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Regulatory framework for geothermal in Europe – with special reference to Germany, France, Hungary, Romania, and Switzerland

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Abstract

Geothermally relevant legislation is reviewed for selected countries. The compilation for Germany, France, Hungary, Romania, and Switzerland reveals that the legal bases show great differences. Governmental policies to support geothermal development are focusing so far on power generation only. Serious efforts are needed to harmonize legislation and to simplify procedures, particularly in the EU, as well as to establish and implement strong policies to boost geothermal direct use.

Keywords: *Direct use, Mining Law, environment protection, permitting, taxation*

1 Introduction

Clear energy and environmental policies and regulations are of paramount importance for the development of renewable energy sources. The institutional framework, legislation and legal constraints are borderlines to delimit development, especially in view of environmental protection. Within these limits there should be unequivocal administration of law.

In reality, governments often lack clear energy policies and environmental policy does not address energy sources but rather the mitigation of their effects. Geothermal energy in general, and geothermal resources in particular, are usually not well defined in legal terms, and the regulation of their development and utilisation is correspondingly diffuse.

In many countries, the geothermal resources are dealt with in the Mining Law whereas the production of geothermal fluids from the subsurface is regulated by Water Protection legislation. This implies that responsibilities are assigned to different Ministries, with often limited cooperation and interaction between them.

A survey of the relevant legislation in various countries results in the perception that the situation is different in each country. Therefore the situation is summarized for a number of selected European countries with the aim of identifying similarities and differences. In the countries addressed in this paper, the utilisation of geothermal energy is for direct use. Policy situations in view of promoting geothermal development are also summarized.

In a concluding section, some recommendations are made for an approach to harmonize (to a feasible extent) the various legislations, especially within the European Union.

2 Germany (mainly from Sanner and Bussmann, 2003)

In Germany, the geothermal energy use is mainly in small plants (ground-coupled heat pumps, commonly for individual space heating), with 400 MWt installed capacity, in addition to larger plants (district heating systems) with 65 MWt. Balneological or agricultural use is not reported.

Laws exist both on the federal level (*Bund*) and on the state level (*Länder*). Geothermal energy in Germany is governed by the Federal Mining Act (*Bundesberggesetz*, or BBergG for short).

According to § 3 BBergG, geothermal energy is not a property of the land owner, but belongs to the federal administration (*bergfreier Rohstoff*). Exploration and exploitation of these kinds of resources, like coal, various types of ore, oil, or natural gas, are regulated by the authorities and granted to an applicant, usually with a certain regular payment to be made according to the amount of the resource exploited (*Förderzins*). However, for geothermal energy, because of the still poor economics and the wish to foster environmentally benign energy, a royalty payment is not required.

A license for exploration and, if the resource has been proven, for exploitation gives a rather strong legal position to its holder. If necessary, even the (temporary) right for land use against the will of the owner can be obtained through court order, of course with fair financial compensation. The extension of a mining field according to such license is delineated on the earth surface and shown in a map, and in the vertical dimension it always starts at the ground surface and extends downward (theoretically down to the centre of the earth). When a mining license is given, other aspects like water protection and environmental issues are dealt with by the mining authorities in collaboration with the relevant offices, and the necessary approvals are included in the mining license.

An exception is stated in the Mining Act for the use of a state-owned resource, if it is used on the same lot where it is exploited, and is used only for the construction and operation of buildings on that lot, belonging to the owner of the lot (§ 4 BBergG). In this case, no license is required. However, even here the mining authorities might come into the play again, if § 127 BBergG is fulfilled, asking for a specific approval for boreholes which penetrate into the underground more than 100 m. Use of this exception is made for most of the ground-source heat pump (GSHP) plants in the residential sector, and this fact is the explanation why so many borehole heat exchangers for heat pumps in Germany have a depth of 99-100 m.

In cases where the mining law is not applicable, other authorities ascertain that there is no harm done to the environment by a geothermal application. Thus shallow geothermal energy is mainly governed by the water law. The Federal Water Household Act (*Wasserhaushaltsgesetz* WHG) only gives a framework, and the relevant state laws handle the details. Water authorities are purely state authorities; on the federal level, there is only a regular coordination group of the states (*Länderarbeitsgemeinschaft Wasser* LAWA).

