



Inventory of RD&D project highlights



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Table of Contents

Executive summary	5
1 Methodology	6
2 Selected RDD&D projects by country	6
2.1 <i>Switzerland</i>	6
2.2 <i>Germany</i>	7
2.3 <i>France</i>	7
2.4 <i>Hungary</i>	8
2.5 <i>Iceland</i>	8
2.6 <i>Italy</i>	9
2.7 <i>The Netherlands</i>	10
2.8 <i>Slovakia</i>	11
2.9 <i>Slovenia</i>	11
2.10 <i>Turkey</i>	11
3 Common interests	12
3.1 <i>Subsurface</i>	12
3.1.1 Geological exploration and geological databases	12
3.1.2 Advanced geologic analysis and monitoring	12
3.1.3 Extremely hot geothermal systems	12
3.1.4 Advanced drilling techniques	12
3.1.5 Operation of wells	12
3.1.6 Enhanced geothermal systems, well stimulation, induced seismicity	12
3.2 <i>Utilisation</i>	13
3.2.1 Direct utilisation of geothermal heat	13
3.2.2 Electricity production	13
3.2.3 New concepts/ new combinations	13
4 APPENDIXES	13

List of Tables

Table 1 List of RDD&D projects for Switzerland	6
Table 2 List of RDD&D projects for Germany	7
Table 3 List of RDD&D projects for France	7
Table 4 List of RDD&D projects for Hungary	8
Table 5 List of RDD&D projects for Iceland	8
Table 6 List of RDD&D projects for Italy	9
Table 7 List of RDD&D projects for the Netherlands	10
Table 8 List of RDD&D projects for Slovakia	11
Table 9 List of RDD&D focal areas for Turkey	11

Abstract

This report shows highlights of ongoing or recently realised R&D, demonstration and deployment projects on geothermal energy in countries, participating in ERANET Geothermal energy. The projects are selected by the various agencies and research councils, because of their interesting impact on fundamental or practical knowledge about geothermal energy utilisation in their specific country.

Executive summary

This report shows highlights of ongoing or recently realised R&D, demonstration and deployment projects on geothermal energy in countries, participating in ERA-NET Geothermal energy. The projects are selected by the various agencies and research councils, because of their interesting impact on fundamental or practical knowledge about geothermal energy utilisation in their specific country.

The report is not a complete inventory. Our aim is to make a start in assessing the joint interests in research themes among the countries participating in ERA-NET Geothermal energy.

The participating countries in ERA-NET geothermal have many interests in common. However, each country has its own focal areas, as a result of the nature of its resources, the maturity of its market, its history and its policy on geothermal energy.

An indicative listing of common RDD&D interests includes topics related to the subsurface, and topics related to the utilisation of geothermal energy:

Subsurface

- Geological exploration and geological databases
- Advanced geological analysis and monitoring
- Extremely hot geothermal resources
- Advanced drilling techniques
- Operation of wells
- Enhanced geothermal systems and induced seismicity

Utilisation

- Direct utilisation of geothermal heat
- Electricity production
- New concepts/new combinations

With this report, we make a contribution to increased collaboration through European energy agencies and research councils on the topic of geothermal energy.

1 Methodology

This report shows highlights of ongoing or recently realised R&D, demonstration and deployment projects on geothermal energy in countries, participating in ERANET Geothermal energy. The projects are selected by the various agencies and research councils, because of their interesting impact on fundamental or practical knowledge about geothermal energy utilisation in their specific country.

The report is not a complete inventory. Our aim is to make a start in assessing the joint interests in research themes among the countries participating in ERA-NET Geothermal energy.

ERA-NET Geothermal Energy produced another report, on policies on geothermal energy, regulations, statistics and relevant support schemes for implementation of geothermal energy R&D, demonstration or deployment projects¹.

2 Selected RDD&D projects by country

This chapter presents selected RDD&D projects by country.

2.1 Switzerland

Switzerland presents seven selected RDD&D projects. R&D topics include induced seismicity, innovative drilling techniques, mapping for geothermal resources, high-temperature geothermal systems (i.e. close to the magma). For Demonstration and Deployment, Switzerland presents an application in the agribusiness, and risk management; early detection of induced seismicity.

Table 1 List of RDD&D projects for Switzerland

CH-a	GEOSIM	Real time assessment of seismic risks
CH-b	Thermal spallation drilling: rock-flame interaction	Revolutionary drilling technique;
CH-c	GeoMol - CH	Delineate the geothermal potential of the sedimentary basins of CH.
CH-d	COTHERM	Better understanding of high-temperature geothermal systems (i.e. close to the magma)
CH-e	GEO THERM	Novel observation techniques for understanding induced seismicity
CH-f	Direct heat for Grob Agri-business in Schlattingen (Canton Thurgau)	Use of geothermal energy for agribusiness. 2nd deviated well to be drilled.
CH-g	GEOBEST	Risk management; early detection of induced seismicity

¹ Geothermal energy status and policies in the ERANET Geothermal Energy

2.2 Germany

Germany presents five selected R&D projects and three selected demonstration/deployment related projects. Topics include prediction of subsurface conditions while drilling and 3D seismic, advanced drilling, predicting and limiting induced seismicity, a study to improve knowledge of the Upper Rhine Graben, and three themes related to smooth operation: diagnosis for muck pumps, understanding corrosion in saline water, and preventing precipitation.

A complete inventory of R&D projects on geothermal energy can be found

<http://www.forschungsjahrbuch.de/>

Table 2 List of RDD&D projects for Germany

DE-a	Seismic prediction while drilling	New approach for seismic exploration in bore-holes
DE-b	Geothermal reservoir analogues for the northern Upper Rhine Graben (AuGE)	Conclusions on deep subsoil to be drawn from superficial rock analogues?
DE-c	Development and testing of an electric pulse method drill head for deep geothermal (EIV)	Develop and test a drillhead with impulse voltage source for deep geothermal.
DE-d	3D seismic in crystalline rocks in Saxony for geothermal project (SIK)	Develop 3D seismic for crystalline rocks. Map Saxony crystalline rocks / fault structures in this way.
DE-e	Microseismic Activity of Geothermal Systems (MAGS)	Understanding and limiting induced seismicity
DE-f	Strategies to avoid negative effects on the thermal water loop in geothermal systems (ContraPart)	Preventing precipitation of barium and strontium by inhibitors
DE-g	Diagnosis and monitoring system for muck pumps	Reliability of muck pumps
DE-h	Longterm corrosion analyses and monitoring in saline thermal water	Regional, fluid-specific catalogue of suitable construction materials

2.3 France

France presents 6 R&D and 3 demonstration/deployment projects. R&D themes include geological mapping, geology of hot subsurface in the West Indies/French overseas islands, fracture/fluid interaction, combination of geothermal energy and ATEs (aquifer thermal storage) and EGS.

Table 3 List of RDD&D projects for France

FR-a	CLASTIC-2	3D geomodel of silico-clastic Trias
FR-b	GHEMOD	Tools to understand the origin of geothermal resources in the French overseas islands
FR-c	GEO3BOU	Modeling and monitoring Bouillante geothermal field in French overseas islands
FR-d	GEFRAC3 EXP	Experimental study of fluid/rock interactions in fractures

FR-e	GEFRAC3 MOD	Modeling study of fluid/rock interactions in fractures
FR-f	THERMO2PRO	Web tool for geothermal potential estimation
FR-g	GEOSTOCAL	Aquifer thermal storage in combination with geothermal energy production, Paris area
FR-h	Soultz III	First pilot EGS project in Europe. Exploitation and monitoring
FR-i	ECOGI	First application of EGS in private sector in France

2.4 Hungary

Hungary presents 4 R&D and 2 Demonstration/Deployment projects. Themes include geological mapping coupled to demand, transboundary management of geothermal resources, and direct use.

Table 4 List of RDD&D projects for Hungary

HU-a	TRANSENERGY	Cross border harmonised utilisation strategy for western part of Pannonian basin
HU-b	Geo-DH	Within Geo-DH, HU is preparing an interactive web-map matching potential and demand
HU-c	Geothermal potential assessment	HIP, inferred resources and probable reserves; reliable numbers on geothermal potential
HU-d	Delineation of geothermal protection zone	Remove administrative barriers for geothermal energy
HU-e	Szentlőrinc	First 100% geothermal district heating system in Hungary
HU-f	Miskolc-Mányi	First large-scale district heating project in Hungary, capacity 55 MW.

2.5 Iceland

Iceland presents 7 R&D and 4 Demonstration/Deployment projects. Themes include interaction between magma and geothermal fluids, subsurface two-phase and supercritical behaviour, innovative methods for geological/geophysical mapping, mapping shallow resources, and applications of the CO₂ produced with geothermal energy: injection of CO₂ for fixation, CO₂ conversion to methanol and CO₂ for growth of algae.

Table 5 List of RDD&D projects for Iceland

IS-a	GEORG “Deep roots of Geothermal systems” project	Understanding interaction between magma and geothermal fluids
IS-b	HYDRORIFT	New method for exploration of supercritical geothermal systems

IS-c	Advanced 3D Geophysical Imaging Technologies for Geothermal Resource Characterization	New geophysical exploration and interpretation methodologies
IS-d	Sustainable Yield of Geothermal Resources and Renewability	Ensuring that the renewable energy society can be sustained for the generations to come
IS-e	Properties of two phase flow of water and steam in geothermal reservoirs	Deepen understanding, improve modeling of such geothermal reservoirs
IS-f	Predicting permeability in igneous formations	From igneous rock samples, improve modeling of permeability
IS-g	ThermoMap	Web GIS application, using existing data for shallow geothermal potential (GSHP)
IS-h	Deep Drilling Project	Economic feasibility of producing energy and chemicals from supercritical waters
IS-i	Carbfix	Fix CO ₂ in basaltic bedrock through carbonate formation
IS-j	Carbon Recycling	Makes methanol – transport fuel - from CO ₂ from geothermal waters, and H ₂ from electrolysis
IS-k	Geochem	X00.000 tons/a CO ₂ , released from geothermal sources; aim to utilise for growth of algae.

2.6 Italy

Italy presents 3 R&D and 4 Demonstration and Deployment projects. Themes include mapping of geothermal resources, deep drilling in a caldera/geothermal properties of supercritical fluids. Selected applications include district heating from “cold” subsurface reservoirs, and district heating and dairy production with steam from geothermal power plant.

Table 6 List of RDD&D projects for Italy

IT-a	Italian Geothermal Atlas of southern regions	Maps favourability of territories to host geothermal systems
IT-b	VIGOR Geothermal potential assessment of italian convergence regions	Feasibility studies for geothermal energy at 8 locations, all southern Italy
IT-c	Campi Flegrei Deep Drilling Project	Volcanological and geothermal study of Campi Flegrei caldera
IT-d	FORIO Project	2 nd zero emissions geothermal power plant (5 MW) on Ischia island
IT-e	SCARFOGLIO Project	5 MW geothermal power plant in Campi Flegrei

		caldera (under evaluation)
IT-f	Grado District Heating	2 MW district heating project in “cold” sedimentary basins.
IT-g	Monteverdi Marittimo District Heating System	Novel district heating, using steam from power generation.
IT-h	Dairy – Podere Paterno	Dairy plant, using heat coming from a geothermal power plant.

2.7 The Netherlands

The Netherlands presents 6 R&D projects and 5 Deployment and Demonstration projects. R&D subjects include on geothermal mapping, drilling and fracking techniques, and co-injection of CO₂. Demonstrations from the Netherlands concern applications for agriculture and district heating, in two cases combined with seasonal storage.

Table 7 List of RDD&D projects for the Netherlands

NL-a	DIRT	Drilling with fiber reinforced composite material
NL-b	Heat atlas of the Netherlands	Mapping heat demand and availability
NL-c	ThermoGIS	Subsurface data to determine potential for geothermal
NL-d	Potential scan deep geothermal energy 2050	Potential of deep geothermal by 2050
NL-e	CO ₂ injection in aquifers combined with geothermal energy	Co-injection of CO ₂ for CO ₂ sequestration
NL-f	"More pressure on geothermal energy"	Informing future owners of geothermal wells on stimulation techniques and consequences
NL-g	Heerlen heated with mine water	Water from former coal mines for district heating and cooling
NL-h	Geothermal heat for greenhouse, A+G van den Bosch	First project with deep geothermal heat in horticulture
NL-i	Californië, peppers with heat from the carboniferous limestone	First project in karstic/fracture aquifer
NL-j	Geothermal district heat The Hague	Second geothermal district heating project in the Netherlands
NL-k	Multi Energy Concept – Greenhouses “Vierpolders” - MEC-V	Application in horticulture, year-round heat supply and demand through seasonal storage.

2.8 Slovakia

Slovakia presents two R&D projects and 5 Deployment and Demonstration projects. R&D focuses on advanced drilling. Deployment and demonstration is mainly district heating, one combination with heat pumps, and a combination with electricity generation under construction.

Table 8 List of RDD&D projects for Slovakia

SK-a	Applied research and development of innovative drilling technology for ultra-deep geothermal wells	Innovative water jet generating system, based on electric-discharge plasma
SK-b	Robust autonomous mechatronic systems for ultra-deep geothermal wells	Innovative mechatronic systems for ultra deep geothermal wells
SK-c	Geothermal District Heating in Sala	Base-load heat source, single well, 1,6 kton/year CO ₂ reduction,
SK-d	Geothermal District Heating in Sered	Combination deep geothermal and heat pump for district heating. 1,1 kton/year CO ₂ reduction
SK-e	Geothermal District Heating in Galanta	90% heat delivered by geothermal, 7 MW system
SK-f	Geothermal District Heating in Svinica-Durkov	Combination 3,5 MWe and 100 MWt, under construction
SK-g	Geothermal District Heating in Podhajska	10,5 MWt project, only operating Slovak project with reinjection instead of single well.

2.9 Slovenia

[Slovenia has been invited to contribute to this report]

2.10 Turkey

Turkey presents six R&D project focal areas. These include mapping of geothermal resources, materials research, and applied research for specific applications.

Table 9 List of RDD&D focal areas for Turkey

TR-a	Searching for geothermal energy in pilot areas of Turkey	Searching for geothermal energy in pilot areas of Turkey
TR-b	Software for geothermal-solar hybrid system	Software for geothermal-solar hybrid system
TR-c	Traditional food production by utilisation of geothermal energy	Traditional food production by utilisation of geothermal energy
TR-d	Water leakage monitoring at geothermal fluid transport systems	Water leakage monitoring at geothermal fluid transport systems
TR-e	Geothermal energy based food drying oven equipment	Geothermal energy based food drying oven equipment
TR-f	Materials for geothermal wells	Materials for geothermal wells

3 Common interests

This chapter presents indicative conglomeration of the selected RDD&D projects. Special focus is on common interests among the participating countries. The interests can be subdivided in projects focusing on the subsurface, and projects focusing on utilisation, the successful coupling of the characteristics of the subsurface and energy demand above ground.

3.1 Subsurface

3.1.1 Geological exploration and geological databases

Obviously, mapping the subsurface is a formidable task with important implications for the increase of the use of geothermal energy. In Switzerland (CH-c), Germany (DE-b) France (FR-a), The Netherlands (NL-d) and Turkey (TR-a) there are projects aimed at better understanding the nature of the geothermal resources. Other projects, in France (FR-f), Hungary (HU-a/d), Italy (IT-a/b), and the Netherlands (NL-b/c), focus on facilitating access to estimation of the potential, and at coupling heat demand and heat supply.

Connected to this is also the project from Iceland (IS-d) aimed at exploring the sustainable yield of geothermal for the generations to come.

3.1.2 Advanced geologic analysis and monitoring

Analysing the subsurface requires analysis techniques. Advances presented by the participating countries include observation techniques for seismic prediction while drilling (DE-a), advanced 3D imaging (DE-d) (IS-c) and improving modeling of permeability of igneous formations through analysis of rock samples (IS-f).

3.1.3 Extremely hot geothermal systems

Our understanding of extremely hot geothermal systems, where there is a significant potential for electricity generation, needs to be improved. This is the reason that countries that have such reservoirs, or specific knowledge connected to this research topic consider ongoing research in this area as crucial. Switzerland (CH-d), France (West Indies) (FR-b/c), Iceland (IS-a/b, IS-e, IS-h) and Italy (IT-c) have interesting research projects on this topic.

3.1.4 Advanced drilling techniques

Advancing drilling technique is relevant for geothermal energy, since the cost of a project are very closely related to drilling cost. Switzerland (CH-b), Germany (DE-c), Netherlands (NL-a) and Slovakia (SK-a/b) present research on drilling.

3.1.5 Operation of wells

Research into practical issues concerning operation of wells may enhance performance and reduce cost. This may be related to corrosion, scaling and injectivity problems. Germany presents very hands-on research into such issues (DE-f/h) concerning operation of wells.

3.1.6 Enhanced geothermal systems, well stimulation, induced seismicity

Enhanced geothermal systems, well stimulation and induced seismicity are related topics, most relevant for electricity production from the deep subsurface. France (FR-h) has the Soultz-III project in this category. Switzerland (CH-a, CH-e, CH-g) and Germany (DE-e) share a focus on induced

seismicity. France (FR-d/e) and the Netherlands (NL-f) present projects on fractures and the fluid flow inside them.

3.2 Utilisation

3.2.1 Direct utilisation of geothermal heat

The direct use projects which have been selected by the country representatives are projects that have a showcase value for the specific country.

This showcase value comes from scale (HU-f) or high percentage of geothermal heat in the district heating system (HU-e, SK-e), being the first-ever application of geothermal district heating (NL-g, -j), or the first-ever with a re-injection well (SK-g).

Apart from district heating, there are other applications or innovative combinations. Switzerland (CH-f) and the Netherlands (NL-h/i, k) show application of geothermal heat in the horticultural sector. France (FR-i), Italy (IT-h) and Turkey (TR-c, -e) have applications in food industry. There are also combinations with seasonal storage, in France (FR-g) and the Netherlands (NL-g, -k). And there are combinations with heat pumps or solar energy, as mentioned by Slovakia (SK-d) and Turkey (TR-b).

Additionally, there is the combination of electricity production and heat utilisation from geothermal resources. These are showcases in Italy (IT-g/h) and Slovakia (SK-f).

3.2.2 Electricity production

There is a handful of countries within the ERA-NET geothermal energy with geothermal power plants in operation or under construction. Selected projects include the Soulz III and from France (FR-h), the deep drilling project from Iceland (IS-h), the FORIO and SCARFOGLIO projects from Italy (IT-d/e) and the Svinica-Durkov project in Slovakia (SK-f).

This is not a complete inventory of electricity production projects throughout ERANET Geothermal energy, but rather a “**showcase**” approach. For an inventory of electricity production, see D2.1 from the ERA-NET Geothermal Energy.

3.2.3 New concepts/ new combinations

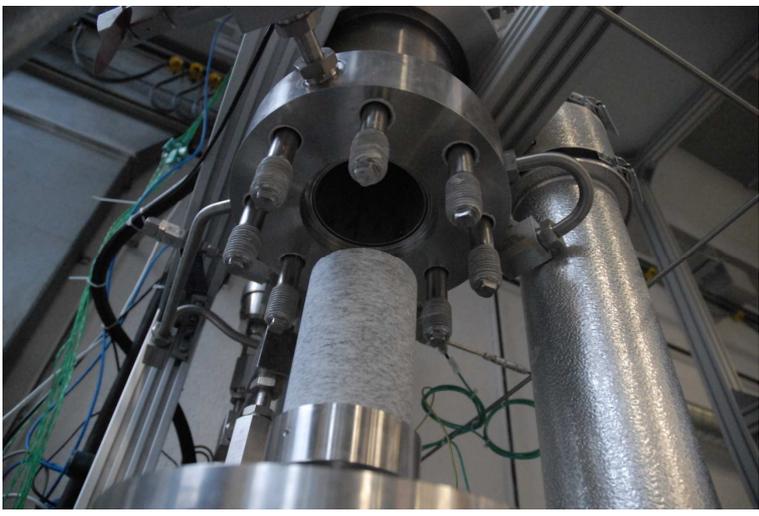
The enhanced greenhouse effect challenges the world to convert to a new energy system with a fraction of the current CO₂ emissions. There are several strategies: avoiding formation of CO₂, re-utilisation of CO₂ from point sources and storage of CO₂ underground. Iceland (IS-i/k) and the Netherlands (NL-e) are both working on projects to explore the potential to join production of geothermal energy to limiting CO₂ emissions, by utilising co-produced CO₂ for mineralisation, conversion to methanol or as a feedstock for algae, or by co-injection of CO₂ in the injection well of a geothermal project.

