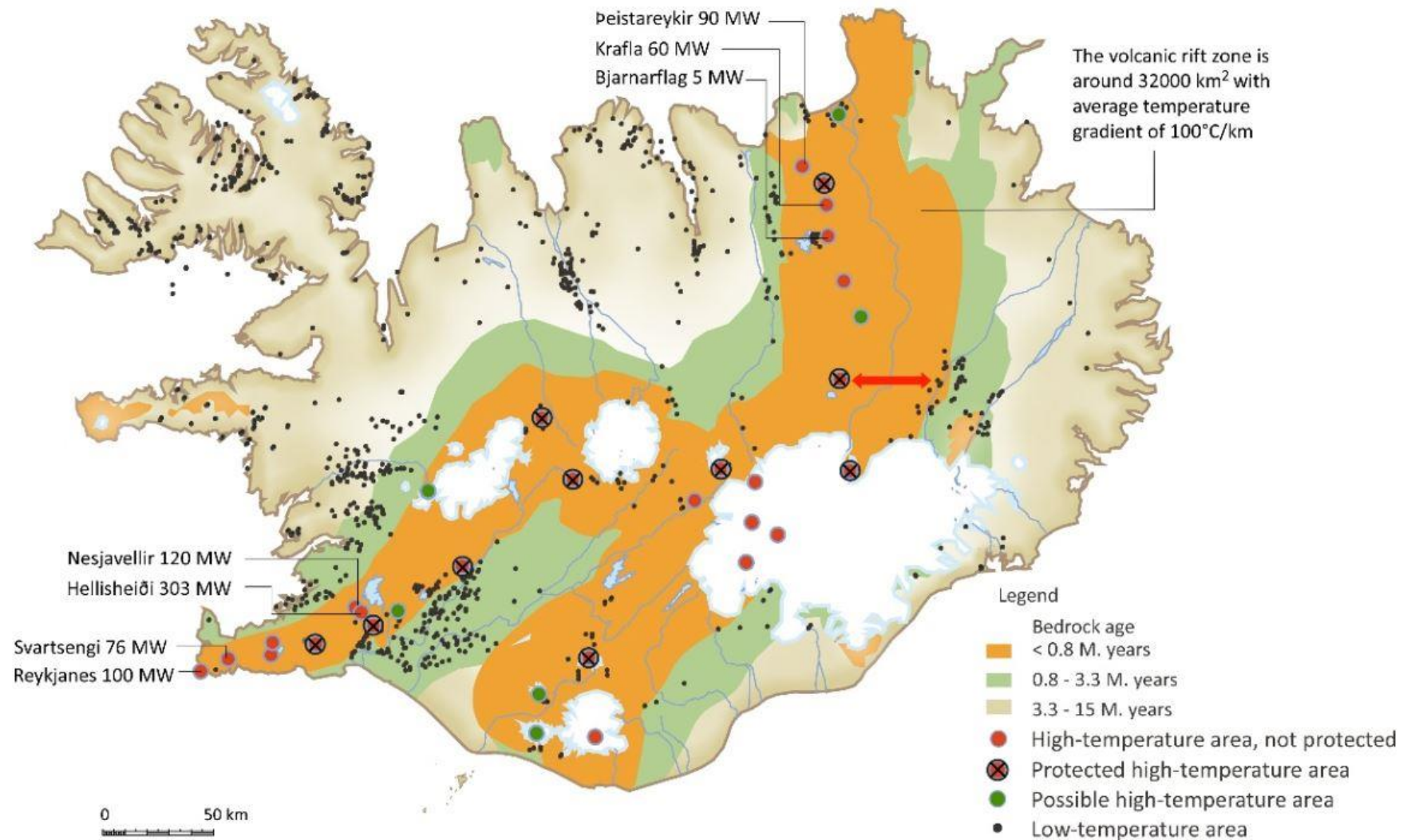


A decorative graphic on the left side of the slide, featuring several overlapping gears of various sizes, rendered in a light grey outline style. The gears are arranged in a roughly circular pattern, with some partially cut off by the edge of the frame.

UTILIZATION OF LOW-TEMPERATURE GEOTHERMAL WATER FOR ELECTRICITY GENERATION IN ICELAND

SDEC 2019

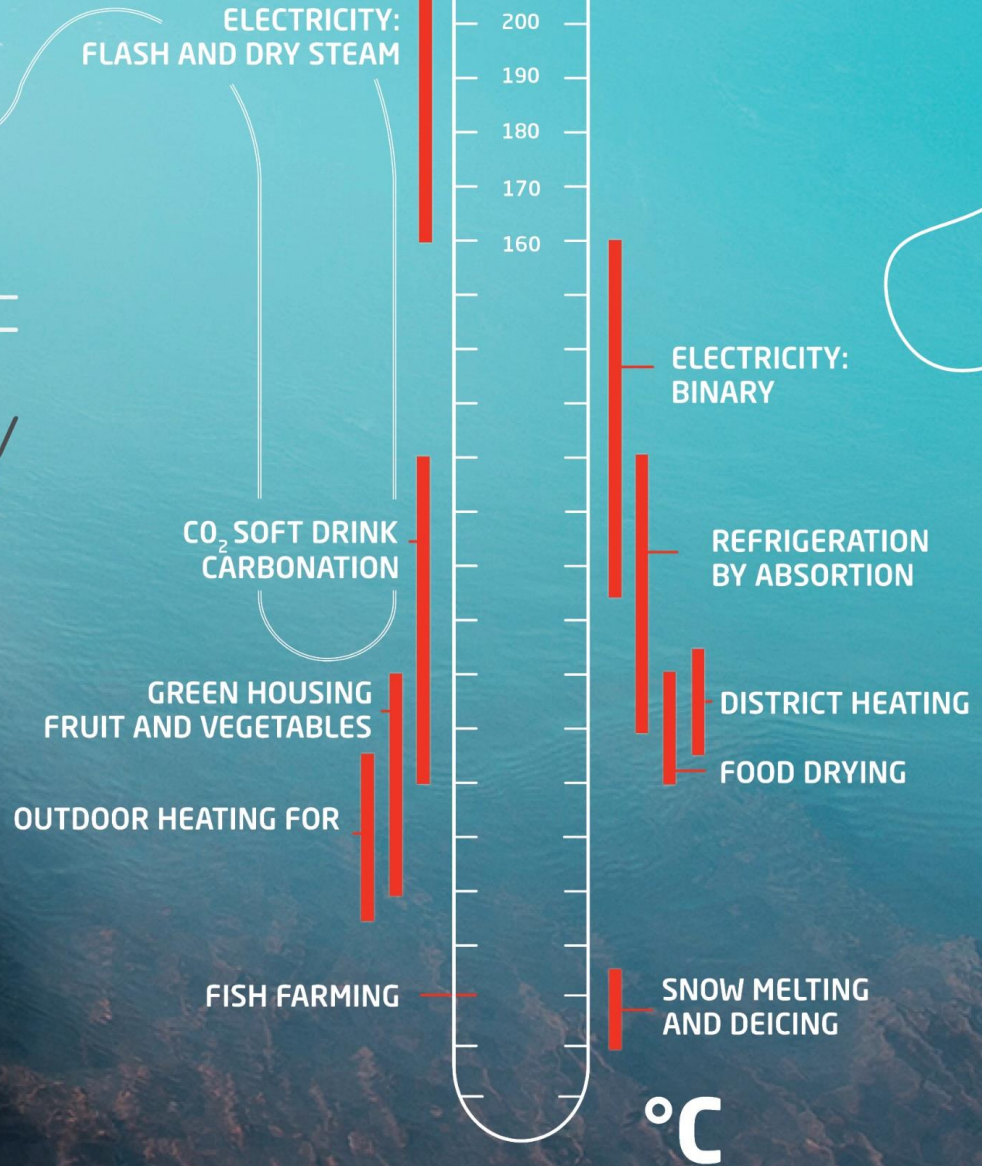
Egill Maron Þorbergsson
Energy Engineer Ph.D.

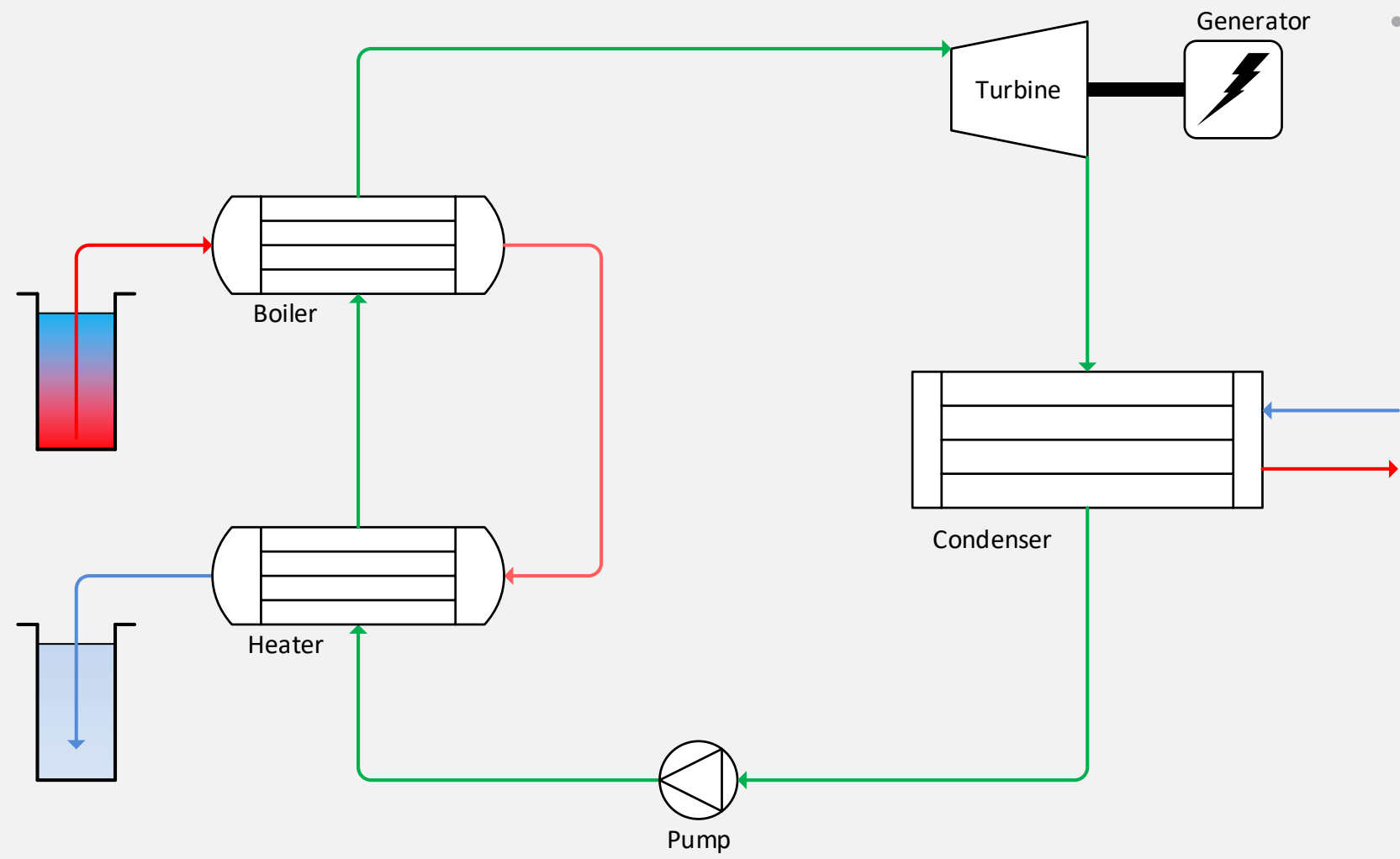


A simplified geological map of Iceland showing the location of the geothermal fields and the present geothermal power plants.

