Iceland Liechtenstein Norway grants

Norway grants

Improving the energy efficiency of geothermal energy utilisation by adjusting the user characteristic

User4GeoEnergy

Overview of the project

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The Project background: goals & target groups

MEERI PAS

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The Project overview

General Information

- *Financing:* 90% Fund EEA and Norway Grants Fund for Regional Cooperation + 10% own contribution,
- *Fund priority sectors:* **Environment, Energy, Climate Change and Low Carbon Economy**,

- *Project title:*
  - **Improving the energy efficiency of geothermal energy utilisation by adjusting the user characteristics**
    Project index number 2018-1-0502

- Name of the lead partner organisation (in English) Mineral and Energy Economy Research Institute, Polish Academy of Sciences,
  Country of the lead partner organisation Poland

- **Start date of implementation 01/10/2020**, end date of implementation 30/09/2023, **duration 36 months**

- ***Total eligible Project costs* 1.319.681 €**; *maximum requested grant amount* 1.215.217 €

The Project summary

THE CONSORTIUM consists of 2 donor members and 3 beneficiary partners.

Donor members

With Iceland in the forefront of high and medium enthalpy geothermal use and **National Energy Authority (NEA, Iceland)**

Norway leading the way in low enthalpy applications.
NORCE Norwegian Research Centre AS are included in the consortium as expertise partners and sources of capacity building.

ORKUSTOFNUN
National Energy Authority

NORCE

The Project summary

The consortium consists of 2 donor members and 3 beneficiary partners.

Beneficiary partners

Mineral and Energy Economy Research Institute, Polish Academy of Sciences **(MEERI PAS, Poland)** is the lead partner and the primary expert of the innovation.

A market leading geothermal operator **SLOVGEOTERM** is responsible for all activities carried out in **Slovakia** and will lead data gathering activities.

INNOGEO is a research non-profit responsible for engaging **Hungarian** stakeholders and designing the operation of the Geothermal District Heating Service Hubs.

Mineral and Energy Economy Research Institute
Polish Academy of Sciences

SLOVGEOTERM a.s.

InnoGeo

The Project summary

The Project objectives

Main activities within the project:

- **Exchange of good practice in the management of geothermal district heating between the donor countries** (Iceland, Norway) **and the beneficiary countries** (Poland, Slovakia, Hungary), that will increase economic as well as environmental and climate benefits for all.
- **Mathematical modelling of geothermal systems** (energy source – heat distribution – end users), **in order to identify optimal solutions for the supply of geothermal heat in the beneficiary countries**, considering geothermal conditions and heat prices on domestic markets.
- The **focus will be on individual customers in their homes by providing knowledge, experience, and technical solutions to improve the efficiency of geothermal heating**. This will be based on data utilisation and the roles of public and individual sustainable solutions. The project will also focus on encouraging customers to modify heating installations in their homes in order to increase their heating efficiency.

The Project background: goals & target groups

The Project target groups

The target groups of our activities **are:**

- the **researchers and scientists** of the beneficiary partners,
- the general scientific community, **DH system operators, energy users** throughout Europe.

The end-beneficiary of our project **is the environment**.

The Project summary

The Project objectives

- Our **objectives are a long-term improvement in the efficiency of geothermal operations and a decrease in their environmental footprint:** direct contributions to a **less carbon-intensive and more energy secure economy in Europe.**

