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Geothermal Energy Use, Country Update for France

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ABSTRACT

France has developed the **various types of geothermal energy** for long, especially after the two oil crises that happened at the end of the 1970s.

The French installed capacity installed for electricity generation still consist of two plants, one located in Guadeloupe and the second in the Rhine valley, totaling 17, 2 MWe net power.

The first market study (2011) carried out in France by the French Association of Geothermal Professionals regarding the geothermal domain has demonstrated that the installed power for heating and cooling reaches 1850 MWth. One third is related to the exploitation of the deep Dogger reservoir in the Paris area but the main part is linked to the recent and strong development of shallow geothermal resources in the whole country. The market for single housing using vertical geothermal probes is decreasing since 2009 due to the economic crisis. On the contrary, the number of installations to feed collective housing and residential blocks including offices buildings is growing fast. The installation of very low temperature small district heating is one solution. The average power installed for each of these mini geothermal loops is of 2-4 MWth in order to connect 1000 dwelling equivalent in sub-urban areas. Consequently, the number of districts to benefit from geothermal energy is high. The direct uses, concentrated mainly in Ile de France, restarted 4 years ago and more than 15 new deep geothermal doublets are planned in the next 5 years representing additional power of 150 MWth. The oldest plants, tapping the Dogger reservoir, have to be revamped because in exploitation since 40 years and more, consequently the drilling companies have already started to buy new rigs which can be operated in restricted area with a reduced noise and the smallest impact as possible for the public acceptance. The very low temperature installations with doublets using underground waters at depths between 20 and 1000m have been boosted by the Fonds chaleur of ADEME which subsidies the plants to be competitive with natural gas. In the other hand the vertical ground source heat pump dry systems represent now 2/3 of the total installed power for heating and cooling. The main barrier remains administrative constraints and delays to get the permission for drilling in one hand and the calculation rules for new buildings (RT2012) which still encourage gas and electricity in the other. In 2020, the market will reach 4000 MWth installed; if ecologically driven, the target objectives at 6500 could be largely attained. In 2011 the turnover of the domain is around 500 million euros.

1. ELECTRICITY GENERATION

The two power plants are namely the **Bouillante** power plant in Guadeloupe (French West Indies) and the EGS pilot plant in **Soultz-sous-Forêts** (Alsace). The Bouillante power plant started again in April 2011; a significant part of 2010 and the beginning of 2011 had been previously occupied by technical problems and improvement works performed on the wells and pipes. A partial reinjection has been put in place and started.

Figure1: View of Bouillante reinjection: a partial reinjection has been put in place to maintain the pressure in the reservoir. ©CFG Services - Géothermie Bouillante

Even if this electricity production is negligible compared to the national demand, it is important to notice that the installed capacity in Guadeloupe represents around 6% of the need for electricity of the island.

Figure 2: View of BO-5 and BO-6 production wells of the Bouillante geothermal plant in Guadeloupe, CFG Services

No new wells have been drilled in 2011; exploration drillings are considered in another part of Bouillante concession and, even though it is less mature, in the Martinique Island.

Figure 3: Overview of the Montagne Pelée in Martinique (French West Indies): the western slope of the volcano is one of the most promising geothermal area of the island (BRGM)

For high enthalpy, the main measure in 2010 is the new **feed-in tariff** put in place in July 2010. The geothermal electricity is now bought at an increased price of 130€/MWh in the overseas departments (instead of 100€/MWh) and 200€/MWh in the mainland. A bonus is given if the co-produced heat is also used.

Two exploration permits have been issued in **Alsace** (East of France), in Lauterbourg and Wissembourg. The geothermal resource expected there in the Rhine graben is more than 150°C, in order to build a combined heat and power plant. Two other permits have been issued in March 2012 in **Massif Central** and in the piedmont of the **Pyrenees** mountains. Ten other applications for exploration permits have been registered in 2011, and six additional ones in 2012: this leads to seven permits under consideration in Alsace, one in Aquitaine basin, five in the Massif Central area, two in the South-East of France and one in the Paris basin.

In the **overseas department**, three important actions have been carried out in 2011.

First of all, additional surface exploration has started in Martinique Island.

