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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 duration of 30 months. The coordinator is EGEC and there are 15 partners in total representing 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 funds in order to cover this type of risk. The GEORISK project will work to establish such risk insurance in Europe and in some key target third countries.

The report presents one dedicated table summarizing the existing national and regional insurance systems dealing with the geothermal resource and technical risks in Europe and worldwide. The result is to delineate their specific features and the relevant parameters that could be taken into account for the establishment of an insurance scheme dealing with the geothermal risk which is the objective of the Work Package 4 of the project.

21 major schemes have been inventoried 7 are terminated and sometimes proved not efficient, 12 are ongoing at world level and 3 have been proposed in Europe (EGRIF), for Africa (GeoFutures) and for EGS in France mainland devoted to EGS. Many existing scheme have been established at national level in the past in general managed by the geological surveys in Iceland, Japan, Indonesia, Turkey, USA, Philippines, European Commission there are not listed neither studied because they were focusing to acquire first geological knowledge.

Four levels of success can be observed across the 21 funds assessed.

- A first family is highly successful, with many developers applying, supported projects and geothermal plants completed. It includes mostly long-existing European schemes devoted to Heat Generation such as SAF Environnement, Swiss 1987, The Netherlands Scheme, the German National Scheme.

- A second family encompasses attractive funds, in the way they attracted many applicants and awarded many supports, yet all money has not been cashed out and the completion of plants actually connected to the grid is still expected. Such funds are GRMF and GDF. The latter benefitted from the learnings of the former.
Recently launched public funds such as Turkish RSM and Swiss 2018 look promising. 8 projects are already engaged in the application process for the Turkish RSM. Swiss 2018 has officially accepted their first project a few months after its launch.

- A third family gathers unsuccessful public funds either because of unattractive service (Swiss 2008, Pluto, IRENA ADFD), insufficient funding (ARCEO RMF, GEOFUND) or adverse local market conditions for geothermal energy due to competition with cheap wind and solar power (MiRig, Mexico)

- A fourth family gathers the unsuccessful private schemes, mostly because either the risk borne is too high or because of unattractive high premiums (Munich Re Private, Marsh A, ART)

- A fifth family gathers the projects to come, such as EGRIF, GEOFUTURES, GEODEEP SAS. EGRIF should be much inspired from the French SAF Environment. GEOFUTURES has a sophisticated approach intending at solving barriers both on developers and stakeholders' sides, at the cost of a certain complexity. GEODEEP SAS is limited to EGS in France mainland.
1. Presentation of geothermal risk insurance schemes

1.1 Presenting in details the existing national and regional “insurance” systems

1.1.1 Europe

1.1.1.1. NL Geothermal Guarantee Scheme

The Dutch National Agency for sustainability, innovation, international business and agriculture which is part of the NL Ministry of Economic Affairs is carrying out policies for various national/international authorities. The history started with the agency Novem (2000) and after with SenterNovem in 2004 issued from the Energy department. The NL agency was created in 2010 before becoming the Netherlands Entreprise Agency in 2014 with a dedicated Geothermal Energy Team.

The important steps to be mentioned were: the establishment of the Dutch Geothermal Association initiated by Novem (2002), the start of the Minewater project in Heerleen (2003), the feasibility studies Bleiswijk and the realization of the plant (2005-2007) in The Hague, the creation of the EOS (Innovation subsidies) managed by the NL Agency. Since 12 years 17 doublets have been created in the country for heating purposes of which 16 for greenhouses heating.
The seventeen geothermal doublets active in The Netherlands

Recent and fast deployment of geothermal doublets in the country

All these steps leading to the creation in 2009 of the first opening of the Geothermal Guarantee scheme which has been followed at the moment by 7 round till now. In the same time there were 17 permits applications in 2008, 57 in 2009 and 87 in 2010 and 100 in 2011.

The policy has been established by the Activepolan Aardwarmte (21 April 2011) which is considered as the first white paper on Geothermal Energy ever in The Netherlands. leading to a scheme including:

- DEI (Demonstratie Energi-Innovative (TSE)) which is a support scheme for Demonstration of Energy Innovations financing: innovative Demo projects with a budget at 35 M€ (2016) and a maximum of 6 M€ per project.
A risk mitigation scheme for geothermal projects which is insurance on disappointing realized performance of a geothermal doublet due to geological risks. The system is based on the difference in between the pre-drill P estimated/insured (max. P90 estimated Geothermal power) vs. Prealised (realised Geothermal power).

![Curve of success based on P 90 method](image)

**The way of managing the project regarding the rate of success**

The proposer has to fill an application which is audited and processed by the NL Agency. The geological part is reviewed by TNO and the audit of economic, financial, technical, organizational and planning aspects are carried out by NL Agency. All the applications are not supported. If the project is accepted the applicant has to pay an insurance premium of 7% of the drilling costs.
The success is evaluated and if total failure the reimbursement of drilling cost is up to 85% with a maximum of 11,05 M€ for a regular project and 18,7 M€ for a deep project. Reinjection is mandatory and all geological/mining data made public after 5 years by MinEZ. As of April 1, 2019, the call for risks for geothermal heat (RNES geothermal) is open for the eighth time. No changes have been occurred since the 7th call.

The budget was published on the 7th of December 2018. The content of the regulation has not been changed compared to the 7th opening. With this scheme, the Ministry of Agriculture, Nature and Food Quality and the Ministry of Economic Affairs and Climate stimulates the use of geothermal energy as a sustainable energy source. At the moment the RNES is been under consideration. One of the questions is if the RNES still fits to market questions. The Netherlands is more and more moving into direction of portfolio operators (one company owns several doublets). They are not willing to pay 7% fee for each new doublet, due to the fact that in certain areas they know more and more about the geological formation. One of the emerging ideas is to adapt the fee regarding the zone and the geological knowledge already available. The last years have shown that less projects rare emerging in zones with less geological information. These projects face more risks, are they going to be supported like the others.

It can be seen also that energy storage in the underground is gaining more attention which could become another challenge for deep geothermal doublets.

The positive result of the scheme is impressive. The negative aspects seems related to the exploitation of these plants on the long run and its appear that like in France a long term coverage system could be promoted in order to fulfil the ambitious plan for geothermal heat in the country.

### 1.1.1.2. Munich Ré - Private insurance scheme

This private insurance scheme was initiated in 2003. Germany was the country for application. The aim was to insure an overall electrical or thermal output for a minimum of 5 geothermal well. The initiative comes from Munich Ré Company as a private company to develop a new business. The phases of the projects to be covered were: the development, construction and exploitation phases. The fee was extremely important (more than 10% of the investment cost of the deep well). This scheme was terminated quickly after the failure of the first two geothermal wells covered showing a failure ratio of 100%. A summary is given on the following table from Geoelec report.

<table>
<thead>
<tr>
<th>Type of insurance</th>
<th>Private insurance policies. Post-damage guarantee.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governance</td>
<td>Insurance companies acting as a direct insurer (Munich Re, Swiss Re, Axa, Goather, R&amp;V) and as insurance brokers (Marsh, Willis).</td>
</tr>
<tr>
<td>Capital and financial structure</td>
<td>The insurance relies on premiums. Premiums are set on a case-to-case basis. In this respect, the higher the probability of success, the lower the premium.</td>
</tr>
</tbody>
</table>
### Beneficiaries
Customers on the national stage and abroad (e.g. in Denmark and in the USA).

### Insurance scope
Heat and electricity production. Deep wells. Hydrothermal projects only, as EGS are still considered as too risk-prone by the insurance private sector.

### Risks insured
The short-term risk (drilling).

### Eligible costs
Usually, all costs spent on drilling, stimulation and test program can be insured. The insurance policy may cover one or several drillings.

*Details of expenses deemed eligible by German insurance companies can be found in Appendix IV.*

### Coverage ratio
Compensation depends on the degree of success of the drilling. A threshold value for either the reached thermal capacity or the reached pair of flow-temperature values defines the project’s success or failure. This threshold value is set individually for each project and is based on economic considerations. A tested thermal capacity/flow-temperature below the threshold value results in the full payment of the insurance sum. Values above the threshold define a successful well. In individual cases, it is also possible to define a partial success in the transition zone where only a certain part of the insurance sum is paid out. According to the general concept of private insurance solutions, the insurance sum is negotiated between the beneficiary and the insurance company.

### Eligibility criteria
The developer shall submit the insurance company:
- A project description;
- A technical, legal and financial feasibility study;
- Seismic investigations including their interpretation;
- A stimulation and hydraulic test program;
- The power plant and heat use concept;
- Information on contractors and key personnel;
- An independent expert’s report on the conclusiveness of all data;
- An external report quantifying the probability of success to generate the requested flow rate and temperature (the POS-study): usually insurance companies only submit an offer where the probability of success exceeds 80%;

### Insurance process
Contractual negotiations. By now, a number of insurance companies and brokers employ in-house experts for geothermal projects.

### Short additional description
The first insurance policy was issued in 2003 for the Unterhaching project in the Molasse Basin. The policy came from the Munich Re Group. In recent years, other insurance companies offered several policies to geothermal projects. German insurance companies thus engaged in providing insurance for the resource risk, both in Germany and abroad. However, policies covering the resource risk in Germany are currently offered for projects located in two of the three main geothermal provinces in Germany (the Molasse Basin and the Upper Rhine Graben) and depend on the individual case.

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### 1.1.1.3. Munich Ré - Germany Geothermal Risk Mitigation

The national risk mitigation scheme is part of the Renewable Energy Incentive Program MAP. The program is administered by KfW. Only deep geothermal projects (deeper than 400 m) in Germany are eligible for this program. The support scheme mainly
consists of project funding via subsidized long-term loans with low interest rates, which is the main difference to the private insurance market. It also contains three risk mitigation modules, one covering the technical drilling risks, one covering general project risks and one covering the exploration risk. The subsidies are only available for geothermal heat projects. The risk mitigation components are available for both heat and power projects. For all applicants apart from municipalities or communities, the application forms may not be submitted to the KfW directly, but need to be conveyed by a clearing bank which is affiliated to the project developer (the so-called “Hausbank”).

The technical drilling risk mitigation is incorporated into the KfW incentive program for renewable energy. The module partly covers the risk of excess drilling costs compared to the initially planned expenses. It mitigates the risk of additional work and expenses exceeding the anticipated costs in the case of technical drilling problems. Up to 50 % of the original planning costs of drilling and a maximum of 1.25 Mio. € are covered. General project risks like the risk of cost increase or business risks can partly be covered by the extended KfW loan program for large renewable energy projects. It is only available to geothermal power projects which can apply for a credit between 10 and 50 Mio. €. The program offers a 50 % credit indemnification option. Thus, part of the credit risk is covered by the KfW.

Exploration Risk, a new program specially tailored to cover the exploration risk was launched in 2009 by the BMU and KfW in co-operation with the Munich Re Group. The risk mitigation module is based on a 60 M€ revolving fund. Projects can apply for a loan of up to 16 M€ covering a maximum of 80 % of the drilling costs. The program implies a credit indemnification clause of 100 % of the loan amount during the drilling phase. In case of not reaching the specified project success parameters (the thermal capacity of a well), the investor is indemnified from repaying the remainder of the loan. Thus, the loan will be for-given and the fund will cover up to 80 % of the drilling costs, if the well is not successful. The own contribution (deductible) in case of project failure consists of 20 % of the drilling costs. The risk surcharge (loading) is represented by a high interest rate during the credit risk period until the termination of drilling works and hydraulic tests plus a specific disagio, which is also defined by the project risk. After completion and positive testing of the well, the credit is continued without indemnity and at a reduced interest rate. The application fee of this program amounts to 65.000€ covering the assessment of the project documentation by Munich Re and KfW. With promise of the loan, a further 45.000€ are charged for ongoing auditing and expert monitoring of the project progress. Prerequisite for an application to the Hausbank and KfW is a mature project status. In order to be eligible for the program, a series of project documentation comparable to the one required for market-based insurances needs to be submitted. All documentation has to be complete and allowing for a qualified assessment of the project, the exploration risk and the eligibility by internal and external experts. The main difference to insurance policies on the private market is that no conventional POS-study is requested for the KfW program. Thus, “alternative” projects outside the traditional geothermal provinces or EGS-projects might have a chance to obtain risk coverage under this scheme, provided that their project concept and documentation promise project success. 3.4 Challenges and Pitfalls One general problem with public support schemes is that large governmental funds like the KfW program are sometimes difficult to administer. The development of guidelines, the answering of inquiries and the processing of application is expected to be longer than on the private market. This is due to the number of involved parties and the political
and legal discussions associated with such programs. Furthermore, governmental funds rely on external expertise in order to structure their programs. This is the case for the specification of the project documentation requirements as well as for the project assessment and the certification of results. The major challenge with the KfW program however, and first hurdle to be taken by a project, is the need for private developers to find a Hausbank willing to convey the application forms to the KfW and to guarantee the payback of the loan to the KfW.

Geothermal project developers in Germany can choose between two options of mitigating their exploration risk: the federal risk mitigation scheme administered by the KfW and private market-based insurance solutions. The main advantage of the KfW risk mitigation scheme is that it combines both project financing via a credit and the mitigation of exploration risk in one program. The risk coverage consists of a loan being fore-given if the project is unsuccessful. This program is the preferred option for “alternative” projects in areas with little reference data or EGS-projects, as it does not require a classical POS-study. When a project is able to find a clearing bank willing to submit the application forms to the KfW, the fund will most likely be granted. The difficulty in finding such a Hausbank however, is a serious pitfall for the program. The issue was raised to the program administrators and discussions have started to take the risk off the clearing banks and rather cover it directly by the KfW. Another problem of the KfW program is the uncertainty of interest rate and “disagio” prior to loan promise. Not knowing the costs of a credit renders reliable budget calculations difficult for developers.

