The Geothermal roadmap 2014 & Its implementation: first results

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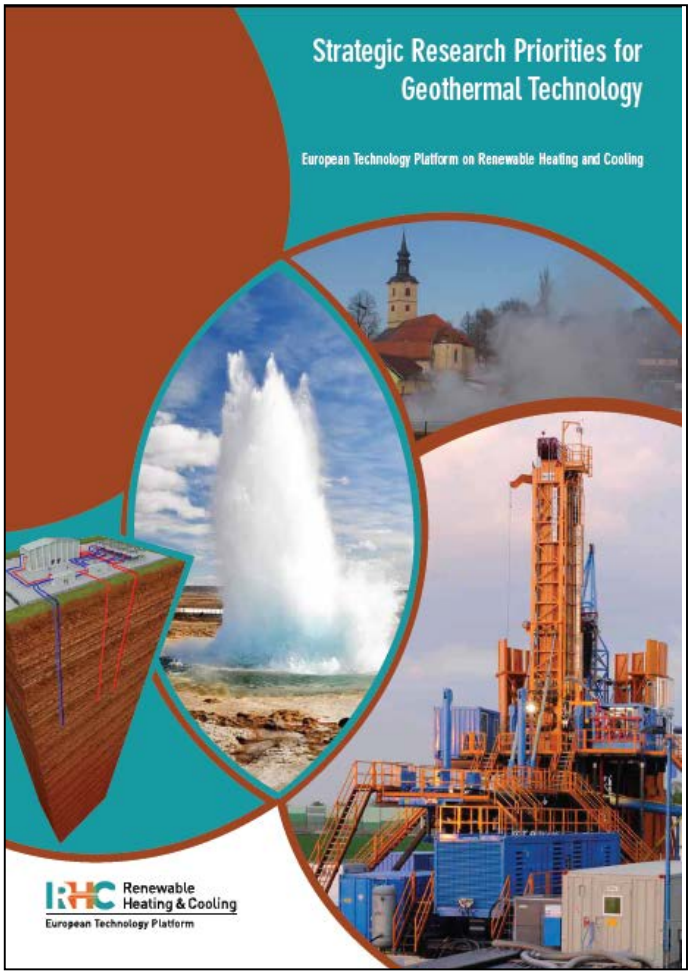
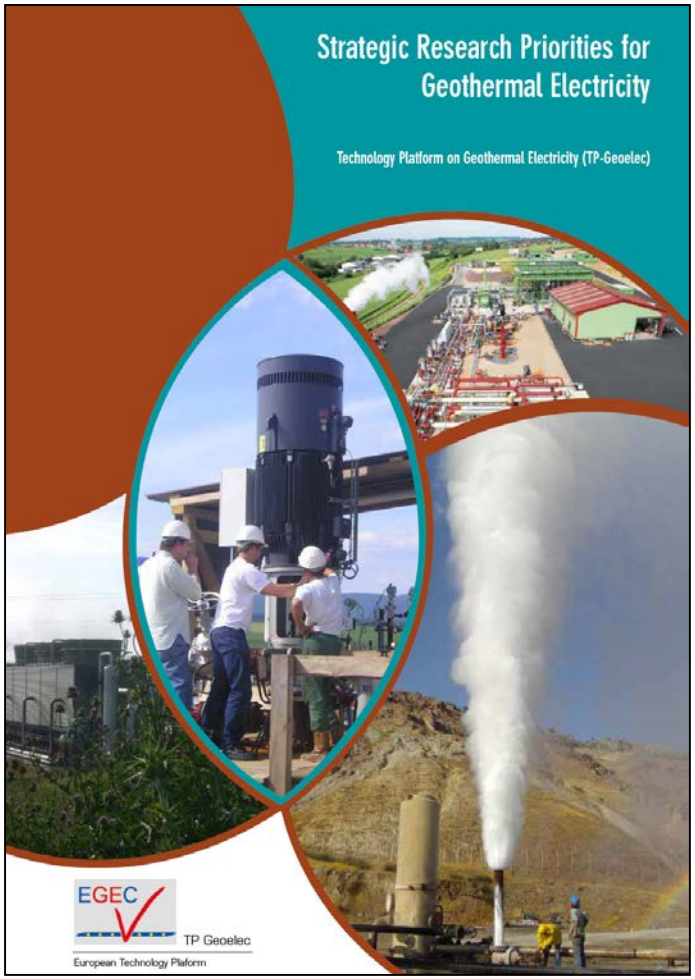
Renewable Heating & Cooling

