This project is implemented through the CENTRAL EUROPE Programme co-financed by the ERDF.

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Transboundary geothermal energy resources of Slovenia, Austria, Hungary and Slovakia (TRANSENERGY) – contributions to integrated resource management policies and regional development

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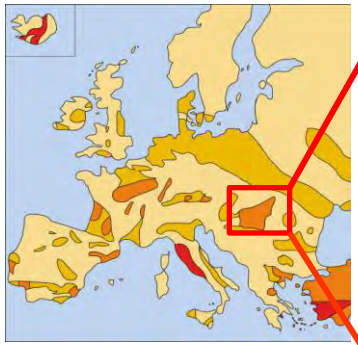
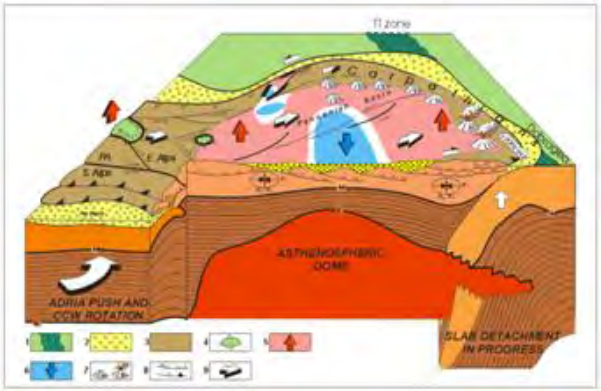
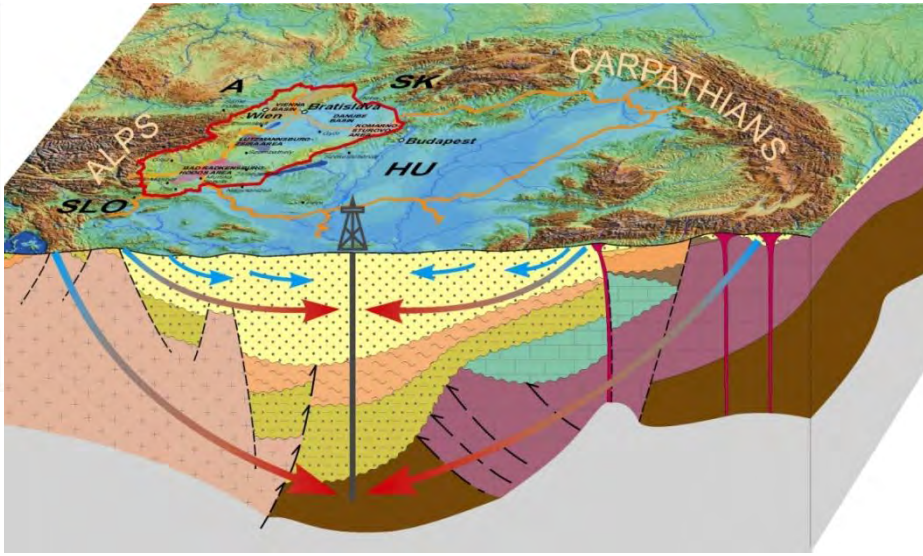
Targets: hot sedimentary aquifers in the Pannonian Basin





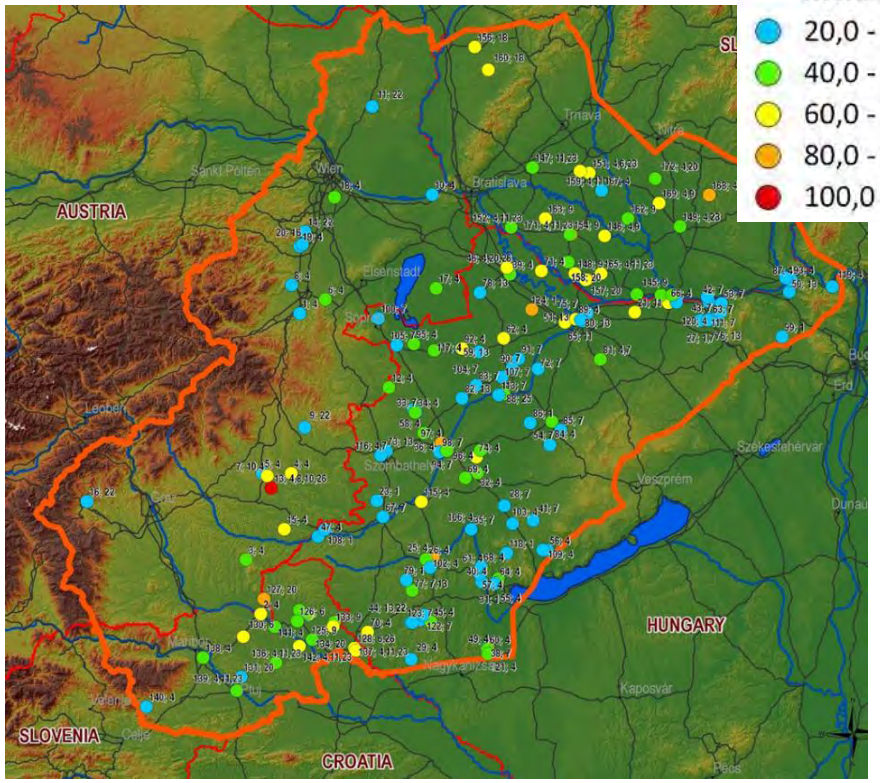


Favorable conditions due to Miocene basin formation

Average terrestrial heat-flow: 100 mW/m^2

Geothermal gradient: 45 C/km

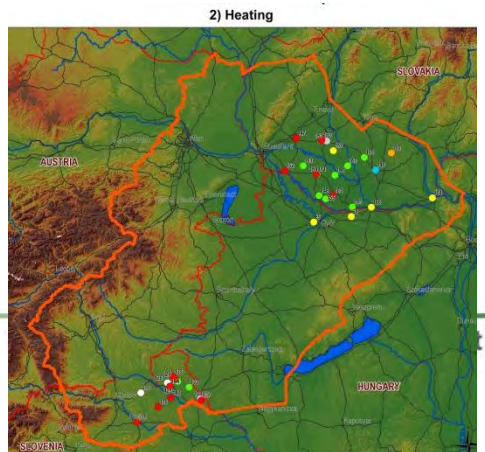
Main geothermal reservoirs	Paleo-Mesozoic fractured, karstified basement rocks	Miocene porous and carbonate reservoirs	Mio-Pliocene porous basin fill: multi-layered sandstones, shales
depth (top)	>2-3000 m	Basement highs	600-1500 m
temperature	>100-150 C	50-150 C	50-100 C
prospect	power, CHP	CHP, direct heat	direct heat, balneology



Current utlization and identified gaps

- Majority of use is low-temperature for balneology
- Hardly any re-injection: some aquifers are already overexploited
- **Many users in the transboundary regions, no harmonized management strategies**
- **Low share of energetic use: Why? Resource-related? Non-technical barriers? Policy-related?**

- 175 users from 308 wells
- Abstraction of ~ 30 million m^3/y of thermal water (except AT)
- 4-6 re-injection wells



More on utilization in HS-1-14 (Rman et al). June 5 at 12.10 Pacinotti

Final goals of TRANSENERGY

1. **Assessment of hydrogeothermal resources at the W-ern part of the Pannoninan Basin – show the potential for energy use**
2. **Recommendations on integrated, harmonized management strategies and sustainable utilization**
3. **Identify and dismantle non-tecnical barriers**

