From an ENhanced Geothermal Innovative Network for Europe to an European geothermal drilling program?

Ledru P., Huenges E., Flovenz O.
A renewed interest for geothermal resources of deep origin

> R&D task force
  • The support of the European Commission
  • The ENGINE contribution
  • Other International initiatives

> Growing interest of industry and investors
  • The heat rush in Australia and Germany
  • A rising force for investing in exploration in Europe

> A favorable context for preparing new ambitious projects within an European geothermal drilling program

> Drilling : a key issue
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> Drilling : a key issue
Drilling and the EGS challenge

- exploration
- resource assessment
- resource management
- advanced drilling
- advanced stimulation
- efficient power cycles
- environmental impact
Enhanced Geothermal Systems: the concept

> Enhancing and broadening geothermal energy reserves

- stimulating reservoirs in Hot Dry Rock systems,
- enlarging the extent of productive geothermal fields by enhancing/stimulating permeability in the vicinity of naturally permeable rocks
- enhancing the viability of current and potential hydrothermal areas by stimulation technology and improving thermodynamic cycles,
- improving drilling and reservoir assessment technology,
- improving exploration methods for deep geothermal resources
- defining new targets and new tools for reaching supercritical fluid systems, especially high-temperature down-hole tools and instruments
A scientific and technical European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems

Coordination action breakdown structure: http://engine.brgm.fr/

ENGINE: ENHANCED GEOOTHERMAL INNOVATIVE NETWORK FOR EUROPE

An updated framework of activities concerning Unconventional Geothermal Resources and Enhanced Geothermal Systems in Europe

Best Practice Handbook and innovative concepts

WP9 Risk evaluation for the development of geothermal energy
Report on the integration of results in a Decision Support system

WP8 Expertise on exploitation, economic, environmental and social impacts
Synthesis on best practices, barriers holding back development and possible solutions

WP7 Expertise on drilling, stimulation and reservoir assessment
Synthesis on best practices, barriers holding back development and possible solutions

WP6 Expertise on investigation of unconventional geothermal resources and EGS
Synthesis on best practices, barriers holding back development and possible solutions

WP5 Exploitation, economic, environmental and social impacts
- Integrated economic approach for cost-effectiveness
- Policy makers and public awareness
- Gaps and barriers holding back development

WP4 Drilling, stimulation and reservoir assessment
- Drilling technology, reservoir modelling and management
- Gaps, barriers and cost effectiveness

WP3 Investigation of unconventional geothermal resources and EGS
- The scientific and technological challenges of the exploration phase
- Gaps, barriers and cost effectiveness

Publications
- state-of-the-art
- proceedings of conferences
- definition and analysis of bottlenecks and solutions

WP1 Project Management
- 1 co-ordinator and secretary
- follow up time / quality / cost
- 1 executive Group
- 1 steering committee
- Connection with international agencies, national programmes, industrial partners

Deliverables
- quarterly reports to EU
- stronger links with potential partners for new projects

WP2 Information and dissemination system
- General information
- Information on training and education
- Reports and results, publications
- Data management
- Publication policy
- Connection with media

Deliverables
- a web site
- access to databases, models and open-source software
- on-line access to articles and reviews

WP1 Project Management

Coordination action breakdown structure:

http://engine.brgm.fr/
A framework for some of the R&D issues that will result from the ENGINE project

> to capitalise the know-how and to define new integrated projects
  • Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems
  • Drilling, stimulation and reservoir assessment
  • Economic, environmental and social impacts

An updated framework of activities concerning Unconventional Geothermal Resources and Enhanced Geothermal Systems in Europe

WP4
Drilling, stimulation and reservoir assessment
- Drilling technology, reservoir modelling and management
- Gaps, barriers and cost effectiveness

Publications
- state-of-the-art
- proceedings of conferences
- definition and analysis of bottlenecks and solutions

29 Jun - 01 Jul 2006 Stimulation of reservoir and induced microseismicity - Zurich, Switzerland, Workshop3
1-05 July 2007 Drilling cost effectiveness and feasibility of high-temperature drilling - Reykjavik, Iceland, Workshop4
As it is already partly expressed in the FP7 work program, researches should

• define conceptual models for irreversible enhancement of permeability of the reservoirs
• analyse the distribution in time and space of the magnitude of seismic events in order to improve the 3D imaging of the fracture system and stress field
• set requirements for seismic monitoring and recommend management strategies for prolonged field operation,
• provide a methodology for the estimation of site-specific seismic hazard prior to development of potential sites for EGS.

