Iceland Liechtenstein Norway grants

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TOPIC: Energy of the Earth's core

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PROJECT: **Comparison of energy potencial of Iceland and the Czech Republic**

DATE: 1/ 8/2021 – 31/ 8/ 2022

Content

1. Geothermal energy – sources, manifestations, use, impact on the living environment
2. Geological conditions of Iceland – geothermal island, causes of high volcanic activity, rift system
3. Geological conditions of the Czech Republic – geological structure, geology of the Czech Republic, remains of volcanic activity
4. Use of the Earth's core energy in Iceland – geothermal power plants in Iceland, Hellisheiði geothermal power plant
5. Use of the Earth's core energy in the Czech Republic – Děčín, Ústí nad Labem, Litoměřice
6. Geothermal potential – summary
7. Sources of information

1. Geothermal energy

Resources

natural thermal energy of the Earth's core

decay of radioactive elements

physico-chemical reactions

tectonic motion (see pictures)

tidal force energy

Plate tectonics

Speeches

volcanic activity, hot water and vapours rising to the surface or hot gas springs

average temperature of the earth's surface = approximately 15 °C

towards the center of the Earth, the temperature gradually increases until it reaches approximately 5,000 °C

with each kilometer of depth, the rocks are 25 to 30 °C warmer

more pronounced temperature gradients are found mainly in the areas of contact of lithospheric plates, in these places there are usually favorable conditions for the use of geothermal energy

1. Geothermal energy

Exploitation

thermal energy (heating, cooling)

1. Hydrothermal systems (hot water tank underground)

hot water underground under higher pressure = > gets to the surface in the form of a steam mixture or dry steam

2. HDR (hot dry rock) system

sufficiently high temperature, but lack of heat transfer liquid, for energy use necessary supply of heat transfer substance from the surface

HDR power plants are based on the use of heat extracted from hot rocks

power generation (geothermal power plants)

conversion of the internal energy of the steam into mechanical and then electrical energy of the turbo-generator, through the steam cycle

According to the parameters and method of obtaining steam, geothermal power plants are divided into dry steam power plants, wet steam power plants and binary cycle power plants.

1. Geothermal energy

Exploitation

Geothermal power plant with wet steam

steam water mixture or sufficiently hot water at higher pressure

most of the geothermal power plants operating today

hot water or steam mixture must pass through separators, where part of the water evaporates due to pressure reduction to form wet steam

the separated steam is then fed into the turbo-generator

the remaining water, together with condensed water from the steam, is pumped back into the geothermal reservoir