The Interreg project “Caribbean Geothermal” has been funded: coordinated by the Guadeloupe regional authorities, this 8.5 M€ project aims to accelerate the development of geothermal energy in the whole Caribbean region,

The French Agency for Development also funded exploration drillings in Dominica island, the island located between Guadeloupe and Martinique; the expected potential is so important that it exceeds the local consumption and that an electric interconnection with surrounding islands is studied. The first results given by three exploration wells are very positive and a proven resource of 100 MWe has been validated.

Geothermal electricity is expected to **reach 80 MW** in France in 2020. There are two main issues: the first ids to provide French islands (French West Indies and La Réunion) with a decarbonized energy, replacing the actual thermal electricity production, at a reasonable cost; moreover, the 2020 objective for these islands is 50% of renewables instead of 23% at a national level, because the current production is mainly made from fossil fuel. The second objective is to acquire a good experience in EGS projects to develop this energy in a larger way in 2050.

2. HEAT PRODUCTION

A **new policy** has been implemented since 2005, mainly due to the ‘*Grenelle de l’Environnement*’ process which aimed to redefine the French policy for sustainable development and which was based on discussions with various stakeholders: industry, environmental associations, local authorities, state services, unions, experts.

Geothermal heat is expected to be multiplied by 5 between 2006 and 2020 whereas the general objectives for renewable heat are a multiplication by 2.

In terms of reduction of energy demand, one main measure was to set the new standard for energy consumption in new buildings at a level of 50 kWh/m^2/year.

In 2011, a **strategic geothermal roadmap** has been published by ADEME (the French Agency for Environment and Energy). Written with the help of a committee of experts, it describes the challenges and issues of the geothermal sector and giving a 2020 vision. It identifies the technical and scientific locks to define the R&D priorities and the needs for demonstration operations.

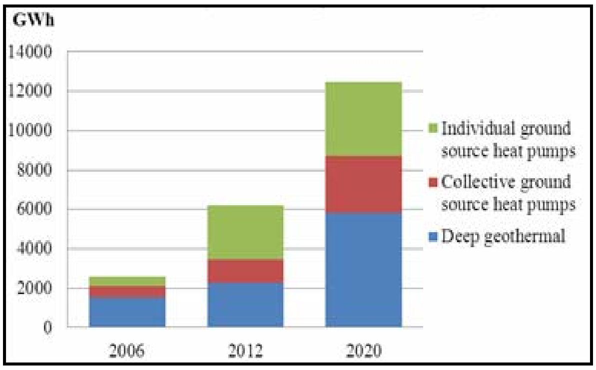

Figure 4: Expected development for geothermal heating in 2020 (ADEME)

2.1 Direct uses – Geothermal District heating (GeoDH)

The direct use of geothermal heat is quite developed in France. The installed thermal power is estimated at 391 MWth and represents about 50 plants. Most of them are used for district heating.

The **Paris Basin** has the special characteristic of offering a strong link between the geothermal resources and the demand for heating, as numerous conurbations are situated directly above continuous aquifers. Out of the approximately 200,000 dwelling equivalents in France heated by geothermal heating networks, approximately 170,000 are situated in the Paris region. This sedimentary basin has five large aquifers, including the Dogger which has the largest number of low-energy geothermal operations in the world, with 36 operations currently recorded, which are used for collective heating applications. Putting this into context, a typical operation in the Paris region allows for the heating of approximately 4,000 to 5,000 housings.

The Dogger covers an area of over 150,000 km² with the temperature measured directly below the Paris region varying between 56 °C and 85 °C according to the depth of the reservoir (between 1,600 and 1,800 m). The district heating networks supplied by the Dogger geothermal resource are mainly exploited by private companies such as Dalkia (Veolia Group), Cofely (GDF SUEZ Group), IDEX Energie and Coriance, but also by local public-private ventures (Sociétés d'Economie Mixte - SEM). They have been operated for more than thirty years and have thus been fully amortised, with their average availability rate still approaching 95%. The oldest of these installations is situated at Melun l'Almont. Commissioned in 1969, it is still into operation.

