

# Deep Geothermal

## Pilot Project Haute-Sorne



**The locality of Haute-Sorne has ideal geological conditions, the required infrastructure and appropriate land use planning for undertaking a pilot project in deep geothermal energy.**

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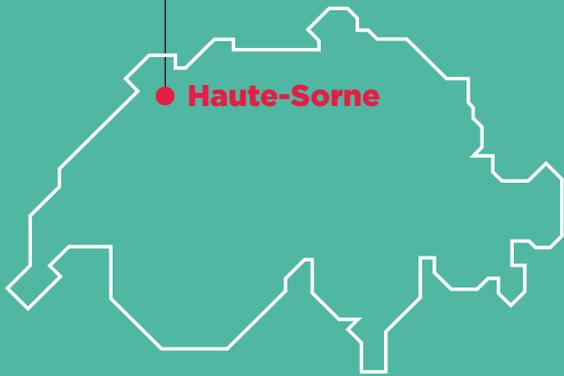
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**Haute-Sorne is a municipality in the Swiss canton of Jura. It was formed in 2013 from the merger of the former administrative municipalities of Bassecourt, Courfaivre, Glovelier, Soulce and Undervelier. The name Haute-Sorne is derived from the Sorne, a small river that flows through the municipality. Haute-Sorne lies at 477 m above sea level and has a population of around 7,000.**



**Aerial photograph of Haute-Sorne with the planned power plant superimposed.**

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# We wish to make use of the vast geothermal reservoir which lies beneath our feet.

## 47°20'00" N 7°13'16" E

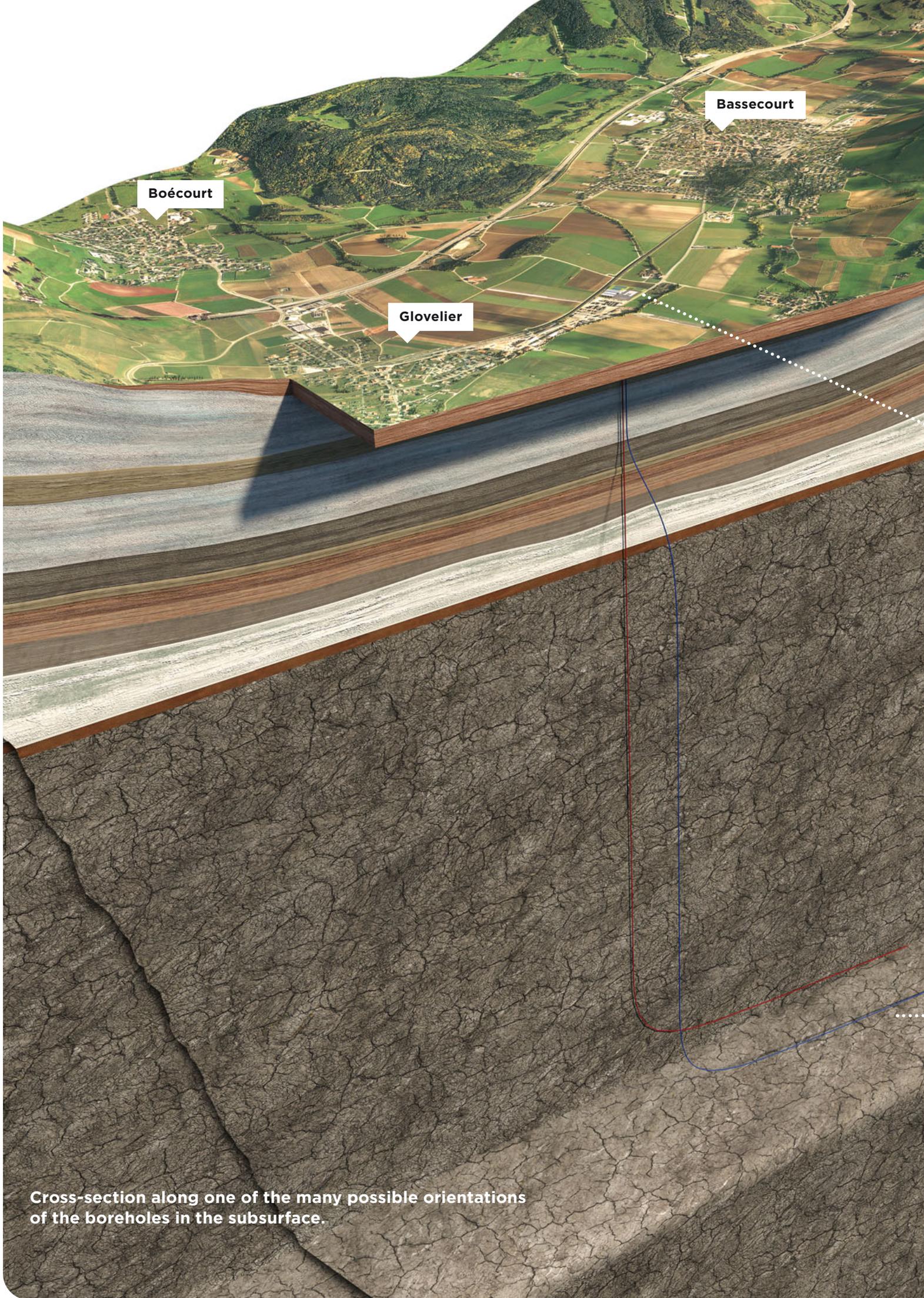
These coordinates remove all doubt from the equation because they effectively bring matters to a head. This is it, it must be here: the plot of land with a surface area of approximately 18,000 square metres, 493 metres above sea level.

