

Are you ready for a new dimension of district energy?

As district energy is on a journey to become one of the fundamental levers to accelerate the heat transition, digitalization is the perfect tool to enable its next generation. AI based software, digital twins and state of the art controls add a new data-driven dimension to district energy performance and unlock unrealized end-to-end optimization and energy efficiency.

Heating and cooling represent half of Europe's total final energy consumption, mostly based on fossil fuels. To achieve a reduction of greenhouse gas emissions by 55% in 2030 and carbon neutrality by 2050, as enshrined in EU law, moving towards renewable sources is imperative. District energy has a key role to play as it enables flexibility of heat sources and supports the journey towards decarbonization. However, in 2021, renewables represented still less than 8% of global district energy supplies². This article unpacks how to increase the share of alternative heat sources in district energy such as excess heat, large heat pumps, geothermal, and biomass and unlock the full potential of district energy to accelerate the heat transition.

Embracing the maze

Some may say that district energy networks are as complex as mazes. But there is a fundamental difference. Traditional mazes have just one starting point and one endpoint, and the challenge is to find the right way through. That's not the case for district energy networks. Rather to the contrary: they have multiple starting points for heat and cold production and thousands of endpoints at the consumer level. In other words, the complexity is not a challenge anymore, but a true opportunity with many different avenues to success – as long as there is good navigation!

"As the system complexity increases, the importance of applying effective control logic to ensure a stable and optimized operation increases as well. In a modern system with multiple thermal plants that utilize a variety of heat sources, it becomes increasingly important to control when, where, and how we produce, distribute, and consume energy," says Director of Business Development Jonas Loholm Hamann, HydronicS at Danfoss. He adds:

"By utilizing advanced control logic throughout the supply system - based on intelligent digital solutions - you can increase resilience, produce energy more cost-effectively and reduce CO₂ emissions while always maintaining comfort for end users."

Improving resilience through flexibility

District energy offers unique opportunities to deliver sustainable heating and cooling from a large variety of renewable sources from excess heat and biomass to geothermal energy, which might otherwise not be accessible at an individual building level. Intelligent control systems are the foundation to realize the full system potential and enable flexibility to select energy sources based on their availability. They will enable operators to leverage economic parameters – for example, using

¹ Source: IEA, District Heating and Cooling: Environmental Technology for the 21st Century

² Source: <https://www.iea.org/reports/district-heating>

heat pumps when electricity costs less or biomass when wood chips cost less – optimize the network and offer operational flexibility to balance the power grid.

“Shifting from fossil fuels to renewables ensures greener operations: historically, district energy has reduced CO₂ emissions by 3–4%¹. Digitalization allows to accelerate the heat transition by combining flexibility, efficiency and openness to new energy sources while increasing security of supply” emphasizes Jonas Loholm Hamann.

Digitalization is the fastest route to decarbonization

Digital tools maximize the value of available information and data while helping utilities and building owners to make informed and therefore better decisions. It means combining expertise in hardware - down to the level of each valve, controller or heat exchanger – with advanced AI-based software and digital twins. The journey towards resilient, data-optimized district energy networks needs to cover the full system from network planning and network operation to heat distribution and heat consumption.

For example, as complexity increases with the diversification of heat sources, digital solutions will help keep design and operation simple and intuitive to control. They will support around-the-clock monitoring and control to manage such networks. To increase resilience, they can also facilitate moving from a branch layout towards a meshed layout by isolating disruptions within parts of the system and ensuring heat delivery to end users through alternative paths.

Another example is the need to reduce supply temperatures. By helping to identify critical pain points, digital tools will help to reduce supply temperatures from typically 100°C (peak) down to 70°-75°C. Maximizing the time when this can be done will not only speed up the introduction of low temperature renewable energy and excess heat sources but also lower operational cost.

Towards a highway of efficiency

In summary, planning and operating complex heat networks - which only continue to increase in complexity is no easy feat. However, digital tools can transform a complex district energy maze into a highway of efficiency - from production to consumption.

The complexity of today's district energy networks is the future of decarbonization - it is one of the fastest routes toward the energy systems of tomorrow. End-to-end transparency enabled by intelligent digital solutions to reduce CO₂ emissions, optimize operations, and ensure better comfort all year round is already here. We just have to use it!

¹ Source: IEA, District Heating and Cooling: Environmental Technology for the 21st Century

² Source: <https://www.iea.org/reports/district-heating>

Danfoss Titan™

Combines best-in-class substations with digital twin technology. Adding a new and data-driven dimension to the district energy network with:

Reliable and continuous cloud commissioning

Best in class settings – ensuring longer station lifetime.

Optimum ΔT unlocking data driven energy with reduced return temperatures up to 1°–3°C

100% Danfoss component-based station ensures highest quality and reliability.

This means you can go from assumption to knowledge. From reactive to proactive.

From noise to harmony. For always reliable commissioning, time savings, and no complaints or callbacks.

Danfoss Leanheat® Production

Production can be optimized based on heat load forecasts, weather conditions, and other planning elements to allow you to produce heat when it costs less - and with the most sustainable sources. Danfoss Leanheat® Production, for example, leverages data to maximize energy efficiency with:

Load forecasting that predicts exact in-network heat consumption

Production optimization that saves 1–3% on fuel costs annually

Temperature optimization that reduces heat losses by 5–10% annually with a low ROI between 0.5–2 years

Danfoss Leanheat® Network

The network can be designed down to the smallest detail - that is, the individual consumer of heat or network branch— allowing you to change and test any parameter before changing any hardware while ensuring better temperature and pressure optimization matched to the exact needs of individual consumers.

Leanheat® Network helps to:

- Reduce annual supply temperature by 6°–8°C
- Reduce existing pipeline network loss by approx. 8–10%
- Reduce heat or cold production costs by up to 2%

Danfoss Leanheat® Monitor & Building

Consumption can be transparently monitored and used to assess the performance of individual buildings— all while working dynamically with when heat is needed and when it is produced. Close cooperation benefits both the utility and the consumer with an information-driven understanding of demand to enable effective load forecasting—ultimately leading to significant cost savings while avoiding fossil fuel consumption.

Danfoss offers several software solutions for supporting the control and monitoring of consumption:

- Leanheat® Monitor: Full transparency at low costs with alarms and commissioning reports
- Leanheat® Building: Up to 20% savings with smart heating control and up to 30% savings on technical maintenance costs