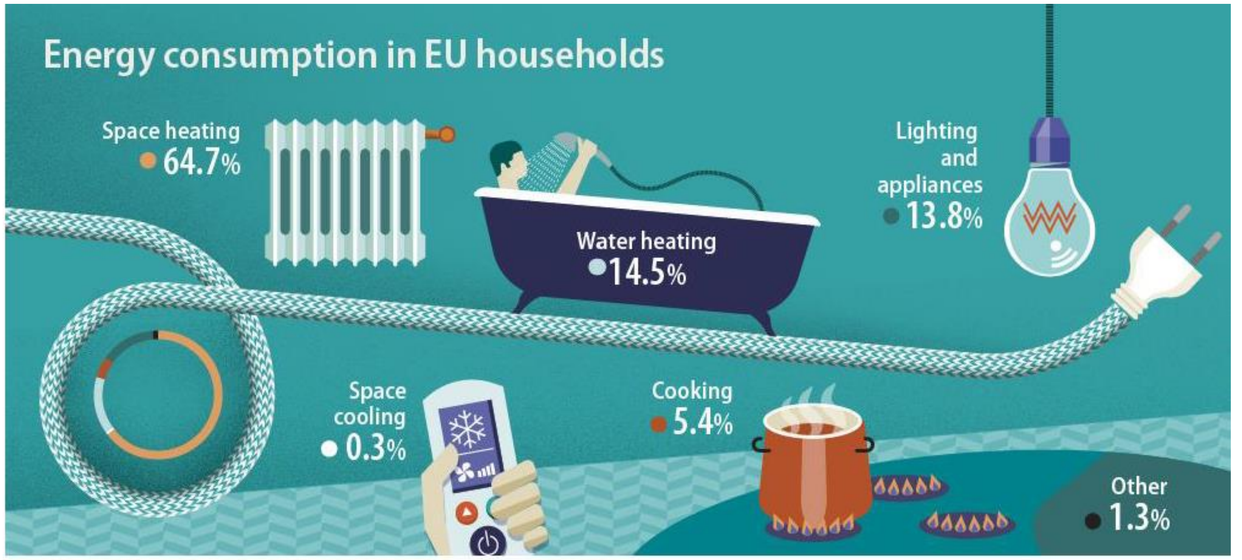
- Our **goal is to increase the economics of geothermal DH systems and to support their environmental sustainability simultaneously.** We wish to achieve this goal by expanding the knowledge of our staff and by providing innovative solutions to operators.

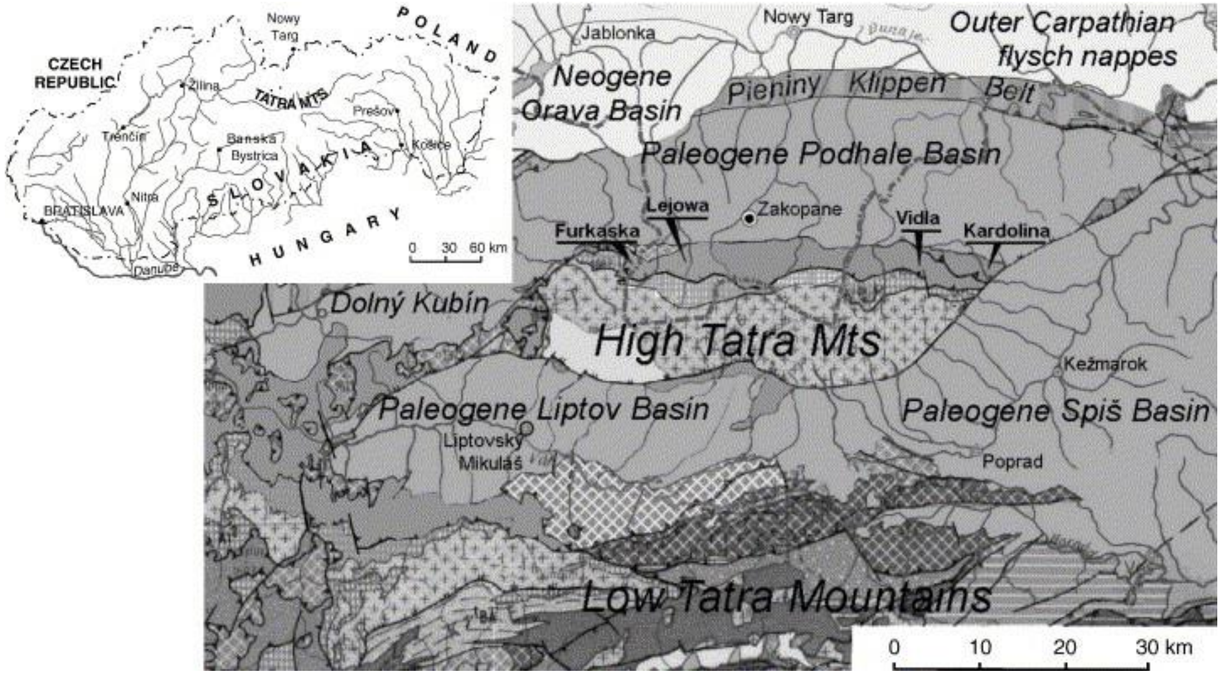
- Moving towards **low-carbon and energy secure economies requires the use of renewables** on the one hand, **and, maintaining a good status of the environment** on the other**.**
  These objectives can be achieved simultaneously.