4 APPENDIXES

Powerpoints, prepared by the participant countries.




Thermal Spallation Drilling: Rock-Flame Interaction



RD&D project highlights Switzerland
 Spalled in ETH Zurich's high-pressure hydrothermal spallation pilot plant (HSDP-II). Image courtesy Professor Philipp Rudolf von Rohr (ETH Zurich).




Thermal Spallation Drilling: Rock-Flame Interaction

Summary	Rock-flame interactions during thermal spallation drilling are key to engineering a desired rate of penetration. The flame impinges on the rock at pressures in excess of 22.1 MPa. Key parameters such as particle size distribution, temperature, heat flux, circulation behavior, high temperature zone control and especially the stand-off distance between flame to rock will be investigated to derive engineering parameters for field pilots.		
Organisation(s)	Swiss Federal Institute of Technology, Zürich		
Contact person	Philipp Rudolf von Rohr		
Innovation	Thermal spallation drilling is one of a number of revolutionary drilling technologies. Field pilots today have been executed at ambient and near-surface conditions. This R&D project addresses issues to in-situ conditions.		
Impact	Enabling engineering design of an in-situ test of thermal spallation drilling.		
Website/E-mail	http://www.ipe.ethz.ch/laboratories/ltr/research/index_EN		
Status	Active	General issues	
Year (planned) delivery	2015	Geological and related issues	
Total budget (€)	700000	(Advanced) drilling or operation of wells	x
Public budget (€)	280000	Power generation	
Names of support schemes for the project	ETH - Domain	Direct use	
		EGS – Enhanced geothermal systems	
		...	

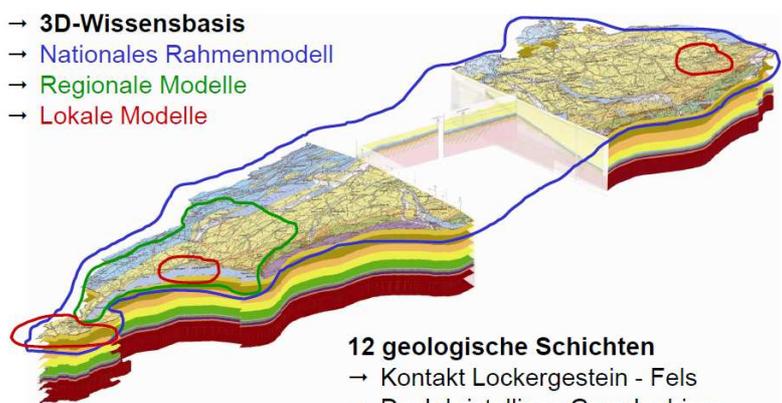
RD&D project highlights Switzerland





GeoMol - CH

- **3D-Wissensbasis**
- Nationales Rahmenmodell
- Regionale Modelle
- Lokale Modelle



12 geologische Schichten

- Kontakt Lockergestein - Fels
- Dach kristallines Grundgebirge

⇒ **Basis: Seismischer Atlas des Schweizerischen Molassebeckens**

RD&D project highlights
Switzerland





GeoMol - CH

Summary	Within the framework of the EU funded Interreg Alpine Space Programm GeoMol aims to delineate the geopotentials of the sedimentary basins of the Northern (Molasse Basin) and Southern Alps (Po Basin) by developing a 3-D geological model which will serve as a planning tool for energy use. Within this framework, Switzerland will develop a refined 3D Model of the Swiss Molasse Basin.	
Organisation(s)	Swiss Geological Survey, swisstopo Federal Office of Topography	
Contact person	Roland Baumberger	
Innovation	A 3D model of the Swiss Molasse Basin to this comprehensive extent has never been developed.	
Impact	Switzerland's federal government and associated cantons will have a unified 3D model of the sedimentary basin – a fundamental tool for any subsurface spatial planning and utilization.	
Website/E-mail	roland.baumberger@swisstopo.ch	

Status		
Year (planned) delivery		
Total budget (€)	€ 2.2 million	
Public budget (€)	€ 1.7 million	
Names of support schemes for the project	Operating and research budgets of Swiss Federal Offices of Topography, the Environment, Energy and Spatial Planning plus 7 cantons	
RD&D project highlights Switzerland		

General issues	
Geological and related issues	x
(Advanced) drilling or operation of wells	
Power generation	
Direct use	
EGS – Enhanced geothermal systems	
...	




COTHERM

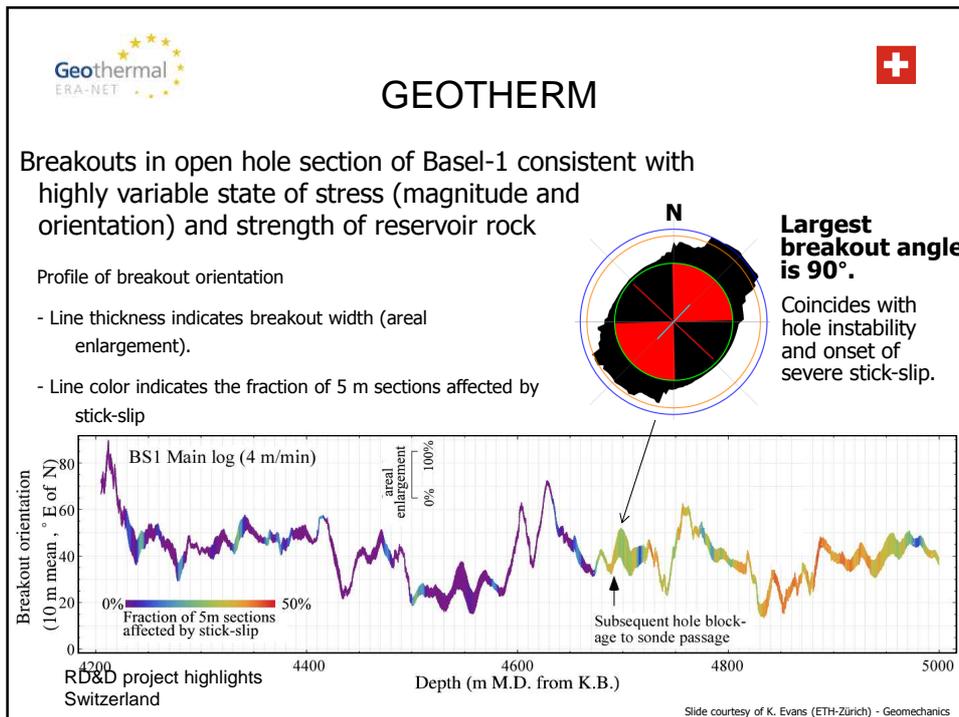
RD&D project highlights
Switzerland




COTHERM

Summary	COTHERM aims at a better understanding high-temperature geothermal systems. How long the geothermal system is active and how much energy the fluid carries depends on the depth and size of the magma body and on the permeability of the surrounding rocks. Both are difficult to assess from the surface. Using the examples of two different geothermal systems in Iceland that have been drilled for geothermal energy exploitation, COTHERM will develop improved geochemical and geophysical techniques for monitoring and imaging of geothermal systems	
Organisation(s)	ETH Zurich, Paul Scherrer Institute and University of Iceland	
Contact person	Thomas Driesner	
Innovation	Development of workflows that allow better characterization of the deep parts of geothermal systems by integrating geophysical and geochemical field data with simulation techniques. Development of new state-of-the-art modeling and simulation of fluid-flow, dissolution-precipitation reactions and time evolution of geometric and transport properties of rock.	
Impact	Commercial numerical codes for reservoir development and management will benefit from novel simulation techniques. Local operators will benefit from application oriented basic research.	
Website/E-mail	thomas.driesner@erdw.ethz.ch	

Status	Active	General issues	
Year (planned) delivery		Geological and related issues	x
Total budget (€)	751 200	(Advanced) drilling or operation of wells	
Public budget (€)	751200	Power generation	
Names of support schemes for the project	Swiss National Science Foundation – Sinergia program funding	Direct use	
		EGS – Enhanced geothermal systems	
RD&D project highlights Switzerland		...	





GEO THERM



Summary	The work contributed to the development of EGS technology by applying novel observation techniques and new process-simulation tools. An important objective was to understand the hydro-mechanical processes that occurred in the Basel EGS reservoir during the injection that led to the ML 3.4 earthquake by analyzing data provided by the industrial developers of the EGS Project as an 'in-kind' contribution to GEO THERM.	
Organisation(s)	ETH Zurich, Paul Scherrer Institute, EPF Lausanne, Geo Energie Suisse AG	
Contact person	Keith Evans	
Innovation	New observations and analysis has demonstrated the importance of highly variable states of stress and strength of host rocks across a reservoir. Together with seismological advances, new conceptual approaches to managing seismic risk have been developed.	
Impact	Health Safety Environmental Management Systems: earthquake statistics offers a substantial refinement in the design of control system for massive EGS stimulation operations; Stimulation design needs to incorporate local stress and reservoir rock strength heterogeneities.	
Website/E-mail	http://www.cces.ethz.ch/projects/nature/geotherm	

Status	Terminated				
Year (planned) delivery	2012	General issues			
Total budget (€)	4 400 000	Geological and related issues			
Public budget (€)	4 400 000	(Advanced) drilling or operation of wells			
Names of support schemes for the project	ETH Competence Centers, Swiss Federal Office of Energy Geothermal Energy Research Program	Power generation			
		Direct use			
		EGS – Enhanced geothermal systems			x
		...			

RD&D project highlights Switzerland



Direct heat for the Grob Agri-business in Schlattingen (Canton Thurgau)





RD&D project highlights
Switzerland

Drilling well Schlattingen-2 to supply geothermal heat for direct use to the Grob Agri-business (February 2013)
Source: Rudolf Minder and Hansjörg Grob



Direct heat for the Grob Agri-business in Schlattingen (Canton Thurgau)



Summary	In addition to an already existing first well, a second deviated well will be drilled into a hot aquifer. If required staged relatively small scale hydraulic and/or acid stimulations will be performed to enhance connectivity to the far field of the reservoir.	
Organisation(s)	Grob Agri-business	
Contact person	Bernd Frieg	
Innovation	A highly deviated geothermal well into the Muschelkalk of the Swiss Molasse Basin,	
Impact	Establish a – for Switzerland – first application for direct use of geothermal energy in a large agricultural business.	
Website/E-mail	http://www.grob-gemuese.ch/cms/index.php?id=23	

Status	Active	General issues	
Year (planned) delivery	2013	Geological and related issues	
Total budget (€)	4 100 000	(Advanced) drilling or operation of wells	
Public budget (€)	1 560 000	Power generation	
Names of support schemes for the project	Swiss Federal Office of Energy Pilot and Demonstration Program Canton Thurgau	Direct use	x
		EGS – Enhanced geothermal systems	
		...	

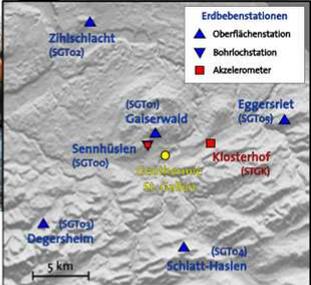
RD&D project highlights
Switzerland

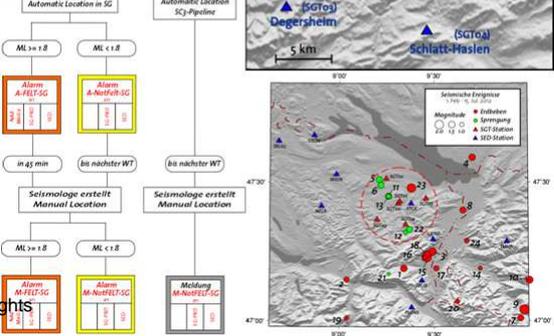


GEOBEST









Lay-out of the first microseismic network and control framework to ensure HSE regulatory compliance. (Source: Toni Kraft, Swiss Seismological Service)



GEOBEST



Summary	Regulatory authorities require practical guidelines to manage risks associated with induced seismicity. The project will work with geothermal operators in differing tectonic regimes and play concepts by setting-up of seismic monitoring networks, developing a warning system and work flow depending on intensity and magnitude of induced seismicity and recording of background seismicity prior to drilling and completing wells and execution of production and circulation tests.
Organisation(s)	Swiss Seismological Service and various geothermal operators (Sankt Galler Stadtwerke and more)
Contact person	Toni Kraft
Innovation	Develop and implement a risk management system for induced seismicity and site-specific good practices in collaboration with regulatory and oversight authorities.
Impact	Maintain, gain and regain public trust
Website/E-mail	http://www.seismo.ethz.ch/research/groups/spec/projects/ProjectGeoBest/index

Status	Active	General issues	x
Year (planned) delivery	2015	Geological and related issues	
Total budget (€)	2 580 000	(Advanced) drilling or operation of wells	
Public budget (€)	2 580 000	Power generation	x
Names of support schemes for the project	ETH Domain and Swiss Federal Office of Energy Pilot and Demonstration Program	Direct use	x
		EGS – Enhanced geothermal systems	x
		...	

RD&D project highlights Switzerland

Seismic Prediction While Drilling [SPWD]



[Looking Up to the hanging SPWD-hole probe. The impression cylinder, the seismic sources and receivers are retracted. (Source: Kay Krüger)]



[Looking Up to the hanging SPWD-hole probe. The impression cylinder, the seismic sources and receivers are deployed. (Source: Rüdiger Giese)]

Photos were taken during the field test of the SPWD-hole probe in the main hole of the KTB (Continental Deep Drilling) of the GFZ depth laboratory included in Windischeschenbach in the period from 27.05.-31.05.

Seismic Prediction While Drilling [SPWD]

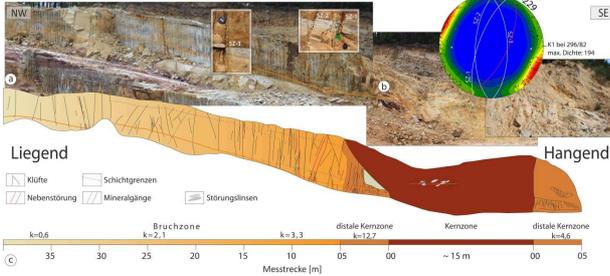
Summary	The project Seismic Prediction While Drilling (SPWD) examines a new approach for seismic exploration in bore-holes. Combining source and receiver in a common device in the drill string would increase the seismic resolution independent from depth and allows an exploration ahead and around the drill bit. With source signal frequencies up to 5000 Hz a resolution of about one meter is feasible. If applied while drilling such a tool allows adjusting the drill path to minimize risks and costs of drilling. A first prototype was designed for tests in dry and horizontal boreholes at standard conditions. Four sources (AK1-AK4) are aligned along the borehole axis to serve as a cascading source in order to enhance and to focus the applied energy. The main principle is to adjust the phase of all source signals for a common wave front in the desired direction of exploration (see figure 2). To achieve a directional radiation effect it is necessary to control the source signal amplitudes and phases of every actuator independently of each other. This adjustment of each sweep signal results in constructive interference with a predefined direction.
Organisation(s)	Geoforschungszentrum Potsdam (GFZ) - Sektion wissenschaftliches Bohren, Technische Universität Bergakademie Freiberg (TUBAF) - Fakultät für Geowissenschaften, Geotechnik und Bergbau - Institut für Bohrtechnik und Fluidbergbau, Fraunhofer-Institut für Nachrichtentechnik, Heinrich-Hertz-Institut (HHI)
Contact person	GFZ: Dr. Rüdiger Giese Tel.: +49 331 288-1575 Fax: +49 331 288-1502 E-Mail: rudi@gfz-potsdam.de; TUBAF: Prof. Dr.-Ing. Matthias Reich Tel.: +49 3731 39-2491 Fax: +49 3731 39-2502 E-Mail: matthias.reich@tbt.tu-freiberg.de; HHI: Dr.- Ing. Thomas Hausstein Tel.: +49 30 31002-340 Fax: +49 30 31002-609 E-Mail: thomas.hausstein@hhi.fraunhofer.de
Innovation	developing an optimized seismic pre-exploration system with the aim of adapting the drilling process to suit the actual geology
Impact	
Website/E-mail	http://www.geotechnologien.de/portal/Struktur/WissenschaftlichesBohren/Struktur/Plattform/WissenschaftlichesBohren/Projekt/Seismungesuehndrilling ; http://www.forschungsjahrbuch.de/ ; http://foerderdateibank.de/

Status	terminated
Year (planned) delivery	31. December 2012
Total budget (€)	1.312.331
Public budget (€)	1.312.331
Names of support schemes for the project	6th energy research programme

General issues	drilling, seismic
Geological and related issues	Yes
(Advanced) drilling or operation of wells	Yes
Power generation	No
Direct use	Yes
EGS – Enhanced geothermal systems	partly
...	

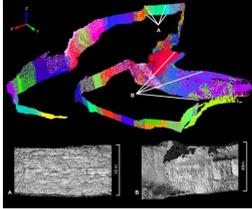


Geothermal ERA
Geothermal reservoir analogues for the northern Upper Rhine Graben [AuGE]



Liegend **Hangend**

[CLEEBOURG fault zone (Source: Bauer)]



[3D-Analyses from opencast "Nussloch" (Source: Miernik)]



[Overview of Knittingen fault zone (Source: Meier)]



Geothermal ERA
Geothermal reservoir analogues for the northern Upper Rhine Graben [AuGE]

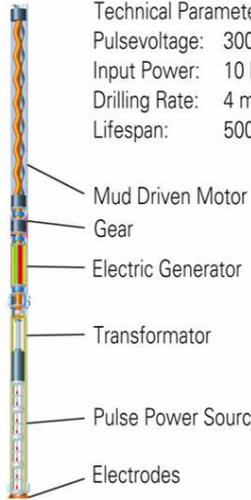
Summary	At the Projekt the example of the Upper Rhine Graben are using to determine whether and to what extent conclusions about the deep subsoil may be drawn from superficial rock analogies. By a process of analogy, using the most representative possible overground rock formations, the relevant prediction characteristics are studied, and characteristic hydraulic parameters defined
Organisation(s)	Geothermal Engineering GmbH; Friedrich-Alexander-Universität Erlangen-Nürnberg; Georg-August-Universität Göttingen; Ruprecht-Karls-Universität Heidelberg; GeoEnergy GmbH
Contact person	Geothermal Engineering GmbH; Dr. Rene Grobe Tel.: +49 721 5704468-4 Fax: +49 721 5704468-9 E-Mail: grobe@geo-1.de
Innovation	The aim is the development of a suitable inventory of methods for qualitative characterization an assessment of the potential for use of geothermal reservoir rocks which are relevant to the Upper Rhine Valley.
Impact	
Website/E-mail	http://www.geo1.de/le/forschung-entwicklung/leistungen/eigene-forschungsprojekte/auge http://www.forschungsjahrbuch.de/ http://foerstedatenbank.de

Status	running	General issues	geological data collection
Year (planned) delivery	31. July 2014	Geological and related issues	Yes
Total budget (€)	2.237.922	(Advanced) drilling or operation of wells	No
Public budget (€)	1.816.895	Power generation	No
Names of support schemes for the project	6th energy research programme	Direct use	Yes
		EGS – Enhanced geothermal systems	No
		...	