European Technology and Innovation Platform

www.rhc-platform.org

Geothermal Strategic Research Agenda(s)





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KEY PERFORMANCE INDICATORS AND MAJOR MILESTONES : DEEP Geothermal

- ***Improved exploration.***

➢ ***Target: not a single project should need to be abandoned after the decision to go ahead with drilling.***

- ***Deep drilling cost reduction.***

➢ ***Target is to reduce cost for drilling and underground installations by at least 25 % compared to the situation today (2014).***

- ***Novel production technologies to improve efficiency, reliability and cost of heat***

➢ ***Target: reduce operation and maintenance cost by at least 25 %, improve system reliability and energy efficiency of operation,***

➢ ***in particular by decreasing energy consumption of production pumps by at least 50 %.***

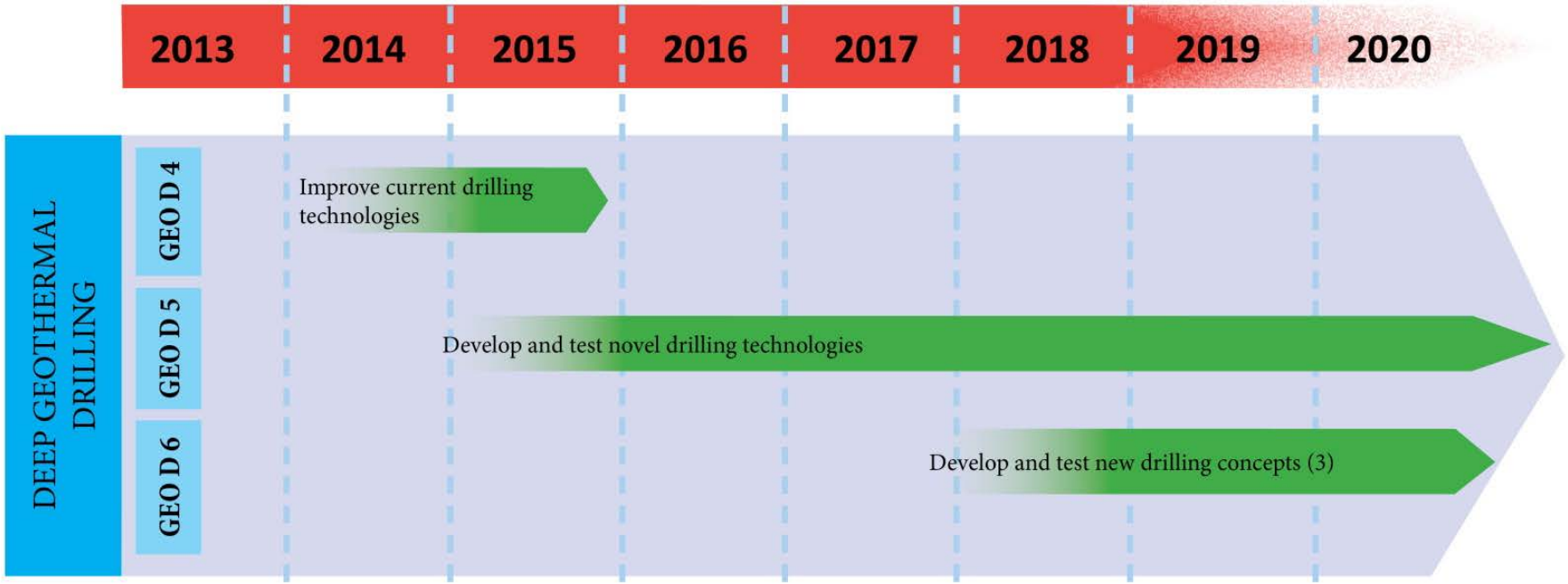
- ***Surface systems for heat uses in DHC (including CHP).***

➢ ***Target is to provide optimum heat transfer from the ground system to the distribution system, increase heat exchange efficiency by 25 % and***

➢ ***component longevity in the thermal water circuit by 40 %.***

- ***Enhanced Geothermal Systems (EGS).***

➢ ***Target is to make EGS a technology applicable as a standard alternative almost everywhere.***