Figure 6: Well head of the Dogger geothermal plant in Melun l'Almont (ADEME)

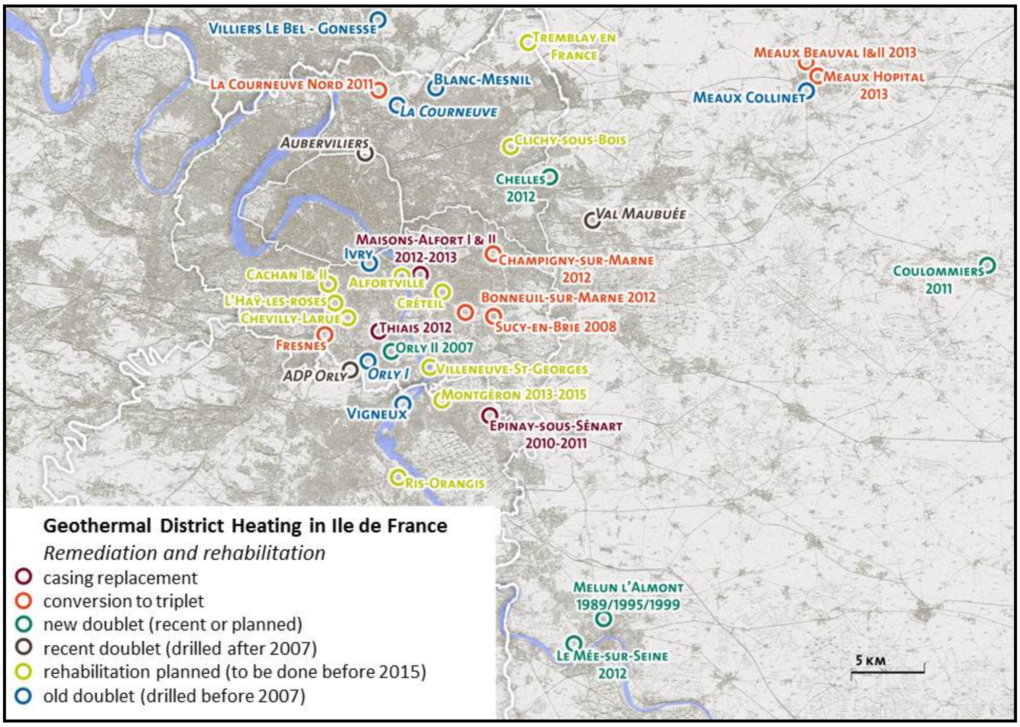

Figure 5: Overview of the geothermal plants running in the Paris basin © BRGM

The second zone for direct use is **Aquitaine** (south-west of France), with around 10 single production wells: these operations have been realised in the beginning of the 1980s and this technical situation was chosen as the pumped water is drinking water and can be discharged to the surface. The regional geology is moreover quite complicated and the aquifers to be produced are made of sands and sandstones inter-bedded with clays, so that the drilling of reinjection wells is not easy. In addition, the temperature is lower than in the Paris basin which makes the profitability of a doublet harder to achieve. Nowadays, secondary uses of the resource, as irrigation, are investigated.
Since 2007, a restart of the activity of deep geothermal doublet for district heating purposes has been recorded.

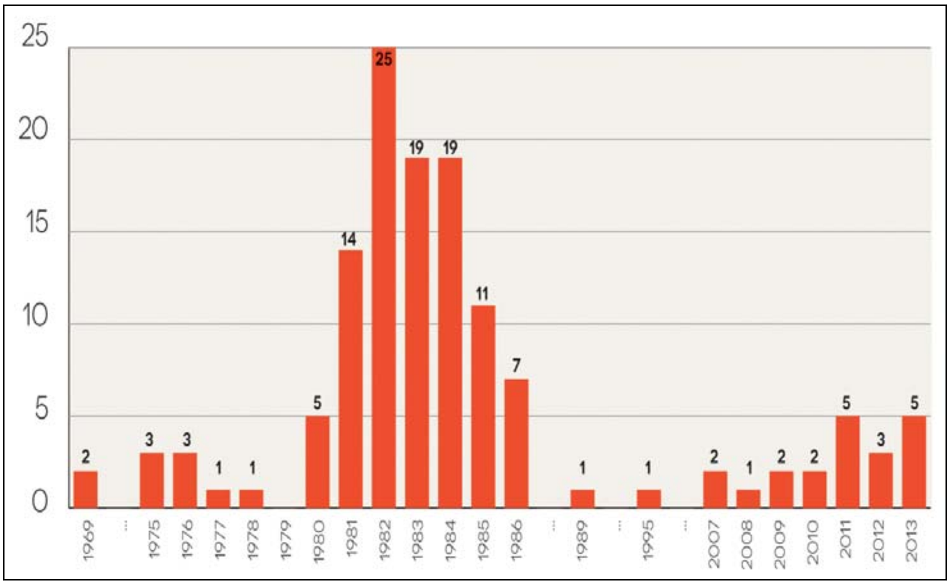

Figure 7: Number of deep geothermal drilling in France from 1969 to 2013 France (AFPG)

