

GEOELEC

Geothermal data Finland

**Based on a document by Jarmo Kallio
and other material and literature**

Regional Workshop Baltic States and Finland

Burkhard SANNER

European Geothermal Energy Council

Vilnius, 22/03/2012



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Information and literature used:

Kukkonen, I.T. (2000): Geothermal Energy in Finland. – Proc. WGC 2000, pp. 277-282, Kyushu-Tohoku

Kallio, J. et al. (2011): Geoenergy research and its utilization in Finland. - Geological Survey of Finland, Special Paper 49, pp. 179–185, Kokkola

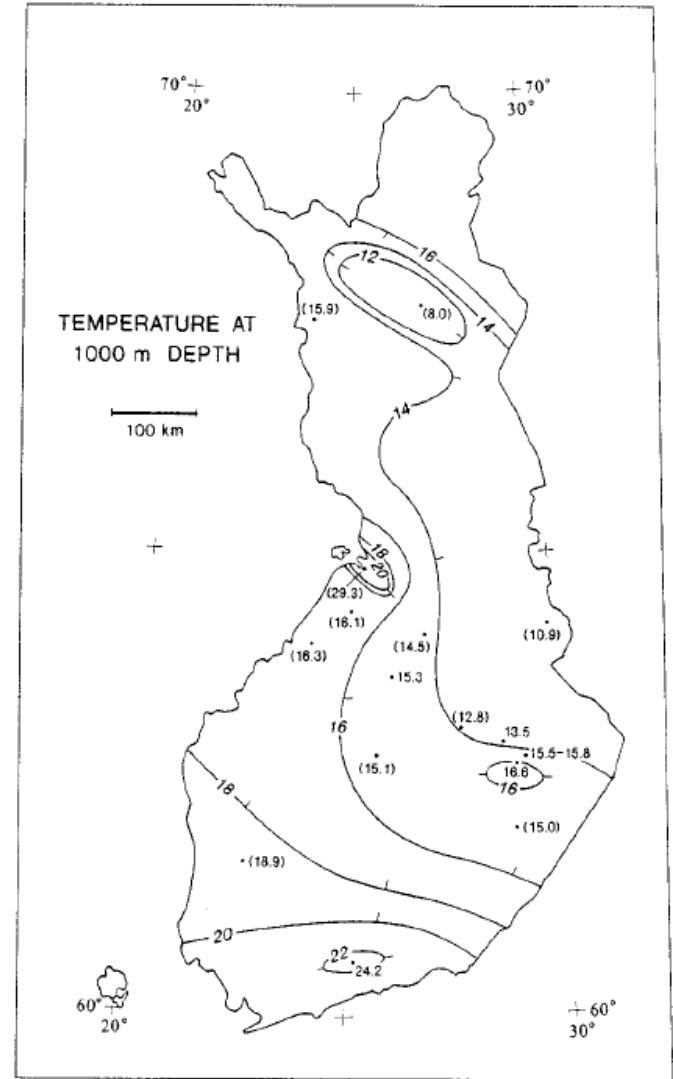
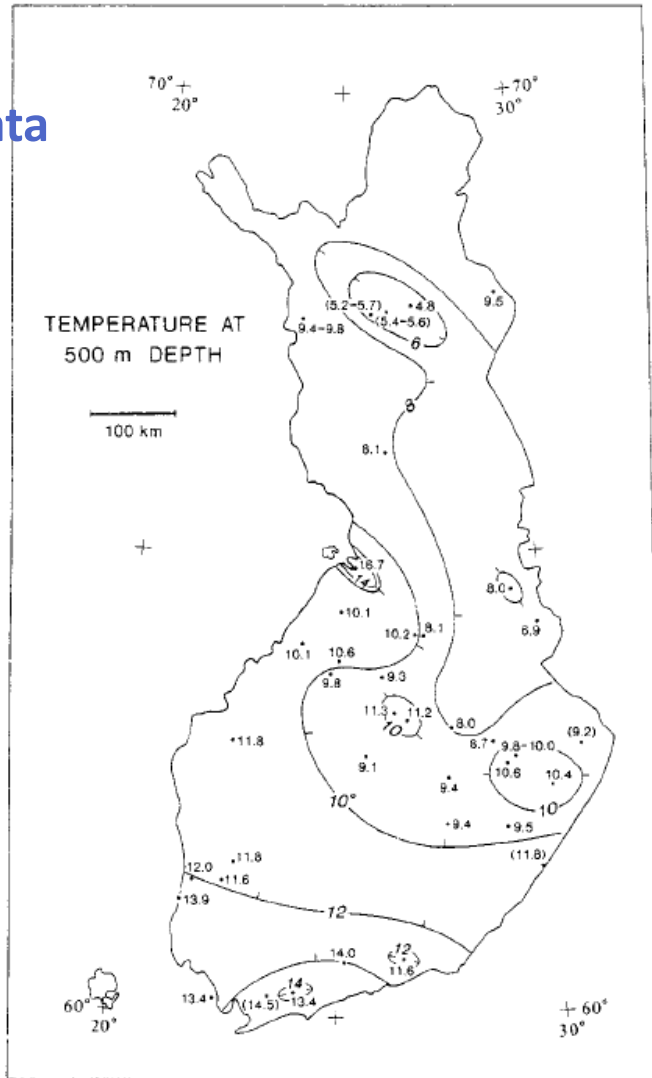
Kukkonen, I.T. et al. (2012): Geothermal Studies of the Outokumpu Deep Drill Hole, Finland: Vertical variation in heat flow and palaeoclimatic implications. - Geophysical Research Abstracts Vol. 14, EGU2012