According to WHG and the state water laws, the use of groundwater requires a license from the water authorities (in a mining license, the right to use groundwater is included, if it is part of the exploitation). The case is obvious for ground water heat pumps; however, by definition even borehole heat exchangers use ground water, if the physical properties of the groundwater are changed (i.e. the water is heated or cooled). Another area of concern is possible groundwater pollution, which may occur during drilling operation, by connecting different aquifers, or in the case of a leakage of antifreeze from a borehole heat exchanger. Some of the states (Bayern, Baden-Württemberg, Rheinland-Pfalz) already have guidelines how the licensing procedure should be handled; in other states (e.g. Hessen and Nordrhein-Westfalen) such guidelines are in preparation.

The basic technical requirements for sound design, safe construction and reliable operation of shallow geothermal installations (down to about 400 m) are given in the guideline VDI 4640 of the Association of German Engineers (*Verein Deutscher Ingenieure*, VDI). To facilitate the site-specific design of smaller plants, the Geological Survey of Nordrhein-Westfalen has compiled a database of ground thermal parameters down to 100 m depth for the whole area of the state, available on CD-ROM. Similar work is under way in other states also to increase the use of GSHPs.

Licences for exploration and production are given, upon submitted programs, for specified licence areas (*Erlaubnisfelder*). Herein the surface area is delimited without a depth limitation. A particular problem may arise here when a larger ground-source heat pump (GSHP) plant, serving more than one owner and thus not eligible for the exception according to § 4 BBergG, has a mining license, and the site is inside an area in which a Hot Dry Rock (HDR) plant is planned (Schulz, 2003). Of course, in practice these two installations would not influence each other, given the several kilometres vertical distance between the HDR heat exchanger and the shallow GSHP plant. Legally, the right to use the geothermal heat resides with the owner of the mining license, no matter what the depth of that use will be. So in said case, the constructors of the HDR plant would need to negotiate with the owner of the license to be allowed to exploit geothermal energy, and they most probably will have to pay the owner. In the worst case, the owner of a mining license for a shallow borehole heat exchanger could prevent the construction of a deep geothermal plant, and vice versa. Now an amendment to the mining law is under discussion to allow for depth-specific mining fields for geothermal energy, in order to avoid the aforementioned problems.

3 France (mainly from Ungemach, 1982; 2003)

Over the past 30 years, France has specialized in the development of low-enthalpy geothermal resources for urban heating, by the “doublet” system consisting of a production and a reinjection well. As of 31 December 1999, the installed capacity was 318 MWt which produced 4.8 PJ/a, and agricultural use (greenhouses, fish farming) had 10 MWt and 125 TJ/a. (Laplaige et al., 2000). Balneological use, in spite of famous spas like Aix les Bains or Vichy, is not reported. Power production is ongoing in the Overseas territories.

French legal regulations of geothermal operations are based upon two main decrees. Decree 77-620 (16 June 1977) added a new title “Low temperature geothermal deposits” to the Mining Law (Code Minier), creating an obligation to obtain an exploration permit before drilling and an exploitation permit before starting up production. Decree 74-498 (24 March 1978) defined legislation concerning “Geothermal prospecting and exploitation licenses”. According to these decrees, geothermal resources are considered concessible and therefore assimilated to mines.

All drillings deeper than 100m are ruled by the Mining Code and thus subject to declaration to the competent authority (DRIRE: Direction Regionale de l'Industrie, de la Recherche et de l'Environnement) which is linked to the Ministry of Industry through DGEMP (Direction Générale de l'Energie et des Matières Premières). Applications are handled by DRIRE and the authorisation to drill and exploit is attributed by a Prefectoral Order (Arrêté Prefectoral).

Geothermal operations which fulfill the following conditions are exempted from declaration/ authorisation:

1. Drilling to depths < 100m; and
2. Maximum possible heat extraction rate is < 200 Thermies per hour (calculated for a 20°C reference temperature; 1 Thermie = 1.128 kJ).