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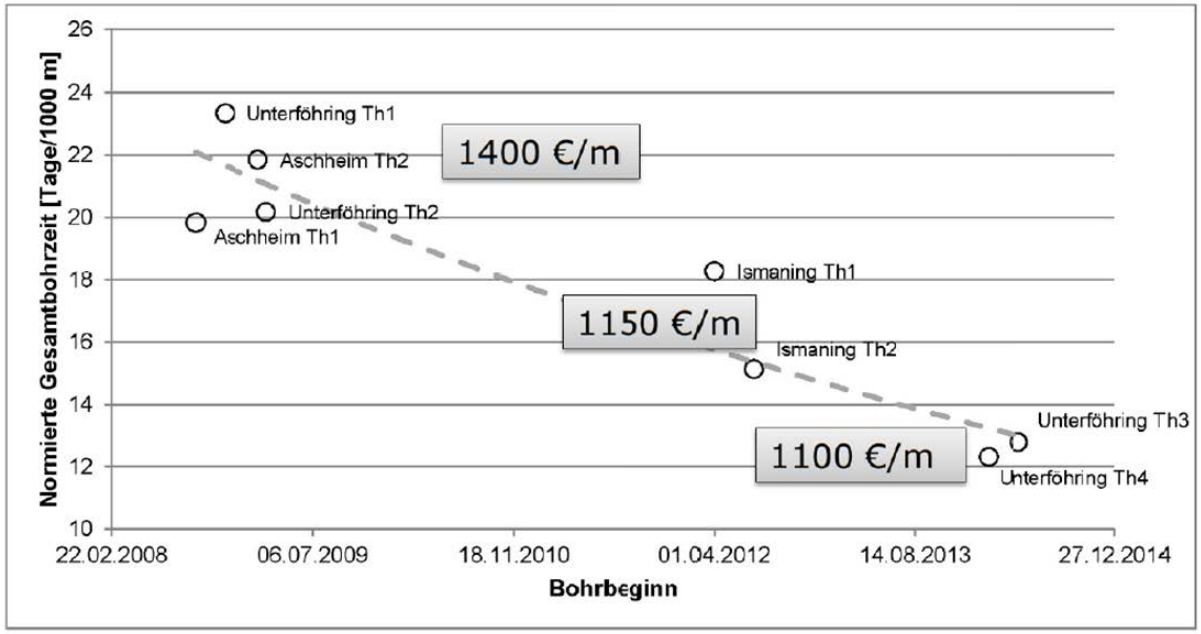
DEEP GEOTHERMAL DRILLING	GEO D 4	Improve current drilling technologies	20 mio €	5	Development
	GEO D 5	Develop novel drilling technologies by 2020: in laboratories (by 2015), on site (by 2017), on a demonstration plant (by 2020)	15+25+40 = 80 mio €	3	Research
	GEO D 6	New drilling concept: horizontal, multi-wells, closed loop systems	15 mio €	3-4	Research
TOTAL			115 mio €		