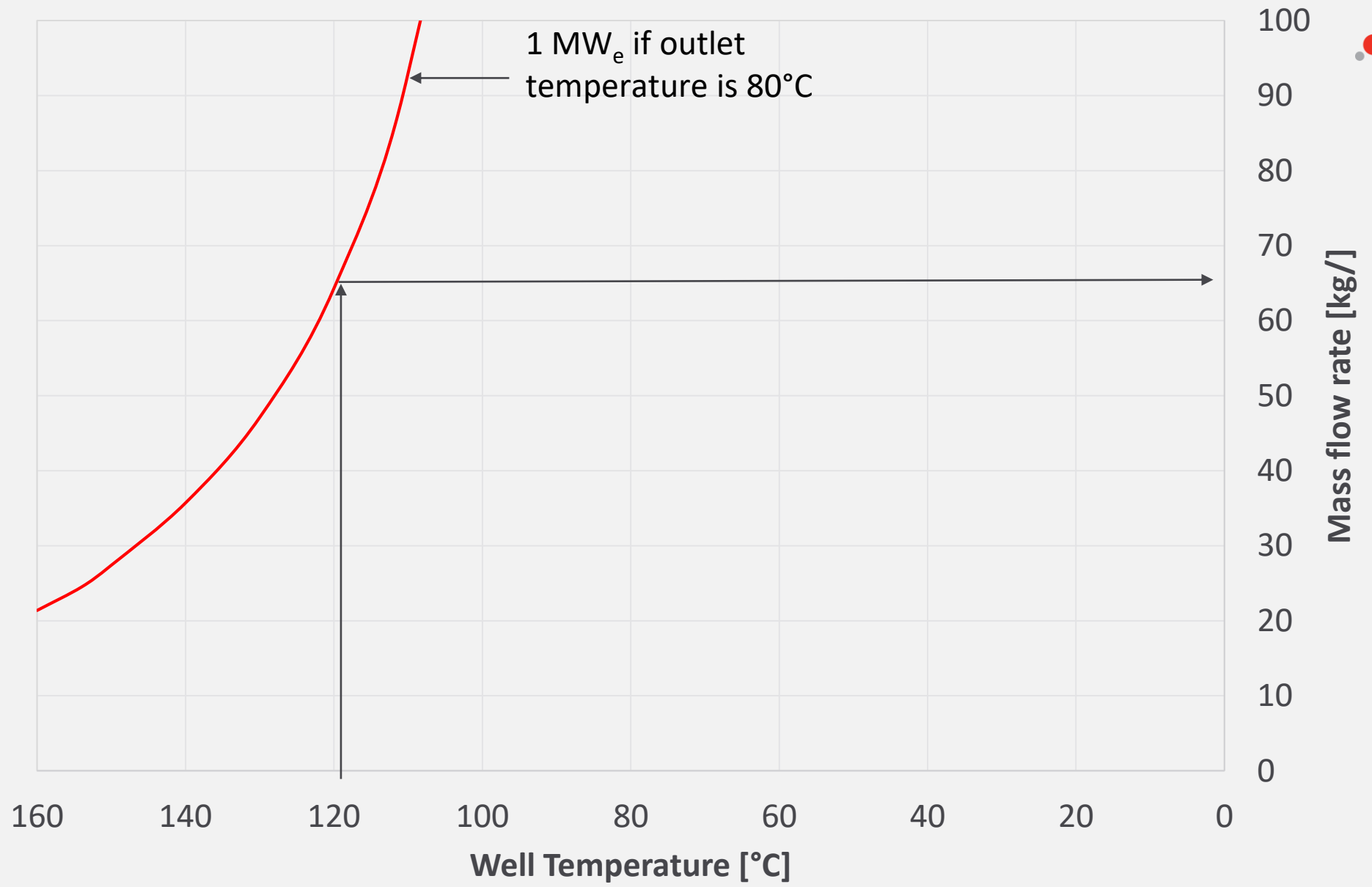
Ólafur G. Flóvenz. *Expanding the Resource Base for High Temperature Geothermal Power Production in Iceland*. GRC TRANSACTIONS, VOLUME 42 (2018).

