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Safety of groundwater resources in terms of development of shallow geothermal energy installations

Maciej Kłonowski, Kirsti Midttømme**, Randi Kalskin Ramstad***, Hans de Beer****, Eliza Dziekan-Kamińska*, Jacek Kocyła*, Grzegorz Ryżyński*, Magdalena Sidorczuk*, Atle Dagestad****, Anna Seither****

*Polish Geological Institute – National Research Institute, **Christian Michelsen Research AS, ***Norwegian University of Science and Technology, ****Geological Survey of Norway

Groundwater Heritage&Sustainability

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Outline of this presentation:

- Definitions of shallow geothermal energy (SGE)
- Market situation
- Types of SGE installations
- Possible effects and threats to subsurface including groundwater
- Conclusions

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Definitions:

Directive 2009/28/EC of the European Parliment and of the Council of 23rd April 2009 on the promotion of the use of energy from renewable sources, Article 2 (c):

"geothermal energy means energy stored in the form of heat beneath the surface of solid earth"

Legal definitions of the EU member countries are based on:

- heat capacity, temperature, depth, associated use, etc.
- those always include open and closed systems

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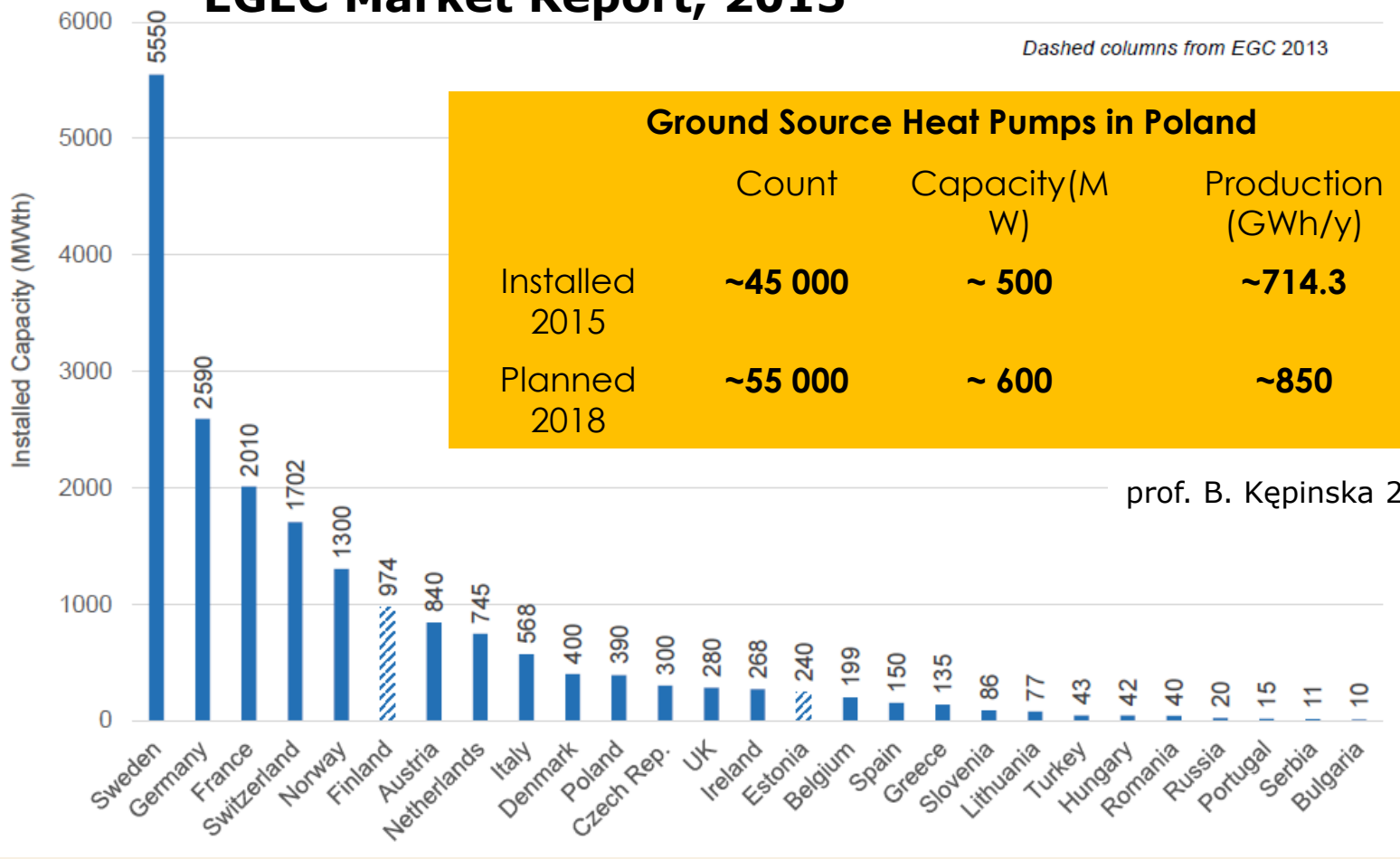
EGEC Market Report, 2015