We are in the north west corner of Switzerland, more precisely in the Canton of Jura within the bounds of the municipality of Haute-Sorne, in the industrial zone between Glovelier and Bassecourt which is clearly defined by the railway line and the cantonal road. The latitude of 47°20'00" N and longitude of 7°13'16" E intersect on the plot exactly at the point where an asphalt path gives way to a field of maize. It can look like this when the past plays with the present, and is getting ready for the future.

### The future of energy lies directly beneath us.

The plot bearing the field name of Pré Beuchin consists of three different sized parcels of land: a former tree nursery and some arable land which today form part of the industrial zone. Apart from a few asphalt path segments, hardly anything remains which suggests the old tree nursery – grasses, bushes and trees have supplanted an order which no longer exists. A fresh morning breeze caresses half grown shrubs which grow in neat rows. The young maize plants sway softly back and forth like small waves on a green lake. Smoke rises from the nearby asphalt works. A local train whooshes along the edge of the plot. A day like any other. Nothing points to the immediate future lying beneath us. Power lies in the depths. One can close one's eyes and see it. Large amounts of energy repose in the layers of rock some kilometres beneath the maize field and the old tree nursery. We are standing on a vast geothermal reservoir and have the means and the opportunity to make safe and varied use of this clean, nearly inexhaustible source of energy. Here, where yesterday a tree nursery stood and today the breeze caresses the maize field, we can extract energy tomorrow: clean electricity and thermal energy for thousands of people and households, around the clock. The future is right beneath us and it began a long time ago. –





Boécourt

Bassecourt

Glovelier

Cross-section along one of the many possible orientations of the boreholes in the subsurface.

# Technology

## The geothermal power plant

Hot water is pumped up the first borehole (in red) to the surface where energy is extracted from the water by a heat exchanger. The cooled water is subsequently re-injected underground through the second borehole (in blue). The water cycle between the two wells and heat exchanger creates a closed geothermal loop. In a separate secondary cycle, the heat is transferred to a turbine, which is connected to the electricity generator.

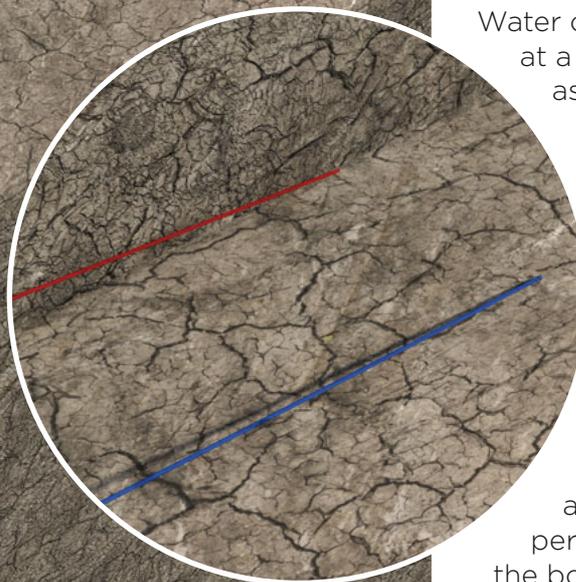


- 1 Air coolers for the turbine**
- 2 Water reservoirs**
- 3 Borehole cellar and well heads**
- 4 Power plant**

## The geothermal reservoir

Water circulates between the two boreholes at a depth of 4,500 metres through fissures as narrow as a hair's breadth. Contact with the hot rock warms the water.

