With 3D seismic squads made of vibro-trucks, DMT can explore the 80 largest german cities in 32 months Source: DMT

"We Need a National Exploration Program for Deep Geothermal Energy"

Deep geothermal energy could sustainably cover a quarter of Germany's heating needs. A national exploration program, a state discovery insurance and shortened approval procedures would make realisation possible in just a few years, explain Prof. Dr. Bodo Lehmann, head of the Geo-Energy & Resources unit at DMT GmbH & Co. KG in Essen/Germany, and his deputy Dr. Boris Dombrowski, in an interview with EUROHEAT&POWER.

Several studies come to similar conclusions: At least 25% of the thermal energy required in Germany can be provided by geothermal energy. The German government has geothermal energy on its agenda. For example, at the beginning of 2022, the Federal Ministry of Economics and Climate Protection issued that a geothermal potential of 10 TWh should be developed by 2030. To this end, at least 100 geothermal projects are to be initiated. Is that realistic? "In principle, it is possible," agree Lehmann and Dombrowski (Figure 1).

They should both know, after all, they head the Geo-Energy & Resources unit at DMT, a TÜV Nord Group company. The curricula vitae of the two experts and their involvement in numerous committees and associations alone would fill pages. Similarly, the DMT Group has more than 100 years of experience in the exploration of raw materials. The company is involved in numerous exploration campaigns, examining subsurface areas for geothermal properties and making the information available to municipalities. DMT has been exploring the potential of geothermal deposits in Germany and Europe for over 20 years.

Developing a geothermal potential of 10 TWh by 2030 is feasible, Dombrowski says, if some conditions are established to make it

happen. "It's not going to work at the pace it's been going in the last few years," he says. "We are proposing a national exploration program, which is necessary to explore geothermal resources across Germany. The cost of that is half a billion Euros. That's peanuts compared to the cost of other energies and what can be achieved."

National exploration program

DMT defines the national exploration program as the seismic exploration of the 80 largest German cities for geothermal resources. Within three years, this could be implemented. "And not with 2D seismics, but in 3D, so that you gain three-dimensional insight into the subsurface and can practically start planning drilling immediately on the basis of this information. That's the crucial point," says Dombrowski.

The area in question is 14,000 km^2. This area is roughly equivalent to the total area of Germany's 80 largest cities, home to an estimated 30% of the population, which could be supplied by heating networks – and in a CO_2-neutral way. Cities and communities can decarbonise their district heating networks with geothermal energy.

The Molasse Basin in the Alpine foothills, the Upper Rhine Rift and the North German Basin are known to have great geothermal potential. These three regions have been explored because the oil and gas industry has been searching for oil and gas almost exclusively there since the end of the war. However, these three regions account for only about 40% of Germany's territory. This means that the remaining 60% have not been explored at all and their deep geothermal potential cannot yet be quantified.

In order to be able to make greater use of the potential of geothermal energy for energy supply, the current federal government wants to improve the data situation according to the coalition agreement. To this end, in the fall of 2022 the Federal Ministry of Economics and Climate Protection adopted a key points paper with eight points, from which only concrete approaches for near-surface geothermal energy have emerged so far with „Wärme-Gut". For deep geothermal energy, DMT can explore the 80 largest German cities with three 3D seismic teams in 32 months down to depths of several kilometers.

3D seismic provides important information

During the seismic exploration, vibro-trucks drive through the city and along country roads. They stop every 30 to 50 m and generate small vibrations on the ground with vibrating plates. These "vibration waves" propagate through the earth, are reflected by the rock layers underground and recorded at the earth's surface by thousands of sensors. DMT then uses this data to calculate a three-dimensional model of the subsurface down to a depth of several kilometres. 3D seismic is significantly more expensive than 2D seismic. "The cost is about €25,000 to €30,000 for 1 km^2 of 3D seismic," Lehmann explains. But it pays off, he says, because it yields significantly more of the information needed and reduces project development by about 50%. "Furthermore, it can also have the added effect of finding previously unknown deposits of raw materials at depth." Lithium, for example, is extracted at the Bruchsal plant in the Upper Rhine Rift.