Whenever an operation falls out of the scope of the current Mining Law, two types of regulations may apply:

1. Either Classified Installations (Installations Classées) relevant to the Environmental Code (Code de l'Environnement); or
2. Authorisation/ declaration in compliance with the Water Law (Loi sur l'Eau).

The Mining Law distinguishes between high- and low-temperature resources. A geothermal resource is categorized as a low enthalpy deposit as long as the fluid temperature measured at the surface during testing (not the reservoir temperature) is < 150 °C.

The exploration license is granted on the basis of a Prefectural (=state regional representation) decision following a public enquiry. The license fixes the drillsites or determines a perimeter within which the wells can be drilled. The exploration right is exclusive, and is granted for three years. A number of documents (technical, economical, administrative, financial, environmental) must be submitted by the applicant in support of the request. The holder of an exploration permit has the right to an exploitation permit, if requested, before expiration of the prospecting permit.

The exploitation license is also compulsory and is issued by the Prefect. It grants exclusive exploitation rights by drilling within the authorized perimeter. The license defines the volume of exploitation by the surface perimeter and two depths. The application must be backed by pertinent information on the drilling locations, the fluid and heat volume yields, the extraction and reinjection dispositives, and the characteristics of the heat uses. The permit is granted for a maximum of 30 years, which can be prolonged by periods of less than 15 years each. An environmental impact study must be carried out before completion of the project. A simplified procedure is foreseen for operations whose overall cost is under 1 million USD.

So far, no formal regulation has been issued for royalties to be paid for geothermal operations. Nevertheless, in principle, geothermal operations can be subject to two types of taxes:

1. The professional tax paid by any registered commercial/industrial entity, which varies locally depending on the municipal financial policy; and
2. The tax on water withdrawals.

The latter does not apply to Paris Basin geothermal district heating systems, which apply the doublet concept. Water taxes are paid by the doublet systems operating in the Aquitaine Basin (Southwestern France), as well as by singlet operators.

The French legislation is very specific in considering low enthalpy utilization concepts and in specifying the application and granting procedures for permits and leases. It is less precise and practical from the operational point of view. Although many conditions specific to geothermal heat extraction and uses have been taken into account in adapting mining and hydrocarbon legislation, the legal formulations are in many aspects not well defined and may be interpreted in different ways. Work to address ground-source heat pumps specifically is under way.

4 Hungary (after Árpási, 2002)

Hungary developed its geothermal resources (thermal waters in sedimentary aquifers) in the 1960s for agricultural use (greenhouses), in addition to bathing and swimming. In 1999, the total producing capacity was 325 MWt and production 2.8 PJ/a. The breakdown is: balneology and swimming pools 36.7%; drinking water 29.9%; agriculture 29.6%; space heating and domestic hot water 3.8% (Árpási et al., 2000). Nowadays, spa development is increasing (A. Ruszinkó, personal communication 2003).

Several laws cover the issues of geothermal development in Hungary: Mining Law (no. XLVIII,1993); Water Management Law (no. LVII, 1995); Concession Law (no. XI, 1991). In the use of thermal waters, the components of water, production (reinjection) well(s), and the land property are dealt with by different laws.

The legislation is unbalanced and often contradictory. For example, the Mining Law states, "Geothermal energy exploited with thermal water is not geothermal energy, because it entails thermal water production". Therefore, it is not subject to the Mining Law, but is subject to the Water Management Law. The latter, however, does not include the terms of geothermal energy and its utilization.

The thermal water occurrences belong to the State. But for obtaining a concession for thermal water production, the current legislation does not allow opening up a tender. In addition, for geothermal exploration and exploitation no concession perimeters can be delimited. The property rights of tens of thousands of abandoned oil/gas exploration wells (many of them with identified rich thermal water occurrences) are presently under examination.

The situation concerning environment protection is equally contradictory. Users for agriculture (greenhouses) and space heating are now forced to reinject the used water, which is considered by authorities to be wastewater, even if it is of drinking water quality. On the other hand, water after being used for balneology cannot be reinjected!

