TRANSGEO Webinar





Well Assessment IT Tool

Transnational Strategy for sustainable development of Central European regions



Agenda

- Introduction to TRANSGEO <u>Julie Friddell</u>
- IT Tool for Well Assessment Ferenc Fedor
- Transnational Strategy for sustainable development of Central European regions
 - Current features of geothermal energy utilisation in Central Europe <u>Monika Hölzel</u>
 <u>& Jacques Brives</u>
 - Environmental Impacts and Financing Opportunities <u>Ema Novak</u>
 - Challenges & Strategic Objectives with Implementation Measures György Márton
- Questions and discussion





Introduction to TRANSGEO

TRANSGEO



TRANSGEO - information and tools for reuse of existing wells for green geothermal energy

- 11 Partners
- 5 Countries Austria, Croatia, Germany, Hungary, Slovenia
- Budget 2.61 Million € (funded by Interreg Central Europe/European Regional Development Fund)
- May 2023 April 2026
- Project Leader Hannes Hofmann, GFZ

Partners











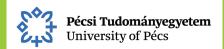












Associated Partners





REPUBLIKA SLOVENIJA GOV.SI















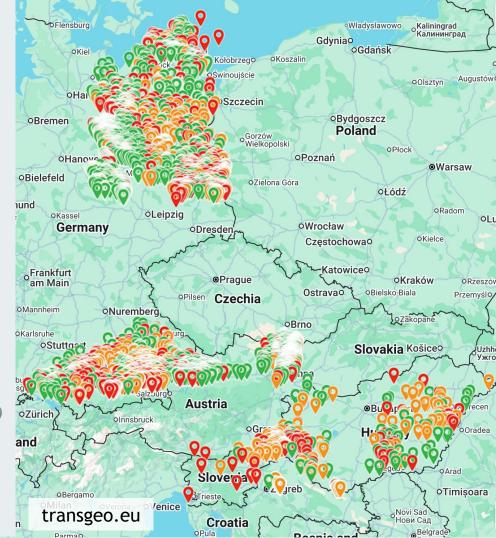






There are thousands of oil and gas wells in central Europe

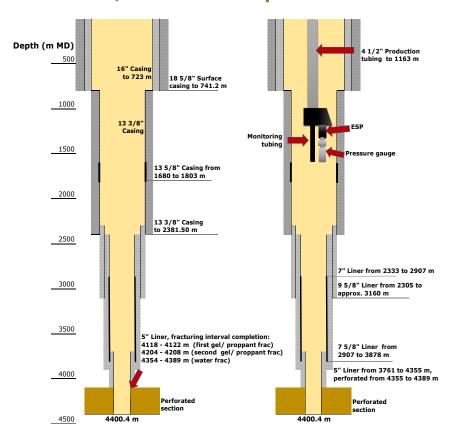
- Germany >20.000 (Jordan et al., 2022)
- Hungary >8.000 (pers. comm.)
- Austria >4.000 (Hamilton et al, 1999)
- Croatia >3.000 (Kurevija and Vulin, 2011)
- Slovenia >100 (pers. comm.)
- All 5 countries have geothermal well reuse projects, especially Croatia and Hungary



Reduction of high up-front investment

- New deep wells cost € millions, often >50% of the total geothermal project cost
- Millions of € can be saved by reusing existing wells, making green heat or energy economic for municipalities and smaller companies

Groß Schönebeck, North German Basin New well, 4400 m depth → 13 M €

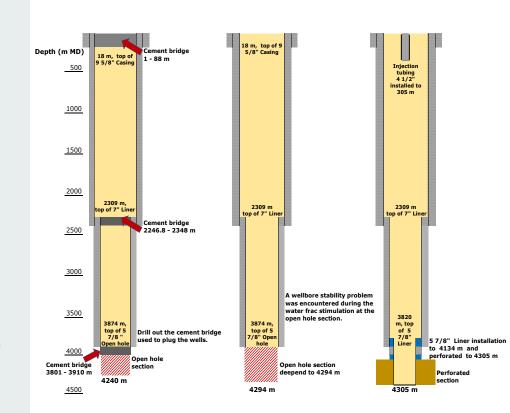


Christi et al., 2024. E. Huenges, pers. comm.

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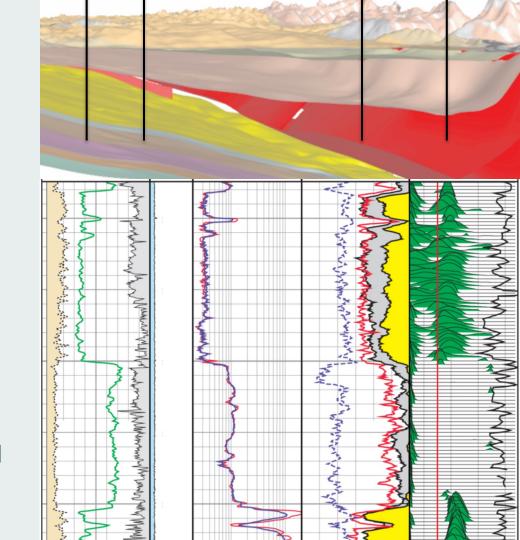
Groß Schönebeck, North German Basin Old well, with workover → 1.5 M €



