

Promote Geothermal District Heating Systems in Europe

Geo-DH



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Programme of the European Union

Geothermal DH potential in Europe

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Relevance of Geothermal Energy to EED Art. 14: Promotion of efficiency in heating and cooling

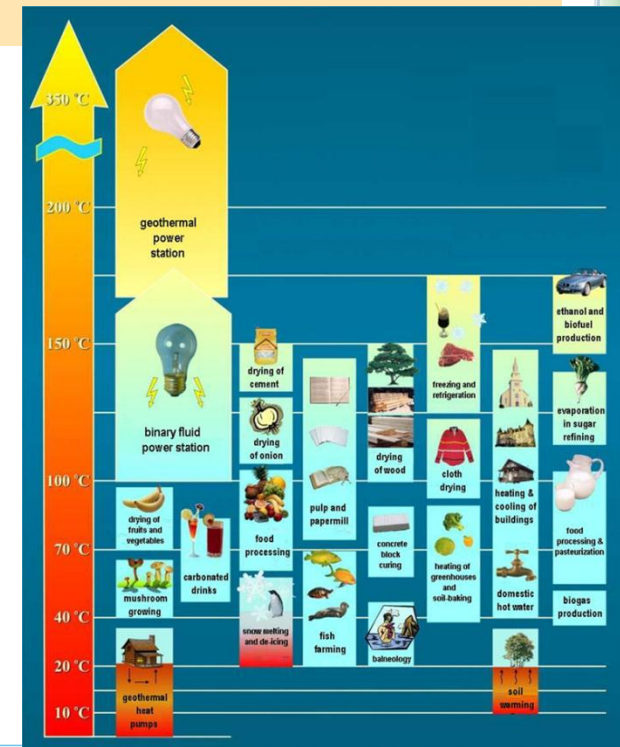
„By 31 December 2015, Member States shall carry out and notify to the Commission a **comprehensive assessment of the potential** for the application of high-efficiency cogeneration and **efficient district heating and cooling**..

Geothermal energy: the energy stored in the form of heat below the surface of the solid Earth (2009/28/EC)

Geothermal heating and cooling: local, baseload and flexible renewable energy, diversification of the energy mix, and protection against rising fossil fuels prices.

High urban density areas: resources and demand need to be geographically matched

- new heat grid infrastructures
- retrofitting existing district heating systems



About geothermal district heating (geo-DH)

More than 240 geoDH plants in Europe

Total installed capacity: 4,3 GW_{th}

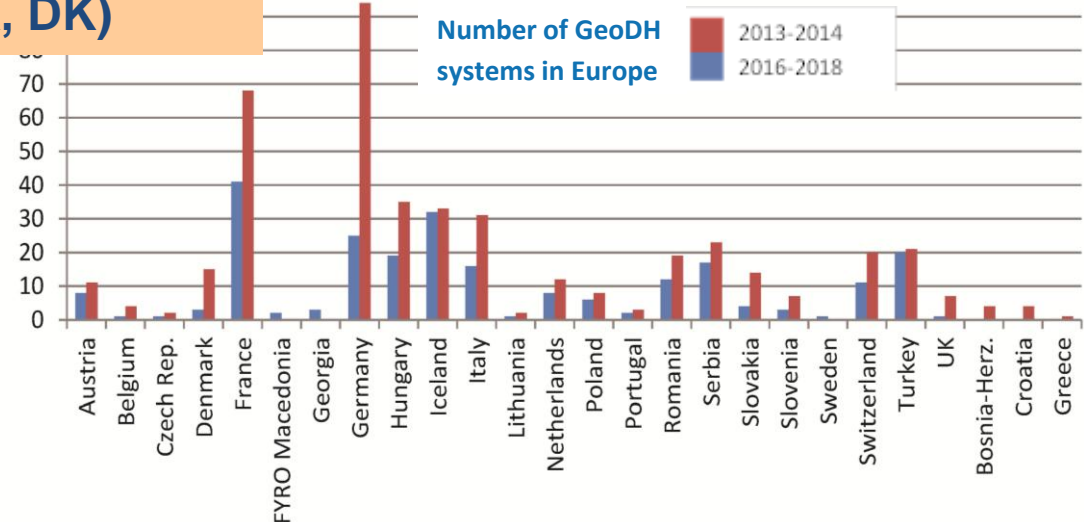
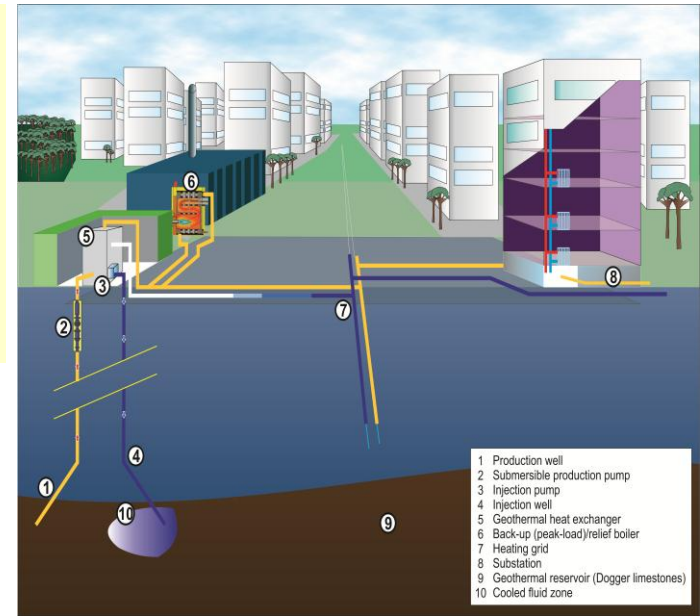
Production: 12900 GW_h

CHP plants represent already a 500 MW_{th} capacity for heating

- Mature markets: long tradition and ambitious 2020 targets (D, F, I, HU)
- Transitional markets: untapped potential, some geoDH systems (PL, SK, RO)
- Juvenile: first plants (NL, UK, DK)

Systems: from small (0,5-2 MW_{th}) to large (50 MW_{th}) operated by ESCO's or municipalities

Utilization of shallow, low T resources by heat pumps → cooling



Untapped geothermal resources could significantly contribute to the decarbonisation of the DH market

12% of the total communal heat demand is DH

Geo-DH would be available for 25% of EU-27 population

heat supply to DH systems:

- power plants: 17%
- waste: 7%
- industrial heat: 3%
- biomass: 1%
- **geothermal: 0,001%**