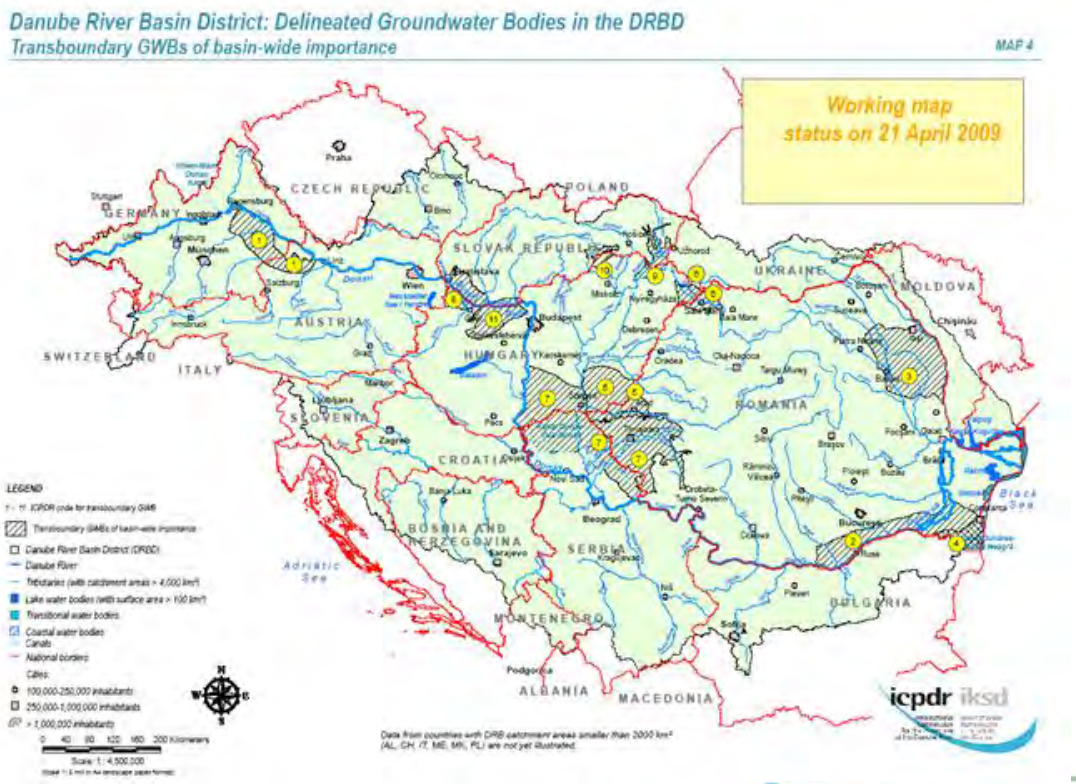
Stakeholder group	Identified needs	Scale of information
Decision makers (ministries, authorities, governmental bodies), also at EU level (e.g. DG Energy, DR Regio, ICPDR)	-overview on the **current utilization** schemes and its impacts, -independent expert-based information on the **limits of an enhanced use** of geothermal resources and its forecasted impacts -concise thematic expert summaries supporting **policy documents**	macro-regional
Potential investors and project developers	-information on the **geothermal potential** -information on the current **regulatory and financial** environment	regional/national
Project developers and users	-information on the targeted **reservoir properties** -transparent and reliable regulatory framework, short and easy licensing procedures	reservoir

Integrated resource management of hydrogeothermal systems – policy aspects „environment”

hydrogeothermal reservoirs ≈ thermal water aquifer

carrying medium: thermal groundwater

Water Framework Directive – good quality and quantity status of aquifers - PROTECTION

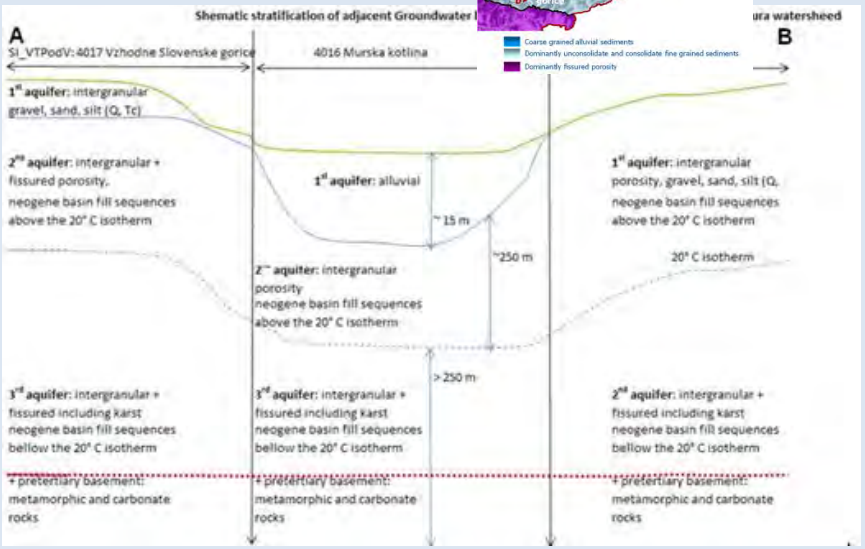


Common Implementation Strategy

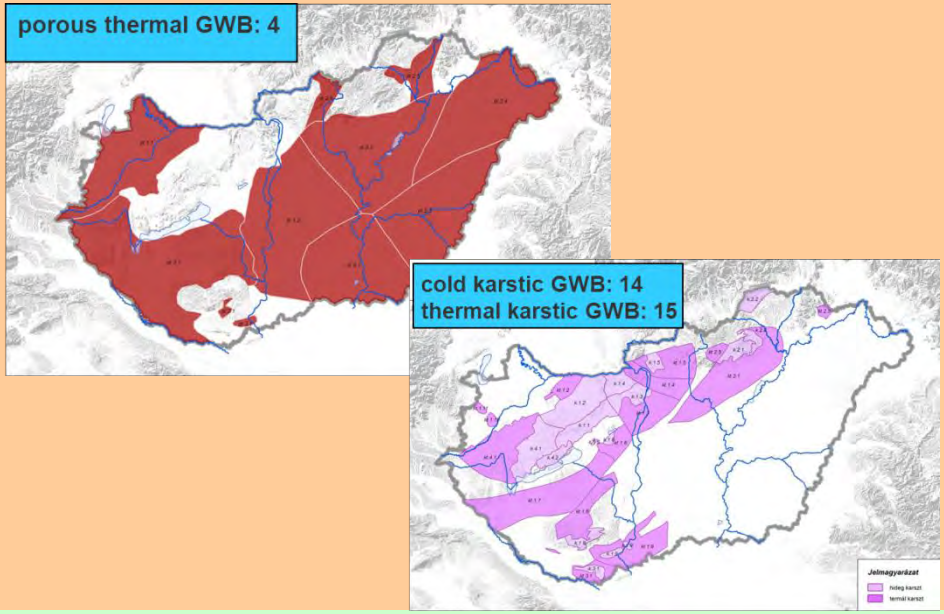
However the way to reach goals („good status”) – national – no/little harmonization

Delineation of groundwater bodies („hydrogeothermal reservoirs”) – differs in countries

