

EUROPEAN UNION  
EUROPEAN REGIONAL  
DEVELOPMENT FUND

This project is implemented through the CENTRAL EUROPE Programme co-financed by the ERDF.

<http://transenergy-eu.geologie.ac.at>

## Overview of EU, national and regional legislation

<b>Title</b>	Overview of EU, national and regional legislation
<b>Creator</b>	Andrej Lapanje and Joerg Prestor in cooperation with GeoZS, ŠGÚDŠ, GBA, MÁFI
<b>Date</b>	31-DECEMBER -2011
<b>Status</b>	final
<b>Type</b>	Text
<b>Description</b>	This document contains overview on legislation of geothermal utilisation, protection, re-injection issues and groundwater management, comparison and problem identification connected to legal implementation of geothermal energy use and transboundary aquifers as well as the description of exploration and utilization permits procedures.
<b>Format</b>	PDF
<b>Language</b>	En
<b>Projec</b>	<b>TRANSENERGY</b> Transboundary Geothermal Energy Resources of Slovenia, Austria, Hungary and Slovakia

**Work package** WP3 Utilization aspects

WP 3.3 Legal aspect of transboundary aquifer management  
3.3.1. Overview of EU, national and regional legislation





EUROPEAN UNION  
EUROPEAN REGIONAL  
DEVELOPMENT FUND

This project is implemented through the CENTRAL EUROPE Programme co-financed by the ERDF.

<http://transenergy-eu.geologie.ac.at>

1	Introduction .....	1
2	Overview EU legislation regarding the development and use of geothermal resources ....	2
2.1	Energy legislation .....	2
2.2	Natural resources legislation.....	9
2.3	Sustainable development legislation.....	12
3	Overview of international and transnational initiatives, declarations and conventions relevant for the development and use of geothermal resources .....	14
3.1	Energy related .....	14
3.2	Water resources related.....	20
4	Overview of bilateral agreements between the participating countries.....	23
4.1	Bilateral agreement between Slovenia and Hungary on the Water Management .....	23
4.2	Bilateral agreements between Slovenia and Austria on the Water Management .....	23
4.3	Bilateral agreement between Austria and Hungary on the Water Management .....	25
4.4	Bilateral agreement between Hungary and Slovakia on the Water Management .....	26
4.5	Bilateral agreement between Slovakia and Austria on the Water Management .....	26
5	Legislation overview Slovenia .....	28
5.1	Overview of Slovene national regulation for geothermal project.....	33
6	Legislation overview Austria.....	43
6.1	Overview of Austrian national regulation for geothermal project.....	49
7	Legislation overview Hungary .....	58
8	Legislation overview Slovakia .....	90
8.1	Overview of Slovakian national regulation for geothermal project .....	99
9	Literature .....	111

# 1 Introduction

In the first period of the TRANSENERGY project partners prepared and filled in the questionnaire for authorities involved in management of geothermal energy (*WP 3.1.1 Questionnaire for authorities involved in management of geothermal energy*). The aim of the questionnaire was to gain an insight how the geothermal energy regulation and legislation in four partner countries (Austria, Hungary, Slovakia and Slovenia) follows the “Geothermal regulation framework” from the authorities’ point of view. Questionnaire was prepared using the draft Amended Version GEOTHERMAL REGULATION FRAMEWORK - Deliverable D 15 GTR-H (September 2009) of the Project *GeoThermal Regulation - Heat (GTR-H)* (<http://www.gtrh.eu/>). We interviewed altogether 40 different authorities.

The analysis of the gathered data had a goal to allow the comparison of differences between countries and to identify the main gaps to approximate the proposed “Geothermal regulation framework”.

Each Geological Survey held the inquiry in its own state by gathering the answers from different responsible institutions and prepared the summary answers in one questionnaire form. Thus in the results we compared only four harmonized national questionnaires instead of 40 responses.

**In the second period activities of the WP 3.3.1 Overview of EU, national and regional legislation began. The aim of the WP 3.3.1 is to present the legislation of geothermal utilization, protection, re-injection issues and groundwater management in each partner country and relations to regional and EU legislation.**

This will finally enable us to identify the problems connected to legal implementation of geothermal energy use and transboundary aquifers as well as give us an idea how to approach further management of transboundary aquifers dealing with overexploitation, best monitoring practice recognition and elaboration of general outline for monitoring system in WP 3.3.2. Methodology for joint groundwater management.

## **2 Overview EU legislation regarding the development and use of geothermal resources**

Geothermal resources management consists of energy production management and environmental resources management. In the following information on European policies related to geothermal energy (the most important EU directives, definition and concepts) that build the skeleton of geothermal resources management are summarized. There are two directives which govern the management of the geothermal resources, the Promotion of the use of energy from renewable sources (2009/28/EC) and the Water Framework Directive (2000/60/EC).

In the year 1997 the EC prepared a Communication from the Commission: ENERGY FOR THE FUTURE: RENEWABLE SOURCES OF ENERGY White Paper for a Community Strategy and Action Plan COM(97)599 final (26/11/1997) [http://ec.europa.eu/energy/library/599fi\\_en.pdf](http://ec.europa.eu/energy/library/599fi_en.pdf). In the white paper the commission set the goals and targets for RES utilization in 2010. In the same paper the EC proposed also measures needed to facilitate the growth of RES industry and suggested the reinforcing of the Community Policies.

The statistics of geothermal sector are monitored by Eurostat and the statistics of the professional associations like is EGEC ([www.egec.org](http://www.egec.org)) or EREC ([www.erec.org](http://www.erec.org)) as well as by the regular geothermal up-date every 5 years by IGA World Geothermal Congress ([www.geothermal-energy.org](http://www.geothermal-energy.org)).

Even so the European Geothermal Energy Council (EGEC) is not an official EU body, it has a tremendous impact and influence on the development of geothermal energy utilisation in EU-27. It is a “voice” of the geothermal sector and such that it promotes the use of geothermal energy, sets the targets, suggests measures to reach them and comments goals and plans set by EC and EU state members.

### ***2.1 Energy legislation***

#### ***2.1.1 Promotion of the use of energy from renewable sources***

EU Directive on Promotion of Renewable Energy Sources (*Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC*)

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0016:0062:en:PDF>

This Directive establishes a common framework for the promotion of energy from renewable sources. It sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport. The overall EU target is to double the share of renewables to 12 % by year 2010 in the gross energy consumption and in particular to achieve a 22.1% indicative share of electricity produced from renewable energy sources.

It also lays down rules relating to statistical transfers between Member States, joint projects between Member States and with third countries, guarantees of origin, administrative procedures, information and training, and access to the electricity grid for energy from renewable sources. It establishes sustainability criteria for biofuels and bioliquids. In this directive the methodology for the accounting of renewable part of the energy from heat pumps is also given (ANNEX VII).

The Directive prescribes the adoption of the national renewable energy action plan (NREAP) for each Member State. These plans are prepared in accordance with the template published by the Commission; provide detailed roadmaps of how each Member State expects to reach its legally binding 2020 target for the share of renewable energy in their final energy consumption. All NREAPs are available at:

[http://ec.europa.eu/energy/renewables/transparency\\_platform/action\\_plan\\_en.htm](http://ec.europa.eu/energy/renewables/transparency_platform/action_plan_en.htm).

The geothermal objectives of NREAPs from partners states submitted to the Commission are evaluated in the report Methodology for joint groundwater management.

### *2.1.2 A Roadmap for moving to a competitive low carbon economy in 2050*

The European Commission prepared a document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS A Roadmap for moving to a competitive low carbon economy in 2050 (COM/2011/0112) which is available at:

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011DC0112:EN:NOT>.

In the roadmap cost-effective ways of reducing greenhouse gas emissions by 2050 have been analysed. Central role in the low carbon economy will be given to electricity and that will require significant use of renewable energy sources, including geothermal energy.

EGEC's response to the EC Public consultation exercise on the Roadmap for moving to a competitive low carbon economy in 2050 is summarized in two documents (EGEC, 2010):

<http://egec.info/wp-content/uploads/2011/02/EGECs-answer-to-EC-consultation-on-roadmap-2050.pdf>

[http://ec.europa.eu/clima/consultations/0005/registered/11458103335-07\\_european\\_geothermal\\_energy\\_council\\_en.pdf](http://ec.europa.eu/clima/consultations/0005/registered/11458103335-07_european_geothermal_energy_council_en.pdf)

In those two documents EGEC demonstrates the current position of geothermal energy utilisation for heating and cooling as well as electricity production sector, and proposes measures to meet the goals of greenhouse gas reductions written in the COM/2011/0112.

### 2.1.3 Energy Roadmap 2050

The European Commission prepared a document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Energy Roadmap 2050 (COM/2011/885/2) which is available at:

[http://ec.europa.eu/energy/energy2020/roadmap/doc/com\\_2011\\_8852\\_en.pdf](http://ec.europa.eu/energy/energy2020/roadmap/doc/com_2011_8852_en.pdf)

In the roadmap several decarbonisation scenarios by 2050 have been analysed. Electricity has to play much larger role than today. The share of renewable energy (RES) rises substantially in all scenarios, achieving at least 55% in gross final energy consumption in 2050. The energy roadmap is not focused on geothermal energy particularly; the geothermal energy (including GHT) is mentioned only as a part of Renewable heating and cooling.

EGEC's reaction to the European Commission's "Energy Roadmap 2050" is summarized in this document (EGEC, 2011):

<http://egec.info/wp-content/uploads/2012/01/EGEC-reaction-to-EC-roadmap-15-Dec-2011.pdf>

In the document EGEC highlight the fact that the geothermal electricity technologies are deeply underestimate in the report and that the Roadmap does not even mention EGS among those technologies needing further investments and development to bring down costs. EGEC also noticed that the potential of utilisation of geothermal heat for heating and cooling sector is underestimated too.

### 2.1.4 Energy statistics

The Eurostat indicators regarding geothermal energy are necessary because of requirements of the *Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market* and *Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market* that call for Member States to report quantitative energy data. In order

to monitor progress towards the achievement of the objectives set in those Directives, detailed, up-to-date energy data are required.

*Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings, Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products* also require Member States to report quantitative energy consumption data. To monitor progress towards the achievement of the objectives set in those Directives, detailed, up-to-date energy data, as well as a better interface between these energy data and related statistical surveys such as the population and housing censuses and transportation data, are needed.

On the basis of those Directives the Regulation (EC) No 1099/2008 of the European Parliament and of the Council of 22 October 2008 on energy statistics was prepared:

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:304:0001:0062:EN:PDF>.

This Regulation establishes a common framework for the production, transmission, evaluation and dissemination of comparable energy statistics in the Community. **Member States have to transmit to the Commission (Eurostat) the annual national geothermal statistics.** It is worth to mention that the statistical indicators which covering the geothermal energy utilization set by Eurostat are rather insufficient and they do not cover all the geothermal energy.

There are many *definition of geothermal energy*. EGEC (European Geothermal Energy Council) suggests the definition of geothermal heat as the heat that is stored under the solid ground of the earth. EGEC view on statistics in regards to the Directive on Promotion of Renewable Energy Sources, geothermal energy exists and shall be counted in the following forms:

- Electric power generated from geothermal sources,
- Heat ((1) swimming, bathing and balneology, (2) space heating including district heating, (3) agriculture applications, (4) aquaculture applications and (5) industrial processes) produced directly from geothermal sources,
- Heat (mainly shallow geothermal) used as input to geothermal heat pumps,
- Cooling (mainly in geothermal heat pump plants).

## Renewables and Waste Classification into Three Groups

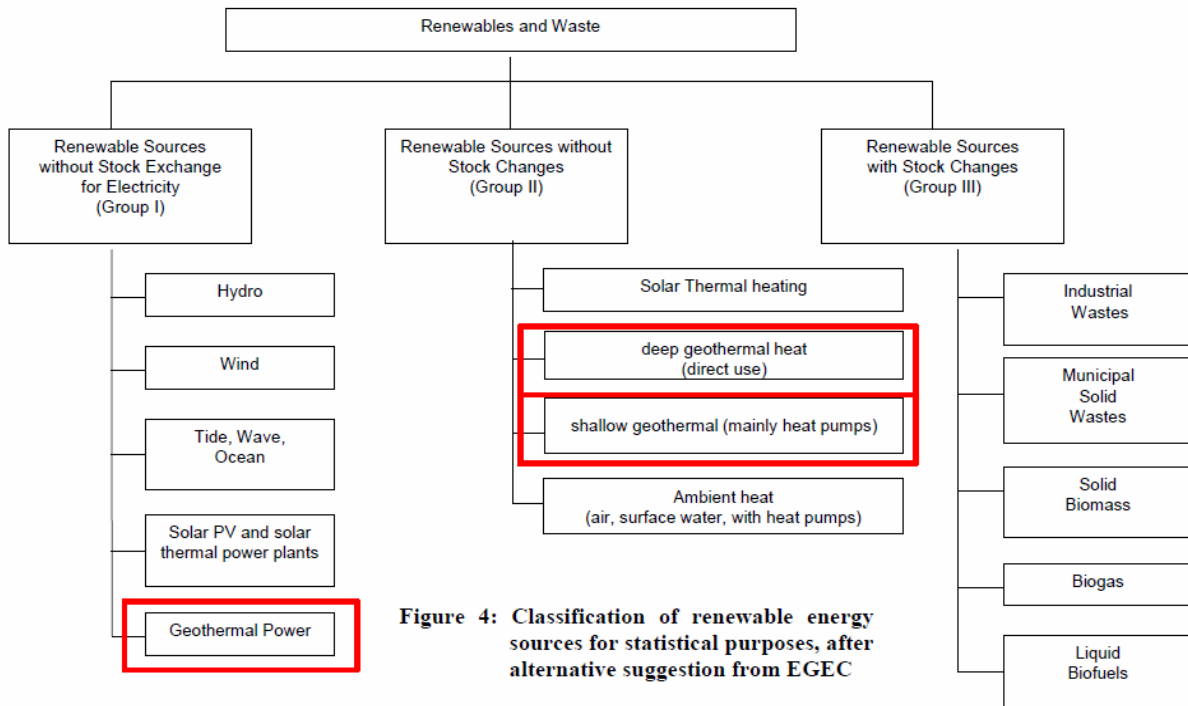


Figure 1. Classification of RES for statistical purposes, after alternative suggestion from EGEC (Antics & Sanner, 2007)

**The Eurostat** definition is more restrictive. The geothermal energy is the energy available as heat emitted from within the earth's crust, usually in the form of hot water or steam. It is exploited at suitable sites for electricity generation using dry steam or high enthalpy brine after flashing, as well as for its direct use as heat for district heating, agriculture, etc. Geothermal heat is used where it is available either 'as extracted' or upgraded by burning fuels to 'add' heat to the geothermal flow.

Geothermal heat following the **THERRA** definition ([www.therra.info](http://www.therra.info)) is usually divided into two types: geothermal and ambient heat, according to the different ways of utilisation. Geothermal heat is used directly, while for the use of ambient heat it is necessary to use heat pumps. Shallow geothermal installations using heat pumps are covered by the method for ambient heat (distinction with the EGEC proposed classification on figure 1).

In THERRA methodology used definitions are:

'Renewable energy' is energy that is derived from natural processes that are replenished constantly. Sources: solar, wind, geothermal, ambient, hydropower and ocean resources, solid biomass, biogas, liquid biofuels and renewable waste.

'Renewable heat' is the energy content of a renewable source that is converted into heat. The renewable INPUT has to be distinguished from the renewable OUTPUT of the source. The renewable heat production can be calculated as primary heat input and as useful heat output.

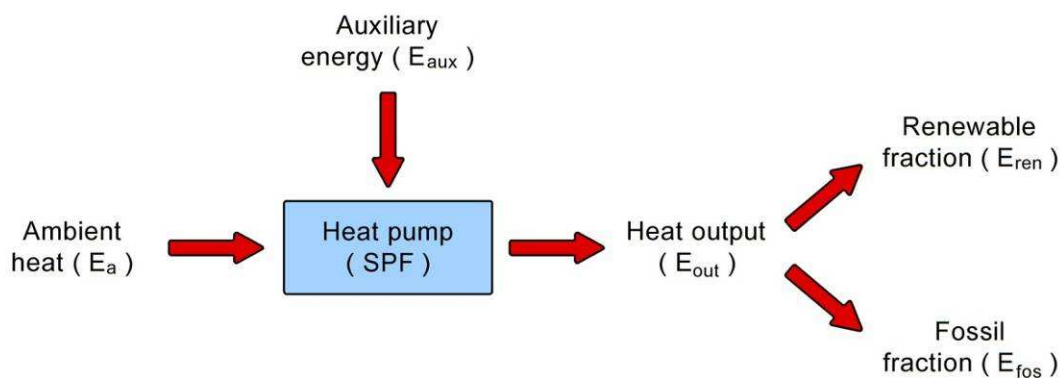


The heat converted from geothermal or ambient heat sources with a heat pump can be included in this methodology.

The methodology can be made to fit the Eurostat and IEA methodology and can help to assess if the European countries reach the EU-goal of 20% renewable energy in the year 2020.



## Proposed calculation method for heat pumps



### Input method (Eurostat):

Ambient heat (or shallow geothermal) is renewable energy

### Output method:

$E_{ren}$  is the renewable heat output (includes correction for electricity)

Figure 2. Proposed calculation method for heat pumps.

### 2.1.5 Eurostat - indicators

Electricity generated from renewable sources (% of gross electricity consumption) <http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsien050>]

This indicator is the ratio between the electricity produced from renewable energy sources and the gross national electricity consumption for a given calendar year. It measures the contribution of electricity produced from renewable energy sources to the national electricity consumption. Electricity produced from renewable energy sources comprises the electricity generation from hydro plants (excluding pumping), wind, solar, geothermal and electricity from biomass/wastes. Gross national electricity consumption comprises the total gross national electricity generation from all fuels (including autoproduction), plus electricity imports, minus exports.

Primary production of renewable energy - (1 000 toe)

<http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&plugin=0&language=en&pcode=ten00081>]

Primary production of biomass, hydropower, geothermal energy, wind and solar energy are included in renewable energies.

Renewable energy primary production: biomass, hydro, geothermal, wind and solar energy - (1 000 toe)

<http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=ten00082>]

Primary production: biomass (heat content of the produced biofuels or biogas; heat produced after combustion during incineration of renewable wastes); hydropower covers potential and kinetic energy of water converted into electricity in hydroelectric plants (the electricity generated in pumped storage plants is not included); geothermal energy comprises energy available as heat emitted from within the earth's crust, usually in the form of hot water or steam; wind energy covers the kinetic energy of wind converted into electricity in wind turbines; solar energy covers the solar radiation exploited for solar heat (hot water) and electricity production

Share of renewable energy in gross final energy consumption (%)

<http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsdcc110>]

This indicator is calculated on the basis of energy statistics covered by the Energy Statistics Regulation. It may be considered an estimate of the indicator described in *Directive 2009/28/EC*, as the statistical system for some renewable energy technologies is not yet fully developed to meet the requirements of this Directive. However, the contribution of these technologies is rather marginal for the time being.

More information about the renewable energy shares calculation methodology and Eurostat's annual energy statistics can be found in the *Renewable Energy Directive 2009/28/EC*, the Energy Statistics Regulation 1099/2008 and in Renewable energy transparency platform of European Commission

[http://ec.europa.eu/energy/renewables/transparency\\_platform/transparency\\_platform\\_en.htm](http://ec.europa.eu/energy/renewables/transparency_platform/transparency_platform_en.htm).

## **2.2 Natural resources legislation**

### *2.2.1 Protection of groundwater against pollution caused by certain dangerous substances*

*Council Directive 80/68/EEC of 17 December 1979 on the protection of groundwater against pollution caused by certain dangerous substances.*

The purpose of this Directive is to prevent the pollution of groundwater by substances belonging to the families and groups of substances in lists I or II in the Annex, and as far as possible to check or eliminate the consequences of pollution which has already occurred. This is mostly relevant in connection with re-injection of thermal groundwater after energetic utilization.

In this directive the re-injection of water in the aquifer is also mentioned (Articles 4, 6, 10, 17). Member States may, after prior investigation, authorize discharges due to re-injection into the same aquifer of water used for geothermal purposes.

Artificial recharges for the purpose of groundwater management shall be subject to a special authorization issued by the Member States on a case-by-case basis. Such authorization shall be granted only if there is no risk of polluting the groundwater.

With regard to discharges into transfrontier groundwater, the competent authority of the Member State which intends to grant authorization for such discharges shall inform the other Member States concerned before an authorization is issued. At the request of one of the Member States concerned and before an authorization is issued, consultations shall be held in which the Commission may participate.

### *2.2.2 Framework for Community action in the field of water policy*

*Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (Water Framework Directive)*

The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which:

- (a) prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;
- (b) promotes sustainable water use based on a long-term protection of available water resources;

(c) aims at enhanced protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of the priority hazardous substances;

(d) ensures the progressive reduction of pollution of groundwater and prevents its further pollution, and

(e) contributes to mitigating the effects of floods and droughts

and thereby contributes to:

- the provision of the sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use,
- a significant reduction in pollution of groundwater,
- the protection of territorial and marine waters, and
- achieving the objectives of relevant international agreements, including those which aim to prevent and eliminate pollution of the marine environment, by Community action under Article 16(3) to cease or phase out discharges, emissions and losses of priority hazardous substances, with the ultimate aim of achieving concentrations in the marine environment near background values for naturally occurring substances and close to zero for man-made synthetic substances.

The *Water Framework Directive (2000/60/EC)* is the most important legislation of (thermal) water management and management of transboundary aquifers. Article 8 of WFD gives provisions on the establishment of monitoring programmes of groundwaters. Monitoring of groundwaters related to the WDF concerns the entire groundwater body, but it also supports the integrated management of the catchment area and reaching its environmental targets. However it does not deal with those local processes and contaminations whose temporal and spatial formation does not influence status of the whole groundwater body, and does not threaten the fulfilment of its environmental targets. Article 11 of WDF states that Member States may authorize reinjection into the same aquifer of water used for geothermal purposes.

### *2.2.3 Protection of groundwater against pollution and deterioration*

*Directive 2006/118/EC of the European parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration (Groundwater Directive)*

This Directive establishes specific measures as provided for in Article 17(1) and (2) of *Directive 2000/60/EC* in order to prevent and control groundwater pollution. These measures include in particular:

(a) criteria for the assessment of good groundwater chemical status; and

(b) criteria for the identification and reversal of significant and sustained upward trends and for the definition of starting points for trend reversals.

This Directive also complements the provisions preventing or limiting inputs of pollutants into groundwater already contained in *Directive 2000/60/EC*, and aims to prevent the deterioration of the status of all bodies of groundwater.

#### *2.2.4 Environmental impact assessment and strategic environmental assessment directives*

Environmental assessment is a procedure that ensures that the environmental implications of decisions are taken into account before the decisions are made. Environmental assessment can be undertaken for individual projects, such as deep geothermal drillings, on the basis of *Directive 85/337/EEC*, as amended (known as 'Environmental Impact Assessment' – EIA Directive) or for public plans or programmes on the basis of *Directive 2001/42/EC* (known as 'Strategic Environmental Assessment' – SEA Directive). The common principle of both Directives is to ensure that plans, programmes and projects likely to have significant effects on the environment are made subject to an environmental assessment, prior to their approval or authorization. Consultation with the public is a key feature of environmental assessment procedures.

The Directives on Environmental Assessment aim to provide a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation of projects, plans and programmes with a view to reduce their environmental impact. They ensure public participation in decision-making and thereby strengthen the quality of decisions. The projects and programmes co-financed by the EU (Cohesion, Agricultural and Fisheries Policies) have to comply with the EIA and SEA Directives to receive approval for financial assistance. Hence the Directives on Environmental Assessment are crucial tools for sustainable development. All info about EIA and SEA Directives are available at <http://ec.europa.eu/environment/eia/home.htm>.

#### *2.2.5 Environmental liability with regard to the prevention and remedying of environmental damage*

*Directive 2004/35/EC of the European parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage*

The purpose of this Directive is to establish a framework of environmental liability based on the 'polluter-pays' principle, to prevent and remedy environmental damages.

### 2.2.6 Eurostat – indicators

#### Groundwater abstraction, volume - Millions m<sup>3</sup>

<http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=ten00004>]

Abstraction of fresh water from underground deposits. These can be permanent or temporary, both artificially charged or naturally. Groundwater includes springs, both concentrated and diffused, which may also be subaqueous.

#### Surface and groundwater abstraction as a share of available resources - % of available surface and groundwater resources

<http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsdnr310>]

This indicator looks at total water abstraction as a percentage of available resources, separated into groundwater and surface water. Annual total gross abstraction from groundwater is presented as a percentage of Member States' renewable groundwater resources available for abstraction, which are defined as long-term annual average groundwater available for abstraction. Annual total gross abstraction made from fresh surface water is presented as a percentage of Member States' renewable surface water resources available for abstraction, which are calculated as total long-term fresh water resources (external inflow plus precipitation less evapotranspiration) less groundwater available for abstraction.

## 2.3 Sustainable development legislation

In the year 2001 the European Commission prepared the Communication **A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development** (Commission's proposal to the Gothenburg European Council) COM(2001)264 known as Gothenburg strategy or EU Sustainable Development Strategy (SDS).

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2001:0264:FIN:EN:PDF>

In the Gothenburg strategy the EU commits to apply certain measures which should limit climate change and increase the use of clean energy, which is to give more support to the research, development and dissemination of technology on clean and renewable energy resources, to facilitate the reduction of energy demand of buildings and appliances, to increase energy efficiency. One other objective of the Gothenburg strategy is to manage natural resources more responsibly, that means that the links between economic growth and misuse of the natural resources should be ceased.

The European Council of June 2006 adopted an ambitious and comprehensive renewed Sustainable Development Strategy for an enlarged EU:

<http://register.consilium.europa.eu/pdf/en/06/st10/st10917.en06.pdf>

It builds on the Gothenburg strategy of 2001 and is the result of an extensive review process that started in 2004. The goals of the SDS 2006 are more ambitious than those in the 2001 version, as well as the set of measures are more demanding. The geothermal energy is partly covered in two objectives: *Climate change and clean energy* and *Conservation and management of natural resources*. Particularly important action foreseen in the strategy was preparation of an analysis of how to achieve the existing targets (2010) for renewables and how to promote further renewable energies in a cost-efficient manner over the long term. The Conservation and management of natural resources include among others the operational objectives and targets to improve resource efficiency using renewable natural resources at a rate that does not exceed their regeneration capacity, to gain and maintain a competitive advantage by improving resource efficiency through the promotion of eco-efficient innovations, and to improve management and avoid overexploitation of renewable natural resources such as fisheries, biodiversity, water, air, soil and atmosphere.

In the 2009 the Communication from the Commission to the European Parliament, the Council, the European economic and social committee and the Committee of the Regions were integrating sustainable development into EU policies: A Review of the European Union Strategy for Sustainable Development was prepared (COM(2009) 400). In this Communication the fulfilment of the 2010 goals as well as progress in the recent years are given:

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0400:FIN:EN:PDF>

The European Strategy for Sustainable Development has its own portal which is regularly updated and where all relevant information could be found.

<http://ec.europa.eu/environment/eussd/>

### **3 Overview of international and transnational initiatives, declarations and conventions relevant for the development and use of geothermal resources**

In this chapter we summarize the most important international initiatives, declarations and conventions which have the common goal to promote the (energy related) utilization of geothermal resources (hydrothermal) in a sustainable way.

#### ***3.1 Energy related***

##### *3.1.1 Ferrara declaration (EGEC initiative)*

On April 29-30, 1999, the European Geothermal Energy Council (EGEC) invited the geothermal business community from all European countries to a seminar in Ferrara, Italy, a city with a thriving geothermal heating system embedded in rich cultural heritage. The goal of the meeting was to discuss the current situation of geothermal energy in R&D, implementation and market deployment, to hear about examples of successful applications, to define the future market possibilities, and to set targets for a geothermal energy in the future. The outcoming conclusions from the meeting are known as the **Ferrara declaration** (EGEC, 1999).

##### *3.1.2 Kistelek declaration (TAIEX initiative)*

The Hungarian Thermal-Energy Society hosted a EC TAIEX conference (Regulatory and Economic Tools Governing the Enhanced Exploitation of Geothermal Energy in the European Union) organized by the Hungarian Geological Survey in April 2005 in Kistelek. Its outcome report is known as “The Kistelek declaration”.

50 experts from 14 Member States and Candidate Countries attended the workshop, representing the European Parliament, the European Commission, and a wide spectrum of government agencies, industrial enterprises, research institutes and professional associations, e.g. European Geothermal Energy Council and EuroGeoSurveys. The presentations addressed

- an analytical evaluation of relevant Community legislation and R&D programmes;
- national figures on exploitation of geothermal energy and national development programmes;
- national inventory and assessment methodologies of geothermal energy;
- relevant regulatory authority and legislation framework, including the property rights over geothermal energy, environmental protection, water management and energy provisions;



- economic instruments, including specific fiscal burdens, waivers and financial support tools.