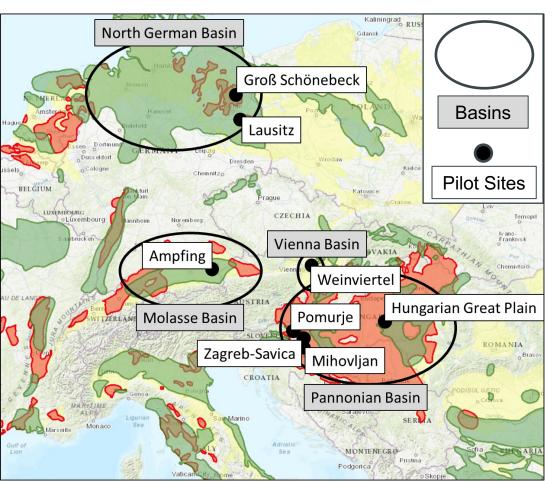
Christi et al., 2024. E. Huenges, pers. comm.

Reduction of exploration risk by using existing data

- The largest technical hurdle for geothermal development is the geological risk of drilling
- Knowledge about the subsurface reduces barriers for large-scale and fast geothermal development

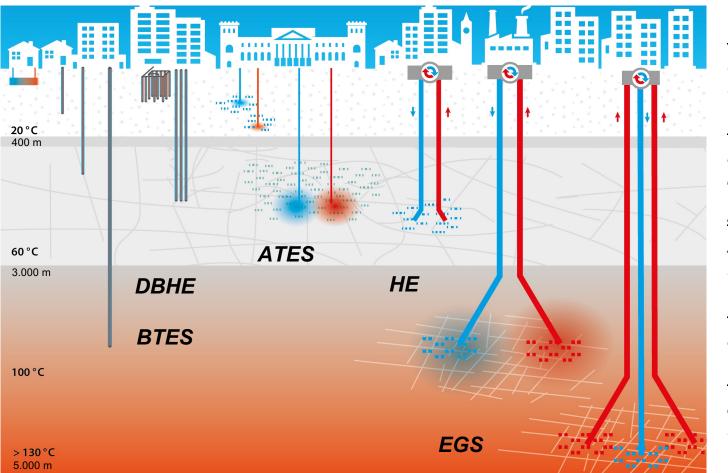


TRANSGEO Technical Deliverables



- Database of old wells in 4 basins + heat/energy demand
- Online Well Selection Tool
 to identify suitable wells for
 reuse
- Engineering Workflows and Well Reuse Procedures to inform well repurposing for 5 geothermal technologies
- 8 Pilot Sites to test and demonstrate reuse potential and procedures

5 Geothermal Reuse Technologies



BTES

Borehole Thermal Energy Storage

DBHE

Deep Borehole Heat Exchanger

ATES

Aquifer Thermal Energy Storage

<u>HE</u>

Hydrothermal Energy

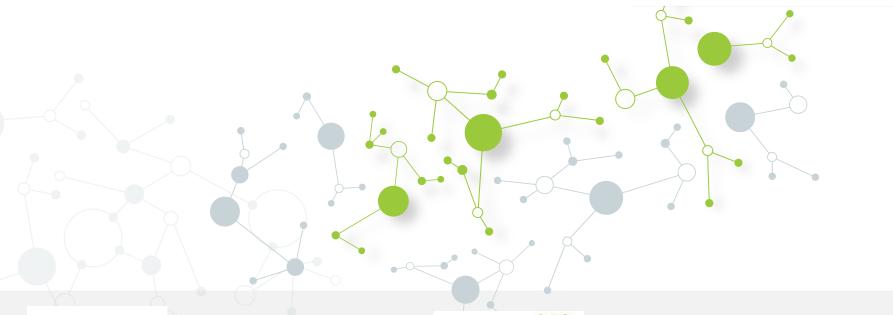
EGS

Enhanced Geothermal Systems

IT Tool for Well Assessment



TRANSGEO









Ferenc Fedor

R. Schön, E. Pirkhoffer

Aim of the IT project

The aim of the project is to investigate the possibilities for using non-productive, shut-in, and abandoned hydrocarbon wells for geothermal purposes.