The development of the rich geothermal resources of Hungary is severely hampered by taxes and royalties for thermal water production as well as by low natural gas prices, subsidized by the Government.

Very recently, the Hungarian Mining Law has been reformulated and relabeled (now "Gas Law"). The new change for geothermal is that for temperatures < 30°C there is no need for licensing (B. Ádám/Budapest, personal communication).

5 Romania (mainly from Antics and Cohut, 2001)

The main direct uses of the geothermal energy in Romania are: space and district heating 37%; bathing and swimming including balneology 30%; greenhouse heating 23%; industrial process heat 7%; fish farming and animal husbandry 2%. The total used capacity of 152 MWth produces 2.9 PJ/a (Antics and Rosca, 2003).

The Mining Law regulates the mining activities in Romania, stimulating the capitalization of the mineral resources, which are public property. The Law assures maximum transparency of the mining activities and a fair competition, without discrimination between the property forms, the origin of capital and the nationality of the operators.

The investments in the mining domain are encouraged by fiscal and administrative facilities, being free of any constraint concerning the return of investment and the utilization of the obtained profit.

The mineral resources located on the territory and in the subsoil of the country and of the continental shelf in the Romanian economic area of the Black Sea (delimited in accordance with the principles of international law and of international regulations to which Romania is a party), are the exclusive object of public property and they belong to the Romanian State. Among the mineral resources that are the subject of the present law is the heat contained in hydrothermal systems, mineral and plain waters, and mineral-thermal waters.

The mineral resources shall be turned into value through mining activities for which these activities shall be concessioned to national mining companies and societies and also to Romanian or foreign legal persons or given into administration to public institutions by the Competent Authority, according to the present law. The National Agency for Mineral Resources, established in 1993, is the regulatory authority to administer the mineral resources as well as the competent authority which coordinates the mining operation under the Mining Law. In particular, the Agency is authorized to institute hydrogeological protection perimeters, for the underground waters (mineral and thermomineral).

Exploration shall be conducted on the basis of an exclusive license, issued upon request, to the interested Romanian or foreign legal persons selected through a semestrial public

offering by the Competent Authority, based on a work program and an adequate bank guaranty to be applied for environmental restoration purposes. The exploration license shall be granted for a maximum period of 5 years, with a renewal right of no more than 3 years, paying an annual fee in advance. The title holder of an exploration license has the right to obtain, upon request, the exploitation license for any mineral resources discovered, according to the present law. Mining shall be conducted on the basis of an exclusive license, granted for all the mineral resources within an exploitation perimeter. The exploitation license shall be granted to:

a) The titleholder of the exploration license, on its request.
b) The winner of a public tender, organised by the Competent Authority, according to the present law.

The exploitation license shall be granted, through negotiation, based on an application, accompanied by:

a) Feasibility study which ensures the capitalisation of the mineral resources and the deposit protection.
b) Development plan of the exploitation.
c) The environmental impact study, approved according to the law.
d) Environmental rehabilitation plan accompanied by a bank guaranty, based on the value of the development plan and the environmental impact study, and calculated according to norms for applying the present law.

The exploitation license shall be granted for a maximum of 20 years, with the right of continuation for successive periods of 5 years each. The titleholder of the exploitation license will pay an annual tax on surface and mining royalty, according to the present law.

Besides the Mining Law, the Romanian legal/institutional framework of the energy industry is also relevant: for the electric and thermal energy sectors the Urgency Ordinance no. 63/1998. Here the competent authority is the National Authority of Energy Regulation. Law no. 199/2000 concerning efficient use of energy was adopted. Currently, proposals are produced at the Ministry of Industry and Resources which concern changes in the Petroleum Law and Mining Law as well as the initial text of the law concerning electric and thermal energy. The aforementioned legislative projects will soon be forwarded for analysis and adoption to the Romanian Parliament.

