

Risk mitigation tools: Framework conditions for establishing a risk mitigation scheme

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Executive summary

The GEORISK project is funded by the H2020 programme under 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 level of maturity regarding their deep geothermal energy market.

One of the main risks faced by developers of geothermal energy is the “resource risk”, linked with the uncertainties of the subsurface and geological objects. Few countries (France, Germany, Iceland, The Netherlands and Switzerland) have developed risk mitigation schemes in order to cover this type of risk. The GEORISK project will work to establish such risk mitigation scheme in Europe and in some key target third countries.

A number of key parameters (technical, economical, commercial, legal and organisational) characterize national systems that offset the developer’s resource risk in today’s markets. The present report provides a review of those parameters not already captured in task 3.1 in light of the experiences gained of such European systems, for setting the framework conditions for target countries that are currently developing such schemes in WP4&5. This report 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.

A total of 14 existing or in-preparation European risk mitigation schemes was reviewed and characterised. The vast majority of these schemes were public (11), eight of which implemented in five GEORISK partner countries: two schemes operating in comparatively mature markets for geothermal power and heat (Germany and Turkey) and six schemes from transitioning or emerging markets (Switzerland, Hungary and Poland). Three additional public schemes were reviewed from solicited European countries at various level 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 in Turkey and two hybrid PPP schemes in France.

Five key aspects of a risk mitigation scheme were identified:

- **Legal and regulatory boundary conditions:**
 - A justification for the existence of a resource risk transfer mechanism.
 - The definition of a funding source and mechanisms of the risk mitigation schemes (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 public RMS, the need for an act, an ordinance or a decree put forward by an executive and legislative branch of government.
 - For private RMS, the need for articles of association and charters of the commercial entity that form the basis of the commercial activity.
 - For public-private-partnership RMS: a mix of public and private legal and regulatory frameworks whereby public entities instruct, co-own and co-fund, directly or indirectly, the PPP.
- **Identification of the risk(s) to be addressed:**
 - Resource risks (later on referred to as the “D” risk category in reference to the GEORISK Risk Register v4, D3.1) due to the lack of knowledge of the geothermal resource. Short-term resource risks (i.e. risks of not finding an adequate resource and/or long-term resource risks (i.e. risks that the resource naturally declines over time), are covered by public or PPP RMS.
 - Risks due to uncertainties in the external context, mainly the lack of financing for the next phases (later on referred to as the “B2” risk) may be covered by public (Germany and Hungary) and private RMS (Turkey).
 - Environmental risks (later on referred to as the “F” risk category) may be covered by public RMS (Poland) as well as private RMS along with social risks (later on referred to as the “B3”) like in Turkey.
 - Technical risks/issues (later on referred to as the “E” risk category) in more mature market conditions may also be covered by public RMS (Germany).
- **Funding of the risk transfer scheme:**
 - Source of public funds are generally revenues generated by public revenues (fees, fines...), levies, tax, surcharges, application fees, repayment of aid.
 - Source of PPP and private funding is typically seed capital, shareholder equity and fees from PPP shareholders or percentages of the revenues of the private company,
- **Procedural aspects:**

- All the procedural aspects related to a particular risk transfer scheme must be clear, simple, streamlined and adapted to the purpose of the RMS.
- A clear list of required information and documents must be specified to the applicants
- **Performance indicators:**
 - They depend on the nature of the RMS (public/PPP/private) but need to comprise:
 - Common performance indicators to all RMS.
 - Dedicated performance indicators linked to the risk categories covered by the RMS and the specifics about the objectives of the implementation of this particular RMS, its legal and regulatory framework or funding mechanism.

These key parameters should be taken into account by any entity willing to accept some or all of the resource risks on behalf of the project developer, and need to be addressed when establishing a new risk mitigation scheme.

Approach

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 organisation 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. These can be found in annex of the current report. The questionnaires collected the following information:

Boundary conditions

The questions were aiming at defining 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 v4 (deliverable D2.1).

Description of RMS

More information were collected including:

- the aims of the RMS,
- 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.

Assessment of the RMS

When relevant, an assessment of the effectiveness of the RMS was asked to be provided by the implementing entity.

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 characterised. 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 is in preparation). The remaining non-public schemes reviewed in the present report are implemented in GEORISK partners with mature market conditions: a private scheme from Turkey and two hybrid PPP schemes from France.

The following chapters complement the work carried out in WP 3.1 which summarised and characterised the existing national and regional risk mitigation schemes in Europe and worldwide.

Analysis of geothermal risk mitigation schemes (RMS)

A. Review of the public RMS questionnaires

Public funding agencies are represented in GEORISK via partners in Switzerland, Greece, Turkey and through associated partners represented in the GEORISK advisory committee: France (ADEME and SAF-Environment), Hungary (Ministry of National Development of Hungary), Greece (General Secretary for Energy and Mineral Resources), Turkey (Turkiye Sinai Kalkinma Bankasi) and Poland (National Fund for Environment Protection & Water Management).

Germany and Turkey are considered as mature markets for geothermal power and heat production while Poland, Hungary and Switzerland are markets in transition.

Countries outside the GEORISK consortium also participated in the public RMS survey, such as the Wallonia and Flanders regions of Belgium and The Netherlands.

A.1. Germany

The Market Incentive Programme (Marktanreizprogramm, MAP) is a major promotion tool created by the German Federal Government in order to cover the investments in the renewable energy sector, including geothermal energy, focusing on heat and cooling production and in some cases for geothermal power projects¹. The MAP has been in effect since 2010 and will be extended beyond its expiration date currently set at 2020. However, the support of geothermal energy was only introduced as a module of the MAP on 01.04.2015. The ultimate goal is to stimulate the geothermal market. The projects concerned by this RMS are geothermal heating or CHP projects with a nominal capacity of more than 100 kWth. The granting authorities for the geothermal RMS are the KfW (a promotional investment bank owned by the German Federation and Germany's Federal States, and governed by the KfW-Act, regulations and by-laws² which concerns the Kreditanstalt für Wiederaufbau) and the Federal Ministry of Finance (Bundesministerium für Finanzen, BMFi). While the annual budget of the entire MAP is over 300 Mio Euro, the fraction of the budget dedicated to provide support to geothermal projects is undefined. The funding of the program is provided by the Federal Office of Economics and Export Control (BAFA).

The RMS consists of two support mechanisms concerning both the drilling /testing phase and the exploitation/development phase: a grant and a repayable loan, respectively.