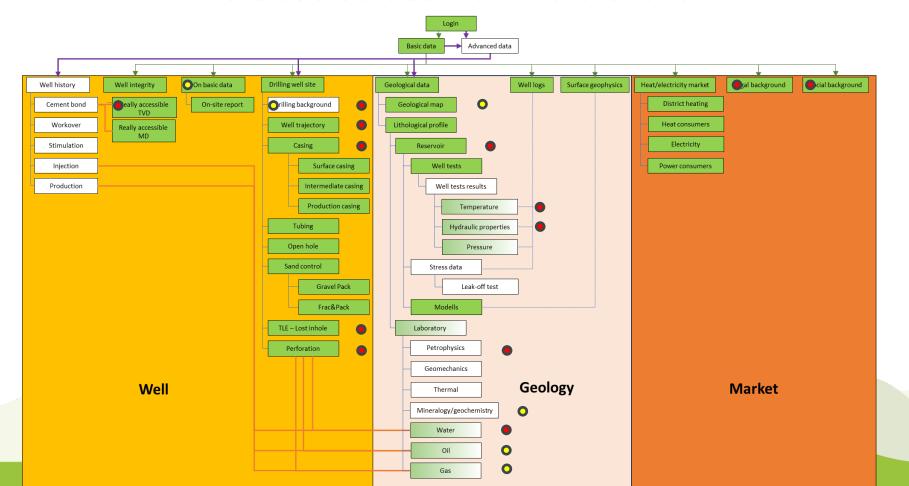
What information we have

- Five technologies are given: ATES, BTES, DBHE, HE, EGS
- > Three options are given: heat storage, heat production, energy production
- > Three markets are given: agriculture, industry, local governments
- A database is given, which can be filled with data on drilling and the environment to any depth
- A decision-making criteria system is given, including exclusion criteria, with the aim of selecting the appropriate market and technology for a given well
- A visual display interface is given, which shows the environment and possible uses of the well on a map and through a filtering system

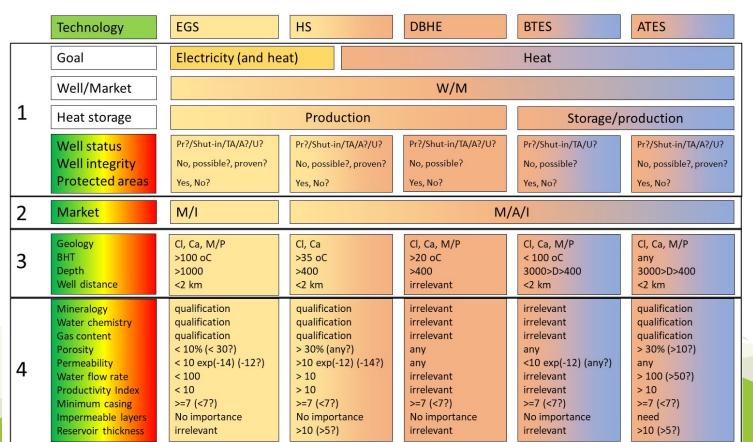
IT tool features

- Hybrid interface (display of GIS-generated calculations on Google Maps with a parallel database-driven interpretation sidebar)
- Currently a static interface, i.e., new drillings are displayed using an inserted step via ARCGIS
- Various permission levels are available
- Traffic light system

Database structure - flow chart



Decision tree - Criteria Catalogue (theoretical background)



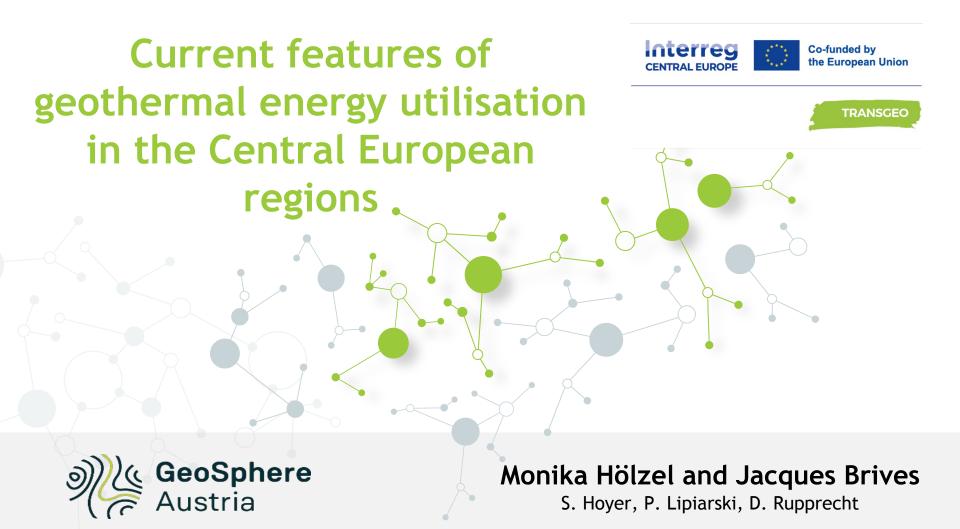
A1.4 IT Tool - Results

- The algorithm does not penalize for lack of data, which means that it rates the suitability of a given well based on existing data
- The more validated information there is in the database, the more likely it is that the color for a given project is correct
- We only make suggestions, which means that when generating a project, the specific well and the circumstances must be examined in detail!

TRANSGEO IT Tool https://transgeo.eu

Transnational Strategy for a sustainable development of Central European regions

- Transition from fossil to geothermal energy use -



Strategies for geothermal energy usage

Germany

Federal plan including exploration campaigns, streamlined permitting, risk mitigation, public acceptance.

Target: 10 TWh and 100 new projects by 2030.

Financial incentives for district heating, feed-in tariffs, integration of CRM (e.g. lithium extraction).

Austria

Expansion of deep geothermal plants to utilise at least 25% of known resources for district heating (500 000 residential units)

Support through a federal geothermal strategy: legal reforms in mining and water rights, and risk-based subsidies to reduce exploration and drilling risks.