"Exploration helps to find out if there are karstified areas," Lehmann explains. "For hydrothermal geothermal energy, it is crucial to reach these areas." Water does not flow through rocks like basalt. Rather, the rocks must have a certain permeability, as is the case with sandstone and limestone. "The important thing is the bulk, that is, how many litres of warm water can be transported upwards per second."

And the temperature? The temperature increases about 3 °C per 100 m depth, so 30 °C at 1,000 m. "In this regard, about 120 °C hot water can be found at a depth of 4,000 m," explains Lehmann (Figure 2). "But the decisive factor is whether there really is a water-bearing rock layer

Figure 1. According to Prof. Dr. Bodo Lehmann (l.) and Dr. Boris Dombrowski, a national exploration programme could realise at least 10 TWh of geothermal heat generation in Germany by 2030 Source: Laufkötter

there. The temperature itself is less decisive; it is only relevant in terms of efficiency. What is important is that there is enough water down there."

Seismic exploration can identify the karstified areas well, but says nothing about the water content at depth. For this, deep geothermal boreholes have to be drilled, one of which costs around €10 million. These are high investments that need to be secured.

Discovery risk insurance

"In order for the municipal utilities to invest, another €500 million is needed for discovery risk insurance," says Dombrowski. A discovery risk insurance costs about €1 million per well, so with €500 million 500 projects could start. "That means that with €1 billion I can ramp up geothermal energy and generate at least 50 TWh of heat – about 10% of space heating in Germany – in a climate-neutral way," Dombrowski says (Figure 3). "Actually, the state only has to pre-finance this, because when a geothermal heating plant is up and running, it is very quickly profitable from an economic point of view. Then the municipal utilities will certainly be happy to pay back these costs – and the population will be supplied with energy at low cost."

Discovery risk insurance reduces this investment risk, because municipal utilities and local authorities cannot usually afford for a deep geothermal well to fail. The initial investment for exploration and drilling is particularly high. Federal funding for efficient heating networks (Bundesförderung effiziente Wärmenetze; BEW) can provide support in this regard. In principle, the funding covers all measures from exploration, installation of the generation plants and heat distribution to transferring the heat to the buildings supplied, provided they contribute to decarbonising and increasing the efficiency of the heating network. Eligible heat sources also include deep geothermal energy.

The fundamental mistake, according to Dombrowski, is that individual measures are promoted. "Seismology can be promoted or the transformation plan. The drilling can be promoted. Afterwards, the construction of the heating plant can be funded with a certain share. So individual measures are funded. Nevertheless, the risk remains with the municipal utilities. I'm not taking away the risk of a drilling failure. They don't lose 100%, but only 50%, but they still lose so much that no municipal utility can afford this loss – and that's why too little is invested despite the subsidy."

Acceleration of the approval processes

Moreover, Dombrowski and Lehmann think that everything takes far too long. The processes need to be made less bureaucratic. They believe that a national exploration

Figure 2. "For hydrothermal geothermal energy, it is crucial to reach water-bearing rock strata," explains Lehmann Source: Laufkötter

Figure 3. "With €1 billion you can ramp up geothermal energy and generate a large part of the total heat supply in a climate-neutral way," says Dombrowski Source: DMT

programme would create a good basis for this. "We will then issue the permits we need for all 80 cities at the same time. All approval processes will be parallelised and not processed serially," Dombrowski explains.

Project idea, feasibility, environmental impact assessment, permits and the like are currently run through for each individual project. For the respective municipal utilities, this means not only high costs, but also a great deal of time. Moreover, the necessary knowledge must first be available. "Companies in the oil and gas industry have hundreds of geoscientists who do nothing but explore and develop the resource. A municipal utility, on the other hand, has one geoscientist, if it comes down to it, who first approaches the subject in three to four years, usually self-taught," says Dombrowski. This effort, which the municipal utilities undertake here, can be greatly reduced.

Industrialisation

The process from the project idea to the finished heating plant has to be industrialised, he says. "We optimise and standardise all processes up to the heating plant." Basically, municipal utilities and energy suppliers can simply commission DMT to build a deep geothermal heating plant and the company will take care of everything from concept and project development to site investigation with 3D seismics as well as drilling planning (Figure 4) and execution and heating plant construction to network connection as a general contractor. This is already possible today. The actual idea behind it is the industrialisation of deep geothermal energy, meaning that deep geothermal heat supply can ramp up in Germany in a relatively short time.

