GEORISK - Framework conditions for establishing a risk mitigation scheme

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ABSTRACT

The objective of the GEORISK project in the framework of Horizon 2020, is to facilitate the development of deep geothermal projects (geothermal heating or geothermal power) by developing suitable tools to establish mitigation schemes to alleviate the risks inherent to geothermal developments. One of the main risks faced by developers of geothermal energy is the “resource risk”, linked with the uncertainties of the subsurface and geological targets. Few countries in Europe (France, Germany, Iceland, The Netherlands, Denmark, Flanders in Belgium and Switzerland) have developed risk mitigation schemes (RMS) in order to cover this type of risks. A number of key parameters (technical, economical, commercial, legal and organizational) characterize national systems that offset the developer’s resource risk in today’s markets. In order to be able to propose a thorough way of establishing a relevant RMS in the countries targeted by GEORISK, it was necessary to identify the key features of a RMS that allow an appropriate transfer of risk to a more competent or able organization to manage a specific risk. These key aspects have been captured through the analysis of existing or in-preparation RMS in GEORISK partner countries and other national schemes dealing with the resource risk in Europe. The analysis has addressed the source of funding of existing schemes and casted them in terms of public, private or hybrid (i.e. public/private or PPP) partnership. Five key aspects were identified and are presented in this article as five key questions one needs to answer while establishing a new RMS. They concern the legal and regulatory boundary conditions, the identification of the nature of the risks to be covered, the funding of the RMS, the procedural aspects and setting performance indicators to trigger appropriate adjustments should it be required.

1. Introduction

As many energy sources, geothermal energy faces a range of technical, economical, commercial, organizational and political risks. Some of the risks can and should be borne by the project owner, some are routinely transferred to entities that are better suited to carry specific risks, yet other risks can be high enough to become, in the absence of appropriate risk transfer mechanism, a showstopper.

In regions of the world such as the Lardarello region in Italy, the Paris Basin and the major grabens along the Northern Anatolian Fault Zone of Turkey, the subsurface is well
characterized and known sufficiently to allow geothermal projects to be developed. However, wherever such subsurface knowledge is not available, the resource risk is a major barrier, if not the greatest, preventing the development of geothermal projects and hampering its market uptake in Europe but also worldwide.

This resource risk, also called geological risk, is unique to subsurface energy resources such as geothermal energy. Indeed, until the first borehole has been drilled into the suspected geothermal reservoir, developers do not know the exact reservoir parameters, in particular temperature and flow rate, required to plan a geothermal project. Once drilling and relevant testing activities are completed and the geothermal reservoir is confirmed and characterized, the resource risk reduces with the improved subsurface knowledge, allowing the project to attract external capital. This represents the so-called short-term resource risk, the risk of not finding an economically sustainable geothermal resource after drilling. The resource risk includes also the long-term component: the risk of the geothermal resource naturally depleting, hence rendering its exploitation economically not viable.

Few countries worldwide have already established risk schemes to mitigate the resource risk. For instance in Europe, France, Germany, Iceland, The Netherlands, Denmark and Switzerland have all set up public risk mitigation schemes such as geothermal guarantees, risk insurance funds or capital grants, which allow project developers to transfer some of the resource risk to public entities. The National and Multilateral funding agencies and banks have launched several schemes in Latin America, including in Mexico and in Chile, as well as in Eastern Africa, mainly in the form of capital grants. However, the emergence of privately owned risk mitigation schemes is geographically restricted. Due to particularly high exploration risks, the size and specificities of its markets and the lack of experience of the operators, private risk mitigation schemes have not significantly developed in Europe.

The GEORISK project aims at developing tools that enable the establishment of bespoke risk mitigation schemes in Europe (Hungary, Poland, Greece, Belgium, Croatia, Slovenia) and in some key target countries worldwide (Chile, Mexico and Kenya). It would also facilitate the transition from existing risk mitigation schemes in European countries according to their geothermal market maturity (France, Germany, Turkey, Switzerland, Denmark, The Netherlands). GEORISK is a European project funded by the H2020 program (grant number 818232). It started in October 2018 and has a duration of 30 months. The coordinator is EGEC, the European Geothermal Energy Council, and there are 15 partners in total representing 7 European countries with various levels of geothermal market maturity.