Ground Source Heat Pumps in Poland

	Count	Capacity(MW)	Production (GWh/y)
Installed 2015	**~45 000**	**~ 500**	**~714.3**
Planned 2018	**~55 000**	**~ 600**	**~850**

prof. B. Kępinska 2016

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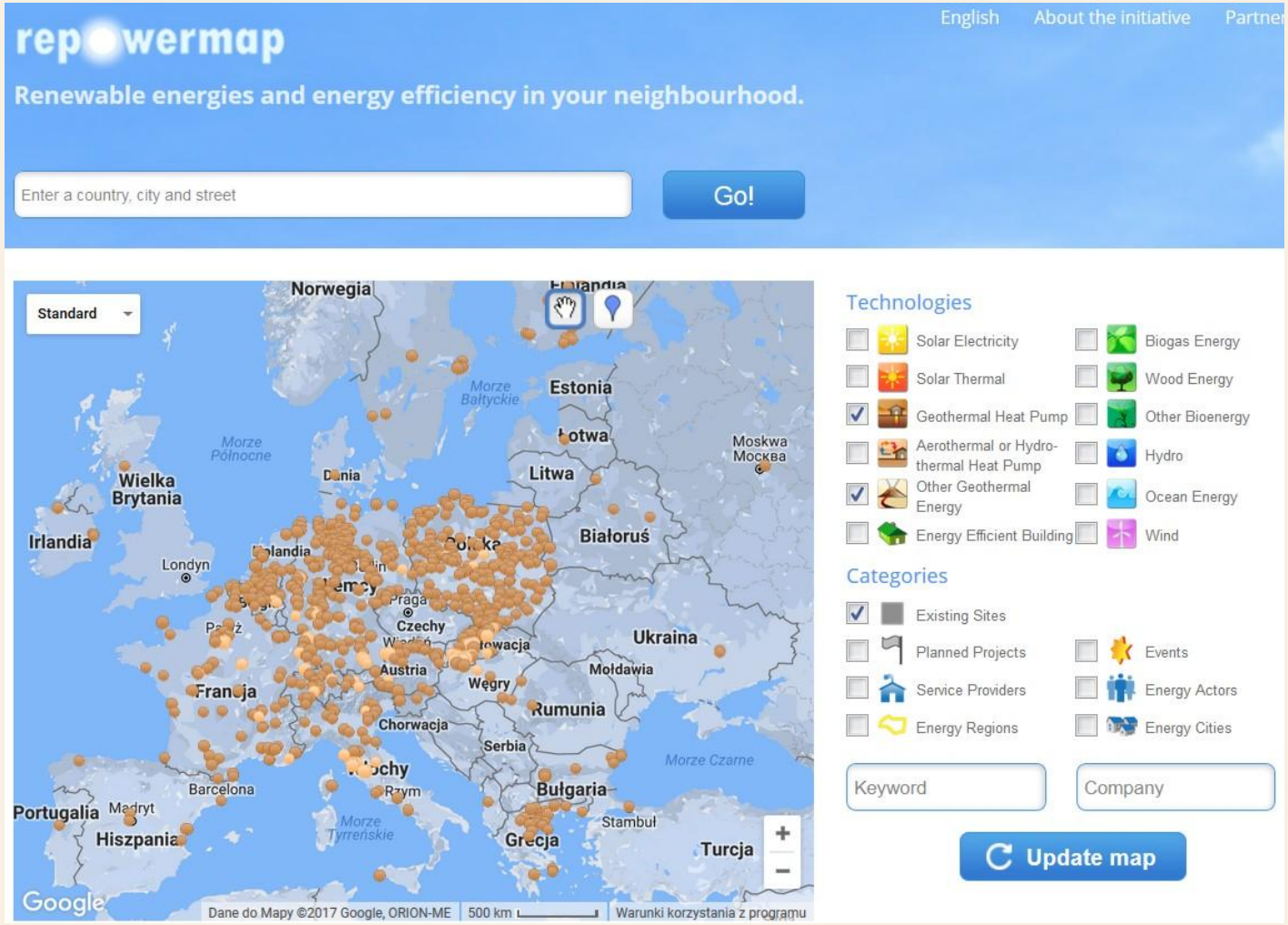