Geothermal ERA-NET

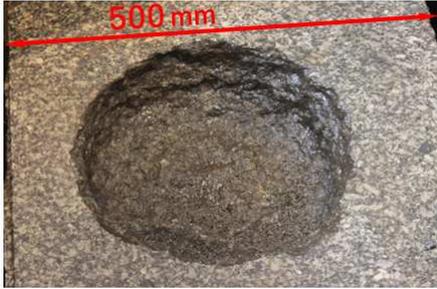
Development and testing of an Electric pulse method drill head for deep geothermal [EIV]



Technical Parameters:
 Pulsevoltage: 300 kV
 Input Power: 10 kW
 Drilling Rate: 4 m/h
 Lifespan: 500 h

Mud Driven Motor
 Gear
 Electric Generator
 Transformator
 Pulse Power Source
 Electrodes

[Construction of the EIV drilling head (Source: Anders)]



[Result after use on hard rock (Source: Anders)]



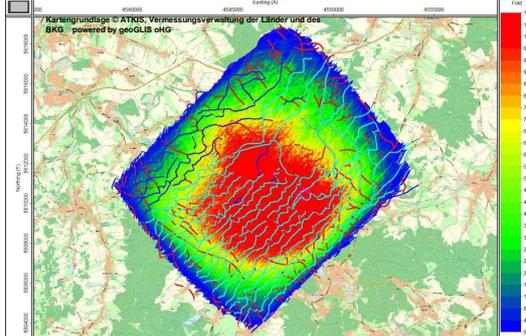
Geothermal ERA-NET

Development and testing of an Electric pulse method drill head for deep geothermal [EIV]

Summary	The scientific and technical targeted of the project is to develop an drill head with an impulse voltage source. Subsequently, experimental studies are performed under similar conditions borehole to show the performance of the new drill head. The detection of a stable function and a corresponding drilling parallel is at a 12 1/2 "hole in crystalline rock. A further focus is the integration of EIV in the drilling technology. Concepts are used to developed the EIV drilling system and examined the compatibility with the existing measurement and control technology.
Organisation(s)	Technische Universität Dresden; Thomas Werner Industrielle Elektronik; BAUER Maschinen GmbH
Contact person	Dipl.-Ing. Erik Anders Tel.: +49 351 463 32544 Fax: +49 351 463 37731 E-Mail: erik.anders@tu-dresden.de
Innovation	A new kind of drilling heads.
Impact	
Website/E-mail	http://phpframe.wcms-file3.tu-dresden.de/generalize/?g_nid=103&node=203&e_id=12643&t_id=107 ; http://www.forschungsjahrbuch.de/ http://foerderdatenbank.de

Status	running	General issues	drilling
Year (planned) delivery	31.10.13	Geological and related issues	yes
Total budget (€)	2.082.892	(Advanced) drilling or operation of wells	partly
Public budget (€)	1.680.375	Power generation	no
Names of support schemes for the project	6th energy research programme	Direct use	yes
		EGS – Enhanced geothermal systems	yes
		...	


3D seismic in Crystalline rocks in Saxony for a geothermal project [SIK]

Realized "common midpoint" (CMP) coverage, 15 mx 15 m "bin" [Source: Lüschen]



3 Vibrators-Trucks Type INOVA AHV-IV each 27 t, sweep length 10 s, 12-96 Hz, 8-fold stacking, Operational in Schneeberg, Saxony [Source: Lüschen]


3D seismic in Crystalline rocks in Saxony for a geothermal project [SIK]


Summary	The current geological models of Saxony extrapolate the known structures of the surface geology and the findings of mining activities in greater depth. The exact location of fault zones in the crystalline basement can only be determined by a special 3D seismic. The spatial image structures placed in relation to each other. After that it is possible to reconstruct the geological evolution. This is essential for their identification. This identification should be supported by an analysis of seismic signals in the form of attribute tests. Since 3D seismic measurements were very rarely performed in Crystalline, to transfer the results in the requirement and to develop new methods it is necessary to develop new seismic methods for reservoir sediments in the Crystalline.	
Organisation(s)	Leibniz-Institut für Angewandte Geophysik (IAG); Technische Universität Bergakademie Freiberg; Universität Hamburg	
Contact person	Dr. Rüdiger Schulz Tel.: +49 511-643-3468 Fax: +49 511-643-3665 E-Mail: ruediger.schulz@iag-hannover.de	
Innovation	to develop new seismic methods for reservoir sediments in the Crystalline	
Impact		
Website/E-mail	http://www.iag-hannover.de/forschungsschwerpunkte/geothermische-energie/seismik-im-kristallin-sachsen-sik.html ; http://www.forschungsjahrbuch.de ; http://foerderdatenbank.de	

Status	running	General issues	geological data collection
Year (planned) delivery	31.03.2014	Geological and related issues	yes
Total budget (€)	6.543.844	(Advanced) drilling or operation of wells	partly
Public budget (€)	6.543.844	Power generation	no
Names of support schemes for the project	6th energy research programme	Direct use	yes
		EGS – Enhanced geothermal systems	Yes/partly
		...	



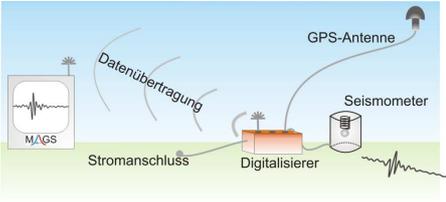
**Microseismic Activity of Geothermal Systems
[MAGS]**





Seismic station in operation. After installation, or maintenance of the box, it is closed. The station recorded continuously the ground movements and sends them to BGR. [Source: BGR-Report, 2012]

Schematic representation of the construction of the station
Mobile stations to Insheim: The ground motion is recorded by the seismometer, the digitizer transmit the data in real time to the Data Centre of the BGR. [Source: BGR-Report, 2012]





**Microseismic Activity of Geothermal Systems
[MAGS]**



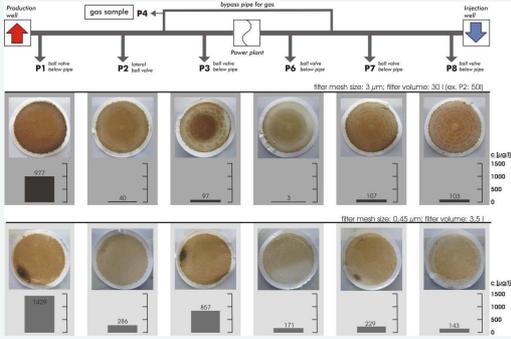
Summary	The Theme of the Project aims to investigate whether induced seismicity can be confined to micro-quakes in future, and thus raise public acceptance. To this end, the first step will be to characterise in as much depth as possible the seismicity at all currently favoured deep hydrothermal geothermal sites in Germany, i.e. the Upper Rhine Graben, the South German Molasse Basin and the North German Basin
Organisation(s)	Bundesanstalt für Geowissenschaften und Rohstoffe (BGR); Karlsruher Institut für Technologie (KIT); Ludwig-Maximilians-Universität München; Freie Universität Berlin; Technische Universität Clausthal; Technische Universität Bergakademie Freiberg
Contact person	Bundesanstalt für Geowissenschaften und Rohstoffe (BGR); Dr. Ulrich Wegler Tel.: +49 511 643-3867 Fax: +49 511 643-3863 E-Mail: ulrich.wegler@bgr.de
Innovation	MAGS is developing strategies for averting tangible seismicity in future
Impact	
Website/E-mail	http://www.mags-projekt.de/MAGS-DE/Home/MAGS_note.html http://www.forschungsjahrbuch.de/http://foerderdatenbank.de

Status	end	General issues	microseismicity
Year (planned) delivery	30. April 2013	Geological and related issues	yes
Total budget (€)	2.329.372	(Advanced) drilling or operation of wells	Partly
Public budget (€)	2.329.372	Power generation	No
Names of support schemes for the project	6th energy research programme	Direct use	Yes
		EGS – Enhanced geothermal systems	partly
		...	



Geothermal ER

Strategies to avoid negative effects on the thermal water loop in geothermal systems [ContraPart]



You see the on-site result of a background screening in the geothermal system of Bruchsal. The particulate load, the quantity, size and type of particles was investigated to select appropriate inhibitors. The picture shows the dried fine filter, the solid sampling-07 12:02:13 by indicating the computed from the ratio of occupancy filter and filtrate volume particle concentration (c) in the thermal water. [Source: M.Sc. Johannes Birner, GTN]



Geothermal ER

Strategies to avoid negative effects on the thermal water loop in geothermal systems [ContraPart]

Summary	The purpose of the project is to investigate the use of inhibitors to prevent the precipitation of barium- and strontium-sulphates. The aim is to identify a mixture of substances which will separate the positively charged barium or strontium ions from the negatively charged sulphate ions. One option would be if the inhibitor and barium or strontium ions were to form complexes which would shield these ions and prevent crystallisation. Another conceivable option would be an inhibitor that adheres to crystal surfaces and restricts their growth.
Organisation(s)	Geothermie Neubrandenburg GmbH; BWG Geochemische Beratung GmbH
Contact person	Geothermie Neubrandenburg GmbH; Dr.-Ing. Frank Kabus; Tel.: +49 395 3677 4-22; Fax: +49 395 3677 4-11; E-Mail: gtn@gtn-online.de
Innovation	The efficiency of filtration effects of cascade filter will be analyzed. On the Basis of that there will be an application elaborated.
Impact	
Website/E-mail	http://www.gtn-online.de/Projekte/TafelGeothermie/Projektbeispiel/vermeidungvonausfallungendurchfiltrationundinhibierungcontrapart http://www.forschungsjahrbuch.de/ http://foerderdatenbank.de

Status	Running	General issues	fluid analysis, plant protection
Year (planned) delivery	30.11.2014	Geological and related issues	Partly
Total budget (€)	574.361	(Advanced) drilling or operation of wells	Yes
Public budget (€)	344.617	Power generation	Partly
Names of support schemes for the project	6th energy research programme	Direct use	Yes
		EGS – Enhanced geothermal systems	partly
		...	



Diagnosis and monitoring system for muck pumps



Laboratory test experimental setup. . [Source: Frederic Seng; Research and Development; Herrenknecht AG]



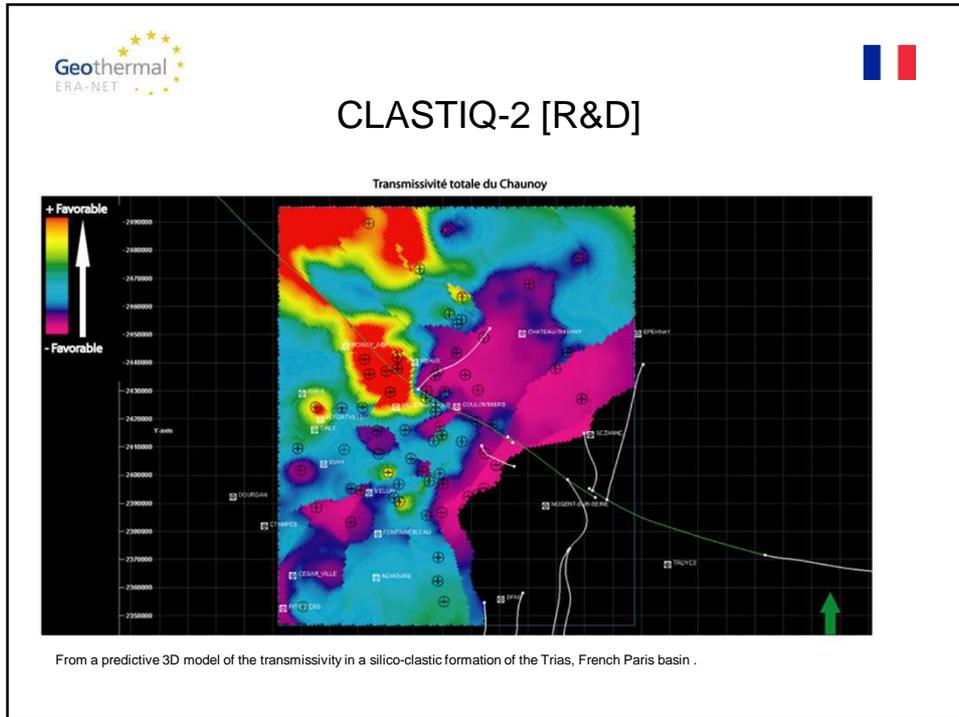
Field test sensor installation. [Source: Frederic Seng; Research and Development; Herrenknecht AG]



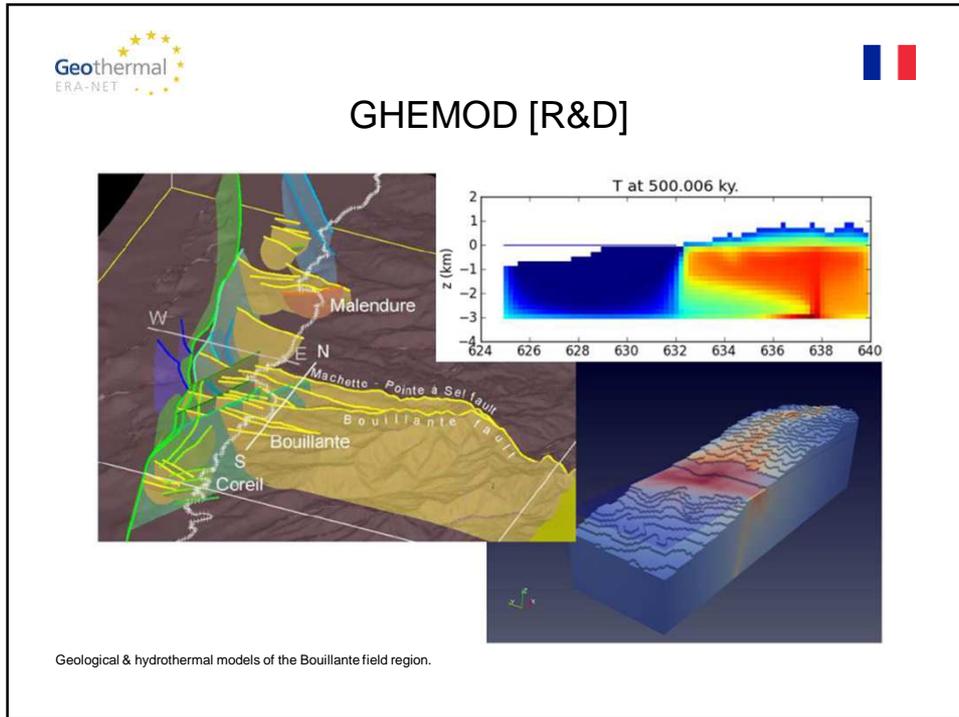
[Project title project 2 demonstration/deployment]

Summary	The project focuses on the reliability of muck pumps. Laboratory experiments indicate that a detection system developed on the basis of strain gauges with pressure and acceleration sensors is particularly well-suited for detecting damage to the pump valves. In Kirchweidach, an initial monitoring system has been installed in the field for on-going drilling.
Organisation(s)	Herrenknecht Vertical GmbH; Friedrich-Alexander-Universität Erlangen-Nürnberg; Schäfer & Utbach GmbH
Contact person	Herrenknecht Vertical GmbH; Dipl.-Ing Frederic Seng Tel.: +49 7824 302-4611 Fax: +49 7824 302-133 E-Mail: seng.frederic@herrenknecht.de
Innovation	At the End of the Project there will be principles for the safe design of drilling rigs. A related diagnostic system an an effective system for an pulsation damper will be developed
Impact	
Website/E-mail	http://www.herrenknecht.de ; http://www.forschungsjahrbuch.de ; http://foerdatenbank.de

Status	Running	General issues	Pump development
Year (planned) delivery	30.09.13	Geological and related issues	No
Total budget (€)	1.117.273	(Advanced) drilling or operation of wells	Yes
Public budget (€)	646.567	Power generation	Partly
Names of support schemes for the project	6th energy research programme	Direct use	Partly
		EGS – Enhanced geothermal systems	partly
		...	



Summary	Only from oil drilling, construction of a regional 3D geomodel of the silico-clastic Trias (French Paris Basin) in order to predict the geometry of the silico-clastic formations, their depositional environments and relevant petrophysical parameters (temperature, porosity, permeability, transmissivity) for low energy geothermal applications(heat production).	
Organisation(s)	ADEME, BRGM, France	
Contact person	Vincent BOUCHOT	
Innovation	The challenge is to realize a 3D petrophysical parametrization of the silico-clastic Trias from data interpolation (diagraphy and measurement) mainly based on their depositional environments	
Impact	To provide relevant information to geothermal operators wishing to explore this geothermal aquifer, especially as an alternative to the Dogger aquifer (actually exploited through more than 30 doublets).	
Website/E-mail	v.bouchot@brgm.fr	
Status	Completed	
Year (planned) delivery	Final report: nov. 2012	
Total budget (€)	1,3 M€	
Public budget (€)	1,3 M€	
Names of support schemes for the project	The funding of the project comes from the ADEME (50%) and BRGM (50%) operational budgets	
General issues		
Geological and related issues		X
(Advanced) drilling or operation of wells		
Power generation		
Direct use		X
EGS – Enhanced geothermal systems		
...		