A summary is given on the following table from Geoelec report.

<table>
<thead>
<tr>
<th>Type of insurance</th>
<th>National revolving Fund. Loan with an indemnification clause.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Governance</td>
<td>Kreditsansalt für Wiederauf (KfW) and Munich Re. The KfW-Bankengruppe is a bank owned by the German government and the federal states of Germany.</td>
</tr>
<tr>
<td>Capital and financial structure</td>
<td>The Fund was initially filled by the Bundesministerium für Umwelt (Federal Environment Ministry) with 60 M € through the Renewable Energy Incentive Program MAP. The application fee amounts to 65000€ covering the assessment of the documentation by Munich Re and KfW. A further 45000€ is charged for auditing and expert monitoring of the project progress. A high interest rate is charged until termination of the drilling work, stimulation measures and hydraulic tests, plus a specific disagio defined by the project risk.</td>
</tr>
<tr>
<td>Beneficiaries</td>
<td>National developers. These developers may be public (e.g. municipalities, local authorities), semi-public (e.g. private companies majority owned by municipalities) or private (e.g. small and medium-sized companies, non-commercial investors).</td>
</tr>
<tr>
<td>Insurance scope</td>
<td>Heat and electricity production. Wells deeper than 400 meters. Hydrothermal and possibly EGS projects.</td>
</tr>
</tbody>
</table>
Geothermal Risk Mitigation – First scheme by MARSH

This scheme has been launched in 2006 by the broker Marsh. It was set up for Germany and The Netherlands. The funders are insurance companies such as: Munich Ré, Gothaer, AXA, R+V. It is built as a private insurance scheme with no grants. The insurance program is organized by Marsh; one lead insurance responsible for management of the contract and taking up most of the risk (like 40-60%) the rest is taken by other insurance companies.

This insurance allowed the developer to include not just the drilling cost but also early development cost (e.g. surface exploration). No claim part refund possible. It is a partly success pay-out scheme. A Probability Of Success study carried out by LIAG (Hannover- Leibniz-Institut für Angewandte Geophysik) is required to appreciate the geological risk linked to the exploration well.

Marsh Company was heavily engaged in geothermal insurance since 2004 in Germany. The insurance scheme applied to single wells and doublets mainly in the Molasse region of Germany (Bavaria) and also in the Upper Rhine Valley (Neuried) and the Netherlands. The insurance premiums (with minimum at 30% of the costs of the drilling) had been a strong barrier avoiding establishing a sufficient market in order
to create a positive ratio for the insurers. The system has been used in a very limited number of projects because of too many pay-outs. The abandonment of the scheme was related also to some management and contracting errors by insurances. At that time insurance premiums had been up to 30% or above.

1.1.1.5 ART (Alternative Risk Transfer)

After the failure of the first scheme, Marsh initiated a new risk funding concept, which has up to now been applied only in Germany and the Netherlands. This concept includes 3 players:

1. Developer/Investor: Has developed the project to a status of drill ready.
2. Drilling Company which is also working as a developer.
3. Insurance Company

The concept includes: a fund which is funded and backed by 2 and 3. The Investor pays a premium, and in the case of success royalties into the fund. The drilling company reviews the project and if he accepts the project hands it over to 3 for a second review. The geothermal well is drilled and tested by 2 and if successful the project continues with a second well, power plant construction and operation. The value of the project has risen and consequently all the parties profit. The operated project pays royalties into the fund.

If not successful the fund pays out 100% of the drilling cost to 1 and leaves the project. The loss of 1 is the premium and the development cost until drilling. The fund then owns the project and the well. 2 improve the well on his own cost and if successful the fund profits from the rise of value and the royalties. If not successful the fund has to cover the loss. There might be a risk share between 2 and 3 in this case. There are several aspects to mitigate the risk: A fund that is shared between 2 and 3. Premiums are paid into the fund as well as royalties from a successful project. If not successful the well will be reused by 2. Only if 2 is not successful the fund has to cover the loss.

A German drilling contractor and energy company Daldrup & Söhne AG had tried to follow this track and funded the scheme in cooperation with the XL Group insuring the scheme. This exploration risk insurance, premium and small percentage from turnover of successful projects to keep fund up and reduce premiums in the future.

Dalrup has become the first firm in Germany to use an innovative integrated drilling risk insurance model backed by a reinsurance structure. The insurance model’s Alternative Risk Transfer (ART) structure is backed by a reinsurance framework and used to hedge the risk of discovery. The concept is significantly reducing client’s capital requirements during the early search phases of drilling in geothermal drilling and energy projects.

The product was initially successfully tested in the Netherlands and has just expanded to Germany for an Enex geothermal project in Southern Germany (Gerestried). Unfortunately the two deep wells drilled in 2013 and 2017 have been unsuccessful.
This ART structure can be backed up right from the start which is a very positive aspect for the equity capital investors and banks.

Reinsurers have been partnering with the fund creating the firms to move closer to the risk and this integrated drilling risk model shows reinsurance solutions also being developed without reliance on tech start-ups as reinsurance is now built into the very structure of primary risk transfer products.

1.1.1.6 Swiss 1987

The first governmental risk guarantee system existed 1987-1997 for geothermal drillings with a total sum of 15 million CHF in order to stimulate direct use development. The risk guarantee system was established by the Parliament in 1986 and implemented by the Federal Government in 1987. The system intended to encourage the involvement of public institutions and private enterprises in geothermal direct use (mainly space heating). 15 MCHF were allocated to the risk guarantee fund and established in 1987 for 10 years. The risk guarantee fund was applicable to development drillings with depths over 400m depth. The coverage extended to 50 % of drilling and testing costs (also of reinjection); in specific cases up to 80 %. The risk guarantee covered the accrued costs in case of insufficient thermal power. No coverage was provided for permitting, insurances, unforeseen and capital costs; in case of success no contributions have been paid.


The first risk coverage program was applied, in the years 1987 – 1997, to 13 projects in various parts of Switzerland, in contrasting geologic environments. The SFOE provided, in addition to the risk coverage, a subsidy for special measures. The program yielded mixed results: 5 success, one partial success and 7 failure cases.
The total sum paid for risk guarantee was 8 MCHF and for subsidy 3.4 MCHF. The positive aspect of the fund is that a lot of geothermal exploratory wells have been drilled in zones where the geology was uncertain. It has allowed building the unique deep geothermal doublet in exploitation at the moment in Riehen.

1.1.1.7 Swiss 2008

In 2008 an new Governmental risk coverage system has been introduced. The new Swiss Electricity Supply Decree “Stromversorgungsverordnung, SVV 743.71“, 14 March 2008 stipulates that geothermal power projects may apply for a risk guarantee (whereas the type of geothermal power project is not specified). Only pure geothermal projects can apply; hybrid systems are not considered. The maximum guarantee is 50% of the subsurface costs (drill site constructions; well drilling and completion for production, borehole geology, injection and observation wells; borehole logging and instrumentation; pumping tests; reservoir stimulation; circulation tests; chemical analysis). The new risk coverage system strongly relies on the experience with the first system. New element is the source of financing: the National Grid Company (NGC). For applicability the geothermal facilities must provide at least 1.5 % electricity utilization degree, as defined by a diagram.

![Required usage degrees for geothermal facilities to be eligible for coverage by the Swiss Federal Electricity Supply Ordinance.](image)

Project developers must submit a detailed application to the National Grid Company, covering issues like technical details, expected yields, success/failure criteria, financing aspects, the users of electricity and heat, and the legal entity of the production company. The Swiss Federal Office of Energy (SFOE) deals with the application and appoints an expert panel for review and evaluation. For the drilling phase the SFOE appoints a project guide who evaluates the results and reports to the expert panel about success, partial success, or failure. The panel in turn reports to the National Grid Company who decides about payments. The unique positive result of the scheme was the realization of the deep geothermal well in ST Gallen which was a failure discovering natural gas instead of geothermal resource.

1.1.1.8 Swiss 2018
This scheme has been launched beginning of 2018 and is managed by SFEO (Federal Agency for Energy in Switzerland). The scheme has been set following the enforcement since the 1st of January 2018 of the revised CO2 Act. The fund amount is 30 MCHF per year. Its cover 60% of the cost related to the geothermal exploration including the deep drilling but also the surface exploration and all pre-spud upstream activities and subsurface investment required for first heat into a heating plant. The procedure including the request system and following stages is summarized on the figure x.

The timeline of the Swiss fund (starting 2018) since request to full completion

In conclusion the fund as just started and no projects have been yet subsidized at the moment. Anyway, one of the specificity of the scheme is the obligation that no later than 6 months after the completion, the applicant will transfer free of charge, the geodata to the Swiss Geological Survey (Swisstopo) and to the Canton where the project is implemented accordingly to their respective technical specifications. At the end all the geological and drilling will be published at the latest, 24 months after the completion of the surface exploration activities. This type of obligations is existing also in the Dutch risk mitigation scheme.

The medium-depth geothermal project, EnergeÔ, in Vinzel, receives the help of the federal government. The amount of the grant granted by the Federal Office of Energy: more than CHF 14 million. It is the first Swiss company to sign such a grant agreement with Bern. EnergeÔ filed a file in January 2018 that has been evaluated by the SFOE. The project has a significant added value for researching geothermal resources in Switzerland because it is the first project to target a hydrothermal reservoir at the foot of the Jura. The fund is to young in order to carry out his success evaluation.

1.1.1.9 Turkey Early Stage Geothermal Development Framework: PLUTO

The European Bank for Reconstruction and Development (EBRD) and the Clean Technology Fund (CTF) developed this program to support exploratory drilling investments in Turkey. PLUTO combines $ 100 million from the EBRD with $ 25 million from the CTF, a funding window of the Climate Investment Funds. The program is available only to private developers in
Turkey.

The main objective of this program is to help mitigate early risks of geothermal projects and provide comfort to lenders (including EBRD) interested in providing finance at early and later stages of project development. PLUTO is intended to help the interested developers to initiate projects according to industry best practices, and assist the Ministry of Energy and Natural Resources with implementing the existing geothermal legislation (mainly the New Electricity Market Law No. 6446) and other related regulations.

PLUTO is structured in two phases: Phase 1 will finance exploratory drilling, drawing on CTF funds, and will be provided for the exploration stage/early stage development of the geothermal power projects. “Soft” loans of up to $ 5 million for each project are offered with a 3-year grace period and a 7-year repayment period. PLUTO will provide up to $ 2 million per well, with the developer required to provide at least 50 percent of equity. If exploration proves successful, EBRD will be available to finance the final stages of the drilling and the construction of the power plant as the second phase. Phase 2 will provide loans to private sector investors aimed at bridging the funding gap existing at early stage of development of geothermal power plants (GPPs). PLUTO’s goal is to develop at least five new geothermal power projects with a combined capacity of at least 60 MW.

<table>
<thead>
<tr>
<th>Overview</th>
<th>The European Bank for Reconstruction and Development (EBRD) and the Clean Technology Fund (CTF) launched a program to support exploratory drilling investments in Turkey. Facility size: $125 million PLUTO, named after the ruler of the underworld in classic mythology, combines $ 100 million from the EBRD with $ 25 million from the CTF, a funding window of the Climate Investment Funds. The program is part of a global push by multilateral development banks to scale up geothermal energy production. It is available only to private investors.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objectives</td>
<td>Help the Government of Turkey to mitigate the geothermal projects’ risks and provide comfort to lenders (including EBRD) interested in providing finance at the early stages of project development. The assignment will help the interested developers to initiate projects according to the best industry practice, and assist the Ministry of Energy and Natural Resources (MoENR) with implementing the existing geothermal legislation (mainly the New Electricity Market Law No. 6446) and other related regulations. The project will provide loans to private sector investors aimed at bridging the funding gap existing at early stage of development of Geothermal Power Plants (GPPs). PLUTO aims to develop at least five new GPPs with a combined capacity of at least 60 MW.</td>
</tr>
</tbody>
</table>
| **Structure and Key Features** | PLUTO is structured in two phases:  
Phase 1 will finance geothermal exploration, drawing on the funds provided by the CTF.  
If exploration proves successful, the EBRD will be available to finance the final stages of the drilling and the construction of the power plant as Phase 2.  
PLUTO provides support to projects according to these two stages. Phase 1 financing is to be provided for the exploration stage/early stage development of the geothermal power projects. Phase 1 offers up to $5 million for each project to be supported under the Program. The soft loan is provided with a 3 year’s grace and 7 years repayment at 75 bps fixed. EBRD will provide up to $2 million per well, with the Sponsor required to provide at least 50 percent of equity for Phase 1 financing. The loan and the equity will be blended on a minimum 50-50 basis. |
| **Funding** | EBRD and CTF |
| **Eligible Activities** | Technical Assistance ("TA") would be provided on a grant basis. The TA program would include, among other activities:  
(i) pipeline preparation;  
(ii) risk mitigation analysis (including early stage exploration best practices);  
(iii) review of drilling campaign to maximize drilling success rate;  
(iv) plant construction due diligence; and  
(v) environmental compliance support, including the abatement and/or commercial distribution of CO2 from geothermal resources. |
| **Funding Mechanisms** | Phase 1 - Clean Technology Fund ("CTF") funds provided as a loan and blended with the Sponsors’ equity on a 50-50 basis.  
After the resource is proven in Phase 1, the project will progress to Phase 2 which allows support for the finalization of the drilling stage and the construction of the power plant, provided that the geothermal resource has been proven and the GPP is ready for construction, in which case EBRD will consider arranging a long term loan for the project. For such a loan EBRD, could provide up to 35% of the total project cost with the balance of the loan being provided by commercial banks. |
| **Indications of Success** | A few projects have begun the process, but no funds have been disbursed to date to the best of our knowledge. |
| **Operation and management** | EBRD operates and manages the fund. |
| **Criteria used to select developers and projects** | The ability of the Sponsor’s company to successfully develop a project and repay a loan in the long term  
A resource with potential for developing a GPP in the near future |
### Criteria and triggers for disbursement
Terms and conditions of the loans and grants are negotiated on a per-project basis.

