Tiefbohrungen im Norddeutschen Becken – Technologische Entwicklungen und Bohrkosten

18. Oktober 2012

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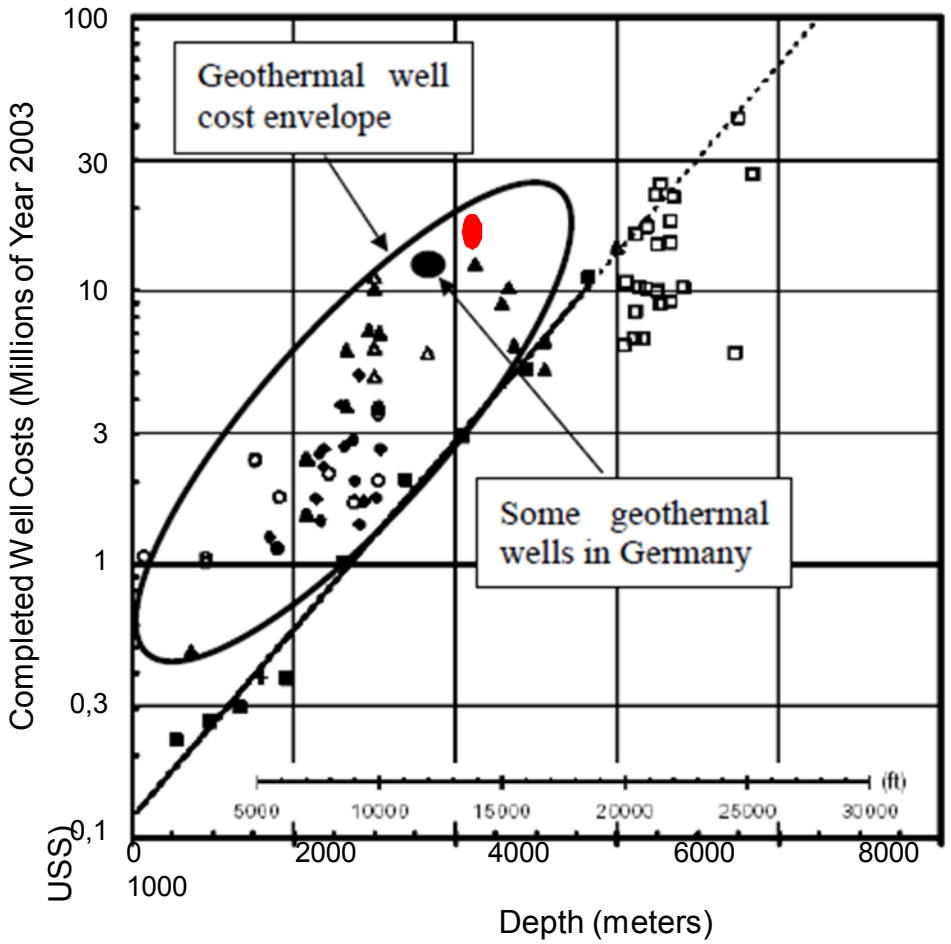
Institut für Erdöl– und Erdgastechnik



- Reducing drilling costs up to 50% (ca. 75% of total project)
- Drilling in hard rocks
- Drilling at high temperatures (>200°C)
- High capacity wells
- Improvement of safety

Geothermal Drilling Costs:

Where is your budget?

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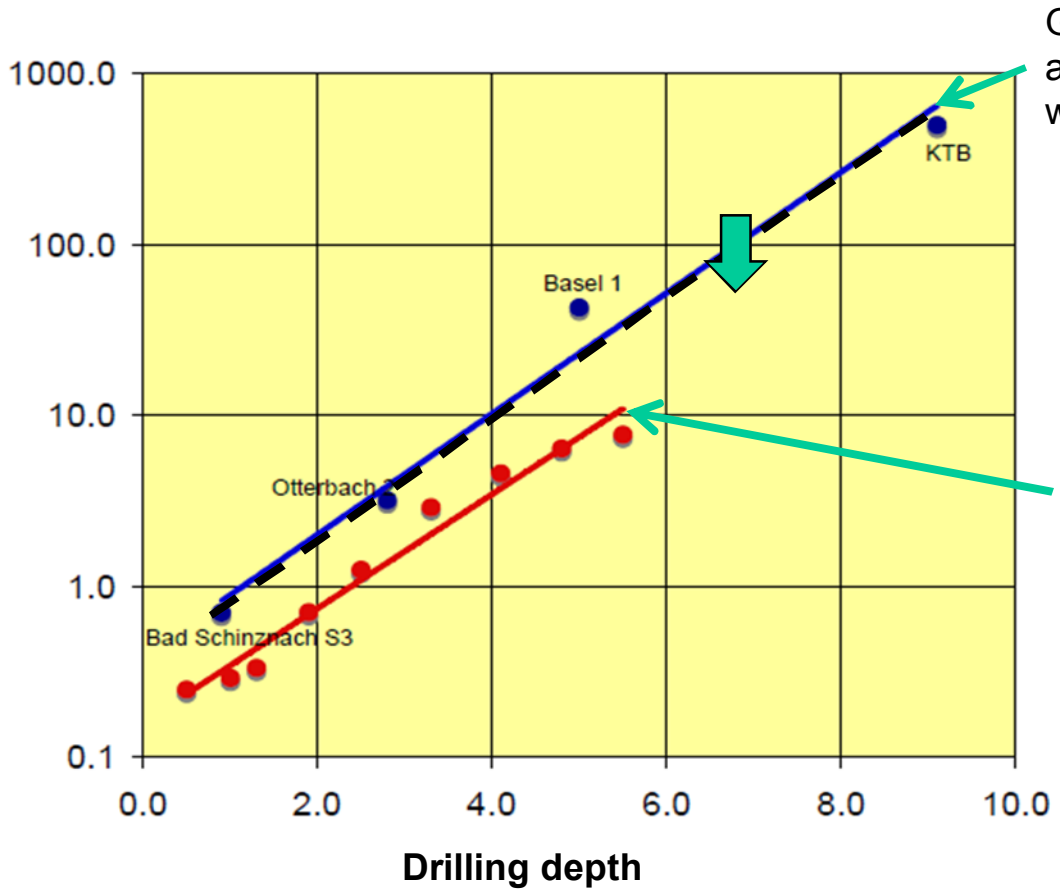
Drilling cost for selected Geothermal Projects in Europe