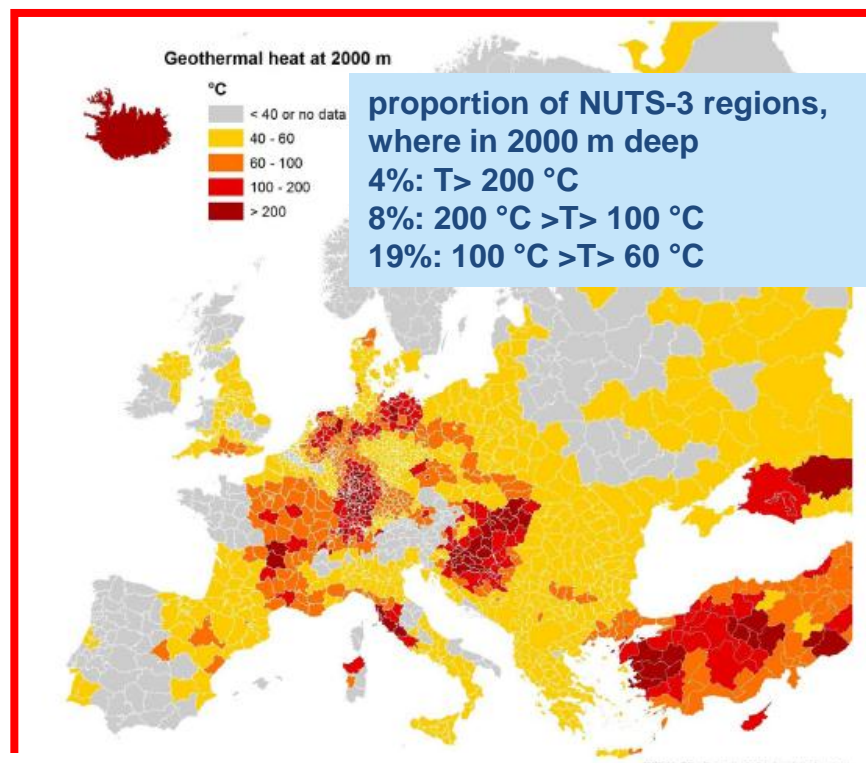
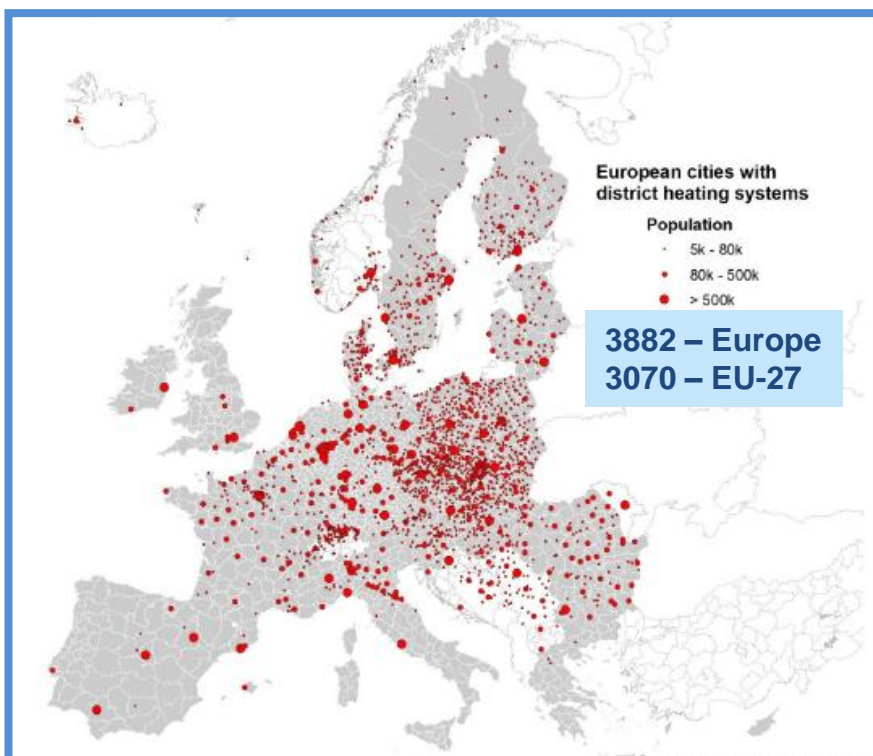


Figure 17: District heating systems in Europe by city size and for ci with 2779 systems. Source: Halmstad University DHC Database.

Source: Heat Road Map Europe 2050 project ,
Aalborg University and Halmstad University, 2013

1 m depth by NUTS3 region. Source: European Commission, nbourg 2002.

About Geo-DH project

Stimulating geothermal district heating projects...

In 14 EU Member States...

By:

- Increasing awareness on the potential applications and benefits
- Simplifying regulations and improving national and local framework
- Attracting more financing
- Transferring best practices
- Training energy officers on geothermal DH technologies.