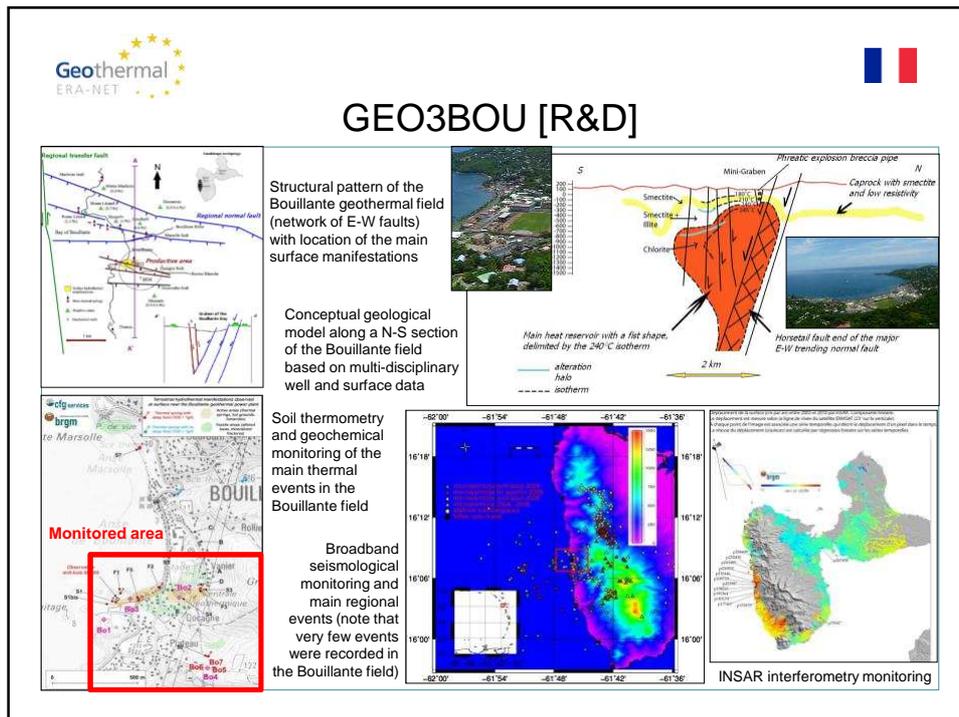


Geothermal ERA-NET

GHEMOD [R&D]

Summary	Objectives of the GHEMOD project were the setup of methods and the use of numerical modeling tools to understand the origin of the geothermal resource in the French overseas island and propose optimal exploitation schemes from the resource management and environmental perspectives. Project activities have been mainly focusing on the Bouillante geothermal field (Guadeloupe island). They included regional geological and hydrothermal modeling, well bore flow modeling, reservoir modeling...	
Organisation(s)	ADEME, BRGM, France	
Contact person	Simon LOPEZ	
Innovation	Alternative conceptual models for the Bouillante geothermal field (Guadeloupe island) have been proposed. New numerical tools have also been produced and a substantial step toward integrated geological and hydrothermal modeling has been made.	
Impact	Many results of the project will be used for the Bouillante field management and its forthcoming development. New numerical tools can be re-used both for production and research works.	
Website/E-mail	s.lopez@brgm.fr	

Status	Completed	General issues	X
Year (planned) delivery	2012	Geological and related issues	X
Total budget (€)	780k€	(Advanced) drilling or operation of wells	
Public budget (€)	780k€	Power generation	X
Names of support schemes for the project	The funding of the project comes from the ADEME (50%) and BRGM (50%) operational budgets	Direct use	
		EGS – Enhanced geothermal systems	
		Reservoir Modeling	X



Geothermal ERA-NET

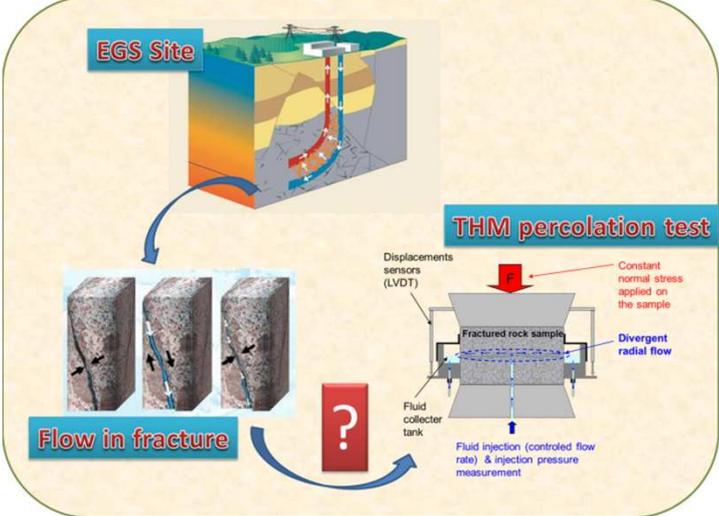
GEO3BOU [R&D]

Summary	Among the research efforts carried out by BRGM group since 1996 in order to develop HT geothermal energy in the French West Indies, this project had two main aims: 1) to study the ancient and present circulations of the deep fluids in the Bouillante geothermal field (Guadeloupe) in relation with regional fracturation and location of the heat source in order to better understand the initiation and the running of this field; 2) to continue to develop different monitoring methods of geothermal exploitation in order to optimize and secure electricity production and control its impact on the immediate environment of the Bouillante power plant.	
Organisation(s)	ADEME (French Environment and Energy Management Agency), BRGM Group (BRGM, CFG Services, Géothermie Bouillante SA), France	
Contact person	Bernard SANJUAN	
Innovation	To obtain the best conceptual geological model of the Bouillante geothermal field in order to be able to run adapted numerical modelling and better understand the running of this field. To develop and valid thermometric, geochemical and geophysical methods (broadband seismology, microgravity, SAR interferometry, etc.) of geothermal exploitation monitoring.	
Impact	To provide relevant scientific information to the different players about the true potential, the running and the optimised exploitation of the Bouillante geothermal field in order to develop geothermal energy in the French West Indies (Guadeloupe, Martinique) and in other Caribbean islands (Dominica, Santa Lucia, etc.)	
Website/E-mail	http://www.brgm.fr/content/bouillante-suivi-multi-methodes-exploitation-geothermique-haute-temperature , b.sanjuan@brgm.fr	

Status	Completed	General issues	X
Year (planned) delivery	Final report (March 2013)	Geological and related issues	X
Total budget (€)	923 k€	(Advanced) drilling or operation of wells	
Public budget (€)	923 k€	Power generation	X
Names of support schemes for the project	The funding of the project comes from the ADEME (50%) and BRGM (50%) operational budgets	Direct use	
		EGS – Enhanced geothermal systems	




GEFRAC3 EXP [R&D]



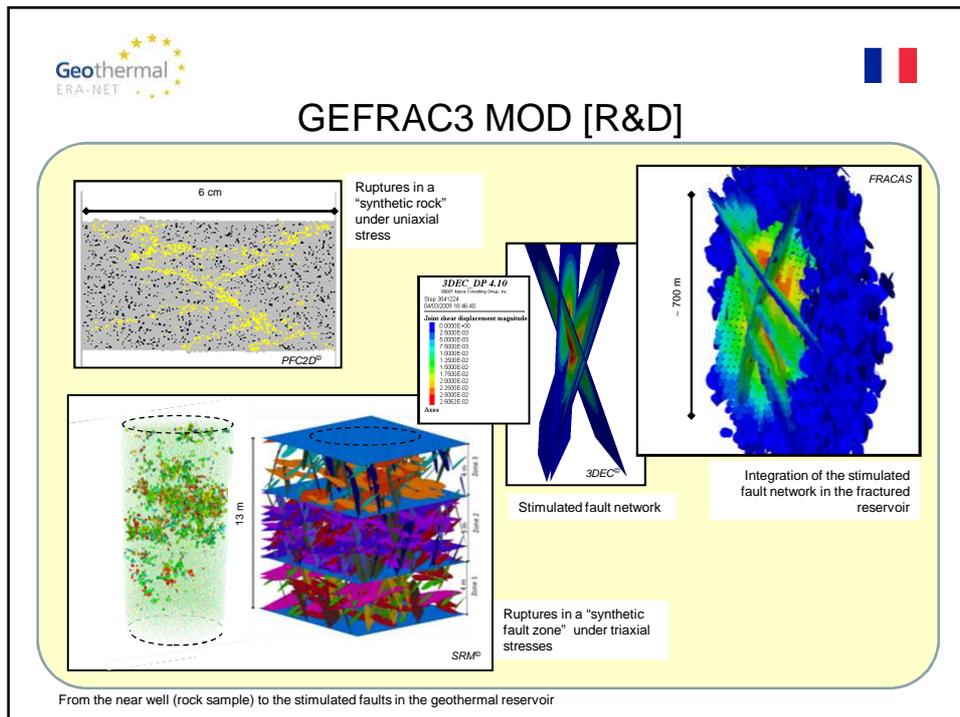
The development of THM percolation tests in fracture.




GEFRAC3 EXP [R&D]

Summary	The study of fluid/rock interactions in fractures is fundamental for the development of Enhanced Geothermal System (EGS) exploitation. Indeed, after the phase of stimulation of the fractured rock reservoir, the fractures permeability evolution depends on the chemical processes due to fluid/rock interactions. The goal of the project is to develop THM percolation tests in fracture in order to improve the understanding of these chemical processes and their repercussion on the fracture permeability.	
Organisation(s)	ADEME, BRGM, France	
Contact person	Arnold BLAISONNEAU	
Innovation	Innovative experimental tests to improve the understanding of complex behavior of fractures	
Impact	Collect data on the THM behavior of fracture in order to feed numerical models.	
Website/E-mail	http://www.brgm.fr/content/gefrac3-exp-etude-interactions-eauroche-reservoirs-geothermiques-fractures_a.blaisonneau@brgm.fr	

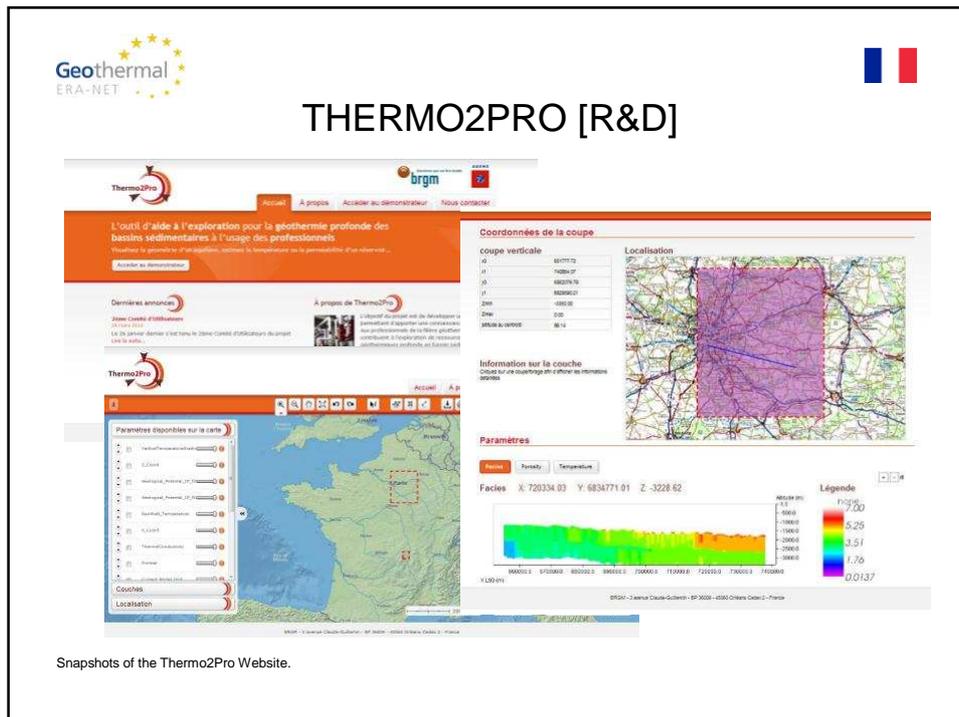
Status	Completed	General issues
Year (planned) delivery	2011	Geological and related issues
Total budget (€)	400 k€	(Advanced) drilling or operation of wells
Public budget (€)	400 k€	Power generation
Names of support schemes for the project	The funding of the project comes from the ADEME (50%) and BRGM (50%) operational budgets	Direct use
		EGS – Enhanced geothermal systems
		Laboratory experimentation



GEFRAC3 MOD [R&D]

Summary	Objectives were the improvement of conceptual models applicable to EGS geothermal sites and the development of numerical tools allowing the integration of thermo-hydro-mechanical phenomena at various scales (near well, fault, fault network). Work are performed mainly on the basis of Soultz-sous-Forêts data.	
Organisation(s)	ADEME, BRGM, France	
Contact person	Sylvie GENTIER	
Innovation	Conceptual models for the thermo-hydro-mechanical behavior of fractured rock mass. Numerical tools have been developed at the various scales, from the near well towards the fault networks, to simulate effects of the hydraulic stimulation.	
Impact	Results of the project will help to understand physical phenomena involved during the hydraulic stimulation and develop better scenarios for hydraulic stimulation.	
Website/E-mail	s.gentier@brgm.fr	

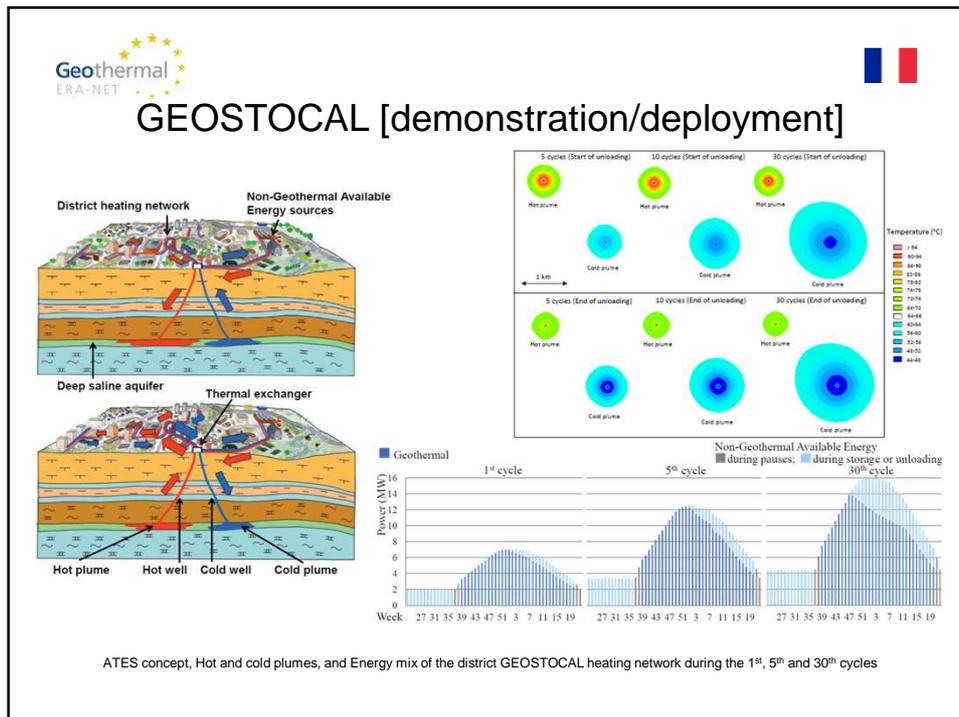
Status	Completed	General issues	X
Year (planned) delivery	2012	Geological and related issues	X
Total budget (€)	700 k€	(Advanced) drilling or operation of wells	
Public budget (€)	700 k€	Power generation	
Names of support schemes for the project	The funding of the project comes from the ADEME (50%) and BRGM (50%) operational budgets	Direct use	
		EGS – Enhanced geothermal systems	X
		Thermo-hydro-mechanical modeling	X



Snapshots of the Thermo2Pro Website.

THERMO2PRO [R&D]

Summary	Thermo2Pro is dedicated to professionals dealing with the deep geothermal exploration. It allows them to access essential parameters such as temperature, geology, permeability, etc. Thermo2Pro is essentially a Web tool designed to fill the gap between the information derived from R&D projects and the authorities of the geothermal sector who need to use it.	
Organisation(s)	ADEME, BRGM, France	
Contact person	Philippe CALCAGNO	
Innovation	Thermo2Pro facilitates the access to information coming from R&D projects. Geographical requests are made through a dedicated Website. Parameters are stored in 3D grids.	
Impact	Thermo2Pro will enhance the development of geothermal energy by facilitating the access to information.	
Website/E-mail	www.thermo2pro.fr , p.calcagno@brgm.fr	
Status	In progress	General issues
Year (planned) delivery	2013	Geological and related issues
Total budget (€)	500 k€	(Advanced) drilling or operation of wells
Public budget (€)	500 k€	Power generation
Names of support schemes for the project	The funding of the project comes from the ADEME (50%) and BRGM (50%) operational budgets	Direct use
		EGS – Enhanced geothermal systems
		Knowledge dissemination
		X
		X
		X
		X
		X
		X



GEOSTOCAL [demonstration/deployment]

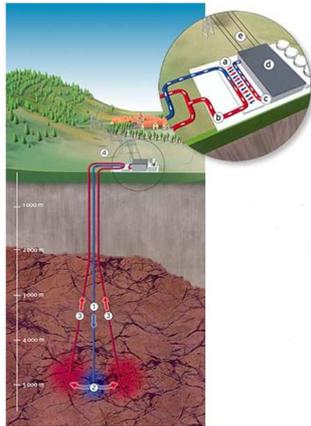
Summary	The GEOSTOCAL Aquifer Thermal Energy Storage (ATES) enables fuel cost savings obtained by avoiding the consumption of expensive energies during the winter in the Paris area. Through the storage during summer of excess heat (e.g. from waste incineration) in a deep aquifer, it maximizes the geothermal contribution to the energy mix of a district heating network over time. Projections indicate an average energy delivery of 54 GWh per year over the next 30 years (9.5 MW during 34 weeks).	
Organisation(s)	BRGM (leader), IFPEN (<i>public-sector research, innovation and training center active in the fields of energy, transport and the environment</i>), Armines-Mines ParisTech (<i>university</i>), EIVP (<i>university</i>), LGUEH (<i>Marne-la-Vallée University</i>), CPCU (<i>Compagnie Parisienne de Chauffage Urbain : production & distribution of heating in Paris</i>), CFG-Services (<i>engineering company, part of the BRGM group</i>)	
Contact person	Hervé LESUEUR	
Innovation	Storage of energy to improve the impact of geothermal use.	
Impact	The share of geothermal energy in the energy mix reaches 70%, compared to 50% possible with a conventional geothermal doublet, notably because of the low level of the temperature (62°C) in the conventional solution.	
Website/E-mail	h.lesueur@brgm.fr	

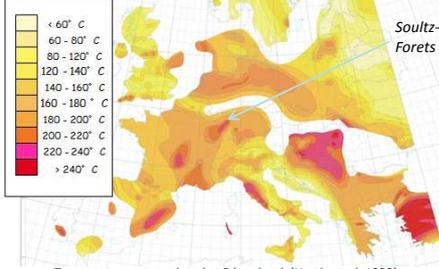
Status	Completed	General issues	X
Year (planned) delivery	2011	Geological and related issues	X
Total budget (€)	1 686 k€	(Advanced) drilling or operation of wells	X
Public budget (€)	800 k€	Power generation	
Names of support schemes for the project	ANR (French national agency for research) STOCK-E program	Direct use & Thermal Energy Storage	X
		EGS – Enhanced geothermal systems	
		Economic and environmental issues	X





Soulz III [R&D / demonstration]



Temperature extrapolated at 5 km depth (Hurtig et al, 1992)

Soulz-sous-Forets area





Soulz III [R&D / demonstration]

Summary	The Soulz-sous-Forets power plant (Alsace region, north-east of France) is the first pilot EGS project in Europe and the most advanced R&D site for deep geothermal energy worldwide. Research and development have been carried out since more than 20 years. In recent years, this pilot project has been structured in several phases. Phase I (2001-2005): drilling of 2 new deviated deep wells and stimulation of the underground reservoir. Phase II (2004-2008): stimulation, circulation tests, conversion in electricity (ORC power plant). Phase III (2009-2013) site exploitation and monitoring, complementary studies (maintenance, corrosion, radioactive hazard, pumping technology, etc).
Organisation(s)	GEIE EMC : Groupement Européen d'Intérêt Économique « Exploitation minière de la Chaleur » [which includes Electricité de Strasbourg (French electric utilities regional company), EDF (French electric utilities company), EnBW (German electric utilities company), Pfalwerke (German electric utilities company), Steag (industrial company)] + ADEME (French public Agency), BMU (German ministry), BRGM (French geological survey), EOST (university), Cryostar (private company) , SFOE (Office fédéral de l'énergie, Switzerland)
Contact person	Guerric Villadangos and Albert Genter (GEIE EMC)
Innovation	Exploration of the geothermal resource in deep crystalline rocks, development of the technologies for the exploitation of such potential for electricity and heat production
Impact	Boosting the development of the EGS sector
Website/E-mail	guerric.villadangos@es-groupe.fr ; genter@soulz.net http://english.geothermie-soulz.fr/

Status	On going	General issues	
Year (planned) delivery	2013	Geological and related issues	x
Total budget (€)	6,6 M€	(Advanced) drilling or operation of wells	
Public budget (€)	1,27 M€ (France: ADEME) + 2,2 M€ (Germany: BMU/BGR)	Power generation	x
Names of support schemes for the project	ADEME operational budget for R&D	Direct use	
		EGS – Enhanced geothermal systems	x

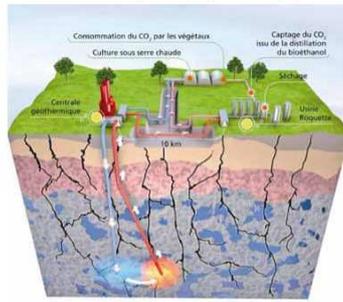




ECOIGI [deployment]



ECOIGI:
When geothermal meets industry



[Picture caption]

Source: Dossier de presse Ecoigi, 6 juin 2011





ECOIGI [deployment]

Summary	ECOIGI is a commercial project and it takes advantage of a partial public funding. It may be intended as a "demonstration" since it's the first application of the EGS technology in the private sector in France. The objective is the installation of a 24 MWth geothermal plant in Rittershoffen (Alsace region, close to Soultz-sous-Forets) based on the EGS technology. The plant will provide 30 % of the steam needed by a factory of the Roquette company. The Roquette factory extracts from wheat and corn the starch, and other constituents like proteins, fibers etc... It also transforms starch into glucose syrups and bioethanol.
Organisation(s)	Projetc company: ECOIGI [40%: Roquette Frères (<i>private company</i>) ; 40% : Electricité de Strasbourg (<i>energy supplier</i>) ; 20%: Caisse des dépôts et consignations (CDC) (<i>French financial organization under the control of the Parliament</i>)]
Contact person	ÉS : Gueric Villadangos ; Roquette Frères: Clément Robert ; Caisse des Dépôts: Gil Vauquelin
Innovation	First commercial application of the EGS technology in France
Impact	Boosting the development of the EGS sector
Website/E-mail	gueric.villadangos@es-groupe.fr ; clement.robert@roquette.com ; gil.vauquelin@caissedesdepots.fr http://www.roquette.com/news-2011-food-feed-pharma-paper/e-c-o-g-i-when-geothermal-meets-industry/

Status	On going	General issues	
Year (planned) delivery	2014-2015	Geological and related issues	
Total budget (€)	20 M€ (plant) + 24 M€ (heating network)	(Advanced) drilling or operation of wells	
Public budget (€)	10 M€ (plant) + 14 M€ (heating network)	Power generation	X
Names of support schemes for the project	Renewable heat fund	Direct use	
		EGS – Enhanced geothermal systems	X
		...	