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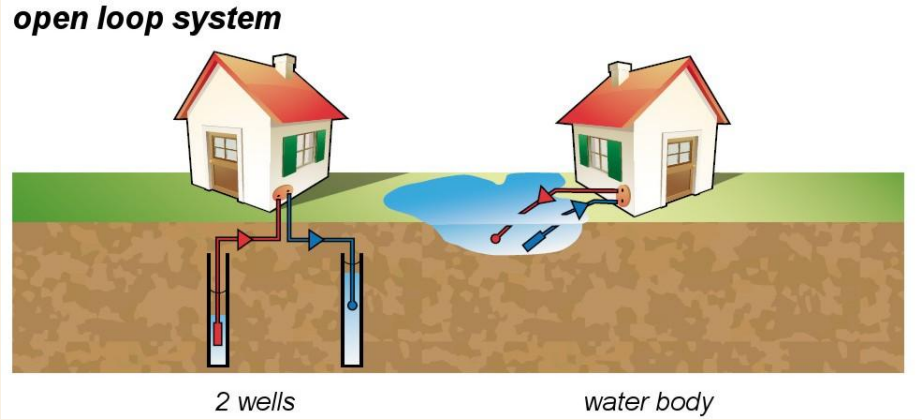
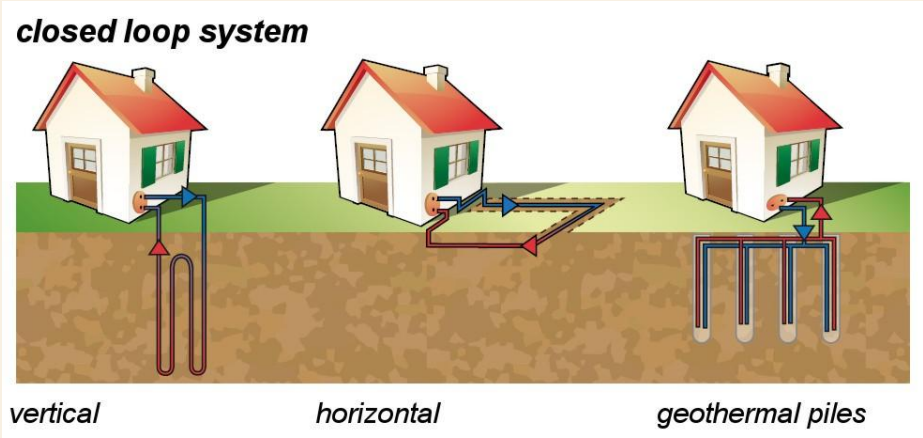
Shallow geothermal energy installations:

- Open loop systems - production well and injection well
- Closed loop systems - Ground Source Heat Pumps (GSHP): horizontal, vertical, other
- Thermal energy storage: UTES, ATES, BTES





Source: Iter Project

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Definition of pollution by EU Water Framework Directive:

„pollution is *the direct or indirect introduction, as a result of human activity, of* ***substances or heat*** *into the air,* ***water*** *or land, which may be harmful to human health or the quality of* ***aquatic ecosystems or terrestrial ecosystems*** *directly depending on aquatic ecosystems, which result in* ***damage to material property****, or which impair or interfere with amenities and other* ***legitimate uses of the environment***"