"Moreover, the idea of industrialising deep geothermal energy is also an exciting topic for plant engineering," adds Lehmann. Submersible pumps, for example, would not be in stock at the manufacturers. But if the market picks up and it is clear that the technology is needed for the numerous new geothermal plants that are being built, that would boost plant construction. And that would boost the economy.

Geothermal energy itself pays for itself as soon as the heating plant is up and running. "Geothermal projects usually pay for themselves within a few years," says Lehmann. Yet geothermal energy is a CO_2-free and inexhaustible source of energy. By using it, Germany is less dependent on imports of fossil fuels and thus more self-sufficient. Geothermal energy can make a significant contribution to achieving Germany's climate goals. In any case, according to Lehmann and Dombrowski, tapping a geothermal potential of 10 TWh by 2030 is feasible – and even quite a bit beyond that if the right steps were taken in politics.

Silke Laufkötter

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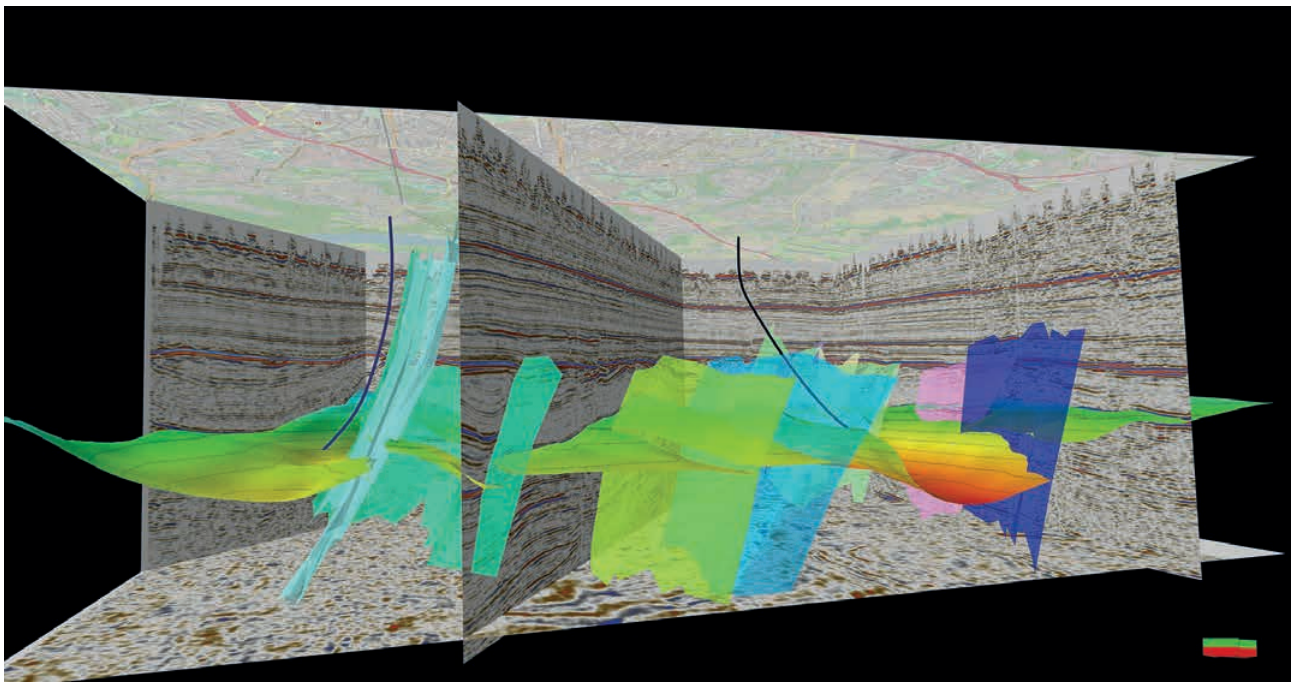

Figure 4. Three-dimensional modelling of the subsurface down to a depth of several kilometres to determine the thermal water horizons in the rock strata with drawn-in bore path planning; such models can be created with 3D seismic site exploration and offer the greatest possible certainty that the borehole will be successful Source: DMT