Hungary

National Geothermal Strategy (2024) sets targets to increase geothermal energy use by 20% by 2026 and double it by 2030

Goal: 12-13 PJ and a 12% share of heat production

Plans require overcoming challenges in financing, geological risks, and regulation, focus on cascade systems, district heating.

Slovenia

Systematic support and financing for deep exploration (2-5 km drilling)

Focus on NE Slovenia (resources promising)

Current usage is minimal (0.7% of supply), and growth depends on incentives, reinjection systems, and attracting investors to expand beyond the few existing sites.

Croatia

Focus on cascade use (electricity → heat)
Promotion of district heating, agriculture, and industry

Focus: Pannonian Basin.

Croatian Hydrocarbon Agency leads exploration with EU-funded projects, drilling new wells to reduce geological risks and prepare investment-ready sites for private developers.

Legislative and legal framework

Germany

Geothermal projects regulated by Federal Mining Law (BBergG)

States apply it with slight variations, requiring multiple permits for exploration, drilling, and environmental impacts.

Data from geothermal wells submitted to State Geological Surveys, with varying levels of public accessibility depending on the type and origin of the data.

<u>Austria</u>

Geothermal energy is not defined as raw material

Regulation is fragmented across several laws: Mineral Resources Act, Water Rights Act, and Commercial Law.

Permits depend on depth, purpose, and location

No single authority: long, inconsistent approval times

Hungary

Reformation of geothermal legislation 2022: Act LXIV, introducing exploration and exploitation rules under the Mining Inspectorate

Exploration licences valid 4 years and protection zones established for up to 35-year concessions.

Negative: overlapping zones, short deadlines, and limited institutional capacity create delays, legal ambiguities, and investment challenges.

Slovenia

Geothermal regulation combines the Mining Act (ZRud-1), Water Act (ZV-1), and Environmental Protection Act (ZVO-2).

Permits from different authorities for exploration and groundwater use needed.

Since 2023, geothermal research concessions under the Renewable Energy Act (ZUNPEOVE) allow phased exploration and pilot electricity generation, but the framework remains complex and overlapping.

Croatia

Geothermal exploration and exploitation are regulated under the Hydrocarbon Exploration and Exploitation Act and its bylaws

Licences granted through public tenders (Ministry and Croatian Hydrocarbon Agency).

Investors must provide exploration plans, guarantees, and environmental assessments, while royalties and fees are shared between local, regional, and state budgets.

Educational opportunities in geothermal energy

Austria: 16

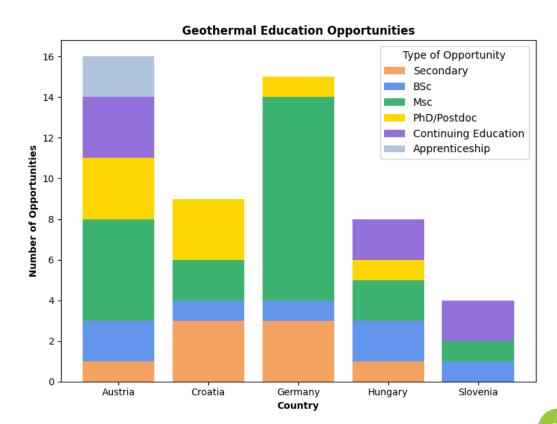
Croatia: 9

Germany: 15

Hungary: 8

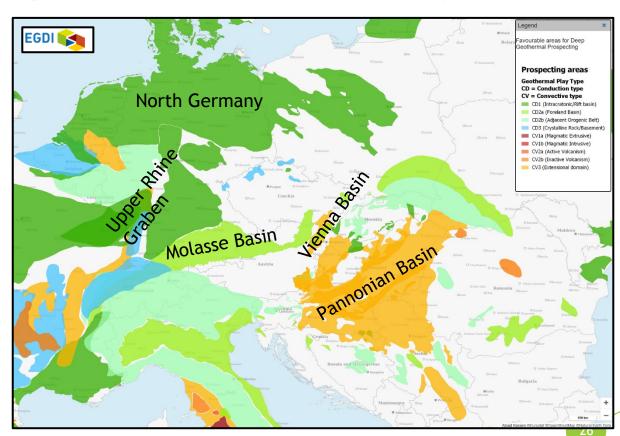
Slovenia: 7

Total: 55 opportunities



Geothermal potential of the CE regions

- 5 Geothermal regions with high potential:
- North Germany
- Upper Rhine Graben
- Molasse Basin
- Vienna Basin
- Pannonian Basin



Country	Main Provinces / Reservoirs	Resource Type	Current Use
Austria	Vienna Basin Molasse Basin Pannonian Basin (Including Styrian Basin)	Hydrothermal aquifers (40-150 °C)	~104 MWt heating, spas, pilot electricity (Bad Blumau, Fürstenfeld), >104k shallow heat pumps
Croatia	Pannonian Basin	Hydrothermal aquifers	Mainly balneology, greenhouses, pilot heating; 24 exploration & 14 exploitation licenses (2025)
Germany	North German Basin Upper Rhine Graben Molasse Basin	Hydrothermal aquifers + Petrothermal (EGS pilots)	42 plants (31 heat, 9 CHP, 2 power), 480,000 shallow systems
Hungary	Pannonian Basin	Hydrothermal aquifers (55-130 °C at 2 km)	~1.700 wells; 21 geothermal DH systems; agriculture (40%), spas (23%)
Slovenia	Pannonian Basin	Hydrothermal aquifers (50-75 °C)	Lendava DH, spas, greenhouses; total use ~0.7% of primary energy