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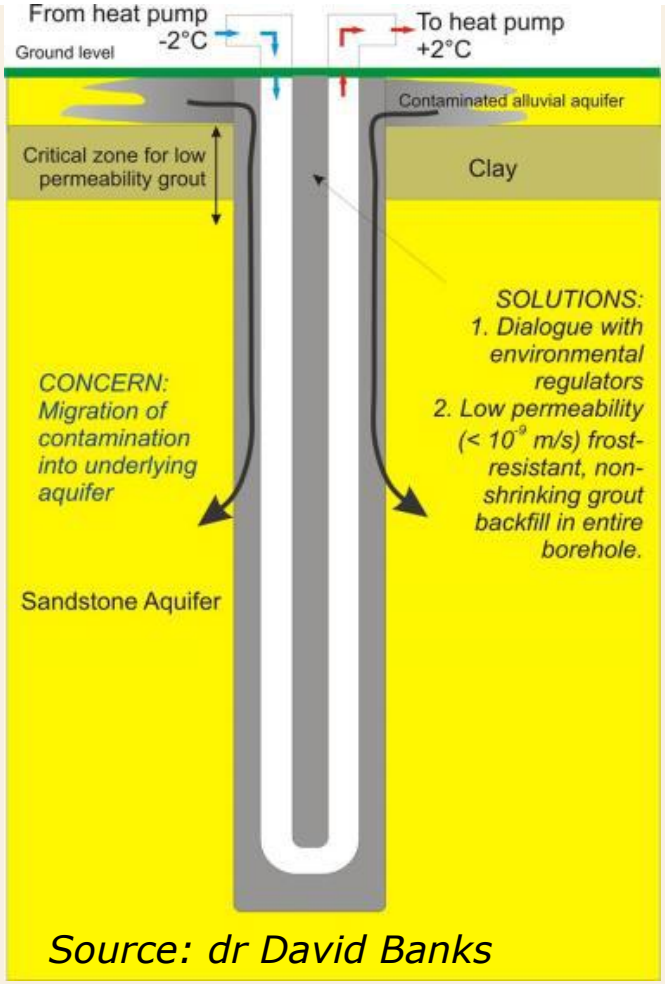
Typical issues for open loop system:

- Ground subsidence due to drawdown
- Ground upheave due to upconing (recharge)
- Groundwater flooding during recharge
- Pumping of sand
- Mineral precipitation in aquifer
- Well clogging
- Scaling
- Corrossion of materials

