



Demonstration of soft stimulation treatments
of geothermal reservoirs

Project Overview

This project has received funding from the European Union's
Horizon 2020 research and innovation programme
under grant agreement No. 691728



About DESTRESS

At a Glance

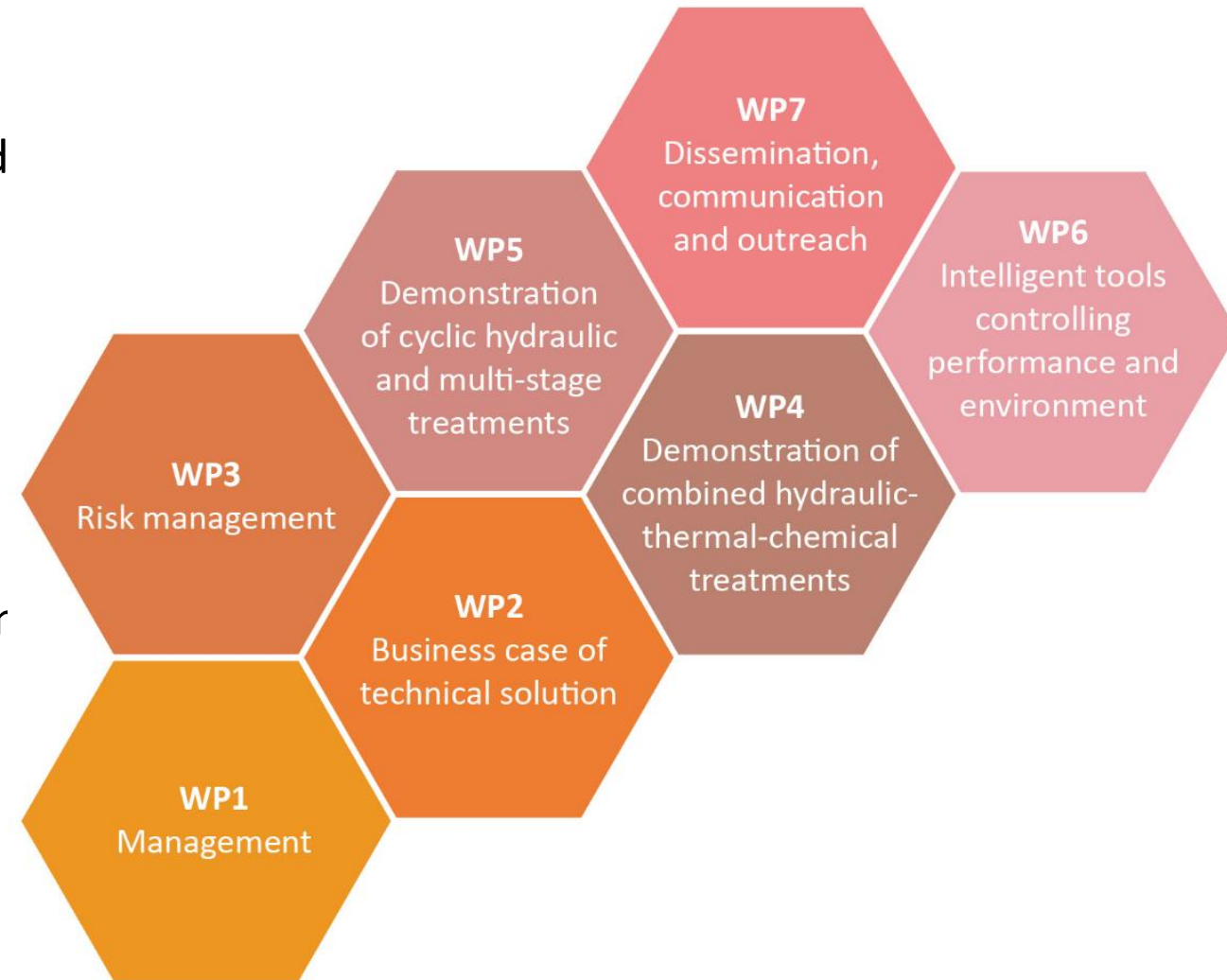
Title	Demonstration of soft stimulation treatments of geothermal reservoirs
Acronym	DESTRESS
Call	H2020-LCE-2015-2
Topic	Low Carbon Energy, LCE-03-2015: Demonstration of renewable electricity and heating/cooling technologies (IA)
Grant Agreement Number	691728
Duration	57 months, 01 March 2016 - 30 November 2020
Estimated Project Costs	€ 25 072 511.25
EU Contribution	€ 10 713 408.63
Project Lead	GFZ German Research Centre for Geosciences
Partners	17 European and East Asian research institutions, universities and industry representatives (large energy suppliers and SMEs)

In Brief

DESTRESS demonstrates methods of enhanced geothermal systems (EGS). The aim is to expand knowledge and to provide solutions for a more economical, sustainable and environmentally responsible exploitation of underground heat.

DESTRESS will improve the understanding of technological, business and societal opportunities and risks related to geothermal energy. Existing and new project sites have been chosen to demonstrate the DESTRESS concept.

The demonstration sites are using **soft stimulation** treatments to minimise environmental hazards.

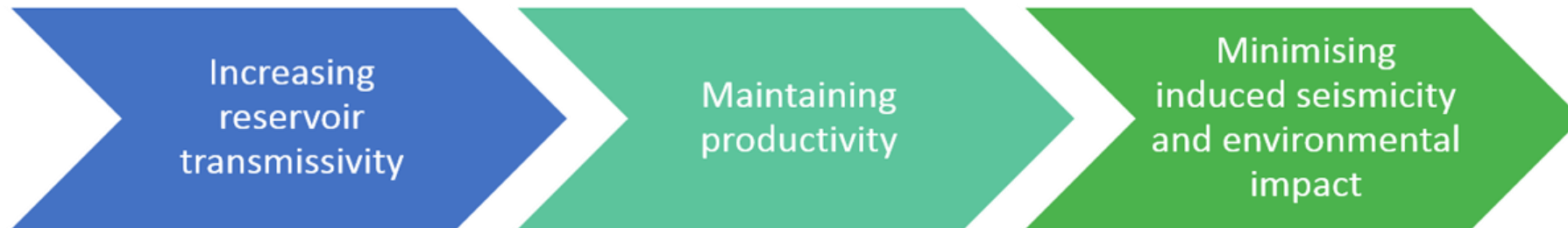


How Do We Define Soft Stimulation?

Soft stimulation is a collective term for geothermal reservoir stimulation techniques. It aims to achieve enhanced reservoir performance while minimizing environmental impacts including induced seismicity. Soft stimulation includes techniques such as cyclic / fatigue, multi-stage, chemical and thermal stimulation.

Objectives

The overall objective of DESTRESS is to develop good practices for creating reservoirs with increased transmissivity, sustainable productivity and a minimised level of induced seismicity.



The variety of the geological system (rocks, structures, tectonic situation, stress field) will be considered

- based on experience in previous projects, on developments in other fields, mainly the oil and gas sector, and on scientific progress in order to use a soft stimulation-approach;
- leading to business cases, including risk management designed to be transferrable to other sites (standardized procedure in the development of EGS projects).