In a first step, the GEORISK team provided a thorough understanding of the main risks faced by developers and operators and presented them in a risk register. This risk register is available online as a tool that identify risks and provide corresponding de-risking measures. This was the starting point for developing a risk management framework adapted to the needs of a particular project by selecting the more appropriate risks from the list. In a second step, the GEORISK team provided a review of key parameters (technical, economical, commercial, legal and organizational) characterizing national systems that offset the developer’s resource risk in today’s markets. The present paper provides a review of those parameters in the light of the experiences gained in European systems, for setting the framework conditions for target countries that are currently developing such schemes. This paper addresses the source of funding of existing schemes and casts them in terms of public, private or hybrid (i.e. public/private or PPP) partnership.
2. Approach

2.1 Methodology

In order to be able to propose a thorough way of establishing a relevant risk mitigation scheme (RMS) in the countries targeted by GEORISK, it was necessary to identify the key features of a risk mitigation scheme that allow an appropriate transfer of risk to a more competent or able organization to manage a specific risk. These key aspects have been captured through the analysis of existing or in-preparation risks mitigation schemes of GEORISK partner countries and other national schemes dealing with the resource risk in Europe.

A questionnaire has been designed to identify those key features for which there should be an answer (for existing schemes) or thought to be put in (if a new one needs to be designed). Bespoke questionnaires have been designed for public RMS and private or PPP RMS. They helped collecting three types of information. A first series of questions allowed to define the boundary conditions of the RMS, including the nature of the scheme, its duration, its legal basis, the aid granting authority, its funding source(s) as well as the nature of the risks covered by the RMS, reference was made to the GEORISK risk register. Secondly, more detailed information were collected about the specificity of the RMS, such as its aims, the eligibility of the projects (heat, power or cogeneration geothermal projects), the nature of the aid (grant, repayable loan etc.), the form of the aid and its coverage ratio, the annual budget for the aid and the procedure for processing the request for aid. Finally, when relevant, an assessment of the effectiveness of the RMS was asked to the implementing entity.

2.2 Sample RMS

A first round of RMS questionnaires was sent to six of the GEORISK partners where RMS are currently implemented: three mature markets for geothermal power and heat (i.e. France, Germany and Turkey) and three transitioning markets (i.e. Switzerland, Hungary and Poland). In a second step, the RMS questionnaires were sent to five additional European countries: The Netherlands, Denmark, Croatia, Slovenia and Belgium.

A total of 14 existing or in-preparation European risk mitigation schemes were therefore reviewed and characterized. The vast majority of these schemes were public (11), eight of which were implemented in five GEORISK partner countries: two schemes from mature markets for geothermal power and heat (Germany and Turkey) and six schemes from transitioning markets (Switzerland, Hungary and Poland). Three additional public schemes were reviewed from solicited European countries at various levels of market maturity, i.e. The Netherlands and Belgium (two schemes, one of which was in preparation at the time of writing). The remaining non-public schemes reviewed are implemented in GEORISK partners with mature market conditions: a private scheme from Turkey and two hybrid PPP schemes from France.

The full description of each of these schemes can be found in the GEORISK report of task 3.2, entitled “Proposal on how to establish an insurance scheme”.

The analysis of the questionnaires allowed extracting the essence of each of these schemes. The findings are presented in the following paragraphs.
3. Framework conditions for the establishment of a new risk mitigation scheme

All actors, whether public, private or PPP, have a common motivation: to develop and diversify the renewable energy mix of a country by stimulating and increasing the contribution from geothermal energy. However each actor willing to carry some of the risks associated with geothermal projects also has specific objectives, whether the reduction of the environmental impact of the energy sector, its diversification for reasons of security of energy supply in case of public institutions, or simply to develop a new business in the case of the private sector.

The five following domains are of interest for establishing a new RMS, independent of the identity of the actor. They are presented as five key questions that need to be asked while setting up a new RMS.

3.1 Legal and regulatory boundary conditions

The underlining important question to be answered here is: what is the basis for a specific risk transfer mechanism?

Legal and regulatory boundary conditions justify an engagement in the development of a risk transfer mechanism, and the sharing of some of the risks. This legal framework also usually defines the funding source and mechanisms of the RMS, its nature and form, its scope and duration, the structure of the aid granting authority as well as the nature of the risks covered.