R&D projects

Project name	TRANSENERGY	Geo-DH
Summary	<p>Thermal water extraction from the same transboundary geothermal reservoir at a national level without cross-border harmonized management strategies may cause negative impacts (depletion or overexploitation) leading to economic and political tensions between neighboring countries. Therefore only the establishment of a joint, multi-national management system may handle the assessment of geothermal potentials and give guidelines for a balanced fluid/heat production. This need was recognized by four Central European countries (Hungary, Slovenia, Austria and Slovakia) which share transboundary geothermal energy resources in the western part of the Pannonian basin. Based on joint data evaluation and the establishment of geological, hydrogeological and geothermal models for the entire project area, and for 5 selected transboundary pilot model areas, Transenergy provides a web-based decision supporting tool (interactive web-map and data service), which together with comprehensive reports on regulatory framework and best practice recommendations on thermal groundwater/geothermal resource management promotes the enhanced and sustainable utilization of hydrogeothermal systems of the region.</p>	<p>Geothermal DH technology is poorly developed in Europe, although the potential of deep geothermal is significant in many regions. The aim of this project is to stimulate the use of geothermal energy sources for heating requests and consequently replace the use of fossil fuels by district heating (DH). GeoDH is covering 14 EU countries with juvenile, transitional and mature DH markets. The specific objectives of GeoDH are to:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Propose the removal of regulatory barriers in order to promote the best circumstances and to simplify the procedures for operators and policy makers. <input type="checkbox"/> Develop innovative financial models for GeoDH in order to overcome the current financial crisis which is hampering the financing of geothermal projects which are capital intensive <input type="checkbox"/> Train technicians and decision-makers of regional and local authorities in order to provide the technical background necessary to approve and support projects. <p>Within GeoDH MFGI (HU partner) is preparing an interactive web-map showing the matching of geothermal potential for DH and heat demand.</p>
Organisation(s)	MFGI, SGUDS, Geo-ZS, GBA	European Geothermal Energy Council, Agency for Geothermal Power Engineering Slovakia, Union of Bulgarian Black Sea local authorities, Slovensko društvo za daljinsko energetiko, Consorzio per lo Sviluppo delle Aree Geotermiche, Association Française des professionnels de la géothermie, Polish Academy of Sciences - Mineral and Energy Economy Research Institute, Fjernvarmens Udviklingscenter, Gemeente Heerlen, Geological and Geophysical Institute of Hungary
Contact person	Annamária Nádor (nador.annamaria@mfgi.hu)	Philippe Dumas - EGEC (p.dumas@egec.org)
Innovation	geothermal database with harmonized data, uniform maps and models for 4 countries	bridging the gap between the potential of deep geothermal, and the potential of new and existing district heating systems, training energy officers on matters concerning geothermal DH technologies.
Impact	recommendations for joint management strategy for transboundary reservoirs	increasing the uptake of geothermal DH (GeoDH) in the heat market by 2020, through the expansion and improvement of district heating systems in Europe, in regions rich in geothermal energy.
Website/E-mail	http://transenergy-eu.geologie.ac.at	www.geo-dh.eu
Status	ongoing	ongoing
Year (planned) delivery	2013	2014
Total budget (€)	2 354 3868	1014560
Public budget (€)	2 354 3869 (85% EU funding, but 15% own contribution is national public funding)	760 920 (EU funding)
Names of support schemes for the project	Central Europe Program	Intelligent Energy Europe
General issues	x	x
Geological and related issues	x	
(Advanced) drilling or operation of wells		
Power generation		
Direct use	x	x
EGS – Enhanced geothermal systems		
...		



Project name	Geothermal potential assessment	Delineation of geothermal protection zone (related to concessio
Summary	As part of the implementation of the National Energy Strategy, an Action Plan targeting the potential assessment of "geo-energy" related resources (hydrocarbon, coal, geothermal, CO ₂ , U/Th and REE) was prepared by the Geological and Geophysical Institute of Hungary (MFGI) in 2012. The geothermal potential assessment comprised both the shallow and deep geothermal and was based on a volumetric approach, it quantified the HIP, inferred resources and probable reserves.	Based on the recent amendments of the Act XLVIII of 1993 on Mining, the principles of outlining the Geothermal Protection Zone - GPZ (3D subsurface space, from where geothermal energy can be exploited below -2500 m in the frame of concession) were elaborated and serve as a basis of legislation. Maximum allowed temperature and pressure drops were identified, which have to be determined for the GPZ by hydraulic flow and transport models and reviewed every 5 years.
Organisation(s)	MFGI	MFGI
Contact person	László Zilahi-Sebess (zilahi.sebess.laszlo@mfgi.hu)	Tóth György (toth.gyorgy@mfgi.hu)
Innovation	individually assessed porosity parameters for the main reservoir rocks taking into account the compaction trends	the outline of the GPZ was determined on the basis of experts' recommendations, scientific considerations (hydrogeological and geothermal modelling)
Impact	new and reliable numbers on the geothermal potential of Hungary	with the definition and implementation of GPZ into legislation, all formerly existing administrative barriers terminated, and there are no more obstacles to call tenders for geothermal concession
Website/E-mail	www.mfgi.hu	www.mfgi.hu
Status	completed	completed
Year (planned) delivery	2012	2012
Total budget (€)	not specified, part of work performed for the Hungarian Office for Mining and Geology based on the order from the Ministry of National Development	not specified, part of work performed for the Hungarian Office for Mining and Geology based on the order from the Ministry of National Development
Public budget (€)	not specified, part of work performed for the Hungarian Office for Mining and Geology based on the order from the Ministry of National Development	not specified, part of work performed for the Hungarian Office for Mining and Geology based on the order from the Ministry of National Development
Names of support schemes for the project	state budget (part of operational costs of MFGI)	state budget (part of operational costs of MFGI)
General issues	x	x
Geological and related issues	x	x
(Advanced) drilling or operation of wells		
Power generation	x	x
Direct use	x	
EGS – Enhanced geothermal systems		x
...		



Demonstration / Deployment projects



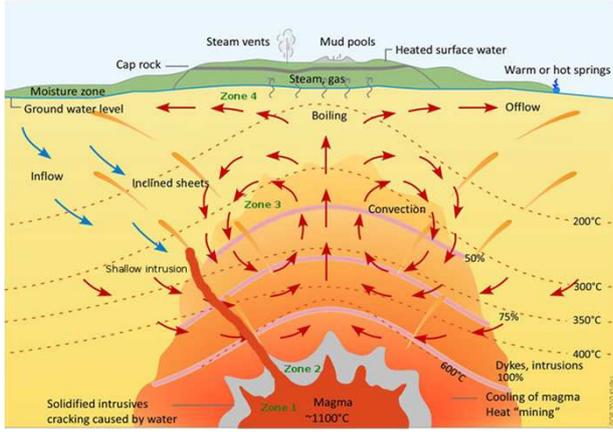
Project name	Szentlőrinc	Miskolc-Mányi
Summary	Hungary's largest operational geothermal-based district heating system (100% geothermal feed), started ordinary operation on January 1, 2011. The off-take partner is a city-owned company, the off-take contract is for 15+5 years. An 1800 m deep production well has an outflow temperature of 87C and max. yield of 25 l/s, coupled with a reinjection well. The heat capacity is 3MW, while the heat demand is 22000-60000GJ.	First "large-scale" project in Hungary, 5 wells drilled: 2 production, 3 reinjection. Parameters of production wells are: depth: 2305 and 1514 m, fluid temperature: 105C and 90C, yield: 6600-9000 l/min. Reservoir is karstified-fractured Triassic limestone. The district heating system will feed Miskolc, 2nd largest town in Hungary, population of 170 000 people. The off-take partner is a city-owned company, the off-take contract is for 15+5 years. The heat capacity is 55 MW. Heat demand is 695000-1100000GJ. 22 km pipelines established
Organisation(s)	Pannergy	Pannergy
Contact person	pannergy@pannergy.com	pannergy@pannergy.com
Innovation		
Impact	first 100% geothermal-based district heating system in Hungary, supplying 900 flats, saving 1.9 million kg CO2 emission	first large-scale district heating project
Website/E-mail	www.pannergy.com	www.pannergy.com
Status	completed	ongoing
Year (planned) delivery	2011	2013
Total budget (€)	The net CAPEX of the investment (including EU grants) was 3.4 million euro.	CAPEX 25 million euro
Public budget (€)	1. 5 million euro (from KEOP-4.2.0)	9 million euro (from KEOP 4.2.0. and 4.7.0)
Names of support schemes for the project	Environment and Energy Operative Program (KEOP-4.2.0)	Environment and Energy Operative Program (KEOP-4.2.0 and 4.7.0)
General issues	x	x
Geological and related issues		
(Advanced) drilling or operation of wells	x	x
Power generation		
Direct use	x	x
EGS – Enhanced geothermal systems		
...		



GEORG

Deep Roots of Geothermal systems





[Picture caption]



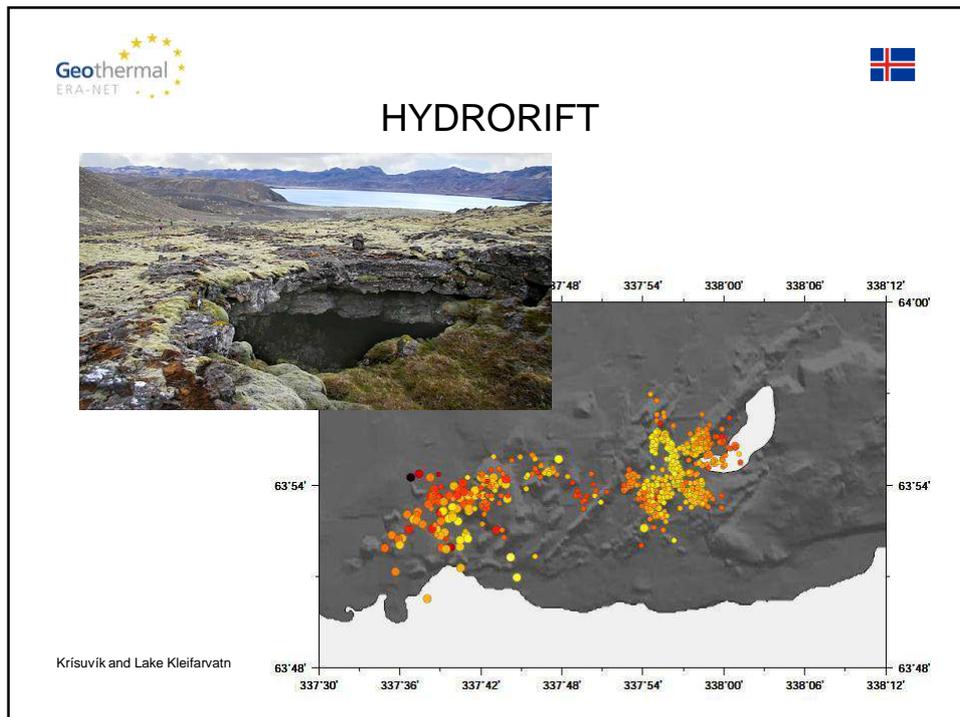
GEORG

Deep Roots of Geothermal systems



Summary	Research on magmatic intrusions as heat sources of geothermal systems and the mode of superheated or supercritical heat transfer up to the conventional geothermal systems at subcritical temperatures and pressures. Properties of fluid and rock in the supracrustal layer and obstacles in exploitation will also be investigated.
Organisation(s)	Landsvirkjun, Reykjavik Energy, HSOrka, Orkustofnun, University of Iceland, Reykjavik University, ISOR, Uppsala University, ETH Zurich,
Contact person	Hjalte Páll Ingólfsson
Innovation	Comprehensive project with close cooperation and commitment of Energy Companies, Universities and research institutions. Will explore new theories and tools to understand the reaction between magma and geothermal fluids under supercritical circumstances.
Impact	Will contribute significantly to increased understanding of the interaction between magma and geothermal fluids and will cast a new light on how geothermal areas renew their
Website/E-mail	http://georg.hi.is/node/136

Status	Planned		
Year (planned) delivery	2016	General issues	
Total budget (€)	1.600.000 €	Geological and related issues	X
Public budget (€)	520.000€	(Advanced) drilling or operation of wells	X
Names of support schemes for the project	GEORG + the Energy Companies and Orkustofnun	Power generation	X
		Direct use	
		EGS – Enhanced geothermal systems	X
		...	



HYDRORIFT

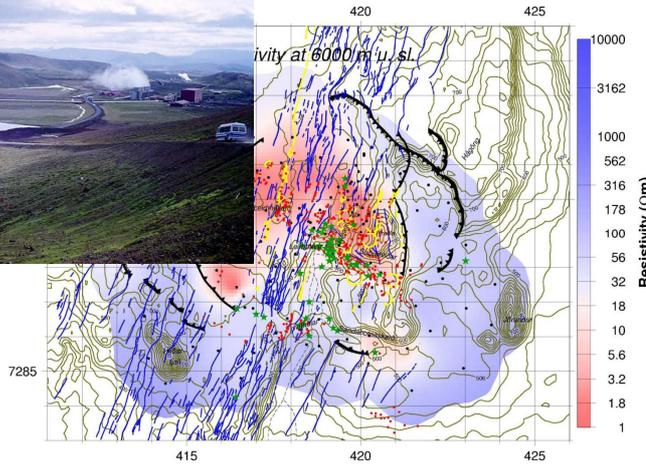
Summary	Understanding the behaviour of fluids in the deep upper crust and at the brittle/ductile crust transition is of importance in both academic and industrial fields. Hydric fluids are thought to play a major role in the seismogenic cycle, mainly by decreasing friction along major faults. The project includes a new highly detailed seismic tomography (P, S and Vp/Vs) of the Kleifarvatn-Fagradalsfjall area of the Reykjanes peninsula and a joint interpretation with the recently collected TEM/MT data supported by information from boreholes.
Organisation(s)	ISOR, HS-orka, University of Le Mans-Nantes (CNRS), EOST - Ecole et Observatoire des Sciences de la Terre
Contact person	Ólafur Flóvenz
Innovation	A unique study in the geothermal world addressing problems that have not been addressed before and results are likely to be of high practical use
Impact	Development of new method for exploration of supercritical geothermal systems making use of the Vp/Vs ratio in relation to resistivity structure. This new method will guide the developer of geothermal fields to the most promising part where the energy content of the fluid is highest. In long perspective its results have the potential to contribute to significantly increase in energy production from existing geothermal fields.
Website/E-mail	http://georg.hi.is/node/148

Status	Ongoing	General issues	
Year (planned) delivery	2014	Geological and related issues	X
Total budget (€)	450.000€	(Advanced) drilling or operation of wells	
Public budget (€)	66.144€	Power generation	
Names of support schemes for the project	GEORG	Direct use	
		EGS – Enhanced geothermal systems	
		...	



**Advanced 3D Geophysical Imaging
Technologies for Geothermal Resource
Characterization**



From Krafla, where part of the test will be done



**Advanced 3D Geophysical Imaging
Technologies for Geothermal Resource
Characterization**



Summary	A comprehensive Icelandic/USA cooperative project under the IPGT agreement. The focus is on the development of joint geophysical imaging methodologies using complementary data for geothermal site characterization and demonstrate their potential in three areas: Krafla, the Reykjanes-Hengill areas and Coso in the USA. The emphasis is on Electro-Magnetic, gravity and earthquake data. The joint inversion will be made in an innovative paradigm of joint geometry rather than parametric correlation. It is divided into four increasingly ambitious stages, from state of the art to fully joint inversion.	
Organisation(s)	ÍSOR, Iceland GeoSurvey, Lawrence Berkeley National Laboratory (LBNL) - USA, Massachusetts Institute of Technology (MIT) - USA, Reykjavik University, Landsvirkjun, Reykjavik Energy, HS Orka	
Contact person	Knútur Árnason	
Innovation	Firstly, novel tomographic techniques will be tested with earthquake data and noise to constrain geothermal reservoir structure e.g. high-frequency ambient seismic noise tomography. Secondly, but with greater weight, new methods of joint imaging and interpretation will be applied to a variety of geophysical data sources.	
Impact	Testing and development of new geophysical exploration and interpretation methods for geothermal exploration, with much higher resolution than the conventional approach. Better resolution, from shallow to great depths, allowing more detailed studies of geothermal systems by surface exploration.	
Website/E-mail	http://georg.hi.is/node/142	

Status	Ongoing
Year (planned) delivery	2014
Total budget (€)	2.670.000 €
Public budget (€)	170.000€
Names of support schemes for the project	GEORG

General issues	
Geological and related issues	X
(Advanced) drilling or operation of wells	
Power generation	
Direct use	
EGS – Enhanced geothermal systems	X
...	



Properties of two phase flow of water and steam in geothermal reservoirs






Experimental setup at Reykjanes power plant



Properties of two phase flow of water and steam in geothermal reservoirs



Summary	The goal of this project is to study two phase flow in geothermal reservoirs, both theoretically using mathematical models and by conducting experiments on such flow situations. The theoretical part involves development of new and improved relations that account for the complex interaction between two phases in porous medium. The experimental part involves measurements of two phase flow in porous media.	
Organisation(s)	Reykjavik University, University of Iceland, Keilir, ÍSOR, Landsvirkjun, HS Orka	
Contact person	María S Guðjónsdóttir	
Innovation	The experiments performed in this project have never been performed before in such a large scale device, therefore they resemble real reservoir conditions better than previous experiments in this field have.	
Impact	Results from this project will not only deepen the understanding of behavior of geothermal reservoirs systems but also be an important tool in decision making of geothermal utilization. The main benefit is though the proposed improvement of known simplifying assumptions in current reservoir models, which will hopefully enhance the accuracy and consistency of reservoir models in the future.	
Website/E-mail		

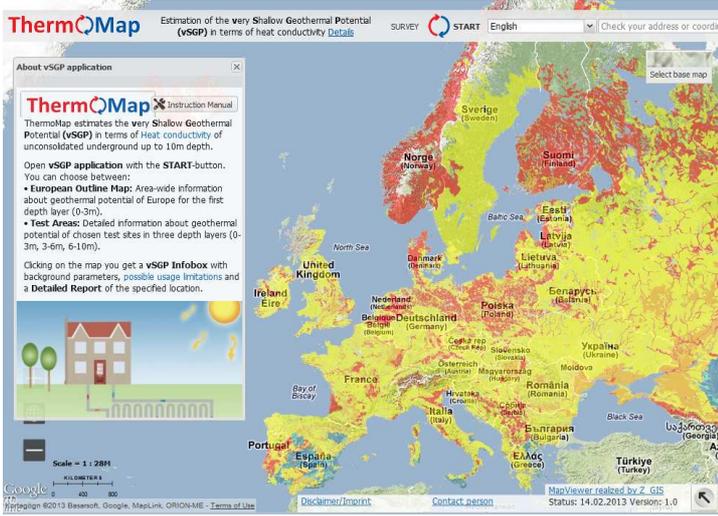
Status	On-going		
Year (planned) delivery	2014		
Total budget (€)	260.000€		
Public budget (€)	26.700 €		
Names of support schemes for the project	GEORG		

General issues	
Geological and related issues	X
(Advanced) drilling or operation of wells	X
Power generation	X
Direct use	
EGS – Enhanced geothermal systems	X
...	