The induced earthquake in Basel on the 8th December 2006 reveals the urgent necessity to fill the gap in knowledge about this matter.
One major target: How to prioritise R&D needs?

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<th><strong>EGS technology</strong></th>
<th><strong>Priority A</strong></th>
<th><strong>Impact of innovation</strong></th>
<th><strong>Priority B</strong></th>
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IEA/GIA Annex VII – Advanced Geothermal Drilling

Participants:

The European Commission
Iceland
Mexico
New Zealand
United States (Operating Agent)

GIA Annex VII
Notes from Annex VII meeting:
Active Subtasks

Subtask A: Compilation of Geothermal Well Drilling Cost and Performance Information
Jaime Vaca, - CFE Mexico

Subtask Leader: Jaime Vaca CFE, Mexico

Subtask C: Collaborations on Advanced Drilling
Subtask Leader: Steve Bauer SNL, USA
A renewed interest for geothermal resources of deep origin

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> Drilling: a key issue
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> The development of conventional geothermal energy shows the cost-efficiency of short term projects

  - The White Paper (Community Strategy and Action Plan, 1997) : doubling (500 to 1000 MW) of electricity production capacity, increase from 750 to 25000 MW for heat production capacity of geothermal origin by 2010 in Europe, to be compared with in 2004: electricity production capacity: 1179 MWE, and in 2005: heat production capacity 13626 MWt

> The Soultz experiment is considered as the international reference by the Australian investors and American scientists for whom EGS is one of the few renewable energy that can provide continuous base load-power

> There is a “heat rush” in Australia and Germany
Growing interest of industry and investors

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The Heat rush
Hot Rock Projects in South Australia (from B. Goldstein, 2006)

- **11 GEL / GELA Holders**
  - Geodynamics
  - Petratherm =MNGI
  - Pacific Hydro
  - Osiris Energy
  - Geothermal Resources
  - Torrens Energy
  - Scopenergy
  - Green Rock
  - Eden (Tasman affiliate)
  - Proactive Energy
  - Origin Energy Resources

- **92 GELs / GELAs over 43,440 km²**

- The 5-year GEL exploration and demonstration work programs correspond to $500+ million, and this excludes up-scaling and deployment projects

- Can benefit from Commonwealth renewable energy initiatives:
  1. Renewable Energy Certificates
  2. REDI Grants
  3. Circa $500 million in Federal grants to demonstrate low emissions technologies

- Just 1 GEL (500 km²) has hot rock emission-free energy potential to yield electricity equivalent to several Snowy Mountain Hydro Schemes (1 SM approx = 550 MWe)
A couple of news items from late May didn’t quite make it into last month’s Newsletter. Firstly, Geodynamics Limited’s new drill rig left Houston by ship on Wednesday 30th May, bound for Brisbane. It was projected to arrive in Brisbane towards the end of June (no fresh word on this as of 1st July) and be on site at the Habanero project about 10 days later. Also on 30th May, KUTh Energy Limited was incorporated and acquired KUTh Exploration Pty Ltd, in preparation for an IPO expected later in 2007.