Slovenia – depth



Hungary – aquifer lithology and T



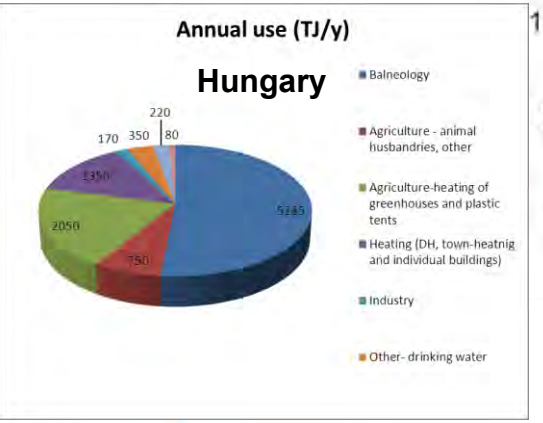
Slovakia – Q, pre-Q, thermal

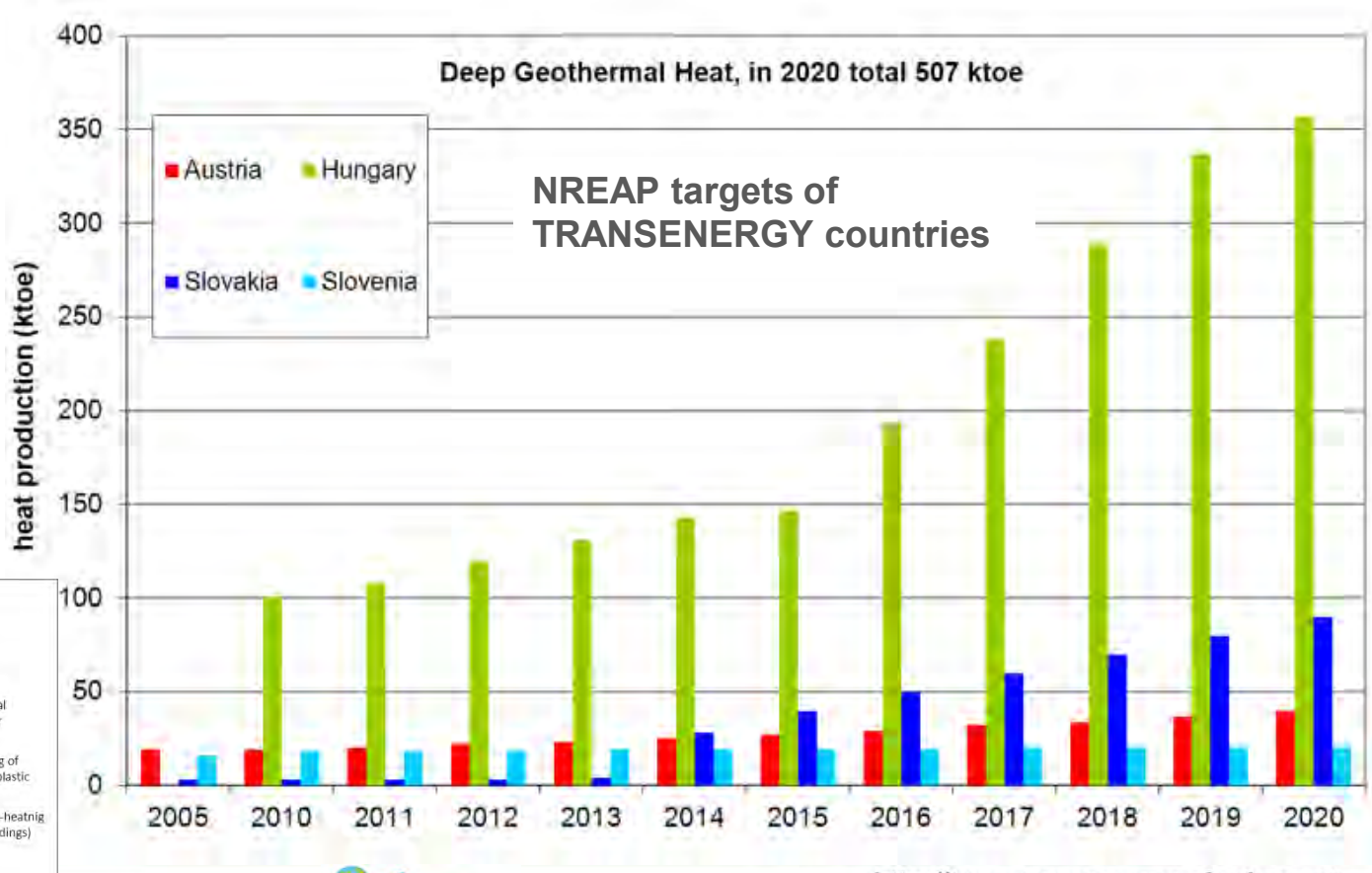
Austria – shallow and deep
No thermal GWB on TRANSENERGY area

Groundwater body code	Groundwater body notation
GK100157	Tertiärsande
GK100158	Thermalgrundwasser
GK100159	Enns
GK100160	Tertiärsande
GK100162	Donau Ost – Heideboden
GK100168	Steirisches u. Pannonisches Becken
GK100169	Oststeirisches Becken
GK100171	Weststeirisches Becken
GK100193	Rabnitzeinzugsgebiet

Integrated resource management of hydrogeothermal systems – policy aspects „energy”

RES goals: increase of geothermal → enhanced abstraction of thermal water - UTILIZATION





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Policy related challenges

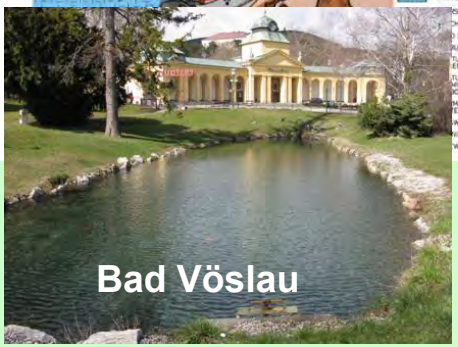
Is it possible to match „energy" and „environmental" goals – can the abstraction of thermal water be increased without threatening the quality and quantity status of the aquifers?

If yes, what are the boundary conditions for sustainable production?

Other aspects

Cross-border utilization conflicts

Competition for different types of use (hydrocarbon, CO_2 storage, etc.)



Where and which depth are the most important potential reservoirs?

GEOLOGICAL MODEL

How much thermal water can be abstracted which has natural recharge? (quantify free water resource)

To which extent abstraction can be increased without threatening environmental targets ? Impacts?

HYDROGEOLOGICAL MODEL

Which are the main flow-directons? Any cross border? Water-budgets among the main aquifers?

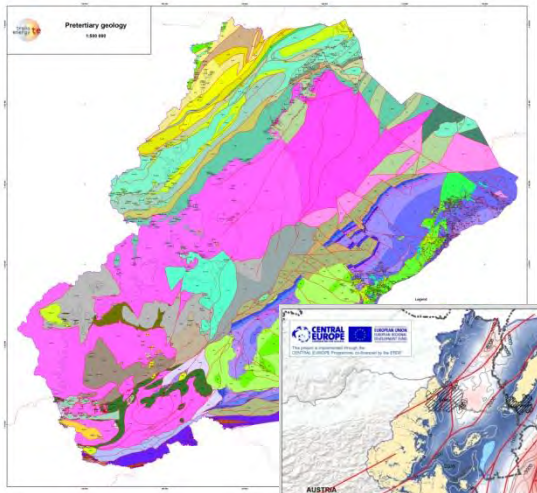
Chemical composition of thermal waters: Gases, dissolved content that might restrict utilization (scaling, corrosion)? Can associated gases be utilized? Is water treatment necessary?

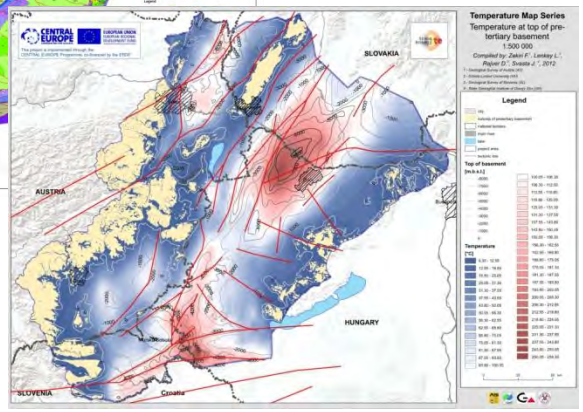
HYDROGEOCHEMICAL INVESTIGATIONS

What is the temperature at certain depths? How much heat is available (resources, reserves)? What sort of utilizations are feasible?

GEOTHERMAL MODELS

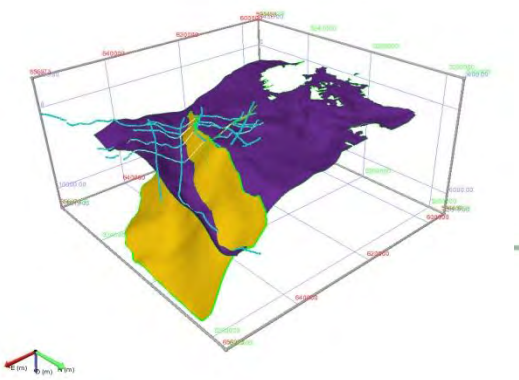
For results of geological, hydrogeological and geothermal models on the entire project area, please visit poster HS-1-39 (Szalkai et al)