6 Switzerland (mainly from Eugster, 2003)

Switzerland has “normal” geothermal conditions, the utilization is entirely for direct use. The total capacity in 2001 was 485 MWt, which produced 3.7 PJ/a heat. The breakdown is: ground-source heat pumps (for space heating) 62.3%; balneology 31.7%; deep aquifers for district heating 3.7%; others like tunnel waters (also for space heating) 2.3% (Kohl et al., 2002).

Being a country of federal structure, there is legislation in Switzerland on the state (Confederation) and the county (Canton) level. According to federal law, the ground property extends to the realm of direct practical interest (a few layers); below that depth everything belongs to the government. No mining law exists on the federal level.

Geothermal energy utilization is not well defined in federal and cantonal legislation. Legal experts like Gottesmann (1985) make a distinction between geothermal heat (an energy source, given by the physical conditions of the subsurface) and geothermal energy, which is used and distributed at the surface. Geothermal heat is thus dealt with by public law and geothermal energy, through its use in private law. So far, geothermal energy is not covered by federal law; existing federal legislation regulating electricity, atomic power and pipelines is not applicable.

On the other hand, in cases where the use of geothermal energy involves water as the heat carrier, water management legislation comes into play. Since shallow and deep groundwater belongs to the cantons, they are regulating the tapping and use of geothermal fluids. In this sense, the use of geothermal energy needs permit and concession. In this, existing and well-established cantonal water laws are being applied.

A special situation exists with ground-source heat pumps involving borehole heat exchangers (BHE). Although such systems operate in closed circuit, their construction and operation falls under environmental legislation. It is feared that the BHEs could establish hydraulic connections between otherwise separated aquifers and/or could have negative effects on groundwater quality. In fact, both the federal Environment Protection Law (*Umweltschutzgesetz USG*) and the Water Protection Law (*Gewässerschutzgesetz GSchG*) are applicable. This leads to permitting regulations: a) No permits can be obtained within groundwater protection zones or in areas with potential groundwater occurrences. b) In special areas like border zones of the above category, karstic areas and environs of thermal and mineral springs, the permits are given on the basis of detailed investigations. c) For all other areas, the permits can be obtained. Based on this practice, several cantons have published maps of BHE exclusion zones. As an example, such a map can be seen for the canton St.Gall (SG) on www.geoportal.ch). The list of permitting cantonal authorities can be found on www.fws.ch. The applications must name the applicant, the geologic advisor, the location, the BHE and heat pump technicalities, as well as the foreseen safety and control measures. The open-mindedness of cantonal authorities allowed rapid BHE development in Switzerland (see below and in Rybach and Kohl, 2003).

For large installations like geothermal district heating systems (>5 MWt) an environmental impact report must be submitted.

So far, no tax must be payed for geothermal energy utilization in Switzerland. Recently, however, the administration of canton Berne considered the introduction of geothermal taxation: a fee of 3 Swiss francs (equivalent of 2 US$) per year and MWt capacity was foreseen for thermal water production from deep drillholes; 0.5 – 2 Swiss francs per BHE meter and year(!). Fortunately, thank to the protests of national and international organisations (including a letter of GRC President John Lund in February 2002), the legislative body (cantonal Parliament) did not follow the suggestion of the administration.

7 Policies to support geothermal development

Governmental policies in Europe to support geothermal development are presently directed towards power production only. Supportive in this respect are recently issued legislations which define the obligations of utilities to take over electricity produced from renewable energy sources. The guaranteed takeover prices vary from country to country and with energy source, with the highest prices assigned to solar photovoltaics. Table 1 summarizes such takeover prices for Germany, France and Austria. Solar electricity is preferentially supported also in Belgium, Italy, Spain, and Portugal.

Table 1. Guaranteed takeover prices (in Eurocents/kWh) for electricity from renewable sources. From *energie extra 3.03*, Swiss Federal Office of Energy, Berne (2003).