The main conclusions and recommendations were the following:

Geothermal energy is a specific natural resource because:

- it is on the border-zone of managing mineral commodities, groundwater reserves and other energy sources by being bound to geological formations and to thermal waters;
- it is a fossil heat of radioactive decay and other geological processes therefore it is a conditionally renewable flow-type resource;
- the property rights over geothermal energy are owned by the State but in some countries landowners can exploit shallow subsurface resources for their own use;
- the utilisation of geothermal energy is still at its infancy stage on the European scale.

The relevant national legislation is spread throughout the mining, energy, environmental, water management and geological acts, sometimes in a contradicting way, and the licensing authority framework for geothermal facilities is rather complex in most countries.

***⇒ A Community level communication shall foster Member States to adopt a coherent legislation system and to designate a rational framework of competent authorities in order to ease application for geothermal energy use.***

The definition of geothermal energy is lacking in the *acquis communautaire* and the national practice is diverse - some authorities consider it as a type of energy carried by thermal waters exclusively -, which hampers the distribution of most up-to-date technologies using shallow depth reserves via heat-pumps or deeper closed-circuit heat-exchanger fluids.

***⇒ A broad sense legal definition of geothermal energy is needed in a relevant piece of Community legislation, e.g. the heating-cooling legislation in preparation.***

As in the case of other state-owned territorial commodities, low-resolution, static inventories of geothermal resources are available or being prepared by water research institutes or geological services, that are not capable of meeting the requirements of neither the investing enterprises nor the licensing environment protection and water management authorities. In some countries nor even the data access for the competent agency hosting the geoinformation and/or the inventory is enforced by the law.

***⇒ The development of national dynamic inventories of geothermal energy resources and reserves designed as to being capable of registering annual changes and allowing country-scale modelling is highly recommended. To make such inventories comparable on pan-European level a common basic methodology shall be elaborated, preferably via the assistance of Community level professional associations, e.g. EuroGeoSurveys.***

The environmental impacts of geothermal installations are limited; it is a green energy source. In terms of environmental sustainability, the maintenance of stable, close-to-original temperature and pressure status of an exploited groundwater reservoir is of prime importance as well as the protection against pollution of surface waters by untreated outflow of saline or used thermal waters. However, the national emission limit values, and re-injection provisions show certain diversity.

***⇒ The new Groundwater Directive and its implementing measures shall provide more detailed prescriptions on surface discharge and re-injection criteria of used geothermal waters. This environmental action, together with the need for harmonised inventories, technology development and raising the public awareness shall optimally be accompanied by a more definite availability of EU funds for the above objectives.***

There is a wide variety of economic instruments in the studied countries which either support or inhibit the enhanced use of geothermal energy in Europe. There are countries where the financial burden of fiscal nature (i.e. mining royalty, sewage penalty, groundwater use fee, environmental tax) are multiple, which breaches general taxation law. The arsenal of supporting instruments is colourful too, including tax exemptions, guaranteed take-over prices, green certificates, direct subsidies, to mention a few. The German example shows clearly how many these supportive tools can contribute to the high growth rate of renewables in a country with moderate natural setting. Moreover, there is a relatively low rate of return of the investment in geothermal energy and the economic risk is higher as compared to other energy sources. This economics does not ensure the security of interested stakeholders and lead to a serious distortion of equal and open competition on the European level. It is foreseen that Community institutions and Member States will face a growing number of related legal disputes at the European Court of Justice in near future.

***⇒ There is an immediate need to highlight the economic discrepancies on the Community level and to urge Member States harmonising financial solutions in reaching their indicative targets, and in improving the energy mix for being less dependent on outside sources.***

***As a general conclusion and recommendation, all participating experts agreed upon that under the realm of the IPPC Directive a best available technology reference document on geothermal energy describing the state-of-art of geothermal energy exploitation, the up-to-date technologies and their environmental aspects, and the economic instruments could serve as strong, quasi-legal document which all stakeholders can refer to in their future activities in direction of the enhanced, sustainable use of geothermal energy.***

### *3.1.3 Brussels declaration and EGEC Research Agenda for Geothermal Energy (Strategy 2008 to 2030)*

In 2009 EGEC published the **Brussels declaration** (EGEC, 2009) in which current goals are set to implement the Geothermal Research Agenda. In this agenda the research priorities for all geothermal technologies until 2030 in order to decrease costs are fixed. The geothermal targets for Europe are set and proposal is made how to achieve them. The geothermal legislation has to be improved to remove legal barriers that hamper the development of geothermal energy in Europe.

The future development should be focused in the concept of Enhanced Geothermal Systems which will tremendously increase potential, into innovative power plants permitting the production of electricity using low thermal water temperatures of the order of 100 °C, in installation of larger plants using clusters of wells and into Hybrid systems for heating & cooling but also for electricity (beneficiating from the geothermal base load ability) with biomass, solar, etc.

To reduce the drilling costs for geothermal wells which are correlated with the oil sector, new drilling rigs are needed. Also adaptation of infrastructure for the future (advanced engineering materials and electricity networks) is needed.

The specific science and engineering geothermal education has to be provided for people who are working in the geothermal industry. The technical staff has to be trained and certify. It is necessary to focus the development in the EGS systems which will increase potential tremendously, into decreasing of the needed temperature for electric power generation into installation of larger plant using clusters of wells.

In the declaration the long term goal is set that until 2030 the geothermal sector can contribute 5% of total electricity production in Europe as well as 3.5% of total heat generation.

<http://egec.info/wp-content/uploads/2011/02/EGEC-Brussels-Declaration-2009.pdf>

### *3.1.4 Re-thinking 2050 (EREC initiative)*

Europe's demand for energy is increasing in an environment of high and unstable energy prices. Greenhouse gas emissions are rising and the energy sector is one of the main emitters of greenhouse gases. Natural reserves of fossil fuels such as oil and gas are concentrated in just a few supplier countries around the world. Climate change along with an increasing dependency on energy imports are only a few of the risks the European economy is facing today. The EU now needs the courage to lead the way out of this climate and energy dilemma with a clear commitment to a 100% renewable energy future by 2050.

EREC document *RE-thinking 2050* (Zervos et al., 2010) presents a pathway towards a 100% renewable energy system for the EU, examining the effects on Europe's energy supply system and on CO2 emissions, while at the same time portraying the economic, environmental and social benefits of such a system. Moreover, the report also provides policy recommendations what is needed to fully exploit the EU's vast renewable energy potential.

[http://www.rethinking2050.eu/fileadmin/documents/ReThinking2050\\_full\\_version\\_final.pdf](http://www.rethinking2050.eu/fileadmin/documents/ReThinking2050_full_version_final.pdf)

### 3.1.5 45% by 2030 (EREC initiative)

In 2011 EREC prepared the report *45% by 2030: Towards a truly sustainable energy system in the EU* (Muth and Smith, 2011).

[http://www.erec.org/fileadmin/erec\\_docs/Documents/Publications/45pctBy2030\\_ERECReport.pdf](http://www.erec.org/fileadmin/erec_docs/Documents/Publications/45pctBy2030_ERECReport.pdf)

The report concludes that with today's policies the EU is going to fail meeting its long-term climate ambitions. The European Commission estimates that a continuation of current trends and policies would result in only a 40% reduction in greenhouse gas (GHG) emissions by 2050. EU energy policy, building upon its 2020 targets needs to be geared up to reach significant greenhouse gas emissions reductions by 2050, while increasing energy security and competitiveness for the benefit of European citizens. This initiative has not directly related to the development of geothermal energy sector, but as geothermal energy is one of RES, consequently promotes its utilisation too.

**EREC calls on the European Commission, Member States and the European Parliament to deliver on the European Union's long-term climate commitment by proposing and endorsing a legally binding EU target of at least 45% renewable energy by 2030.**

As a consequence, the effectiveness of the (Emission Trading Scheme - ETS) has been clearly undermined as a means of shifting the EU away from high-carbon fossil fuel investments. Instead, it has created vast windfall profits for heavy industry and led to cheap business-as-usual solutions. **This is well documented by the fact that in 2010 – for the first time in years – more new coal power capacity was installed than decommissioned.** This will have serious negative consequences for Europe's emissions performance, both regarding its 2020 ambition and the 80-95% GHG reduction objective endorsed by the European Parliament and the European Council. To re-establish the effectiveness of the ETS and to avoid oversupply on the carbon market and hence a low price of carbon before 2020, the EU must raise the currently established emission reduction target to 30% domestic reduction in 2020. Moving to 30% emissions reductions is the most effective way to establish the high carbon price, which is needed, alongside the binding 45% renewable energy target for 2030 and a mandatory 2020 energy savings target, in the move to a resource efficient and

renewable energy economy. EREC therefore calls on all EU Member States and the European Parliament to agree on a 30% domestic GHG reduction by 2020, putting the EU on a pathway to a maximum 2 °C temperature increase.

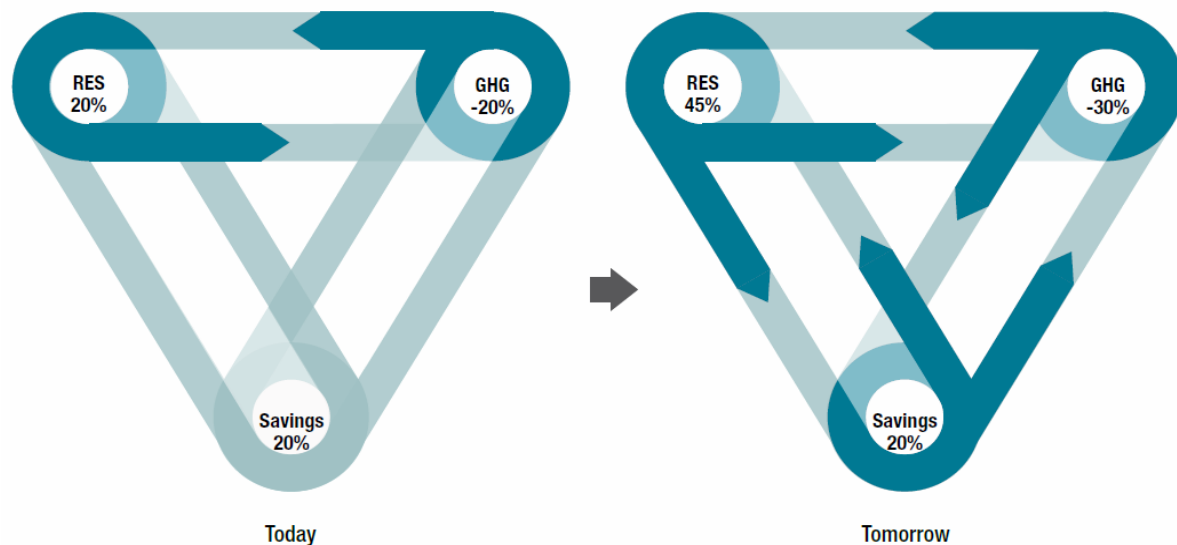


Figure 3. The Triangle for Success: RES – GHG – ES

### 3.1.6. Technology Road Map Geothermal Heat and Power (OECD/IEA)

The report “Technology Road Map Geothermal Heat and Power” was prepared in 2011 on the initiative of ministers from G8 countries, China, India and South Korea. In the technology road map OECD/IEA the overview of current state of the geothermal energy technology, exploration and utilisation is given as well as the primary actions and tasks that must be addressed to accelerate geothermal energy globally are identified. The vision for the geothermal deployment to 2050 is prepared too. Several key actions in next 10 years are foreseen:

- Establish medium-term targets for mature and nearly mature technologies and long-term targets for advanced technologies, thereby increasing investor confidence and accelerating expansion of geothermal heat and power.
- Introduce differentiated economic incentive schemes for both geothermal heat (which has received less attention to date) and geothermal power, with incentives phasing out as technologies reach full competitiveness.
- **Develop publicly available databases, protocols and tools for geothermal resource assessment and ongoing reservoir management to help spread expertise and accelerate development.**
- Introduce streamlined and time-effective procedures for issuing permits for geothermal development.
- Provide sustained and substantially higher research, development and demonstration (RD&D) resources to plan and develop at least 50 more EGS pilot plants during the next 10 years.

- Expand and disseminate the knowledge of EGS technology to enhance production, resource sustainability and the management of health, safety and environmental (HSE) performance.
- In developing countries, expand the efforts of multilateral and bilateral aid organizations to develop rapidly the most attractive available hydrothermal resources, by addressing economic and non-economic barriers.

As an example of good practice the German public information system Geotis is shown. As is marked in bold letters roadmap recommends that between 2011-2015 governments, geothermal industry, hydrocarbon industry and research institutes compile and combine existing geological databases, and expand geological datasets to develop a publicly accessible database of geothermal resources. This is clearly the goal of the TRANSENERGY project.

In the last part of report a summary of actions needed by geothermal stakeholders, presented to indicate who should take the lead in specific efforts. In most cases, a broad range of actors will need to participate in each action. The IEA, together with government, industry and NGO stakeholders, will report regularly on the progress achieved toward this roadmap's vision.

[http://www.iea.org/papers/2011/Geothermal\\_Roadmap.pdf](http://www.iea.org/papers/2011/Geothermal_Roadmap.pdf)

## **3.2 Water resources related**

### *3.2.1 Helsinki convention on the protection and use of transboundary watercourses and international lakes (UNECE initiative)*

The Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) (<http://live.unece.org/env/water/text/text.html>) was drawn up under the auspices of the United Nations Economic Commission for Europe (UNECE) and signed in Helsinki on 17 March 1992.

Water Convention is intended to strengthen national measures for the protection and ecologically sound management of transboundary surface waters and groundwaters.

The Convention obliges Parties to prevent, control and reduce transboundary impact, use transboundary waters in a reasonable and equitable way and ensure their sustainable management. Parties bordering the same transboundary waters shall cooperate by entering into specific agreements and establishing joint bodies. The Convention includes provisions on monitoring, research and development, consultations, warning and alarm systems, mutual assistance, and exchange of information, as well as access to information by the public.

The Convention entered into force in October 1996 and includes important provisions on the monitoring and assessment of transboundary waters, the assessment of the effectiveness of

measures taken to prevent, control and reduce transboundary impact, and the exchange of information on water and effluent monitoring. Other relevant aspects deal with the harmonization of rules for setting up and operating monitoring programmes, which includes measurement systems and devices, analytical techniques, data processing and evaluation techniques. In 1994, the UNECE established the Task Force on Monitoring and Assessment of Transboundary Waters, which drafted guidelines on monitoring and assessment of transboundary waters in four volumes:

Almássy, E., Buzás, Zs., 1999: Guidelines on Monitoring and Assessment of Transboundary Groundwaters Volume 1: Inventory of transboundary groundwaters. UN/ECE Task Force on Monitoring & Assessment under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992), Working Programme 1996/1999 Lelystad, Netherland.

van der Grift, B., van Dael, J.G.F., 1999: Guidelines on Monitoring and Assessment of Transboundary Groundwaters Volume 2: Problem-oriented approach and the use of indicators. UN/ECE Task Force on Monitoring & Assessment under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992), Working Programme 1996/1999 Lelystad, Netherland.

Arnold, G.E., Chiastel, R. Novak, V., Ognianik, N.S., Simonffy, Z., 1999: Guidelines on Monitoring and Assessment of Transboundary Groundwaters Volume 3: Application of models. UN/ECE Task Force on Monitoring & Assessment under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992), Working Programme 1996/1999 Lelystad, Netherland.

Uil, H., van Geer, F.C., Gehrels, J.C., Kloosterman, F.H., 1999: Guidelines on Monitoring and Assessment of Transboundary Groundwaters Volume 4: State of the art on monitoring and assessment of groundwater. UN/ECE Task Force on Monitoring & Assessment under the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki, 1992), Working Programme 1996/1999 Lelystad, Netherland.

### *3.2.2 Danube River Protection Convention and International Commission for the Protection of the Danube River (multilateral initiative)*

The Danube River Protection Convention (DRPC) forms the overall legal instrument for co-operation on transboundary water management in the Danube River Basin. The convention was signed on 29. June 1994 in Sofia, Bulgaria by eleven states from Danube river basin – Austria, Bulgaria, Croatia, Czech republic, Germany, Hungary, Moldova, Romania, Slovak republic, Slovenia and Ukraine, – and EU, and came into force in 1998. In Slovenia the ratified convention was published in Ur. l. RS, No. 47/98.

The International Commission for the Protection of the Danube River (ICPDR, [www.icpdr.org](http://www.icpdr.org)) is a transnational body, which has been established to implement the [Danube River Protection Convention](#). The work of the ICPDR is supported by a [Secretariat](#) located in Vienna, Austria.

In 2000, the ICPDR contracting parties nominated the ICPDR as the platform for the implementation of all transboundary aspects of the EU *Water Framework Directive* (WFD) in the Danube river basin district (DRBD).

The main objective of the Danube River Protection Convention (DRPC) is to ensure that surface waters and groundwater within the Danube River Basin are managed and used sustainably and equitably and safeguarding the Danube's Water resources for future generation. This includes also protection, remediation and rational utilization of the surface waters and groundwaters.

In the Danube River Basin Management Plan (DRBMP) (ICPDR, 2009) the transboundary thermal water source “**Komarnanska Vysoka Kryha / Dunántúli-khgs. északi r.**” was nominated as transboundary GW-body of basin-wide importance in the DRBD and marked as GWB-11. The thermal GWB is described in the Status assessment for groundwater: characterisation and methodology. Annex 9 of the DRBM Plan (p. 56-69).

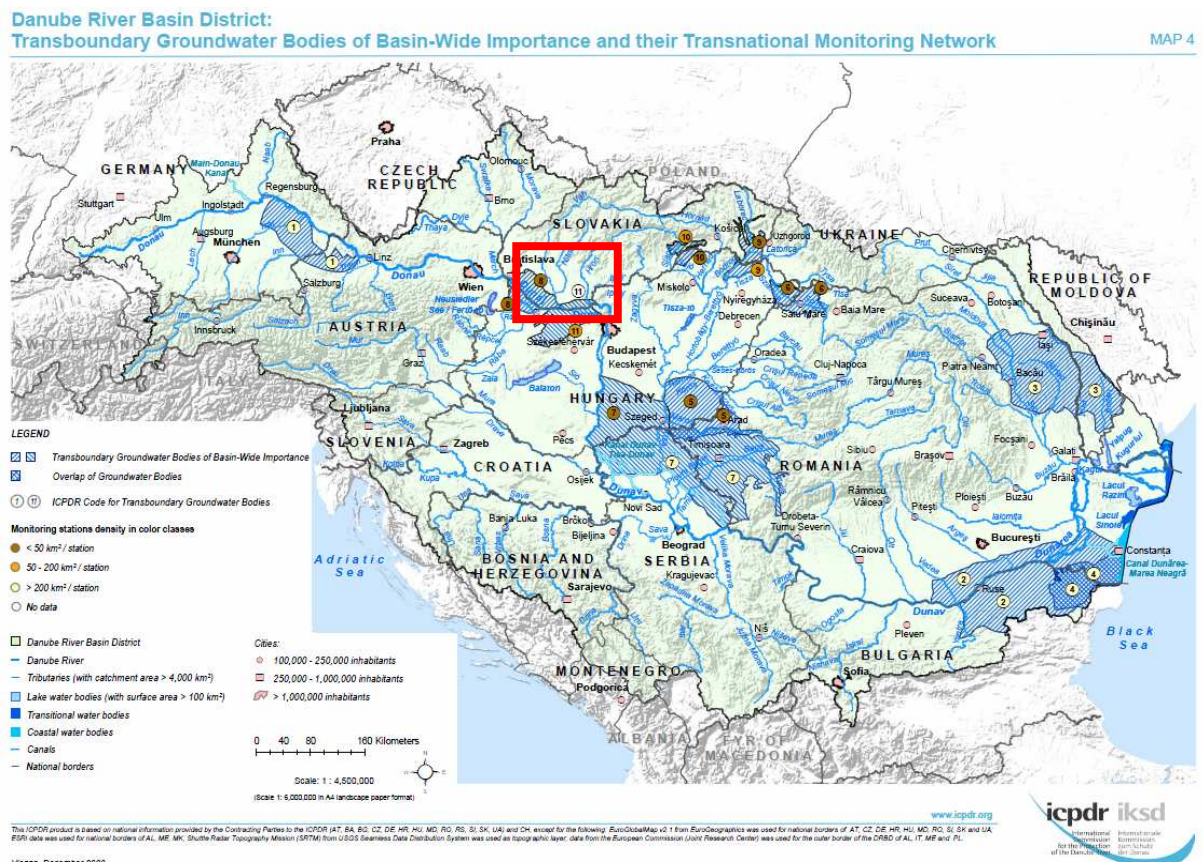


Figure 4. Position of transboundary GWB “Komarnanska Vysoka Kryha / Dunántúli-khgs. északi r.” in DRBD (ICPDR, 2009)



## **4 Overview of bilateral agreements between the participating countries**

### ***4.1 Bilateral agreement between Slovenia and Hungary on the Water Management***

The water management issues between Hungary and Slovenia are governed by the Agreement among Slovenia and Hungary on the Water Management (*Ur. l. RS, no. 2/95, ratified on 27. 5. 1995, Ur. l. RS, 10/1995; 41/2001 (III.14.) Governmental decree*) On the basis of this agreement the permanent bilateral Slovenian – Hungarian water management commission was established. Until now it held the 17<sup>th</sup> meeting with notified minutes.

Agreement provisions are related to:

- surface water and groundwater reserves,
- protection and defence against the harmful effects of water,
- the use and exploitation of water,
- protection against pollution and irrational use of water, examining the quality of waters at State borders,
- examination of the effects of interventions on the environment,
- research, design, implementation and exchange of information relating to previous points.

The thermal groundwater issues were opened in 2011 meeting. The permanent bilateral Slovenian – Hungarian water management commission is starting activities for transboundary management of thermal water body. The project T-JAM was presented to the commission ([www.t-jam.eu](http://www.t-jam.eu)).

### ***4.2 Bilateral agreements between Slovenia and Austria on the Water Management***

#### ***4.2.1 Permanent Slovenian – Austrian commission for river Drava – Drava commission***

Permanent Slovenian – Austrian commission for river Drava is established on the basis of the Agreement between the Government of the Federative People's Republic of Yugoslavia and the Federal Government of Austria on the water-management issues regarding river Drava, which was ratified by the Decree on ratification of the Agreement between the Government

of the Federative People's Republic of Yugoslavia and the Federal Government of Austria on the water- management issues regarding river Drava (Official Journal FLRJ - MP, no. 1/55).

Republic of Slovenia implements the act of ratification into its legal system by Act ratifying the Agreement between the Republic of Slovenia and the Republic of Austria on the continuation of certain Yugoslav - Austrian contracts in relations between Slovenia and the Republic of Austria and the Agreement between the Government of the Republic of Slovenia and the Austrian Federal Government on the continuation certain Yugoslav - Austrian contracts in relations between Slovenia and the Republic of Austria (Official Gazette RS - MP, no. 4/93) and in Austria BGBl. Nr. 715/1993.

Range of activities of the Commission includes in particular:

- Water Quality protection,
- Flood protection,
- Mutual information about issues regarding the economy of the Drava River;

So far there were no initiatives regarding thermal water in the work of this commission.

#### *4.2.2 Permanent Slovenian – Austrian commission for river Mura – Mura commission*

Permanent Slovenian – Austrian commission for river Mura is establish on the basis of the Agreement between the Government of the Federative People's Republic of Yugoslavia and the Federal Government of Austria on the water-management issues regarding the river Mura border flow and Mura border waters, which was ratified by the Decree on ratification of the Agreement between the Government of the Federative People's Republic of Yugoslavia and the Federal Government of Austria on the water- management issues regarding the river Mura border flow (Official Journal FLRJ - MP, no. 10/56) and in Austria BGBl. Nr. 119/1956. The agreement is entered into force on 9 February 1956.

Republic of Slovenia implements the act of ratification into its legal system by Act ratifying the Agreement between the Republic of Slovenia and the Republic of Austria on the continuation of certain Yugoslav - Austrian contracts in relations between Slovenia and the Republic of Austria and the Agreement between the Government of the Republic of Slovenia and the Austrian Federal Government on the continuation certain Yugoslav - Austrian contracts in relations between Slovenia and the Republic of Austria (Official Gazette RS - MP, no. 4/93) and in Austria BGBl. Nr. 714/1993. The commission has one regular meeting per year for discussing current topics.

Scope of work is a common treatment and water-management issues and actions at the river Mura border flow and border waters between Republic of Slovenia and the Republic of Austria because of pollution or the discharge of water from catchment areas of Mura.

Range of activities of the Commission:

- control, construction of dams,
- flood protection,
- the exploitation of water bodies
- changes in river regime
- land reclamation,
- water supply,
- water pollution.

The commission open the geothermal issue regarding the dispute between utilisation of geothermal water at Bad Radkersburg (A) and newly establishing Korovci project (SI), where borehole was drilled in the same aquifer in 2009. The aim of TRANSENERGY project is to prepare the scientific basis for the solution of the open question.

### ***4.3 Bilateral agreement between Austria and Hungary on the Water Management***

The Hungarian-Austrian bilateral agreement is the oldest agreement in Hungary concerning border Waters. The permanent Austrian - Hungarian commission for border Waters was established based on the Agreement between the Government of People's Republic of Hungary and the Government of Republic of Austria on the water-management issues regarding the border Waters (BGBl. Nr. 225/1959; "*Vertrag zwischen der Republik Österreich und der Ungarischen Volksrepublik über die Regelung von wasserwirtschaftlichen Fragen im Grenzgebiet*", Council of Hungarian People's Republic declaration 32 of 1959). The treaty was signed on April the 9<sup>th</sup> 1959 in Vienna and entered into force on July the 31<sup>th</sup> and regards issues and measures for the preservation of watercourses along the state border as well as border crossing and neighboring Waters that may have an adverse effect on the other party.

In Austria the responsible authority is the Federal Ministry of Agriculture, Forestry, Environment and Water. In Hungary the responsible authority is the Ministry for Rural Development.

Every year one regular meeting of the permanent Hungarian – Austrian commission is held for discussing current topics. The treaty between Austria and Hungary refers to water routes along the border between Austria and Hungary and waters within an area of 6 km on both sides, water projects and plants in border region.

Their range of activities is listed below:

- Practical solutions to technical and economic issues as well as for securing the hydraulic engineering collaboration
- Research, measurements and studies related to water works at border waters and mutual exchange of experiences in this area
- Surface and groundwater bodies
- Mutual exchange of information about projects which may have effects on water management on the Hungarian side
- Extraction of water for irrigation systems
- Discharge of water
- Flood barriers
- Water pollution

#### ***4.4 Bilateral agreement between Hungary and Slovakia on the Water Management***

With **Slovakia** a bilateral agreement on transboundary water management became into force by the Decision of Council of Ministers 55/1978. (XII. 10.). The agreement focuses on surface waters, but also encompasses groundwater cut by the state border. A permanent Czechoslovakian-Hungarian Water Management Committee is set up, which holds a meeting once a year. The update of the agreement is ongoing. In addition to this bilateral agreement, Governmental Decision of 2093/1999. (V. 5.) on the general cooperation between the Republics of Hungary and Slovakia on environmental and nature protection, discusses general aspects of protecting the environment and its elements (such including water), but no specific water- or groundwater relate points are included. In Hungary the responsible authority is the Ministry for Rural Development.

#### ***4.5 Bilateral agreement between Slovakia and Austria on the Water Management***

Based on the treaty between the Czechoslovak Socialist Republic (now Republic of Slovakia) and the Republic of Austria with the subject of border waters and transboundary water-management, which was signed on December the 7<sup>th</sup> 1967 in Vienna a permanent Slovakian – Austrian commission for these Waters (water route March /Morava) was founded (BGBl. Nr. 106/1970; „*Vertrag zwischen der Republik Österreich und der Tschechoslowakischen Sozialistischen Republik über die Regelung von wasserwirtschaftlichen Fragen an den Grenzgewässern*“). This agreement concerns issues and measures for the preservation of watercourses along the state border as well as border crossing and neighboring Waters that may have an adverse effect on the other party. The treaty focuses on surface waters excluding fishing and any water utilization of energy-economic importance.

The most recent update was made in 1994 (BGBl. 1046/1994) and was coming into effect on January the 1<sup>st</sup> 1993 (the number of the agreement is now BGBl. III Nr. 123/1997). The responsible authority in Austria is the Federal Ministry for Transport, Innovation and Technology.

Every year one regular meeting of the Slovakian – Austrian commission is held for discussing current topics.

Their range of activities is listed below:

- Practical solutions to technical and economic issues as well as for securing the hydraulic engineering collaboration
- Questions concerning possible individual cases of disadvantageous changes in water conditions
- Research, measurements and studies related to water works at border waters and mutual exchange of experiences in this area
- Surface water and groundwater bodies
- Mutual exchange of information of projects which have effects on water management on the Slovakian side
- Extraction of water from river March for irrigation systems
- Discharge of water
- Flood barriers
- Water pollution
- Gravel and sand extraction

## 5 Legislation overview Slovenia

### 1) Geothermal installation and utilisation classification / parameters

#### Drilling depth

Differentiation between shallow boreholes and deep boreholes is set to three classes:

- 1)  $\leq 30$  m      Shallow boreholes
- 2) 30 - 300 m
- 3)  $\geq 300$  m      Deep boreholes

#### Temperature of water

Thermal water means ground water from a well, a spring or a catchment area that complies with the prescribed criteria (Water Act). Criteria are still not defined in the regulation. In the actual practice it is accepted that thermal water is water with 20 °C and over.

