How policy, technology and innovation can foster geothermal district heating development

An Icelandic case study

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EGC 2016

European Geothermal Congress

Overview

- Reykjavík district heating – forerunner of geothermal utilization in Iceland
- The Westman Islands Enhanced Geothermal District Heating System – The lava district heating system

The first EGS system in the world?

Laundry springs in Reykjavík


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Reykjavík district heating - Milestones

- 1930 – Laugaveita → 14 l/s, 87°C hot water
- 1943 – Reykjaveita → 200 l/s, 86°C hot water
- 1958 – Deep wells drilled - Deep well pumps developed
- 1970 – All houses in Reykjavík connected
- 1990 – Nesjavellir CHP → 1680 l/s, 83°C hot water, 300 MW_{th}
- 2013 – Hellisheiði CHP → 800 l/s, 85°C hot water, 150 MW_{th}
- 2016 – 190.000 people connected

Austurbæjarskóli, connected 1930

Morgunblaðið

Vikublað: Ísafold. 25. árg., 24. tbl. — Sunnudaginn 30. janúar 1938. Ísafoldarprentsmiðja h.f.

Kjósið hitaveituna í dag — C-listann

Reykurinn yfir bænum, sem hitaveitan útrýmir!

Burt með fyrirhöfn, óþrifnað og kostnað við kolakyndinguna.

Heitt vatn þarf að koma í öll eldhús, og gróðurhús að rísa um allan bæ.

Hreint loft yfir Reykjavík, þegar hitaveitan er komin! Sólar nýtur til fulls!

Kolakyndingu er útrýmt, kolaofnum, kolaryki, kolakostnaði. Með einu handtaki er hitanum veitt um íbúðirnar.

Með hitaveitunni kemur heitt vatn í eldhúsin. Og við húsveggina er hægt að koma upp gróðurskálum, þar sem ræktaðar verða matjurtir, blóm og aldini.

Reykvíkingar! Tryggið yður hitaveituna með því að kjósa C-listann

Vote for the district heating today!

Announcement regarding house heating systems

Due to plans of installing district heating in Reykjavik, those who are constructing new houses or renovating old ones shall install heating systems that can fully utilize the new district heating!

Hitaveita Reykjavíkur.

Auglýsing viðvíkjandi hitalögnum

Vegna væntanlegrar hitaveitu er þeim, er byggja ný hús eða breyta gömlum húsum, ráðlagt að haga hitalögnunum í húsunum þannig, að fult tillit sje tekið til hinnar nýju hitaveitu, er hitalagnir eru ákveðnar.

Skrifstofa Hitaveitu Reykjavíkur, Austurstræti 16, mun gefa upplýsingar um þetta kl. 11—12 f. h. daglega.

Bæjarverkfræðingur.

The first Reykir piping main installed in 1943

14 km, 2 x 14 in seamless steel pipes from the USA

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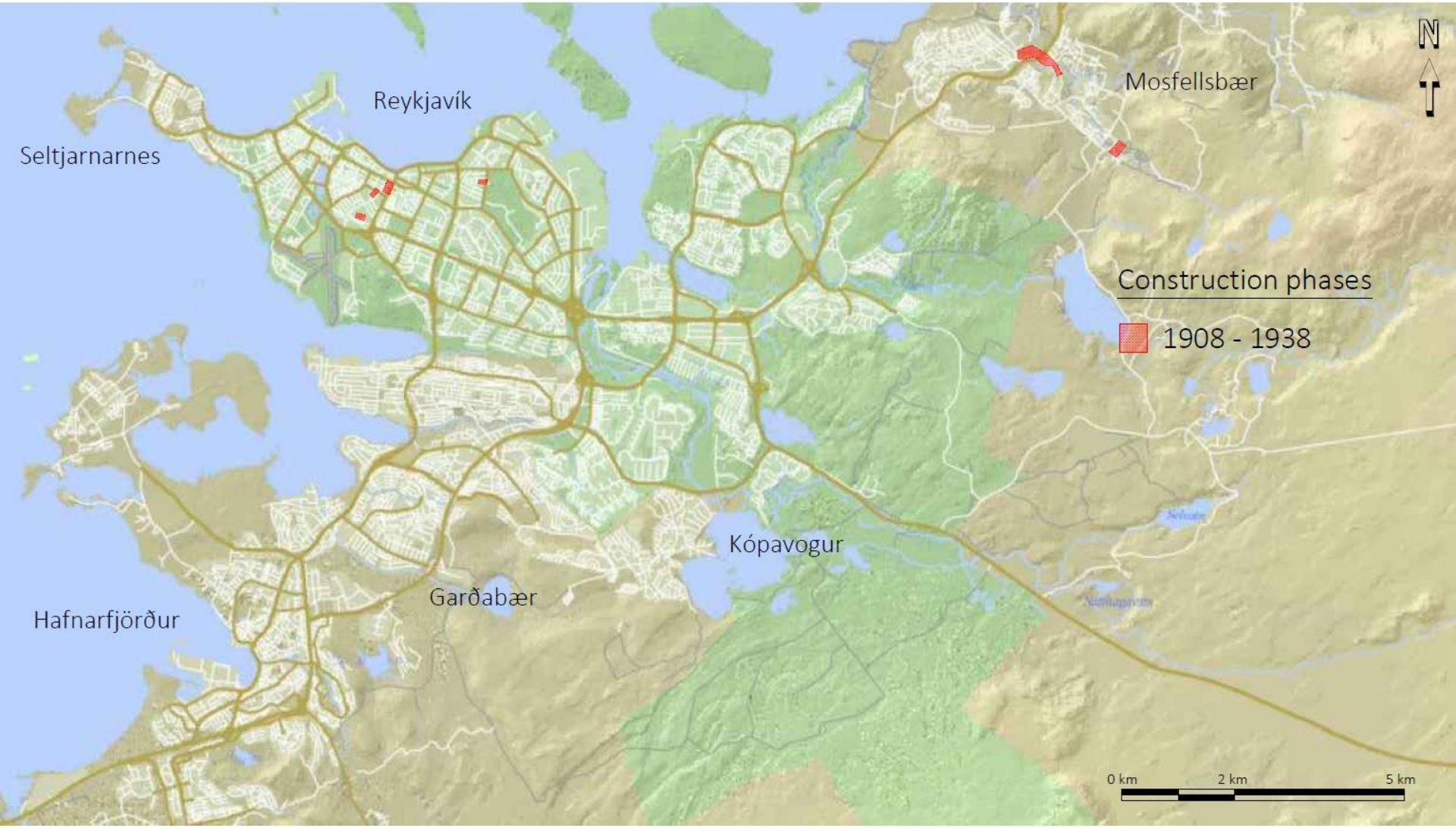
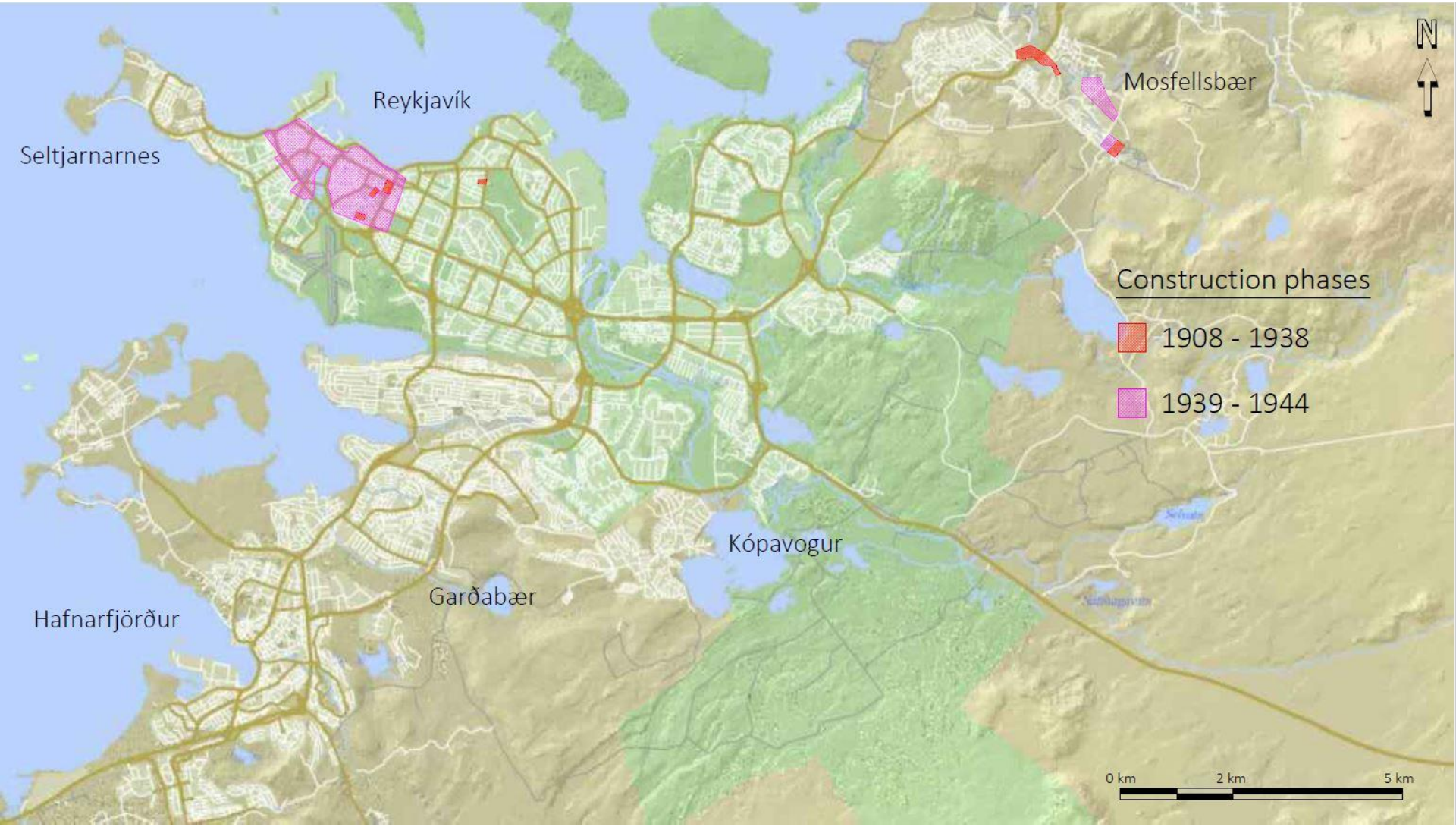
Insulation with Icelandic turf

