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GEOTHERMAL HEAT PUMPS

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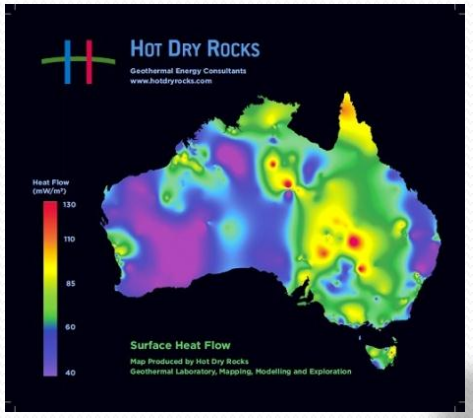
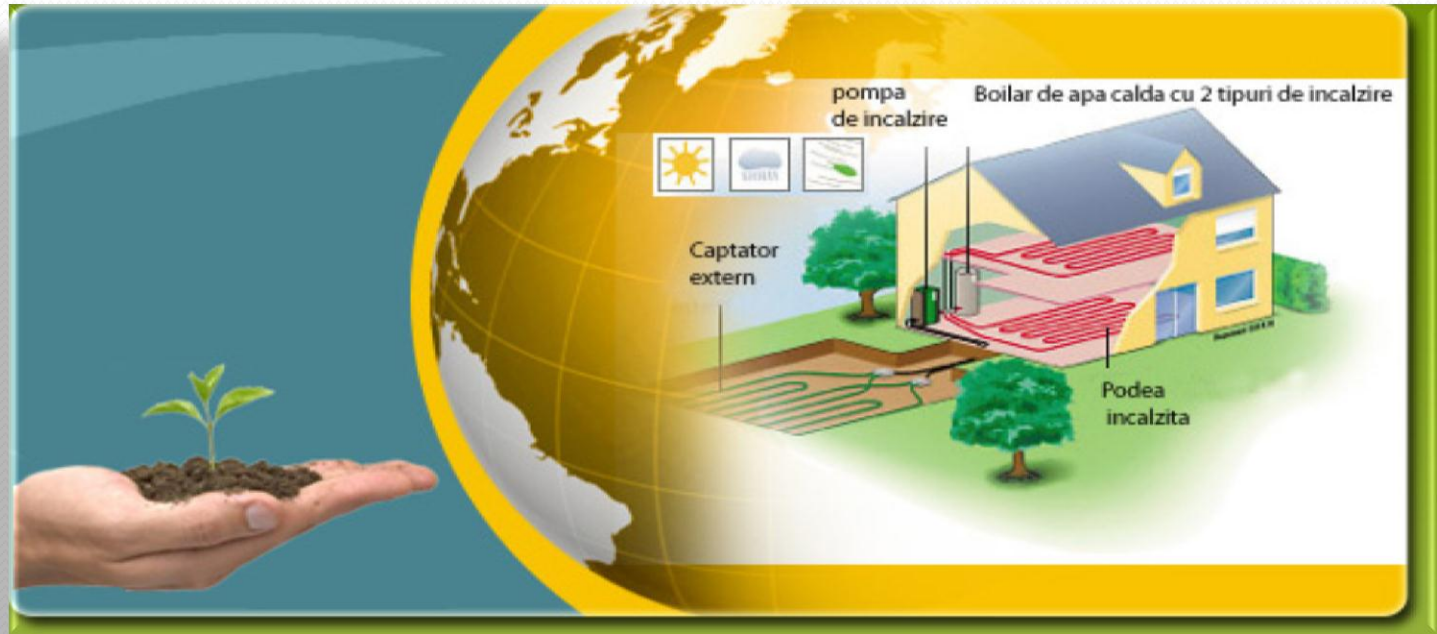
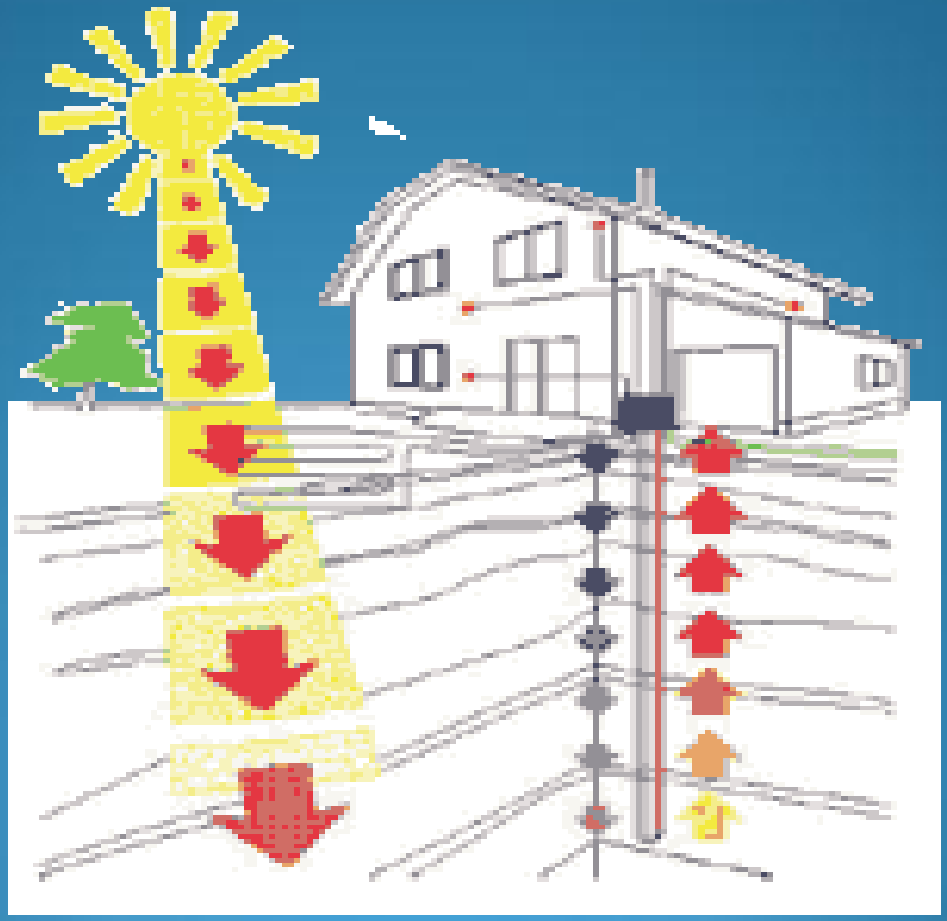




