SUSTAINABLE ENERGY WEEK

An initiative of the European Commission

17-21 JUNE 2019

# EU SUSTAINABLE ENERGY WEEK

## SHAPING EUROPE'S ENERGY FUTURE

#EUSEW19

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# GEORISK Project

## PROJECT OVERVIEW

**June 2019**

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No [818232 — GEORISK]

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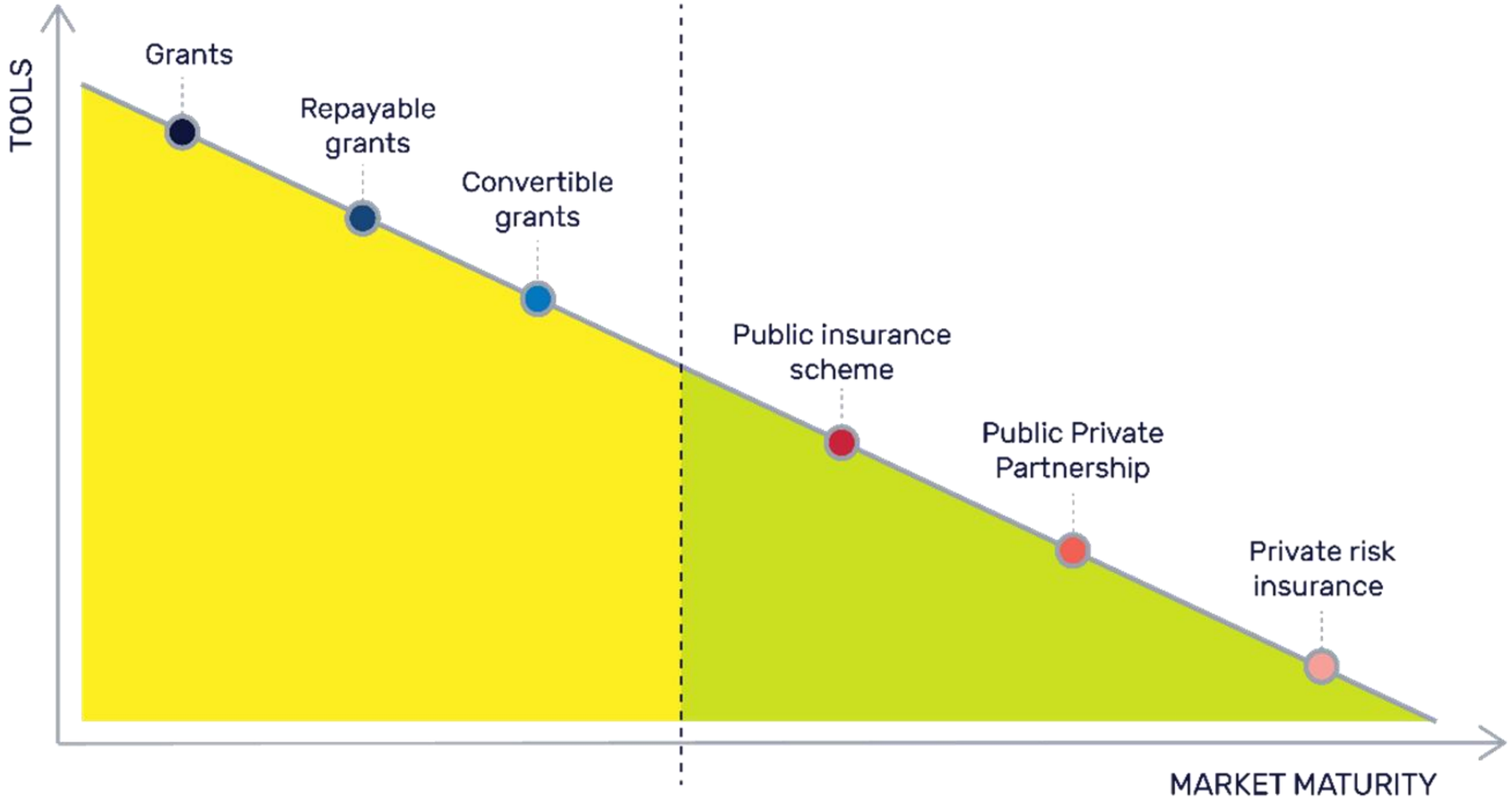
# Where it comes from…

