

# ***A review of geothermal heating and development prospects in Europe and Project partner countries:***

***Poland***

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# Poland - geothermal water resources

## Areas of occurrence:

- Polish Lowlands (1)
- Inner Carpathians – Podhale Region (2)
- Outer Carpathians (3), Carpathian Foredeep (4) – some areas
- Sudetes Region (some localities) (5)

## Main reservoir parameters:

- Depths of exploited aquifers: 1 – 3.5 km
- Water temperatures: 20 – 97°C  
(locally >100°C waters *found*)
- Water mineralization (TDS): ~ 0,5 – 150 g/dm<sup>3</sup>
- Water flow rates /well: several m<sup>3</sup>/h – 550 m<sup>3</sup>/h
- Main reservoir rocks: sandstones, carbonates



map: M.Hajto, AGH-UST, FFD

Potential suitable for heating and other direct uses

# Good regional geothermal recognition: summary in „Geothermal Atlases” and other works (1995-2014) (for ~ 80% of Polish area)

## Scientific and practical aspects, eg.:

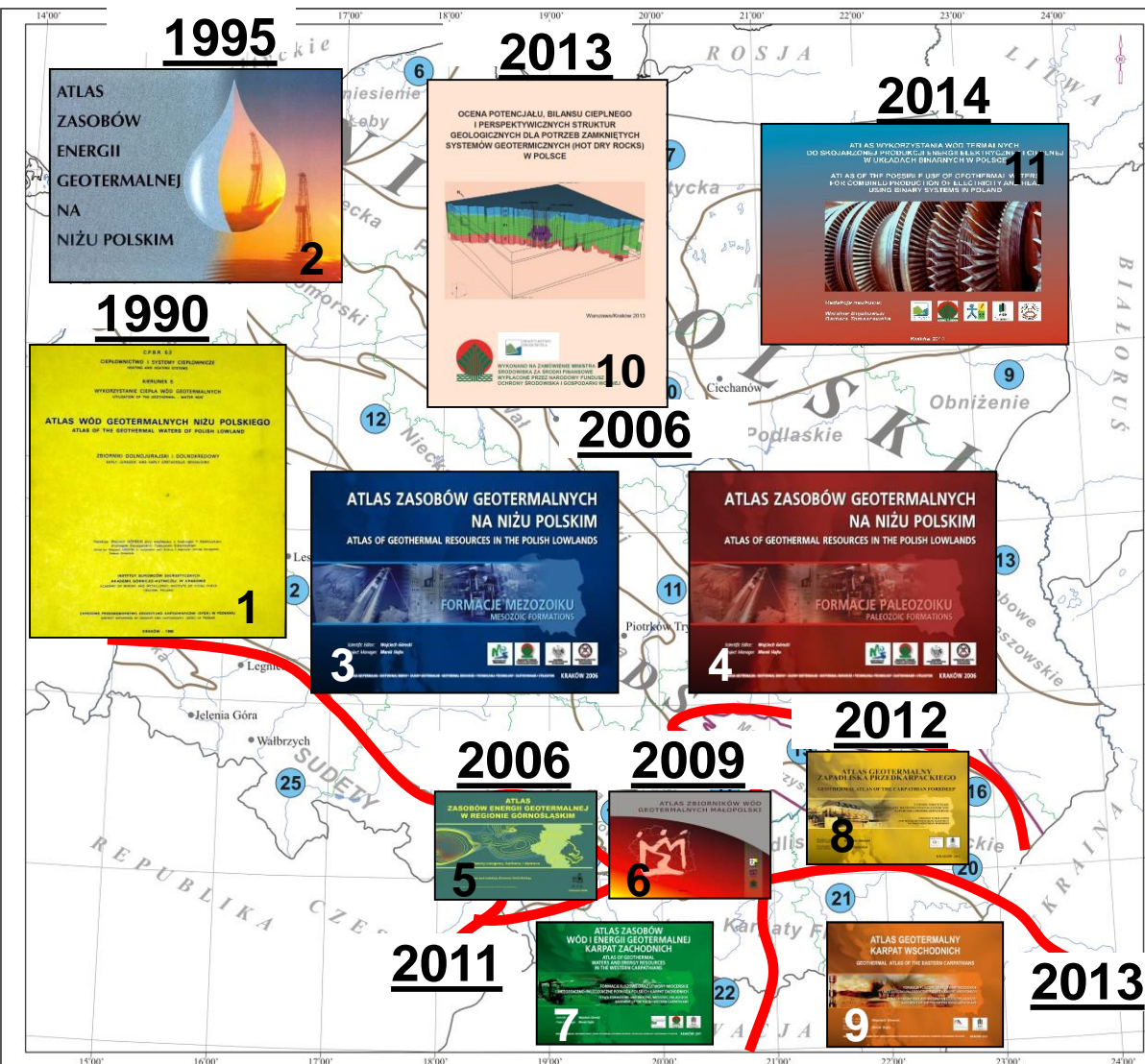
- Evaluation of resources
- Indicating prospective areas
- Etc.

