French geothermal RMS: the existing system and evolution expected soon

Christian Boissavy (AFPG/GEODEEP)

28th June 2021 - Webinar
1. Existing Short and Long Term Risk system
2. New fund to be operational 2022
The key for success in Paris basin has been the risk mitigation system put in place by ADEME in 1980 and revamped already in 2008

A financing system to cover the geological risk based on two complementary mechanism

**Short term risk**: based on the socialization of risks and guarantees for geothermal wells

**Long term risk**: beginning at the starting up of the geothermal plant and guarantees covering the sustainability of the geothermal resources and the potential risk of resources depletion during a 15 years period
Operating the French RMS

- **Investment from the French government**
  - **AFME**
  - **TECHNICAL COMMITTEE**
    - Fund management
    - Technical expertise by BRGM
  - **SAF**
    - **GUARANTEE FUND**
  - **DEVELOPERS PUBLIC OR PRIVATE**
    - Fees paid by the developers
  - **ADMINISTRATION**
    - Relation with the administration in charge of the Mining Code
    - Reimbursement in case of failure
The Short Term Risk (STR) insurance mechanism

The STR covers the geological and hydrogeological risk in the event of temperature and or flowrate not in line with expected value.

Success parameter are based on general geological models and take into account the project profitability, including the energy to pump and re-inject the geothermal water in the same reservoir.

STR insurance is utilized to secure the profitability of the project in spite of geological and hydrogeological uncertainties.
Conditions to subscript to the insurance

- Acceptance of the project by a technical committee after a detailed expertise including, technical, economical, financial and juridical aspects

- Payment of 3 to 5% of the covered cost depending on the zone (for a Dogger doublet of 10 M€ the insurance cost is around 350 K€)

  - Maximum compensation reach 65% of the eligible cost which consist in: total cost minus subsidies plus additional costs due to unforeseen events in relation with the geological conditions encountered

  - The regional authority can add a complementary compensation to reach 90% in Ile de France which in not the case in other regions
The Long Term Risk (LTR) system

Prior to LTR obligation to subscribed STR

Acceptance of the rules of good technical management and respect of regulations. Annual fee for a doublet is about 15 K€

The level of compensation depends on the drilling exploitability’s decrease

- Partial damage (exploitation is still economically viable after repairing of the wells; compensation calculated according to the plant’s lifetime and contract references
- Total damage (no more economic viability ); compensation calculated according to a contractual ceiling and the residual value of the geothermal plant
Result of the last fund Short and Long Term aggregated
Period 2008 - 2020

Resources 24 M€
Public participation (ADEME) at 47%  Private participation (developers) at 53%

Expenses 24 M€
Reimbursement for failures 14 M€ - 53%
Management and expertise 4 M€ - 15%
Reserve after 12 years of operations 8M€ - 32%

Short Term benefits
80 geothermal wells covered (33 doublet and triplet + 13 single wells)
11 reimbursement including: 7 failures partial or total and 4 related to extra costs

Long Term achievements
34 contracts signed for 400 years of coverage
6 failure reimbursed for an average of 3% /year
A new RMS in order to attain the PPE 2030 (Energy Programme defined by the Ministry of environment elaborated in cooperation with the French geothermal Association)

The target is to triple the number of successful plants assuming to multiply by 5 the number of drilled geothermal wells including failures covered by the RMS system.

C. Boissavy March 2021 (GEODEEP)

- 140 successful wells
- 120 wells
  - 20/year
- 80 wells
  - 8/year

1980 to 1986 | 2008 | 2020 | 2030

Number of geothermal wells per year including dry wells

PPE MAX
- 30/year
- 5.2 TWh

PPE MIN
- 20/year
- 4 TWh

90 successful wells

1 TWh

1,6 TWh
3 zones of risk defined in the country

<table>
<thead>
<tr>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Well known</strong></td>
<td><strong>Some knowledge</strong></td>
<td><strong>Unknown</strong></td>
</tr>
<tr>
<td><strong>Low risk</strong></td>
<td><strong>Medium risk</strong></td>
<td><strong>High risk</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>% of failure for the first drilling before detailed studies</th>
<th>First well - 6%</th>
<th>First well - 33%</th>
<th>First well - 60%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling campaign - 11%</td>
<td>Drilling campaign - 57%</td>
<td>Drilling campaign - 85%</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>% of failure for the first drilling after detailed studies and geophysics</th>
<th>First well - 5%</th>
<th>First well - 25%</th>
<th>First well - 40%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling campaign - 9%</td>
<td>Drilling campaign - 45%</td>
<td>Drilling campaign - 67%</td>
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</table>