ThermoMap



[Picture caption]





ThermoMap

Summary	Area mapping of superficial geothermic resources by soil and groundwater data	
Organisation(s)	FAU, BRGM, ISOR, MALI, IGR, NERC, RBINS-GSB, REHAU, GBI, PLUS, IGME, EGEN	
Contact person	David Bertermann, FAU	
Innovation	Using existing data to evaluate possibility for GSHP	
Impact	Web GIS application	
Website/E-mail	Thermomap-project.eu	

Status	Ongoing			X
Year (planned) delivery	2013	General issues		X
Total budget (€)	3,8M€	Geological and related issues		
Public budget (€)	1,9M€ (EU contribution)	(Advanced) drilling or operation of wells		
Names of support schemes for the project	ICT PSP	Power generation		
		Direct use		
		EGS – Enhanced geothermal systems		
		Shallow Geothermal		X





IDDP






[Picture caption]





Iceland Deep Drilling Project IDDP

Summary	The main objective of the IDDP is to investigate and explore whether it is economically feasible to produce energy and chemicals from geothermal systems at supercritical conditions. The knowledge obtained may be of a considerable economic significance for the parties as well as for Iceland and the international community and may contribute significantly to development of worldwide sustainable energy resources.	
Organisation(s)	Orkustofnun, HS Orka, Landsvirkjun, Reykjavik Energy and Alcoa. Statoil supported the projects for a few years.	
Contact person	Guðmundur Ómar Friðleifsson	
Innovation	Currently supercritical resources are not being exploited. In order for this to work innovative measures need to be taken in the field of drilling, well logging, fluid evaluation and treatment.	
Impact	For Iceland the estimated geothermal reserves could be tripled. A similar effect for other resource assessments for high temperature hydrothermal systems.	
Website/E-mail	www.iddp.is	

Status	2007-2015	General issues	x
Year (planned) delivery	2015	Geological and related issues	x
Total budget (€)	9.000.000 €	(Advanced) drilling or operation of wells	x
Public budget (€)	2.700.000 €	Power generation	x
Names of support schemes for the project	None	Direct use	x
		EGS – Enhanced geothermal systems	x





Carbfix





[Picture caption]





Carbfix

Summary	A primary goal of the CarbFix project is to imitate the natural storage process of CO ₂ already observed in geothermal fields where carbonate minerals sequester CO ₂ of volcanic origin. The project's implications for the fight against global warming may be considerable, since basaltic bedrock susceptible of CO ₂ injections are widely found on the planet.		
Organisation(s)	Reykjavik Energy, University of Iceland, Reykjavik University, Earth Institute – Columbia University, CNRS, NanoGeoScience – University of Copenhagen, AMPHOS 21		
Contact person	Edda Sif Pind Aradóttir		
Innovation	Development of methods and technology of a complete CCS cycle, i.e. capture and treatment of otherwise emitted gases, transport and injection involving immediate solubility trapping. Development of geochemical monitoring methods, downhole sampling device and numerical models aimed at predicting the fate of injected CO ₂ .		
Impact	Reduced CO ₂ emissions from geothermal power plants. Environmentally benign CO ₂ sequestration method that can be applied in areas containing basaltic bedrock.		
Website/E-mail	www.carbfix.com		

Status	Ongoing	General issues	
Year (planned) delivery	2015	Geological and related issues	X
Total budget (€)	7 million at end of 2011. Updated figures for 2012 not available yet.	(Advanced) drilling or operation of wells	X
Public budget (€)		Power generation	X
Names of support schemes for the project	European Commission, GEORG, DOE, Reykjavik Energy	Direct use	
		EGS – Enhanced geothermal systems	



Carbon Recycling International



Geothermal Power Plant Exhaust to Renewable Fuels from HS Orka Power Plant in Svartsengi.

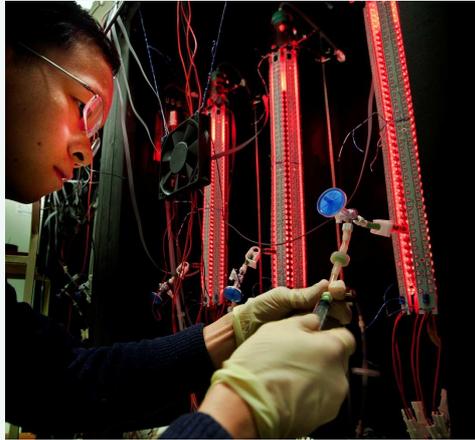


Carbon Recycling International

Summary	Carbon Recycling International (CRI) captures carbon dioxide from industrial emissions and converts carbon dioxide into Renewable Methanol (RM). RM is a clean fuel that can be blended at different levels with gasoline and used for bio diesel manufacturing to meet EU Renewable Energy Directives.	
Organisation(s)	Carbon Recycling International (CRI ehf.)	
Contact person	Andri Ottesen	
Innovation	Takes Non Condensable Gases from Geothermal Power Plants Exhaust, separate H ₂ S and CO ₂ . Electrolyzes water into H ₂ and O ₂ . Mixes CO ₂ and H ₂ into methanol and O ₂ and H ₂ S into sulfuric acid.	
Impact	The production process captures carbon dioxide and minimizes emissions from energy intensive industries and transforms it to automobile fuel with very low carbon footprint.	
Website/E-mail	www.cri.is / andri@cri.is	
Status	First plant operational	General issues
Year (planned) delivery	2013 - 1000 tons , 2014 – 4000 tons, 2015 – 44.000 tons.	Geological and related issues
Total budget (€)		(Advanced) drilling or operation of wells
Public budget (€)		Power generation
Names of support schemes for the project	Technology Development Fund	Direct use
		EGS – Enhanced geothermal systems
		...



GeoChem



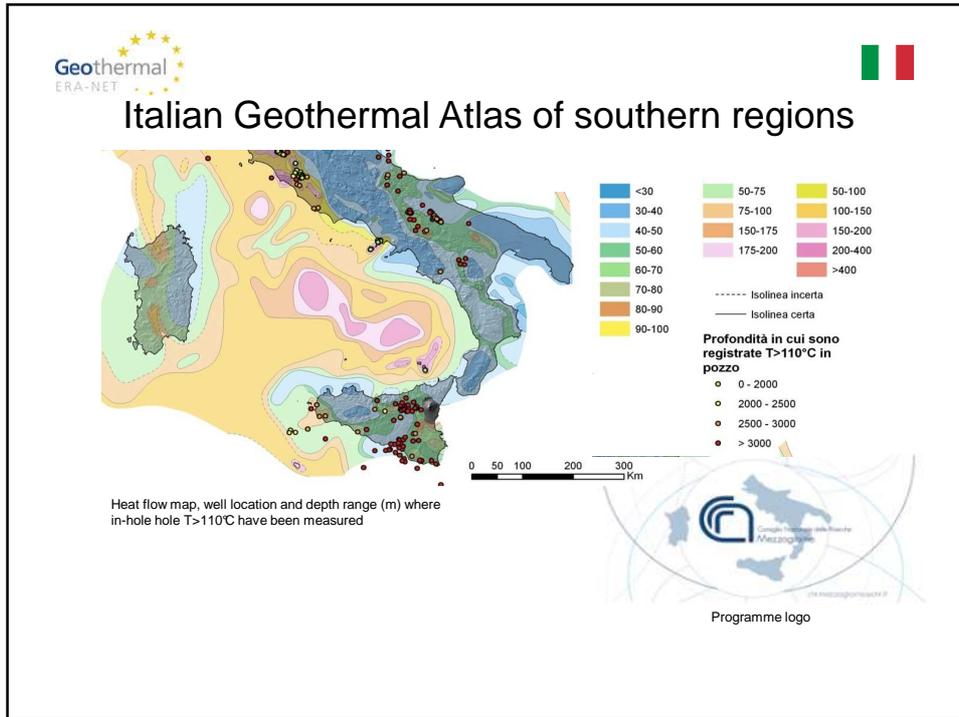
An experimental light emitting diode (LED) based photobioreactor



GeoChem

Summary	Geothermal wells in Iceland produce hundreds of thousands of tonnes of carbon dioxide per year that is released into the atmosphere. This production, or release, rate is likely to increase in the coming years. The convergence of light-emitting diode technology, photobioreactor design, algal biotechnology and low energy processing costs make biological fixation of this CO ₂ into fine chemicals feasible.
Organisation(s)	University of Iceland, Center for Systems Biology
Contact person	Sigurður Brynjólfsson
Innovation	This project will aim at design and build a prototype of a photobioreactor based factory and determine the spectrum of algal strains and bacteria that can be cultivated with this system.
Impact	If successful, a spin-off company will be formed to carry out the scale-up, product selection and business development. It would significantly add to the diversity of industries operating in Iceland.
Website/E-mail	https://systemsbiology.hi.is/ sb@hi.is

Status	In progress	General issues	x
Year (planned) delivery	2014	Geological and related issues	
Total budget (€)	650.000	(Advanced) drilling or operation of wells	
Public budget (€)	650.000	Power generation	
Names of support schemes for the project	Technical Development Fund	Direct use	X
		EGS – Enhanced geothermal systems	
		...	



Geothermal ERA-NET Italian Geothermal Atlas of southern regions

Summary	The Atlas provides: i) favourability maps for conventional (hydrothermal) and non-conventional (EGS, geopressurised, suocritical, co-produced) resources, ii) Data Centers for managing geothermal information, iii) potential environmental impact evaluation of geothermal deployment, iv) dissemination, promotion of geothermal energy training for scientists, operators, administrative personnel interested in managing geothermal resources.	
Organisation(s)	6 Institutes of CNR and INGV	
Contact person	Adele Manzella (coordinator), CNR-IGG, Via Moruzzi 1, 56124 Pisa, Italy, manzella@igg.cnr.it , +39 050 3152392	
Innovation	The project provides maps related to the distribution and favourability of territories to host hydrothermal systems, as well as EGS, magmatic, supercritical and geopressurized conditions. Test remote sensing techniques for geothermal exploration and for investigating and monitoring environmental impact of geothermal exploitation.	
Impact	The project will be strategic for inserting geothermal energy and its potential deployment in the energy policy documents and regional energy plans. The evaluation lacked in Italy, especially for non-conventional resources.	
Website/E-mail	http://www.mezzogiorno.cnr.it/index.php?option=com_content&view=article&id=17&Itemid=65	

Status	Ongoing	General issues	X
Year (planned) delivery	3 years, 2012-2014	Geological and related issues	X
Total budget (€)	1.5 M€	(Advanced) drilling or operation of wells	
Public budget (€)	1.5 M€	Power generation	X
Names of support schemes for the project	R&D funds from CNR	Direct use	
		EGS – Enhanced geothermal systems	X
		Other Unconventional Geothermal Systems	X
		Data Center	X
		Thermal model of Southern Italy	X
		Environmental impact	X



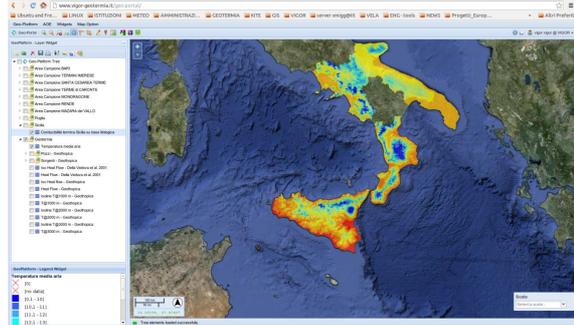


VIGOR

(Geothermal potential assessment of italian convergence regions)



VIGOR project logo and banner



VIGOR webGIS platform: contains all the maps produced for the project





VIGOR

Summary	In two years of activity, VIGOR has provided 8 feasibility studies for geothermal resources in a wide range of temperatures, proposing 8 different kinds of exploitation technologies which have been chosen on the base of the resource as well as on the energy demand of the area. Geothermal potential has also been evaluated, both at surface for GSHP technology and at depth for different kinds of application (power production, district heating and various industrial processes). Economics and regulatory aspects have also been considered and described.
Organisation(s)	10 Institutes of CNR, INGV and 4 Universities (Naples, Bari, Cosenza, Palermo), AMRA, TNO
Contact person	Adele Manzella (scientific coordinator), CNR-IGG, Via Moruzzi 1, 56124 Pisa, Italy, manzella@igg.cnr.it , +39 050 3152392
Innovation	Updated assessment of hydrothermal resources; organization of geothermal non-technical data; development of an integrated methodology to compute geothermal potential including economic analysis and energy demand; development of a procedure to compute energy exchange map for shallow geothermal resources; planning and schemes for an innovative use of geothermal energy applied to several industrial processes (waste water treatment, past production) and improvement of energy efficiency in several processes (desalination, heating&cooling plants).
Impact	VIGOR, which is related to low, medium and high temperature resources for direct uses (including geothermal heat pumps) and power production, can represent an example of a comprehensive geothermal assessment (resource, plant, economics), to be followed in other regions and to meet the energy demand for future benefit of the society.
Website/E-mail	http://www.vigor-geotermia.it

Status	Ongoing			
Year (planned) delivery	2+1 years, 2011-2013			
Total budget (€)	8 M€			
Public budget (€)	8 M€			
Names of support schemes for the project	Structural Funds 100% (50% EU, 50% IT)			

General issues	X
Geological and related issues	X
(Advanced) drilling or operation of wells	X
Power generation	X
Direct use	X
EGS – Enhanced geothermal systems	X
Feasibility study (eight different exploitation technologies)	X
Regulatory aspects	X





Campi Flegrei Deep Drilling Project




Campi Flegrei Drilling site





Campi Flegrei Deep Drilling Project

Summary	Campi Flegrei Deep Drilling Project is a Volcanological and Geothermal study of the Campi Flegrei caldera by scientific deep drilling activities. Deep drilling in the caldera with 'in situ' permeability and stress measurements by leak-off tests; temperature measurements and stratigraphy; rock sample laboratory analyses.	
Organisation(s)	INGV-ICDP	
Contact person	Giuseppe De Natale (coordinator), INGV-OV, Via Diocleziano, 328 - 8124 Napoli, giuseppe.denatale@ov.ingv.it , +39 081 6108510	
Innovation	The main interest for geothermal activities consists in the detailed determination of geothermal system properties (temperatures, permeabilities, rock-fluid interaction, etc.) and in the study of supercritical fluids.	
Impact	Crucial for volcanological and geothermal interpretation at calderas, in Italy and around the world, also for monitoring and civil defence issues.	
Website/E-mail	https://sites.google.com/site/cfdpproject	

Status	Ongoing		X
Year (planned) delivery	3/5	General issues	X
Total budget (€)	9 M€ provisional	Geological and related issues	X
Public budget (€)	9 M€ provisional	(Advanced) drilling or operation of wells	X
Names of support schemes for the project	R&D funds of INGV, ICDP funds, Campania Region Structural funds	Power generation	X
		Direct use	
		EGS – Enhanced geothermal systems	
		Supercritical fluids	X
		Environmental impact	X





FORIO Project



Ischia Island









FORIO Project

Summary	Realization of n. 2 geothermal pilot power plants for electricity (5 MW each) and thermal co-generation on Ischia Island. The project has been recently approved by the Italian Ministry for Development, and the effective starting of drilling and building activities is now subordinated to the positive evaluation of environmental impact (VIA) by the Campania Regional Government. Drilling activities could start in about 6 months.	
Organisation(s)	Project owner (financing the programme): TADDEI srl; Project managing organisation: INGV – Osservatorio Vesuviano.	
Contact person	Giuseppe De Natale (scientific coordinator), INGV-Osservatorio Vesuviano, Via Diocleziano, 328 - 8124 Napoli, giuseppe.denatale@ov.ingv.it , +39 081 6108510	
Innovation	Research and characterization of geothermal resource at two sites in the Ischia Island. Prototypes of binary (ORC) pilot power plants with total re-injection of geothermal fluids and incondensable gases. Innovative solutions for re-condensation of working fluid.	
Impact	Zero emission binary plants on two sites of Ischia Island, where environmental issues are very crucial.	
Website/E-mail	giuseppe.denatale@ov.ingv.it	

Status	Planned		X
Year (planned) delivery	4/5	General issues	X
Total budget (€)	20 M€ provisional	Geological and related issues	X
Public budget (€)	-	(Advanced) drilling or operation of wells	X
Names of support schemes for the project	The project is owned and financed by a private TADDEI srl	Power generation	X
		Direct use	X
		EGS – Enhanced geothermal systems	X
		Environmental impact	X





SCARFOGLIO Project




Campi Flegrei area





SCARFOGLIO Project

Summary	Realization of n.1 geothermal pilot power plant for electricity (5 MW each) and thermal co-generation at Agnano, a particular site in Naples, within the Campi Flegrei caldera. The project is actually under evaluation by the Italian Ministry for Development. After eventual approval, it will be checked for environmental compatibility from the Campania Regional Government.
Organisation(s)	Programme owner (financing the programme): GEOELECTRIC srl; Programme managing organisation: INGV-Osservatorio Vesuviano.
Contact person	Giuseppe De Natale (scientific coordinator), INGV-Osservatorio Vesuviano, Via Diocleziano, 328 - 8124 Napoli, giuseppe.denatale@ov.ingv.it , +39 081 6108510
Innovation	Research and characterization of geothermal resource at a site located at Agnano, within the Campi Flegrei caldera. Prototype of binary (ORC) pilot power plant with total re-injection of geothermal fluids and incondensable gases. Innovative solutions for recovering and industrial use of geothermal CO ₂ .
Impact	Zero emission binary plant and recovery of geothermal CO ₂ in an area where environmental issues are very crucial.
Website/E-mail	giuseppe.denatale@ov.ingv.it

Status	Planned
Year (planned) delivery	4/5
Total budget (€)	20 M€ provisional
Public budget (€)	-
Names of support schemes for the project	The project is owned and financed by a private GEOELECTRIC srl

General issues	X
Geological and related issues	X
(Advanced) drilling or operation of wells	
Power generation	X
Direct use	X
EGS – Enhanced geothermal systems	
Total re-injection of geothermal fluids and incondensable gases	X
Recovery of geothermal CO ₂	X
Environmental impact	X



Grado District Heating demonstration project Gorizia NE Italy





[Deployment of the distribution network on Grado Is.]



[Pumping tests at Grado-1 well.]





[Air lifting from the first thermal aquifer at 727 m depth.]



[Drilling rig of the Grado-1 well on Grado Is.]