## Elaborated by teams from:

AGH-UST, MEERI PAS,  
Polish Geological Institute  
Chief Mining Authority (Silesia)  
in cooperation with some  
other teams

## Funding:

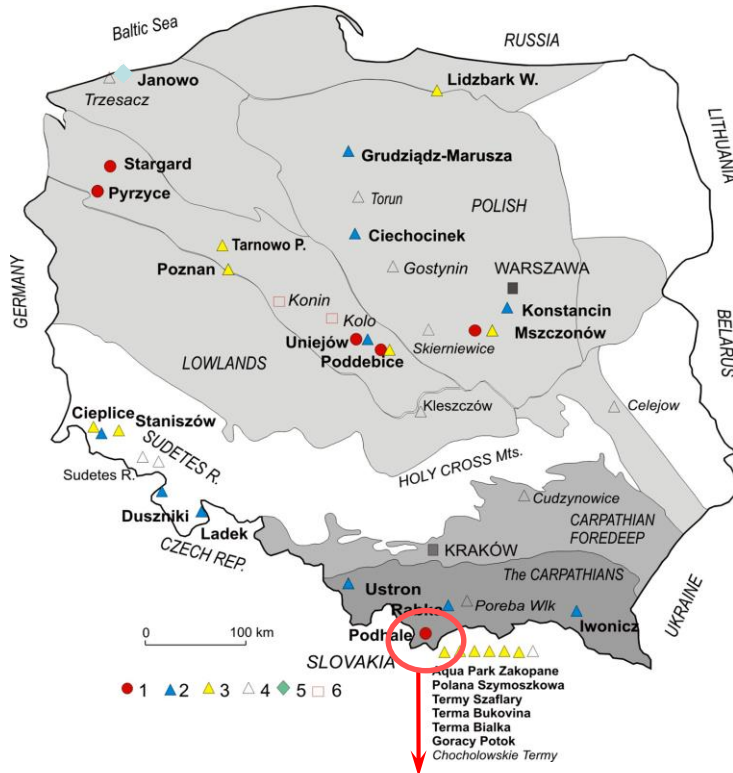
Ministry of Environment,  
NFEP&WM, Ministry of  
Science&Education, NCR&D,  
etc.



# Main prospects for geothermal development in Poland

- **Space heating, specially district heating (geoDH)**
- **Recreation/balneotherapy**
- **Locally – binary electricity generation (CHP)**  
(water  $T > 80 - 100^{\circ}\text{C}$ , hundreds  $\text{kW}_e - 1 - 2 \text{ MW}_e$ )
- **Agriculture, aquaculture, ecological food production**  
(incl. eco-agriculture (also in nature protected areas), bio-active food production based on geothermal waters/energy – some project ideas and initiatives in progress)
- **Shallow geothermal (heat pumps)**
- **Geothermal waters for drinking, mineral waters production**  
(several R+D+I works completed or in progress)
- Underground thermal energy storage, UTES / ATES / BTES