the efficiency of a wet steam power plant is around 8 to 10%

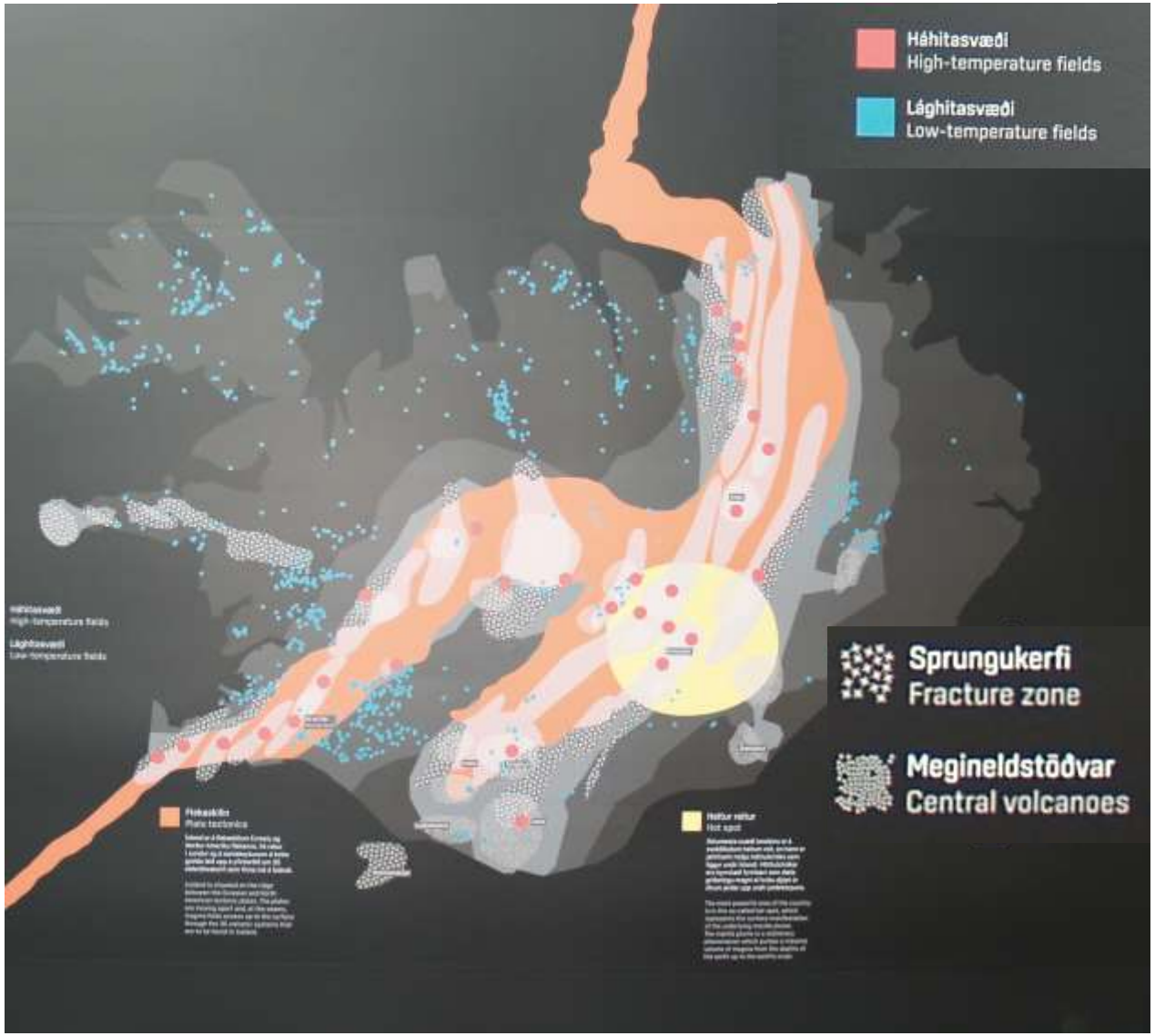
Environmental impact

geothermal resources = cheap, renewable and environmentally acceptable solution with huge potential

geothermal power plants = affect the surrounding environment only to a small extent, some power plants cause subsoil settling or increased seismic activity

2. Geological conditions of Iceland

Geothermal Island



Photos taken at GE Hellisheiði

2. Geological conditions of Iceland

Causes of high volcanic activity

The island lies in the northern part of the Atlantic Ocean at the point of confluence of the divergent plate interface (the plates move apart) on the mid-Atlantic ridge and the mantle diapir (chochole).

The divergent plate interface in Iceland consists of branched rift zones between the Ridges of Reykjanes on the SW and Kolbeinsey on the SV.

rift (trench depression, deep subsidence) is a seismically and volcanically active zone in the earth's crust, characterized by disturbances of a subsidence character

There is an increase in the new crust of the Earth and the separation of the North American and Eurasian continental plates at a rate of about 2 cm / year.

The presence of a mantle diapir (hot spot) under Iceland causes a constant uplift of the Icelandic plateau and high volcanic activity.

At present, the mantle diapir is situated under the Vatnajökull glacier.

Background image = > area of Þingvellir on the western rift zone.

2. Geological conditions in Iceland

Rift system

It includes 40–50 km wide rift zones consisting of fault systems up to 200 km long:

1. 16 million years old, area S and SZ of the island, east coast
2. 0.2 to 3 million years old, the area forms narrow strips around the current volcanic zone
3. 0.7 million years old, the area of the central young volcanic zone, one of the most active areas in the world