During construction of the power plant the opening of the fissures will be enhanced by a process referred to as hydraulic stimulation to increase the permeability of the rock. To optimise the energy performance of the geothermal system whilst minimising the seismic risk, Geo-Energie Suisse has developed a multi-stage stimulation process. Using this new process, a number of small stimulations will be performed along the horizontal sections of the boreholes. —

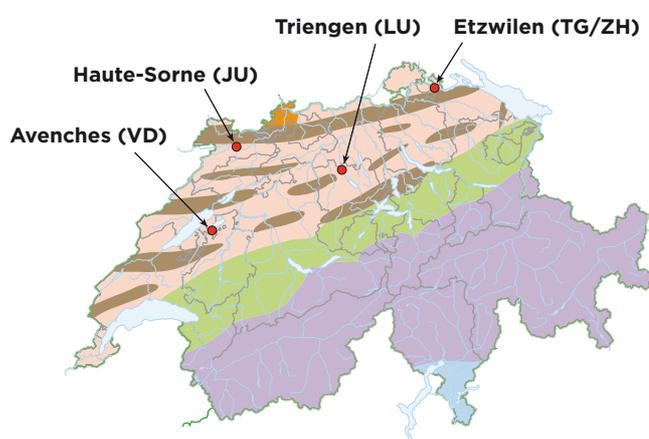


# Project Development

## Milestones 2012–2019

### 2012–2013: Site Selection and Project Development

In the first phase, Geo-Energie Suisse evaluated more than 100 potential sites across Switzerland. The company conducted preliminary studies and started the authorization procedures at four of the most suitable sites before finally opting for the municipality of Haute-Sorne for the pilot project. Subsequently, project planning began and additional detailed investigations as well as public information meetings and a group representing local interests were introduced.



### 2015: Incorporation of the Project Company and Grant of a Construction Permit

Geo-Energie Jura SA was incorporated and registered in the municipality of Haute-Sorne for the purpose of carrying out the project and third-party liability insurance was secured up to a value of CHF 100 million. The construction permit was granted by the public authorities for the construction of a pilot geothermal plant with two deep boreholes and power plant premises.

The municipality of Haute-Sorne, the canton of Jura and Geo-Energie Jura SA drew up an agreement covering the fees for electricity generation, the status of the operating company, and also the setting up of an information commission.



Signing of the cooperation agreement in Bassecourt on the 15th July 2015.

From left to right: Peter Meier (CEO GES), Philippe Receveur (Minister of the canton of Jura), Jean-Bernard Vallat (President of the Municipality of Haute-Sorne).

## Energy Strategy 2050 and new Energy Act

Through its Energy Strategy 2050, Switzerland has realigned its energy policy. By 2050 the country wishes to cease its involvement with nuclear power and gradually transform its energy system. In the process, energy efficiency should increase, the proportion of renewable energy should rise and energy-related CO<sub>2</sub> emissions are expected to fall.

Deep geothermal energy has great potential for the renewable supply of power and heat in Switzerland. However, a significant challenge for deep geothermal lies in the fact that our knowledge of the deep underground is only partial, which brings with it uncertainty regarding the costs and feasibility of the plants. None the less, the prospect of nearly inexhaustible, clean and uninterrupted sources of energy is irresistible: it is nearly free of CO<sub>2</sub>, delivers base load power and requires little space. In the long term it is conceivable that a substantial proportion of Swiss energy consumption could be supplied by geothermal power plants. Currently the Federal Government estimates a potential of 4.4 TWh annually, which equates to an installed capacity of approximately 550 MW. Since the new Energy Act came into effect on 1st January 2018, the Federal Government has supported deep geothermal energy with new incentives, including the funding of up to 60% of exploration costs.

## 2018–2019: Federal Supreme Court Ruling and Exploration Funding by the Federal Government

The Federal Supreme Court eventually rejected the pending appeals and thereby put into force the special land use plan that enables the realisation of the project. Consequently, Geo-Energie Suisse bought the necessary land for the pilot project. The Swiss Federal Office of Energy (SFOE) granted funding of 60 percent of exploration costs which equates to a sum of CHF 64 million.