In the 1960‘s

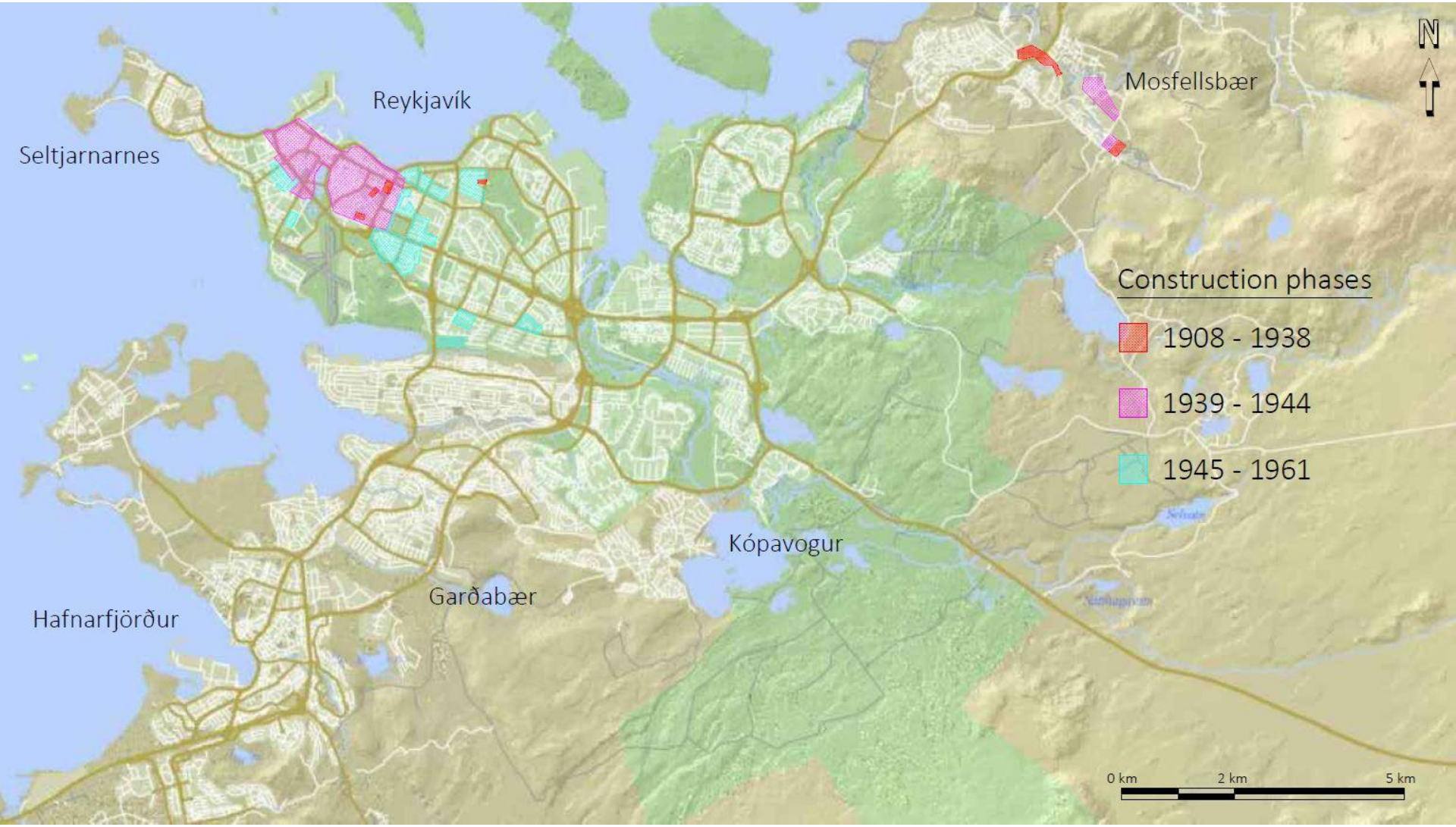
Reykjavík district heating development



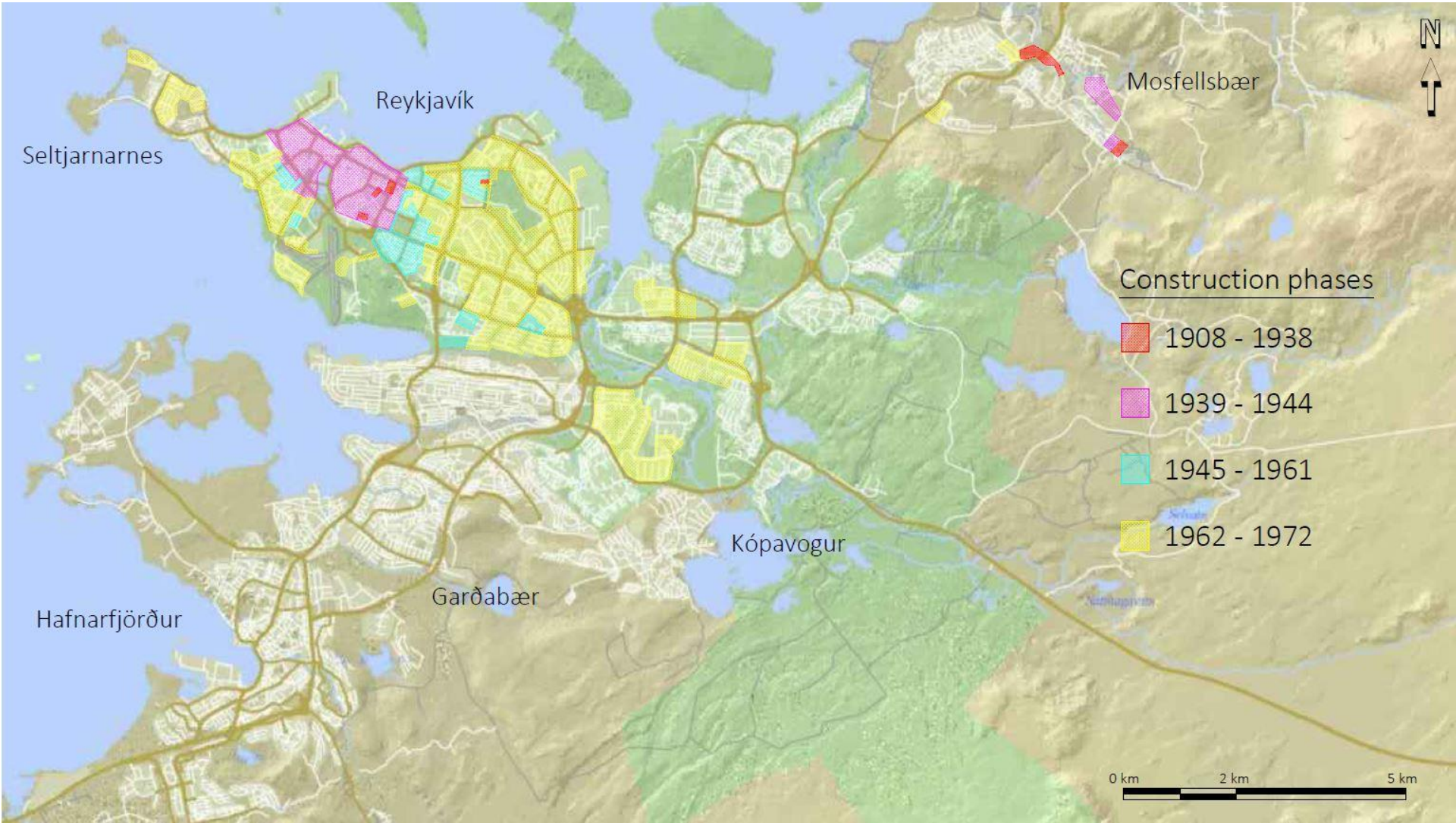
Reykjavík district heating development



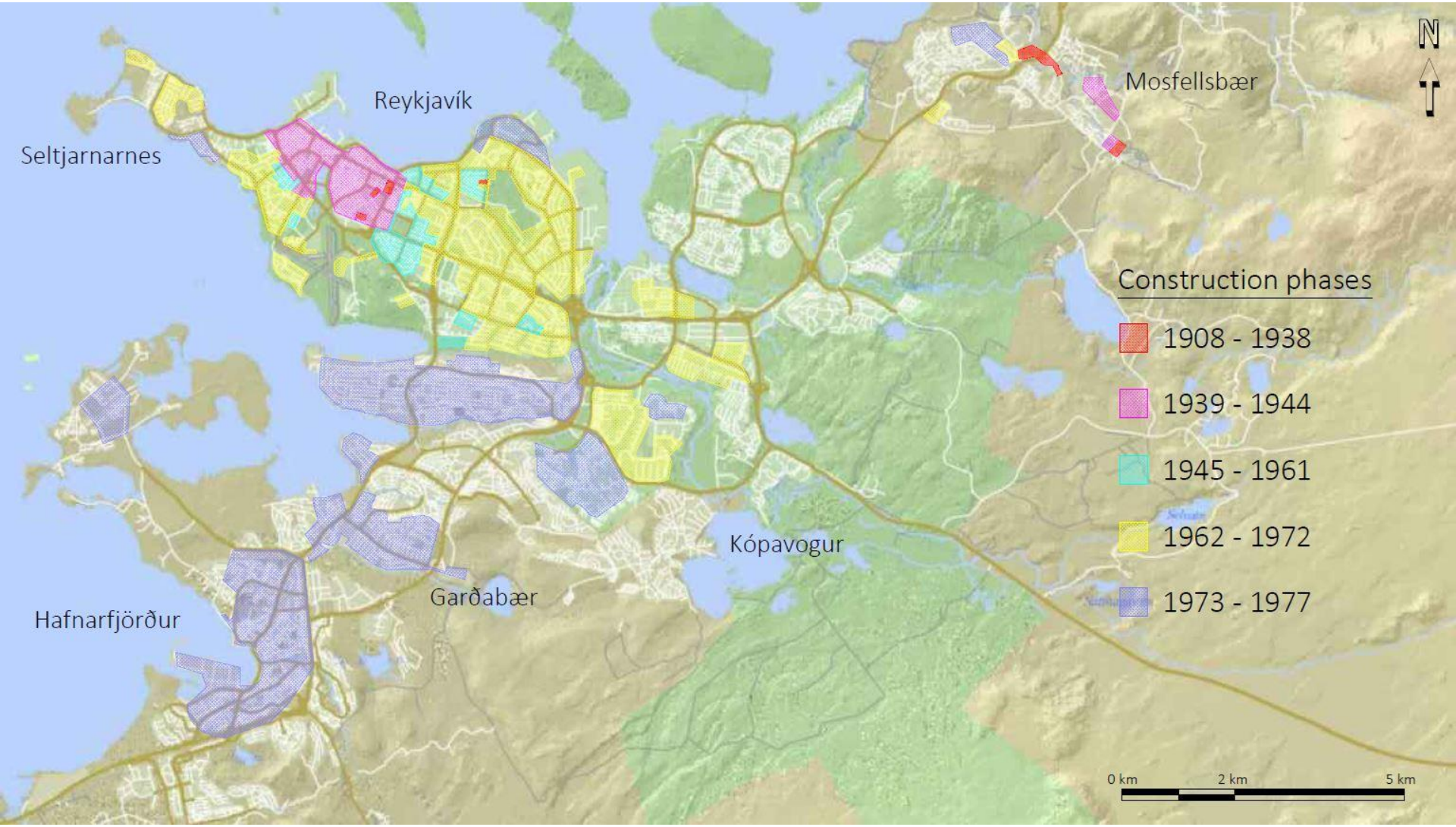
Reykjavík district heating development



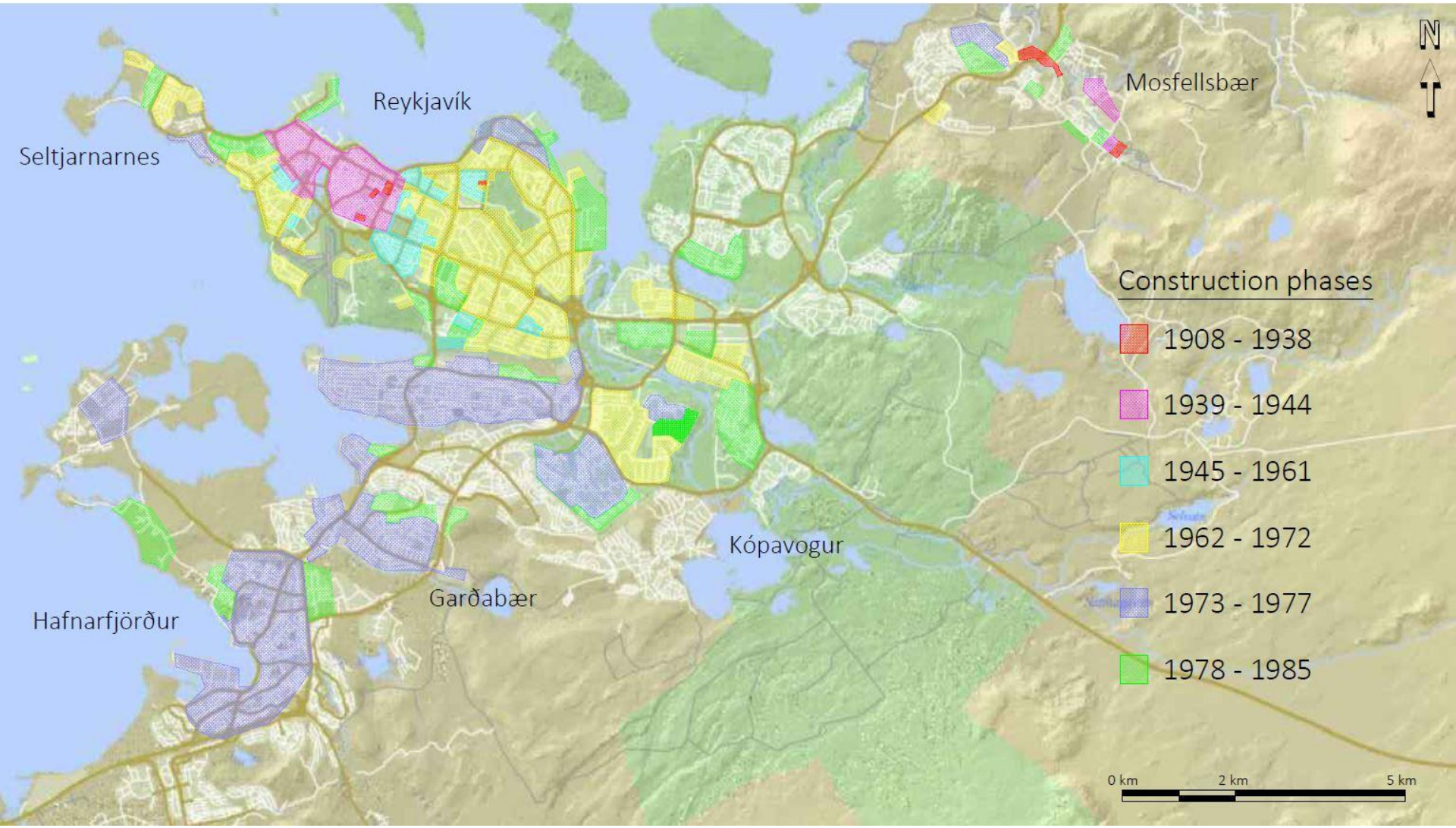
Reykjavík district heating development



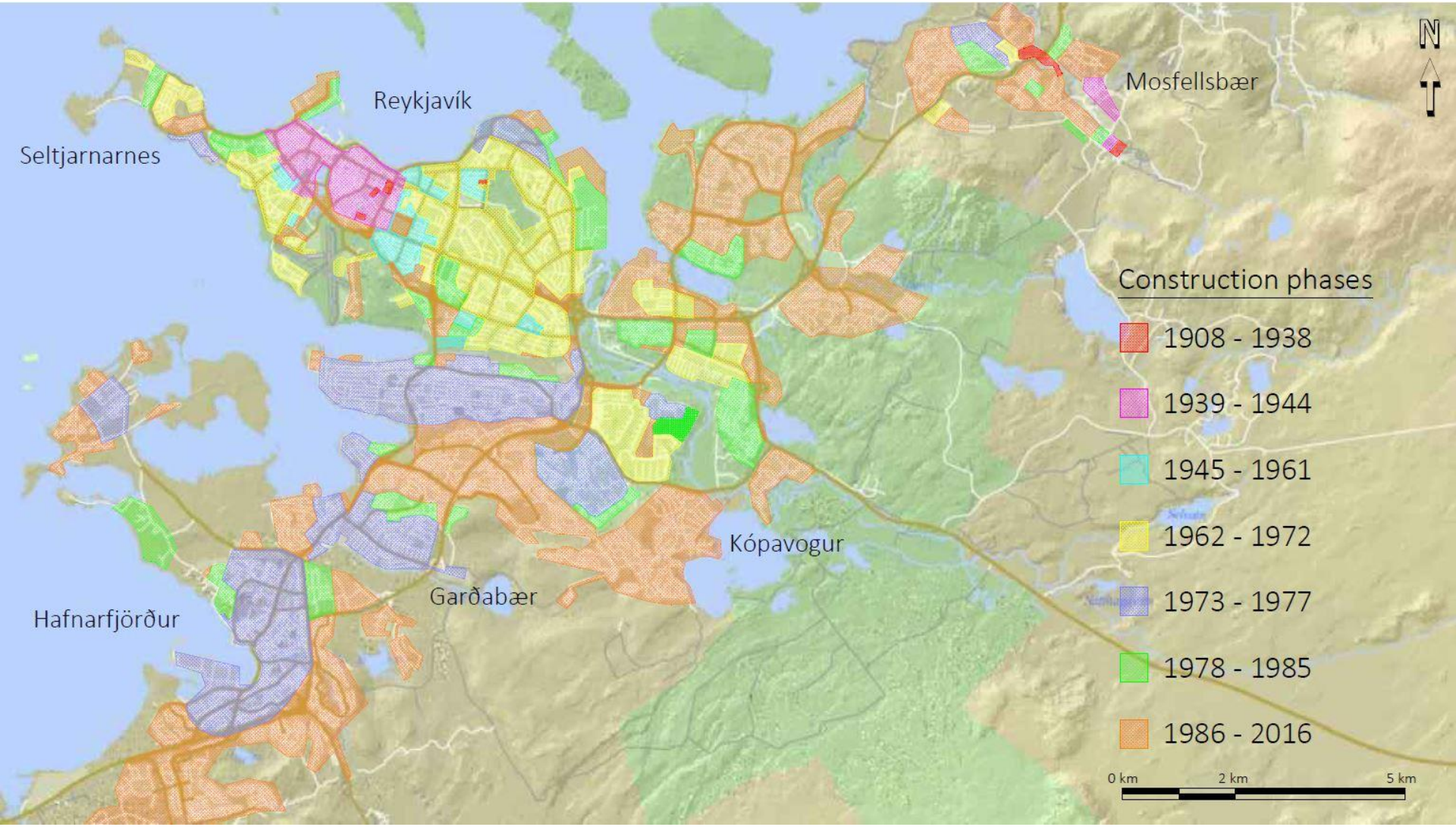
Reykjavík district heating development



Reykjavík district heating development



Reykjavík district heating development



Reykjavík geothermal fields – 1GW$_{th}$

- Laugarnes → 10 wells, 340 l/s, 125 – 130°C, 125 MW$_{th}$
- Ellidaar → 8 wells, 260 l/s, 85 – 95°C, 50 MW$_{th}$
- Reykir – Reykjahlid → 34 wells, 1980 l/s, 85 – 100°C, 375 MW$_{th}$
- Nesjavellir – CHP → Heated & de-aerated cold water, 1680l/s, 83°C, 300 MW$_{th}$
- Hellisheiði – CHP → Heated & de-aerated cold water, 800l/s, 85°C, 150 MW$_{th}$

