5.12.2. Geothermal Risk Guarantee Fund Recommendations for Poland

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1. Towards a risk coverage scheme in Poland – summary

Key recommendations for designing new and improving the functioning of existing public support schemes for geothermal include:

• Support schemes are crucial tools of public policy for geothermal to compensate for market failures and to allow the technology to progress along its learning curve. By definition, they are temporary and shall be phased out as this technology reaches full competitiveness;

• Market failures and unfair competition prevent full competition in the electricity and heat markets, while the current capital crunch obstructs the necessary private financing mobilisation to realise the enormous geothermal potential;

• Geothermal technologies hold significant potential for cost reduction. Dedicated support schemes should allow to reduce costs;

• Innovative financing mechanisms should be adapted to the specificities of geothermal technologies and according to the level of maturity of markets and technologies;

• Geothermal Risk Insurance Fund is seen as an appealing public support measure for overcoming the geological risk. As costs decrease and markets develop, the private sector will be able to manage project risks with, for example, private insurance schemes, and attract private funding;

• While designing a support scheme, policy-makers should take a holistic approach, which goes beyond the LCoE and includes system costs and all externalities. As an alternative, there is the chance to offer a bonus to geothermal for the benefits it provide to the overall electricity system: flexibility and base-load;

• Geothermal heat technologies are heading for competitiveness, but support is still needed in certain cases, notably in emerging markets and where a level-playing field does not exist.

• Given the level of maturity of innovative geothermal technologies and the negligible support received so far, it seems premature to talk about the need for more market-based mechanisms or even phase-out financial support for geothermal

With the notable exception of a few European market participants operating in well-developed geothermal regions, project developers have very little capability to manage the financial risk owing to the poor knowledge of the deep subsurface, lack of technological progress and high cost. In effect the probability of success/failure weighted net present values of project cash flows tend to be overly negative, thus effectively shutting out private capital from investing in geothermal energy.

However, with technology development (increasing the probability of success of finding and developing geothermal reserves) coupled with experience and thus reductions in cost, project developers will eventually be able to accept and, where appropriate, transfer project risks (technical, economical, commercial, organisational and political) in such manner that private funding will become available. Until then, a Geothermal Risk Insurance Fund (GRIF) is seen as an appealing public support measure for geothermal.

Although the geothermal market in Poland is ancient and that a national expertise exists, with less than ten projects in operation and less than ten under development, the polish market can still be considered in its juvenile phase.

The objective would then be to guarantee the cost of a well in case of partial or total failure. Firstly for such a juvenile market, (Convertible) Grants for seismic exploration, slimholes, and the 1st well are the most adequate support schemes. Subsequently when more wells have been drilled and dozen of deep geothermal projects are in operatiuon, so for intermediate market, a public risk insurance is then seen as the most appropriate tool. It should be the case of

Poland by 2020 or just after that date. Indeed, then the geology would be better known, more projects would be developed and be able to mutualise the risk all together, more financial institutions should be attracted. The geological risk should be easier to mitigate and more economical.

The governance of such a public national financial tool is shared between the Ministry, National Energy Agency, Geological Survey and a committee of experts. A State budget of 40-60 Mio € could help to launch this fund in Poland. This amount would indeed allow to cover the next 6-10 wells (3-4 deep geothermal systems), with a premium of 6-7% of the maximum guaranteed amount. It is a mutual insurance in order to develop projects in favorable regions and to have operations in new areas. The ultimate stage is when the market is considered enough mature to see private insurers proposing risk insurance at a competitive price.

If risk insurance is recognised to be a prerequisite for developing deep geothermal projects, financial subsidies for investment and operational support are also crucial.

