Geothermal Experience in Iceland

Iceland Liechtenstein Norway grants

A Leader in the use of **Renewable Resources**

Baldur Pétursson, Manager International Projects and PR National Energy Authority, Iceland, Bergen, October 2017

Our Team

- Óskar P. Einarsson, Mechanical Engineer
- Helga Tulinius, Senior Geophysicist
- Friðfinnur K. Daníelsson, General Manager
- Baldur Pétursson. Manager International Projects and PR



Role of Orkustofnun





Share of Renewables in Total Primary Energy use 2014





Sources: OECD, IEA, Samorka

Primary Energy Use in Iceland 1940-2015



Source: Orkustofnun Data Repository OS-2016-T002-01



Geothermal Electricity Generation



Source: Orkustofnun Data Repository OS-2016-T003-01



Geothermal Fields in Iceland



 $T_{avg} = 0^{\circ}C$ (january) to 10°C (july) in Reykjavík



High and low temperature

In low temperature geothermal systems, temperatures in the uppermost 1,000 m may reach up to 150°C. In the high temperature fields, on the other

hand, temperatures reach over 200°C at 1,000 m depth. High temperature geothermal areas are found within the active volcanic zone of Iceland.

The Oil Crises



Expansion of GeoDH Space Heating by Source 1970–2013

- Biggest steps in GeoDH were taken during the oil & war crises 1970 1982
- External conditions raised the need of evaluation and GeoDH Planning
- Policy goals to increase geothermal both national and within main cities
- It took only <u>12</u> years to increase GeoDH from <u>40% to 80%</u> of total space heating



I --- OR National Energy Authority Source: Orkustofnun

Districht Heating – Map of Iceland



National Energy Authority

Renewable Energy mitigates Global Warming



National Energy Authority

Comparison of Energy Prices for Residential Heating Mid year 2013



UNKUSTURNU

National Energy Authority

Economic Benefits of Geothermal District Heating National Savings by Geothermal District Heating, as a % of GDP 1914–2013



ORKUSTOFNUN National Energy Authority Reykjavík – biggest District Heating network in the World Renewable Energy mitigates Global Warming

Reduction in CO₂ emissions in Reykjavík due to space heating

250,000

,150,000

Sequence 100,000 50,000

Environmental Benefits of Geothermal Utilisation

Reykjavík 1933

Reykjavík today



Source: Reykjavik Energy



Global Warming

Temperature in February 1.35 °C on average warmer than 1951 – 1980, NASA



ORKUSTOFNUN National Energy Authority

Global Warming

Five-year Global Temperature Anomalies from 1880 – 2015 1883 - 2100 (NASA)





1967 - 1971

> 44 years >

2011 - 2015

The future will depends on actions today

2050 - 2055



The future will depends on actions today



2094 - 2101



Global Warming

Recent satellite observations have detected a thinning of parts of the Greenland ice sheet at lower elevations. A partial melting of this ice sheet would cause a 1-meter (3-foot) rise.

If melted completely, the Greenland ice sheet contains enough water to raise sea level by 5-7 meters (16-23 feet).

This visualization shows the effect on coastal regions for each meter of sea level rise, up to 6 meters (19.7 feet). Land that would be covered in water is shaded red.



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3 meter rise

1 meter rise

https://climate.nasa.gov/interactives/climate-time-machine



Global Warming More and more weather extremes

Wow — Watch Hurricane Irma Turn The Streets Of Miami Into An Overflowing River

9/10/2017 3:57 PM ET | Filed under: Twitter • Health • Scary! • Instagram • Viral: News • Gotta Have Faith

🔟 Like 2.2K 🕇 🗟 💆 🕁 🛨



Hurricane Irma, streets in central Miami 2017





Interstate 45 in Houston after Hurricane Harvey. REUTERS/Richard Carson

Hurricane Harvey, Houston 2017







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Competitiveness of the Geothermal Sector

Success of Geothermal District Heating is based on 8 Key Factors

8 Key Elements of Success in the Geothermal Sector and District Heating

- 1. Authorities and regulation,
- 2. Geothermal resources,
- 3. Scientific & technical factors,
- 4. Education & human factors,
- 5. Access to capital,
- 6. Infrastructure and access to markets, sectors and other clusters,
- 7. Access to international markets and services,
- 8. The company, management, expertise & industry, clusters assessment

In cooperation with international and domestic experts, on geothermal resources, finance, legal, management and other expertise.





Source: Sölvell & Lindquist 2012, Amended, B. Petursson, National Energy Authority, 2014

International Cooperation - Geothermal

The United Nations University Geothermal Training Programme in Iceland



UNU-GTP Fellows in Iceland 1979-2014 – 583 from 58 countries.

The Geothermal Training Programme of the United Nations University (UNU-GTP) is a postgraduate training programme, aiming at assisting developing countries in capacity building within geothermal exploration and development. The programme consists of six months annual training for practicing professionals from developing and transitional countries with significant geothermal potential. Priority is given to countries where geothermal development is under way, in order to maximize technology transfer.



International Cooperation – EEA Grants Orkustofnun is Donor Program Partner (DPP) for Renewables in some Countries



Bilateral Projects in Poland Poddebice



Geothermal Project in Poland Supported by EEA Financial Mechanism 2009-2014 Geothermal Energy Utilisation Potential in Poland – town Poddębice Study Visits' Report



2017



Energy Supply Composition of District Heating Generated in 2013



ORKUSTOFNUN National Energy Authority

Romania



April 2017





Benefits of Geothermal District Heating

GEOTHERMAL ENERGY – Offers Major Opportunities

- **1. Harnessing Natural Resources**
- 2. Economic opportunities and savings
- 3. Improve energy security
- 4. Reducing greenhouse gas emissions
- 5. Reducing dependence on fossil fuels for energy use
- 6. Improving industrial and economic activity
- 7. Growing the low-Carbon and Geothermal technology industry, and create employment opportunities
- 8. Improving quality of life



International Geothermal Projects with Icelandic Participation





Geothermal Energy is a Powerful Tool to Fight Against Global Warming

Iceland Liechtenstein Norway grants