| Example of different zone regarding the geology and hydrogeology | Eastern part of Ile de France (IDF) region, in the Dogger reservoir | Western part of IDF, Aquitaine, Hauts de France, Occitane when oil & gas drillings | All the other part of the French territory without oil & gas drillings |
|------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------------|

| Criteria for the geology to attain the geothermal reservoir | Good geological knowledge between the surface and the top of the reservoir | Average geological knowledge with some deep drilling to calibrate | Poor geological knowledge without deep wells and sometimes no geophysics |
|-------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------|

| Criteria regarding the potential geothermal reservoir productivity | Good quantitative value of the geothermal reservoir with existing pumping tests | The geothermal resource is poorly exploited without REX and stratigraphic correlations | The geothermal resource is not exploited and unknown without any testing |
Utilization of probabilistic plots depending on the level of risk in each zone

This approach is helpful to evaluate the level of risk for each type of geothermal resource and the different zones in order to reassess the type and number of geothermal doublet to be covered by the RMS.
RMS framework

- Same system with the Short and the Long term warranty

- Reimbursement in case of failure at 90% on the entire territory

- Preliminary studies including seismic are included in the CAPEX to be reimbursed in case of failure

- France divided in 3 zones from well known zones like Ile de France, known zones with some deep wells and unknown zones where preliminary investigations are mandatory

- Premium are adapted to the 3 zones from 5% in Zone 1, 10% in zone 2 and 15% in zone 3
- For the Long Term fee at 20 to 25 K€/year

- Management and expertise would be amended but will remain close to the existing one

- Administration of the RMS will remain by Caisse des Dépôts et Consignations
### Investment of the government for different scenarios

<table>
<thead>
<tr>
<th>Scénarios Libellé</th>
<th>A 5 ANS ECONOME DIRIGÉ</th>
<th>B PPE MIN ECONOME 1 2 DIRIGÉ</th>
<th>D ADEME PPE MIN 1 2 petit 3 DIRIGÉ</th>
<th>B' PPE MIN 1 2 3 LIBRE</th>
<th>C PPE MAX 1 2 DIRIGÉ</th>
<th>C' PPE MAX 1 2 3 LIBRE</th>
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<tbody>
<tr>
<td><strong>Dotation initiale - total</strong></td>
<td>k€</td>
<td>39 111</td>
<td>104 122</td>
<td>140 489</td>
<td>193 049</td>
<td>166 926</td>
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<tr>
<td>Dotation CT Segm 1 &amp; 2</td>
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<td>37 591</td>
<td>103 223</td>
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<td>Dotation CT Segm 3</td>
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<td>43 704</td>
<td>99 612</td>
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<tr>
<td>Dotation LT</td>
<td>k€</td>
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<td>899</td>
<td>947</td>
<td>872</td>
<td>910</td>
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<tr>
<td><strong>Remboursement final - total</strong></td>
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<td>-32 176</td>
<td>-47 182</td>
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<tr>
<td>Dotation CT Segm 1 &amp; 2</td>
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<td><strong>Dotation nette - total</strong></td>
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<td>71 947</td>
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<td>136 779</td>
<td>126 186</td>
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<td>Dotation CT Segm 1 &amp; 2</td>
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### Benefits expected for each scenarii

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<tr>
<th>Scénarios Libellé</th>
<th>Nb Campagnes engagées</th>
<th>Nb Doubles réussis</th>
<th>Nb Réseaux de Chaleur</th>
<th>Nb Eq Logs additionnels</th>
<th>GWh additionnels</th>
<th>TCO2 évitées</th>
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- **A** : 5 ANS ECONOMIE DIRIGÉ
- **B** : PPE MIN ECONOME 1 2 DIRIGÉ
- **D** : ADEME PPE MIN 1 2 petit 3 DIRIGÉ
- **B’** : PPE MIN 1 2 3 LIBRE
- **C** : PPE MAX 1 2 DIRIGÉ
- **C’** : PPE MAX 1 2 3 LIBRE
RMS planning to be operational

- The study to establish the new Fund has been finished in April 2020

- The different scenarios has been presented to both Ministries of Environment and Economic Affairs

- Final decision is anticipated in September 2020 for a 150M€ RMS

- Due to the fact that there is a strong state participation, the project has to be submitted to the approval of the DG COMP in Brussels

- Launch of the fund anticipated beginning of 2023
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No (818232 – GEORISK)