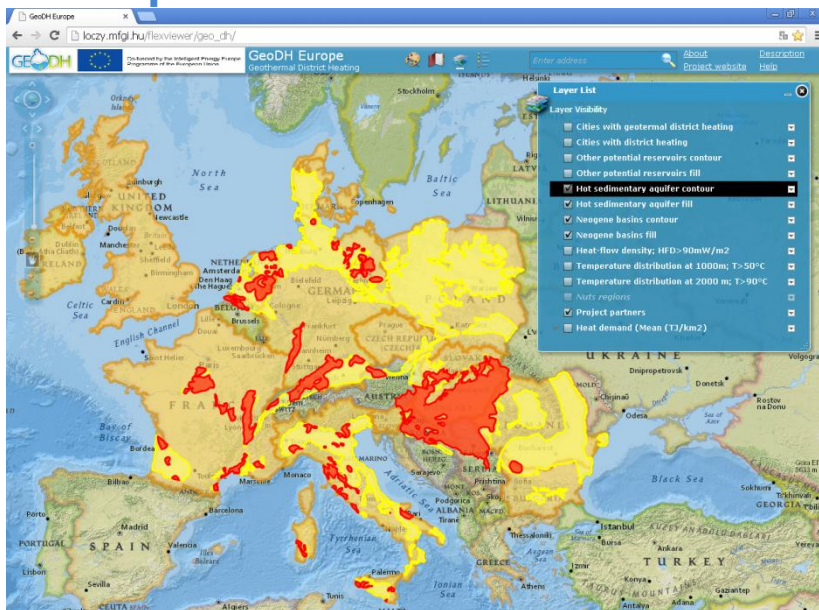


www.geodh.eu

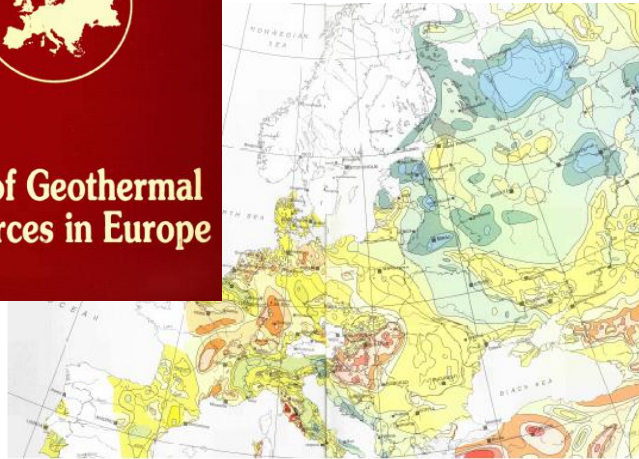
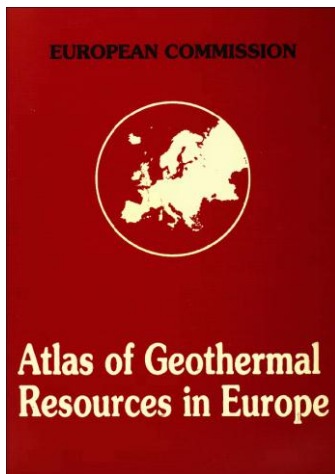


Methodology: Data collection → Necessary resource parameters for geo-DH → targeted geological environments

- ✓ temperature of fluid (thermal groundwater) > 50 °C (heat-pumps → low-temp. resources → **energy efficiency along the entire supply chain!**)
- ✓ high yield (several thousand l/min)
- ❖ young Neogene basins with thick porous sedimentary sequence infill
- ❖ large, preferably active tectonic zones, where enhanced permeability may exist in deep-lying carbonate / crystalline rocks, older sedimentary rocks

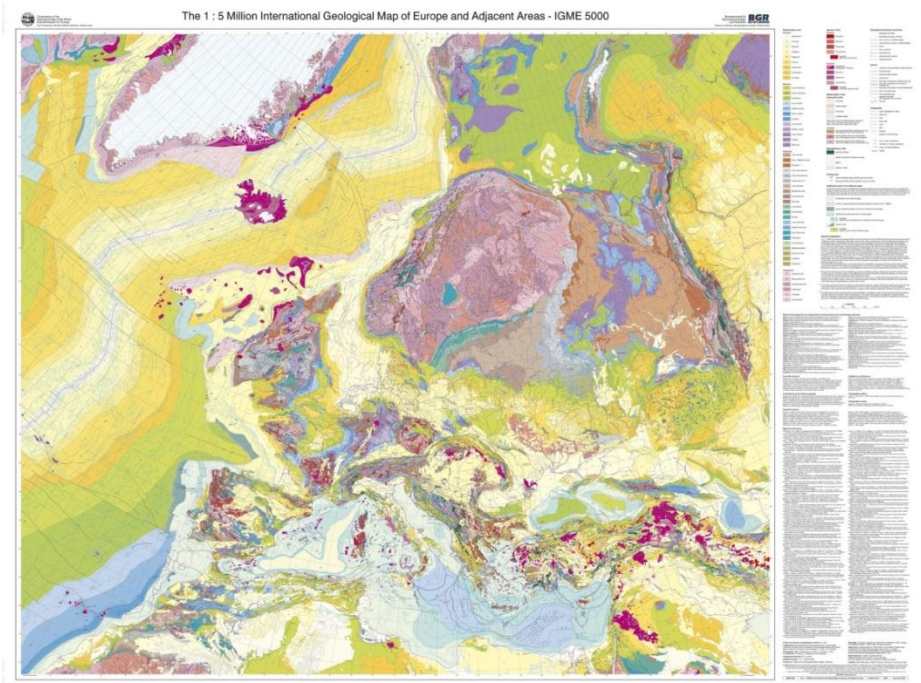


Data compilation: maps available at European scale

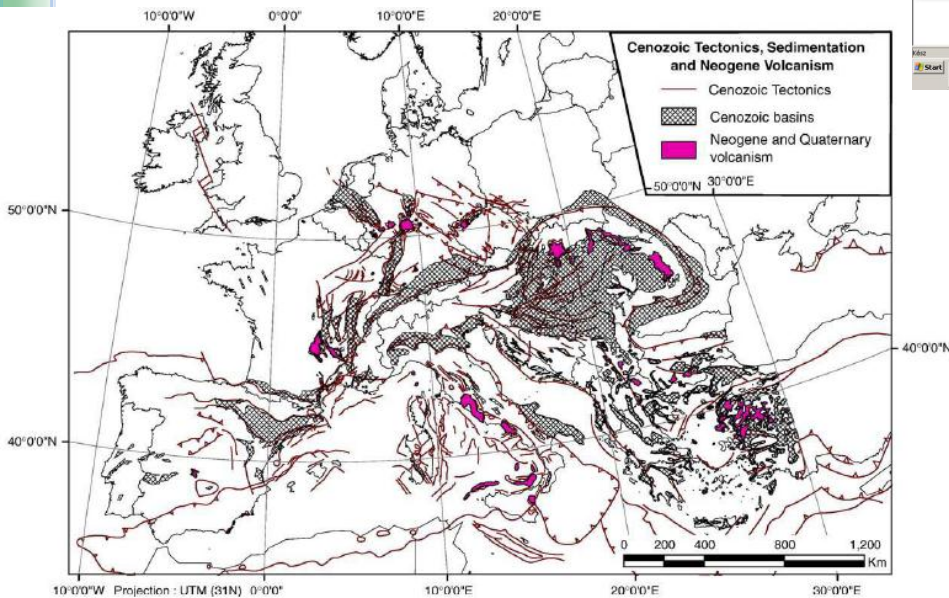
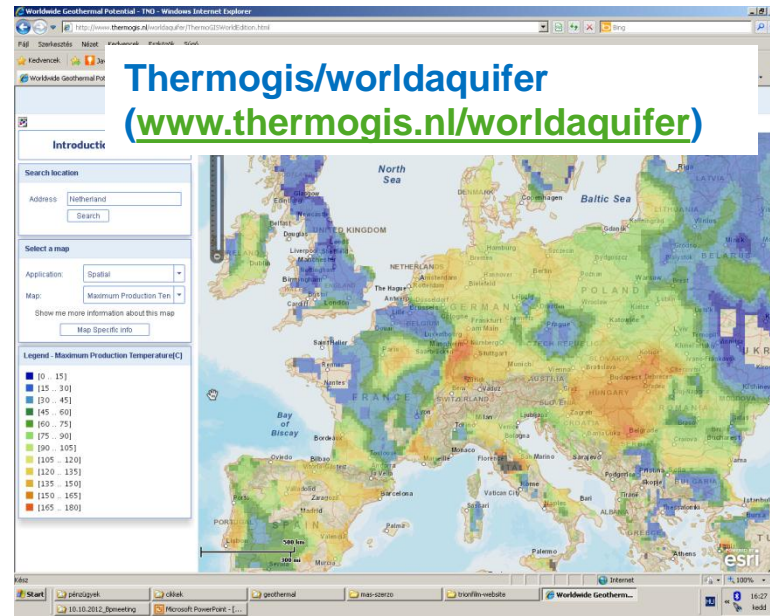
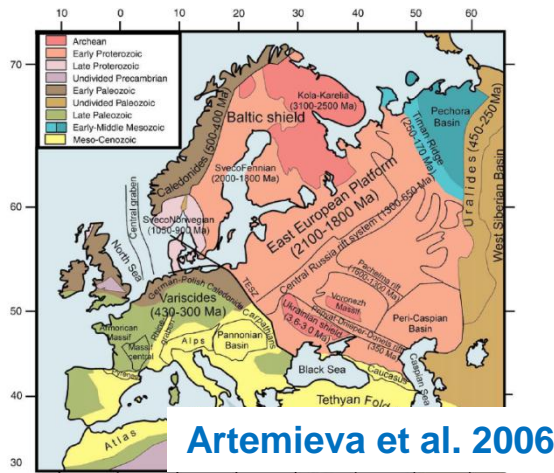