Source: Internet

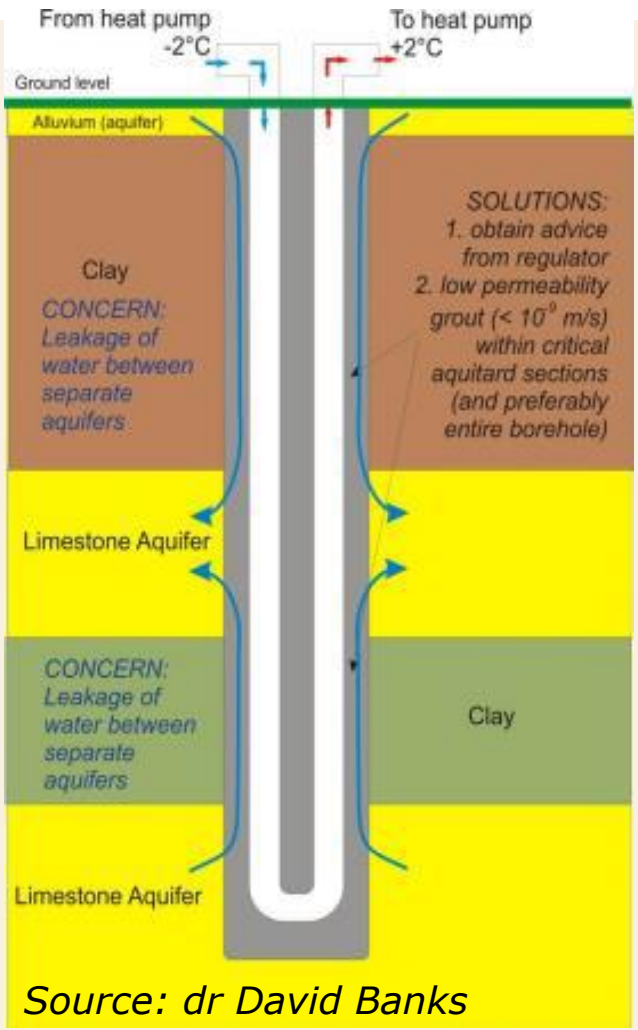


Source: dr David Banks

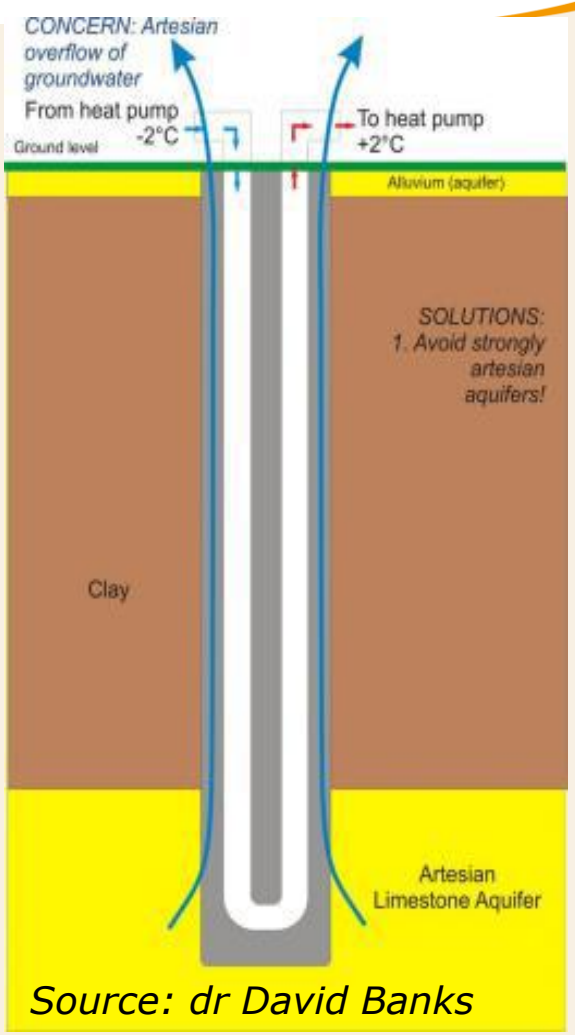
Typical issues for closed loop system:

GSHP:

- contaminated areas
- artesian and subartesian aquifers
- multilayered aquifer systems



Source: dr David Banks



Source: dr David Banks

Accidental spills of carrier fluids and refrigerants:

- Ethylene glycol: toxic, biodegradable
- Propylene glycol: low toxicity, biodegradable
- Ethanol: low toxicity, biodegradable
- Water: non-toxic

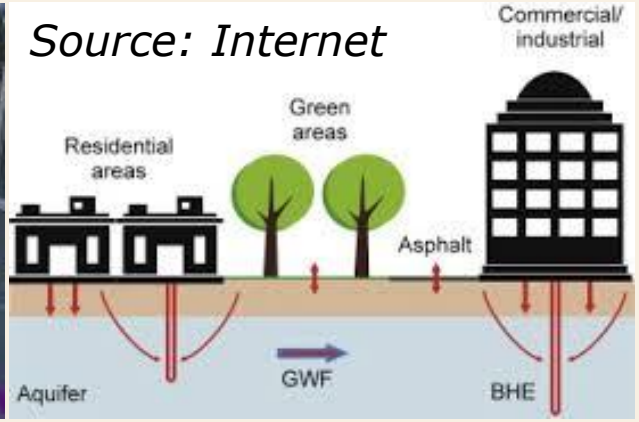
Safe installation

Source: Internet

Other issues:

- Geothectnical: ground stability and expansion, cavities
- Evaporites: dissolution of halite and anhidrite
- Urban environment and underground infrastructure
- Urban heat islands
- Gas migration from subsurface: CO_2, radon, methane
- Microbial risk
- Geothermal plum migration and interactions between installations

Source: Internet



Conclusions:

- According to UE regulations heat and coolth are not potential pollutants themselfs, however installing SGE installations may influence subsurface and groundwaters
- Care should be taken while designing, drilling and installing all types of SGE installations
- Usual concerns refert to perforation of artesian aquifers and drilling through multilayered aquifer systems
- Other issues are: leakege of carrier fluid and refrigerants
- Geothecnical problems, dissolution of evaporites, migration of gases

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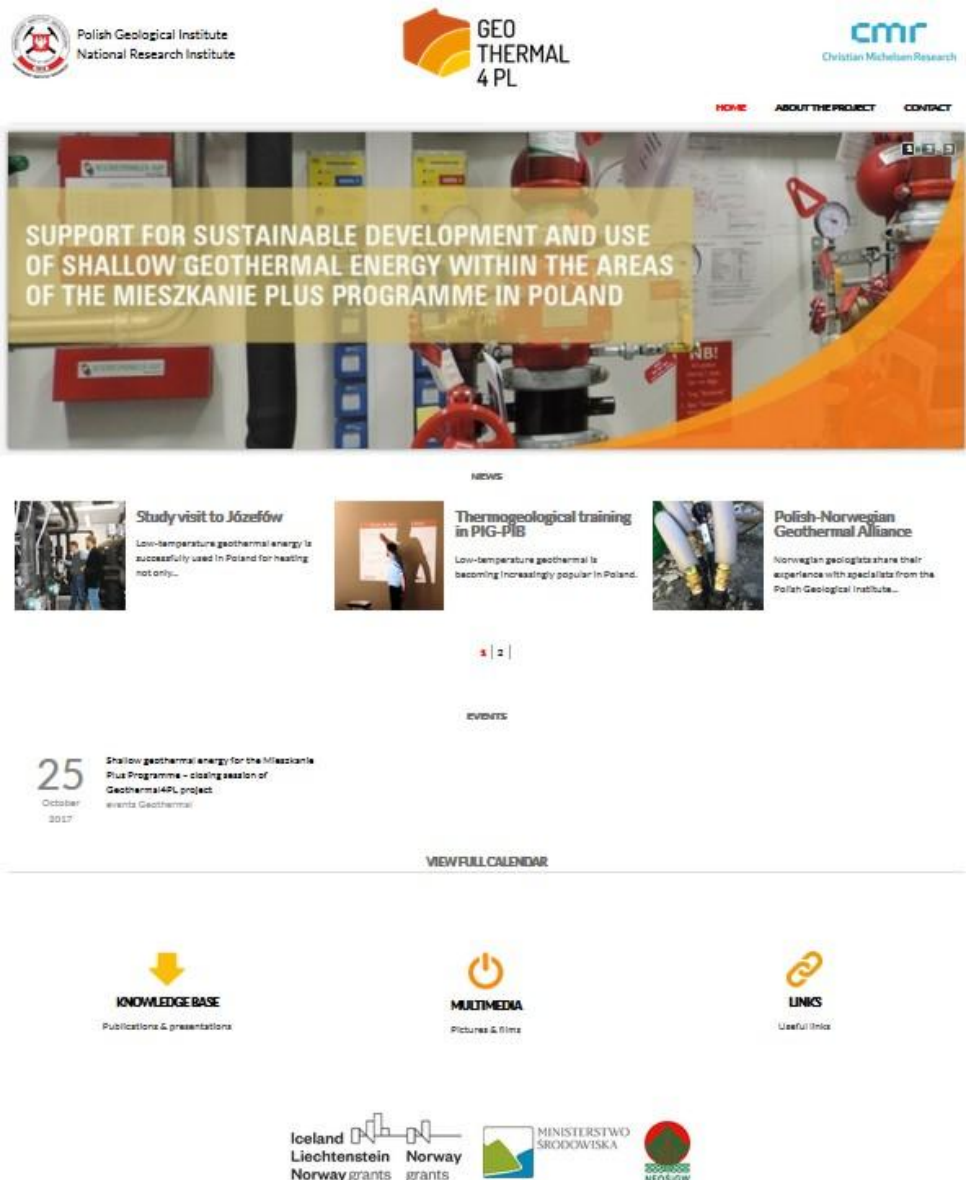
Thank you very much!

Contact:
Maciej.Klonowski@pgi.gov.pl

www.pgi.gov.pl/geothermal4pl



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