Geothermal and Scientific well

Oil and gas

After Haering, 2007

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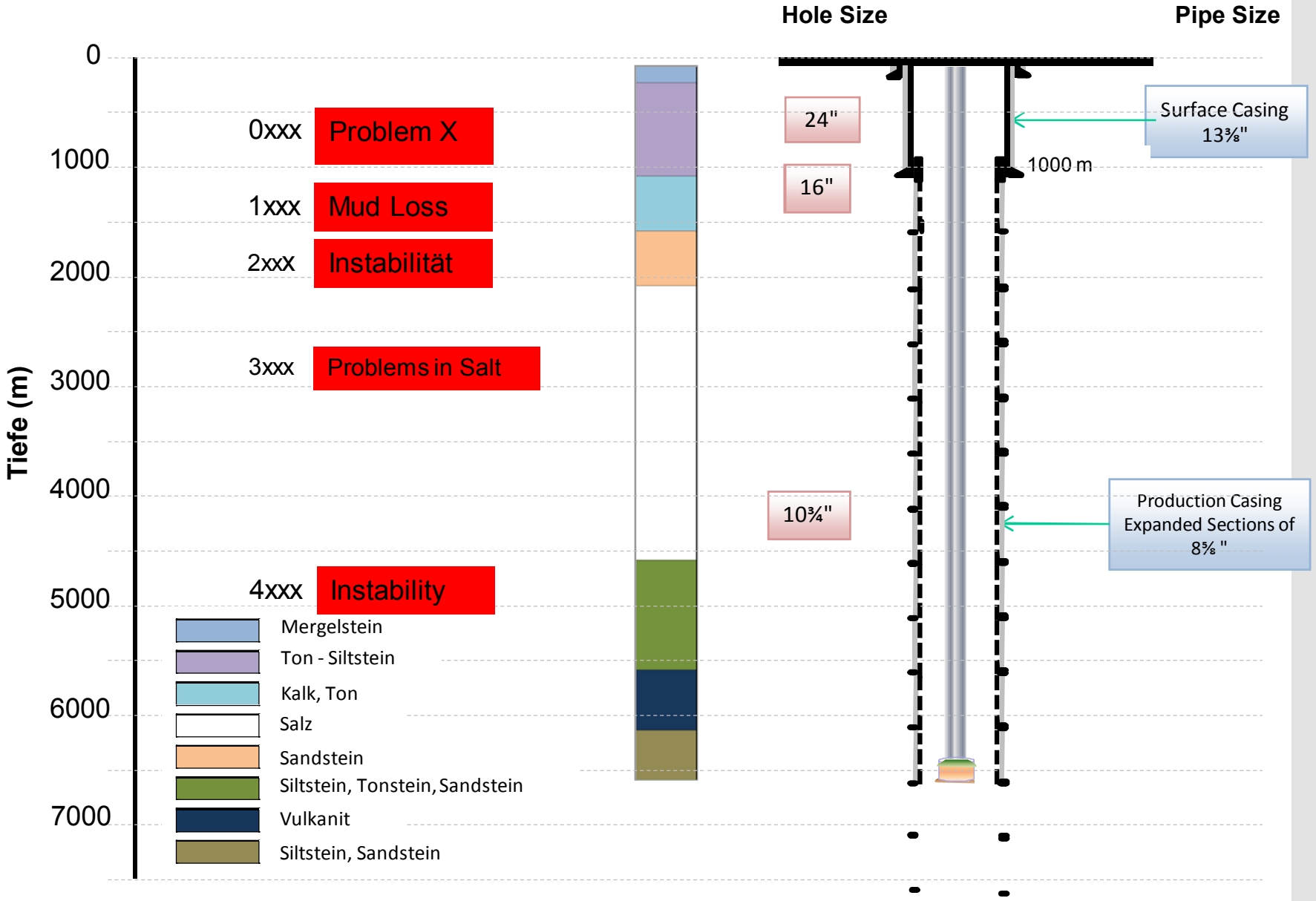
Why Are Geothermal Well Costs High?