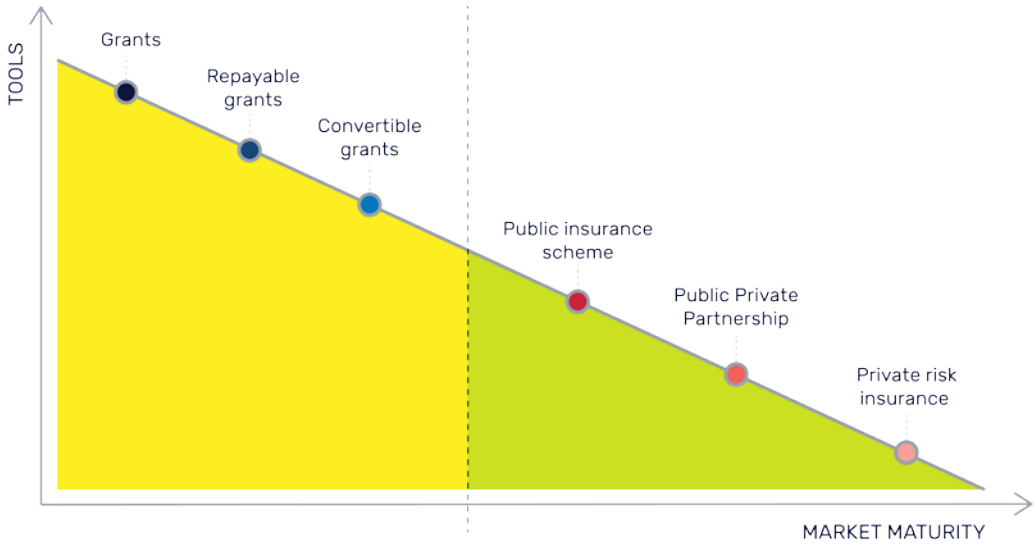
The Risk insurance should cover the exploration phase and the first drilling (test). It means activities to be funded before financial institutions and IPP funding the confirmation drilling and surface systems. It appears clear that a risk mitigation scheme must be designed according to the market maturity of the sector (figure below):

- Investment aid in forms of Grants is seen more appropriate for juvenile markets. Starting with direct grants, this could evolve secondly to repayable grants in case of success and thirdly to convertible grant aiming at financing the second well.

- A Public risk insurance scheme would fit for intermediate market

- And Public-Private partnership for the risk insurance fund for pre-commercial technologies in a near mature market

- When market is mature and with a fair competition, this market will reward geothermal for its value and a fully private risk insurance scheme could be established



2. Poland: state of play

The energy mix in Poland differs substantially from the one of the EU28, due to a much higher share of solid fuels (ca.54%). For the last 20 years, the share of renewable energy is increasing, more than the EU average, from less than 4% in 1995 to 12% of gross inland energy consumption in 2015. But during the same period, the share of gas also increased by 5 percentage points. The main decrease concerns the use of solid fuels (17 percentage points).

Poland has an overall low import dependency, although increasing, mostly due to the presence of national sources of solid fuels. However, import dependency is high for crude oil, and also above EU average as regards gas. Poland imports a significant share of its crude oil and gas needs from Russia.

The Polish energy sector is historically based on fossil fuels, which occur abundantly in Poland (ninth largest deposits in the world). In electricity production, two major fuels play a key role: hard coal and lignite, which produce nearly 90% of Poland's electricity.

In the heating and cooling sector, the share of renewables in Poland is about 14 %. Coal fired boilers and furnaces play a major role in Poland with more than 2 million of units installed (stock 2013). Moreover, Poland is one of the countries with higher installed district heating (DH) thermal capacity (57 GWth). Cogeneration (CHP) plays also an important role in Poland, with an installed capacity of 21 GWth. But for both DH and CHP the share of renewables (biomass, geothermal or solar thermal) is negligible.

In space heating and cooling in buildings, coal technologies still have a share of 36% in the total installed heating capacity in Poland. Gas, imported mainly from Russia (74% of gas consumed in Poland is imported), is also supplying a large share of the heating and cooling in buildings.

Production from	Electricity (GWh)	Heat (TJ)
Coal	132.962	242.947
Oil	2118	3406
Gas	6387	20167
Waste	75	711
Hydro	2435	0
Geothermal	0	0.1
Solar PV	57	0
Wind	10858	0
others	115	1290

Source: IEA

The potential for fuel switch is large both in the heating and cooling sector and the electricity area, and geothermal could play a role to decarbonising these sectors.

- Coal is the main fuel for heating in Poland: in 2013, 36% of the heat demand in buildings was covered by coal fired boilers.

- Space heating and domestic hot water is supplied notably by 443 district heating systems, representing 41% of the heat demand.
- Less than 5% of the heat supplied in district heating is produced by renewables, and less than 1 by geothermal.

- District heating installations are ageing: the majority of district heating installations were built in the 1960's and 1970's in the large housing estates (panel blocks).
- Conventional coal and gas boilers operating in Poland are also old.

The geothermal resource based in Poland is very interesting for power and heat production but so far little progress in that sector was done in comparison with other European countries. Geothermal uses development in Poland has been moderate, especially in the heating sector. It means some barriers must be removed for tapping the great potential.