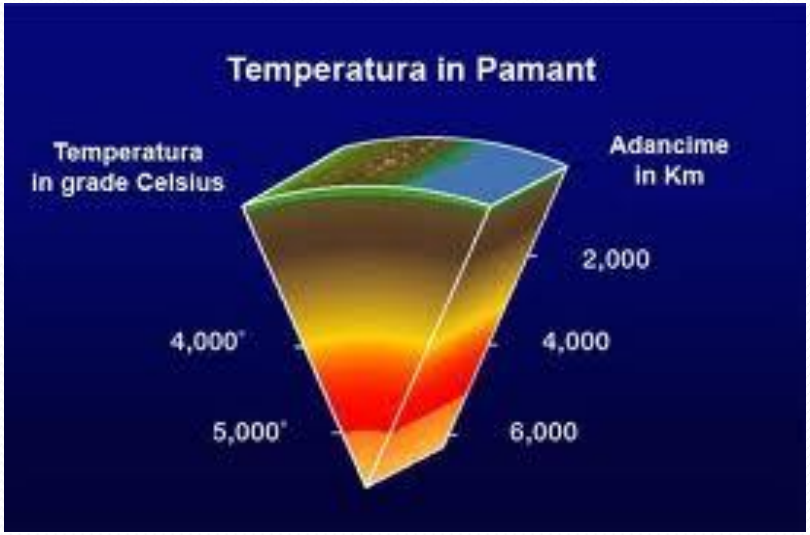
Contents:

- Operation principle of geothermal pumps.
- Types of heat pumps.
- Geothermic potential of Romania

Operation principle of geothermal pumps

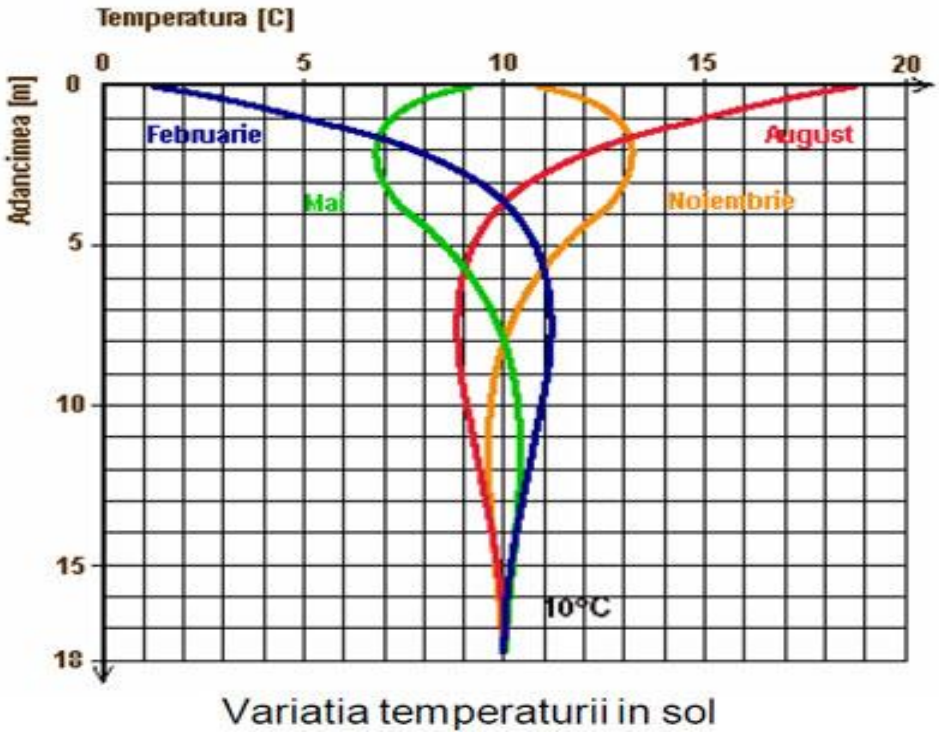


GEOTHERMAL ENERGY: heat from fluids and from subterran rocks. Geothermal energy is used in: heating rooms, industrial heating, electric energy production.



Humans have used hot reservoirs since thousands of years ago, to ensure cooking, heating and washing.

Direct usage of geothermal energy can be made possible through geothermal reservoirs that can be found deep in the surface of the Earth (a few km).



Variatia temperaturii in sol

Operation principle of heat pump with electric operated steam compression (heat pump – HP)

The heat pump is not a new discovery. It has been certified at he beginning of the 20th century, together with the invention of the refrigerator.

The operation principle of HP is based on a series of phenomenons and physics laws:

- The 2nd principle of thermodynamic by Rudolf Clausius: "The heat cannot pass itself from an object that has a lower temperature to another with a higher temperature"