Diversity of geothermal applications:

- > **a** Oistrict Heating e.g., Vienna, Szeged, Munich
- Flectricity Velika Ciglena (HR), Bad Blumau (AT), pilot plants
- Balneology Spas across AT, HU, SI, HR
- Agriculture Hungary's greenhouses (40% geothermal), Croatia's new projects
- Industry Audi, Mercedes, LEGO using geothermal in Hungary
- Shallow / UTES 480,000+ heat pumps in Germany, Berlin & Neubrandenburg storage

Geothermal highlights:

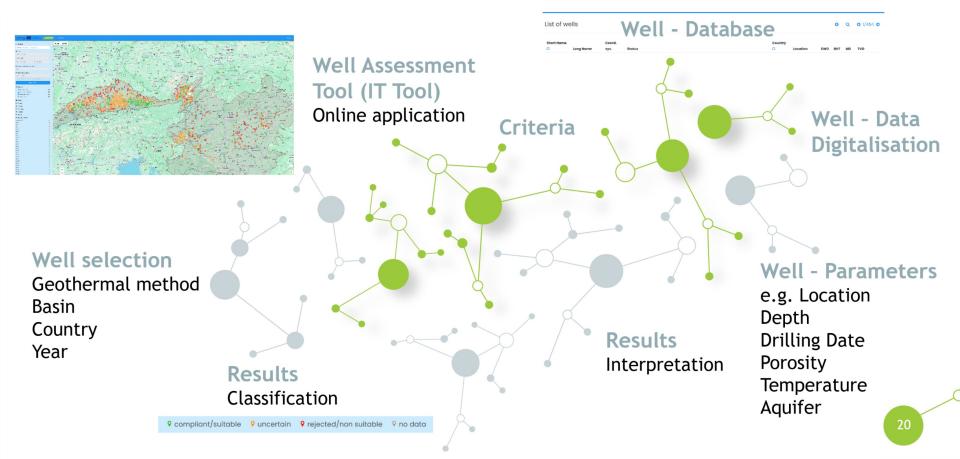
- > Austria: Vienna Basin alone > 1,000 MWt potential
- Croatia: 4,000 historic wells; reusing oil wells = major growth
- Germany: 42 plants operating + 16 under construction (2025)
- Hungary: 5.6% of thermal energy from geothermal; Europe's highest well density
- Slovenia: 148 °C at 4 km (Ljutomer) proves high potential

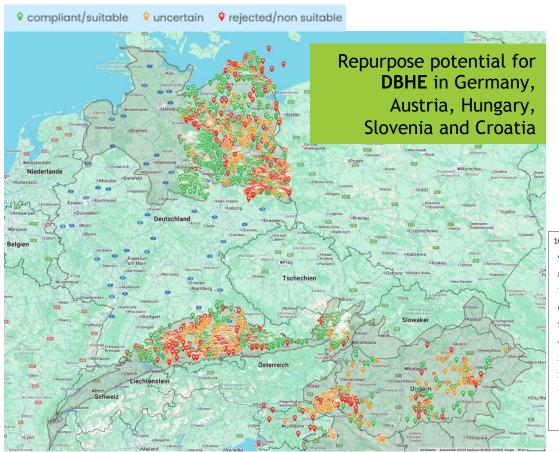
Future Outlooks:

- **Expansion** more district heating networks (Vienna, Szeged, Munich)
- ➤ Integration repurposing oil wells, scaling shallow + deep systems
- Cooperation cross-border projects, shared reservoirs

Well repurpose potential of the CE regions

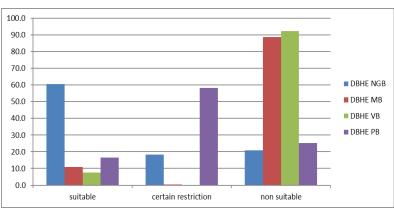
Workflow for Evaluation

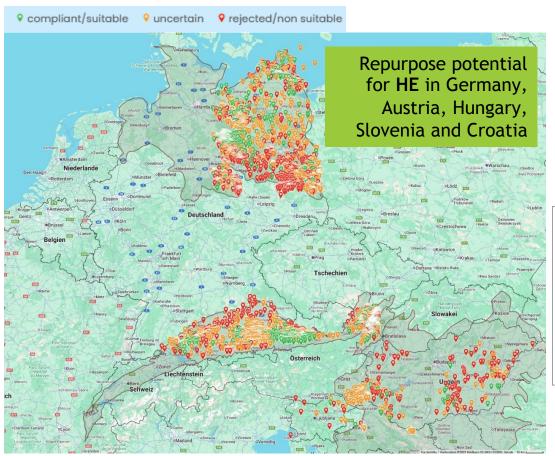




Highest numbers of wells are suitable for DBHE and HE reuse

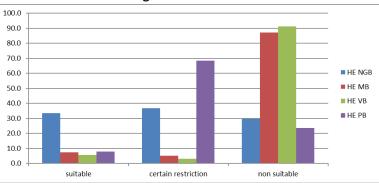
Percentage of suitable or non-suitable boreholes for DBHE per basin





