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GEOELEC

Deliverable n° 4.1

Report presenting proposals for improving the regulatory framework for geothermal electricity

Date: September 2013

Authors:P Dumas (EGEC), M Serdjuk & R Kutschick (GGSC), S Fraser (BRGM), S Reith & T Koelbel (EnBW)

REPORT ON GEOTHERMAL REGULATIONS

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REPORT ON

GEOTHERMAL REGULATIONS

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Executive Summary

Regulatory barriers and other legal factors may hinder the large scale development of geothermal power. This Geoelec report on geothermal regulations presents not only an overview of the issues but also proposes recommendations to minimise their negative effects and to enable an effective development of geothermal projects.

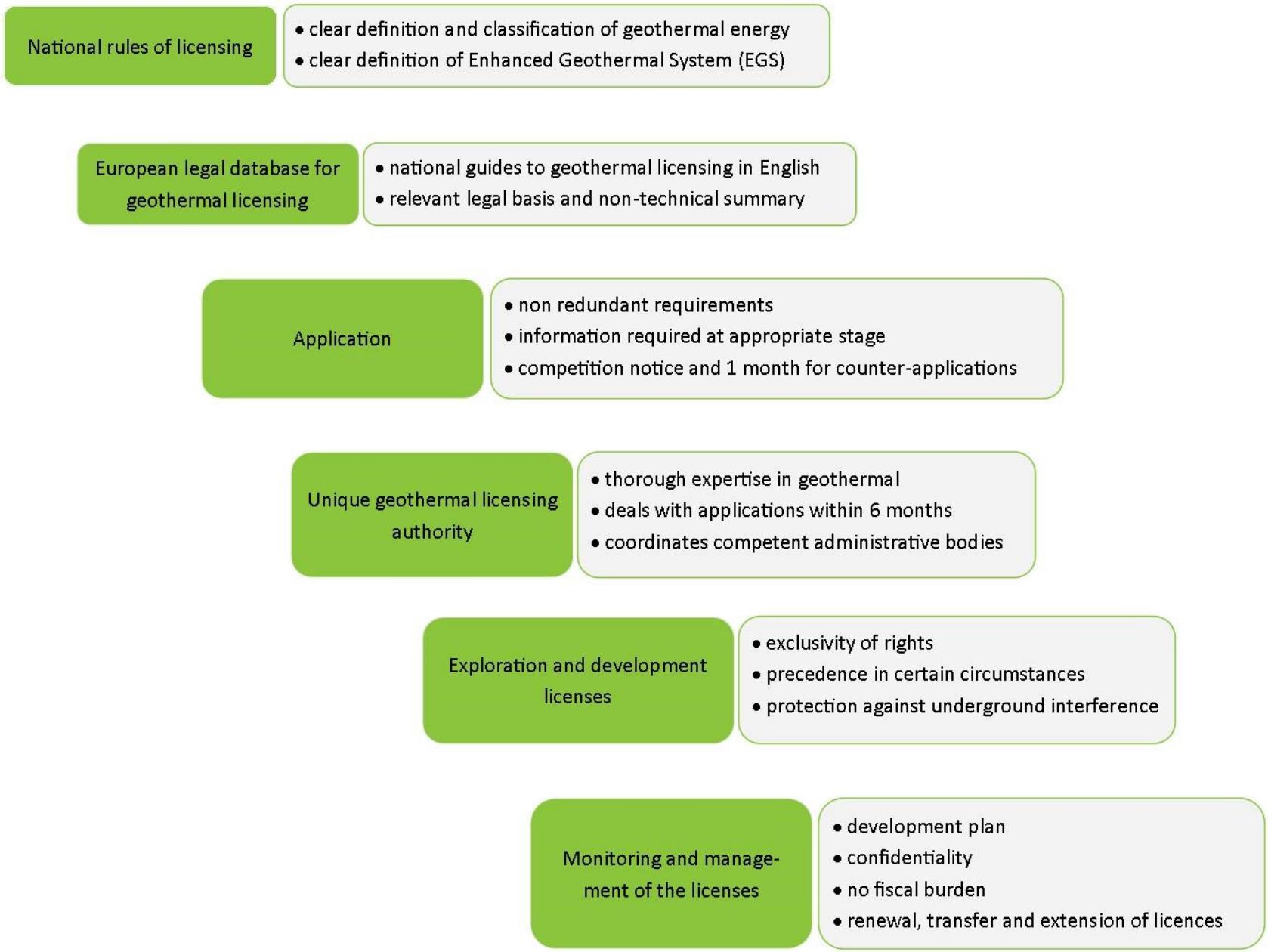
One objective is to contribute to the transparency, reliability and cohesion of legal framework conditions of geothermal power development and implementation and therefore the long-term security of investments in the sector. A Reduction of legal barriers through the implementation of clear/standard administrative procedures to obtain concessions is a second goal.

Barriers against geothermal power plants can result from:

- Uncertainty with regard to resource ownership difficult procedures for obtaining exploitation rights. A number of countries already solved satisfactory this issue, they could serve as best practice examples.
- Environmental regulations need to take a wise approach, protecting the environment but not killing projects, wherever possible
- Secured grid access is a must for geothermal power. In some countries this has already been solved with legislation e.g. for feed-in-tariffs, stipulated in the RES Directive
- Public acceptance problems must be taken seriously and solved, even if not required legally

GEOELEC Recommendations

Within the GEOELEC project an advised licensing process was developed, which is presented in the following figure:


National rules of licensing
• clear definition and classification of geothermal energy
• clear definition of Enhanced Geothermal System (EGS)
European legal database for geothermal licensing
• national guides to geothermal licensing in English
• relevant legal basis and non-technical summary
Application
• non redundant requirements
• information required at appropriate stage
• competition notice and 1 month for counter-applications
Unique geothermal licensing authority
• thorough expertise in geothermal
• deals with applications within 6 months
• coordinates competent administrative bodies
Exploration and development licenses
• exclusivity of rights
• precedence in certain circumstances
• protection against underground interference
Monitoring and manage-ment of the licenses
• development plan
• confidentiality
• no fiscal burden
• renewal, transfer and extension of licences

Introduction

Geothermal developers overtly abhor opaque, complex and lengthy licensing procedures. Deficient licensing rules can undoubtedly cramp the investment in the geothermal electricity sector in Europe. Licensing rules for geothermal projects are no exception to the European diversity. They may be significantly different from one country to another and have uneven degrees of achievement all over Europe.

The initial assumption here is that, no matter the diversity and progress of the national geothermal licensing rules in Europe, they all remain to be perfected if geothermal electricity developers are to be guaranteed legal certainty. In order to kick-start development geothermal electricity deserves at European stage, policy makers should remain aware of the need to further tighten national regulations so as to provide effective, reasoned and pragmatic licensing rules for geothermal. In this respect, the report provides some yardsticks and recommendations for such effective and pragmatic geothermal licensing to be enforced. A review of some national geothermal licensing systems existing in Europe can be found in appendix I.

Firstly, it gives an overview of the geothermal regulatory frameworks in Europe. This state-of-play presents what are the main areas of legal problems and legal barriers, gives details about the licensing process for exploration, drilling and mining with example of Germany, Italy, and Iceland, and finally details the environmental regulations.

The second chapter aims at providing 12 key recommendations for improving the regulatory framework for geothermal electricity with:

- Guidelines to achieve effective and pragmatic licensing rules for geothermal electricity projects in Europe
- The existence of a licensing system for geothermal
- Clear definition of geothermal energy
- Easy access to the licensing process
- One-stop-shop licensing process
- Transparency and adequacy of criteria against which applications are examined
- Reasonable timeframes of licensing procedures
- Transparency and security of rights for the licensee
- Transparency and relevance of monitoring and reporting obligations
- Alleviation of fiscal burden associated to geothermal licenses
- Flexible and reasonable management of licenses over time
- Standardisation

Finally, the third chapter concerns specific regulatory issues as Competition for the use of the underground, further legal aspects, in particular, civil law and dispute resolution, legal conditions for grid access.

Two annexes complete this report:

- Annex I: Overview of national regulations for geothermal electricity
- Annex II: Report on Legal conditions for grid access

1. Overview of geothermal regulatory framework in Europe

1.1 Main areas of legal problems and regulatory barriers

a) Legal basis:

A basic problem EU-wide was solved by the Directive on Renewable energy sources (2009/28/EC), with a binding definition of Geothermal Energy in the Article 2:

(c) 'geothermal energy' means energy stored in the form of heat beneath the surface of solid earth;

b) Resource ownership and protection

Regarding the ownership of the resources, two situations can be found within the European countries. In some countries where plants are operational, the issue is covered by the adoption of mining law or mineral resources law. The procedure mentions that the State / the crown gives a concession to project developer for exploiting the resource. It is a good option if licensing is regulated properly but it creates difficulties if it is included in water legislation.

In other countries, the owner of the surface also has the underground resource ownership. It creates difficult situation as for a larger project multiple owners will be concerned. For deep geothermal project this is very time consuming.