# Poland - geothermal energy uses, 2016/2015



- **Water temperatures: 20–86°C**
- **Balneotherapy, recreation:**  
10 spas, ~15 recreation centers
- **Space heating: 6 geoDH plants**  
Heat production - geothermal / total 2015):  
~ 820 TJ / 943 TJ, ~147 MW<sub>th</sub>  
(~ 0.35% share in RES heat)
- **Heat pumps:** > 45 000 units (GSHPs)  
(dynamic market growth in recent years)
- **Installed capacity:** ~ 705 MW<sub>th</sub>  
(~ 500 MW<sub>th</sub> GSHPs)
- **Heat production:** ~ 3670 TJ  
(incl. ~ 2 500 TJ heat pumps, GSHP)
- *Some further investments in progress*

## Podhale Region:

**Geo-capacity ~41 MW/ total ~83 MW**

**Geo-heat production 463 TJ/2015 (total 511)**

**The biggest geoDH in Europe – still expanding!**

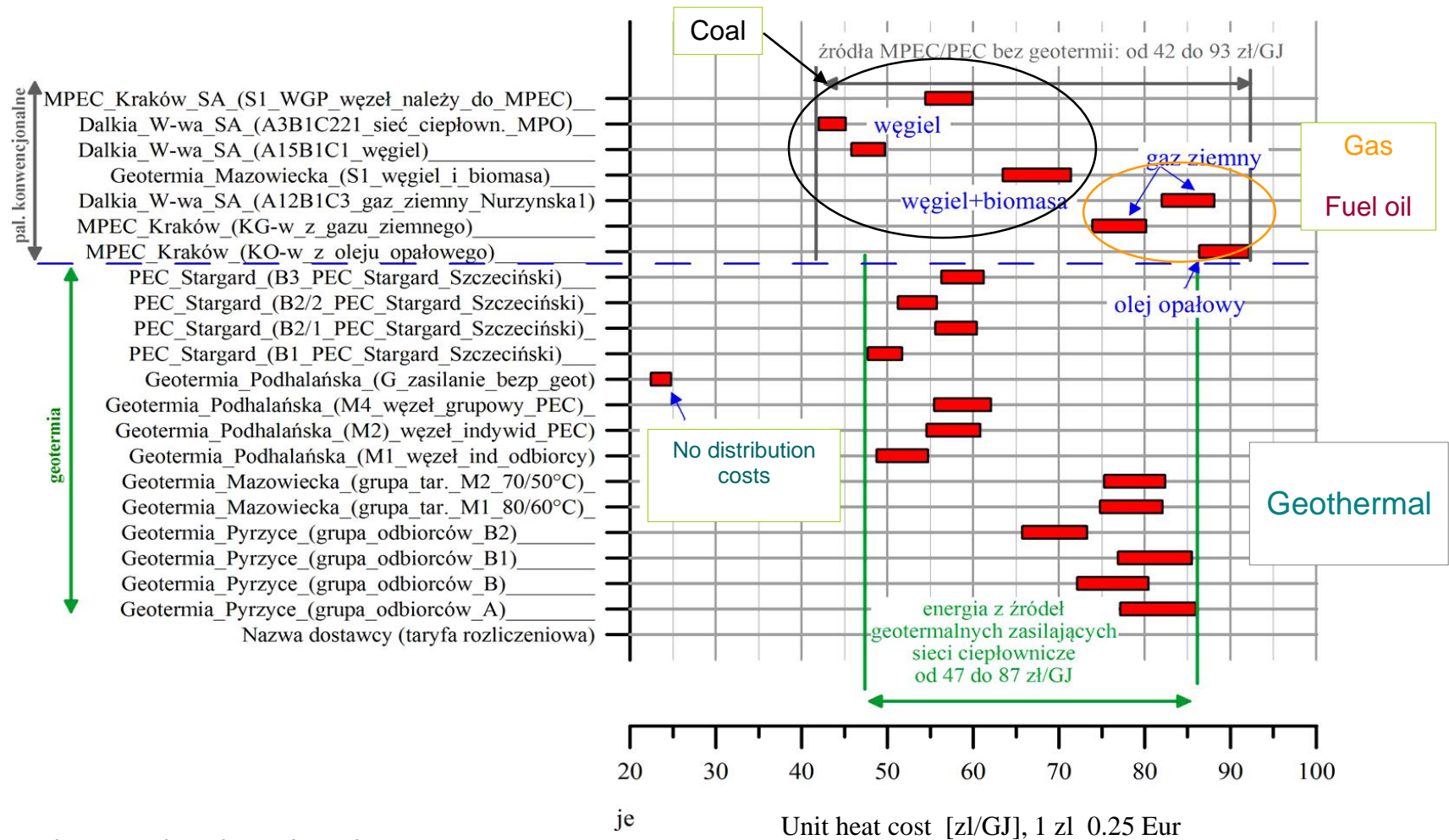
1. District heating plants, geoDH,
2. Health resorts, 3. Recreation centers,
4. Recreation centers in realization (some),
5. Atlantic salmon farm, 6. CHP (initial project stages)