The grant aims at mitigating the risks that the geological lithology or stratigraphy is different from what is expected (GEORISK Risk Register v4: D11) and that the drilling of the wells is more complicated and hence, more expensive than anticipated (GEORISK Risk Register v4: E4). The eligible costs are therefore all drilling and stimulation related costs with a maximum grant of 2.5 million Euro per well for heat projects and no more than 10 million Euro per project

¹ https://www.erneuerbare-energien.de/EE/Redaktion/DE/Downloads/Foerderbekanntmachungen/marktanreizprogramm-erneuerbare-energien.pdf?__blob=publicationFile&v=13

² <https://www.kfw.de/PDF/Download-Center/KfW-Gesetz-und-Satzung-sowie-Geschäftsordnungen/KfW-Gesetz-DE-EN-2.pdf>, its regulations (https://www.kfw.de/PDF/Download-Center/KfW-Gesetz-und-Satzung-sowie-Geschäftsordnungen/KfW-Verordnung_EN.pdf) and by-laws (https://www.kfw.de/Download-Center/KfW-Gesetz-und-Satzung-sowie-Geschäftsordnungen/Law-concerning-KfW-and-KfW-By-laws/KfW_Satzung_E.pdf).

(i.e. for four wells); or a maximum grant of 0.975 million Euro per well for power projects, with no more than 3.9 million Euro per project (or four wells). The grant only covers the unforeseen costs due to complications during the drilling or deviations from original drilling plan. For both power and heat projects, the lesser of 50% of the actually incurred excess net drilling costs is granted or 50% of the planned costs is granted. The grant is capped at 1.25 million Euro per well and 5.0 million Euro per project.

The loan scheme aims to mitigate the risk due to lack of financing (GEORISK Risk Register v4: B2). Loans may cover 80% of the actual investment costs with a maximum coverage of 25 million Euro. Loan repayments are calculated on a project-specific basis and depend on the loan duration as well as the project-specific terms and conditions of the loan. Costs related to planning and construction of the geothermal heating plant are eligible. For loans taken out on individual wells, the maximum is 2.5 million Euro. However no more than 10 million Euro will be allocated per project (at most 4 wells).

A.2. Turkey

In Turkey, the entire exploration risk in licensed areas has to be fully taken by the private license holders who are expected to commit significant capital expenditures and exploration risks even if no commercial financing is available for the early phases of geothermal development. The Action Plan indicates that the Government of Turkey, in collaboration with the Turkish financial sector and international financial institutions focused on economic development will consider enabling mechanisms that mitigate capital risk to support geothermal exploration and drilling activities. This is the basis on which the *Turkey Geothermal Development Project – Risk sharing mechanism for resource validation* was implemented on 2016, Nov. 30. This RMS, dedicated to geothermal power projects, aims at promoting the development of renewable geothermal energy projects in the early stages of geothermal exploration drilling in the private sector.

The grant partially covers the cost of unsuccessful wells of private geothermal projects (40% - 60%). The eligible costs include drilling costs such as site preparation, well pads, provision of drilling rigs, related services including cementing, mud engineering, wireline services, waste disposal, well testing costs, consumables, personnel accommodation and transfer costs and reasonable contingencies. The scheme limits the amount and cumulation of aid such to two unsuccessful wells per project. There is also an environmental limit related to CO₂ release from geothermal fluids produced to surface, which equates to a limit in specific emissions of 583 g/kWh. The maximum RSM pay-out amounts to USD 4 million. There are strong provisions in

case of failure to comply with the World Bank Anti-Corruption Guidelines and Turkish legislation. The detailed terms and conditions of the grants have been defined in the agreement signed between World Bank and TKYB. The World Bank in the name of the Clean Technology Fund (CTF) is the granting authority. The RMS will run from the 30.11.2016 to 31.12.2022 with an annual budget of 39.8 million USD.

The granting authority is not yet able to assess the effectiveness of the RMS because the implementation is still ongoing.

A.3. Poland

Two public schemes are currently implemented in Poland.

In 2015 the priority program “*Geology and Mining Part I: Recognition of geological structure of the country and the management of mineral deposits and underground waters*” was launched. The scheme, applicable to heat and to Combined Heat and Power (CHP) projects, aims at fostering the exploration and recognition of Polish hydrothermal reservoirs and mitigating the risk of not finding a geothermal reservoir suitable for district heating heating (grants are mostly for drilling the first exploration geothermal well in a given area). According to the GEORISK Risk Register (v4), the nature of the risks targeted is: 1. the risks due to subsurface uncertainties (D1, D3, D5, D7, D9, D10, D11, D7) and 2. the risk due to uncertainties in the external context, in this particular case, the risk that other users of the subsurface resources cause a change in the exploitation parameters (B7). The aid is two-fold: 1. Grants up to 100% for local government units (LGU) 2. Loans up to 50 % for entities other than LGU. The aid can be increased by 10% for medium-sized enterprises and by 20% points for small and microenterprises. An annual announcement defines the contribution of each support mechanism from global budget: grants are allocated up to 1 052.96 million PLN (ca. 245 million Euro), whilst loan facilities exist for up to 50 million PLN (ca. 11.6 million Euro) over the duration of the scheme (2015-2023). A list of eligible costs typical of the identification/exploration phase and the drilling/testing phase is common to both grants and loans. The applications must provide specific information that depends on the type of the project and covers both, ecological/environmental and technical aspects, as well as the financial management in relation to the public aid component. The Ministry of Environment, National Fund for Environment Protection & Water Management (NFEP&WM) assesses the applications.

In case of the repayable loans, in 2016-2018, five projects received support to increase geothermal heat production in some existing geo-district heating schemes, as well as several other projects related to investments into surface infrastructure.

Very recently, on 3 July 2019, a new RMS has been implemented in Poland: the *Polish Geothermal Energy Plus* program. This new support mechanism available to both combined heat and power projects (CHP) and heat projects, aims to increase the use of geothermal resources in Poland by mitigating the risk of not finding a geothermal reservoir with characteristics suitable for space heating / CHP. The scope of this program is much wider than the first scheme. It covers drilling of geothermal exploration wells, well work-overs, modernisation of district geo-heating schemes, and construction of surface heating infrastructure, power / CHP, investment in energy efficiency measures and so on. The scheme targets risks encountered during the drilling, exploration, testing phases (D1, D3, D5, D7, D9, D10, D11 and D15 of the GEORISK Risk Register v4) as well as those encountered during the operational phase (well workovers, risks D2, D4, D12-14, D16-17, F7 of the GEORISK Risk Register v4). The scheme consists of a series of grants up to 40% of eligible costs. Specifically for projects that utilise organic rankine cycle power plant technology, up to 50 % of eligible costs or up to 50% of eligible costs in the case of the first geothermal exploration well to verify the feasibility of constructing a new heat/CHP/geothermal power plant or the extension of an existing one. Second, the scheme may also provide (repayable) loans up to 100% of the eligible costs. A total budget of 600 million PLN (ca. 142 million Euro split in equal parts between the grants and the loans) is allocated to the Polish Geothermal Energy Plus Program which will be implemented until 20 December 2019 or until the fund is exhausted. The procedural aspects of the assessment are similar to that of the “*Geology and Mining Part I: Recognition of geological structure of the country and the management of mineral deposits and underground waters*” priority program.

