

Navigating challenges in the sustainability transformation of District Heating

As district heating networks transition towards decentralized and renewable energy sources, operational challenges are increasing.

Discover how one of Germany's largest district heating networks manages increasing operational complexity with the help of Danfoss' Virtus heavy-duty pressure and flow controllers. This approach results in a more efficient, stable operation and significant cost savings.



Advancing District Heating in the Lower Rhine Region

Fernwärmeverbund Niederrhein Duisburg/Dinslaken GmbH & Co. KG is a cooperative venture between Stadtwerke Duisburg AG and Stadtwerke Dinslaken GmbH, and has been a pioneer in sustainable district heating for over four decades. With the construction of the Niederrhein district heating network between 1980 and 1984, it became one of the first interconnected district heating systems in Germany, enabling the use of industrial waste heat for domestic heating and hot water supply.

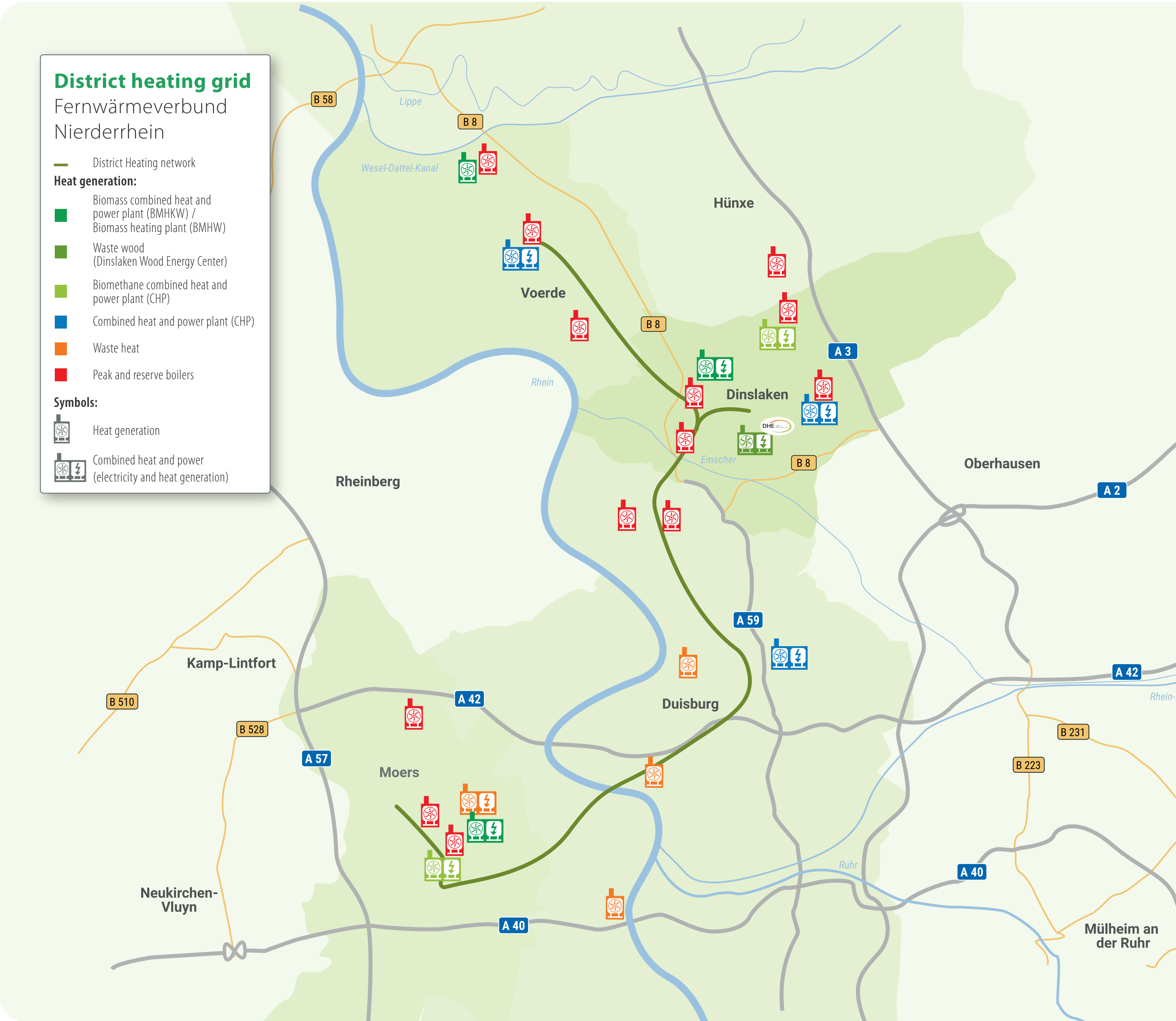
Today, the heating network spans approximately 40 km and supplies several distribution networks totaling 700 km in length through network stations. Each year around 980 million kilowatt-hours of thermal energy is distributed, which equates to the needs of more than 168,500 households across the cities of Dinslaken, Voerde, Duisburg and Moers.