Most of the Polish territory is suitable for geothermal district heating, corresponding to areas where around 60% of the population lives (see map overleaf).

The geothermal HP market is still juvenile, but the development (initiated several years ago) is persisting. One may roughly estimate that in 2015 they reached at least 500 MWth capacity, and a production of and 714 GWh (2500 TJ)

Geothermal power plants demonstration projects should be launched for showing the potential based on low temperature resources.

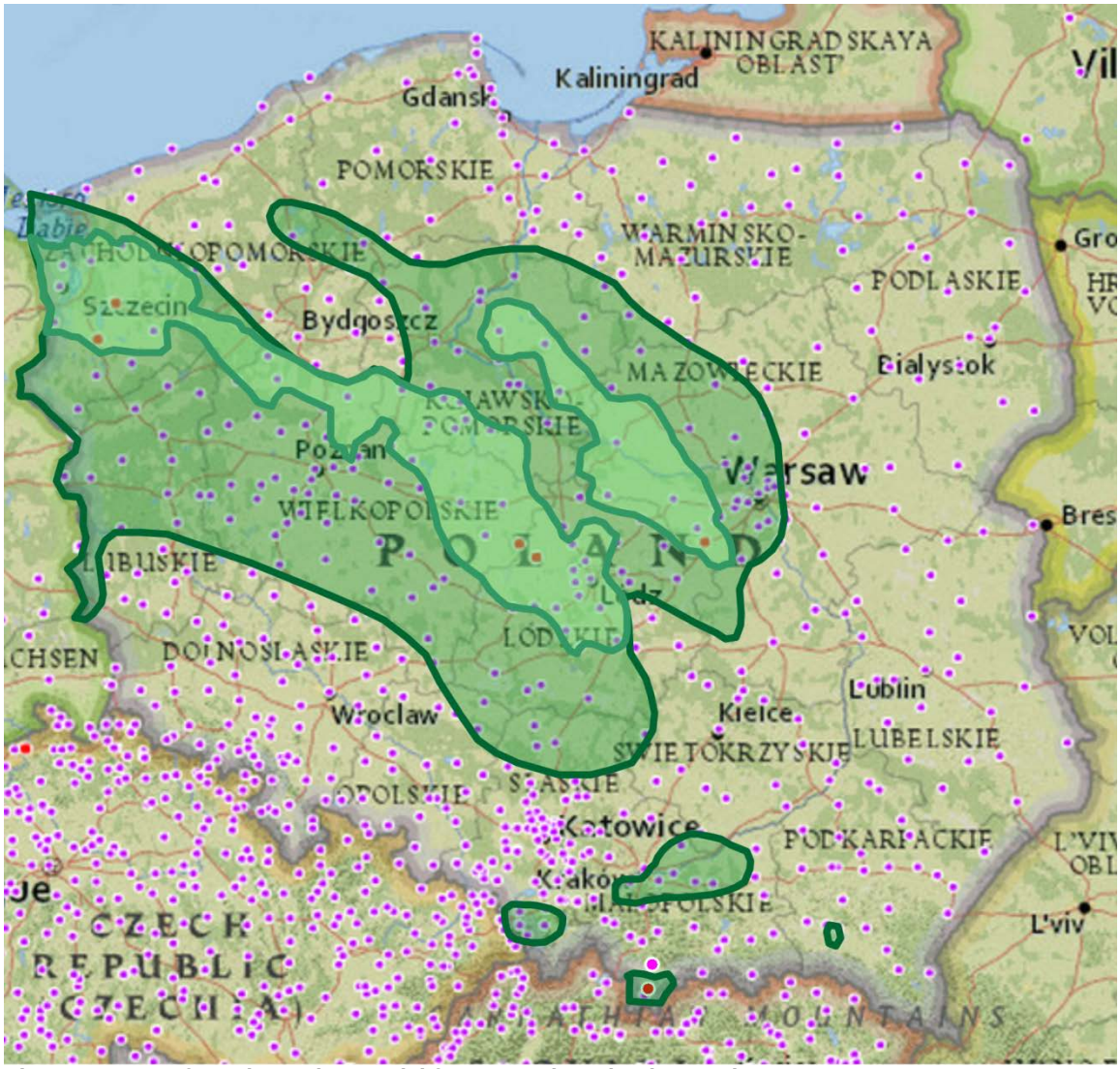


Figure 1 : Map of geothermal potential for geoDH in Poland. Based on GEODH.