# Poland – geothermal district heating plants, 2015

Locality	Year of opening	Outflow water temperature (°C)	Max water flow rate (m <sup>3</sup> /h)	TDS (g/L)	Geoth. capacity installed (MW <sub>th</sub> )	Total capacity installed (MW <sub>th</sub> )	Geo-Heat sales (TJ)	Geot. in total prod. (%)
<b>Podhale Region</b>	1993	<u>82-86</u>	960	2.5	40.7	82.6	300.3	90.51
<b>Mszczonów</b>	2000	<u>42</u>	60	0.5	3.7	8.3	15.8	38.2
<b>Poddębice</b>	2014	71	150 / 290	<u>0.4</u>	10	10	15	100
<b>Uniejów</b>	2006	68	120	6	3.2	7.4	19.2	80
<b>Pyrzyce</b>	1994	61	360	120	6	22	54.6	63.0
<b>Stargard</b>	2012	83	180	<u>150</u>	12.6	12.6	168	100
<b>Total – 6 geoDH plants</b>					<b>76.2</b>	<b>142.9</b>	<b>572.9</b>	



# Heat costs' comparison: geothermal vs. fossil fuels (acc. to approved tariffs) – June 2016 (similar 2015 and earlier)\*



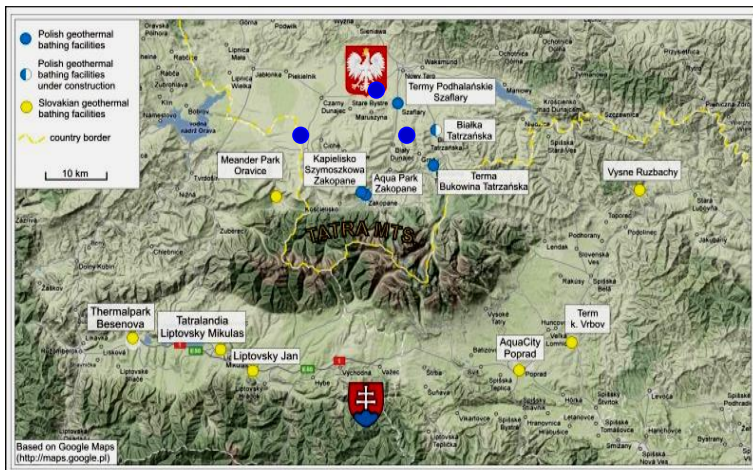
\* [in:] Pająk L., Bujakowski W. (2016), MEERI PAS

# Recreation, balneotherapy



Zakopane: geothermal pool  
in front of the Tatra Mts

- Main line of geo-investments in recent years:
- **14 big centers opened in 2006–2016 (!)**
  - Prospective business sector, great demand
  - Benefits:
    - attractive recreation and spa offer
    - modern development of local economics
    - new employments
    - and more ...
  - Some further investments in progress



Uniejów - the youngest geothermal resort in Poland (since 2012).  
Background - buildings heated by geoDH (photo: Uniejów Municipality)