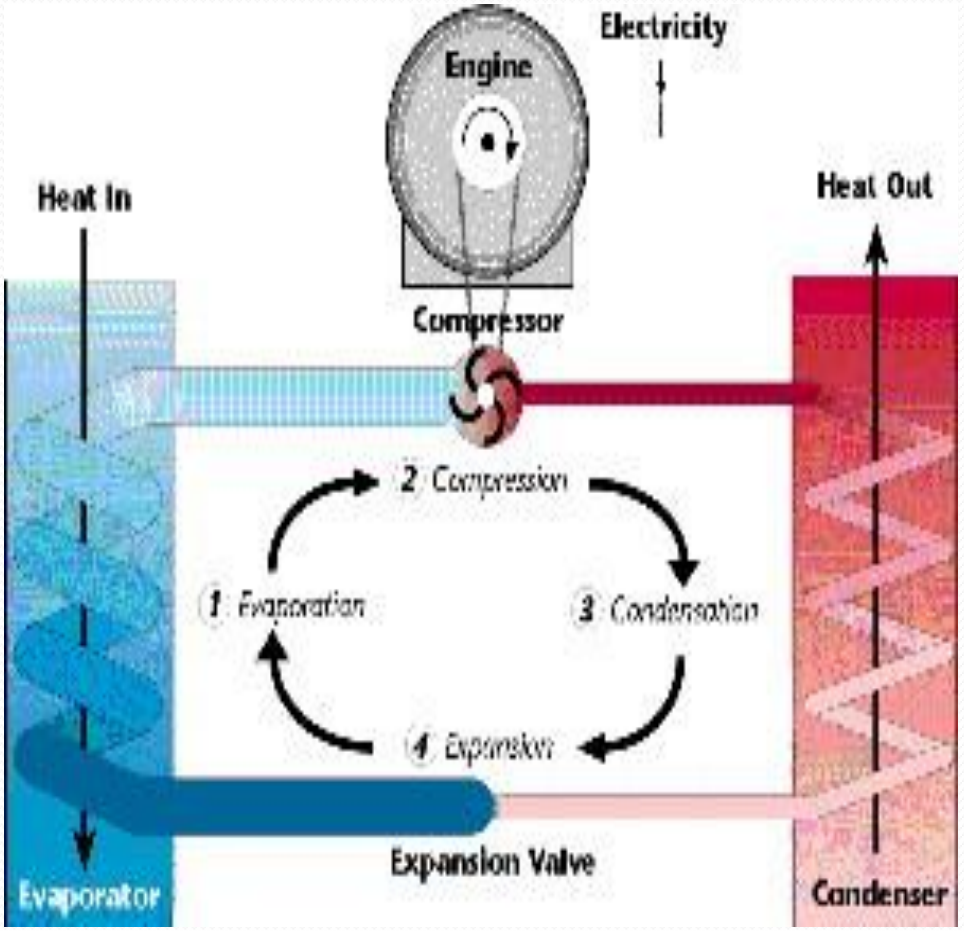
- In the 19th century, the well-known physician James Watt discovered that "a gas that is compressed emits heat, and if it is dilated it absorbs heat!"

So, heat pump technology is also known as "CLAUSIUS TECHNOLOGY"

CLAUSIUS TECHNOLOGIES

During the usage of a HP there are:

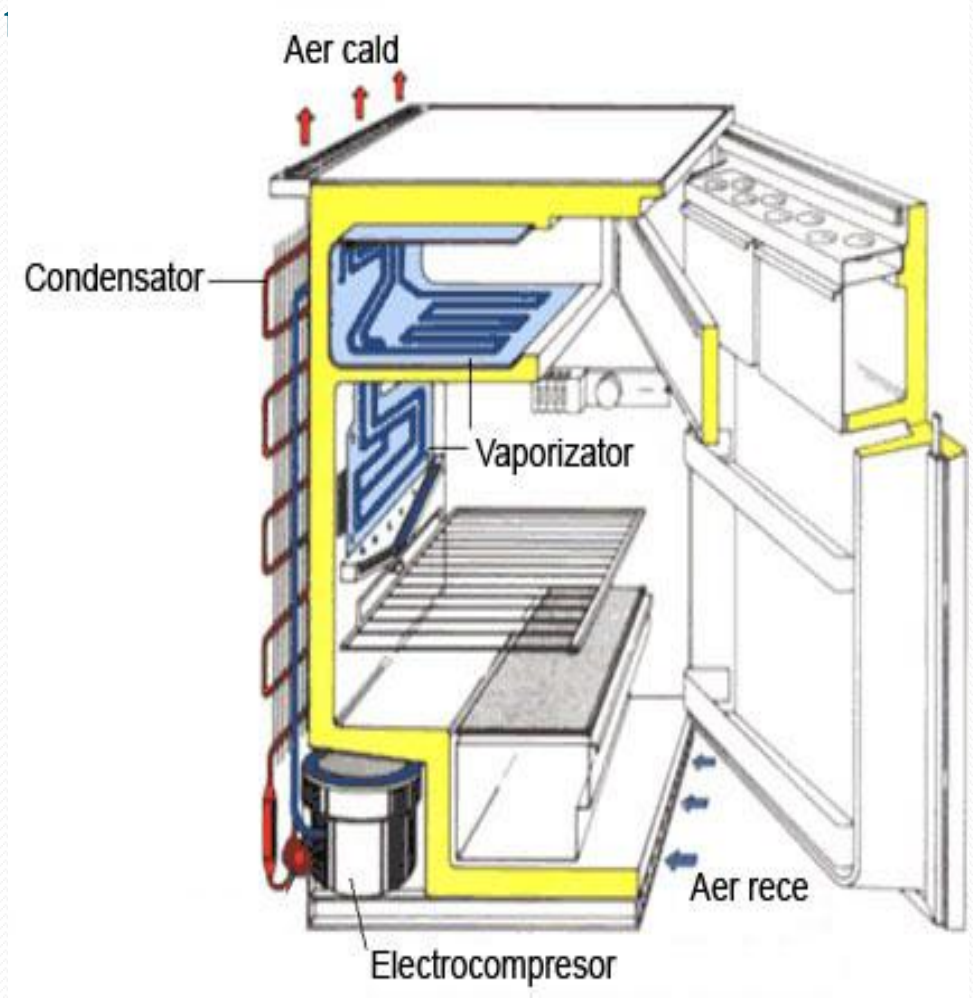
- an object with a lower temperature (for example: air, water) which we will call cold source (and it reaches in the evaporator)
- an object with a lower temperature than the cold source named refrigerant (according to the 3rd principle, this can absorb the heat from the cold source)
- an object that will receive heat, from the refrigerant (in the condenser), name thermal agent.
- the refrigerant, has a very low boiling point (about -2 º C), and has the property of storing energy and transform from a liquid state in a gas and can easy give heat, transforming back in a liquid state.