- Drilling larger production casing
- Drilling deeper with respect to average oil and gas wells (especially in case of EGS)
- Drilling in hard formations, which are unlikely to contain hydrocarbons
- Drilling in tectonically “sensitive” areas and through faults
- High temperature environment
- Country regulations and specific subsurface conditions

Gebo Monobore Concept



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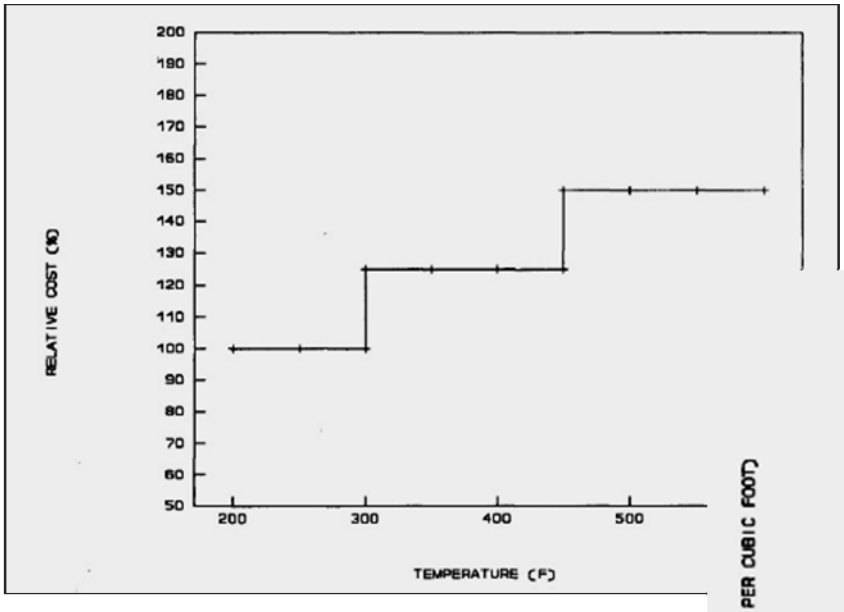
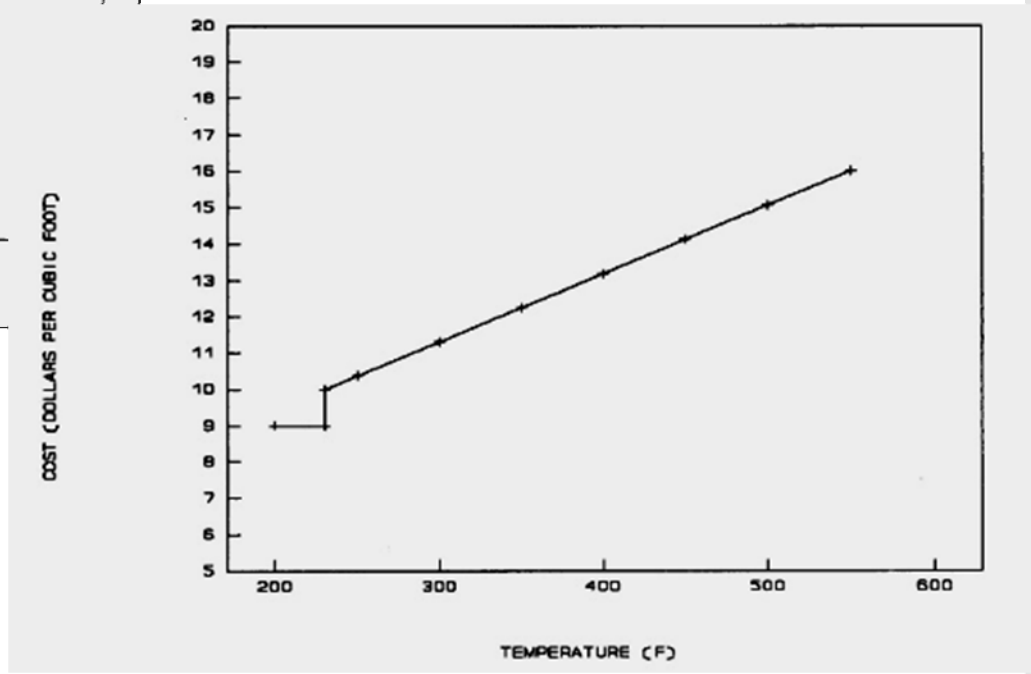
Cost of well services with increasing temperature