Project Members

Academic Partners



Industrial Partners



Funding Partners



European Union's Horizon 2020 research and innovation programme under grant agreement No. 691728 funds the DESTRESS project



Funding of KICT and NEXGEO



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

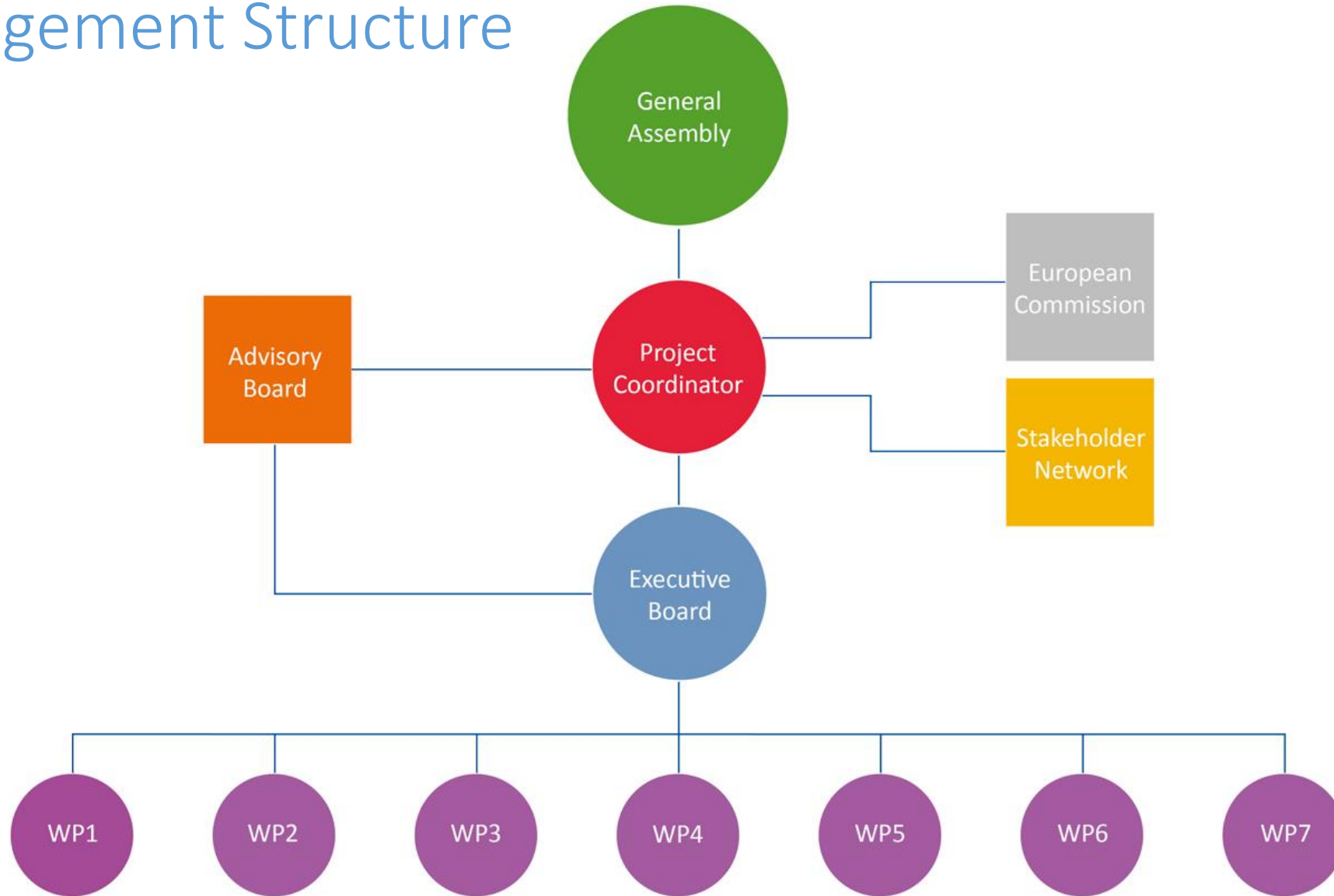
Federal Department of Economic Affairs,
Education and Research EAER
**State Secretariat for Education,
Research and Innovation SERI**

Funding of ETH Zurich and Geo-Energie Suisse AG



Funding of Seoul National University

Management Structure



Input and Output

DESTRESS addresses...

... relevant key factors and impacts about geothermal energy

... advances in the technology readiness level

... risk re-movement

... regional approaches

... socio-economic and environmental aspects

DESTRESS expects results on...

... demonstrated practices for stimulation of geothermal reservoirs

... various geological settings

... minimized costs of treatments

... optimized performance

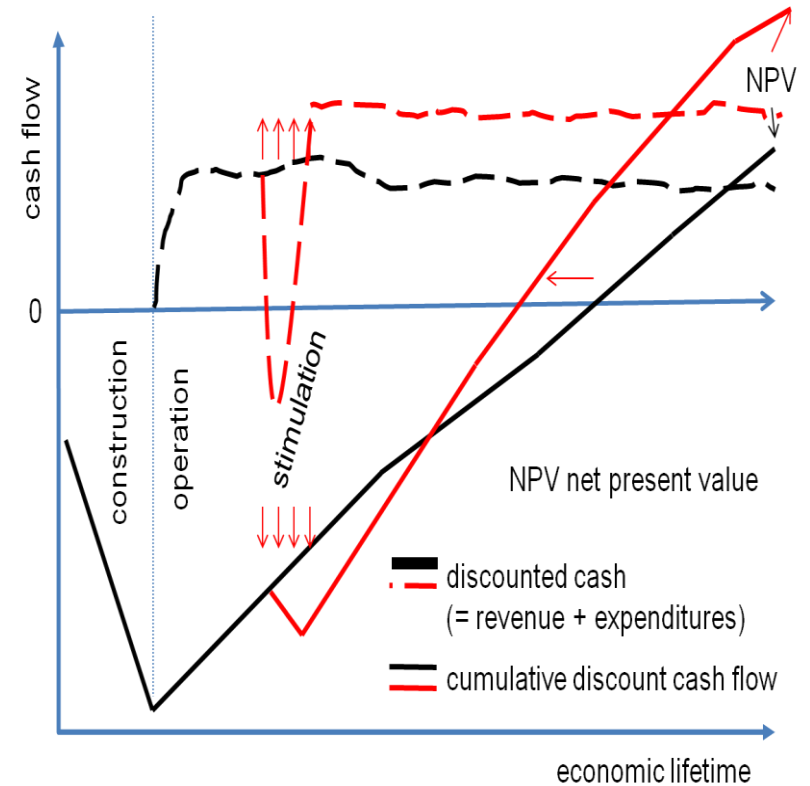
... controlled impact on environment

Business Case of Technical Solution

The stimulation leads to more thermal flow from the formation and higher cash flow; therefore investment in stimulation treatment of economically viable projects is needed.

To create efficient EGS, industrialization of geothermal energy needs a systematic and safe technique.