Kallio, J. (2012): Material prepared for Geoelec Workshop Vilnius

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Geothermal data

Isotherms at
500 m and
1000 m depth
(from
Kukkonen,
2000)



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Geothermal data

Extrapolation and calculation of temperatures at greater depths indicate that the

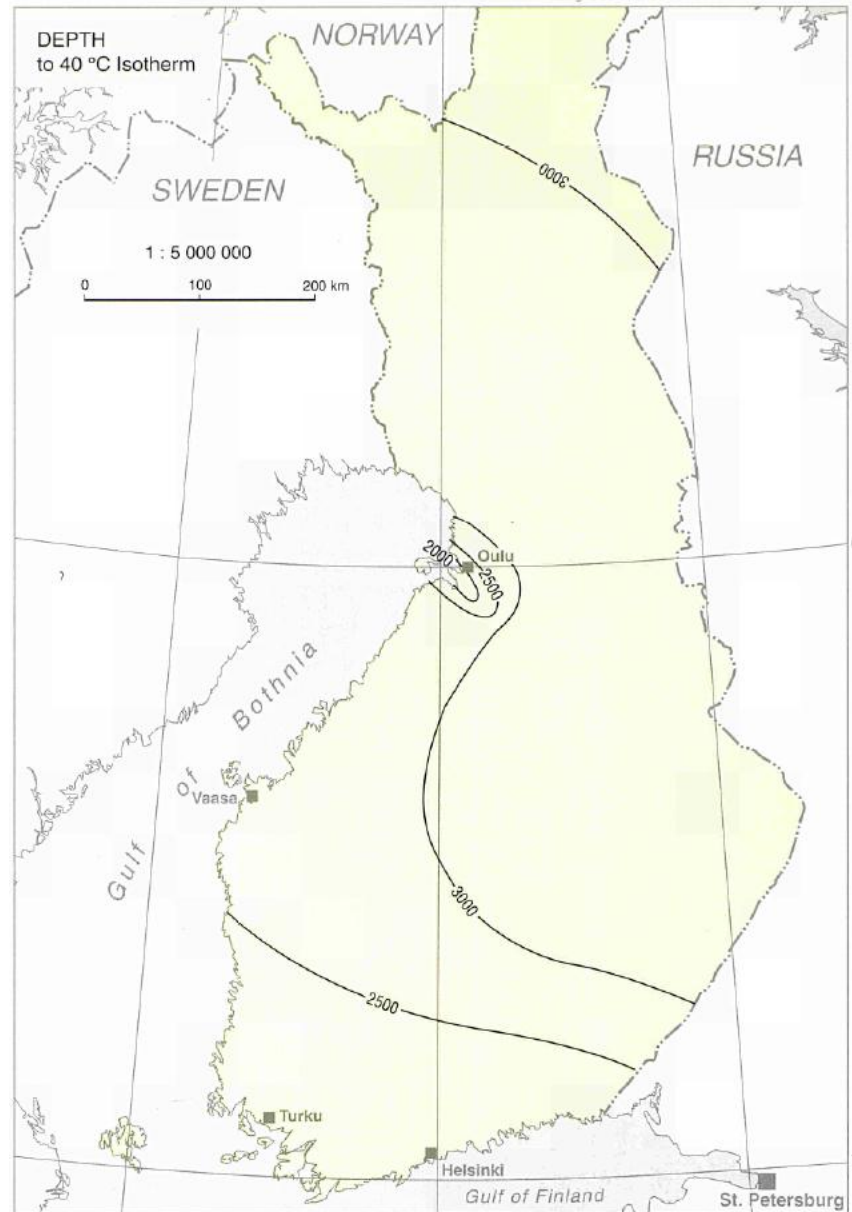
- **40 °C** isotherm would be reached at **2-3 km**, and the
- **100 °C** isotherm at depths of **6-8 km**