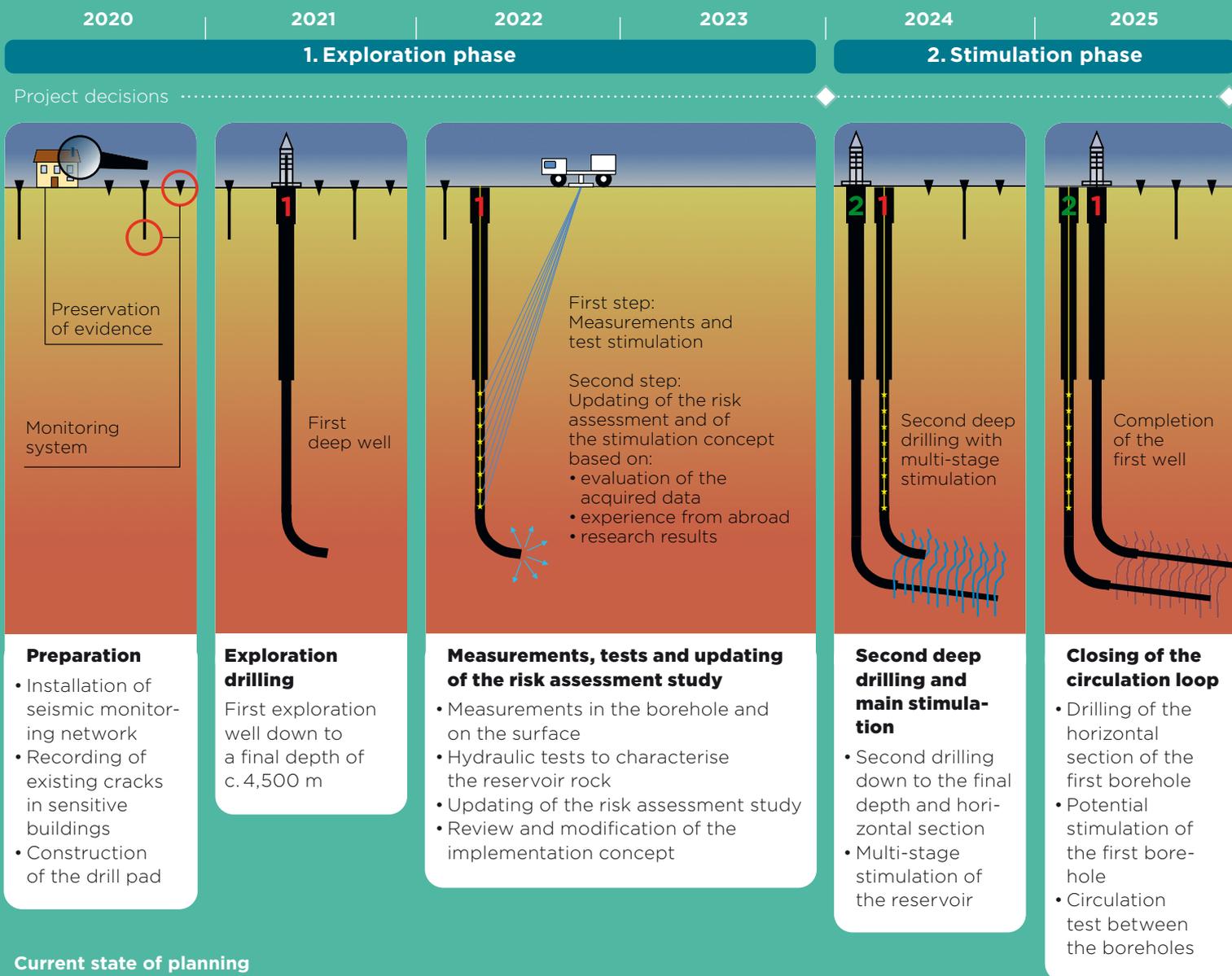
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## Eine neue Chance für die Geothermie

Newsnet Tamedia, 11 september 2019

# Project Development

## Planned milestones 2020–2030



Type of plant: hydrothermal doublet  
 Drilling depth: 4,083 metres (production borehole), 4,453 metres (re-injection borehole)  
 Installed thermal capacity: 50 MW  
 Installed electrical capacity: 4.5 MW