Numerous GeoDH systems are already designed and have received their drilling permits. A significant number of old existing plants are going also to be refitted with casing of existing wells in smaller diameter (triplet systems) or with the drilling of new doublets in bigger diameter in order to allow a possible life time of 50 to 60 years.
Ile de France represent at the moment 83% of the total power installed but Alsace region will have soon about 20 MW installed for an industrial purpose in a factory in Beinheim and numerous projects are on-going in the Bordeaux region.

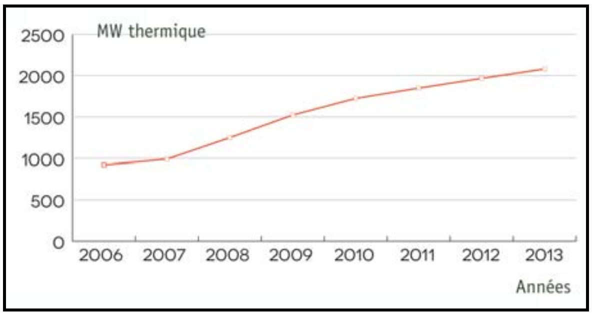

Figure 8: Cumulative installed power for Ground Source heat Pump systems (AFPG)

2.2 Geothermal heat pump

The geothermal heat pump market shows a decrease since 2010 especially due to the small number (-15% in 2011) of installations for private housing based on single heat exchanger, horizontal or vertical, with an average power of 10 kW per installation. Nevertheless, the full market including collective housing, offices and small district heating networks is still increasing.

This market is supported via a credit tax for private investors and the “Fonds Chaleur” for installations exceeding 30 kWth of installed power.

The regions which are leaders in this market are Britannia, Ile de France and Alsace as shown on the Figure 9.

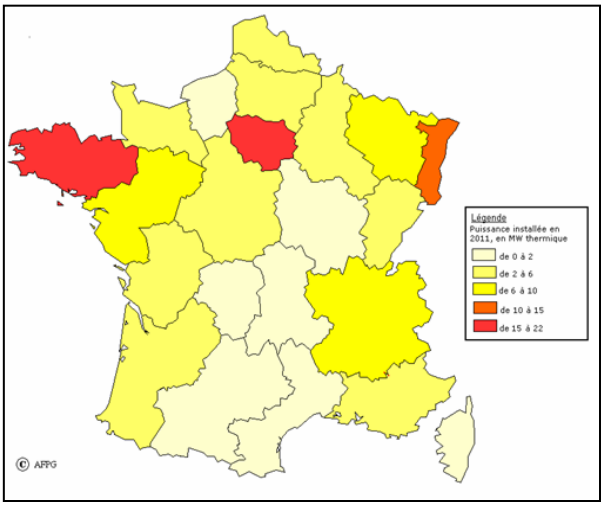

Figure 9: Geothermal Ground Source Heat Pumps installed power in 2011 (AFPG)

In 2012 the power installed is close to 2000 MWth which represent an annual heat production of 2800 GWh. At national level the close loop systems represent 46% and the open loop systems based on aquifers 54%.The private housing represents 60% of this production based mainly on vertical and horizontal heat exchanger. The collective housing and office buildings count for 40%, based mainly on doublet systems exploiting shallow aquifers.

3. SCHEMES IN SUPPORTING GEOTHERMAL ENERGY INDUSTRY

France has been a pioneer for the **coverage of geological risks** in geothermal energy. Indeed, one of the major obstacles to the development of geothermal energy projects is what is referred as the geological risk. This risk is linked to the fact that the exploitable geothermal energy resource can only be precisely known after the drilling of boreholes, a costly operation which may result in failure (e.g. due for instance to a lack of resources, to insufficient temperature or exploitable flow rates in relation to the forecasts or to the inability to exploit the geothermal fluid due to excessive acidity).