Geothermal recreation centers around Tatra Mts - Poland and Slovakia





## „Jurassic Salmon” Farm, 2015



- Geothermal water used for farming and heating (25°C, 180 m<sup>3</sup>/h, M=14 g/L, Na-Cl type)
- Geothermal aquifer: Jurassic sandstones (depth 1220 m /top/, well drilled in recent years)
- High production standard, no surface water\*, no GMO, antibiotics, etc.
- Target Atlantic salmon production: ~ 1 000 T/y (22 T/week)



\* both geothermal and fresh water discharged by wells

# Main recent geothermal projects and activities

## Investments:

- Several investments in recreation
- Initial stages of some projects of next geoDH (and other uses) and first CHP plants
- Projects of several deep new drillings
- Optimisation, extension of operating geoDHs

## R&D, publications, eg.:

- 'Guidelines for design, execution and acceptance of installation with heat pumps'
- R+D on corrosion / scaling mitigation
- Prospects for HDR and for binary CHP
- R+D+I on geo-water desalination's prospects (easier injection, mineral, drinking water, etc.)

## Participation some EU and international projects, e.g.:

- IGE-T (project leader: GFZ Potsdam, Germany)
  - 'Promote geothermal district heating systems' (GeoDH), 2012-2014
- EEA „Geothermal potential for heating in Poland – Poddębice Town”, 2016 - 2017
- Shallow geothermal: 'Geothermal energy for transboundary development of the Neisse Region' (TransGeoTherm); Geoplasma, Geothermal4PI (EEA, 2017)
- GeoHeatPol – current EEA Project (2017)

Other studies, works, etc. for individual investors, LAs, etc.

## Main recent geothermal projects and activities, cont.

Several new drillings and other works expected to start in 2017/18  
thanks to state support

# Public support for geothermal development\*

by Ministry of Environment since 2016

/program operator: National Fund for Environment Protection & Water Management/

## **June 2016 - Program of financial support for geothermal development:**

200 mio Zloty (ca. 45 mio euro) - for exploration (drillings)

500 mio Zloty (ca. 113 mio euro) - for heating infrastructure (+ continuation)

Long-awaited support for take-off of wider geothermal development

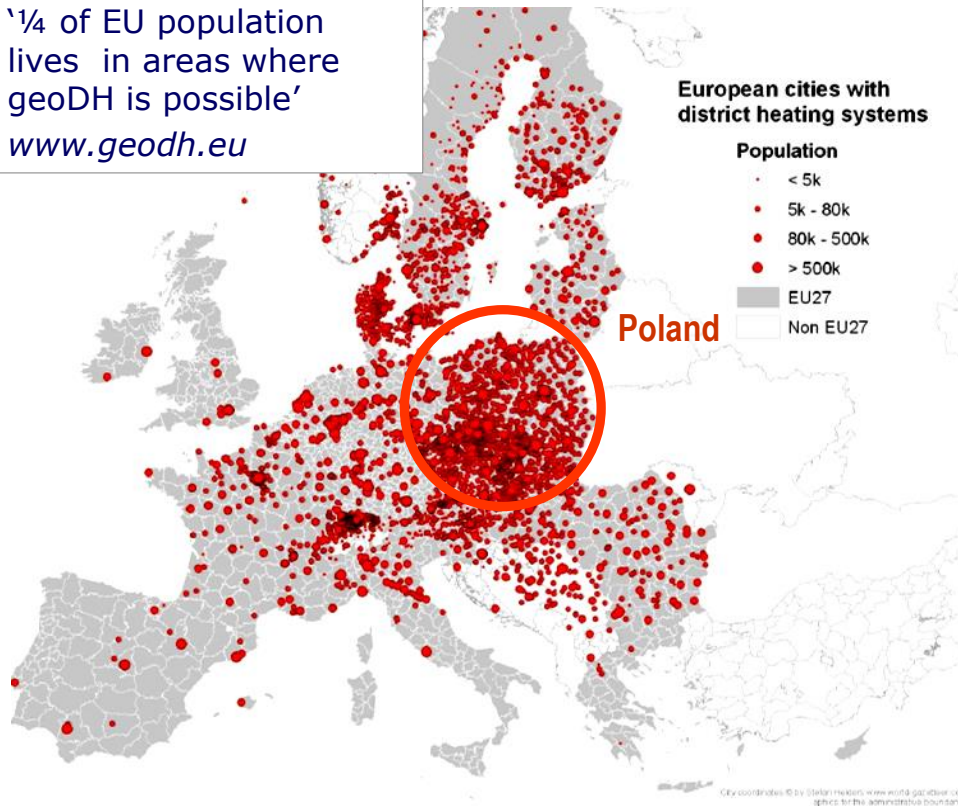
- Beneficiaries: local authorities, other investors, entities
- Types of support: grants (up to 100% for LAs), loans, capital investments
- September 2017 – several drilling projects granted the support (incl. Sochaczew, Łądek-Zdrój), some awaiting for decisions, support for other works and infrastructure
- Next stage of support coming soon
- Other opportunities in frames of national, EU-, NFM and EEA programs (in various thematic areas/objectives, where one may find space for geothermal)