Both RMS, supported by the Ministry of Environment, are rooted in the Environmental Protection Act and operated by the Ministry of Environment, National Fund for Environment Protection & Water Management (NFEP&WM). The schemes are funded through revenues of the NFEP&WM as described in the Environmental Protection Act.

A.4. Hungary

Hungary participates in an EU-financed operative program - *Environmental and Efficiency Operative Program (EEOP)*. The purpose of the EEOP is to promote the sustainable

development of the environment, nature conservation and water management tasks and the more efficient use of natural resources. In order to achieve these objectives, the programme focuses on Priority Axes (PA), one of which (PA5) aims to increase the use of renewable energy sources such as geothermal energy for both, power generation and/or heat supply. The nature of the risk targeted by this RMS is the lack of financing for the next phases (Risk B2, GEORISK Risk Register v4).

The implementation of the EEOP is governed by the “Partnership Agreement between the European Committee and Hungary: Common provision Regulation [CPR]”, 1303/2013 EU “Provision and Template and Guidelines on the content of the partnership agreement 2014HU16M1OP001” as well as by the local regulation. This programme provides grants to hydrothermal heating and/or electricity projects and covers between 40% and 100% of the geothermal project preparation and implementation costs. It runs from 01.01.2014 to 31.12.2020 and has an annual budget (for the whole spectrum of PA5) of 142 million Euro.

The legal framework for geothermal energy use is rather complex in Hungary, regulations and licensing procedures are shared by the mining, energy, environmental protection and water management sectors.

A.5. Switzerland

Switzerland has three public RMS: two dedicated to geothermal power (with combined heat generation) projects and one for direct use projects for heat production.

Geothermal power projects traditionally benefited from *risk guarantee* schemes (Ref: Report D3.1). The latest risk guarantee scheme was updated in 2018 with a coverage increase from the 50 % to up most 60 % of exploration, drilling and testing expenditures in case of total or partial failure of finding suitable subsurface conditions for power generation. A second grant, the *Prospecting and Exploration grant for power production*, was implemented at the same time. This new investment aid is covering at most 60% of prospecting for geothermal reservoirs and 60% for exploration, drilling and testing expenditures to prove a suitable subsurface geothermal reservoir for power generation. The common purpose of the schemes is to increase electricity production from renewable sources while increasing the knowledge of the Swiss subsurface. The nature of the targeted risks is solely the geological risks, i.e. the risks due to subsurface uncertainties (Risks D1, D3 and D9 of the GEORISK Risk Register v4). Both risk guarantee and prospecting and exploration grants are rooted in the Energy Act, which also

secures a common source of funding. It consists of a surcharge on the high-voltage transmission grid (max. 0.1 Rp/kWh of power transmitted), which sums up to max. 50 mio CHF annual budget. These RMS, operated by the Swiss Federal Office of Energy SFOE, are available until the 31.12.2030. The application must provide information on the technical, economic, legal, security, environmental and organizational aspects of the project. The assessment is carried out on a case-by-case basis by an expert group according to the requirements stated in the Energy Ordinance.

On 01.01.2018 also came into force a new RMS for the direct use of geothermal energy for heat production. This new grant (*Prospecting and Reservoir development grant for geothermal energy direct use*) shares many similarities with the grant for geothermal power production described in the previous paragraph. The similarities include the nature of the risks targeted, the level of the investment aid (at most 60% of prospecting for geothermal reservoirs and 60% for developing a suitable subsurface geothermal reservoir for direct use), the operations by SFOE and the procedural aspects. However, fundamental differences also distinguished the RMS for geothermal and heat productions. Unless the support mechanisms for power projects, the heat RMS is rooted in the CO₂-Act, it is financed by a levy on manufacture, production and import of fossil heating fuels as described in the CO₂-Act (30 mio CHF of max. annual budget) and will only run until 31.12.2025. The rationale for these differences lies in the purpose of this new scheme: it aims at lowering the CO₂ emissions from the building sector by substituting fossil fuels with geothermal energy for direct use. The implementation of the RMS will also enable new geodata to be collected and will therefore also contribute to increasing the knowledge of the Swiss subsurface.

As mentioned in the D3.1 report, the new grant schemes are deemed successful with 76 mio CHF and 26 mio CHF respectively granted to geothermal power projects and direct use projects since the Energy-Act and the CO₂-Act came into force in 2018.

A.6. The Netherlands

The information below completes the work carried out in WP 3.1 which included the Dutch public RMS in its review of the existing risk mitigation scheme.

Since the first publication of the scheme on 30.10.2009, the Dutch *Risk Coverage for Geothermal Heat (RNES Geothermal Heat)* under the authority of the Ministry of Economic Affairs and Climate Policy has been open 6 times. The scheme has been continuously updated

and improved to account for lessons learned. The scheme has now been opened continuously as of 1.1.2018. The grant scheme is based on the “National Economic Affairs Subsidies” of the Minister of Economic Affairs of 11 July 2014, No WJZ / 13125043, and article 41 of the General block exemption Regulation (GBER), “Investment aid for the promotion of energy from renewable sources”.

The purpose of this public RMS is to encourage the use of geothermal energy for heating purposes. The main goal is to cover the geological risk, i.e. the risk of not finding the geothermal resource expected at the end of the drilling in terms of flow and/or temperature. This corresponds to the risks D1 (Flow rate lower than expected in the reservoir) and D3 (Temperature lower than expected in the reservoir) of the GEORISK Risk Register v4. Project developers benefit from a financial contribution, if the productivity in MWth proves to be lower than the P90 expectation value.

The pre-requirements for a project aiming at the guarantee are:

- a location-specific geological survey that must have been prepared by an ISO 9001 certified company. This survey intends to clarify the capacity that can extract from the subsurface.
- an exploration or production license;
- a detailed financing plan (the plan may include other subsidies).

The eligible costs covered by the RMS include: production and injection wells; the mobilisation and demobilisation of the equipment insofar as they relate to the guaranteed well; premium for RNES geothermal heat; drilling management and supervision; well pads, mud systems and cuttings, well testing and reporting; the costs for acquiring data for the geological evaluation of the aquifer; and unforeseen expenses on the previous cost items. It also accounts for, per well doublet, 500'000 Euro for installing pumps, abandoning or towards additional wells, a maximum of 11'050'000 Euro per “regular” project, a maximum of 18'700'000 Euro for geothermal project greater than 3'500 m depth; but it also states that a “premium” of 7% of the subsidy with a maximum of € 773'500 (or € 1'309'000 for a “deep” project) is needed to be paid.

The scheme is funded by a joint budget between the Ministry of Economic Affairs and Climate Policy and the Ministry of Agriculture, Nature and Food Quality. The 7th edition of the fund has a provision of a total of 66.6 million Euro of which “regular projects” benefit from 47.9 million and deep projects from 18.7 million Euro.

