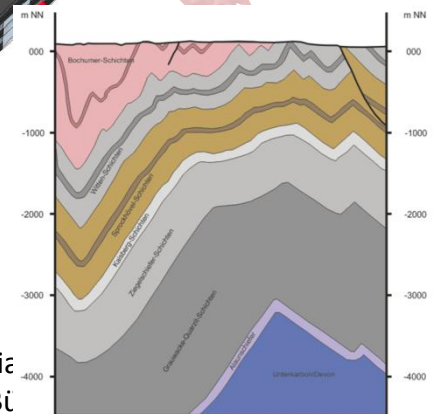
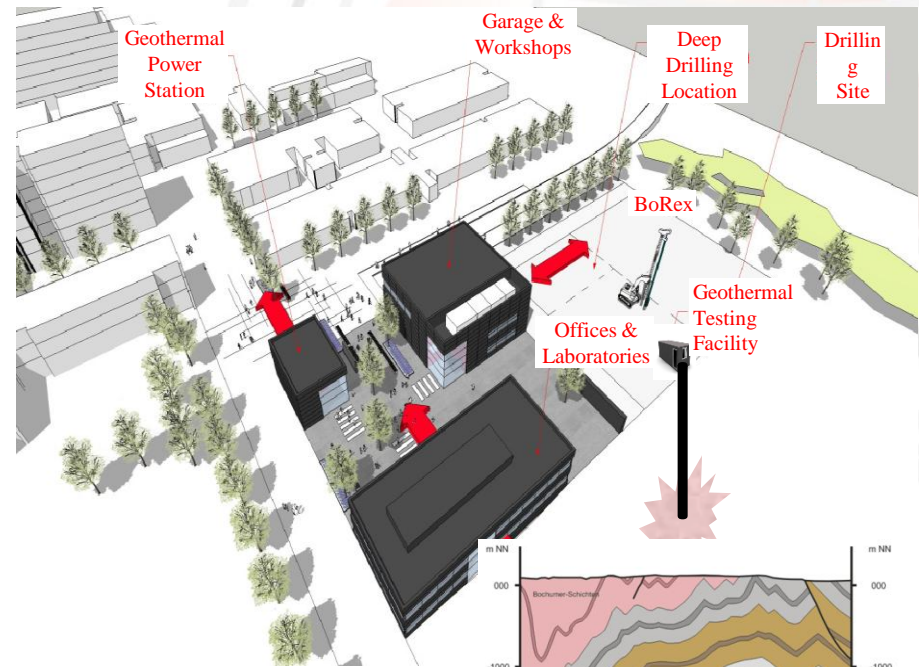
Workshop of Geothermal Energy, Trieste Uni
IGO - International Geothermal Office



GZB 500 m technical / scientific / educational borehole :

Drilling / logging / monitoring with several partners

- Well depth up to 500 m at GZB drill site
- 6" DTH fluid hammer with 6" drill pipe to 200 m
- seismic-while-drilling (SWD) logging
- University of Trieste + OGS, Italy
- Ruhr University of Bochum (RUB)
- NRW geological survey (geol. Dienst)
- complete coring from 200 – 500 m
- AGES – PHD program of International Geothermal Centre GZB + Ruhr University Bochum



GANDOR

Geothermal Academic Network in the Danube Region

- ◆ Support of the geothermal energy sector
- ◆ Establishment of a network of experts in geothermal
- ◆ Phase 1: Essential exchange of knowledge in three workshops
- ◆ Development of a Joint Action Plan in Phase 1
- ◆ Development of ideas for following activities in Phase 2
- ◆ Turning geothermal research results into new geothermal products and services
- ◆ Funded by the BMBF and DLR