In addition to heat from chemical production and steel manufacturing, the use of heat energy from biomethane-based combined heat and power plants, biomass facilities utilizing wood chips, and energy recovery from reclaimed wood is increasingly common. The purchase of district heating from the coal-fired power plant in Duisburg-Walsum was discontinued in 2022.

Of the 980 million kWh of heat distributed annually, more than 50% currently comes from renewable sources, and by 2030, this figure is expected to exceed 80%, significantly surpassing the current national average of 20%.

However, the shift from centralized fossil fuel power plants to decentralized renewable heat sources through sector coupling has introduced new operational complexities, requiring innovative solutions.

Figure 1: The Lower Rhine District Heating transportation network with a length of 40 km connects grids from several utilities in the area, into a multi-sourced network with a total length of 700 km.



Challenge

Managing Complexity in a Decentralized Network

The shift to and expansion with smaller, decentralized renewable energy sources has increased the complexity of pressure, temperature, and flow conditions within the network. In addition to the volatile availability of unavoidable industrial waste heat, which can fluctuate between 0 and 70 MW within just a few minutes, the increase of feed-in points compounded these challenges.

Especially at the different network stations, where up to 60 MW of heat output is decoupled from the network into the distribution networks, the existing valve and control technology struggled to maintain stability, leading to oscillations in differential pressure and volume flow regulation. This resulted in unstable temperatures, suboptimal station alignment, and inefficiencies in pump operations – ultimately impacting network reliability, end-user comfort and increasing operational costs.



Figures 2/3/4/5: The grid obtains its thermal energy from different sources such as thyssenkrupp's steel production (Fig. 2 and 5) and waste wood recycling at the Dinslaken Wood Energy Center (Fig. 3), among others. However, the re-use of heating from the Duisburg-Walsum coal-fired power plant (Fig. 4) was discontinued back in 2022.