Since the 1980s, to hedge this type of risk and allow for the effective execution of geothermal energy projects, France implemented an innovative solution consisting of an insurance system that covers the geological risk, managed by ADEME and SAF Environnement (a subsidiary of the French Consignments and Loans Fund [*Caisse des Dépôts et Consignations*]), and financial aid for the implementation of projects. This scheme has allowed for the execution of several dozen geothermal heat installation systems in mainland France, which provide heating for over 200,000 dwelling equivalents, mainly in the Paris and Aquitaine regions.
The same type of risk mitigations scheme also exists for smaller operations on shallow aquifers. It is called Aquapac and is managed by the same entities.

The **Renewable Heat Fund**, with a budget of 1.2 billion euros for the 2009-2013 period, is dedicated to the funding of projects using renewable heat in the collective housing, tertiary and industrial sectors. It allows installations that produce heat from renewable energies to be economically competitive in relation to installations that cover the same energy needs but operate using conventional energy sources. ADEME has been appointed to manage this scheme. With regard to geothermal energy, the eligible operations are deep geothermal energy installations with or without heating networks, installations with heat pumps on surface water bodies or on probe fields, in addition to installations that recover energy from wastewater or seawater. The Heat Fund may be approached for aid in the upstream phase of projects for the implementation of feasibility studies, thermal response tests or experimental drilling.182 geothermal energy projects, allowing for the exploitation of more than 50,000 TOE/year, have been funded in France by the heat fund since the scheme was created in 2009.
It should also be noted that in France, in addition to the aid granted by the Renewable Heat Fund, heat networks exploiting more than 50% of renewable and recovered energy sources, including geothermal energy, benefit from a reduced VAT rate (5.5%) applied to the heat that they distribute.

In 2012, a national debate on “Transition Energétique” is on-going to build the strategy of the new energy mix.

4. SUPPORT FOR R&D AND INNOVATION

French stakeholders in geothermal energy are involved in numerous projects that seek to improve current technologies or develop new technologies.
R&D and innovation for geothermal energy may benefit from different research support schemes implemented at the French or European levels, examples of which include: European financing (FP7, Intelligent Energy for Europe Programme), the French single inter-ministry fund (FUI) for competitive clusters, funding from the French National Research Agency (Agence nationale de la recherche -ANR), ADEME, OSEO, etc., regional funding and other associated financing (European Regional Development Fund).

The development of **demonstration projects** in the context of a major national loan that aims to revive French industry (“Investments for the future” – **Investissements d’avenir**), a vast programme costing 1.35 billion euros has been dedicated to the implementation of “demonstration” projects concerning renewable and carbon-free energies. This programme will run from 2010 to 2014.

Demonstration projects – be they “demonstrators’’ or technological platforms are intended to promote pre-industrial experimentation with “breakthrough” technologies. In particular, they allow companies to take a technological and financial risk between the research phase and the mass production of new eco-technologies.

Based on the needs identified by “Strategic Roadmaps’’, Calls for Expressions of Interest (CEI’s) are then launched and the best of the proposed projects are selected.

A CEI for geothermal energy was issued at the end of 2011. It has several components:

- Generation of EGS-type electricity or via conventional reservoirs, with the creation of: demonstrators and action programmes concerning the components, technologies and knowledge of geothermal resources and their exploitation,
- Construction of deep geothermal demonstrators for direct use of heat,

- Production of heat with the implementation of technological platforms for very-low-energy geothermal power.

The financial support takes the form of subsidies, reimbursable advances and equity holdings in companies. ADEME has been appointed to manage this programme. Competitive French clusters for growth and employment are cornerstones of French public policy for innovation and R&D. They bring together companies (SMEs/SMIs and large groups), research laboratories and higher education institutions on a single site and cover the entire value chain, thus uniting public and private innovation capacities on projects of high potential.

To stimulate the emergence of projects, invitations to tender are issued by the public authorities. These represented €1.5 billion of funding for the 2009-2011 period. In addition, the French local authorities provide support and the clusters benefit from a special tax regime. France has around ten clusters operating in the renewable energies field, including the Avenia cluster, dedicated to geosciences.

In addition to the aforementioned demonstrators, R&D and innovation in geothermal energy are also supported in the framework of the Investments for the future (*Investissements d'avenir*) scheme via other mechanisms, such as the Institutes and Laboratories of Excellence (*Instituts et Laboratoires d'excellence*).

Geodenergies Institute of Excellence (Orléans)
Institutes of Excellence for Carbon-Free Energies (*Instituts d'excellence dans le domaine des énergies décarbonées* – IEED) are field specific institutes which, through a strategic public-private partnership, conduct research programmes associated with technological platforms, carry out experimental research and development activities focusing on market requirements, contribute to the engineering of initial and continuing training courses and ensure the socio-economic exploitation of the results obtained.