Reykjavík today – 100% heated with geothermal

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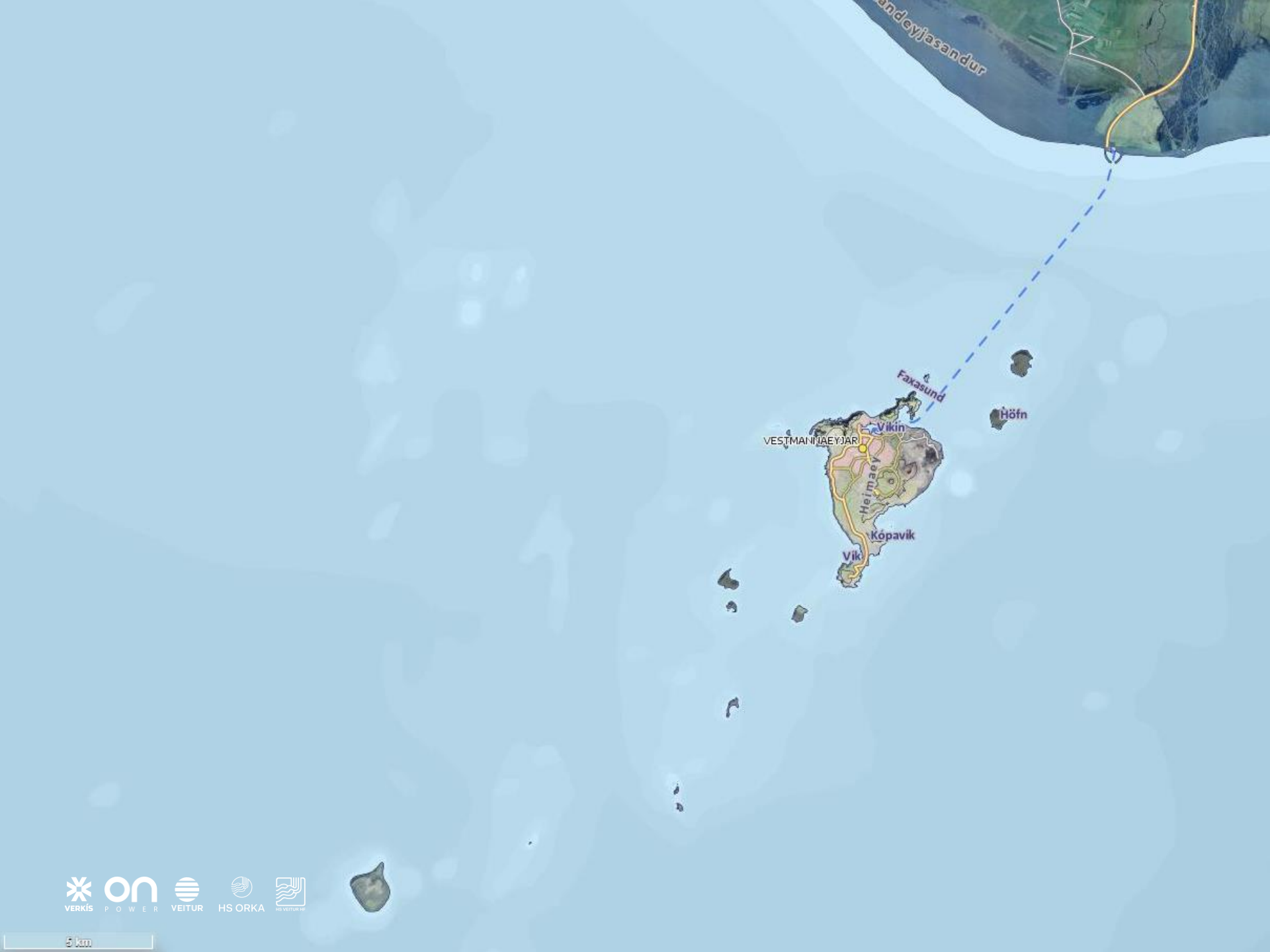
Iceland
Arctic Ocean
Norwegian Sea
Héradsvötn
Jökulsá á Fjöllum
Skjálfandafljót
Hofsjökull
ICELAND
65°
Hvítá
Langjökull
Vatnajökull
Thjórsá
Reykjavik
Hvítá
Eyjafjallajokull
Vestmannaeyjar
Atlantic Ocean
Glacier
Feet
Meters
10000
3050
5000
1525
2000
610
1000
305
500
153
Sea Level
0
25
50 mi
0
25
50 km
20°
15°
©MAPS.com


Landeyjasandur
Faxasund
Höfn
Víkin
VESTMANNAEYJAR
Heimaey
Kópavík
Vík
5 km

January 23rd 1973 - Eruption at Heimaey

1,5 km long volcanic fissure opened in the east part of the island

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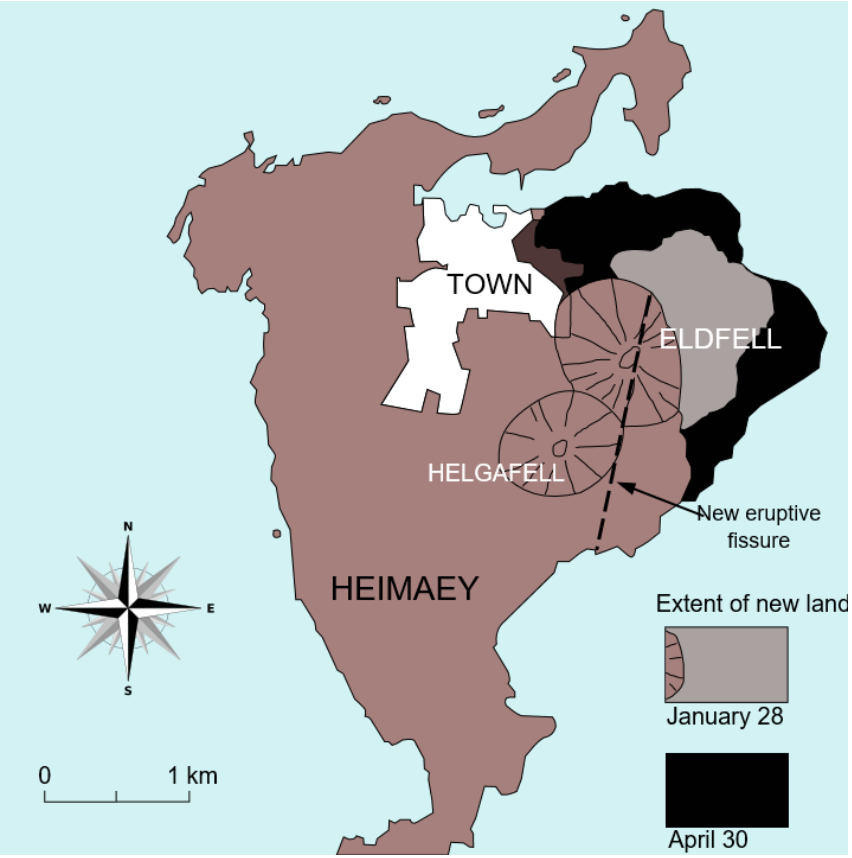
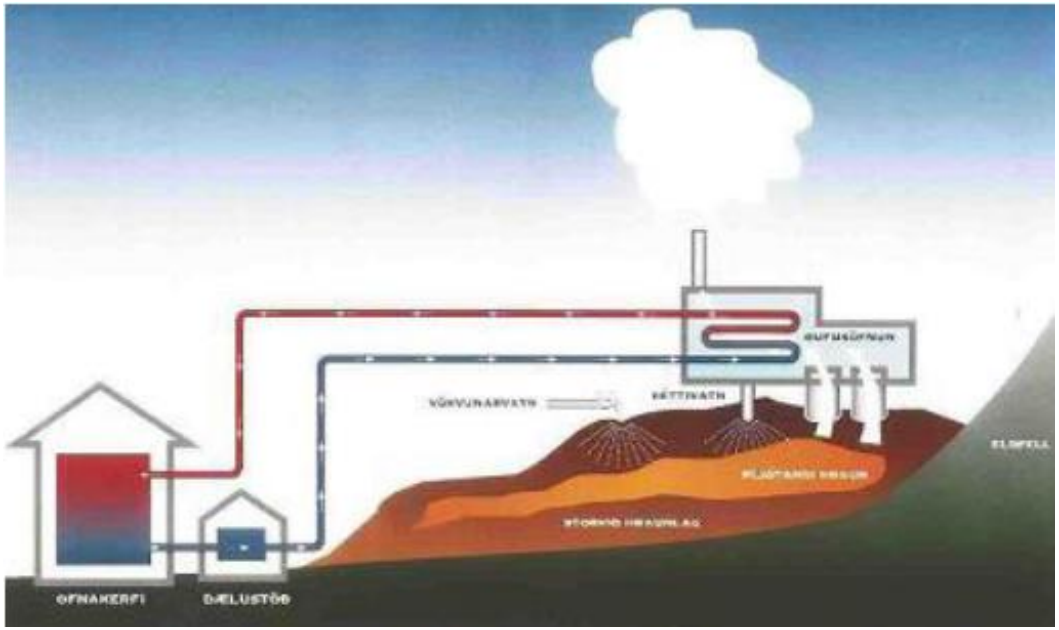
Heimay - Westman islands



