

Geothermal Energy Use, Country Update for the Czech Republic

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ABSTRACT

Utilization of geothermal energy in the Czech Republic is mostly limited to low - enthalpy sources using the heat pumps. Moreover, the number of new installations of the ground-water systems has stagnated in the recent years.

The direct use of the low-temperature sources occurs only in balneology and the direct use of medium or high temperature sources for production of electricity or heat still does not exist. However there are several such projects under preparation and new research infrastructure RINGEN (Research INfrastructure for Geothermal ENergy) has been established in order to develop the utilisation of deep geothermal energy in the country.

1. INTRODUCTION

In a worldwide context the geothermal energy utilization in the Czech Republic doesn't play a significant role (Lund and Boyd, 2015), and is based almost entirely on indirect shallow energy use by the heat pumps.

Development of direct energy utilization from medium or high temperature sources is limited by the geological conditions and tectonic structure and by the insufficient support from the public sources. Territory of the Czech Republic is formed by two geological units – the Bohemian Massif and the Western Carpathians. The Bohemian Massif that occupies major part of the area is a stable Variscan platform without active volcanic zones. Beside the local anomalies, the heat flow varies between 40 – 90 mW/m² (see the Figure 1) around the mean value of 68 mW/m². In absence of sufficiently large deep-reaching hydrothermal zones and with temperatures generally below 150°C in the uppermost 5 km, the country is predetermined to the deep geothermal energy extraction using EGS (HDR) systems for the direct district heating.

1.1 Legislation

At present, the only public support provided for the geothermal energy utilization is that for the heat pumps installations. All other forms of the support has been stopped recently.

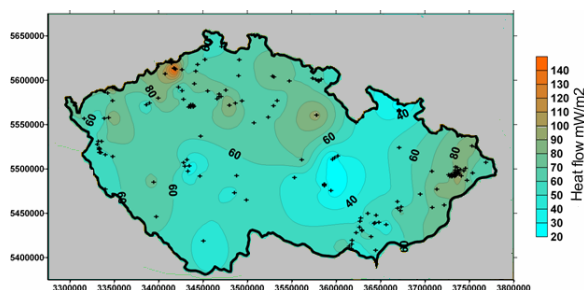


Figure 1: Heat flow distribution in the Czech Republic.

2. INDIRECT GEOTHERMAL ENERGY USE BY HEAT PUMPS

The heat pumps remain the most common way of the geothermal energy indirect use. Most of the installations heat family houses and much less find use in larger, mostly municipal buildings. There is only one case when the heat pumps are used for the district heating.

Considering the high initial investment, the number of new installations depends significantly on the public support. The Ministry of the Environment's "New Green Savings Programme" administered by the State Environmental Fund of the Czech Republic was launched in 2014. Programme focuses on energy savings and renewable energy sources in family houses and supports heat pumps installations like the replacement of high emission coal-burning boilers (<http://www.novazelenausporam.cz/en/>). But it is fair to say that most of the installations are Air-Water systems.

History of the annual supply of heat pumps on the Czech market is shown in Fig. 2 (values for 2015 are estimated from data provided by companies with 70% market share). Despite the overall growth, the number of Ground-Water system installations decreases.

Lower initial investment and increasing efficiency of Air-Water systems and last but not least moderate winters in recent years contribute definitely to this trend.

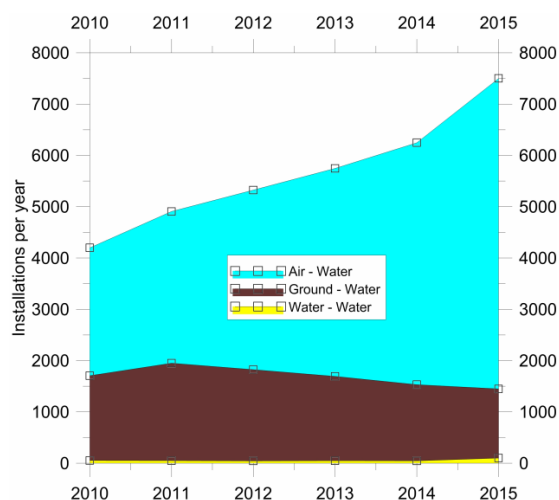


Figure 2: Number of heat pumps supplied annually on the market in Czechia (based on Bufka, 2016)

3. DIRECT ENERGY USE

Only the low enthalpy geothermal sources are exploited directly in Czechia and only for balneal and relaxing purposes. Beside the well-known traditional spas predominantly located in the tectonically active north-western part of the Bohemian Massif, there is a new big project located at Pasohlávky in the south-eastern part of the Czech Republic. The biggest thermal waterpark in the Czech Republic containing several swimming pools (3000 m²), wellness and hotel complex was opened in 2013 and is fed by 1,5 km deep geothermal well. The new project (investment of about € 80 mil.) of biggest spa in central Europe is planned to open at the same place in 2018.