The GEODENERGIES IEED (Geotechnologies for producing carbon-free energies) was awarded its official quality label in March 2012. A 15.9 M€ funding is expected. The institute aims to produce technological "bricks" to facilitate the emergence of three industrial sectors associated with subsurface levels: CO2 storage, energy storage and geothermal energy (heat and electricity). Coordinated by the BRGM in Orléans, Geodenergies associates 22 companies and 11 public research bodies.

"G-eau-thermie profonde" deep geothermal Laboratory of Excellence (Strasbourg)
Through the Laboratory of Excellence (*Laboratoire d'Excellence* – LabEx) call for projects launched in 2011, laboratories with an international profile have the opportunity to receive significant resources that will allow them to compete on equal terms with their foreign counterparts. The objective is to attract teaching and research staff of international renown, and develop a high-level integrated research, training and exploitation policy. 171 Laboratories of Excellence have thus been selected for funding over a long enough period to allow them to deploy a large scale scientific strategy.

Situated in the Alsace region, the G-EAU THERMIE PROFONDE laboratory received its official quality label in March 2012. It seeks to develop the use of deep geothermal energy by improving the knowledge of deep geothermal reservoirs and through the development of new technologies allowing for their exploitation. It combines the academic skills of the University of Strasbourg with the industrial skills of the Electricité de Strasbourg group. This medium-term programme (8 years) has received government funding of €3 million.

5. CONCLUSIONS

The curve in figure 10 shows that the increase of geothermal energy uses for heating and cooling is substantial, with the doubling in the last 6 years. Nevertheless the estimation calculated by AFPG for 2020 indicates that without the continuation of strong incentives the target will not be attained.

The continuation of the "Fonds Chaleur" is obviously a key point, but the administrative simplification for small operations (less than 30 kWth) is also of paramount importance and the rewriting of the Mining Code in preparation could favor the development of numerous projects.

For electricity generation, the activity was stopped since about 10 years and consequently the expected targets for 2012 at 80 MW installed in France are already not possible to complete, even taking into account the plant to be built in Dominica island in order to sell the production to French Caribbean islands. Nevertheless, the permits to be granted in France overseas departments will allow the development of new EGS-CHP operations.

For direct uses applications, the on-going projects in Ile de France, Aquitaine and Alsace region and the use of great power heat pumps installed on existing plants to lower the temperature of geothermal deep fluids before injection in the reservoir will permit an average increase of 50 MWth of installed power during the next 7 years.

For GSHP, the future is to use geothermal energy in more than 5% of the buildings annually built, which is a bad result if compared with leading countries such as Sweden, Switzerland and Germany. In parallel the market of GSHP in old construction to be renewed is the key for shallow geothermal resources use.

The regulation regarding energy in building (RT2012) is not favourable at all for the development of heat pump technology, in particular the green gas effect which is not taken into account to encourage this renewable technology. These regulations have to be modified in order to allow geothermal energy to attain the ambitious objectives fixed by the government.