GANDOR – The Partners

- ◆ University of Zagreb, Faculty of Civil Engineering
Prof. Dr. Meho Saša Kovačević
Head of Department of Geotechnics
- ◆ University of Szeged, Department of Mineralogy,
Geochemistry and Petrology
Dr. Janos Szanyi
- ◆ University of Belgrade, Faculty of Mining and Geology
Prof. Dr. Dejan Milenic
Head of the Centre
- ◆ Bochum University of Applied Sciences
International Geothermal Centre GZB
Prof. Dr. Rolf Bracke
Head of the Centre



GANDOR – First Workshop Topics

- Venue will be the GZB in Bochum, Germany
- Each Institute presents its:
country / research institute / research priorities
- Describe and analyze the existing local networks
- Geothermal topics will be inter alia:
geometric seismics / reservoir modeling / drilling engineering /
plant engineering
- Field trip to geothermal companies
- Combined with the DGK2014 for a larger audience

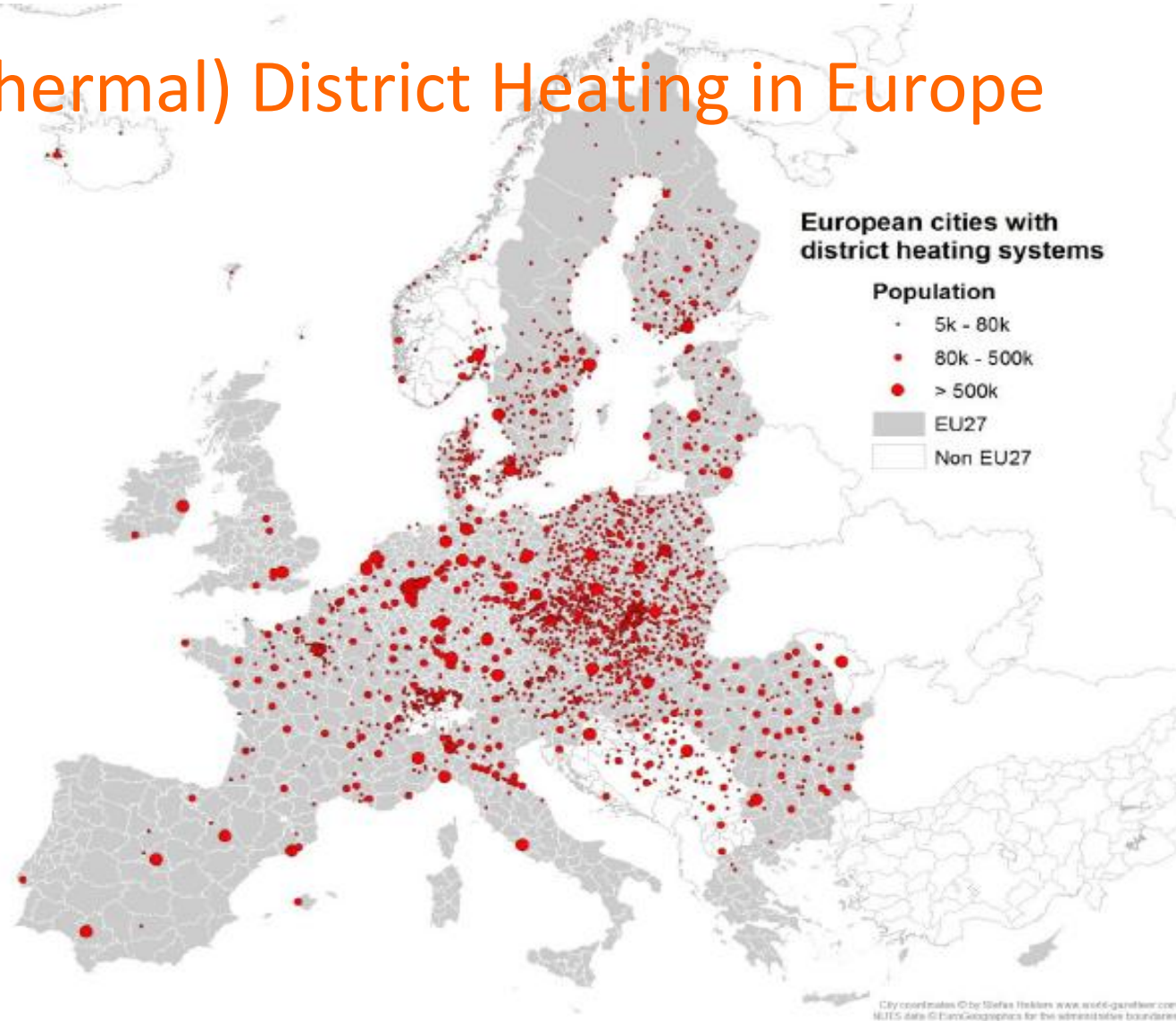


GANDOR - First Workshop: Agenda

First Workshop Day		Second Workshop Day	
Time	Agenda	Time	Agenda
13. Nov. 2014, 09:00	beginning first day	14. Nov. 2014, 09:00	beginning second day
30-60 minutes	presentation IGC country / research institute / research priorities	9:00 - 12:00	field trip to companies
30-60 minutes	presentation Croatia country / research institute / research priorities		
30-60 minutes	presentation Hungary country / research institute / research priorities		
30-60 minutes	presentation Serbia country / research institute / research priorities		
12:00 - 13:00	Lunch break	12:00 - 13:00	Lunch break
30-60 minutes	presentation Croatia respective geothermal topics	30-60 minutes	guided tour at the IGC
30-60 minutes	presentation Hungary respective geothermal topics		
30-60 minutes	presentation Serbia respective geothermal topics		
30-60 minutes	presentation IGC respective geothermal topics		
13. Nov. 2014, 17:00	end first day		
	social evening	14. Nov. 2014, 17:00	end second day



(Geothermal) District Heating in Europe



Development Area

- First systems in regions with simple hydrothermal systems
- Since 30 years: Paris basin, Bavaria, Pannonian basin (Hungary, Serbia, Romania, Slovakia) and Thisted (Denmark)
- Most intensive extension: Paris, Munic, Hungary

