COOLING INDOOR SPACES WITH GEOTHERMAL ENERGY

HAZARD

HEAT

IMPLEMENTATION STEP

CONSTRUCTION

RENOVATION

AREA OF ACTION

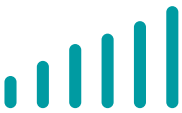
COOLING

COSTS

€ € €

low medium **high**

LEVEL OF SKILL



high

Faced with rising temperatures and increasing heatwaves, surface geothermal energy offers a passive cooling solution for buildings. Starting at about ten metres underground, the temperature stabilises at around 15°C throughout the year. Geothermal energy uses the ground as a source of coolness (in summer) or heat (in winter), and is therefore part of a process of exploiting the advantages of the territory. This method can be used in all types of building.

IMPACTS

Surface geothermal energy can be exploited to **cool the building's interior spaces**, thereby maintaining the thermal comfort of occupants during the summer months. Installing a geothermal system can result in **significant energy savings**, reducing the building's energy bill and the environmental impact of equipment, particularly as there is no need to transport energy.

INSTALLATION GUIDE

Numerous geothermal systems exist, which may be vertical or horizontal, based on air or water. The choice of system depends on the characteristics of the building (e.g. surface area) and the land, the space available, and the budget.

Two so-called "passive" geothermal systems are particularly interesting because they consume little or no energy:

- **Geocooling** uses the difference in temperature between the ground and the inside of the building to cool it by means of a heat exchanger, without active extraction. It can be installed independently from other geothermal systems (in which case geocooling is a standalone system) or used with other geothermal systems, bypassing the heat pump. A similar principle is used in the "free-cooling" systems installed in district cooling systems, which exploit the cool temperature of a water source to cool buildings.

- With a **Canadian well**, fresh air collected from outside is circulated through a buried duct and then blown into the building. This is mainly a pre-cooling or pre-heating method. For greater efficiency, it can be combined with a single- or dual-flow CMV.

The design and installation stages of geothermal systems are extremely important. No mistakes should be made, because once the system has been installed, it's often difficult and costly to work on the buried parts.

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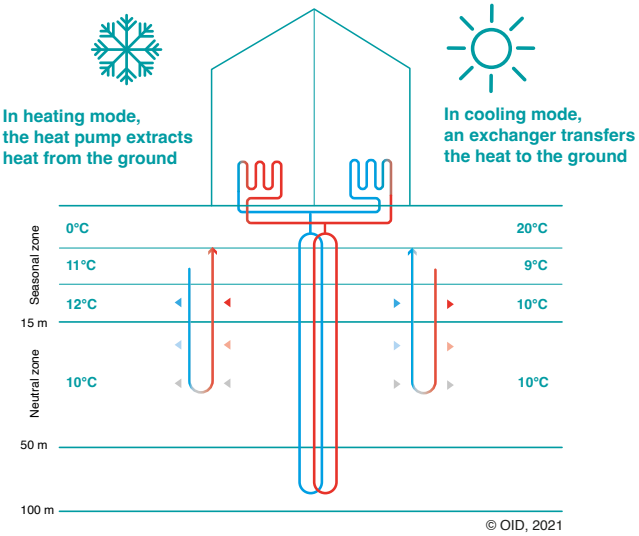
OPERATION OF A GEOTHERMAL SYSTEM IN WINTER AND SUMMER



Source : Ma solution chauffage (2020)

WEAK POINTS AND STRONG POINTS

⊕ Using geothermal energy in an **urban environment can be difficult**, as it often requires a free plot of land. However, the use of **public spaces**, such as parks or parking areas, by public authorities can be an interesting and innovative solution for geothermal energy, thanks to a “tempered water loop” system.

⊕ When constructing, the system **can be installed under the building,** so that no additional land is required.

⊕ Although the cost of installing a geothermal system is high, individuals, local authorities and businesses can **benefit from** financial support when installing geothermal solutions, such as the Ademe’s Fonds Chaleur or MaPrimeRénov’.

⊖ The **consequences for biodiversity** have yet to be fully assessed: emissions of toxic pollutants, disruption of the soil ecosystem, etc.

⊕ Geothermal energy doesn’t always meet all the energy needs of building occupants, particularly in winter. It can be used as a **basic solution**, but may require the **occasional use of other systems.**

MALADAPTATION

The use of surface geothermal energy to cool the interior spaces of buildings may be affected by climate change. The ability of the ground to act as a source of cooling depends on its thermal stability over seasons and years. If the temperature of the ground or its geothermal characteristics change due to factors such as **global warming**, this could **reduce the effectiveness of the passive cooling system**. For example, if the ground temperature increases over time, the temperature difference between the ground and the interior of the building could decrease, which could compromise the system’s ability to effectively cool interior spaces.

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MONITORING INDICATORS

MONITOR MY ACTIONS FOR CLIMATE CHANGE ADAPTATION

+/− : Quantitative indicator ★ : Qualitative indicator

INDICATORS OF RESULTS	INTERPRETATION
+/− Comparison between the temperature outside and inside the building in summer (°C)	Increase in temperature difference between the outside and inside of the building in summer
+/− Comparison between energy consumption for cooling using a geothermal system and that of a control situation* (kWh)	Energy consumption using geothermal system < control situation*
+/− Percentage of cooling requirements covered by geothermal energy (%)	To be maximised

**The control situation is defined by the parameters set to isolate the influence of the adaptive action (similar conditions: weather, time of measurement, space, etc.).*

FIND OUT MORE

Agence de l'environnement et de la maîtrise de l'énergie (*ADEME*) (2017), *Chauffer et rafraîchir avec une énergie renouvelable*

Association française des professionnels de la géothermie (*AFPG*) (2020), *La géothermie de surface*

Guide bâtiment durable Brussels (2016), *Puit canadien*

The building's car park located on top of the vertical geothermal probes.

REAL-LIFE EXAMPLE

CAF DU LOIRET

BUILDING : ADMINISTRATIVE BUILDING (FAMILY BENEFITS FUND), ORLÉANS
SURFACE AREA: 12,000M²
USE: COMMERCIAL
COST: €150,000 - €180,000

Because of its proximity to the Loire River, the building was able to install a geothermal system using groundwater. The work was carried out when the ageing air handling units were being replaced. The system was designed to meet the cooling needs of the 290 occupants of the 5-storey, 12,000 m² building, while reducing the energy consumption of the heating equipment. Located under the car park adjacent to the building, the geothermal system was inaugurated in August 2019. The system is highly efficient, with temperatures 6 to 7°C lower than outdoors in summer and a drop of around 25% in energy consumption . Geothermal energy covers 100% of the building's cooling needs (geocooling) and 15-20% of its heating needs (the remainder is supplied by the old gas-fired heat pump system). The fairly high cost of installation was partly covered thanks to financial assistance from Ademe (Heat Fund) and is expected pay for itself in around ten years.

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