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Article | District heating microgrid

How small and rural communities can **unleash the potential of district energy**

Rising energy prices, concerns over energy security and the pressing need to decarbonize heating and cooling are fueling the adoption of district energy networks in urban areas across the globe. District energy offers an enormous potential to harness a city's local, renewable energy sources and create a resilient, energy efficient energy network. And large cities aren't the only areas that can tap into this potential.

microgrid.danfoss.com

> While district energy is widely acknowledged as a stable and energy-efficient source in larger cities, it is also a viable solution for smaller communities through the use of micro district energy grids or so-called; district heating microgrids."
>
> **Jonas Hamann,**
> Head of Business Development, Danfoss Climate Solutions

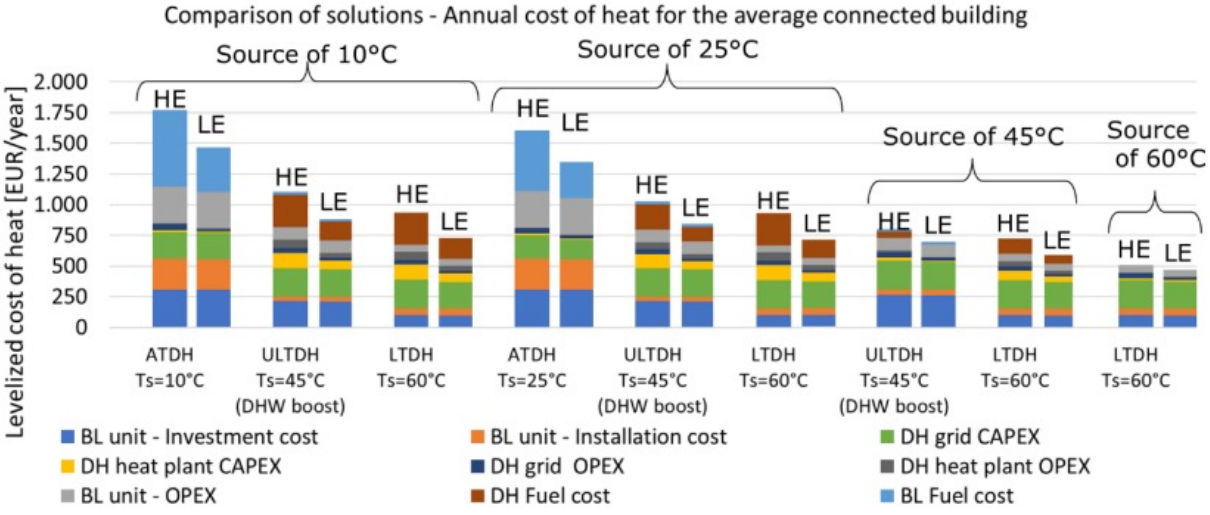
District Heating Microgrids are small district heating networks that can serve between 10 and 1,000 buildings. "They're a great way of connecting producers and consumers of energy at the local level, which is essential for meeting the climate challenges facing our communities," he says. "And since they can rely on decentralized, renewable heating sources, microgrids give us the benefit of a secure energy supply that can satisfy increasing energy demand while lowering CO_2 emissions."

A cost-effective way to **decarbonize multiple buildings**

Another advantage of district heating microgrids is the cost factor. "District heating microgrids are often established in rural communities or in a smaller part of a city where the alternative may be for each building to acquire its own heating source," Hamann explains. "However, compared to individual heating solutions, microgrids are significantly more cost-effective." The cost of a microgrid is approximately 19% lower than that of individual natural gas boilers and 30% lower than individual biomass boilers and air-to-water heat pumps on an annual basis.[1]

In the example below, with a heat demand of 13,800 kWh/year, a district heating microgrid powered by a wood chip boiler can ensure savings of approximately €430 compared to an individual gas boiler and approximately €805 compared to an individual biomass boiler or air-to-water heat pump.

Reference: At a heat demand of 13 800 kWh/year, which corresponds to an energy renovated building, a new district heating system is the most cost-effective source of heating.