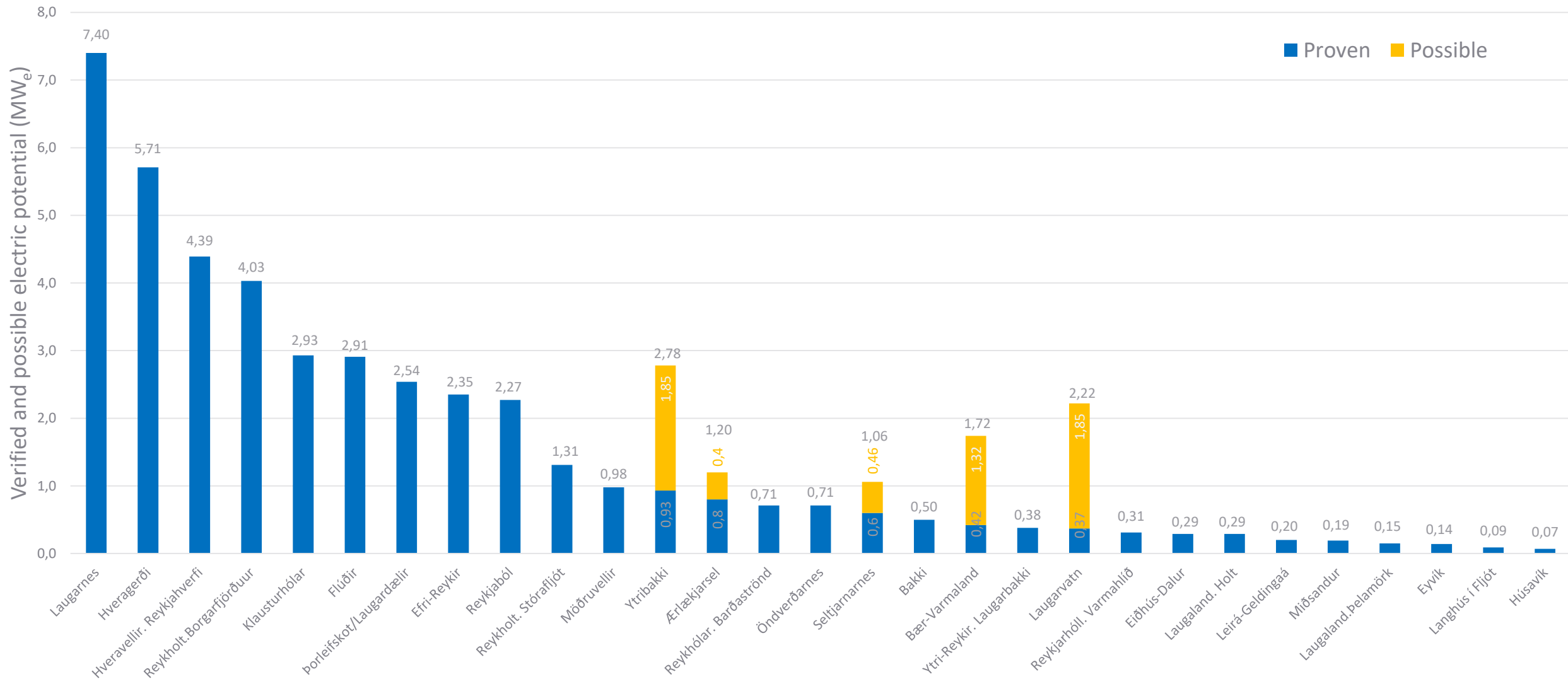
THE MULTIPLE USE OF GEOTHERMAL ENERGY





Binary Cycle

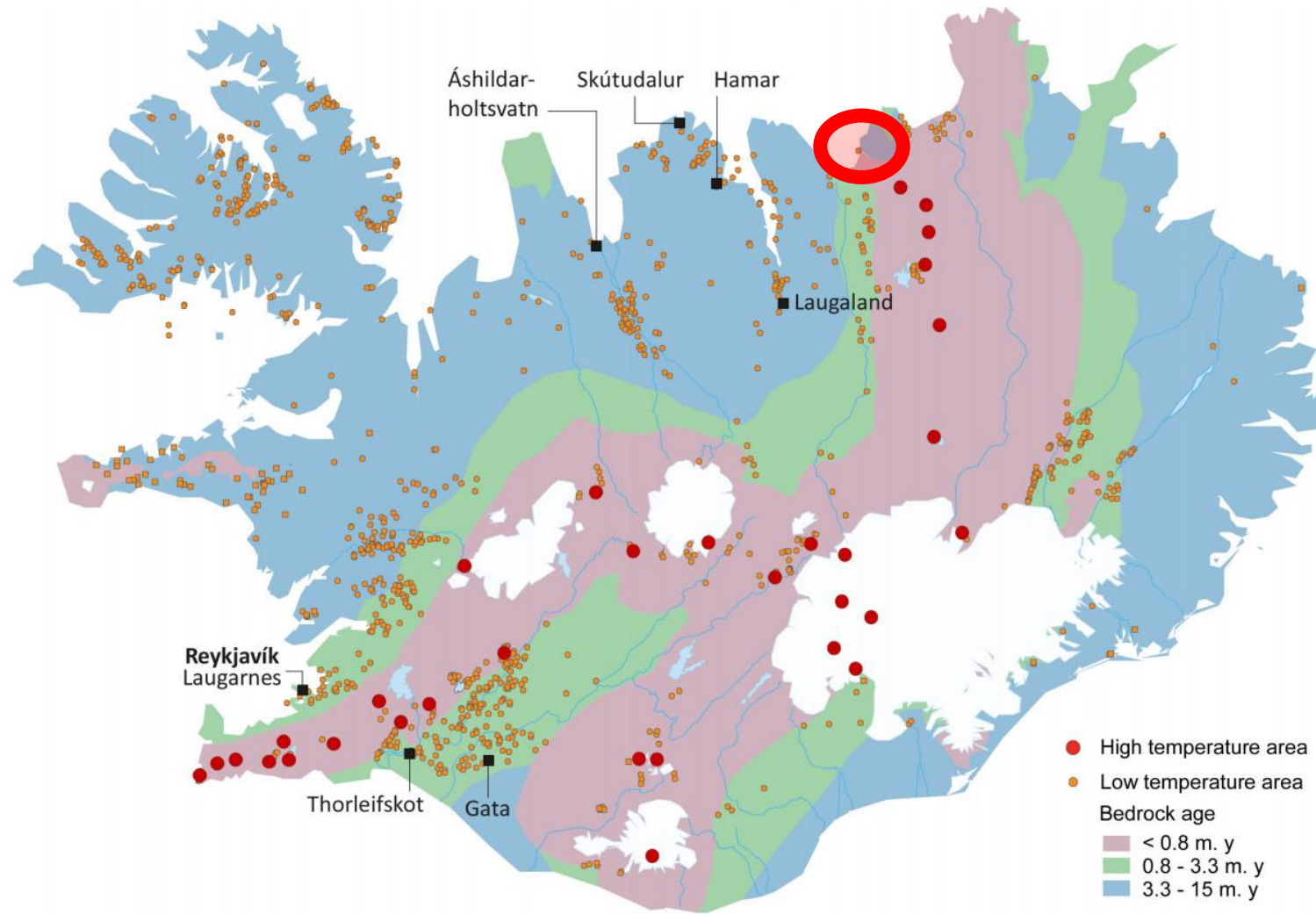




Proven and possible electric potential (MWe) of 29 medium enthalpy geothermal systems in Iceland using binary cycles and 80°C of effluent water.

Björn Már Sveinbjörnsson. *Medium Enthalpy Geothermal Systems in Iceland. Thermal and Electrical Potential. ÍSOR-2016/008*

Húsavík



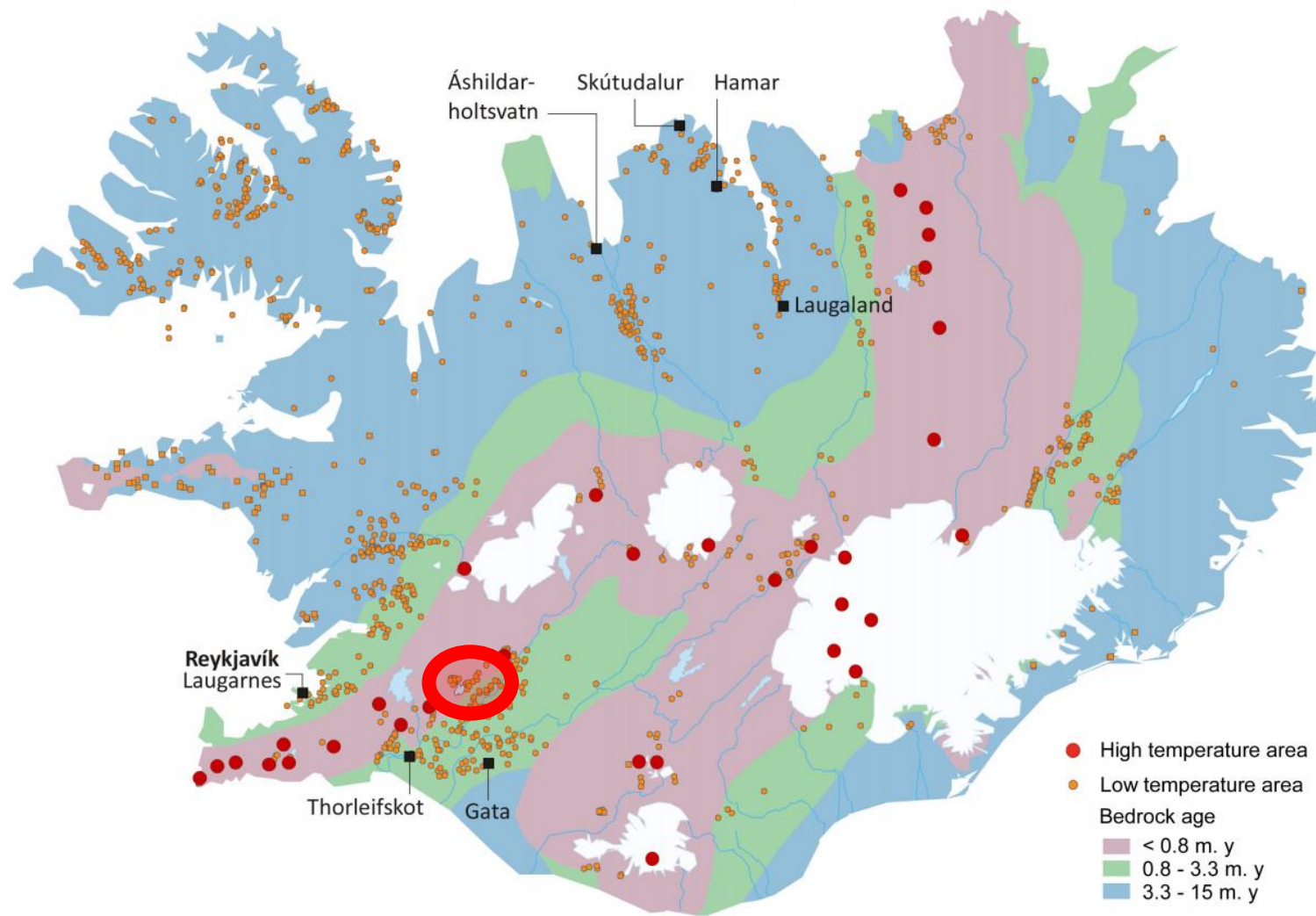
Temperature: 120°C
Flow: 90 l/s
Potential: 2 MW_e

There is an open competition to find partners to utilize the energy



Húsavík

Efri Reykir



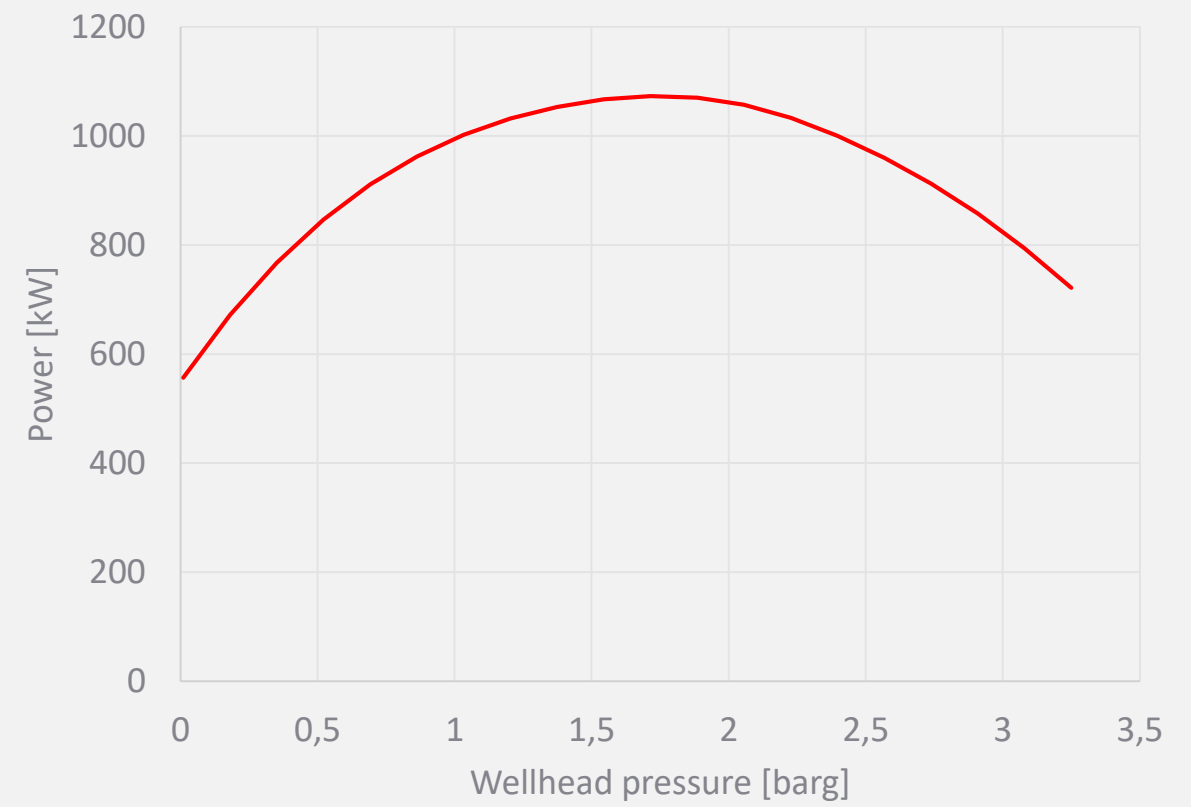
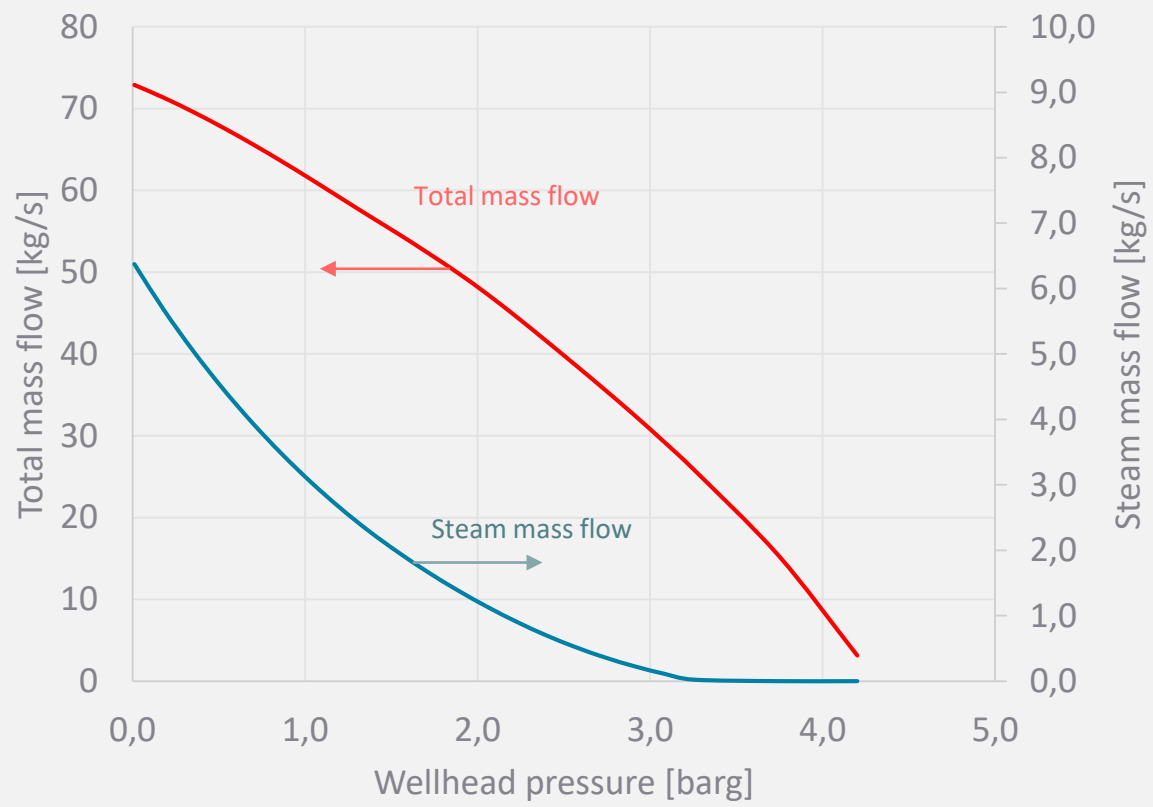
Artesian well
Enthalpy: 610 kJ/kg