- 1973: 5.300 inhabitants
- Lava field:
  - 250 million cubic meters
  - Thickness 100-130 m
  - Estimated energy contained: 250 million megawatt hours
- Increased island area from 11,2 km^2 to 13,44 km^2

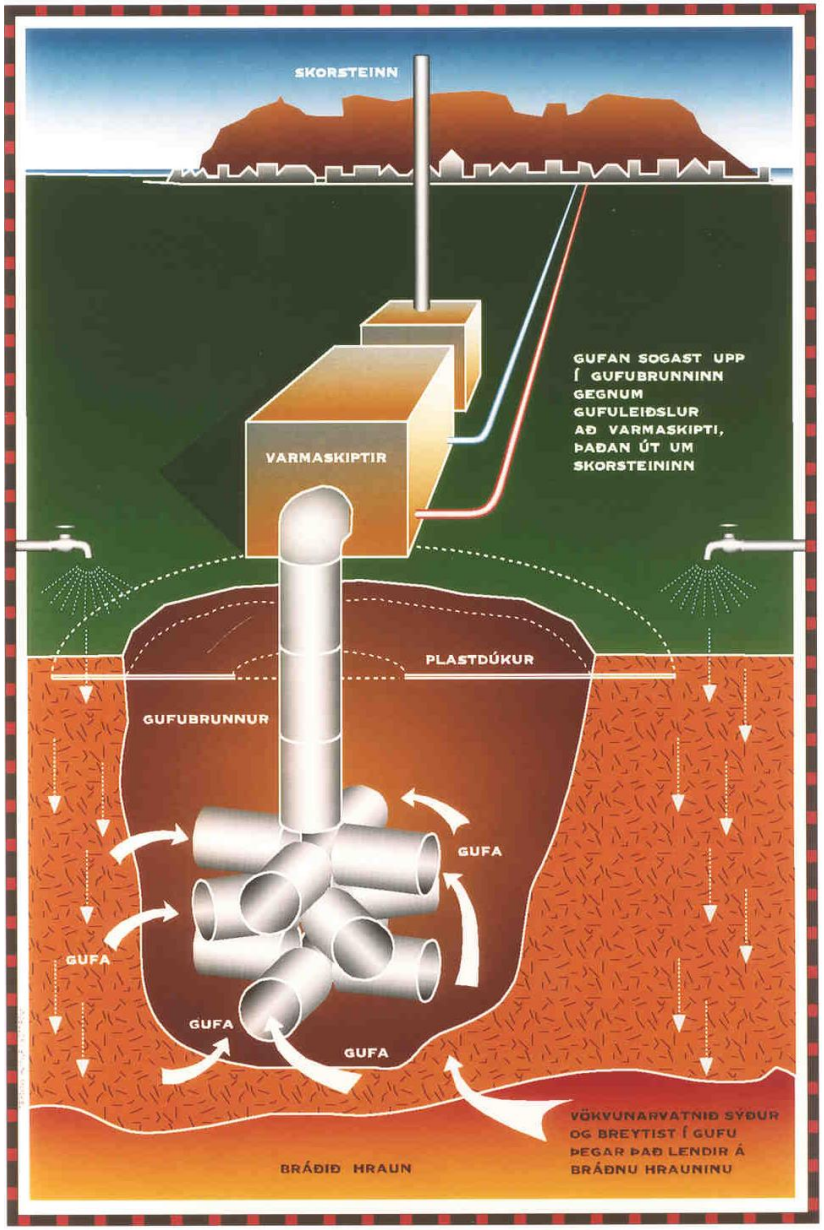
The “wise guys!”