GEO D 4: Improve current drilling technologies

Project Expansion Unterföhring

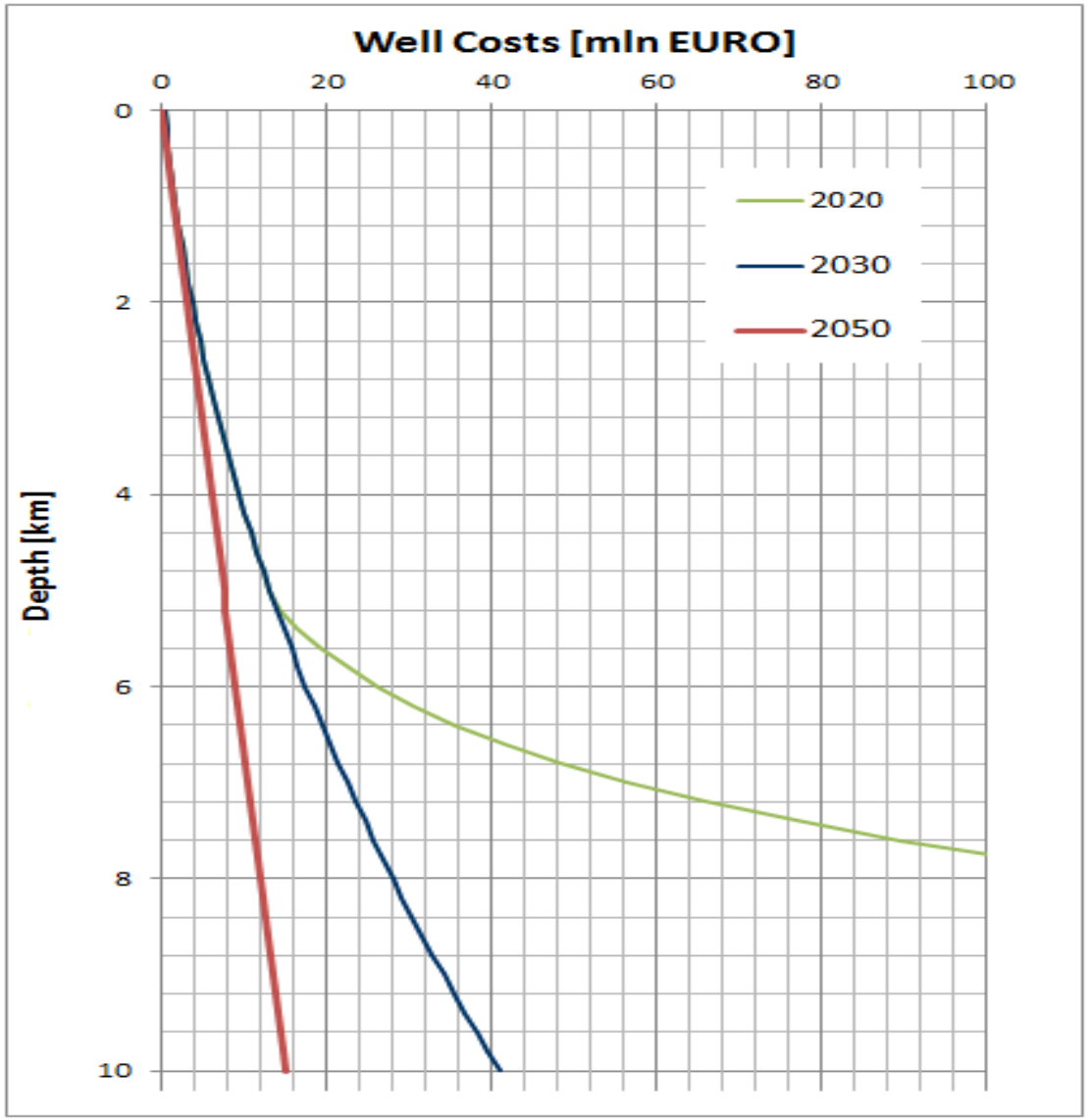
Lessons learnt



Weitere Info in: • *BBR: Sonderheft Geothermie 2015*

GEO D 5: Develop novel drilling technologies

The challenge of Well costs: from exponential to linear curves



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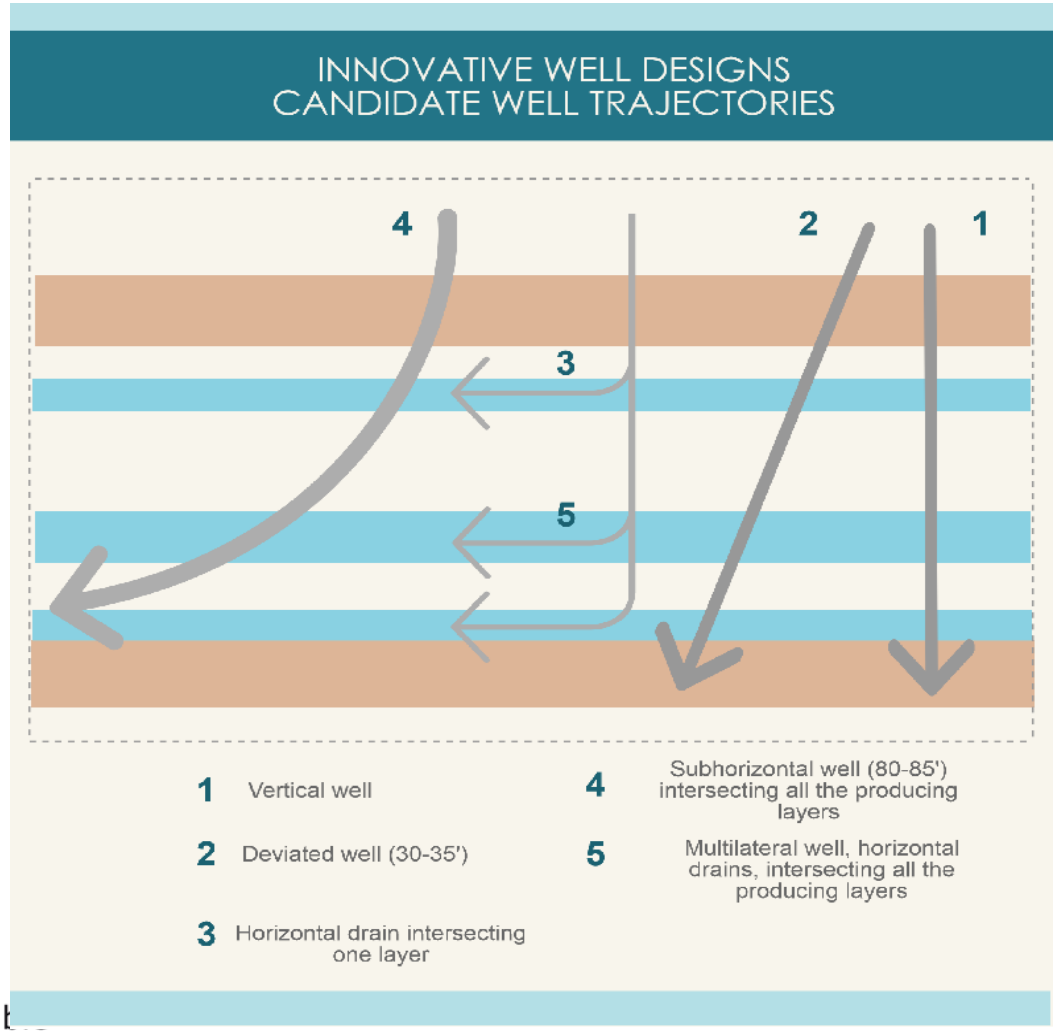
GEO D 6: New drilling concept