	2012	2015
Germany	24	77
France	42	69
Turkey	20	21
Hungary	17	34
Denmark	2	15

- Always in all countries possible

Source: EGEC 12



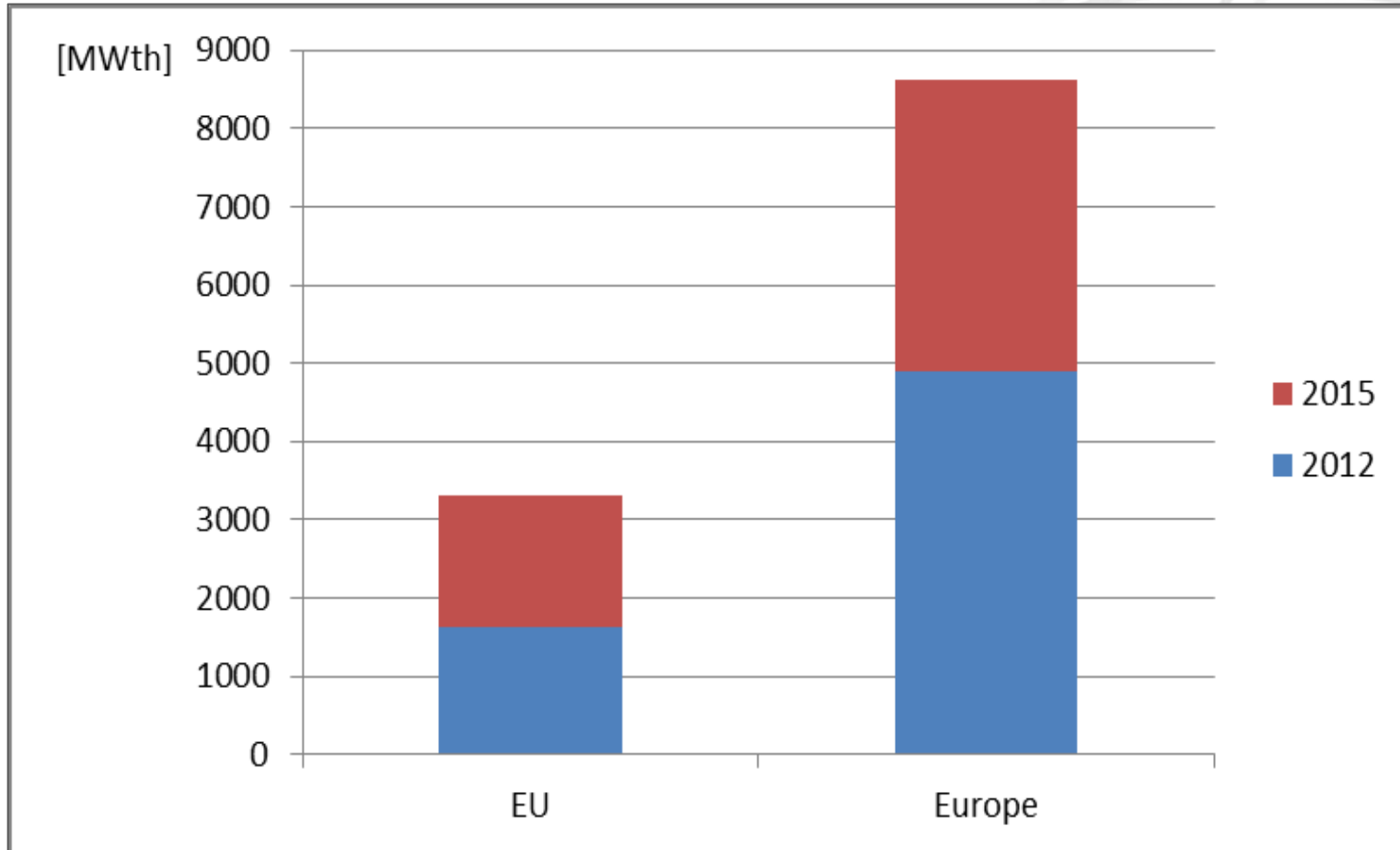
Geothermal District Heating in Europe

Development

- New areas:
 - Netherlands: DG Potentials well known due to gasdrillings
 - Hungary: small nets existing, large potential
 - Poland: large Potential
 - Spain: Centralregion Madrid and Burgos
 - Newcastle (England): poor geothermal potential
 - Bosnia-Herzegowina, Croatia, Norway
- Small heat-networks for 1,000 – 1,500 building units with $15\text{ °C} < \vartheta \leq 40\text{ °C}$; decentral heatpumps in the housea