- heat-flow density
- temperature at 1000 m
- temperature at 2000 m

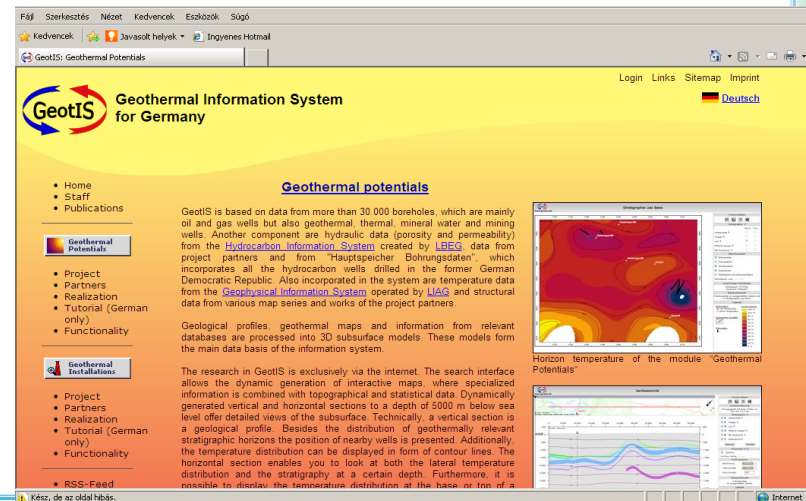
International Geological Map of Europe and Adjacent Areas (IGME 5000)



Data compilation: other information at European scale + country specific information (internet search, bibliography studies, etc.)



Cloetingh et al. 2010



By clicking on HELP, you get an easy overview on the use

The screenshot shows the GeoDH Europe web-map viewer interface. At the top, there is a search bar with the text "München, Bavaria, Germany" and a search icon. Below the search bar, there is a "Layer List" panel with a "Layer Visibility" section. The "Layer Visibility" section contains several checkboxes: "Cities with geothermal district heating" (checked), "Cities with district heating" (unchecked), "Country boundaries" (checked), "Temperature distribution at 1000m; T>50°C" (unchecked), "Other potential reservoirs fill" (checked), "Other potential reservoirs contour" (unchecked), "Heat-flow density; HFD>90mW/m2" (checked), "Neogene basins fill" (checked), and "Neogene basins contour" (unchecked). The "Heat-flow density" layer is highlighted in black. A callout box points to the "Help" link in the top right corner, stating "These links give additional information about layers and the project itself". Another callout box points to the search bar, stating "Enter city name to search city". A third callout box points to the map navigation controls, stating "Use the slider to adjust zoom level, and the hand tool drag the map". A fourth callout box points to a city information popup for "Zagreb, Croatia", stating "Click on points to get information about cities". A fifth callout box points to the "Layer List" panel, stating "By clicking on the checkboxes layers can be turned on and off". A sixth callout box points to the "Layer Visibility" section, stating "Additional layers settings can be found by clicking to the triangle mark". A seventh callout box points to the "Layer List" panel, stating "Click on widget icons to draw and measure, to bookmark extent or to view layer legend". The interface also includes a "Project website" link and a "Help" link. The map shows a geographical view of Central Europe, including Germany, Czech Republic, Austria, and Slovakia.

Click on widget icons to draw and measure, to bookmark extent or to view layer legend

Enter city name to search city

Use the slider to adjust zoom level, and the hand tool drag the map

Click on points to get information about cities

By clicking on the checkboxes layers can be turned on and off

Additional layers settings can be found by clicking to the triangle mark

These links give additional information about layers and the project itself

Click on widget icons to draw and measure, to bookmark extent or to view layer legend