Poland extends over parts of four major tectonic provinces: the East European Platform in the North East, the Mid-European Platform in the South West, the Variscan fold belt in the West, and a fragment of the Alpine belt, i.e. the Carpathians and Carpathian Foredeep in the South. The most important geothermal reservoirs for heating purposes lie in the Central and North Western Poland (the Polish Lowlands) and are mostly connected with the Mesozoic formations of the so-called Polish Trough (filled with Permian-Mesozoic sediments creating a cover of older formations).

In general, the aquifers hosted by Early Cretaceous, Early Jurassic and some Early Triassic formations have the greatest geothermal potential in the Permian-Mesozoic cover of the Polish Lowlands. Good conditions are found also in the Podhale region (part of the Inner Carpathians also in Slovakia) and, locally, in some areas of the Outer Carpathians and Carpathian Foredeep. In recent years (2006 – 2013) geothermal potential for prevailing area of the

country was presented in a series of regional atlases (Górecki, Hajto et al., 2006, 2011, 2013: Górecki, Sowizdzal et al., 2012 Barbacki et al., 2006; Solik-Heliasz, 2009). These works extended and updated the knowledge given, among others, several years earlier in Geothermal Atlas of Europe (Hurter, S. and Haenel, R., 2002).

Euroheat and Power (2013) shows that in Poland there has been a significant increase in natural gas consumption in the preceding ten year period. However, due to new installations in DH and CHP an increase in the use of renewable fuels, in particular biomass is expected.

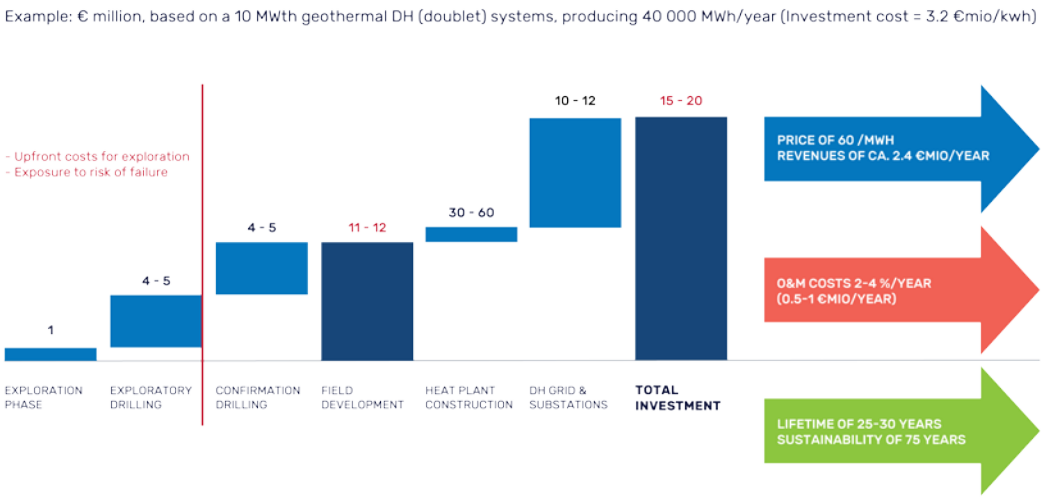
Coal is the main fuel in Poland. Around 76% of the heat supplied was produced by coal and coal products, while natural gas accounted for 6.77% and oil and petroleum products for 6.18%. Deep geothermal has almost the lowest share (0.09%) followed by geothermal heat pumps (0.02%) (EHP, 2013).

There were around 500 District Heating Systems installed in Poland as of 2011. Currently (2017) there are 6 geoDH plants; among them in Podhale Region with the highest installed geothermal capacity of 40.7 MWth (total ca. 81 MWth) and Pyrzyce, with installed geothermal capacity of 35.2 MWth (total ca. 48 MWth).

Cities with geothermal DH	
Localisation	**Capacity (MWth)**
Podhale Region	40.7
Pyrzyce	35.2
Stargard*Szczeciński*	12.6
Mszczonów	6.4
Poddębice	3.8
Uniejów	3.5

1.2 The Geothermal risk – a resource risk

Geothermal project development has several risky components, the most important one being the resource risk. This concerns mainly deep geothermal projects, but some shallow geothermal open systems could also be included in this category of projects.