Intelligent Flow Control with Danfoss Virtus

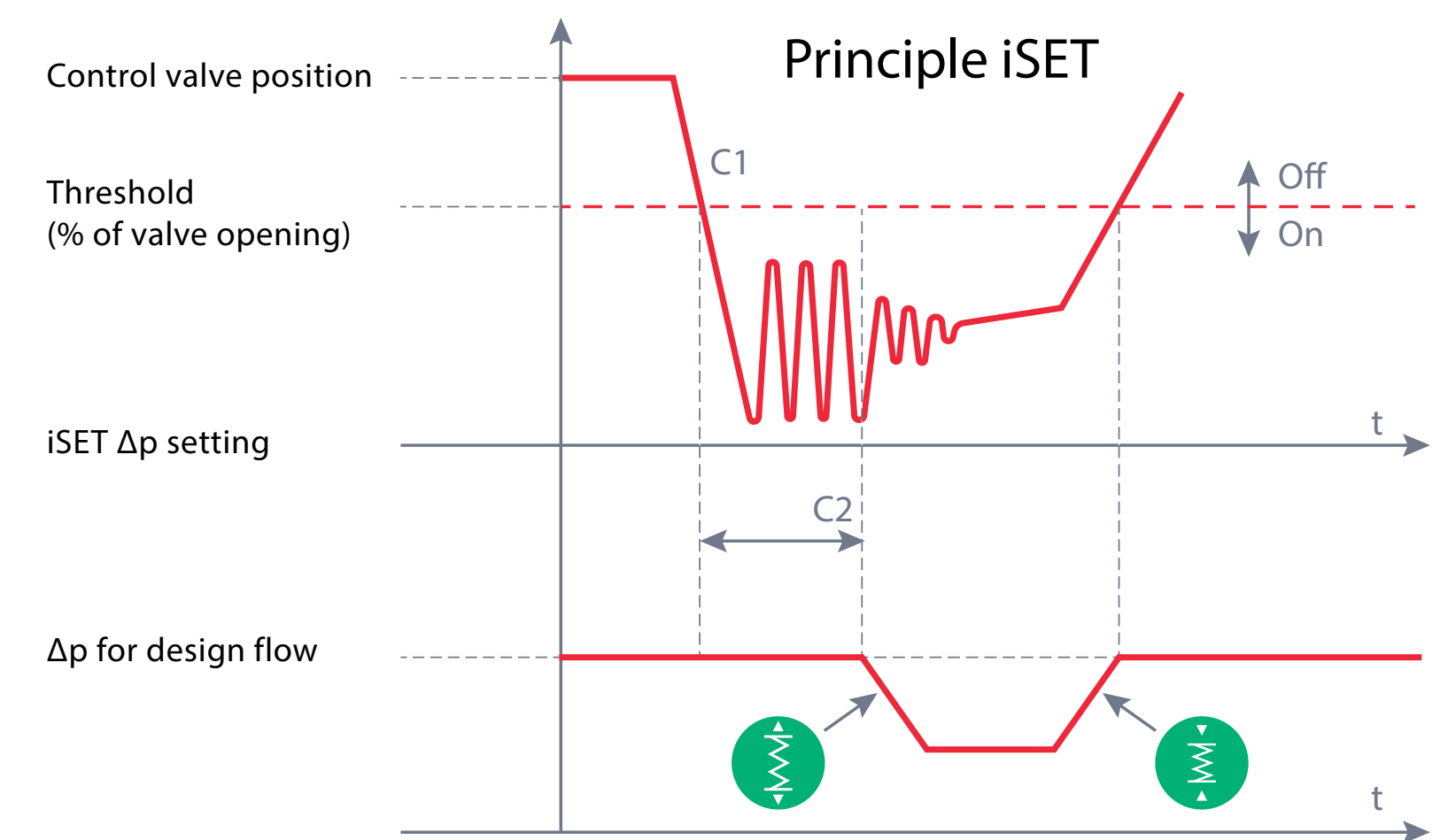
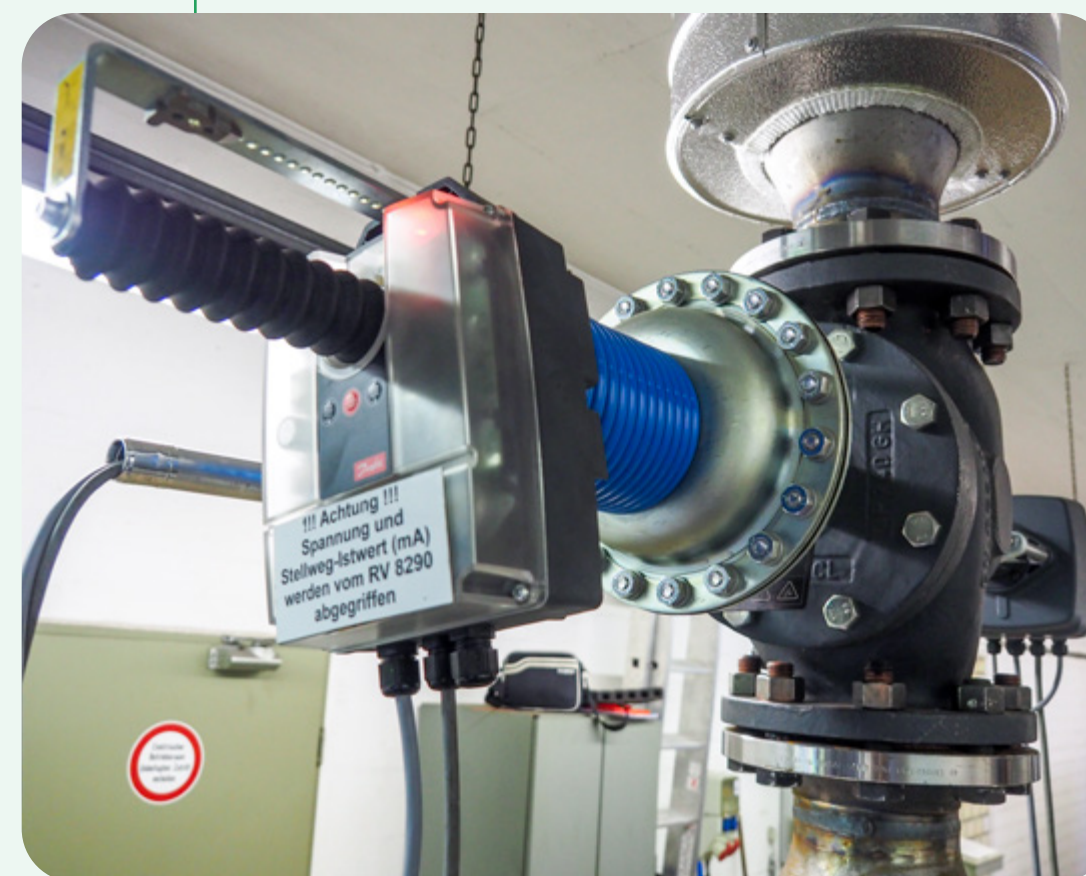
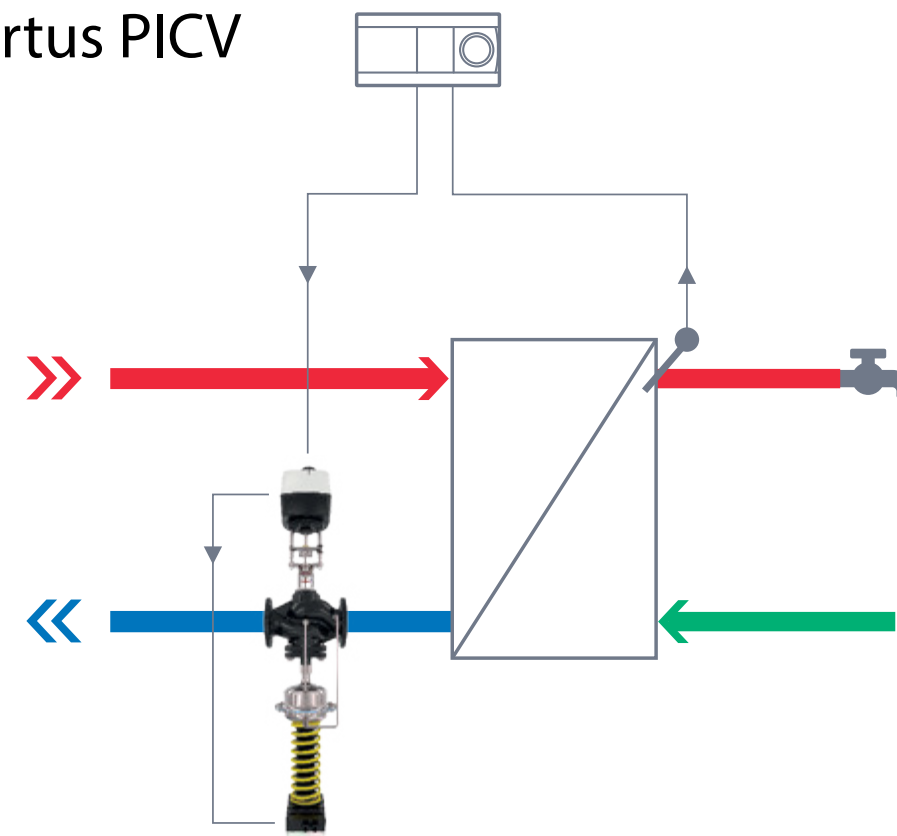
To stabilize network operations, Fernwärmeverbund Niederrhein decided to gradually modernize their network stations and installing Danfoss Virtus heavy-duty differential pressure and flow controllers. In alignment with Danfoss they selected the highly innovative pressure independent control valve AFQMP 2 with corresponding AME 655 and AMEi 6 actuators.