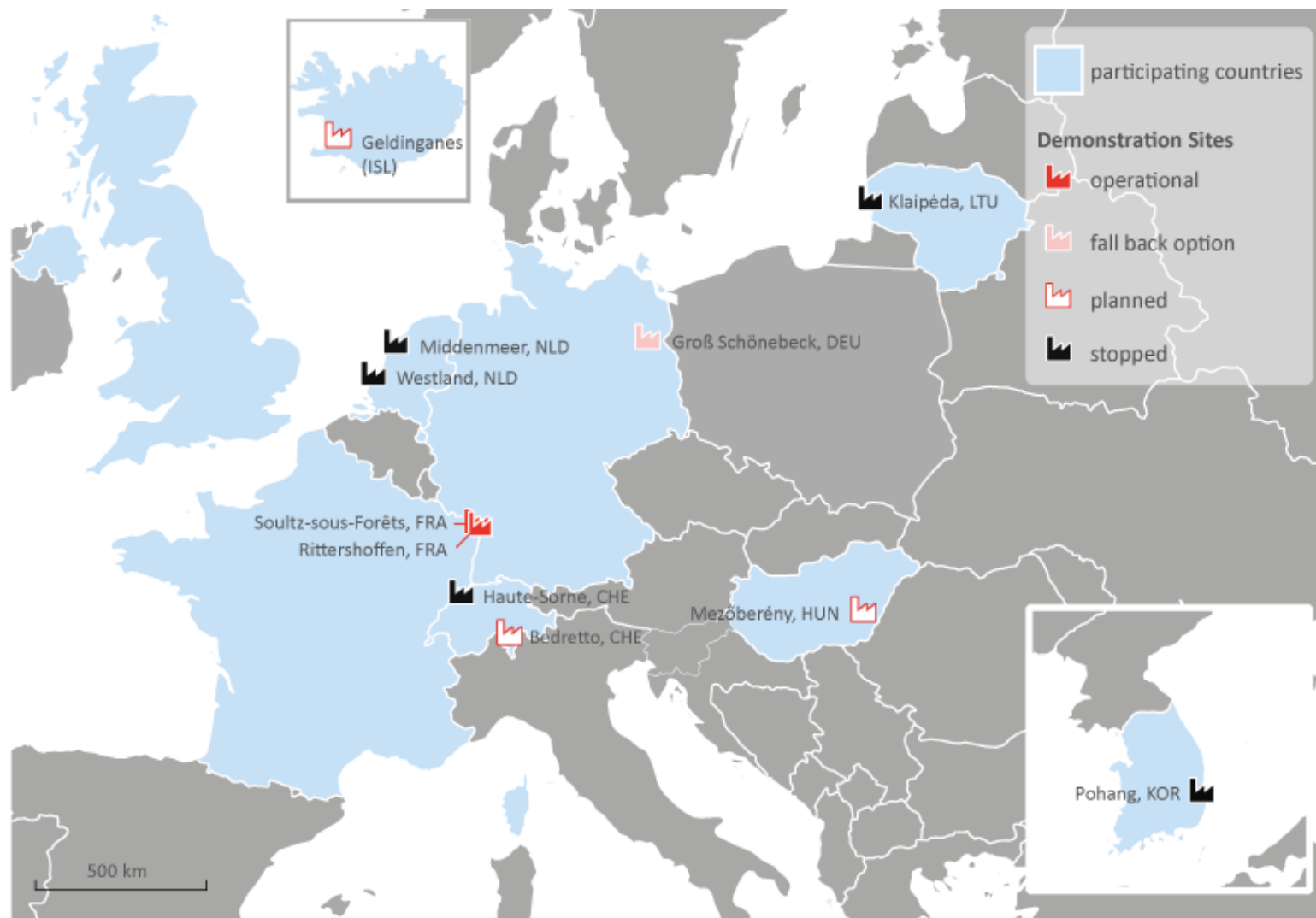
The issues of public acceptance and all market and regulatory barriers including financing and other supply-side issues of relevance are influencing the business.



Cash flow and net present value of a EGS project

How DESTRESS Tests Its Concept

Participating Countries and Demonstration Sites



Site Access Programme

The DESTRESS Access Programme invites you to visit its geothermal project sites for knowledge exchange and in-depth training. DESTRESS offers virtual (data) and physical access to its sites. The courses are taking place in the DESTRESS partnering countries.

WHO

Anyone with a strong interest in geothermal energy, including researchers, industry representatives, journalists and politicians is welcome to take part.

WHEN

Detailed information will be published on the DESTRESS website at least two months in advance and advertised in the DESTRESS newsletter.

More information on www.destress-h2020.eu/demonstration-sites/visit-demonstration-sites

Foreseen Stimulation Techniques

Borehole configuration



doublet



single well



sw with one fracture



sw with laterals



sw with multistage fractures

Treatments



hydraulic injections



chemical injections



thermal injections

Pumping



continuous



cyclic



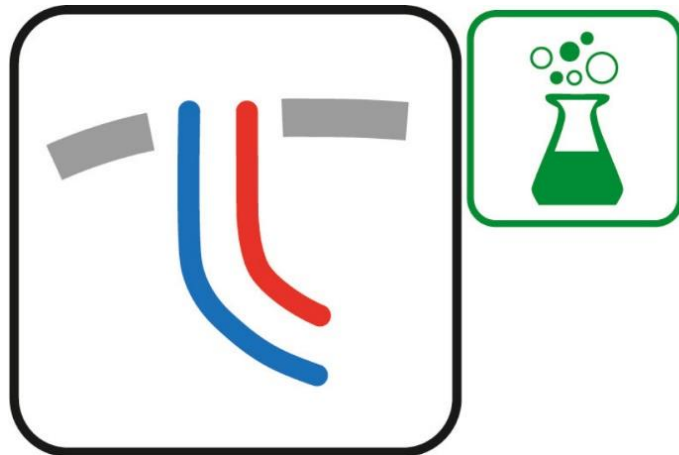
stepwise increase

Bedretto, Switzerland (planned)

Operator: Geo-Energie Suisse
ETH Zurich

WP No: 5

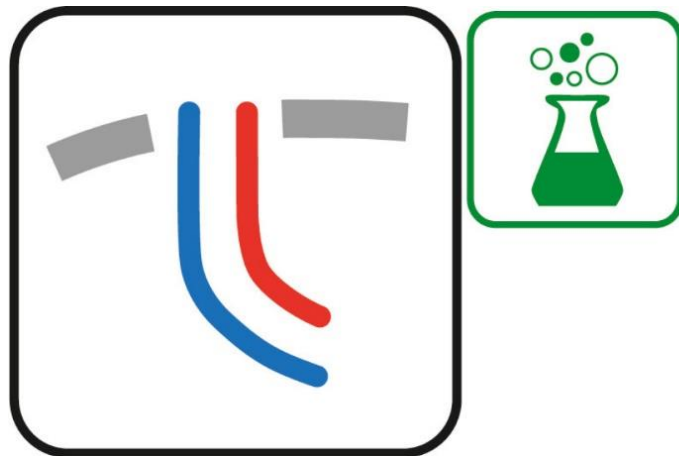
Status: planned



Foreseen Stimulation Techniques	Multi-zonal stimulation
Type of Use	Demonstration of multi-zonal stimulation concept
Soil Condition	Fractured granite
Production Horizon	Prove of concept
Upper Depth (m)	1000 m
Thickness (m)	Ca. 100 m
T (C°)	14
Salinity (g/l)	low

Geldinganes, Iceland (planned)