Enter city name to search city

Use the slider to adjust zoom level, and the hand tool drag the map

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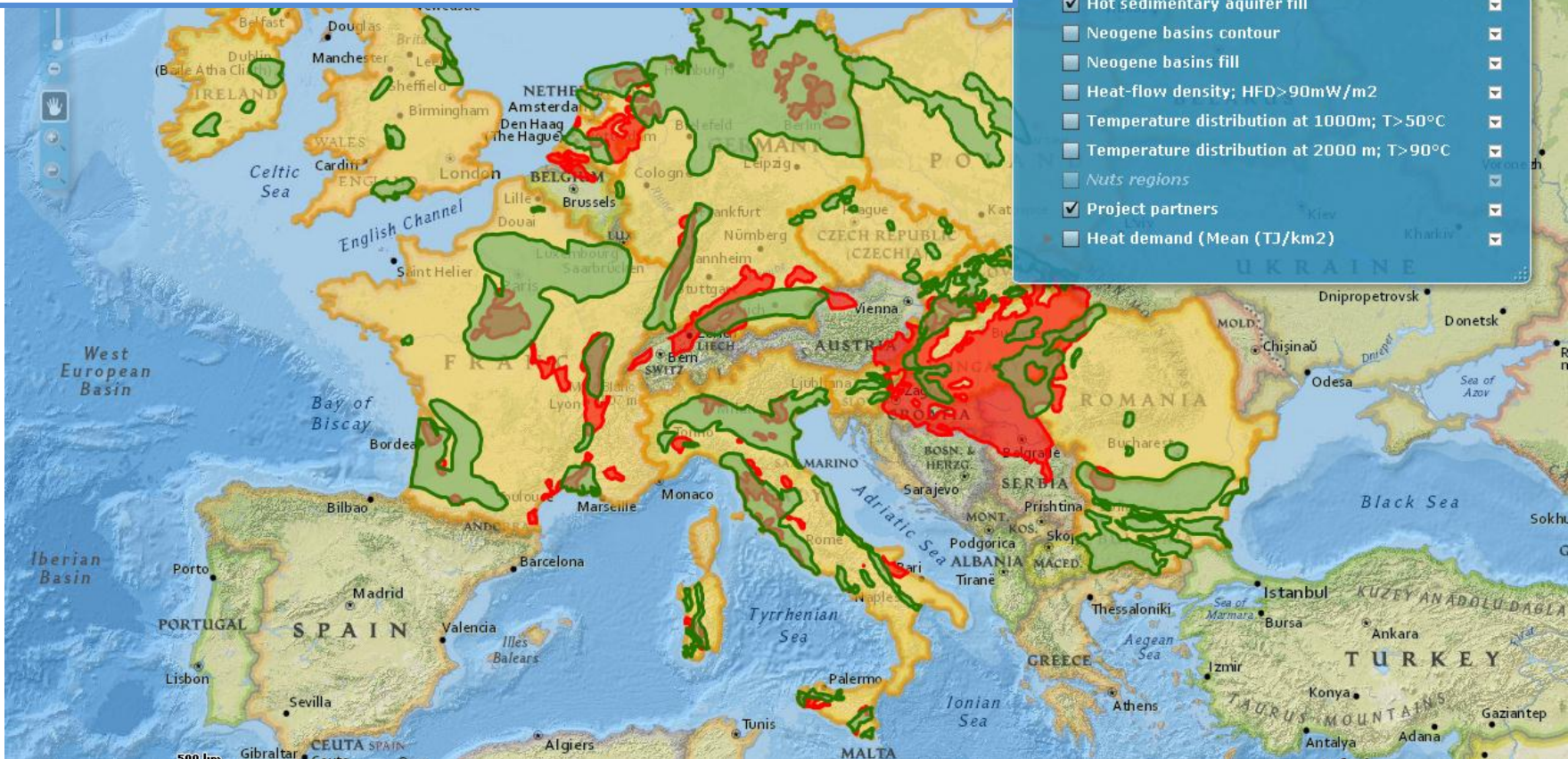
By clicking on the checkboxes layers can be turned on and off

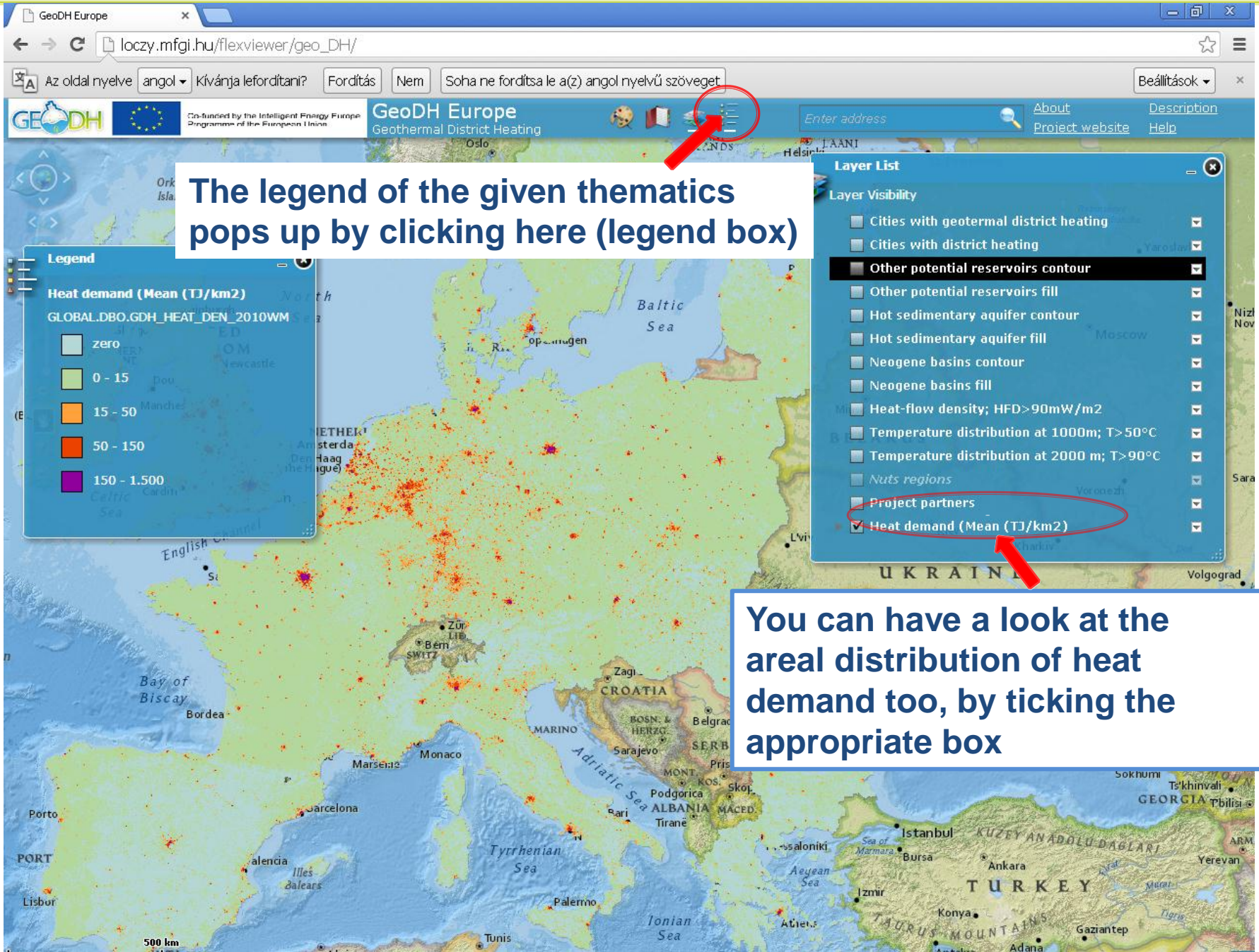
Additional layers settings can be found by clicking to the triangle mark

These links give additional information about layers and the project itself

Web-map viewer available at: http://loczy.mfgi.hu/flexviewer/geo_dh/

By clicking on selected checkboxes, layers can be turned on/off – e.g. shows areas where hot sedimentary aquifers (red) and other types of potential reservoirs (green) exits. These represent areas with best potential from the resource side.