In juvenile markets there are no specifications about ownership. Licenses allow the protection of an area and to avoid competitors using the same underground resources. Traditionally, a first come - first served approach is in place; with the exception of states where a priority is given by law to a specific resources: water, energy etc. Moreover, a licensing regime defines the frame for dispute solutions: the mining authorities and the responsible court of justice.

A clear title for exploitation rights over a sufficient period is crucial. For a renewable energy, 'exploitation' might not be the best word; the energy extraction should be seen more a use of the resource, a temporary exploitation and recovery, or similar.

Photo1: geothermal field in Larderello (Italy). EGEC copyright

c) Resource licensing

In order to get the legal authorisation, project developers must pass several steps and deal with a number of public authorities. With state ownership, the following items are crucial for geothermal development:

- Who can apply for a license (non-discriminatory process)
- One- or two-step-process (exploration, exploitation)
- Time period for which a license can be obtained, possible prolongations
- Royalties (based upon what parameter? Fixed or as a percentage of production?)
- Time for obtaining a license

Typically, an exploration permission is firstly given for a period (4-6 years) and for a specific area. Afterwards an exploitation authorisation is attributed for 30 years or more, with in each case possibility of extension.

The length period of the permits should be enough long to allow for exploration and proper production, but should prevent speculations and fake exploratory projects.

The protection of the resource against other uses/users is crucial. No licenses should be given for other uses/users that would jeopardize the resource; and certain distance (or other protection) must be kept for other uses.

The public entities involved to cover geological, water, energy aspects can be numerous: Mining authorities (national, regional), environmental agencies, local authorities etc. Each step can be time consuming.

Regulatory barriers can also result in cost barriers: These financial burdens include:

- Cost for legal fees, license fees
- Cost for royalties: in particular problematic if fixed and not related to production!
- Cost for environmental studies, public hearings, etc.

Taxes for the exploration permit (x €/Km² of annual lease), for the mining lease and for the electrical production should neither be too high, and so preventing any investigation, nor too low and so creating speculation on permits.

In total, the legal procedure today in Europe can take between 6 and 24 months, on top to the time needed for collecting the supporting documents required. Issues like micro-seismicity and hydraulic stimulation add a new step to the process. It is important to set deadline for each step. A framework is especially needed for the environmental impact assessment, which lasts 1 to 2 years. Uniform environmental reporting procedures are needed to cover drilling work, health & safety rules, noise, micro-seismicity etc.

The acquisition of geological data can also be a barrier when the data purchase is too expensive and when the confidentiality block the communication of the data. In the case of publicly funded projects, data protection is rather short but for private developers the confidentiality can remain for several years, with copy to the geological surveys.

d) Environmental regulations

The state has a duty to provide regulations protecting the environment or other human interests from possible negative consequences of geothermal power production.

The following rules should be adhered to:

- A viable equilibrium has to be found between regulations that might have not the necessary protective effect, and those that might damage geothermal development
- A full Environmental Impact Assessment (EIA) procedure is required only for large projects with considerable risk potential
- Keep environmental regulations focussed on the protection of the ground, groundwater, and surface from possible harm caused by the geothermal plant, and do not address unrelated issues!

Environmental regulations should include Groundwater protection incl. pressure issues, soil protection but also protocol on micro-seismicity, and surface issues.

Regarding the protection of waters, Article 11 of Directive 2000/60/EC (Water Framework Directive) gives Member States the option to authorise the reinjection into the same aquifer of water used for geothermal purposes. It is therefore within the competence of the national governments to decide whether reinjection of the geothermal fluids is required.

For work safety, construction and traffic, any legislation applicable for similar activities in mining, drilling, construction, etc. should be applied.

Examples of damaging action:

- A confusion is made between fracking for shale gas and EGS stimulation, and all stimulation actions are banned (e.g. German state NRW)
- Drilling and safety regulations for hydrocarbon exploitation are imposed on geothermal drilling

The list of barriers resulting from environmental regulations can be rather long. There will, of course, be cases where environmental issues make a project impossible. However, this should be limited to as few cases as possible, and be known as early in the project as possible!

Photo2: Geothermal deep drilling in Germany (copyright: H kreuter)

e) <u>Grid access</u>

For geothermal power, grid access is key. It is important to have a secured right of connection, or a negotiation with grid operator. All regulations for electricity grids apply to geothermal power plants. Misleading interpretation of the Energy Efficiency Directive could put geothermal plants in second ranking for grid access. The main risk could be that in the event of oversupply, notably from variable RES, some other plants can be curtailed . Legal procedure should include the need of legally binding contract with grid owner.

Within Directive 2009/28/EC grid access is treated in Art. 16:

- Art. 16, 2

(a) *Member States shall ensure that transmission system operators and distribution system operators in their territory guarantee the transmission and distribution of electricity produced from renewable energy sources;*

(b) *Member States shall also provide for either priority access or guaranteed access to the grid-system of electricity produced from renewable energy sources;*

- Art. 16, 3

Member States shall require transmission system operators and distribution system operators to set up and make public their standard rules …

Photo3: geothermal power plants san Martino (Italy) EGEC copyright

1.2 Licensing process for exploration, drilling and mining

This chapter intends to give an overview of the licensing scheme for geothermal electricity in Europe with a particular focus on Germany, Italy and Iceland, a few of the most dynamic geothermal countries in Europe. Firstly, the German mining, water and emission control law is outlined and then compared to the situations in Italy and Iceland. A particular attention is put on Enhanced Geothermal Systems (EGS).

1.2.1 Germany

In Germany, a mining permission, a license under the Water Act and a building permit are required to build and operate a geothermal power plant. The Federal Mining Act is the central law for the overall approval of geothermal plants. For the exploration and exploitation of geothermal energy, a mining authorisation is required. In addition, the operator has to prove financial capacity that must fulfil the licensing authority separate proceedings.

The mining licenses are provided as a concession, i.e. the authority shall give the holder an extensive list of rights according to the public interest, which may lead to conflicts with land owners, because in German mining law geothermal resources are called 'mining free mineral resources'. They are not attached to the ownership of the overlying ground and thus are ownerless. Besides that, the property owner is unable to take legal action for damages to be expected from the mining operation. Another limitation is that the extent of a transfer that may take place must only be carried out with the consent of the mining authority.

1) Exploration permit issued by the State Mining Authority

In order to begin to explore the ground, the operator must have an exploration permit. This includes both the seismic exploration and drilling permit. The owner is entitled to take all the facilities for the purpose of on-study. The applicant shall preclude a claim for grant of permission, provided there are no grounds for refusal. The decision is not at the discretion of the Authority. In particular, the following conditions must be met:

- License area must be accurately described;
- Work Program must be present (type, scope, purpose, period of exploration activities);
- Reliability is to be checked;
- Required funds must be applied;
- Mineral resources may not be affected;
- It may preclude any overriding public interests.

For geothermal projects, the main points are the work program as well as the financial capacity. In the examination of such aspects, the Authority has a certain margin of appreciation available in the result. If the authority issues the exploration permit, three factors are decisive for the applicant:

- The permit relates to a specific field within the owner can investigate.
- It is conceded as an exclusive right.
- The holder can receive a funding grant for geothermal resources found.

Permission fields can have an area of 50 km² to 250 km². The authority shall take into account the extent to which the size of the field can jeopardize the competitive position. A hazard is unfortunately never excluded because of the exclusive concession of mining rights. Once granted

permission, the owner enjoys the protection from competitors. The other interested parties are excluded in the truest sense of the word. Although it is technically possible to use geothermal resources at different depths, it is not allowed under German mining law. If a company wants to use along with a permit holder of its field, only the way is through the private legal agreement. An amendment to § 4 paragraph 7 Mining Law, which governs the area and mining exclusivity, could create the effect in which the authority can assign different underground "storey" to various interested parties.

2) Approval

The approval is another form of legal mining concession. With it, the authority may authorise the production and appropriation of geothermal energy as well as the construction and operation of related facilities. This is, in contrast to the permit, usually granted after it has been determined that geothermal energy sources are available, although these are not yet known. The following eligibility requirements are:

- The reservoir must be specified;
- The approval field must be fulfilled;
- The geothermal water must be obtainable;
- There must be a work program (technical implementation for the production, adequacy of surface and underground facilities, the extraction should be carried out in a reasonable time).

3) Rights of the land owner

The exclusivity of the mining law concessions brings with them the toleration obligation of the landowner. She/he can proceed only with considerable difficulty before the administrative courts against the exploration and extraction in his/her land. She/he often relies on compensation claims. Furthermore, it is impossible for him/her to proceed by civil law prohibiting claims against the operator. This privileging of production entitled carries a high potential for conflict (see "Right protection").

4) Operation plans

Exploration and authorisation are made regardless of the type of contractor, the approval of the operating plan is crucial. The authorization does not grant a new right, but a mere supervisory authority. The conditions are that:

- The applicant is the holder of a mining right;
- He has reliability and expertise;
- Prevention of risks in keeping with the latest technological developments;
- There are no overriding public interests against the use.