Differentiation between cold and thermal water is set to two classes:

- 1)  $< 20$  °C
- 2)  $\geq 20$  °C

### 2) Research (exploration) rights

Research permit is granted by Environmental agency of Slovenia (ARSO):

- 1) could not be granted in the narrowest (1<sup>st</sup>) water protection areas of public water supply systems,
- 2) is not required for closed loops horizontal installations (GCHPh),
- 3) is always required for:
  - borehole deeper than 30 m,
  - borehole in the narrower (2<sup>nd</sup>) and wider (3<sup>rd</sup>) water protection areas of public water supply systems.

Research licence for borehole in the narrower (2<sup>nd</sup>) and wider (3<sup>rd</sup>) water protection areas of public water supply systems could be granted only conditionally if the acceptability of the expected impact of drilling works on groundwater quality and quantity is verified (Rules on criteria for the designation of a water protection zone, Official Gazette RS, No. 64/2004, 5/2006, 58/2011).

Licensing provisions in water protection areas of public water supply systems could differ depending on the individual Decree on determining the drinking water protection area for the certain water resource.

The content of the application for research permit is determined by Rules on the content of application for acquiring water permit and on the content of application for acquiring groundwater research permit (Official Gazette RS, No. [79/2007](#)).

The research permit defines which measurements and samplings are obligatory and what information has to be reported in the resulting Hydrogeological research report.

Requirements by Mining act:

- Research for mineral resources (including geothermal energy) → it must be ensured that no damage would be caused to the third party
- Boreholes deeper than 300 m (are classified as complex mining works) → requires confirmed revised mining project of a borehole.

### **3) Environmental Impact Assessment: requirements / procedure**

Decisive parameters:

- Temperature of waste thermal water discharged to surface water:  $T_{dis} > T_{srl} + 4$  °C ( $T_{srl}$  = average annual air temperature of the site)
- Total dissolved solids of waste thermal water discharged to surface water:  $TDS_{odp} \Rightarrow 1,000$  mg/l ( $TDS_{odp}$  = total dissolved solids of waste thermal water)
- Drilling for exploitation of water reserves with a capacity of pumping at least 100 l/s.
- Geothermal drilling with capacity utilization of heat at least 30 kW in the case that thermal water is not discharged into surface waters.
- Pumping station for groundwater or system for artificial recharge of groundwater if annual volume of abstracted or recharged water is equivalent or greater than 106 m<sup>3</sup> (31.7 l/s on yearly average).
- Geothermal energy source with capacity utilization of heat 30 kWt (also environmental consent is required).

Spatial planning of national importance in the area of energy infrastructure for electricity supply is ascribed to combined heat and power stations operating on RES with a rated output of 30 MWe and more → Integrated environmental impact assessment.

### **4) Environmental objectives / constraints**

Environmental objectives for groundwater in Slovenia were set in the frame of Water Framework Directive implementation and the preparation of River basin management plan. They are written in the Decree on groundwater status (Official Gazette RS, No. [25/2009](#)).

Environmental objectives are achieved if following conditions come true:

- the chemical and quantitative status of groundwater is good and the status is not deteriorating,
- any significant upward trend in concentration of any pollutant\* is reversed,
- the input of hazardous contaminants into groundwater is prevented,
- the input of other contaminants into groundwater is limited so that they could not have any actual or potential impact to groundwater.

\*Pollutant resulting from human activity and posing a threat to the quality of aquatic or terrestrial ecosystems, human health or the actual or potential uses of the water environment.

Probably the most significant issue for the good status of thermal groundwater achievement is to preserve the level of groundwater in the groundwater body such that the available groundwater resource is not exceeded by the long-term annual average rate of abstraction. The alterations to flow direction resulting from level changes may occur temporarily, or continuously in a spatially limited area, but such reversals do not cause saltwater or other intrusion, and do not indicate a sustained and clearly identified anthropogenically induced trend in flow direction likely to result in such intrusions.

Thermal waste water emissions must not provoke any significant diminution of the ecological or chemical quality of such bodies nor in any significant damage to terrestrial ecosystems which depend directly on the groundwater body.

Open loop system:

The water right is required by ARSO or government before the operation.

*Obligation of re-injection*

Abstracting only heat from the groundwater:

The reinjection of the total abstracted water is required.

The water or part of the water is used for other purposes:

The discharged waste water to the environment has to obtain environmental protection approval and/or water consent.

*Emitted water temperature:*

- Max. 30 °C - direct and indirect discharge of wastewater into waters
- Max. 40 °C - discharge of wastewater into the public sewage system



*Obligation of re-injection:*

The artificial recharge or the re-injection may only be carried out on the basis of water consent.

Returning water back into the aquifer must be planned and carried out in such a way that it will not significantly degrade the properties of the water regime and significantly disturb the natural balance of aquatic and depended terrestrial ecosystems.

*Chemical emission of thermal waste water:*

A general emission decree lays down the required thresholds of the substances in effluent.

**5) Technical requirements, recommendations and standards**

There are no existing standards for installing heat pumps in Slovenia, only a group of EN standards (mostly in English only) is introduced into Slovenian legislation. Installers in Slovenia usually follow the standards and instructions for installation of geothermal heat pumps, which were developed in Switzerland, Germany, Sweden and Austria.

*Existing standards for heat pumps:*

- **EN 378-1:2000:** Refrigerating systems and heat pumps – Safety and environmental requirements – Part 1: Basic requirements, definitions, classification and selection criteria
- **EN 14511-1:2004:** Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors for space heating and cooling – Parts 1-4
- **ISO 13256-2:1998:** Water-source heat pumps -- Testing and rating for performance -- Part 2: Water-to-water and brine-to-water heat pumps

*Existing drilling standards, which relate to geothermal heat pumps:*

- **EN 791:1996:** Drill rigs. Safety
- **ISO 3551:1992:** Rotary core diamond drilling equipment -- System A
- **ISO 3552:1992:** Rotary core diamond drilling equipment -- System B
- **EN 12717:2001:** Safety of machine tools. Drilling machines
- **EN ISO 22475/1:2006:** Geotechnical investigation and testing -- Sampling methods and groundwater measurements -- Part 1: Technical principles for execution

Slovenian installers mostly follow the standards listed below:

Table 1. List of standards followed by Slovenian geothermal heat pumps installers.

AT	ÖWAV Regelblatt	Thermal use of the groundwater and the underground, heating and cooling	2009
CH	AWP T1	Heating system with heat pumps	2007
CH	SIA D 0190	Use of the earth heat through foundation piles etc.	2005
CH	SIA 384/6 (SN 565)	Borehole heat exchangers for heating and cooling	2009
DE	DIN 8901	Refrigerating systems and heat pumps - Protection of soil, ground and surface water	2002
DE	VDI 4640 Blatt 1-4	Thermal use of the Underground – part 1 -4	2000-2009
SE	Normbrunn-07	Drilling for water wells and energy	2008

## 6) Exploitations rights

Closed loop system (GCHPv - Geoprobe) → utilization can be implemented without getting mining or water right.

Water Act → a water right for exploitation as

- water permit, for own use - individuals / residential (granted by Environmental Agency),
- concession, for own use - individuals / residential (granted by the government) if the temperature of thermal water is more than 20 °C,
- concession, for the use in balneology, heating, etc. - legal persons / enterprises (granted by the government).

The water right defines the provision of yearly abstracted volume of water (m<sup>3</sup>/y) and the operation abstraction rate (l/s).

## 7) Monitoring requirements

Geoprobe → monitoring is not required.

The monitoring of water level, abstraction rate and yearly volume of water is required to be yearly reported (to the Environmental Agency) for the abstractions higher than 2 l/s.

Reinjection and open loop systems with no or partial injection → the obligations, the way of executing the monitoring and the methods of reporting data to the ministry are prescribed in water permit or concession contract. Each concession contract handles the monitoring obligations individually.

General monitoring requirements are prescribed in the Rules on initial measurements and operational monitoring of waste water and on conditions for its implementation (Official Gazette RS, No. 74/2007).

### **8) Reporting requirements**

In practice it is most commonly yearly reporting which is individually given in the water concession or permit.

Environmental agency is reviewing the adequacy and compliance of reporting with regulations. Agency is also responsible for evaluation and intervention.

There is no specific methodology prescribed in the regulations.

### **9) Transboundary issues**

Transboundary issues are the matter of bilateral commissions for the water management. Slovenia has two bilateral commissions with the neighbouring countries: The permanent Slovenian-Austrian "Mura commission" with Austria and the permanent Slovenian-Hungarian Water management commission with Hungary. Until now no official transboundary geothermal aquifer is delineated among these countries.

The Slovenian-Austrian Mura commission has already discussed a geothermal well drilled in Korovci (SI) in 2008, with the ordering of a pumping test controlled by both sides, a precedent case of this kind.

### **10) Conclusions**

Criteria for thermal water classification are still not defined in the regulation.

Register of closed loop systems installation is not present. That is why also their energy contribution to RES and efficiency of installations is indirectly assessed.

There is no specific methodology prescribed in the regulations for the evaluation of monitoring results and quantitative criteria for the prolongation of water right procedure.

## ***5.1 Overview of Slovene national regulation for geothermal project***

### ***5.1.1 Introduction to legal and administrative conditions***

Renewable energy resources, including geothermal energy, are discussed in the various regulations and Slovene national development strategy documents. The legal basis for exploration and utilization of geothermal energy in Slovenia is under the jurisdiction of the Ministry of the Environment and Spatial Planning and the Ministry of Economy.

According to the definition in Mining Act a geothermal energy resource is a thermal energy, which is stored in the geological strata beneath the surface of solid earth and which is being regenerated by the heat flow from Earth's interior. Mining Act in the second Article defines two methods for exploitation. Exploitation of geothermal energy resource with geoprobe (geocollector) can be implemented without a license under this Act. To exploit a geothermal energy resource with an open loop system with no or partial injection, an exploration permit and water right for the exploitation must be obtained in accordance with the regulations regarding water (Water Act).

Energy is traditionally linked to Economy sector and geothermal energy resources are treated together with mineral resources in the Mining Act. Mining sector is traditionally linked to Ministry of Economy although it was also transposed to the Ministry of Environment and Spatial Planning in the past. Actually mining sector is responsible for the mineral resources management plan including geothermal energy resources. The logical approach from past years was that geothermal energy abstraction was regulated by the Ministry of Economy, mining sector. Energy abstraction in the closed loop was considered as the abstraction where there is practically negligible impact on the groundwater.

It also originates from tradition that mining engineers are educated for exploration of hydrocarbons, petroleum where demanding and hazardous drillings operation are designed and effectuated. From this reason all drilling operations are thus traditionally understood as a mining work despite the demanding drilling operations usually starts not before 300 m or from the safety reasons not before hydrocarbons or gas are present in the borehole.

From this point of view drilling and mineral resources exploration bellow 300 m depth is classified as complex mining works by the Mining act.

Considering intended method of exploitation of geothermal energy, a various administrative and legislative procedures for exploration and exploitation of the resource need to be followed. A detailed description of the legal procedures for the exploitation of geothermal energy for different purposes (gaining heat for hot water and buildings, generate electricity, aquaculture, irrigation, balneology...) is described below, regard to the method of exploitation.

*Exploitation of geothermal energy resource with geoprobe or geocollector (ground coupled heat pump – vertical or horizontal – GCHPv or GCHPh)*

System with geoprobe means exclusively earth heat abstraction. The system consists of a closed system of pipes in which special fluid is circulating. Heat from the soil is transferred through pipes to the heat pump. Heat pump reheats liquid in the heating system to the desired temperature. Utilized heat transfer fluid re-circles along closed system of pipes under the surface of soil. This system requires borehole drilling (vertical system - GCHPv) or surface

excavation (horizontal system - GCHPh). This intervention does not affect the quantitative status of groundwater.

*Exploiting geothermal energy with reinjection (ground source heat pump – water system – GSHP<sub>w</sub>)*

These systems utilize heat from groundwater. Groundwater is abstracted from borehole penetrating the aquifer. The water is transferred through the heat pump system into buildings where it absorbs or releases heat. The ground water is then discharged through an injection borehole back into the aquifer, at the adequate distance from the abstraction borehole. Distance between abstraction and reinjection boreholes should be at least 25 m (distance determined also in Mining act) for shallow groundwater and low productivity boreholes. For deep groundwater or higher productivity boreholes the distance should be determined by thermodynamic calculation or modelling.

*Exploitation of geothermal energy resource in an open loop system with no or a partial injection*

This system operates on the same principle as a system with reinjection, with the difference that used groundwater is then entirely or partially discharged to surface water bodies or to public sewer or partially reinjected to the aquifer.

### *5.1.2 Starting a geothermal project*

Starting geothermal project, in the first stage it is necessary to take the basic consideration and decision regarding the purpose of exploitation of geothermal energy resource (heating/cooling, balneology, power generation). This consideration has to be done regarding the energy needs and according to the geothermal energy potential in the planned location (engineers, energy consultants).

There are some prohibitions to be considered at the starting stage of geothermal project:

- 1) Construction in the first narrowest water protection areas is prohibited. In the individual narrower (the second) water protection area we could also find prohibitions of certain construction or drilling, what could be checked by obtaining the official information on conditions for the construction by the competent local authority?
- 2) Discharge of wastewater into natural lakes, fishponds, waterholes and other natural reservoirs with permanent or periodic inflow or outflow of inland or groundwaters is prohibited.
- 3) Discharge of wastewater into reservoirs originating from the extraction or exploitation of mineral resources and other similar encroachments and which are in contact with groundwater is also prohibited.

- 4) The temperature of discharge into sewers shall not exceed 40 °C and for discharges into water 30 °C.
- 5) A general emission decree also lays down the allowed thresholds of the substances in effluent.

Agricultural land and various protected areas are subject of special limitations and requirements that could affect any further steps of the project. These areas are water protection zones, bathing waters areas, nature protection areas, and cultural heritage areas where specific decrees and ordinances should be taken into consideration already in the initial stage of the geothermal project.

Legal examination of geothermal project follows each single step of a project (Figure 4).

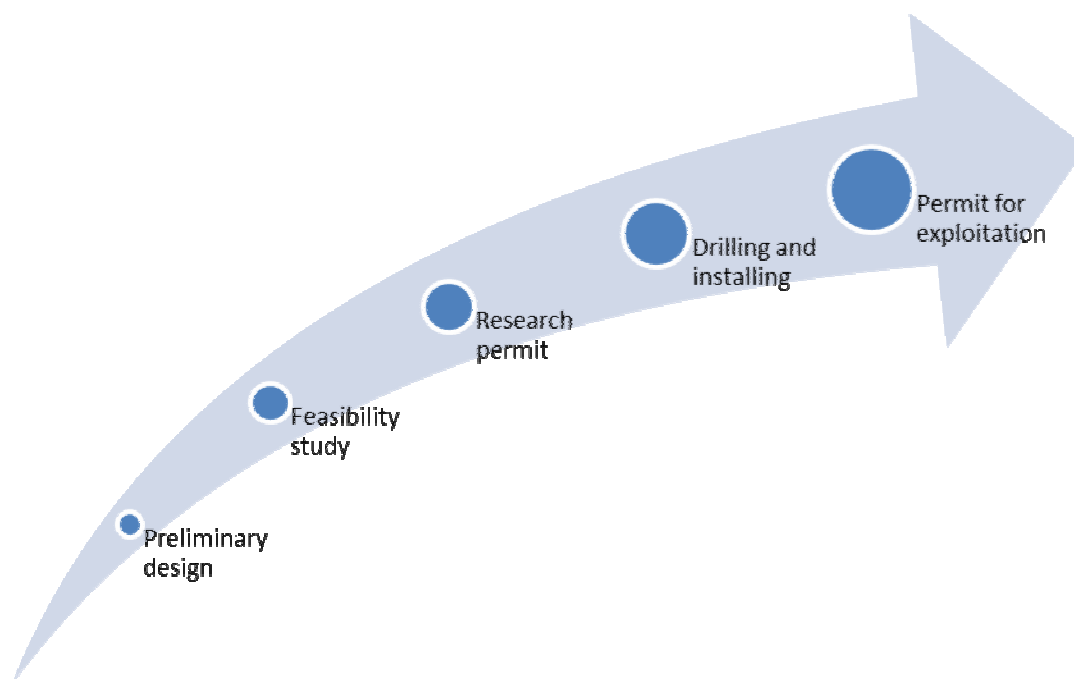


Figure 4. Steps of geothermal project

At the starting level a planner in cooperation with the investor (owner) specifies the specific needs and technical requirements. It is necessary to gather information about the possible forms of exploitation of the geothermal resource. Considering the circumstances (technical requirements of performance of the system, energy balance of groundwater or soil) we select the appropriate technology. For the exploitation of geothermal energy, we can choose between a close loop system with geoprobe and open loop system with reinjection or with no or partial reinjection.

The next step towards is the calculation (mechanical engineer) of energy balance for the building or other end user. Calculations of the heat demand, heat losses and other components (review suitability of the existing heating system, determination of the maximum power heating facility ...) are needed for optimal design of mechanical installations.

The most important is the financing plan. An estimate of investment costs (purchase of equipment, the cost of the installation, engineering) and operating costs (maintenance, operation, amortization) is needed. At this stage the possibilities for subvention, loans or grants should be examined (e.g. Eco Fund, Rules on the allocation of funds for the promotion of efficient use of energy and utilization of renewable energy resources).

### *5.1.3 Licensing procedure for the construction*

In this stage the most appropriate solution for the project has already been selected. In addition, it is necessary to determine the location of boreholes – production, reinjection. With regard to the selected system, it is necessary to obtain licenses. After licenses have been obtained it is appropriate time to submit applications for subsidies, grants or soft loans.

#### 5.1.3.1 Real property, right of land use

Prior to the beginning of acquiring license the initiator, who is not himself the owner of the land has to acquire this land by concluding a legal transaction, or to obtain an approval from the owner of the land to limit his property rights. Agricultural land is practically not saleable except for the agricultural purpose. To change the purpose of this land, very complicated procedure is required and outcome is hardly predictable. It depends on case by case and on local community policy and as a rule, the procedure is long lasting.

#### 5.1.3.2 Research permit

The investor who is intending to effectuate boreholes 30 m or more deep or boreholes situated on water protected areas needs to obtain a research permit on the legal basis of the Water Act.

Drilling and constructing in the nearest water protection zone is not allowed. For constructing in the narrower and wider water protection water consent must be obtained. For certain construction, water consent is obtainable only when risk analysis is submitted and the specific measures are designed to assure that no significant impact could be expected. Risk analysis procedure is determined in the Rules on criteria for the designation of a water protection zone, Official Gazette RS, No. 64/2004).

The exact licensing requirements have to be checked individually for each individual area and eventual water protection area. The most convenient way to check this is to obtain the “Information of conditions for constructing” by the competent administrative unit. The Municipality gives us the information on which administrative unit is competent.

In the research for mineral resources it must be ensured that no damage would be caused to the third party. Secondly, in the case of search with borehole deeper or equal 30 m it must be

verified that in the geological structure in which we intend to carry out a borehole, are no beds of coal or hydrocarbons and finally that the borehole does not exceed a depth of 300 m.

For drilling in depth between 30 m and 300 m it is necessary to submit a technical (= mining) report for drilling borehole. Boreholes deeper than 300 m are according to Mining act classified among complex mining works. Such an operation requires submission of revised mining project of a borehole.

#### 5.1.3.3 Environmental impact assessment

Environmental impact assessment is mandatory for the following types of interventions:

- a) Pumping station for groundwater or system for artificial recharge of groundwater if annual volume of abstracted or recharged water is equivalent or greater than 10 million m<sup>3</sup> (31.7 l/s on yearly average);
- b) Deep drilling in particular:
  - geothermal drilling with capacity utilization of heat at least 30 kW in the case that thermal water is not discharged into surface waters;
  - geothermal drilling in the case that thermal water is discharged into surface water, if the temperature exceeds 4 °C or more above average annual air temperature of the site or if the dissolved salts in the geothermal water exceed 1,000 mg/l;
  - drilling for exploitation of water reserves with a capacity of pumping at least 100 l/s.

#### 5.1.3.4 Reporting the exploration results

When above described licenses are acquired the drilling of borehole(s) may be followed.

All the drilling and research results that are required in the written research permit must be reported to the licensing authority immediately after the effectuation of the research.



## 5.1.4 *Licensing procedure for operation*

### 5.1.4.1 Exploitation outset

#### *Geoprobe*

Utilization according to a system with a geoprobe does not demand an exploitation permit. According to the Mining Act the exploitation of geothermal energy resources with geoprobe or geocollector can be implemented without getting concession.

#### *Reinjection or partial reinjection*

Utilization of geothermal water is special use of a water asset and shall only be possible on the basis of a water right according to Water Act.

Water right must be obtained as a water permit for own use (individuals / residential) or as a concession for the use of thermal water, water for balneology, heating, etc. (legal persons / enterprises).

Water permit is granted by Environmental Agency, the concession is granted by the government.

In the actual practice it is accepted that thermal water is water with 20 °C and over, thus the concession has to be obtained also for own use.

The discharge of thermal (wastewater) water back into the aquifer cannot be permitted without obtaining water consent first. Returning water back into the aquifer must be planned and carried out in such a way that it will not significantly degrade the properties of the water regime and significantly disturb the natural balance of aquatic and depended terrestrial ecosystems.

Thermal waste water can be discharged directly or indirectly to surface water bodies or to public sewer. If amount of discharge thermal waste water to public sewer exceeds 12,000 m<sup>3</sup>/a it is necessary to obtain an environmental protection approval within environmental protection regulations. The direct or indirect discharge of (thermal) wastewater and the emission of heat into surface waters shall only be permitted using the method and under the conditions laid down with general emission decree. The latter lays down, that temperature of discharge into sewers shall not exceed 40 °C and for discharges into water 30 °C. A general emission decree also lays down the required thresholds of the substances in effluent.

Discharge of wastewater into natural lakes, fishponds, waterholes and other natural reservoirs with permanent or periodic inflow or outflow of inland or groundwaters is prohibited.

Discharge of wastewater into reservoirs originating from the extraction or exploitation of mineral resources and other similar encroachments and which are in contact with groundwater is also prohibited.

#### 5.1.4.2 Monitoring

A system with geoprobe has no impact on the quantitative status of water, so no monitoring is required.

The open loop systems have to perform monitoring of groundwater qualitative and quantitative status. The way of executing the monitoring and the methods of reporting data to the ministry are determined in individual water permit or concession act. Each licensing deal is handled individually. The monitoring requirement contains a particular range of observed parameters and manner and frequency of reporting. In practice it is most commonly yearly reporting. Environmental agency is reviewing the adequacy and compliance of reporting with regulations.

The user has also to ensure the operational monitoring for wastewater discharges, in cases if an environmental protection approval has been issued for the discharge of wastewater into public sewers or directly into surface water or indirectly into ground water.

Table 2. The frequency of initial and periodic measurements and time of sampling for each effluent from the device (Rules on initial measurements and operational monitoring of waste water and on conditions for its implementation, the Official Gazette of RS, no. 74/2007)

Device type and annual volume of industrial waste water (1.000 m <sup>3</sup> /year)	Annual frequency of measurements (no. of measurements per year)	Time sampling of a representative sample (hour)
<4	1 measurement each year	6
>=4<10	2 measurements each year	6
>=10<50	3 measurements each year	6
>=50<200	4 measurements each year	24
>=200<500	6 measurements each year	24
>=500	12 measurements each year	24

In the exploitation of geothermal energy with reinjection the holder of mining exploitation right, has to ensure monitoring of the impacts of their activities on the water environment.

#### 5.1.4.3 Validity of the exploitation right

For utilization of geothermal energy with geoprobe system, there is no time limit.

For the exploitation of geothermal energy with reinjection or with an open loop system with no or a partial injection, the water permit or concession is granted for a limited time. Water

permit is granted for a maximum period 30 years and concession for maximum period 50 years. In practice, the water right is granted for a period of 30 years, if there is no other reservation.

Environmental agency is reviewing the adequacy and compliance of required monitoring reports and based on these results decides on permit prolongation. Ministry of Environment and Spatial Planning prolongs the concession holding a consultation with Environmental Agency.

### *5.1.5 Regulations*

Mining Act (ZRud-1), Official Gazette RS, No. 61/10 (62/10 corr.), 76/10.

Water Act (ZV-1), Official Gazette RS, No. 67/02, 57/08.

Environmental Protection Act (ZVO-1), Official Gazette RS, No. 41/04, 17/06, 20/06, 28/06  
SkI.US: UI-51/06-5, 39/06-UPB1, 66/06 Odl.US: UI-51/06-10, 112/06 Odl.US: UI-40/06-10,  
70/08, 108/09.

Decree on the emission of substances and heat in the discharge of wastewater into waters and public sewage system, Official Gazette RS, No. 47/05, 45/07, 79/09.

Rules on the content of application for acquiring water permit and on the content of application for acquiring groundwater research permit, Official Gazette RS, No. 79/07.

Decree on the categories of activities for which an environmental impact assessment is mandatory, Official Gazette RS, No. 78/06, 72/07, 32/09.

Rules on the content of applications for acquiring project conditions and conditions for other land use and on the content of applications for acquiring water consent, Official Gazette RS, No. 25/09.

Regulation on the promotion of efficient energy use and use of renewable energy sources, Official Gazette RS, No. 49/03, 38/05, 89/08.

Rules on criteria for the designation of a water protection zone, Official Gazette RS, No. 64/2004.

Table 3. Exploitation of geothermal energy resources (Slovenia).

Exploitation of Geothermal Energy Resources			
The choice of exploitation	Geoprobe (geocollector)	Reinjection	Open loop systems with no or partial injection
Drilling depths	Shallow boreholes < 30 m 30 m - 300 m Deep boreholes > 300 m		
Exploration permit	Property right, right of land use		
	Boreholes deeper than 30 m or situated on water protected areas → a research permit. Drilling on the specific water protection zone → a water consent (risk analysis)		
	Boreholes 30 m - 300 m → a technical basis for drilling borehole. Boreholes > 300 m → revised mining project of borehole.		
	<ul style="list-style-type: none"> <li>- ensuring that the search not causes damage to third participant</li> <li>-borehole &gt; 30 m → verify that in the geological structure in which it intends to carry out a borehole, are no beds of coal or hydrocarbons</li> <li>-the borehole does not exceed a depth of 300 m.</li> </ul>		
Environmental impact assessment	Boreholes > 300 m → complex mining works → revised mining project of borehole. An opinion of Ministry of the environment and spatial planning is required in regard to monitoring.		
	<ul style="list-style-type: none"> <li>- Pump station for groundwater or system for artificial recharge of groundwater if annual volume of abstracted or recharged water is equivalent or greater than 10million m<sup>3</sup>;</li> <li>- Deep drilling in particular:                             <ul style="list-style-type: none"> <li>- geothermal drilling with capacity utilization of heat at least 30 kW in case that thermal water is not discharged into surface waters;</li> <li>- geothermal drilling in the case that thermal water is discharged into surface water, if the temperature exceeds 4°C or more above average annual air temperature of the site or if the dissolved salts in the geothermal water exceed 1000 mg/l;</li> <li>- drilling for exploitation of water reserves with a capacity of pumping at least 100 l/s.</li> </ul> </li> </ul>		
Drilling			
Reporting the exploration results			
An exploitation permit	Water right (special use of a water asset ) - on the basis -water permit (individuals, residential / for own use - Environmental Agency) -concession (individuals, residential / for own use, if the temperature of exploited water is 20°C and over - the government) -concession (enterprises, legal persons: balneology, heating, etc. - the government)		
	The discharge of thermal (wastewater) water: -Returning water back into the aquifer: a water consent		The discharge of thermal (wastewater) water: -public sewage: > 12,000 m <sup>3</sup> → an environmental protection approval - surface waters: an environmental protection approval  Temperature of discharge: 30°C - discharges into water 40°C - discharge into sewers  A general emission decree lays down the required thresholds of the substances in effluent.
Construction and operation			
Monitoring	Monitoring of groundwater qualitative and quantitative status: The way of executing the monitoring and the methods of reporting data to the ministry are determined in individual water permit or concession act. Environmental agency is reviewing the adequacy and compliance of reporting with regulations.		
	The operational monitoring for wastewater discharges - if an environmental protection approval has been issued		
Validity of the exploitation right	Water permit shall be granted for a maximum period 30 years Concession shall be granted for maximum period 50 years. In practice - for a period of 30 years, if there is no other reservations.		

## 6 Legislation overview Austria

### 1) Geothermal installation and utilisation classification / parameters

#### *Definition of thermal water*

The Austrian Legislation has no criteria for thermal water, therefore thermal water equals groundwater (OEWAV, 2010) and its extraction is regulated by the Austrian federal water act (§10 WRG 1959).

In practice the OEWAV-Regelwerk 215 “Nutzung und Schutz von Thermalwasservorkommen” [Guidelines for Utilization and Protection of thermal water in Austria] (OEWAV, 2010) is applied for the definition of thermal water from a thermal point of view. It says, that groundwater with a minimum outflow temperature of 20°C is defined as thermal water. This is in accordance with national laws on balneological issues, such as:

*Bgld. HeiKuG 1963; WHKG 2007; Steiermärkisches Heilvorkommen- und Kurortegesetz 1962 und Niederoesterreichisches Heilvorkommen- und Kurortegesetz 1978.*

#### *Definition of shallow and deep geothermal utilizations*

In Austria there is no legal definition of “shallow” and “deep” geothermal utilization.