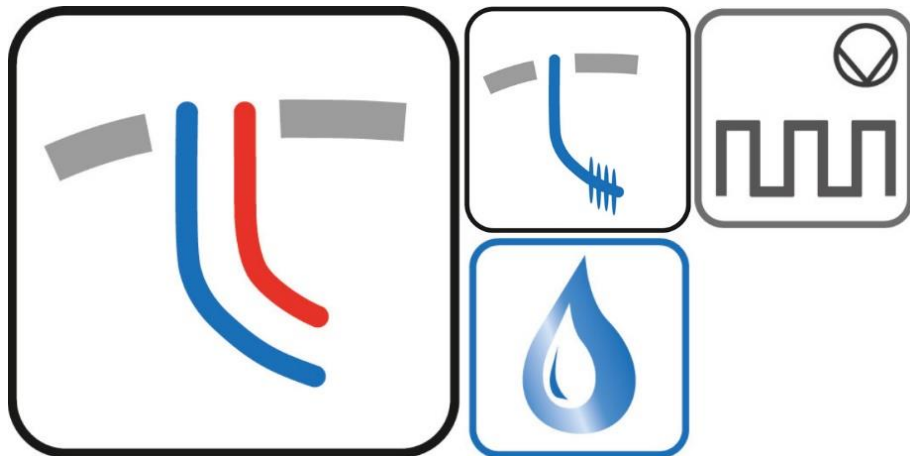
Operator: Reykjavik Energy
WP No: 5
Status: planned



Foreseen Stimulation Techniques	Cyclic hydraulic stimulation and multi-stage stimulation
Type of Use	District heating
Soil Condition	Highly altered basalts, doleritic intrusions and coarse-grained gabbros
Production Horizon	Basalts and gabbros
Upper Depth (m)	700
Thickness (m)	NA
T (C°)	> 100
Salinity (g/l)	NA

Groß Schönebeck, Germany (fall back option)

Operator: GFZ
WP No: 5
Status: fall back option



Foreseen Stimulation Techniques	Multistage (tensile and shear) fracturing
Type of Use	Geothermal Research Platform
Soil Condition	Tight sandstone and volcanic rocks
Production Horizon	Rotliegend
Upper Depth (m)	4200
Thickness (m)	200
T (C°)	150
Salinity (g/l)	250

Mezőberény, Hungary (planned)

Operator: Mezőberény Város
Önkormányzata

WP No: 4

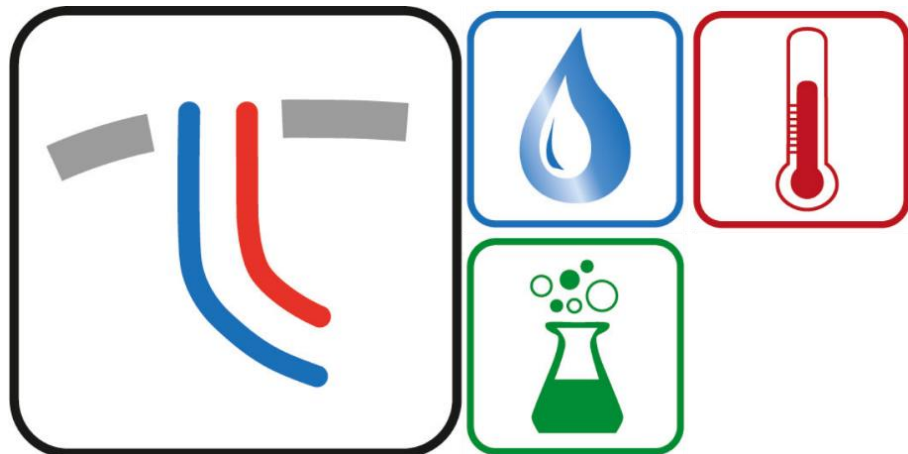
Status: planned



Foreseen Stimulation Techniques	Chemical
Type of Use	District Heating
Soil Condition	Clastic rocks (Sandstone, Siltstone, Marlstone)
Production Horizon	Upper-Pannonian rocks is the Újfalui and Zagyva Formation
Upper Depth (m)	1600
Thickness (m)	n.a.
T (C°)	109 (bottom hole T)
Salinity (g/l)	5360 $\mu\text{S/cm}$

Rittershoffen, France

Operator: és Géothermie
WP No: 4
Status: 2 wells finished and stimulated in 2014



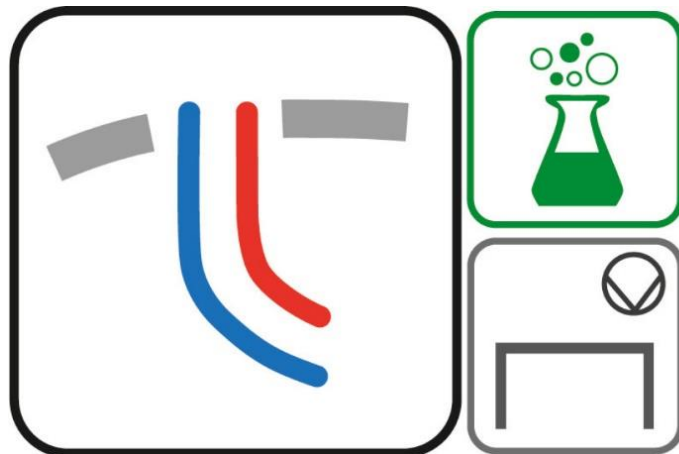
Foreseen Stimulation Techniques	THMC-Stimulation techniques performed 2013
Type of Use	Heat for (green) chemical industry
Soil Condition	Fractured clastic rocks (SS) and fractured granite with high temperature geothermal resources
Production Horizon	Fractured Triassic sandstone & carboniferous fractured granite
Upper Depth (m)	2600
Thickness (m)	680
T (C°)	>160
Salinity (g/l)	~100

Soultz-sous-Forêts, France

Operator: G.E.I.E. / EOST

WP No: 4

Status: 2008 (1st power plant) and 2016 (2nd power plant, currently in operation)



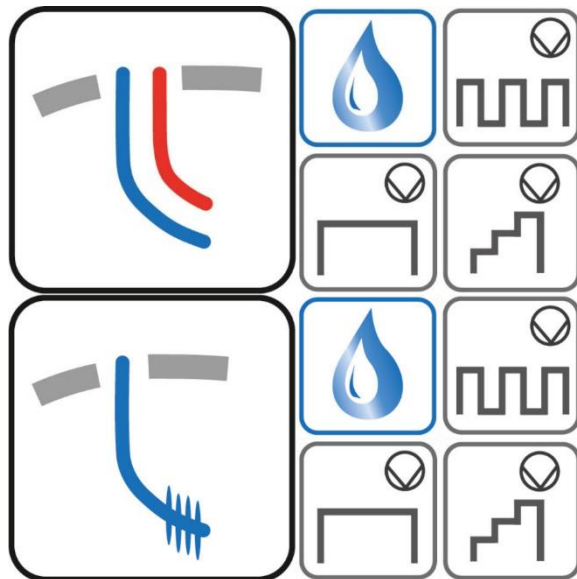
Foreseen Stimulation Techniques	Core treatment, injection tests in GPK4
Type of Use	ORC: 1.5 MWe gross power
Soil Condition	Fractured granite with high temperature geothermal resources
Production Horizon	Carboniferous fractured granite
Upper Depth (m)	5000
Thickness (m)	500
T (C°)	200
Salinity (g/l)	~100