There are five different types of operation plans: basic, main, special, community management and closure plan. Below the most important three plans are presented, which are the basic operating plan, the main operating plan, and the special operating plan.

- Operation plan approval: During the audit for approval of operating plans, the authority investigates the environmental impact of the project. Geothermal is not a mining activity like classical mining for coal or other conventional resources. Even if the authority has already

checked the environmental impact of mining authorisation process, a renewed examination in the operating plan approval is by no means superfluous. Because of the potential adverse environmental impacts of EGS plants, such as small earthquakes in geologically sensitive areas, it is the responsibility of the developer to monitor possible effects at each step of the process.

- Basic operating plan and zoning procedure: The basic operating plan has only general information about the proposed development, including the technical implementation and schedule. It is essentially mandatory when drilling with greater depth is within a kilometre of a natural habitat and/or a bird sanctuary.In this case, a plan approval procedure is performed and there is a special demand for citizen participation. Through interpretation of the planning documents, citizens have the opportunity to object in writing and to discuss in a public hearing, together with the project proponent. The competent authority may also participate apart from planning approval process, as well as non-governmental organisations for nature conservation and the surface owner.

- For the developer, the implementation of the plan approval procedure has the advantage that it does not further need the water rights permit, building permit, or exemption from nature conservation law prohibitions, in part due to the concentration effect of the so-called formal zoning. The plan approval includes all of these permits. However, the company must take into account that it can implement this plan only after approval of the main operating plan, as the basic operating plan is relatively abstract.

- Main operating plan: The main operating plan is the most important for the developer, because key points of the operation must be specified within it. Here, the developer must operate and provide the authority "means to a comprehensive picture of the planned operating system, devices and its production". These include the description of the wells in the exploration field, which later bare the geothermal energy, the reinjection of liquid (if necessary) and the power system .

- The mining authority may in turn make conditions for the approval. It can specify that the operator must complete a liability insurance of a certain amount or it may set security services to ensure the subsequent filling of the wells or reutilisation of the earth's surface. Further, it can determine that the company should meet certain technical measures for noise protection and nature conservation. In addition, the authority shall require the operator to perform regularly actual seismic monitoring, particularly before the implementation of stimulation works.

- Special operating plan: Special operating plans are set up only on special request of the authority for certain parts of the operations or specific projects. The subject of special operation plan may be the establishment of the well site, especially in the case of any demolition when hot water is not found. Moreover, the developer has to adopt security measures including in particular, the description of the execution of the hole (depth, distraction, etc.) and potential water contamination that may be caused by the project.

- Bails: When there are doubts about the financial security or the experience of the operator, financial guarantees may be required.

- Operating plan and EGS systems (the case of Landau): After the micro-seismic events at the geothermal power plant in Landau, there was an adjustment of the operating plan to prevent damage. The geothermal power plant in Landau is based on EGS methods and is located in the Upper Rhine Valley, which is known as an area of increased seismicity. On August 15th and September 14th 2009, there were micro seismic events in Landau measuring 2.7 and 2.4 on the Richter scale. Since the beginning of the commissioning of the plant, there have been no noticeable micro-earthquakes.

  According to the results of expert studies, the most likely cause is the injections of water under high pressure into the rock. This increased the pore water pressure, leading to the reduction of the shear strength (breaking strength) of the stone in which it was injected. So it came ultimately to shear fracture, which degraded already existing tectonic stresses.

  As a consequence, the mining authority has imposed conditions to the main operating plan of the operator. Thus, the operator of the geothermal power plant in Landau is asked to establish a recording system. The injection pressure during normal operation has to be reduced and then higher surface damage insurance should be made.

Photo4: Geothermal drilling operation in Germany (copyright: H kreuter)

1.2.2 Italy

1) Statutory regulation

In Italy, in contrast to the German legal system, there are laws that regulate exclusively the use of geothermal energy. The most important of these rules is the Legislative Decree 22 of 11/02/2010.

The geothermal resource in Italy is not owned by the surface owner, but by the central and the regional governments. Furthermore, a subdivision of the geothermal resources is provided in various types of deposits, after which the property status is defined. Thus, the deep enthalpy valleys, which consist of vapours or liquids with temperatures over 150°C, were declared of national interest. Alternatively, areas are also covered, which can provide a geothermal capacity of about 20 MW and their reinjection liquid has an average temperature of 15°C. These sources meet the requirements, as they are property of the state. Otherwise, they shall only be on the local interest and are therefore the property of the region.

The legal rules are thus less resource-based (water, mining, etc.), but primarily plant-based or sector based. Notwithstanding, the use of geothermal energy in Italy should be further simplified: liberalise the electricity market, implement new regulations. In contrast to the previous legal research permits, partly state-owned companies, such as ENEL and ENI, no longer have preferential treatment.

2) Responsibilities for the issuance of concessions and review

The permits for exploration and mining are issued by the Italian regions. This division of powers to the regions can be problematic. They were often overwhelmed with the administrative procedures necessary for the approval of a geothermal power plant. In particular, some authorities outside Tuscany lack experience in terms of monitoring the environmental impact of geothermal projects. The legislator justifies the distribution is justified however, with greater involvement in the administrative processes of the regions and provinces, which in any case would have taken decisions about urban planning, building regulation or other legal environmental issues to decide.

3) Permits

The contractor will initially require an exploration permit. This includes a detailed description of its technical and financial capacity in a work program. The authorisation permit is only for a single person. If there are several interested parties, a choice is to be made. These relate to:

- The importance of the resource;
- The knowledge of the interested parties about the research field;
- The complexity of the project and
- The experience of the entrepreneur.

In its work program, the operator shall demonstrate exactly how he wants to determine the geothermal resources and the type of geology in the study area. The field of research has a maximum size of 300 km². Within the same region as an administrative unit, the authorities may grant more approvals up to an area of 1,000 km² for the same entrepreneur. They issue the permit for a maximum of four years, with a possible extension. The owner has to pay once € 325 per km² to the competent authority.

Once the entrepreneur has discovered potential sources in the investigation, he requests the exploration permit. For this, details about the geological characteristics of the sources, adjacent cultivations and the objectives of the exploration and use are to be known. The entrepreneur needs to broaden the work program and explain details of the hole, especially about the schedule.

At the end of a successful exploration and research process, a concession for the dismantling is issued. A significant requirement for its issue is the compatibility of the system with the environment. Accordingly, it may be necessary to carry out an environmental impact assessment. The operator has to pay € 650 per km² to the competent authority for this. In addition, annual taxes to local municipalities, where the plant is located, are included. The evaluation of the environmental impact requires independent institutes and expertise from the regional authorities.

1.2.3 Iceland

As Italy, Iceland has many geological anomalies that can be used without the EGS technology for power generation. There is a energy law specially tailored to the use of geothermal. The Secure Survey of Ground Resources and Electricity Act is of central importance for the successful development of geothermal resources exploration. It will be presented in detail below. The peculiarity is that in Iceland the owner of the land also holds the title to the underground resources.

1) survey and utilisation of ground resources

- Examination and research permits:

The national Minister of Industry issues the investigation and research permit, and investigation is not allowed until then. Property owners in Iceland enjoy the advantage that study and research do not need a permit. It is only required to inform the Icelandic national energy authority, the Orkustofnun, about plans for drilling, blasting or similar work. With the participation of the Minister of Industry, the Orkustofnun can impose to the landowner requirements for technical or safety reasons.

In contrast to the German regulation system, the Minister of Industry may issue several permits, which lead to a sharing of a study area. For this, the parties must have jointly filed a civil law agreement on its approach.

- Dismantling license

For the use of geothermal energy sources, a total approval of the Minister of Industry is required in every case. The holder of the occupancy permit must seek the agreement with the private property owners before the start of mining. Subject matter of this agreement may, for example, be a compensation for the use of resources or an approval of dismantling. This statutory obligation according to private law agreement is different in comparison to other European countries: the underground, if not in the public domain, can be a private property. It even goes so far that the use permit expires in the absence of private law agreement after 60 days. The holder of the authorization shall then only be able to stimulate an expropriation of the property owner at the Industry Minister. If this is done, the Minister grants the holder the real property. However, he must pay the full cost of expropriation.

In the event that two owners of a use permit do not agree, they should seek a judicial resolution, in order for a united opinion on the efficient use of resources and to the balance between the right positions.

2) Electricity Act

Iceland's Electricity Act regulates the licensing of power plant units and ensures that powerful geothermal power plants generate the required energy for the expansion of energy-intensive

industries. A permit is only required if the system can deliver more than 1 MW. If the operator of smaller facilities (30-1000 kW) wishes that his energy goes into the national distribution system or transmission system, he must at least communicate the technical details of the system the Orkustofnun.