#### *Definition of deep drillings and application of mining law*

According to the Austrian federal mining law, there is a common differentiation between shallow and deep boreholes (§119, MinroG):

- Shallow boreholes are drillings with a depth minor 300 meters.
- Deep Boreholes are classified as boreholes with a depth greater than 300 meters with the need of a drilling permit (§ 2 (2) 1 MinroG 1999).

#### *Competences of governmental authorities*

The competence of governmental authorities is depending on the maximum amount of water extraction (§§98, 99 WRG 1959) as well as on transnational aspects (§100 WRG 1959):

- Regional authorities: less than 5 l/s: (§98 WRG 1959)
- State authorities: more than 5 l/s: (§99 WRG 1959)
- Federal Ministry of Agriculture, Forestry, Environment and Water Management: Transnational water utilization: (§100 WRG 1959).
- Federal Ministry of Economics, Family and Youth: Deep drillings (§2(2) 1 MinroG 1999).

### ***Refits for electric power generation by application of geothermal techniques***

Refits for electricity production from renewable energy sources are regulated by Green Electricity Act (OESG, 2002). At §5(1) (OESG, 2002) geothermal energy is defined “renewable energy sources” as renewable, non-fossil energy sources.

#### **2) Research / exploration rights**

- Boreholes deeper than 300 m require a drilling permit (§2(2) 1 MinroG 1959)
- Drilling in water protection areas require a licensing procedure (§16 WRG 1959)
- Exploration and exploitation of geothermal energy must not influence other existing license holders of subsurface waters in a quantitative or qualitative way (§12 WRG 1959).
- Geothermal utilization in active concession-areas of hydrocarbon exploitation requires consent of the license holder, irrespective of the geological targets (§119(6) MinroG).

#### **3) Environmental Impact Assessment: requirements / procedure**

General issues concerning possible environmental impact are governed by the Environmental Impact Assessment Act (§1 UVP 2000), which requires public involvement to a certain extend. The Environmental Impact Assessment Act treats the determining, describing and evaluating immediate and indirect effects, which a project has or would have on:

- humans, animals, plants and their habitats
- ground, water, air and climate
- landscape
- cultural inherits.

This procedure examines measures, which prevent harmful or stressful effects on the environment and intends to present pros and cons and intends to identify less harmful alternative approaches if available.

According to appendix 1 (UVP 2000) it has to be distinguished between the following different proceedings:

- a) Broad Environmental Impact Assessment procedure with public participation: For thermal plants with an installed thermal capacity of more than 200MW.
- b) Simplified Environmental Impact Assessment procedure: not applied for hydrogeothermal issues.
- c) Case specific, individual Environmental Impact Assessment procedure: applied in environmentally protected areas for:
  - Thermal power plants with a minimum thermal capacity of 100 MW, situated in areas contaminated by air pollution.

- Deep drillings with a length of more than 1,000 meters for water withdrawal in water protection areas, except for explorative drillings.

#### **4) Environmental objectives / constraints**

##### Re-injection:

The handling of re-injecting thermal water is regulated by WRG 1959, summarized in the OEWAV guideline 215.

The reinjection of geothermal used water is governed under §32a(2) WRG 1959. It is important to sustain the hydraulic and chemical balance of the thermal aquifer. In general the documentation of the planned reinjection is a part of licensing requirements. For that reason each reinjection is licensed for individual water consents by the responsible governmental authority. Thermal water for balneological purpose builds an exception to reinjection, due to danger of microbial contamination of the thermal aquifer by balneologically used, reinjected waters (OEWAV, 2010).

The discharge of natural or artificially developed thermal water into sewage purification plants is regulated by §32b WRG 1959. The discharge of used thermal water into surface streams or sewage purification plants is limited by terms of charge and concentration of dangerous substances according to the present state of technology (§33b WRG 1959).

The requirements for example consent of thermal water discharge are determined in the individual water permit.

#### **5) Technical requirements, recommendations and standards**

In Austria the following standards and instructions are used for geothermal utilizations:

##### a) Technical requirements and recommendations

- OEWAV-Regelblatt (RB) 207: Thermische Nutzung des Grundwasser und des Untergrundes – Heizen und Kühlen (shallow geothermal utilization).
- OEWAV-Regelblatt (RB) 213: Tiefbohrung zur Wassergewinnung (deep drillings).
- OEWAV-Regelblatt (RB) 215: Nutzung und Schutz von Thermalwasservorkommen (hydrogeothermal utilization).
- VDI-Richtlinie 4640: Blatt 3 - Thermische Nutzung des Untergrunds – Unterirdische thermische Energiespeicher (seasonal energy storage).
- VDI-Richtlinie 4640: Blatt 4 - Thermische Nutzung des Untergrunds – Direkte Nutzungen (German guideline oftenly applied in austria in addition to OEWAV-Regelblatt 215).

b) Standards

- OEN B 4400-1: Benennung, Beschreibung und Klassifizierung von Boeden (classification of soils).
- OEN B 4400-2: Benennungen und Definitionen, Beschreibung und Klassifizierung von Fels (classification of rocks).

## **6) Exploitation rights**

In general the land owner has property rights on groundwater, which also includes thermal water (§3 WRG 1959), because property extends vertically to unlimited depths (see also OEWA-V-RB 215, 2010). Therefore any exploration on thermal water has to be in accordance with property owners. This also includes properties, which are only hit by the track of the geothermal drilling – even in case that the target of subsurface water extraction is located at another land property. Furthermore any exploration activities including non-invasive methods (e.g. surface seismic or geological mapping) have to be in accordance with property owners for entry rights and compensation of possible crop damage.

Exploitation activities within areas of active concessions of hydrocarbon exploitation have in addition to be in accordance with the concession holder (§119(6) MinroG).

Explorative drillings are not attached by the Environmental Impact Assessment Law (UVP 2000, Appendix 1). But for drillings with total lengths of more than 300 meters license procedures according to Mining Law (§1 MinroG) have to be carried out.

## **7) Monitoring requirements**

In Austria monitoring requirements are specified by Water Act (WRG 1959).

Relevant parameters for monitoring can be divided into:

- a) Qualitative parameters: physical, chemical and biological properties
- b) Quantitative parameters: yield, pressure and temperature

The water authority only grants a water permit after the establishment of a system-monitoring program (§58 WRG 1959). Relevant parameters have to be monitored to make sure their suitability for describing the quantitative and qualitative situation of groundwater bodies and demonstrating long-term trends of anthropogenic impacts (§59 WRG 1959). Generally, it aims to assess a baseline of relevant aquifer conditions (temperature, pressure and chemistry) before any implementation of geothermal utilization.

If a geothermal utilization is planned in the vicinity of already existing uses there are certain measures the license holders of the neighbouring wells may apply in order to grant compensational payments in case of damage. Their application already during the drilling and



testing phase can be used for preservation of evidence concerning the qualitative and quantitative conditions of the targeted thermal aquifer.

Depending on the type of geothermal utilization and according to the latest scientific expertise the monitoring requirements can be adjusted. A recently approved geothermal power plant located near Vienna with an installed thermal capacity of around 40 MW is a precedent concerning novelty in licensing procedures. As a consequence of the incidents occurring at the geothermal power plant in Basel, the power plant near Vienna was approved by the relevant authorities only under the premise of a seismic monitoring system in order to survey possible induced seismicity.

## **8) Reporting requirements**

In general reservoir data are company secrets in Austria. That means, that the license holder has no obligation to provide them to the general public (§58(4) WRG 1959).

During the permitting procedures (Water Law, Mining Law) the following reporting activities to the responsible authorities are required:

### a) Before drilling and testing

- Submission report to the water authority, including (amongst others): location, geological target, type of utilization (purpose, production yield, reinjection yield and temperature, load curves), hydrogeological concept (geological profile of the aimed well), plan of the technical program concerning the drilling and testing including water disposal, existing utilizations and reference list of land owners.
- Submission report to the mining authority, including (amongst others): location, technical concepts of the drilling and the drilling site including emergency plans as well as a reference list of used materials, machinery and electric installations including authorized data sheets.

### b) After drilling and before testing

- Reporting of the drilling results to the mining authority in case of non-successful results or significant trapping of hydrocarbons.

### c) After testing and before licensing

- Summary report of drilling and testing results including qualitative and quantitative reservoir parameters to water and mining authority.

### d) After water and mining permits (monitoring)

- Annual monitoring reports about production- and reservoir data to the water authority.

## 9) Transboundary issues

Transboundary issues are governed by bilateral commissions, at which the federal state of Austria is represented by the Federal Ministry of Agriculture, Forestry, Environment and Water Management and involved national authorities. In Austria the following bilateral commissions are installed:

- Austria-Hungary „Water management commission“
- Austria-Slovakia „Water management commission“
- Austria-Slovenian „Mur-Commission“
- Austria-Slovenian „Drau-Commission“

## 10) Conclusions

In order to summarize the present situation concerning legislation aspects the following conclusions can be stated:

- Legal definition of thermal water and the energy stored in it: A clear legal statement concerning the definition of thermal water (e.g. minimum level of temperature) as well as a definition of the energy stored in thermal water is missing at federal legislation.
- Licensing procedures and utilization conflicts: Because the energy stored in thermal waters is not defined as an energy resource by mining- (MinroG) or water laws (WRG) no clear licensing procedure is defined for the extraction of energy without extraction of mass (water discharged to surface drains). For that reason it is currently not possible to gain concessions on geothermal heat extraction in Austria. Ownership as well as protective aspects are still covered by the Austrian water act (WRG) by assuming an extraction of water and therefore are inadequately for geothermal licensing procedures. On the one hand the aspects concerning ownership and protection areas are assumed to be too restrictive; on the other hand there is a complete lack of standardized estimation methods for the thermally influenced subsurface considering applied geothermal utilization. As there are standardized methods for defining concession areas for hydrocarbon exploitation and because hydrocarbon themselves are defined as federally owned energy resources geothermal utilization is at a disadvantage compared to hydrocarbon exploitation, irrespective of the geological target zone.
- Data ownership: The present legal situation in Austria clearly privileges data owner of geothermal utilizations. This may block or at least delay future development of geothermal utilization in Austria as exploration data, which may be of public interest, are restricted to owners of geothermal utilizations.
- Refits and risk insurance: Compared to neighbouring countries like Germany and Switzerland the refits for geothermal production of electricity according to the Green Electricity Act (OESG, 2002) may be seen as too low to provide an enhanced development in an economically way. And generally there are no standardized

concepts or procedures concerning risk insurance for geothermal projects. At the present only one individual concept of risk insurance has been developed for a planned geothermal heating plant near Vienna.

The acknowledgement of heat stored in thermal waters as an energy resource could serve as a crucial administrative step towards further development of geothermal utilization in Austria, without affecting the extraction of water. This could switch the ownership from private to public (federal or national) and in turn allow licensing of geothermal concessions for heat extraction. In that case the data ownership could also switch from private to public.

Standardized procedures for federally supplied risk insurances would lead to the advantage of providing high quality explorative data to the public, which may be part of risk assessment and would have to be financed by the concession applicant in return.

## ***6.1 Overview of Austrian national regulation for geothermal project***

### *6.1.1 Introduction to legal and administrative conditions*

Considering the national regulations for geothermal utilization in Austria the following Acts in combination with their associated by-laws have to be considered from a geoscientific point of view:

- Administrative procedures in general are governed by the Act on Administrative Procedures (AVG 1991): general regulations concerning procedures and permits.
- Issues concerning the utilization of thermal water are governed by the Water Act (WRG 1959): e.g. responsible authorities, ownership rights, monitoring.
- Issues concerning the drilling of wells with lengths above 300 meters are governed by the Mining Act (MinroG 1999): e.g. technical concepts of drilling and drilling sites, utilization conflicts with hydrocarbon exploitation.
- Procedures concerning possible environmental impacts are governed by the Act on Environmental Impact Assessment (UVP 2000): this act only comes into effect at large geothermal plants or drillings in environmentally protected areas.
- Refits for geothermal electric power generation are governed by the Green Electricity Act (OESG 2012).

Please note that this listing does not include issues concerning technical facilities for transformation and distribution of geothermal energy, summarized in Factories Acts or Industrial Codes.

In Austria geothermal energy is defined as part of renewable energy resources. Various national energy strategy documents discuss the different types of renewable energy resources,

in which deep geothermal energy is only playing a minor role (q.v. Biermayr, 2009, 2010, 2011; BMLFUW, 2009; BMWFJ & BMLFUW, 2010).

### *6.1.2 Starting a geothermal project*

The following administrative steps are required during the planning of a geothermal project:

- 1) Location check-up of the selected project area including the geothermal subsurface target zone: It has to be cleared if it is located in a water protection area, nature reserve (environmental protection area according to UVP 2000, Appendix 1) or in a hydrocarbon concession zone (§119(6) MinroG 1959).
- 2) Assessment of existing utilizations concerning subsurface water of any kind (water supply, thermal water utilization). During a later stage of the procedure it has to be proven, that no existing utilization is constrained in its use by any influences on the water quantity, water temperature or other possible parameter (§ 12 WRG 1959).
- 3) Assessment of land owners within the project area. It has to be kept in mind that geothermal utilization is only allowed in accordance with land property owners (§ 3 WRG 1959).
- 4) Evaluation of the target depth of the aimed geothermal reservoir. In case that wells exceed total lengths of 300 meters mining law comes into effect concerning permitting procedures (§2(2) MinroG 1999).

General geo-scientific explorative tasks have been excluded from this listing, as a standardized federal risk insurance, which could demand a minimum standard of explorative activities, is not yet realized in Austria.

### *6.1.3 Licensing procedure for the construction*

The licensing procedures for the construction of drillings and the testing of geothermal reservoirs is under administration of the water authorities (according to WRG 1959) as well as under administration of mining authorities for drillings exceeding a total depth of 300 meters (according to MinroG 1999).

In this context the following administrative steps are a prerequisite:

#### Before drilling

- 1) Applying for allowance at the responsible water authority for exploration (trapping and testing) of thermal waters (WRG 1959).
  - Submission of technical report (exploration and utilization plan) consisting of:
    - General information (ownership; geotechnical developer / representative of operator; specification of aimed type of utilization including consent and recharge).

- Geological and hydrogeological conditions (description of aimed reservoir including an estimated hydrogeological profile).
  - General technical concept (location; technical concept of the well including drilling methods as well as a definition of drilling mud and the technical concept of drilling site including emergency plans).
  - Explorative concept (borehole logging, hydraulic tests).
  - List of existing utilizations and land property owners.
  - Preservation of evidence (by existing users in adjacent boreholes).
  - Reference list of used documents.
- 2) Administrative procedure concerning the Water Act including the following crucial steps:
- Hearing including all involved parties (land property owners).
  - Administrative decision including orders to be fulfilled.
- 3) Applying for allowance at the responsible mining authority for construction of the drilling (MinroG 1999):
- Submission of technical report (exploration and utilization plan) consisting of:
    - General information (proposer, project engineer, construction supervision, geological supervision and drilling contractor).
    - Borehole data (reason, location, well site, drilling start, advance profile, drilling method, drilling scheme, fluid, tests, pumping tests and filling).
    - Drilling facility (movement, electricity supply, flushing pump).
    - Surveys and test reports (drilling site, fuel tank, static drilling, acoustic propagation, propagation emission).
    - Concept of waste disposal (drilling fluids).
    - Operating materials and machinery (storage of diesel fuels, water supply, and electrical energy supply).
    - Safety plans (emergency plan, hazardous areas, fire extinguishing systems, and safety distances).
    - Responsible person (MinroG 1999) (drilling contractor, customer).
    - Appendices ( e.g. plans and fact sheets).
- 4) Administrative procedure concerning the Water Act requiring the following basic steps:
- Hearing including all involved parties (concession owners in case of geothermal utilization in hydrocarbon concession areas).
  - Administrative decision including orders to be fulfilled.

After drilling and testing (end of explorative phase), in case of a non-successful drilling:

- 5) Notification on the liquidation of the drilling to the responsible mining authority.

#### 6.1.3.1 Real property, right of land use

The affected parties at the administrative procedures concerning the Water Act (WRG 1959) and Mining Act (MinroG 1999) are:

- a) Land property owners covering the subsurface geothermal reservoir. In Austria the subsurface water belongs to the owner of the real property to an unlimited vertical extend (§3 WRG 1959).
- b) Land property owner covering the drilling site as well as covering the pathway of the drilling.
- c) Existing registered users of subsurface water of any kind possibly influenced by the aimed geothermal utilization.
- d) Existing concession holders at hydrocarbon concession zones (§119 (6) MinroG 1999).

All owners mentioned above are representing legal parties at the administrative procedures. That means during the negotiations in terms of administrative governed hearings accordance has to be found, at which owners of category (i) to (iii) are affecting water authorities, while concession holders (iv) are affecting mining authorities.

If the project initiator is not the owner of the selected project area there are two possibilities to strike an agreement with the real property owner:

- a) Purchase of the concerned property
- b) Long-time lease agreement.

For that purpose the actual kind of designation of area at the selected site has to be clarified. If the land for example is used for agricultural purpose a rededication is necessary before it can be used otherwise.

#### 6.1.3.2 Research permit

As already listed at chapter 4.3 the project initiator gains a temporary research authorization by the water- and mining authority after submission of technical project plans during the allowance procedure.

The federal Water Act paragraph §11 WRG 1959 represents the legal basis of the research approval. It governs the measures and orders to avoid significant damage to the thermal reservoir quantitatively and qualitatively.

The construction of drillings with total depths of more than 300 meters below surface is, in addition, governed by the federal Mining Act (MinroG 1999) until the well is completed. If hydrocarbons are trapped in a significant extend during the drilling or testing phase of a geothermal project, the responsible mining authority must be informed. If the project initiator does not have the ability to exploit the trapped hydrocarbons, the drilling is handed over to competent companies by the mining authority (§69(1) MinroG).

The temporary research permit expires after success of the drilling is proven by pumping tests and approved utilization licenses concerning the installation of a geothermal well (mining authority) as well as an approved water consent (water authority).

#### 6.1.3.3 Environmental impact assessment

Measures for the assessment of environmental impacts are regulated by the Act on Environmental Impact Assessment (UVP 2000) as well as by the Water Act (WRG 1959).

The Act on Environmental Impact Assessment regulates general issues associated with large facilities with expected significant impact on the environment. It has to be applied at administrative procedures at the cases below:

- Broad Environmental Impact Assessment procedure: Thermal plants with an installed thermal capacity of more than 200MW.
- Case specific, individual Environmental Impact Assessment procedure applied in environmentally protected areas for thermal power plants with a minimum thermal capacity of 100 MW, situated in areas contaminated by air pollution.

Environmental impact assessment regulated by the Water Act (WRG 1959) affects the following issues:

- Discharge of wasted waters to surface discharge systems: §33 WRG 1959.
- Re-injection of thermal waters in subsurface reservoirs: §32 WRG 1959.
- Monitoring and reporting of reservoir conditions: §58 and §59 WRG 1959.

#### 6.1.3.4 Reporting the exploration results

After accomplishing the drilling and hydraulic tests a technical summary has to be reported to (a) the mining authority as well as to (b) the responsible water authority. These reports contain the achieved results and are representing the fundament for:

- (a) The authorization by the responsible mining authority of installing a well based on the accomplished drilling
- (b) The allowance of thermal water utilization (water permit) in terms of a quantified consent on water extraction and water injection by the responsible water authorities.

After installation and initiation of the geothermal utilization monitoring reports (normally annual reports) have to be provided to the responsible water authority.

## 6.1.4 *Licensing procedure for operation*

### 6.1.4.1 Exploitation outset

The responsible water authority orders a consent, which limits the quantity of extracted and injected water in the units of l/s (maximum allowed amount for short time operation), m<sup>3</sup>/day (average daily extraction / injection) or m<sup>3</sup>/year (cumulated annual extraction or injection) (§98, §99 and §100 WRG 1959). The amount of thermal water reinjected to the subsurface structure, where it has been trapped, is also defined in an individual water permit. By law only energetically used thermal water is allowed to be reinjected in order to sustain the hydraulic regime of the reservoir (§32a WRG 1959). In contrast balneologically used thermal water has to be discharged to the public sewers or surface streams because of hygienically reasons. Discharge into public sewers is only allowed for water temperature under running temperatures of 40°C and discharge into surface water bodies require a water temperature of less than 30°C (§§32b, 33b WRG 1959).

The water consent is defined in the individual water permit, which is only valid for a temporary use. In regions with intensive geothermal utilization, such as the Upper Austrian Molasse Basin, water permits have to be negotiated on an annual basis based on reported monitoring data.

### 6.1.4.2 Monitoring

The water license holders can be obliged by the responsible authority to install a monitoring system (§59a WRG 1959). Each individual water permit defines the parameters to be monitored as well as the frequency of measurements. The monitoring data contains qualitative and quantitative parameters of the geothermal reservoir, and they must be reported to the responsible authority periodically (§58(4) WRG 1959). The handling of monitoring programs as well as the associated reporting by license holders, especially implicated to water grant permit periodically re-negotiated varies significantly between the individual Austrian state authorities.

### 6.1.4.3 Validity of the exploitation right

In practise the responsible Water Authority grants the permit only for a limited period for sustainability reasons. Conventionally the water permit for balneology without re-injection is granted for a maximum time period of 20 years and water permit for energetic use with reinjection for a maximum period of 30 years (OEWAV RB 215, 2010). The Water Act also orders that geothermal plants must be built at current state-of-technology (§12a WRG 1959).

Six months before the expiration of license validity the owner of the geothermal system can apply for a prolongation of the permit with minor administrative effort. In case the



exploitation permit already expired, a simplified procedure for a prolongation is no longer possible and the whole application process has to be renegotiated.

### *6.1.5 Regulations*

#### **Legislation**

ACT ON ADMINISTRATIVE PROCEDURES: Allgemeines Verwaltungsverfahrensgesetz AVG 1991, BGBl. Nr. 51/1991.

WATER ACT: Wasserrechtsgesetz, WRG 1959, BGBl 1959/215, amendment 2011.

MINING ACT: Mineralrohstoffgesetz MinroG 1999, BGBl I 1999/38 idF BGBl. I, Nr. 113/2006.

ACT ON ENVIRONMENTAL IMPACT ASSESSMENT: Bundesgesetz über die Prüfung der Umweltverträglichkeit (Umweltverträglichkeitsprüfungsgesetz 2000 – UVP-G 2000) StF: BGBl. Nr. 697/1993, idF BGBl. I Nr. 144/2011.

ACT ON GREEN ELECTRICITY: OEKostromgesetz OESG, BGBl. I Nr. 149/2002, idF BGBl. I Nr. 75/2011.

#### **Various national acts on balneological issues covering the Austrian part of the project area**

STATE OF BURGENLAND: Burgenländische Heilvorkommen- und Kurortegesetz 1963, idF LGBl. Nr. 40/2001 (Bgl. HeiKuG)

STATE OF VIENNA: Wiener Heilvorkommen- und Kuranstaltengesetz, idF LGBl. Nr. 13/2007 (WHKG)

STATE OF STYRIA: Steiermärkisches Heilvorkommen- und Kurortegesetz 1962, idF LGBl. Nr. 15/2002

STATE OF LOWER AUSTRIA: Niederoesterreichisches Heilvorkommen- und Kurortegesetz 1978, LGBl. Nr. 219/2001

#### **Guidelines**

OEWAV-Regelblatt 207: Thermische Nutzung des Grundwassers und des Untergrunds – Heizen und Kühlen. 2., vollständig überarbeitete Auflage, 2009.

OEWAV-Regelblatt 213: Tiefbohrungen zur Wassergewinnung, 2002.

OEWAV 215: Utilisation and Protection of thermalwater resources, Wien 2010.

VDI-Richtlinie 4640: Blatt 3 - Thermische Nutzung des Untergrunds – Unterirdische Thermische Energiespeicher. – Juni 2001, 42 S (seasonal energy storage).

VDI-Richtlinie 4640: Blatt 4 - Thermische Nutzung des Untergrunds – Direkte Nutzungen. – September 2004, 40 S .

OENORM B 4400-1 - Geotechnik Teil 1: Benennung, Beschreibung und Klassifizierung von Boeden, 15.3.2010.

OENORM B 4400-2 – Geotechnik Teil 2: Benennungen und Definitionen, Beschreibung und Klassifizierung von Fels – Regeln zur Umsetzung der OENORM EN ISO 14689-1, 15.3.2010

**Register of involved laws:**

Paragraph	Law	Content (German)	Content (English)
§ 2 (2) 1	MinroG 1999	Suchen und Erforschen von Vorkommen geothermischer Energie sowie des Gewinnens dieser Energie ab 300 m tiefe Bohrloecher	Search and utilization of geothermal energy resources in boreholes with depths of more than 300 meter below surface.
§ 119	MinroG 1999	Ab 300 m Bohrlochtiefe ist eine Bewilligung der Bergbauanlage noetig	Permitting procedure for wells with a depth of more than 300 meters.
§ 3	WRG 1959	Privatgewässer	Ownership of groundwater
§ 10	WRG 1959	Benutzung des Grundwassers	Use of groundwater
§ 11	WRG 1959	Bewilligung	Procedure on water authorization
§ 12	WRG 1959	Oeffentliche Interessen und fremde Rechte	Public interests and third party rights
§ 12a	WRG 1959	Stand der Technik	State of the art concerning the extraction of subsurface water
§ 16	WRG 1959	Widerstreit zwischen bestehenden Wasserrechten und geplanten Wasserbenutzungen	Conflicts between existing rights and planned utilization
§ 32a	WRG 1959	Einbringungsbeschränkungen und -verbote	Restrictions on injection and discharge of used waters and sewage
§ 32b	WRG 1959	Indirekteinleiter	Definition and measures of water disposal by indirect discharger
§ 33b	WRG 1959	Emissionsbegrenzung für Abwasserinhaltsstoffe	Restrictions on emissions of sewage ingredients
§ 55f	WRG 1959	Maßnahmenprogramme	Programs of measures
§ 55g	WRG 1959	Umsetzung der Maßnahmen	Implementation of measures
§ 58	WRG 1959	Foerderung der Gewässerkunde i. A.: Wissenschaftliche Untersuchungen über die Herkunft und Art der Gewässer	Support of scientific investigations concerning the nature of used subsurface waters
§ 58 (4)	WRG 1959	Dateneinsichtnahme durch die Behoerde	Data inspection by responsible authorities
§ 59a	WRG 1959	Elektronisches Register der Belastungen und Auswirkungen	Monitoring and registering data about extraction and impacts
§ 98	WRG 1959	Zuständigkeit - Bezirkshauptmannschaft	Specifications of competences – regional authority
§ 99	WRG 1959	Zuständigkeit des Landeshauptmannes	Specifications of competences – state governors
§ 100	WRG 1959	Zuständigkeit des Bundesminister für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft	Specifications of competences - Federal Minister of Agriculture- and Forestry, Environmental and Water Management
§ 1	UVP 2000	Aufgabe von Umweltverträglichkeitsprüfung und Bürgerbeteiligung	Specification of Environmental Impact Assessment with public participation
§ 5 (1) 11	OESG 2002	Definition Erdwärme als Erneuerbare Energie	Definition Geothermal energy as renewable energy

Table 4. Exploitation of geothermal energy resources (Austria).

Exploitation of Geothermal Energy Resources - Austria			
The choice of exploitation	<i>Geoprobe (geocollector)</i>	<i>Reinjection</i>	<i>Open loop systems with no, or partial injection</i>
Drilling depths	Shallow boreholes < 300 m Deep boreholes > 300 m		
Exploration permit	Property right, right of land use.		
	Boreholes which are situated on water protected areas or in concession areas of oil companies need a research permit.		
	Boreholes deeper than 300 m need a research permit → Water act and Mining Act. No mutilation existing license holder.		
Environmental impact assessment	Groundwater extraction with more than 10 Mio m <sup>3</sup> .		
	Rebuilding geothermal plants with deep boreholes with water water supply from a depth of 1000 m in protected areas. Thermal power plants capable of a minimum of 200 MW heat capacity.		
Drilling	Responsibility till end of drilling is Federal Ministry of Economy, Family and Youth.		
Reporting the exploration	Exploitation results have to be reported to the responsible authority.		
An exploitation permit	Water law is the legal basis: Water extraction less than 5 l/s needs permit from the regional authority. Water extraction with more than 5 l/s needs permit from the governor of the respective authority.		
	The discharge of thermal (wastewater) water:		The discharge of thermal (wastewater) water:
	Returning water back into the aquifer a water consensus is obligatory.		public sewage: environmental protection is approval surface water: environmental protection is approval  The discharge temperature will be fixed in water permits (mostly between 25 and 35°C).
Construction and operation			
Monitoring	Monitoring of groundwater, qualitative and quantitative status: In individual water right process the consensus are individual given, due to that monitoring and the methods of reporting data to the		
	Monitoring of wastewater discharges is regulated by water permit.		
Validity of the exploitation right	Water permits will be granted for a maximum of 90 years.		
	Normally water permits are granted for balneology for 20 years, energetic use with reinjection for 30 years. The state of technology		

## 7 Legislation overview Hungary

### 1) Geothermal installation and utilisation classification / parameters

#### *Definition of thermal water*

In Hungary the definition of thermal water is “water originating from a subsurface aquifer having outflow temperature higher than 30 °C (Appendix 1, Definitions of the *Act LVII of 1995 on water management*). In general provisions related to water management and environmental protection does not make difference between thermal water and cold groundwater, the environmental objectives related to the implementation of the Water Framework Directive (good quality and quantity status, its evaluation and assessment via river basin management plans) stand generally for (surface and) groundwaters.