### The Grünwald Reference Project

To the south of Munich, the municipality of Grünwald in Oberhaching-Laufzorn has realized a geothermal project with two boreholes, with the aim of producing heat and of generating electricity. Planning began in 2008: since 2011 the plant has been producing heat and since the end of 2014 it has been generating electricity. In 2012 Grünwald joined up with the neighbouring municipality of Unterhaching to create Germany's first geothermal district heating network. —

2026

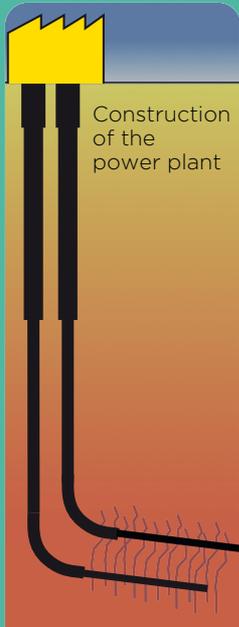
2027

2028

Subsequent years

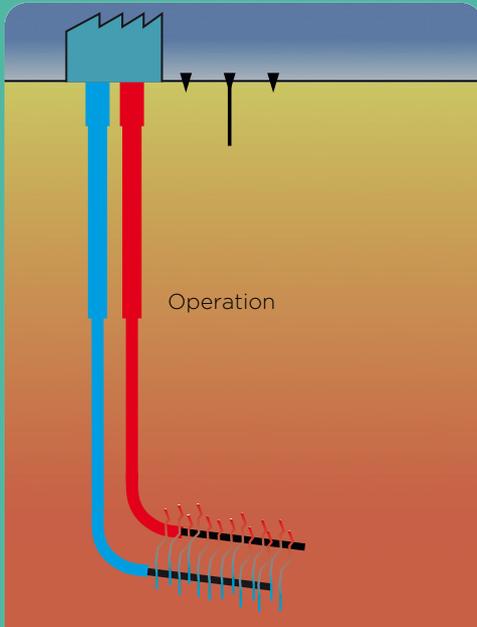
### 3. Construction and operational phase

### Multiplication of the technology



#### Construction of the power plant

- Construction of the surface installations and of the building
- Connection to the power grid



#### Commissioning, trial run and regular operation

- Commissioning of the power plant
- Measurements and optimisation of the plant
- If possible, connection to the district heating network



#### Multiplication of technology

- Based on the experience of the Haute-Sorne pilot project, further similar plants may be established across all of Switzerland.
- This can contribute to achieving the aims of Energy Strategy 2050 in generating up to 4.4 TWh annually.



Architectural model of the Haute-Sorne geothermal power plant.

### Architecture of the Haute-Sorne geothermal power plant

The power plant building is 9.5 m high, 55 m long and 18 m wide. Towards the east, in the direction of Croisées farm, the building serves as a barrier against noise emissions from the air condensers. On the ground floor, technical installations (turbine, pumps, water treatment) are to be found, as well as a visitors' room. The upper floor houses offices and the control centre. The facade to the west is open but will be equipped with sound absorbent slats. —

# **Our exploration borehole will be the first to penetrate the crystalline bedrock under the Jura.**

**Daniel Schafer, President of the Board of Directors of Geo-Energie Suisse, examines in an interview the potential and challenges of deep geothermal energy in Switzerland and highlights the next steps to be taken in order to bring the project in Haute-Sorne to fruition.**



## **In conversation with Daniel Schafer**

Interview Lars Knuchel

**Geothermal energy is in its infancy. It has to suffer setbacks and meets with resistance. Nevertheless, GES continues to research the potential of geothermal energy in Switzerland, identifying possible project sites and planning the construction of power plants. Why are you doing this?**

Because geothermal energy has immense potential – and because we in Switzerland will depend on just this potential, at a time no later than when the last nuclear power station leaves the grid. To achieve this switchover in energy we will require a lot more renewable base load capacity in the future. Alongside hydroelectric power, geothermal energy is the sole form of energy that can deliver this. This is already up and running in Germany and France where in certain locations in Bavaria and Alsace a great amount of electricity, available day and

night for the entire year, is already being generated by geothermal energy plants. There is no reason why something like this should not also be possible in Switzerland. At GES we wish to concentrate the cumulative knowledge of deep geothermal energy and develop it further, so as to render a huge store of experience of use to our country. In the process we will steadily accumulate the experience of geothermal energy so far encountered in Switzerland. We know of the processes which have led to problems: these findings will constantly be included in our planning.