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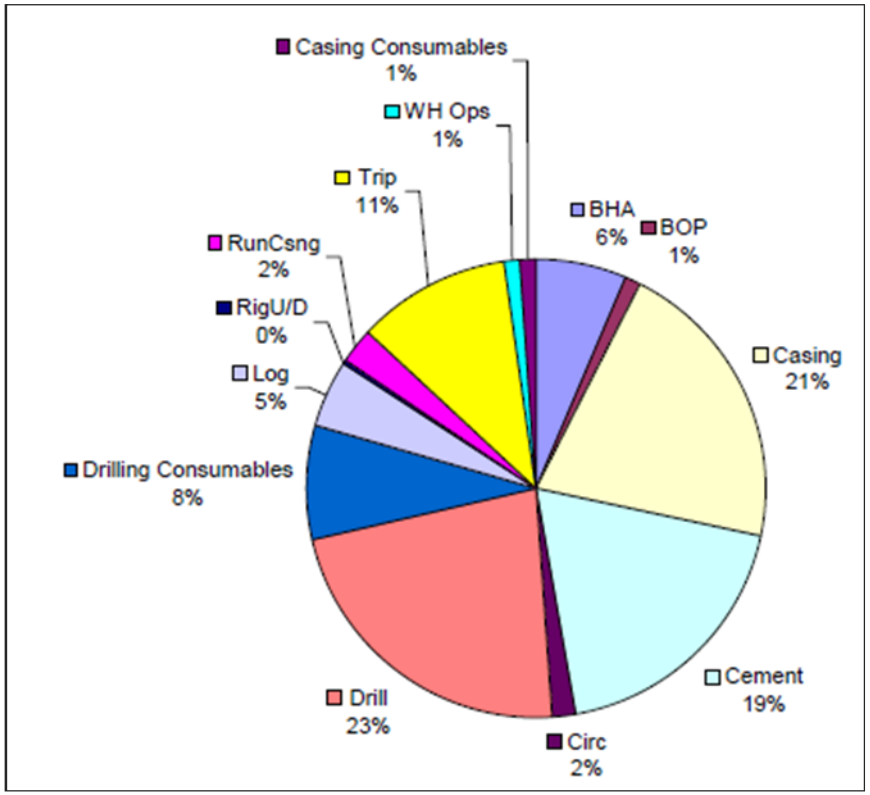
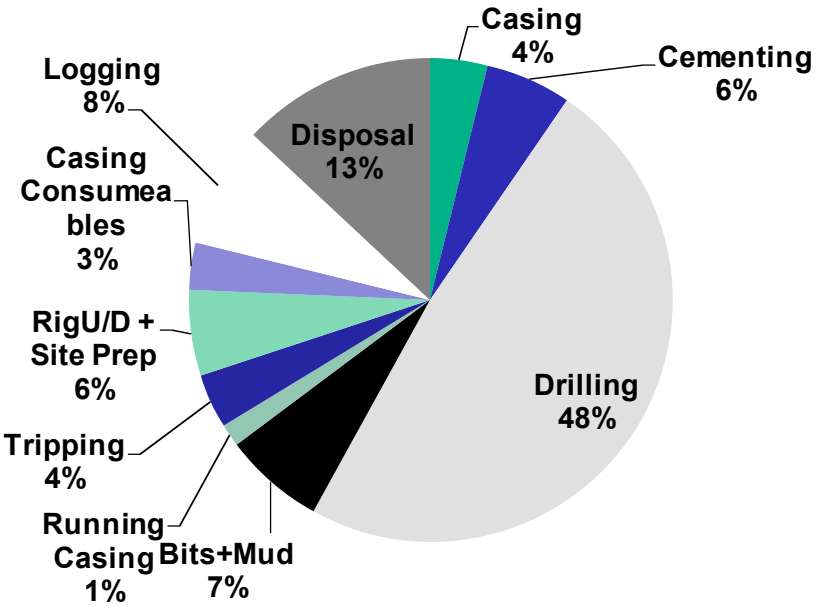
Well Cost Breakdown for EGS