The Project summary

The Project background

- Geothermal is a main participant in diversifying the energy supply of a wide range of direct uses including space heating.
- **The share of heating in household consumption is over 70% of energy used in Europe, 81% of this is generated from fossil fuels, large scale integration of Earth's energy into heating is a major step towards a low carbon economy**.
- **For geothermal energy to contribute to long-term economic growth and to achieve environmental benefits simultaneously a resource-efficient use is required**.
- With systems tapping crossborder reservoirs, overexploitation of local resources becomes a transnational problem.
- **Producing as much water as possible then dumping it, without utilizing its full heat content is standard procedure in all 3 beneficiary countries.**
  The reason for this is transnational: the vast majority of **DH systems in Poland, Slovakia and Hungary were designed for fossil fuel use.**





The Project summary

The Project background

A heating system is characterised by technical requirements:

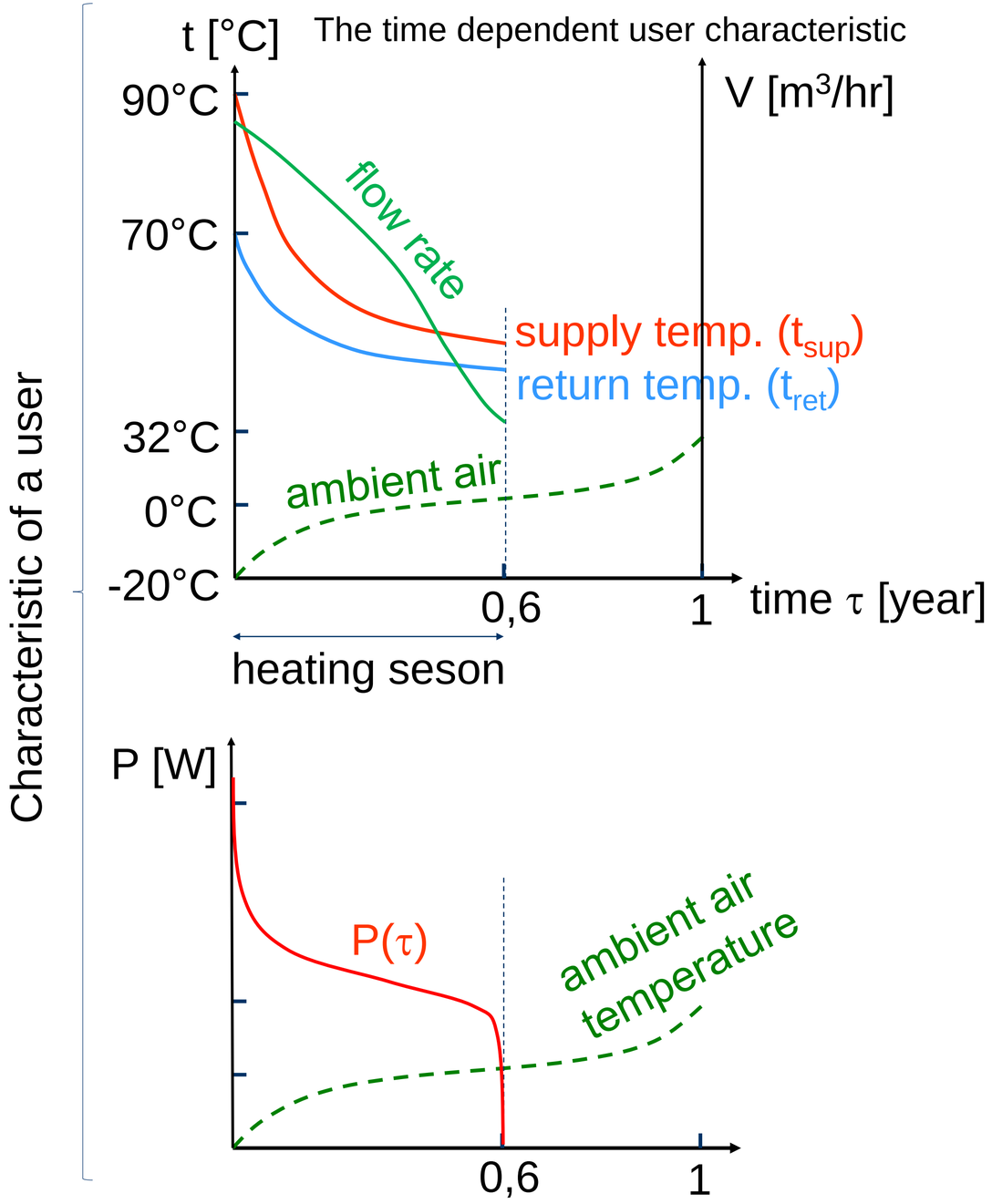
- supply temperature,
- the required flow of water.

