



2018 SITUATION AND COMPARISON WITH NATIONAL OBJECTIVES

The following table summarizes the main figures about the geothermal energy in France in 2018 versus with the national objectives written in the project 2019 of the pluriannual program of energy (PPE):

| GEOHERMAL MARKET SITUATION | | Total installed capacity (MW) and energy production (TWh/year) | | 2018 AFPG data expected | Growth between 2018 and 2023 | 2023 (PPE 2019 project PP) | 2028 (2019 project) lower objectives | 2028 (2019 project) higher objectives |
|----------------------------|-------------------|--|------------|-------------------------|------------------------------|----------------------------|--------------------------------------|---------------------------------------|
| Shallow geothermal | Individual sector | MWth | 1400 | | | | | |
| | | TWh/an | 2,5 | | | | | |
| | Collective sector | MWth | 500 | | | | | |
| | | TWh/an | 0,9 | | | | | |
| | TOTAL | TWh/an | 3,4 | 35% | 4,6 | 5,0 | 7,0 | |
| Deep geothermal | Heat | MWth | 600 | | | | | |
| | | TWh/an | 1,8 | 61% | 2,9 | 4,0 | 5,2 | |
| | Electricity | MWe | 17 | 41% | 24 | 24 | | |
| | | TWh/an | 0,12 | | | | | |



L'AFPG

Geothermal energy, tomorrow's energy starting today!

The French Geothermal Association of Professionals was created in June 15, 2010 in Paris. Beginning 2020, AFPG gathers around 100 members representing the different geothermal professions in France and overseas: drillers, heat pump manufacturers and installers, district heating operators, consulting engineers, ...

It is organised into **2 sectors**:

- **Shallow geothermal energy**
- **Deep geothermal energy**

AFPG objectives are to promote the use of geothermal energy, as a renewable energy that allows the production of electricity, heat and cooling. These tasks are divided into four major areas:

- **Representing and federating** French professionals of the sector (mainland and overseas),
- **Inform communities**, manufacturers and individuals of geothermal resources and the diversity of the geothermal offer and advantages,
- **Support the public authorities** to adapt regulations, legislation and certifications,
- **Contribute to the emergence of new technologies** such as temperate geothermal water closed-loop.

GEODEEP
FRENCH GEOTHERMAL CLUSTER FOR HEAT AND POWER

AFPG also federates **GEODEEP**, a multidisciplinary cluster for geothermal heat and power that brings together French companies involved in deep geothermal energy with export activities. Specialized in resource exploration, engineering, construction of high-energy geothermal power plants, and district heating. GEODEEP covers the entire value chain and offers turnkey solutions.

Follow our AFPG profile for inform you about the news French geothermal.



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GEOHERMAL ENERGY IN FRANCE

2019 SECTOR STUDY OVERVIEW



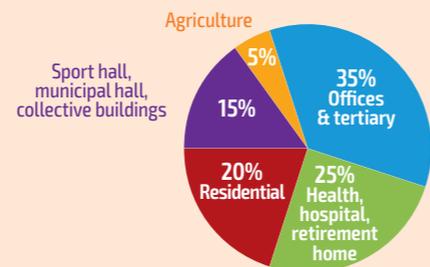
SHALLOW GEOTHERMAL ENERGY

Shallow geothermal energy can provide heat, domestic supply water, cooling and cold for individual housing but also for collective one (tertiary buildings, hospitals, retirement homes, ...).

Evolution of geothermal heat pumps sales (P = 2 to 50 kW) between 2008 and 2018 (AFPAC, PAC & Clim'Info)



Distribution of collective geothermal operations according to establishment type in 2018 (Observ'ER)

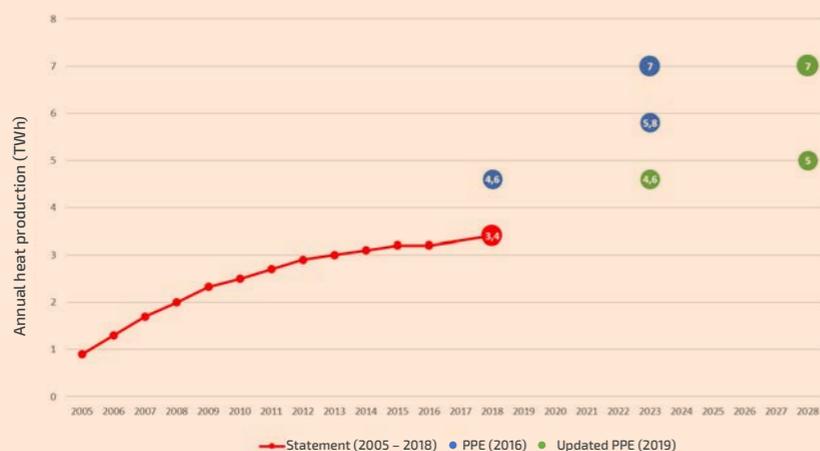


The individual house geothermal heat pump market has stabilised since few years, but at a very low rate: around 2500 geothermal heat pumps sold in 2018 (AFPAC, PAC & Clim'Info).

