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Status Quo of the Geothermal Pilot Project in Germany: Significance of a Professional Project Management

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1. INTRODUCTION

In the last years deep-seated geothermal projects in Germany do not fail predominantly due to technical and geological problems. It appears more and more that the success of geothermal energy generation projects depends strongly on qualified answers in the field of political topics, risk management, financing models, project organization, profitability and contract law.

As the first large auditing, tax and legal consulting enterprise in Germany, Rödl & Partner was engaged early on with the challenges of development, implementation and financing, as well as finding special public and private solutions for the utilization of deep-seated geothermal energy. In these areas we have developed significant successful standards for the whole sector. Rödl & Partner is also a member of the Economic Forum Geothermie in Germany and consults among numerous private clients the World Bank, the KfW, AUC, CAF, UNEP, DENA and the European Commission.

2. STATUS QUO OF THE GEOTHERMAL PROJECT UNTERHACHING

The municipality of Unterhaching near Munich is the first community in Germany, which uses geothermal energy for district heating as well as for power generation.

As shown in the construction and operation timeline of the co-generation plant in Table 1 the geothermal co-generation plant supplies heat to a district heating system since 2007 and baseload power since 2009. The aquiferous layer, the Malmkarst, should secure the supply of the municipality with approximately 22,000 inhabitants with heat and power in the long-term. The heat plant has a capacity of 37.5 MWt. The heat is distributed via a network with a length of approximately 40 km. The power generated in the Kalina plant (3.36 MWe) is fed into the public grid according to the renewable energy act (EEG) with a feed-in tariff of 23 €cent/kWh.

Table 1: Construction and operation timeline of the co-generation plant in Unterhaching (Source: Geothermie Unterhaching GmbH & Co. KG)

11/2003	Conclusion of Europe's first private-sector exploration risk insurance contract
02/2004	Official start of the first deep geothermal drilling in Unterhaching
09/2004	Thermal water with a temperature of 122°C and a flow rate up to 150 l/s was found during the first drilling at a depth of approximately 3,350 m
05/2006	Start of construction of the district heating network
01/2007	The temperature of the thermal water found during the second drilling at a depth of 3,577 m reached 133°C and thus exceeded all expectations
10/2007	Start of the heat supply for a connected load of 20 MWt
05/2008	Start of the test operation of the first geothermal Kalina power plant in Germany
02/2009-04/2009	Power from the geothermal Kalina plant is fed into the electricity grid of Unterhaching

Rödl & Partner was responsible for the overall project management of the geothermal project in Unterhaching and still advices the project company in legal and economic questions.

2.1 Innovative drilling conception

Before the project in Unterhaching no deep-seated geothermal drilling in Germany was designed for such dimensions, in particular for these flow rates. For the energetic use of thermal water, at least two drillings were necessary in principle, one well for the production of the hot thermal water and one reinjection well to insert the cooled water into the aquiferous layer.

The production and reinjection wells are connected with a thermal water pipeline (length approximately 3.5 km). Using two heat exchange systems the thermal water is cooled after the heat and power production from 122°C to about 60°C at a flow rate of 150

l/s. Afterwards, the cooled thermal water flows through the thermal water pipeline to the second well to be reinjected into the water reservoir at a depth of 3,577 m. The power plant is situated in a typical commercial area with neighboring dwellings in Unterhaching.

2.2 Low priced and price-stable heat supply

The geothermal energy plant delivers approximately 37.5 MWt of energy output whereas the construction of the district heating network took place in annual construction phases. Already in the first stage of extension, 4,000 average households with a connected load of 28 MWt could be supplied. In the second stage of the extension, the connected load increased up to a total of about 40 MWt. In the last stage, a connected load of approximately 60 MWt was reached. The whole project was constructed as a heat-led installation, so that the power production is used as an additional source of income, however, the heat customers are the first to benefit from the advantages of geothermal energy. This constitutes a location factor increasingly gaining significance for communities.

For the project in Unterhaching an innovative pricing concept was developed by Rödl & Partner for the "Geothermie Unterhaching GmbH & Co KG" for the selling of district heat (Figure 1).