Efri Reykir

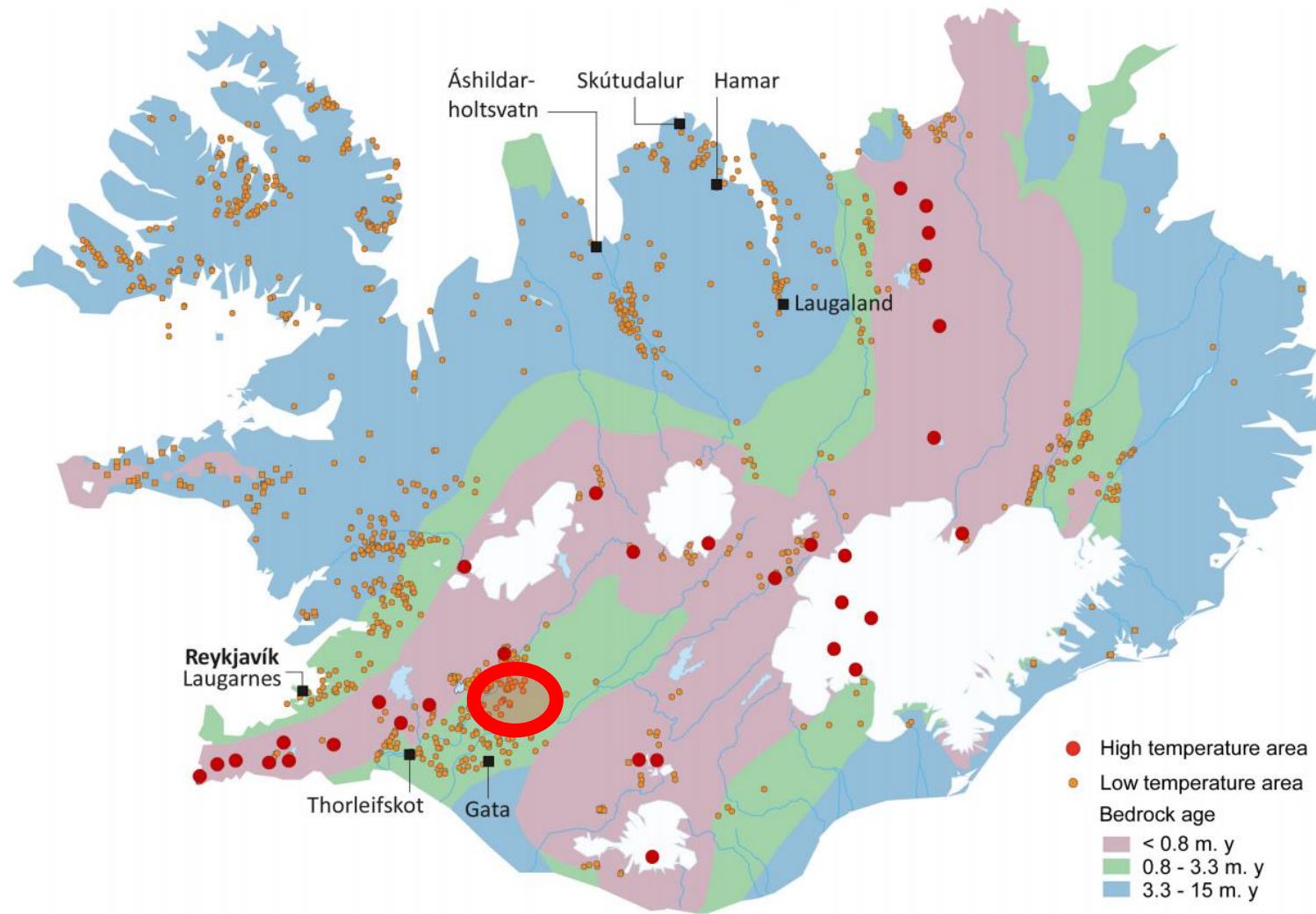


Efri Reykir



Efri Reykir

Kópsvatn



Temperature: 115°C

Flow: 30 l/s

Power output: **600 kW** in phase 1 and **1200 kW** after phase 2



VARMAORKA

Nýsköpun í raforkuframleiðslu

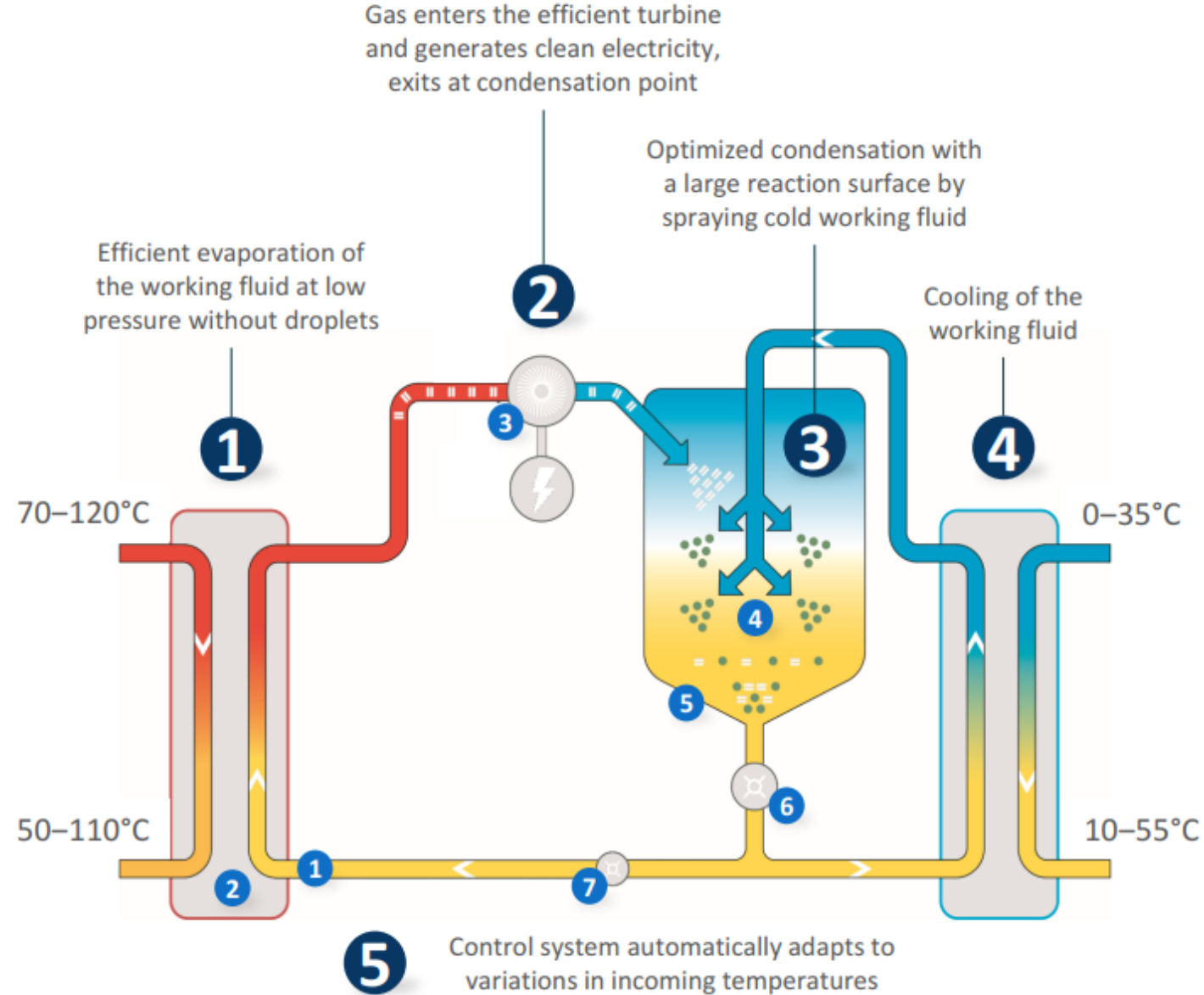
Icelandic company developing the low temperature geothermal electricity generation market