Haute-Sorne, Switzerland (stopped in 2019)

Operator: Geo-Energie Suisse AG

WP No: 5

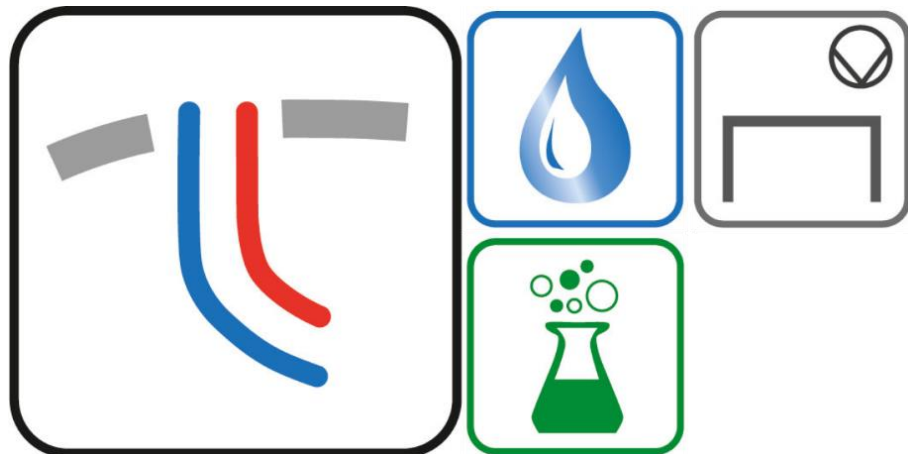
Status: Drilling starts in 2017



Foreseen Stimulation Techniques	Multi-stage shear stimulation
Type of Use	Provision of electricity
Soil Condition	Granite
Production Horizon	not known yet
Upper Depth (m)	5000
Thickness (m)	1700
T (C°)	170
Salinity (g/l)	no data available

Klaipėda, Lithuania (stopped in 2018)

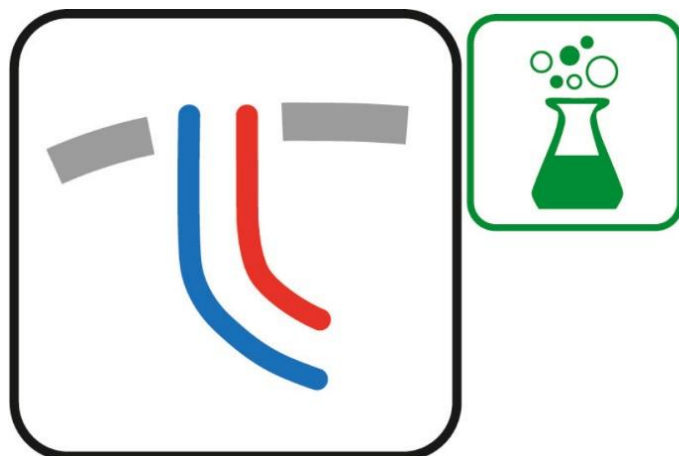
Operator: Geoterma
WP No: 4
Status: 4 wells since late 1990s



Foreseen Stimulation Techniques	Optional drilling radials, cleaning, cross flow, and stimulation techniques: Acid (HCL and/or HCL-HF)
Type of Use	District Heating system
Soil Condition	Clastic rocks (SS) of the low-enthalpy geothermal resources
Production Horizon	Lower Devonian (Viesvile formation)
Upper Depth (m)	990
Thickness (m)	128
T (C°)	38
Salinity (g/l)	108

Middenmeer, The Netherlands (stopped in 2019)

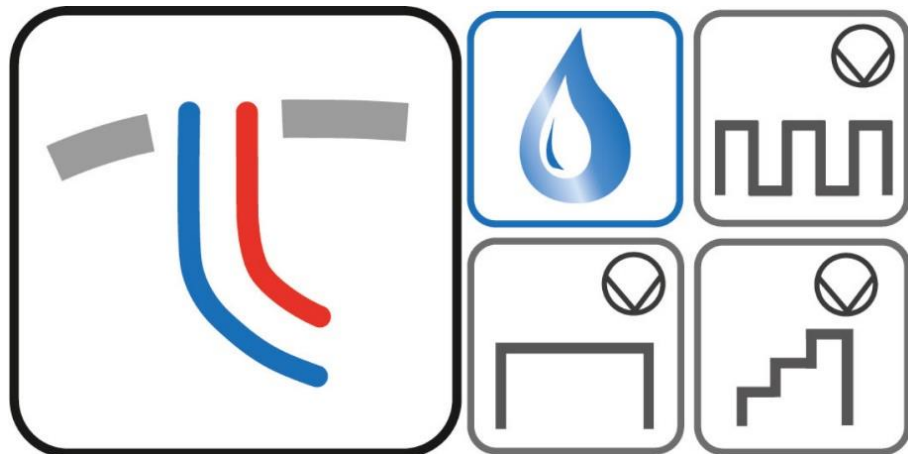
Operator: ECW Netwerk
WP No: 4
Status: 4 wells completed 2014



Foreseen Stimulation Techniques	Acid (HCL and/or HCL-HHF)
Type of Use	Heat for greenhouses
Soil Condition	Heterogeneous sandstone
Production Horizon	Rotliegend
Upper Depth (m)	2200
Thickness (m)	200
T (C°)	90
Salinity (g/l)	200

Pohang, South Korea (stopped in 2018)

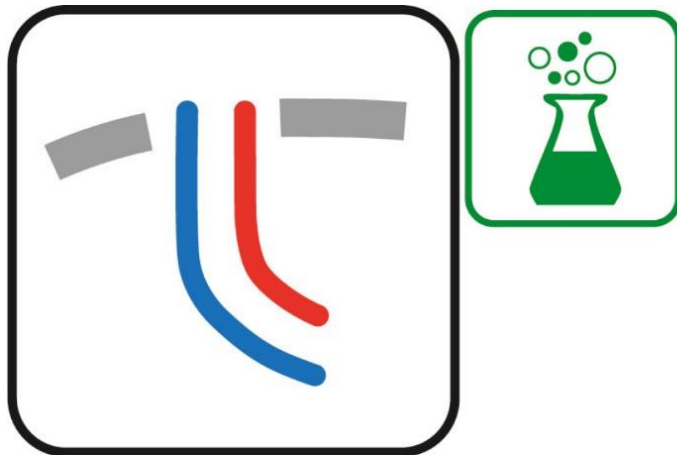
Operator: NexGeo
WP No: 5
Status: 2 wells in 2016



Foreseen Stimulation Techniques	Cyclic hydraulic stimulation (optional: multi-stage fracturing)
Type of Use	Provision of electricity
Soil Condition	Granodiorite formation
Production Horizon	Fractured granite/granodiorite
Upper Depth (m)	4248
Thickness (m)	>1000
T (C°)	140
Salinity (g/l)	<1

Westland, The Netherlands (stopped in 2018)