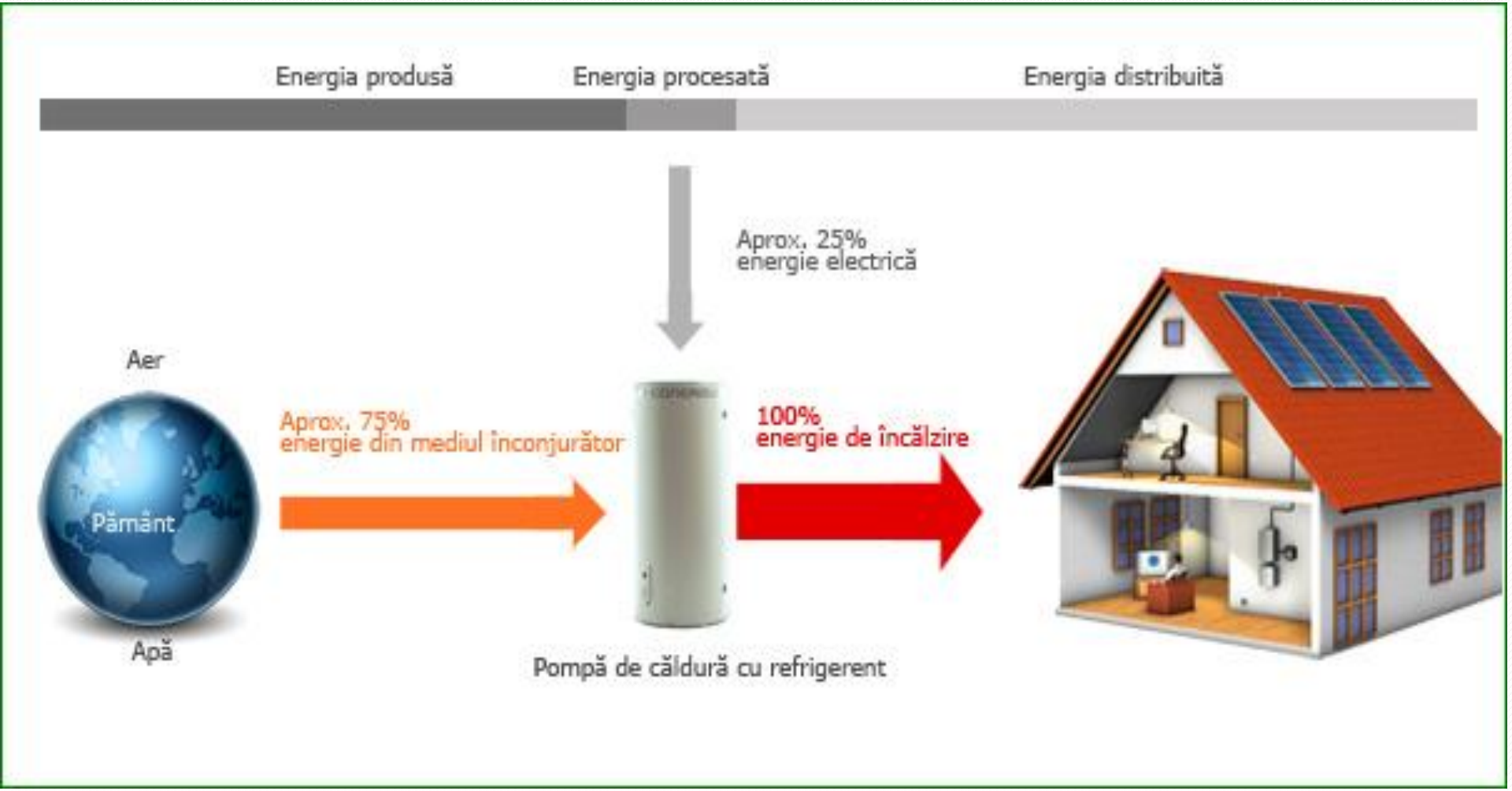
Maybe you did not knew that your refrigerator is in fact a heat pump that works in reverse: it has the property of cooling the air in a place and warms the air next to it. You will see that these machines are reversible

During the functioning of a HP, the refrigerant plays an essential role. Nowadays, the freon, considered non-ecologic, has been replaced with frigorific agents like R407C, R134a, or similar.

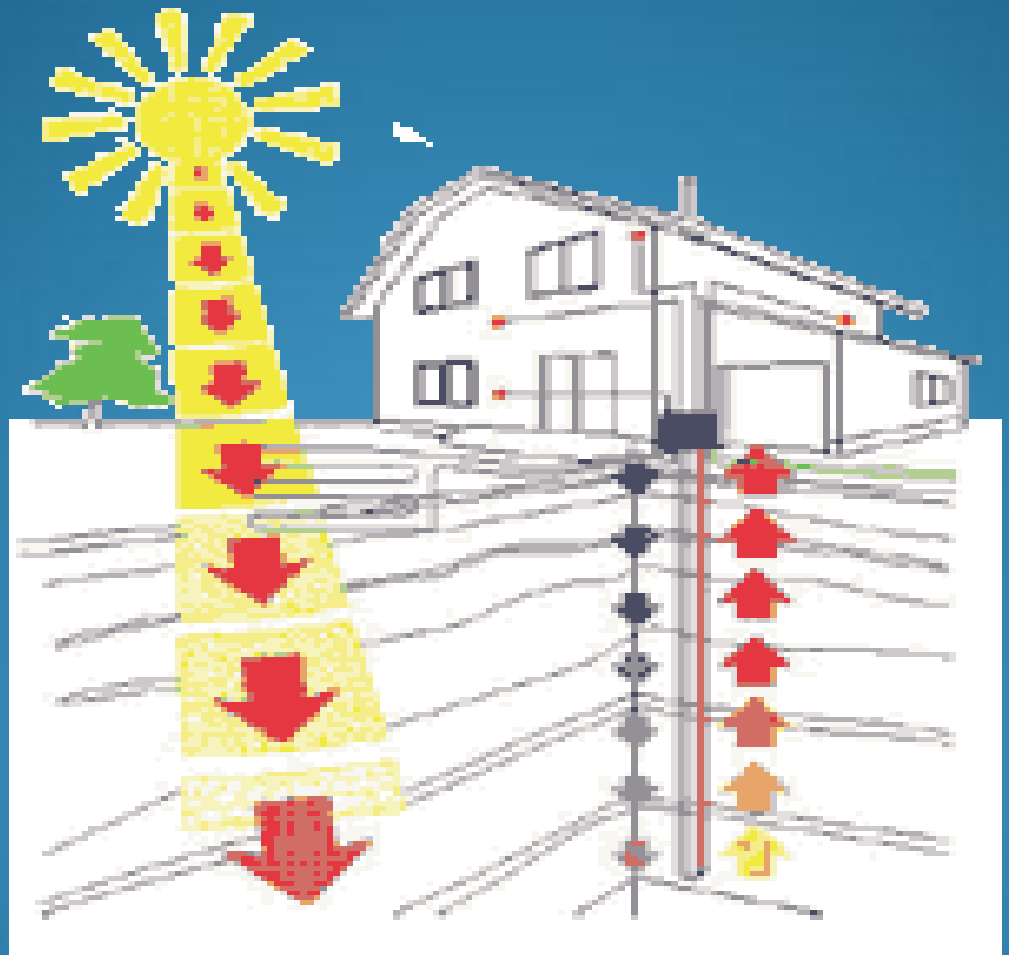
Also liquid gas like propane or carbon bioxid is used. These are found free in nature and can be considered ecologic.