Climeon Heat Power 150

- Standardized solution
- Power output 150 kW
- Possible to get 50% of Carnot efficiency
- With 90°C hot water and 20°C cooling water possible to get 10% efficiency

Process overview



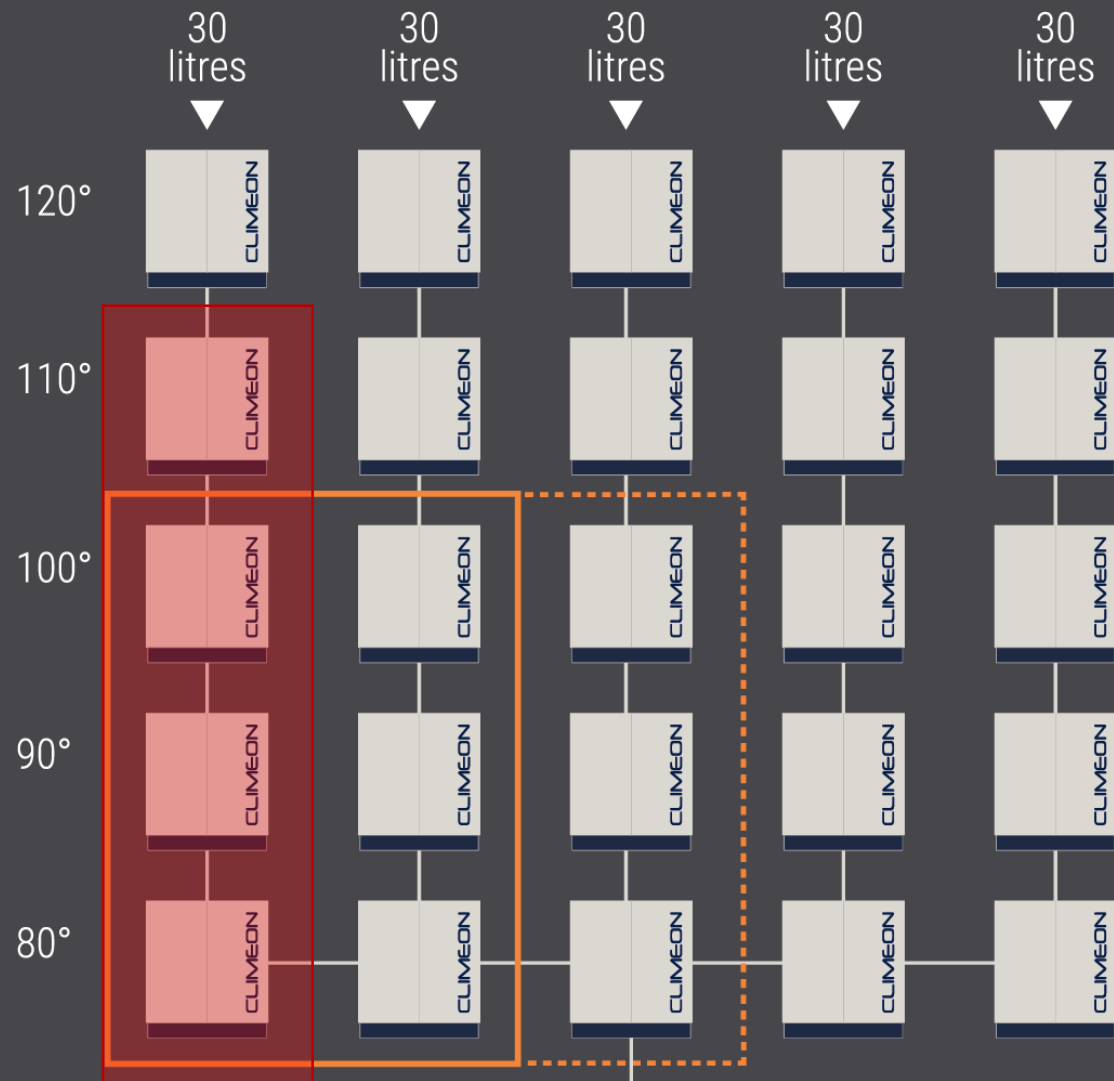
Patent overview

STRONG PATENT PROTECTION

Climeon has 1 approved patent and 11 patents pending. Together they protect the most critical innovations with the C3 technology in the temperature range 70–120°C.

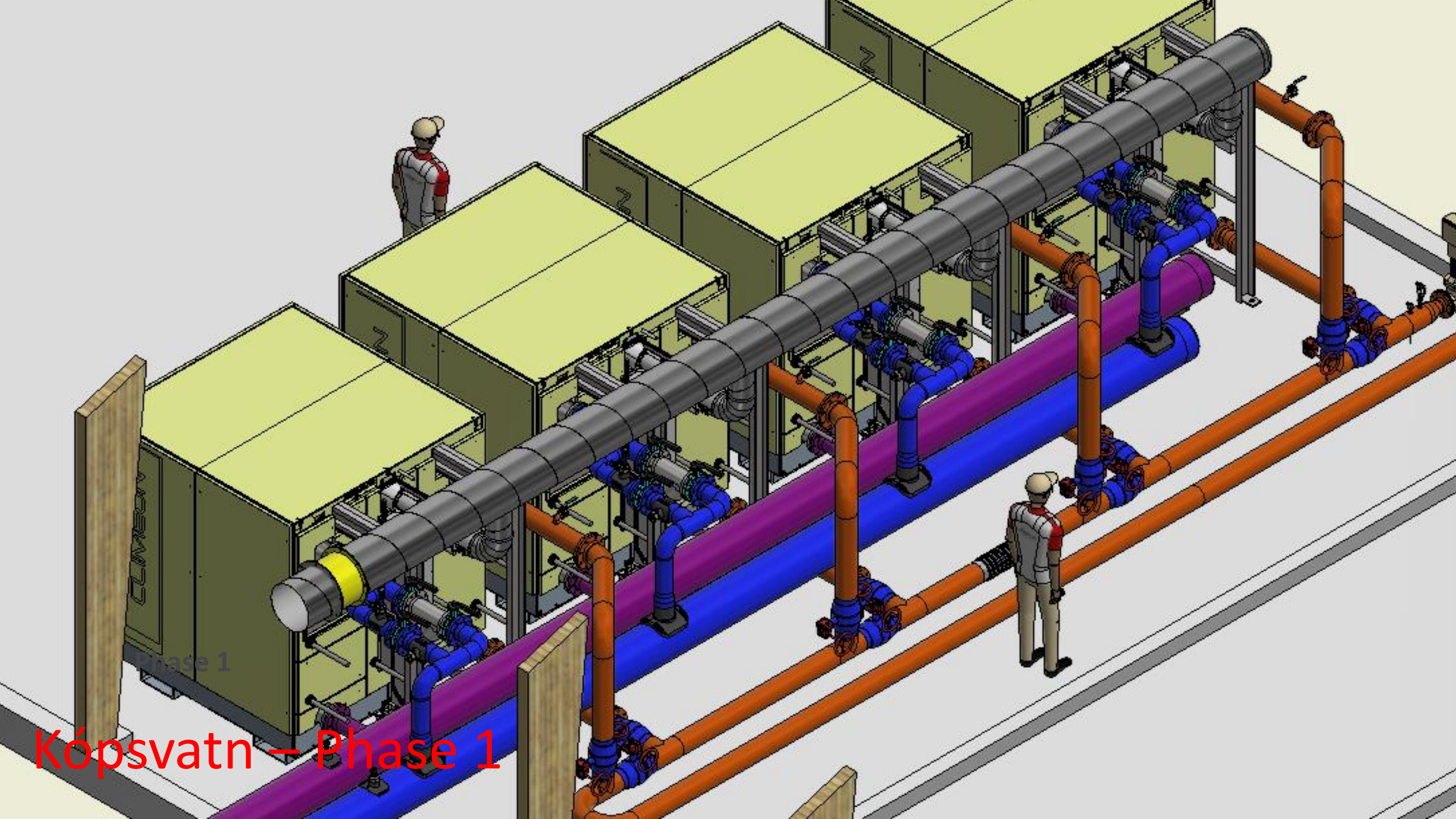
SELECTED PATENTS

- 1** – Working fluid
- 2** – Heat exchanger
- 3** – Radial turbine
- 4** – Direct contact condensing
- 5** – Air Trap Unit
- 6** – Circulation pump
- 7** – Pump control & management