**Does enough potential therefore exist in Switzerland to be able to produce electricity or thermal energy, both economically and in the required quantities, from geothermal sources?**

The greatest potential lies in deep crystalline rock several kilometres beneath the surface of the earth. However, one needs appropriate technology to tap into this resource. At GES we are developing precisely this technology which, once established, will serve as the basis for

numerous projects across the whole of Switzerland. Our vision is as follows: wherever thermal energy and electricity are required, local combined heat and power geothermal plants will follow.

**We are standing here in the Jura municipality of Haute-Sorne on a piece of land purchased by GES with the aim of constructing a geothermal power plant for generating electricity nearby, and therefore of drilling down to a depth of 5 kilometres below our feet. Why here, exactly?**

In this location the geological conditions underground for such a project are excellent, as is the framework regarding infrastructure, environmental protection and regional planning. It is no accident that the Canton of Jura has made meaningful provision for geothermal energy in its energy strategy. And it is no coincidence that the cantonal structure plan also identifies the region of Haute-Sorne, alongside the urban agglomerations of Delémont and Porrentruy, as a region which is supposedly under consideration for the first geothermal project.



**GES began planning its project here in Haute-Sorne in 2012. What have you actually achieved in the last seven years and where exactly is the project today?**

Over these years we have developed our technology in the areas of monitoring, reservoir and stimulation to enable the safe and reliable delivery of the project. After the Jura cantonal government granted a comprehensive permit for our project in 2015, there followed a process of appeals. Both the cantonal court and, later, the federal court unequivocally endorsed the granting of the permit. Material support was forthcoming from the Swiss Confederation, which in 2017 granted our project a risk guarantee and in 2019 dispensed an exploration grant on the basis of the new Energy Bill. In 2019 we were also able finally to complete the purchase of the plot on which our power plant will stand.

**Your project has been approved by the Federal Supreme Court in the final instance and has received an exploration grant from the Swiss Confederation. How important to you is this backing from the Swiss Federal Office of Energy?**

This backing is central to the financing. Without the exploration grant which covers up to 60 percent of the costs of the first deep drilling, this project would not exist. The backing also demonstrates that geothermal energy is a central pillar of Energy Strategy 2050 because it represents a domestic solution to the production of seasonally independent, renewable base load capacity.

**Daniel Schafer**, President of the Board of Directors, Geo-Energie Suisse AG, and CEO of ewb (Energie Wasser Bern), in Haute-Sorne.

# Geothermal energy, a central pillar of Energy Strategy 2050.

## **Can you understand the scepticism of many people and grasp that parts of the local population here in Jura remain opposed to the approved geothermal project?**

New technologies always trigger concern and fears. A glance at the history of innovation and development on our planet shows just how human that is. We take the scepticism with which many people still regard our project here in the region very seriously. This is precisely why we are wholly committed to carrying out this project in a safe and professional manner. For the same reason a strict traffic light system underpins our project – we proceed step by step and take no shortcuts. We know exactly what we are doing: only when all requirements for the next stage of the project are met do we give the green light. Flawless technical delivery in addition to sincere, open communication are crucial. We should be judged on that.

## **What concrete measures is GES taking to win over the confidence of the local people?**

Maintaining an ongoing dialogue is of central importance to us. Our firm intention is also to set up an monitoring and information commission. Representatives from the canton, municipality, population, associations and the company undertaking the project will regularly meet on this platform and be able to exchange information. This is also the appropriate framework in which to seek pragmatic solutions to possible problems in a spirit of mutual respect. Furthermore, we will be open in providing information about our project and will commit ourselves to the level of transparency required. Included in this is, for example, permitting the representatives of the canton of Jura and of the Haute-Sorne municipality to take part in the meetings of Geo-Energie Jura SA's board of directors.

## **How might the region and the local population benefit from your geothermal project one day?**

Our project will provide the people from the region with clean, locally sourced energy in the form of electricity and heat, which will enhance the independence of the canton and of the municipality. Because we will be providing services, creating jobs and paying taxes, our project will also contribute to the local economy. It should also not be forgotten that this project can help the canton of Jura project a progressive image throughout Switzerland and abroad.

