

## THE WORLD EFFICIENCY OF THE HEATS PUMPS

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**Abstract:** There is a lot of energy around us that we can use for our beneficial interest, therefore heat pumps which belong into the most famous systems for obtaining the energy from the environment are connected to this topic. We can state that heat pumps represent an alternative, modern, energy-efficient, and environmentally friendly source of thermal energy. Heat pumps are economical and ecological devices for heating and cooling water, leveraging renewable energy sources. All over the world, heat pumps are used very well as alternative sources of energy. Heat pumps belong into the group of renewable resources. Nowadays, heat pumps are showing the great progress in heating as well as in cooling systems. In the most developed countries in the world, equipping new buildings with heat pumps is a common practice.

**Key words:** heat pump, economy measures, heat demand, energy demand.

### 1. INTRODUCTION

As reserves of non-renewable energy sources continue to decline, renewable energy sources offer promising potential and prospects for the future. Admitting this scenario, heat pumps emerge as one of the most effective systems for extracting and utilizing environmental energy. The use of renewable energy sources has potential and a great perspective for the future [1], [2]. All around the world, savings on fuel and energy can be reached by means of heat pumps that use non-traditional sources of energy. These devices are recognized as an alternative and eco-friendly solution for heating and hot water supply, utilizing renewable energy sources to ensure sustainability.

Applications of Heat Pumps:

- Cooling: An increasingly integrated function, with heat pumps operating in reverse for cooling purposes.
- Heating: Suitable for all heating system types, especially low-temperature systems.

### 2. OVERVIEW OF HEAT PUMPS

Heat pumps can be categorized as one of the alternative renewable energy sources. They consist of two main parts: an external unit (the evaporator), which extracts heat from sources like air, water, or ground, and an internal unit, which includes a compressor and a heat exchanger for transferring heat to the heating system.

Basic Types of Heat Pumps:

- Air-to-water heat pump
- Air-to-air heat pump
- Ground-to-water heat pump.
- Water-to-water heat pump

Heat pumps essentially function as heating and cooling machines, differentiated by their application. The heat extracted is used for heating, while the cooling system focuses on reducing temperatures. Despite the operational differences, their underlying thermodynamic principles remain unchanged. The heat pump itself does not produce energy; it only pumps the temperature to a higher temperature potential [3].

It is a system that uses low-temperature energy sources  $\sum Q_o$  in the form of (air, water, or earth), transforms them into heat and transfers the obtained heat at a higher temperature to the heating system  $\sum Q_i$ . When pumping heat to a higher temperature level, it is necessary to supply a certain amount of energy, usually electricity  $\sum P_k$ .

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According to the first law of thermodynamics, it must be true that the sum of the energy flows entering the system ( $\sum Q_{in} + \sum P_k$ ) must be equal to the sum of the energy flows leaving the system ( $\sum Q_k$ ).

Therefore, the following applies:

$$\sum Q_{in} + \sum P_k = \sum Q_k \quad (1)$$

According to the second law of thermodynamics, it must be true that the sum of the energy flows entering the system ( $\sum E_{Q0} + \sum E_P$ ) is greater than the sum of the energy flows leaving the system ( $\sum E_{Qk}$ ).

Therefore, the following applies:

$$\sum E_{Q0} + \sum E_P \geq \sum E_{Qk} \quad (2)$$

## 2.1 Heat pumps utilization worldwide

Heat pumps can obtain heat from various low-temperature sources like air, soil, domestic or industrial flows of energy. The growing adoption of heat pumps in world is driven by their increasing affordability and rising energy costs. These devices provide a more energy-efficient means of delivering heating and cooling by leveraging renewable environmental energy.

Advantages of Heat Pumps:

- Low energy consumption
- Eco-friendly operation
- Independence from prices of energy
- Comfort and cost-effective heating
- Low operational costs
- Safe operation
- Rapid return on investment

Disadvantages:

- High initial costs and purchase price
- Performance dependent on specific technologies

Heat pumps are connected to non-traditional sources of energy that create new potential of energy of low-temperature energetics. The use of this potential is mainly in the fields of common heating systems with more effective components. In the most developed countries of the world, equipping new buildings with heat pumps is a common practice.