Petratherm Limited had a big day of announcements on Monday 4th. PTR has appointed California-based geothermal energy consultancy Global Power Solutions to provide technical oversight to well design and drilling processes at Paralana, together with planning and engineering design work for a power generation plant. On the same day, PTR announced that the Paralana Energy Joint Venture, consisting of PTR and Beach Petroleum, has approved the commencement of deep well design and the rig selection process to develop an underground heat exchanger at Paralana by the end of July next year.
German Regions of Interest

Dr. Lothar Wissing, 16th ExCo meeting GIA IEA, San Diego August 7 – 8, 2006

- North German Basin
- Upper Rhine Rift Valley
- German Molasse Basin

Drilling cost effectiveness and feasibility of high-temperature drilling, Reykjavik, 2-5 July 2007
The heat rush in Germany…

and precursors in Spain and Hungaria…
The Landau case history

Landau: Die Planung

Kenndaten

- Projektstart: 2004
- Inbetriebnahme: 2007
- Thermalwassertemperatur: 150 grd C
- Fördermenge: 70 l/s
- Erzeugter Strom:
  - Leistung: 2,58 MW
  - Arbeit: 19.591 MWh
  - Benutzungsstunden: 7.600 h/a
- Erzeugte Wärme:
  - Leistung: 5,1 MW
  - Arbeit: 9.183 MWh
- Gesamtinvestitionen: 15,2 Mio €
A continent explored by new investors…

Why?
- The Soultz sous Forêts case history
- A strategy for exploration based on geological knowledge
- A supported market access for geothermal innovative technologies in Germany
- A guarantee from World Bank to manage risks
- A strategy for raising funds from private investors
The use of Oil and Gas wells

Could we exploit the geothermal potential of North Sea oil fields as their oil runs out? Some have reservoir temperatures over 100º C and so electricity generation might be possible (J. Busby, 2006, BGS)

Re-use of E&P-boreholes for geothermal energy production

Geothermal energy applications have gained renewed interest in recent years. One of the interesting applications is the re-use of deep boreholes drilled by oil and gas industry for a Deep Borehole Heat Exchanger (DBHE).

(J. D. Van Wees, 2007, TNO)
Conclusion: A renewed interest for geothermal resources of deep origin

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> ENGINE, along with other coordinating initiatives (European Commission, IEA-GIA, MIT expert panel, IGA, EGEC…) can
  • contribute to the construction of an international strategy
  • consolidate the available information systems
  • propose spin-off projects that will receive the support of stakeholders, decision makers and private investors.

> A need for a scientific exchange platform: a R&D task force for defining research projects that could be presented to the EU commission as a possible contribution for the future work programme of the FP7
  • A result from the identification of bottlenecks and prioritisation of research needs, a direct contribution of ENGINE

> A need for a political exchange platform: an appropriate consortium joining R&D institutes and private investors (an European Economic Interest Group?)
  • A promotion of past and on-going experiences by making them visible and reproducible
  • A lobby to promote supported market access for geothermal innovative technologies
From an ENhanced Geothermal Innovative Network for Europe to an European geothermal drilling program?

> A need for an ambitious research program
> An European geothermal drilling program for demonstrating that EGS can provide continuous base load-power for Europe: 30 EGS projects for the next 15 years?
  - A required convergence between the scientific and political exchange platforms, i.e. a common approach of both scientist and stakeholders
  - Reference to the Soultz experiment and to all specific target research projects for promoting new EGS projects: highly radiogenic reservoirs at depth, extension of existing geothermal fields, geothermal recovery from existing oil and gas operations…
Our proposal is expected…

- **Topic ENERGY.2008.2.4.1: Increased electricity production from Enhanced Geothermal Systems (EGS), including Hot Dry Rock**
  - **Expected impact:** Demonstration of efficient and sustainable electricity production from EGS; reduced costs; better understanding of plant operation

- **Topic ENERGY.2008.2.4.2: Innovative cycles for low/medium temperature geothermal power**
  - **Expected impact:** Increase the range of potentially interesting geothermal sites for exploitation, with reduced capital costs and higher energy conversion efficiency

- **Topic ENERGY.2008.4.3.1: Innovative components and subsystems for geothermal district heating/cooling**
  - **Expected impact:** Increased market penetration of geothermal heat supply, facilitated by affordable and easy-to-use off-the-shelf components tailored to the market needs