#### *Definition of deep drillings and application of mining law*

Article 49 of the *Mining Act XLVIII of 1993* provides the definition of “deep borehole” as the following: “result of such a technological procedure, when a permanent hole is deepened into the earth crust which depth is (considerably) bigger than its diameter and is deepened for a geological or mining purpose by a machine. The borehole can be vertical, tilted, or in its final phase even horizontal”. Therefore this definition does not settle any fixed number for the depth.

According to article 5 of the *KvVM / Ministerial Decree 101/2007 (XII.23.) on the rules of intervention to groundwater resources and guidelines to the drilling of wells*, all wells deeper than 30 m can be drilled only on the basis of a water permit.

#### *Regulation of the open loop or closed loop GHP*

The licensing of closed-circuit vertical geothermal heat-pumps is performed by the mining inspectorates, according to *GKM / Ministerial Decree 96/2005 (XI.4.)*, however down to a depth of 20 m, no permit is required. The application for open groundwater doublets has to be submitted to the Regional Inspectorate for Environment, Nature and Water (which is similar to the licensing procedure of a water-well, see under chapter 2 – exploration rights).

#### *Utilisation purpose (end use)*

In the Hungarian legislation it is not the purpose (end use), but the exploitation parameters (temperature, yield, dissolved content, etc.) that determine different sets of regulation. E.g. an EIA has to be prepared in all cases where thermal groundwater exploitation from karstic aquifers exceeds 500 m<sup>3</sup>/day, or 2,000 m<sup>3</sup>/day from porous aquifers irrespective of power generation or direct heat purposes.

An end-use specific requirement is the preparation of an environmental impact assessment for geothermal power plants of 20 MW, or more, but also without output restrictions for those ones which are established within the protection zone of mineral-, medicinal-, or drinking water resources, or on nature protection areas.

### ***Decisive parameters for determination of law jurisdiction***

In the Hungarian legislation the two decisive parameters of geothermal utilization are (1) whether the exploitation happens with-, or without the abstraction of water, and (2) the depth.

The research, exploitation and utilization of geothermal energy - in case if it is not connected with the abstraction of thermal groundwater - and all related activities are under the scope of the ***Mining Act XXVIII of 1993***. However survey and exploitation of thermal groundwaters yielding geothermal energy (irrespective of depth and purpose of utilization) is regulated by the environmental and water management legislation.

Exploration of geothermal energy from a depth below 2,500 m can take place only in a frame of a concessional system (article 49 of the ***Mining Act XXVIII of 1993***) (*see in details in chapter 2 – research and exploration rights*)

Another set of classification is related to the dissolved content of the water on the basis of which groundwater can fall into the category of mineral / medicinal water. Some special legislation is related to mineral, medicinal waters, e.g. provisions of ***EüM / Ministerial Decree 74/1999 (XII.25.) on natural medicinal***. According to article 15 the terminology of natural mineral water, or medicinal water can be only used, if the water quality meets the requirements defined in Appendix 2, i.e. a natural mineral water is derived from a protected aquifer, it is clean by its origin, it is harmless to human health from a microbiological and chemical point of view, its dissolved content is permanent and it is at least as high as 1,000 mg/l, or it is between 500 and 1,000 mg/l and contains one of the active biological components give in the appendix. According to Appendix 2, medicinal water is a natural mineral water that has a proven healing effect. The operator of the water supply is obliged to make quality check measurements at his own costs in each 5 years in case these waters are used externally, and in each 2 years if they are also used internally.

### **2) Research / exploration rights**

In Hungary exploration rights and grants are basically determined by the depth. The exploration of geothermal energy from a depth of 2,500 m below the surface (closed area) can take place only in a frame of a concessional system (***Mining Act XLVIII of 1993***, 49§). License for the prospection, exploitation and utilization of geothermal energy from this depth interval is issued by the mining inspectorate (i.e. the Hungarian Office for Mining and Geology) in case exploitation of geothermal energy is not in connection with water abstraction.

Irrespective of the depth, water license is required for the utilization of geothermal energy, combined with the abstraction of thermal groundwater, which is issued by the Regional Inspectorates for Environment, Nature and Water. After the Mining Act's amendment (February 2010) geothermal energy users already possessing water licenses (for construction, or operation) valid for depths below 2,500 m may continue their activities for a determined period under conditions established in their permits. However, ongoing licensing processes (being under judgment) for prospection, exploitation and utilization of geothermal energy are abolished, if they are carried out in territories declared to be closed areas (>2,500 m).

The area above a depth of -2,500 m from the surface is considered as an open area; where concession is unnecessary, therefore the planning, establishment and operation of geothermal energy utilization combined with thermal groundwater abstraction is licensed by the Regional Inspectorates for Environment, Nature and Water. However, according to 22/B § of the *Mining Act*, the license for the utilization of thermal groundwater in an open area shall be considered as a license for prospection, exploitation and utilization of geothermal energy, simultaneously, i.e. the mining inspectorate participates as a co-authority in the licensing procedure (Table 5).

The *Mining Act* acknowledges three types of exploration and mining activity, which also refers to geothermal. The first type is a preliminary surface survey (4§) which does not require a permit. In order to carry out this activity the company needs to have an agreement with the caretaker/user of the land and report the commencement of prospection to the mining authorities 30 days in advance. This type of survey does not pose any exclusive rights for the operator concerning exploitation.

Mining activities performed on the basis of authority permission are defined by articles 5–7 of the Mining Act. In open areas (above 2,500 m) the mining inspectorate grants exploration licenses as well as licenses for the exploitation and utilization of geothermal energy, including the construction and putting to use of the related underground and surface facilities in cases the activity does not require a water license (i.e. does not abstract thermal groundwater). In this depth interval in practice this refers to closed-loop ground-source heat-pumps deeper than 20 m (Table 5).

The third type of exploration/exploitation is based on concession, which general rules are described in the *Act XVI of 1991 on Concession*, specific regulations related to geothermal energy in the *Mining Act* Sections 8–19. Closed areas – below a depth of 2,500 m from the surface – can be assigned for exploration, exploitation and utilization by the Minister for domestic or foreign, legal or natural persons, and their companies without legal entities after concluding a concession contract (8§). Contents and the evaluation of the open tender are regulated by articles 10–11.

According to Mining Act article 9 – and taking into consideration regulations set in the *Governmental Decree 103/2011 (VI.29.) on the complex vulnerability and impact assessment*

*of the natural occurrences of mineral resources and geothermal energy* – the Minister shall consider the closed areas to be designated for concession, in which the exploitation of the geothermal energy seems to be favourable.

According to article 10 of the Mining Act, the Minister calls a public tender for concession, in which – in addition to the general contents set up in the *Act XVI of 1991 on Concession* – the location of the concessional area with the indication of other already existing bids owned by a third party, activities to be performed in the frame of the concession, a work programme and the regulations set up in the complex vulnerability and impact assessment, as well as securities serving its performance are determined. The call also has to inform about the tendering conditions, payment duties, regulations about remediation and guidelines of evaluation. The public call has to be published in the official journal of the European Union.

According to article 12 of the Mining Act, the Minister shall conclude a concessional contract with the winner of the public competition, in which the duration of the concession, the work programme and the securities serving its performance are determined. The holder of the concession should establish a concessional enterprise for carrying out the mining activity within 90 days of the signature of the contract (13§).

The contract may be concluded for a period of not more than 35 years, which may be extended on one more occasion, by not more than half of the term of the concession contract. According to article 14 of the Mining Act, the planned period of prospection for geothermal energy cannot be longer than 4 years within the period of the concession. This may be extended on not more than two occasions, by half of the original period of prospection per occasion. Within the period of 1 year of the completion of the prospection, the mining entrepreneur may initiate the designation of a geothermal protection zone ('equivalent' of the mining plot). In case the concessional activity is due to an environmental impact assessment (see *Governmental Decree 314/2005 (XII.25.)*), than the period of this procedure does not fall within the 1 year.

Concession license (22§) gives an exclusive right to the entrepreneur to submit a technical operation plan, and —in case of its approval — the commencement of geological exploration (instrumental measurements, analyses, drillings), and the initiation for the designation of the geothermal protection zone based on the accepted closing report of prospection. The special rules of exploration, exploitation and utilization of geothermal energy are summarized by Mining Act Section 22/B. According to this, in closed areas (> -2,500 m) geothermal energy can be exploited solely from the geothermal protection zone, which is designated by the mining inspectorate. According to article 15 of the Mining Act utilization for energetic purposes should be commenced within 3 years after the designation of the geothermal protection zone, otherwise refund must be paid, in default whereof the concession shall be discontinued.

According to article 22/B of the Mining Act, licensing of exploitation and utilization of geothermal energy on open areas without water license (i.e. ground-source heat-pumps) falls in the competence of the mining inspectorates, based on **the GKM /Ministerial Decree 96/2005 (XI.4.) on the regulations of certain building processes concerning special buildings**. Exploitation and utilization of geothermal energy from the Earth's crust above a depth of 20 m from the natural surface requires no licenses, however this does not free the entrepreneur from obtaining other necessary permits.

Requirements of water permits are regulated in the legislation related to water management and environmental protection. Basic framework is given by articles 28-29 of the **Act LVII of 1995 on water management** and article 12 of the **Governmental Decree 219/2004 (VII.21.) on the protection of groundwaters**. According to this the Inspectorates for Environment, Nature and Water can issue a water permit only in case the water use does not threaten the safety of the water resources and it is in line with other regulations related to the protection of water budget, groundwater resources management and water quality. A new water permit can be issued only if the required amount of water is available, i.e. a water license for abstraction can be issued only in those cases, when exploitation – taking into account all existing water abstractions in the given region – does not threaten the achievement of environmental targets and the performance of those measures determined in the **Governmental Decree 221/2004 (VII.21.) on certain rules of river basin management**.

Contents of the application form and its annexes to be submitted for granting the water permits are standardized in **KHVM / Ministerial Decree 18/1996 (VI.13.)**. Applications for the planning (preliminary)-, construction- and operation permits have to be submitted to the regional Regional Inspectorates for Environment, Nature and Water.

Water permits have different types. The planning (preliminary) permit describes the general water management objectives and basic technical parameters of the planned activity and determines the amount of water to be used in the future (which is registered as reserved water resource by the Inspectorates and is considered during new applications), but it does not authorize for drilling of a well, or any kind of water utilization. The construction permit is necessary for drilling, reconstruction, or abandonment of a well, while only the operation permit authorizes for the execution of water use within the given period.

According to article 1 and Appendix 1, the application for a planning (preliminary) permit should contain the aim of the planned water use, the quality and quantity of the water to be abstracted, time schedule, planned methods for water treatment, technology of the acquisition, results of preliminary investigations (if there were any), location map, area to be effected by the well, other water uses, etc.

Article 2 and Appendix 2 gives provisions on the content of the application for a construction water permit which has to contain the documentation of the property rights. The application has to give information on the category of water use (private, public), utilization purpose



(agriculture, balneology, energy), the type of the targeted water resource/aquifer (fissured, karstic, porous), groundwater temperature, exact location of the drilling (settlement, coordinates, etc.). Furthermore information has to be provided on the detailed use of the groundwater (quality, quantity, mean- and maximum values), technical parameters for operation (periodical, continuous), detailed technical parameters of the well (depth, diameter, screened intervals, etc.), yields (l/sec, m<sup>3</sup>/day), the type of the well (free outflow, or pumped, in the latter case the technical parameters of the pumping), other technical devices associated with the well, water sampling facilities, protection of the water resources (protection zones). The application for the permit has to contain also a geological description (lithological chart of the well) as well a hydrogeological model including hydrogeological parameters of the units, recharge and discharge conditions of the groundwater resources according both to the natural state (before water abstraction) and to the operation of the well. The hydrogeological model has to assess the effects all other water abstractions on the targeted area, too, including water resources reserved in already issued preliminary permits, as well as the description of water quality. The application for the permit should describe the potential contamination sources according to Appendix 3 (communal, industrial, agricultural, transport, mining, other) and actions for protection (e.g. establishment of a monitoring system, different restrictions, etc.). The documentation has to provide an action plan to prevent environmental damage, too.

According to article the most important parts of an operational water permit are the name of the operator, in case of any deviations from the construction permit the detailed technical documentation of the real status, results of testing, the conditions, rights and obligations of operation and a hydrogeological report.

The water permits can be modified both by the applicant and by the inspectorate. According to article 11, the water permit can be modified on the request of the license holder in case of the reconstruction of the well, different type of utilization as defined in the water permit, different amount of water to be exploited, or the owner/operator has changed. For the amendment all documentation has to be attached, which are relevant for the evaluation of the required modification. According to article 12, the permit can be modified by the authority in case conditions – on the basis of which the permit was issued – have changed, especially regarding the amount, the abstraction limit value (Mi), or contamination limit values of the available water resources.

According to article 14, the water permit can be withdrawn, if the license holder does not fulfil his obligations, or the conditions – on the basis of which the permit was issued – have been fundamentally changed. Articles 15-16 give provisions on the wells constructed/operated without permission. Under special circumstances a special remaining permit can be applied for. Article 18 regulated different fines.

In the field of district heating, two authorities are empowered: the Hungarian Energy Commission and the local government. According to *Act XVIII of 2005 on district heating*

(articles 4-8) the Hungarian Bureau of Energy is the responsible authority in case that heat energy and electrical energy are produced in a construction, either separately, or combined and heat energy is produced partly, or completely for district heating. For this reason a permit for the installation and a permit for the operation of a heat producing construction are granted by the Hungarian Bureau of Energy. In all other cases, (i.e. producing only heat energy for district heating, but no electrical energy), the local government is the responsible authority.

***Summary on licencing procedure and its steps***

Exploitation of geothermal energy in Hungary is under a dual regulation of mining and environmental protection – water management. Utilization of geothermal energy falls within the scope of the Mining Act XLVIII of 1993, except for cases when it happens with production of groundwater (1§). In this latter case the provisions of the environmental and water management legislation have to be considered. In view of that, the licensing procedure is also two-folded and depends on two basic facts: whether the geothermal utilization happens with or without the abstraction of thermal water, and on the depth (below or above - 2,500 m, i.e. whether it is obliged to concession or not, according to the Mining Act). Accordingly, the licensing procedure can be initiated at the ‘green authorities’ (above -2,500 m, with water production), or at the mining authorities (below -2,500 m, without water production). However in all cases the partner authority takes part in the licensing procedure as consulting co-authority (Table 5).

Table 5. Flow chart of licensing procedures

Depth below surface (m)			Licensing Authority	Consulting co-authority
0-20				
20-2,500	Open area	Closed loop, no water produced (GSHP)	Regional Mining Inspectorate	
		Abstraction of thermal water	Regional Inspectorates for Environment, Nature and Water	Regional Mining Inspectorates (technical-safety licensing of deep drilling)
Below 2,500	Closed area (concession procedure)	Abstraction of thermal water	Regional Mining Inspectorates (concessional procedure)  Regional Inspectorate for Environment, Nature and Water (water permits)	
		without production of	Regional Mining Inspectorates	Inspectorate for Environment, Nature

		thermal water (EGS)		and Water (environmental impact assessment)
--	--	------------------------	--	---

Furthermore, local municipalities also have a decisive role in licensing affairs. The Hungarian Bureau of Energy has got a prime role in power plants, electricity, gas network issues and setting the trade-in prices. It has no regional authorities.

The licensing/permission procedure is always conducted by the responsible authority (see ‘licensing authority’ in Table 5) that has to collect and incorporate the opinion of the participating co-authority, so this is not the task of the applicant (however the applicant has to provide all necessary documentations). (Principle of ‘concentration’ or ‘one-stop shop’ according to *Act CXL of 2004 on the general rules of administrative official procedures and services*).

### Steps of licensing

1. To carry out a preliminary surface survey, the company needs to have an agreement with the caretaker/user of the land and report the commencement of prospection to the mining authorities 30 days in advance (surface survey itself does not require a permit from the mining inspectorate). The report has to contain the exploration plan (text and map showing locations) (Mining Act, 4§).
2. Exploitation of geothermal energy in Hungary down to a depth of -2,500 m is happening all the time with the abstraction of thermal water (except for GSHP-s), so they licensing falls in the competence of the responsible Regional Inspectorates for Environment, Nature and Water, where the application has to be submitted. The procedure of licensing (applications for the planning (preliminary)-, construction- and operation permits) are regulated in KHVM / Ministerial Decree 18/1996 (VI.13.), and in Governmental Decree 72/1996 (V.22.) (see details in the legislation overview).

The licensing procedure of the production and reinjection wells has to be handled separately, however the procedure is rather the same for both drillings.

The technical-safety licensing of the drilling is issued by the Mining Inspectorates.

In case of activities fall within the scope of an environmental impact assessment study, the user must obtain a valid environmental permit (also issued by the green authority) before starting activities. Details are given in the *Governmental Decree 314/2005 (XII.25.)* (see legislation overview).

3. Below -2,500 m geothermal energy (with, or without thermal water abstraction) falls under concession, whose steps are given in the Mining Act articles 8-19 as well as in *Governmental Decree 103/2011 (VI.29.)* (for details see legislation overview).

Environmental permit, and (if necessary water permits) are issued by the green authority (see above).

*For Ch. 10: Are there any interference between different regulations or any problems with misinterpretation?*

### **3) Environmental Impact Assessment: requirements / procedure**

According to *Governmental Decree 314/2005 (XII.25.) on environmental impact assessment* an EIA has to be prepared for activities that include thermal groundwater abstraction exceeding 5 million m<sup>3</sup>/year, or re-injection of 3 million m<sup>3</sup>/year for the generation of electricity or direct heat, or in all cases where thermal groundwater exploitation from karstic aquifers exceeds 500 m<sup>3</sup>/day, or 2000 m<sup>3</sup>/day from porous aquifers. Furthermore, an environmental impact assessment has to be prepared for geothermal power plants of 20 MW, or more, and for all power plants without output restrictions which are established within the protection zone of mineral-, medicinal-, or drinking water resources, or on nature protection areas.

The environmental impact assessments are licensed by the Regional Inspectorates for Environment, Nature and Water.

### **4) Environmental objectives / constraints**

In Hungarian legislation environmental objectives are widespread and are present from the very first phases of exploration, through exploitation and utilization.

In a preliminary phase of exploration, related to the concessional procedure, the aim of the complex vulnerability and impact assessment (*Governmental Decree 103/2011 (VI.29.)*) is to determine those areas, where mining activity cannot be performed due to environmental- and nature protection, water management and protection of water resources, protection of cultural heritage, - agriculture, public health, national defense, land-use, transportation issues, as well as mineral resource management. Furthermore the aim of the study is to set up the rules of the mining activity to be performed in the frame of the concessional contract.

Study is performed for those closed areas, where exploitation of geothermal energy can be potentially favourable taking into account available geological data as well as initiatives from entrepreneurs. The detailed content of the study is listed in Appendix 2 of the decree. It includes the geographical location of the area, description of land-use, geological, hydrogeological, tectonic characterization and status of previous exploration, protected areas related to the water management plans, status of the surface- and subsurface (ground)water bodies, their monitoring, rate of groundwater abstraction, other valid licenses for exploration and exploitation. The study also summarizes data related to the geological environment of geothermal energy, expected amount to be exploited, foreseen exploration and exploitation methods, introduction of the energy concept, duration of activity and forecast of

environmental impacts with a special regard to surface and subsurface (ground)water bodies, drinking water resources, areas of natural protection (Natura 2000), and possible transboundary effects.

According to article 4, The Hungarian Office for Mining and Geology (who is responsible for the compilation of the study) sends the report to the public authorities listed in Appendix 1 for comments and supplement with further specific data. These authorities determine those areas where mining activity cannot be performed, or only with certain restrictions.

Major set of laws regarding environmental objectives and constrains are set up in the Acts on the general rules of environmental protection and on water management and related governmental decrees. These provide a general framework for protection of waters (including groundwater) in line with the Water Framework Directive. The ***Governmental Decree 221/2004 (VII.21.) on certain rules of river basin management*** integrates all actions that are necessary to achieve targets of good status of waters determined in the *Water Framework Directive*, and determines the content of the river basin management plans.

There hardly, if any articles that are specifically phrased for thermal waters. Therefore environmental protection and water management-related legislation associated with the utilization of thermal waters (for energetic or balneological purposes) are encompassed in these general formulations.

Basic principles regarding the protection of waters are given in articles 18-21 of the ***Act LIII of 1995 on the general rules of environmental protection*** and in article 15 of the ***Act LVII of 1995 on water management***. According to these the protection of water in general encompasses the protection of surface and groundwaters, their reserves, quality (including temperature conditions) and quantity, their natural aquifers (such including thermal water reservoirs). Groundwater resources can be utilized only to that extent that the dynamic equilibrium of recharge and abstraction is maintained without quality deterioration, and targets related to the good status of waters phrased in the *Water Framework Directive* are achieved. The actions to achieve the good status have to be determined in the river basin management plans, which details are regulated in the ***Governmental Decree 221/2004 (VII.21.)*** (see there).

Article 15 of the ***Act LVII of 1995 on water management*** defines priority to satisfy water demands as the following:

- water uses aimed at substantial drinking water supply, public health and emergency responses to disasters
- medicinal purposes, as well as direct services of the population
- livestock watering, fish-farming
- nature conservation
- economic
- other activities (such as sport, recreation, tourism, balneology)

This means that thermal water abstraction for energy production, as economic activity is placed at a low level of the hierarchy.

The aim of the *Governmental Decree 219/2004 (VII.21.) on the protection of groundwaters* is to regulate tasks, rights and obligations associated with ensuring and maintaining the good status of groundwater, progressive reduction and prevention of their pollution, a sustainable water use based on the long-term protection of available groundwater resources and the remediation of the geological medium.

In terms of thermal groundwater, their qualitative status has been primarily investigated, as due to overexploitation drops in groundwater level / hydraulic head is registered at many places. According to the decree a groundwater body is in good quantitative status if the long-term (min. 6 years) annual abstraction rate does not exceed the available groundwater resource determined in the *Governmental Decree 221/2004 (VII.21.)*, abstraction does not cause a permanent decrease in groundwater level or hydraulic head, ecological or chemical status of associated surface waters are not threatened by any deterioration in the coupled groundwaters. Further criteria are that no alterations in the subsurface flow directions take place which could cause significant changes in the chemical or physical status of the groundwater body and no groundwater-dependant terrestrial ecosystems are damaged.

A groundwater body is in good chemical status if its monitoring proves no contamination, measured values do not exceed the thresholds, water quality does not hinder to achieve the environmental objectives of associated surface waters, and no groundwater-dependant terrestrial ecosystems are damaged.

A groundwater body is in good qualitative status if it has good chemical status and its temperature does not decrease to such extent which may cause changes in its chemical or qualitative status, or flow paths and does not disturb utilization.

According to article 7, groundwaters have to be classified according to their status and level of protection, considering their recharge, transmissivity of the aquifer and the protected areas. Guidelines of classifications are listed in Appendix 2. According to this, the hydrogeological protection zones of the water abstractions for mineral and medicinal waters are considered as outstandingly vulnerable areas to be protected.

According to article 9, in order to achieve the good quality status, water abstraction cannot exceed the abstraction limit value (Mi) and cannot cause the physical or chemical deterioration of the groundwater body. According to the *Governmental Decree 221/2004 (VII.21.) on certain rules of river basin management*, the abstraction limit value (Mi) should be determined for the different parts of the groundwater body ensuring that abstractions do not endanger to achieve the environmental objectives, do not cause permanent drop in the groundwater table / hydraulic head and do not result the mixture of other surface or subsurface waters causing unfavourable changes in quality. Articles 4–5 list those activities,

which cannot be carried out (or only with restrictions) on the areas being vulnerable regarding groundwaters.

***KvVM /Ministerial Decree 30/2004 (XII.30.) on certain rules of examination of groundwaters*** applies to the designation, characterization, status assessment, monitoring of groundwater bodies, as well as the collection, processing and reporting of data necessary for the execution of these tasks.

According to article 3, water bodies should be designated on the type and occurrence of the aquifer, such as karstic formations, non-karstic and porous formations of basin areas, and formations of non-karstic mountainous areas. Based on the outflow temperature, the 2 main categories are cold waters with a temperature below 30 °C, and thermal groundwaters with temperature exceeding 30 °C.

According to article 9, the status of groundwater bodies has to be evaluated and assessed according to Appendix 2. During the quantity status assessment the relationship of the contents of the application form and its annexes to be submitted for granting the water permits – determined in the *Governmental Decree 221/2004 (VII.21.) on certain rules of river basin management* – and real load (amount of exploited water) has to be investigated by the followings tests: water budget test (ratio of recharge and abstraction), surface water test (effects on related surface water body), ecosystem test (effects on related terrestrial ecosystems), flow pattern test (admixture of saline, or other chemical types of waters).

During quality status assessment the following tests have to be performed: general water quality test (to determine spatial distribution of contamination), surface water test (contamination effects on related surface water body), ecosystem test (contamination effects on related terrestrial ecosystems), drinking water test (contamination effects on drinking water reserves), temperature test.

For the chemical status assessment the background concentration of natural components has to be determined.

In addition to the above summarized sets of laws approaching the protection of groundwater reserves (such including thermal waters) from a river basin management / groundwater body quantity/quality status point of view in line with the Water Framework Directive, article 14 of the ***Act LVII of 1995 on water management*** introduces the terminology of protection zones, also related to mineral and medicinal waters, which is regulated in details under ***Governmental Decree 123/1997 (VII.18.) on the protection of water resources***. According to article 2, the protection of such groundwater resources means the delineation and maintenance of protection blocks and zones, which have to be divided into inner-, outer- and hydrogeological protection zones. The boundaries of these zones have to be outlined on the basis of hydrogeological conditions, the actual, or potential water exploitation of the water resource, and details provided in Appendix 2.

According to article 3, the task of the inner protection zone is the technical protection of the well itself and the protection of the water resource from direct contamination. The outer protection zone should safeguard the water resources from other degrading and bacterial contaminations, while the hydrogeological protection zone should protect the resources from non-degrading contamination which has to be outlined for parts, or for the entire recharge area.

According to article 4, the dimensioning of the protection zones is based on the travel times, calculated from permanent groundwater flow velocity (i.e. the time necessary for a pollutant, or water particle to reach the abstraction site).

Article 8 summarizes the main aspects of delineation of the different protection zones, such as the targeted depth interval, the amounts of water with abstraction permits, brief geological, characterization of the aquifers of the protected water resources, restrictions in land-use, necessary measures and monitoring and their assessment.

According to article 10, only those activities can be performed in the different protection zones, which do not endanger the quality or quantity of the water to be abstracted. Article 11 regulates and gives restrictions for activities to be performed in the inner protection zone, article 12 for the outer protection zone and article 13 for the hydrogeological protection zones. Such activities are potential pollutions from agriculture, animal farming, industry, etc. The detailed list of the prohibited activities in the different zones is listed in Appendix 5.

According to article 5 of the *Governmental Decree 121/1996 (VII.24.) on the establishment and utilization of public baths* water resources providing water for public baths have to be protected and protection zones have to be delineated and maintained according to Governmental Decree 123/1997 (VII.18.).

At last, but not at least, in addition to the above outlined two major approaches on environmental objectives (groundwater body status assessment and protection zones of groundwater resources), the third major set of laws is really specific to the sustainable utilization of thermal groundwaters and is associated with re-injection.

According to article 21 of the *Act LVII of 1995 on water management* the utilization of water, their load, the input of used and wastewaters into water bodies – after a necessary treatment – can happen only in a way that does not threaten the natural processes and the quality and quantity renewal of the water reserves. Article 15 explicitly states, that thermal water abstracted solely for geothermal energy utilization has to be re-injected. Further general provisions of re-injection are given in *Governmental Decree 219/2004 (VII.21.) on the protection of groundwaters* (article 10: to prevent re-injection of contaminating materials into groundwaters and to limit those activities which would cause the deterioration of the good chemical status of the water body, or would permanently increase the concentration of contaminating materials, article 13: the re-injected groundwater does not contain any



materials different from the originally abstracted water, and thus does not cause the deterioration of water quality).

***Governmental Decree 147/2010 (IV.29.) on the general regulations related to the activities and establishments serving the utilization, protection and mitigation of damages of waters*** comprises the most important regulations concerned re-injection of thermal groundwater.

According to article 10, waterworks (wells) aiming water production solely for energetic purposes have to be planned in a way, that their operation does not affect unfavourably the discharge and temperature of thermal karstic springs. The thermal groundwater abstracted for energetic purposes has to be reinjected to the same aquifer after utilization.