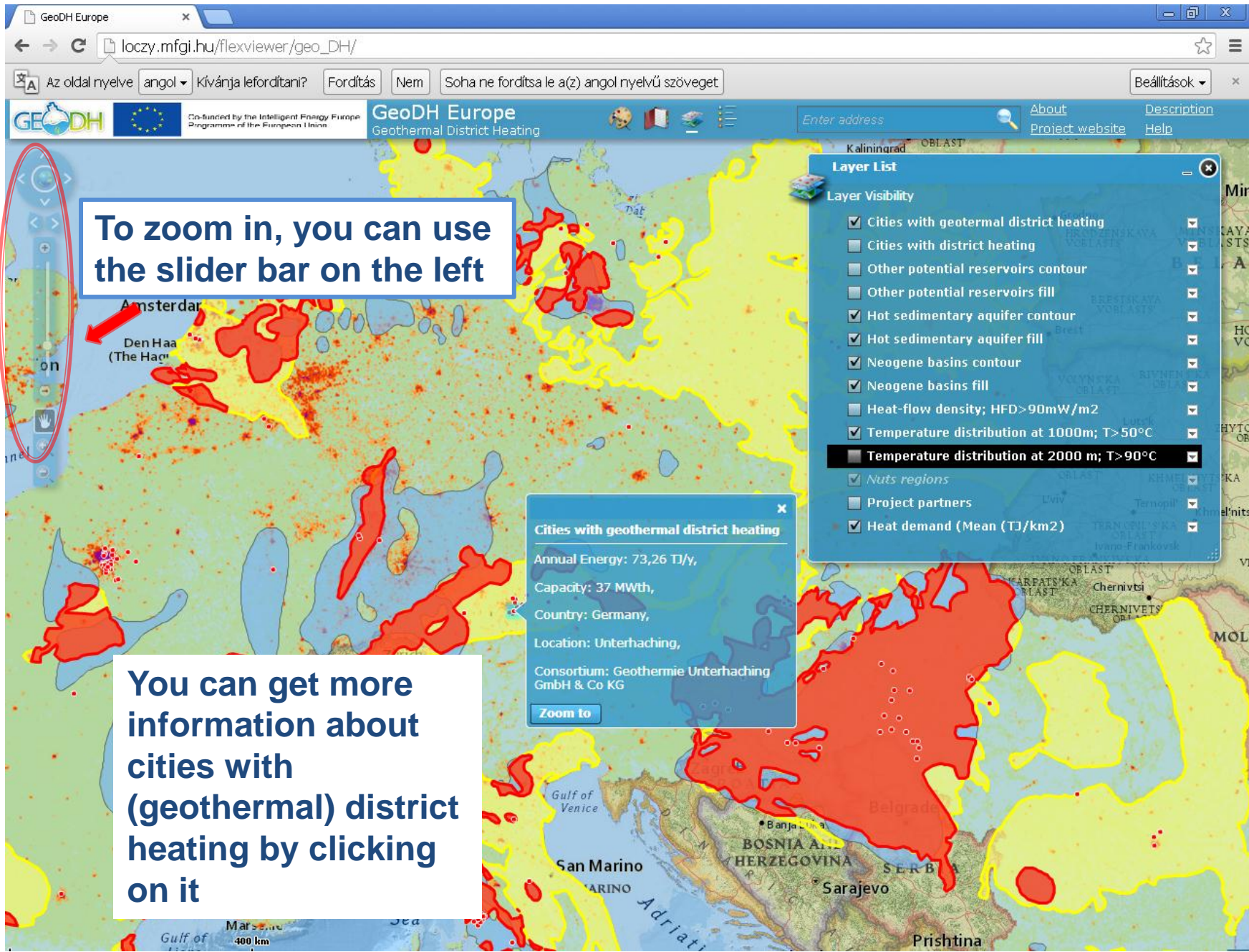
The legend of the given thematics pops up by clicking here (legend box)

You can have a look at the areal distribution of heat demand too, by ticking the appropriate box