A.7. Belgium

A.7.1. Flanders

Flanders implemented its *Guarantee Scheme for Exploration and Exploitation of Geothermal Heat in the Deep Subsurface* on the 26.10.2018. This public RMS is not limited in time but an evaluation will be performed every other year. The ultimate goal is to encourage investments in deep geothermal energy and help overcoming the high initial risk related to exploration, i.e. the risk of not finding the geothermal resource expected in terms of flow and/or temperature (Risks D1, D3 and D9, Risk Register v4) due to the lack of precise knowledge of the subsurface.

The 8 May 2009 Decree for the Deep Subsurface and a ministerial order establishing guidelines and models for application in the guarantee scheme provide the regulatory framework conditions to this scheme. The process was initiated by the Ministers of Environment and Energy and investors who wished to start a geothermal prospection in Flanders. In parallel, legislation was developed to enable geothermal permitting by adapting existing regulations to fit geothermal projects and finally elaborating a guarantee scheme. The process of implementation of the guarantee scheme (writing decree, executive decree, guidelines, software testing, discussions, etc.) lasted for about 2 years. The Flemish Department of Environment is the granting authority and the Department of Environment (DOE) operates the RMS.

The scheme is funded via an application fee amounting to 7% of the projected guaranteed investment that is paid by participants, as well as a supplement from the Flemish Region. The number of projects that can profit from the scheme depends on the yearly budgetary resources. Owing to the novelty of financing the scheme, there is no basis for estimating an average annual budget.

The guarantee scheme was established based on the good practices acquired in The Netherlands and owes to close collaboration with experts from The Netherlands throughout the elaboration of the Flemish scheme. External experts from the Netherlands were also consulted for advice when evaluating the first application, to make use of a common ground of existing cases.

The scheme is available to both power and heat geothermal projects which dispose of a permit for geothermal energy exploration / exploitation following the decree for the deep subsurface. Closed geothermal installations are not eligible because those have a lower exploration risk.

Detailed criteria for open systems are applied:

- The projects need to show at least 90% chance of achieving a minimal thermal output in order to be eligible: systems between -500 and -1500m depth need to obtain P90 > 0.5 MW without stimulation measures, while systems deeper than -1500m need to obtain P90 > 2 MW without stimulation measures.
- The chance to obtain the insured geothermal power is at least 90% needs to be proven by relevant geological investigations according to minimal provided guidelines for quality and data, methods etc.
- Available data from previous well need to be taken into account in order to accept a new application for extra wells.
- The project plan needs to make clear that within two years after drilling the geothermal heat is effectively used.
- The applicant must not have contracted financial debts.

The geothermal guarantee covers at most 85% of exploration, drilling and testing expenditures in case of total or partial failure of finding suitable subsurface conditions for geothermal energy extraction. The applicant needs to carry the financial equivalent of at least 5% of the exploration risk on its own. At any time, the sum of the guaranteed amount is adapted to make sure that the sum (including other subsidies for the project and insurances) is lower than 95% of the realized eligible costs. Max. 85% of the eligible cost can be covered with a maximum of 18.7 million Euro per project.

Eligible costs include costs for drilling, site preparation & (de)mobilization, drilling management & supervision, cuttings & cleaning, testing, interpreting, reporting, data acquisition for geological evaluation, extra costs for alternative use after failure, extra costs for stimulation measures, unforeseen costs related to drilling & testing, a fixed fee of 250k€ for the pump or abandonment of a failed well. Only costs covered by the applicant and not compensated for by other subsidies are eligible.

The application must provide information on the technical, economic, legal and organizational aspects of the project. A project plan, a financial model form and a geological research must be present in the application. The expected P90 geothermal power output needs to be

calculated through a standard methodology and software. All used parameters need to be documented for unequivocal evaluation.

The Department of Environment (DOE) decides within 15 days whether the application is complete and communicates its decision to the applicant. If needed, the applicant can complete missing information within 30 days (can be extended twice upon request). If by then the application is not complete, it is rejected. Once a complete application has been received, the DOE issues a request for advice to be completed within 60 days. External advice may be solicited from the Flemish Energy Agency and geology experts. In this case an extra 30 days may be needed for the total advice.

A ministerial order with the decision is issued within 90 (or 120 with use of external advise) days after receiving a complete application. The applicant must then pay the application fee of 7% of the guaranteed amount in order to participate in the guarantee scheme. The aid can be (partly) recovered within 10 years after application in case of insolvency, sale, and cessation of activities, or failure to comply with the legislative obligations.

By participating in the guarantee scheme, the exploration data become public.

A.7.2. Wallonia

Wallonia is currently working at the implementation of a risk guarantee scheme for geothermal heat projects. This public RMS is not yet applicable, as it has to be validated by the Walloon Government and parliament.

While not all the details are yet defined, this scheme was inspired by the French and Flemish models. Its main aim is to cover the geological risk, i.e. the risk of not finding the geothermal resource expected at the end of the drilling in terms of flow and/or temperature due to the lack of precise knowledge in this part of the Walloon subsurface. This corresponds to the risks D1 (Flow rate lower than expected in the reservoir) and D3 (Temperature lower than expected in the reservoir) of the GEORISK Risk Register v4.

The main lines of the procedural aspects are as follows: a technical committee (composed of the administration and scientific experts in geology and geothermal energy) validates each guarantee request to the government. The validation concerns the project as a whole based on the best scientific knowledge and recommends to the Walloon government whether or not to grant the guarantee (under conditions). The project developer who has obtained the

coverage pays a premium. After completion of the drilling, he goes on with the evaluation of the actual resource: if it is less than the expected resource (in terms of flowrate and/or temperature), the risk guarantee can be activated. The technical committee validates the actual resource and determines the actual amount of the risk guarantee in order to partially cover the encountered losses.

B. Review of the Private/Public Partnership (PPP) RMS questionnaires

PPP RMS are only implemented in France, a mature geothermal market. France has two PPP risk mitigation schemes: the existing *Short and Long Term Geothermal Fund* dedicating to support low temperature (<120°C) geothermal heat projects and the soon-to-come *Guarantee Fund for EGS* (Enhanced Geothermal Systems) projects dedicating to support the development of high temperature resources (>120°C) for power production in Metropolitan France.

The following paragraphs complete the work carried out in WP 3.1, which already gave an overview of the RMS situation in France.

B.1. Short and Long Term Geothermal Fund

The aim of the *Short and Long Term Geothermal Fund* is to increase the exploitation of underground resources to produce heat and sanitary hot water using district heating systems. This fund is adapted to low temperature resources (<120°C) as defined in the Mining Code (Code Minier) set up in 1978 and soon to be modified. Any project, onshore and offshore in France, is eligible. To support the expansion of geothermal energy, the authorities set up a technical committee in 1974 called the Geothermal Committee which was placed under the authority of the Ministry of Industry. The fund was created in 1980 by the French Ministry of Industry. This geothermal committee continues to exist and is now under the Presidency of ADEME (the French Agency for Energy Management and Environment). The fund consists of a geothermal guarantee covering at least 65% of the exploration and exploitation drillings and testing expenditures in case of total or partial failure of finding suitable resources to be exploited at a calculated IRR. Additionally some French regions may increase support (in Ile

de France, for instance, regional authorities add another 25%) to attain a maximum of 90% with a total guarantee cap per well in place.