\* For energetic uses – heating / CHP



# Heating / district heating – main sector for geothermal uses in Europe / Poland

'¼ of EU population lives in areas where geoDH is possible'  
[www.geodh.eu](http://www.geodh.eu)



District heating systems in Europe according to the current content of the HUDHC database (June 2012)

Source of map:

Persson *et al.* (2012) – HUDC Database 2012

/The Halmstad University District Heating and Cooling Database/

## Europe:

- ca. 5000 DH systems,
- ca. 270 geoDH, next in progress

## Poland:

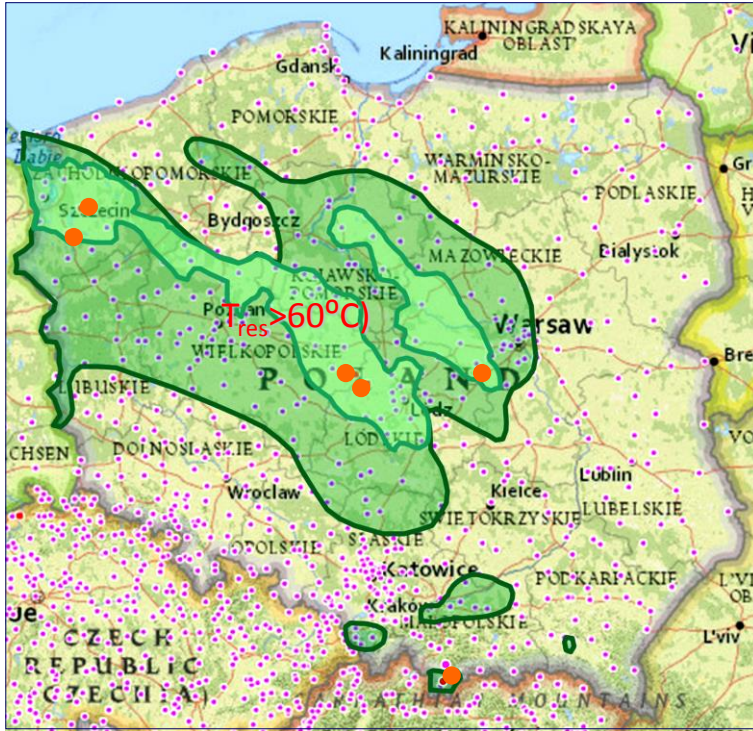
- ca. 500 DH systems
- 6 geoDH

Particular chance for geoDH both in Europe and Poland:

introducing to existing DH systems (some possible for geoDH )