For a public scheme, a legal basis (an act, an ordinance, a decree) usually exists. This implies that schemes are subject of a legislative process involving legislative branches of government. Administrative units of executive branches of government usually support the legislative process. These processes can be complex if many public entities have to be involved, lengthy and may carry a large degree of uncertainty. This seems to suggest that the implementation of public schemes is best suited for implementation at national levels. Unlike Canada (British Columbia) or Kenya, no country in Europe has a single Geothermal Act which would establish a clear, specialized, consistent and stable basis to meet geothermal needs and support efficiently the development of geothermal energy. It is expected that such a dedicated act would improve the implementation and management of public RMS as it would bring coherence between the various RMS available in a country, for instance when RMS for power and heat projects are not rooted in the same act.

For PPP schemes, it may be that publically held banks or insurance companies are mandated by government or energy agencies to provide low-interest loans or loan-guarantees, sometimes together with commercially operating privately owned entities. In this case, the legal framework comprises both company laws, banking regulations and public laws. The public entity has influence on the PPP through shareholdings.

For a private scheme, the legal and regulatory framework is set by articles of association and charters of a commercial entity that states that the private company may engage in developing insurance solutions; or there is a business unit that caters to specific needs of the geothermal industry.

A consequence of this institutional, legal and regulatory framework is that it sets the rules that geothermal project developers will have to follow throughout the execution of their projects. In order that these laws and regulations do not represent a barrier to the development of geothermal energy, it is essential that the rules enacted are the result of a systematic approach in the support of developing a risk mitigation scheme.
3.2 Definition of the risk(s) to be addressed

A second domain of interest is an exact definition of the type of risks that is being addressed. There are, for example, commercially available insurance products for property, employers liability, general liability often coupled with “failure to supply”, professional liability, environmental liability insurances, control of well insurance, and maybe even insurance schemes that cover the geologic risk.

The analysis of the RMS questionnaires was carried out using of the risk register tool developed in the first stage of the GEORISK project. The approach enabled the identification, compilation and categorization of various risks a geothermal development might have to face throughout the various project phases in. For a full review of all the risks covered by the analyzed RMS, please refer to the GEORISK report of task 3.2, entitled “Proposal on how to establish an insurance scheme”.

The engagement of the public, PPP and private institutions depends on the risk profile of projects. Historically, it is at the earliest stages of development, where geological risk is significant and of biggest consequence, that risks are frequently transferred to public institutions. Private insurance solutions are unavailable, unattractive and unlikely to be economically justifiable for a commercially operating entity at these early stages. However, this exploration phase is increasingly seen to be a matter of cost-shared public-private initiatives implementing PPP type RMS. The private sector steps in and attracts more private investment and commercial financing (thus moving away from reliance on purely public funds), when the project reaches the confirmation phase, i.e. geological risks have been vastly reduced. It is at this point only and going forward, that the project risk profile matches the risk appetite of the international insurance sector, and thus sets the stage for a new form how private sector capital may support geothermal development: well productivity insurance.

The significant geological risks due to reservoir uncertainties remain one of the main drivers for the engagement of public authorities in the development of geothermal power and heat projects. This is particularly noticeable during the early development phases in countries where the geothermal market is either juvenile or in transition, but also – for more mature markets - during the exploration and development phases.

During the early phase, public RMS focus on the risk of not finding the anticipated geothermal resource in terms of flowrate and temperature while during the later phase, the public RMS cover risks associated with the potential impairment of the geothermal resource. In cases where only short-term resource risks are covered, geothermal project developers may argue that further support is critical to allow the project to proceed to implementation – exploitation or production phases of geothermal reservoirs are, after all, subject to wide-ranging geological uncertainty. Such uncertainties stem from the fact that flow paths are controlled by the complex hydrogeological architecture of the geothermal reservoir, which only reveals itself after years and years of production. Similarly, geological uncertainties influence the evolution of the production chemistry of produced geothermal fluids and gases. In addition, importantly, maintaining production rate is a complex interplay of pressure support via reinjection of spent brine and the natural flow dynamics of the reservoir. The persistence of geological uncertainty particularly in green-field developments (or poorly explored regions) requires public institutions to have long-term plans to support the development of geothermal energy supply. Public institutions need to make available a range of support mechanisms tailored to meet the specific needs for each development phase.