### **How would you assess the current cooperation with the cantonal and municipal authorities in the Jura?**

We have worked together very well so far. We have encountered much openness and a perceptible desire to make a contribution towards the development of the canton and the municipality. We have found the authorities and administration to be competent, efficient and focused on finding solutions.

### **Apart from the acceptance by the local population, what further challenges are there to overcome in ensuring the success of the geothermal project in Haute-Sorne?**

Our exploratory drilling will be the first to penetrate into the crystalline bedrock underneath the Jura. As with all exploration it is also the case that the underground could be formed somewhat differently to what we expect. This is an additional reason why we are involved with the rock laboratory at the Swiss Federal Institute for Technology Zürich in the Val Bedretto. The laboratory there gives us the opportunity to test technical solutions to our project here in Haute-Sorne under controlled conditions.

### **Finally, take a look into the future and venture a prognosis: what does this site look like in ten years' time? What can you see here around you?**

In ten years a new power plant will exist here, producing clean, renewable and locally sourced energy in the form of electricity and thermal energy. In ten years this will be a place where we will continue to learn much about deep geothermal energy and gain important experience in delivering our vision across Switzerland. Finally, I believe that in ten years' time the local population too will be proud that this pilot project is making a significant contribution to delivering Energy Strategy 2050. —

**In ten years a new power plant will exist here, producing clean, renewable and locally sourced energy in the form of electricity and thermal energy.**



# Figures | Data | Facts

## Key financial indicators

Total investment including construction of the power plant	<b>CHF 120 million</b>
Support of the Swiss Confederation	<b>CHF 60 million</b>
Net investment by investors and banks	<b>CHF 60 million</b>
Feed-in tariff by the Swiss Confederation	<b>54 cents / kWh</b>
Fee due to the canton of Jura	<b>0.3 cents / kWh plus a one-off fee of CHF 100,000</b>
Fee due to the municipality of Haute-Sorne	<b>0.2 cents / kWh plus a one-off fee of CHF 100,000</b>

## Key technical and geological figures

Depth of the boreholes	<b>4,000–5,000 metres</b>
Expected heat at this depth	<b>&gt; 140 °Celsius</b>
Expected flow rate	<b>&gt; 60 litres per second</b>
Deviation of the boreholes from the well head	<b>&gt; 1.5 kilometres</b>
Number of deep boreholes	<b>2</b>
Target formation	<b>crystalline bedrock (granite, gneiss)</b>

## Key operational indicators

Duration of construction work until completion of the power plant	<b>&gt; 5 years</b>
Operational lifespan of the power plant	<b>&gt; 30 years</b>
Output of the power plant	<b>max. 5 MW</b>
Expected annual production of electricity	<b>&gt; 20 million kWh</b>
Annual reduction in CO <sub>2</sub> (electrical only)	<b>&gt; 3,200 tonnes per annum</b>
Number of households which can be supplied with electricity	<b>6,000</b>

## Organisation

Number of Geo-Energie Suisse AG employees	<b>10</b>
Monitoring of seismic activity	<b>permanent</b>
Interruption or discontinuation of operations if predefined seismic thresholds are exceeded	<b>at any time</b>
Cessation of project in the event of unexpected problems	<b>at any time</b>

Figures are estimates and can differ from real values

## Haute-Sorne Deep Geothermal Project

# 8 Key Features

### Potential

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**Deep geothermal energy can significantly contribute to achieving the aims of the Energy Strategy 2050.**

### Pioneering spirit

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**Something new is happening in Haute-Sorne: the first electricity generating, geothermal power plant in Switzerland.**

### Technology

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**Geo-Energie Suisse's technology for extracting heat and electricity from geothermal resources is new and promising because it has been adapted to geological settings in Switzerland.**

### Standing

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**The project in Haute-Sorne is enjoying significant national and international attention.**

### Broad-based support

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**The Haute-Sorne Project has attracted broad support from the Swiss Government (Swiss Federal Office of Energy), from local authorities and environmental associations, and also the five participating Swiss energy providers.**

### Open company structure

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**The company's structure is open-ended and therefore suited to the participation of all types of investor.**

### Scalable

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**The project can be duplicated at further sites in Switzerland.**

### Secure

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**The Haute-Sorne project benefits from liability insurance cover of over CHF 100 million.**

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