### Requirement s for monitoring, reporting and evaluation of results
Third party consultants evaluate project technical data at the request of EBRD. The frequency and detail of the reports is determined by EBRD and may vary on a per project basis. Basic reporting requirements are:
- review and recommendations on early stage exploration, exploration drilling and production drilling campaigns
- review of due diligence reports
- project monitoring to ensure successful completion and continued implementation of required institutional support measures

### Financial Impact on Stakeholders
Stakeholders get access to project financing in a risk adverse market. By lowering the resource risk through early stage exploration, more capital for development is available at later stages.

### Liquidity and availability of risk capital
$125 million fund, with per-project funding of up to $5 million for Phase 1 and several million for Phase 2, depending on project size.

### Options for recovering funds
Loans are granted with the EBRD terms and conditions for repayment negotiated at the time of contracting.

### Who pays the bill / holds the risk
In the event of failure, since the funds are provided as loans, the developer holds the majority of the risk. However, EBRD holds some risk via loan financing.

### Strong and Weak Points

<table>
<thead>
<tr>
<th>Strong</th>
<th>Weak</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Focused on areas of most risk in Turkish project development</td>
<td>- Ties the Sponsor to EBRD financing</td>
</tr>
<tr>
<td>- Provides a path for low cost financing in the event of successful exploration.</td>
<td></td>
</tr>
</tbody>
</table>

The advantages of the scheme are that the Phase 1 funding is focused on an area of high risk in the development of geothermal projects in Turkey (and elsewhere), i.e., exploration drilling and the scheme is providing a path for low cost financing in the event of successful exploration and determination of feasibility. The cons are that it is unclear how EBRD selects projects for participation and that EBRD’s main objective may be to leverage Phase I funding to enable EBRD to provide project financing in Phase II. While this alone is not a “con,” some selected projects may not succeed, but would have utilized some of the available fund EBRD’s main objective may be to leverage Phase I funding to enable EBRD to provide project financing in Phase II.

### 1.1.1.10 Turkish Risk Sharing Mechanism

18
Geothermal exploration and development is a high-risk investment because of the uncertainty associated with a natural resource that can only be validated for power generation with high capital expenditures for drilling. MTA (Turkish geological survey) has limited its exploration and license tendering activities and private investors now have to finance 100% of the exploratory risk after acquiring rights to the license area. Moreover, similar to many other countries, commercial financing is generally not available in Turkey until the geothermal resource has been validated and construction of the power plant has commenced.

The development objective of Geothermal Development Project for Turkey is to scale up private sector investment in geothermal energy development. This project has two components. The first component, Risk Sharing Mechanism (RSM) for Resource Validation, aims to promote private sector development of renewable geothermal energy projects in the early stage geothermal exploratory and confirmation drilling stages by sharing the risk of failing to validate a geothermal resource among two parties: the administrator of an RSM, capitalized by a Clean Technology Fund (CTF) contingent recovery grant, and the geothermal developer (that is, the beneficiary). The second component, Loan Facility for Resource Development, aims to address the financing gap that license holders face today in the resource development stages of geothermal projects by providing debt financing to encourage and support both license holders and financiers investing in (a) the capacity or production drilling stage and (b) the steam gathering and power plant construction stage.

Funding of the RSM will be provided by a contingent grant from the Climate Technology Fund (CTF) to the Government of Turkey. It is expected that a total of 38 million USD will be available for exploration drilling projects by the RSM. The implementing agency will be a dedicated unit (RSM Unit) within the Development Bank of Turkey (TKB). 1,8 M US$ is a grant to TBK to fund technical assistance (managing and implementation of the fund). The mechanism started on November 2016 and terminates in 2022.

\[ \text{Determination of success/failure} \]
In order to stimulate the exploration in zones where the geological and geothermal exploration is less advanced, a higher coverage will be given for wells outside the Aydin, Denizli and Manisa.

Within the scope of RSM, once the Beneficiary is successfully enrolled in the program. Developers pay a 10% success premium for the 3 first wells and 25% for the wells 4 and 5. In case of failure, RSM will reimburse 40% of the well costs in Aydin, Denizli and Manisa and 60% in the rest of Turkey. The maximum reimbursement for a three wells program is capped at 4 M US$. Additional constraints are linked to the CO2 emission rate when exceeding 583 g/kWh. If the first two wells in a three well program are unsuccessful, the contract between the RSM and the Beneficiary is automatically terminated.

Map of the geothermal resources of Turkey (exploited zones with existing power plants)

A success fee, amounting to 10% of the estimated well cost, is either paid upfront by the Beneficiary to the RSM or a letter of guarantee is provided. When a completed well meets or exceeds the success criteria that has been set on a custom basis for the drilling program the success fee is retained by the RSM, but otherwise it is reimbursed to the Beneficiary. The mechanism has just started to work and the first projects supported will be carried out end of 2019.

1.1.1.11 GeoFund

The project (initiative of World Bank) covered the countries in Europe and Central Asia, CEA (Bulgaria, Czech Republic, Hungary, Poland, Slovak Republic and Russia). Project aims were to develop further geothermal projects through the provision of
technical assistance, capacity building, the development of reforms of the energy market and related policies and the monitoring of trends. The project was in force between 2006 and 2009. The Program objective of the GeoFund was to systematically promote the use of geothermal energy in the ECA region through assistance in barrier removal. The most important barriers included (i) knowledge and information barriers; (ii) institutional, policy, legal and regulatory barriers, and (iii) financial barriers. The financial source at 25 MUS$ was coming from GEF (Global Environment Fund), the International Finance Cooperation (IFC) as Executing Agency of the GeoFund Program.

The GeoFund Program was an umbrella facility for multiple numbers of geothermal subprojects in participating ECA countries and involved the provision of Technical Assistance, Direct Investment Funding and Geological Risk Insurance.

Initial allocations for each window were:

**Technical Assistance Window (US$7 million):**

The Technical Assistance (TA) component of the GeoFund addressed information and capacity barriers that retard the use of renewable energy resources (RER) and geothermal energy.

**Direct Investment Funding Window (US$8 million):**

Direct Investment funding (DIF) supported project developers through providing low-cost loans and contingent/direct grants. Grant funds may be used solely to defray a portion of the direct investment costs associated with geothermal drilling of production and reinjection wells and post drilling project implementation. The GeoFund was given priority to providing grant funding for exploration drilling and well testing expense in order to maximize the risk coverage offered to Project Developers at that critical juncture of project development. After a positive drilling result, further project direct investment costs may be considered for grant funding to the extent that the Project Developer was able to argue persuasively that further support was critical to enhance project economics sufficiently to allow the project to proceed to implementation.

**Geological Risk Insurance Window (US$10 million):**

The Geological Risk Insurance (GRI) component helped to mitigate the geological risks associated with geothermal energy exploration and operation. The GRI was designed to cover part of the drilling and exploration cost or operational cost in the event of less than expected level of geothermal energy found in the wells or higher than expected deterioration rate of geothermal energy coming out of the well overtime. The GRI insured project developers/investors/lenders against such geological risks which are generally considered one of the key investment barriers for geothermal energy investment. GeoFund could issue both short-term exploration geological risk insurance (EXGRI) or long-term operational geological risk insurance (OPGRI). It was envisaged, however, that EXGRI would dominate during the Pilot Phase. OPGRI was developed during the implementation period by learning through the experience of EXGRI and the new product development in the market, and, if warranted, may be used in the Main Phase.

The International Geothermal Association (IGA) was a recipient primarily responsible for the execution of region-wide TA activities under the capacity building component. Reasons for the cooperation with IGA were its profound knowledge about the specific characteristics of geothermal energy and its worldwide operations.
Between mid-1990 to around 2010, the World Bank and GEF were involved in the preparation of a number and in the implementation of a few geothermal DH operations: Lithuania (Klaipeda); Poland (including Podhale, Mszczonow, Stargard geothermal plants). In some countries, these projects have been integrated well with the mainstream of the Bank’s policy dialogue with its clients, and may have contributed to the removal of some barriers in the use of RER. Commonly these small and scattered projects, however, were not able to contribute to the removal of major barriers to RER development. In fact, project managers had to fight for support from the governments rather than being able to influence policy.

The Bank and GEF have recognized that a systematic approach in the support of developing strategies for RER in general, and for geothermal energy (GE) in particular, is essential. Mechanisms need to be developed to systematically support the identification, preparation, and implementation of GE projects. This is even more important when considering the typically high up-front costs and risks of geothermal energy projects, since drilling costs can be excessive and the nature of the deposit and the reservoir might differ from expectations of exploration results. Also no broad generalization of production costs is possible because of the great variability of technical and economic parameters involved in the implementation of geothermal projects.

The proposed region wide facility provided risk insurance and investment to project developers that otherwise would refrain from investing in this energy source. Streamlined procedures for the risk insurance scheme and successful project implementation were expected to convince the private insurance market, developers, the public, and decision makers of the viability of geothermal energy.

The structure and management of the fund in case of the Hungarian project

The final result of the fund is not positive. The technical assistance carried out by the IGA has been fully utilized (0.81 MUS$) into upstream studies for the facilitation of geothermal plants. Another project has been financed in Hungary for the Zala site for the development of a 3 MW electricity project ensured by MOL (Hungarian Oil and Gas
Company). The support consisting in supporting the completion of two wells and testing for a total subsidies amount of 3,72 MUS$.

In Armenia, a project was supported for a 3D geophysical assessment completed in 2012 and the economic and financial viability of the conceptual plant at the Karkar site indicate that the economic and financial viability critically depend on the resource temperature, which would be confirmed through exploratory drilling, with no other works carried out since 7 years.

The fund has been globally unsuccessful with the allocation of a very small part of the initial expected budget.

1.1.1.12 French risk mitigation scheme

The late 1970s saw the birth in France of a heat producing industry built on the use of vast geothermal resources located 2,000 metres under the Greater Paris Region. This home-grown source of energy at a time when the price of fossil fuels was exploding, in the wake of the first oil crisis of 1973, offered temperatures of 60 to 85°C, therefore directly usable for heating residential complexes with or without shared heating networks.

This industry was initiated back in 1969 by French engineers with a world premiere, the geothermal dual drilling at Melun l’Almont in the Seine et Marne department near Paris. This approach went on to expand to a number of French regions, especially the Aquitaine Region centred on Bordeaux.

To support this expansion, in 1974 the authorities set up a technical committee – the Geothermal Committee – placed under the authority of the Ministry of Industry. In 1982, the Geothermal Committee was transferred to AFME (French Agency for Energy Management) – a newly created public agency later to become ADEME (French Agency for the Environment and Energy Management) in 1991.

In France, underground property rights belong to the State, which may or may not permit their use. The Mining Code was also enacted to ensure a legal framework for operations, with a Decree published in 1978 permitting the search for, and the use of, deep level geothermal resources.

In 1979, when the second oil crisis hit, GÉOCHALEUR (the National Company for Applying Geothermal Energy) was founded. This body was tasked with encouraging the expanding use of geothermal energy to save imported energy and further social aims.

Lastly, in the early 1980s, a mechanism for covering geological hazards was set up, initiated by the Ministry of Industry with, in 1981, the creation of the Long Term Guarantee Fund to cover the operating life of geothermal works. This duration was initially planned to last for 15 years (before later being extended to 25 years). In 1982, the Short Term Guarantee Fund was set up to cover geological risks linked to the search for geothermal resources, namely the risk that no usable resource would be found. These two funds were managed by a Caisse des Dépôts et Consignations subsidiary, the Auxiliary Financing Company for Geothermal operations (SAF-Géothermie), created in 1980 for this purpose before it became SAF-Environnement in 1993.
Geothermal wells drilled in France from 1961 to 2001

At that time, it was the first guarantee mechanism of this kind ever created. In parallel, a financial support mechanism for operations, taking the shape of subsidies and repayable advances was also set up. It was this policy taken together that allowed the deployment, between 1981 and 1986, of low temperature geothermal energy in France, with unrivalled success not seen in the rest of the world. Today, some two-thirds of the operations kicked off in the early 1980s are still in operation, cumulating over 500 MW of heating power installed and the equivalent of over 200,000 homes connected. Over a 35 year period, this represents fossil fuel savings of some 4.5 million tons and some 9 million tons of CO2 emissions avoided. After a long twenty-year period from 1987 to 2007, when no new operations were conducted in the Paris Basin and only three in the Aquitaine Basin, at the end of the 1980s, a relaunch in activity was initiated after 2008. To do this, a new public policy of financial support for drilling new wells was put into place thanks to the renewable heat fund created by ADEME in 2009. In parallel, as the Short Term Fund was eliminated in 1996, a new mechanism for covering geological risk, coupling a Short Term and a Long Term aspect, was created ahead of time in 2006, to support this relaunch of activity. Existing 1980s operations remained covered by the Long Term Fund until its closure in 2013 (the year when the guarantee for the last operation taken on 25 years earlier expired). Since then, some ten new operations have come on stream and most of the existing installations dating back to the 1980 and in place in the Paris Region have, or will in the coming years, seen new drillings to replace the original ones that have reached the end of their lives. This way, the life of these existing installations will be prolonged for another thirty years. Although the new operations undertaken, for now, remain dedicated to using the Dogger geothermal reservoir in the Paris Basin, a stated aim for the coming years is to develop installations in the Paris Region that use aquifers other than Dogger, like Triassic for example, or in other geographical areas (Alsace, Rhone River Corridor, Mediterranean areas, etc.) and to relaunch work on the Aquitaine Basin.
To conclude, if low temperature geothermal energy is what it is in France today, with—despite the teething troubles encountered—a large number of operations kicked off some 35 years ago and still in operation today, this is thanks to Public support and to the technical expertise developed progressively by the operators. It has also become what it is, thanks largely to the determining part played by the guarantee mechanisms put into place. The Short Term mechanism, by lifting the geological risk factor inherent in geothermal operations, allowed the initial drilling and the Long Term mechanism, by covering the repair work due to using geothermal fluids, ensured that installations were kept in sustainable use over the long term.