(Kukkonen, 2000)

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Geothermal data

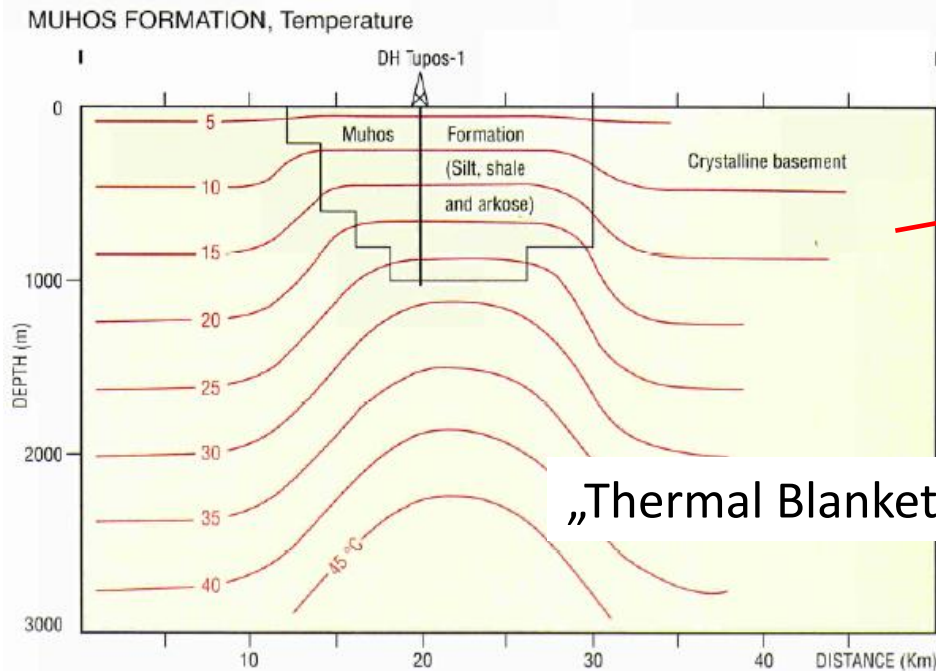
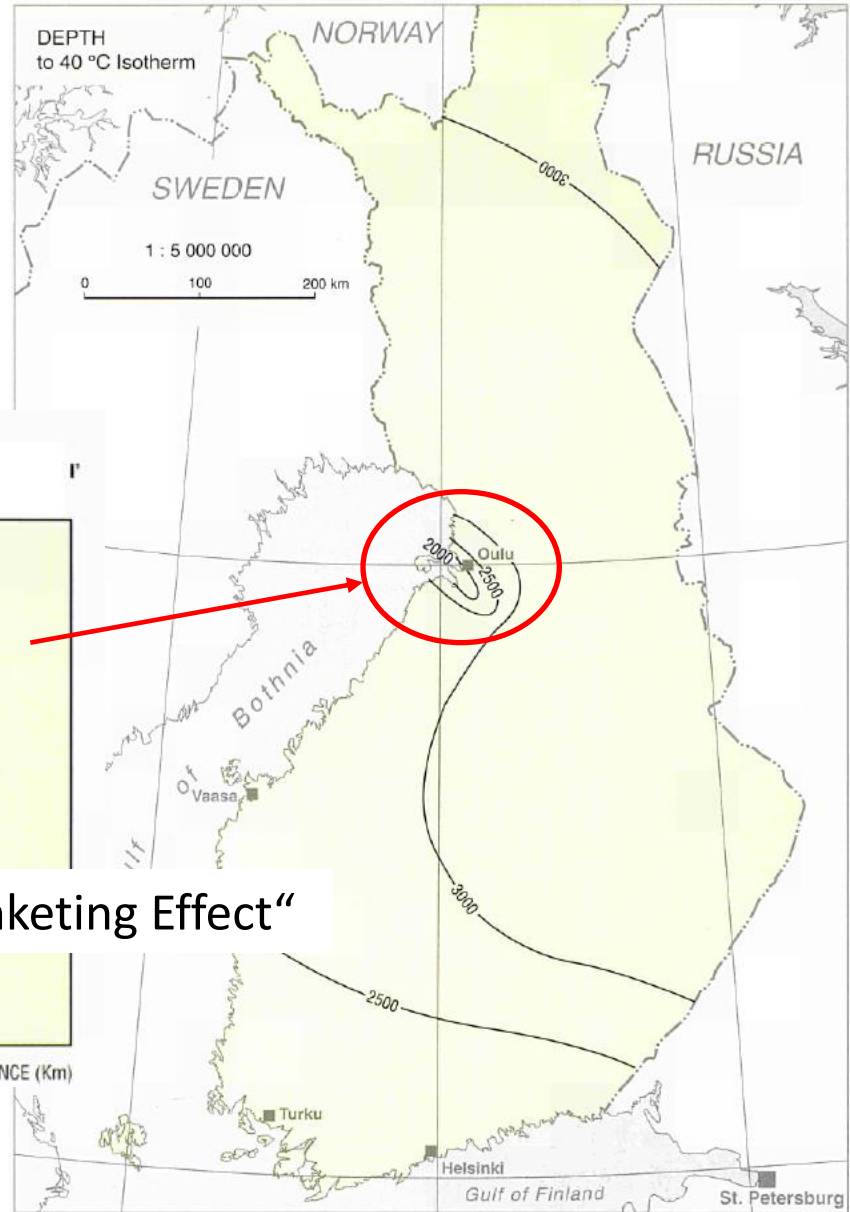
Depth of 40 °C isotherms
(from Atlas 2002)