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# PARTNERS

| Participant | Participant organisation name | Country |
|---|---|---|
| 1 (Coordinator) | European Geothermal Energy Council (EGEC) | Belgium |
| 2 | GEODEEP | France |
| 3 | BRGM | France |
| 4 | TUBITAK | Turkey |
| 5 | JESDER | Turkey |
| 6 | GEOEX | Hungary |
| 7 | MBFSZ | Hungary |
| 8 | IGSMiE PAN | Poland |
| 9 | PPC RES | Greece |
| 10 | CRES | Greece |
| 11 | SFOE | Switzerland |
| 12 | GEC-CO | Germany |
| 13 | BvG | Germany |
| 14 | TKB | Turkey |
| 15 | Geothermie-Suisse | Switzerland |

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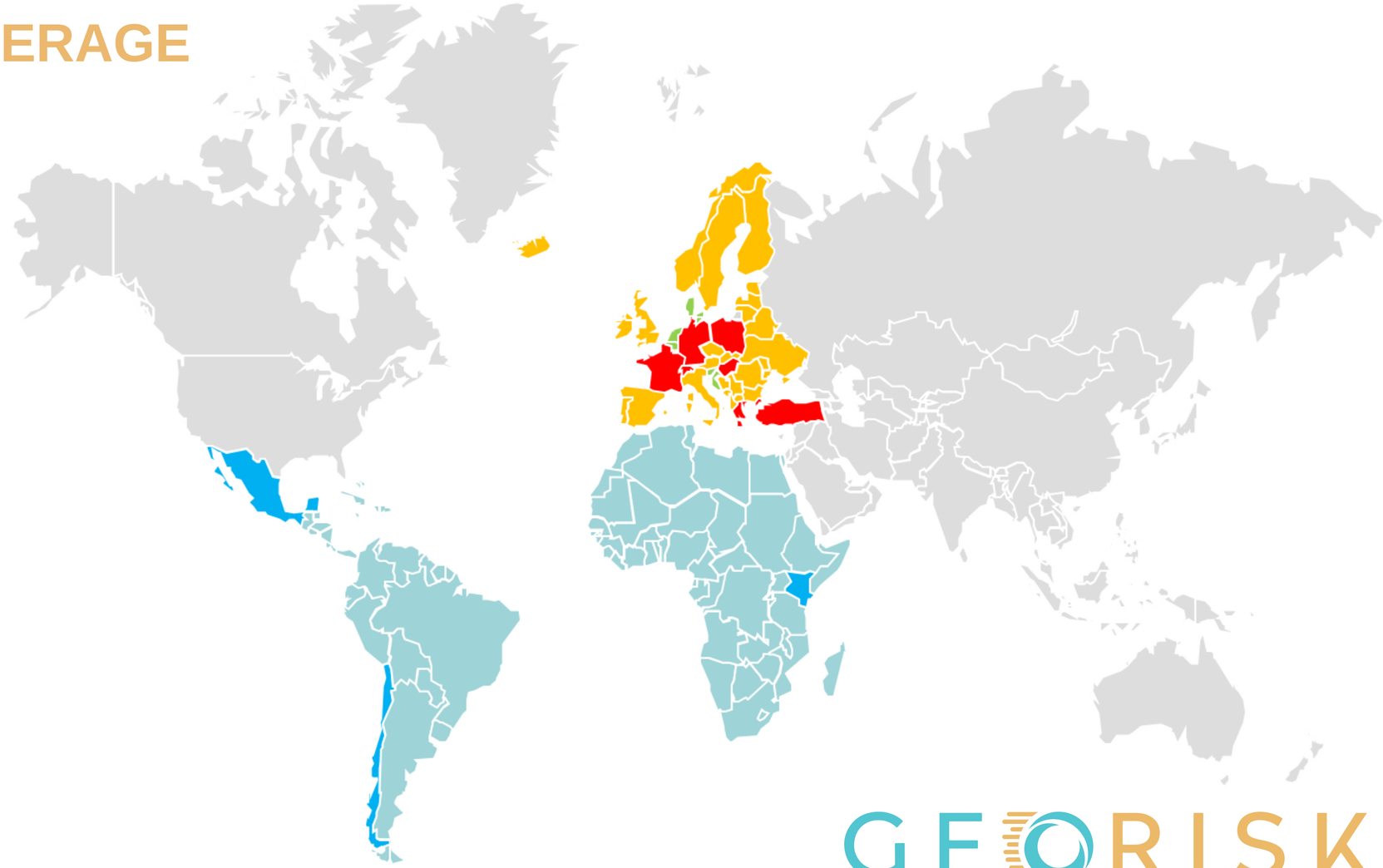
# GEOGRAPHICAL COVERAGE