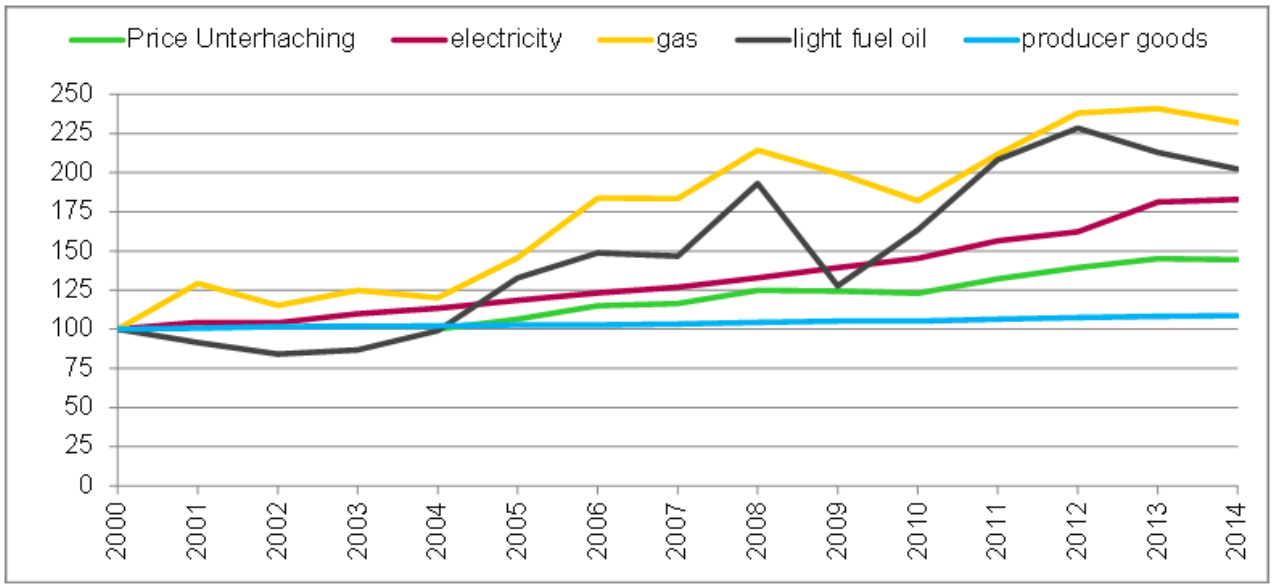

Figure 1: Heat price comparison Unterhaching (Source: Rödl & Partner)

In contrast to the prices for the delivery of power or gas, the prices for district heating are not legally regulated. However, the legislator has taken into account the protective requirements of the customers in relation to a long-term development of prices. In 1967, the AVBFernwärmeV (general terms and conditions for the delivery of heat) were brought into force, in which clear specifications for the adjustment of prices using sliding-price clauses were determined for district heating suppliers. According to the AVBFernwärmeV, the development of district heating prices which are handed over to the customer using sliding price clauses has to be orientated to the development of costs for production and supply of heat and has to take into account the circumstances on the heat market appropriately. For a geothermal plant, these factors result in the investment and labor costs, the power consumption of the pump as well as expenditures for fossil fuels, which have to be used for bridging time gaps or during peaks of demand.

Therefore, cost increases of fossil energy sources affect the energy rate in Unterhaching only by a fifth. The base rate in Unterhaching remains completely unaffected. Due to the almost entire independence from fossil energy sources, the heat supply through geothermal energy reaches a high price stability.

Figure 1 shows the comparison between the heat price development in Unterhaching and the price development of fuel oil and natural gas. The geothermal heat price is updated yearly in accordance to, among others, the electricity and producer goods price trends and hasn't exceeded the price for natural gas and light fuel oil over a period of ten years.

Originally, the planning was designed for the fact that the power production has priority over the district heating production. In the course of the project the price spiral of oil and natural gas turned upwards. This also changed the economic basis of this pioneer project. The prices of fossil fuels reached a level on which geothermal heat supply became economically more attractive day after day. In Unterhaching this led to the priority shift from power to heat production. Therefore, Unterhaching can offer favorable and, in the medium and long term, price-stable heat supply to its citizens.

The fact that already before commissioning of the district heating supply more than two thirds of the possible connected load of the first construction phase are bound by contract shows how much this was appreciated. Currently the second stage of extension of the district heating network is already in planning. With the geothermal district heating supply combined with power production, the community of Unterhaching invests for the future in a local advantage of location: favorable and price-stable district heat supply.

2.3 Power production using the Kalina technology

"Geothermie Unterhaching GmbH & Co KG" installed the first Kalina plant in Germany, as these plants assured the highest gross electricity yield at that time and was strongly subsidized. The Kalina plant ensures an electric gross output of 3.36 MWe. The advantage of the Kalina process is the high heat transfer efficiency. Using a water ammonia mixture in binary circulation the evaporation can be optimized to convert part of the thermal energy into electric energy.

The German renewable energy act (EEG) offers an additional incentive for the use of geothermal energy. The power produced by geothermal plants is actually remunerated by law with 25 cent/kWh for a period of twenty years.

An economically and environmentally ideal utilization of the geothermal energy was reached by combined heat and power generation. Due to the combined use for power and heat generation the project executing organization reaches a high exploitation of the geothermal resource. Each year more than 30,000 tons CO2 are saved by the project in Unterhaching.

3. CENTRAL ELEMENTS OF INVESTORS PROTECTION

Subject areas:

- "warranty and liability" (e.g. for drilling contracts, power generation plant, etc.),
- "closing of necessary insurances", especially insurance for drilling exploration risk with regard to a risk distribution among the project participants as well as
- an "independent, interdisciplinary risk and project management"

make up the central elements of the investor´s protection.