# Poland – geoDH: the most prospective areas for development

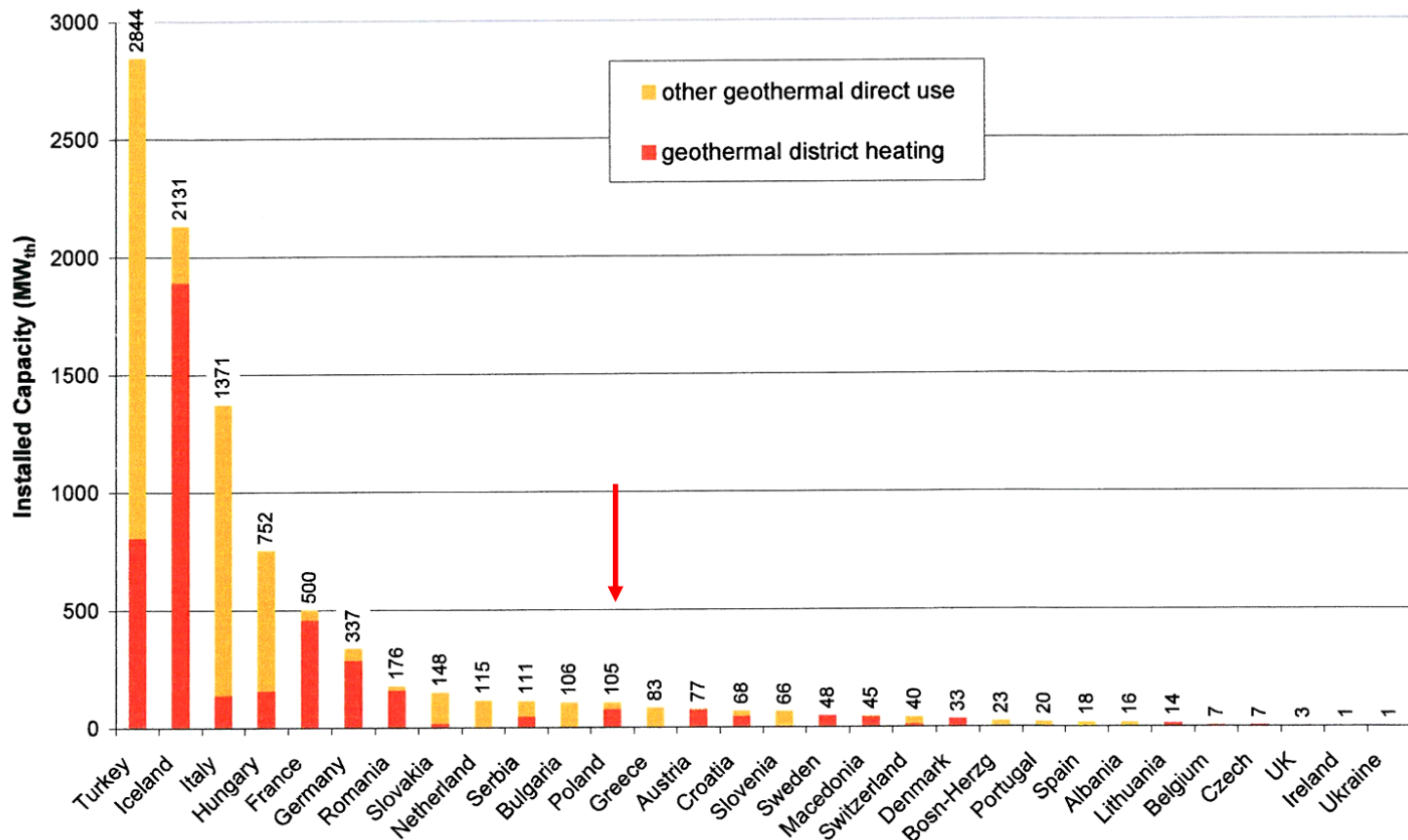
(background: map of district heating grids /ca. 500 in total/)



- Reservoir temperatures >60°C ('green' areas)
- Depths of aquifers up to 3-4 km  
(Polish Lowlands: aquifers mainly in Lower Cretaceous and Lower Jurassic formations)
- GeoDH systems – feasible mainly in localities with operating DHs, wells close to grids and customers  
(-> best way to increase number of geoDHs)

[in:] Report on Geothermal DH Potential  
in 14 EU-countries, 2014 ([www.geodh.eu](http://www.geodh.eu))