Heat demand and the temperature of the return water depend mainly on the efficiency of the heating systems and weather conditions, but also the characteristics of the user(s) and the technology used.

The selection of appropriate parameters and management of the system is referred to as the control of power delivery. Suitable equipment and software control the work of an energy source.

$$P(\tau) = V(\tau)\, c\, \rho\, [t_{sup}(\tau) - t_{ret}(\tau)]$$

$$Q[J] = \int_0^{1\,yr} P(\tau)\, d\tau$$



The Project summary

$$P(\tau) = V(\tau)\, c\, \rho\, [t_{sup}(\tau) - t_{ret}(\tau)]$$

Why and how geothermal differs from fossil fuels?

The conventional source specified installed power.

A decrease in the return temperature while keeping constant value of supply temperature results in a increase of power. If maximum power is already reached the supply temperature decrease.

Geothermal always gives a stable temperature t_{sup}, independently of the return temperature and the recipient characteristic.

You will not exceed the maximum power, you will always get constant water supply temperature → for geothermal t_{sup} = const.

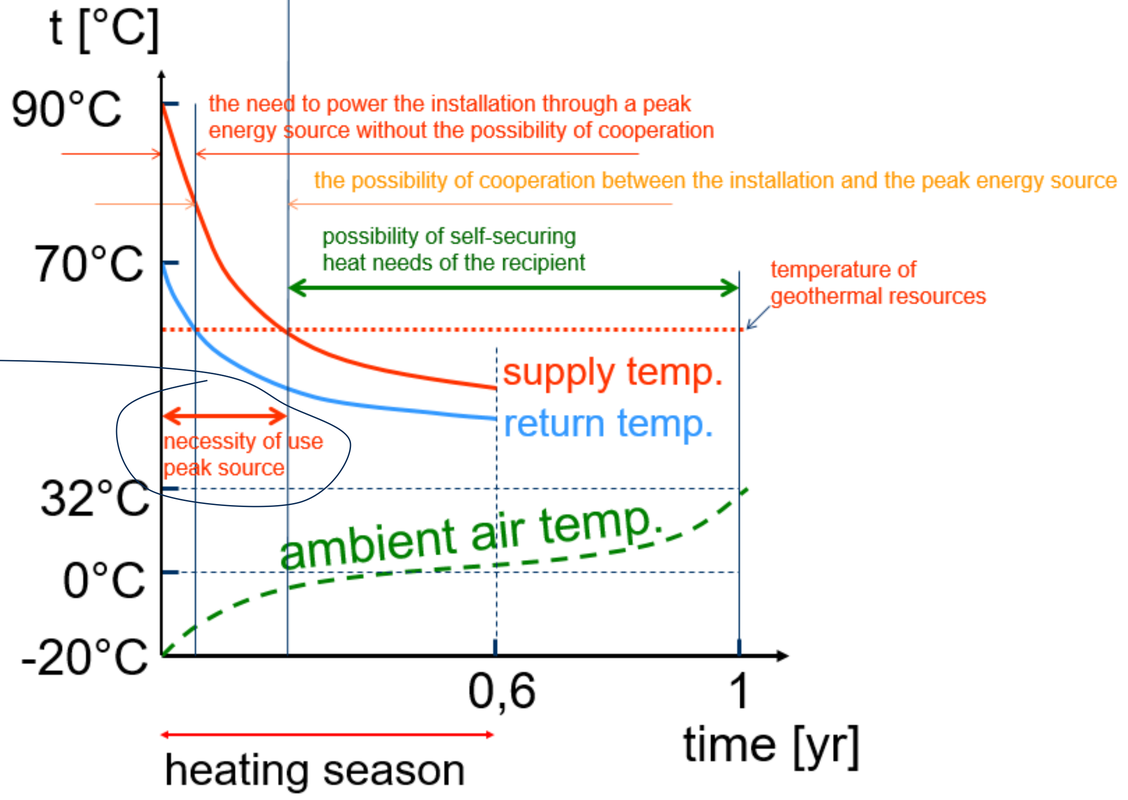
Maximum power depends on the return temperature – the lower value of t_{ret} the higher power P.