Intuitive schemes:



Types of heat pumps

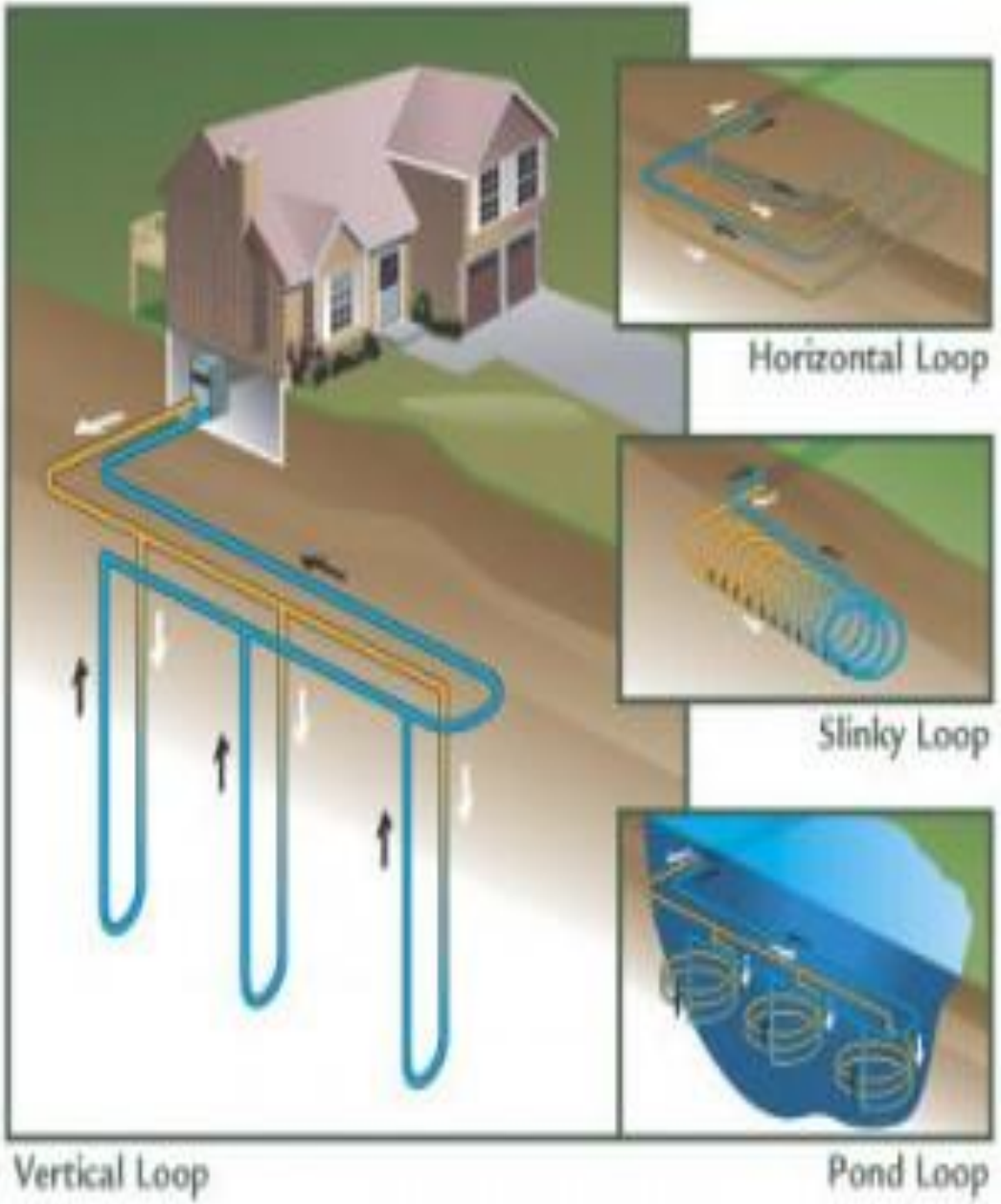


Heat extraction from Earth

"Heat extraction from Earth" system starts with the heat pumps made of three parts:

- a heat pump;
- a connection with the ground ;
- an interior distribution system for heating and cooling (conditioning system).