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# RISK ASSESSMENT

MONTHS Oct 2018-Sept 2019, BRGM

1) Context and Identification of potential risks (BRGM) (months 1-6)

Geothermal Risks register, A workshop organised in each country

2) Risk Assessment (GEC-CO) (months 5 to 12)

Geothermal Risk Matrix

3) Tools to assess the risks (BRGM) (months 5 to 15)

GEOriskREPORT: Online tool for developers

Globally recognised reporting code

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# Risk register overview

| Phases | | | | Description | Consequences | | Mitigation | | Comments |
|---|---|---|---|---|---|---|---|---|---|
| identi | drillin | explo | post-c | | economic/performa | Health, Safety, Envir | technical | insurance | |
| | X | X | X | External natural hazards damaging the infrastructure | X | X | Thorough emergency planning - Include adequate specifications fo | yes | magmatic area is aggravating factor |
| | X | X | X | External aggression damaging the infrastructure | X | X | Thorough emergency planning - Include adequate specifications fo | yes | terrorism, trucks |
| | X | X | X | Changes in policies, laws, taxes and regulations put development/econo | X | | Keep continuous monitoring of standards, technologies and politic | no | |
| X | X | X | | Lack of financing for the next phases | X | | Throrough feasibility study including risks - Thorough cost manage | no | includes bankruptcy of project developer (SPV), developping in a unknown region |
| X | X | X | | Low social acceptance put barrier to development | X | | Thorough Preparation of PR Program | no | |
| | X | X | | Public opposition against nuisances from the exploitation | X | | | no | |
| | X | X | | Unanticipated delays and costs in operations (materials, services, mainte | X | | Include time/cost buffer in the planning | no | |
| X | X | X | | Lack or loss of clients | X | | Throrough feasibility study including risks | no | |
| X | X | X | | Significant changes of energy costs | X | | Keep continuous monitoring of standards, technologies and politic | no | |
| | X | X | X | Low financing for work leading to low safety standards | | X | Preparation of cash reserves - Harm Fund | no | include abandonment, drilling, maintenance, etc.; the cause be a change in the economic en |
| | X | | | Design of well leads to reduced flow rate | X | | | no | |
| X | X | X | | Best practices not applied (data aquisition modelling, decision making, d | X | X | | no | includes: wrong design of filters/screens |
| | X | | | Unsuitable contracts (roles and responsibility not clearly defined) leadin | X | X | Select Experienced and suitable Management | no | depends on who takes the risk between financer/operator/subcontractor |
| | X | X | | Human error leading to failure during drilling / work | X | X | Training and certifying of the personell | no | |
| | X | | | Wrong choice of stimulation fluids or techniques damaging the reservoir | X | | Training and certifying of the personell - Select Experienced and su | no | in case of acid stimulation, also hydraulic stimulation |
| | X | X | | Organization is not experienced / financially robust enough for the challe | X | | | | includes the experience of the organization to undertake its role, the financial capacity to un |
| X | | X | | Demand analysis and forecast are inaccurate | X | | | | electricity generation, heat production |
| | X | | | Flow rate lower than expected (reservoir) | X | | Adaptation of the drillpath to reach multiple targets - Avoid excess | dedicated fund | includes enthalpy/transmissivity |
| | X | | | Temperature lower than expected (reservoir) | X | | Increase of the flow rate - Adaptation of the drillpath to reach mul | dedicated fund | includes enthalpy/transmissivity |
| | | X | | Temperature degrades too quickly | X | | Thorough reservoir management plan ( e.g. Thermal fluid re-inject | dedicated fund | |
| | | X | | Flow rate degrades over time | X | | Thorough reservoir management plan ( e.g. Thermal fluid re-inject | dedicated fund | Recharge of the aquifer; design of the wells; seismic activity which may have an influence |
| | X | | | Target formation is missing in the well | X | | Thorough geologicals survey/core sample analysis | dedicated fund | could be a fault, a fault zones, a specific geology |
| | X | X | X | Fluid chemistry/physical properties are different from expected | X | | Adapt the material selection to the chemical/physical properties o | dedicated fund | calcite scaling is easy to clean, lead scaling and silica scaling are more difficult to handle |
| | | X | | Fluid chemistry/physical properties change | X | X | Thorough reservoir management plan ( e.g. Thermal fluid re-inject | dedicated fund | Removal of gas in injection fluid can change properties (ph) in the reservoir |