The *Short Term Risk Guarantee* scheme covers the risk not to find the anticipated geothermal resource in terms of flowrate and temperature (GEORISK Risk Register v4: D1 and D3 related to flowrate and/or temperature being lower than expected). The eligible costs are limited to the drilling and testing operations of the two wells of geothermal doublets including the platform construction for the rig and the extensive production tests usually carried out to calculate the effective potential of the resource. The maximum aid corresponds to 90% of the drilling cost for one well. The guarantee is capped at a maximum of 4.8 million Euro in 2018. A complementary aid is granted by the region Ile de France only to cover an additional percentage of 25% giving a total guarantee at 90%. In other regions, there is no dedicated scheme and the complementary aid is possible.

After the realisation of the geothermal wells, there is the possibility to subscribe a *Long Term Risk Guarantee* to ensure the potential decrease of the geothermal resource during 15 years (GEORISK Risk Register v4: D2, D4, D6 and D8).

SAF Environment is the granting authority for the Short and Long Term Geothermal Fund. There is no time limitation to this fund: it can run as long as it is sustainable in terms of finance. Normally, if the balance of the fund appears to be insufficient to cover the next geothermal plant, the percent coverage will be decreased first, while an official request is made to ADEME (French Agency for Environment and Energy Management) to replenish the Fund's cash position. In addition, there is no annual budget allocated to this fund. It started in 2008 with a financial contribution of 10.5 million Euro from the state agency ADEME and Region of Ile de France. At the end of 2016, the fees paid by the subscriber of the guarantee schemes amounted to 8.5 million Euro and the interest earned by the capital around 0.6 million Euro. Thus, the balance of the fund for the first 8 years was maintained at 54% via public and 46% private funds.

In terms of procedure and assessment, a full project description is submitted by the project developer which includes geological and hydrogeological data; the exploration permit issued by the administrative authorities (Prefecture of the Department); data regarding the district heating network (whether it is in existence or not); the business plan of the plant including proof of sales contracts.

The French Geological Survey, BRGM is the evaluator for the sub-surface component and ADEME is the evaluator for the surface data and economics. The project is evaluated by a geothermal committee composed of: ADEME, Caisse des Dépôts et Consignations, French Geothermal Association for Professionals (AFPG), Association of Geothermal Plants Owners (AGEMO), mining authorities (DRIEE) and representatives of ESCO (SNCU). The average time required of an evaluation until the signing of the contract is 6 months.

B.2. Guarantee Fund for EGS (Enhanced Geothermal Systems) projects

The aim of the *Guarantee Fund for EGS projects* is to increase the exploitation of underground resources to produce electricity and when possible cogeneration of heat via DH systems. The fund is adapted to high temperature resources (>120°C) in mainland France with the operating phase to commence towards the end of 2019.

While the granting agency is GEODEEP SAS, the fund will be managed by SAF Environnement. The initiative for the fund has been taken jointly between SAF Environnement and GEODEEP SAS to propose a fund for EGS, which had been out of scope for other schemes or funds. GEODEEP SAS (a simplified joint-stock company) created in 2017 is a simplified stock joint company with 4 shareholders comprising Caisse des Dépôts et Consignations (a bank), and three French geothermal developers (ES Géothermie, Electerre de France and Fonroche).

The risk addresses not finding an expected geothermal resource in terms of flowrate and temperature for both wells of the geothermal doublet (GEORISK Risk Register v4: D1 - D3: flowrate and/or temperature lower than expected). The RMS is not an outright grant; instead, a premium is paid before exploration commences, and in case of success, royalties will be paid to the fund during the exploitation period. In case of no success, the project developer is reimbursed with up to 60% of the costs related to drilling operations to find an exploitable geothermal reservoir. The geothermal guarantee covers at least 60% of the exploration and exploitation wells, and testing expenditures. Actual pay-outs in case of total or partial failure of finding suitable resources to be exploited are based on project economics and deviations from expected metrics, in this case an internal rate of return (IRR).

The fund has to be financially sustainable. Shareholder capital is preserved by both, the repayable advance and the shareholders. Additionally, each project requesting a risk guarantee has to pay a fee, and, in case of success, royalties will be paid by the successful

projects throughout the exploitation period. The budget is not augmented in annual instalments. Instead, a new fund will start with an equity injection from the French Government via ADEME. The company benefits from the participation of the French state via the ADEME (French Agency for Environment and Energy Management) through a repayable advance: this support has to be reimbursed if the fund remains positive during a 6-year period upon a formal request from ADEME. Even though the participation of the French state via ADEME is through a repayable advance, the European Commission has to accept the French government's proposal for this fund has to ensure that the fund does not create a commercial advantage in comparison to what the market may offer (insurance companies). The scheme is original because the payment of royalties in case of success.

Applications include a full report of feasibility studies including all the exploratory tasks that have already been carried out. Internal and external experts, appointed by the board of GEODEEP SAS undertake the evaluation, which is financed by the project developers (estimated to cost about 100'000 Euro). It is expected that the full process will have a duration of up to 6 months.

C. Review of the private RMS questionnaire

No private risk management scheme has returned detailed information on its scheme. Turkey is the only GEORISK partner to have implemented a private RMS, the *European Bank for Reconstruction and Development (EBRD) Credit Program*. The main purpose of this bank loan is to use a comprehensive financing package to the company developing geothermal power plant projects. The scheme is ruled by banking regulations and is funded by a Loan Consortium including EBRD. Unless any other RMS presented in the current report, the risks solely targeted by this private RMS are social and environmental risks.

EBRD is one of the four creditors of Kizildere-III Geothermal Power Plant (GPP) Unit-2, which is the first geothermal power plant of Turkey established in the Sarayköy District of the Denizli Province in 1984 with a total installed capacity of 17.4 MWe. Akbank led the Loan Consortium. All costs related to power plant including exploration, drilling, testing and construction are eligible except operations and maintenance cost. The loan requested covered around 73% of the project costs; the remaining portion was equity of Zorlu Holding SA, the asset owner. The loan payback period is approximately 13 years including a grace period.

EBRD, one of the creditors of Kizildere-III GPP Unit-2, requested the preparation of the ESIA (Environmental and Social Impact Assessment) Report within the framework of the environmental and social criteria determined by them in addition to the compulsory EIA report. With this report, the social impacts of the investment in the region are under scrutiny.

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.

