2016 Norway Country Report

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IEA Geothermal

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1. Introduction

Geothermal energy use in Norway is dominated by the relatively widespread deployment of geothermal heat pumps. There is no electricity production from geothermal resources, and there are no deep geothermal energy installations in operation. As the third-largest exporter of energy in the world and with an electricity supply almost totally dominated by hydropower, Norway is unique with respect to energy resources in having one of the largest shares of renewable energy both in its total primary energy supply and in electricity supply. Although energy use per capita is close to the average for European countries, the electricity consumption ratio is very high (23 MWh per capita), being second only to Iceland.

There is a strong lobby from academic institutions (universities and research institutes) and industry to promote geothermal energy (including deep geothermal) to the politicians and the public. The umbrella organisation is the “Norwegian Centre for Geothermal Energy Research” (CGER) established in 2009. At the end of 2016 there were 10 partner organisations from universities, research institutes and industry involved. The reason for establishing geothermal energy in Norway is alignment with the country´s energy policy of increasing the use of renewable energy resources. Additionally, the Norwegian industrial and academic expertise in off-shore technologies could be readily utilised in an emerging geothermal industry.

To date all geothermal installations in Norway are geothermal heat pumps (GHP). Statistics from the Norwegian heat pump organization (NOVAP) identifies a peak of 3,600 GHP installations in 2011 (Figure 1). For 2014, 3,000 were installed and since then the annual installation is about 2,500. NOVAPs statistics cover approximately 90% of the Norwegian heat pump market. According to NOVAP, in 2016 2,571 GHPs were installed (mainly “fluid-to-water”), which is an increase of 8% from 2015. In comparison, in 2016 65,542 “air-to-air” heat pumps were installed. However, air-to-air heat pumps are less effective then GHPs, and provide relatively less heat. Though GHPs accounted for only 3.8% of all installed heat pumps (2016), they delivered 27% of total heat. In 2016, all heat pumps in Norway delivered 7,5 TWh renewable heat, about 30% (2,3TWh) of which came from GHPs.

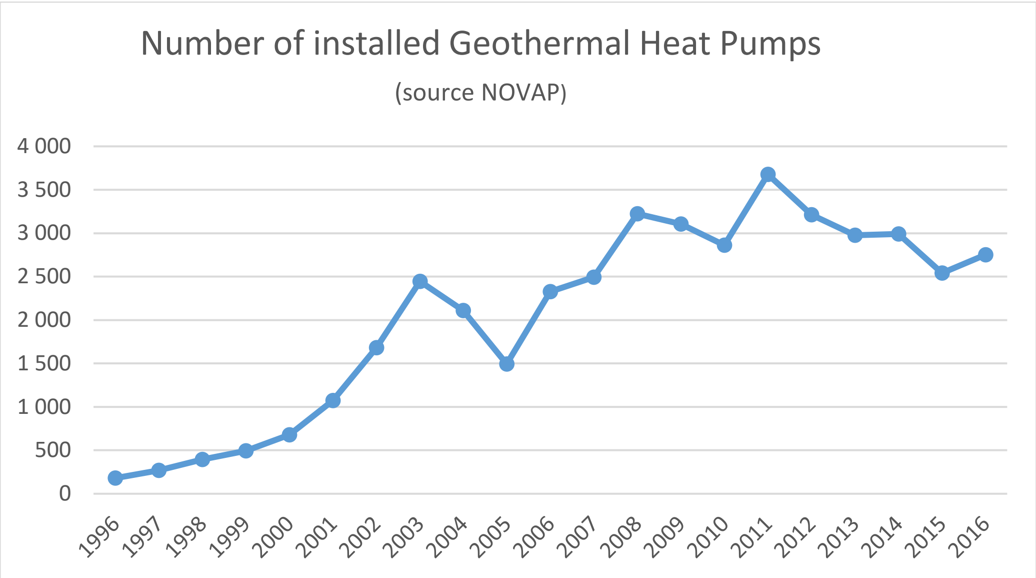

Figure 1 Ground Heat Pumps (GHPs) sales statistics from NOVAP.