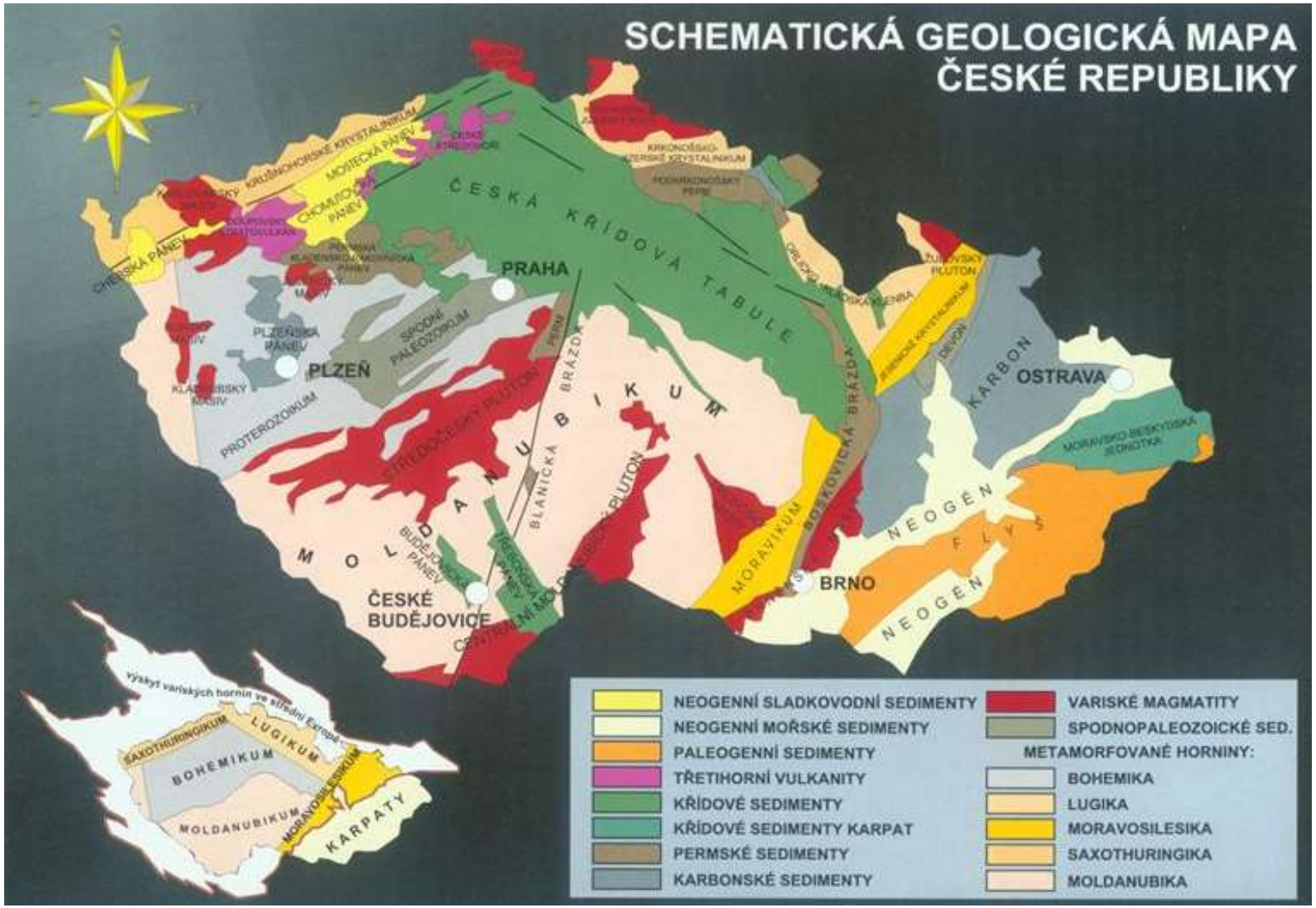
In these zones, a volcanic center with very high volcanic activity is occasionally formed.

High-temperature geothermal fields are bound to these volcanic regions (Svartsengi (GE) on the Reykjanes Peninsula, an area with strong volcanic activity in the background image).

Areas outside the rift zones (Snæfellsnes peninsula, Westfjords and east coast of Iceland) are characterized by generally lower volcanic and geothermal activity.

