Industry's hidden champion: the heat pump

Operating in the dark, hidden in basements, on roofs or in machine rooms, the heat pump is often overlooked and its capabilities underestimated. However, improved engineering coupled with tougher CO_2 regulations has shone a spotlight on this unassuming hero.

With applications in B2B and B2C, the heat pump has come a long way since it was first used to dry salt mined from Austrian marshes in the 1850s. Already well known for its use in district heating and the residential sector, heat pumps are quickly becoming the technology of choice by manufacturers scrambling to meet ever-stricter environmental rules, their own targets and reduce costs.

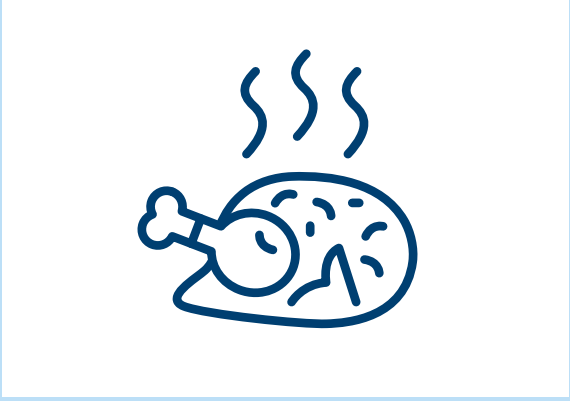
So, wherein lies its magic? Heat pumps use renewable energy or waste energy from buildings and processes to provide heating. For example, during cooling, refrigeration systems emit heat from a condenser. Normally, this heat is simply released into the environment. The heat pump captures this wasted heat and then "pumps" or boosts the temperature to create heat suitable for other purposes. And when a heat pump is combined with a refrigeration unit, both cooling and heating are possible, turning one-time energy use into a circular energy economy, lowering energy costs by 30 percent or more. That's a significant savings when you consider that within the food, dairy and beverage industries, up to 60 percent of energy usage goes to heating and cooling.

NATURAL REFRIGERANTS, NEW OPPORTUNITIES

As fluorinated gases are phased out, natural refrigerants are becoming more popular, especially ammonia, which is readily available, inexpensive and has no global warming impact. Although noxious at high concentrations, the implementation of carbon absorbers in ammonia-based heat pumps eliminates the smelly element before the air passes through a ventilator and leaves the plant room.

Due to improvements in compressor technology, ammonia heat pumps can now heat to higher temperatures. This has paved the way for their more widespread use in the food, beverage and dairy industries, where waste heat can be used for washing, cleaning and drying products; heating water for cleaning and processing purposes, as well as pasteurization.

GEA leverages its deep knowledge of industrial refrigeration and heating & cooling expertise to create both tailored and plug-and-play solutions for large customers, SMEs and cities all over the world. Here is just one example:



Moy Park, ammonia heat pump installations, Anwick, UK

Moy Park is one of the UK's top food companies and a leading European poultry producer, processing more than 280 million birds per year. GEA installed the first heat pump at Moy Park's Anwick plant to support poultry processing.

Over the years, Moy Park saw the difference this technology was making to its business, eventually adding another GEA heat pump to provide the hot water used for plant cleaning. By using the waste heat from the refrigeration plant, the heat pumps ultimately replaced three boilers. In addition to delivering massive cost savings, oil usage has gone down dramatically and CO_2 emissions reduced by more than 700 metric tons annually.

While Moy Park was one of the first in the UK food industry to install a high temperature heat pump, it is now becoming common practice for manufacturers in the food, beverage and dairy industries to integrate heat pumps into their processes.

Traditionally, these industries used boilers to cook or pasteurize products, and then refrigerated products to cool them down again, resulting in massive energy waste since the temperature of the waste heat from the refrigeration process was too low to be reused. A heat pump, however, boosts the waste heat temperature up to 70-85 degrees Celsius so it can be put back into the system. The result: more boilers can be retired, heat is no longer wasted and CO_2 emissions are reduced – by as much as 50 percent in some cases. According to Robert Unsworth, Head of Sales (Utilities) in the UK for GEA, "The application of heat pumps in the food, dairy and beverage sectors is going to be the biggest leap forward that food production and refrigeration has ever seen."

A PEEK BEHIND THE LAB DOOR

In some industries and applications, even higher temperatures are required. Sintef, a Norwegian R&D company, has been working on this issue for several months and is also participating in the largest heat pump project – the DryFiciency consortium – to be funded under the EU's research and innovation program, Horizon 2020. Sintef is looking into solutions that combine ammonia and water heat pumps in one system and developing others that will leverage steam to allow heat pumps to reach 150-175 C.

According to Sintef Research Scientist, Dr. Michael Bantle, at temperatures above 90 C, water is the best natural refrigerant in terms of efficiency and safety, particularly for the food industry. "If energy-efficiency and cost-efficiency targets are met," he says, "it's basically a no-brainer for the industry to choose this kind of solution." He anticipates the first industrial heat pumps using water as a refrigerant will be available on the market starting this year.

DISTRICT HEATING – SMARTER

Heat pumps have played a critical role in district heating since the 1980s – particularly in Scandinavia – centralizing the heating or cooling of water and then distributing it to multiple buildings through a pipe network. Fast-forward forty years, and heat pumps are now essential to our "energy transition," particularly in cities, due to their ability to connect electricity and thermal energy grids, even storing excess electricity and acting as a thermal battery. These capabilities are key as municipalities move away from centralized electricity production to decentralized power production, where photovoltaic, wind and small-scale combined heat and power plants are augmenting or will eventually replace existing structures.

Now that more district heating networks have been established, some businesses are even selling their unused waste heat and cooling, much like the people who sell their extra solar or wind-generated electricity back to the grid. In Stockholm, for example, data centers have established long-term, multi-million Euro contracts to sell their recovered heat which is used to provide central city heating to tens of thousands of households.

CLOSING THE LOOP & THE GAP

The heat pump is a technology that delivers value regardless of the industry in which it is used or the extent to which it is utilized. It can do basic jobs, like heating and cooling a small suburban home, right up to taking a central role in a super smart, zero-emissions strategy for district heating or in a large food production plant.

In countries where emission requirements are less stringent or where cap and trade policies allow, some manufacturers are choosing to maintain the status quo given that fossil fuels still tend to be cheaper than electricity. However, according to the International Renewable Energy Agency, renewable energy needs to be scaled up at least six times faster if we expect to meet the emission goals set out in the 2015 Paris Agreement. Most would agree: any winning strategy to meet these targets must include the heat pump.