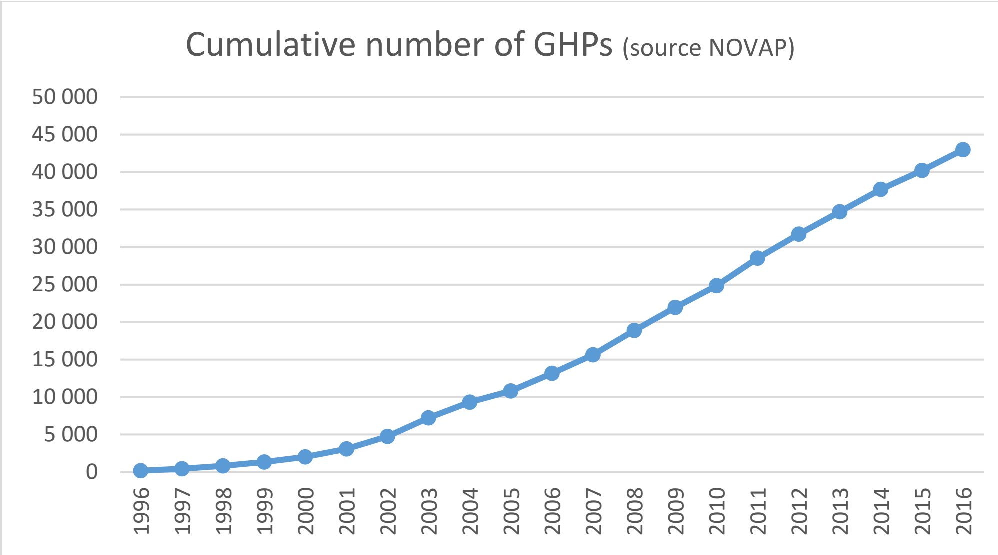

Figure 2 Geothermal Heat Pumps (GHPs) sales statistics from NOVAP

The majority of the GHP systems in Norway are vertical closed loop systems extracting heat and/or cold from crystalline rocks through borehole heat exchangers (BHE). The Geological Survey of Norway (NGU) collects statistics on GHP boreholes in the GRANADA database (http://www.grunnvanninorge.no/databaser_ngu.php). The data base is incomplete because of delayed reporting by drillers and not all boreholes drilled are registered. GRANADA borehole statistics show a similar trend to the NOVAP data, with maximum installations in 2011 and a decrease from 2011 to 2015.

A typical Norwegian GHP is based on one or more boreholes drilled to between 50 and 300 meters. A trend towards deeper boreholes has been observed in the last 5 to 10 years, partly due to reduced drilling costs for deeper boreholes. The average borehole depth in fields with 4 or more boreholes increased to more than 200 meters in 2009 and to about 230 meters in 2014 and 2015 (Figure 3).

A typical Norwegian GHP system uses a 115 mm diameter borehole with a single 40 mm U tube installed. Some BHEs use alternative collectors, such as coaxial arrangements or collectors with a rougher surface which produce turbulent flow at lower flow rates. The Norwegian drilling industry has historically been dominated by Norwegian companies, but in the last few years some companies from Finland and Sweden have started servicing the market.

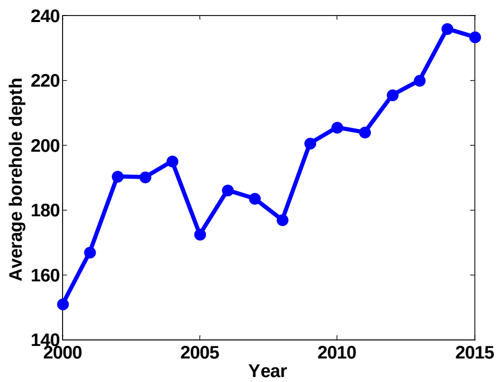

Figure 3 Average borehole depth for fields with 4 boreholes or more for Norway from 2000 to 2015. Source: GRANADA/NGU

European Union guidelines for calculating renewable energy from heat pumps from different heat pump technologies (2013/114/EU) pursuant to Article 5 of Directive 2009/28/EC of the European Parliament is used in calculating the total annual energy use from GHP installations. Europe is divided into three climate zones. Norway is situated in the cold climate zone. The default HHP value for equivalent full load operation hours for GHPs is now 2470 hours. Previously, in calculations for national energy savings from GHPs annual operation in heating mode was 4000 hours. Norway spans over 13 degrees of latitude, some of which is north of the Polar circle, with no sunshine in the coldest season. In addition, there is a large diversity in the climate zones from coastal, high mountains and inland. There are large differences in building heating and cooling demands depending on location, building type and age. It is worth noting that new buildings have lower heating demands than older established buildings.

Table 1 Geothermal energy use in Norway in 2014.

Electricity		Direct Use	
Total Installed Capacity (MW_e)	0	Total Installed Direct Use (MWth)	na
Contribution to National Capacity (%)	0	Total Heat Used TJ/yr Total Heat Used TWh/yr	8260 2,3
Total Generation (GWh)	0	Total Installed Capacity for Heat Pumps (MWth)	1300
Contribution to National Demand (%)	0		

(The data is based on gross estimates. na=data not available)

2. Changes to Policy Supporting Geothermal Development

The Norwegian geothermal community was not successful in obtaining a prestigious national project (run by RCN) *"FME (environmentally friendly energy research centre) for geothermal energy"*; however the Research Council of Norway (RCN) has increased its financial support to geothermal research projects through its programme "ENERGIX" (see Section 4).