3. Geological conditions of the Czech Republic

Geological structure of the Czech Republic



3. Geological conditions of the Czech Republic

Geology of the Czech Republic

There are two basic units on the territory of the Czech Republic:

1. Bohemian Massif (Bohemia and Western Part of Moravia)
2. Western Carpathians (eastern and southeastern part of Moravia).

The boundary of both units is approximately the line Znojmo – Ostrava.

The Bohemian Massif is a fragment of the Variscan orogen (a belt mountain range).

It consists of fundamentals (older crystalline subsoil) and platform covers (younger sediments).

The Western Carpathians are part of the alpid – a vast mountain system formed by sediments of the Mesozoic and Tertiary, which stretches from Spain to South Asia.

3. Geological conditions of the Czech Republic

Remains of volcanic activity

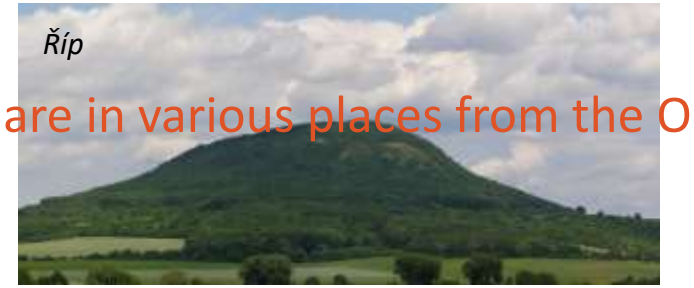
Among the youngest are volcanoes in the vicinity of Bruntál (about 2 million years old) and volcanoes in the vicinity of Cheb – Železná hůrka (170–400 thousand years old) and Komorní hůrka (over 450 thousand years old).

The maximum volcanic manifestations occurred during the Tertiary approximately 40–18 million years ago – e.g. the solitary volcano Říp (see picture)

This volcanism was associated with the processes of alpine folding.

At this time, the Volcanic Activity of the Doupov Mountains and the Central Bohemian Uplands (only remnants of the supply paths of volcanoes and volcanic bodies that were hidden under the surface remained).

Older remnants of volcanic activity in the form of volcanic (volcanic) rocks are in various places from the Old Mountains and Paleozoic periods.


Říp

4. Energy use of the Earth's core in Iceland

Geothermal power plants in Iceland

Nesjavellir (120 MW)

Reykjanes (100 MW)

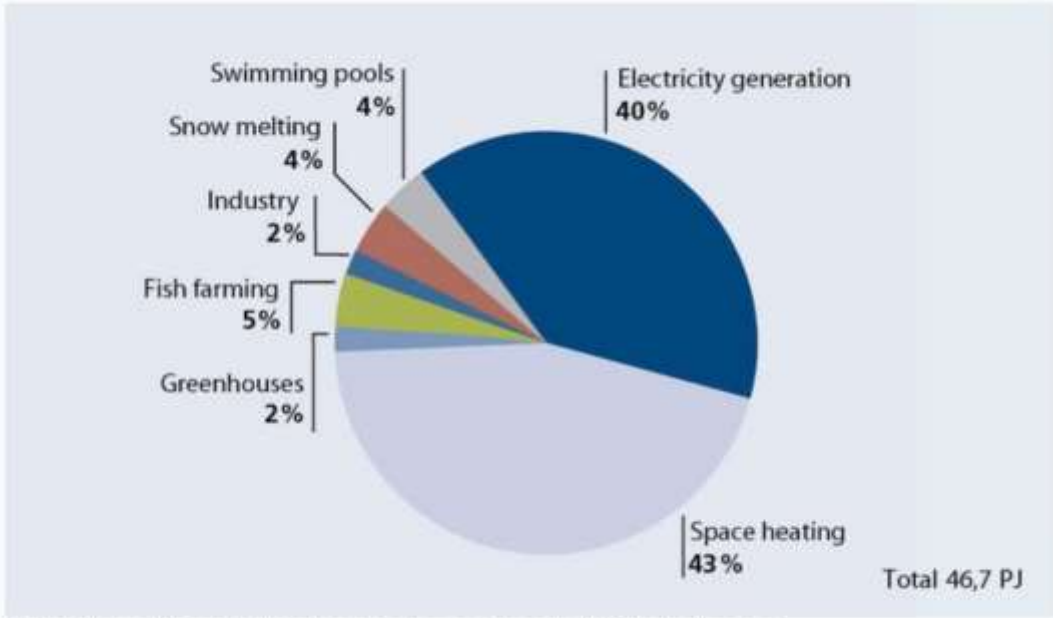
Hellisheiði (303 MW)

Krafla (60 MW)

Svartsengi (76.4 MW)

Bjarnarflag (3MW)

These power plants also produce electricity.