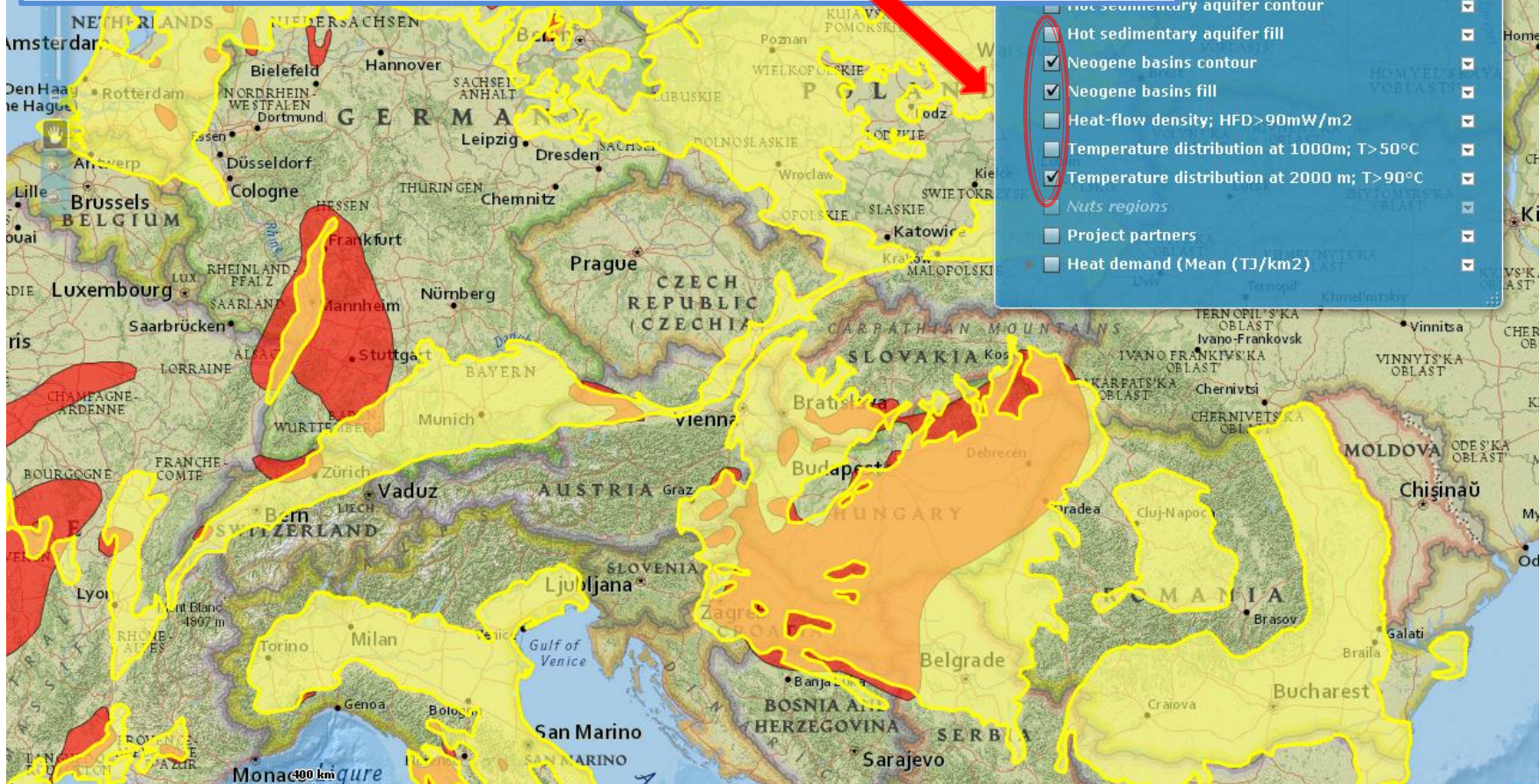
By clicking on „cities with district heating”, little purple dots show where district heating already exists.

Where these overlap with areas of good geothermal potential (red or green areas), there is a real opportunity for future geo-DH developments.





If you are interested more in details, you can make various queries by combining different layers, i.e. to know more about the hot sedimentary aquifers, click on areas of Neogene basins (yellow) that can be combined with areas, where temperature exceeds 90 C at a depth of 2000 m (red)