Regarding the guarantee mechanism created in the early 1980s, the history and results of which are the focus of this report, and we also need to stress the usefulness of such a mechanism in relation to the public purse. Hence, for the Short Term Fund, investments worth €198 million were guaranteed for the drilling phase, with €4.7 million paid by the public purse to the Funds, which means that for every €1 paid by the State, €42 of investments were guaranteed.

<table>
<thead>
<tr>
<th>Income</th>
<th>Amount (in FRF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Endowment by AFME (25 MFRF) and ADFEME (0.85 M)</td>
<td>30 688 251,34</td>
</tr>
<tr>
<td>2. Developers fees</td>
<td>3 516 992,74</td>
</tr>
<tr>
<td>3. Île de France Region participation</td>
<td>28 333,00</td>
</tr>
<tr>
<td>4. Financial results at the closure on April 30, 1999</td>
<td>31 737 401,16</td>
</tr>
<tr>
<td><strong>Total income</strong></td>
<td><strong>65 970 978,24</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Expenses (from the origin on 1st January 1982)</th>
<th>Amount (in FRF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Payments to developers, financial supports and expertise</td>
<td>42 182 644,77</td>
</tr>
<tr>
<td>- claims indemnified</td>
<td>18 509 429,06</td>
</tr>
<tr>
<td>- financial supports</td>
<td>19 808 939,87</td>
</tr>
<tr>
<td>- expertise for the priority program</td>
<td>2 864 275,84</td>
</tr>
<tr>
<td>2. Management fees</td>
<td>4 588 858,69</td>
</tr>
<tr>
<td>3. Reimbursement to ADEME at the end of the fund</td>
<td>10 000 000,00</td>
</tr>
<tr>
<td><strong>Total expenses</strong></td>
<td><strong>56 771 503,46</strong></td>
</tr>
</tbody>
</table>

**Finance balance of the short term fund fund in 1999**

For the Long Term Fund, investments worth €259 million were guaranteed, taking into account not only the cost of dual wells but also that of the related production equipment (pumps, heat exchangers, etc.) and this for tens of operations nationwide. The payments made by the State for this Fund came to €8.5 million, which means that for every €1 paid by the State, €33 of investments were covered for 25 years.
Lastly, with this guarantee tool that was both a forerunner and a rather innovative one, France gained real life experience that can easily be transposed outside of France, as was the case with the Netherlands a few years ago. Although the production of geothermal heat is comes second in renewable energy contributions to heat production worldwide, widely distributing this experience would no doubt allow further increasing its contribution.

### 1.1.2. Third Countries

#### 1.1.2.1 MiRiG

The Chilean government encourages electricity generation from renewable energy in different market segments through several policies and measures, including improving the framework for geothermal exploration and exploitation.

In 2013-14, the government obtained USD 53 million from the "Clean Technology Fund" (CTF), of which 50 MUS$ were designated to the Risk Mitigation Program in geothermal exploration (MiRiG), implemented by IDAB and USD 3 MUS$ to a technical assistance program, implemented by the World Bank. In 2015, the government and CTF agreed to add another USD 25 million to MiRiG. The World Bank contributed an additional USD 500 000 to the technical assistance project, from the Bank's Energy Sector Management Assistance Program (ESMAP).

The World Bank has been working, with ESMAP financing, on the technical assistance program since March 2015 on the following topics:

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<table>
<thead>
<tr>
<th>Income:</th>
<th>Expenses (from the outset on 1 January 1981)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Funding from ADEME and Ministry of Industry</td>
<td>1. Pay outs made (Table n°3)</td>
</tr>
<tr>
<td>2. Initial payments from the beneficiaries</td>
<td>2. Operating costs (incl. taxes)</td>
</tr>
<tr>
<td>3. Payments for extending the guarantees to 1999</td>
<td></td>
</tr>
<tr>
<td>4. Payments for extending the guarantee by ten years</td>
<td>Total expenses in FRF</td>
</tr>
<tr>
<td>5. Financial income as of 31/12/2015</td>
<td>157 840 351,52</td>
</tr>
<tr>
<td>6. Exceptional income</td>
<td></td>
</tr>
<tr>
<td><strong>Total income in FRF</strong></td>
<td><strong>Long term fund balance in FRF</strong></td>
</tr>
<tr>
<td>161 190 200,92</td>
<td>3 349 849,40</td>
</tr>
<tr>
<td></td>
<td>in € 510 681,24 €</td>
</tr>
</tbody>
</table>
• Technical documentation and/or regulatory support.
• A technological visit to Nicaragua under the framework of the Indigenous and Tribal Peoples Convention No. 169 and the consultation process for geothermal exploitation applications.
• Call for a study to assess how to co-ordinate the Chilean geothermal industry to contract drilling equipment and services efficiently.
• Creation of the Geothermal Energy Working Table, a public–private entity that aims to analyse the systemic impact of geothermal energy development on the interconnected electrical systems, as well as potential benefits and co-benefits in the short and long term, and the tools needed for its development.

The fund is based on conditional loans for production and exploratory drilling with the goal of providing project financing in the construction stage. Fund is existing for de-risk early drilling to help projects reach the stage of full development and operation. The conditional loan is limited to a maximum of $30 million per project.

Several projects submitted Expressions of interest and were compared to each other on based on a due diligence review of each project, its planned drilling activities, its overall project development plan, and the qualifications of the developer. Two projects were selected and further review of the drilling activities was undertaken. One project has been selected to receive funds.

The MiRiG is being implemented with the Cerro Pabellon project as the first beneficiary (it belongs to the Empresa Geotermica del Norte S.A., a company created by Enel Green Power and the National Oil Company, ENAP). Two other projects, Mariposas (EDC) and Licancura III (Transmark), were also selected.

In the event of failure IDB / IIC hold the risk.

The positive aspects of the scheme are:

• Lean structure for program administration with little risk of high cost and delays due to administrative complexity.
• Flexibility in designing support structure to match project needs.

The negative aspects of the fund are:

• Chile is not an ideal place to develop geothermal because there are alternative power sources that are available at lower cost than geothermal, and because many geothermal resources are located in areas without access to the transmission grids.
• IDB / IIC seek to provide project financing, and would therefore might tend to favor projects that are close to needing finance rather than those at earlier stages of development.
• Limited fund size

1.1.2.2 Mexico Geothermal Financing and Risk Mitigation Program

Geothermal Financing and Risk Mitigation Program for Mexico was
developed and funded by the Interamerican Development Bank (IDB), the Clean Technology Fund (CTF) and the Mexican Government to channel support to private developers for work at different stages of geothermal development, including exploratory drilling. The application, award and post-award monitoring process is implemented by Nacional Financiera (“NaFin,” Mexico’s internal development bank), with support from IDB.

Offering a range of financial mechanisms to support exploration, drilling, field development and construction activities, the Mexico facility was designed with the intention of scaling-up investments in geothermal power generation projects by the private sector. There is a Technical Assistance window that can be used for regulatory support, technical due diligence, capacity building and facilitation of PPP schemes. In addition, there is a drilling support element that uses a Partial Risk Guarantee (PRG) approach, as follows. The program offers loans at favorable terms for drilling the first two wells in new geothermal prospects, for a maximum amount of $5 million per well (which is estimated to represent 60% of the total drilling and testing costs). In the event that the wells do not yield an average capacity of at least 3 MW per well (which is the standard criteria for “success” in any project that uses this facility), the loan would convert to a grant. The use of well productivity insurance would help offset the facility losses: CTF funds would be deployed to cover the premiums for well productivity insurance, which would make a payout (back to the facility) if “success” was not achieved. On the other hand, if the first two wells have an average capacity of at least 3 MW per well, five confirmation wells would be funded at the same level ($5 million per well), for a total loan amount of $35 million, which would yield at least 21 MW (at least 3 MW per well x 7 wells).

This facility was anticipated to provide support to private developers, but because the geothermal department of the Mexican state utility CFE holds perhaps as many as 13 geothermal concessions (and it is possible that these include the most prospective remaining geothermal resources in Mexico), there are few private-sector players. Plans are underway within the Ministry of Energy (SENER) to define concessions for three to five sites that will be offered to the private sector, which has some interest in geothermal development (there are at least two and probably more private-sector geothermal companies; at least one is active). However, at recent power auctions, the prices bid by gas and solar projects were reported by IDB to have been between $0.35 and $0.40 per kW-hour. Geothermal project costs are almost always higher than these prices; since this was an auction, no geothermal projects were selected for contract awards. IDB is continuing to work with Sener to allow geothermal to participate, perhaps by applying a premium or “adder” for base-load geothermal power (this remains a concept at present).
| Overview | The Geothermal Financing and Risk Mitigation Program will channel resources from the Interamerican Development Bank (IDB), the Clean Technology Fund (CTF) and the Mexican Government (specifically, Nacional Financiera or “NaFin”) to private developers for different stages of geothermal development, including exploration.  
**Fund Start:** July 2015  
**Fund Amount:** $54 million |
<table>
<thead>
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<th></th>
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</thead>
<tbody>
<tr>
<td>Objectives</td>
<td>The objective of the program is to increase power production from geothermal sources by the private sector, thus contributing to the diversification of the energy mix, reducing dependency on fossil fuels, and reducing GHG emissions in Mexico. To this end, the program intends to scale up investments in geothermal power generation projects by making available a range of financial mechanisms tailored to meet the specific needs for each project’s stage of development. This included risk mitigation mechanisms as well as various forms of financing for exploration, drilling, field development and operation phases of private-sector geothermal projects.</td>
</tr>
</tbody>
</table>
| Structure and Key Features | Technical assistance under the Program includes regulatory support, technical due diligence, capacity building and facilitation of PPP schemes.  
Component I: Risk mitigation for geothermal projects in the early stages of exploration and test drilling.  
Component II: Financing adapted to different phases of project exploration and development.  
Loans Convertible to Grants: this is the primary mechanism that will be used for projects in the exploration and confirmation drilling phases.  
Due Diligence Grants: to cover due diligence for insurance coverage. |
| Funding | CTF, IDB, and Mexican government (via NaFin and the Ministry of Energy, “SENER”) |
| Geographical Extent | Mexico |
| Eligible Activities | Exploration and test drilling activities of geothermal power generation projects – This will be a loan convertible to grant in case of failure,  
Partial payment of premium/interests for insured loan - Grant |
### Funding Mechanisms

The funding mechanism includes 3 main phases with 3 facilities.

- An early exploration risk mitigation facility in which a CTF US 20M backstop guarantee supports a well productivity insurance policy for the development of up to 4 wells in a project (in 2 stages of 2 wells each) on a success/failure basis. This facility is funded by NaFin, with long term funds provided by CTF and IDB for up to $20 million with an equity/debt ratio of no less than 30/70.

- If the first wells are successful, the guarantee facility and the funding will still be in place, and financing for another 3 wells will be available on similar terms. Maximum total financing in this stage would be $35 million for the 7 wells ($5 million per well).

- If the second phase proves a minimum capacity of at least 21 MW (i.e., 3 MW per well), a third long-term facility would be available for project development and operation on the same 30/70 equity/debt ratio. Depending on project conditions and PPA prices, this ratio could be changed to up to 20/80.

### Indications of Success

At the moment program is in hiatus due to unfavorable market conditions. This facility was anticipated to provide support to private developers, but because the geothermal department of the Mexican state utility CFE holds perhaps as many as 13 geothermal concessions (and it is possible that these include the most prospective remaining geothermal resources in Mexico), there are few private-sector players. Furthermore, recent power auctions in Mexico have had responses at costs ranging from $0.035 to $0.040 per kW-hour, which is lower than geothermal prices.

### Operation and Management

- **Borrower, Beneficiary and Executing Agency:** Nacional Financiera S.N.C (NaFin)
- **Criteria used to select developers and projects**
  - A robust project with all the legalities in place
  - A firm commitment of equity investors either in the case of success or failure
  - A firm commitment of equity investor for all stages
  - A marketable PPA that will enable a successful project to proceed and make a reasonable profit
- **Criteria and triggers for disbursement of funds**
  - All normal procedures for obtaining Project Finance basis, plus compliance with all requirements for the insurance policy that is issued in the first and second stages. Success in stages 1 and 2 will lead to the third stage.
- **Back-stopping**
  - Equity stake guaranteed for 3 stages and PPA.
- **Financial Impact on Stakeholders**
  - Loans offered on favorable terms for drilling of first two wells. In the event of failure, the use of well productivity insurance would help offset the facility’s losses. If successful, five additional wells can be funded at the same level.
- **Liquidity and availability of**
  - The developer must guarantee sufficient equity to fund all three stages
**Options for recovering funds**
The use of well productivity insurance helps offset the facility losses. CTF funds would be deployed to cover the premiums for well productivity insurance, which would make a payout (back to the facility) if success (defined as an average of 3 MW per well, regardless of specific conditions in a project) is not achieved. If the project is successful, funding is repaid through normal operating revenue. The only likely option for recovering funds from a failure in exploration drilling would be the insurance coverage.