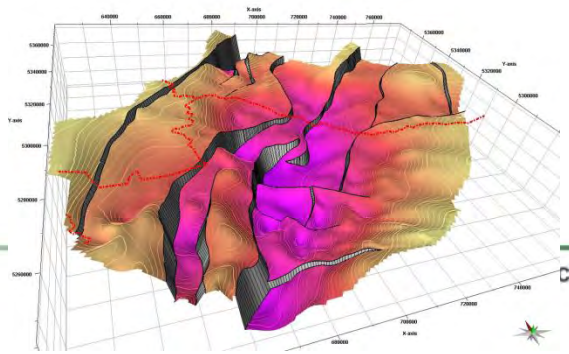




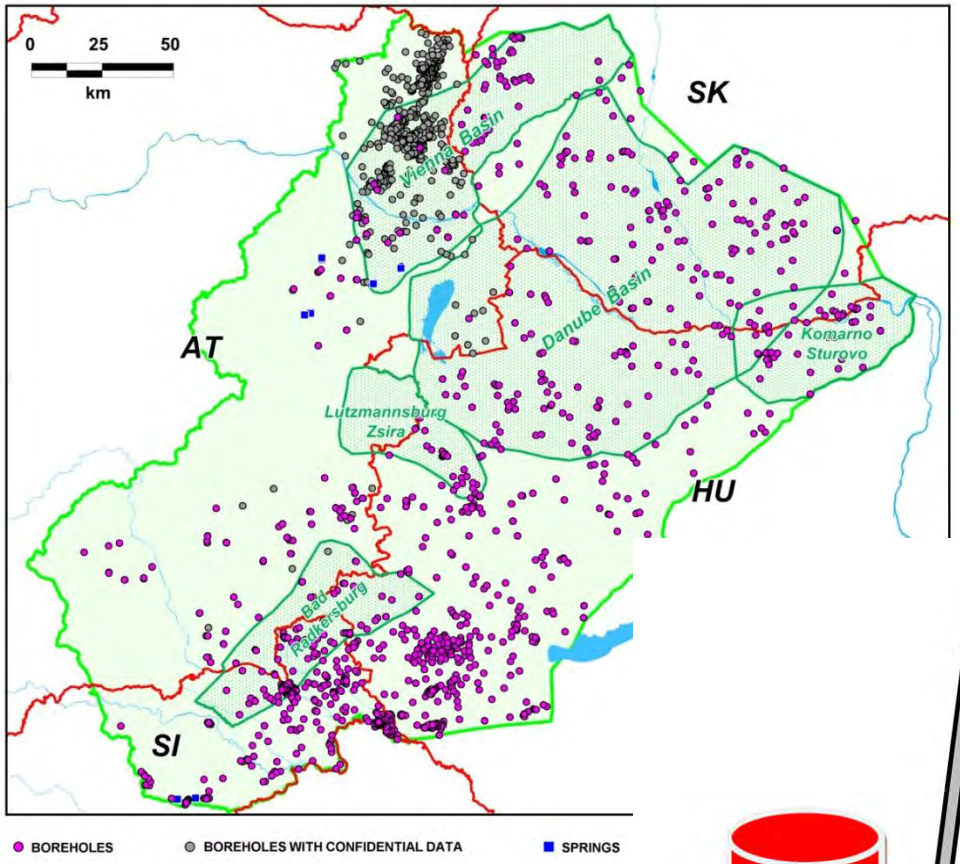
For results of the pilot areas please visit posters

1. Lutzmannsburg-Zsira HS-1-40 (Kovács et al)
2. Komarno-Sturovo HS-1-49 (Gáspár et al)
3. Danube basin HS-1-59 (Svasta et al)
4. Bad-Radkensburg – Hodos HS-1-79 (Fuks et al)
5. Vienna basin HS-1-20 (Goetzl et al) June 5 15.20 Pacinotti

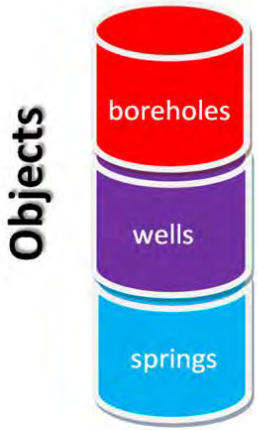




Data collection, harmonization, multi-lingual database (boreholes) (MS-Access)



Data from **1686** objects (boreholes)



Parameter groups	Parameters - content
General	• borehole identification, localization, purpose, ownership, etc.
Utilization	• thermal power, thermal groundwater usage/monitoring, waste water data, etc.
Technical	• borehole dimensions and construction, drilled profile, casings, screened intervals, geophysical surveys (inclination and dip), etc.
Geology	• lithology and stratigraphy (age) of rocks, facies, formations, fault traces
Hydrogeological	• hydraulic tests, hydraulic parameters, aquifer hydraulic properties, groundwater level monitoring, etc.
Geothermal	• thermal properties of rock and fluid, temperature profiles and monitoring, thermal gradients, etc.
Geophysics	•geophysical borehole logs
Basic chemistry	•Water analyses or monitoring of respective macrocomponents (Ca, Na, Cl, ...)
Trace elements	•water analyses or monitoring of respective microcomponents (Se, B, I, ...)
Isotops and noble gases	•water/gas analyses or monitoring of respective Isotopes (^{14}C, δ^{18}...) and Noble gases (He, Ne, Ar, ...)
Organic compound	•water analyses or monitoring of respective components (PAH, VOC, AOX, ...)

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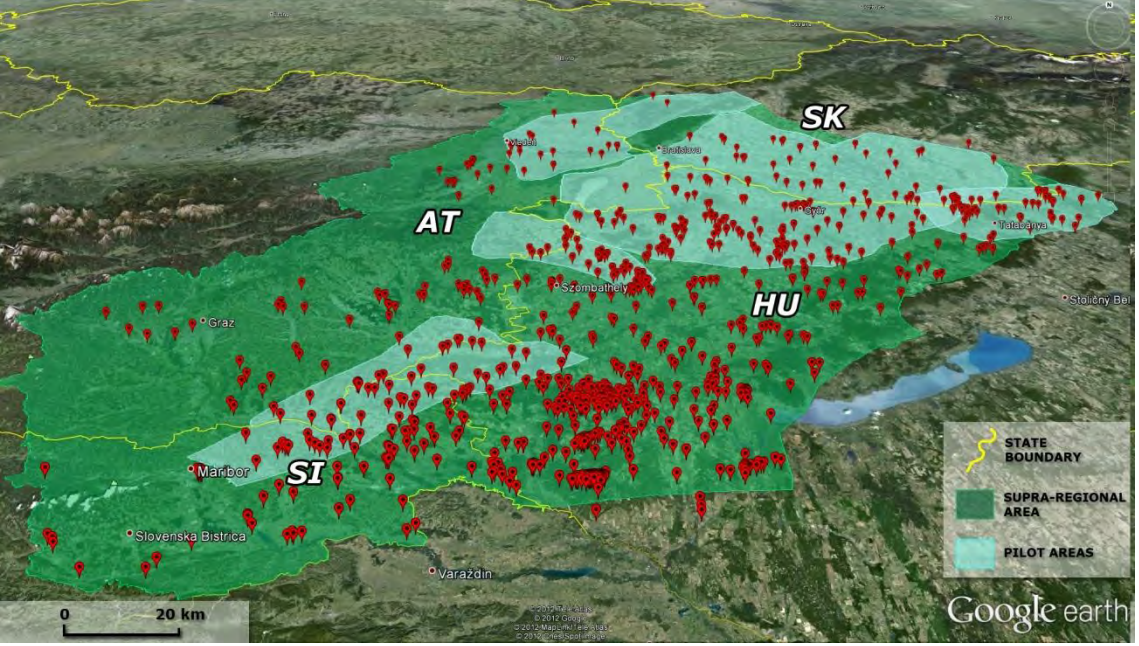
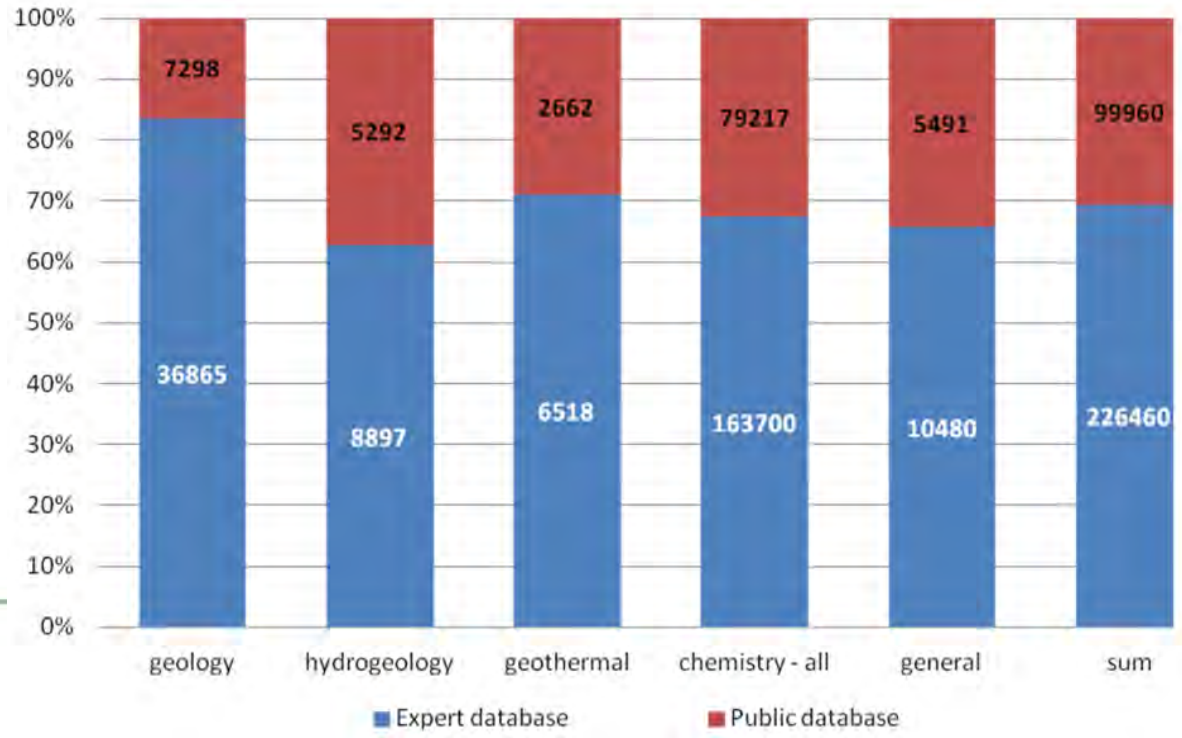