3. Geothermal Project Development

See section 4 "Research highlights".

4. Research Highlights

4.1 SINTEF

SINTEF is engaged in Horizon 2020 EU project DESCRAMBLE (headed by ENEL) which deals with drilling in a continental crust supercritical geothermal reservoir in order to test and demonstrate novel drilling techniques.

Figure 4 Bulkhead with temperature probe and pressure port constructed for the DESCRAMBLE project

In another project INNO (financed by RCN), SINTEF (together with IRIS) tackles issues related to fundamental processes in hard rock penetrations.

4.2 CMR

CMR has ongoing activities related to distributed fibre optical sensing.

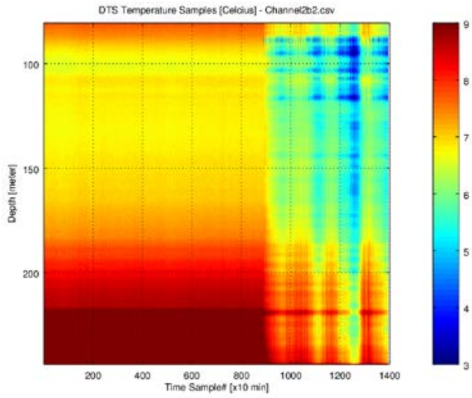

Figure 5 DTS Temperature Samples

4.3 IRIS

IRIS is involved in EU Horizon 2020 project “GeoWell” (headed by ISOR in Iceland) where they lead activities related to risk assessment for geothermal wells. Furthermore, IRIS takes part in a feasibility study on Deep Geothermal Drilling in Ålgård” (Western Norway, close to Stavanger) with the objective to assess the feasibility to utilize deep geothermal energy for heat and electricity production in the Ålgård region.

4.4 IFE

IFE is involved in EU FP7 project IMAGE (headed by TNO in the Netherlands) where IFE develops and qualifies new tracers suitable for supercritical conditions.

Figure 6 Experimental setup at IFE for monitoring flow of tracer at supercritical conditions.

4.5 UiB (University of Bergen)

UiB is engaged in basic and applied research in geological characterization, mathematical modelling and computation geoscience. This work is supported by RCN and Statoil.

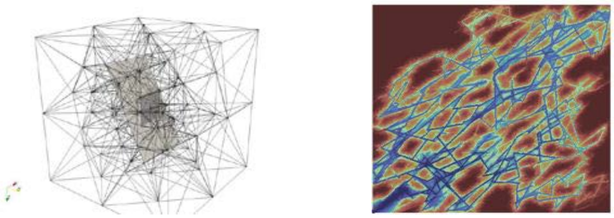

Figure 7 Simulations of fractured reservoirs from UiB

4.6 Statoil

Through its internal programme GEOMAGMA, Statoil is interested in going deeper and hotter targeting high temperature (400-500 C). The company is heavily involved in the IDDP-2 project in Iceland.

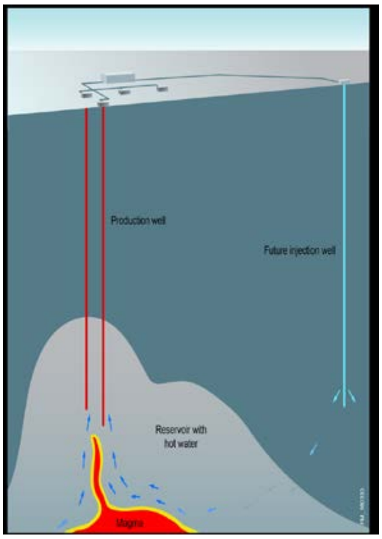

Figure 8 Going deeper and hotter

5. Other National Activities

5.1 Geothermal Education

Please refer to previous Norway country reports

5.2 Conferences

CGER will host international conference GeoEnergi in May 2017 with participation from international scientific guests, politicians and media. The conference was a follow-up to the successful GeoEnergi 2011, 2013 and 2015. The keynote speaker is Guðmundur Ómar Friðleifsson, HS Orka who will talk about the IDDP2 project in Iceland.

5.3 Useful Websites

www.rcn.no
www.cger.no
www.enova.no
http://www.energi21.no/
www.novap.no
www.innovasjonnorge.no

6. Future Activity

The geothermal community in Norway is determined to continue expanding its activities. This concerns more than academic institutes and universities. Small Norwegian enterprises which are spin-offs from declining oil industry are motivated to penetrate emerging domestic and international geothermal markets. They are encouraged and co-financed by the Norwegian governmental organizations (RCN, ENOVA, INNOVATION NORWAY) which support development and deployment of renewable energies.

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