| | X | X | X | Excessive scaling in the geothermal loop | X | | Installation of inhibitor dosing station - Temperature Maintenance | dedicated fund | |
| | X | X | X | Excessive corrosion in the geothermal loop | X | | Installation of inhibitor dosing station - Temperature Maintenance | dedicated fund | Change of dissolved CO2 quantities is a factor, Ca-,Mg-, Si-, Pb- and other slt precipitations |
| | X | | | Pressure lower/higher than expected | X | | Adapt the power plant design under given temperature/pressure | dedicated fund | too high: difficult to inject, need to redesign the plan; too low: difficult to produce |
| | | X | | Pressure is changing during the operation in an unexpected way | X | | Thorough reservoir management plan ( e.g. Thermal fluid re-inject | dedicated fund | increase or decrease of pressure due to (no) reinjection, interferences with other wells |
| | X | | | Geological stratigraphy is different than expected | X | | Thorough geologicals survey/core sample analysis | dedicated fund | |
| | | X | | Hydraulic connectivity between wells is suboptimal | X | | Thorough well testing - Thorough reservoir planing | dedicated fund | too high or too low is "bad". Problem is mainly with injection |
| | X | | | Target formation has no fluid | X | | Thorough geologicals survey/core sample analysis | dedicated fund | |
| | X | X | | Re-injection of the fluid is more difficult than expected | X | | Thorough geologicals survey/core sample analysis - Adapt the pow | dedicated fund | |
| | | X | | Particle production | X | | Filtering | dedicated fund | increase wear, decrease injectivity. Eg sand, clays, particles of scaling and corrosion; can affe |
| | | X | | Degradation of the reservoir | X | | Proper reservoir management plan | dedicated fund | one of the main factor is quality of the injection fluid |
| | X | | | Mud losses leading to severe technical issues | X | X | Avoid extreme overpressure drilling | yes partly | |
| | X | | | Wrong density of mud leading to damage to well/reservoir | X | X | Thorough preparation of Mud Program | yes partly | leads to blowout, breakout. Can be due to wrong estimation of high pressures, not consideri |
| | X | | | Not able to lower the casing string | X | | Ensure safe clearance and drift diameter of the well | no | hole instability |
| | X | | | Trajectory issues (deviation from target) | X | | Thorough Drill Plan/Program and its execution | yes partly | can induce cementing problems |
| | X | | | Drilling is more complicated/more expensive than anticipated | X | | | no | high T, high corrosion, highly abbrasive, can improve probability of losing tools |
| | X | | | Technical failure during drilling | X | | Exploitation of the equipment according to the manuel | yes partly | including irreversible, loss in energy supply, lost in hole, Swelling clay, stuck in fault, total m |
| | X | | | Rig issues | X | | | ? | include stability (dependant on soil type), transport |
| | X | X | | Issues in transporting/handling radioactive sources for diagraphy | X | | Radioactive waste management plan | no | |
| | | X | | Technical failure of the equipment | X | | Preparation of backups/hot spares | yes partly | includes the plant, heat exchangers and subsurface equipments, prolonged breakdown and c |
| | X | | | Well casing collapse | X | | Extreme caution in during the instable formations - Throrough wel | yes partly | if water is trapped between the cement and the casing, especially in the intervals where one |
| | X | X | X | Blowouts | X | X | Thorough Drill Plan/Program and its execution - Exploitation of sui | yes partly | various causes: including damage to wellhead / surface installation / higher pressure than ex |
| | X | X | X | Fluid communication between different formations due to bad isolation | X | X | Thorough cementing procedures | no | also economic because loss of productivity |
| | X | X | | Induced seismicity | X | X | Avoid high re-injection presure/rate | no | includes st gallen case: excessive injection of mud, other factors: stimulation techniques, de |
| | X | X | X | Subsidence or uplift | | X | Avoid high re-injection presure/rate - Thorough reservoir manage | no | fluid loss in anydrites or swelling clays, overpressure during exploitation |
| | X | X | | Toxic emissions due to produced in-situ gases and fluids | | X | Installation of toxic substance(gas/fluid) detection system - Safe w | no | H2S, CH4, , CO2, radioactive materials |
| | X | X | X | Lack or loss of integrity of the well/subsurface equipment | X | X | Thorough cementing procedures -Throrough well design | yes partly | cementing problems, casing problems, and plugs in the abandonment phase |
| | X | X | X | Loss of integrity of surface equipments | X | X | Installation of the leakage detection system | partly yes | |