Phase 1

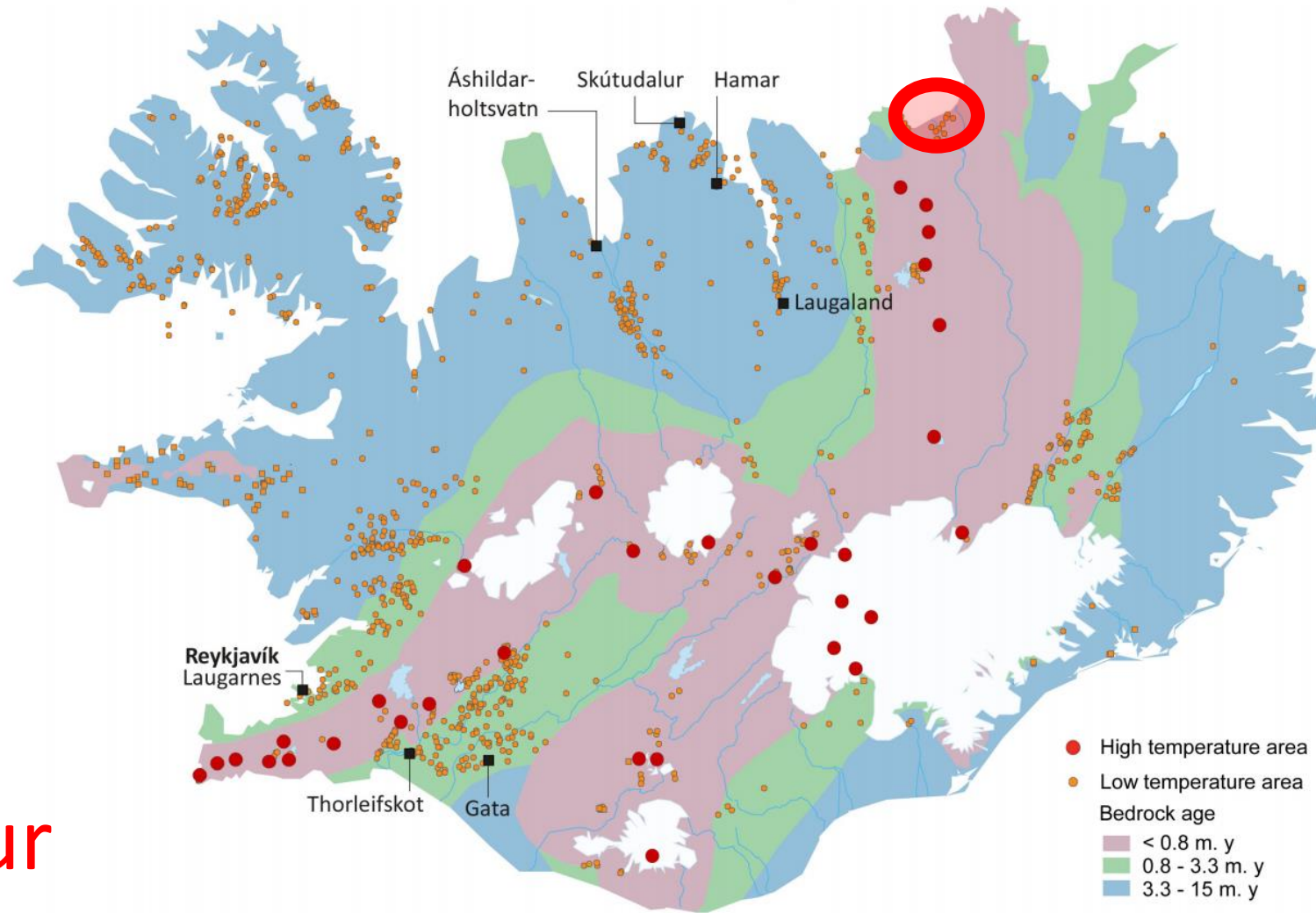
Power: 600 kW



Phase 1

Kópsvatn - Phase 1

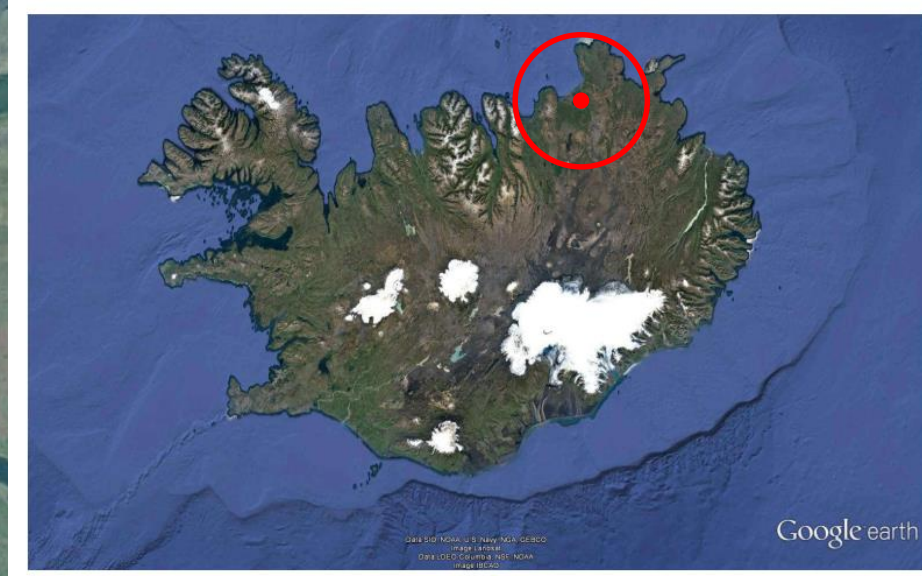
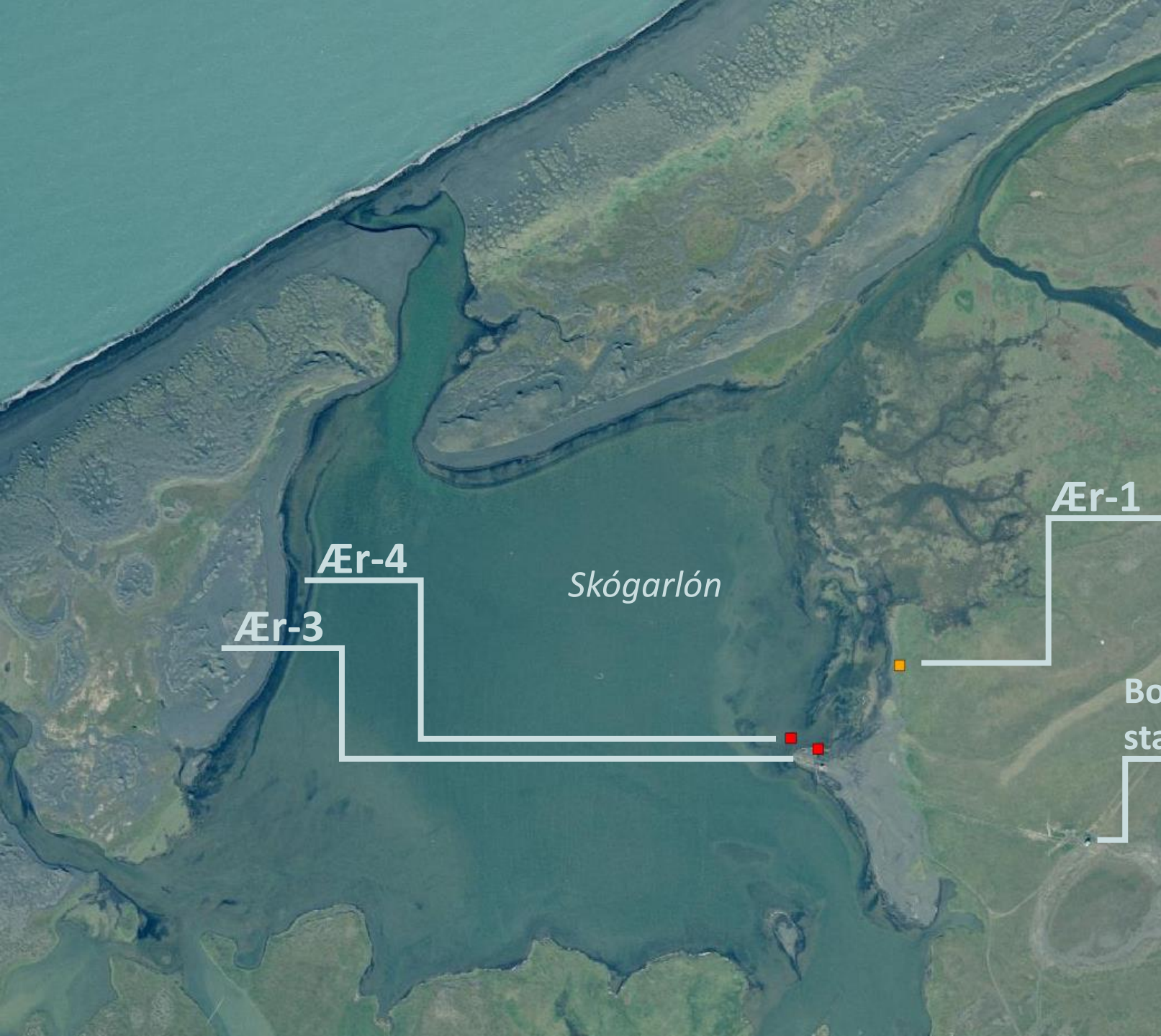
Öxarfjörður