Beyond exploration, the bankability of a geothermal project is threatened by this geological risk. The geological risk includes:

- The short-term risk of not finding an economically sustainable geothermal resource after drilling;
- The long-term risk of the geothermal resource naturally depleting rendering its exploitation economically unprofitable;

Available geological data help to find geothermal resources and give indications for their profitability but the only way to purge the geological risk and confirm the geothermal resource is to actually initiate the exploration and drilling work. This requires developers and investors to lay out significant amounts of cash beforehand without certainty as to the availability and perennity of the geothermal resource and hence the bankability of the project.

For now, the fairly small number of deep geothermal operations in Poland does not provide a sufficient statistical basis to assess their probability of success. Therefore, geothermal developers struggle to find public or private mitigation schemes under affordable terms and conditions for the resource risk. In those circumstances, A polish scheme would aim at alleviating the shortage of insurance policies for the resource risk and ease investments in geothermal electricity and heat projects.

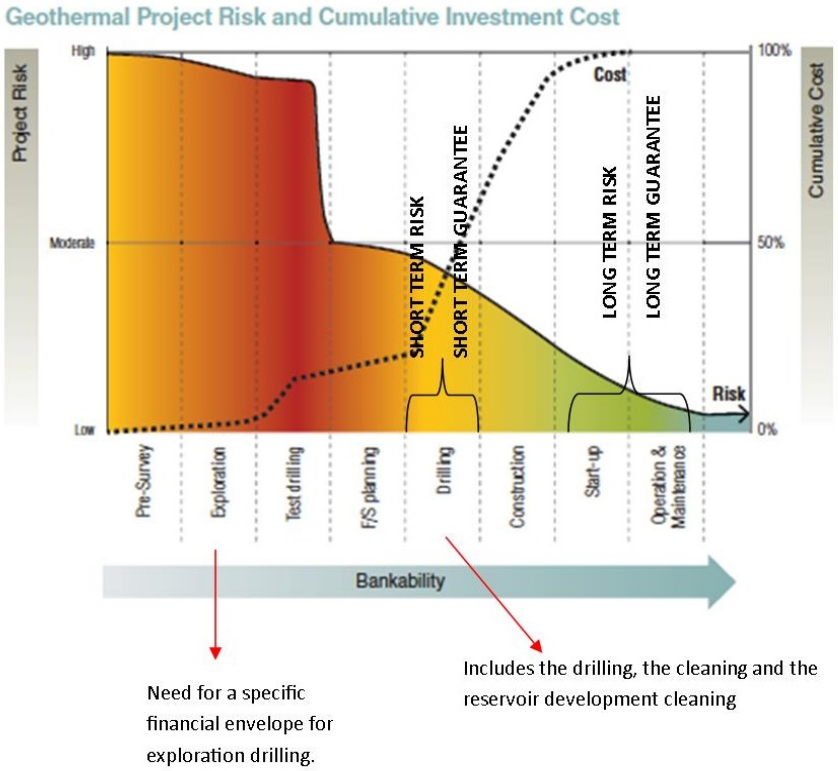


Figure 1 –Geothermal project risk and cumulative investment cost, modified from ESMAP, April 2012 GEOELEC-

Until the first borehole has been drilled into the geothermal reservoir, developers cannot be sure about the exact parameters (temperature and flow rate) of the planned geothermal electricity or h&c project. Once drilling has taken place, in situ pump tests, temperature and hydrological measurements then reduce the resource risk and make it possible to attract external capital.

Risk insurance Funds for the geological risk already exist in some European countries (France, Germany, Iceland, The Netherlands and Switzerland). The geological risk is a common issue all over Europe. In countries where geothermal developers might not internalise the resource risk into the costs of their projects, they may resort to private insurance policies. In Germany for instance, insurance companies and brokers are engaged in obtaining experience in relation to the resource risk. They provide adequate insurance policies to geothermal developers. In the rest of Europe however, the private insurance sector stands back.

In this context, some governments have taken action to settle a national insurance Fund in order to further develop geothermal projects (France, The Netherlands, Germany, Iceland and Switzerland). Where such a Fund has been created, two insurance patterns may be distinguished, either:

- consisting of a post-damage guarantee;
- involving a guaranteed loan;

1.2.1 Technical details about the geological risk

The validation of geothermal resource through test drilling is capital intensive and its financing is hard to find due to this risky Commercial financing.

As explained in the first part, 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).

In consequence of this resource risk is a much higher levelized tariff required mainly because the rate of return on equity is higher due to high risk premium of an early entry.

As for deep geothermal electricity and heat generation in Poland, the mitigation scheme shall be concerned with the exploration phase, the short-term risk and the long-term risk.

a) 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 collection. However, if exploration proves favourable, the exploration well may be used as a production or injection well.