# Risk register: details

## Phases / Consequences / Mitigation

Each risk is placed in one or several phases:

- identification/exploration (activities before drilling)
- drilling/testing/development (activities before exploitation)
- exploitation
- post-closure

Two kind of consequences

- economic/performance
- health, safety, environment

Two kind of mitigation action

- technical
- financial (insurance)

# Risk register

## Current list of risks

Currently the risks are divided in 6 categories:

- external hazards
- external context
- internal deficiencies
- subsurface uncertainties
- technical issues
- environmental risk

**The goal is to be comprehensive**

**Better have overlaps than gaps**

**Several risks may be part of a chain**

**The goal of the project is to focus on solutions, not only on the (potential) problems!**

# WP 3: RISK MITIGATION TOOLS

MONTHS October 2018-Sept 2019, GEC-CO

1) Existing and innovative financial tools: public and private (GEODEEP) (months 1-8)

comparison of the Risk Mitigation Systems

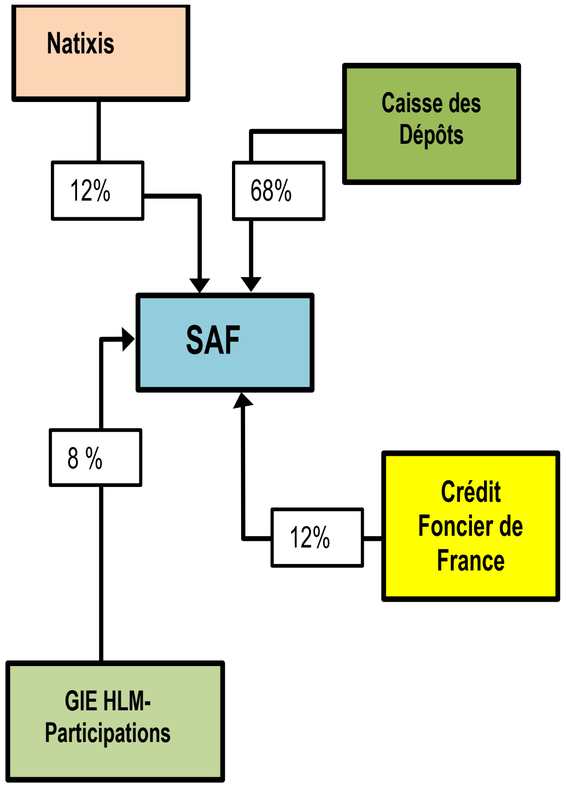
2) Framework conditions for establishment a new insurance scheme (SFOE) (months 1-10)

3) Conditions for a transition in the insurance schemes, according to market maturity (GEC-CO) (months 6-12)

4) Helpdesk for establishing an insurance scheme (EGEC) (months 8-15)

- For public authorities

# Example of the French fund created in 1980




- Natixis is a private bank
- Caisse des Dépôts et Consignations is the French state bank
- SAF is a subsidiary of Caisse des Dépôts et Consignations
- Crédit Foncier de France is a bank active in construction
- GIE HLM participation is an aggregate of companies which are building and exploiting low cost collective housings

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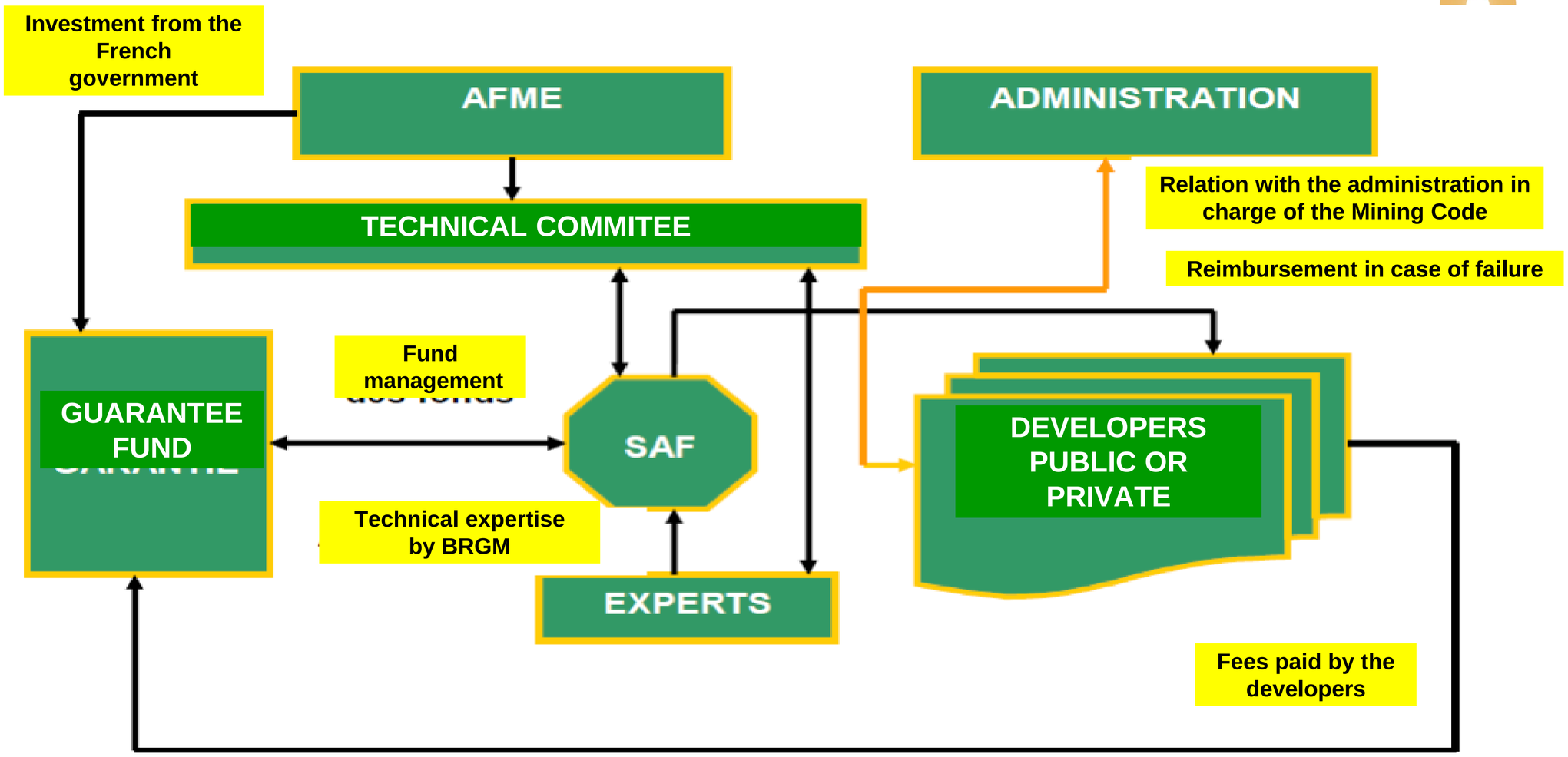
# Operating the Fund