1.3 Environmental regulations

The Geoelec report on environment provides clear explanations on the environmental impact of geothermal projects. The report also gives an overview of the possible environmental impact of three geothermal facilities i.e. geothermal facility for exploiting high enthalpy hydrothermal resources, medium enthalpy hydrothermal resources and Enhanced Geothermal Systems (EGS). The impact is described in relation to different development phases of the geothermal power plant facilities. Those phases are:

- Access roads and pipe laying
- Well repair, well stimulation, well drilling and testing phase
- Plant construction and equipment installation
- Power plant commissioning and operation
- Decommissioning of facilities

Different impact is generated in different phases of the development but the following main categories were identified:

- *Surface disturbances,* such as those caused during the plant construction possibly affecting flora, fauna, surface water (access roads, pipe and power lines, plant and associated land use).
- *Physical effects*, like the effect of fluid withdrawal on natural manifestations, land subsidence, induced seismicity, visual effects (buildings, cooling towers, surface pipelines, power transmission lines etc.)
- *Noise*, such as equipment noise during drilling, construction and operation.
- *Thermal pollution*, such as due to hot liquid and steam release on the surface.
- *Chemical pollution*, like due to disposal of liquid and solid waste, gaseous emissions to the atmosphere etc.
- *Protection*, such as ecological protection (fauna and flora).

Most of the impact identified can be minimised by mitigation measures and monitoring along with proper environmental management procedures.

The environmental regulations are rather long. The rules protecting the environment in geothermal regulatory frameworks cover principally water protection, control of emissions, impact assessment and landscape assessment.

Photo5: Geothermal blue lagoon (Iceland) EGEC copyright

1.3.1 Groundwater protection

The protection of groundwater is important during the drilling phase. The groundwater is to be managed sustainably. It is part of the ecosystem, is a habitat for animals and plants, and has a role in the livelihood of local residents.

a) General duty of care

The operator is obliged to be diligent in any action which may affect or changes on a body of water. This includes in particular the obligation to avoid an adverse change in the properties of water and to use water sparingly. However, a violation does not lead to sanctions.

b) Permits according to water law

- Use of water: The operator of a geothermal drilling is required, for various reasons, to obtain a water permit. Even the drilling of an aquifer by means of an oily drill bit or using other drilling support instrument could induce detrimental changes in groundwater quality. Even the very deep wells can connect multiple water-bearing layers. As part of the permit, the authority has also to consider that the steam generation process of ORC or Kalina power plants can be hazardous to water. Water enriched with minerals during heat cycle can seep out of the system.

- Decision makers: The authority shall approve the mining permit according to the decision of the water authority, as far as the mining law operating plan provides a use of the water.

- Special cases: geothermal wells in water protection zones are excluded from the outset, because they serve to protect drinking water quality. Geothermal wells are, however allowed in protection zone III. The requirement is that the operating plan ensures adequate measures to prevent harmful changes.

1.3.2 Emissions

Because of low emissions, the geothermal power plants also meet the most stringent clean air standards. It should be noted that all geothermal plants have to meet various national and local environmental standards and regulations, although emissions are not routinely measured below a certain threshold, and emissions from geothermal plants typically fall below this threshold. The pollution control regulations provided for EGS systems are no major obstacles for permit granting. Only noise limits may be of relevance, with regard to the cementation of the pipes and the hydraulic test work.

1.3.3 Environmental Impact Assessment

A major obstacle for geothermal projects, for example in Iceland, is the environmental impact assessments (EIA), where the National Planning Authority is responsible for monitoring the implementation and management of the EIA: It has the power to decide which projects require an EIA.

a) Obligation to conduct

The drilling of production or research holes may be subject to EIA in regions with very low temperature, hot springs or nearby areas or where minerals are located. This is only the case when the National Planning Authority concludes it is necessary based on the submitted data by the contractor of the project, and due to the nature, extent and location of significant environmental effects. Before deciding, the authority will seek dialogue and consultation with all involved parties. Geothermal power plants with a thermal output of more than 50 MWth or electrical output of more than 10 MWe, however, necessarily require an EIA.

b) Review

Andrésdóttir and others questioned in 2003 whether in practice the confusing regulatory framework for EIA requirement enables predictable planning for the entrepreneur. They criticized that a project of implementation of power plant construction sometimes has to go through several stages of the procedure in EIA. As a result, the project could be considerably delayed. In one case, the contractor did not receive a drilling permit despite two performed EIA. In another case, a contractor has received seven permits for drilling without an EIA.

To make matters worse, the contractor has the costs of implementation of an EIA. Clear guidelines, which establish the conditions which require an EIA should be established.

1.3.4 Landscape Protection

Geothermal plants have very low visual impact as most of the infrastructure can be hidden beneath the ground. Most visual disturbances are during preparatory & drilling phase and equipment installation. A significant benefit of geothermal energy and heat generation is that minimal land use is required during construction, with an area of only one or two acres necessary.

The main visual impact during the construction phase is the presence of a drilling rig, but once a project is in the production phase the rig is not required and the energy centre footprint is very small. The visual impact will also be minimal as the permanent energy centre can be constructed sub terrain.

A major conflict arises from the landscape only in Iceland. The geothermal resources are often located in scenic areas. For the people of Iceland, the scenery, especially the heavily embossed

volcanic highlands, has a very high value. There is also an economic point: tourism and recreation areas are of great importance for Iceland. The Nature Conservation Act protects therefore in conjunction with the declared by the National Nature Reserves Authority and the Icelandic countryside areas. On this line, the use of geothermal energy in Iceland will have to change in the future.

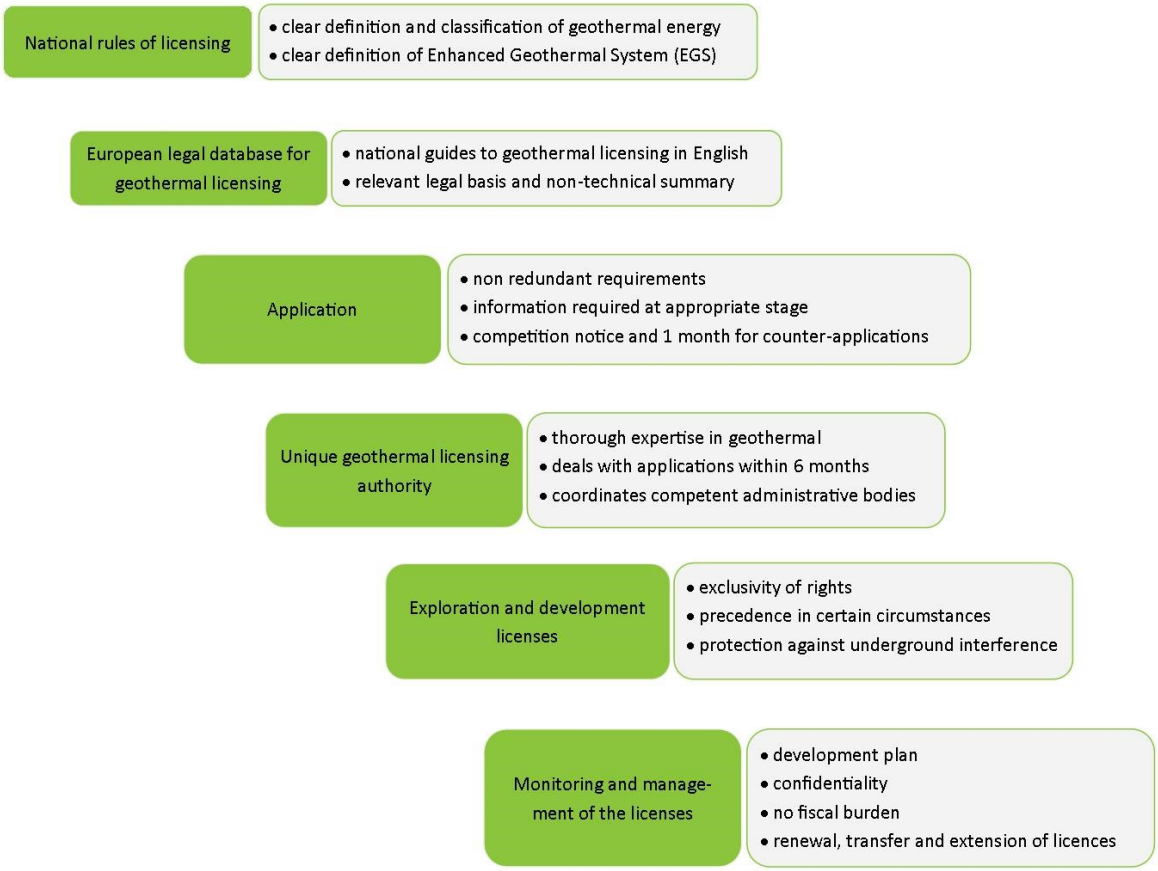
2. Proposals for improving the regulatory framework for geothermal electricity

2.1 Guidelines to achieve effective and pragmatic licensing rules for geothermal electricity projects in Europe

Legal certainty and transparency for geothermal licensing rely on ten key conditions that are shown in figures 1 and 2. Recommendations to meet these key conditions are reviewed in turn.

Figure 1 – GEOELEC Key conditions to reach effective geothermal licensing rules

Figure 2 – GEOELEC Description of the advised licensing process



2.2 The existence of a licensing system for geothermal

It is essential that Member States' legal framework provides some specific rules for geothermal licensing.