Source Polski, 2008

Source Fitza, 2012



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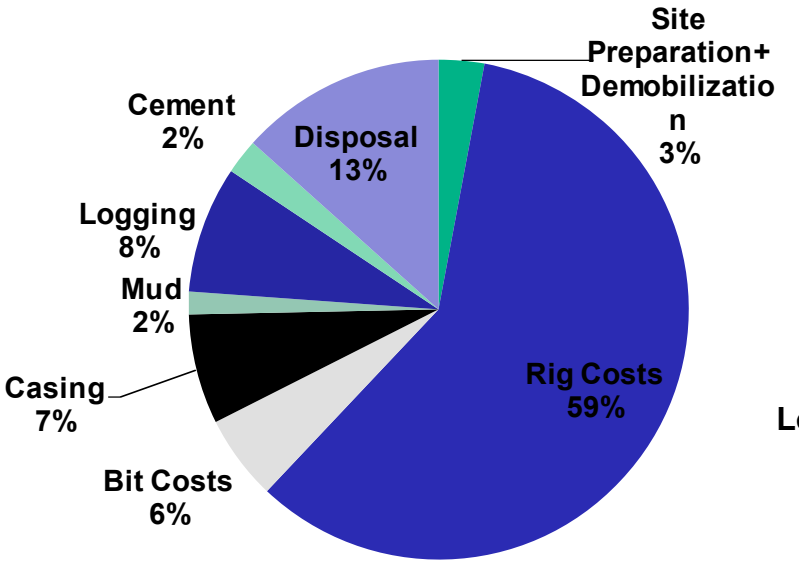
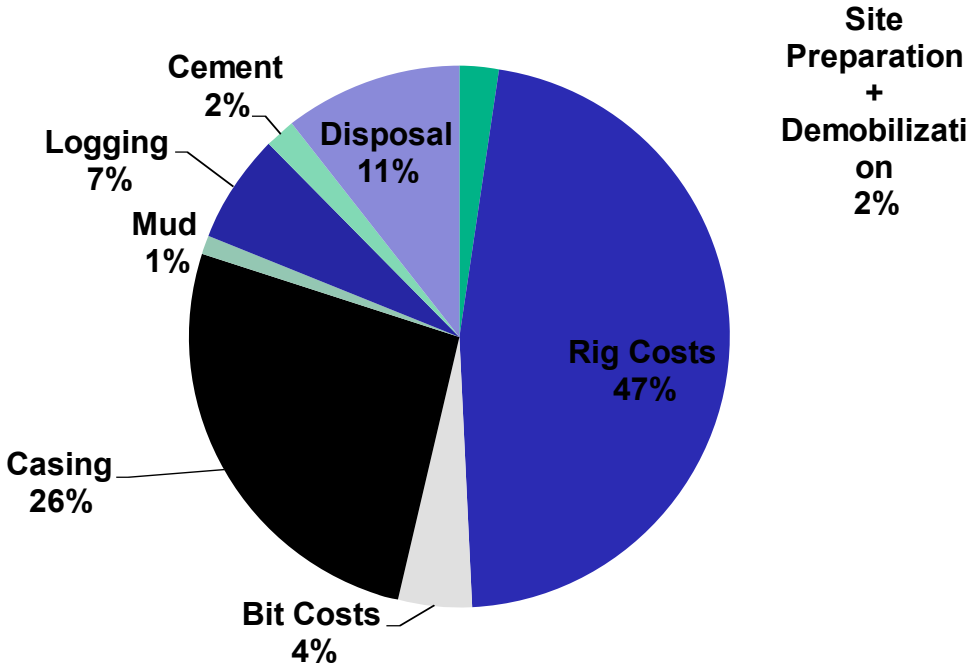
Well Costs as a Function of Casing Connections