# The 2 funds: short term and long term re-initialised in 2008

**End of 2017 the resources of the fund were at 13,8 M€**

- Subsidies from ADEME (French Government) + 9 M€
- Subsidies from Ile de France Region +1,30 M€
- Fees from developers: +7,4 M€
- Financials products: +0,8 M€
- Reimbursements, expertise and management: - 4,7 M€

**31 short term contracts signed** which demonstrate that even with a very good geological and hydrogeological knowledge, the developers continue to subscribe after nearly 40 years of drilling in the Paris basin area (one failure since 2008)

**15 long term contracts signed for 20 years** (one failure since 2008)

The exploitation period, of about 10 years, represent 250 M€ guaranteed with a leverage effect of **28 for 1 euro** granted by the French government.

For the long term fund, 170 M€ are guaranteed with a leverage effect of **19 for 1 euro** granted by the French government

# WP 4: ESTABLISH sustainable RISK MITIGATION SCHEMES IN TARGET COUNTRIES

MONTHS July 2019 to Sept 2020, IGSMIE PAN

1) Create relationship with decision makers (IGSMiE PAN) (10-24)

2) Support establishment of insurance scheme in target countries (CRES) (months 10-20)

3) Assess its establishment, adopt corrective measures (Geoex) (months 18-24)

A 10 years operation simulation of the financial model

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# WP 5: REPLICATION AND PROMOTION IN EUROPE & GLOBALLY

MONTHS July 2019-March 2021, GEODEEP

- Countries to target in WP5 will be confirmed by the partners before this WP starts. Candidate countries are in Europe (Denmark, Netherlands, Belgium, Croatia, Slovenia) and outside (Chile, Kenya & Mexico).
- A regional, Pannonian Basin geo-risk insurance scheme is to be evaluated in WP5

# WP 5: REPLICATION AND PROMOTION IN EUROPE & GLOBALLY

MONTHS July 2019-March 2021, GEODEEP

Adapt tools, set framework conditions (GEODEEP) (months 10-20)

Create liaison with decision makers and international & national stakeholders, present tools (CRES) (months 10-25)

one-to-one interviews, webinars,

3) Capacity building (TBK) (months 20-30)

Organise one workshop in each third countries

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