IEA GEOTHERMAL

Germany Country Report
2012

IEA Geothermal
Implementing Agreement

National Activities
Chapter 11 of Draft 2012 GIA Annual Report
Germany

Figure 11.1 Kraftwerk Landau, Germany.

11.0 Introduction and Overview

The use of geothermal energy offers significant potential, and could theoretically meet Germany's energy demands several times over. Considerable efforts have already been made to tap into this potential, from the exploration and development of particularly suitable regions and the development of drilling technologies, through to systems for converting extracted geothermal heat into electricity.

In Germany, there are three regions particularly well positioned to use geothermal energy – the North German Basin in the northern third of Germany, the Upper Rhine Graben in the south-west, and the Molasse Basin in the south.

In 2012, two sites in these regions were developed for electricity generation: Sauerlach (Bavaria) and Insheim (Rhineland-Palatinate) joined the existing sites in Landau (Rhineland-Palatinate, 2007), Unterhaching (Bavaria, 2008/2009) and Bruchsal (Baden-Württemberg, 2009).

Three further geothermal projects to generate electricity are currently under construction: Kirchstockach, Kirchweidach (both in Bavaria) and Oberhaching (likewise Bavaria, electricity as secondary use only). According to the German Geothermal Association (GtV), in October 2012 there were 20 geothermal CHP plants in operation in Germany which supply households, companies and public buildings with thermal energy via the district heating networks.

11.1 National Programme

Germany has set itself ambitious climate protection targets and resolved to phase out the use of nuclear energy by 2022. By the middle of this century, the German Government aims for an energy supply based predominantly on renewables, meeting 80 % of electricity consumption and 60 % of final energy consumption by 2050. To support the development of renewable energy sources, the government has set aside some 3.5 billion euros (US$ 5 billion) for research and development of future energy technologies between 2011 and 2014 under the 6th Energy Research Program.

The share of renewable energy sources in Germany's gross electricity consumption rose significantly again in 2012 to reach 22.9%. This represents an increase of nearly two and a half percentage points against the previous year (20.5 percent). At 136 million kilowatt-hours (kWh) electricity generation from solar, wind, hydro, biomass and geothermal was around 10 percent higher than in 2011.

Electricity	
Total Installed Capacity [MWe]	12,1
New Installed Capacity [MWe]	4,6
Contribution to National Capacity [%]	< 0,1
Total Generation [GWh]	25.4
Contribution to National Generation (%)	< 0,1
Direct Use	
Total Installed Capacity [MW_{th}]	211,5
Heat Use (deep geoth. sources) [GWh/yr]	731
Total Heat Used (deep + GSHP) [GWh/yr]	7070
Number of geoth. heat pumps	230.000
Commercial indications	
Employment [jobs]	13.900
Investment [Mio. €]	930
Revenues [Mio. €]	780

There was a noticeable rise in heat supply from renewables in 2012, from just under 135 billion kWh in 2011 to more than 144 billion kWh. Nevertheless, the share of renewable energy sources in Germany's heat consumption remained at the 2011 level of 10.4 percent. This was because overall heat consumption in 2012 was higher due to cold weather (initial estimates put the figure at 1,385 billion kWh1 in2012 against 1,301 billion kWh2 in 2011). This means that the renewables' share in heat consumption stagnated for the third consecutive year.

11.2 Industry Status & Market Development

Apart from funding carefully selected research projects, the Federal Government is also creating incentives for new projects by remunerating geothermal electricity under the Renewable Energy Sources Act (EEG) and by offering subsidies towards drilling costs. Since the amendment to the EEG was adopted by the Bundestag (Lower House of Parliament) in late June 2011, the framework conditions for promoting geothermal energy will be improved starting the beginning of 2012. In order to mitigate the current high risks for investors, the subsidy for geothermal electricity will be increased to 25 euro-cents per KWh. The use of enhanced geothermal system (EGS) techniques will also attract a subsidy of 5 euro-cents per KWh as of 2012. With these new rates, the Government is hoping to encourage further advancement of geothermal energy, since

Insheim Geothermal Project.
(photo courtesy of Pfalzwerke geofuture GmbH / BESTEC GmbH)

construction of new capacity has fallen short of expectations to date. In order to set a realistic time frame for the commissioning of projects, while at the same time pushing for fast implementation, the reduction of subsidy rates has been postponed until 2018.

The market incentive program (MAP) of the German Government promotes renewable energy systems that provide space heating, hot water, cooling and process heat.

It has a section for smaller buildings administered by the Federal Office of Economics and Export Control (BAFA), and one for large buildings and commercial uses, the latter being a premium component of the KfW Banking Group renewable energies program. Several geothermal technologies can be supported by the MAP: The MAP backs up the installation of efficient heat pump systems in residential buildings with a maximum of 12,300 € (US$ 17,500)/ heat pump. For large heat pump systems over 100 kWt a repayment bonus of 80 € (US$ 115) per kW heat capacity is granted with a maximum of 50,000 € (US$ 72,000) for a single system.