R&I priority: DEEP GEOTHERMAL- DEEP GEOTHERMAL DRILLING Improve current drilling technologies (GEO D 4)		
Specific KPI	Value of the KPI at the date of submission of deliverable D1.2	Statements and figures supporting the value provided
Reduce cost for drilling and underground installations by at least 25% compared to the situation today	Current Market conditions for commodities helps costs reduction for drilling Improve current technology ready in 2-3 years: thermodrill, descramble Cost reduction also with Development, learning by drilling: example erdwerk in Germany Drilling cost should reduce by 15-20% by 2025 DoI target is to reduce the unit cost of drilling (€/MWh) by 15% in 2020, 30% in 2030 and by 50% in 2050 compared to 2015;	• ETH Zuerich (Spallation drilling), • Fraunhofer Institute (Laser Jet drilling) • University Dresden (Electro-Pulse drilling): Development and testing of an electric pulse method drill head for deep geothermal (EIV) • HH300 geothermal drilling facility • DIRT Drilling with fiber reinforced composite material • ThermoDrill - Fast track innovative drilling system for deep geothermal challenges in Europe • DESCRAMBLE - Drilling in supercritical geothermal condition • InnoDrill - Technology platform for research-based innovations in deep geothermal drilling

R&I priority: DEEP GEOTHERMAL- DEEP GEOTHERMAL DRILLING Develop novel drilling technologies by 2020: in laboratories (by 2015), on site (by 2017), on a demonstration plant (by 2020). (GEO D 5)		
Specific KPI	Value of the KPI at the date of submission of deliverable D1.2	Statements and figures supporting the value provided
Reduce cost for drilling and underground installations by at least 25% compared to the situation today	Novel drilling technologies are not expected to be commercial before 2025	• New Drilling Technique Based on Firing Projectiles • Thermal spallation drilling: rockflame interaction • Applied research and development of innovative drilling technology for ultra-deep geothermal wells: Innovative water jet generating system, based on electric discharge plasma • Robust autonomous mechatronic systems for ultra-deep geothermal wells: Innovative mechatronic systems for ultra deep geothermal wells • Germany: joint project of the TU Bergakademie Freiberg and the Technical University Dresden on Lightning shattering rock: new drilling method for deep geothermal energy: 25 Lightning strikes with a voltage of 500 kV crush the rock