Public database:
1041 boreholes

available under web-map services on http://transenergy-eu.geologie.ac.at

AT – 115 boreholes
SLO – 128 boreholes
HU – 742 boreholes
SK – 56 boreholes



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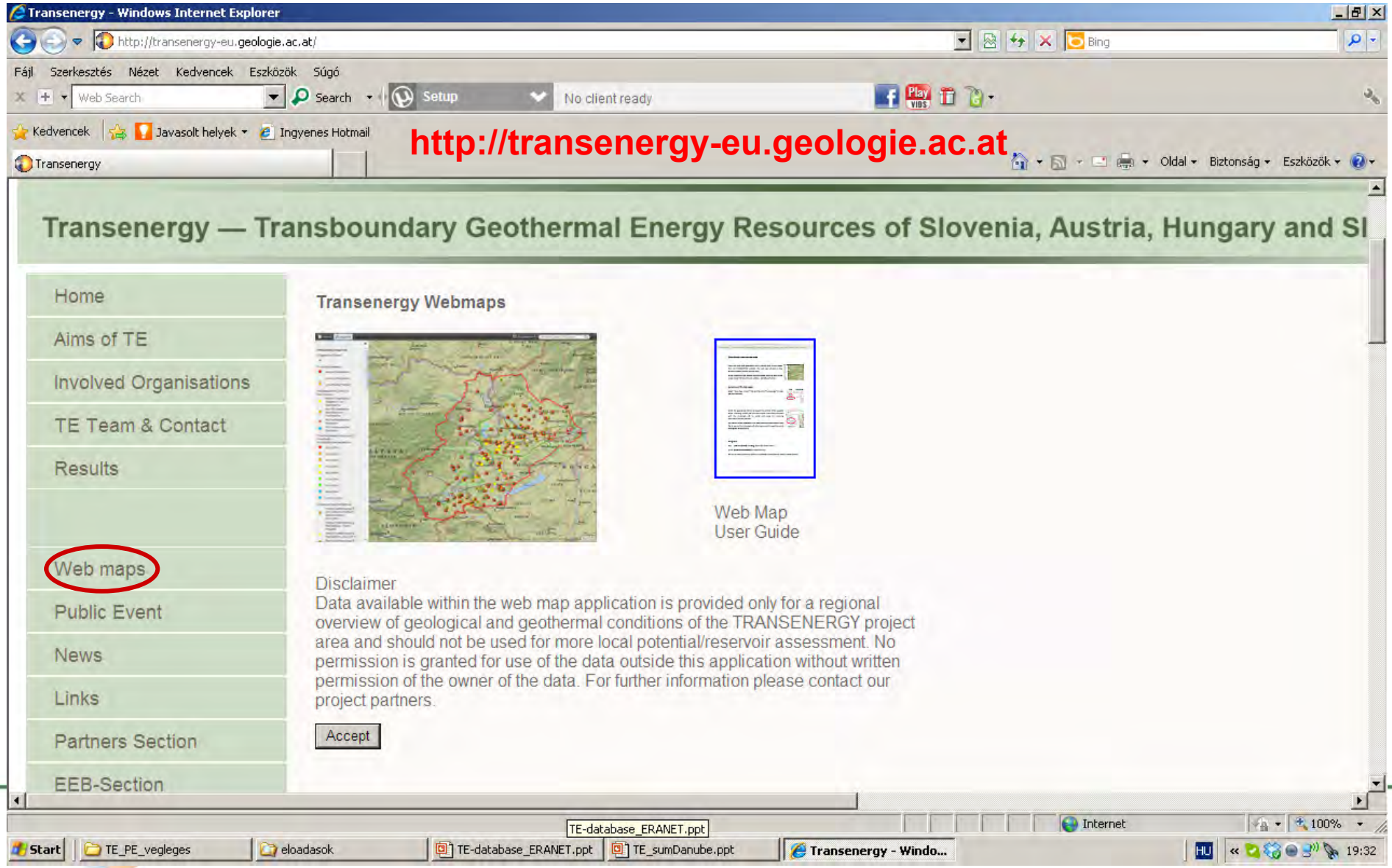
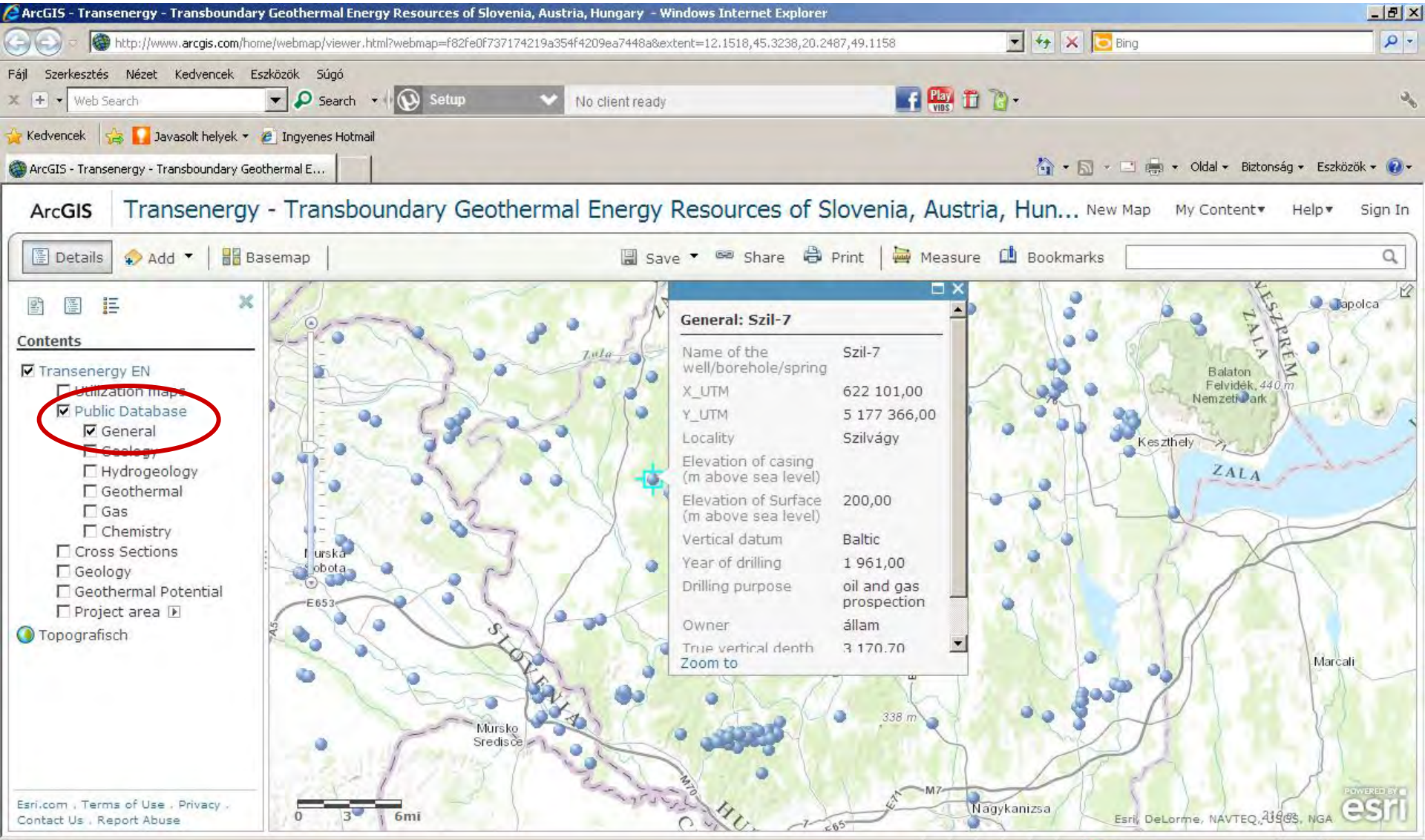
Web-map and web-feature services as management supporting tools





