

Shifting focus and raising the bar

District heating is the cornerstone of a truly integrated energy system, where demand adapts to the fluctuating production based on renewables and waste heat – but it will require a much higher degree of flexibility than today.

The integration of renewables and waste heat requires intelligent cross-sector energy systems. This places new demands on district heating utilities, as they will be dependent on an increasing number of production sources that fluctuate depending on power generation, industrial production, wind conditions, sunshine hours etc.

Supply and demand reversed

Utilities used to base their production on traditional forecasts. In other words, the better they were at predicting the consumption, the more efficient they were able to be. In an integrated energy system, it will be the other way around. Here, heat production is based on multiple fluctuating energy sources resulting in a variable heat supply that must be matched with the demand from buildings and end users in the other end of the district heating system.

Getting the whole system to balance and interplay efficiently increases the need for flexibility throughout the entire value chain. This necessitates adding to the mix the energy performance of buildings as well as involving end users much more than they are today.

Boosting the energy efficiency of buildings is critical because the gains from optimisations in the distribution system will often depend on how the buildings perform under different conditions.

This may be in relation to both the building envelope and the technical heat installation. Additionally, buildings can potentially act as thermal storage capacity in the network.

Also, energy consumption and peak demands are still closely connected to the behavior of end users. Easing their access to knowledge about their consumption and behaviour will enable them to better understand their energy use and take an active part in saving energy and utilising it optimally.

What characterises the intelligent energy system?

The intelligent and integrated energy system focuses on high energy efficiency in order to reduce energy waste. This involves utilising the available energy sources as efficiently and sustainably as possible while creating the ideal circumstances for integrating renewables. The district heating networks are used to link the available heat sources with the heat demand from buildings and end users.

By lowering return temperatures in the network, district heating utilities not only reduce energy waste but also boost the efficiency of their production based on renewables.

The challenge for district heating utilities will be to balance the electricity systems while at the same time utilising waste heat from industries and integrating as much renewable energy as possible. This requires running production close to the limit and lowering distribution temperatures, making it even more crucial to continuously manage and optimise their production and distribution network decisions.

Utilities must constantly be able to assess the current conditions to decide if, for example, they should start the heat pump, or if it would make more sense to get their heat from Combined Heat and Power production [CHP] or e.g. solar.

Knowledge-based optimisation

Imagine if you knew the weather forecast, the exact behaviour of your end users, and how individual buildings would perform under various weather conditions. Then imagine that you were also able to see the dynamics and the retention time in the distribution network.

This knowledge would enable you to make exactly the right decisions about your energy production and distribution for the upcoming operating hours. Unlike assumptions and theoretical models about e.g. the distribution system, this knowledge would be based on facts and what is actually going on in the network.

This is one of the focus areas of the 4DH Research Centre developing 4th generation district heating (4GDH) technologies and systems. 4GDH focuses on energy efficiency, flexibility, and integration of all renewable energy sources and waste heat. Therefore, in 4GDH systems, synergies are created between grids and components, production and system integration, and planning and implementation⁶.

Higher energy efficiency goes hand in hand with lower and more flexible distribution temperatures because they allow 4GDH to efficiently utilise renewable energy sources, while still fulfilling both the requirements of low-energy buildings and energy conservation measures in the existing building stock.

The 4DH Research Centre is a collaboration between industry, universities and the public sector investigating the potential and development of 4th Generation District Heating (4GDH).

Read more at: 4dh.dk