Lava district heating system

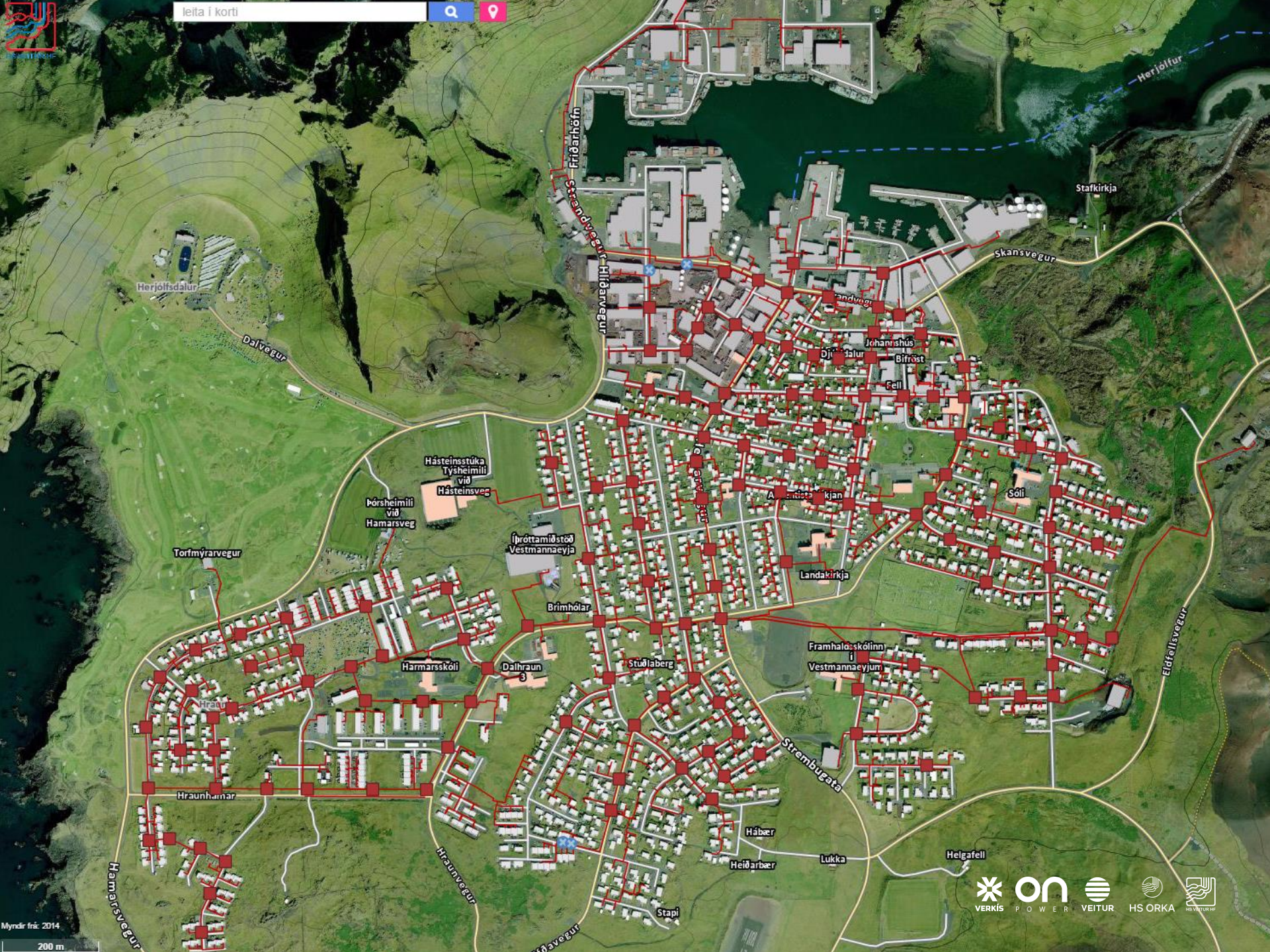


Main system components:

House heating systems
District heating system
Pumping station
Supply/return piping
Heat exchanger
Steam Collector



Steam Collector


leita í korti
Herjólfur
Friðarhöfn
Strandvegur
Hilmarsvegur
Stafkirkja
Skansvegur
Herjólfsdalur
Dalvegur
Johannshus
Bifröst
Fell
Sóli
Landakirkja
Hásteinsstúka
Týsheimili
við
Hásteinsveg
Þórsheimili
við
Hamarsveg