**Who pays the bill / holds the risk**
- Exploration Risk – CTF Backstop Facility / Equity 70/30 ratio.
- Development Risk – Developer
- Price Risk – Developer and/or Off taker

**Strong and Weak Points**
- **Pro**
  - Engages domestic insurance industry, helping to build domestic capacity
  - Attractive for private sector
  - 60% of investment paid in advance and reimbursable in case of success
- **Cons**
  - Very complicated because too many entities involved
  - Structurally complex
  - The power threshold at 3 MW could be considered too if considering the price of electric Kwh in the country lower than effective kWh geothermal cost.

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**Project and money flow under the drilling mitigation mechanism program**

Although initially launched in July 2015, the Mexico facility has not supported any geothermal projects to date and is essentially inactive at present due to the current geothermal development climate in Mexico.
The fund has a very high potential to effectively leverage and recycle public funds for private projects because of the well productivity insurance element.

The negative aspect is that no projects have been funded to date because of market conditions in Mexico. Numerous entities are involved (including various government agencies), increasing the level of bureaucracy and time for reviews and approvals. The mechanism is structurally complex and may be difficult to explain to developers.

Under the new geothermal risk mitigation scheme, an international public tender has been launched for the provision of drilling services for geothermal wells to a depth of 3,500 meters.

1.1.2.3. IRENA ADFD Project.

In 2009, the United Arab Emirates committed concessioning financing of up to $350 million, to be disbursed in seven cycles to renewable energy projects in developing countries that are recommended or endorsed by the International Renewable Energy Agency (IRENA). Through the Abu Dhabi Fund for development (ADFD), the facility supports IRENA mandate to promote the widespread and increased adoption and use of renewable energy and is not limited to only geothermal developments or to any particular geographical extent.

Since 2013 $189 million in ADFD loans have been allocated to 19 projects and over $387 million has been leveraged through other funding sources to cover the rest of the project costs. The projects must be in developing countries that are IRENA members, signatories or State in Accession. Projects must be one of the six renewable energy technologies as per the IRENA Statute which includes geothermal projects and they must have the full support of the government of the country where the project is implemented. The ADFD loan must be backed by a sovereign guarantee. The Abu Dhabi Fund for Development decides on the final selection of projects based on the submission of recommended projects by the Advisory Committee. The ultimate selection, financial support, administrative management and reporting of results remain the exclusive responsibility of the ADFD. A progress report of all selected projects is presented annually by the ADFD to the Director-General who, in turn, reports to IRENA Members.

The program provides concessional loans to the selected projects, as follows: The concessional loan value for projects ranges between $5 million and $15 million, the loan amount for each project shall not exceed 50 percent of the estimated project cost. Loan rates vary by country with 1% in least developed countries and other low income countries and 2% in lower middle-income and upper middle-income countries as per the OECD DAC list of ODA recipients. Loan repayment periods are 20 years including a 5 years grace period. Loans obtained from ADFD must be used for activities or
assets directly related to the proposed project. Loans cannot be used to fund any pre-development activities, such as feasibility, environmental-impact or socio-economic studies.

Two geothermal project loans have been granted to date: $15 million to St. Vincent and Grenadines and $6 million to Iran, for a 10-15 MW and 5 MW project respectively. Going forward, ADFD will select geothermal projects that are beyond exploratory drilling stage.

The positive point is that the financing scheme provides low interest rate loans to renewable energy projects, which often have difficulty finding adequate and affordable financing.

The negative impact is that the scheme is not geothermal specific, which will likely reduce the impact of this facility on the geothermal industry.

1.1.2.4 ARCEO-RMF

The Risk Mitigation Fund (RMF) inside the African Rift Geothermal Program (ARCEO) was initiated in 2003, approved in 2009 and launched in 2010, covering Djibouti, Eritrea, Ethiopia, Kenya, Uganda, and Tanzania.

The UNEP was responsible for the global project. The World Bank was the executing agency for the risk mitigation fund and the transaction advice components. Other stakeholders included the bilateral banks Africa Union Commission-German Development Bank, Icelandic International Development Agency (ICEIDA), German Federal Institute of Geosciences and Natural Resources (BGR), United Nations University-Geothermal Training Programme (UNU-GTP), US-Power Africa- East African Regional Programme.

The project fund was sized at about USD 18.6 million, out of which USD 13 million for the risk mitigation of drillings, the remaining part being for pre-feasibility and feasibility studies and support to policy regulations and transaction advice support for private sector stakeholders. The risk mitigation structure is handled by the World Bank. In addition, Iceland was to provide about USD 2.5 million over five years for technical assistance and training, equipment pool management. BGR was to provide about USD 2.8 million for various exploration projects in Ethiopia, Kenya, Tanzania and Uganda.

The mitigation includes partial compensation of the costs incurred in case of failure of wells drilled. The risk is covered by insurance guarantees with lowering premiums if the first drillings are a success. A fixed premium kept at a relatively symbolic level will have to be paid by the applicant. The compensation of a failure will be 85% of the total drilling cost excluding local taxes and will cover exploration, appraisal and production wells. The rate of success of drilling will determine the rate of depletion of the risk mitigation fund.
A dozen of projects had been initially targeted (see table below).

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<th>Djibouti</th>
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Eventually drillings in Ethiopia have benefitted from the support of ARCEO-RMF. Yet the initial funding of ARCEO has proven to be short and the initiative has not had the expected success.

### 1.1.2.5 GRMF

The Geothermal Risk Mitigation Fund (GRMF) for Eastern Africa has been launched in 2012. It covered initially five countries (Ethiopia, Kenya, Rwanda, Tanzania and Uganda), later extended to Burundi, The Comoros, Djibouti, Democratic Republic of Congo, Eritrea and Zambia.

The fund is sized over $115 M, financed with grants awarded via KFW (Germany) by the German Federal Ministry for Economic Cooperation and Development (BMZ, 30 million), ITF (EU-Africa ITF Infrastructure Trust Fund, 20 million), UK Department for International Development (DFID, GBP 39 million). It is hosted by the African Union Commission.

The mitigation scheme consists for pure grants, with no payback from the developers. The grants are provided through repayments to the developers.

Infrastructure grants provide 20% of approved allowable costs for infrastructure required for eligible surface studies and eligible drilling programs (e.g. access roads, water supply, etc).
Surface studies grants provide 80% of approved allowable costs (excluding infrastructure costs).

Drilling grants provide 40% of approved allowable costs for the exploration drilling and testing program for reservoir confirmation wells (excluding infrastructure costs), for a maximum of 2 full size exploration wells (>5") or up to three slim hole wells (<5") or a combination of 2 slim holes and one full size reservoir confirmation well.

In case of success, a Continuation Premium is awarded: up to 30% of the approved eligible and expended costs of continuation activities, or up to 30% of the developer’s share of the eligible and expended costs incurred during the initial drilling and testing program - whichever is lower. The continuation premium covers an additional full size well, the installation of wellhead generation unit(s), long-term discharge testing (minimum six months), reservoir evaluation updates, and plant feasibility studies.

The 5 rounds occurred from 2012 to 2018, awarding support to 33 projects in Kenya, Ethiopia, Djibouti, Ruanda, Tanzania, Uganda, Comoros, out of which 15 surface
studies and 18 drilling campaigns. $136 million grants have been awarded, though a large part has still to be disbursed.

In 2017, some projects were completed, particularly surface studies having led to drilling programs in two countries (Comoros and Ethiopia), but no geothermal power plant had been commissioned since the beginning of the GRMF.

The positive aspect is that the GRMF addresses the geological risk at early stages, on a large country scope in Eastern Africa. The high level of rigor required in the presentation of projects by developers helps to discard higher risk projects and select better projects. Developers benefit from pure grants, with no payment or repayment of service required.

The negative aspect is the GRMF’s impact on the pace of geothermal development which is not considered as having clearly demonstrated. No or very few power plants have been commissioned since the beginning of the GRMF. Developers still face the difficulty to finance the exploratory phase upfront. The GRMF is not seen by developers as a tool to de-risk and trigger the closing of equity and debt project finance, but even in its role of providing grants it is seen by developers as a bonus if received, rather than part of the initial financing package.

The operational reasons are the reimbursement-based design of the fund, the heavy administrative process not only at initial application phase but also at reimbursement phase, and the uncertainty endured by applicants not only at the start but also along the subsequent process.

By design the funds does not provide upfront grants but repays incurred costs after completion. Uncertainty hinders the efficiency of the GRMF concerning what is required for projects to be awarded and actually receive funds and due to restricted communication with GRMF during the application and award process. Because funds are distributed as reimbursements after expenditure there is a rigorous review of the activity actually completed vs. what was planned, developers are uncertain if they will be reimbursed or not.

The heavy administrative process requires time and external expenses at all phases. Some developers consider as exhausting the process to access to GRMF funds.

An additional reason for the lack of evidence of the impact of the GRMF on the effective commissioning of power plants is the political focus of the fund on covering all countries and therefore favouring non matured geographies locations and preliminary surveys at the expense of better deserving projects and drilling phases.

These GRMF returns of experience were taken into account when the GDF fund for Latin America was designed.

1.1.2.6 GDF Latin America
Based on the learnings of the GRMF, the GDF LA (Geothermal Development Facility for Latin America) has been announced on April 2016 for duration of 10 years. It focuses on projects in Andean Region and Central America, namely Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Colombia, Ecuador, Peru, Bolivia and Chile.

Its initial capital amounts to 50 M$. The GDF was funded primarily by the German Federal Ministry for Economic Cooperation Development (BMZ), the European Union through the Latin America Investment Facility (EU-LAIF) through KfW Development Bank. Other key stakeholders include Stakeholders CAF, CABEI, WB, ESMAP, IDB, AfD, EIB, JICA, NDF, BGR, GIZ. Further grants are foreseen by members of the Stakeholder Group and third donors. The Facility and is managed by IDA Fund Management, LLC, a consortium between Interlink Capital Strategies (financial manager) with Dewhurst Group, LLC (technical manager).

The GDF aims at fostering the development of 7 geothermal plants with a cumulative capacity of at least 350 MW at a total estimated investment of € 1 billion at least, with the optimistic target being €2 Billion. Late 2018 the GDF has applied for further funding by the Green Climate Fund, with the purpose to double these objectives.

The process has been streamlined in a preliminary plus 2 steps as transparent and clear as possible. The list of documents and expectations for applications are clearly stated with full documentation online.

The process starts with providing a short eligibility sign-up form (Pre-EOI, available form online). An answer is given to the developer telling whether the project fits with the GDC after a quick review. If the answer is positive the applicant can participate to the Call for Proposals (CFP) occurring each year through a 2 progressive stages process. A Developers' Manual with significant detail on the application process is provided to everyone who is eligible to apply.

The first CFP stage is an Expression of Interest (EOI) that requires the applicant to provide the developer's articles of incorporation, a cover letter describing the requested funding, and a narrative describing the project. EOIs receiving a score of 70% or more will be invited to submit proposals in the second stage of the CFP.

The second CFP stage requires a precise list of documents specific to preliminary studies or to drilling campaigns to be provided by the applicants. After examination the GDF teams communicate the selected projects receiving support. If the GDF support is awarded, requirements for the follow-up monitoring and reporting of the activities as well as specifications on the disbursement of grant funds are detailed in the grant agreements on a per-project basis.

The support to preliminary feasibility studies consist of grants up to €600,000. Preliminary studies include surface studies program, if necessary, infrastructure roads, and drilling up to one slim-hole well (<5”).

The support to exploratory campaigns consists of contingency grant (refundable advance with payback criterias) covering 40%, up to €5.8 million per project. In case of failure the advance is converted to a full grant, in case of success 80% of the loan
should be returned by the developer to the Fund. Exploration campaigns include up to three full-size drillings (≥ 5") suitable for production, well testing. It can include infrastructure required for the exploration (e.g., access roads, water supply, and electrical power), and the feasibility study for siting additional wells with the explicit objective of securing financing for subsequent reservoir-confirmation wells or steam-field development.

In addition the GDF facilitates the access to financing. The GRMF experience showed that despite the existence of a fund developers still faced difficulties to close up the funding of their project. Follow up Financing for Capacity Drilling and/or Plant Infrastructure can be provided by several Members of the Stakeholder Group. The GDF provides personal contacts with respective individuals from Agence Française de Développement (AFD), Joint CABEI / KfW Geothermal Financing Program, Joint CAF / KfW “Capacity Drilling and Investment Financing Line”, European Investment Bank (EIB), Inter-American Development Bank (IDB), Japan International Cooperation Agency (JICA), World Bank Group. The GDF also mentions Additional Investment Financing Windows for the production drilling and construction stages consisting in two financing lines provided by KfW in cooperation with CAF and BCIE, as well as financing lines by the World Bank, IDB, Afd, EIB and JICA.

The first call for proposal was issued in May 2017 with 25 parties submitted information, 13 applicants where selected to complete Call for Proposals.
8 projects are selected for the CFP from 25 EOI applications. The second call opened in June 2018 and of the 16 initial applications for the EOI, 11 were chosen to apply to the CFP.

8 projects supported since the beginning:
- Surface Studies grants have been approved for Bolivia, Chile, Ecuador, and Guatemala.
- Confirmation Drilling grants have been approved for Colombia, Guatemala, and Honduras.

The third call for expression has been closed in Q1 2019.

The positive aspect is that lessons learned from GRMF have been taken into account and that the process is well streamlined.

The fund is only partly revolving: 80% paid back to fund in case of success.

The negative aspect is that the coverage is only 40% for exploration campaigns.

1.1.3. Proposal for new funds

1.1.3.1 EGRIF

Where knowledge of the geothermal resource is lacking, exploration is of crucial importance to collect relevant data before drilling. Beyond exploration, two risks threaten the bankability of a geothermal project: the risk not to find an adequate resource (short-term risk) and the risk that the resource naturally declines over time (the long-term risk).

The proposed fund by EGEC was built for geothermal electricity generation in Europe; EGRIF shall be concerned with the exploration phase, the short-term risk and the long-term risk.