With exploration, there are no clear success and failure criteria. Success is determined on an empirical basis. This makes any insurance irrelevant in relation to exploration. Instead, exploration is usually supported by public financing.

b) THE SHORT-TERM RISK

With regard to the short-term risk, the insurance shall aim at covering the costs of one or several drillings in case of a geothermal resource being economically flawed (see infra ‘eligible costs and coverage ratio’).

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 Geothermal Risk Mitigation Fund

c) 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 (see infra ‘eligible costs and coverage ratio’).

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 Risk Mitigation Fund shall provide a post-damage guarantee for the long-term risk considering the accounting advantages of this option compared to the guaranteed loan.

1.2.2 Risk mitigation technical and non-technical measures

Several risk factors (e.g. technical, financial, and environmental) need to be carefully evaluated during the exploration phase while the subsurface model is not well understood, the resource not completely proven and the development scenarios not yet clearly defined.

Some of these risks can be mitigated by technological development with Research, Development and Innovation actions. Risks associated with EGS projects and ground deformation associated with exploitation of shallow reservoirs should be addressed and technological mitigation actions identified accordingly in stimulation planning.

It is assumed that in early exploratory stages a framework insurance policy would be promoted to mitigate the exploration risk. It should act as a stimulus until, after the initial high level risk be mastered, developers carry out exploration/development issues under their own responsibility and resources.

- Potential for technological development

The objective is to have better data collection and treatment to use high-quality public databases for the exploration phase.

It includes the development of advanced approaches, guidelines and tools addressing exploration risk assessment and mitigation easing the decision making process. Other topics for RD&I aim for economic optimisation of the exploration: slimholes, standard well exploration campaigns, approaches to early reservoir assessment/performance, guidelines for risk assessment/mitigation, methodology for economic projections and anticipated cost benefits.

A drilling campaign could be a flanking measure to further reduce risk by getting new geological data, and thereby promote commercial initiatives, by supporting secondary exploration through drilling of characterisation wells in prospective regions based on commercial initiatives.

In top of technological development, a technical improvement is expected with learning by doing or “learning by drilling”. The average drilling success rate is increasing with the number of wells drilled. In top, it is notable that drilling costs reduce when more projects are developed in a given region, and when multi-well projects are developed. Such a cost reduction has been demonstrated by the project in Unterföring (Germany) developed by Erdwerk gmbh. In 2009, the first two wells in Unterföhring had drilling costs of 1400€/m then, two years after, a project in nearby Ismaning had a drilling costs of 1150 €/m; by 2014 when two new wells were drilled for the expansion of the Unterföring system, the drilling cost was 1100€/m. In five years, drilling costs were been reduced by more than 25%, principally through ‘learning by doing’.

- Potential for regulatory and financial measures

Some practice on regulations is perceived as being pre-requisite or very favourable to the development of deep geothermal technology. This is the case, for instance, where:

- Information on geothermal resources suitable for deep geothermal systems should be available and easily accessible. In some countries, geological data are freely available to project developers (e.g. after a five year period in the Netherlands).

- There is the need of a clear definition of procedures and licensing authorities (e.g. France, Poland and Denmark). A unique geothermal licensing authority should be set up.