## Poland – share of geoDH in direct uses on European background, 2015\*



**Figure 8: Installed capacity in geothermal direct use in Europe 2015, showing the share of district heating in the total direct geothermal use**

\* acc. to European Geothermal Congress 2016 data  
[in]: Antics et al., 2016

# Poland – share of geothermal in RES mix and prognoses

2020 RES share in gross final energy consumption: 15.50%

2016 geothermal share in RES heating & cooling:

Deep geothermal:	~0.35%
Shallow geothermal (GSHPs):	~0.50%

2020 geothermal share in RES heating & cooling (NREAP):

Deep geothermal:	3.0%
Heat pumps:	2.5% (all types, incl. GSHPs)



to achieve prognosed 3% share of deep geothermal in H&C by 2020,  
further investments are needed – specially in geoDH sector (!)

Wider geothermal deployment is expected to be facilitated by:

- New public support introduced in 2016
- Other regulations, Strategy for Responsible Development



# Amendments of RES Law and Regulation proposed by the Ministry of Energy, 2016 facilitating RES / geothermal deployment

Amendments in RES Law and other acts from 22 June 2016 – *inter alia*:

- Introduction legal concepts of specific */sui generis/* autonomous Energy Regions (clusters, cooperatives) - possibility of new forms of business
- Several other regulations facilitating, among others, connecting RES/geothermal to district heating systems (DH)

Regulation proposed by the Minister of Energy on detailed scope of obligation and technical conditions of connection of installation and purchase of RES heat:

Contains mechanisms initiating the development and use of RES in heating networks (even if based on fossil fuels), including (inter alia):

- Possibility of RES heat supply to DH network on its return side from the grid
  - important also for geoDH development

# Strategy for Responsible Development by the Ministry of Development, 2016

## Actions foreseen for energy and RES (including geothermal):

- Promoting and initiating local projects (clusters) for energy production (-> indication for RES' development) and energy efficiency in order to strive for energy self-sufficiency of municipalities and counties (microgrids)
- Introduction of energy-saving and high-efficiency technologies
- Support electricity and heat co-generation (CHP)

## Operational objectives of the achievements by the-above-actions:

- Providing local energy security
- Improving the local environment
- Increasing the competitiveness and economic efficiency of the local economy

# Some other essential legal and economic aspects of geothermal development

## Positive provisions of Geological and Mining Law, e.g.:

- One-staged license for exploitation, no license for exploration / prospecting of geothermal water,
- No royalty for geothermal water exploitation,
- No fee for the geological information for project purposes,
- Reduction of fees for geological information's use to exploit geothermal water (up to 1% of its value to end 2020)

## Missing so far:

- Geological Risk Insurance Fund

# Prospects for geothermal energy development in Poland

Poland - prospective conditions for wider geothermal development, incl. heating:

- Proper resources (specially Polish Lowlands, Podhale R., some localities in Sudety R.
- Potential receivers of geothermal energy
- High involvement of scientific manpower
- Teams of geological, drilling, consulting, servicing companies (possible to 'switch' into geothermal sector),
- Relatively high public acceptance
- The need to fulfil international and domestic obligations related to RES and realisation of responsible sustainable economic and energy development

The-so-far geothermal uses have resulted in positive economic, environmental, social and other effects in many places.

Even though the Polish energy sector is based on fossils / coal there is a space and many opportunities for geothermal development and

for international cooperation with leading world-class experts – like in the framework of EEA/NG mechanisms



# Prospects for geothermal energy development in Poland, cont.

## ❑ **Positive effects and benefits, eg.:**

- Low-emissions' heating (limitation of coal-based heating systems)
- Increased the RES share, energy saving and efficiency
- Improving living and health conditions
- Competitive prices, secure energy supply

## ❑ **Enhancement for local economies**

## ❑ **Sustainable, innovative local / regional development**

## ❑ **Absorption of national and European funds**

## ❑ **International / bilateral cooperation**

**Thank you!**

**[www.eeagrants.agh.edu.pl](http://www.eeagrants.agh.edu.pl)**

**[www.min-pan.krakow.pl](http://www.min-pan.krakow.pl)**