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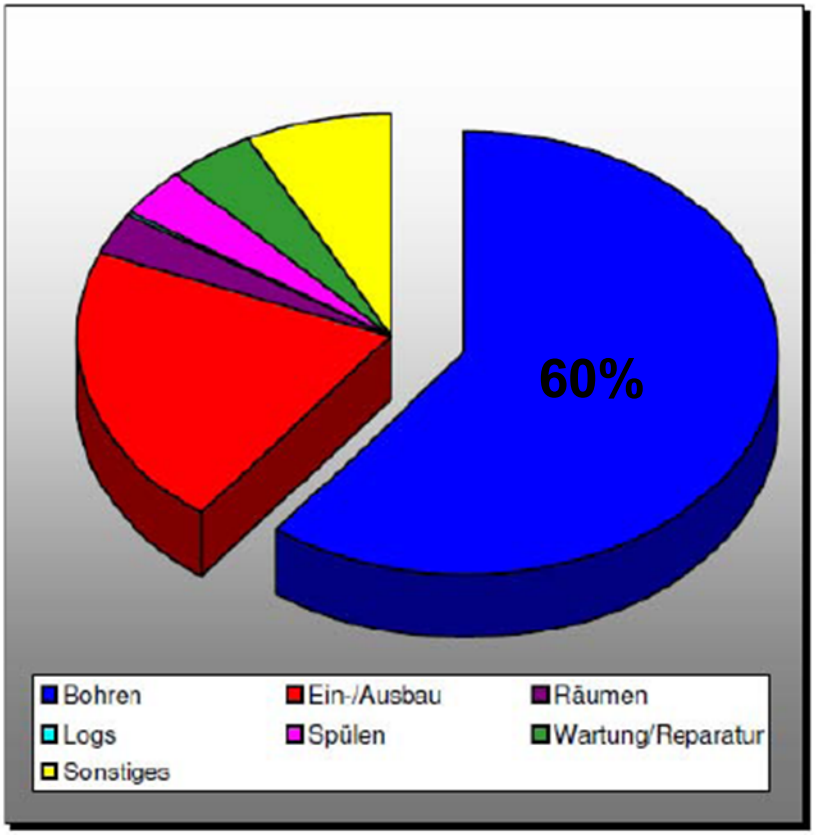
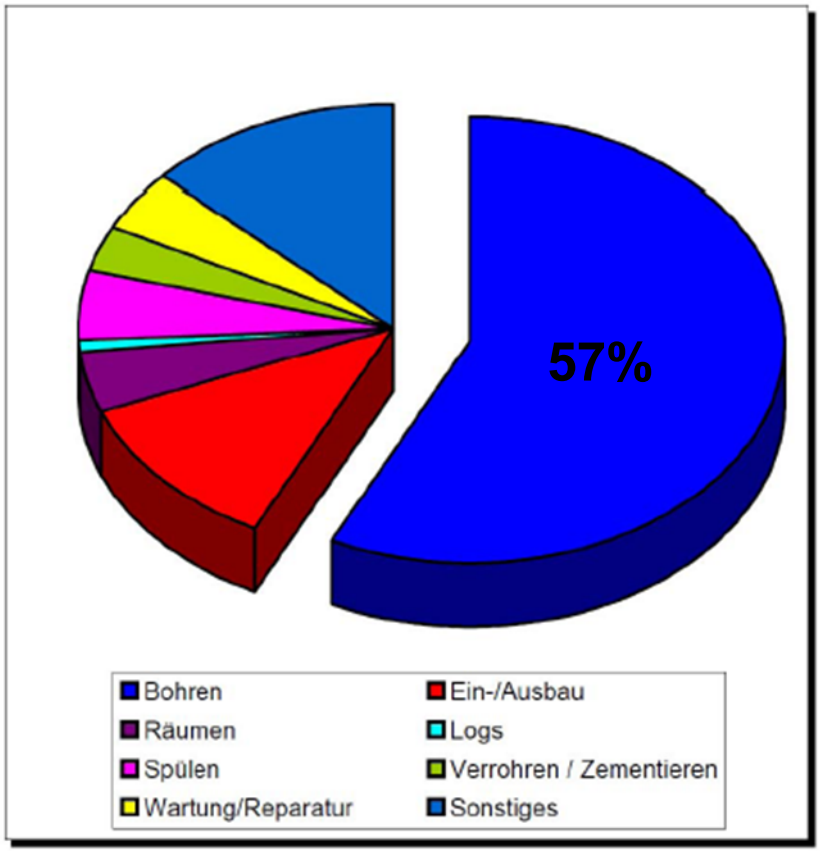
Well Costs Distribution Well A – South Germany



Operation:	in Prozent
Bohren	60.17 %
Ein-/Ausbau	20.95 %
Räumen	3.04 %
Logs	0.30 %
Spülen	3.50 %
Wartung/Reparatur	4.60 %
Sonstiges	7.45 %
Gesamt	100.00 %

Source: Schoenebeck, 2010

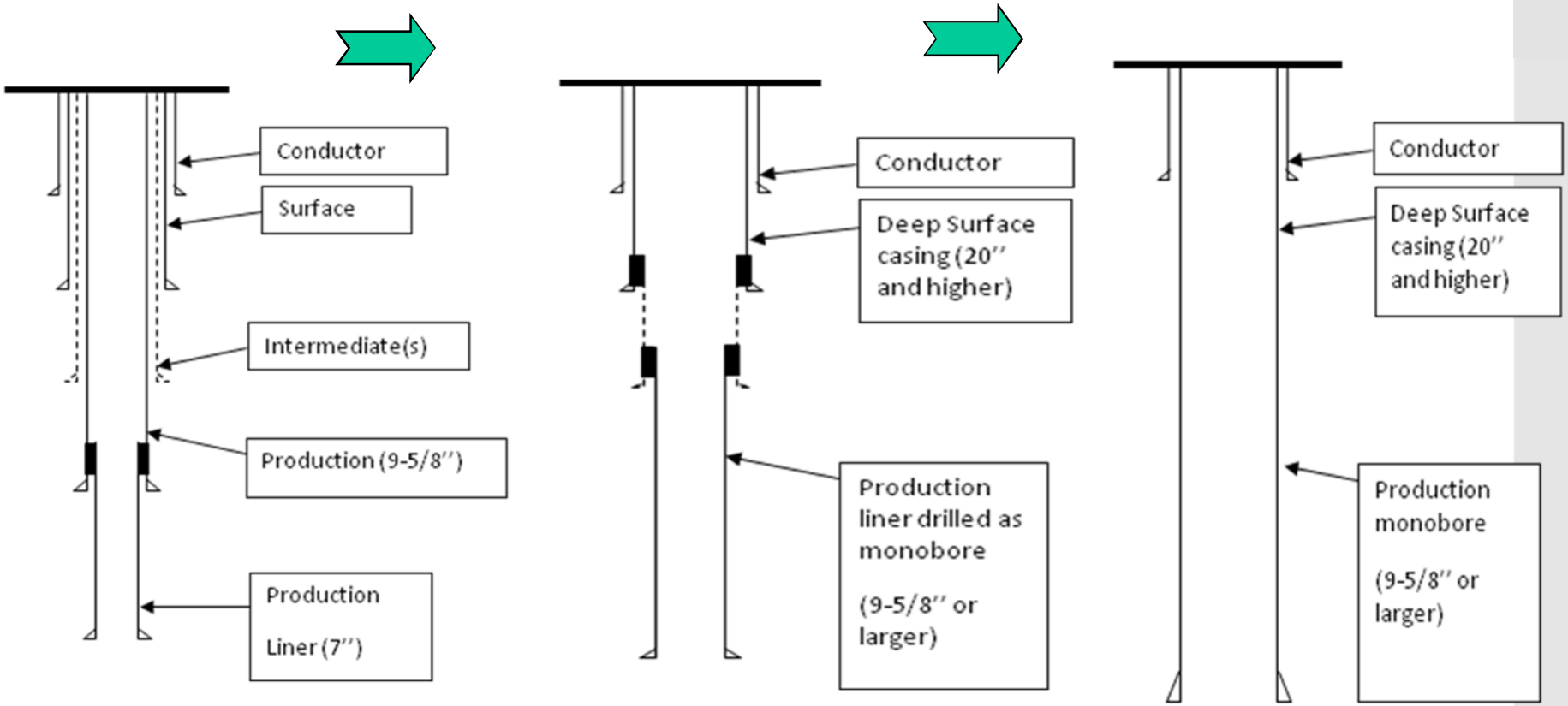
Well Costs Distribution Well B – South Germany