According to article 11, thermal groundwater can be utilized for medicinal and other health purposes, as drinking – and mineral water, for balneology, warm water supply in households, heat production and generation of electricity. During the planning of utilization, a multi-purpose (cascade system) operation and economic water use should be targeted. The utilization of accompanying gases should be also considered. During the construction of a waterworks using thermal groundwater, the safe disposal of utilized water, especially their reinjection has to be taken care of. Throughout the selection of a potential surface reservoir, environmental aspects and natural recharge processes have to be considered. Thermal water for household warm water supply can be delivered to the pipeline system only if the water meets the quality requirements of drinking water. If the thermal water is a certified mineral-, or medicinal water, than water treatment has to be designed on the basis of individual analyses. Medicinal waters can be treated only by a technology that does not weaken its healing effect.

In relation to reinjection, the provisions of this decree have to applied in licensing procedures starting after the decree comes into force, except for those activities, which preliminary water permit was already issued before (78§). Operational water permits applied for after December 22, 2012 and their prolongation are under the scope of this decree. An exemption can be applied for those users, who abstract thermal water solely for energetic purposes from groundwater bodies of poor, or declining quantity status (according to the assessment in the river basin management plans) till December 22, 2014, and till December 22, 2020 in case thermal water is exploited from groundwater bodies of good quality status.

However, due to recent lobbying from the agricultural sector, a recent legislation (***Governmental Decision 1002/2012 (I.11.) on the exemption of re-injection of thermal water used for energetic purposes in agriculture***) prolonged the deadline of compulsory re-injection of Dec 22, 2014 till June 30, 2015 for thermal waters users for energetic (direct heat) purposes in the agriculture sector. This exemption stands both for already existing and planned wells. This decision does not change the deadline of December 22, 2020. Furthermore, the decision requires preparing a suggestion for the government till February 1, 2012 about the modifications of the related acts and legislations, with a special attention to

the surface disposal of used thermal water and modification of the different water permits. The Government asks the Minister of Rural Development (responsible for water management issues) to prepare a long-term concept of thermal water utilization in the agricultural sector considering sustainability, economic aspects, related tasks and their timing till May 31, 2012.

***Governmental Decree 220/2004 (VII. 21.) on the protection of surface waters*** is relevant when discussing of releasing used thermal water (without re-injection) into surface waters, which may contaminate them, as thermal waters may contain natural components (e.g. remnants of hydrocarbons, some metal compounds) listed as ‘hazardous materials’ for surface waters in the Appendix 1. The Decree discusses in details the waste water fine and Appendix 2 provides its detailed calculation method.

***KvVM / Ministerial Decree 28/2004. (XII. 25.) on the threshold values of water contaminating materials and on certain rules of their application*** contains provisions on the thresholds values of various contaminating materials in different fields. Chapter 34 specifies threshold values (allowed before inlet) in case of thermal water utilization in 3 categories: medicinal, balneological, and energetic. The highest allowable threshold values are provided for the medicinal utilization (thus appreciating its economic and public health value), while lower values are allowed for balneological and energetic utilization (e.g. allowed total dissolved content is 5000 mg/l for medicinal waters, 2000 mg/l for spas, and 3000 mg/l for energetic utilization). The allowed heat load is 30 °C in all 3 categories (i.e. this is the maximum allowed temperature at which thermal water can be released at the surface).

The last topic related to environmental constraints is related to waste management during the drilling of thermal water wells. The produced waste (e.g. drilling mud, drilling devices) has to be handled according to the provisions of the **Act XLIII of 2000 on waste management**.

## **5) Technical requirements, recommendations and standards**

Major technical standards related to the completion of boreholes and mining activity in general are covered by the ***Mining Act XLVIII of 1993***. Mining activity can be only carried out on the basis of an approved technological-operation plan (Act 27§), which should be prepared by taking the following aspects into consideration: the rules related to technical safety, health protection and fire-protection, the requirements of mineral resource management, water management as well as environmental protection, nature conservation and landscape protection. The content of the technological-operation plan is regulated by article 13 of the ***Government Decree 203/1998. (XII.19.) on the execution of the Mining Act***, and it is approved by the mining inspectorate.

***KvVM / Ministerial Decree 24/2007 (VII.3.) on water safety regulations*** discusses in details all technical and safety issues related to activities associated with waterworks, such as drilling

of wells, water treatment, establishment and operation of baths, etc. including their planning, construction, operation, reconstruction, abandonment, etc.

The scope of the *KvVM / Ministerial Decree 101/2007 (XII.23.) on the rules of intervention to groundwater resources and guidelines to the drilling of wells* covers all activities related to the planning, execution and operation of production-, reinjection- and monitoring wells, as well as the rights and obligations of their technical designer, constructor and supervisor.

During drilling a wide range of geophysical, technical, and hydrodynamic measurements have to be performed, which are listed in Appendix 1. These are the following:

- Geophysical logging: SP, gamma, resistivity, as additional measurements: neutron-porosity, micro-resistivity, bottom-hole temperature, acoustic, thermal logging, mud-resistivity, magnetic susceptibility, etc.
- Technical measurements, e.g. checking of inner diameter and bottom, position of screens, etc.
- Hydrodynamic measurements: flow and thermal logging at max. yield (below 100 m – bottom-hole temperature, below 500 m – continuous thermal logging), well capacity (at 80, 60 and 40 % yield), pressure gradients, etc.

The Decree also contains the types and frequency of measurements to be performed which are scheduled in the operational water permits issued by the water authority. There are separate details on the examinations to be performed regarding mineral and medicinal wells. In production and re-injection wells yield, well-head pressure, or operational water level and temperature has to be measured and registered according to the operational rules but at least every day, preferably with a digital data acquisition system. Temperature, water level and well-head pressure have to be measured and recorded in the inactive wells serving water level and water pressure observation at least once a week. More frequent measurement and registration may be required in the operation regulation. In the frame of the monthly control of active, continuously operating thermal wells, operators have to determine well-head pressure, operation water level and outflow temperature of the operation time. In addition to these regular tests, periodical examinations have to be performed before and after maintenance and transformations, but at least in every four year. Some tests e.g. gas test have to be performed in a frequency prescribed by a special measure.

A separate article (5/A) discusses thermal wells. According to this, a thermal well has to be equipped with a special well-head that makes possible the differential water abstraction following the actual water demand, thus the economical and sustainable utilization of thermal groundwater bodies. Thermal wells have to be outfitted with devices that are resistant to changes in temperature and aggressive waters. It also has to be considered to hinder scale precipitations and make it possible to remove them.

*KHVM Ministerial Decree 12/1997 (VIII.29.) on the degassing of the produced and supplied waters* is relevant, because thermal groundwaters often have a high gas content.

According to article 1, the scope of the decree covers all waterworks that are related to the production, treatment, storage, transport and supply of these waters, which have to be regularly controlled by the license-holder (in every five years in category “A”, in every three years in category “B”, in every two years in category” C”).

A groundwater is classified as gas-contented, which has dissolved hydrocarbon content determined at a pressure of 1013 millibars and 20 °C temperature in the following three categories: class A: below 0,8 l/m<sup>3</sup>, class B: between 0,8-10 l/m<sup>3</sup>, class C: above 10 l/m<sup>3</sup>.

According to article 2, during the water permitting procedure, the license holder is obliged to measure the gas content of the abstracted groundwater during the probe-tests, and if necessary, to modify the water permits accordingly.

Article 3 summarizes the different de-gassing procedures for the categories B and C. De-gassing has to be performed in away, that it does not cause the deterioration of water quality.

According to the *EüM/ Ministerial Decree 74/1999 (XII.25.) on the natural medicinal factors* the operator of the water supply is obliged to make quality check measurements at his own costs in each 5 years in case these waters are used externally, and in each 2 years if they are also used internally.

## **6) Exploitations rights**

According to article 6 of the *Act LVII of 1995 on water management* (ground)waters and their natural aquifers are in state property. Similarly according to 3§ of the *Mining Act XLVIII of 1993*, mineral resources and geothermal energy are, at their natural place of occurrence, in state property. As (minerals and) geothermal energy are exploited for energetic use, they are transferred into the property of the mining entrepreneurs, who pays royalty (20§). Similarly the user, who abstract (thermal) groundwater, has to be pay a water resource fee. In this chapter the legal background of these two fees is discussed in details, as being directly related to exploitation.

According to article 20 of the Mining Act the rate of the mining royalty shall be 2 per cent of the value of the exploited geothermal energy. No mining royalty needs to be paid for geothermal energy exploited from an energy carrier of a temperature not higher than 30 °C or for the quantity of geothermal energy which utilization rate exceeds 50% (such supporting efficient utilization).

According to article 4 of the *Government Decree 203/1998. (XII.19.) on the execution of the Mining Act* royalty shall be defined in a self-assessment and shall be paid to the account of the central budget separated for this purpose. Section 34 defines the utilized quantity of geothermal energy as the part utilized for the purposes of energy generation of the quantity exploited from the energy carrier with a temperature exceeding 30 °C. In this respect the person using geothermal energy for medical, balneological, or water supply purposes on the

basis of a water license, shall not qualify as a mining entrepreneur, even if the exploited thermal water is used also for the purposes of a secondary energetic utilization (i.e. heating of a spa), therefore has to pay only water resource fee (see below) and no mining royalty.

**Governmental Decree 54/2008 (III.20.)** determines the specific value of geothermal energy and its calculation methodology. According to article 3, the value derived from the geothermal energy – exploited for the purposes of the generation of energy – can be determined as the multiplication of the amount of the exploited energy (E) (from a carrier of a temperature at least 30°C) and the specific value.

According to the Annex 1/b of the Governmental Decree, the specific value – in case of its direct exploitation together with the geothermal carrier ('thermal groundwater') is 1650 Ft/GJ, whereas in case of the heat transfer material being recirculated in the Earth's crust, the specific value is 325 Ft/GJ. The amount of geothermal energy exploited for the purposes of the generation of energy must be measured by the entrepreneur: temperature and amount at the well-heads and the temperature of the energy carrier ('thermal water') at the heat exchanger outflow point. Based on this the exploitation of geothermal energy coupled with water extraction:

$$E = V \cdot (T_{wh} - T_{he}) / 2 \cdot 0,004186, \text{ where}$$

E = the amount of exploited energy in GJ

V = volume of exploited water (m<sup>3</sup>)

T<sub>wh</sub> = temperature at wellhead (°C)

T<sub>he</sub> = temperature at heat exchanger outflow (°C)

Mining royalty in thousand Forints:  $E \cdot 1650 / 1000$

In case of the exploitation of the geothermal energy via the circulation of secondary heat-exchanger fluids:

$$E = V \cdot (T_{wh} - T_{he}) / 2 \cdot T_f, \text{ where}$$

E = the amount of exploited energy in GJ

V = volume of exploited energy carrier at the well-head (m<sup>3</sup>)

T<sub>wh</sub> = temperature at wellhead (°C)

T<sub>he</sub> = temperature at heat exchanger outflow (°C)

T<sub>f</sub> = specific heat of the circulated fluid GJ/m<sup>3</sup> • °C

Mining royalty in thousand Forints:  $E \cdot 325 / 1000$

Article 15/A of the **Act LVII of 1995 on water management** regulates water resource fee, which the user is obliged to pay to the state after the amount of water used, or reserved in the water permits for construction and operation. According to article 15/C no water resource fee

has to be paid after the amount of groundwater re-injected into the same aquifer. Water-resource fee to be paid for the thermal groundwater abstracted solely for energetic purposes can be reduced (max. to the extent of the water resource fee) by the amount to be spent for construction of a re-injection well in the given year.

Details of calculation of water resources fee are given in ***KHVM / Ministerial Decree 43/1999 (XII.26)***. The water resource fee is based on the amount of used water, the basic fee (defined in the *Act on the State budget*, yearly), and modification factors which aim to distinguish between the “value” of the water:

$$VKJ = V \text{ (m}^3\text{)} * A \text{ (Ft/m}^3\text{)} * m * g$$

V: amount of used water

A: basic fee

m: modification number (non-measured water use: 2, measured water use: 1)

g: modification number according to the type of utilization and water resource. In case of thermal groundwaters the ‘g’ values are the following:

	medicinal	public	drinking water	bath	other
medicinal water	1	5	5	5	10
thermal water (>30 °C)	1	1	3	3	7.5

According to article 5, the amount of used water, on the basis of which the water resource fee is paid, has to be measured by a continuously measuring, certified water clock which has to be equipped at the well-head.

An important issue to be mentioned related to exploitation rights is related to the term of “geothermal protection zone”, solely from which geothermal energy can be exploited in closed areas (> -2,500 m) (*Mining Act Section 22/B*). Elaboration of the scientific and technical content of the determination of the geothermal protection zone is still an ongoing process in the frame of recent modification of the *Act XLVIII of 1993 on mining* and the *Governmental Decree 203/1998 (XII.19.) on the execution of Act XLVIII of 1993 on mining*.

According to the recommendations in the case of exploitation of geothermal energy with deep circulation of fluids, but without the abstraction of thermal groundwater, the protection zone has to be outlined at that part of the subsurface, where temperature change within 25 years is less than 10 °C. In those cases where geothermal energy is exploited by the abstraction of thermal groundwater (hydrostatic reservoirs), the threshold values are temperature changes less than 10 °C, and pressure changes less than 1 bar within 25 years, while in overpressured reservoirs only the temperature limit (less than 10 C) stands.

## 7) Monitoring requirements

**Water Framework Directive** sets the standardized regulations at EU level for groundwater monitoring of in Hungary. The cited regulations concern groundwater monitoring in general, no specific sets of laws are related to the monitoring of thermal waters exclusively. Specific requirements of measurements in thermal water wells are determined in *KvVM / Ministerial decree 101/2007. (XII. 23.) on the rules of intervention to groundwater resources and guidelines to the drilling of wells* (see under chapter technical requirements), but these are not related to monitoring.

The basic need for monitoring is articulated in the **Governmental decree 219/2004. (VII. 21.) on the protection of groundwater** which says that the significant and permanently declining hydraulic head / groundwater level, and the significant and steadily rising pollutant concentrations have to be identified in the groundwater bodies. In order to identify these threats, the groundwater has to be monitored. Based on the monitoring results the status of the groundwater body has to be assessed regularly, but at least in every 6 years related to the river basin management planning.

Monitoring has to be performed according to the provisions of the **Governmental decree 221/2004. (VII. 21.) on certain rules of river basin management**. The monitoring programme has to be planned, elaborated and operated in a way that is compatible with the technical specifications and standardized methods and procedures determined in article 21 of WFD in order to perform river basin management planning effectively and reliably.

According to article 12 of the **KvVM / Ministerial Decree 30/2004 (XII.30.) on certain rules of examination of groundwaters**, the decree changes in the quantitative and qualitative status of groundwaters have to be traced by monitoring that includes an observational network that detects the quality and quantity status of groundwaters influenced by natural processes and diffuse human effects (aerial monitoring). In addition it also includes a monitoring that supports the knowledge on the effects of point-like human activities influencing the quantity and quality of groundwater (environmental impact monitoring).

According to article 14 the detection and monitoring stations of groundwater body monitoring have to be recorded in the river basin management plan. The water body monitoring consists of a quantitative and a qualitative monitoring including chemical surveillance and chemical operational monitoring.

The quantitative monitoring provides information about long-term changes in groundwater level and hydraulic heads, as well as changes in the spring discharges. The quality monitoring outlines a coherent and comprehensive picture on the quality status of groundwaters and their effects on drinking water reserves and terrestrial ecosystems. In the case of transboundary aquifers, the density of the monitoring points and the frequency of observation have to be determined in a way that they are appropriate for the inventory and control of the impacts of

abstractions in the neighbouring countries, as well as for the determination of cross-border groundwater flow paths and discharges.

Annex no. 3. of the decree gives details about aspects on the establishment of the different groundwater body monitorings. According to this, the spatial density and frequency of observation of transboundary groundwater bodies has to be determined in the way that it should be suitable for a reliable review and control on changes in the hydraulic head due to water extraction and / or inlet as well as for the determination of the zone-budgets and groundwater flow direction crossing the border (see also at transboundary issues).

Based on this legislative framework the groundwater monitoring system in Hungary consists of two sub-systems. One of them is the so called areal monitoring that belongs to the sphere of the state and local governments and it is detailed and dense proportionally to the rate of the public interest.

**The areal monitoring system** includes the following elements:

- monitoring systems continuously operated by governmental organizations under the auspices of the Minister of Rural Development. These include the *quantitative* monitoring systems, such as observing unconfined and confined groundwater, karstic and thermal water pressures and water levels, spring monitoring systems, monitoring regarding the quantity and quality of surface waters related to groundwater bodies. These monitoring systems also include regular measurements regarding to the *quality*, and monitoring systems implemented for special observations of a certain area including strategic water reserves,
- other monitoring systems continuously operated by other state organizations (e.g. groundwater level monitoring system operated by the Geological Institute of Hungary, Soil Protection Information and Monitoring System operated by the plant and soil protection services, maintained by the Ministry of Rural Development)
- monitoring of quantitative and qualitative status of groundwater in the public administration area of the settlement performed by the municipal local governments
- periodical surveys performed by government bodies, scientific institutes and organizations and expedition surveys.

The other sub-system of the national monitoring system includes measurements and observations performed by environmental users. Measurements performed by waterworks, monitoring in connection with operation of industrial firms, waste deposition, drinking water reserves, mineral- and medical water usage, and activities related to water resource protection are ranked under **the environmental impact monitoring**. According to a special regulation remediation monitoring systems in contaminated, permanently damaged areas and measurements performed in the surroundings of emission sources and polluted areas are also part of the environment impact monitoring.



For the assessment of the status of groundwater bodies, related to the provisions of the Water Framework Directive, all elements of areal monitoring performed by the state, and environmental impact monitoring performed by the users are necessary. The monitoring assessing the status comprises not only the classical quantitative and qualitative observations, but data related to the use of the subsurface / groundwater aquifers whether they cover natural elements (e.g. groundwater dependant ecosystems), or man-made processes (e.g. sludge deposition).

Based on the *Act XLVI. of 1993 on Statistics*, data supply of the operators complements the regular monitoring measurements. In the frame of the National Statistics Data Collecting Programme - according to the *Government decree 288/2009. (XII. 15.)* - statistical data supply for water management purposes, survey and analysis is obligatory for regional and municipal waterworks, cities or locations having individual waterworks and other enterprises, institutions and organizations who provide water supply or sewage-disposal and treatment for the public. In the frame of the obligatory statistical data supply, user have to measure parameters as listed in Annex 3 of the *KöViM Ministerial decree 21/2002 (IV.25)*.

However the reporting to the European Commission does not require all individual data, therefore representative monitoring stations were determined for groundwater bodies, transboundary aquifers and protected areas. The national monitoring report sent to the European Commission on March 22, 2007, altogether 3,500 monitoring stations and observations were listed, which officially form part of the **EU-WFD monitoring program**. The monitoring program of the River Basin Management Plans was also established on this document. The document is a legal obligation towards the EU for the performance of the monitoring program.

The EU-WFD monitoring program is performed by the 12 regional Directorates for Environmental Protection and Water Management the 10 regional Inspectorates for Environment, Nature and Water, the Geological Institute of Hungary and the selected users. The selected users (waterworks, spas, etc.) have to perform measurements on their own wells (except for those situations, when they were previously measured by the Water Management Inspectorates). Data collection and control is the task of the Directorates for Environmental Protection and Water Management, with the contribution (if necessary) of the Inspectorates for Environment, Nature and Water (as authority at 1st instance).

## **8) Reporting requirements**

According to the *Mining Act XLVIII of 1993* (article 4) geoscientific data in general gained during the preliminary survey of exploration have to be sent to the Hungarian Office for Mining and Geology. Article 25 states that the mining entrepreneur has to send annually the geological data obtained in the course of the mining activity to Hungarian Office for Mining and Geology which operates the National Archive of Geological, Geophysical and Mining Data. Concerning the publicity of data, information for the site of prospection, the amount

and of the annual production and the holder of the exploration right are public. Data concerning technologies, exploration and exploitation methods, logistics, know-how supplied in the closing report and resource assessment are confidential during the period of the license

Handling of data related to water management is regulated in separate sets of laws.

**Government decree 178/1998 (XI. 6.)** states that a water management information system has to be set up and operated in order to gather, process and serve data for the water management tasks performed by the state and local governments. Its way and details are regulated in the **KHVM / Ministerial Decree 23/1998 (XI.6.) on the water management register of the water inspectorates** which states that groundwaters and their reservoirs, as well as related water reserves, their quality and quantity data are part of the national water registration system. The registration has to contain all associated hydrogeological, hydrological, technical data as well as relevant economic and legal facts and figures. The bases of the register are data fixed in the water permits. According to article 8, the preparation and maintenance of the water registers is the task of the Regional Directorates for Environmental Protection and Water Management. Water reserves have to be updated and re-assessed at 5 years, while changes in the water budgets related to the water use have to be evaluated continuously, but at least once a year.

Documentation and data supply obligations of completed wells are discussed under article 8 of **KvVM / Ministerial Decree 101/2007 (XII.23.) on the rules of intervention to groundwater resources and guidelines to the drilling of wells** A hydrogeological report has to be prepared in case the abstracted water is from porous, karstic or fissured aquifer, and the amount of exploitation/reinjection exceeds 1,5 m<sup>3</sup>/day, as well as for monitoring wells, if the well is representative for a given groundwater body and is part of the regional monitoring system. The hydrogeological report has to be prepared by the constructor of the well; its content is defined in Appendix 2. It should contain the basic data (cadastral number, coordinates, locality, etc.), drilling technology, geological log, casing and screening depths, operational data, flow curve, etc. The report are collected by the Inspectorates for Environment, Nature and Water, who are obliged to send a copy of the hydrogeological report to the Regional Directorate for Environmental Protection and Water Management as well as to the Geological Institute of Hungary.

According to **KvVM / Ministerial Decree 30/2004 (XII.30.) on certain rules of examination of groundwaters** all data related to monitoring are maintained and stored by the Inspectorates for Environment, Nature and (see also under chapter “Monitoring requirements”).

According to article 22 of the **EüM / Ministerial Decree 74/1999 (XII.25.) on natural medicinal factors** the National Health Office maintains the register of the mineral and medicinal waters, as well as balneological centres.

Appendix 1 of the *KvVM /Ministerial Decree 30/2004 (XII.30.) on certain rules of examination of groundwaters* provides a list about data and information that has to be collected continuously for characterization of groundwater bodies, such as location of water abstractions, utilization aspects, chemistry and temperature of exploited groundwater, depression areas related to water abstraction, quality and quantity of re-injected waters, potential contaminations on the recharge areas.

## 9) Transboundary issues

Hungary has seven neighbouring countries of which Slovenia, Austria, and Slovakia (Transenergy partners) are all EU Member states. With all neighbouring countries (in addition to Transenergy partner countries Romania, Croatia, Ukraine and Serbia) Hungary has valid bilateral agreements.

The oldest bilateral agreement is with **Austria**: “Agreement between the People’s Republic of Hungary and Republic of Austria in association with regulating transboundary water management issues”, which entered in force on July 31, 1959 (announced in declaration no. 32 of 1959 of the Council of Hungarian People’s Republic). The scope of the agreement encompasses border waters and waters within 6 km zone in each direction from the border, and deals only with surface waters and does not specify any questions related to groundwater management. A permanent Austrian-Hungarian Water Management Committee is set up, which holds a meeting once a year.

With **Slovakia** a bilateral agreement on transboundary water management became into force by the Decision of Council of Ministers 55/1978. (XII. 10.). The agreement focuses on surface waters, but also encompasses groundwater cut by the state border. A permanent Czechoslovakian-Hungarian Water Management Committee is set up, which holds a meeting once a year. The update of the agreement is ongoing. In addition to this bilateral agreement, Governmental Decision of 2093/1999. (V. 5.) on the general cooperation between the Republics of Hungary and Slovakia on environmental and nature protection discusses general aspects of protecting the environment and its elements (such including water), but no specific water- or groundwater relate points are included.

The water management issues between Hungary and **Slovenia** are governed by the Agreement among Slovenia and Hungary on the Water Management (Governmental decree 41/2001 (III.14.)). On the basis of this agreement a Permanent Slovenian – Hungarian Water Management Committee was establishing. Agreed topics include:

- surface water and groundwater reserves,
- protection and defence against the harmful effects of water,
- the use and exploitation of water,

- protection against pollution and irrational use of water, examining the quality of waters at State borders,
- examination of the effects of interventions on the environment,
- research, design, implementation and exchange of information relating to previous points.

The thermal groundwater issues were opened in 2011 meeting.

In general terms of transboundary water management, only scattered references are found in different sets of laws and no integrated approach, or detailed specifications are provided.

According to article 4 of the *Governmental Decree 221/2004 (VII.21.) on certain rules of river basin management*, in the case of transboundary aquifers, river basin management plans have to be prepared in co-operation with the neighboring countries. It has to be ensured that the status of water does not change disadvantageously at the state borders and to ensure a good status of waters as a result of mutual measures.

Article 2 of the *KvVM /Ministerial Decree 30/2004 (XII.30.) on certain rules of examination of groundwaters* states, that in case of transboundary aquifers, designation of groundwater bodies should be harmonized with the relevant country, involving the Geological Institute of Hungary. According to Annex no. 3. the spatial density and frequency of observation of transboundary groundwater bodies has to be determined in the way that it should be suitable for a reliable review and control on changes in the hydraulic head due to water extraction and / or inlet as well as for the determination of the zone-budgets and groundwater flow direction crossing the border.

## **10) Conclusions**

As there is no complex EU legislation regarding the utilization of geothermal energy, each member state elaborates its national legislation regarding the complex protection and management of groundwater resources based on the provisions of the Water Framework Directive and considering the geological-hydrogeological-environmental conditions of the country.

The regulation framework of geothermal energy utilization is rather complicated in Hungary; regulations and licensing procedures are shared by the mining, energetic, environmental protection and water management sectors. Despite the continuous efforts to legal harmonization, a number of contradictions exist among them which, together with the complicated licensing processes, make the work of users and potential investors fairly difficult. Therefore a uniform legislation of geothermal energy utilization would be indispensable. Some existing discrepancies and gaps are the following:

1. The **monitoring** of thermal water wells, their production is highly deficient, therefore the country **does not have an up-to-date and exact register** on the abstracted amount of thermal water. Based on the quantity status assessment of thermal groundwaters and modeling results, experts estimate much higher abstraction values than reported by the users. It would be essential to check whether all operating thermal wells are appropriately equipped with water measures, as required by the *KvVM / Ministerial decree 101/2007. (XII. 23.) on the rules of intervention to groundwater resources and guidelines to the drilling of wells.*

2. The **legislation** related to **water management and environmental protection** puts emphasis on achieving and maintaining the good status of groundwaters (quality and quantity), in line with the Water Framework Directive and prioritizes balneological utilization (*article 15 of the Act LVII of 1995 on Water Management*), consequently there are several **discriminations regarding energetic utilization**. This includes the higher allowed threshold value of contaminants of thermal waters released at the surface in case of balneological utilization. Legislation concerning the protection of surface waters against pollution (in this case the natural high dissolved content and man-made pollution from the inlet of used thermal water) groups the utilization of thermal waters into 3 main categories and defines different threshold values (*KvVM / Ministerial Decree 28/2004. (XII. 25.) on the threshold values of water contaminating materials and on certain rules of their application*). Balneological centres using medicinal waters (thermal waters with proven healing effect) belong to the first category, where their outstanding economic and public health value is prioritized and environmental protection aspects are subordinate, therefore threshold values are higher. Utilization in thermal spas (“wellness” without healing effect) belongs to the second category. In the third category, when only the heat content of the thermal water is used (direct heat purposes) the contamination of the water is not possible, as it is utilized in a closed system and its re-injection is otherwise compulsory (*Article 15 of the Act LVII of 1995 on water management*), the allowed threshold values are the lowest.

Waterworks using thermal water are obliged to **pay waste-water fine**, (details are given in the *Governmental Decree 220/2004 (VII. 21.) on the protection of surface waters*). The aim of the waste-water fine is to encourage the user for an economic and environmental-friendly utilization of water resources. However the differentiation in the threshold values – on the basis of which the waste water fine is defined – among the main utilization groups (see above) is discriminative regarding energetic utilization. Furthermore, in the case of a cascade system, when following direct heat utilization thermal water is used for balneological purposes too, the user pays a lower rate of waste-water fine (related to the higher thresholds set up for balneological utilization), and is not forced (just in contrary forbid!) to re-inject. It is clear that this legislation does not promote re-injection, which otherwise would be essential for the sustainable management of thermal water reserves.

The other discriminative example of thermal groundwater exploitation for energetic purposes comprises **multiple taxation** (water resource fee - *Act LVII of 1995 on water management*, mining royalty- *Government Decree 203/1998. (XII.19.) on the execution of the Mining Act*).

The person using geothermal energy for medical, balneological, or water supply purposes on the basis of a water license has to pay only water resource fee and no mining royalty, even if the exploited thermal water is used also for the purposes of a secondary energetic utilization (i.e. heating of a spa). However both water-resource fee and mining royalty has to be paid for the thermal groundwater abstracted solely for energetic purposes (with the given exemptions when the water resource fee can be reduced (max. to the extent of the water resource fee) by the amount to be spent for construction of a re-injection well in the given year)

3. The **exclusive usage** of a permitted groundwater reservoir of the applicant is **not guaranteed**. Therefore the reservoir can be used by several competitors and projects (sometimes from different fields of interest, e.g. hydrocarbon and geothermal exploration, geological storage of carbon-dioxide, etc.).