Íþróttamiðstöð
Vestmannaeyja
Torfmýrarvegur
Brimhólar
Framhaldsskólinn
í
Vestmannaeyjum
Eldfellsvegur
Harmarsskóli
Dalhraun
3
Stuðlaberg
Hraun
Hraunhamar
Strembugata
Hábær
Heiðarbær
Lukka
Helgafell
Hraunvegur
Hamarsvegur
Stapi
Myndir frá: 2014
200 m
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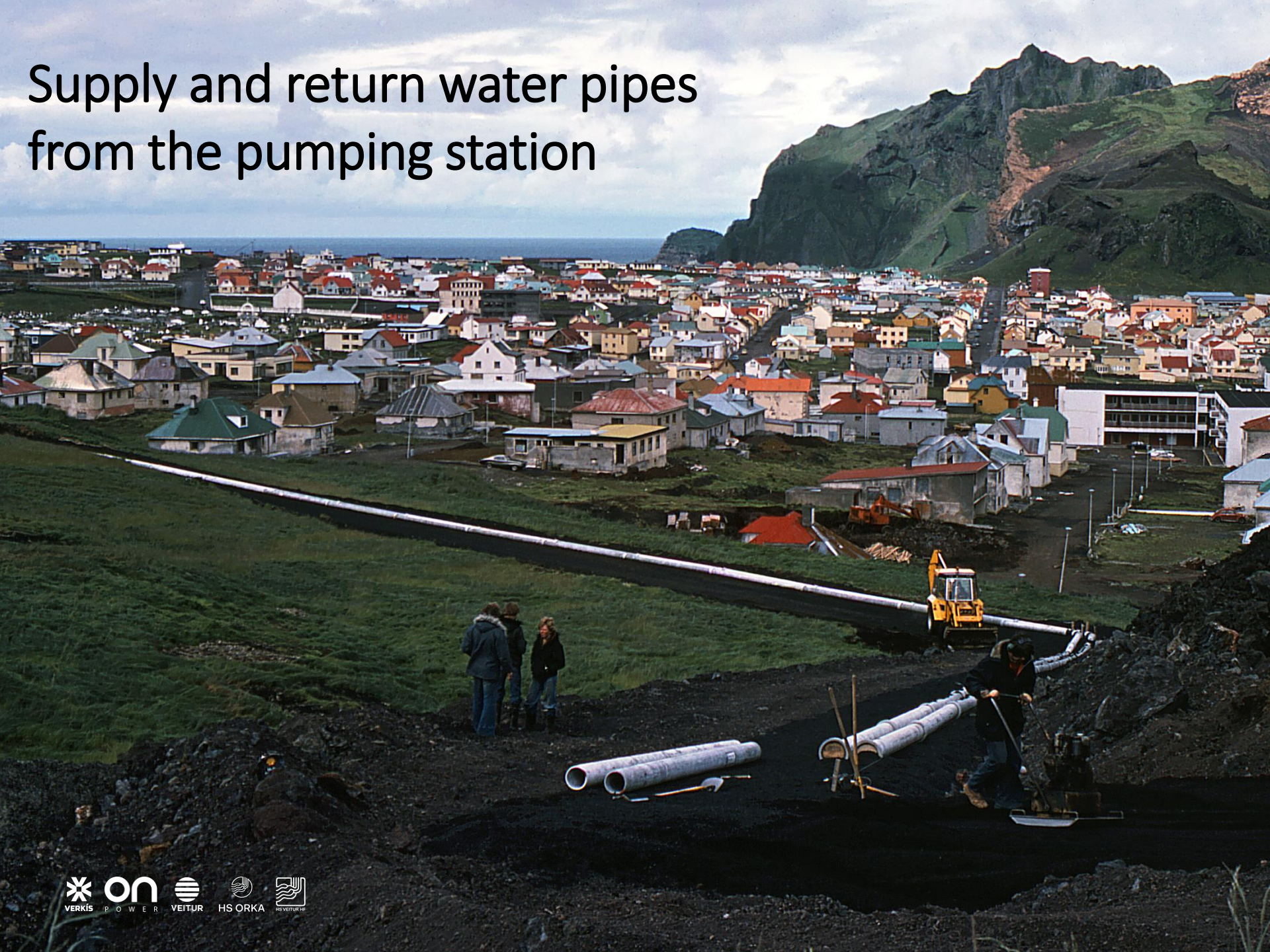
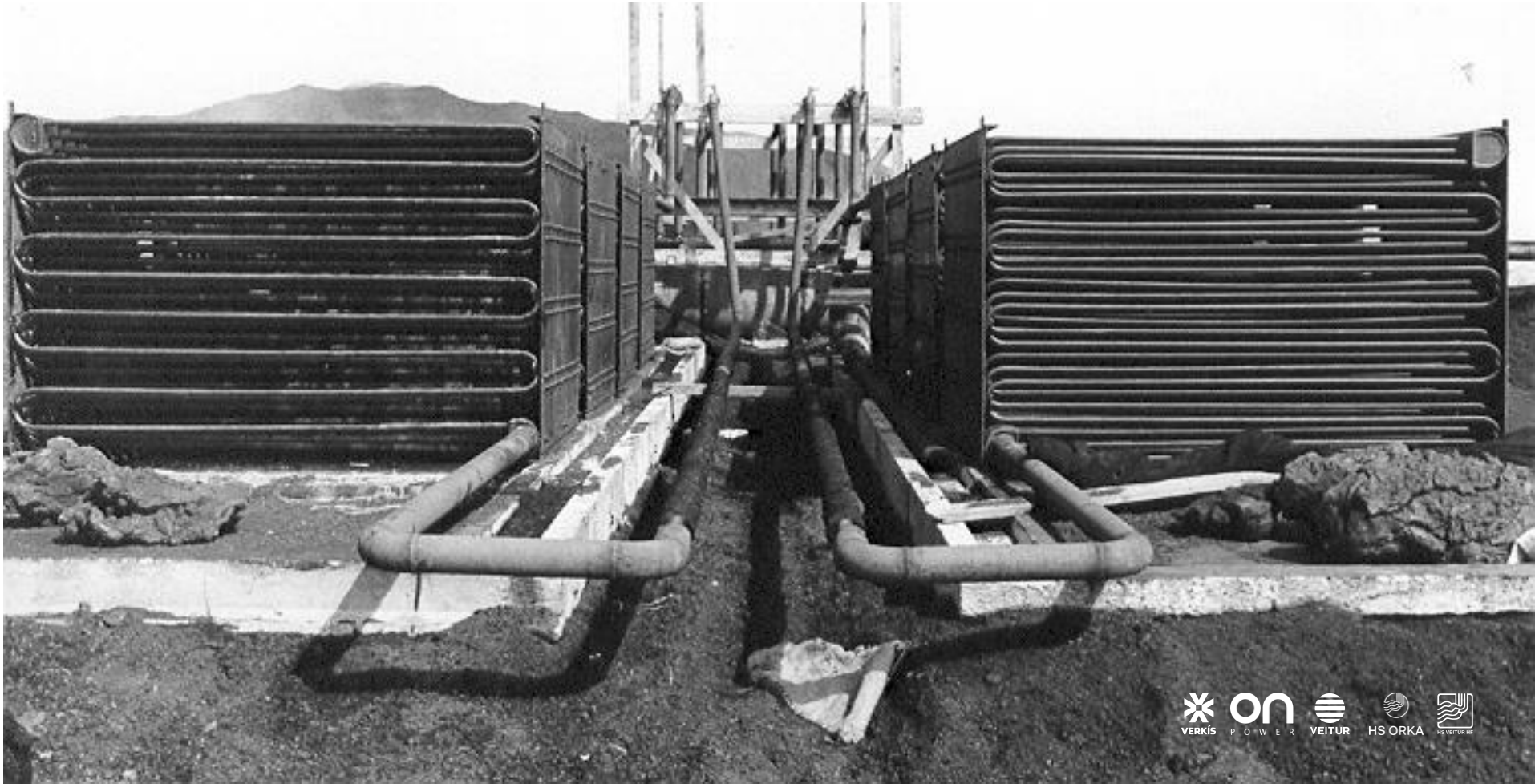
Supply and return water pipes from the pumping station



