

Flexible, sustainable, and clean system solutions - building heating in the future

Energy is the dominant contributor to climate change and accounts for nearly 60 % of global greenhouse gas emissions. The global emissions of CO₂ have increased by almost 50 % since 1990. Studies show that heat savings can cost-effectively reduce the total heat demand in Europe by 30-50 % if waste heat is used. Today, 30 % of the Danish total energy consumption is used for heating of buildings, and although future buildings will be Zero Energy Buildings, the replacement of old buildings in Denmark is only 1 % per year. Thus, as the share of energy for heating will be just as high in the future, more efficient systems and solutions are needed.



District heating systems are one way to obtain a more efficient energy supply - through more efficient central heating plants and the possibility of utilizing surplus (or waste) heat from industrial sites. The district heating network transports energy to (heating) and from (cooling) the consumers. Today, this is mostly based on hot water (and steam) in some systems, but new interesting concepts using CO₂ are being investigated.

Both central and decentralized heat pumps are central technologies in the transformation to the future energy system based on electric renewable power. Heat pumping is a very efficient way to level the different required temperature levels in these efficient systems - to consumers and from possible suppliers of waste heat. Heat sources for central large heat pumps are necessary in order to reach high COPs. Sea water heat pumps based on vacuum ice, as well as MW-scale air to water heat pumps, are planned to be implemented in Denmark.

Heat pump technologies are also a way to reach the goals of creating affordable, reliable, sustainable, and modern energy for all as stated in the Sustainable Development Goals from the United Nations. Today, one out of five people does not have access to electricity, and three billion people rely on wood, coal, charcoal, or animal waste for cooking and heating. Combinations of heat pump technologies with energy storage, solar, and wind energy are possible solutions to fulfil these goals. For remote areas with little access to central generation stations or costly connection to the grid, systems with solar geothermal heat pump systems could be a solution.

Most countries focus on the electrification of the energy system and the phase-out of fossil fuels to decarbonise the energy system. As the production cost per kWh electricity has reduced to a level competitive with fossil fuels, most countries are investing in both photovoltaic panels and wind power to stabilise, optimise, and increase the renewable electricity production. Many solutions are available, but there are also (regulation) barriers, and the incentive or economical gain is currently very low for the consumer with around 18-73 Euro per heat pump annually. Thus, the demand side needs to be more flexible. Heat pumps, large scale and low-consumption, clustered in pools, can act as balancing units in the grid. Heat pumps are already starting to play a major role in the transformation of the energy system but work still needs to be done in the field of choosing the best mode of integration of heat pumps into thermal heating/cooling systems and the electrical grid, including energy storage.

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