Public RMS should not only be implemented to give an impulse for the initial development
and to kick-start the early stages of geothermal exploration. Importantly, they should also support the establishment of sustainable geothermal activities on a longer term or until the geological risk can be managed appropriately, that is specifically until there is a sound basis to quantify uncertainty and thus to transfer the risks to another actor.

Long-term vision and continuity of support mechanisms are crucial to establish a sustainable geothermal market. Risks should be covered until it is possible to transfer the remaining risks to another actor, ideally – due to efficiency – a private sector entity. Public RMS are usually created to offset the shortage of private risk transfer mechanisms. However, before the risks are totally transferred to the private sector and private RMS are offered to project developers, there is an opportunity to share the coverage of the risks between public authorities and private investors in the form of PPP RMS.

### 3.3 Funding

The underlining important question to be answered here is: how is the risk transfer mechanism financed? Funding of RMS relies on a clear capital and financial structure to guarantee a sustainable and reliable support for the development of geothermal activities. The legal basis justifying the existing public RMS usually also defines the source of funding of the RMS.

For public funding, the sources of funding can include revenues of a single or a group of public institutions, a surcharge on the high-voltage transmission grid or a levy on manufacture, production and import of fossil heating fuels. Some public RMS are also funded by some operating costs, such as a small fixed fee but set on a case-to-case basis or a variable application fee to be paid by the project developers. Usually those fees help defray costs that are due to assessing requests for investment grants, loans or guarantee schemes (i.e. the running costs of the scheme).

RMS based on a Public Private Partnership are funded via seed capital and are fed by premiums and, where applicable, by a small percentage of the turnover of the successful projects. One or several partners of the PPP deposit the seed capital. The diversity of the sources of the seed capital assures the reliability of the system. Balancing and maintaining the liquidity of the fund is essential. This is ensured by the payment of premiums, the reimbursement of repayable advances, the payment of royalties in case of success as well as interest paid on capital. It may also require additional capital injections.

Private RMS are funded by a dedicated percentage of the benefits of the company (company internal cash flows) and premiums set on a case-to-case basis.

Additional balancing methods include setting terms (for instance, variable coverable depending on availability of the fund) or financial limits to the payment of the financial aids. Management of such RMS and funds requires a governance structure with the setup of appropriate stewardship, which may be handled by an independent public or private interest institution. The duration of the RMS can be linked to the availability of the fund rather than adapted to the performance of the scheme and the availability of new risk transfer mechanisms.

### 3.4 Procedural aspects

A fourth question to be answered while establishing a new RMS is: what is the process for granting aid? An efficient assessment of requests for aid from public, PPP and private organizations requires a clear definition of 1) what is expected from the applicant, 2) how are
the requests processed and by whom and 3) how is managed the contractual relationship in case of an awarded.

3.4.1 Application requirements

The contents of documentation that must be submitted by the applicant must be clearly stated along with any time constraints. The required information is made available to the entity operating the RMS. In the case of public RMS, these requirements are often also stated in the act, ordinance or other legal text associated to this particular public RMS.

Public, PPP and private risk mitigation schemes share some common requested information. This information concerns the technical, economic, legal, safety, environmental and organizational aspects of the project. It must be relevant to the identification of the risks, to the legal framework of the RMS, to the assessment criteria and to the Health, Safety and Environmental regulations in place.

In addition, further specific information can be requested depending on the objectives of a particular RMS. For instance, an estimation of the expected reduction of CO$_2$ emissions could be required for any request rooted in an environmental act which objective is to reduce CO$_2$ emissions. This also applies to PPP and private schemes.

The quality of the planning of the project is somehow reflected in the quality of the documentation submitted. Setting high standards for the documentation of the application helps selecting better projects.

3.4.2 Assessment and decision-making workflows

The granting authority or the mandated entity to operate the RMS must manage the assessment and decision-making workflows. This requires specific technical, financial and legal expertise in the development of geothermal projects as well as some management and administrative skills to handle the risk transfer process. The granting authority should aim for a lean structure with streamlined procedures, which will foster efficiency and reduce the risk of high cost and delays due to administrative complexity.