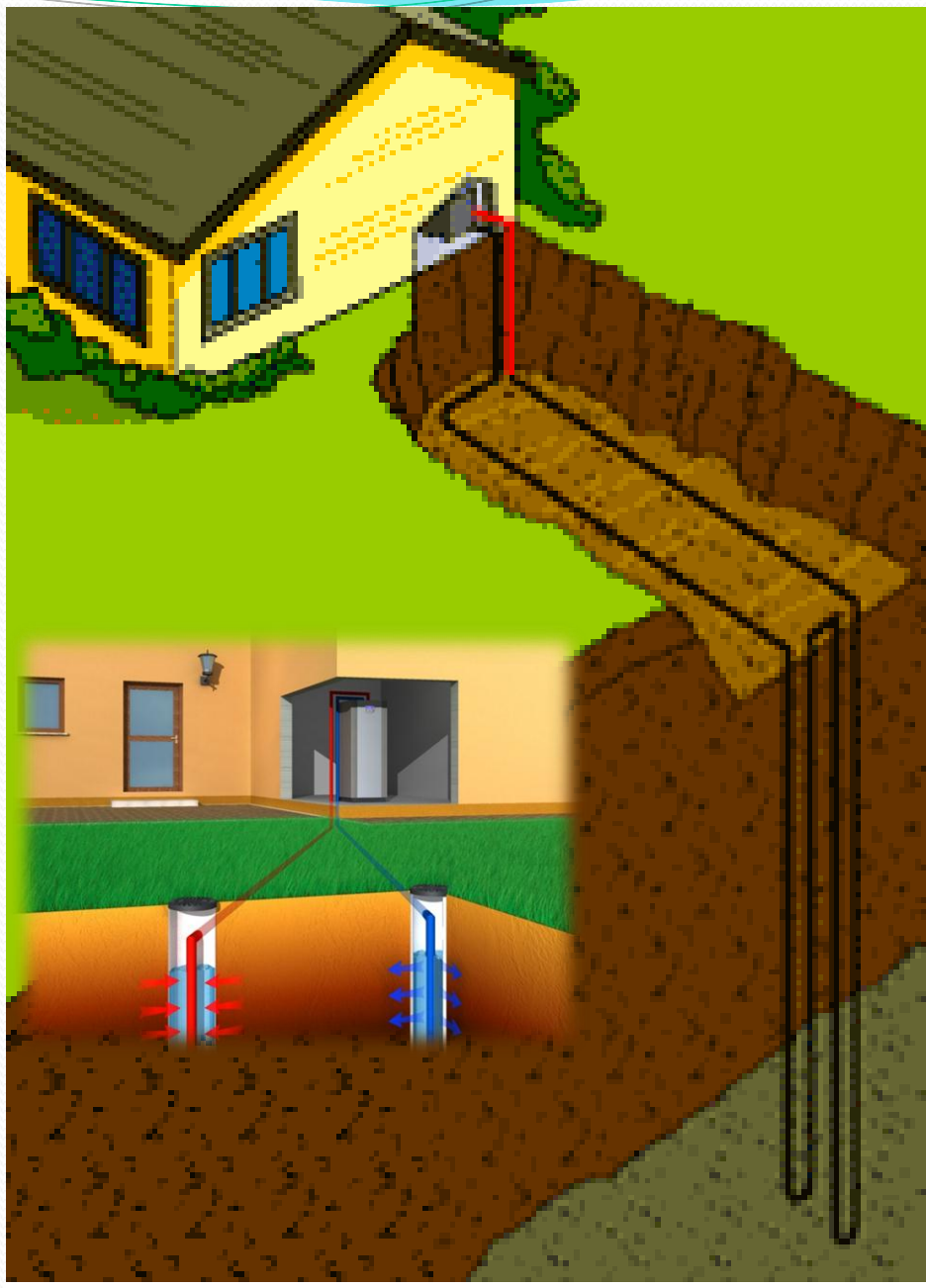
The heat pump works in the same way as a refrigerator works. It uses compression and dilation of the working agent to lead the heat wave between the interior of the building and the ground. The heat wave will pass only from the warm areas to the colder ones, but the pump can extract heat from the ground (5°C), raising the temperature inside (21°C)



Underground probes

In one or more parallel wells with a depth of approx. 100 meters, a probe is introduced and through it runs a working agent (like water with antifreeze). This type of collectors are placed in a tight place. The functioning of the system is based on the fact that at 15 meters below the surface of the Earth the geothermic temperature has a constant value all year long.

The deeper you go, the temperature is also rising. The collected energy is transferred to a fluid in the heat pump called refrigerant, which passes from a gas state through compression and reaches an optimal temperature high enough to ensure heating and hot wastewater.



Functioning of water pumps

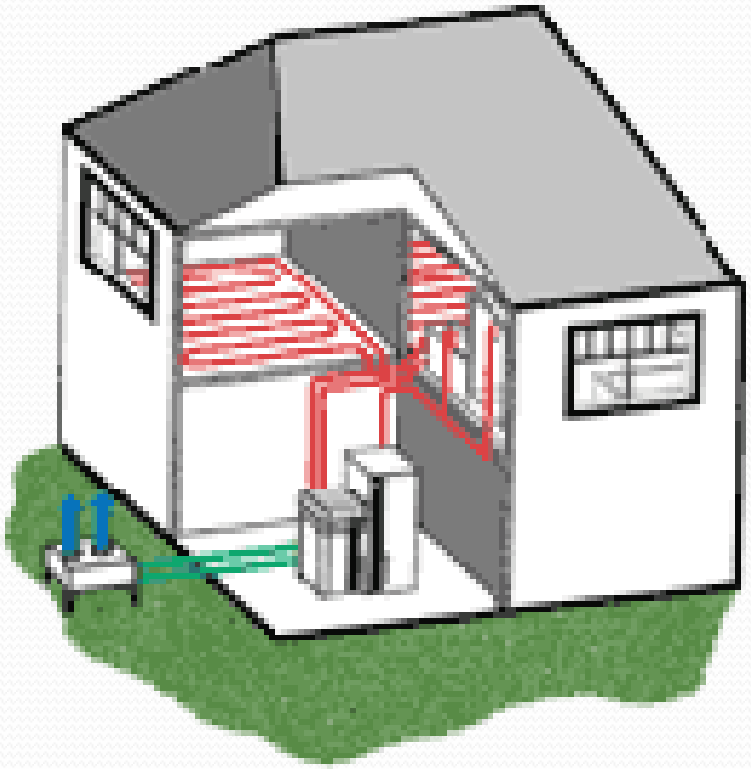
The most efficient source for ecological heating is the underground water. A constant temperature of 7-12 °C makes the underground water a thermal energy carrier through the entire year, without being influenced by meteorological conditions.

It is necessary making two wells: from the first one, the water extracted is carried to the heat changer in the pump and in the second one the cold water is thrown. The optimum distance between the two wells is approx. 15 meters.