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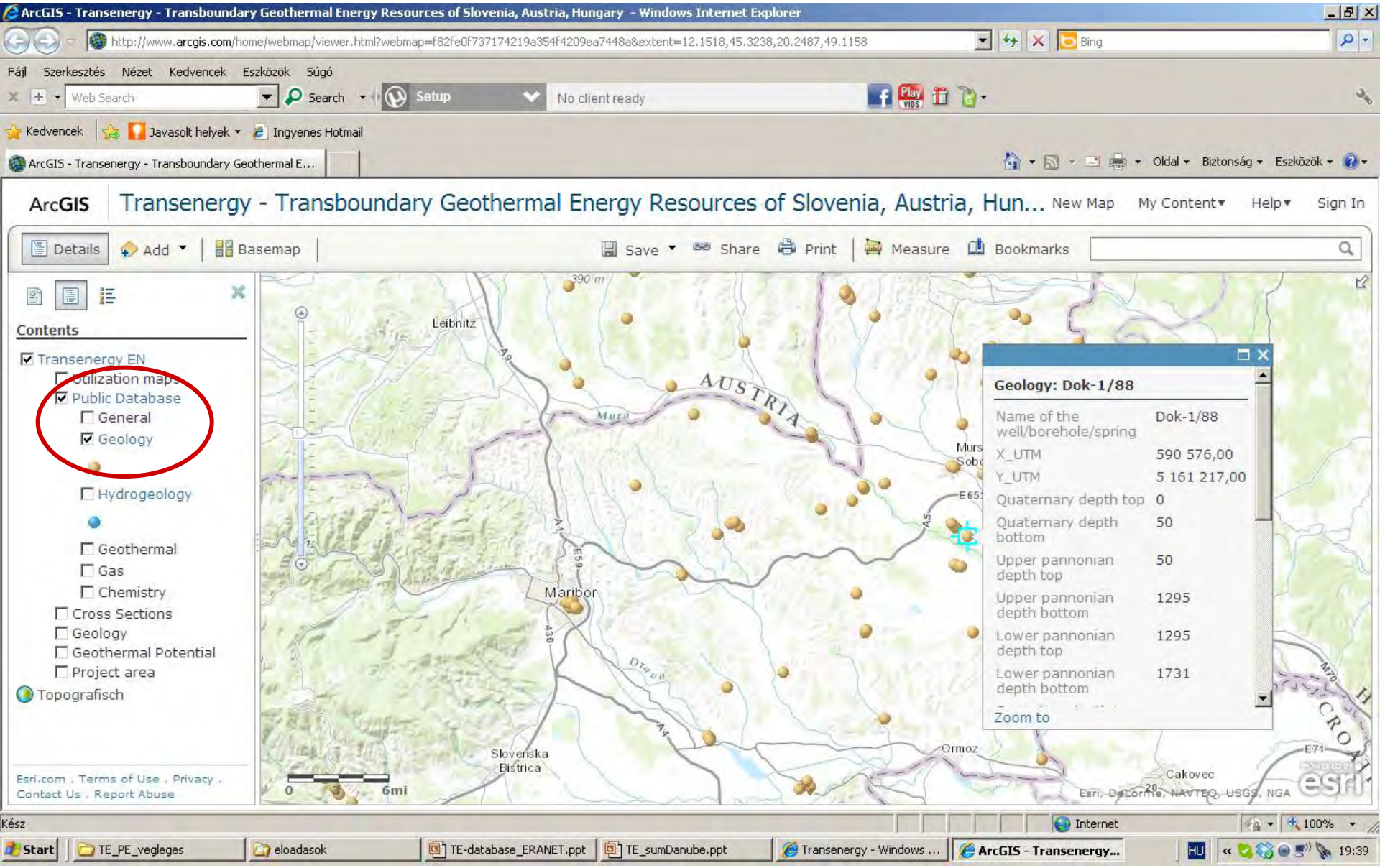
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Geothermal Potential
Project area
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Geology: Dok-1/88
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Dok-1/88
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Y_UTM
5 161 217,00
Quaternary depth top
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50
Upper pannonian depth top
50
Upper pannonian depth bottom
1295
Lower pannonian depth top
1295
Lower pannonian depth bottom
1731
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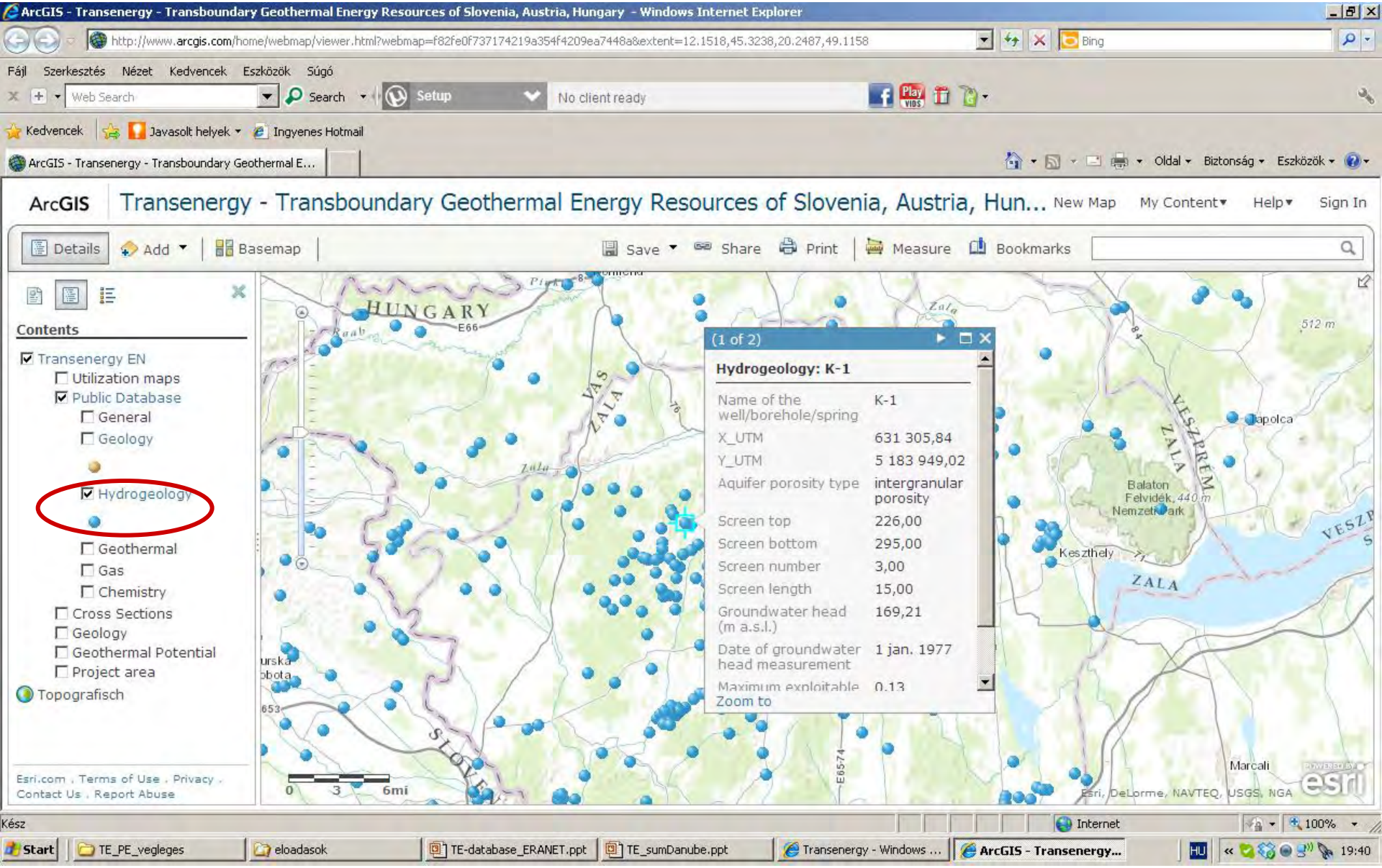
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Chemistry
Cross Sections
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Geothermal Potential
Project area
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(1 of 2)
Hydrogeology: K-1
Name of the well/borehole/spring K-1
X_UTM 631 305,84
Y_UTM 5 183 949,02
Aquifer porosity type intergranular porosity
Screen top 226,00
Screen bottom 295,00
Screen number 3,00
Screen length 15,00
Groundwater head (m a.s.l.) 169,21
Date of groundwater head measurement 1 jan. 1977
Maximum exploitable 0,13
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SLOVENIA
Keszthely
Balaton Felvidék Nemzeti Park
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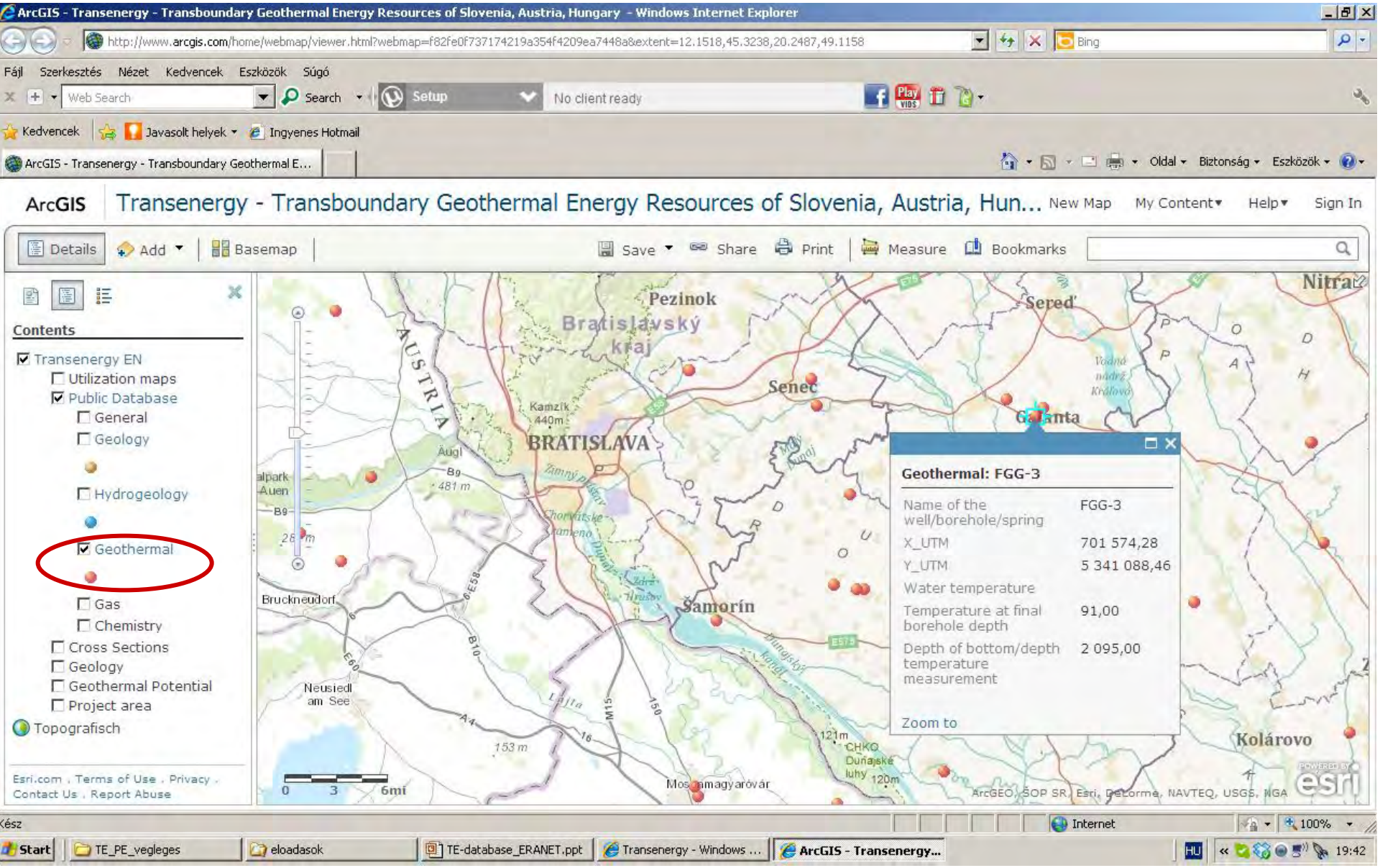