Highest numbers of wells are suitable for DBHE and HE reuse

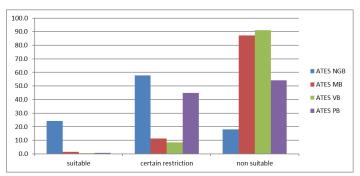
Percentage of suitable boreholes

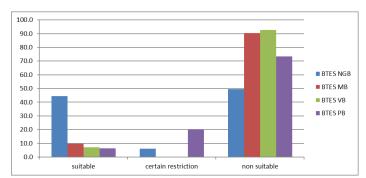


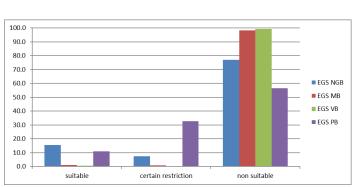
Repurpose potential in central Europe in the countries Germany, Austria, Hungary, Slovenia and Croatia for HE.

Well repurpose potential of the TRANSGEO Area

Percentage of other suitable boreholes per method and basin







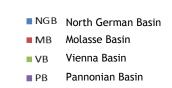


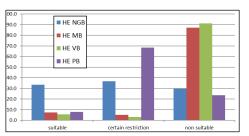
Well repurpose potential of the TRANSGEO Area

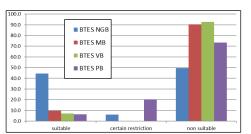
Percentage of suitable boreholes per method and basin

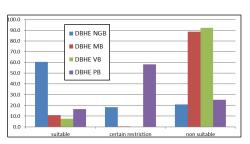
Comparison of the potential between basins:

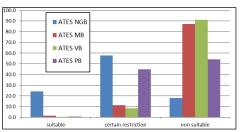
- There are restrictions to keep in mind and to put further work in
- Databases are not unified over country borders
- Hungary & Croatia's well inventory is preselected
- Austria's well inventory misses important data due to publication restrictions, e.g. well status > criterion added: "1990 cut-off" applied in IT Tool query
- Germany has a large dataset, lots of parameters, but they are incomplete

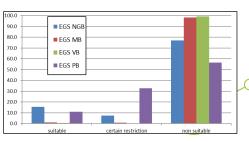
















TRANSGEO



Environmental impacts

- Application of energy technologies => effects on the environment
- Different impacts on various environmental components:
 - Land and soil use
 - Surface disturbances and seismicity
 - Groundwater and waterways contamination
 - Ecosystem and local ecology impacts
 - Temperature and biological/chemical changes
 - Radionuclides and gas release



Lower when repurposing abandoned hydrocarbon wells



Repurposing hydrocarbon wells



Challenges

Compromised well integrity

Inadequate design

Regulatory and monitoring gaps

Legacy pollution and emissions

Induced seismicity and subsidence





Advantages

Reduced land use, ecosystem and surface disturbances

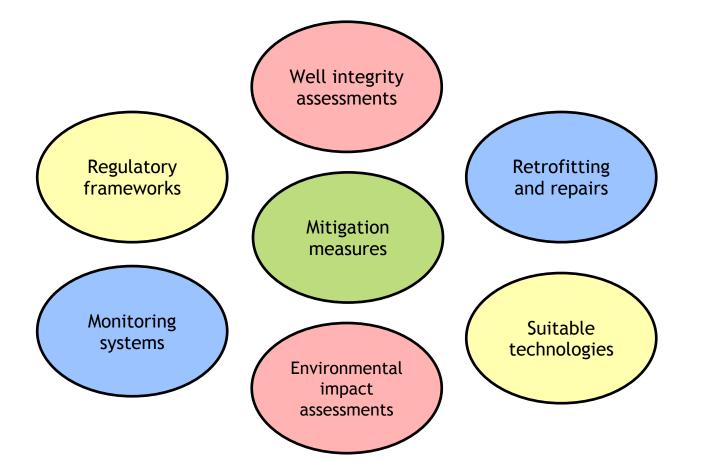
Less waste generation

Better material and energy use

Managed number of wells

Monitored risk of contamination and GHG emissions

How to reduce environmental impacts?



5 geothermal technologies

(D)BHE & BTES

- Small impact
- More wells for extraction of energy
- Penetration into geological barriers

HE

- > Small impact
- Reinjection of produced water
- Isolation from the surface, avoidance of contamination and subsidence

ATES

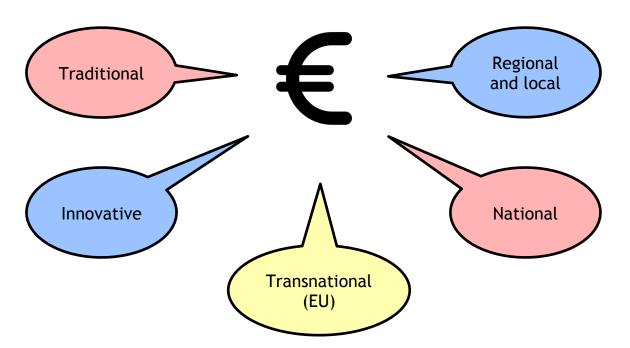
- Medium impact
- Shallow systems
- Risk for shallow groundwater aquifers

