# DESTRESS

Demonstration of soft stimulation treatments of geothermal reservoirs

# Project Overview

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#### 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.



#### Project Members

#### **Academic Partners**





**ETH** zürich



University of Glasgow

**KIC** 





**Industrial Partners** 















### Funding Partners



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

Swiss Confederation

Funding of ETH Zurich and Geo-Energie Suisse AG



#### Funding of Seoul National University



### 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.





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#### Chemical Aspects: WP 4



#### WP4: Demonstration of combined hydraulic-thermal-chemical treatments in sandstones, carbonates, granites

- identify the current baseline conditions at sites of interest
- perform combined and site-specific THC treatments
- demonstrate productivity sustainability by monitoring the long-term performance of the sites
- develop and deploy intelligent tools to quantify and predict the transient productivity behaviour of the reservoirs

- **D4.1** Thermal, hydraulic, and chemical parameters before and after the stimulation treatment.
- D4.4a Laboratory experiments and subsequent simulator development and simulations of hydraulic, thermal, chemical stimulation. → See presentation Kong
- D4.4b List of measured parameters, the predictive modelling, data acquisition and analysis, as well as monitoring needs, depending on the stimulation method. → See presentation Maren



#### Participating Countries and Demonstration Sites



04.11.2017 More information on <u>www.destress-h2020.eu/demonstration-sites/visit-demonstration-sites</u> 8



### Foreseen Stimulation Techniques

#### Borehole configuration









single well



sw with laterals

sw with multistage fractures

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A

#### Treatments



0.0

hydraulic injections

chemical thermal injections injections

#### Pumping





continuous

stepwise increase





# Rittershoffen, France

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

| Foreseen<br>Stimulation<br>Techniques | THMC-Stimulation techniques performed 2013   |
|---------------------------------------|--|
| Type of Use                           | Heat for (green) chemical<br>industry  |
| Soil Condition                        | Fractured clastic rocks (SS) and<br>fractured granite with high<br>temperature geothermal<br>resources |
| Production Horizon                    | Fractured Triassic sandstone & carboniferous fractured granite   |
| Upper Depth (m)                       | 2600   |
| Thickness (m)                         | 680  |
| T (C°)                                | >160   |
| Salinity (g/l)                        | ~100 10  |





# Westland, Netherlands

| <b>Operator:</b> | Trias Westland          |
|------------------|-------------------------|
| WP No:           | 4                       |
| Status:          | Drilling starts in 2017 |



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



# Klaipėda, Lithuania

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

| Foreseen<br>Stimulation<br>Techniques | Optional drilling radials,<br>cleaning, cross flow, and<br>stimulation techniques:<br>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  |





### Pohang, South Korea

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

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





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



# Groß Schönebeck, Germany (Fall Back Option)

| Operator: | GFZ              |
|-----------|------------------|
| WP No:    | 5                |
| Status:   | 3rd Well in 2018 |







#### Haute-Sorne, Switzerland

| Operator: | Geo-Energie Suisse AG   |
|-----------|-------------------------|
| WP No:    | 5                       |
| Status:   | Drilling starts in 2017 |



| Foreseen<br>Stimulation<br>Techniques | Multi-stage shear<br>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                |



# Middenmeer (Fall Back Option)

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

| Foreseen<br>Stimulation<br>Techniques | Acid (HCL and/or HCL-<br>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                           |





#### Risk Management and Reduction Measures





#### Project Lead

#### **Project lead**

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