1.1.3.1.1. THE EXPLORATION PHASE

Here again, exploration aims at acquiring some data about the geothermal resource. This may be achieved through surface studies and/or exploration drilling. The exploration drilling is not necessarily a production drilling. It is focused on data...

Considering the importance of exploration for geothermal electricity generation in Europe, EGRIF shall provide some financial envelope to support exploration. This financial envelope shall take the form of a repayable advance. This would allow for some financing of exploration, without depleting the Fund as the advance would be reimbursed.
The amount of the repayable advance shall be set contractually. It shall cover the costs of exploration drilling and tests. Exploration costs specific to EGS shall also be considered (see *infra* ‘eligible costs and coverage ratio’).

The advance would have to be reimbursed in case of production. In such a case, the amount to be repaid to the Fund shall be enhanced. A classical interest rate as well as a discount factor shall be applied.

1.1.3.1.2. THE SHORT-TERM RISK

With regard to the short-term risk, the insurance shall aim at covering the costs of one or several drillings.

Two types of insurance may apply: a post-damage guarantee or a guaranteed loan. A guaranteed loan has the main advantage of serving as a source of financing while at the same time providing some insurance, as the loan is forgiven when the resource risk materializes. However, it requires an immediate disbursement of funds. This severely limits the financial flexibility of the Fund. The post-damage guarantee does not serve as a source of financing for geothermal projects. Nevertheless, it proved to be an effective insurance design in EU Member States that provide it, as it allows geothermal developers to attract external capital. From an accounting point of view, the funds are frozen when the guarantee is granted but only released when the risk occurs. As such, it allows some financial relief to the Fund and this flexibility ensures that many projects can be covered at the same time.

With regard to the aforementioned considerations, a post-damage guarantee shall be favoured in relation to the European Geothermal Risk Mitigation Fund.

1.1.3.1.3. THE LONG-TERM RISK

With regard to the long-term risk, the insurance shall aim at covering the remaining depreciable value of the wells and the geothermal loop as well as the loss of geothermal resource. The coverage of the “long term” risk should take into account some specific elements. Natural depletion is a standard technical risk that operators can deal with proper reservoir management. Offering the option to have insurance coverage for the “long term” risk should not set up a classic moral hazard situation where “unsustainable reservoir management” is an unintended consequence. As previously explained, the EGRIF shall provide a post-damage guarantee for the long-term risk considering the accounting advantages of this option compared to the guaranteed loan.

1.1.3.1.4. GOVERNANCE
The existence of an insurance Fund on the European stage calls the establishment of some governance. Basically, the governance implies some administration to handle the insurance process and requires some decision-making as well as some expertise. The most significant point in relation to governance is the level at which this governance shall be settled.

The European Geothermal Risk Insurance Fund could be managed in various ways. There could be:
- An exclusive management by an EU institution;
- An exclusive management by a national institution;
- A shared management between an EU institution and a national institution;

An exclusive management by an EU institution implies that all applications for the benefit of insurance and insurance claims be submitted to a unique institution operating on the EU level in a one-stop-shop process. In theory, such governance could exist. An exclusive management by a national institution implies that on each national stage, a specific institution deals with applications and insurance claims. This option seems inadequate since:
- It would require specific technical, financial and legal expertise for geothermal electricity projects. Yet, some countries may not benefit from this expertise;
- The board shall include some representatives of each shareholder. Having an exclusive governance on each national stage would require these representatives to take part in each national governance, which may prove quite complex;

A shared management would imply some functions to be entrusted to national institutions and others to an EU institution. However, it seems undesirable to have the decision-making and the expertise split out between two different levels as this would presumably lead to a burdensome process. Nevertheless, there could be a secretariat on the national stage while the decision-making and the expertise would be dealt with on the EU stage.

Another governance pattern should be discussed regarding the possible existence of a national insurance system dealing with the resource risk for geothermal. Where a national insurance exist, this could lead to a shared coverage. Such a shared coverage would necessarily imply some kind of cooperation between the national Fund/insurance company and the EU institution.
In this respect, the national insurance company or the national insurance Fund shall address the EU or national institution in charge of the secretariat. The completed applications and insurance claims could then be examined by the national insurer and the EU institution either jointly or separately.

A joint examination, as opposed to a separate examination, would require:
- A one-stop-shop process;
- A unique application;
- A unique insurance claim;
- A unique expertise;
- A unique decision relating to the grant/the release of the insurance and the respective coverage ratio provided;

Presumably, a joint examination would therefore ensure a more efficient insurance process than a separate one.

1.1.3.1.5. GUIDELINES
The secretariat shall take place on the national stage or the EU stage. Applications and insurance claims as well as any relevant document shall be submitted to the secretariat in English.

The board and the expertise shall be settled on the EU level to avoid any shortage of expertise and any governance issue. Where a national insurance exists, cooperation shall be favoured. In this respect, the national insurance company/Fund shall address the EU governance. A joint examination shall be favoured involving a unique expertise on the EU level and a common final decision by the EU board. In this regard, a representative of the national insurance system shall be part of the EU board when final decision is made. An agreement between the EU governance and the national insurer shall be found on the provision of a shared coverage. The respective coverage ratio and all relevant criteria shall be set contractually.

- The secretariat

The secretariat, whether on the national or the EU stage, shall be in charge of receiving applications and insurance claims, as well as any relevant document. Any information submitted to the secretariat shall be in English (applications, claims, reporting documents).

The secretariat shall acknowledge receipt of applications or insurance claims. If these are incomplete, the secretariat may require additional information. If the secretariat remains silent for two months, the application or insurance claim shall be considered as complete.

- The board and the rapporteur

The board shall be in charge of decision-making ie it shall ultimately decide whether the insurance should be granted and released, according to sound expertise. In this regard, the board shall also be in charge of appointing technical, financial and legal independent experts having sound knowledge of geothermal.

The board shall include 9 members being:

- Representatives of EGRIF shareholders;
- Geothermal professionals;
- Experts;
- In case of a national insurance being available and a shared coverage being considered, a representative of the national insurance system shall take part in the decision-making process;

Shareholders shall agree on the appointment of their representatives. They shall also agree on the appointment of representatives of the geothermal sector and experts. Members of the board shall be appointed for a renewable three-year term. They shall avoid any conflict of interests.

Members of the board shall elect an Executive Chairman for a renewable three-year term. He shall have a casting vote. He shall act in any circumstances on behalf of the board. He shall organize the board’s work in coordination with the secretariat. In particular, he shall ensure that members of the board may carry out their functions and deal with suspicion of any conflict of interest. He may be dismissed ad nutum following a majority vote of the board.
An attendance quorum of 5 members shall be respected for decisions to be taken by the board. The Executive Chairman shall mandatorily be part of the attendance quorum. The board shall decide by means of reasoned decisions that may not be appealable.

Each submitted application shall be entrusted to a member of the board. Each member of the board shall thus be a rapporteur for a number of projects. The rapporteur shall supervise the projects entrusted to him from beginning to end and report to the board.

- The expertise

The board shall rely on expertise regarding the submitted applications and claims. Experts shall be independent both from members of the board and from developers whose application or claim is being assessed. These experts shall be familiar with the geothermal field and have some proven technical, financial or legal skills.

1.1.3.1.6. CAPITAL AND FINANCIAL STRUCTURE

The European Geothermal Risk Insurance Fund shall rely on a strong capital and financial structure. This underlying principle raises the matter of reinsurance as well as the likelihood of a balancing of the Fund.

The seed capital shall have as many diversified sources as possible. Indeed, the more diversified the seed capital is, the more reliable the insurance system will be. The minimum seed capital shall be of 50 Mio – 100 Mio €.

The seed capital shall stem from all possible sources such as:

- The European Union;
- The Member States;
- The regional level authorities of the Member States;
- Insurance companies and brokers;
- Private and public financial institutions;
- Other reliable stakeholders;

In any circumstances, the distribution of the seed capital shall be made public and transparent.

1.1.3.1.7 OPERATING INCOMES

Among all possible incomes for an insurance system, the following shall be considered as suitable. They could apply cumulatively or not.

Fees

Insurance fees shall be charged in relation to each application made to the Fund (for the repayable advance, for the short-term guarantee and for the long-term guarantee). In relation to each phase of the project, fees shall be charged according to the following ranges of values. These ranges of values are based on the existing insurance concepts for the resource risk in Europe:
- The exploration phase: a 6% to 8% interest rate could be charged as for the repayable advance;
- The short-term guarantee: a premium amounting to 3.5% to 5% of the eligible costs could be charged;
- The long-term guarantee: a fixed fee of 12,000€ to 13,000€ per year could be charged;

These insurance fees might be modulated according to the estimated resource risk. They shall be set in the reference contract signed between the developer and the governance.

Proceeds of investments made with the EGRIF treasury:
The governance of EGRIF shall be allowed to make investments with the treasury and use the proceeds of these investments as an income.

**THE FUND BALANCE**
Aforementioned incomes may not be sufficient to allow the balancing of the Fund. In addition, when relying on these incomes, the balancing would mainly depend on the success of insured geothermal projects.

In this context, the European Geothermal Risk Insurance Fund shall be able to exhaust and be replenished with available public and private funding. This would give the EGRIF more flexibility from an accountancy point of view.

**REINSURANCE**
Considering the financial stakes the EGRIF may face and the flexibility needed to insure as many reliable geothermal projects as possible, some reinsurance shall be applied to in order to provide the European Geothermal Risk Insurance Fund with some financial relief. This shall be achieved contractually between the EGRIF and a reinsurer.

1.1.3.1.7. BENEFICIARIES
The European Geothermal Risk Insurance Fund shall be made available to private and public organizations developing geothermal electricity projects on the EU territory.

1.1.3.1.8. ELIGIBLE COSTS AND COVERAGE RATIO
The European Geothermal Risk Insurance Fund shall be concerned with the exploration phase, the short-term risk and the long-term risk. In relation to each of these phases, the EGRIF shall cover some of the costs borne by the developer, where these are deemed eligible, and up to a certain level set contractually.

a) **THE EXPLORATION PHASE**
The costs considered as eligible regarding the exploration phase shall be the costs of the exploration well. These shall include in particular, but not exclusively, the costs relating to:
▪ Installing and breaking down the rig;
▪ The drilling itself;
▪ Tubing;
▪ The cleaning;
▪ Well testing and improvements;
▪ Drilling management;

Specific case of EGS: where EGS is considered, exploration may involve specific costs in relation to the reservoir development concept. These costs shall be eligible for coverage.

Eligible costs shall be specified in the reference insurance contract eventually signed between the developer and the EGRIF.

Regarding the exploration phase, a financial support taking the form of a repayable advance shall be provided to the applicant.

Depending on the risk assessed by the independent experts and the amount of the eligible costs, a certain amount would be released to cover the aforementioned costs. This amount shall be set contractually on a case-to-case basis. If the developer benefits from national subsidies with respect to the exploration drilling, these shall be removed from the amount of the repayable advance.

As the success and failure criteria cannot be determined exactly in the exploration phase, the advance shall be repaid when production begins. The reference contract shall specify the starting point and deadlines for reimbursement.

As for reimbursement, the amount to be repaid shall be enhanced. An interest rate as well as a discharge factor shall be set contractually.

b) THE SHORT-TERM RISK

The costs deemed eligible with regard to the short-term risk may differ depending on the kind of technology considered for geothermal electricity production:

Heat and electricity production using conventional technologies

The costs deemed eligible shall be the costs of the first production/injection drilling. These shall include in particular, but not exclusively:
▪ Installing and breaking down the rig;
▪ The drilling itself;
▪ Tubing;
▪ The cleaning;
▪ Well testing;
▪ Drilling management;

Electricity production using EGS
In addition to the aforementioned eligible expenses, where geothermal electricity is generated using non-conventional technologies, eligible costs shall also include in particular, but not exclusively:

- The reservoir development (e.g. seismic sensors and modelling);
- The reservoir stimulation (e.g. hydraulic pumps, pumping costs, chemicals, seismic monitoring);

Eligible costs shall be specified in the reference contract signed between the developer and the EGRIF. Subsidised costs shall be excluded from the eligible expenses. Lists of expenses considered as eligible for insurance coverage in France and Germany can be found in Appendix IV.

The insurance provided in relation to the short-term risk shall work through a revolving mechanism: the first drilling shall be insured. When successful, the insurance provided may be reused to cover a following drilling. The insurance may be successively reused in this way to cover several drillings until one fails and the insurance be released.

As for the coverage ratio in relation to the short-term risk, two options may apply:

**1st option**

The eligible expenses may be covered up to 70-90%. A ceiling shall apply for each drilling. In this respect, the costs insured shall be established on a case-to-case basis.

The rate eventually applied shall depend on the drilling being partially successful or unsuccessful. The rate shall also depend on the possible energy recovery, where for instance heat can be generated instead of electricity (see *infra* ‘eligibility criteria’).

In any way, the coverage rate shall be set contractually with respect to the above mentioned range of values. A franchise amounting to 100 000€ - 150 000€ shall be borne by the developers.

**2nd option**

This option has pros and cons:

+ It provides a homogeneous rate for all EU developers;
+ It provides a generous rate encouraging the development of geothermal electricity generation;
- The generous rate provided may lead to competition with existing national insurances;
The eligible expenses are differently covered depending on whether a national insurance coverage exists.

Where no insurance exists, eligible expenses would be covered up to 50%.
Where insurance for the resource risk exists, the EGRIF would provide an additional 10% coverage. The national insurance could then provide coverage up to 30% of eligible expenses, the overall coverage not exceeding 90% of these expenses.

A ceiling shall apply. In this respect, the costs insured shall be established on a case-to-case basis.