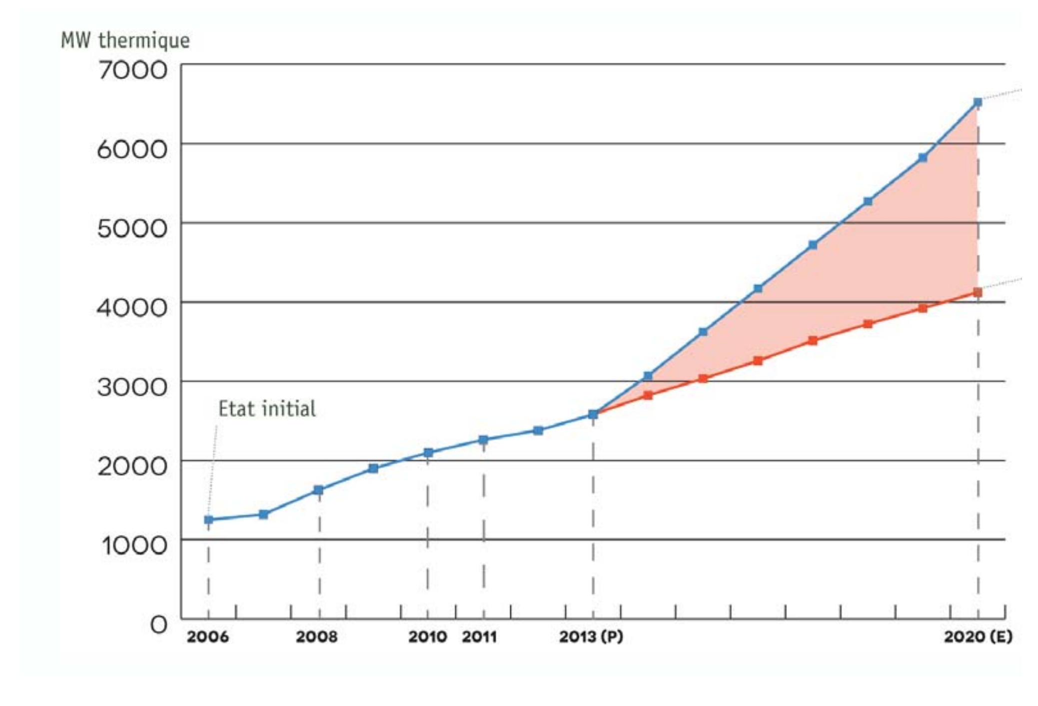

Figure 10: Evaluation of installed power for heating and cooling from 2012 to 2020 (AFPG)

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Tables A-G

Table A: Present and planned geothermal power plants, total numbers

	Geothermal Power Plants		Total Electric Power in the country		Share of geothermal in total	
	Capacity (MW_e)	Production (GWh_e/yr)	Capacity (MW_e)	Production (GWh_e/yr)	Capacity (%)	Production (%)
In operation end of 2012	17,1	108	127000	534000	0,013	0,020
Total projected by 2015	22	148				

Table B: Existing geothermal power plants, individual sites

Locality	Plant Name	Year commiss.	No of units	Status	Type	Total inst. Capacity (MW_e)	Total running cap. (MW_e)	2012 product. (GWh_e/y)
Guadeloupe	Bouillante	1986 & 2004	2	O	D	15	15	102
Alsace	Soultz-sous Forêts	2010	1	O	B-ORC	2,1	1,5	6

Table C: Present and planned geothermal district heating (DH) plants and other direct uses, total numbers

	Geothermal DH Plants		Geothermal heat in agriculture and industry		Geothermal heat in balneology and other	
	Capacity (MW_{th})	Production (GWh_{th}/yr)	Capacity (MW_{th})	Production (GWh_{th}/yr)	Capacity (MW_{th})	Production (GWh_{th}/yr)
In operation end of 2012	295	1116	20	100	50	100
Under construction end of 2012	50	200	0	0	0	0
Total projected by 2015	120	480	24	168	0	0

Table D: Existing geothermal district heating (DH) plants, individual sites

Locality	Plant Name	Year commiss.	Is the heat from geo-thermal CHP?	Is cooling provided from geo-thermal?	Installed geotherm. capacity (MW_{th})	Total installed capacity (MW_{th})	2012 geo-thermal heat prod. (GWh_{th}/y)	Geother. share in total prod. (%)
Ile de France	Alfortville	1986	N	N	9,5		44	78
Aquitaine	Blagnac 2		N	N	3		7	
Ile de France	Blanc Mesnil	1983	N	N	7		0	
Ile de France	Bonneuil sur Marne	1986	N	N	10		26	66
Ile de France	Bordeaux Mériadeck		N	N	2,5		4	
Ile de France	Cachan Nord et Sud	1984	N	N	11,5		50	85
Ile de France	Champigny sur marne	1985	N	N	11		59	71
Ile de France	Chateauroux		N	N	2,5		15	
Ile de France	Chelles	1987	N	N	9,5		19	38
Ile de France	Chevilly larue-L'Hay les Roses	1985	N	N	19,2		73	58
Ile de france	Clichy sous Bois	1982	N	N	5,6		16	33
Ile de France	Coulommiers	1981	N	N	6,4		25	94
Ile de France	Créteil	1985	N	N	10,1		57	37
Ile de France	Epinay Sous Sénart	1984	N	N	6,7		50	78
Ile de France	Fresnes	1986	N	N	7,9		32	48
Poitou Charente	Jonzac 1		N	N	1,1		6	
Ile de France	La Cour-neuve N et S	1982	N	N	7,4		34	50
Ile de France	Melun l'Almont	1971	N	N	9		45	68