4. The legislation is slightly ambivalent regarding “**protection zones**”: while the delineation of the geothermal protection zone (mostly assessing the quantitative status of the reservoir, e.g. pressure field) is in the mining legislation, the protection zone of water resources (mostly from a qualitative point of view) is under environmental legislation. However the legislation about the specification of the geothermal protection zone (equivalent of the mining plot in case of exploitation of geothermal energy – *Mining Act XLVIII of 1993* section 22/B) is still under elaboration.

5. While the protection of **thermal groundwater** from a qualitative point of view is regulated in details (see protection zones against pollutants according to *Governmental Decree 123/1997 (VII.18.) on the protection of water resources*), its **quantitative protection** is rather deficient. *Governmental Decree 219/2004 (VII.21.) on the protection of groundwaters* defines the **abstraction limit value (Mi)**, and *Governmental Decree 221/2004 (VII.21.) on certain rules of river basin management* gives provisions about its establishment for groundwater bodies, however it has not been determined during river basin management plans. A few “good practices” exist (e.g. Lake Hévíz, transboundary thermal groundwater body Mura-Zala in the frame of T-JAM project – see in details in the management report), where based on local studies requirements were provided for the quantitative protection of thermal groundwaters.

6. A major deficiency in legislation (and water management) is in the field of **re-injection**. As re-injection into porous reservoirs (from where the major part of thermal groundwater is abstracted for direct heat purposes – mostly greenhouses and other agricultural utilization on the S-ern part of the Great Hungarian Plain) still raises a lot of technological and reservoir management concerns, only a few re-injection wells exist and operate. However re-injection would be compulsory for these users according to the article 15 of the *Act LVII of 1995 on water management* who are unable to construct them in the lack of appropriate financial incentives. Despite that *Governmental Decree 147/2010 (IV.29.)* and *Governmental Decision 1002/2012 (I.11.)* provide various extensions of deadlines for the establishment of re-injection wells, the problem itself is not solved, just postponed. Various expert opinions

(including the one of the Geological Institute of Hungary) suggested a differentiated legislation concerning the variable hydrogeological conditions at different parts of the country.

Thermal water production data clearly show, that the overwhelming majority of thermal water abstraction is related to balneology and drinking water supply, where re-injection is forbidden. Differentiated registration of the actual water-use is not solved (e.g in the case of a water permit for balneological utilization, it is not registered how much water is used for “only” heating purposes). Energetic utilization without re-injection cannot be blamed itself for the poor quantity status of some thermal groundwater bodies. Economic water use is a must for all sectors utilizing thermal groundwater!

7. The maximum size of a **concessional area** is not determined; following international practice it should be limited as max. 50 km<sup>2</sup>.

8. It is not clear how the procedure of getting a water permit fits into the procedure of **concession** (in cases of exploitation of geothermal energy with the abstraction of thermal water from a depth below -2,500 m). The concessional contract is valid for max. 35 years (and can be prolonged with another 17.5 years), however it is not clear what happens if conditions – on the basis of which the water permit was issued – change, especially regarding the amount, the abstraction limit value (Mi), or contamination limit values of the available water resources which requires the modification / withdrawal of the water permit (according to *KHVM / Ministerial Decree 18/1996 (VI.13.)*).

9. Legislation considers **concessional blocks / geothermal protection** zones as a “closed units” where after detailed investigations certain activities are permitted, however does not (cannot) give provisions how to handle possible **interactions** deriving from activities outside of them, e.g. effect of a new thermal groundwater abstraction nearby. The -2,500 m horizon (depth boundary for concession) is an artificial one, not clear how interactions within the same reservoir below and above it can be handled and evaluated.

Furthermore, the spatial relationship between a concessional block and a geothermal protection zone is not clarified either, in an extreme hypothetical situation (when the production well is drilled close to the edge of the concessional block), its protection zone (which is outlined on the basis on hydraulic modelling of temperature and pressure changes) may partly fall outside of the concessional block itself.

It is not clear either, what happens if a large hydraulic system is shared by several concessionaires.

In relation with possible interactions, the relationship of other competitive sectors (e.g. hydrocarbons, geological storage of carbon-dioxide) is not clarified either. The Mining Act handles hydrocarbon and geothermal similarly (as fluid mining). Potential conflicts include

overlapping of the concessional blocks (for hydrocarbons, the entire area of the country is closed).

10. As the installation of the closed-loop heat pumps shallower than 20 m does not require a permit, the register of the existing Hungarian heat pumps is largely based on estimations and does not give a reliable picture of the heat-pump market.

#### *7.1.5 Regulation*

##### **Regulations related to mining**

*Act XVI of 1991 on concession*

*Act XLVIII of 1993 on mining*

*Governmental Decree 203/1998 (XII.19.) on the execution of Act XLVIII of 1993 on mining*

*Governmental Decree 267/2006 (XII.20.) on the Hungarian Office for Mining and Geology*

*Governmental Decree 54/2008 (III.20) on the determination of the specific value of mineral resources and geothermal energy and the method of value calculation*

*Governmental Decree 103/2011 (VI.29.) on the complex vulnerability and impact assessment of the natural occurrences of mineral resources and geothermal energy*

##### **Regulations related to energetics**

*Act LXXXVIII of 2003 on energy tax*

*Act XVIII of 2005 on district heating*

*Governmental Decree 157/2005 (VIII.15.) on the execution of Act XVIII of 2005 on district heating*

*Act LXXXVI of 2007 on electric energy*

*Governmental Decree 273/2007 (X.19.) on the execution of certain regulations of Act LXXXVI of 2007 on electric energy*

*Governmental Decree 389/2007 (XII.23.) on the compulsory acceptance system and feed-in tariffs of electricity produced by energy gained from renewable energy resources and waste, as well as the co-generated electricity*

*GKM/Ministerial Decree 110/2007 (XII.23.) on the calculation method to determine the quantity of the useful heat and the co-generated electricity*

##### **Regulations related to environmental protection**

*Act LIII of 1995 on the general rules of environmental protection*

*Act XLIII of 2000 on waste management*



*Governmental Decree 219/2004 (VII.21.) on the protection of groundwaters*

*Governmental Decree 220/2004 (VII. 21.) on the protection of surface waters*

*Governmental Decree 221/2004 (VII.21.) on certain rules of river basin management*

*KvVM /Ministerial Decree 28/2004. (XII. 25.) on the threshold values of water contaminating materials and on certain rules of their application*

*KvVM /Ministerial Decree 30/2004 (XII.30.) on certain rules of examination of groundwaters*

*KvVM /Ministerial Decree 33/2005 (XII.27.) on the administrative service fees of environment, nature protection and water authorities*

*Governmental Decree 314/2005 (XII.25.) on the licensing process of environmental impact assessment*

### **Regulations related to water management**

*Act LVII of 1995 on water management*

*KHVM / Ministerial Decree 18/1996 (VI.13) on the contents of the application form and its annexes to be submitted for granting the water permits*

*Governmental Decree 72/1996 (V.22.) on the implementation of authority powers in water management*

*Governmental Decree 121/1996 (VII.24.) on the establishment and utilization of public baths*

*KHVM /Ministerial Decree 12/1997 (VIII.29.) on the degassing of the produced and supplied waters*

*Governmental Decree 123/1997 (VII.8.) on the protection of water resources, potential water resources and water establishments supplying drinking water*

*KHVM /Ministerial Decree 23/1998 (XI.6.) on the water management register of the water inspectorates*

*KHVM /Ministerial Decree 43/1999 (XII.26.) on the calculation of the water resource fee*

*EüM/ Ministerial Decree 74/1999 (XII.25.) on the natural medicinal factors*

*KvVM /Ministerial Decree 24/2007 ((VII.3.) on the Water Safety Regulations*

*KvVM /Ministerial Decree 101/2007 (XII.23.) on the professional requirements about the intervention into the groundwater reserves and water well drilling*

*KvVM /Ministerial Decree 30/2008 (XII.31.) on the technical regulations related to the activities and establishments serving the utilization, protection and mitigation of damages of waters*

*Governmental Decree 147/2010 (IV.29.) on the general regulations related to the activities and establishments serving the utilization, protection and mitigation of damages of waters*

*Governmental Decision 1002/2012 (I.11.) on the exemption of re-injection of thermal water used for energetic purposes in agriculture*

**Special regulations related to heat pumps:**

*Governmental Decree 264/2004 (IX.23.) on the taking back of waste deriving from electric and electronic gadgets*

*KTM /Ministerial Decree 10/1995 (IX.28.) on the environmental protection product fee and the execution of Act LVI of 1995 on the environmental protection product fee of certain products*

*GKM /Ministerial Decree 96/2005 (XI.4.) on the regulations of certain building processes concerning special buildings falling within the competence of the mining inspectorates*

*TNM /Ministerial Decree 7/2006 (V.24.) on the determination of energetic features of buildings*

The mining legislation still lacks the regulation of the geothermal protection zone.

Table 6. Exploitation of geothermal energy resources (Hungary).

Exploitation of Geothermal Energy Resources - Hungary			
The choice of exploitation	Geoprobe (geocollector)	Reinjection	Open loop systems with no, or partial injection
<b>Drilling depths</b>	Shallow boreholes for GSHP (closed circuit) < 20 m; no permits Deep borehole: not exact depth is defined: "deepened into the earth crust which depth is (considerably) bigger than its diameter and is deepened for a geological or mining purpose by a machine" Water wells > 30 m can be drilled on the basis of water permit (planning (preliminary), construction, operation permit )		
<b>Exploration permit</b>	Agreement with the caretaker/user of the land to carry out a preliminary surface survey.		
		Based on mining authority permission above 2500 m (open area) and in the frame of concession below 2500 m from the surface (closed area) WITHOUT ABSTRACTION OF THERMAL WATER	
		water licence is required in all cases when utilization of geothermal energy is combined with the abstraction of thermal groundwater (irrespective of depth)	
		Planning (preliminary) water permit (defines general water management objectives and basic technical parameters of the planned activity and determines the amount of water to be used in the future)	
<b>Environmental impact assessment</b>		thermal groundwater abstraction exceeding 5 million m <sup>3</sup> /year, or re-injection of 3 million m <sup>3</sup> /year for the generation of electricity or direct heat, Exploitation from karstic aquifers > 500 m <sup>3</sup> /day (5,8 l/s), or > 2000 m <sup>3</sup> /day (23 l/s) from intergranular aquifers irrespect of power generation or direct heat purposes	
		For geothermal power plants > 20 MW, for those ones which are established within the protection zone of mineral-, medicinal-, or drinking water resources, or on nature protection areas.	
<b>Drilling</b>		technical-safety licensing of deep drillings by the Regional Mining Inspectorate	
		Construction water permit is necessary for drilling, reconstruction, or abandonment of a well.	
<b>Reporting the exploration results</b>	Report the commencement of prospection to the mining authorities 30 days in advance to carry out a preliminary surface survey.		
	Geoscientific data in general gained during the preliminary survey of exploration, as well as geological data obtained the course of the mining activity have to be sent to the Hungarian Office for Mining and Geology.		
		Groundwaters and their reservoirs, as well as related water reserves, their quality and quantity data are part of the national water registration system, which is based on data are fixed in the water permits. Register is prepared and maintained by the Regional Directorates for Environmental Protection and Water Management, and has to be re-assessed at 5 years, while changes in the water budgets continuously, but at least once a year	
		A hydrogeological report has to be prepared by the constructor of the well in case the abstracted water is from porous, karstic or fissured aquifer, and the amount of exploitation/reinjection exceeds 1,5 m <sup>3</sup> /day and sent to the Inspectorates for Environment, Nature and Water.	
<b>An exploitation permit</b>	Down to a depth of 20 m, GSHP requires no permit and no licenses, however this does not free the entrepreneur from obtaining other necessary permits.	Irrespective of the depth, water licence is required for the utilization of geothermal energy, combined with the abstraction of thermal groundwater In closed areas (> 2500 m) geothermal energy can be exploited solely from the geothermal protection zone. The operation water permit authorizes for the execution of water use within the given period. Water-resource fee and mining royalty has to be paid for the thermal groundwater abstracted solely for energetic purposes (with the given exemptions when the water resource fee can be reduced (max. to the extent of the water resource fee) by the amount to be spent for construction of a re-injection well in the given year). A thermal well has to be equipped with a special well-head that makes possible the differential water abstraction following the actual water demand.	
		The thermal groundwater abstracted for energetic purposes has to be reinjected to the same aquifer after utilization	Waterworks (wells) aiming water production solely for energetic purposes have to be planned in a way, that their operation does not threaten the environmental objectives (good quality and quantity status of groundwater bodies)
		Time limits are set for operational water permits concerning reinjection (various extensions of deadlines for the establishment of re-injection wells).	
<b>Construction and operation</b>	Mining activity (exploitation and utilization of geothermal energy) can be only carried out on the basis of an approved technological-operation plan.		
		drilling of water wells, water treatment, establishment and operation of baths, etc. including their planning, construction, operation, reconstruction, abandonment are regulated in details types and frequency of measurements to be performed are scheduled in the operational water permits	
<b>Monitoring</b>		Monitoring of groundwater, qualitative and quantitative status (related to WFD river basin management plans)	
<b>Validity of the exploitation right</b>		The concessional contract is valid for max. 35 years (and can be prolonged with another 17,5 years) The water permits can be modified both by the applicant and by the inspectorate in cases conditions – on the basis of which the permit was issued – have changed, especially regarding the amount, the abstraction limit value (Mi), or contamination limit values of the available water resources.	

## 8 Legislation overview Slovakia

### 1) Geothermal installation and utilisation classification / parameters

#### Geothermal water

In Slovak legislation two terms having the same meaning (“geothermal water”, “thermal water”) can be found, though more frequently used is the term “geothermal water”.

The term “*geothermal water*” can be found in Water Act (Act No. 364/2004 Coll. on Water and in amendment to Act of the Slovak National Council No. 372/1990 Coll.) where the term is explained as a part of the groundwater that can act as a media for accumulation, transport and exploitation of earth’s heat from rock environment.

The term “*thermal water*” is defined in the Geological Act (Act No. 569/2007 Coll. on Geological Works) with similar definition as above as “Natural thermal water is ground water that is heated by the action of the earth's heat in the rock environment with a minimum water temperature at the point of seepage 20°C”.

#### ***Competences of governmental authorities***

The competence of governmental authorities in the connection to geothermal water (ground water) prospection and development of the facilities and the law regulations:

- Ministry of Environment – Geological Act. 569/2007 Coll., Mining Act. 44/1988 Coll. – Prospection and research in geological, hydrogeological, geothermal problems and other research related to geology,
- Ministry of Environment – Water Act.372/1990 Coll. - Water (surface, groundwater) utilization, disposal, quantity, quality, protection problems and objects,
- Ministry of Environment – EIA 24/2006 Coll. – environmental impact assessment, besides other issues - water (surface, groundwater) utilization, disposal, quantity, quality, protection problems and objects,
- Inspectorate of Spas and Springs under the Ministry of Health — Balneology Act. 538/2005 Coll. and Decree 100/2006 Coll. of the Ministry of Health- Geothermal or mineral water with classification as healing water. Every discovery of geothermal water or water with certain parameters has to be reported to Inspectorate of Spas and Springs under the Ministry of Health,
- Ministry for Construction and Regional Development – Building Act. 50/1976 Coll. – Development, building and construction of the facilities,
- Ministry of Economics – Act. 755/2004 Coll., Act. 309/2009 Coll., Act. 656/2004 Coll., Act. 657/2004 Coll. – energy regulations, heat and electricity productions, price regulations, energetic utilization of geothermal water.

## 2) Research / exploration rights

Research and evaluation of geothermal water is performed by hydrogeological research. Technical works (e.g. wells, drillings) that serve for obtaining geological information, are considered as geological works (as understood by the Geological Act. 569/2007) as well.

Hydrogeological (geological) research can be performed only by subjects that are authorized by Ministry of Environment of Slovak Republic (MZP SR).

Hydrogeological (geological) research is controlled/regulated by Geological Act. 569/2007 and Decree 51/2008 of the Ministry of Environment and can be performed based on approved project.

Geological Act defines “special (selected) geological works”, which includes the exploration of ground water in order to determine and verify the geological conditions for the establishment and operation of facilities for industrial exploitation of geothermal energy. This kind of exploration is possible only on “the prospection area” (exploratory territory) – issued (or cancelled) by Ministry of Environment.

The prospection area is issued under certain conditions – e.g. prospection time schedule (time limitation), size of the area, payment (retribution) for size of the area, no overlap with other prospection area for the same purpose and other.

Conditions during the exploration if the drilling works are present:

- permission from the landowner is required to execute the works on his ground
- the consent (approval) from infrastructure authorities (companies) with statement of no interference with infrastructure nets (gas, oil, electricity, water supply companies, etc.) is required
- hydrodynamic test less than 5 days requires no permission for water disposal from the test hydrodynamic test more than 5 days requires a permission from Regional Environmental office for water disposal from the test

If hydrogeological or geological research finds (discovers) the groundwater that exceeds one of the parameters:

- Temperature more than 20 °C

- TDS more than 1,000 mg/l
- CO<sub>2</sub> content more than 1,000 mg/l
- H<sub>2</sub>S more than 1 mg/l,

reporting (notification) to Inspectorate of Spas and Springs under the Ministry of Health is obligatory (based on Act 538/2005 Coll., on natural healing waters, natural healing spas, spa sites and natural mineral waters).

### **3) Environmental Impact Assessment: requirements / procedure**

Environmental Impact Assessment is based in Act 24/2006 Coll.

EIA is in effect based on aims of the business plan – elaboration of EIA required (or no elaboration required). Competences for execution of the Act.24/2006 depend on the localization and extent of the business plan.

Aim – drilling the geothermal exploitation wells between 300 - 500 m depth. Before the permission for drilling in designed location, approval process (inquiry / screening processing) is required under mining authority.

Aim – drilling the geothermal exploitation wells over 500 m depth. Before the permission for drilling in designed location, the elaboration of EIA is compulsory and is treated under the mining authority . In Slovak geological conditions it is concerning practically all of the geothermal wells.

Aim – building of the geothermal power plant or heating system facility with the power less than 5MW or for activities not listed in the Act 24/2006, appendix 8. Before the permission for building the investor is obliged to request the Ministry of Environment for decision whether the intention for building the facility affects ecosystems. The Ministry issues a written decision if EIA is required or not. Aim – building of the geothermal power plant or heating system facility with the power between 5MW and 50 MW. Before the permission for building approval process (inquiry / screening processing) is required. Decision maker – Local Environmental office or Regional Environmental office. Building of the facility is treated under the energy industry.

Aim – building of the geothermal power plant or heating system facility with the power over 50 MW. Before the permission for building the elaboration of EIA is compulsory and is treated under the energy industry. Decision maker - Ministry of Environment.

### **4) Environmental objectives / constraints**

Two possibilities for disposal of cooled geothermal waters.

- Reinjection
- Discharge into surface water

#### *Reinjection to aquifer*

- Treated as disposal of waste water into the groundwater based on Water Act 364/2004 Coll.
- Permission for disposal from Regional Environmental Office
- The chemical composition of disposed and cooled geothermal water changes in presence of inhibitor. Regional Office for the Environment gives an assessment on inhibitor effect.

Reinjection of cooled geothermal waters back to the structure affects sustainable pressure conditions and steady recharge of the structure. Cooling (progression of the cooled down front) from reinjection well to exploitation well is verified by modelling.

#### *Discharge into surface water*

- The cooled geothermal water disposed into surface water recipient has to be adapted/modified (chemical composition and temperature) to avoid negative effect to the environment of the surface water body (surface flow)
- Limiting values are published in Regulation of the Government 269/2010 Coll. defining demands on waste and special water disposal to the surface water body (surface flow)
- Water Act 364/2004 §21 (permission for water utilization on special purposes) and §36 (waste water disposal and special water disposal to surface water body (surface flow)) has to be fulfilled
- Thermally used water are treated as an industrial waste water, based on Regulation of the Government no. 269/2010 Coll. - immision limits are listed in Appendix 5
- Permission for disposal from Regional Environmental Office
- The discharged water cannot exceed the long term indicators like for dissolved solids, heavy metals, chlorides (200 mg/l), temperature 26 °C
- Regional Environmental Office– in permission states conditions under which the geothermal water can be discharged – frequency of measurement of temperature, quantity of the discharged water, frequency and the range of chemical analyses

### **5) Technical requirements, recommendations and standards**

In drilling and exploration – general law regulation are set in Geological Act. 569/2007 Coll., Mining Act. 44/1988 Coll.

In geothermal utilization technical standards - for the heat pumps the standards are set in Slovak Technical Standards class 14 (<http://www.slovenske-normy.sk/trida-14>). Standards are concerning different aspects of heat pump installation.

Selection of basic Slovak Technical Standards:

<i>Standard Label</i>	<i>Number</i>	<i>Date of Issue</i>	<i>English description</i>	<i>Slovak official name</i>
<a href="#">STNEN 378-1+A1</a>	140647	01.04.2011	Refrigerating systems and heat pumps– Safety and Environmental Protection requirements	Chladiace zariadenia a tepelné čerpadlá. Požiadavky na bezpečnosť a ochranu životného prostredia. Časť 1: Základné požiadavky, definície, klasifikácia a kritériá výberu (Konsolidovaný text).
<a href="#">STNEN 378-2+A1</a>	140647	01.09.2009	Refrigerating systems and heat pumps– Safety and Environmental Protection requirements	Chladiace zariadenia a tepelné čerpadlá. Požiadavky na bezpečnosť a ochranu životného prostredia. Časť 2: Návrh, konštrukcia, skúšanie, označovanie a dokumentácia (Konsolidovaný text).
<a href="#">STNEN 378-3</a>	140647	01.07.2008	Refrigerating systems and heat pumps– Safety and Environmental Protection requirements	Chladiace zariadenia a tepelné čerpadlá. Požiadavky na bezpečnosť a ochranu životného prostredia. Časť 3: Miesto inštalácie a ochrana personálu.
<a href="#">STNEN 378-4</a>	140647	01.07.2008	Refrigerating systems and heat pumps– Safety and Environmental Protection requirements	Chladiace zariadenia a tepelné čerpadlá. Požiadavky na bezpečnosť a ochranu životného prostredia. Časť 4: Prevádzka, údržba, oprava a regenerácia.
<a href="#">STNEN 12693</a>	140648	01.08.2009	Refrigerating systems and heat pumps– Safety and Environmental Protection requirements	Chladiace zariadenia a tepelné čerpadlá. Bezpečnostné a environmentálne požiadavky. Objemové chladičové kompresory.
<a href="#">STNEN 1861</a>	142007	01.04.2001	Refrigerating systems and heat pumps– Circuit diagrams of equipment and piping and instrumentation scheme	Chladiace zariadenia a tepelné čerpadlá. Schémy okruhov zariadení a schémy potrubí a prístrojov. Usporiadanie a značky.
<a href="#">STNEN 13313</a>	149010	01.05.2011	Refrigerating systems and heat pumps. The expertise of people	Chladiace zariadenia a tepelné čerpadlá. Odborné znalosti osôb

## 6) Exploitations rights



Exploitation rights in relation to geothermal water (geothermal structures) are based on results approved by the Commission for Approval of Groundwater Resources ("Hydrogeological Commission"), established by the Ministry of Environment of Slovak Republic. "Hydrogeological commission" is responsible for the approval of water sources and resources for groundwater exploited as drinking water sources and for groundwater exploited as healing media and thermal groundwater – geothermal water. "Hydrogeological Commission" is established by the Ministry of Environment and represents an advisory authority of the Minister.

Proposals for exploration rights are treated by Hydrogeological commission on a case by case basis, according to the results of the geothermal survey and documented exploration results. To obtain permission to use the water from the geothermal source (borehole, e.g.), groundwater resources need to be classified in the "B" category, what requires documented hydraulic tests of a borehole in a duration of more than 21 days and a proof of any substantial decrease of piezometric levels in the borehole and in the nearby boreholes. The exploitation rights (permission for geothermal water exploitation) are then issued by Regional Environmental Office, based on assessment notice elaborated by "Hydrogeological Commission" and confirmed by the Minister of Environment.

## **7) Monitoring requirements**

Conditions for monitoring of quantity and quality of *surface water bodies and groundwater bodies* are generally defined in regulation of the Ministry of Agriculture, Environment and Regional Development of the Slovak Republic no 418/2010. (Note: in 2010 the three ministries – Agriculture, Environment and Regional development were joined for a short time – before elections – into one. After elections new government split them again back to original setting.)

Monitoring of the surface water bodies and groundwater bodies is performed by the state. Monitoring consists of information about the quantity, quality, regime of groundwater, yield of spring, groundwater level, well head pressure, heat-energetic potential of geothermal water, natural and extractable groundwater amount, physical, chemical and microbiological properties of groundwater. Slovak Hydrometeorological Institute (SHMI) is responsible for collecting and publishing the results form monitoring.

Programme for monitoring elaborated respectively for every watershed (for surface water and groundwater). The update of the monitoring programmes is in 6 year period.

The geothermal water user is (by the law 364/2004 - Water Act) required to pay for water use. That's why geothermal water user is required to perform monitoring of the geothermal source. The conditions for monitoring (parameters to be measured and frequency of measurement) are stated in permission for water exploitation by Regional Environmental Office. The measured parameters include yield of source (well, spring), temperature of water, well head pressure. The permission can include the request for measurements of chemical components to assess the change in chemistry of the water. Based on the monitoring of the exploitation (yield, temperature, chemistry) the remedial action can be performed to protect the geothermal source.

This means the monitoring of the geothermal water is on level of exploitation of geothermal water (mostly extracted amount and temperature) by user.

Regional Environmental Office issues the permission for geothermal water disposal with stated conditions for monitoring of disposed water into surface recipient or reinjection. Conditions include measured parameters (usually temperature, TDS, basic chemical compounds) and frequency of measurements.

***Monitoring of geothermal sources waters*** (springs, wells) ***that have status of healing water and natural mineral water*** is performed by Inspectorate of Spas and Springs under the competence of Ministry of Health as Central Monitoring System (CMS IKZ) from 2004. Monitoring net has 36 sites with 152 monitoring objects (103 have record as “declared source”, 49 are monitoring objects of groundwater). The conditions for monitoring are stated in Decree of Ministry of Health issued for every healing or mineral water source respectively. In the area of the TRANSENERGY project only geothermal water from well FGČ – 1 (locality Šamorín – Čilistov) has status natural healing source. The monitoring is based by Decree of Ministry of Health (06433/2006/IKŽ).

## **8) Reporting requirements**

*Exploitation of water (geothermal water):*

While *geothermal* water is by Water Act part of *groundwater*, the reporting is obligatory when reaching or exceeding some limits (amount of yielded water)

The limits of exploited water by Water Act (364/2004):

- Exploitation from one water installation/facility in amount higher than 15,000 m<sup>3</sup>/year, or 1,250 m<sup>3</sup>/month
- Or using special water (natural healing sources, natural sources of mineral drinking water) for business activity.

The reporting of the water (geothermal water) exploitation is performed by water (geothermal water) user with the reporting period on year basis (usually with monthly values of exploited volumes). The geothermal water user is required to pay for water use as stated in Water Act (364/2004).

The reporting of exploited water volumes and other data stated in permission for exploitation (special water, stated in Water Act 364/2004, § 21 section. 2.b) and 2.c)) is addressed to the authorized institution (Slovak Hydrometeorological Institute, SHMI), that will provide the data to the watercourse administrator.

Results from monitoring are collected, stored and provided by Slovak Hydrometeorological Institute (SHMI).

#### *Discharge of waste water*

The reporting of the waste water and special water disposal is obligatory after some limits are reached or exceeded. The limits are set by Water Act as amount of disposed wastewater is higher than 10 000 m<sup>3</sup>/year or 1 000 m<sup>3</sup>/month.

The reporting of disposed water volumes and other data stated in permission for exploitation (special water, stated in Water Act 364/2004, § 21 section. 2.d)) is addressed to the authorized institution (Slovak Hydrometeorological Institute, SHMI), that will provide the data to the watercourse administrator.

The fees for exploitation and disposal of water are described in Water Act 364/2004 § 79.

