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## **ALTERNATIVE METHODS OF ENERGY PRODUCTION (HEAT PUMPS)**

A heat pump is a device that transfers heat energy from a source of heat to what is called a thermal reservoir. In this use, heat pumps generally draw heat from the cooler external air or from the ground. Heat pumps can also be used in district heating and are a main element of cold district heating systems.

Heat pumps have rapidly has been popular, as they are marketed to be used in any building whether it is an industrial or residential building.

Heat Pumps are the most efficient alternative way to heat any building; supplying with hot water, running at over 300 % efficiency. This means that they produce around 3 times more heat than the energy they use. Heat Pumps require a small amount of electricity to run, which can be produced by solar power, further reducing your environmental impact and increasing the sustainability.

Types of heating pumps:

### **1. Air-to-Water**

Air to water heat pumps take heat from the outside air and transfer it to a water-based system. The created heat can be used for space heating or as a hot water supply for the house. Air to water heat pumps are among one of the most efficient air source heat pumps nowadays.

This type of heat pump works best in moderate climates. The efficiency of an air to water heat pump is most optimal at 7 ° C, as opposed to dry and cold locations, where outside temperatures is less than -20 ° C. Keeping the working principles of an air to water heat pump in mind, the decline in temperatures will affect in the operating efficiency.

In climates with very low temperatures in winter, ground source heat pumps may seem a more suitable choice, as they extract heat from the ground and perform well in freezing cold temperatures. The technology developments for cold climate heat pumps using the air to water principle are used to cover heating needs even with a low temperature set point of below -25 ° C.

Choosing the right heat pump depends on the needs of the house. Airs to water heat pumps are more common in the market, though they are also very well-suited to new-builds.

### **2. Water source**

A water source heat pump is a device that can produce a big amount of low-grade heat that cannot be used directly, then convert it into heat energy that can be

used directly. The working principle of water source heat pump unit is transferring heat from the building to the water source during the summer. In winter, the energy is extracted from the water source of the relative constant temperature, using the heat pump principle to be sent to the building after the air or water is used as the coolant to raise the temperature. Usually the water source heat pump consumes 1kW energy, and the user can get more than 4kW of heat or cold. Water source heat pump overcomes the deficiency of air source heat pump winter outdoor heat exchanger frosting, and the operation reliability and thermal efficiency are high, which has been widely used in recent years.

### 3. Geothermal

A geothermal heat pump (GHP) is also known as ground source heat pump (GSHP) is a central heating and/or cooling system that could transfers heat to or from the ground, mainly through a vapour-compression refrigeration cycle. They are also known by other names, including geoexchange, earth-coupled, earth energy systems. The geothermal heat pump, also known as the ground source heat pump, is one of the highly efficient renewable energy technology that is achieving wide acceptance in both residential and commercial buildings. Geothermal heat pumps are used for space heating and cooling, as well as water heating. The benefit of ground source heat pumps is they concentrate naturally existing heat, rather than by producing heat from the combustion of fossil fuels.

The efficiency of GHP units are described by the Coefficient of Performance (COP) in the heating mode and the Energy Efficiency Ratio (EER) in the cooling mode (COP<sub>h</sub> and COP<sub>c</sub>, respectively in Europe) which is the ratio of the output energy divided by the input energy (electricity for the compressor) and varies from 3 to 6 with present equipment (the higher the number the better the efficiency). Thus, a COP of 4 would indicate that the unit produced four units of heating energy for every unit of electrical energy input. In comparison, an air-source heat pump has a COP of around 2 and is dependent upon backup electrical energy to meet peak heating and cooling requirements. In Europe, this ratio is sometimes referred to as the “Seasonal Performance Factor” (“Jahresarbeitszahl” in German) and is the average COP over the heating and cooling season, respectively, and takes into account system properties.

Ground-source heat pumps (GSHP) can offer both heating and cooling at any location, with a very good flexibility to meet any demands needed. In central and western European countries, the direct usage of geothermal energy to supply heat from district heating to a larger number of buildings.