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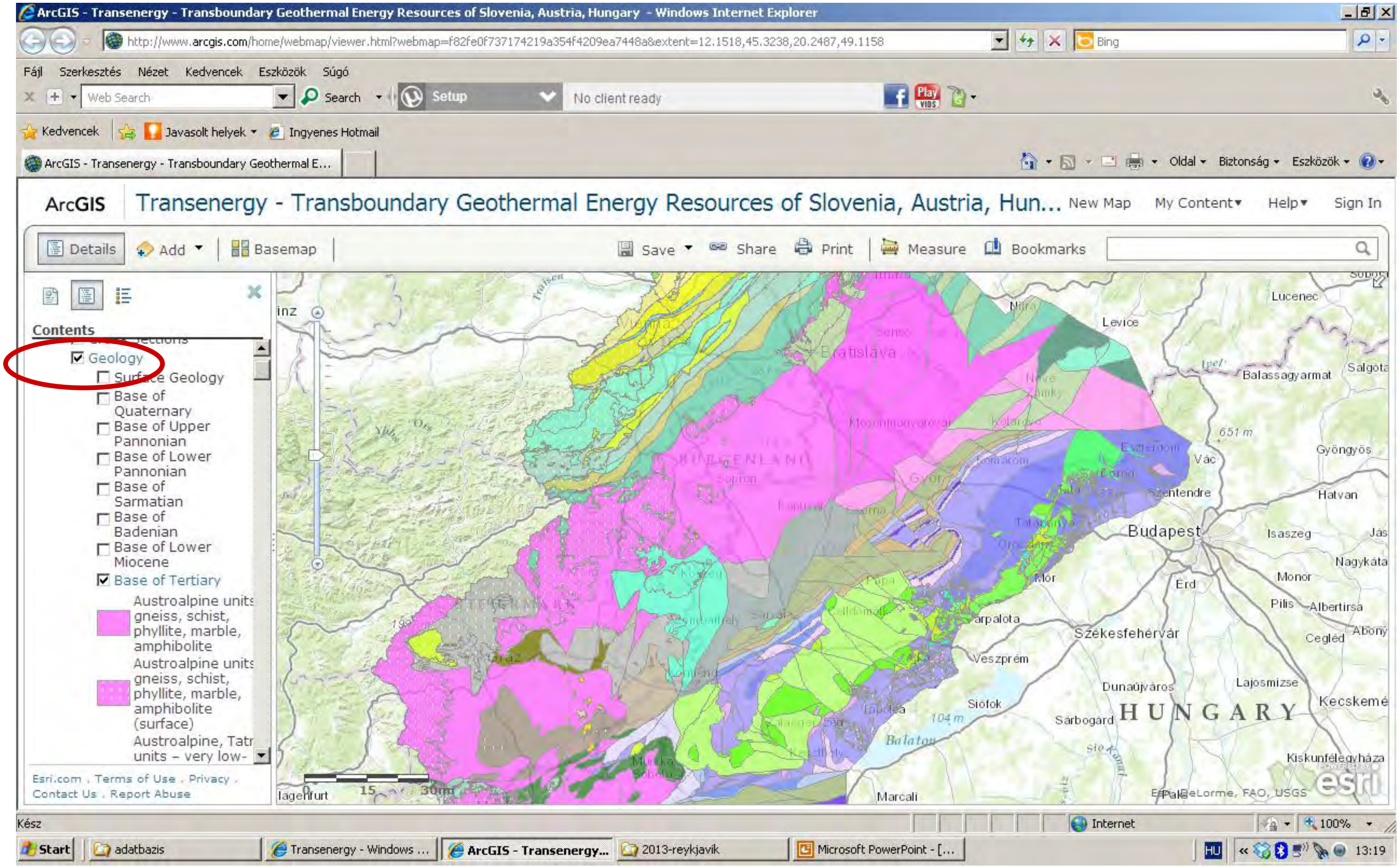
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Base of Upper Pannonian
Base of Lower Pannonian
Base of Sarmatian
Base of Badenian
Base of Lower Miocene
Base of Tertiary
Austroalpine units gneiss, schist, phyllite, marble, amphibolite
Austroalpine units gneiss, schist, phyllite, marble, amphibolite (surface)
Austroalpine, Tatr units – very low-
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Lucenec
Balassagyarmat
Salgóta
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Vác
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Cegléd
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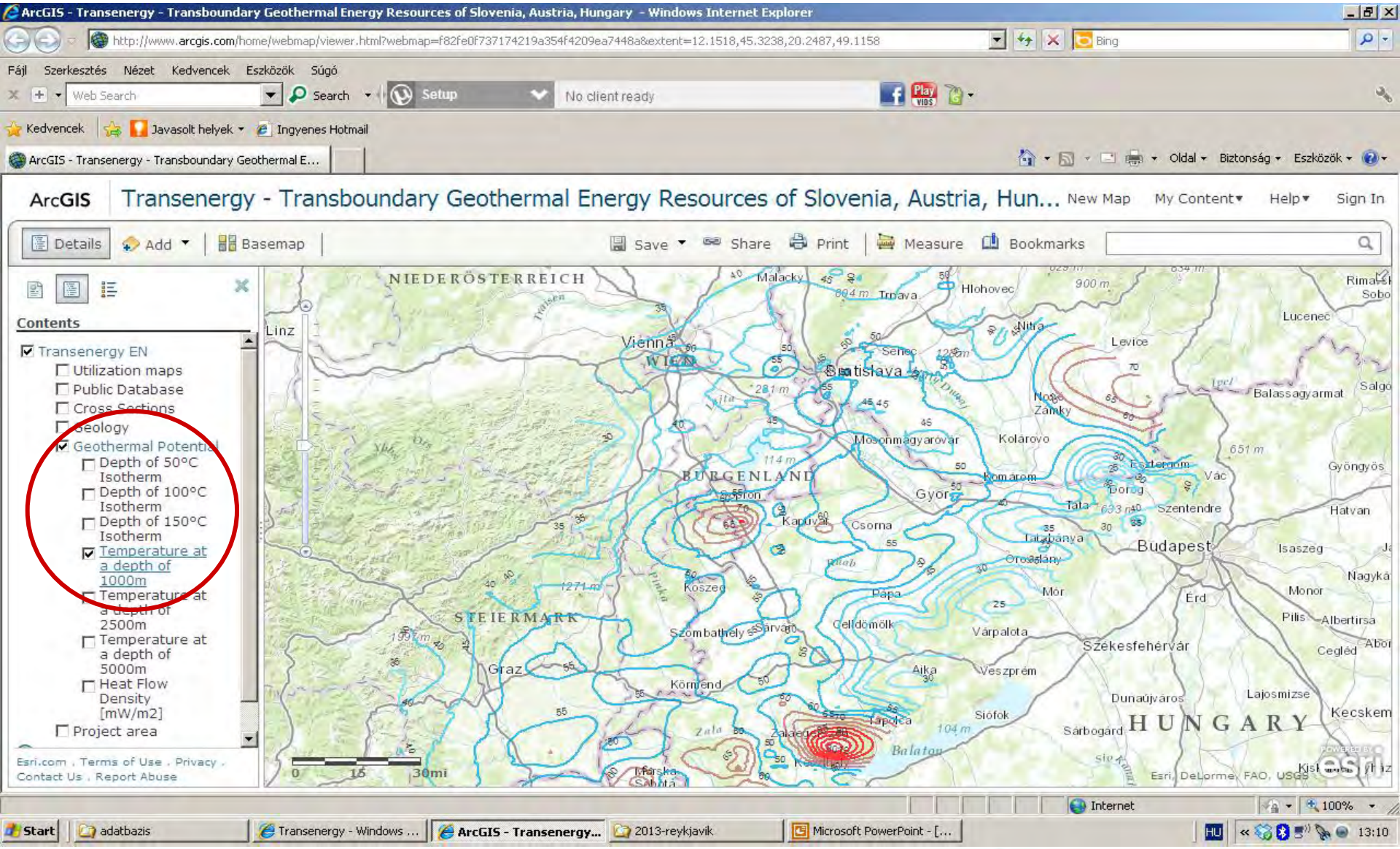
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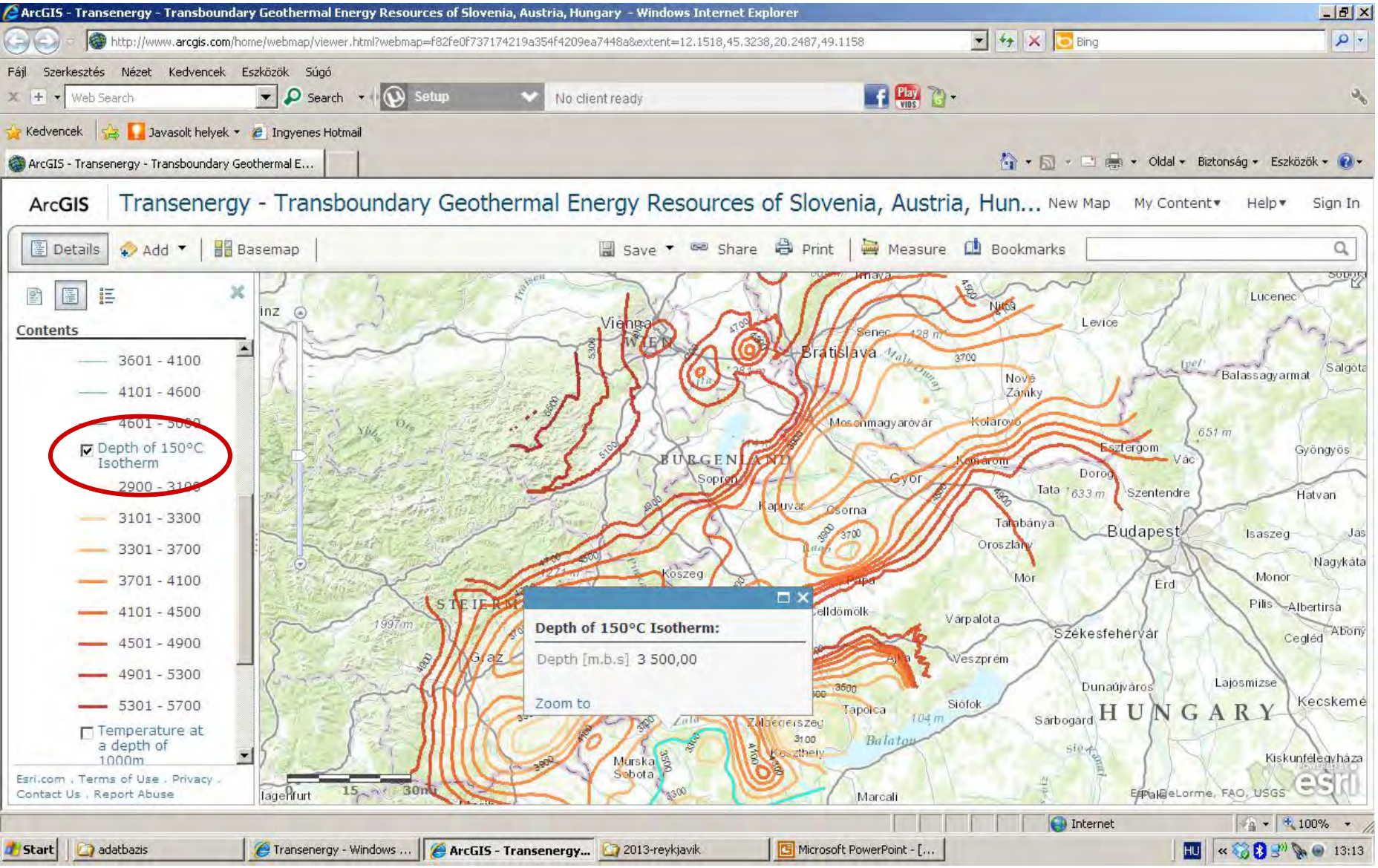
Geothermal Potential
Depth of 50°C Isotherm
Depth of 100°C Isotherm
Depth of 150°C Isotherm
Temperature at a depth of 1000m
Temperature at a depth of 2500m
Temperature at a depth of 5000m
Heat Flow Density [mW/m2]
Project area
NIEDERÖSTERREICH
BURGENLAND
STEIERMARK
HUNGARY
Vienna
WIEN
Linz
Graz
Bratislava
Budapest
Győr
Székesfehérvár
Balaton
Esri, DeLorme, FAO, USGS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Depth of 150°C Isotherm
3101 - 3300
3301 - 3700
3701 - 4100
4101 - 4500
4501 - 4900
4901 - 5300
5301 - 5700
Temperature at a depth of 1000m
Depth of 150°C Isotherm:
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Bratislava
