Geothermal well drilling

Various types of « geothermy »

- very low energy (T° < 30 °)
- low energy (T° from 30 to 90° C)
- high energy (T° > 150 ° C)

Very low energy geothermy

- Production from a source T°<30°
- Does not allow a direct use of the heat through a simple exchange process
- Requires the use of heat pumps, to extract this energy low temperature and increase it up to a temperature high enough for heating systems

2 types of natural sources used

- The energy stored in the soils/rocks
- The energy stored in the undergound water

Geothermal gradient

- At 10 m depth, the average temperature of the soil is between 10 and 12° C.

- This temperature increases at a rate of

3 °C/100 m.

Techniques to produce heat from this renewable energy

- Water well type drilling (open loop)
- Well drilling for the installation of vertical geothermal equipment (closed loop)

Water well drilling

- Advantages :
- High COP
- Limited footprint
- Allows in some cases, to produce high power

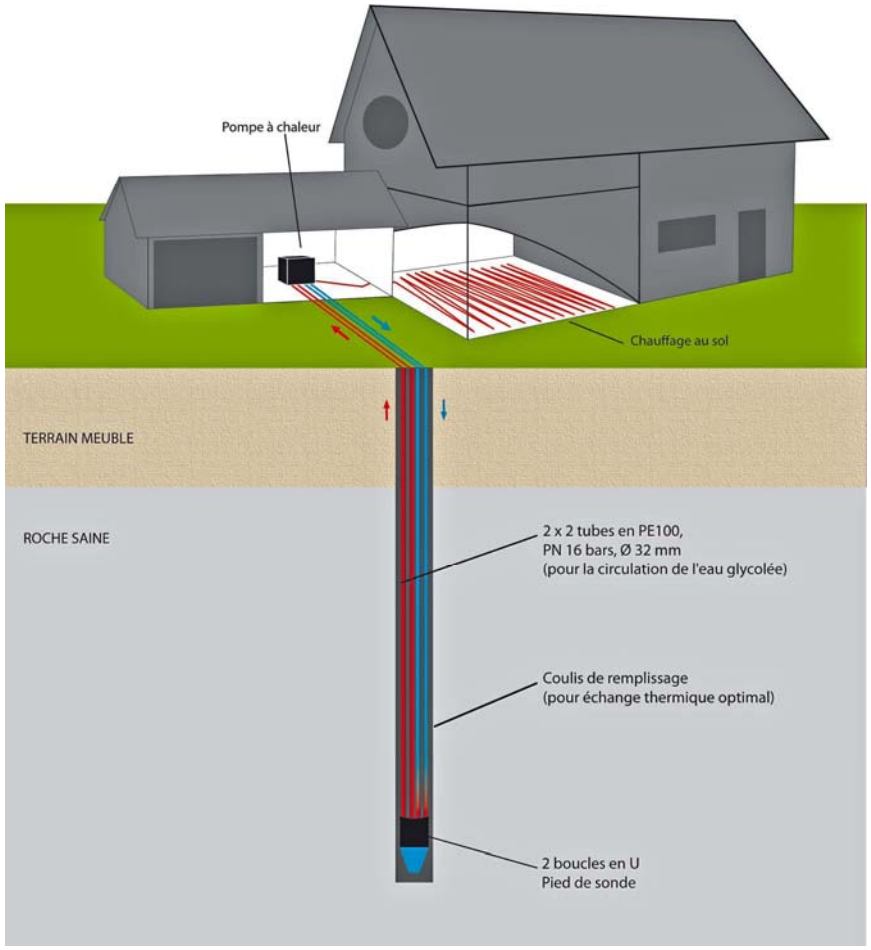
- Drawbacks :
- Heat « reserves » are uncertain
- Wells depth and exploitation cost
- Water mineral composition
- Problem of water discharge
- Legislation

Drilling for the installation of vertical geothermal equipment

- Advantages :
- High COP
- Limited footprint
- VG’s may be installed in almost any type of geological formation
- Underground water not absolutely necessary
- Equipment materials used are very durable
- No impact on water ressource
- Option to reverse the system during summer time

- Drawbacks :
- Quite high costs for high powers
- Sizing

Description of vertical geothermal installation



Equipment specification

- Calculation of the « cold power » of the heat pump

  P cold = P hot – P elec

- Calculation of the electrical power of the heat pump

  P elec = Phot / COP

- Extractable power out of the ground

  In average : 50 W/m drilled

Puissance que l'on peut extraire du sol

Sous-sol	Extraction de chaleur spécifique (W/m)	
	1800 h/a	2400 h/a
Valeurs indicatives générales :		
Sous-sol pauvre (sédiments secs) (λ<1,5 W/(m.k))	25	20
Sous-sol rocheux sol normal et sédiments saturés en eau (λ<1,5 – 3,0 W/(m.k))	60	50
Roche compacte à conductibilité thermique élevée (λ > 3,0 W/(m.k))	84	70
Roche seule		
Gravier et sable secs	< 25	< 20
Gravier et sable saturés en eau	65 - 80	55 - 65
Terre argileuse humide	35 - 50	30 - 40
Calcaire (massif)	55 - 70	45 - 60
Grès	65 - 80	55 - 65
Granite	65 - 85	55 - 70
Basalte	40 - 65	35 - 55
Gneiss	70 - 85	60 - 70
Valeurs d'extraction spécifique potentielle pour les échangeurs de chaleur verticaux (VDI 4640, partie 2)		

Example

- A heat pump of power 11,8 kW with a COP of 4,5
- P elec = 11,8/4,5 = 2,6 kW
- P cold = 11,8-2,6 = 9,2 kW

9,2 kW are extracted from the ground.

Drilling depth: 9200 W/50 W = 184 m

Two geothermal wells 92 metres deep will be needed.

Drilling steps: practicle aspects and technique

- Geological data (data bases, experience)
- Accessibility – size of machines – machines installation
- Water projections and debris drilling (sediments sensor, protection sheet, settling pit)
- Checking of potential water venues and presence of several aquifers
- Installation of geothermal equipment (reel, protection)
- Setting of filling materials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