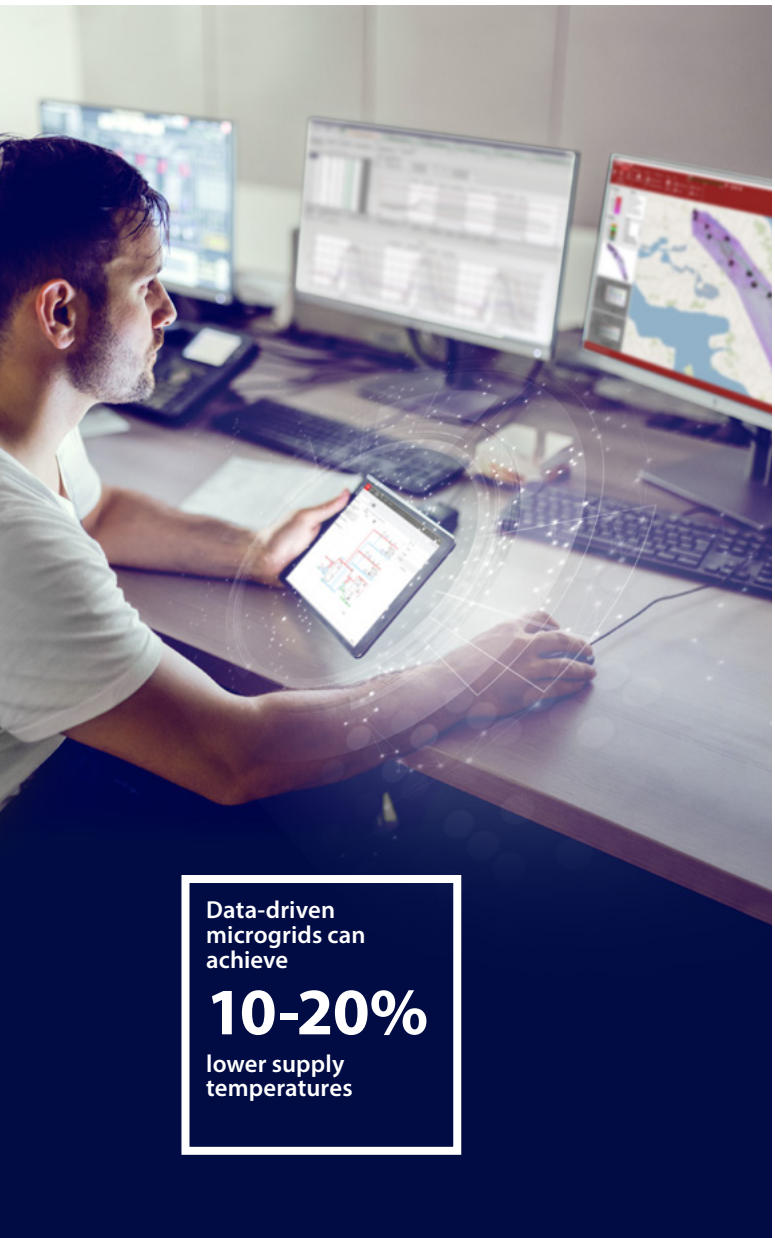
Source: individual vs collective, https://lsta.lt/wp-content/uploads/2019/04/EU-DH-vs-IND-heating-03052018-The-competitiveness-of-district-heating-compared-to-individual-heatingv2.pdf

[1] https://danskfjernvarme.dk/media/zulfbv0j/the-competitiveness-of-district-heating-compared-to-individual-heating.pdf

Microgrids help local communities **comply with climate-related regulations**

Establishing a district heating microgrid will also help smaller communities reach the carbon emission targets set by authorities around the world. For example, the European Performance Buildings Directive (EPBD) includes a renovation wave strategy with a 2030 deadline. The directive contributes to reducing greenhouse gas emissions by 60% and energy demand by 14%, with the ultimate goal of decarbonizing all existing building stock in the EU by 2050. By connecting a community's buildings to a local district heating microgrid, municipalities can as an example ensure that heating is produced based on excess heat and funneled back into the district heating microgrid benefitting the local citizens.

As part of the European Union's Energy Efficiency Directive (2023/1791), creating heat plans is mandatory for cities larger than 45.000 people. However, it can benefit municipalities down to a couple of hundreds of citizens to have a clear plan. Energy Efficiency Directive (EU) 2023/1791



Data-driven microgrids can achieve

10-20%

lower supply temperatures

Digitizing the microgrid paves the way for increased efficiency

For district heating microgrids to achieve maximum energy efficiency, the local network needs to optimize both the energy supply and demand sides. This includes making sure energy consumers – be it commercial and multi-tenant buildings or individual households – use the energy produced optimally. This is where digitization comes into the picture. "Digital solutions enable utility managers to add a data-driven dimension to the microgrid. Software makes it easier to identify challenges and incorporate and operate different energy sources including thermal storage in the network, and ensure correct commissioning, enhance system performance and achieve the lowest possible return temperature," Hamann explains. For example, data-driven microgrids can achieve 10-20% lower supply temperatures and stabilized temperature regimes, which lower pipe maintenance costs and extend the district heating microgrid network's lifetime.