4. SIGNIFICANCE OF PROJECT AND RISK MANAGEMENT

To secure an optimal development of the utilization of geothermal energy potential, a firm and well-defined allocation of competences, risk management for an early identification of problems, permanent and restrictive cost control, optimization of workflows and securing a smooth communication among all involved persons is essential.

The overall project management has to include:

- form of contracts (e.g. articles of association, lease contract, contract for work and services, drilling contract; statutes, etc.)
- legal advice (water rights, mining law, emission control law, property rights, licensing procedure, insurances)
- tax consultancy (tax optimization, incorporation)
- financing (business planning, investment planning, public subsidies)
- organization (deadline monitoring, preparation of decisions)
- costs (cost control, comparison of offers)
- technology (steering and monitoring of planning and execution)

The deep-seated geothermal project in Unterhaching also set new benchmarks in the fields of risk strategies and risk instruments. The origin for some of the most essential, currently available instruments is found in the project management approach of Rödl & Partner.

Decisive is the fact that the financing by a bank puts high demand on the security and coverage of the whole project. This requires special conditions from insurance solutions as well as contract models.

The most essential milestones were initiated, brought into being and were made use of for the first time in Unterhaching. Thereof the most important ones are:

- For the first time ever the successful closing of a private-enterprise insurance agreement for the drilling exploration risk.

Up to now the drilling exploration risk constitutes to be the biggest investment barrier for deep-seated geothermal energy projects, especially in Germany. It describes the risk of not reaching the planned flow rate and temperature through production drilling. In Unterhaching, the drilling exploration risk was solved for the first time in the private sector by Rödl & Partner in cooperation with "Münchner Rück" through the closing of insurance for the drilling exploration risk. In the meantime, many countries offer public risk mitigation programs, which boost the insurance industry in some regions.

- Repeated closing of a drilling contract which protects the awarding authority to a large extent.

Of utmost importance is the contract for drilling performances as it represents 30-40 % of the entire investment. The risk allocation fixed by contract which the drilling company takes together with its subcontractor particularly regarding technical defects during the drilling clearly into liability is also highly important. Furthermore, the remuneration structure of the drilling contract - "daily rate" or "fixed price per meter" - is an important aspect concerning the control of drilling costs, as well as a basis for the conclusion of an insurance for the drilling exploration risk. The contract habits of the hydrocarbon industry can not readily be transferred to geothermal projects as "daily rates" are common in this industry. In Unterhaching, the concluded drilling contract in combination with an insurance concept for the drilling performances for the second deep drilling provided a maximum of security for the awarding authority.

- Operations management contracts

After the first five years of technical operation this service was newly put out to tender. Therefore a list with all necessary technical services was created with the support of Rödl & Partner. This list was handled together with Geothermie Unterhaching GmbH & Co. KG" and it determined the responsibilities for the defined tasks. Furthermore, the responsibilities were clearly arranged and included in a contract.

In the context of contract drafting a variety of aspects have to be considered to achieve a matching of all contracts:

- Duties and services of the contractor and the client, authorities
- Availability, bonus extra premium arrangement
- Interference management and reaction times
- Information, documents, reporting and documentation, indicating duties and hint duties
- Deadlines, contract penalty and approval
- Deficiencies claims and liability
- Insurances
- Contract period and right to cancel
- Remediation of area, etc. after termination of a contract
- Business interruption insurance

The extraction pump is one of the central elements of a deep geothermal plant in Germany. A pump failure leads to a standstill of the plant. On the other hand, the development of the extraction pump market is not satisfactory. There are no providers which will bear the financial losses due to a failure of the pumps. Therefore, an insurance industry is required. A still existing hedge mechanism has been developed for Unterhaching.

- Key factors for the insurability are:
- Know-how of the pump manufacturer
- Quality of the used equipment
- Concept for spare parts
- Availability of pump changing companies
- Scope of insurance protection
- Deductible
- Obligations of the insured and the insurer
- Contract term and termination
- Insured risks, subject of insurance and scope of the compensation, insurable value, duration of liability
- Damage due to interruption of operation
- Damage due to extra costs
- Payment scheme in case of a claim
- Premium level and payment
- Expiration of a damage report

5. CONCLUSION

The technical and geological feasibility of deep geothermal projects has been demonstrated by the project Unterhaching in the South German Mollassebecken However, subsequent projects in Germany were faced with significant delays attributed to insufficient project management, especially concerning legal and economic issues, which were usually identified and handled too late. The geothermal project in Unterhaching is innovative in all fields concerned and had a considerable pilot character not only geologically and drilling-technically but also economically, administratively and as far as contracting is concerned. After about 7 years of continuous operation, it has become clear that the economic planning had been precise. A groundbreaking success of the project management focused on the economic criteria of Rödl & Partner.