Grado District Heating demonstration project Gorizia NE Italy



Summary	District heating system demonstration project for public buildings, based on a geothermal doublet. The Grado-1 well, 1110 m deep, Outflow of 100 tons/h, 2.8 bar, 42-48 °C, 16 ‰ salinity, allowed the geothermal potential assessment (Phase I, 2004-2008). Phase II started in 2011, including gravity, multichannel seismic and VSP measurements, to locate the 2nd borehole of the doublet (950 m eastwards of Grado-1 well). Drilling of Grado-2 is due by 2013. The deployment of the distribution network is due by early 2014. Estimated thermal power in excess of 2 MW _{th} .		
Organisation(s)	Municipality of Grado city (Gorizia), Regione Autonoma Friuli Venezia Giulia (FVG), University of Trieste and OGS (National Institute of Oceanography and Experimental Geophysics).		
Contact person	Andrea De Walderstein (technical manager), Municipality of Grado city, a.dewalderstein@comunegrado.it; +39 0431 898159; Bruno Della Vedova (scientific supervisor), University of Trieste, dellavedova@units.it, +39 040 5587159		
Innovation	The flagship value of the project is to demonstrate that the buried carbonatic platforms of cold sedimentary basins, like those of Friuli and Veneto, are good potential geothermal resources to sustain district heating systems. The success of the project would support the replication of similar initiatives in other contexts.		
Impact	The expected impacts are: a substantial reduction in heating costs of the public buildings in Grado City, an increased environmental sustainability and improvement of the turistic offer of this historic and resort island.		
Website/E-mail	http://www.unionegeotermica.it/pdfiles/geotherm-expo-09/Presentazioni/Sessione3-DellaVedova.pdf		

Status	Ongoing	General issues	X
Year (planned) delivery	2014	Geological and related issues	
Total budget (€)	2,3 M€ (Phase I) 2,5 M€ (Phase II)	(Advanced) drilling or operation of wells	
Public budget (€)	77% European Funding 23% Grado and Regione FVG funding	Power generation	
Names of support schemes for the project	DOCUP-2 (2000-2006) POR-FESR (2007-2013)	Direct use	X
		EGS – Enhanced geothermal systems	



Monteverdi Marittimo District Heating System









ENTI PUBBLICI



[Picture caption]



Monteverdi Marittimo District Heating System



Summary	A new DH plant in Monteverdi Marittimo, Tuscany, was inaugurated on the 4th April 2013. The plant uses steam from an Enel Green Power well. It is now being used by 100 families but aims to reach a total of 450 users, corresponding to 250.00m ³ of final heated volume. The Monteverdi Marittimo district heating network will have a total length of 25km.		
Organisation(s)	Municipality of Monteverdi Marittimo, Tuscan Region, Province of Pisa, CoSviG and Enel Green Power.		
Contact person	Sergio Chiacchella (director), CoSviG, Via Tiberio Gazzei 89, Radicondoli, Siena, s.chiacchella@cosvig.it , +39 0577 752950		
Innovation	The condensation is sent by turbo pump to the reinjection point managed by ENEL, in order to renew and maintain the geothermal resource - All the power plants can be remote-controlled and they adopt a climatic control system. Automatic flow rate controller in each user in order to distribute just the quantity of thermal energy that the users require.		
Impact	Savings 1,3 million of m ³ of gas consumption per year and the emission of 2.500 tons of CO ₂ per year. Great benefits for the inhabitants, for the local economy (industry, tourism etc..) and for environmental issues.		
Website/E-mail	http://www.comune.monteverdi.pi.it/ ;		

Status	Completed	General issues	X
Year (planned) delivery	2006-2013	Geological and related issues	
Total budget (€)	5 M€	(Advanced) drilling or operation of wells	
Public budget (€)	5 M€	Power generation	
Names of support schemes for the project	Financed by Tuscan Region (Geothermal Funds).	Direct use	X
		EGS – Enhanced geothermal systems	





Dairy – Podere Paternò









Dairy – Podere Paterno

Summary	The podere Paterno uses the heat coming from Enel S. Martino power plant for milk pasteurization and for producing cheese.
Organisation(s)	AZIENDA AGRICOLA TANDA GIUSEPPE E MARIO S.S.A.
Contact person	Mario Tanda (owner), AZIENDA AGRICOLA TANDA GIUSEPPE E MARIO S.S.A., POD. MURIGLIONI, 32 - 58025 MONTEROTONDO M.MO, GROSSETO, mtanda@inwind.it , +39 0566 917042
Innovation	Optimization of energy efficiency for milk pasteurization and cheese production by using geothermal heat.
Impact	Economic saving about 20.000 €/year.
Website/E-mail	http://www.poderepaterno.com/

Status	Completed	General issues	X
Year (planned) delivery	<1 year	Geological and related issues	
Total budget (€)	9 k€	(Advanced) drilling or operation of wells	
Public budget (€)	-	Power generation	
Names of support schemes for the project	Renewable feed-in-tariff 25.80 € MWh	Direct use	X
		EGS – Enhanced geothermal systems	
		...	



DIRT

Demonstration INPUT REGION Technology





DIRT Field test in Drachten (picture Verkleij BV)



DIRT



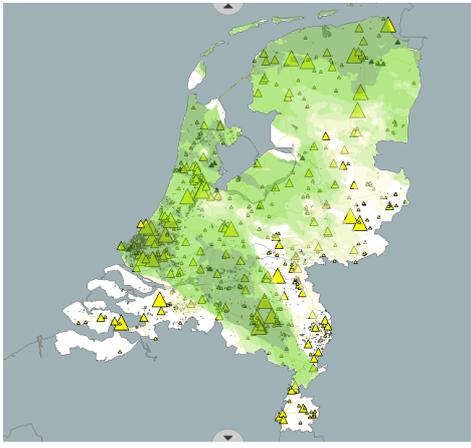
Summary	Demonstration of novel drilling technique with fiber reinforced composite material. Such pipes allow for lighter drilling equipment to be used. The project will be brought farther by drilling the "Delft geothermal energy project" (DAP) using technology based on this project.		
Organisation(s)	Verkleij BV, WEP BV, Acquit BV, Delft UT aerospace technology		
Contact person	info@verkleij.nl		
Innovation	Drilling technique with fiber reinforced composite material.		
Impact	Significant cost reduction		
Website/E-mail			

Status	Ongoing	General issues	
Year (planned) delivery	Depending on financed Delft project	Geological and related issues	
Total budget (€)		(Advanced) drilling or operation of wells	x
Public budget (€)	M€ 0,8 + M€ 0,8	Power generation	
Names of support schemes for the project	EOS Demo, IAE UKP (Delft project)	Direct use	
		EGS – Enhanced geothermal systems	
		...	





Heat atlas of the Netherlands



Map constructed from data in the Atlas, showing potential for geothermal heat of 40-120 C with 25 C return, in GJ/year/ha (green background colour), industrial heat demand < 120C (triangles) and presence of greenhouses (black dots).

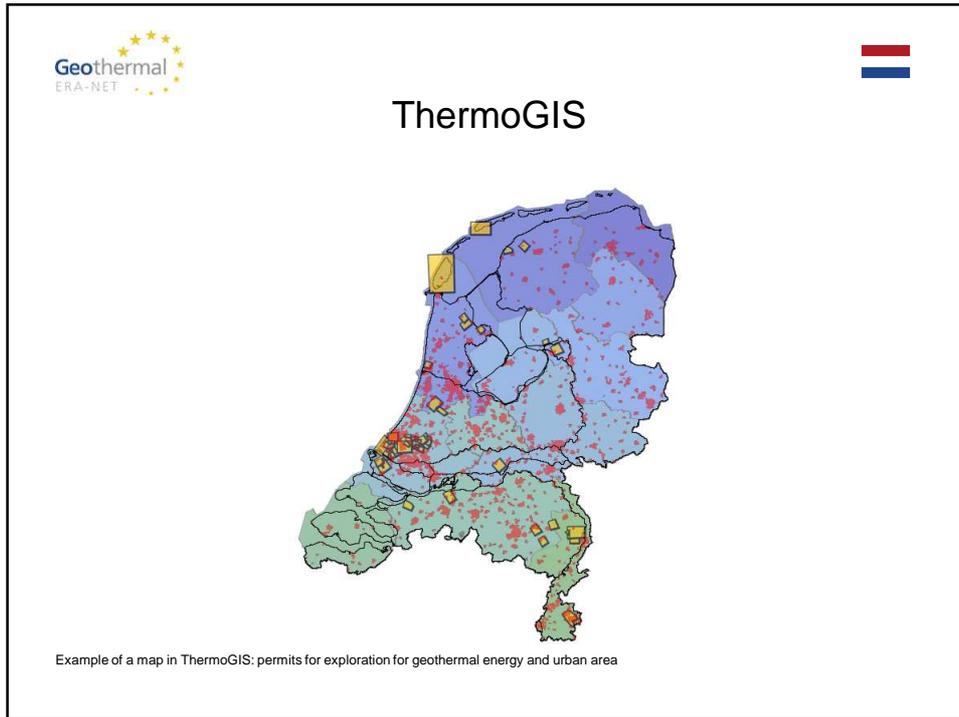




Heat atlas of the Netherlands

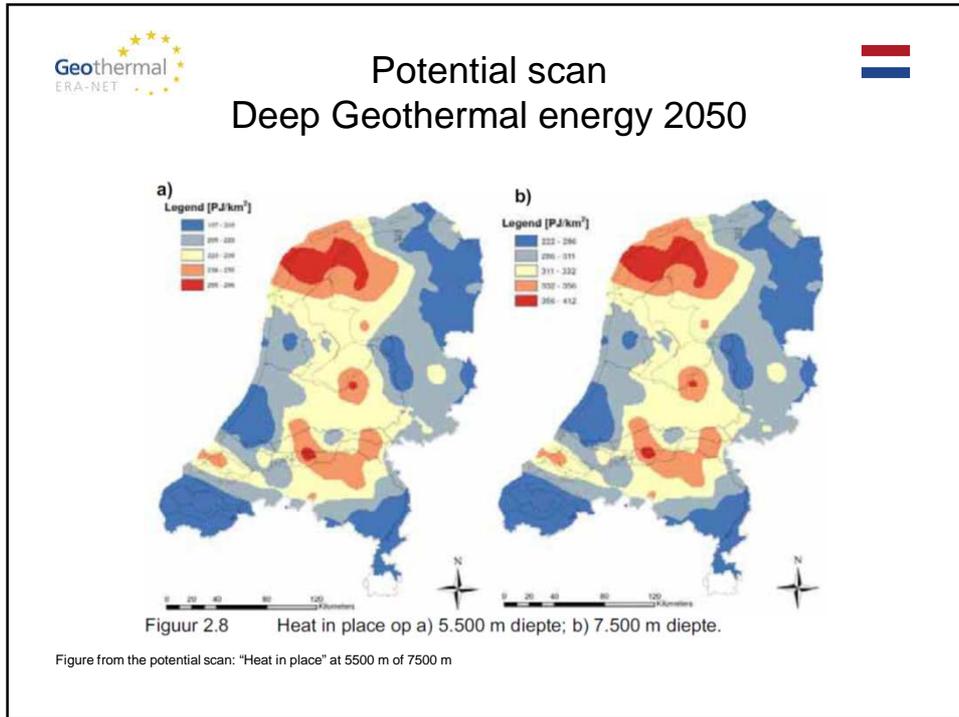
Summary	The heat atlas of the Netherlands makes available information on heat demand and availability through a GIS viewer, see www.warmteatlas.nl . The atlas includes information on suitability of locations for geothermal energy, heat/cold storage, biomass and sources of waste heat.	
Organisation(s)	Agentschap NL	
Contact person	Lydia Dijkshoorn lydia.dijkshoorn@agentschapnl.nl	
Innovation	The heat atlas was the first to provide a country-wide yet detailed overview of heat demand and availability, including geothermal energy and point sources of (industrial) waste heat.	
Impact	Especially provinces and local communities use the map to plan their future energy systems.	
Website/E-mail	www.warmteatlas.nl (application in Dutch)	

Status	Available on the Internet	General issues
Year (planned) delivery	2011	Geological and related issues
Total budget (€)		(Advanced) drilling or operation of wells
Public budget (€)		Power generation
Names of support schemes for the project	From Agency NL operational budget	Direct use
		EGS – Enhanced geothermal systems
		...



ThermoGIS

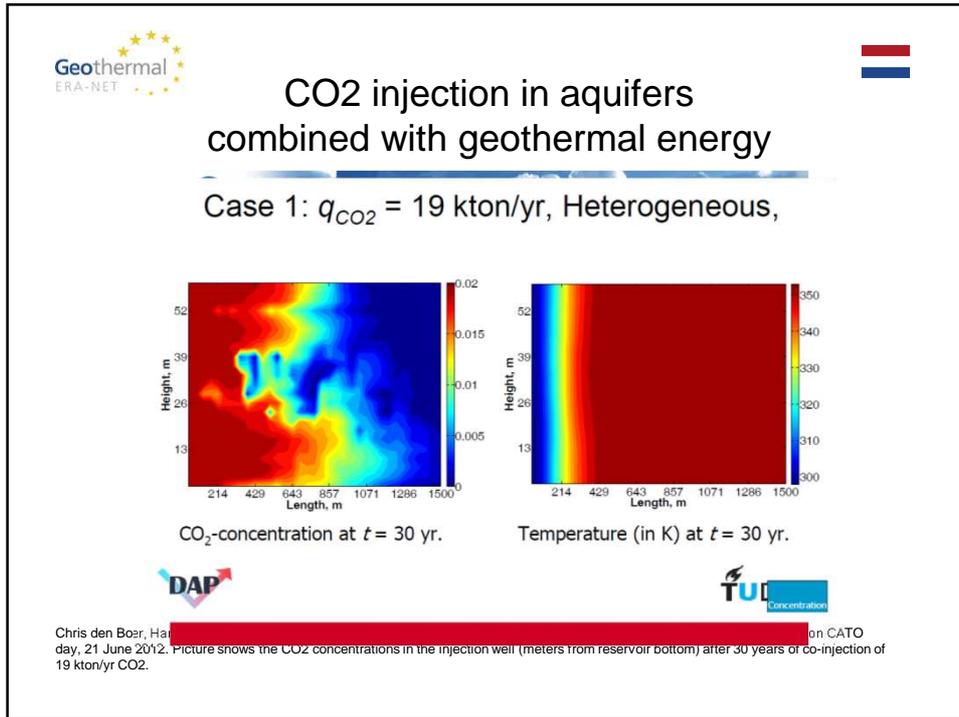
Summary	ThermoGIS makes available subsurface data on potential for geothermal energy through a GIS viewer. Possible selections include specific aquifer groups. The recoverable heat map, available from ThermoGIS, has been adopted in the Heat atlas. ThermoGIS is available for free.			
Organisation(s)	TNO			
Contact person	Jan-Diederik van Wees, Leslie Kramers – leslie.kramers@tno.nl			
Innovation	ThermoGIS makes available information on the potential for geothermal energy. This helps users to estimate whether geothermal energy is a viable option for their energy demand.			
Impact	Engineering consultants use ThermoGIS for estimations of geothermal potential. The results may be used directly for application for the Guarantee fund geothermal energy.			
Website/E-mail	www.thermoGIS.nl			
Status	Completed, available on Internet		General issues	X
Year (planned) delivery	2010		Geological and related issues	X
Total budget (€)			(Advanced) drilling or operation of wells	
Public budget (€)			Power generation	
Names of support schemes for the project			Direct use	
	NB: a new version with more possibilities will be online March 2013		EGS – Enhanced geothermal systems	
			...	



Potential scan Deep geothermal energy 2050

Summary	This study looks into the potential of deep geothermal energy by 2050 from a geological, financial and energy technology point of view, and concludes that deep geothermal energy offers perspective. The study then sets a target for 2050 of 20% geothermal heat and 20% geothermal electricity.	
Organisation(s)	IF technology, Ecofys, TNO, commissioned by Agentschap NL	
Contact person	Lydia Dijkshoorn: lydia.dijkshoorn@agentschapnl.nl	
Innovation	This is the first study in the Netherlands that structurally considered deep (up to 7500 m) geothermal energy	
Impact	This study redefined the horizon for geothermal energy. Interest from industrial parties has increased.	
Website/E-mail	http://www.iftechnology.nl/wm.cgi?ws=1:id=272:main=185	

Status	completed	General issues	x
Year (planned) delivery	2011	Geological and related issues	
Total budget (€)		(Advanced) drilling or operation of wells	
Public budget (€)		Power generation	
Names of support schemes for the project	From Agentschap NL budget	Direct use	
		EGS – Enhanced geothermal systems	x
		...	



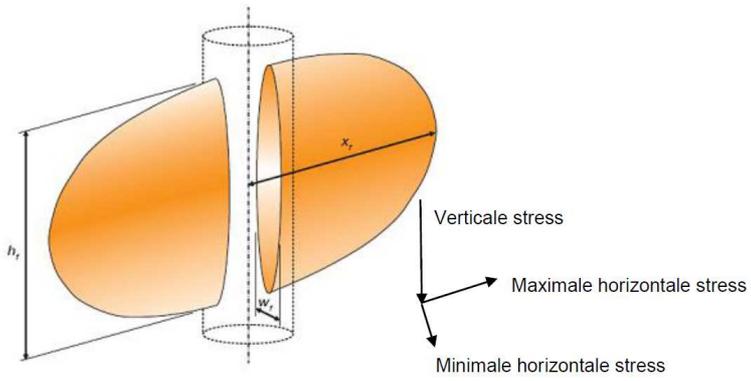
CO2 injection in aquifers combined with geothermal energy

Summary	Aim of this R&D project is to investigate possibilities and problems for co-injection of CO ₂ in an injection well for geothermal direct use. Model is the planned well of the DAP (Delft Geothermal Project). Research into e.g. influence of co-injection on lifetime, and maximal stored CO ₂	
Organisation(s)	Delft University of Technology	
Contact person	Hamidreza Salimi, h.salimi@tudelft.nl , Karl-Heinz Wolf	
Innovation	Combination of geothermal energy production and storage of CO ₂ (as produced at the Delft University power plant).	
Impact	In principle, this could make the energy system of Delft University CO ₂ -free; though at the moment, CO ₂ storage under land is not supported by the government.	
Website/E-mail	http://www.co2-cato.org/publications/publications/integration-of-delft-geothermal-project-dap-and-carbon-sequestration	

Status	ongoing	General issues	
Year (planned) delivery	2014	Geological and related issues	x
Total budget (€)	M€ 0.7	(Advanced) drilling or operation of wells	
Public budget (€)	M€ 0.4	Power generation	
Names of support schemes for the project	CATO (National CCS research programme)	Direct use	
		EGS – Enhanced geothermal systems	
		CO ₂ storage	x




“More pressure on geothermal energy”



Figuur 2.3 Aanwezige stressrichtingen in relatie tot frac oriëntatie (Economides and Martin, 2007).

[Figure from the report, explaining orientation of a frac, from Economides and Martin, 2007]




“More pressure on geothermal energy”

Summary	This study is on reservoir stimulation aims to inform (future) owners of geothermal wells on reservoir stimulation: what it is, legal aspects, seismicity, technical aspects and cost, insurability.	
Organisation(s)	IF Technology, info@IFtechnology.nl	
Contact person	N.A. Buik	
Innovation	A balanced view on, and use of, reservoir stimulation as sometimes applied for geothermal energy, is important for geothermal energy and public acceptance of this resource.	
Impact	See above	
Website/E-mail	http://www.energiek2020.nl/fileadmin/user_upload/energiek2020/docs/Aardwarmte/Putsimulatie_Geothermie - DLV.pdf	

Status	Completed	General issues	
Year (planned) delivery	2012	Geological and related issues	
Total budget (€)		(Advanced) drilling or operation of wells	X
Public budget (€)		Power generation	
Names of support schemes for the project	Energiek 2020	Direct use	
		EGS – Enhanced geothermal systems	
		...	