A. Legal and regulatory boundary conditions

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. The public schemes can be rooted in an Energy Act (Switzerland) or Environment Act (Poland), including CO₂-Act (Switzerland) and climate change legislation (The Netherlands). This implies that schemes are subject of a legislative process involving legislative branches of government (parliament at all levels such as in Belgium or Switzerland). The legislative process is usually supported by administrative units of executive branches of government (several ministries such as the case for The Netherlands or Germany). For ultimate approval, even the sovereign may

have to approve, the people, as is the case of Switzerland with a strong component of direct democracy. These processes can be complex if many public entities have to be involved, lengthy and may carry a large degree of uncertainty (Wallonia). 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, specialised, 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. In the case of the French PPP, it is the French Agency for Environment and Energy Management (ADEME) who plays this role in all the PPP currently or soon-to be available RMS in France.

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.

Similar to the role of Germany's KfW which is directly mandated by the relevant German ministries, there are a number of European institutions whose mandate may provide a path towards Europe-wide transfer of geological risk: the European Investment Bank ([EIB](#)) may provide a whole host of solutions that help offset the negative financial consequences of the geological risk of finding a suitable geothermal reservoir.

B. Definition of the risk(s) to be addressed

Which precise risk(s) need(s) to be transferred?

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 (i.e. finding a suitable reservoir) risk.

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. As highlighted in the D3.1 report, 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 analysis of the RMS questionnaires was carried out using of the GEORISK tool developed in GEORISK’s work package 2: the GEORISK Risk Register (deliverable D2.1). The approach enabled the identification, compilation and categorisation of various risks a geothermal development might have to face throughout the various project phases in. All risk categories listed below refer to the GEORISK Risk Register v4.

The significant geological risks due to reservoir uncertainties (risk category D) 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 (Belgium) or in transition (Poland, Switzerland, The Netherlands), but also – for more mature markets - during the exploration and development phase (e.g. France).

During the early phase, public RMS focus on the risk of not finding the anticipated geothermal resource in terms of flowrate and temperature (risks D1, D3) while during the later phase, the public RMS cover risks associated with the potential impairment of the geothermal resource (risks D2, D4, D6, D12-D17). In cases where only short-term resource risks are covered (Switzerland, The Netherlands, Belgium), 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 be implemented to not only 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.

Public participation in risk mitigation also exists in case of risks due to uncertainties in the external context (mainly the lack of financing for the next phases, B2 risk) as is the case in Germany and Hungary RMS, by environmental risks (Poland, F risk category) and by technical issues in more mature market conditions (Germany, E4).

In the PPP set-up in France, where ADEME (French Agency for Environment and Energy Management) represents public authorities, the risks covered by the two RMS are risks due to reservoir uncertainties (D risk category). The two risks threatening the bankability of a geothermal project in France are the short-term risk of finding an adequate resource, and the long-term risk that the resource naturally declines over time. The short-term resource risks will be covered by the *EGS Fund* for geothermal power projects while both the short and long-term resource risks encountered by both power and heat geothermal projects are currently covered by the combination of the *Short Term and Long Term Geothermal Fund*.

The private RMS implemented in the mature geothermal power market of Turkey is a bank loan aimed at financing the development of geothermal power projects (B2 risk) by providing a comprehensive financing package to the project developer.

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.

C. Funding

How is the risk transfer mechanism financed?

Funding of Risk Mitigation Schemes 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. Possible public funding includes:

- revenues of a single public institution: for instance, the Federal Office of Economics and Export Control (BAFA) in Germany, the NFEP&WM in Poland, or the EU for the Hungarian scheme;
- joint budget between several public institutions: for instance, in the Netherlands with both the Ministry of Economic Affairs and Climate Policy and the Ministry of Agriculture, Nature and Food Quality feeding the fund or in Turkey with the agreement between the World Bank and the Turkish public development aid bank TKB;
- a surcharge on the high-voltage transmission grid feeding a fund for public RMS for power projects in Switzerland;
- a levy on manufacture, production and import of fossil heating fuels that feeds a fund for a public RMS for (geothermal) heat projects in Switzerland.

Public Risk Mitigation Schemes

Some public RMS are also funded by some operating costs, such as a small fixed fee but set on a case-to-case basis (Switzerland) or a variable (Flanders, The Netherlands 7%) 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).

Public-Private schemes

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. One of the prerequisites of the funding of the French PPP RM is that the funds have to be sustainable. In both RMS, the public institution (ADEME) provides the seed capital. The review of the operations of the currently available Short and Long Term Geothermal Fund showed that the sustainability of the fund was guaranteed by the fees paid by the subscriber of the guarantee schemes and the interest paid on the capital. The balance of the fund in the first 8 years was ensured at 54% by public fund and 46% by private funds. New features will be introduced in the upcoming Guarantee Fund for EGS, including that the capital will be ensured both by the repayable advance and the shareholders, and that, in addition to the premium, royalties will be by the successful plants during the exploitation period.

Geothermal risk mitigation through private financing

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. For the Turkish credit program, the funding is defined by the terms of the loan consortium including EBRD.

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. This is the case for most of the reviewed RMS in the present report with the exception of the French PPP RMS, which will be available as long as the fund is sustainable.

D. Procedural aspects

What is the process for granting aid?

An efficient assessment of requests for aid from public, PPP and private organisations 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.

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

D.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 (Energy and CO₂ ordinances in the case of the Swiss public RMS).

Public, PPP and private risk mitigation schemes share some common requested information. This information concerns the technical, economic, legal, safety, environmental and organisational 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 CO₂ emissions is required for any request for a *Prospecting and reservoir development grant for geothermal energy direct use* in Switzerland. This owes to the fundamental objective of this RMS, which is to reduce CO₂ emissions from the building sector as specified in the CO₂-Act. This also applies to PPP and private schemes. For instance, the private Turkish covering social and environmental risks require a proper Social and Environmental Impact Assessment to be performed by each submitted project.

A POS-study (a study quantifying the probability of success (POS) to generate the announced flow rate and temperature) is a frequent requirement by private insurance company who will only issue a guarantee if the POS exceeds a defined value. This requirement does not exist in

the reviewed public and PPP RMS with the exception of the Dutch public RMS. Indeed, the Ministry of Economic Affairs and Climate Policy will award a financial contribution only to projects when the productivity in MW proves to be higher than the P90 expected productivity.

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. This principle is applied by some public granting authority (Flanders, Switzerland) who, after giving the opportunity to provide missing information, can reject incomplete applications.

D.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 minimise the level of bureaucracy and time for assessment and approval. This is the case for the Swiss public RMS, where the number of experts mandated by the Swiss Federal Office of Energy is limited to six with well-defined roles and responsibilities. This is described in the relevant ordinances (Energy and CO₂ ordinances).

Applications can either be accepted at fixed dates (early version of the Dutch scheme) or be accepted continuously (Poland, Switzerland, France). 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 (France, Switzerland). The development of guidelines may, for instance, improve the throughput time of this workflow. Flanders is the only one who has a detailed schedule for the assessment.

D.3. Contractual relationship

When 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 (Switzerland, Flanders), comply with schedules and work programs and reporting obligations. Some obligations are specific to a particular RMS, such as specific safety obligations for EGS for instance in France.

E. Performance indicators

How is the RMS performing?