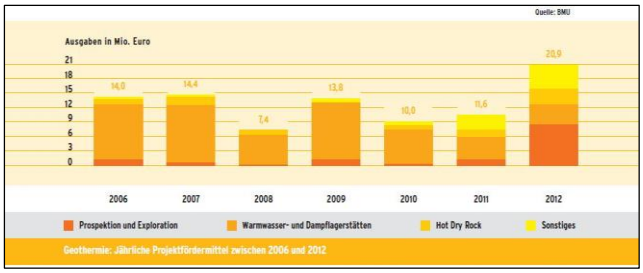
For heat and power plants using deep geothermal energy, a repayment bonus up to a maximum of 2,000,000 € (US$ 2.9 M)/ plant is granted. Well drilling accounts for a large amount of the total projects cost. The repayment bonus for drill costs (only wells over 400 m) amounts to US$ 540 up to US$ 1,000/ m TVD depending on the depth of the well. The maximum bonus per well is US$ 36 million. Furthermore, part of the exploration risk can be covered within a KfW Program.

11.3 Research, Development & Demonstration

In recent years, significant scientific and technical progress has been achieved with the use of deep geothermal energy to generate electricity. Despite this, geothermal energy is not yet sufficiently advanced to support reliable use on a commercial scale. Mindful of the considerable potential and anticipated contribution of geothermal to a future energy system based on renewables, BMU supports related research projects.

Considerable efforts have already been made to tap into this potential, from the exploration and development of particularly suitable regions and the development of drilling technologies, through to systems for converting extracted geothermal heat into electricity.

Current BMU research projects cover all stages of geothermal value-added. Their primary objective is to keep cutting costs until geothermal energy becomes cost-efficient. Technological advancement throughout all project phases will contribute to this: at the planning and exploration phase, the drilling/construction/assembly phase, and in the test and operational phase. Drilling work currently accounts for the bulk of investment costs. It therefore needs to become faster and less expensive. However, completed plants must also be efficient, low-maintenance and reliable. Alongside technical advancements in geothermal energy, successful research projects now also include concepts to improve public relations as a matter of course. Last but not least, we need to find ways of using geothermal energy in less favourable regions as well.



The funding of on-going projects in the deep geothermal sector increased from around 11.6 million euros the previous year to 20.8 million euros in 2012, due to the sharp rise in new approvals over the previous two years. 37 new projects with a volume of 21.4 million euros were approved in 2012, on a par with the previous year. This has helped to stabilise research success in the deep geothermal sector. On average, the total of new approvals has doubled since 2004.

11.3.1 Research Highlights

Inauguration of a high-temperature test rig for optimised pumps: Reliable, efficient submersible pumps are critical to the cost-effective operation of a geothermal power plant. High temperatures and volumetric flows, coupled with aggressive components in deep waters, mean that they are exposed to very different conditions than pumps used for petroleum extraction, for example. Against this background, Baker Hughes INTEQ GmbH is developing modified underground pumps for use in geothermal drillings in the "Optimised Geothermal Pumps" project. In summer 2012, a high-temperature pump test rig began operation at the Baker Hughes site in Celle, which it is hoped will provide fresh insight into optimum pump design.

The test rig was inaugurated in September 2012 by the then-Prime Minister of Lower Saxony, David McAllister. It is used for high-temperature testing, whereby the motor winding insulation and the pump compensation system are deliberately exposed to temperatures well above 200°C. The team is also undertaking a comprehensive analysis of all recorded pump failures in geothermal applications, which has already prompted a number of motor modifications.

Reliable operation in the Bavarian Molasse Basin: When designing an installation for efficient, long-term operation, as well as an understanding of the thermal water's cooling behaviour, it is also important to have knowledge of its precise composition. Until now, accurate data capture has been lacking, leading to unnecessarily high design and maintenance costs, possible malfunctions, and even a shorter life span of the plant. Under the coordination of Stadtwerke München, in collaboration with the Institute of Hydrohemistry at Technische Universität München TUM

Optimierte Förderpumpen für die Geothermie: Hochtemperatur-Teststand am Standort der Baker Hughes INTEQ GmbH

Pump test facility.

and Erdwerk GmbH, a project is underway to minimise the risks associated with the planning and operation of deep geothermal installations in the Bavarian Molasse Basin. The work has been divided into four areas: Modified materials, modified filters, measurement techniques for status changes in the borehole and reservoir, and measurement of pressures arising in the system. For example, cost-intensive safety margins of 100 percent are currently added to calculations to allow for pressure measurement uncertainties. The team is therefore hoping to develop a method for continuous quantitative gas analysis during operation.

Geothermieheizkraftwerk Sauerlach im bayerischen Molassebecken

Sauerlach geothermal site.

Attention will focus on the Sauerlach geothermal site, the second geothermal project by the public utility Stadtwerke München. With a comparatively high gas content and a high concentration of sulphide in the water and in the gas phase, a significant concentration of hydrocarbons and high temperatures (up to 142°C), within the Bavarian Molasse Basin, Sauerlach exemplifies particularly challenging conditions. BMU has provided around 770,000 euros towards this project.

More Highlights of geothermal project in Germany are extensively described in "Innovation Through Research 2012- Annual Report on Funding in the Renewable Energies Sector" published by BMU.

11.4 Future Outlook

The aim of the governmental research support is to further advance the cost-effective extraction and use of heat and power from deep geothermal reservoirs. To boost the market penetration of geothermal energy, heat production from geothermal resources is a principal focus of research funding. Over the medium term, this is the best way to ensure that this non-intermittent renewable source can secure a foothold in the energy market, and significantly increase sales of geothermal energy in Germany.

11.5 References and Websites

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Leibniz Institute for Applied Geophysics (LIAG):
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