HELMHOLTZ KLIMA INITIATIVE

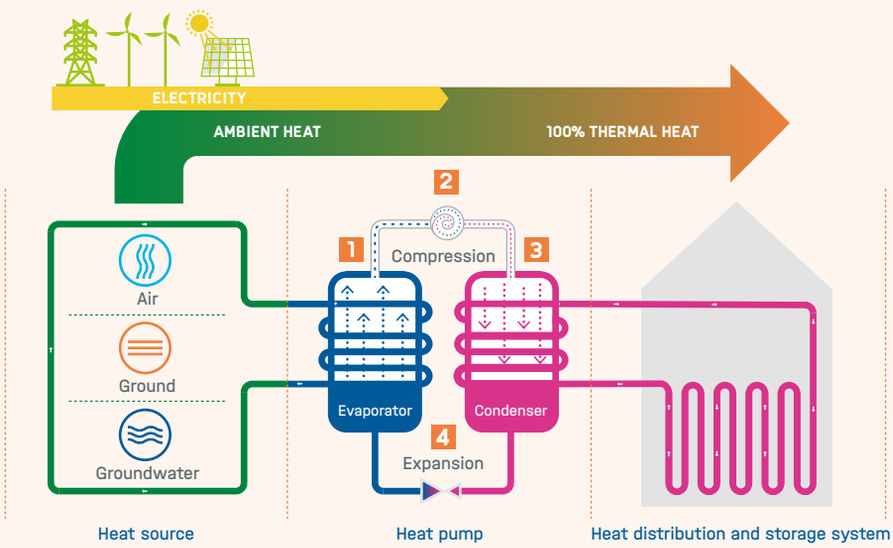
FACTSHEET

12

TOPIC: HEAT PUMPS

HOW DO HEAT PUMPS WORK?

An electric* heat pump transfers heat from the environment into a building to raise the temperature indoors. The greater the share of renewable energy in electricity is, the more environmentally friendly heating with heat pumps becomes.



This diagram illustrates the functional principle of a heat pump. © Bundesverband Wärmepumpe (BWP) e.V.

*Gas can also be used to operate heat pumps, but that is less environmentally friendly.
All of the information in this fact sheet therefore relates to electric heat pumps.

Heat pumps use a cycle in which a refrigerant circulates. The refrigerant is a liquid that vaporizes at a low temperature.

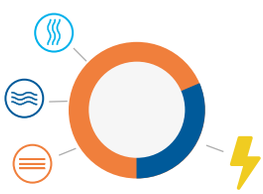
1. Heat from the air, ground or groundwater vaporizes the refrigerant.
2. The vaporized refrigerant is compressed by the compressor. Compression heats up the refrigerant.
3. The heated refrigerant enters the condenser. As the gas returns to the liquid state, it releases heat to the heating water, which is used to heat the building.
4. The pressure decreases and the liquid refrigerant returns to the evaporator. The cycle begins again.

ADVANTAGES OF HEAT PUMPS

EFFICIENCY

Heat pumps get **2/3** of their energy from their surroundings (air, ground or groundwater) and **1/3** from electricity.

Currently, their greater efficiency compensates for the price difference compared to heating oil and natural gas. Switching to a heat pump also makes it possible to gain some independence from fluctuations in energy prices.

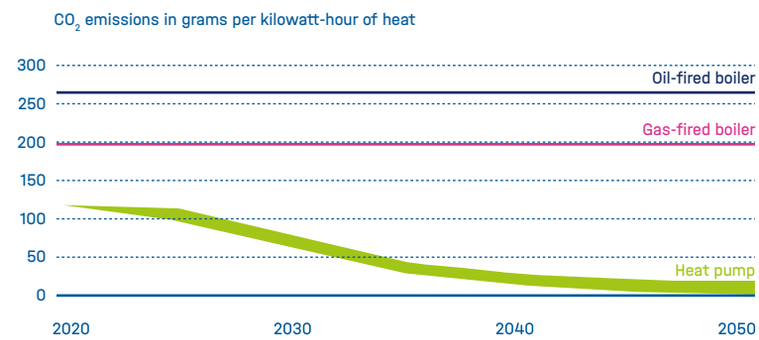


NO EMISSIONS

Since heat pumps consume no fossil fuels, they cause no CO_2 emissions on site.

NO AIR POLLUTION

Heat pumps do not produce nitrogen oxides (NOx) or particulates like oil and gas heating systems do.