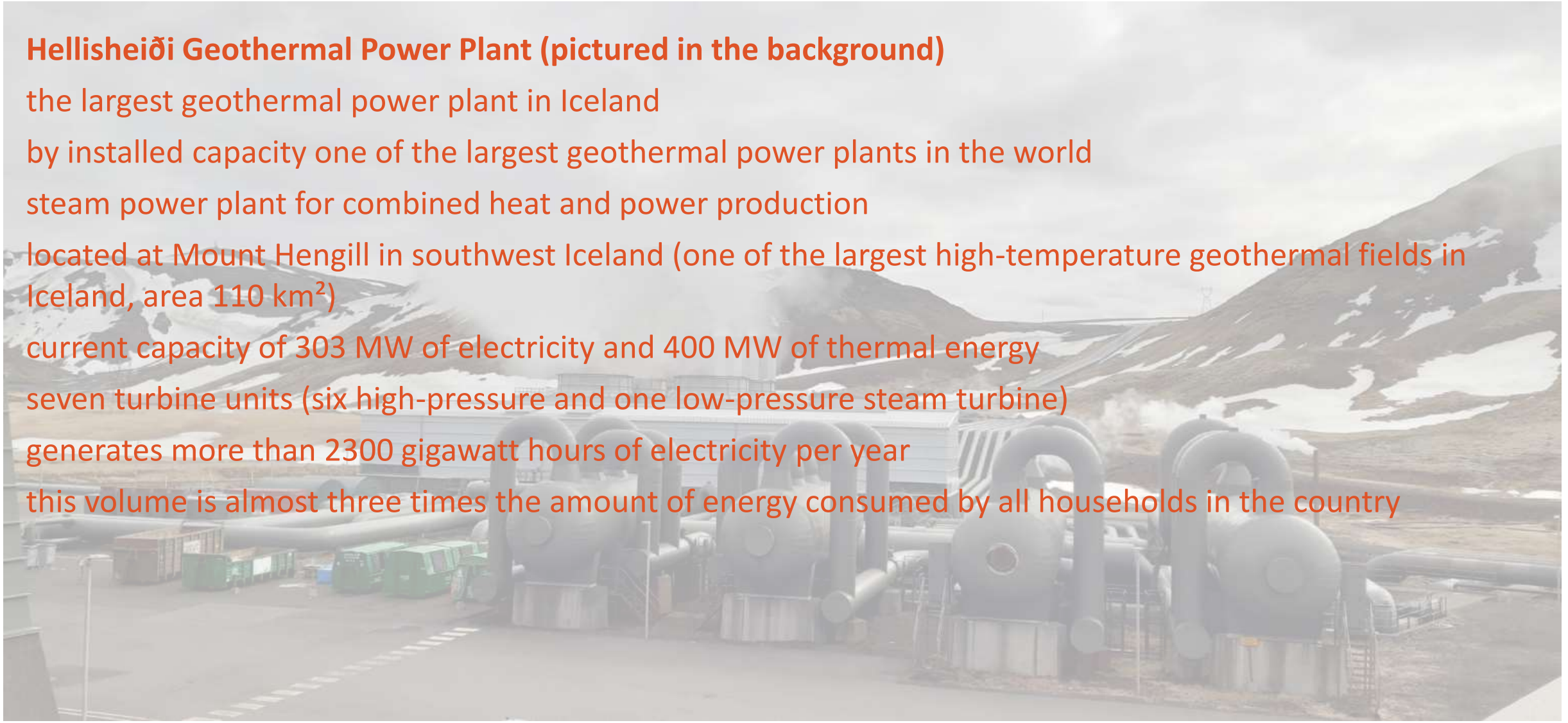


Způsob využití geotermální energie na Islandu, 2013. Zdroj: nea.is

Geothermal energy heats 89% of houses in Iceland and more than 54% of the primary energy used in Iceland comes from geothermal sources.