In European countries where licensing rules for geothermal exist, these rules may be incorporated into specific legislation; this often being mining law, with references to related legislation (e.g. groundwater law, planning law, environmental law). It may also be that licensing rules for geothermal are scattered in various texts with no clear legal matrix for developers.

The comprehensibility of geothermal licensing is better ensured where licensing rules are dealt with by a single type of legislation; let it be mining, hydrocarbons or natural resources law. Where appropriate, related considerations, such as environmental or groundwater impact of the contemplated geothermal electricity project, may be addressed by a reference to related legislation and regulation.

Existing law such as mining law may therefore be seen as a convenient receptacle for geothermal licensing rules. However it should not allow considerations specific to geothermal to be shrugged off (e.g. potential induced seismicity). In this respect, where existing national legislation fails to take these considerations into account, a geothermal amending act addressing the shortfalls should be enforced.

- **Existing national legislation may be used as a receptacle for geothermal licensing rules.**
- **As far as possible, licensing rules for geothermal should be gathered into a unique kind of legislation and related considerations shall be dealt with by appropriate references to related legislation.**
- **Considerations specific to geothermal shall be duly addressed by the existing legislation chosen as a receptacle and any shortfall in this regard shall be remedied by an amending geothermal act.**

2.3 Clear definition of geothermal energy

Licensing rules for geothermal can only be effective where they stem from a clear definition of geothermal energy. Such a definition shall be in accordance with the 2009/28/EC Directive on the promotion of the use of energy from renewable sources, which provides that "'geothermal energy' means energy stored in the form of heat beneath the surface of solid earth" (article 2).

Legal frameworks that define geothermal energy usually introduce a classification of geothermal based on depth, temperature or enthalpy. This classification allows for adequate licensing rules to apply depending on the targeted geothermal resource (e.g. shallow geothermal or deep geothermal) with notably the aim of providing regulatory relief for shallow geothermal projects. Within such a classification, the legal framework may further address the particular characteristics of geothermal electricity production and provide a definition of Enhanced Geothermal System (EGS). As such, EGS could be defined as "*an underground reservoir that has been created or improved artificially*".

- **Licensing rules for geothermal shall first of all set a clear, broad definition of geothermal energy with regard to the 2009 RES Directive.**
- **Licensing rules for geothermal shall introduce a classification of geothermal based on clear parameters such as the depth, the temperature, the enthalpy or the end use. The best parameter shall be chosen according to the national geological conditions.**
- **Where desirable, licensing rules may define the term EGS as "an underground reservoir that has been created or improved artificially".**

2.4 Easy access to the licensing process

Geothermal developers may be loath to address any licensing process where its accessibility is scarce. To avoid such pitfall, some regulatory steps shall be taken to deepen and develop European entrepreneurship into the geothermal sector.

Accessibility depends on transparency, which can easily be ensured by providing a guide to national licensing rules for geothermal exploration and development. Such a guide could be displayed on an official website. It could even be worthwhile to have a European e-portal gathering all national guides to geothermal licensing, properly translated in English, to help access information. In any case, the guide should include complete references to relevant national legal structure concerned with geothermal as well as a non-technical summary of the national licensing rules.

In addition, the licensing process should be streamlined (see infra 'one-stop-shop process'). This implies that the application requirements borne by geothermal developers should be reduced to a minimum. Geothermal developers may struggle when inadequate and/or repeated information, in particular environmental impact assessment, is required at different stages of the licensing process, thus leading to extra expenses and delays. Licensing rules shall allow for applications to simply reflect the complexity, cost and potential impacts of the potential geothermal electricity project without being over demanding.

Eventually, accessibility to the licensing process can only be guaranteed where licensing rules allow time for competition. National legal frameworks shall ensure that once an application for an exploration/development license is submitted, a competition notice is officially issued to call for counter-applications to be proposed within a certain timeframe. Such timeframe could reasonably be limited to 1 month.

- **National guides to licensing rules shall be provided and a European e-portal shall be created to centralise this information and make it available in English to geothermal developers. The EU ERANET project may serve as a tool to have an EU e-portal settled. See chapter on 2.12 on standardisation.**

- **The application file for exploration and development licenses shall address all relevant considerations relating to the contemplated geothermal electricity project. The data required shall be in accordance with EU Directives, in particular the Groundwater Framework Directive. However, this data shall only reflect the complexity, cost and potential impacts of the planned geothermal electricity project. In this regard, appropriate exemptions from the environmental impact assessment regulations or planning regulations shall be considered in the licensing rules. The legal framework shall also clearly mention the conditions and time period for the data submitted in the application to remain confidential.**
- **Competition shall take place and counter-applications shall be submitted within 1 month.**

2.5 One-stop-shop licensing process

Here again, effective licensing rules require the licensing process to be streamlined. It is quite obvious that a geothermal electricity project is at the interplay of various legislations, dealt with by various authorities. These various authorities may have a national, regional or local scope of action.
Having several competent administrative bodies to assess an application for geothermal licenses is fair. It is a direct consequence of the need to equally address all considerations in an impartial way.
However, this requirement should not lead geothermal developers to carry out multiple steps for each of these administrative bodies. The legal framework should give the State the exclusive right to grant licenses for geothermal exploration and development and shall specify that a unique authority is entrusted with such a power as well as the responsibility to coordinate all administrative bodies that should give their view on the application for a geothermal exploration/development license.

The licensing authority for geothermal exploration and development could be the government department responsible for minerals licensing. In any case, the geothermal licensing authority should have a thorough expertise in geothermal energy and in geothermal electricity production in particular.
The geothermal authority will be responsible over the whole licensing process for:

- Receiving applications and coordinating competent administrative bodies required to provide an opinion on the application for an exploration or development license;
- Issuing licenses for geothermal exploration and development;
- Reviewing the licenses;
- Monitoring the licensed geothermal electricity projects;

- **A unique authority shall be in charge of the licensing process, and shall coordinate all competent administrative bodies required by law to provide an opinion on the application.**
- **The geothermal licensing authority shall have expertise in geothermal electricity production and shall be the single interlocutor of the geothermal developer over the whole geothermal electricity project with regard to licensing.**

2.6 Transparency and adequacy of criteria against which applications are examined

Regulation shall provide a clear list of criteria against which the application for an exploration/development license will be assessed. These criteria shall not refer to any extraneous consideration, such as the intended power generation. They shall fit the licensing process and may in this regard address the technical and financial reliability of the applicant or the environmental impact of the project.

Where the application is deemed not to adequately fulfill these criteria, legislation shall clearly allow the geothermal licensing authority to nevertheless issue the license if the shortfall can be remedied by appropriate solutions attached to the exploration or development license (e.g. methods to prevent and monitor induced seismicity).

- **Criteria against which applications for exploration/development licenses will be assessed shall be relevant and clearly mentioned in national regulations.**
- **Where criteria are not initially met by the geothermal developer, the geothermal licensing authority shall be allowed to issue a license provided some adequate solutions remedying this shortfall are attached to the license.**

2.7 Reasonable timeframes of licensing procedures

As stressed previously, geothermal developers dread lengthy procedures. It is therefore desirable to impose time limits on the administrative process for granting exploration and development licenses for geothermal.

- **Applications for exploration licenses and development licenses shall be examined within a 6-months period from the date the geothermal licensing authority receives the complete application file. The 6-months licensing process shall include a 1-month period dedicated to fair competition relying on an official competition notice duly published in an official publication.**

2.8 Transparency and security of rights for the licensee

The rights attached to an exploration/development license need to be clearly specified in the licensing process. They shall reflect the balance between the need to guarantee an optimal temporary exploration or exploitation of the geothermal resource by the licensee and the need to preserve the sustainable use of the geothermal resource on the long-term.

In this respect, the licensee shall be granted the exclusive rights to exploration or development of geothermal resources over a defined area and for a specified period of time. The area and the duration of the license shall be appropriate for the production of geothermal electricity and the capital investment engaged. In this respect, a 6-year term for the exploration license may reasonably be set. The term of the development license shall comply with the minimal lifetime of the development wells i.e. a minimum of 30 to 40 years. In any case, licensing rules should be transparent as for the validity period of licenses.

Licensers should consider giving assurances to exploration license holders that they will have precedence when applying for a development license, provided the application for a development license is made before the expiry of the term of the exploration license or within a certain timeframe after the exploration license expires. In any case, legislation shall clearly specify the conditions for precedence to be given to the holder of the exploration license.

The licensee shall also be protected against the thorny risk of underground overlaps. In this regard, the geothermal licensing authority shall be required to take into consideration other existing natural resource licenses before issuing geothermal exploration and development licenses.

In addition, licensing rules shall allow the geothermal licensing authority to set a perimeter of protection around the targeted geothermal reservoir to ensure that the geothermal resource will not be depleted or damaged by competing underground uses taking place in the vicinity of the geothermal electricity project.

Besides, the legal framework shall allow for geothermal electricity generation to be given priority over competing underground uses, in particular carbon capture and storage.