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Geothermal data

Depth of 40 °C isotherms
(from Atlas 2002)

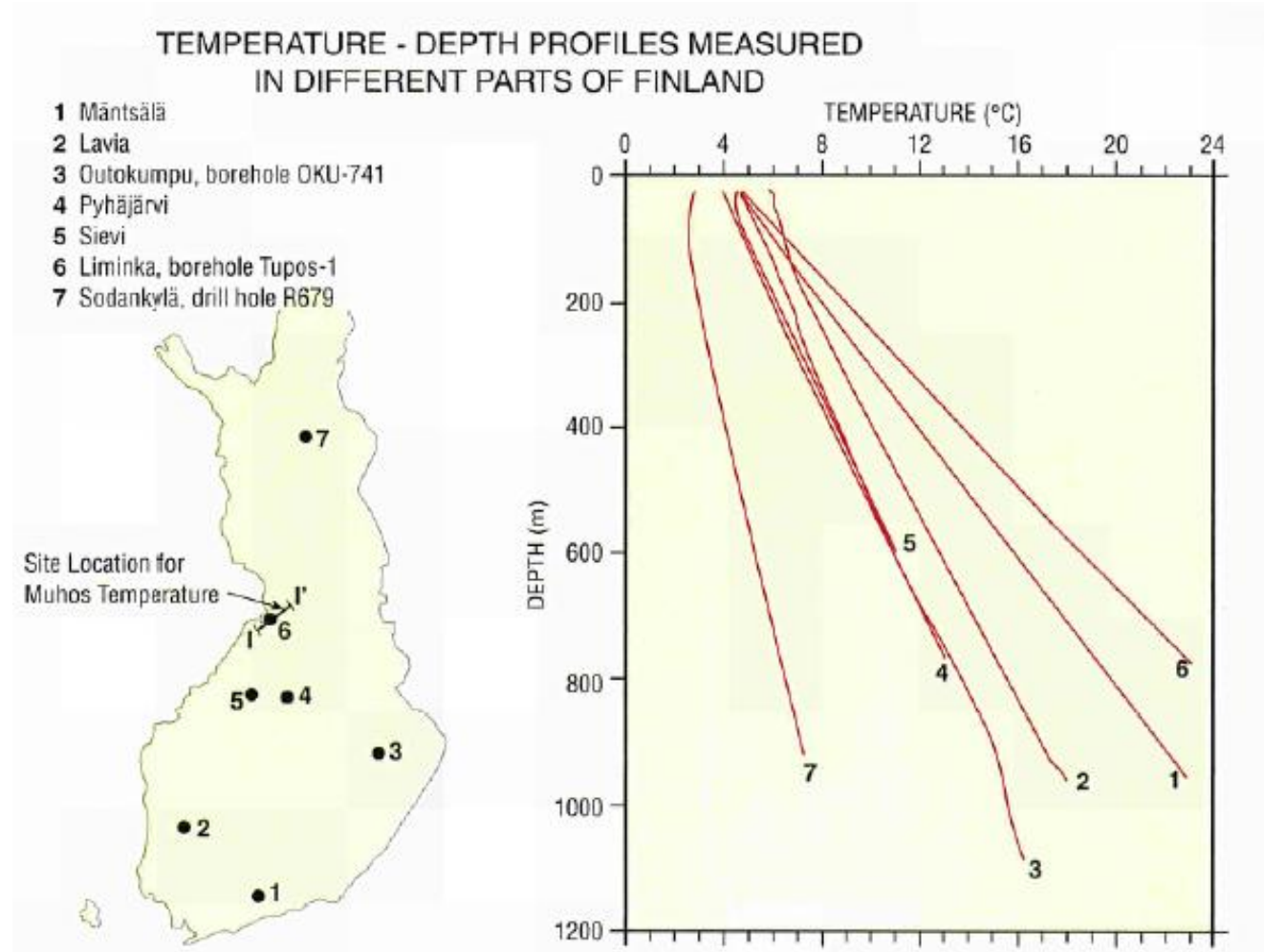


„Thermal Blanketing Effect“

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Geothermal
Gradients
(from Atlas 2002)



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Geothermal data

Outokumpu Deep Drill Hole in eastern Finland

- drilled in 2004-2005
- 2,516 m deep

Heat flow density increases from about

- 28-32 mW m⁻² in the uppermost 1000 m to
- 40-45 mW m⁻² at depths exceeding 2000 m.