The direct use of the high enthalpy geothermal sources for electricity or heat production is still missing in the Czech Republic, but there are several EGS/HDR projects under preparation. Two geothermal power plants (4 – 5 MW) are planned in granitic plutons in north part of Bohemian Massif by private investors. The third, most developed project located in Litoměřice (see 3.1) targets the heat extraction for direct district heating.

3.1 Litoměřice Deep Geothermal Project

The research project of the deep geothermal energy potential in the locality Litoměřice was initiated in 2006-7 by drilling the exploratory well PVGT-LT1 to the depth of 2,111 m.

Since 2013 the project has been developed as a research project of the consortium consisting of the top Czech universities, the Czech Academy of Sciences and the Czech Geological Survey (altogether 9 partners). Its application will be submitted within the

call „Excellent Research“ of one of the EU structural funds for the Czech Republic by June 2016. Its main aim is to drill 2 geothermal wells up to 4-5 km and develop an EGS underground geothermal heat exchanger. The project is expected to be part of the European research effort focusing on geothermal energy utilisation in dry granitic rocks.

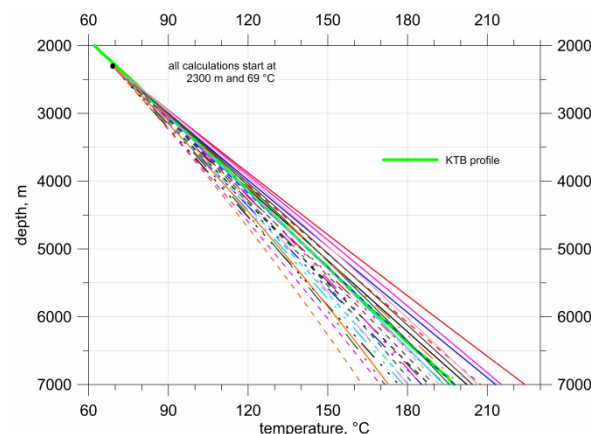


Figure 3: Temperature prognosis for the Litoměřice site based on the data from 2.1 km deep well PVGT-LT1

In 2014, a unique research infrastructure RINGEN (Research INfrastructure for Geothermal ENergy) was established as part of the Czech contribution to the European Research Area (ERA). RINGEN is based in Litoměřice at the same locality as the above-mentioned 2.1 km deep exploratory well and is led by Faculty of Science of Charles University in Prague. The project's overall budget of about € 4,5 mil. will be covered by the Ministry of Education and Research for the period of 2016-2019 (with possible prolongation to 2022). RINGEN will serve as a research base providing preliminary groundworks and infrastructure for the major geothermal project of 2 deep geothermal wells mentioned above. RINGEN is supposed to work as long as geothermal research will be developed.

Currently, all crucial permits required for the major project (drilling permits, construction permits, EIA, etc.) have been obtained and the project is ready for implementation.

If the major project is successful, a pilot project of geothermal heat production feeding existing district heating system should follow.

4. CONCLUSIONS

Despite the long tradition of the basic geothermal research in the Czech Republic, the level of the geothermal energy utilization is rather low at the present. The main reason for that is a lack of sufficiently large and hot hydrothermal sources on its territory. In such a situation, the effective use of geothermal energy requires technologically complicated and risky and financially quite demanding approach like the enhanced geothermal - or more probably the hot dry rock technologies. In absence of a

systemic governmental/public support it is very difficult to raise private funds/bank loans for such projects.