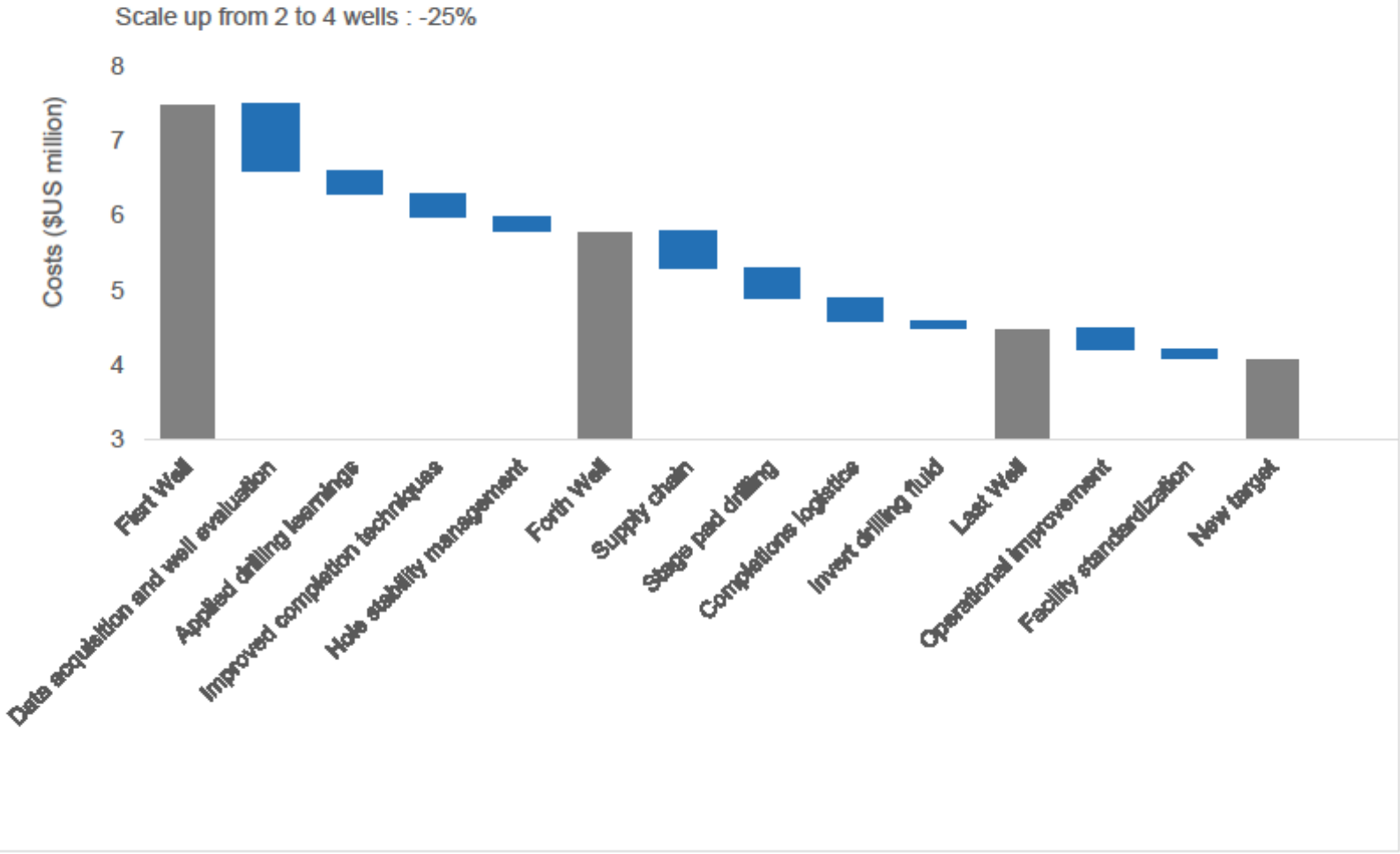
R&I priority: DEEP GEOTHERMAL- DEEP GEOTHERMAL DRILLING New drilling concept: horizontal, multi-well, closed loop system (GEO D 6)		
Specific KPI	Value of the KPI at the date of submission of deliverable D1.2	Statements and figures supporting the value provided
Reduce cost for drilling and underground installations by at least 25% compared to the situation today	Multilateral wells available in some countries (France…) from 2017	For a geothermal DH project in Paris region, developed by private companies HYDRA (Fostering new skills by means of excellent initial training of researchers): Hydraulics modelling for drilling automation UK: Single well technology developed in Cornwall