EGS

- Potentially large impact
- Hydraulic stimulation treatments
- Risk of seismicity and type of stimulation fluid

Financing opportunities

Repurposing hydrocarbon wells ⇒ cheaper than drilling
 ⇒ necessary risk management
 ⇒ direct and indirect financing



Financing instruments in Central Europe

Country	Traditional	Innovative
	National Funding ProgramsGreen Financing Instruments	EU Funding ProgramsGreen Bonds and LoansPrivate Sector Funding
***	Public Support SchemesEU Funding Programs	 Green Financing Instruments Energy Service Companies Public-Private Partnerships Citizen-Led Initiatives Private Sector Funding
	Debt FinancingMunicipal FinancingEU Funding Programs	 Green Financing Instruments Public-Private Partnerships Crowdfunding and Community-Led Initiatives
	 EU Funding Programs Swiss-Hungarian Cooperation Programme Modernisation Fund 	 Green Financing Instruments Energy Efficiency Loans Private Sector Funding
	Slovenian Environmental Public FundEU Funding Programs	 Green Financing Instruments Collaborative Projects Private Sector Funding

Good practice examples

InnoGeoPot

- Innovative methods for assessing geothermal energy potential and thermal energy storage with consideration of repurposing abandoned wells
- Croatian Science Foundation (HRZZ)

Geothermal energy from old oil wells (A way to a little more independence!)

- Repurpose of a depleted hydrocarbon well into BHE and integration into the existing DH system
- Austrian Climate and Energy Fund (KLIEN); Program: New Energies 2020

Horstberg

- Repurposed abandoned hydrocarbon well for deep geothermal energy production using the single-hole approach
- Federal Ministry for Environment, Nature Conservation and Nuclear Safety

MEET

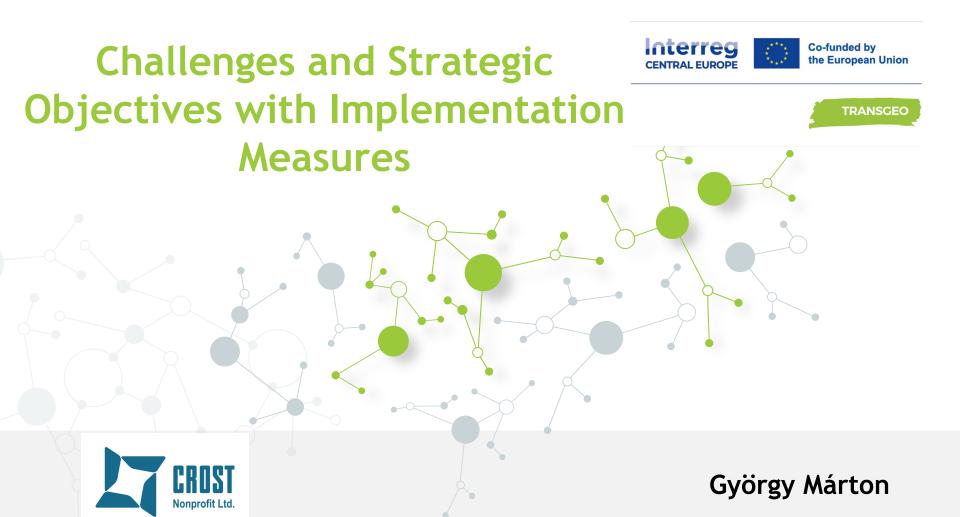
- Multidisciplinary demonstration of EGS techniques and potentials with focus on increasing heat production from repurposed wells
- ➤ Horizon 2020

Groß Schönebeck

- Geothermal research platform with two research (production and injection) wells reopened and drilled for geothermal energy utilisation
- Federal Ministry for Economic Affairs and Climate Protection, Federal Ministry of Education and Research

Landau

Two hydrocarbon wells repurposed into geothermal wells for heath production supplying a local swimming pool and car dealership



Legal, knowledge and social frameworks

STRATEGIC OBJECTIVE 1: Clear, efficient and sustainable regulatory framework

Priority 1.1 Simplify, coordinate and modernize policy frameworks

Measure 1.1.1 Clarify well and land ownership, usage rights, liability and responsibilities

Measure 1.1.2 Coordinate and unify policies across jurisdictions

Measure 1.1.3 Ensure new legislation and regulations align with national and EU energy transition goals

Measure 1.1.4 Adjustment of national and regional strategic and planning documents for fostering geothermal energy use from repurposed wells

Priority 1.2 Streamline permitting procedures for well repurposing

Measure 1.2.1 Create one-stop shop permitting systems for well reuse

Measure 1.2.2 Introduce fast-track approval for projects meeting well integrity verification and safety criteria standards

Legal, knowledge and social frameworks

STRATEGIC OBJECTIVE 2: Deeper knowledge and competencies

Priority 2.1 Educate and train well reuse experts and workforce

Measure 2.1.1 Develop educational programs at secondary, university and postgraduate levels to create quality geothermal workforce in well reuse