Here again, the rate eventually applied shall depend on the drilling being partially successful or unsuccessful and on the possible energy recovery (see infra ‘eligibility criteria’).

The coverage rate shall be set contractually with respect to the aforementioned range of values. A franchise amounting to 100 000€ - 150 000€ shall be borne by the developers

This option has pros and cons:
- Both rates (50% for countries without insurance and 60% for countries with insurance) are sufficient to encourage geothermal electricity development without competing existing insurances;
- The additional coverage offered by EGRIF acts as a lever for the development of national insurances;
- This option leads to a differentiated treatment and potentially favours countries where insurance is already available;

c) THE LONG-TERM RISK

The costs deemed eligible in relation to the long-term risk shall be:
- The remaining depreciable value of the well(s) and the geothermal loop(s);
- The stimulation measures;
The loss of the geothermal resource, as a percentage of the enthalpy multiplied by the flow rate;

These eligible costs shall be clearly specified in the reference contract. If national subsidies are available on the national stage in relation to the perennity of the geothermal resource they shall be removed from the eligible expenses.

The coverage rate for the long-term risk shall depend on the results of the previous drilling(s) i.e whether the drilling(s) was (were) completely or partially successful. The rate shall also depend on the possible energy recovery in spite of the resource depletion (see infra 'eligibility criteria’). It shall be set contractually.

Where a national insurance exists, a shared coverage shall be made available from the EGRIF. The national insurer shall address the EGRIF in this respect and the respective coverage rates shall be set on a contractual basis.

The long-term risk guarantee shall be provided for a period of 10 to 20 years, as set contractually between the developer and the Fund on a case-to-case basis.

A franchise amounting to 100 000€ - 150 000€ shall be borne by the developer.

1.1.3.1.9. ELIGIBILITY CRITERIA

Eligibility criteria shall enable the experts to assess applications and claims in relation to each insured phase of a geothermal electricity project. Eligibility criteria with respect to both applications and insurance claims are considered.

a) ELIGIBILITY CRITERIA FOR APPLICATIONS MADE TO THE EGRIF

Applications made to the EGRIF may vary depending on the coverage sought (repayable advance, short-term guarantee or long-term guarantee). Regardless of the phase concerned with the application, some requirements shall be common to each application.


Criteria common to all applications

- The obligation to disclose the data collected

Any developer willing to benefit from the guarantees provided by the European Geothermal Risk Insurance Fund shall engage to disclose to the EGRIF all data collected during his geothermal project.

This data shall be in particular, but not exclusively:

- The temperature;
- The depth and thickness of the reservoir;
- The flow;
- The geology;
- The porosity;
- The permeability;
- The geochemical analysis of the fluid;
- The seismicity measurements;

The reference contract shall determine the data to be disclosed as well as the term when this data shall be made public. It shall also provide that any breach of the disclosure obligation shall lead either to the termination of the insurance contract or the review of the insurance, in particular of the coverage rate.

The data shall be submitted by means of a unique and exhaustive report, with respect to the terms of the reference contract.

The data collected shall be used in the establishment of a Public Geothermal European Database.

- The obligation to comply with schedules

The developer benefiting from at least one guarantee under the EGRIF shall engage to comply with schedules. In other words, the reference contract shall specify the time limit for the exploration and drilling to be undertaken and achieved. In particular, the reference contract shall specify the starting point of the schedule as well as any possible extension of the term. This shall apply even where exploration/drilling/exploitation is successful.

These schedules and their relating considerations shall be set contractually depending on the specificities of each geothermal electricity project.

- Reporting obligations

Developers benefiting from one of the guarantee under the EGRIF shall abide by reporting obligations. Concretely, the developer shall inform the rapporteur appointed by the board to supervise his project about the project’s execution, whether the
insurance is granted for the exploration phase, the drilling phase or the production phase.

The reference contract shall specify the information to be submitted under the reporting obligation and the frequency of the reporting obligations. The rapporteur shall be allowed to require any information at any time.

- Public and confidential information within the application procedure

Among the information submitted to the European Geothermal Risk Insurance Fund, the reference contract shall set the one which shall eventually be made public and when it shall become public.

Besides, where the applicant desires to keep some information secret (e.g.: use of a specific industrial process) he shall submit this information under separate cover. The reference contract shall determine whether this information shall eventually be made public.

In this respect, the board and experts appointed by the board shall comply with confidentiality duties and shall not disclose any information until it is made public.

Criteria to benefit from the repayable advance

In order to apply for the repayable advance, the developer shall submit the following information to the secretariat:

- A detailed presentation (identity, legal form, information on contractors and key personnel);
- The location of the exploration site;
- Detailed surface studies and any relevant document or piece of information proving the probable existence of a commercially viable geothermal resource;
- A detailed program of exploration work;
- Available financing and proof of financial capacity to achieve the whole exploration program;
- Legal permits and licences;

Specific case of EGS: where EGS are considered, the developer shall in addition submit:

- The reservoir development concept;
- Seismicity studies;
- Stimulation modelling ie expected impact of chemical, hydraulic or thermal stimulations;

Criteria to benefit from the short-term risk guarantee

A developer shall be entitled to apply for the short-term guarantee whether he has benefited from the repayable advance or not.
In order to apply for the short-term guarantee, the developer shall submit the following information to the secretariat:

- A detailed presentation (identity, legal form, information on contractors and key personnel);
- Whether he has benefited from the repayable advance;
- The location of the drilling site;
- A prefeasibility study as a result of exploration, which proves the likelihood of electricity production for the considered geothermal project;
- A feasibility study, which should particularly insist on the expected flow rate and temperature;
- A detailed program of wells and tests;
- The power plant use concept (electricity generation/CHP) and the intended use of the energy. In particular, the developer shall submit a curve displaying the possible recovery of the energy (heat generation/CHP) according to the achieved flow rate and temperature;
- Seismic investigations and their analysis;
- Legal permits and licences required for exploitation and proof of compliance with legal requirements (e.g. environmental impact assessment, public information);

Where EGS are considered, the developer shall in addition submit:

- The degree to which the project involves technical innovation;
- The reservoir development program;
- The planned stimulation measures;
- The planned seismic monitoring;

**Criteria to benefit from the long-term risk guarantee**

A developer shall be entitled to apply for the long-term risk guarantee if he has benefited from the short-term guarantee only or if he may provide all relevant results of the drilling phase to the board.

Where the developer has not previously benefited from the short-term guarantee, the board shall decide whether the developer may apply for the long-term guarantee on a case-to-case basis.

In order to apply for the long-term guarantee, the developer shall submit the following information to the secretariat:

- A detailed presentation (identity, legal form, information on contractors and key personnel);
- Whether he has benefited from the short-term risk guarantee;
- The location of the geothermal site;
- The results of the drilling phase, in particular the achieved flow rate and temperature;
- The financial plan of the operational phase (e.g. return on investment, financing of the project, initial value of the well(s) and loop(s));
- The power plant use concept, the intended use of the energy in case of the resource depleting and a curve displaying the possible recovery of the energy according to the flow rate and temperature;
- Legal permits and licences required for exploitation and proof of compliance with legal requirements;
- The operations and maintenance program, including the frequency and method of control as well as the controlled parameters;

b) ELIGIBILITY CRITERIA FOR INSURANCE CLAIMS SUBMITTED TO THE EGRIF

Regardless of the phase concerned with the insurance claim, some requirements shall be common to each claim.

- The obligation to engage stimulations measures before submitting the insurance claim

Whether the project generates geothermal electricity using conventional technologies or EGS, the developer shall only be allowed to file an insurance claim where he has undertaken all relevant stimulation measures either to find a viable resource or to avoid its depletion.

Stimulation measures to undertake shall be determined by the board and supervise by the rapporteur.

- Public and confidential information within the claim procedure

The reference contract shall determine which of the information disclosed by the developer in its insurance claim shall eventually be made public and when this shall be made public.

In this respect, the board and experts appointed by the board shall comply with confidentiality duties and shall not disclose any information until it is made public.

1.1.3.1.10. INSURANCE PROCESS

Criteria for the guarantees to be released

It shall ultimately be up to the board to decide whether the short-term guarantee or the long-term guarantee has to be released. The decision shall be based on sound expertise. Criteria taken into account by the independent experts in determining whether the insurance has to be released shall be those set in the reference contract.
In relation to the short-term guarantee, the developer shall in particular, but not exclusively, submit the following information in his insurance claim:

- The achieved flow and temperature;
- The possible recovery of the energy in accordance with the curve provided in his application;

In relation to the long-term guarantee, the developer shall in particular, but not exclusively, submit the following information in his insurance claim:

- The remaining depreciable value of the well(s) and loop(s) and supporting financial documents;
- The proof that the electricity/heat generation decreases;
- The proof that the geothermal resource depletes (flow rate and/or temperature) and the proof of the natural origin of this depletion;
- The proof of the causal relationship between the resource depletion and the decrease in the electricity/heat generation;

Each application and claim shall be duly assessed by experts and the board against eligibility criteria. In this respect, the insurance process shall take place as follows.

**a) EXAMINATION OF APPLICATION**

Applications could take place on a tendering basis or be submitted to the governance continuously. Considering that tenders may ease the insurance process by examining all completed applications at once, regular tenders (e.g. 3 to 4 times a year) shall be favoured.

Once the call for tender is launched, the secretariat shall acknowledge the receipt of applications. It shall then ensure that applications are complete. If not, it may require applicants to provide additional information. If the secretariat remains silent for two months, the application shall be considered as complete. Applications which are not complete at the time of the tender shall be resubmitted when a following tender takes place.

The secretariat submits all completed applications to the board. The board then appoints a rapporteur for each application. In relation to applications for the long-term guarantee, when the developer has not previously benefited from the short-term guarantee, the board shall also immediately decide whether the developer may apply for the long-term guarantee.

Independent experts are appointed to assess the technical, legal and financial viability of the geothermal electricity project. These experts shall be independent from members of the board as well as from developers whose application they are assessing. As soon as they are appointed, applications are submitted to them.

Independent experts shall submit their opinion to the rapporteur within three months from the date of their appointment. They shall be able to require any additional
information from the rapporteur, any adequate interview with the developer and any visit of the geothermal site. Their opinion shall have a binding effect and experts shall be able to provide binding recommendations to be complied with by the developer when drilling or plant operation begins. In particular, the experts shall provide the board with recommendations as to the success and failure criteria as well as the curve displaying the possible recovery of energy as proposed by the developer.

From the date experts provide their opinion to the board, the board shall have two months to provide the applicant with a reasoned decision as to whether the repayable advance/the guarantee is granted. This decision of the board shall not be appealable.

The reference contract relating to the repayable advance, the short-term guarantee or the long-term guarantee shall be signed within two months from the date the board has provided the applicant with its reasoned decision.

1.1.3.2 GEODEEP SAS

The fund is limited to deep geothermal wells producing waters > 110°C for electricity and/or heat generation, in France onshore, DROM (Caribbean and Reunion islands) are excluded. The size of the fund is about 30 M€ (public 55%, private 45%). The public amount is given by the ADEME (French Agency for Energy Management and Environment) and the private part is funded by 3 French private companies (developers) and the Caisse des Dépôts et Consignations (a bank). The fund is receiving public financing and will be adopted and operational after the notification by the European Commission DG Competition. The fund will start before the end of the year 2019.

The functioning of the fund is based on a maximum repayment for one single well including extra costs due to geological-hydrogeological difficulties of 16.5 M€. Indicating if the first two projects are total failures the fund should be terminated.

The project is submitted to a technical committee (the applicant have to pay a lump sum to finance the expertise of the project and after acceptation, the board of GEODEEP SAS which accept to support the project.

Each project supported will propose as a customized balance in between premium and royalties

The reimbursement for the first well is case of failure is at a maximum of 60% including extra costs, for the second well the percentage is the same but extra costs in relation with geological or hydrogeological difficulties are reimbursed at 100%.

Signing the contract, the operator engages a security deposit representing 10% of the total operation costs. In case of success, the reimbursement takes place after 11 years following the starting of the exploitation

Royalties are project dependent and would represent 2 to 4.5% of the turn-over of the plant during 15 years.
1.1.3.3 GeoFutures

This fund proposal has been elaborated by Geotermex and Parhelion for the USEA (United States Energy Association (USEA) Washington, D.C. and published end of 2017 under the title: “Development of a risk mitigation mechanism for geothermal development in East Africa”. The main conclusions of the study based on the screening of several existing funds established to support the geothermal electricity production deployment is resumed here after focusing on the analysis of the GRMF and GDC Latin America.

GRMF, while complicated and bureaucratic, has provided some support and has helped applicants to increase the rigor of their own process of project development.

GDC Latin America is an attractive direct financing mechanism that places the best elements of GRMF into a more streamlined and simpler framework.

Resource risk remains a significant barrier.

Insurance based solutions offer attractive public-to-private leverage ratios. These conclusions have significantly informed the concept for the proposed GeoFutures Facility, which has been designed with three principal pillars as described below.

Pillar 1: Technical Assistance (TA)

This will provide non-financial assistance via advisory services from local or international specialists to address barriers that affect public and private developers.
and financiers and thus impact the enabling and implementation environment for geothermal projects. This TA pillar needs maximum flexibility to address the broad range of requirements already identified by stakeholders and others that will emerge in the short and medium term. In addition to its direct benefit in solving a particular problem, TA by local and international experts provides an inevitable and significant element of capacity building for geothermal developers. The TA could address issues in a number of risk categories, including: Legal and regulatory (development of geothermal policies and regulations, geothermal Master Planning, community engagement program design, resource licensing / concessioning process and maintenance requirements, etc.)

Financial (instruments to reduce capital requirement and/or cost of capital, access to loan guarantee facilities, credit wraps for off-takers, etc.)