Operation:	in Prozent
Bohren	57.32 %
Ein-/Ausbau	11.59 %
Räumen	4.39 %
Logs	0.78 %
Spülen	5.01 %
Verrohren / Zementieren	3.52 %
Wartung/Reparatur	4.33 %
Sonstiges	13.05 %
Gesamt	100.00 %

Source: Schoenebeck, 2010

A possible Evolution of Geothermal Well Construction - 1



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Well Costs?

Oil and Gas Germany: 1000 to 2000 EUR / m

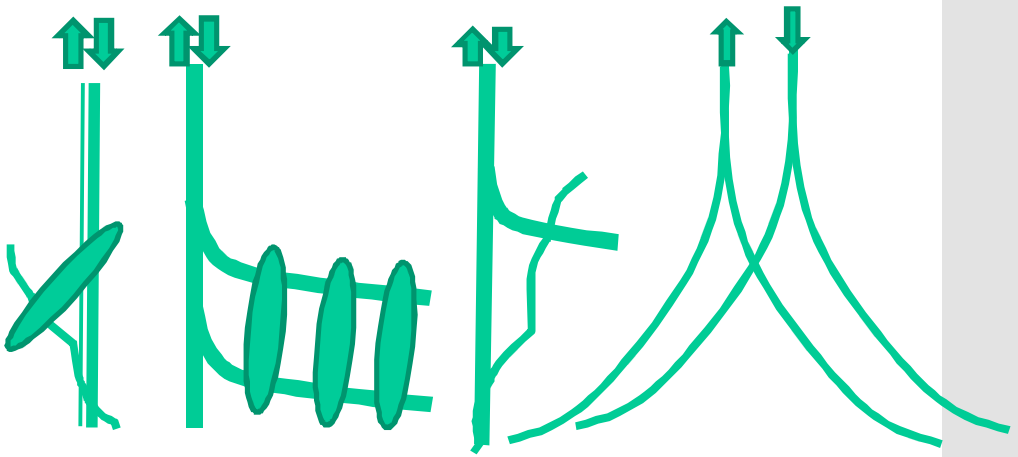
What is your number?

Well type	Depth	Production casing size	Final bit diameter	Cost/days of drilling
EGS	2,500 m (8,200 ft)	11 3/4"	10 5/8"	$3,400 m / 43
Oil / Gas average	2,500 m (8,200 ft)	8 5/8"	6 3/4"	$1,800 m / 29
Oil / Gas Slim Hole	2,500 m (8,200 ft)	5 1/2"	6 3/4"	$1,400 m / 21