Temperature: 120°C

Artesian

Capacity: 40 – 50 l/s

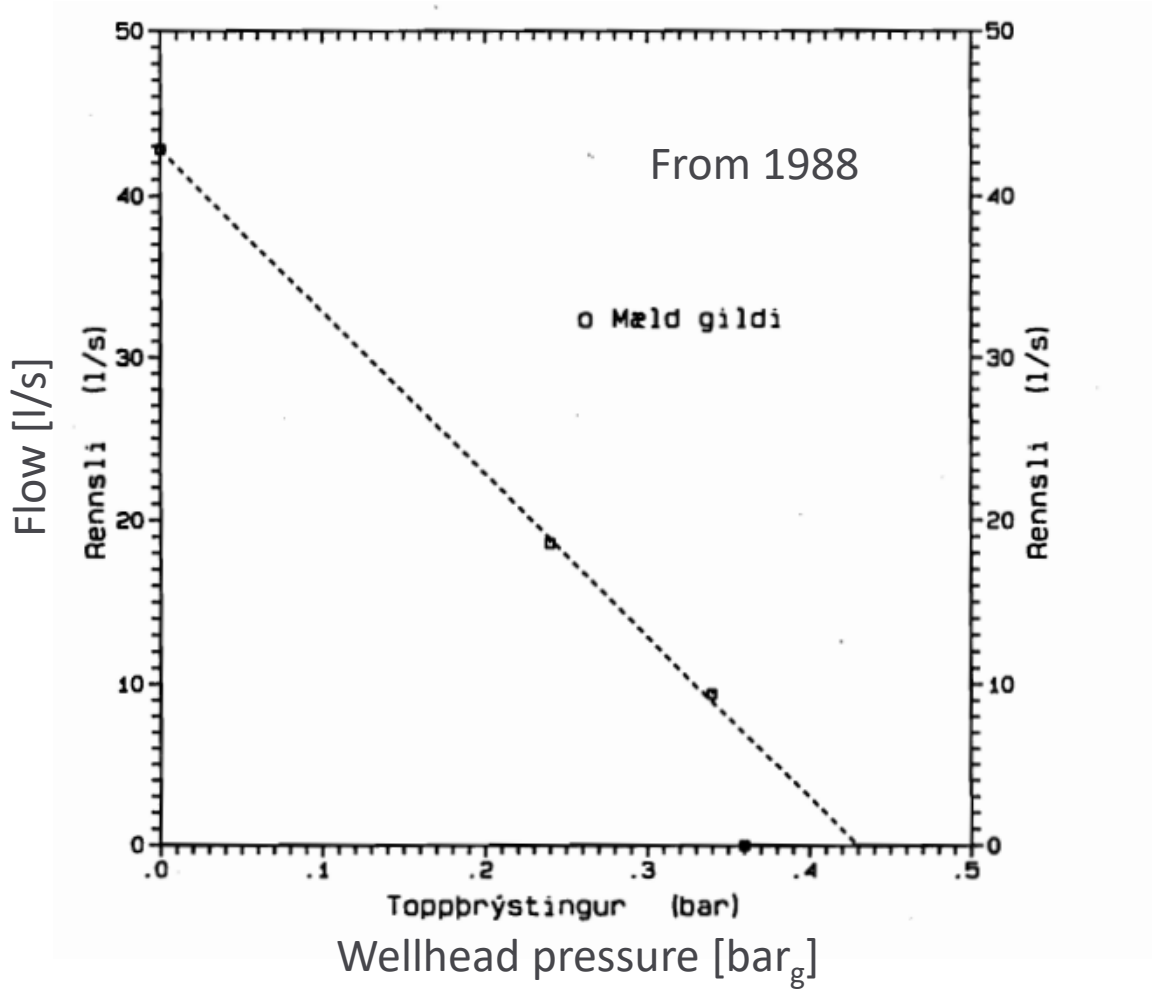


Source: NEA
<http://map.is/os/#>

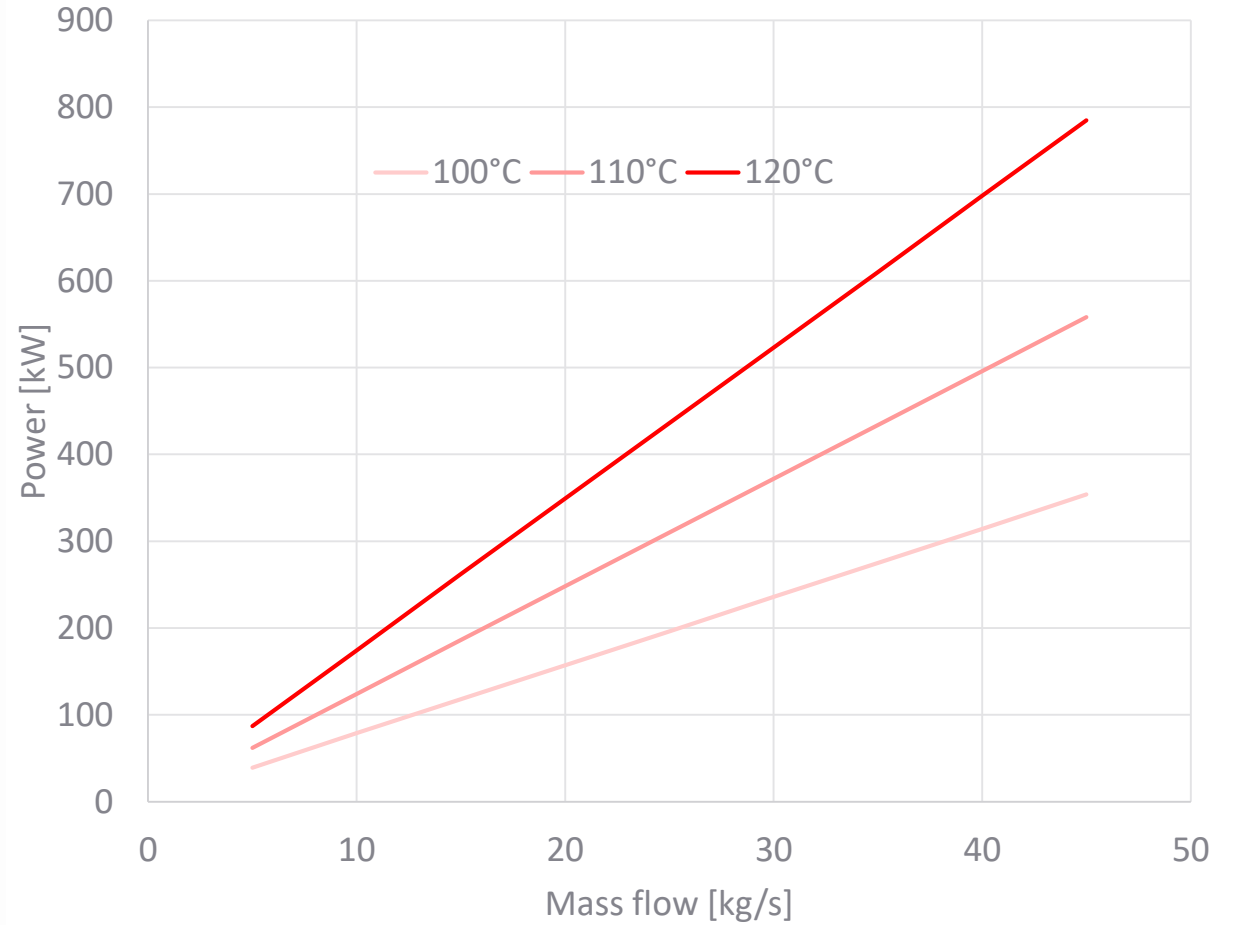
ÆR-3 History

- 1987 - ÆR-3 drilled to depth of 322m
- Artesian well with flow of 40-50 l/s and temperature of effluent at 96°C in the **beginning**
- Around 15 l/s of the geothermal fluid has been used in district heating since 1994
- The fluid temperature has since risen up to 116°C today



