The heat that comes from Air & Water

INTRODUCTION

A heat pump is a device that can provide heating, cooling and sanitary hot water for residential, commercial and industrial applications. It converts energy from air (aerothermal), ground (geothermal) and water (hydrothermal) to useful heat. This conversion is done via the refrigerant cycle.

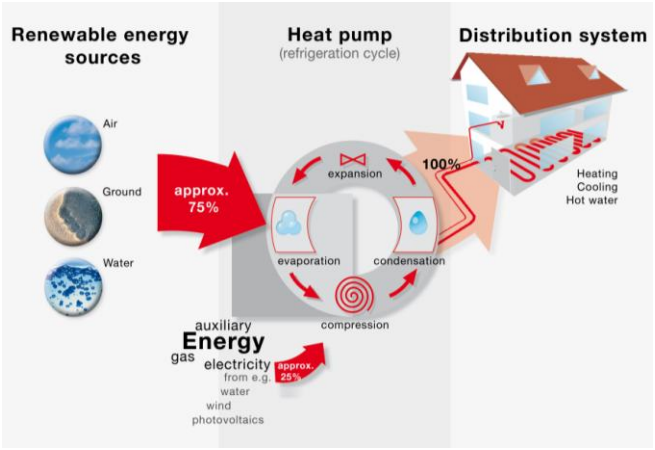
Typical capacities range from 2-20kW for single family buildings up to 100kW for multi-dwelling residential applications. For commercial applications, the capacity is even bigger, and for industrial and district heating installations, the capacity can reach the range of several MW.

This document refers solely to aerothermal and hydrothermal heat pumps. Geothermal heat pumps are discussed in another document.

THE TECHNOLOGY

Heat pumps transform renewable energy from outdoor air or water to useful heat. A heat pump system consists of a heat source, the heat pump unit and a distribution system to heat/cool the building.

The main type of refrigeration cycle that is used is the electric compression cycle, that works in the following way: a transfer fluid (refrigerant) transports the heat from a low-energy source to a higher energy sink. Auxiliary energy is needed to run the compressor and the pumps (usually electricity or gas).



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Heat pump systems can be used for heating or cooling. In the heating mode, outdoor ambient energy is the heat source and the building is the heat sink. In the cooling mode, the building is cooled down using the outside as heat sink.

Energy distribution: Heat pumps use air or water as heat distribution media inside the building. Depending on system design, they can use the air directly at the installation point or use a duct (air) or pipe (water) distribution system to provide energy to fans, radiators or floor heating systems. Ductless heat pumps are installed on a wall and act as a localized heat source, like a wood/pellet stove. This is a typical solution for homeowners, in particular when also cooling is needed.

Air source heat pumps: This technology comes in several variants, with the most typical ones being:

1. compact (monobloc) units: all heat pump components are combined inside one case;

2. Split systems: the outside and the inside heat exchanger are installed in two cases, with one installed on the outside of the building and the other inside. Both are connected via a refrigerant line. In single family buildings, most often single split systems are used in which the outside unit is connected to one inside unit. In multifamily or commercial applications, typically multi-split solutions are used where one outside unit supplies several inside units.

Efficiency considerations: The efficiency of heat pumps depends mainly on the temperature difference that needs to be overcome. The higher the sink temperature required by the distribution system, the less efficient the heat pump. This fact makes heat pumps more suitable for the connection to low temperature heat distribution systems (fan coils, floor heating or low temperature radiators).

BENEFITS AND CONSIDERATIONS

Heat pumps are an established and reliable solution to cover the heating, cooling and hot water needs of today's buildings. The technology complies with requirements for near zero energy, passive house and plus energy building designs. Heat pumps are also compatible with the overarching goal of a small energetic and environmental footprint of buildings.

If operated with 100% green electricity, heat pumps provide a 100% renewable, emission free heating and cooling supply.

The use of heat pumps requires proper **planning** and is often influenced by **cost considerations**. Efficient heat pump systems require skilled architects, designers, planers and installers. These parties need to understand the interrelation between building design, heating and cooling demand and the efficiency of its provision. The lower the design temperature of a buildings heat distribution system, the better the efficiency of heat pump systems.

A simple replacement of an existing boiler with a new one is still a challenge and requires careful consideration.

COSTS

The **investment cost** of heat pump systems still exceed those of the fossil fuel alternatives. However this is changing with increasing requirements on the energy efficiency of buildings and the share of renewable energy used for heating and cooling.

In terms of **operating cost**, heat pump systems are very competitive in areas with mainly direct electric heating. In areas with existing gas grids, the cost situation presents itself different: the cost of gas fired heating is usually lower than the cost of thermal energy from heat pumps. If governments want to encourage heat pump technology, they need to address the issue on the political level.

HEAT PUMP ENERGY LABELS

Since 26 September 2015, all new heat pumps with a thermal capacity < 400kW must comply with the requirements of the 'Ecodesign' for energy related products, All units with a capacity < 70kW must be labeled with the Energy label sticker. The label provides information on the efficiency of the product, noise emissions and its capacity in different climate zones.

Installers that combine different products at the installation side must provide a package label.

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