BURGENLAND
Budapest
HUNGARY
Graz
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Non-technical barriers

LEGISLATIVE:

- GE is state owned, except for AT
- responsibilities are shared between ministries „energy-mining” and „environment”
- water concession in SLO, geothermal concession in HU
- licensing mostly by water permits: different authorities requirements and procedures
- re-injection: for the entire amount of abstracted water: SLO, AT, case-by-case: HU, SK

FINANCIAL:

- Direct subsidies, loans: for large projects EIB, EBRD
- FIT: exists, but low, under revision in HU
- No off-take, or support for green-heat
- No risk-insurance
- Tax incentives: only SK
- Indirect support schemes: energy-related operative programs of the Structural and Cohesion Funds: SK, SLO, HU

For details: **MA-12 (Prestor et al.) June 5, at 11.30 Auditorium**

Concusions

- ✓ Sustainable utilization of hydrogeothermal resources needs consensus between water management („protection”) and energy („utlization”) policies
- ✓ A win-win situation can achieved: if resorce-related questions are clearly defined and answers are based on firmly based gescientific models
- ✓ Harmonized management strategies can be based on:
  - common understanding and co-operation
  - joint database and information platform
  - transparency
- ✓ Non-technical barriers to be dismantled
- ✓ TRANSENERGY concepts to be applied elsewhere

Thank you for your attention!