The lower return temperaturę t_{ret}, the lower geothermal water discharge V.

The Project summary

The Project background

- The inability to reach the temperature required by the energy user (the installation that the user uses) results in the need to use additional, supporting heat sources (peaking sources).
- The peaking sources generate additional investment outlays and their use occurs when the supply temperature isn't high enough.



Emission factors of selected pollutants generated during the production of heat unit from [kg / GJ]

Polutant	Yellow Straw	Gray straw	Wood	Hard coal	Heating oil	Natural gas	Electricity (in Poland)
B(a)P	b.d.	b.d.	b.d.	0,001	$5{,}340 \cdot 10^{-8}$	0,000	$5{,}288 \cdot 10^{-5}$
Soot	b.d.	b.d	b.d.	0,514	0,000	0,000	0,005
Total dust	0,148	0,147	0,143	2,057	0,053	0,000	0,106
CO_2[14]	128,079	119,816[15]	123,81	105,714	48,954	60,475	290,851
CO	2,463	0,249	0,295	5,714	0,018	0,011	0,661
NO_2[16]	0,591	0,599	0,524	0,057	0,148	0,039	0,529
SO_2	0,128	0,129	0,095	0,731	0,113	0,000	1,798
polycyclic arom. HC	0,128	0,120	0,142	0,286	0,007	0,003	0,033
aliphatic HC				0,286	0,003	0,001	0,033