It is used for space heating, greenhouses, electricity generation, for swimming pools, fish farms, etc.

4. Energy use of the Earth's core in Iceland



Hellisheiði Geothermal Power Plant (pictured in the background)

the largest geothermal power plant in Iceland

by installed capacity one of the largest geothermal power plants in the world

steam power plant for combined heat and power production

located at Mount Hengill in southwest Iceland (one of the largest high-temperature geothermal fields in Iceland, area 110 km²)

current capacity of 303 MW of electricity and 400 MW of thermal energy

seven turbine units (six high-pressure and one low-pressure steam turbine)

generates more than 2300 gigawatt hours of electricity per year

this volume is almost three times the amount of energy consumed by all households in the country

5. Use of the Earth's core energy in the Czech Republic

Decin

since 2002 in operation heating plant on Benešovská Street

the central heat source (CZT) for the right-bank part of the town of Děčín represents the largest and unique project in the Czech Republic for the use of geothermal water

a test well was drilled in 1998 and the source was commissioned in September 2002

for heat production, geothermal energy from water with a temperature of about 30 °C is used from an underground lake located below Děčín

geothermal water rises by natural pressure from a borehole with a depth of 545 m and in heat pump technology the thermal potential of this geothermal water is used to heat the heating water up to 72 °C

at maximum output, the borehole yield is 54 l/s

the heating plant technology is further supplemented by other heat sources (gas cogeneration engines for the production of electricity and heat and gas hot-water boilers) used in case of need for a higher heat output of the heating plant

5. Use of the Earth's core energy in the Czech Republic

Karel Stibral

Usti nad Labem

heating of swimming pools

since May 2006 heating of the ZOO

Litomerice

test borehole for geothermal power plant (depth 2500 m)

if the results of the measurements are favorable = > two more production wells will begin to be drilled (depth 5000 m)

rock temperature 150 to 200°C, expected power plant output 50 MW

GE will focus not on heat generation, but on electricity generation

the main obstacle is funding

the project is not verified

6. Geothermal potential – summary

Hydrothermal systems

conditions suitable in Iceland

dominantly used

hot water naturally occurring underground is pumped

hydrothermal systems with the highest temperatures are located on convergent edges of lithospheric plates, in rift zones or in areas of hot mantle spots

Heat of dry rocks (Hot Dry Rock System, HDR)

the most suitable way to use geothermal energy in the conditions of the Czech Republic

hydrogeothermal sources occur to a very limited extent and their temperature is relatively low

practically unlimited resources are offered in the Czech Republic in the field of low-potential geothermal heat

There are no active volcanoes on the territory of the Czech Republic, only remnants of volcanic activity.

Unlike Iceland, the resources of the Czech Republic for the use of geothermal energy are limited.

7. Resources

- https://www.svetenergie.cz/cz/energetika-zblizka/obnovitelne-zdroje-energie/geotermalni-elektrarna/vyklad
- https://oenergetice.cz/elektrina/geotermalni-energie
- https://wikijii.com/wiki/energy_in_iceland#Geothermal_power
- https://st3.depositphotos.com/2465573/12770/v/600/depositphotos_127709010-stock-illustration-tectonic-plates-spanish-text.jpg
- https://www-power--technology-com.translate.goog/projects/hellisheidi-geothermal-power-plant/?_x_tr_sl=en&_x_tr_tl=cs&_x_tr_hl=cs&_x_tr_pto=sc
- www.gweb.cz
- https://concrete.fsv.cvut.cz/projekty/pdf/2016/pomucky_GET_geologicke_mapy.pdf
- http://www.gepo.cz/geotermalni-energie-v-cr-a-ve-svete-cln6.php
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- http://www.spvez.cz/pages/OZE/geoterm.htm
- http://www.cgta.eu/2020/12/03/potencial-geotermalni-energie-na-uzemi-ceske-republiky/
- https://oenergetice.cz/elektrina/geotermalni-energie
- https://www.stredohori.cz/detail/rip
- https://cs.wikipedia.org/wiki/Island