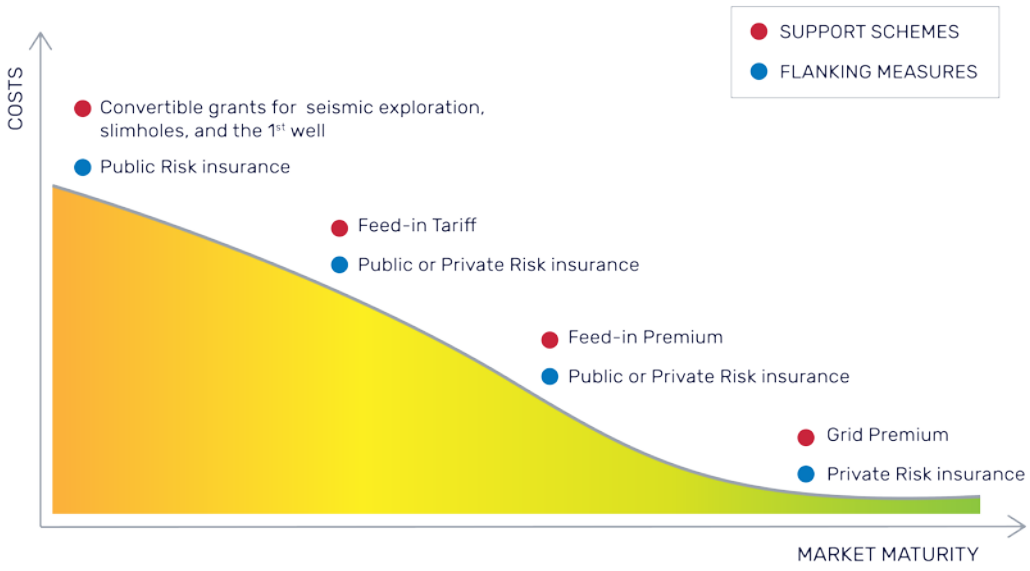
- The rules concerning the authorisation and licensing procedures must be proportionate and simplified, and transferred to regional (or local if appropriate) administration level.
- Administrative procedures for geothermal licensing have to be fit to purpose – they should be streamlined wherever possible and the burden on the applicant should reflect the complexity, cost and potential impacts of the proposed geothermal energy development.
- Ownership rights should be guaranteed.
- Legislation should aim to protect the environment and set priorities for the use of underground: geothermal energy should be given priority over other uses such as for unconventional fossil fuels, CCS, and nuclear waste deposits.

With the notable exception of a few European market participants operating in well-developed geothermal regions, project developers have very little capability to manage the financial risk owing to the poor knowledge of the deep subsurface, lack of technological progress and high cost. In effect the probability of success/failure weighted net present values of project cash flows tend to be overly negative, thus effectively shutting out private capital from investing in geothermal energy.

However, with technology development (increasing the probability of success of finding and developing geothermal reserves) coupled with experience and thus reductions in cost, project developers will eventually be able to accept and, where appropriate, transfer project risks (technical, economical, commercial, organisational and political) in such manner that private funding will become available. Until then, a public Geothermal Risk Insurance Fund is seen as an appealing public support measure for geothermal.

Public fundings can be in form of several innovative financing such as grants: direct, repayable or convertible, insurances and guarantees. They aim at financing the test drilling and so improving the economy of the projects. A public Geothermal Risk Insurance Fund can help to reduce the required levelized tariff by notably delaying the call to private investors by 2 to 4 years. The risk being lower, the rate of return requested is also lower.

Support schemes for Geothermal adapted to technology maturity



3. Towards a risk coverage scheme in Poland

In Poland, the public fundings currently established do not allow to cover the resource risk. New funding programmes are needed. For now, the small number of deep geothermal operations for power and heat in Poland does not provide a sufficient statistical basis to assess the probability of success. therefore, geothermal developers struggle to find insurance (public or private) schemes with affordable terms and conditions for the resource risk. In those circumstances, a public fund aims at alleviating the shortage of insurance policies for the resource risk and ease investments in geothermal electricity and heat projects.

The Fund is meant to work through the pooling of the resource risk among geothermal electricity and h&c projects taking place in Poland. Public money should first support the risk mitigation scheme; when mature this could be phased out and replaced by private schemes.

Considering the importance of exploration for deep geothermal generation, a mitigation scheme shall provide some financial envelope to support exploration studies. 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 insurance will cover risk in the short and long term. The main criteria for the level of risk will be a combined ratio including the flow rate and the temperature. The guarantee should cover the cost of a well in case of partial or total failure (partial up to 90 % compensation). It would be supported by Public and Private Funds and by subscriptions from project developers.

The advance could be granted, repayable or converted. it would have to be reimbursed or converted 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. These shall be set contractually and modulated according to the estimated exploration risk. It shall cover the costs of exploration drilling and tests. Exploration costs specific to EGS shall also be considered.

3.1 Options for Eligibility criteria

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

a) ELIGIBILITY CRITERIA FOR APPLICATIONS MADE TO THE FUND

Applications made to the risk mitigation scheme 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.

The obligation to disclose the data collected

Any developer willing to benefit from the guarantees provided by the Geothermal Risk Insurance Fund shall engage to disclose to the Fund 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 Database.

Public and confidential information within the application procedure

Among the information submitted to the 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.

Criteria to benefit from the repayable and convertible advance

In order to apply for the repayable/convertible 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 and heat 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;

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 and h&c 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.

3.2 Its establishment

The Geothermal Risk Insurance Fund shall be made available to private and public organizations developing geothermal electricity and heat projects in Poland. The 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 Fund 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 Fund.