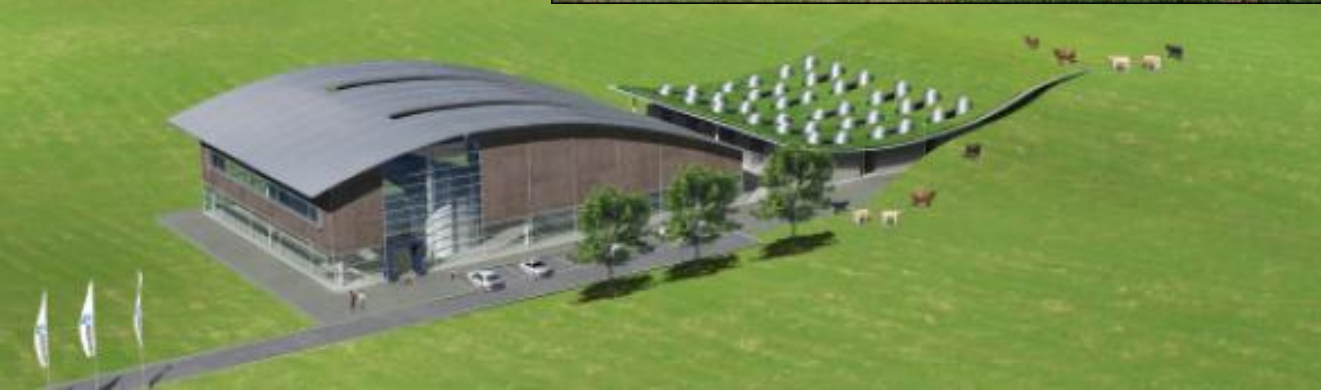


Estimated Development for the Capacity of DH-Systems





District Heating and Cooling in Germany



Geothermal Situation in Germany

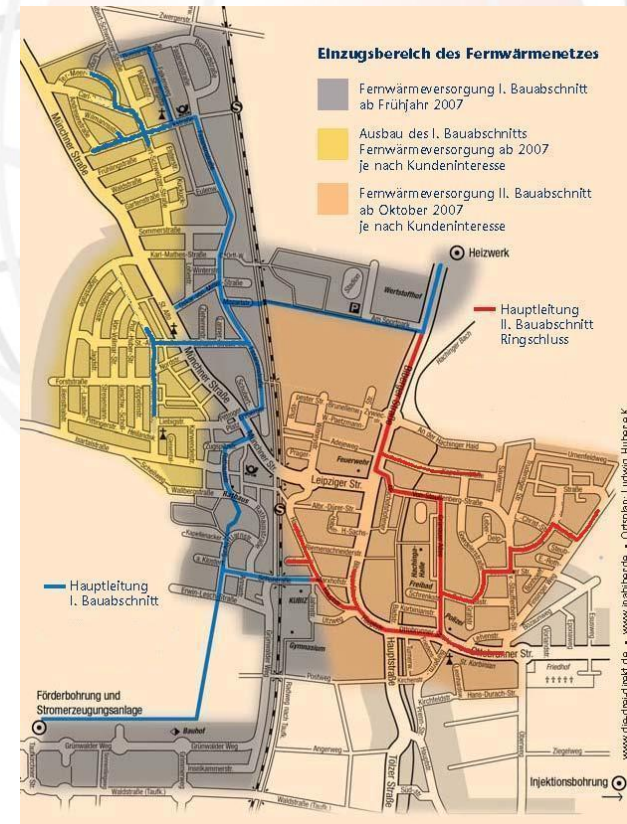
- ✓ 300,000 shallow projects
- ✓ 27 deep projects in operation
thereof 6 with electricity generation
- ✓ 12 deep projects under construction
thereof 11 with electricity generation
- ✓ More than 40 deep geothermal projects in the
planning phase