- **The licensee shall be granted exclusive rights to exploration and/or development of the targeted geothermal reservoir over a sufficient time period. The holder of an exploration license may be given assurances of precedence to a development license under certain circumstances clearly mentioned in the legislation.**
- **Exploration and development of the targeted geothermal reservoir shall be preserved from any underground interference and given priority over other competing underground uses such as carbon capture and storage.**

2.9 Transparency and relevance of monitoring and reporting obligations

Licensing rules shall ensure that the licensed geothermal electricity project will be adequately monitored over time. The legal framework shall clearly specify that an exploration or development plan shall be agreed upon during the application for an exploration or development license. Such a plan shall include the work programme and expenditure for the exploration or development phase of the geothermal electricity project. The performance of the project will be monitored against this plan. The legal framework shall also specify the measures the geothermal licensing authority may adopt to ensure the plan is complied with (e.g. written warning, revocation of the license).

In addition, the legal framework shall be clear as to the reporting obligations that may be imposed upon the geothermal developer in the exploration or development license. In particular, the license shall specify the required methods and time basis of reporting obligations as well as the parameters being monitored (e.g. flow rates, pressure, temperature of the fluids, chemistry of the produced and injected waters, seismic recording). It may also be imposed on the developer to inform the geothermal licensing authority of any circumstance likely to weaken the geothermal developer financial reliability and capacity to successfully conclude exploration or development of the geothermal reservoir.

It shall eventually be ensured that the licensing rules provide for some confidentiality of the data submitted under the reporting and monitoring obligations. Conditions and time period for such confidentiality rights shall be clearly specified in the legislation.

- **The exploration/development license shall specify the exploration/development plan against which the performance of the geothermal electricity project will be monitored.**

- **Legislation shall also clearly mention the reporting obligations that may be imposed upon geothermal developers, notably regarding the financial reliability of the developer.**
- **Legislation shall also allow some of the data provided under the reporting obligation to remain confidential for a certain time period.**

2.10 Alleviation of fiscal burden associated to geothermal licenses

Here again, investment into the geothermal sector is restricted by stringent licensing rules, including financial considerations surrounding the delivery of exploration and development licenses. The licensing rules shall be such that these financial considerations do not ultimately cripple the capital that may be engaged into geothermal electricity projects.

- **The licensing fees shall reflect the cost of administrating the licensing process but not target the potential economic return that may be made out of a geothermal electricity project. Only then may geothermal become competitive as a renewable source with, say hydrocarbons, on the European electricity market.**
- **The legal framework shall furthermore ensure that financial compensation legally or judicially imposed on geothermal developers for the use of a third party property or exploration results is fair and reflect the value actually added to the geothermal electricity project.**

2.11 Flexible and reasonable management of licenses over time

Licensing rules shall allow some flexibility in the handling of licenses over time. In this regard, legislation shall allow the geothermal electricity developer to request a renewal or extension of his license. This renewal or extension shall be subject to a review of the accomplished geothermal reservoir development, the economics of the geothermal electricity project and its environmental impact at the time the request is made.

Licensing rules shall allow license to be transferrable subject to the condition that the third party willing to acquire the license fulfills all conditions initially met by the geothermal developer when he applied.

- **Licensing rules shall allow for renewal, extension and transfer of the exploration and development licenses.**

2.12 Standardisation

A good example has been given this year by the U.S. National Renewable Energy Laboratory which established a website promoting document standardisation for renewable energy industries. The website provides a number of standard agreements and contracts that could be of interest to geothermal developers.

Having standardised documents could be quite beneficial and of interest especially for financial actors. It can concern the creation of set of contracts, forms, permits, etc., required during the project development cycle.

Therefore, the risk profile could be easier to compare between geothermal power projects. This could help to relieve some of the due diligence in the underwriting process and ultimately contribute to more affordable premiums.
Moreover, standardisation provides some financial benefits:

- standardized documents (PPAs, leases, interconnection agreements, and other contracts) could clarify the project evaluation process for financiers and facilitate their investment.
- The transaction costs associated with securing financing can be burdensome, and relieving some of this issue in the early stages can have positive impacts throughout the development cycle.

Same online information platform should be developed in Europe going towards standardization of a set of documents:

- PPAs
- RFPs
- Interconnection agreements
- Engineering, procurement, and construction contracts
- Operations and maintenance contracts
- Leases.

Photo 6: Drilling at Ecogi Project (France) EGEC copyright

REFERENCES

- Legal and regulatory framework – Barrier or motivation for geothermal development?, Haraldsson, Short Course on Geothermal Development and Geothermal Wells, El Salvador, March 11-17, 2012;
- GTR-H – Geothermal Legislation in Europe, Goodman et al., Proceedings World Geothermal Congress 2010, Bali, Indonesia, 25-29 April 2010;
- GTR-H project, Specific framework for geothermal regulation, Final version, Deliverable D 17, Recommendations & Template for Country Specific Action Plans, December 2009;

3. Specific regulatory issues

3.1 Competition for the use of the underground

There is obviously conflicting potential as a result of the competition between CO2 disposal, the final disposal of nuclear waste, the production of shale gas and geothermal energy projects because they may target the same deep aquifers, or the same areas within sedimentary basins. Geothermal energy may also be produced from rocks below the depth range for potential CO2 disposal sites, and investigations are needed to determine if geothermal exploitation beneath CO2 deposits might be feasible at all. Zones of dual use capability should be clearly identified.

3.1.1 CCS Conflict

Directive 2009/31/EC on Carbon capture and storage mentioned in its recital 19 and article 4 that: *"Member States should retain the right to determine the areas within their territory from which storage sites may be selected. This includes the right of Member States not to allow any storage in parts or on the whole of their territory, or to give priority to any other use of the underground, such as exploration, production and storage of hydrocarbons or geothermal use of aquifers. In this context, Member States should in particular give due consideration to other energy-related options for the use of a potential storage site, including options which are strategic for the security of the Member State's energy supply or for the development of renewable sources of energy".*

Currently there are 19 CCS projects in the planning phase in Europe, two of them are already in place in Norway – but offshore. The area required for CCS technology could be enormous. A noticeable potential for conflict is thus possible.

Here the situation in several European countries:

a) Situation in Germany

The Federal Institute for Geosciences and Natural Resources developed the geological basis for potential CO2 storage sites in Germany. Conflicts of use with geothermal projects should be considered, amongst other things. The legislator has therefore recognised the conflict. It remains to be seen how the Federal Government will prevent conflicts. Anyway, it is also required to keep a public register of planned and existing CO2 liners and storage, so that entrepreneurs can access information.

Concrete plans or trials of CCS plants do not currently exist in Germany. Resistance from the general public is to be expected- some civic groups have already been established. Furthermore, the federal states can determine which or if the testing and demonstration of permanent storage in certain areas is not permitted. It could therefore be that the potential use conflicts never occur.

Potential areas for this purpose are the northern regions, including Brandenburg, where the plant "Schwarze Pumpe", the first functioning CO2 storage facility in the world, was built, which decreases the gas of the nearby Siemens industry. Other potential deposits are in the Munich area, where numerous geothermal projects have been successfully carried out and more are planned. It is unlikely that CCS could gain a foothold there.

A mechanism to prevent conflicts of use is regional planning. It serves the order, development and protection of large territorial units and is also suitable for the spatial development of subterranean uses. The federal government is obliged to assess in their periodic inspection report on the

development of CCS projects, the need to set goals and principles to prevent competition for the use of the underground. Furthermore, the licensing authority has taken into account goals, principles and requirements of regional planning in the plan approval for the construction and operation of storage. However, this rule can only be effective if use and protection claims, in particular the storage capacity, are included in the planning.

Since the planning is well suited for the control of underground activities, this also applies for various geothermal uses. If the reported activities are listed during planning, the mining authorities are as technical authorities bound to the operating plan approved by them.

b) Situation in Poland

The estimated total capacity of the geological formations for the storage of CO2 in Poland is aggregated to nearly a billion tons of CO2. The Ministry of Environment has been suggesting that the Polish legislation on CCS should be exclusively limited to support and regulation of the demonstration projects. Under this proposal, a license is required for CO2 capture and is assigned by the Ministry of Environment. The license specifies the maximum amount of CO2 that can be permanently stored. The project developer must monitor the storage location for at least 20 years after the injection. If the long-term stability of the storage site is proved as useful (after 30 years), the state assumes the responsibility for monitoring.

Despite its capacity for geothermal power Poland utilises the hot water sources mainly for leisure activities. Nevertheless the government wishes the independence of coal (which accounts for almost 50% of electricity) and has initiated research for probably suitable geological sites. The regions with the best geothermal operations lay in the Carpathian Mountains in southern Poland. Many projects are planned and a large geothermal plant was built near Krakow. It remains to be seen whether there will be a conflict.

c) Situation in Great Britain

Great Britain regards the CO2 underground storage as a good option for the climate policy and promotes research into and the development of new projects. Nowadays no more new coal plants may be approved without CCS projects; existing conventional coal-fired power plants should be retrofitted with CCS within five years. Eight applications have already been made, but the government funding is still missing. The reservoirs are in Yorkshire and Scotland, the latter is also a suitable site for geothermal energy. Here, therefore, there could perhaps be a conflict.