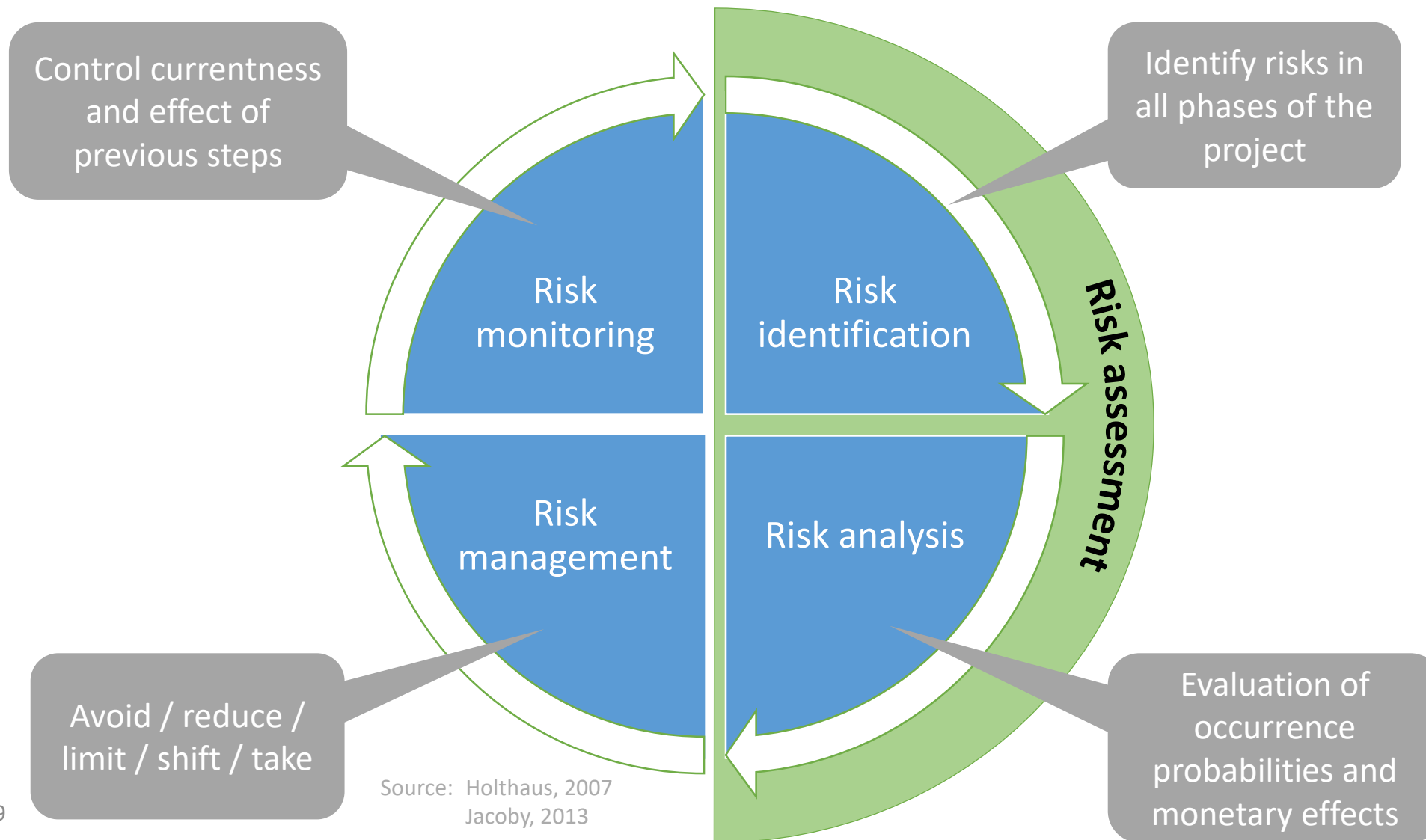
Operator: Trias Westland
WP No: 4
Status: Drilling starts in 2017



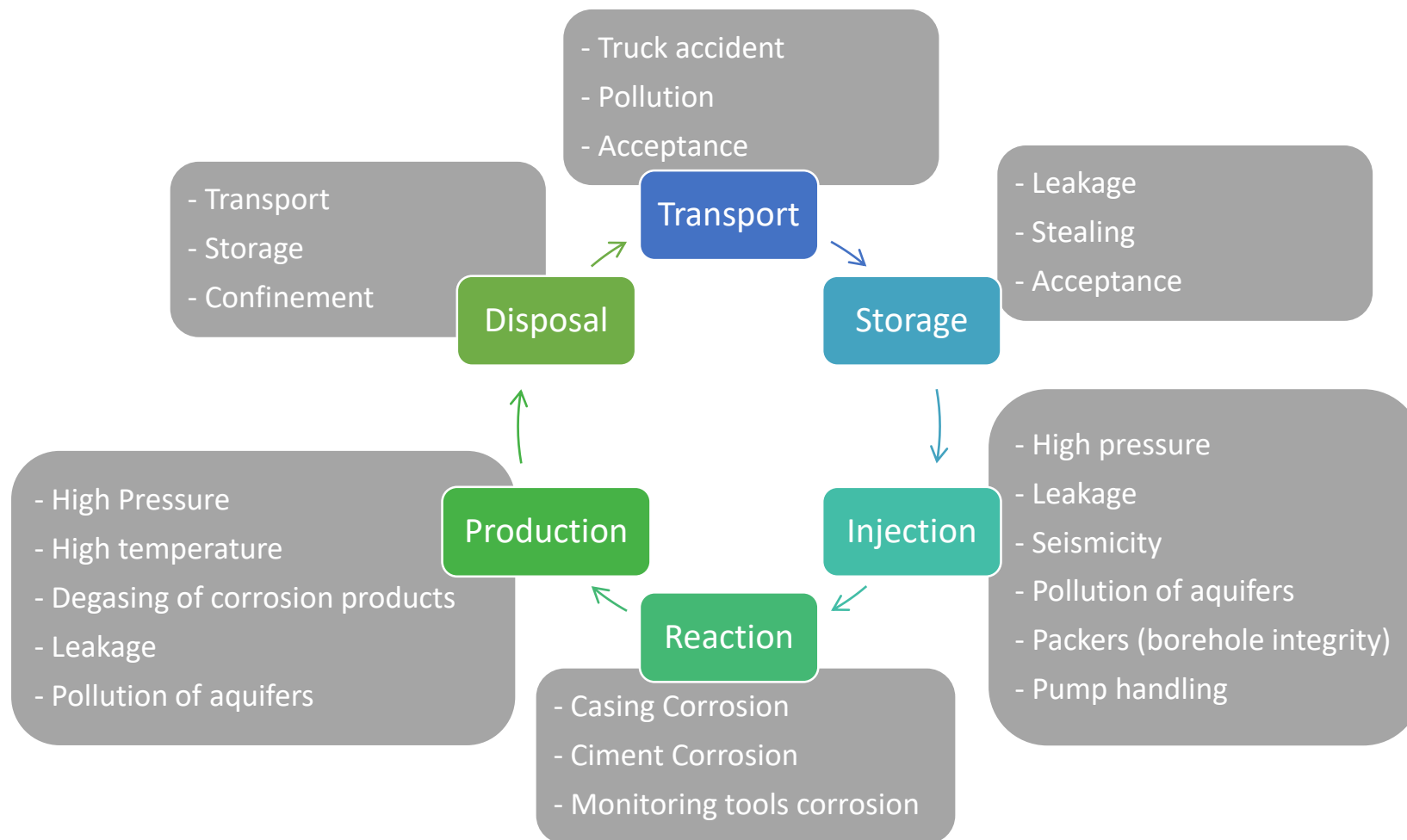
Foreseen Stimulation Techniques	Acid (HCL and/or HCL-HF). Option: (tensile) fracturing or thermal stimulation
Type of Use	Heat for greenhouse
Soil Condition	Clastic (fractured) rocks (SS) with low-enthalpy geothermal resources (cores available)
Production Horizon	Triassic Sandstone
Upper Depth (m)	4000
Thickness (m)	175
T (C°)	140
Salinity (g/l)	~70