GtV Bundesverband Geothermie

Example Unterhaching, near Munic

Division of the thermal water (38 MW) due to demand

- District heating
- Powerproduction (Kalina) 3,3 MW_{el}








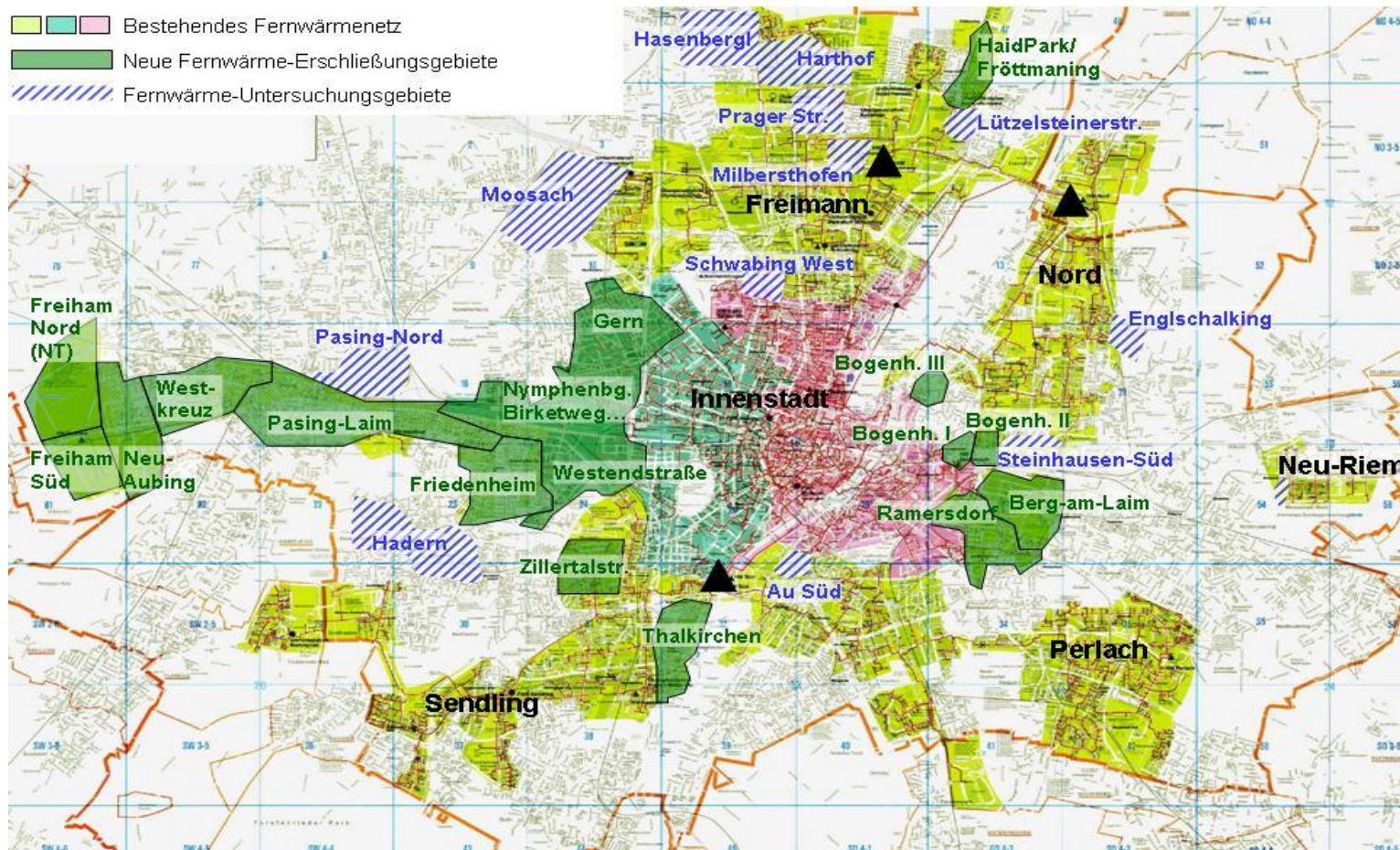
Heating of the City of Munich

- more than 2 million inhabitants
- Munich wants to become the first CO₂-free capital of the world.
- 100% of the electricity should be produced from renewable sources until 2025.
- 100% of its heat demand on renewable energies with biomass and geothermal energy until 2040.