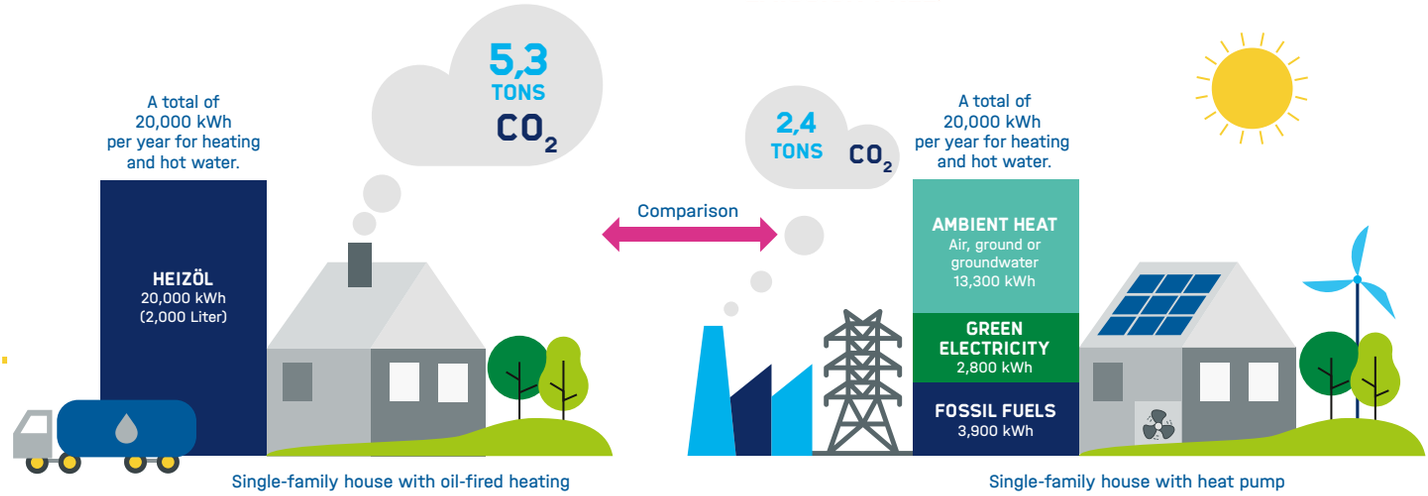
This diagram compares the trend in the emission factor for oil- and gas-fired boilers to that of heat pumps. The emission factor is a measure of the amount of greenhouse gas emissions for each kWh of heat produced. © Wüstenrot Stiftung/Forschungsstelle für Energiewirtschaft e.V.

HEAT PUMPS AND THE CLIMATE

Private households and public buildings use nearly **35%** of the final energy in Germany, mostly for heating and hot water. They account for approximately **30%** of all CO_2 emissions.

In this sector, heat pumps can make a significant contribution to achieving climate neutrality in Germany by 2045.

At an average efficiency level, today's heat pumps cause **40 TO 55%** lower CO_2 emissions than oil-fired heating systems. When operated with green electricity, heat pumps are even **EMISSION-FREE.**



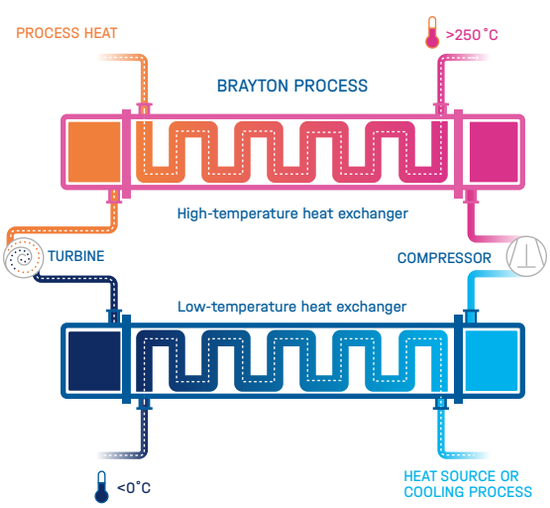
Single-family house with oil-fired heating

Single-family house with heat pump

This diagram compares the efficiency and environmental friendliness of oil-fired heating systems and heat pumps using a single-family house as an example.

HELMHOLTZ' RESEARCH

SUSTAINABLE PROCESS HEAT FOR INDUSTRY



This diagram illustrates how the CoBra pilot plant works.

The decarbonization of energy-intensive industrial processes is a major challenge. Many industrial sectors, such as production of paper or chemicals, need process heat temperatures of up to 500°C. The German Aerospace Center's (DLR) Institute for Low-Carbon Industrial Processes is investigating how that can be done with high-temperature heat pumps.

The CoBra (Cottbus Brayton process) pilot plant, which began operation in Cottbus in September 2022, uses air as its working fluid and can reach temperatures of up to 300°C at an energy output of about 200 kW. Another pilot plant, ZiRa (Zittau Rankine process) in Zittau, which uses water as its working fluid, is under construction.

INFO

The DLR Institute of Low-Carbon Industrial Processes in Cottbus and Zittau is working on technologies and solutions for industrial production without fossil fuels.

Its research focuses on providing process heat from renewable energy sources for energy-intensive industries using high-temperature heat pumps.

Would you like to learn more about this topic?

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