How DESTRESS Assesses Risk

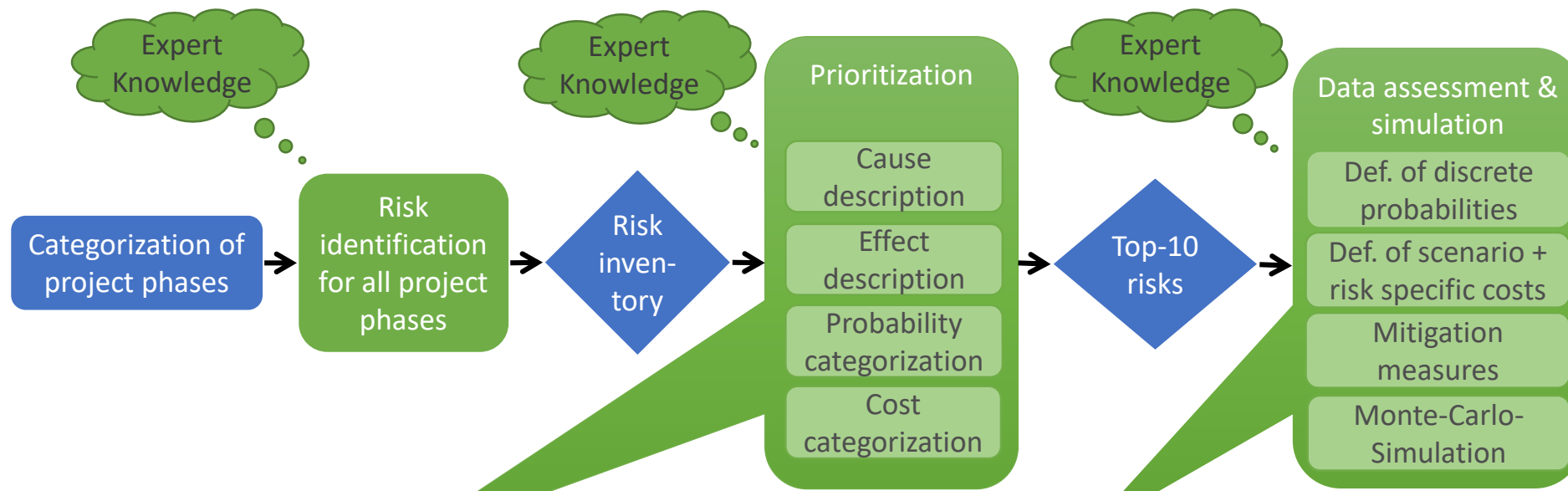
Risk Management and Reduction Measures



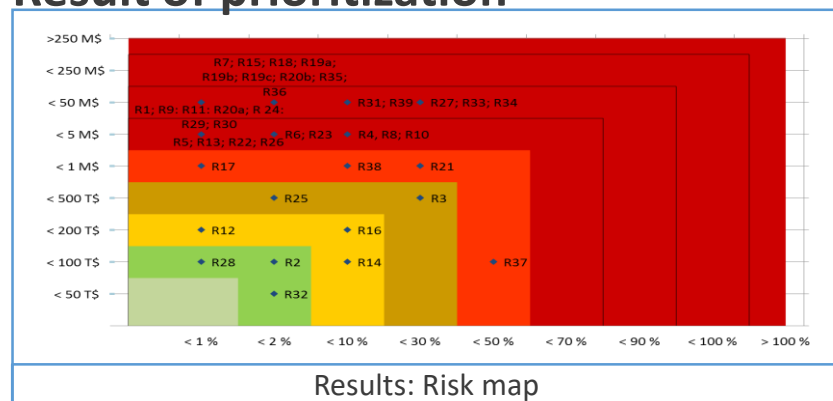
Risk Identification



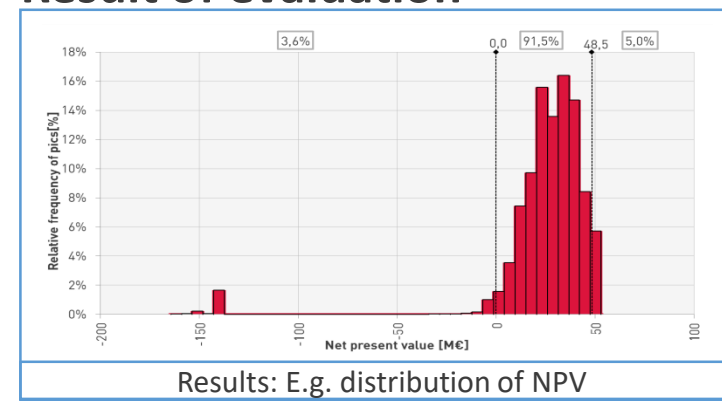
Risk Analysis and Evaluation Process



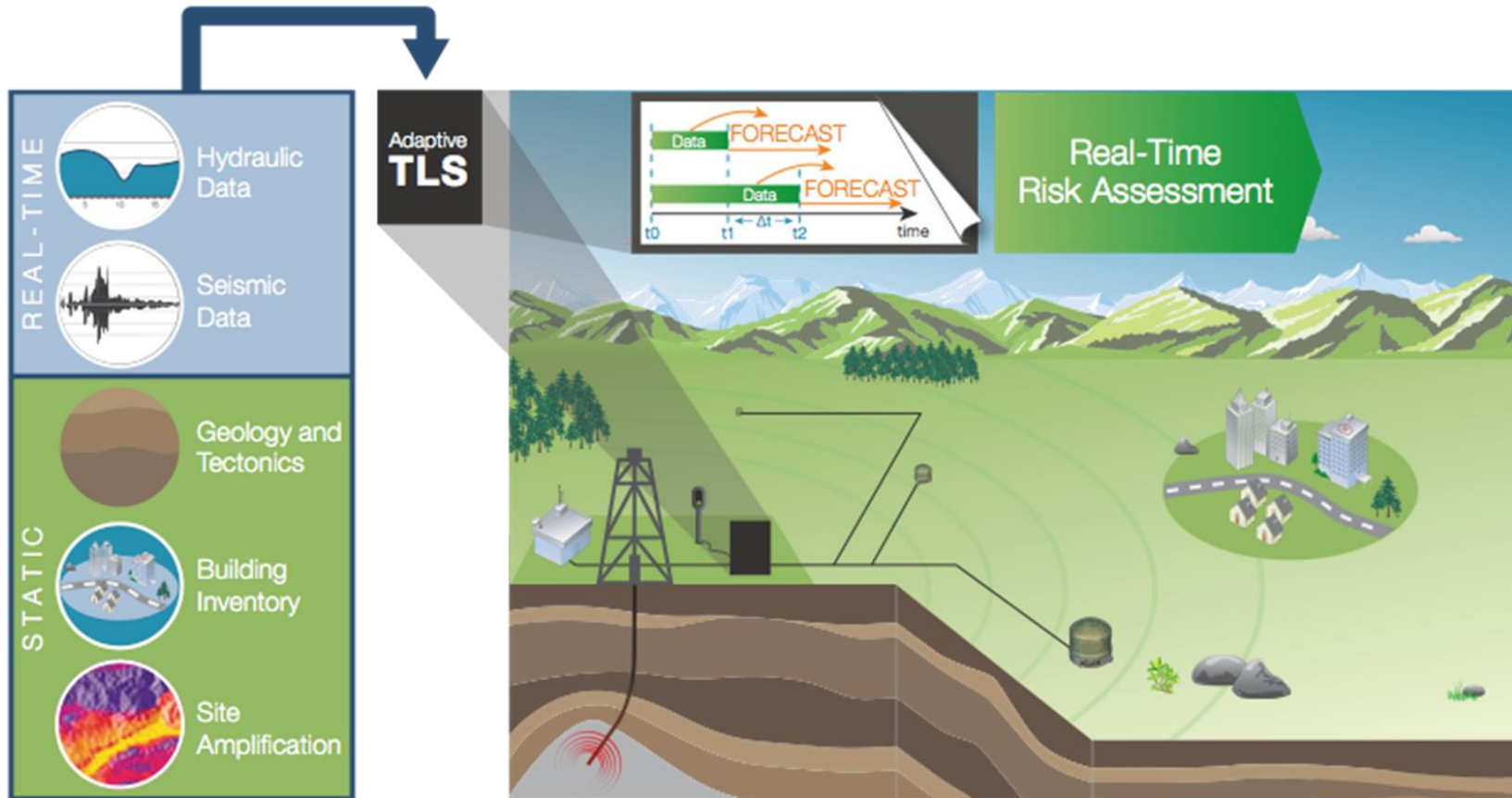
Result of prioritization



Result of evaluation



Risk Monitoring



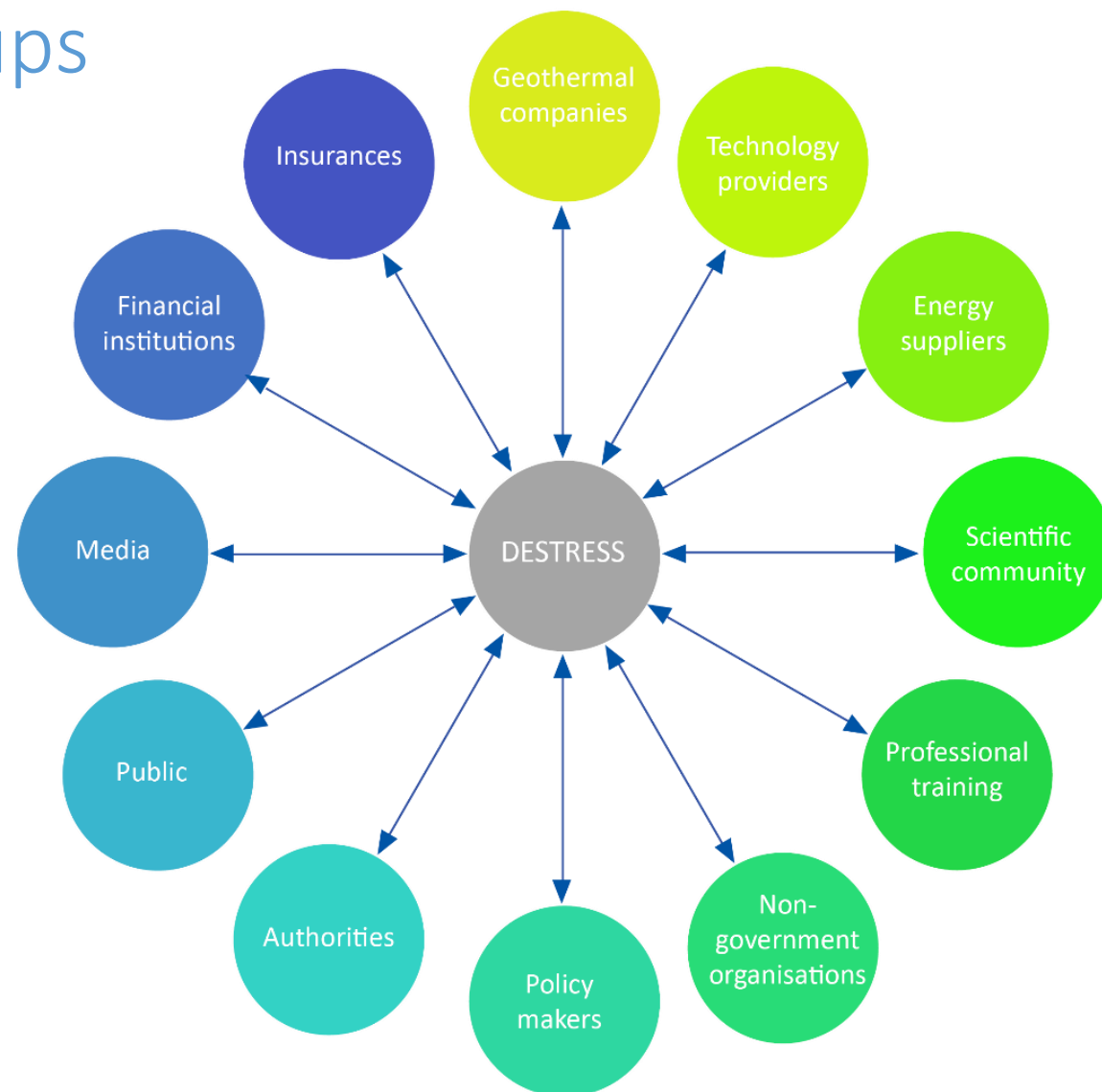
Stakeholder Network

Targeted Stakeholder Groups

The joint vision for the various stimulation treatments performed within DESTRESS is to ensure minimised environmental hazard, develop innovative approaches and risk management procedures and secure broad public acceptance. To share and spread the joint vision, DESTRESS is establishing a stakeholder network to facilitate the exchange of best practices. Become a part of it!

Learn more about the stakeholder network:

www.destress-h2020.eu/stakeholder



Your Interest and Our Offer

Your interest	Our offer
Familiarity or concern with geothermal energy issues in Europe	Involvement in knowledge, development and technology transfer
Link to research on geothermal energy	Exchange of good practices
Commitment to exploit DESTRESS results	Access to our demonstration sites and latest research
Willingness to support the vision of accelerated deployment of EGS	Invitations to attend internal conferences

Contact Details

Project Lead

Project lead

GFZ German Research Centre for Geosciences
Telegrafenberg, 14473 Potsdam (Germany)

www.gfz-potsdam.de/en/home

Project coordinator

Prof. Ernst Huenges
huenges@gfz-potsdam.de
+49 (0)331 288 1440

Project manager

Dr. Justyna Ellis
ellis@gfz-potsdam.de
+49 (0)331 288 1526

Newsletter

Subscribe now!

www.destress-h2020.eu/newsletter

Learn More

www.destress-h2020.eu

destress@sed.ethz.ch