Geothermal energy is not supported or encouraged by government. 2 EGS projects are under-development in Cornwall. However, geothermal energy could cover up to 20% of UK energy supply.

d) Situation in Portugal

Implementation of the CCS Directive is planned and the Portuguese government has finalised an agreement with Norwegian economists to map the geology and to import the CCS technology.

Portugal only uses geothermal energy in the Azores Islands. Five power plants cover nearly 25% of the island’s energy use. On the mainland, geothermal waters are associated with active faults. The already examined potential for the use of geothermal heat pumps on aquifers is high throughout the country. Conflicts with CCS are thus very likely.

e) Situation in Italy

Implementation of the CCS Directive has already begun with the exploitation of coal mines in Sardinia for the generation of electricity with CCS. A region near Venice, Porto Tolle, was selected and it is expected that up to 1 million tons of CO2 can be stored annually. In northern Italy (Lombardia) research is also being carried out, because the surrounding area is an industrial area – projects in Bordolano, Romanengo and Rivara are in advanced stage. Since most geothermal plants are located in central Italy (Tuscany), the CCS is not a competitor for the moment.

f) Situation in Austria

In Austria, the CO2 disposal is prohibited. Only research projects for up to 100,000 tons of CO2 are allowed. These are, however, only allowed if no dangers to man and environment exist. The conflict was thus solved at the expense of CCS.

According to the Austrian Energy Minister, the government prefers to focus on renewable energy sources and energy efficiency improvement. The potential for geothermal energy is estimated at 34% of total energy demand of the country.

g) Situation in Norway

The government in Norway has so far stopped the plans for the world's largest CCS project, justifying the decision saying that - the technology is not mature, the cost would have multiplied. There, too, the priority question is not an issue in the short term.

3.1.2 Nuclear waste final storage Conflict

a) Situation in Germany

Nowadays there are in Germany only aboveground nuclear waste deposits, most of them in Niedersachsen. The former iron ore mine "Konrad" in Salzgitter has been investigated since 1975 as a possible repository for radioactive waste with negligible heat generation. The conversion of the mine "Konrad" into a repository began in May 2007, following a decision of the Federal Administrative Court. The deep storage is to be finished by the end of 2013 and can be up to 1,300 meters deep.. Currently there is a big debate about the final disposal of nuclear waste in Germany. In June 2013, a new law was approved that shall regulate the future search for a location of nuclear waste storage. Public authorities are speaking about a white map, so whole Germany could be a possible location for deep storage of nuclear waste.

b) Situation in Poland

In Poland nuclear waste disposal sites are provided only in the north-west and center of the country. Competitions to the geothermal reservoirs in the south are likely not to occur.

c) Situation in France

In France, nuclear power is the main source of power. A law defines a plan for the management of all solid radioactive waste, in particular according to the fact that it is updated every three years and is headed by a national plan for the management of radioactive materials and waste. A high-level geological waste disposal is planed (with retrievability for at least 100 years). Currently, the two

aboveground (up to 100 meters deep) repository disposals are in Le Havre and in Aube. The first has already been closed and, after 15 years of research, the competent authority has decided to initiate from 2017 the early construction work of the first deep conditioning in France. It will be located in Bure, near Nancy. The project includes a 500-meter-deep storage building and the plant will use the properties of Bure´s clay formation as a geological barrier to prevent a possible spread of radioactivity.

Several EGS projects are under development in Eastern Part of France (Alsace), Paris region, Central part (Auvergne) and South-west part. There is so a threat of competition.

d) Situation in Denmark

Denmark has never implemented a commercial nuclear power plant program. There were three research reactors between the late 1950s and 2000. The country has still low and intermediate level wastes that are stored-up whilst the selection and the construction of a repository above ground is completed. Studies come to the conclusion that a deep repository would be the most appropriate repository from a security point of view. Six regions are considered good options, but none agrees to have a nuclear waste dump nearby.

Denmark has widespread geothermal aquifers, which can be used for district heating. Geothermal resources have been identified in sandstone aquifers whose energy could be used for district heating for hundreds of years. The possibility of establishing a geothermal plant in the Copenhagen area was investigated and the Danish government has provided financial support for the initial phases. The first geothermal power plant was built in Thisted and in 1984 was expanded due to higher use. The second is located in Copenhagen and a third plant in Sonderberg will be put into operation.

e) Situation in Sweden

In Sweden, ten nuclear reactors run, which covers almost 45% of electricity demand and their waste is until today disposed in only up to 100 meters deep repository systems. After 30 years of research, the government now plans to build a 500-meter-deep storage for nuclear waste, which is designed to protect up to 100,000 years. The granite in the bottom of the selected area shows little cracks or breaks and the repository could be used from 2020 for 40 years.

In Sweden geothermal energy is mainly used for heating buildings using heat pumps. Despite the non-ideal geological conditions it is possible to establish geothermal power plants widely. Sweden's largest commercial geothermal plant is currently in Lund, where since 1985 around 75% of all homes have been connected to a geothermal district heating system, but the geological properties and the low enthalpy are disadvantageous for expansion. Further research will be conducted.

Since the disposal issue is restricted there, no threat of conflict with the use of geothermal energy.

3.1.3 Conflict with shale gas

EU law permits Member States to exploit their natural resources as they wish, as long as they respect the minimum environmental standards. Some countries have already banned hydraulic fracturing for the exploitation of shale gas, for example, France and Bulgaria. Others want to use it, for example, Poland and Denmark. Despite all the risks of environmental damage, some countries are interested in fracking because of the possibility of cheap gas and increased security of supply.

The European Parliament's resolution (2011/2309(INI) urges public authorities to introduce underground regional planning in order to optimise resource allocation between geothermal energy, shale gas, carbon capture and storage (CCS) and possible other possible underground uses, and thereby maximising the benefits of our underground resources for society.

As our use of the underground changes, we will need to prioritise the way we use it. Shale gas is an extension of classical hydrocarbon technology whereas geothermal energy is a sustainable and renewable energy resource.

a) Situation in Germany

In Germany, an on-going assessment of opportunities, risks and environmental regulations is currently being conducted by the federal authorities. Shale seems present mainly in northern Germany, so here's a great competition could occur for geothermal energy.

b) Situation in Poland

Poland has the greatest interest in shale gas inside Europe. The government wants to promote this practice and a new law is to be enacted in 2013, which will regulate the taxes on production, the business conditions for the launch and the distribution gas. The potential areas lie mainly in the north and southeast of the country. Mostly researched areas are in the Carpathians so it can come to competitive situations.

c) Situation in Great Britain

In December 2012, the UK repealed the prohibition on fracking. The competent ministry has classified the regions in the east and the south of England as the most favourable. The geothermal energy projects in Scotland and Northern Ireland would therefore not be affected.

d) Situation in Denmark

Denmark wants to maintain its energy supply self-sufficiency by encouragement of shale gas. Gas reserves were discovered in Jutland and in Nordsjælland and research permits issued in 2010 shall be valid until 2016. Until then, the research phases to be completed. The first region is located near Thisted and the second near Copenhagen, where geothermal projects are planned. Fracking is therefore most likely to be a competitor.

e) Situation in Sweden

In southern Sweden entrepreneurs research gas and it is expected that fracking could cover Swedish actual gas consumption for 1000 years. The Motala shale gas project is further evidence of the growing interest in the unconventional gas resources. Also Alum Shale, a project in an area that is approximately 150 km², is a way for the extraction of the gas through fracking. By end of April 2011, the Swedish Parliament voted to ban the promotion of fossil fuels, but the required majority was not reached. In the area around Lund could lead to competitive situations with geothermal energy.

f) Situation in Austria

In Austria, a shale gas reserve at 4,000-6,000 meters depth was discovered in Weinviertel in November 2011. The shale gas production by means of fracking technology is, however, due to the negative environmental impact, under sharp criticism. The sample holes in Weinviertel were planned in the regions surrounding the city and the village Herrnbaumgarten and mandatory environmental

impact assessment for shale gas drilling followed. Should the critical attitude towards the fracking not change, it threatens no competition with geothermal energy.

3.2 Further legal aspects, in particular, civil law and dispute resolution

3.2.1 Public procurement law

In a geothermal project many different services are to be obtained, especially around the wells: from the drilling area and the purchase of liners until the disposal of drilling mud and special waste.

As a rule, there is an obligation to tender such services in all GPA States. These are *inter alia* the 28 EU Member States, Hong Kong, South Korea, Japan, the U.S. and Canada. The Concessions Directive and nationally implemented law should be noted. In addition, private developers should consider using the same process for contracting.

The thresholds are for work contracts of € 5 million for supply and service contracts of € 400,000. It could even be exceeded in geothermal projects, usually at the individual allocation of trades, because the overall project is evaluated as a single procurement process.

Contractors cannot freely choose, during the public process between the placing of orders, a non-public process in the notice and in negotiation stage.

