

## Autonomous house: Energy of earth heat

A series of articles on the autonomous existence of your cottage will tell you about the possibilities of using renewable and non-traditional energy sources (RES), the advantages and disadvantages of different solutions, payback periods and more.

### Earth heat energy in theory

If we compare the principles of geothermal energy with other methods of generating electricity or [heat](#), it should be noted that wind, solar and biofuel energy are engaged in generating energy from external sources. In the case of geothermal energy, heat or electricity is not generated but "transferred" as heat from one system to another. This is its uniqueness. Why spend on energy extraction, shipment, transportation? Everything you need to create warmth is under our noses, and to be quite precise, under our feet. The soil at a certain depth (usually from 2 meters) always has a positive temperature and often this temperature is higher than the surface temperature. I am sure that many of us have watched the repair of the road or water supply system more than once in the morning, when steam rises from the dug pit. Just a few meters and a relatively significant temperature difference. Using technological solutions, this heat of the earth can be transferred to your home to heat the floor, walls or heat water or cool the air. This technological solution is called a heat pump, and the principle of its operation coincides with the principle of operation of your favorite kitchen appliance - a refrigerator.

Like a heat pump, a refrigerator takes heat from one system (refrigeration chamber) and transfers it to another system (room), heating the radiators on the back of its housing. The only difference is that the refrigerator takes heat from the chamber and gives it heat to the environment. In the case of a heat pump, the opposite is true - it takes heat from the environment and transfers it to the room (to the facility).

### Heat extraction technology

The circuit (external circuit) is buried in the ground, it is a closed system of polyethylene pipes through which the heat carrier circulates. For efficient operation of the heat pump, it is necessary that the freezing point of the heat carrier is lower than zero, so the mixture of water and antifreeze could serve as a coolant. The heat carrier, which is pumped through pipes, gets heated by several degrees due to the heat of the soil and enters the heat exchanger, in our case, the heat exchanger is an evaporator. A low-boiling refrigerant circulates through the inner circuit. The temperature of the coolant is completely enough for the refrigerant to boil and turn into steam, while removing heat from the coolant. The gaseous refrigerant is then pumped by a compressor, where it is compressed and its temperature rises. Then the compressed refrigerant enters the condenser, where the heat is transferred to the coolant, which circulates along the circuit of the heated object. The cooled refrigerant is then returned to the evaporator in the liquid state, where it is heated by the coolant from the external circuit.

### Heat pump efficiency

If we are talking about the effectiveness of such an alternative solution as a heat pump, it is worth finding out its correctness coefficient. There are articles on the Internet in which the authors claim that the heat pump has an efficiency of more than 100%, namely 300-400%, meaning that the heat pump is a perpetual motion machine. But, as we know from the school physics course, this is impossible. First, because the heat pump does not take energy from anywhere, it takes it from an object whose mass and size are much larger than the heated object. Secondly, for the whole system, which is a heat pump, it would be correct to use the concept of Heat Transfer Coefficient (CPT), rather than efficiency. In fact, after consuming one amount of electricity from the grid for personal needs, the pump in the form of heat will bring 3-6 times more from an external source (soil, [water](#),

air), but this energy is taken from an object that is in the same system with the heated object which does not allow such a relationship to be called efficiency.

### Some facts about the heat pump:

1. The United States produces about 1 million heat pumps annually.
2. Japan produces about 3 million heat pumps annually.
3. In Sweden, 50% of all heating is provided by heat pumps. 12% of Stockholm's total heating is provided by HPPs with a total capacity of 320 MW, that use the Baltic Sea as a heat source at an average annual temperature of eight degrees Celsius.
4. In 2001, in Switzerland, HPPs were installed in every third newly built building (no information for other years). One TN is installed for every two square kilometers of Switzerland (covering forests, mountains and reservoirs).
5. A geothermal heat pump has been installed in the apartment of US President George W. Bush in Texas since 2001, reducing heating and air conditioning costs by 75%.
6. "The Queen is drilling a well to heat the palace," the London Times reported on 21 August 2005 on plans to build a heating tank for Buckingham Palace.
7. In November 2003, Sir Elton John installed a TN to heat a private mansion (Windsor, UK).
8. According to the forecasts of the World Energy Committee, in 2020 the share of HP in heat supply in the world will be 75%.

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