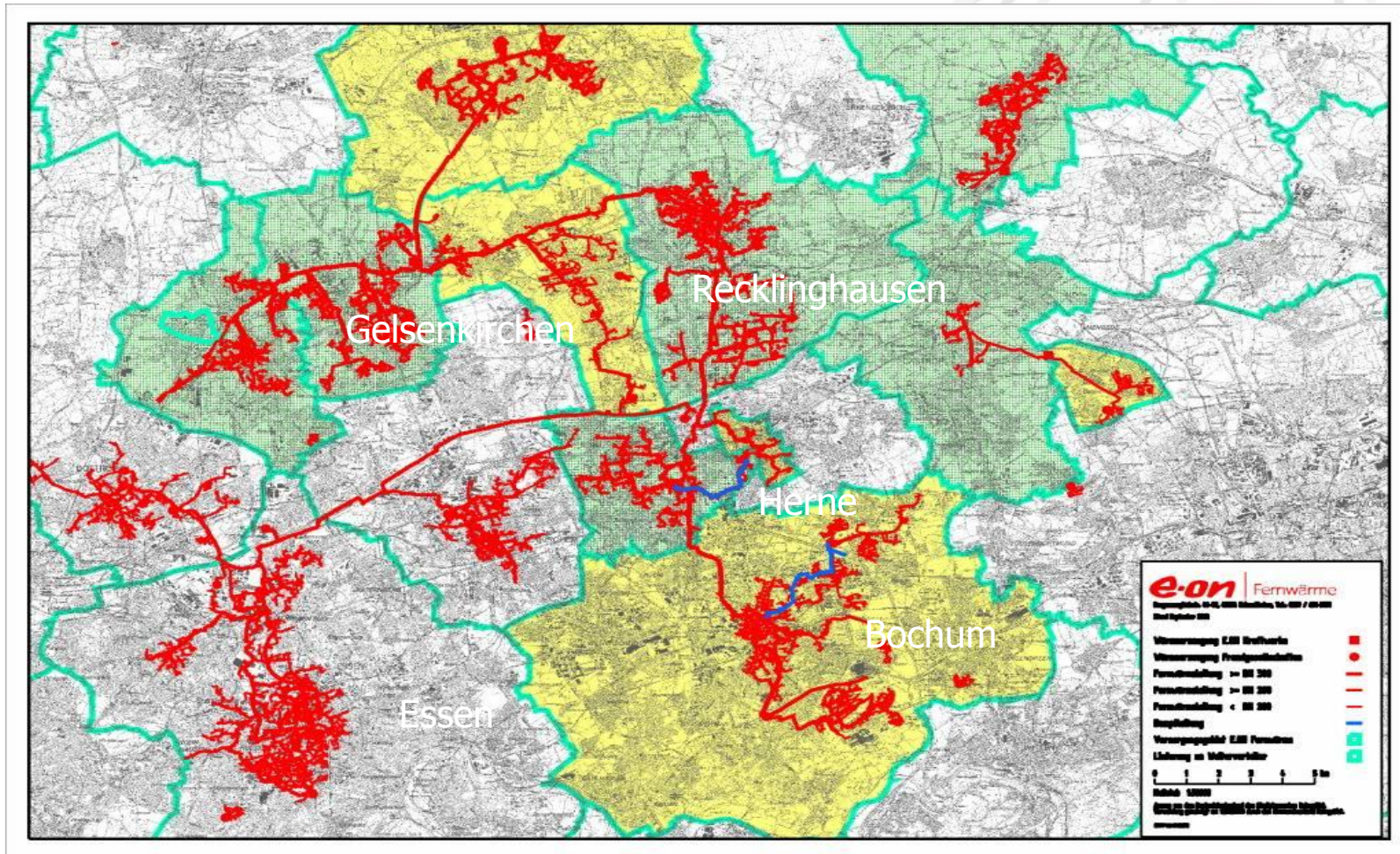


Fernwärme Ausbaustrategie

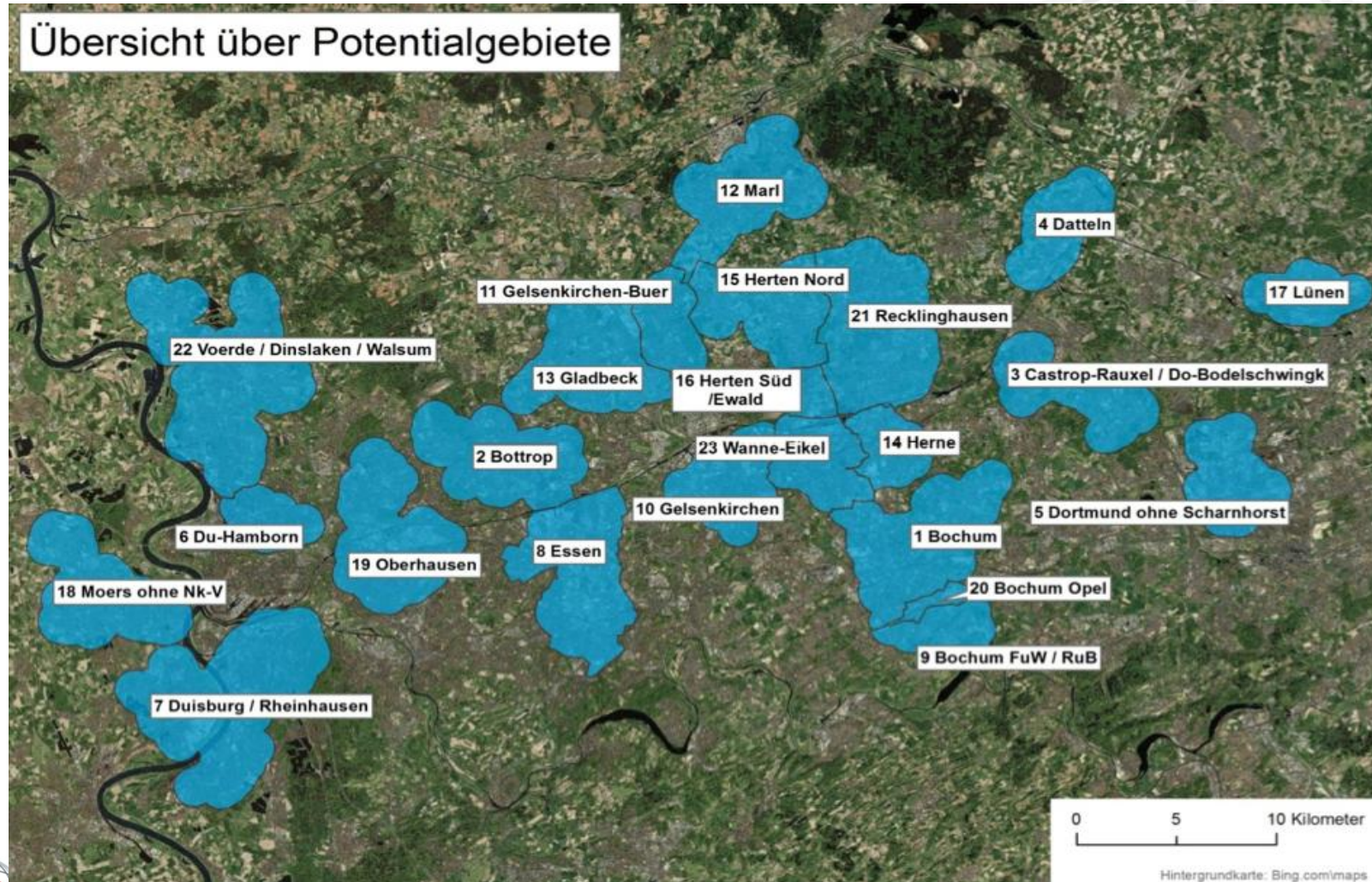
-    Bestehendes Fernwärmenetz
-  Neue Fernwärme-Erschließungsgebiete
-  Fernwärme-Untersuchungsgebiete



District Heating in Germany, i.e. Ruhrgebiet



Übersicht über Potentialgebiete



Cordial Invitation to

1. Geothermal Congress DGK 2014
2. Workshop Eastafrica
3. Workshop Poland
4. GANDOR-Workshop1, GZB
5. International Fair Geo-T Expo

Essen, Germany, 11.-14. Nov. 2014



Herzlichen Dank für die Förderung mit Mitteln der EU aus dem
"Europäischen Fond für regionale Entwicklung (EFRE), Ziel 2
Phase 6 und des Landes NRW im Rahmen des Programms
„Rationelle Energieverwendung, regenerative Energien und
Energiesparen (proges.NRW)“



Hvala, mille grazie, thank you
& Glückauf!



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