Heat pump principle with air as a heat source

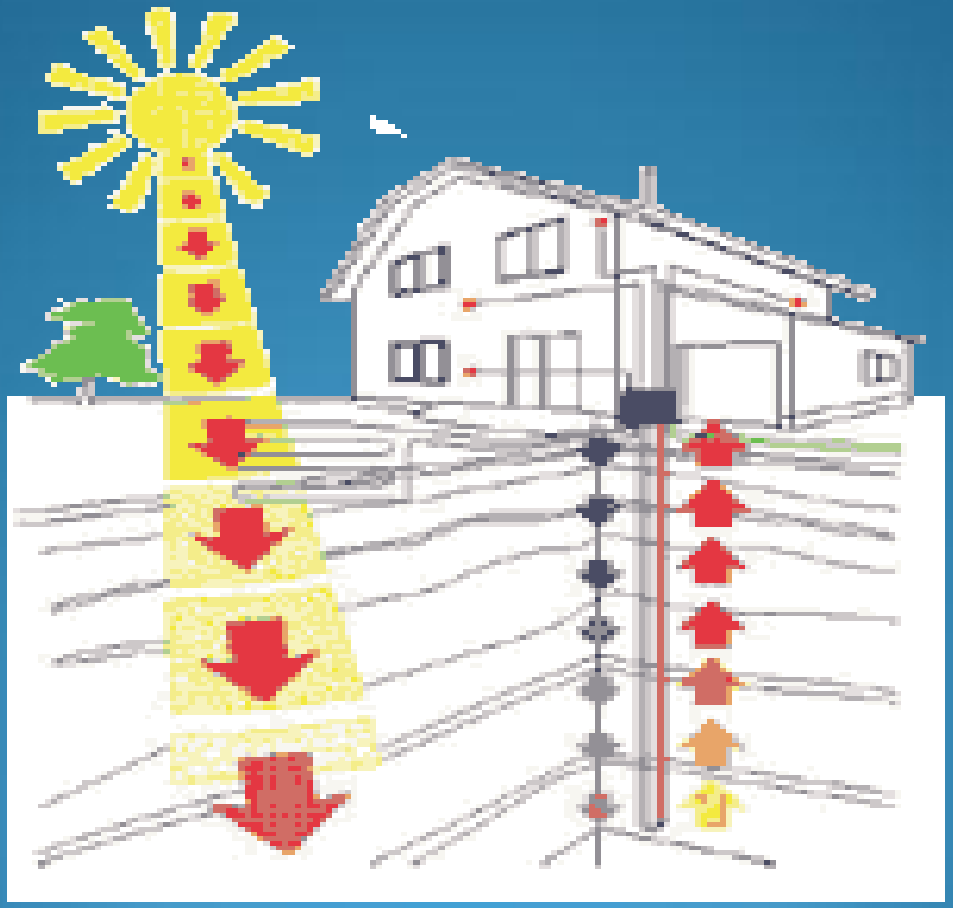
In the case of air-water heat pumps, an air module replaces the drilled well, the hose or the heat changer.

The module for air is placed near an outside wall of the building and is working together with the heat pump, placed inside or outside the building. A thawing unit is installed near the pump and if it is necessary, it can thaw (defrost) the air module, a necessary operation for efficient working even in low temperature conditions.



The energy from the outside air is transferred from the air module to the refrigerant in the heat pump, and through compression, it reaches a temperature high enough to ensure heat and wastewater. In the few days when the temperature is placed under -10 °C, the heat pump is automatically helped by an electrical resistance.

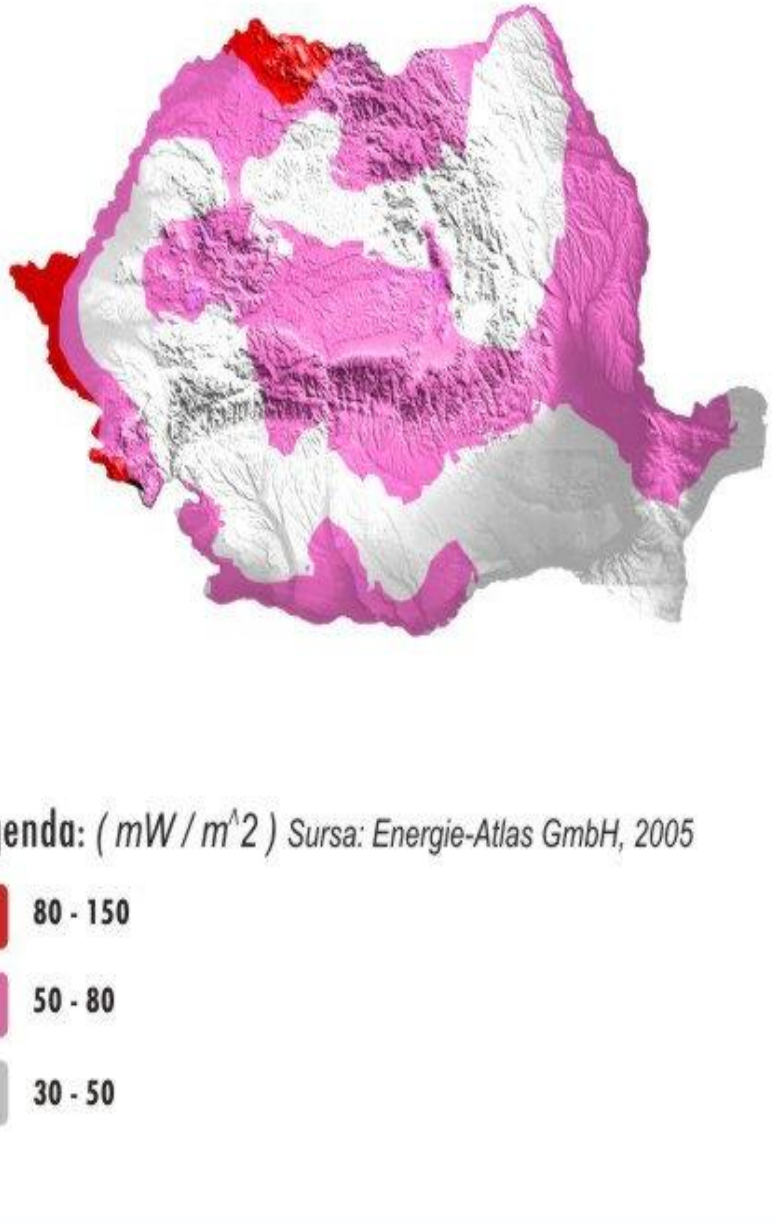
Geothermic potential of Romania



On our territory, a number of over 200 drillings for hydrocarbons have met at depths of 800 and 3500 meters, geothermal resources of low and medium enthalpy (40-120° C).

Experimental exploitation of about 100 drills, in the last 25 years, allowed the achievement of the energy potential evaluation of this type of resource.