Heerlen heated with mine water



Mine water plant, Heerlerheide, The Netherlands



Heerlen heated with mine water

Summary	Heerlen, situated in the former Dutch coal mining area, uses geothermal heat from the mines. Five wells were drilled precisely into old mine galleries. The luke-warm water (35 oC) from the deeper galleries (800m) is used for heating and the colder water from shallower levels for cooling. This energy system is heating and cooling an increasing number of buildings in Heerlen.
Organisation(s)	Municipality of Heerlen, Weller, CBS, Arcus, OU, ABP,
Contact person	Louis Hiddes, Mijnwater N.V. i.o.; Elianne Demollin, Municipality of Heerlen: e.demollin@heerlen.nl
Innovation	First geothermal project in NL (drilled > 500m). The project uses a unique source, the water in the former mine galleries. Integral LowEx design: Buildings are adapted to be able to use LTH and HTC. The system is transforming to Minewater 2.0 using the underground for (HT)-storage
Impact	The project is gradually increasing the number of buildings connected to the system, being a catalyst for the transformation to a sustainable energy supply. The project is felt to connect the modern world to the past of mining activity in a positive way.
Website/E-mail	http://www.mijn-water.nl/home.aspx

Status	In operation, district heating network is expanding	General issues	x
Year (planned) delivery	2007	Geological and related issues	
Total budget (€)	M€ 20	(Advanced) drilling or operation of wells	
Public budget (€)	M€ 9,6 Interreg, M€ 3.2 UKR	Power generation	
Names of support schemes for the project	UKR, Interreg	Direct use	x
		EGS – Enhanced geothermal systems	
		Social issues / acceptance	x

¹http://ec.europa.eu/environment/ecoap/about-eco-innovation/good-practices/netherlands/328_en.htm



Geothermal heat for greenhouse A+G van den Bosch



Picture: www.vleestomaat.nl – site of A+G van den Bosch



Geothermal heat for greenhouse A+G van den Bosch

Summary	First project with geothermal heat utilisation in greenhouses in NL. Water (60 C) is produced from an aquifer at 1700 m depth. A capacity of 5 MWth and a flow of 150 m ³ /h were initially realised – in the meantime, improvements were made. 14,8 ha greenhouse for growing tomatoes is heated this way.
Organisation(s)	A+G van den Bosch
Contact person	R.A. van den Bosch, rik@vleestomaat.nl
Innovation	First project with deep geothermal heat utilisation in horticulture in the Netherlands.
Impact	This project marked the start of geothermal energy in horticulture in the Netherlands. Since then, 6 further projects have been realised and up to 100 more are planned, predominantly in horticulture.
Website/E-mail	www.vleestomaat.nl ; http://www.agentschapnl.nl/content/van-aardgas-naar-aardwarmte

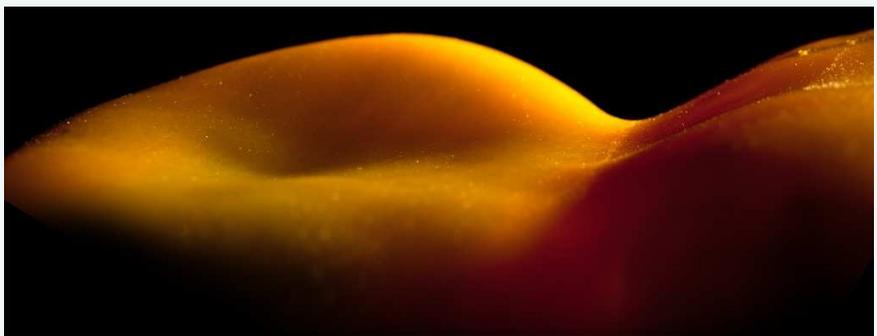
Status	Completed	General issues	x
Year (planned) delivery	In use	Geological and related issues	
Total budget (€)		(Advanced) drilling or operation of wells	
Public budget (€)	M€ 1.000.000 from DEMO	Power generation	
Names of support schemes for the project	DEMO subsidy Maatwerkgarantie Z-Holland From 2013 onwards: SDE+	Direct use	x
		EGS – Enhanced geothermal systems	
		...	



Californië

Peppers with heat from ...





Sweet pepper – from the company's website www.square-crops.com



Californië

Sweet peppers with heat from carboniferous limestone



Summary	Pepper-grower Wijnen realised a geothermal heating system for 35 ha of greenhouse. Challenge for the project was, that it would drill into the carboniferous limestone, a relatively little-known geological formation in the Netherlands.	
Organisation(s)	Wijnen square crops	
Contact person	Julian Santegoeds	
Innovation	First project in karstic/fractured aquifer in NL. First into carboniferous limestone. First deep project in North-Limburg area	
Impact	One of Largest sweet pepper growers (> 35ha) in NL turning geothermal. Creating confidence for geothermal in lesser known areas.	
Website/E-mail	http://www.square-crops.com/en/csr/geothermal+energy	

Status	Being drilled	General issues	
Year (planned) delivery	2013	Geological and related issues	
Total budget (€)	..	(Advanced) drilling or operation of wells	
Public budget (€)	Ca 6 M€ risk-guarantee + support Limburg province	Power generation	
Names of support schemes for the project	Geothermal Guarantee Scheme	Direct use	X
		EGS – Enhanced geothermal systems	
		...	



Geothermal district heat The Hague



Inside the The Hague Geothermal heat plant – from www.geothermie.nl



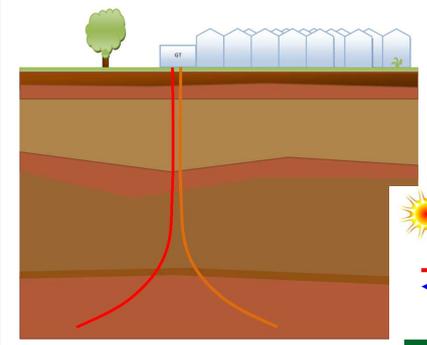
Geothermal district heat The Hague

Summary	A new district heating network using geothermal heat from 2200 m depth at 75 C is developed in The Hague. Flow is 150 m ³ /h. Co-production of some natural gas (1 kg/m ³). Target 6000 residences connected, but this is much delayed as a result of the crisis.
Organisation(s)	E.ON, Platform Geothermie, Aardwarmte Den Haag v.o.f.
Contact person	Victor van Heekeren, heekeren@heekeren.nl
Innovation	This is the second direct-use project in district heating in the Netherlands. Construction and drilling have been performed in an existing residential quarter.
Impact	
Website/E-mail	http://www.agentschapnl.nl/content/de-benutting-van-geothermie-een-nieuwbouwwijk-den-haag , http://www.aardwarmtedenhaag.nl

Status	ongoing	General issues	
Year (planned) delivery	2012 first production	Geological and related issues	
Total budget (€)		(Advanced) drilling or operation of wells	
Public budget (€)	€ 4.000.000 (UKR) + support per kWh sustainable (feed-in premium, SDE)	Power generation	
Names of support schemes for the project	UKR, SDE	Direct use	X
		EGS – Enhanced geothermal systems	
		...	

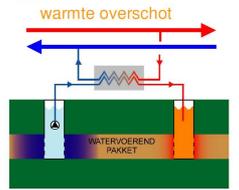



“Multi Energy Concept” Greenhouses “Vierpolders” – MEC-V



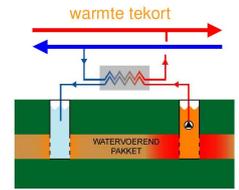



warmte overschot





warmte tekort



The MEC-V concept combines geothermal energy with high temperature heat storage.




“Multi Energy Concept” Greenhouses “Vierpolders” – MEC-V

Summary	The Multi Energy Concept Vierpolders project combines geothermal heat with high temperature heat storage. Users are a cluster of horticulturists and potentially a number of residences. CO ₂ , which is necessary to enhance the growth of the plants, comes from the Rotterdam harbour by pipeline.	
Organisation(s)	Hydreco GeoMEC BV, VSH, T4P Project BV, GeoMEC 4P R&E BV	
Contact person	Cees van der Zalm, c.vd.zalm@VSHANAB.nl	
Innovation	The innovative value of this project is integral approach to year-round heat supply and demand. The high temperature heat storage matches both.	
Impact	High temperature storage adds a new possibility for clusters with a heat demand.	
Website/E-mail	http://www.agentschapnl.nl/content/voorne-putten-uitwisseling-geothermische-warmte-en-co2-bedrijven-en-tuinders http://www.energiek2020.nu/transitiepaden/aardwarmte/meer/detail/multi-energie-concept-vierpolders-biedt-perspectief/	

Status	ongoing	General issues	x
Year (planned) delivery	2013	Geological and related issues	
Total budget (€)		(Advanced) drilling or operation of wells	
Public budget (€)	~M€ 20 including feed-in premium over first 5 years of operation	Power generation	
Names of support schemes for the project	Guarantee Fund Geothermal Energy, UKR, Kas als Energiebron, MEI, SDE	Direct use	x
		EGS – Enhanced geothermal systems	
		...	




Applied research and development of innovative drilling technology for ultra-deep geothermal wells (R&D)

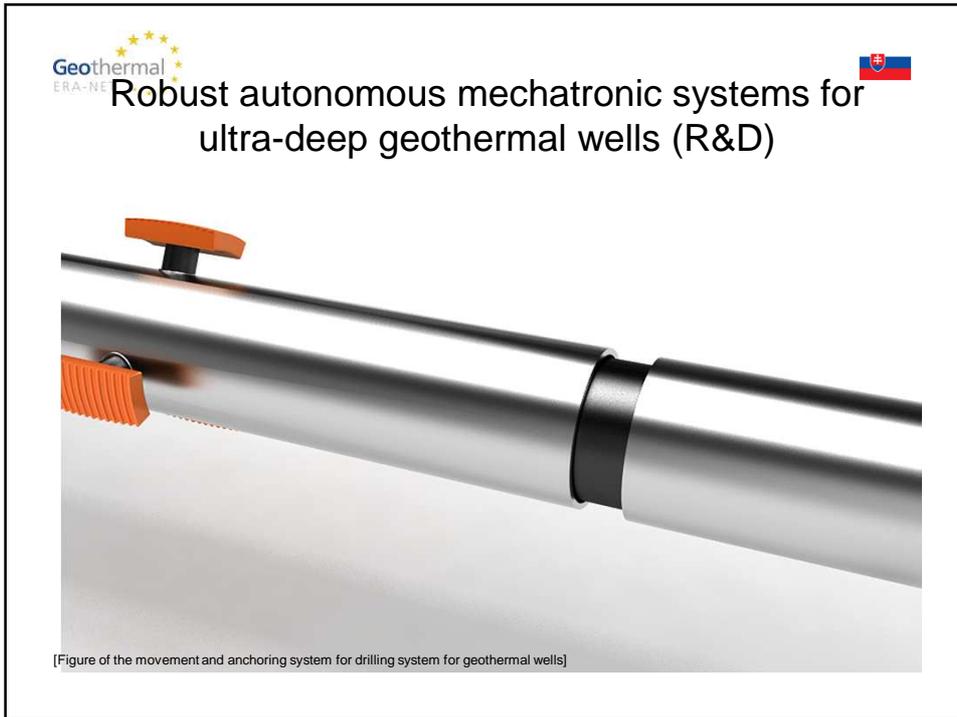


[Figure of the innovative drilling technology for geothermal wells]




Applied research and development of innovative drilling technology for ultra-deep geothermal wells (R&D)

Summary	Since August 1st 2010 by Geothermal Anywhere implements the project funded from Structural funds of EU along with its partners, Institute of Materials & Machine Mechanics of Slovak Academy of Sciences, Comenius University in Bratislava and the Slovak Technical University in Bratislava.		
Organisation(s)	Geothermal Anywhere		
Contact person	Igor Kocis		
Innovation	The goal of project is to create an innovative water jet generating system based on the use of electric-discharge plasma with increased pulse effect.		
Impact	The project consists of six main activities, and two supporting activities. The length of the applied research project is 36 months, what is the optimum time to achieve the set objectives.		
Website/E-mail	http://www.geothermalanywhere.com/en/asfeu-project-qapplied-research-and-development-of-innovative-drilling-technology-for-ultra-deep-geothermal-wellsq.html		
Status	Under development	General issues	
Year (planned) delivery	2013	Geological and related issues	
Total budget (€)	1.77M	(Advanced) drilling or operation of wells	X
Public budget (€)	1.45M	Power generation	
Names of support schemes for the project	Structural funds of EU - Operational Programme Research and Development	Direct use	
		EGS – Enhanced geothermal systems	
		...	



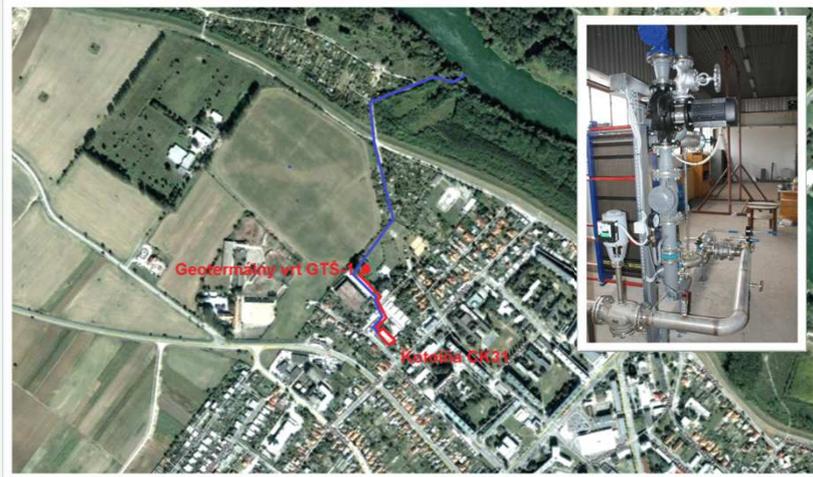
Geothermal ERA-NET

Robust autonomous mechatronic systems for ultra-deep geothermal wells (R&D)

Summary	On February 1st 2011, Geothermal Anywhere started to implement the project funded from Structural funds of EU along with its partner The University of Žilina. The project is being implemented through three main activities, and two supporting activities.		
Organisation(s)	Geothermal Anywhere		
Contact person	Igor Kocis		
Innovation	The goal of the project is to research and implement the innovative mechatronic systems for extreme conditions of ultra deep geothermal wells.		
Impact	The length of the applied research project is estimated for 36 months, what is the optimum time to achieve the objectives.		
Website/E-mail	http://www.geothermalanywhere.com/en/asfeu-project-robust-autonomous-mechatronic-systems-for-ultra-deep-geothermal-wellsq.html		
Status	Under development	General issues	
Year (planned) delivery	2014	Geological and related issues	
Total budget (€)	2.42M	(Advanced) drilling or operation of wells	X
Public budget (€)	2.06M	Power generation	
Names of support schemes for the project	Structural funds of EU - Operational Programme Research and Development	Direct use	
		EGS – Enhanced geothermal systems	
		...	



Geothermal District Heating in Sala



[Map of town of Sala with highlighted production system / Heat exchanger station]



Geothermal District Heating in Sala

Summary	Geothermal energy from new well GTŠ-1 with depth of 1 800 m is being used for heat production in existing boiler plant CK31. Flow rate is 15 l/s and temperature 70°C. After the utilization of thermal energy in heat exchangers, geothermal water flows through plastic pipe into the recipient, Vah river.
Organisation(s)	MeT Šala, a.s., Town of Sala, Slovgoterm a.s.
Contact person	Oto Halas
Innovation	Geothermal energy combined with the heat pump represents the base load heat source with the maximal working time throughout the year.
Impact	Geothermal energy covers 30% of overall annual heat production of CK31, while savings of 843 000 m ³ of natural gas per year and CO ₂ emissions reduction of 1 662 ton per year are achieved.
Website/E-mail	http://www.slovgoterm.sk/index.cfm?s=sala_1

Status	In operations	General issues	
Year (planned) delivery	2011	Geological and related issues	
Total budget (€)	2M	(Advanced) drilling or operation of wells	
Public budget (€)		Power generation	
Names of support schemes for the project		Direct use	X
		EGS – Enhanced geothermal systems	
		...	

Slovakia

Geothermal District Heating in Sered

[Map of town of Sered with highlighted production system / Heat exchanger station]

Slovakia

Geothermal District Heating in Sered

Summary	Geothermal energy from new well SEG-1 with depth of 1 800 m will be used for heat production in existing boiler plant K5. Flow rate is 8 l/s and temperature 6°C. Water will be delivered via pre-insulated pipe to a separator and subsequently to a heat exchanger station.	
Organisation(s)	MBP Sered., Town of Sered, Slovgoterm a.s.	
Contact person	Oto Halas	
Innovation	Geothermal energy combined with the heat pump represents the base load heat source with the maximal working time throughout the year.	
Impact	Geothermal energy covers 45% of overall annual heat production of K5, while savings of 547 000 m ³ of natural gas per year and CO ₂ emissions reduction of 1 078 ton per year are achieved.	
Website/E-mail	http://www.slovgoterm.sk/index.cfm?s=sered_1	

Status	In operations	General issues	
Year (planned) delivery	2011	Geological and related issues	
Total budget (€)	1.6M	(Advanced) drilling or operation of wells	
Public budget (€)		Power generation	
Names of support schemes for the project		Direct use	X
		EGS – Enhanced geothermal systems	
		...	



Geothermal District Heating in Galanta



[View of heat exchangers in geothermal station in Galanta / Galanta's FGG-3 wellhead with motor of line shaft pump]



Geothermal District Heating in Galanta

Summary	Geothermal water with temperature of 77°C is pumped off two geothermal wells 2 100 m deep. Water flowrate is 15,7 l/s and 18,0 l/s, altogether it is 33,7 l/s. Heat output of geothermal water is 7 MWt which suffices to cover heat demand of the system up to outdoor temperature 0°C.
Organisation(s)	Fjarhitun, Town of Galanta, Slovgeoterm a.s.
Contact person	Oto Halas
Innovation	The geothermal system uses cascade connection of the heat exchangers and geothermal water delivers heat step by step into the heating loops with different temperature gradients.
Impact	Maximal heat demand of the system is 14,7 MWt. Annual heat production ranges around 90 000 GJ 90% of which is produced by geothermal energy.
Website/E-mail	http://www.slovgeoterm.sk/index.cfm?s=galanta_1

Status	In operations	General issues	
Year (planned) delivery	1996	Geological and related issues	
Total budget (€)		(Advanced) drilling or operation of wells	
Public budget (€)		Power generation	
Names of support schemes for the project		Direct use	X
		EGS – Enhanced geothermal systems	
		...	




Geothermal Power Plant in Svinica-Durkov




[Technology equipment during hydrodynamic test in Svinica-Durkov / Drilling rig in Svinica - Durkov]




Geothermal Power Plant in Svinica-Durkov

Summary	Project of geothermal heat utilization for the purpose of power generation and district heating of Kosice counts with building of three geothermal stations in villages of Bidovce, Durkov and Olsovary with overall 5 doublets (doublet = production + reinjector well).	
Organisation(s)	SPP a.s., Slovgoterm a.s., Town of Kosice, CFG Orleans, Dalkia International	
Contact person	Oto Halas	
Innovation	Total heat output of the first stage of the project is 100 MWt. Reservoir located in depth 2100 up to 3200 metres. Temperature of the water about 125 °C.	
Impact	Ecological asset in form of significant decrease of emissions of combustion processes (NOx, SO2, CO, CO2, ashes), because current heating plant burns both gas and coal.	
Website/E-mail	http://www.geoterm-kosice.sk/projekt.html	

Status	Under development	General issues
Year (planned) delivery	2014	Geological and related issues
Total budget (€)		(Advanced) drilling or operation of wells
Public budget (€)		Power generation
Names of support schemes for the project		Direct use
		EGS – Enhanced geothermal systems
		...





Geothermal Project in Podhajska




[Podhajska's thermal spa / Accumulation tank by reinjection well GRP-1 in Podhajska]





Geothermal Project in Podhajska

Summary	Project in Podhajska is focused on heating of greenhouses with area of 2 ha and thermal spa. Geothermal water is driven from the well Po-1 by its own pressure into a separator. Further, the water is thermally used in the heat exchangers and flows via pipeline to reinjection well GPR-1.	
Organisation(s)	SPP, a.s., Slovgeoterm a.s.	
Contact person	Oto Halas	
Innovation	So far, it is the only implemented project in Slovakia, where the exploited geothermal water is reinjected back to the Earth's crust.	
Impact	A heat exchanger station with heat output of 10,5 MWt was built for this purpose. Three plate heat exchangers each of 3,5 MWt are installed.	
Website/E-mail	http://www.slovgeoterm.sk/index.cfm?s=podhajska	

Status	In operations	General issues
Year (planned) delivery	1996	Geological and related issues
Total budget (€)		(Advanced) drilling or operation of wells
Public budget (€)		Power generation
Names of support schemes for the project		Direct use
		EGS – Enhanced geothermal systems
		...



Geothermal ERA-NET

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