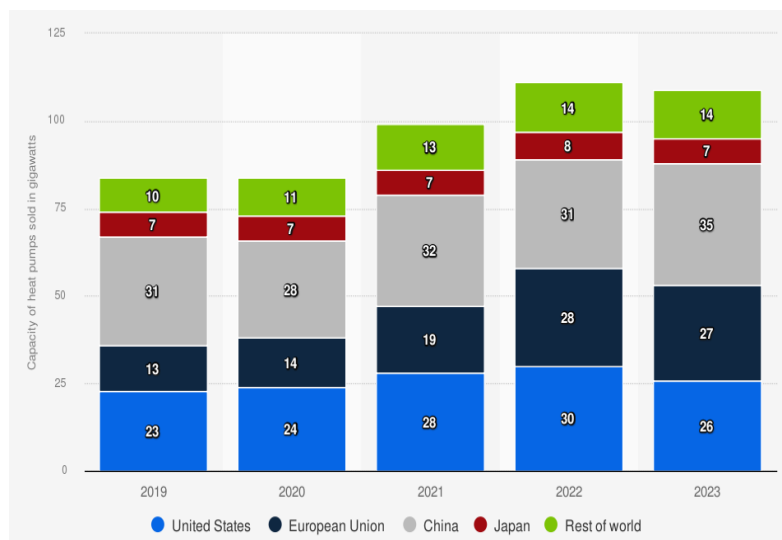
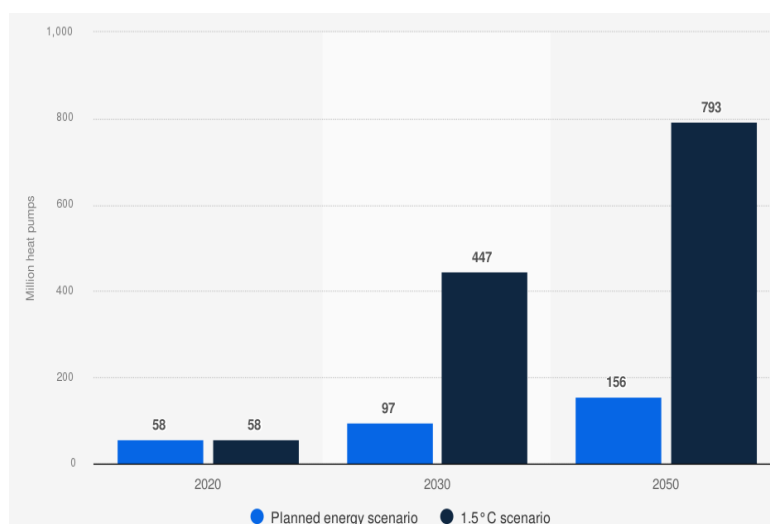


Figure 1 – Capacity of heat pumps sold in selected regions and countries worldwide from 2019 to 2023(in gigawatts)

The capacity of the heat pumps sold worldwide in 2023 was lower than in the previous year. China was the only major economy with an increase in heat pump sales in 2023. Nevertheless, heat pump sales worldwide were significantly higher than in 2019. The heat pumps sold in the United States in 2022 had a capacity of 30 gigawatts [4].

## 2.2 Heats pumps installed buildings worldwide

Heat pumps are alternative devices to produce thermal energy compared to its conventional production using the combustion of fossil fuels. They can achieve significant primary energy savings compared to conventional thermal energy production and can be the most effective form of providing heating and cooling processes in industry, apartment buildings as well as in the municipal sphere.



*Figure 2 – Number of heat pumps installed in the buildings sector worldwide in 2020, with forecasts for 2030 and 2050, by scenario (in millions)*

By 2050, 793 million heat pumps would need to be installed worldwide to reach a 1.5°C scenario. However, the number of heat pumps that is estimated to be installed if current governments' plans were to be followed is much lower. Geothermal heat pumps were the type of space heating with the least CO<sub>2</sub> emissions in the Upper Midwest of the United States [5].

## 3. CONCLUSION

All over the world there are favourable and practical conditions for the use of heat pumps as alternative sources of energy. Thanks to development and modern technology, we can consider heat pumps as a reliable, cost-effective and progressive heating system that works ecologically. It will be very important for the future of ecological awareness to gain as much use of renewable energies as possible, and we could say that as part of this development, devices such as the heat pump are experiencing a renaissance all over the world.

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