The geothermal energy extracted is used in a proportion of 37 % for heating, 30 % for agriculture (greenhouses), 23 % in industrial processes and 7 % in other ways.



The chart below presents a synthesis of the main parameters from the important geothermal perimeters in Romania, including the theoretical energy potential.

Nr. crt.	Geothermal system	Estimated area	No. of probes	Drilling depth	Exploitable debit	Resource temperature	Theoretical energy potential
		km^2		m	L / s m^3/h	°C	MWt
1.	Crișul Negru- Someș Săcuieni, Marghita, Ciumeghiu, Salonta - județele Bihor și Satu-Mare	3570	18	1500	148 533	77	29,14
2.	Orașul Borș județul Bihor	13	4	2800	30 108	100	8,79
3.	Municipiul Oradea județul Bihor	77	12	2800	151,5 545,4	83,8	34,1
4.	Mureș - Crișul Negru Curtici, Macea, Municipiul Arad -județul Arad	1060	113	1500	79 285	58	9.3
5.	Banatul de Vest: Nădlac, Sânnicolau Mare, Sărăvale,Tomnatic, Lovrin, Jimbolia, Periam, Teremia Mare, Comlosu Mare, Grabat, Beregsăul Mic - județele Arad și Timiș	2790	20	2000	318 1144,8	77	62,75

The geothermal energy potential of Romania

Parameter	Measure unit	Tehnical	Economical
Nominal power	MWt	480	375
Electric energy	TJ/yr	9000	7000
	Thousand temp/yr	215	167

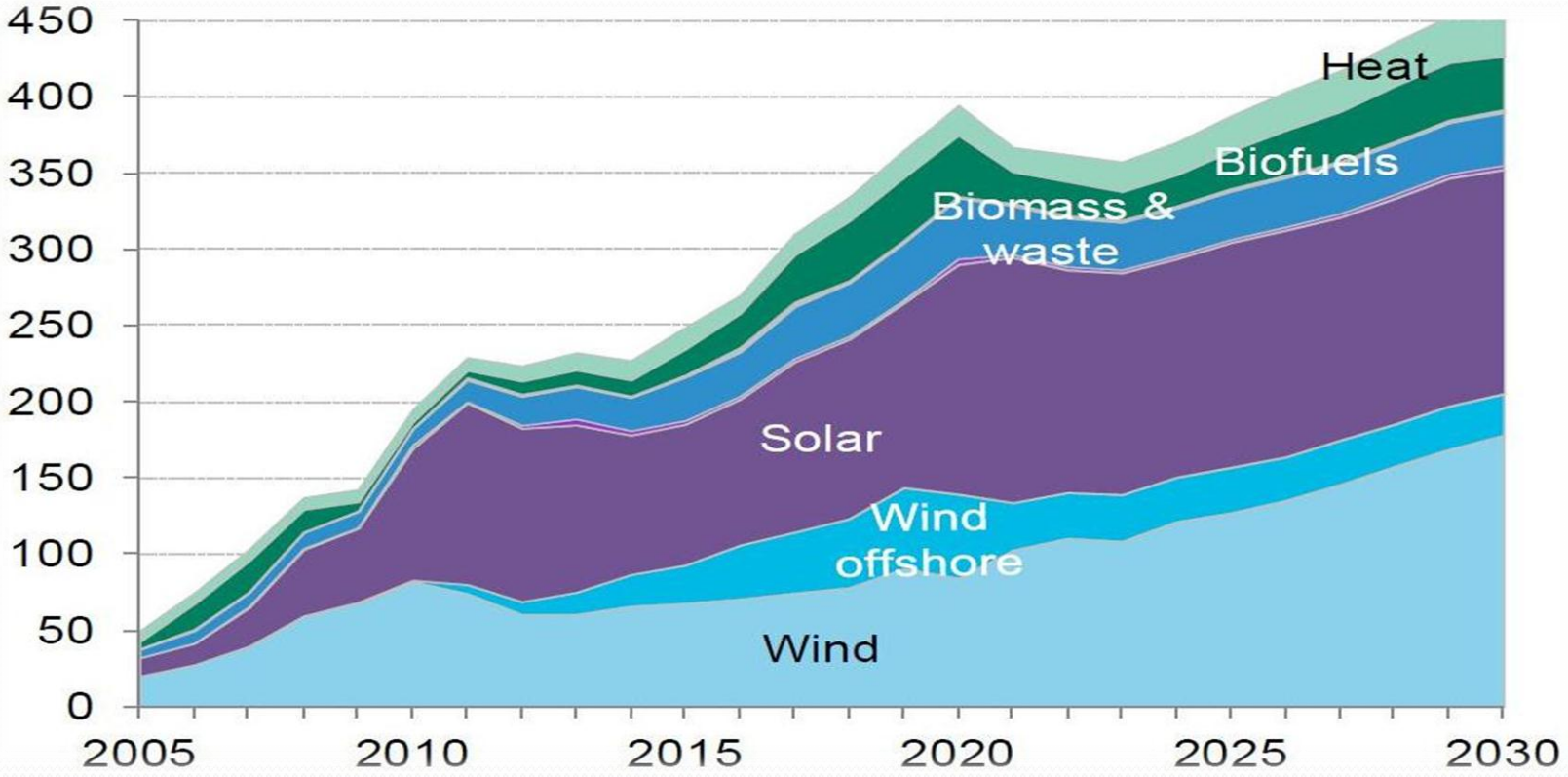
Conclusion

- Investments in renewable energy have grown in the last few years due to the decrease of the natural sources and high worries regarding the environment.

- China is the biggest investor in these kind of projects, with 51,1 billion dollars invested in 2010.

- According to Bloomberg Renewable Energy Market Outlook, in the next 10 years we will witness an accelerated growth of investments in renewable energies. Most of the investments between 2018 and 2020 will be directed to offshore aeolian projects, especially Germany and Great Britain.

Here is the evolution of investments in renewable energy at a worldwide level in the next 20 years, according to the forecasts of Bloomberg New Energy Finance:



As you can see in the graphic, the solar energy will hold a significant share of the renewable energy project investments, together with the aeolian and geothermal energy projects.

The geothermal potential of Earth: 4000 times the global energy necessary!

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