Parties involved in the assessment must be identified, their role defined and the workflow they follow to arrive at a decision must be described. The entities involved in the assessment and decision-making processes should be restricted to the added value of their expertise to the assessment. Their number should be capped in order to minimize the level of bureaucracy and time for assessment and approval.

Applications can either be accepted at fixed dates or be accepted continuously. Applications can be assessed on a case-by-case basis or the evaluation be carried out on a regular basis when a defined number of applications is submitted.

The definition of eligibility criteria will enable an efficient, transparent and traceable assessment of the applications by the experts. These criteria depend on the nature of the aid seek by the applicant. For private RMS, the coverage ratio is set individually for each project and is based on economic considerations. According to the general concept of private insurance solutions, the insurance sum is negotiated between the beneficiary and the insurance company. In the case of public and PPP RMS, the level of support awarded is based on the conclusions of the assessment of the application according to clear eligibility criteria and is not open to negotiation.
The duration of the assessment and decision-making processes usually varies and depends on the nature of the RMS (public/PPP/private), the complexity of the project, the form of the RMS and the associated eligible criteria. For instance, it can be difficult and time consuming to determine success/failure thresholds in guarantee schemes. The development of guidelines may, for instance, improve the throughput time of this workflow.

### 3.4.3 Contractual relationship

When an aid or a guarantee is awarded, the granting authority and the applicant enter a contractual relationship ruling the obligations to one another. Some obligations are common to all forms of RMS, including the obligations to disclose certain types of data collected, comply with schedules and work programs and reporting obligations. Some obligations are specific to a particular RMS, such as specific safety obligations for EGS projects for instance.

All the procedural aspects related to a particular risk transfer scheme must be clear, simple, streamlined and adapted to the purpose of the RMS.

### 3.5 Performance indicators

This last question allows to answer in due time the important question of how is the RMS performing. This fifth domain covers aspects related to the performance of the risk transfer scheme; what are the key performance indicators, which may naturally vary widely if it is a commercial scheme versus that of a public entity. The key performance indicators must be defined while designing a RMS and monitoring actions must be performed on a regular basis during the implementation phase of the RMS.

Common metrics include the number of applications submitted and the percentage of successful applications, the volume of aid awarded, the evolution of the installed capacity, the creation of long-term employment, the increase of public subsurface data, the availability of new local competent work force, the creation of new industry standards, and so on. In addition, key performance indicators may be linked to specifics about the objectives of the implementation of a RMS, the legal and regulatory framework or the funding mechanism. For example, a key metric may be the amount of CO$_2$ emissions avoided since the implementation of a geothermal RMS rooted in an environmental act.

In the case of private RMS, measuring private equity performance is defined in the internal guidelines and targets of the private company and uses internally defined economic indicators or combinations indicators.

A regular measure and analysis of the selected performance indicators will trigger adjustments in the structure and/or implementation processes of the RMS, which will improve the reach of the support mechanism.

### 4. Conclusion

A total of fourteen existing or in-preparation European risk mitigation schemes was reviewed and characterized. The vast majority of these schemes were public (eleven), eight of which were implemented in five GEORISK partner countries: two schemes from mature markets for geothermal power and heat (Germany and Turkey) and six schemes from transitioning markets (Switzerland, Hungary and Poland). Three additional public schemes were reviewed from solicited European countries at various levels of market maturity, i.e. The Netherlands and Belgium (two schemes, one of which is in preparation). The remaining non-public schemes reviewed in the present report are implemented in GEORISK partner countries with...
mature market conditions: a private scheme from Turkey and two hybrid PPP schemes from France.

Five key aspects of a risk mitigation scheme were identified, which should be taken into account by any entity willing to carry the resource risk and that need to be addressed when establishing a new risk mitigation scheme. They were presented in this article as five key questions one needs to answer while establishing a new RMS and concern the legal and regulatory boundary conditions, the identification of the nature of the risks to be covered, the funding of the RMS, the procedural aspects and setting performance indicators to trigger appropriate adjustments should it be required.

The analysis performed during the GEORISK project extracted the essence of a risk mitigation scheme. This methodology can be applied way beyond the European borders as it is relevant anywhere an entity is considering setting up such a scheme, whether it be a public or a private entity, and for any market maturity level.

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https://www.georisk-project.eu/

Risk assessment results: https://www.georisk-project.eu/publications/risk-assessment-results/