Table D: Existing geothermal district heating (DH) plants, individual sites (continued)

Locality	Plant Name	Year commiss.	Is the heat from geo-thermal CHP?	Is cooling provided from geo-thermal?	Installed geotherm. capacity (MW_{th})	Total installed capacity (MW_{th})	2012 geo-thermal heat prod. (GWh_{th}/y)	Geother. share in total prod. (%)
Ile de France	Melun Le Mée	1978	N	N	3,2		21	94
Ile de France	Maisons Alfort 1 et 2	1985	N	N	14,1		58	45
Ile de France	Meaux Beauval et Collinet	1983	N	N	13,7		58	35
Ile de France	Meaux Hopital	1983	N	N	3,8		21	44
Aquitaine	Mérignac		N	N	3,4		17	
Aquitaine	Mont de Marsan 1 et 2		N	N	2,7		16	
Ile de France	Montgeron	1982	N	N	7		17	77
Lorraine	Nancy 2		N	N	1,7		7	
Ile de France	Orly 2 et 3	1986	N	N	11,1		68	80
Ile de France	Orly ADP	2010	N	N	8		40	50
Ile de France	Paris CPCU	2010	N	N	8,5		52	60
Aquitaine	Pessac		N	N	6		17	
Ile de France	Ris Orangis	1983	N	N	4,1		16	58
Aquitaine	Saint Paul les Dax		N	N	4,4		14	
Ile de France	Sucy en Brie	2008	N	N	6,2		35	90
Ile de France	Thiais	1986	N	N	8,8		44	87
Ile de France	Torcy	2012	N	N	10		42	85
Ile de France	Tremblay en France	1984	N	N	8,6		46	87
Ile de France	Vigneux sur Seine	1985	N	N	8,2		34	66

Table D: Existing geothermal district heating (DH) plants, individual sites (continued)

Locality	Plant Name	Year commiss.	Is the heat from geo-thermal CHP?	Is cooling provided from geo-thermal?	Installed geotherm. capacity (MW_{th})	Total installed capacity (MW_{th})	2012 geo-thermal heat prod. (GWh_{th}/y)	Geother. share in total prod. (%)
Ile de France	Villeneuve Saint Georges	1987	N	N	12,6		34	65
Ile de France	Villiers Le Bel	1987	N	N	7,2		34	65
total					**295**		**1116**	

Table E: Shallow geothermal energy, ground source heat pumps (GSHP)

	Geothermal Heat Pumps (GSHP), total			New GSHP in 2012		
	Number	Capacity (MW_{th})	Production (GWh_{th}/yr)	Number	Capacity (MW_{th})	Share in new constr. (%)
In operation end of 2012	Over 150000	1850	2775	Over 5000	65	<5%
Projected by 2015	180000	2200	4400			

Table F: Investment and Employment in geothermal energy

	in 2012		Expected in 2015	
	Investment (million €)	Personnel (number)	Investment (million €)	Personnel (number)
Geothermal electric power	50	50	200	200
Geothermal direct uses	120	1000	150	1300
Shallow geothermal	385	3150	500	4200
total	**555**	**4200**	**750**	**5700**

Table G: Incentives, Information, Education

	Geothermal el. power	Geothermal direct uses	Shallow geothermal
Financial Incentives – R&D	Call for Expressions of Interest tendered by ADEME in the “investment for the future” framework	na	Na
Financial Incentives – Investment	FIT - Feed in tariff at 200 €/MWh (130 in ultra-marine departments and regions).	RC - Deep geothermal fund DIS - Fonds Chaleur (Heat Fund) for 2013 to be pursued in 2014	RC - Aquapac Fund DIS - Fonds Chaleur (Heat Fund) for 2013 to be pursued in 2014
Financial Incentives – Operation/Production	na	na	Na
Information activities – promotion for the public	ADEME-BRGM website: www.geothermie-perspectives.fr AFPG website www.afpg.asso.fr		
Information activities – geological information	na	Thermo2Pro tool and Dogger database	Regional shallow aquifer atlas
Education/Training – Academic	na	na	na
Education/Training – Vocational	na	na	na

Key for financial incentives:

DIS	Direct investment support	RC	Risk coverage	FIP	Feed-in premium
LIL	Low-interest loans	FIT	Feed-in tariff	REQ	Renewable Energy Quota