A 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, an obvious key performance indicator of the PPP RMS is the sustainability of the fund as illustrated by the French support schemes. A key metric may be the amount of CO₂ emissions avoided since the implementation of the *Prospecting and Reservoir development grant for geothermal energy direct use* in Switzerland or the social sustainability in Turkey.

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.

Conclusions

A total of fourteen existing or in-preparation European risk mitigation schemes was reviewed and characterised. 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:

- **Legal and regulatory boundary conditions:**
 - Justify engaging in the development of a risk transfer mechanism.

- Define 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 public RMS: an act, an ordinance, a decree...
 - For private RMS: articles of association and charters of the commercial entity.
 - For PPP RMS: mix of public and private legal and regulatory frameworks.
- **Identification of the risk(s) to be addressed:**
 - Resource risks (D risk category) due to the lack of knowledge of the geothermal resource. Short-term resource risks (i.e. risks of not finding an adequate resource and/or long-term resource risks (i.e. risks that the resource naturally declines over time), are covered by public or PPP RMS.
 - Risks due to uncertainties in the external context, mainly the lack of financing for the next phases (B2 risk) may be covered by public (Germany and Hungary) and private RMS (Turkey).
 - Environmental risks (F risk category) may be covered by public RMS (Poland) as well as private RMS along with social risks (B3) like in Turkey.
 - Technical issues (E risk category) in more mature market conditions may be covered by public RMS (Germany).
- **Funding of the risk transfer scheme:**
 - Source of public funds: public revenues (fees, fines...), levy, tax, surcharge, application fees, repayment of aid.
 - Source of PPP and private funding: capital seed (from PPP shareholders or percentage of the revenues of the private company)
- **Procedural aspects:**
 - All the procedural aspects related to a particular risk transfer scheme must be clear, simple, streamlined and adapted to the purpose of the RMS.
 - A clear list of required information and documents must be specified to the applicants
- **Performance indicators:**
 - Depends on the nature of the RMS (public/PPP/private)
 - Common performance indicators to all RMS

- Dedicated performance indicators linked to the risk categories covered by the RMS and the specifics about the objectives of the implementation of this particular RMS, its legal and regulatory framework or funding mechanism.

In conclusion, these are the key learnings for establishing a new risk mitigation scheme:

- **About legal and regulatory boundary conditions**

- Define the adequate legal basis and regulatory conditions for the implementation of the RMS of interest, specifying its funding source(s), its nature and form, its scope and duration, the structure of the aid granting authority as well as the nature of the risks covered

- **About risks to be addressed**

- Identify the nature of the risks to be address.
- Identify the most appropriate RMS knowing that 1) public RMS mainly focus on short-term and long-term resource risks in juvenile and transitioning geothermal markets, but may also cover the lack of financing for the next phases as well as environmental risks and technical issues in more mature market conditions. 2) PPP RMS solely focuses on the resource risks. 3) Private insurance schemes cover the risk of lack of financing for the next phases as well as social and environmental risks.
- De-risk early stages of project development; it helps projects reach the stage of full development and operation.
- Long-term planning and continuity of support mechanisms are crucial to establish sustainable geothermal markets. Risks should be covered until it is acceptable to transfer the remaining risks to another actor. PPP can bridge the gap between public institutions and private investors.

- **About funding**

- Growing funds and maintaining liquidity is essential. Various available methods including premiums, application fees, payment of royalties in case of successful development, setting terms or financial limits to the payment of the financial aids.

- **About procedural aspects**

- Establish clear application and assessment rules.

- Apply high quality standard to the documentation submitted by the applicants.
- Prioritise lean structure with the right expertise applying streamlined procedures, which will foster efficient assessment and decision-making processes.
- **About key performance indicators**
 - Start monitoring with the implementation of the RMS and perform analysis on a regular basis.
 - Define both common key performance indicators to all RMS and specific ones to a particular RMS / risk category to be addressed.

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Annexes

Annex 1 – Questionnaire about public RMS

Number	Country XX-1	Public Scheme		
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Country: XX	TITLE OF THE AID SCHEME (ENGLISH)
	TITLE OF THE AID SCHEME (ORIGINAL LANGUAGE)
	LEGAL BASIS (PRECISE REFERENCE)

1. PROCEDURAL ASPECTS

	Date	Remarks
Date when the scheme entered into effect		

2. DESCRIPTION OF THE SCHEME

To which geothermal projects does the scheme apply?	<input type="checkbox"/> Power projects	<input type="checkbox"/> Heat project		
Which risk does it address?				
Which downside does the scheme protect against?				
Which is/are the Risk IDs? GEORISK Risk Register v4				
What is the main objective of the aid?				
What is the form of the aid?				
Which projects are eligible, what are the conditions of their eligibility?				
What are the concerned phases of the project?	<input type="checkbox"/> Identification/Exploration	<input type="checkbox"/> Drilling/Testing	<input type="checkbox"/> Exploitation/Development	<input type="checkbox"/> Post-closure
- What are the eligible costs? - What are the maximum aid intensities?				
Multiple subsidies: is the project eligible for other support schemes when benefiting from risk mitigation scheme?				
Does the scheme provide for "operating aid"? If "Yes", please provide details				
Is the aid in any way linked to export performance ? If "Yes", please provide details				
Are "sensitive sectors" excluded (Steel, shipbuilding, cars, synthetic fibres)? If "No", does the scheme provide an explicit reference to the special State aid rules applying to these sectors?				
Does the scheme contain provisions limiting the cumulation of aid? Please explain.				

Aid granting authority	
-What documents need to be submitted and what are the criteria to be granted an aid ? - Is the evaluation performed by the granting authority or externalised? - Briefly describe the evaluation workflow and the average duration of an evaluation	
Is the aid subject to recovery in any instances ?	
How is the scheme financed (specify the legal basis)	
Average annual budget (in million Euro)	
Duration of the scheme	
Other issues	

3. ASSESSMENT BY STATE AID MONITORING AUTHORITY

Which were the EU State aid provisions on the basis of which the aid measure was assessed (Name of the frameworks, guidelines, communications, regulations concerned)?	
Which was the national equivalent of the above EU provisions on the basis of which the aid measure was assessed?	
Please explain <u>in detail</u> the State Aid Monitoring Authority's analysis of the case. This should include the identification of all the requirements under the relevant Community Provisions and should demonstrate how these requirements have been fulfilled.	
Did the State Aid Monitoring Authority approve the aid measure unconditionally?	
If the approval was conditional, please specify in detail the conditions imposed?	
Has the aid measure been modified in conformity with the conditions imposed?	
Other questions (1) During implementation, was there a link to other similar schemes to apply best practices (if so please describe)? (2) Where does the initiative of this proposal come from? From that moment, how long did it take to implement the scheme? (3) Are you already able to assess the effectiveness of the scheme? If so would you be willing to share results of this assessment?	