The rule is the open process. In this, the client uses an unlimited number of companies and asks them to submit tenders. This is done through publication in the Supplement to the Official Journal of the European Union on the eNotices portal. The deadline for receipt of tenders is 52 calendar days from the date of dispatch of the notice.

A special feature of the examination and evaluation of bids in the energy supply (so-called sector area) is the lack of banned renegotiation. Even with implementation of an open procedure, it is permissible to allow changes in the presented plan. This is very welcome and should be maintained.

3.2.2 Legal protection for ordinary and extraordinary emissions

The construction and operation of geothermal power plants is increasing. However, local residents can be opposed to their construction. Since there are only small disturbances caused by noise, the potentials for conflict are very limited. Here is the balance of interests.

Otherwise, residents have to accept, in principle, the light to medium damage. At most, in case of serious damage, they can go to the courts with complaints. The mining authority has a margin of judgment. The damage must have been correctly determined and a correct method for assessment should be used. Moreover, the authority may order other approval requirements for the operating plan.

3.2.3 Insurance

In 2002, Munich Re AG offered the first private geological risk in Europe for the geothermal project in Unterhaching. Then; other private insurers were on the market, such as Axa, Swiss Re, ERGO or the Gotha. In general, different configurations can be insured in respect of the parameters of

temperature and/or bulk. There is also the possibility of downhole equipment and persons, property and the environment insurances. Finally, the usual risks (fire, machinery and business interruption risk) must be insured.

Risk insurance for the project must be described on relevant documents, especially a feasibility study, seismic effects, budget, schedule and the involved companies. Furthermore, an independent test report shall confirm, in general, the sufficient probability of success. There are no agreed parameters, appropriate measures for the stimulation, so the important points must be agreed with the insurance company or the previously agreed measures implemented. Upon definitive no water reservoir is found, the costs for the drilling of the wells, the liners and stimulation measures for the decommissioning and reclamation of the site may be refunded depending on the insurance coverage exploration costs.

Sometimes, individual insurers pull back after damage from the business, or no longer insure certain drillers, or only with significantly worse conditions. The insurance premiums are very high in the current projects, as they can reflect up to circa 7 percent of the total costs.

An official agreement could co-insure projects. Exemplary in this respect, Switzerland has guaranteed the risk for geothermal drilling to the total amount of 300 million Swiss francs. The insurance usually covers half, and in exceptional cases up to 80 percent, of drilling costs.

More details on geothermal risk insurance can be found in the Geoelec report: “Report on risk insurance” (June 2013).

3.2.4 Access and protection of geological data, implementation of the INSPIRE Directive

In Europe a major recent development has been the entering in force of the INSPIRE Directive in May 2007, establishing an infrastructure for spatial information in Europe to support Community environmental policies, and policies or activities which may have an impact on the environment. INSPIRE is based on the infrastructures for spatial information established and operated by the 28 Member States of the European Union. The Directive addresses 34 spatial data themes needed for environmental applications, with key components specified through technical implementing rules.

For geothermal, compatible datasets and compilation and exchange of data are a prerequisite to building models predicting the distribution of heat at depth, and should be one of the first actions to be undertaken, with the support of the European geological surveys and in compliance with the INSPIRE Directive.

This piece of legislation provides the legal framework for:

1. Access to spatial data, spatial data services and metadata of spatial data-points;

2. Use of these data and services, in particular to measure the impact on the environment.

This ensures that each spatial data and metadata can be provided in the appropriate form. It would be helpful if, in addition to mandatory data from all geothermal projects, for example seismic data and measurement data from holes was completed in a central database and companies to the industry.

Photo7: EGS plant at Soultz-sous-forêt (France) EGEC copyright

3.3 Legal conditions for grid access

This chapter aims to introduce the reader to the legal conditions for grid access of geothermal electricity. In contrast to the "Geoelec Technical report on grid access", this part focuses in particular on the existing European regulations and legal barriers for grid access. Besides that, questions concerning the costs of grid access, the process of grid access and the demand of electricity in general and geothermal electricity in special is addressed.

A report presented in Annex II gives the reader the full overview of the European regulations concerning the grid access of geothermal electricity. In a second step it shows legal, organisational and systemic barriers for grid integration on a European level and finally the report takes a look at the situation in the Member States of the European Union.

To better understand the reasons and circumstances of regulations concerning the grid integration of geothermal power sources, the main challenges of geothermal integration are explained in the following paragraphs.

The main challenge is that adaptions have to be made to the existing electricity grid. The current grid has grown since the beginning of the electrification and is therefore based on large, controllable, centralized, fossil and nuclear power plants. To allow the integration of a growing RES-capacity the whole electricity system has to be redesigned and adapted to handle three main challenges:

- Geographical distribution: RES are local, this means that electricity production and consumption should be close together, which makes an enforcement of the electricity grid necessary to adapt to regional and local production and more decentralized production.
- Distributed generation: Small scale installations of RES like geothermal low temperature power plants (CHP) are called distributed generation (DG). These generation capacities are mostly connected to the distribution grid.
- Flexibility and intermittency:

Generally speaking one can say that barriers for the grid integration of renewables arise through problems with the structure of the electricity system. The electricity grid has to be adapted to the new challenges of a renewable electricity system with more flexibility and variability.

These challenges can be solved through technical, organizational and legal measures. But these adaptions to the current system are not only costly but in some cases also attract the resistance of the public in the often discussed 'Not-in-my-backyard'-syndrome. These issues won't be addressed in this report but nevertheless Table 1 gives an overview over challenges and measures of the integration of RES.

Some RES technologies, e.g. Geothermal electricity, are dispatchable. This means they are capable of responding to command from system operators to ramp output up and down demand, and thereby can provide valuable flexibility to the electricity system.

The main principles are the following:

- A regional approach (a level between nationally centralised and individually decentralised systems) should be considered for designing the electricity system and manage the grid

- Being sizable and controllable, these flexible RES technologies will reduce the need of installed capacity e.g. gas fired backup systems

- Trough the use of flexible RES it is expected to decrease the total costs for the society: no need of large storage capacities and large infrastructure. Flexible RES technologies deal with both transmission grid issues (balance of supply/demand and frequency control at various time scales, congestion of transmission grid line) and distribution grid (voltage control issues).

Table 1: Challenges of renewable electricity integration and related measures (Timpe, Bauknecht, Koch, & Lynch, 2010)

<table>
<tr><th>Challenges / Measures</th><th>Geographical distribution</th><th>Distributed generation</th><th>Variability and Intermittency</th></tr>
<tr><td>Expansion of the transmission network</td><td>Adapt grid structure to connect new generation and demand</td><td>Generation in the distribution grid reduces the demand for transmission capacity</td><td>Adapt grid structure to enable improved balancing between intermittent generation e.g. leveling-out wind generation in different areas; renewable base load; flexible resources such as geothermal</td></tr>
<tr><td>Expansion of the distribution network</td><td></td><td>Increase network capacity to accommodate DG</td><td rowspan="6">Variability and intermittency have to be counterbalanced by increased flexibility in the system
Flexible renewable and conventional power plants compete here with electricity storages and demand-side-management</td></tr>
<tr><td>Intelligent (distribution) networks</td><td></td><td>Increases capacity of existing network to accommodate DG</td></tr>
<tr><td>Increased flexibility through RES power plants</td><td colspan="2">Increasing share of renewables replaces spinning reserve
Flexible RES power plants can help to reduce network bottlenecks</td></tr>
<tr><td>Energy storages</td><td colspan="2" rowspan="3">These options can help to deal with bottlenecks in both the transmission and the distribution grid</td></tr>
<tr><td>Flexibility on the demand side</td></tr>
<tr><td>Increased flexibility of small-scale RES</td></tr>
</table>

In the centre of European legislation concerning the grid integration of geothermal electricity are three legislative initiatives.

- Directive 2009/28/EC

- "This Directive establishes a common framework for the promotion of energy from renewable sources." (European Parliament and the Council of the European Union, 2009)

- Directive 2012/27/EU

- "This Directive establishes a common framework of measures for the promotion of energy efficiency." (European Parliament and the Council of the European Union, 2012)

- The third European energy package with directive 2009/72/EC

- "This Directive establishes common rules for the generation, transmission, distribution and supply of electricity, together with consumer protection provisions, with a view to improving and integrating competitive electricity markets in the Community." (European Parliament and the Council of the European Union, 2009)

Within Directive 2009/28/EC grid access is treated in Art. 16:

- Art. 16, 2

(a) *Member States shall ensure that transmission system operators and distribution system operators in their territory guarantee the transmission and distribution of electricity produced from renewable energy sources;*

(b) *Member States shall also provide for either priority access or guaranteed access to the grid-system of electricity produced from renewable energy sources;*

- Art. 16, 3

Member States shall require transmission system operators and distribution system operators to set up and make public their standard rules …

Generally speaking one can say that barriers for the grid integration of renewables arise through problems with the grown structures of the electricity system. The grown electricity grid has to be adapted to the new challenges of a renewable electricity system.

Annex I: Overview of national regulations for geothermal electricity

Annex II: Report on Legal conditions for grid access