Digital solutions can also provide load forecasting – predicting the exact in-network heat consumption – which can reduce operational and annual fuel costs by up to 3%. And they can visualize network operating conditions for microgrid operators, so they can see if a part of the network isn't optimized and address any network issues. This type of overview is especially important for smaller networks, as Hamann points out. "Larger utilities can afford expensive investments in their operations. But for smaller utilities operating on limited budgets, operational efficiency is paramount. Software tools and solutions can help them achieve this with a minimal investment."

> As the owner of a district heating microgrid, you are essentially a provider of critical infrastructure, which means that whether you are a private person, or a municipality, you have a legal obligation to ensure that your customer data is stored securely."
>
> **Jonas Hamann,**
> Head of Business Development, Danfoss Climate Solutions

Choose digital solutions that **prioritize data and energy security**

Choosing the right SCADA platform can also help smaller municipalities address some of the challenges digitization brings. For example, in 2023, the International Energy Agency (IEA) District Heating and Cooling Task Share Project published a report highlighting the key digitalization challenges facing the district energy sector. Two of the challenges were GDPR compliance and ensuring the safety and security of IT systems in the face of cybersecurity threats.

A case in Austria helps to illustrate the importance of cybersecurity. An employee at a biomass network in the country opened a seemingly legitimate email, which created a backdoor for a hacker. The hacker shut down the entire operating system, preventing the utility from restarting the boiler and accessing consumer data.

To prevent further incidents, the utility upgraded to Danfoss Leanheat® Monitor, which operates on an ISO27001 certified platform that enables GDPR-compliance. Hamann describes how SCADA platforms like Leanheat® Monitor can offer microgrid operators peace of mind. "Because Leanheat® Monitor is a cloud solution, smaller utilities can achieve a level of security that would be challenging to attain on a local level. Danfoss' cloud provider invests EUR 2bn annually in data security and has over 40 security certificates globally, so customers get a level of encryption and data protection that really is second-to-none."

Tips for a successful microgrid implementation

1. Use a thermo-hydraulic modeling tool to support the planning, design and operational processes.
2. Create a future-proof network design by incorporating connectivity options across the network.
3. During the construction phase, make sure you thoroughly test prefabricated solutions before they arrive on-site.
4. Consider using digital twin tools to shorten commissioning time.
5. Use AI temperature optimization tools to help you plan production and fine-tune temperature control throughout the network.

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Creating a local heating network in Eurasburg, Germany

The rural town of Eurasburg, Germany is an excellent example of how creating a district heating microgrid can accelerate decarbonization. In 2018, the town needed a heating solution for an extension to its local daycare center. Local homeowners were also interested in finding a renewable energy alternative to their aging oil-heated boilers. The town decided to tap into its abundant natural resource – the Eurasburger Forest. To do so, they built a local heating network – or microgrid – with a central wood chip system. The aim was to create a heating network that could connect to all public buildings in the community.

The town selected Danfoss' substations suitable for local heat needs: VXe Solo stations for single-family homes with up to approx. 30 kW; wall-mounted DSA1 mini stations for 30-100 kW; and flexible DSE stations for everything over 100 kW. The substations handle the hydronic balancing of the grid and between the stations themselves, as well as regulating the temperature. "The Danfoss substations guarantee the deltaT, which is very important," comments Michael Gail, the heating engineer on the project. "We sometimes have a deltaT of almost 30 degrees on the grid, and the return temperature is always below a maximum of 55°C".

The local utility chose Leanheat® Monitor as its SCADA solution, which makes it easy to monitor and control settings and troubleshoot the network remotely. They also use Leanheat to analyze network data and improve the microgrid's efficiency.

According to Hamann, Eurasburg's experience highlights the key ingredients for microgrid success. "Being able to tap into local heat resources is critical to establishing a well-functioning microgrid, and that's exactly what Eurasburg has done by using wood chips sourced from its forest." Local community support is another important factor. "We see a number of cases where local communities are resistant to transitioning to new heat sources and technology, and this can make it challenging to implement a microgrid. Getting local buy-in and engagement are really crucial to the success of these initiatives."

Martin Gail, Junior Manager at Gail and MG Energie in Eurasburg also believes that the town's approach can be a source of inspiration for other communities. "This model is exciting for the development of rural communities because the added value remains regional, and also promises a certain degree of independence."

Eurasburg is not alone. District heating microgrids are growing in popularity in rural communities throughout countries such as Austria, Germany, France, Denmark and many other countries. "At Danfoss, we work with hundreds of utilities like the one in Eurasburg to help them establish energy efficient microgrids that capitalize on local, renewable energy sources," Hamann says. "We not only provide the mechanical stations they need, but also software tools and solutions, like Leanheat® Monitor and Leanheat® Network that can help them monitor, manage and optimize their district energy networks."

Find out more about Danfoss' district heating and cooling solutions ›

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