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Climate responsibility: surface geothermal energy, a powerful weapon

François Bayrou, Haut-commissaire au Plan

The energy challenge is the most important every country in the world has to face in the context of climate change. Our societies cannot function without energy consumption, which enables human activity across all its dimensions: housing, travel, lifestyles, industrial and agricultural production as well as exchanges – including digital ones. However, the omnipresence of various energy sources that emit greenhouse gases, particularly CO₂, considerably worsens the human contribution to **climate imbalance**.

Confronted with this dilemma, we are gradually developing collective **strategies**, to which we are all committed, in order **to decarbonise** our lifestyles as much as possible.

The first challenge is the **decarbonisation of our energy consumption**. To achieve this goal, the most common response is the **electrification of activities**. This is particularly the case for mobility, as illustrated by the systematic replacement of the internal combustion engine, which emits important amounts of CO₂ as soon as it is in operation, with the electric engine, powered by a battery or by an on-board fuel cell which produces electric current on demand by oxidising hydrogen. This is also the case for domestic use, particularly when it concerns heating. From then on, **the essential question is how to produce electricity as efficiently as possible in terms of minimising greenhouse gas emissions**. The renewable sources are well known: wind power, onshore or offshore, photovoltaic or hydroelectric production units. Yet many of them are intermittent. Hence controllable resources are fundamental to complement the renewable units. Traditional controllable sources are highly, although unequally, emitting greenhouse gas (coal, fuel oil, gas), with the sole exception of nuclear power – which is a challenging technology but which guarantees production on the scale of needs with almost no CO₂ emissions.

It is that vision which underpinned the choices made by the President of the French Republic and the government in favour of an ambitious plan to secure and revive our nuclear power capacity.

However, while the energy crisis has been considerably aggravated by the Russian aggression against Ukraine, other efforts and other technologies must be mobilised to move towards a sustainable balance as far as climate and energy are concerned.

Many people on this energy issue rightly insist on the need for sobriety. **The least emitting and cheapest KWh is certainly the KWh that will not be used.** That is the reason why numerous policies encourage lower energy consumption: insulation of buildings, frugality of use, acceptance of lower standards of comfort, lower consumption of appliances or motors, through persuasion or constraint.

Yet it is surprising to realise that relatively little attention is paid to approaches that lead to more **efficient use of energy**, meeting standards of comfort while simultaneously saving energy.

In this regard, one of the most promising paths is the exploitation of an almost inexhaustible source of energy, compatible with the most advanced needs in terms of air-conditioning, whether for collective or individual heating, and for cooling in periods of extreme heat.

This source is right beneath our feet: it is contained in the subsoil of our towns and countryside, it is free, inexhaustible, without any pollution, and it can advantageously complement or even replace all other heat or cold production systems, generating very significant operating savings in the short term.

Geothermal units are of very different natures. In this study, the Haut Commissariat au Plan focuses on surface geothermal systems (a few dozen to a few hundred metres deep). In another study, it will consider deep geothermal energy (several thousand metres deep) because of issues about drilling and operating costs, and certain seismic risks that have recently been revealed.

The industrial aim is not the same with respect to these two types of geothermal energy: thanks to the temperatures reached at such great depths, deep geothermal energy aims at producing not only heat but also electricity by driving large-capacity turbines. The search for lithium production, for example, even if it may be promising, is an industrial challenge that requires very challenging techniques, such as hydraulic fracturing. However, **surface geothermal energy has none of these disadvantages:** it provides access to low-cost heat or cold production, using the controlled and improvable technologies of drilling and the heat pump. This is an economical method of production, with no appreciable alteration over time, and which simply uses the limitless capacities of our planet, directly on site, through the shortest possible production/consumption circuit.

The potential of surface geothermal energy is considerable. Nowadays, in France, surface geothermal energy provides only 3% of renewable heat, i.e. a little bit over 1% of heat production in France - cold production is currently negligible. Geothermal energy can be developed quickly in individual homes, without impacting our landscapes, and does not emit greenhouse gases. **By adding up the different deposits, the Bureau de recherches géologiques et minières (BRGM) estimates that 100 TWh per year of gas savings can be achieved within 15 to 20 years thanks to surface geothermal energy. We can estimate that geothermal energy, which can be installed everywhere in France (whatever the underlying geology), could provide 100 TWh of sovereign energy that would be independent of fluctuations in fossil fuel prices, non-polluting and non-emitting of greenhouse gases. This is the equivalent, in terms of electricity production, of about 5 nuclear units.**

The Haut Commissariat au Plan considers that launching an ambitious action plan for the development of surface geothermal energy is both feasible and necessary. This programme could make a substantial contribution towards our goals: to reach strategic and energy sovereignty, to achieve carbon neutrality and to move away from fossil fuels.

This plan has four components:

- **Developing the vocational training in this sector of activity in order to strengthen the skills base and increase the volume of supply.** This vocational training effort, the cost of which is estimated at 60 million euros over approximately 7 years, aims at increasing the number of drillers on the national territory. Their number will have to increase from barely a few hundred for the entire country today to several thousand which will be necessary to carry out a vast plan to replace gas and oil boilers by geothermal heat pumps. France had this capacity to master the drilling sector, but it has lost it over the years and the time has now come to regain it.
- **Developing drilling capacities and the supply of heating systems, which are currently insufficient to meet a higher demand.** The development of surface geothermal energy requires a strengthening of our industrial capacity, which is currently insufficient in terms of drilling tools and heat pumps production. By means of a multi-year programme, the public authorities could give the industrial companies of the sector the necessary visibility on the prospects for geothermal deployment and allow them to start ramping up the production capabilities.
- **Reducing, for private individuals and the tertiary sector, the initial investment effort and the financial risks.** Surface geothermal energy is a major source of savings, with 30% less electricity consumption than an aerothermal heat pump, but its initial investment cost is higher. It is therefore necessary to implement a coordinated incentive scheme jointly funded by the State, local authorities and funding agencies.
- **Establishing a more precise land mapping** to encourage the development of surface geothermal energy, in particular by identifying the most favourable areas for efficient drilling.

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Executive Summary

The Haut-commissariat au plan highlights an under-exploited, inexhaustible and safe source of energy for heating or cooling individual or collective housing and for many sectors of society. Producing renewable heat from our subsoil can contribute to France's goal to avoid fossil fuels, while energy crisis and climate change are major challenges for the country's independence and for all French people.

Beneath our feet lies a renewable, permanent and inexhaustible source of energy that is called geothermal energy. Nowadays in metropolitan France, surface geothermal energy provides 3% of the renewable heat, i.e. a little bit more than 1% of heat production in France - cold production is negligible. Yet the potential of geothermal energy in France is very important in meeting the energy demand of buildings.

This note focuses on surface geothermal energy (between 0 and 200 metres deep) for heating and cooling buildings and the associated geothermal heat pumps system.

Surface geothermal energy is little used today but it does not have the disadvantages associated with deep geothermal energy (deeper drillings, risk of induced seismicity and higher costs). Moreover, its rapid implementation can be developed for individual housing, without impact on our landscapes, and it does not emit greenhouse gases. By adding up the different deposits, the Bureau de recherches géologiques et minières (BRGM) estimates that 100 TWh per year of gas savings can be achieved within 15 to 20 years thanks to surface geothermal energy.

The Haut-commissariat au Plan therefore suggests launching an ambitious action plan for the development of surface geothermal energy. This programme could make a substantial contribution to our goals of reaching strategic and energy sovereignty, of achieving carbon neutrality and of moving away from fossil fuels.