Deep drilling costs reduction

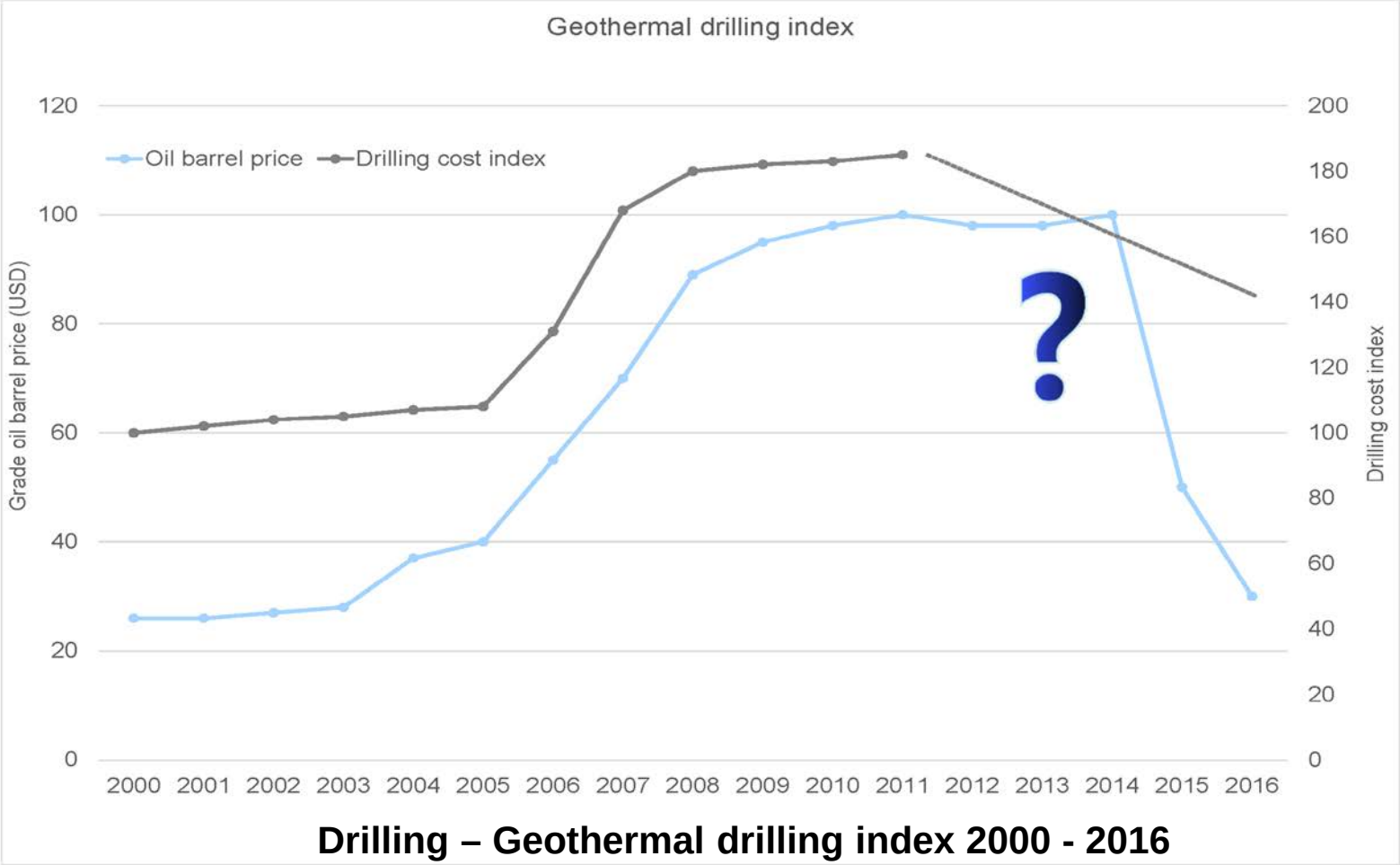
How Deep drilling costs can be reduced ?

- With RD&D activities
- With Learning by doing series of drilling
- With a better functioning drilling market