## 9) Transboundary issues

International treaties:

- Agreement between Czechoslovak Socialistic Republic and government of People's Republic of Hungary about the water management issues on transboundary waters
- Treaty between Czechoslovak Socialistic Republic and the Austrian republic about the water management issues on transboundary waters
- Danube River Protection Convention

In the process of ratification:

- Treaty between Slovak Republic and the Austrian republic about the water management issues on transboundary waters
- Agreement about the protection and utilization of transboundary water courses and international lakes UN (Helsinki Convention)

Based on treaties the bilateral commissions were established:

- Slovakia -Hungary „Water management commission“
- Slovakia - Austria „Water management commission“
- International Commission for the Protection of the Danube River (multilateral initiative) - for Slovak part by represented by Ministry of Environment

Reference: [http://www.minzp.sk/files/sekcia-vod/modra-sprava\\_za\\_rok\\_2010.pdf](http://www.minzp.sk/files/sekcia-vod/modra-sprava_za_rok_2010.pdf)

## 10) Conclusions

Summary or the legislation overview:

- Legal definition of thermal water: Defined in 2 Acts (Water Act, Geological Act) under the Ministry of Environment – thermal water and geothermal water.
- Licensing procedures: Prospection for geothermal water is governed by Geological Act under the Ministry of Environment. The utilization of geothermal water is governed by Water Act under the Ministry of Environment. After the positive prospection survey in which the geothermal water is discovered by the prospection borehole in quantities that could be exploited (water supply, geothermal water) the borehole has to be reclassified form geological object (under the Geological Act) to water work (under the Water Act). After this the borehole can serve as a pumping well for geothermal water utilization. If prospection survey (research or exploration) discover the geothermal water it has to be reported to Inspectorate of Spas and Springs too. The amount of utilized water is matter of permission stating the rules (for extraction, monitoring, waste water disposal, geothermal structure protection) and is issued by Hydrogeological Commission established under the Ministry of Environment.

- Data ownership: The data from drilling and prospection are obligatory to report and are stored by authority stated by Ministry of Environment – Geofond database under the competence of State Geological Institute of Dionýz Štúr. To protect the data (gained during the research) the *private investor* can put “embargo” on publishing the data for up to 10 years. If the research is sponsored by governmental budget the data must be published after the final report approval without any restriction.
- Risk insurance: To ensure the sustainable utilization of geothermal structures and have certain knowledge about the geology in the area of Slovak republic, the government adopted a directive that recommends starting geothermal research in not exploited or poorly exploited geothermal areas every 4 years. This way the government tries to minimize the risk generated by knowledge (providing the data about the geological and geothermal environment) of geological environment. There is no other risk insurance for private developer.

## ***8.1 Overview of Slovakian national regulation for geothermal project***

*Note: This is overview of the national regulation. The translation is not an official translation of the Acts, orders or Decrees and cannot serve as a document upon which the legal decisions will be made. Please consult the official translations of the laws.*

### *8.1.1 Introduction to legal and administrative conditions*

According to Art. 4 of the Constitution of the Slovak Republic, mineral resources, caves, ground water, natural healing springs and waterways are owned by the Slovak Republic. In accordance with the Constitution, the law no. 40/1964 Coll. Civil Code, as amended, is declared the separation of watercourses and groundwater from land. This also provides separation of ownership:

- Land (the property of the property owner) and
- Water underground or on land (the property of the Slovak Republic).

With regard to the exclusivity of ownership of watercourses and groundwater (Slovak Republic represented by the competent authorities of state administration in accordance with the Act. 92/1991 Coll.) are excluded from privatization. Surface water and groundwater (quantities, heat potential, water with high mineral content exploited industrially for mineral production) therefore cannot be used as in kind businesses contribution.

### *8.1.2 Starting a geothermal project*

For purpose of exploration (survey, research) of geological conditions, hydrogeological, geothermal setup of the area and (potential) future geothermal utilization the following steps are needed (from phase of prospection to the stage of geothermal energy utilization).

Operation/law regulation	Activity	Responsibility
I. Geological survey, prospection exploration, research (Geological Act, Water Act)	Prospection (exploration) area	Ministry of Environment of Slovak Republic
	performing geological works - geological concession (license) - approval to perform geological works	Ministry of Environment of Slovak Republic
	Entrance to the property (property admission)	Property owner
	Execution of works: - drilling - geological company/institution with geological concession - testing of borehole - hydrodynamic test (up to 5 days) - hydrodynamic test (over 5 days)	- Ministry of Environment of Slovak Republic  - without permission - Regional Environmental Office
	Final report with the calculation of water amounts	Ministry of Environment of Slovak Republic
II. Water use (Water Act)	Permission for water use and waste water disposal: - water withdrawal/use and waste water disposal - permit determines the measuring intervals for quantity, temperature, pressure, sampling, the range of analyzes, etc. - water use fees	Regional Environmental Office  administrator of the watercourse
III. Assessment of the business plan (Act on the assessment of environmental impact)	1. construction of the exploitation well over 500 m - mandatory assessment	Ministry of Environment of Slovak Republic
	2. construction of electricity power plants and heating plants with an installed capacity -	
	a) up to 5 MW – request to the Ministry of Environment for a decision on whether this activity should be processed by EIA	
	b) 5 to 50 MW – screening procedure	District Environmental Office or Regional Environmental Office
	c) over 50 MW - mandatory assessment	Ministry of Environment of Slovak Republic
IV.A) Business Plan - electricity production (the Energy Act, the law on promotion of renewable energy)	Authorization/license in for business activities in energy sector - power over 1MW - the power up to 1 MW of electricity from geothermal energy - license is not required, only the duty (obligation) for notification	Regulatory Office for Network Industries Regulatory Office for Network Industries
	Qualifications	Ministry of Economy
	Certificate of conformity of the investment plan	Ministry of Economy
	Certificate of origin of electricity from renewable sources	Regulatory Office for Network Industries
	Request for connection to the electricity net	transmission system operator or transmission system operator
	Agreement/contract on the transmission or distribution of electricity	transmission system operator or transmission system operator
	Reporting requirements for electricity producer: - Characteristics/basic data of delivery (if power over 1 MW) - Support of electricity consumption with additional payment	distribution system operator distribution system operator, Regulatory Office for Network Industries

IV.B) Business Plan - production of thermal energy (Energy Law, Law on the promotion of renewable energy)	Authorization/license in for business activities in thermal energy Qualification	Regulatory Office for Network Industries Ministry of Economy
	Construction of thermal power plant with capacity: - Up to 10 MW - mandatory community/town opinion on compliance of the upcoming construction with the concept of community development - Over 10 MW - certificate of compliance with the upcoming construction of the concept of the Energy Policy	Community/Town Ministry of Economy
	Contract about heat supply and heat consumption	Consumer / Customer
V. Discharge of used geothermal water – waste water	Permission for waste water (discharge): 1. discharge of used geothermal water in the groundwater (hydrogeological re-injection into the collector)	Regional Environmental Office
	2. discharge of thermal water used in surface water	Regional Environmental Office, Surface water body authority
VI. Monitoring	Permit for water use: - Water use/withdrawal and discharge (the permit determines intervals for quantity measurement, temperature, pressure, sampling, range analysis, etc.)	Regional Environmental Office
VII. Water source protection	For geothermal water sources there are no protection zones defined in legislation	

### 8.1.3 Licensing procedure for the construction

Assessment of the geothermal water state (geological setup, geothermal characteristics, and groundwater properties) is provided by a comprehensive geological works and hydrogeological prospection/survey. The geological works are defined in the Act. 569/2007 Coll. (Geological Act, as amended). Geological works include technical works - “geological constructions” and “geological objects” (boreholes, wells), which provide geological information. It is considered as a temporary construction and after geological evaluation (end of the research project) “geological constructions” and “geological objects” have to be removed (if the investor is not interested in using them later), because the goal of the research has been accomplished. This is the fundamental difference between the terms of Building Act (regulations) and “geological constructions” and “geological objects”, as a result of geological activity. The purpose of geological work is not to set up a construction but to acquire geological information with geological works or geological objects and after that bring the property (real property) to its original condition.

In case that “geological constructions” and “geological objects” (boreholes, wells) will be used in future as a hydrogeological or geothermal wells, the review (reclassification) is needed from category "geological work" to "water works" under a special regulation.

The “geological construction” and “geological object”, which was realized in the implementation of the geological project funded from the state budget or from other public funds (and in future implementation of the project is not needed) can be used for other purposes and can be transferred to other user by:

a) gratuitous transfer of administration of such construction or object to the authority established by the Ministry of Environment,

b) gratuitous transfer of ownership of the municipality or Regional Self-governing Unit (higher territorial unit) for the publically beneficial services or intentions,

c) transfer (sale) of property based on calculated price of such construction or object to the:

- private investor or company
- municipality or Regional Self-governing Unit (higher territorial unit) for purposes other than providing publically beneficial services.

#### 8.1.3.1 Real property, right of land use

*For the purpose of geological prospection*

The realization of geological works (e.g. drilling, geophysical works, mapping) is carried on in the public interest. In performing geological work is therefore the contractor (or authorized person) authorized to enter into real estate properties to establish their working place (e.g. drilling site), access roads, water supply and energy as well as perform the necessary adjustments to remove soil and vegetation. Contractor of geological work is therefore required to ensure the least (minimal) interference with the rights and legitimate interests of the owner of the property, making sure it does not create any damage. Besides that the contractor of the geological work is required to negotiate with the owner of the property scale about the method of implementation and duration of the geological works. He must notify the property owner about the beginning of the realization of geological works at least 15 days in advance. If a property owner disagrees with the scope and manner of implementation and duration of implementation of geological works in the Contractor proposal, the matter of geological works on particular problems is decided by the Ministry of Environment. On the other hand owner of the property can be paid the reasonable/ appropriate compensation for the use of real estate property. This compensation shall be paid by Contractor of geological works. If no agreement on appropriate compensation, the decision is made upon by the court process.

Ownership of tangible assets acquired in the process of carrying out geological works (geological works the geological objects) are not affected by geological law.

#### 8.1.3.2 Research permit

Geological Act not only defines, but also sets the conditions for implementing, designing and evaluating geological works. Such works are allowed to implement only by authorized individuals or entities - contractors of the geological works.

To perform geological works are authorized only subjects (persons, entrepreneurs, companies, institutions) having the permission "***geological authorization***" for a works issued



by Ministry of Environment (Geological Act). Without geological authorization, geological works may be carried out only by persons and institutions listed in the Geological Act.

#### *Prospection area*

*Special geological works* are geological works, including the exploration of groundwater in order to determine and verify the geological conditions for the establishment and operation of facilities for industrial exploitation of geothermal energy. *Special geological works* can be performed only on *Prospection area* (as stated in geological Act.).

*Prospection area* is issued for the purposes of research and evaluation of the geothermal water quantities, their (heat) energy potential (in general carrying out geological works). The State (as owner of the groundwater) provides thus exclusive right to carry out such works to the investor of the geological works.

*Prospection area* is determined in the written permission of the Ministry of Environment. The permission of the Ministry for the determination of the *prospection area* is not a land use decision under the Building Act and therefore is not affected by a separate law on territorial planning and building regulations. This is based on the assumption that geological activity in the research areas can be performed along with another utilization of the same territory by owner.

The use of *prospection area* is charged (to an investor) with redistribution: 50% of the revenue of the Environmental Fund and 50% of the income of the municipality within which territory the prospection area is located.

#### 8.1.3.3 Environmental impact assessment

As a result of geological research shows that the realized geothermal well is positive and realization of additional geothermal wells is planned, the business plan is necessary to be elaborated. The objectives of the plan determine to what extent is subject to compulsory assessment or investigation assessment under the Act. 24/2006 Coll. (EIA and amendment of certain laws). EIA must contain at least two variants of the proposed action and zero variant. The zero variant is a variant of a condition that would occur if the proposed activity would not be realized.

If the aim of the project is to **build the geothermal wells** before deciding on its location or permitting such works (based on Act. 24/2006 Coll. - Environmental Impact Assessment and amendment of certain laws), following must be met:

- geothermal wells deeper than 500 m - subject to compulsory assessment in accordance with the Act. 24/2006 Coll. to be approved by the Ministry of

Environment. In terms of geological conditions in Slovakia it is concerning all the geothermal wells suitable for the extraction of geothermal energy.

- geothermal wells deeper than with a depth of 300-500 m - activity in accordance with the Act. 24/2006 Coll. subject of the investigation of the aims and conditions.

If the implementation of the research/prospection wells or extraction wells shows that the business plan is to **build geothermal power plant and/or heating plant** before deciding on its location or permitting such works (based on Act. 24/2006 Coll. - Environmental Impact Assessment, amendment of certain laws) following must be met:

- installed capacity over 50 MW - the proposed activity must be subject to compulsory assessment in accordance with the Act. 24/2006 Coll. to be approved by the Ministry of Environment. Building power plants and heating plants covered by the energy industry.
- installed capacity of 5 MW to 50 MW - subject of the investigation according to Act. 24/2006 Coll.

In the case that the proposed activity is not listed in the Annex 8 of Act. 24/2006 Coll. (for example construction of the geothermal power plants and heating plants of installed capacity up to 5 MW) the applicant is requested to contact the Ministry of Environment for decision whether the activity is regarded as intervention in the area, which can cause significant changes in biodiversity, structure and function of ecosystems. The decision by the Ministry of Environment is made whether the proposed activity will be assessed under EIA Act 24/2006 Coll., or not. The activity that is not necessary to be assessed under EIA Act 24/2006 Coll. is given a statement by Ministry.

Competencies by EIA Act 24/2006 Coll. are determined by the location and size of the business plan - project. If the business plan is located in the district level, a district office is in charge.

#### 8.1.3.4 Reporting the exploration results

During the research the aims of the geothermal project can include calculation of available of geothermal water verified by hydrodynamic test (specified in the project of the works). If the hydrodynamic test was conducted for up to 5 days, no need for water discharge permit. However, if hydrodynamic test was performed for more than 5 days, a permit to discharge water during the test is needed and is issued by Regional Environmental Office.

The results of exploration are evaluated in the final report. If the results of geological investigation/research identified and verified quantities of groundwater (including thermal waters and mineral waters) the final report should include calculation groundwater (geothermal water) amounts or geothermal potential. Final Report with the calculation of the

water amounts in hydrogeological units is assessed and approved by the Ministry of Environment, regardless of funding source geological tasks.

Regional Environmental Office issues the permission for water abstraction/utilization (abstraction of geothermal waters in order to use their energy potential) based on the decision of the Ministry of Environment that approves the final report and the calculated amounts of water or geothermal water and the energy potential.

To protect the yield and quality of the water sources, the water authorities determine/delineate the protective zones (protection area). Water sources are surface water bodies and groundwater bodies used for abstraction for drinking water or usable water supply for the population to more than 50 people or allow withdrawals of water for this purpose, on average, more than 10 m<sup>3</sup> per day. Based on this definition geothermal resources do not have delineated any protection areas/zones.

#### *8.1.4 Licensing procedure for operation*

##### *8.1.4.1 Exploitation outset*

###### *Assessment of the business plan for using geothermal water*

If the geothermal water temperature exceeds 100°C production of electricity and use the residual heat for heating is possible. In accordance with the Act. 309/2009 Coll. (the promotion of renewable energy and high-efficiency cogeneration and amending some laws) it can be achieved by the technology of high-efficiency cogeneration organic Rankine cycle.

If the geothermal water temperature is below 100°C, the production of electricity is not efficient and geothermal water can be used to produce thermal energy (heating buildings, heating greenhouses, drying timber, recreation, fisheries).

Methods of using geothermal energy for heat and power levelling are subject to different legal regulations, therefore, in the following text shown separately.

The objectives of the business plan determine to what extent (compulsory assessment or investigation) is the project treated by Environmental Impact Assessment Act. 24/2006 Coll. (amending certain laws).

###### *Electricity production*

Electricity generation is regulated by Energy Act. 656/2004 Coll., under competence of the Ministry of Economy of the Slovak Republic, the Regulatory Office for Network Industries and the State Energy Inspection.

Ministry of Economy publishes every five years the report on the intentions of electricity from renewable sources and the actions taken to ensure the goals in electricity production from renewable sources are met. Every 2 years report on the fulfilment of the objectives of electricity production from renewable energy sources. The report is published in the Journal of the Ministry and the Ministry's website. The Ministry may require that the electricity producer, system operator and network supplier use renewable energy sources in electricity generation.

The owner of the geothermal well has the open possibilities to step into the business in energy production. Doing business in the energy sector can only be upon authorization by Regulatory Office for Network Industries. Electricity from renewable energy facilities is entitled the financial support with a total installed capacity to 10 MW of electricity.

#### *Production of thermal energy*

Heat producer can be individual person or legal entity (company) that produces heat for sale and holds a license. Doing business in the thermal energy sector can be realized only with permission. Such permission is issued by the Regulatory Office for Network Industries, upon written request and if certain conditions are met. In the competence of the Regulatory Office for Network Industries is as well revocation of thermal energy business permission.

A company (individual) that holds a permit and plans to build a system of thermal installations with capacity of 10 MW and more can start the business activity only after the issuance of the certificate of compliance of the thermal installations system with the Energy Policy of the Slovak Republic concept. This certificate is issued by the Ministry of Economy, upon written request of a company (individual).

Construction of the system of thermal installations with a total installed thermal capacity of 10 MW (or less) can be done only after the permission of the municipality/community/town (with a population over 2,500). The permission states the compliance of the upcoming thermal system installation/construction with the concept of thermal energy community development. Establishment of protection zones to protect the system of thermal installations is defined in § 36 of Act no. 657/2004 Coll.

#### 8.1.4.2 Monitoring

##### *Monitoring requirements for exploitation*

Terms of monitoring and evaluation of the quantity and the quality of surface water and groundwater as well as calculation of the amount of surface water and groundwater is defined in Decree of MPŽPRR (Ministry of Agriculture, Environment and Regional development) no. 418/2010 Coll. implementing certain provisions of the Water Act. (Note: in 2010 the three ministries – Agriculture, Environment and Regional development were joined for a short time – before elections – into one. After elections by new government were split again

back to original setting.) Monitoring results of groundwater, surface and geothermal water are stored by the SHMI (Slovak Hydrometeorological Institute).

Monitoring of groundwater and surface water is conducted by the State. The monitoring of the basic data on the quantity, quality of groundwater, yield, groundwater level, the pressure head, thermal energy potential of the geothermal water, natural and available quantity of groundwater, physical, chemical and microbiological characteristics of groundwater. Water monitoring programs are being developed separately for each river basin district, broken down separately for surface and groundwater. Water monitoring programs shall be developed in accordance with the Slovak Water Plan at least every six years.).

The monitoring of geothermal water is performed by the user, includes amounts and quality of waste water and geothermal water sources (their quantity, quality, customers and subscriptions).

State water authorities, namely the Regional Environmental Office, determines in the permission for the groundwater use (exploitation) the conditions under which groundwater can be used and discharged – e.g. yield measurements intervals, temperature, pressure, sampling, analysis, and range. Each geothermal water user is required (by Water Act.364/2004 Coll.) to pay for groundwater exploitation. The geothermal user is therefore required to carry out monitoring of geothermal reservoir and measuring its yield according to the terms of use or geothermal temperature and pressure at the well (in the ideal case, the automatic recording at prescribed intervals - almost continuous recording). It is in the interests of users of geothermal water that the measurements are frequent and in case of potential problems the structure can be evaluated accordingly. During the exploitation qualitative aspects of geothermal water are necessary to evaluate. Permission for geothermal water use may include water sampling intervals for physical-chemical analysis needed to assess whether there is a change in water chemistry. Such measurements are a necessary basis for evaluating changes in the geothermal water in the collector for their exploitation and to take corrective measures to protect the resource. For these reasons, it is in the interests of users to elaborate the monitoring plan during the exploitation.

Type of measurements, measurement intervals and sampling intervals should be determined both by sampling groundwater conditions (attached in the permit) by the Regional Environmental Office and also taking into account the specific conditions in geothermal structure, type of the structure (open, closed, semi open) and hydrogeological conditions, which are unique for each source.

The issue of water protection zones of the natural healing waters and natural mineral water is set in Act 538/2005 Coll.( § 26 of the Act) establishing protection areas/zones with first and second order restrictions. Protection areas/zones of water resources are governed by § 32 of Act no. 364/2004 Coll. (Water Act). The issue of water protection zones in geothermal water

structures is not based in legislation unless it fulfils the conditions stated in above mentioned law regulations.

The monitoring of water with status as a mineral and/or healing water is performed by the user and controlled by the Inspectorate of Spas and Springs (Ministry of Health). The data are stored by Inspectorate of Spas and Springs.

#### 8.1.4.3 Validity of the exploitation right

Conditions for exploitation of geothermal water, responsibilities of the geothermal water user, along with conditions for waste water disposal and monitoring are stated in permission issued by Regional Environmental office.

#### 8.1.5 *Regulations*

In the further legislation overview are listed acts, orders and regulations that address the question of ownership of the geothermal waters, respectively to buildings and equipment by which they are able to be utilized in a stage of their research, exploration and exploitation in order to obtain their energy potential.

#### *Transposition of European legislation into Slovak legislation*

Directive 2000/60/EC of the European Parliament and the Council (23 October 2000 establishing a framework for water policy - Water Framework Directive - WFD) and the Directive of the European Parliament and European Council Directive 2008/105/EC (December 16<sup>th</sup> 2008 on environmental quality standards in the field of water policy), amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC and 86/280/EEC and amendment of the European Parliament and Council Directive 2000/60/EC is transposed into Slovak legislation in Water Act 364/2004 Coll. on water and amending the Act of Slovak National Council. 372/1990 Coll. on Offences, as amended (Water Act) as amended.

European Parliament and Council 2009/28/EC (April 23<sup>rd</sup> 2009 on the promotion of energy from renewable energy sources) and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC is transposed into Slovak legislation in Act. 309/2009 Coll. dealing with the promotion of renewable energy and high-efficiency cogeneration and amending certain laws.

#### *National Slovak legislation in relation to geothermal energy exploration and exploitation*

Set of legal regulations relating to exploration and exploitation of geothermal energy is based on legislation governing the issue in the following legislation (state of regulation valid to the date August 31<sup>st</sup>, 2011)

- a) Constitution of the Slovak Republic, Constitutional Act. 460/1992 Coll. as subsequently amended;
- b) Civil Code, Act. 40/1964 Coll., as amended,
- c) Water Act. 364/2004 Z.z. on waters as amended and amending Law No.. 372/1990 Coll. on offences, as amended;
- d) Geological Act. 569/2007 Z.z. on geological works, as amended;
- e) Mining Act. 44/1988 Coll., protection and utilization of mineral resources, as amended;
- f) Act. 92/1991 Coll. on the transfer of state property to other persons, as amended;
- g) Commercial Code Act. 513/1991 Coll., as amended;
- h) Trades Act. 455/1991 Coll. on trades, as amended;
- i) Building Act. 50/1976 Coll., the Planning and Building Order (Building Act) as amended;
- j) Slovak Republic Government Order no. 755/2004 Coll., laying down the amount of non-regulated payments, fees and details related to charging for water use;
- k) Ministry of the Environment Regulation no. 51/2008 Coll. that administers Geological Act, as amended;
- l) Act. 309/2009 Coll. the promotion of renewable energy and high-efficiency cogeneration and amending certain laws;
- m) Act.656/2004 Coll., on energy and amending certain laws;
- n) Decree of the Regulatory Office for Network Industries 225/2011 Coll. establishing price regulation in the electricity energy;
- a) Act 657/2004 Coll. of thermal energy and amending certain laws;
- p) Decree of the Regulatory Office for Network Industries no. 219/2011 Coll. establishing price controls on thermal energy;
- q) Act. 24/2006 Coll. Assessment of environmental impact (Environmental Impact Assessment) and amending certain laws;
- r) Government Order no. 269/2010 Coll., laying down the requirements for achieving good water status;
- s) Ministry of Agriculture, Environment and Regional Development of the Slovak Republic no. 418/2010 Coll. for implementing certain provisions of the Water Act.

Table 7. Exploitation of geothermal energy resources (Slovakia).

Exploitation of Geothermal Energy Resources - Slovakia			
The choice of exploitation	<i>Geoprobe (geocollector)</i>	<i>Reinjection</i>	<i>Open loop systems with no, or partial injection</i>
Drilling depths	Shallow boreholes < 300 m 300 - 500 m (approval process - inquiry / screening processing, permission for drilling) Deep boreholes > 500 m (permission for drilling, mandatory assessment EIA) (thermal water > 20°C)		
Exploration permit	Proposals for exploration rights are treated on a case by case basis, according to the results of the geothermal survey and documented exploration results.		
Environmental impact assessment	Depend on the localization and extent of the business plan		
	Hydrodynamic test: duration > 5 days - requires a permission for water disposal from the test		
Drilling	Geothermal power plant or heating system facility < 5MW: the Ministry decide whether the activity should be processed by EIA 5 - 50 MW: approval process - inquiry / screening processing		
	Permission from the landowner is required to execute the works on his ground. The consent (approval) from infrastructure authorities (companies) with statement of no interference with infrastructure nets (gas, oil, electricity, water supply companies, etc.).		
Reporting the exploration results	If the groundwater proven by hydrogeological (geological) research exceeds prescribed values of parameters (T>20°C, TDS>1,000 mg/l, CO2>1,000 mg/l, H2S>1 mg/l).		
An exploitation permit	A <u>heat producer</u> that produces heat for sale needs an authorization/license issued by Regulatory Office for Network Industries. A thermal installations with capacity > 10 MW require a certificate issued by Ministry of Economics A thermal installations with capacity < 10 MW require the permission from the municipality/community/town (with a population over 2,500).		
	A <u>electricity producer</u> that produces electricity: - capacity > 1MW needs the authorization/license issued by Regulatory Office for Network Industries. - capacity < 1 MW of electricity from geothermal energy - license not required, only the duty (obligation) for notification addressed to Regulatory Office for Network Industries.		
	Groundwater resources need to be classified in the "B" category - requires documented hydraulic tests of a borehole in a duration of more than 21 days and a proof of any substantial decrease of piezometric levels in the borehole and in the nearby boreholes. The exploitation permit is issued, based on assessment notice elaborated by "Hydrogeological Commission" and confirmed by the Minister of Environment.		
	Permission for disposal (treated as disposal of waste water into the groundwater)	Permission for waste water disposal (thermally used water are treated as an industrial waste water - immision limits for TDS, heavy metals, chlorides (200 mg/l), T= 26 °C)	
Construction and operation	Fees for exploitation and disposal of water.		
Monitoring	Conditions for monitoring defined in permission for exploitation (conditions under which the geothermal water can be discharged – frequency of measurement of temperature, quantity of the discharged water, frequency and the range of chemical analyses).		
	Reporting requirements of users (usually once a year, monthly values): - If the exploitation from one water installation/facility in amount > 15,000 m3/year, or 1,250 m3/month. - If using special water (natural healing sources, natural sources of mineral drinking water) for business activity.		
Validity of the exploitation right	Reporting if amount of disposed waste water is higher than 10,000 m3/year or 1,000 m3/month.		
Validity of the exploitation right	Validity of the exploitation right is defined in permission issued by Regional Environmental office.		



## 9 Literature

Antics, M., Sanner, B., 2007: Status of Geothermal Energy Use and Resources in Europe. Proceedings European Geothermal Congress 2007, Unterhaching, Germany, 30 May-1 June (2007).

Beerepoot, M. et al., 2011: Technology Roadmap Geothermal Heat and Power. pp. 45, OECD/IEA, Paris.

Biermayr, P., 2009: Erneuerbare Energie in Zahlen, Die Entwicklung erneuerbare Energie in Osterreich im Jahr 2008.

Biermayr, P., 2010: Erneuerbare Energie in Zahlen, Die Entwicklung erneuerbare Energie in Osterreich im Jahr 2009.

Biermayr, P., 2011: Erneuerbare Energie in Zahlen, Die Entwicklung erneuerbare Energie in Osterreich im Jahr 2010.

BMLFUW: Erneuerbare Energie 2020, 2009.

BMWFJ & BMLFUW: EnergieStrategie Osterreich, Wien, 2010.

EGEC, 1999: Ferrara declaration Available at [www.geothermal-energy.org/files-3.html](http://www.geothermal-energy.org/files-3.html).

EGEC, 2009: Brussels declaration Available at <http://egec.info/wp-content/uploads/2011/02/EGEC-Brussels-Declaration-2009.pdf>

EGEC, 2010: Response to the EC Public consultation exercise on “Roadmap for a low carbon economy by 2050” Brussels, 26. 11. 2010. Available at <http://egec.info/wp-content/uploads/2011/02/EGECs-answer-to-EC-consultation-on-roadmap-2050.pdf> and [http://ec.europa.eu/clima/consultations/0005/registered/11458103335-07\\_european\\_geothermal\\_energy\\_council\\_en.pdf](http://ec.europa.eu/clima/consultations/0005/registered/11458103335-07_european_geothermal_energy_council_en.pdf).

European Commission, 2000: Directive of the European Parliament and of the Council 2000/60/EC Establishing a Framework for Community Action in the Field of Water Policy. Luxemburg 23 October 2000.

European Commission, 2006: Directive of the European Parliament and of the Council 2006/118/EC on the protection of groundwater against pollution and deterioration. Strasbourg 12 December 2006.

ICPDR, 2009: Danube River Basin Management Plan. Vienna.

Muth, J., Smith, E., 2011: 45% by 2030. Towards a truly sustainable energy system in the EU. European Renewable Energy Council, Brussels. Available at [http://www.erec.org/fileadmin/erec\\_docs/Documents/Publications/45pctBy2030\\_ERECReport.pdf](http://www.erec.org/fileadmin/erec_docs/Documents/Publications/45pctBy2030_ERECReport.pdf)

Zervos, A. Lins, C. and Muth, J., 2010: Re-thinking 2050. A 100% Renewable Energy Vision for the European Union. European Renewable Energy Council, Brussels. Available at <http://www.rethinking2050.eu/index.php?id=4>.