This rate is very low compared to 10 years ago and represents a small percentage of a market dominated by air/air heat pumps and thermodynamics water-heaters (around 100 000 unities sold a year each).

In the shallow geothermal energy sector, the situation is contrasted: if the private market felt-down in recent years, the collective one shows a permanent growth (+10% a year). Several innovative technologies have showed a strong dynamism, like the geothermal temperate water closed-loop also known as "thermal smart-grid".

Annual heat production since 2005 and perspectives for 2028



In 2018, the shallow geothermal heat production has been estimated at 2.5 TWh for the private sector and 0, 9 for the collective one. These numbers are still far away from the objectives planned by the French Ministry of solidarity and ecologic Transition in its project of multi-annual energy planning called "PPE".

DEEP GEOTHERMAL: GEOTHERMAL PLANTS PRODUCING ONLY HEAT

Operating geothermal resources at temperature between 30°C and 90°C, can deliver large amount of heat. It supplies urban districts heating, agricultural installations or thermal baths.

It is a dynamic sector with 11 operations realised between 2016 and 2018, listed in the following table:

Geothermal districts heating: operations in Île-de-France Region between 2016 and 2018 (AFPAC)

| Site Name | Geothermal capacity (MWth) | 2018 Geothermal Production (MWh/an) | 2018 production (MWh/an) | Geothermal share in total production | Housing equivalent |
|---------------------------------------|----------------------------|-------------------------------------|--------------------------|--------------------------------------|--------------------|
| NEW DISTRICTS | | | | | |
| Dammarie-les-Lys (77) | 12 | 35 856 | 40 648 | 88% | 3 871 |
| Saclay (91) | 5 | 0 | 0 | N.C. | 0 |
| Grigny (91) | 10 | 0 | 0 | N.C. | 0 |
| OLD REVAMPED DISTRICTS HEATING | | | | | |
| Vigneux-sur-Seine (91) | 10 | 11 274 | 36 497 | 31% | 3 476 |
| La Courneuve Nord (93) | 4,1 | 25 000 | 29 625 | 84% | 2 821 |
| Thiais (94) | 10 | 27328 | 36998 | 74,6% | 3 524 |
| Champigny sur Marne (94) | 10,1 | 56 703 | 81 265 | 70% | 7 740 |
| Fresnes (94) | 7,5 | 43 996 | 93 811 | 47% | 8 934 |
| Bonneuil-sur-Marne (94) | 10 | 0 | 36 500 | N.C. | 3 476 |
| Cachan (94) | 18 | N.C | 81 980 | N.C. | 7 808 |
| Villiers-le-Bel (95) | 6,22 | 9 714 | 83 172 | 12% | 7 921 |



The deep geothermal heat in France in 2018 represents about 1, 75 TWh, among which 82% is delivered by districts heating.

DEEP GEOTHERMAL: THE ELECTRIC POWER PLANT

By exploiting geothermal resources at temperatures higher than 120°C, it is possible to produce electricity and heat (co-production). France has developed a significant know-how since 2011 with 2 power plants: Bouillante (Guadeloupe) and Soultz-sous-Forêts (Alsace). This development has been accomplished in June 2016 with the inauguration in Alsace of the third French power plant, ECOGI producing only high temperature heat.

The achievement of numerous ongoing projects would enable to reach an installed capacity of 180 MWe and 250 MWth in France by 2028.

| | Number of projects | Electric capacity (MWe) | Thermal capacity (MWth) | Investment (M€) |
|---------------------------|--------------------|-------------------------|-------------------------|-----------------|
| Existing plant (in 2018) | 2 | 16,7 | 0 | 120 |
| Plants Extension | 1 | 10 | 0 | N.A. |
| Mainland permits | 14 | 130 | 245 | 970 |
| Research permits overseas | 2 | 25 | 0 | 70 |
| France Total 2028 | 19 | 181,7 | 245 | 1160 |



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