Reducing cost:
Scale up effects while drilling



Market conditions

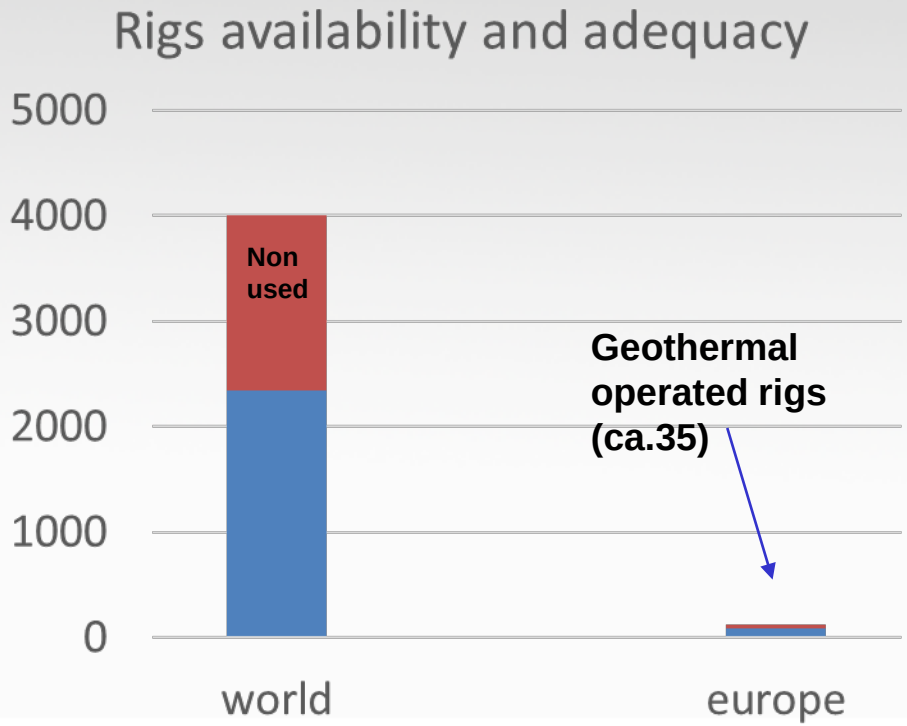


Drilling – Geothermal drilling index 2000 - 2016

A better functioning drilling market

Drilling costs are dependent on:

- the rig demand (mainly for oil & gas, therefore dependant on crude oil prices),
- the drilling price (€/m),
- and the raw material cost.



Drilling costs comparison: GeoHeatPol project

country	Drilling contract	Drilling price €/m	Ponderation factors	Other factors
Iceland	Integrated meter rates contracts	•A: 250 m fresh water / low-temp well, 60 to 100 €/m Small rig •B: 1000 m geothermal well 350 to 550 €/m Medium rig •C: 2500 m high-temp well 1.100 to 1.400 €/m Large rig.	Rig demand Raw material cost	Market maturity : n° of geothermal plants, n° of drilled geothermal wells N° of national drilling companies Drilling market open or not to foreign competitors Complexity of tender documentation
France	rig daily rate, lump sum	Under 1000m depth: 1000 €/m Below 1000 m depth: around 870 €/m		
Germany	metre rate, rig daily rate and lump sum	Below 2000m depth: 1100-1500 €/m		
Hungary (and similar in the Pannonian Basin)	Lump sum drilling contract	•<2 km: 350-500€/m, with “small” capacity, “old” rig •>2 km: 800-1000€/m, with “large” capacity rig		
Netherlands	lump sum, rig daily rate			
Italy	rig daily rate			

Cost headings characteristic

- **Civil works for access and drilling platform**
- **Mob-demob drilling rig and auxiliary equipment**
- **Drilling**
- **Casing & installation**
- **Directional drilling**
- **Logging**
- **Stimulation, test and pumping**
- **Well head equipement**
- **Treatment and transportation of cuttings and waste material**
- **Engineering and supervision**
- **Insurance**
- **Unexpected**

Iceland

A:	250 m fresh water / low-temp well,	60 to	100 €/m	Small rig
B:	1000 m geothermal well	350 to	550 €/m	Medium rig
C:	2500 m high-temp well	1.100 to	1.400 €/m	Large rig.

France

For the Dogger target, Example : One off the last doublet in 2016

Drilling cost alone with mob-demob at 2300 m = 860 €/m

Hungary

The price rate is strongly determined by the oil price. In the latest years there are less and less hydrocarbon exploration in Hungary, therefore free drilling capacities push down the drilling price. There are minimum 5-6 potential drilling contractors now instead of 2-3 formerly.

Drilling price depends on rig size (incl. 27%VAT):

- <2 km: 350-500€/m, with “small” capacity, “old” rig
- >2 km: 800-1000€/m, with “large” capacity rig

Drilling is implemented by old water rig, selecting always cheaper solutions.

“Large rig” technology comes from the hydrocarbon industry, with high standard solutions. Unfortunately, municipalities and greenhouse companies often unable to finance this cost level.

Conclusions

5 Key parameters to improve

1) Technical: new materials, experienced crew…
2) Technological: proper rigs and bits
3) Regulatory: nature and its local/national aspect
4) Financing
5) Economical and market conditions.