Source : eere.energy.gov

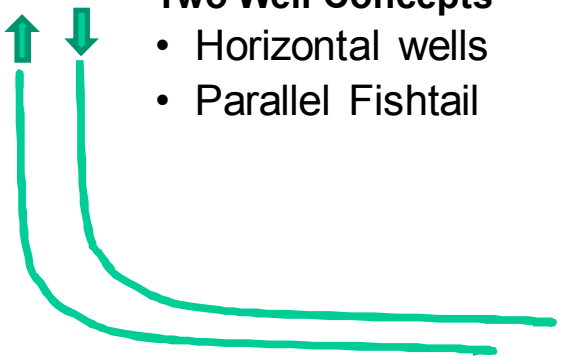
One Well Concepts

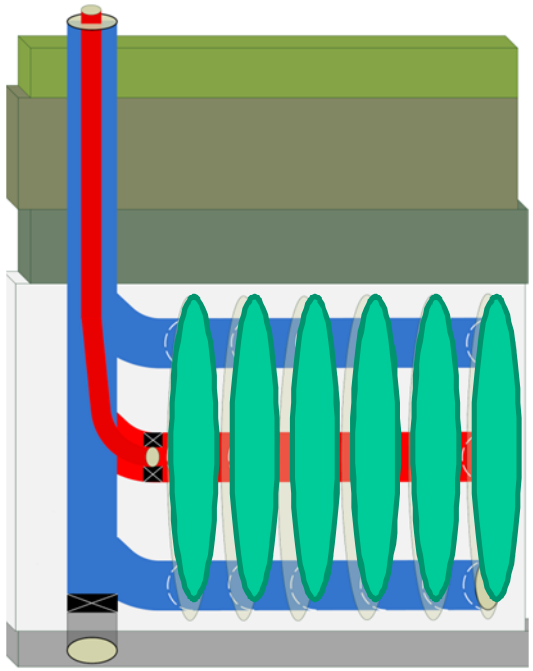
- GeneSys-type
- gebo-multilateral with Multifracs
- gebo-lateral through faults



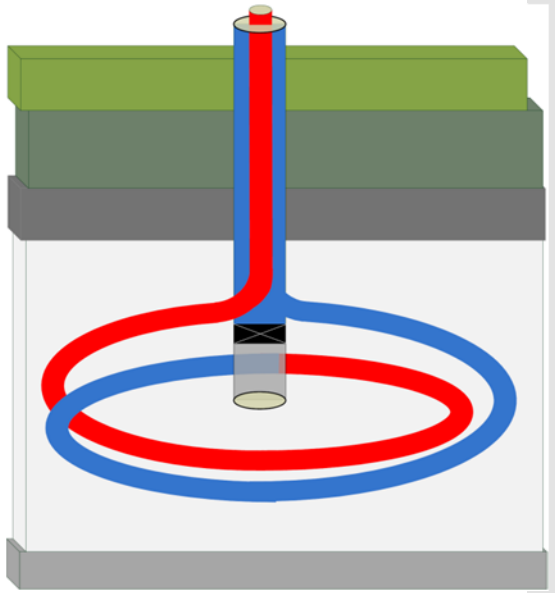
Two Well Concepts

- Horizontal wells
- Parallel Fishtail





One Well Concept
with one injector (blue) and two producers (red)
from the blue into the red well



Innovative Closed System

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Discussions

- Geothermal needs
  - Drilling Faster
  - Drilling Deeper
  - Drilling Cheaper
  - Drilling Cleaner

However, in order to reduce total well costs by18% , drilling rig costs, drilling time and trip time must each be reduced by 50%.

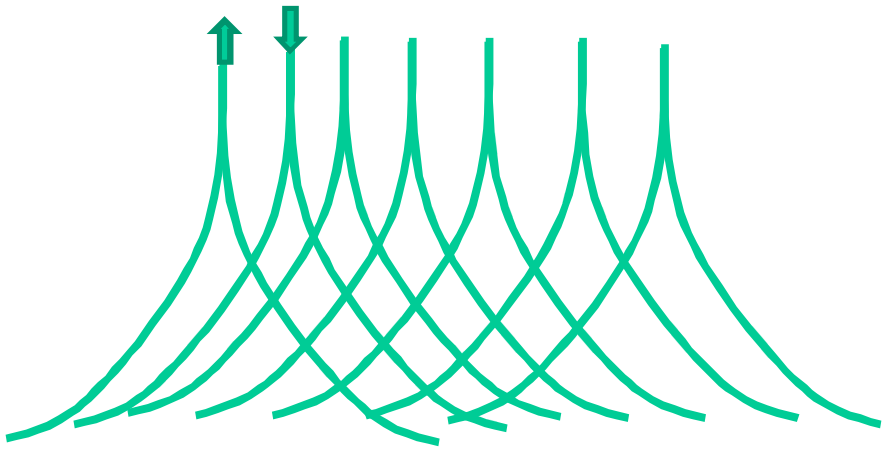
Further cost reductions can only be achieved by reviewing current well construction strategies.

- Geothermal also means drilling a **BIG BORE** to depths beyond what conventionally done for oil & gas

Cutting Costs?

PAD Drilling and Standardizing

Create a competition market



For example: drill 300 wells until 2020!!!

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Conclusions - 1

- Cutting drilling costs is not only important for oil and gas, but also a challenge for the economical exploitation of geothermal resources.

- Different drilling methods are currently under testing and evaluation. They seem to offer a good ROP compared to conventional systems, but require new and specialized equipment for field application.

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Conclusions - 2

- Different drilling technologies have been optimized for oil and gas applications, but only a few may be applicable to deep geothermal drilling.

- Significant cost reduction for geothermal drilling can be achieved through new well construction concepts, but new technologies are required to achieve these goals.

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gebo Forschungsverbund Geothermie und Hochleistungsbohrtechnik

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Vielen Dank für Ihre Aufmerksamkeit.

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