Annex 2 – Questionnaire about private or PPP RMS

Number	Country XX-1	Private Scheme	Mixed Scheme	
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Country: XX	TITLE OF THE BUSINESS (ENGLISH)
	TITLE OF THE BUSINESS (ORIGINAL LANGUAGE)
	REFERENCE TO OVERALL ARTICLES OF ASSOCIATION OR WHY THE ENTITY OFFERS SUCH PRODUCTS (PRECISE REFERENCE)

1. PROCEDURAL ASPECTS

	Date	Remarks
Date or Time when business started		

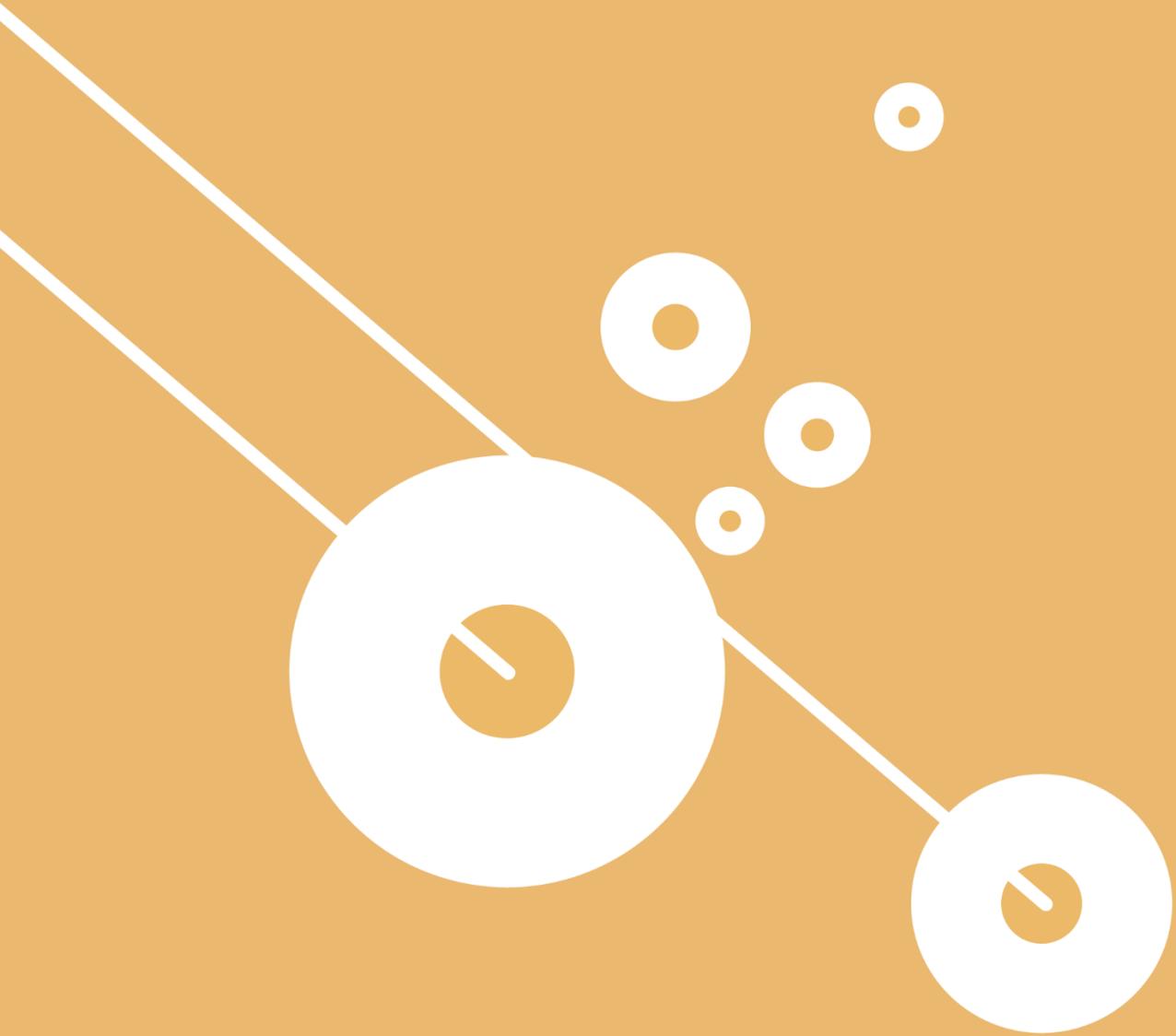
2. DESCRIPTION OF THE SCHEME

To which geothermal projects does the scheme apply?	<input type="checkbox"/> Power projects	<input type="checkbox"/> Heat project		
Which risk does it address?				
Which downside does the scheme protect against?				
Which is/are the Risk IDs? GEORISK Risk Register v4				
What is the main objective of the scheme?				
What is the form of the scheme?				
Which projects are eligible, what are the conditions of their eligibility?				
What are the concerned phases of the project?	<input type="checkbox"/> Identification/Exploration	<input type="checkbox"/> Drilling/Testing	<input type="checkbox"/> Exploitation/Development	<input type="checkbox"/> Post-closure
- What are the eligible costs? - What are the maximum aid intensities?				
Multiple subsidies: is the project eligible for other support schemes when benefiting from risk mitigation scheme?				
Does the scheme provide for "operating aid"? If "Yes", please provide details				
Is the aid in any way linked to export performance ? If "Yes", please provide details				
Are "sensitive sectors" excluded (Steel, shipbuilding, cars, synthetic fibres)? If "No", does the scheme provide an explicit reference to the special State aid rules applying to these sectors?				
Does the scheme contain provisions limiting the cumulation of aid? Please explain.				
Aid granting authority				

-What documents need to be submitted and what are the criteria to be granted an aid ? - Is the evaluation performed by the granting authority or externalised? - Briefly describe the evaluation workflow and the average duration of an evaluation	
Is the aid subject to recovery in any instances ?	
What is – in general terms – the business concept?	
Average annual turnover (in million Euro)	
Business pursued since	
Other issues	

3. ASSESSMENT BY STATE AID MONITORING AUTHORITY

Which were the EU State aid provisions on the basis of which the aid measure was assessed (Name of the frameworks, guidelines, communications, regulations concerned)?	
Which was the national equivalent of the above EU provisions on the basis of which the aid measure was assessed?	
Please explain <u>in detail</u> the State Aid Monitoring Authority's analysis of the case. This should include the identification of all the requirements under the relevant Community Provisions and should demonstrate how these requirements have been fulfilled.	
Did the State Aid Monitoring Authority approve the aid measure <u>unconditionally</u> ?	
If the approval was conditional, please specify in detail the conditions imposed?	
Has the aid measure been modified in conformity with the conditions imposed?	
Other questions (4) During implementation, was there a link to other similar schemes to apply best practices (if so please describe)? (5) Where does the initiative of this proposal come from? From that moment, how long did it take to implement the scheme? (6) Are you already able to assess the effectiveness of the scheme? If so would you be willing to share results of this assessment?	



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