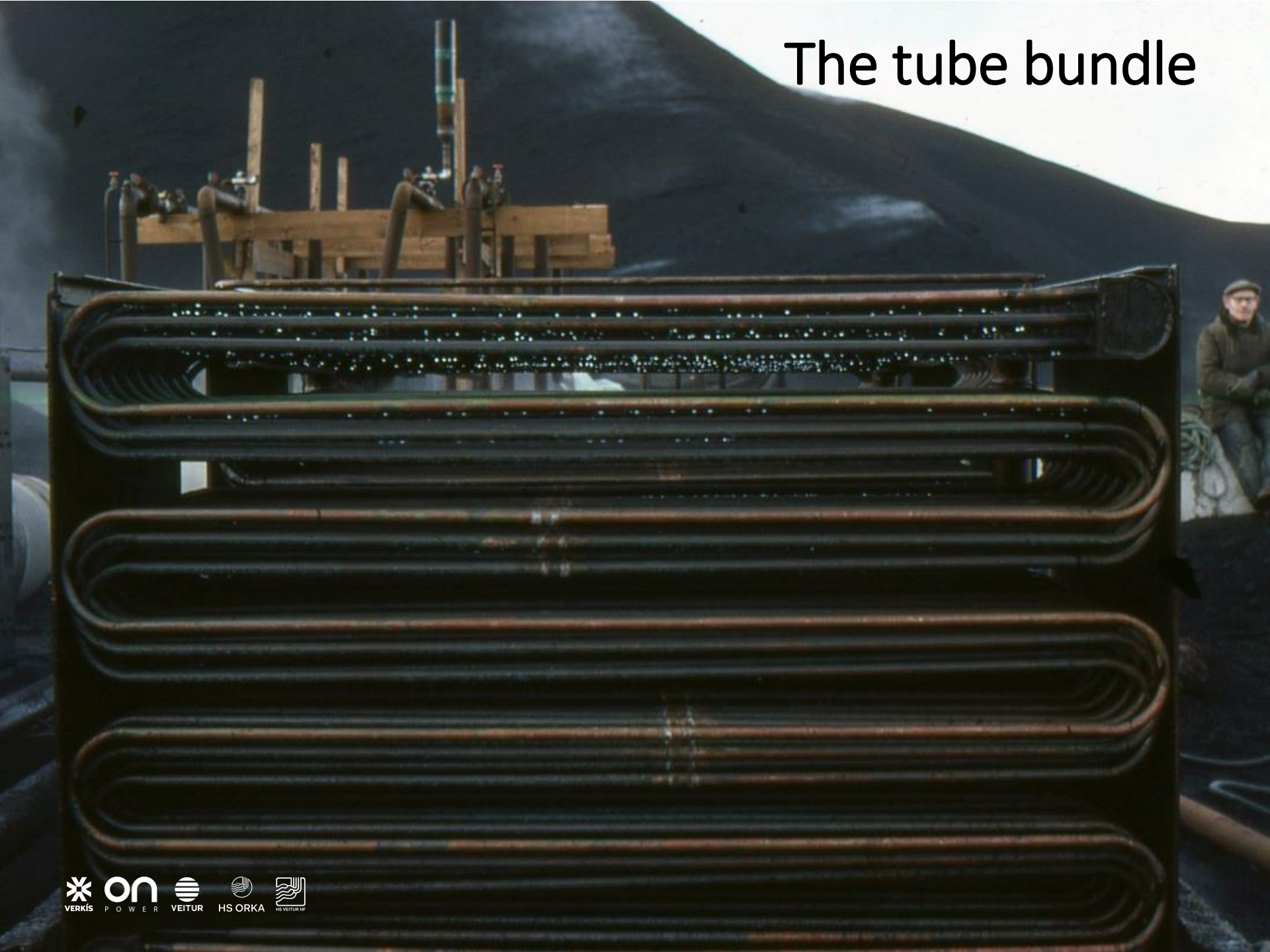
A steam collector installation

Steam collector site

“Cave and tube” heat exchangers



The tube bundle



Prefabricated concrete “cave” covers for the heat exchangers

The town, seen from one of the production areas

Milestones and latest development

- 1973 Eruption in Heimaey , one of the Westman islands
- 1975 Installation of the district heating system started
- 1977 Heating with lava energy starts+ 3 MW peak load oil boiler
- 1988 Electrical boiler installed, 20 MW + 2 x 7 MW oil boilers as backup
- 1998 Waste heat harnessed from a waste heat boiler
- 2000 Waste heat from fishing industry added to the system
- 2016: 4.300 inhabitants on the island,
  - Installed power: 20 MW
  - energy consumption: 67 GWh p.a.,
  - 81% electricity, 9% from waste heat boilers, 6% fish processing factories and 4 % oil.
- 2017-2018: 3-9 MW seawater heat pump

The key: Correctly designed district heating system and house heating systems that can harness low grade heating energy

The town of Heimay today

Do what you can with what you have where you are.

(Theodore Roosevelt)

Thank you for your attention

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