Technical (exploration project design, data evaluation, infrastructure development, pre-feasibility studies / well targeting, feasibility studies, resource management issues, technology review and transfer, etc.)

To ensure that the GeoFutures Facility is complementary to these existing facilities, it is suggested that one of the qualifying criteria for accessing this TA Pillar is that public-sector applicants could be that applicants have considered EAGER and the Geothermal Exploration Project (ICEIDA/NDF) for the same TA first, before approaching GeoFutures.

100% of eligible costs would be covered by the Technical Assistance facility. It is suggested that applications may be made at any time by public or private sector parties, or PPPs, and the Facility will hold quarterly reviews of applications and funding awards.

Pillar 2: Direct Finance

Because the risk profile of projects at the earliest stages of development are unattractive to most equity providers, and insurance solutions are unlikely to be economically justifiable at these early stages, Direct Finance would be used to support three main activities:

- focused exploration work that is required to de-risk the selection of well-sited and drilling targets, such as detailed geophysical surveys and temperature gradient surveys (which, although it involves drilling, is essentially a geophysical method);
- infrastructure development (roads, drilling pads and water supply); and
- the first deep exploratory drilling (at least the first well, and possibly the first 2 or 3 wells).

As for Pillar 1, public-sector applicants for focused exploration work could be required to consider other sources of similar funding first (such as GRMF, EAGER, and the Geothermal Exploration Project ICEIDA / NDF), before approaching GeoFutures. With regard to drilling support, the GRMF and GDF Latin America facilities have influenced the design of this pillar. It is proposed that the GeoFutures would cover up to 40% of eligible costs for focused exploration in the form a non-recoverable grant. In addition, 40% of eligible costs for project infrastructure may also be covered; however, this support will be provided in the form of a contingent grant or convertible
loan that would be repayable in the event of a successful project (funds would be considered a grant if no project is developed). The reason for infrastructure funding to be a convertible loan rather than a grant is to encourage good project selection by developers. This is not to say that remote projects should not apply to the fund, but that there would need to be a clear path to a project (possibly including local off-take rather than a grid connection) for projects that are far from the grid and other infrastructure. It is proposed that the first deep exploration wells are also funded at 40%, as a non-recoverable grant.

As for Pillar 1, it is suggested that applications are accepted continuously and evaluated quarterly.

For this and the other two pillars, it is recommended that procurement procedures are kept as simple as possible, although it is acknowledged that the governance of the GeoFutures Facility would be dependent to some degree on the procurement requirements of funding entities.

**Pillar 3: Risk Mitigation Instruments**

When projects have reached the phase of confirmation / appraisal drilling, GeoFutures shifts from providing direct finance to supporting risk mitigation measures. At this point, the project risk profile matches the risk appetite of the international insurance sector, setting the stage for a new form of private sector capital (albeit contingent capital) to support geothermal development: well productivity insurance. The insurance will be provided by private-sector insurers both domestically and internationally, meaning that the private sector is taking the majority of the risk at this crucial stage of project development. It also means that there is significant transfer or skills into the domestic insurance sector. Another benefit can be realized in Ethiopia, where international reinsurance is allowed, whereas international banks are not. This is therefore a potentially important way for Ethiopia to access international private capital within existing laws.

The contribution from the public sector would cover the costs of the pre-underwriting due diligence review and part of the premium payment, reflecting the model being implemented in Mexico with support of the Climate Investment Funds, via the Interamerican Development Bank (IDB) and Mexico’s internal development bank Nacional Financiera (NaFin).

The insurance will guarantee the project developer a minimum energy output from their project over a campaign of typically 6 appraisal wells, effectively removing the tail risk of total loss, which typically dissuades other forms of private capital from participating. To maximize flexibility of the facility, the option to include exploratory wells in a drilling campaign of up to 10 wells in total could also be considered.

Importantly, the proportion of premium funded by the GeoFutures Facility can itself be insured, thereby ensuring the facility is reimbursed in the event of a project failure, thus extending the facility lifetime and increasing the number of projects that can be supported.

This pillar has four sub-facilities, as described below.
Due Diligence Facility

For any project to access private investment and insurance, a robust and independent due diligence study is required to assess the project’s bankability and if it is possible to underwrite the resource risk, and if so, determine the appropriate insurance structure and premium rates. These costs will not be accepted by the insurers and therefore need to be borne by the project developer. It is recognized that these costs, which range between $ 75,000 and $ 125,000 (and significantly more when drilling and well testing and monitoring costs are included), act as a barrier to obtaining the insurance because they represent an upfront cost, which is an additional capital requirement when capital is typically at its most scarce.

It is proposed that a Due Diligence Facility is made available to project developers to cover 60% of these costs, which are assumed to be about $150,000 on average, including monitoring costs during drilling and testing. These funds would be issued as a contingent loan that would be recoverable (repaid) in the event of a successful project. However, because not all covered wells will lead to successful projects (particularly since the due diligence is undertaken at an early stage), this facility is expected to have some degree of concessionality, because some projects will not progress beyond the due diligence stage and therefore there will be no repayment either from insurance or project cash flows.

Importantly, the due diligence report developed under this part of the facility will not only enable the project to access private sector insurance, it may also be used by potential equity investors and financiers to assess the bankability of the project.

Premium Payment Facility

Once a project has successfully demonstrated that it is insurable, the exact insurance structure and premium rates will be defined and agreed. In view of the significant risk that is being transferred from the developer to the insurer, the required premium rates are likely to be in the range of 15-25% of total drilling costs. This means that premiums may be between $ 6.3 million and $ 6.5 million per project, assuming a drilling cost of $ 7 million to drill each well, a 20% premium, and that a 6-well program that would be insured. Representing only a small proportion of total project costs, this premium cost does not have a major impact on the overall project IRR; however, it can act as a significant barrier to projects because it represents an additional upfront cost before the resource is proven.

For this reason, it is proposed that the Premium Payment Facility will cover 60% of the premium costs. The amount made available to each project will be agreed on a project by project basis with reference to the project developer’s resources, the IRR impact and the commercial requirements of the insurers.

The funds made available to cover the premium costs will be repaid by the project in the event of a successful project, and by the insurers in the event of an unsuccessful project, ensuring this facility to be replenished and recycled many times over without recourse to public funds.

In addition to the above Due Diligence and Premium Payment Facilities that are
core elements of this scheme, there is the opportunity to extend the intervention with other potential insurance structures. These may include offering similar due diligence and premium payment mechanisms for other risks as identified by Stakeholders (see Chapter 3). These mechanisms could include Cost Over-Run Insurance and Drilling Risk Insurance

**Commercial Public Sector Co-Insurance**

The opportunity exists to create a co-insurance vehicle (or an insurance fund investing in such a vehicle) and supported by public sector investment. Being on a *pari passu* basis, this form of support will have zero concessionality. The presence of multilateral development banks (MDBs) as commercial co-insurers will help validate the risk being underwritten and thereby attract and accelerate the provision of private sector insurance capacity. The minimum investment size is likely to be in the range of $25 to $50 million, depending inter alia on the other forms of support available.

**Public Sector Reinsurance**

Recognizing the risk profile being underwritten and the newness of the risk to the private sector insurers, it may be necessary to provide reinsurance protection either as a First Loss and/or a Stop Loss layer to reduce the risks. First Loss Reinsurance protects insurers against multiple small losses whereas Stop Loss reinsurance contracts are designed to cap overall loss experience at a specified level. The degree of concessionality for this reinsurance is expected to be relatively modest, but will vary significantly depending on the risk position, scale and insurance structure finally agreed. The minimum investment size is likely to be in the range of $25 million to $50 million, again depending inter alia on the other forms of support available.

**2. Conclusions**

The exploration is increasingly a matter of cost-shared public-private initiatives. Initially form the 80′ to 2010′ many countries facilitated the development of geothermal energy through taking directly the responsibility of full exploration down to electricity generation (Iceland, Indonesia, Kenya, Philippines, Mexico before 2015, etc.), or at least full public responsibility of the first risky steps of exploration (Kenya with GDC, Turkey, Indonesia, Philippines,…). Starting development were made possible, yet scaling up geothermal development needed more participation from the private sector both financial and technical momentum.

Private developments were mostly held in OECD countries, coinciding with the creation of the first risk mitigation funds in France, Germany and Switzerland, mostly dedicated to direct usage).

In the last ten years trend has shifted to encouraging public/private geothermal development schemes and an increasing role of private IPPs, even on early stages in Africa, Latin America and Europe including Turkey.
New Risk mitigation funds therefore developed to cover the geothermal risk in these regions.

21 risk mitigation schemes have been analysed. 7 are closed, 3 are at project stage, 11 schemes are ongoing. 11 schemes are national, 9 have international scope, generally in only one region of the world (Africa, Latam, Europe).

11 funds are based on multilateral development and/or public financing (GDF LA, GRMF, PLUTO, Turkish RSM, Mexico, MiRig, RMF ARGEO, GEOFUND, IRENA ADFD, Geofutures, and EGRIF)

7 funds are national public initiatives, held over time in only in 4 countries: France (SAF Environnement, GEODEEP SAS), Switzerland (Swiss 1987, Swiss 2008, Swiss 2018), Germany, Netherlands.

Only 3 funds were pure private initiatives, mostly located in Europe (ART, Munich RE Private Insurance Scheme, Marsh A).

All schemes cover the exploration drilling campaigns. Most of them cover preliminary surface studies. Some cover confirmation campaigns. One covers Feasibility/Financial Closing Studies.

The service provided to exploration campaigns takes diversified forms
- Pure grant (GRMF, Swiss 1987, Swiss 2008, Swiss 2018)
- Subsidized refundable advances with low/partial repayments to the Fund in case of success (GDF LA, Mexico, German National Scheme,
- Subsidized warranty, with low premiums (SAF Environnement, Turkish RSM, SAF, NL Geothermal Guaranty Scheme, ARGEO RMF, EGRIF)
- Concessional Loan repaid to fund in both success and failure cases (PLUTO, Mirig, IRENA ADFD
- Hybrid Public-Private scheme: Subsidized Warranties with low premium and royalties in case of success (GEODEEP SAS)
- Hybrid Public Private scheme : Private Warranty with real cost premium, Premium covered b a refundable advance by the public fund (Mexico, Geofutures)
- Private unsubsidized Warranties with real cost premiums (Munich RE Private Insurance Scheme, Marsh A),
- Private unsubsidized Warranties with low premium and royalties in case of success (ART)

The coverage of the costs for exploratory campaigns range from 40% (example GRMF, through grants) up to 80% - 90% (SAF for Region Ile de France). Major funds such as GRMF and GDF cover only 40% of exploratory campaigns.
At 40%-60% coverage rate the risks remains important for the developer. Specifically in Europe funds with an 70%-90% coverage have demonstrated their attractiveness. For example in Switzerland, the first fund covered 60% to 80% of the drilling costs and proved very successful. A second Swiss fund lowered the coverage to 50%, resulting in only one project applying for support. The last Swiss fund corrected the trend up to 60% on the whole process from preliminary studies to drillings.

The comfort zone is obviously above 60%, without impairing the commitment of the developers.

Some distinctiveness can be observed. All funds provide short term productivity insurance (ie just after few months testing period). Only the SAF Environnement fund covers the long term risk of well productivity depletion. The Turkish RSM provides increased support to risky zones (up to 60%) against 40% in already explored zones. Two funds involve a specific role of the drilling company. If accepted in the Mexican risk mitigation scheme, the developer can benefit from low cost drilling services hired by the Mexican authority in a national tender. In the ART scheme, Dalrup, the drilling company is a key stakeholder of the fund along with the insurance company XL Group. Dalrup takes ownership of shortly failed drillings and tries to save them.

Four levels of success can be observed across the 21 funds assessed.

A first family is highly successful, with many developers applying, supported projects and geothermal plants completed. It includes mostly long-existing European schemes devoted to Heat Generation such as SAF Environnement, Swiss 1987, The Netherlands Scheme, the German National Scheme.

A second family encompasses attractive funds, in the way they attracted many applicants and awarded many supports, yet all money has not been cashed out and the completion of plants actually connected to the grid is still expected. Such funds are GRMF and GDF LA. The latter benefitted from the learnings of the former.

Recently launched public funds such as Turkish RSM and Swiss 2018 look promising. 8 projects are already engaged in the application process for the Turkish RSM. Swiss 2018 has officially accepted their first project a few months after its launch.

A third family gathers unsuccessful public funds either because of unattractive service (Swiss 2008, Pluto, IRENA ADFD), insufficient funding (ARGEO RMF, GEOFUND) or adverse local market conditions for geothermal energy due to competition with cheap wind and solar power (MiRig, Mexico)

A fourth family gathers the unsuccessful private schemes, mostly because either the risk borne is too high or because of unattractive high premiums (Munich Re Private, Marsh A, ART)

A fourth family gathers the projects to come, such a EGRIF, GEOFUTURES, GEODEEP SAS. EGRIF should be much inspired from the French SAF Environment. GEOFUTURES has a sophisticated approach intending at solving barriers both on developers and stakeholder’s sides, at the cost of a certain complexity. GEODEEP
SAS is limited to EGS in France is a public-private structures waiting the green light from the DG COMP of the European Commission.

In conclusion, key learnings for a future GEORISK fund addressing European region

- Cover electricity, heat and cogeneration plants
- Base the project on the French SAF Environnement and the Netherlands Scheme already taken into account in the EGRIF proposal
- Improve it based on the Turkish RSM example with increasing coverage rates in regions with poor geological knowledge.
- Adopt a 60% coverage as a strict minimum, up to 90% if possible
- Long Term risk coverage is attractive but only sustainable with many projects applying..
- Low premiums in the range of 3 to 7% (Cf: NL and SAF Environnement schemes) are needed, therefore requiring a certain level of concessionality.

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3.2 Risk mitigation tools

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