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:

Geothermal 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;

Geothermal 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);

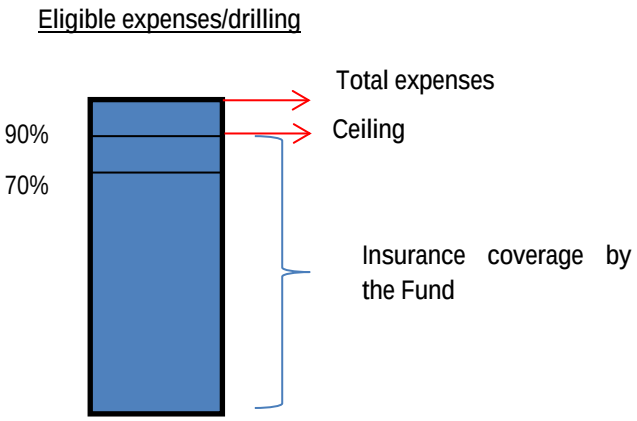
Eligible costs shall be specified in the reference contract signed between the developer and the Fund. Subsidised costs shall be excluded from the eligible expenses.

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, 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.



This option has pros and cons:

+ It provides a homogeneous rate for all developers;

+ It provides a generous rate encouraging the development of geothermal power and heat generation;

-The generous rate provided may lead to competition with existing national insurances;

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) ie 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. 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.

3.3 Its funding

The 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.

a) THE SEED CAPITAL

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 40 Mio – 60 Mio €.

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

- The European Union; European Investment Bank (EIB), Modernisation Fund, Innovation Fund, Structural Funds, Horizon 2020 programme with InnovFin.
- The National level;
- 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.

b) 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 Poland:

- 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 13000€ per year could be charged;

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

c) 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 Geothermal Risk Insurance Fund shall be able to exhaust and be replenished with available public and private funding. This would give the Fund more flexibility from an accountancy point of view.

d) REINSURANCE

Considering the financial stakes the Fund 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 Geothermal Risk Insurance Fund with some financial relief. This shall be achieved contractually between the Fund and a reinsurer.

Country fiche: summary

Country	Poland
Market deep Geothermal	- 2 geothermal power plants in under investigation - 6 geothermal district heating systems in operation - 5 geoDH projects under development (Extension existing networks) - Other direct uses with deep geothermal N° of wells drilled: 12-20 N° of wells to drill until 2020:15-20
Background	The technical factors determining the success or failure of a project depend on the exploitation of the subsurface (flow rate and temperature of the resource).After drilling, the risk that the geothermal resources will have insufficient production and/or temperature characteristics, rendering the operation unprofitable, is commonly known as the geological risk. Well costs at 3 Km: 6-8 €mio
Objective	The objective is to guarantee the cost of a well in case of partial or total failure.
Type of insurance (see details in the table below)	Firstly for juvenile market: (Repayable or Convertible or Direct) Grants for seismic exploration, slimholes, and the 1st well Subsequently for Intermediate market: Public Risk insurance.
Governance	Ministry, National Energy Agency, Geological Survey and a committee of experts
Capital and financial structure	State budget of 40-60 Mio €. To cover the next 6-10 wells (3-4 deep geothermal systems) Repayable/Convertible Grants or Insurance Premium of 6-7% of the maximum guaranteed amount. It is a mutual insurance in order to develop projects in favorable regions and to have operations in new areas
Beneficiaries	Public and private developers based in Poland.
Insurance scope	Heat and Power production. Two drillings (one production well and one injection well deeper than 500 meters).

Risks insured	Short-term risk (drilling) Long-term risk (reservoir)
Eligible costs	Drilling and test costs. Definition of success: fixed parameters or a formula
Coverage ratio	100% in case of grants and Risk insurance criteria for the level of risk: flow rate and temperature . Total failure: compensation up to 70-90% of the well costs . Partial failure: partial compensation
Eligibility criteria	The developer must provide a technical, legal and financial feasibility study. He must comply with schedules: the drilling must start within 6 months after guarantee approval, completed within 1 year after guarantee approval and lead to application of geothermal energy within 2 years. The developer has to abide by reporting and disclosure obligations.
Insurance process	Complete applications are evaluated in order of receipt. Geological Survey has an advising role, both in the application phase and in the assessment of results.
Short additional description	Risk insurance funds for geothermal already exist in France, Switzerland and the Netherlands in the past also in Iceland)