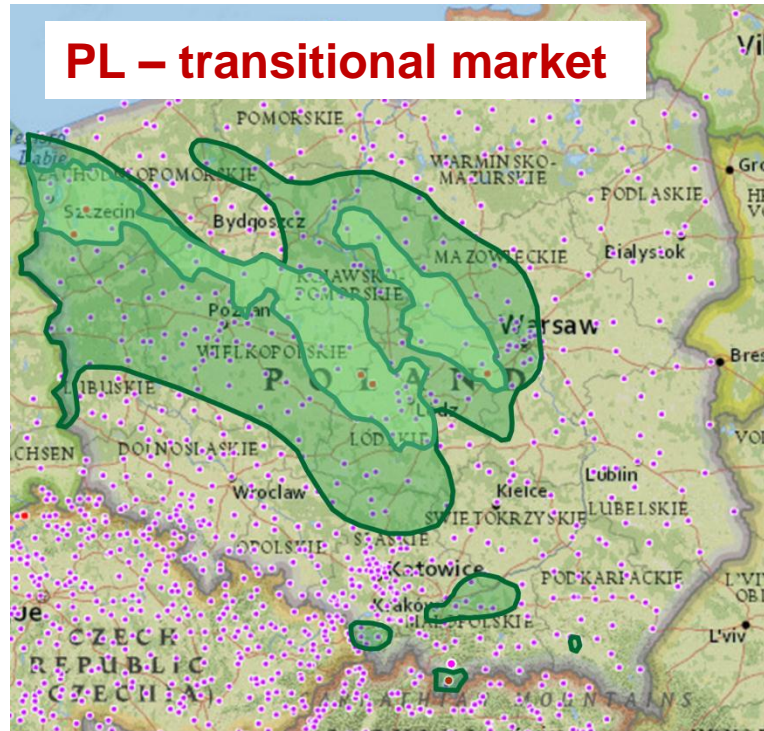


Geo-DH development potentials

NL – juvenile market

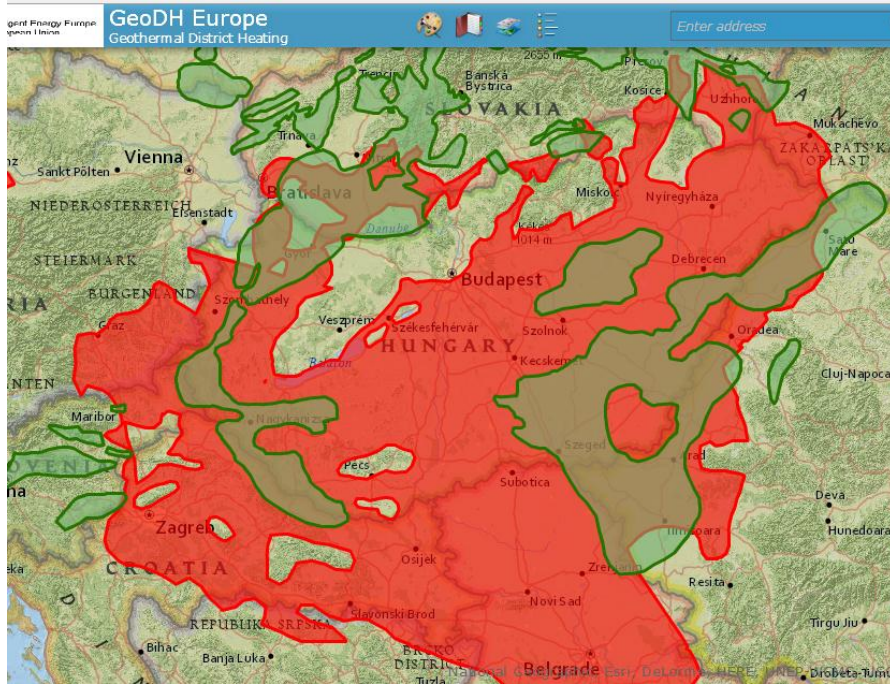


PL – transitional market



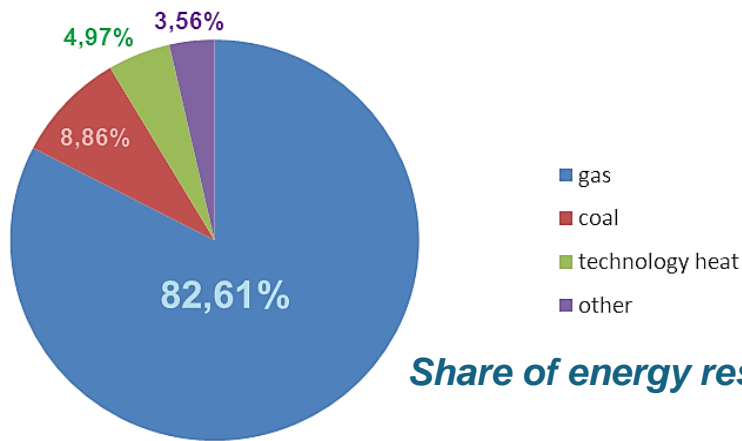
**Aquifers: few m - 4.000 m in Permian, Lower Triassic and Lower Cretaceous sandstones and in Tertiary sand units,
NREAP target: 7x increase by 2020
4% of dwellings with DH connection
92% natural gas**

**Potential Mesozoic reservoirs in the basement of the Polish Lowlands – 85 °C
500 DH systems designed for inlet temp 110-130 °C, mainly fueled by coal
6 geo-DH plants**



Development potentials in mature markets: The Hungarian DH case

62% of energy demand is from import of fossil fuels
annual gas use: 9-10 billion m³ -
82 % import (Russia)



Share of energy resources in DH

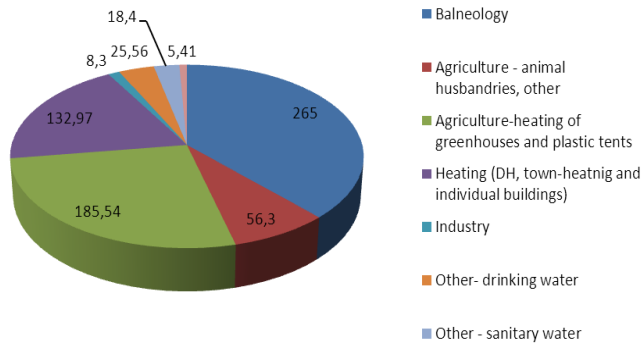
Large and vulnerable DH sector fed by import gas

95 settlements with DH infrastructure (648 500 flats)

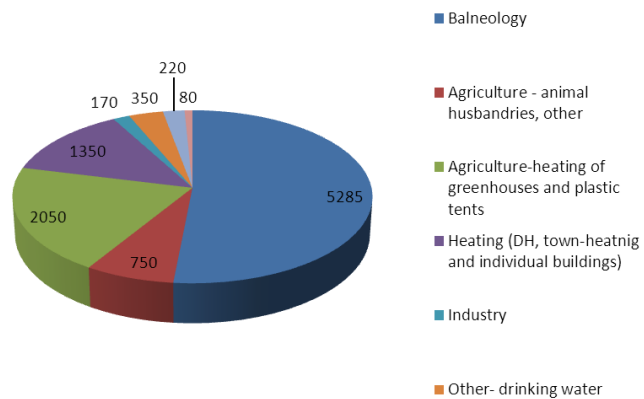


The Hungarian geo-DH case and its potentials

Installed capacity (MW_{th})



Annual use (TJ/y)



Geo-DH systems: 9 settlements, 5-20 MW_{th} with share of geothermal 10-90%

Local heating systems: 11 settlements, no utility company, operated by municipalities, based on water licence, 1-5 MW_{th}, heating of public buildings

NREAP: Contribution of GE	2010 9% of RES	2020 17% of RES
Direct heat (PJ)	4,23	14,95

Development potentials:
45 settlements with good geothermal potential
28 - DH infrastrucutre
17 - existing heat market

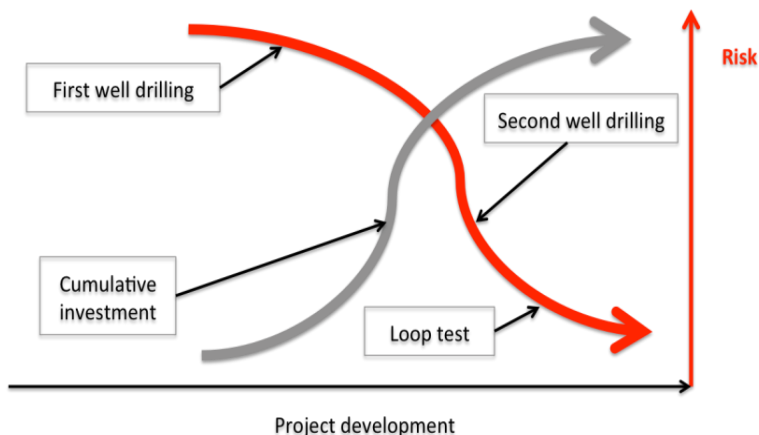


Financial aspects of geo-DH

EED Art 14: „Member States shall carry out **a cost-benefit analysis** ...for the identification of the most resource- and cost-efficient solutions to meeting heating and cooling needs”

Geo-DH: high CAPEX (investment costs for production and injection wells, pumps, pipelines, monitoring and control equipment, peaking stations, and storage tanks, **low OPEX**)

Generating costs and selling prices: **~60 €/MW_h thermal** (20 to 80 €/MW_h thermal). This depends on local geothermal settings (high/low heat flows, shallow/deep seated sources), socio-economic conditions and pricing policies. **Combining heating and cooling increases financial performance**



risk and capital expenditure are concentrated in the early phases of a project; the existence and quality of the geothermal resource can only be proven after the initial drilling has been completed



Summary – key messages

- ✓ **Geothermal energy is a real option in efficient district heating and cooling**
- ✓ **Geo-DH potentials of Europe are huge and untapped;**
- ✓ **Geo-DH would be available for 25% of EU-27 population**
- ✓ **Geothermal can be installed with existing DH systems during extension or renovation, replacing fossil fuels;**
- ✓ **New GeoDH systems can be built in many regions of Europe at competitive costs**
- ✓ **Many of Geo-DH project results are highly relevant to EED Art 14 (potential assessment and CBA)**





Partners



Thank you for your attention!

www.geodh.eu