The estimated undisturbed surface heat flow value is 42 mWm⁻².

(Kukkonen et al., 2012)

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=> Conclusion Kukkonen (2000):

These numbers suggest that Finland is not a good candidate for either wet or dry hot rock systems

=> Conclusion Kallio (2012): EGS in Finland is not economically possible because of:

- cool crystalline bedrock, no younger sedimentary formations
- low heat gradient 0,5 – 1,5 °C/100 m:
deepest mine Pyhäsalmi 1,5 km/22 °C,
deepest borehole Outokumpu 2,5 km/40 °C

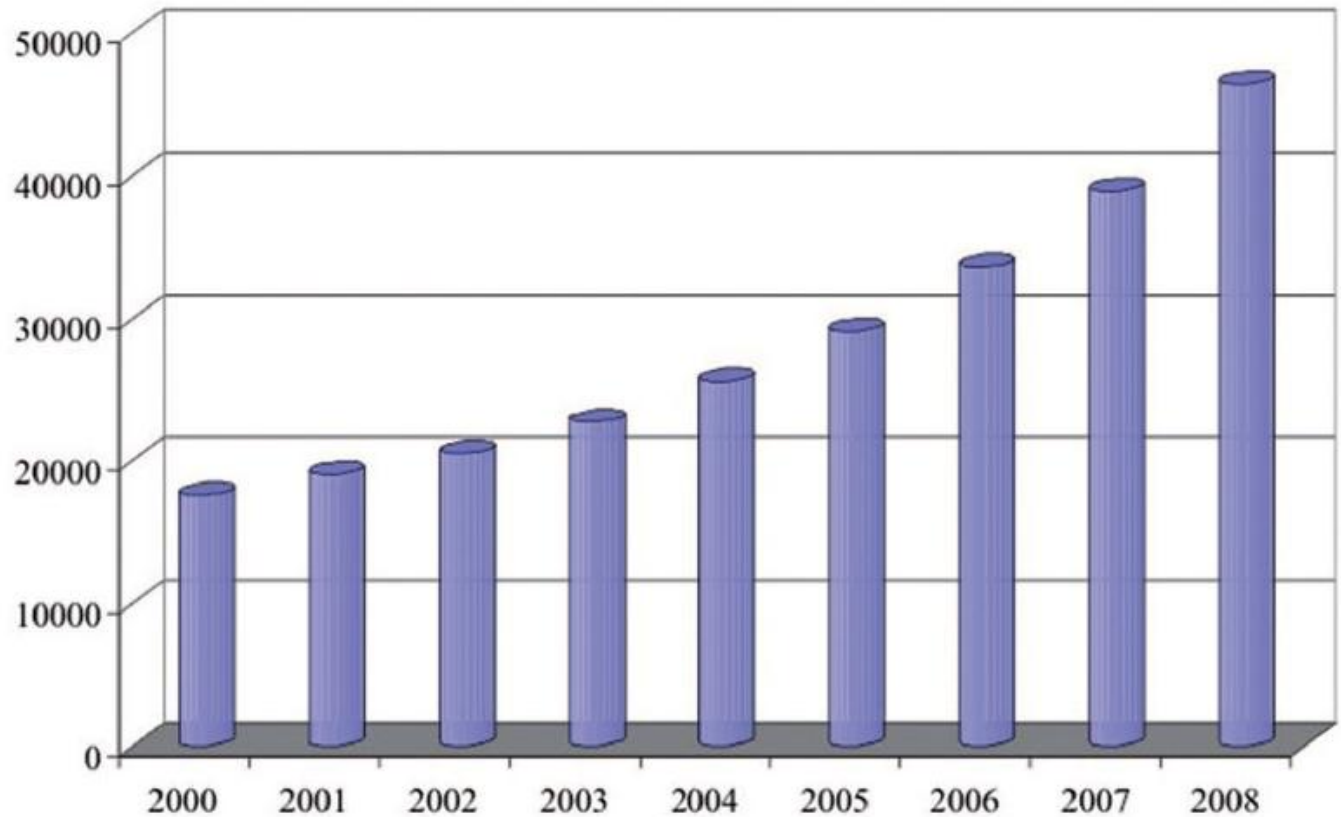
=> Opinion EGEC:

Extremely difficult economical situation for any EGS project

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Geothermal energy use

... but very good opportunity for GSHP!



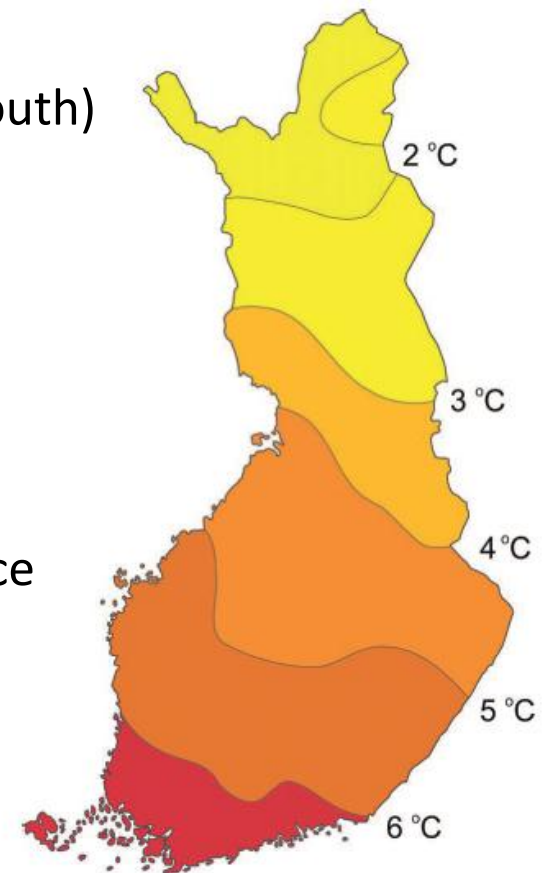
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Geothermal energy use

Suitable for heating (GSHP) and (free) cooling,
typical COP 3 and more

Average ground Temperature : 2 – 8 °C (North-South)

Annual average ground surface
temperatures in Finland
(Leppäharju 2008)



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Geothermal energy use

3- 4 TWh from HPs, of which 2-3 TWh GSHPs (estimates)

14 000 GSHPs installed in 2011 (2010: 7500 units)

> 50% of small houses,

many mega-class targets (shopping centres, logistics centres, office houses, schools...), and many more in planning phase

GTK has the most sophisticated equipment and know-how for planning and modelling of large geoenergy fields

BHEs 200-300 m deep/ single/double U, fibre optic monitoring systems



TRT-rig

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Geothermal energy use

GTK's TRT equipment



Combined TRT and DTS measurement



Thank You!

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TRT-rig of GTK in harsh conditions