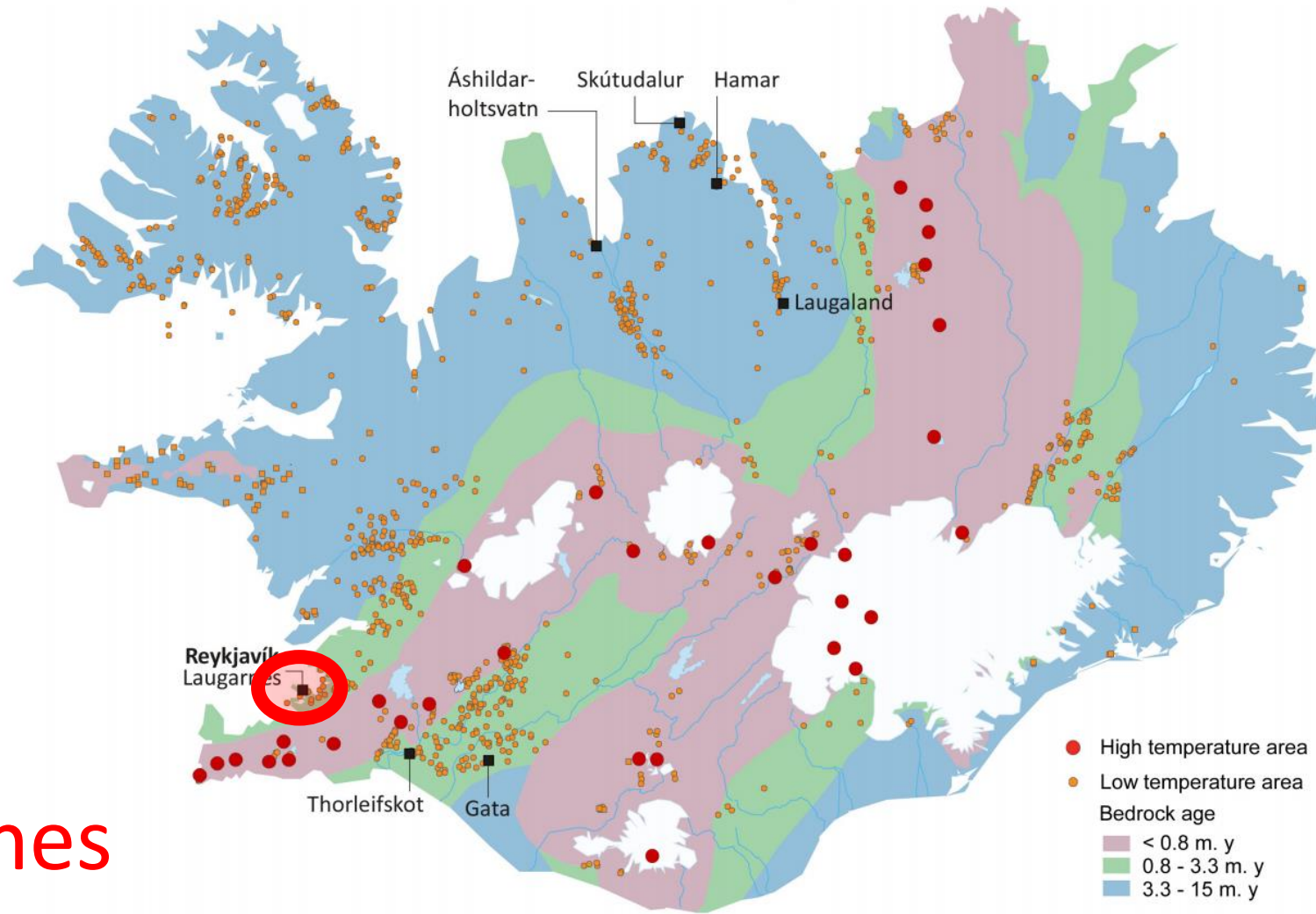


Output from AER-3 in 1988

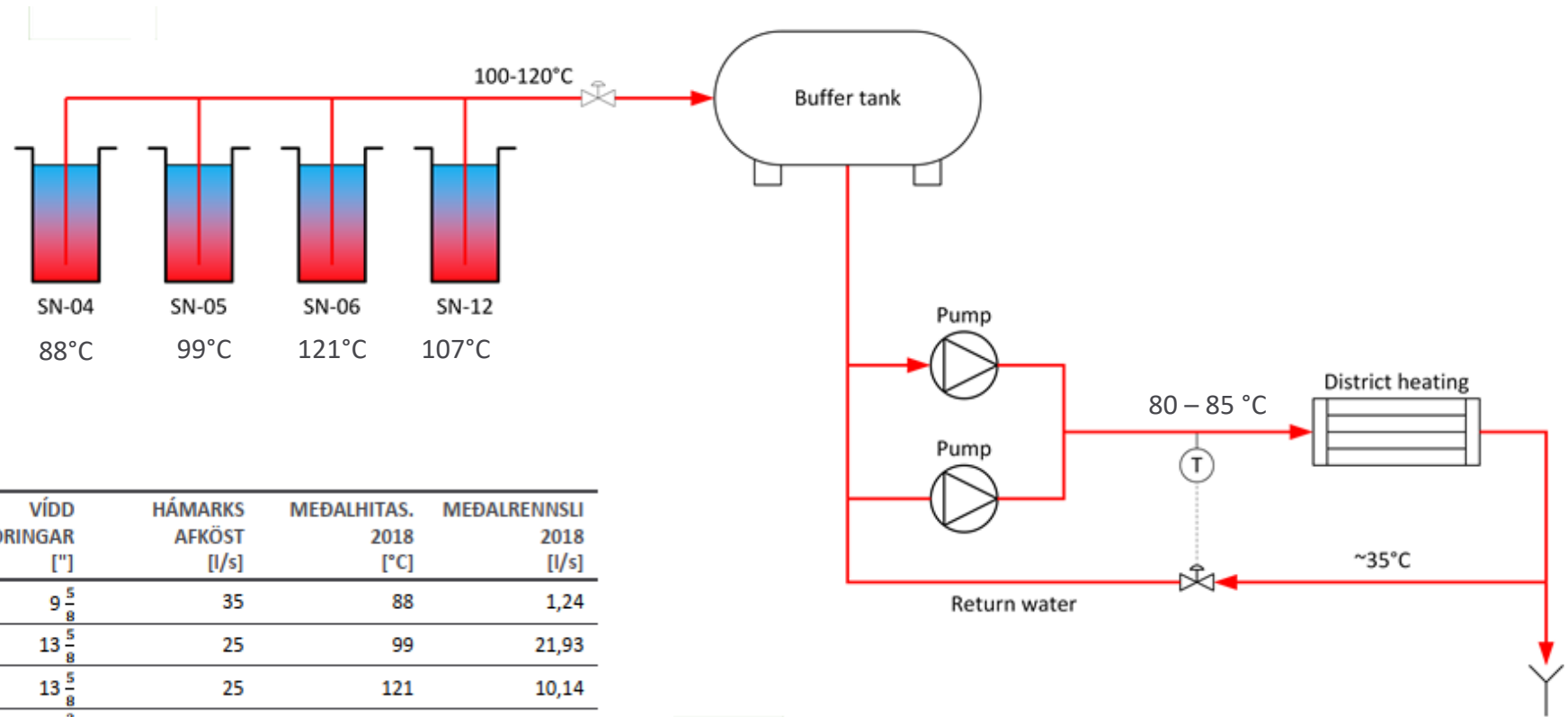


Potential power output

Seltjarnarnes

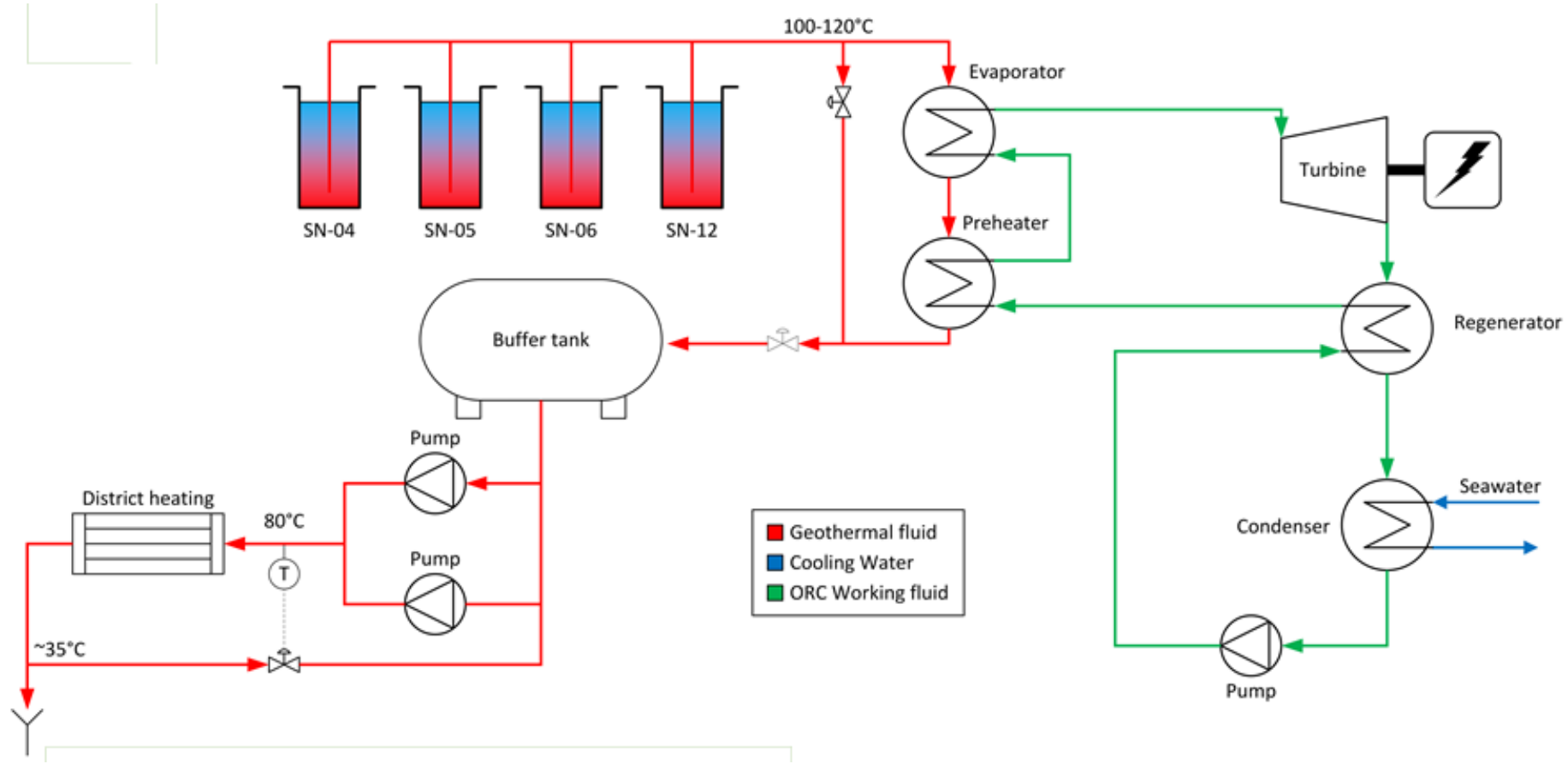


Temperature: 88 – 121 °C
Four production wells: 25 – 35 l/s

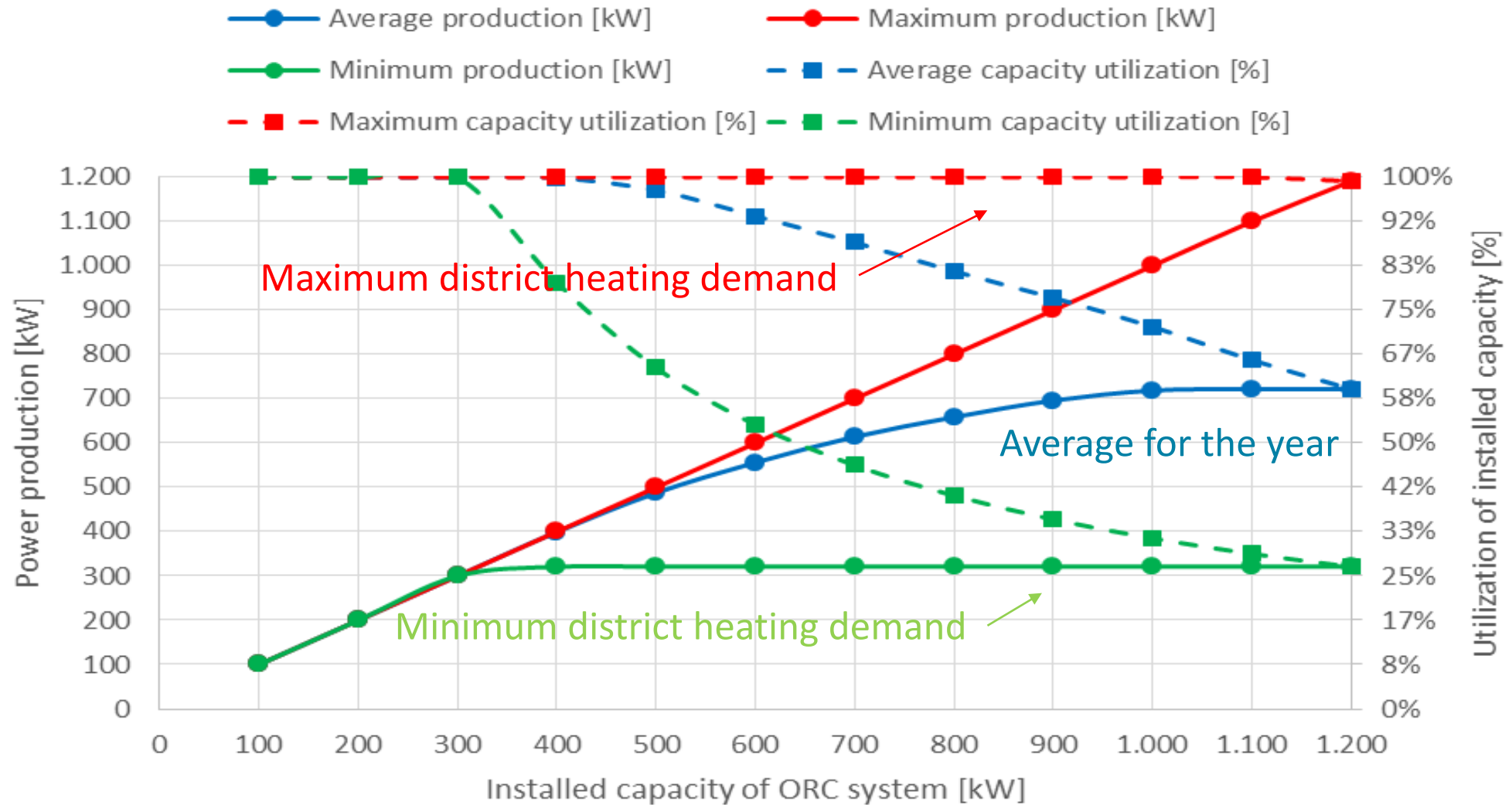


TAFLA 1 Upplýsingar um vinnsluholur.

NR.	BORUN ÁRIÐ	DÝPI [m]	DÝPT FÓÐRINGAR [m]	VÍDD FÓÐRINGAR ["]	HÁMARKS AFKÖST [l/s]	MEDALHITAS. 2018 [°C]	MEDALRENNSLI 2018 [l/s]
SN-04	1972	2.025	172	9 $\frac{5}{8}$	35	88	1,24
SN-05	1981	2.207	168	13 $\frac{5}{8}$	25	99	21,93
SN-06	1985	2.701	414	13 $\frac{5}{8}$	25	121	10,14
SN-12	1994	2.714	791	10 $\frac{3}{4}$	35	107	21,06



Seltjarnarnes



Seltjarnarnes

Thank you

Contact:
emt@efla.is