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- Bufka, A.: Heat Pumps in 2014, Ministry of Industry and Trade of the Czech Republic – Results of statistical survey, (2016)

Table A: Present and planned geothermal power plants, total numbers

	Geothermal Power Plants		Total Electric Power in the country		Share of geothermal in total electric power generation	
	Capacity (MW _e)	Production (GWh _e /yr)	Capacity (MW _e)	Production (GWh _e /yr)	Capacity (%)	Production (%)
In operation end of 2015 *	-	-	21 923	86 003	-	-
Under construction end of 2015	-	-	-	-	-	-
Total projected by 2018	< 10	< 80	-	-	< 0.1%	< 0.1%
Total expected by 2020	< 10	< 80	-	-	< 0.1%	< 0.1%
In case information on geothermal licenses is available in your country, please specify here the number of licenses in force in 2015 (indicate exploration/exploitation, if applicable):					-	

* In operation end of 2014

Table B: Existing geothermal power plants, individual sites

Locality	Plant Name	Year commissioned	No of units **	Status	Type	Total capacity installed (MW _e)	Total capacity running (MW _e)	2015 production * (GWh _e /y)
Geothermal power plants do not exist in the Czech Republic								

Explanation to tables C, D1 and D2: ‘Geothermal district heating or district cooling’ (Geothermal DH plants) is defined as the use of one or more production fields as sources of heat to supply thermal energy through a network to multiple buildings or sites, for the use of space or process heating or cooling, including associated domestic hot water supply. If greenhouses, spas or any other category is among the consumers supplied from such network, it should be counted as district heating and not within the category of the individual consumer. In case heat pumps are applied in any part of such a network, the also should be reported as district heating and not as geothermal heat pumps. An exception is for distribution networks from shallow geothermal sources supplying low-temperature water to heat pumps in individual buildings; systems of this kind should be reported in table E. For table D2, please give information on large systems only ($>500 \text{ MW}_{\text{th}}$); installations with geothermal source temperatures $<25 \text{ }^{\circ}\text{C}$ and depth $<400 \text{ m}$ should be reported in table E.

Table C: Present and planned geothermal district heating (DH) plants and other direct uses, total numbers*

	Geothermal DH plants		Geothermal heat in agriculture and industry		Geothermal heat for individual buildings		Geothermal heat in balneology and other **	
	Capacity (MW_{th})	Production ($\text{GWh}_{\text{th}}/\text{yr}$)	Capacity (MW_{th})	Production ($\text{GWh}_{\text{th}}/\text{yr}$)	Capacity (MW_{th})	Production ($\text{GWh}_{\text{th}}/\text{yr}$)	Capacity (MW_{th})	Production ($\text{GWh}_{\text{th}}/\text{yr}$)
In operation end of 2015	6.5	25	-	-	-	-	-	-
Under construction end 2015	-	-	-	-	-	-	-	-
Total projected by 2018	-	-	-	-	-	-	-	-
Total expected by 2020	6.5	26	-	-	-	-	-	-

* Reliable statistic isn't available in the Czech Republic

Table D1: Existing geothermal district heating (DH) plants, individual sites

Locality	Plant Name	Year commissioned	CHP **	Cooling ***	Geoth. capacity installed (MW_{th})	Total capacity installed (MW_{th})	2015 production * ($\text{GWh}_{\text{th}}/\text{y}$)	Geoth. share in total prod. (%)
Děčín	Děčín Geothermal Resource	2002	no	no	6.5	33	26	-
total					6.5	33	26	-

* 2014 production

** If the geothermal heat used in the DH plant is also used for power production (either in parallel or as a first step with DH using the residual heat in the brine/water), please mark with Y (for yes) or N (for no) in this column.

*** If cold for space cooling in buildings or process cooling is provided from geothermal heat (e.g. by absorption chillers), please mark with Y (for yes) or N (for no) in this column. In case the plant applies re-injection, please indicate with (RI) in this column after Y or N.

Table D2: Existing geothermal direct use other than DH, individual sites

No other direct use reported

Explanation to table E: ‘Shallow geothermal’ installations are considered as not exceeding a depth of 400 m and (natural) geothermal source temperatures of 25 °C. Installations with geothermal source temperatures >25 °C and depth >400 m should be reported in table D1 or D2, respectively. Distribution networks from shallow geothermal sources supplying low-temperature water to heat pumps in individual buildings are not considered geothermal DH *sensu strictu*, and should be reported in table E also.

Table E: Shallow geothermal energy, ground source heat pumps (GSHP)

	Geothermal Heat Pumps (GSHP), total			New (additional) GSHP in 2015 *		
	Number	Capacity (MW _{th})	Production (GWh _{th} /yr)	Number	Capacity (MW _{th})	Share in new constr. (%)
In operation end of 2015 *	~18300			1450		
Projected total by 2018	~22500					

* If 2014 numbers need to be used, please identify such numbers using an asterisk