Measure 2.1.2 Facilitate and encourage research and development programs, including joint industry-academic research on well reuse

Priority 2.2 Enhance collaboration between experts

Measure 2.2.1 Build a network of experts to accelerate and enable geothermal well reuse

Measure 2.2.2 Promote cross-border best-practice exchange through regional forums

Legal, knowledge and social frameworks

STRATEGIC OBJECTIVE 3: Favourable social and market conditions

Priority 3.1 Enhance stakeholder trust and social acceptance

Measure 3.1.1 Raise awareness and knowledge among relevant stakeholders on the geothermal potential of repurposed hydrocarbon infrastructure

Measure 3.1.2 Mandate early and ongoing transparent stakeholder consultation with affected communities

Measure 3.1.3 Introduce community benefit agreements

Priority 3.2 Create favourable market conditions

Measure 3.2.1 Develop integrated online platform for matching supply and demand of repurposed wells and proposing cost-effective geothermal reuse methodologies

Measure 3.2.2 Foster reuse of hydrocarbon wells by local heat market needs assessment and integration of well reuse in urban planning

Measure 3.2.3 Support scaling-up of the geothermal reuse market through development district heating systems and related infrastructure

Technological opportunities

STRATEGIC OBJECTIVE 4: Accelerated innovation in well reuse

Priority 4.1 Improve data and information access

Measure 4.1.1 Develop open-access database of candidate and reused hydrocarbon wells by upgrading TRANSGEO IT tool

Measure 4.1.2 Require public disclosure of well integrity testing, seismic monitoring and water quality data

Measure 4.1.3 Develop screening tools to identify and assess suitable wells, using digital technologies

Priority 4.2 Develop new downhole technologies

Measure 4.2.1 Design new and innovative casing repair technologies

Measure 4.2.2 Pilot new closed-loop geothermal retrofit technologies, including plug-and-play downhole heat exchanger systems

Measure 4.2.3 Test geothermal reservoir stimulation techniques in suitable wells

Priority 4.3 Integrate digital monitoring

Measure 4.3.1 Deploy fiber-optic sensing for real-time well performance, well integrity and induced seismicity monitoring

Measure 4.3.2 Use predictive digital twins to optimize energy extraction and system design

Priority 4.4 Facilitate related technological breakthroughs

Measure 4.4.1 Develop solutions for reinjection problems in difficult geology

Measure 4.4.2 Develop highly efficient heat pump technologies to enable heat utilisation of low and medium enthalpy geothermal energy potential

Environmental impacts

STRATEGIC OBJECTIVE 5: Environmentally-protective and sustainable well repurposing

Priority 5.1 Ensure knowledge of environmental status and potential impacts prior to reuse

Measure 5.1.1 Conduct Environmental Impact Assessment

Measure 5.1.2 Conduct baseline well integrity assessment

Priority 5.2 Protect land, water and ecosystem prior to field operations

Measure 5.2.1 Restore habitat and remediate pollution

Measure 5.2.2 Mitigate noise and light pollution

Measure 5.2.3 Avoid gas emissions and apply safe management protocols

Priority 5.3 Protect the environment during well workover

Measure 5.3.1 Ensure workover operational plan to manage hydrogeological and geomechanical risks

Measure 5.3.2 Conduct well repair or retrofit to avoid leakage and isolate well from swelling formations

Measure 5.3.3 Limit sound and light disturbance by isolating the site and operating during daytime

Priority 5.4 Protect the environment during system operation

 ${\it Measure~5.4.1~Reinject~produced~fluids~to~avoid~subsidence,~scaling,~gas/radionuclide~release,} \\$ and waste processing

Measure 5.4.2 Conduct appropriate monitoring/inspection and maintenance to detect and prevent leaks and other potential environmental impacts

Financing instruments

STRATEGIC OBJECTIVE 6: Favourable financial conditions for well reuse

Priority 6.1 Ensure long-term repurposing investments through the use of EU financing instruments

Measure 6.1.1 Create targeted grant programmes for well repurposing at EU level

Measure 6.1.2 Establish well repurposing community in Central Europe

Measure 6.1.3 Foster transnational project collaborations for EU funding (including community-led initiatives)

Priority 6.2 Broaden the portfolio of financing instruments on national and regional level

Measure 6.2.1 Introduce innovative public funding programs for environmental remediation and for well testing

Measure 6.2.2 Initiate national and regional funding mechanisms for well reuse

Priority 6.3 Attract private sector investment

Measure 6.3.1 Educate potential investors on well reuse for geothermal energy production

Measure 6.3.2 Facilitate private sector investment and Public-Private Partnerships (PPPs)

Questions and discussion

Please raise your hand or type your Questions in the Chat







TRANSGEO



GFZ Helmholtz Centre for Geosciences

Julie Friddell

Input to our Products

- → online Well Assessment Tool
- → Transnational Strategy
- → Transnational Action Plan coming this winter



Strategy and Action Plan



○ Vienna, 15 April 2026 → Final conference!



Thank you!

Connect with us!

- ✓ Julie@GFZ.de

- in linkedin.com/company/transgeoproject/
 interreg-central.eu/projects/transgeo/
 youtube.com/@TRANSGEO-project