Energy source	Germany	France	Austria
Solar PV	45.7	15.25 – 30.5	47 – 60
Wind	6.17 – 8.9	3.05 – 8.38	7.8
Biomasse	8.5 – 10.0	4.5 – 4.9	2.7 – 16.5
Small hydro	7.67	5.49 – 6.1	3.15 – 6.25
Geothermal	7.16 – 8.95	7.62	7.0

These prices led to a development boom in wind energy, especially in Germany. Also in Germany, several projects for geothermal power production are now in implementation, mainly based on the Hot Dry Rock (HDR)/Enhanced Geothermal System (EGS) principle. The projects are supported by the Ministry of Environment.

Besides policies, market forces are also coming into play for electricity from renewable sources. Green certificates and carbon credits are now increasingly discussed and their impact on further development of renewable energy systems is foreseeable.

Not so for geothermal direct use. So far, no "green label" is being issued for geothermal space heating, although it saves fossil fuel and thus reduces CO_2 emissions. However, indirect supporting means that the installation of heat pumps can have significant impact. For example, the Swiss Federal Office of Energy sustained a heat pump promotion program in the years 1990 – 1997. For the installation of heat pumps to replace fossil-fuel heating systems a subsidy of 300 CHF (200 €) per kWe was contributed. Nowadays, a large number of communal and cantonal utilities provide similar subsidies. This led to a veritable boom of ground-coupled heat pumps (for details see Rybach and Kohl, 2003).

A decisive role in boosting geothermal direct use by heat pumps could be played by the utilities. An example to be followed is given by the Swiss EKZ (Electricity Company of Canton Zurich): it provides "Energy Contracting" which means that EKZ installs, owns, and operates the system and sells the heat (± sanitary hot water) at a fixed price to the building owners.

Definitely more supportive governmental policies and efforts are needed to speed up the development of geothermal resources for direct use. Only by these means can their great potential be tapped and utilized.

8 Conclusions and regulatory tasks for the future

Clear energy and environmental policies and regulations are of paramount importance for the development of renewable energy sources. The institutional framework, legislation and legal constraints are borderlines to delimit development, especially in view of environmental protection.

A review of selected countries in Europe, representing EU countries, EU candidate countries, as well as non-EU countries, reveals great differences in existing legislation. Table 2 summarizes the findings.

Table 2: Summary of legislation characteristics relevant to geothermal energy utilization for selected European countries.

Country	Mining Law coverage	Special provision for GSHPs*	Geothermal tax applicable
Germany	yes	yes	No
France	yes	no	No
Hungary	yes	no	Yes
Romania	yes	no	Yes
Switzerland	no	yes	No

*) GSHP = ground-source heat pumps

In this situation, it is clear that some harmonization is needed. The EU could and should take the lead here. At the same time, simplifications of application and licensing procedures should be implemented. An example for harmonization within the EU is given by the Mining Waste Directive now under preparation (Hámor, 2002). Environmental considerations are key elements in legislation relevant for geothermal energy. Herein not only the geothermal

resources need to be clearly defined (see e.g. Reed and Bloomquist, 1995 in this respect) but the sustainable use of the resources and protection of the environment need to be addressed. Examples for sustainable resource management and legislation for environmental protection are given for New Zealand by Luketina (2000), and for Mexico by Ortega-Rubio et al. (1995), respectively.

Equally important for increased development of geothermal energy utilization, not only for power generation but also for direct use, are appropriate governmental policies. For renewable energies, the EU has issued the *Directive 2001/CE du Parlament Européen et du Conseil du 27 september 2001 relative à la promotion d l'électricité produite à partir de sources d'énergie renouvables*. Also herein, the reexamination of administrative procedures with the aim of simplification is foreseen. The Directive also lists geothermal energy as a renewable source. Agencies like the International Energy Agency (IEA) could and should become instrumental in leading governments to supportive legislations. Unfortunately, not much happened since the promises of the IEA Policy Office set out by Skinner (1995).

In summary, clear and supportive energy and environmental legislations as well as governmental policies are vital for the future development of geothermal energy. The findings presented above show that at present only a fraction of what is needed is available and still a lot remains to be done. Such tasks are usually completed by legal specialists like lawyers. It cannot only be hoped, but must be ascertained that they will rely on knowledgeable geothermal specialists like reservoir engineers in their work.

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