The Project summary

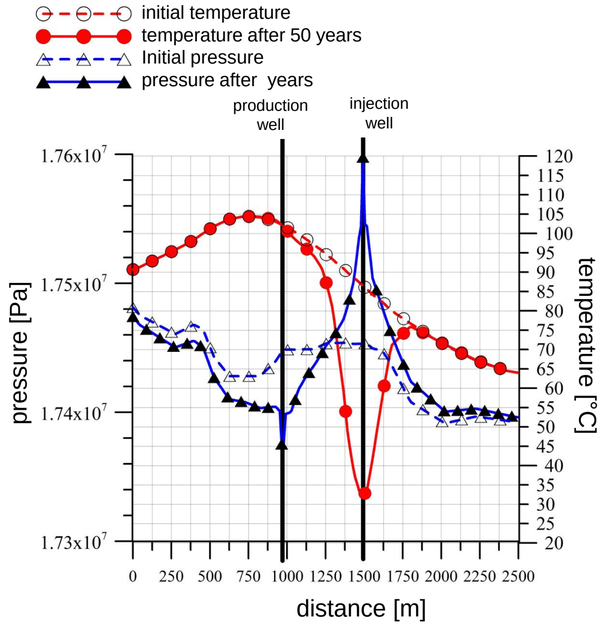
The Project background

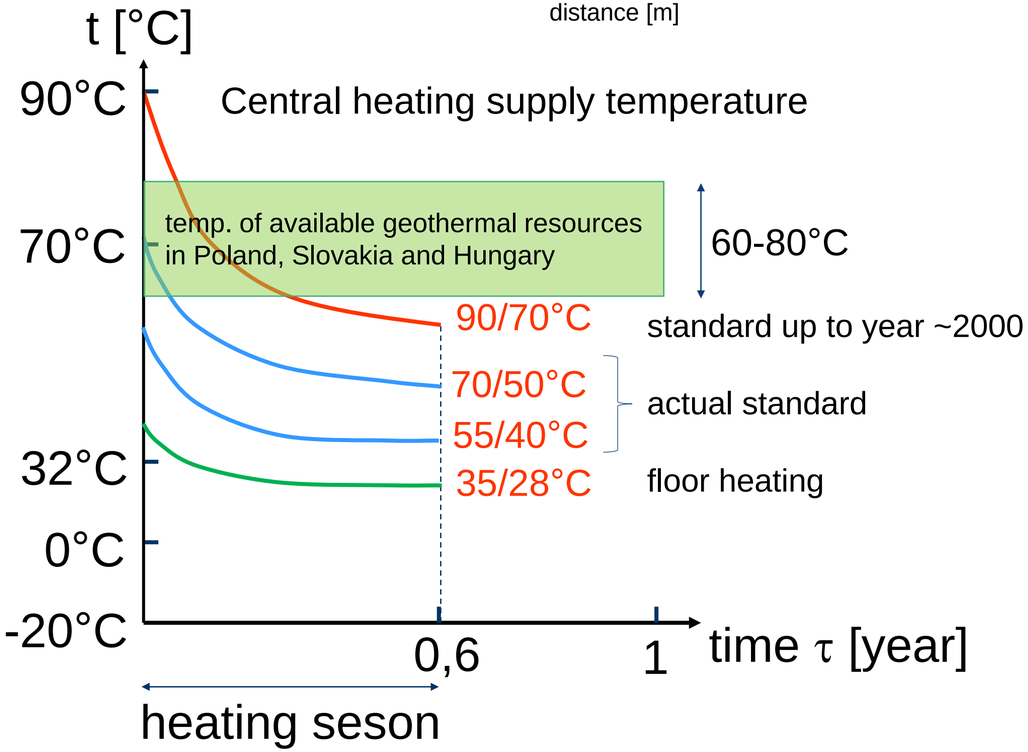
- **Geothermal energy is renewable – but it is not infinite nor free.** Overexploitation can deplete a reservoir while inefficient use of the water. The operation might be uneconomical.
- Still, **40-60°C thermal fluids being discarded without further use in many geothermal systems**, even new ones.

We have the technology allows use even 35°C for space heating.

Why? Because:

- **it is easier to control a DHS while it is overheated** (each user have high enough temperature),
- if an operator needs to **reduce the supply temperature users have to be ready**. An DHS is „as good as the worst user”.
- to get users ready **money have to be spent for extending the heating surface**.
- increase of heating surface might be done by **DH Operator** or by **USER**. Both sides **should know how much does it cost** and **what kind of results are expected** (economical, ecological, energy-saving effect).





The Project summary

The Project background

What we are going to do?

We are going to answer the question: WHETHER IS IT PROFITABLE?

Model database (WP 4)
Description of:
1. **current state of a system** (numerical model calibration), unitary price of primary energy carriers

2**. possible undertakings on a side of: energy users, district heating system, energy source**.
Information about available technology, which allows:
- changing characteristic of energy users,
- improve a district heating grid,
- modernise an energy source.

Local weather conditions
- ambient air temperature,
- wind speed,
- relevant humidity,
- solar radiation

Mathematical Modelling (WP5)
- users demand (characteristic vs weather conditions).
- district heating (heat and pressure losses, characteristic, power controlling),
- the energy source (technology, efficiency, power controlling),
- primary energy carriers.

Results
- Primary energy carriers consumption,
- Power vs time for all sources used,
- Energy production by each source,
- Pollutants emission,
- Cost of energy production,
- Estimated financial expenditures for assumed retrofitting and modernisation,
- CAPEX, OPEX estimation,
- Results interpretation.

Thank you