These advanced controllers:

- Detect low-load oscillations and autonomously adjust valve settings for optimal flow conditions.
- Adapt dynamically to varying differential pressure and load conditions, maintaining stability across changing demands.
- Enable remote control (with iSET adaption to iNET mode) for even greater precision and flexibility.
- Reduce the need for oversized valves – DN 150 proved sufficient where other solutions required DN 200, offering substantial cost savings.
- Ensure year-round operation with a single valve type, eliminating seasonal adjustments.
- Meet DIN EN 14 597 safety standards, ensuring safe operation in critical district heating environments.

Figures 6/7/8/9: The Danfoss Virtus controllers with intelligent iSET function detect low-load oscillations and automatically adjust the differential pressure over the valve exactly to the load conditions. They can be installed and operated in almost all installation positions. →

Virtus PICV



Stabilized Operations and Cost Savings

Since the installation of Danfoss Virtus AFQMP 2 controllers, the three upgraded network stations in Dinslaken and Duisburg have reported:

- ✓ Significant reduction of oscillation issues, leading to stable flow control.
- ✓ More consistent temperatures in municipal distribution networks.
- ✓ Lower return temperatures, enhancing overall efficiency.
- ✓ Reduced operational costs by optimizing hydronic performance.
- ✓ Seamless integration into digital grid management, paving the way for further modernization.

Encouraged by these results at three of their stations, Stadtwerke Dinslaken is now gradually implementing the solution in all their other network stations.

In addition, plans are made to install the Virtus AFQMP 2 solution in all of the Fernwärmeverbund Niederrhein interconnected network stations by 2028.

Figures 10/11: Two example diagrams, showing how Virtus heavy-duty controllers stabilize the distribution network flow and temperature (Fig. 10) and how the iSET function prevents oscillations (Fig. 11) despite large fluctuations in the differential pressure.

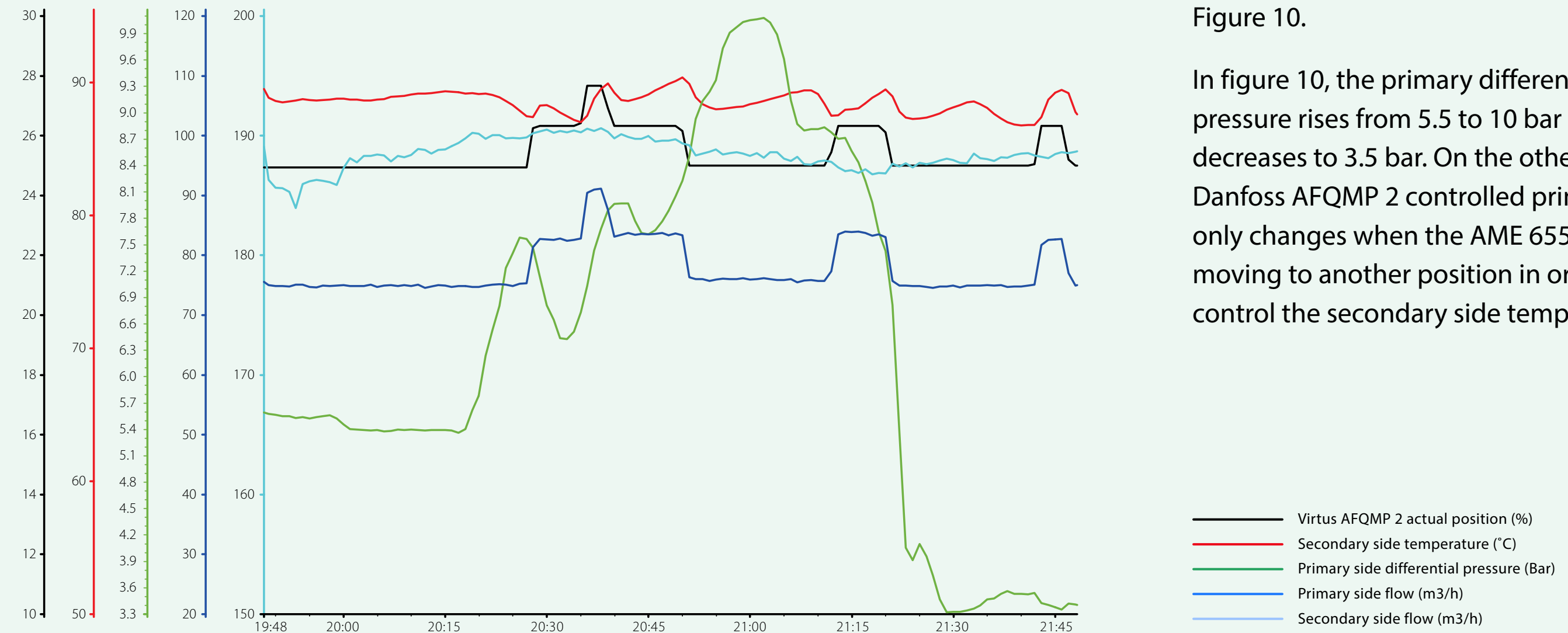


Figure 10.

In figure 10, the primary differential pressure rises from 5.5 to 10 bar and then decreases to 3.5 bar. On the other hand, the Danfoss AFQMP 2 controlled primary flow only changes when the AME 655 actuator is moving to another position in order to control the secondary side temperature.

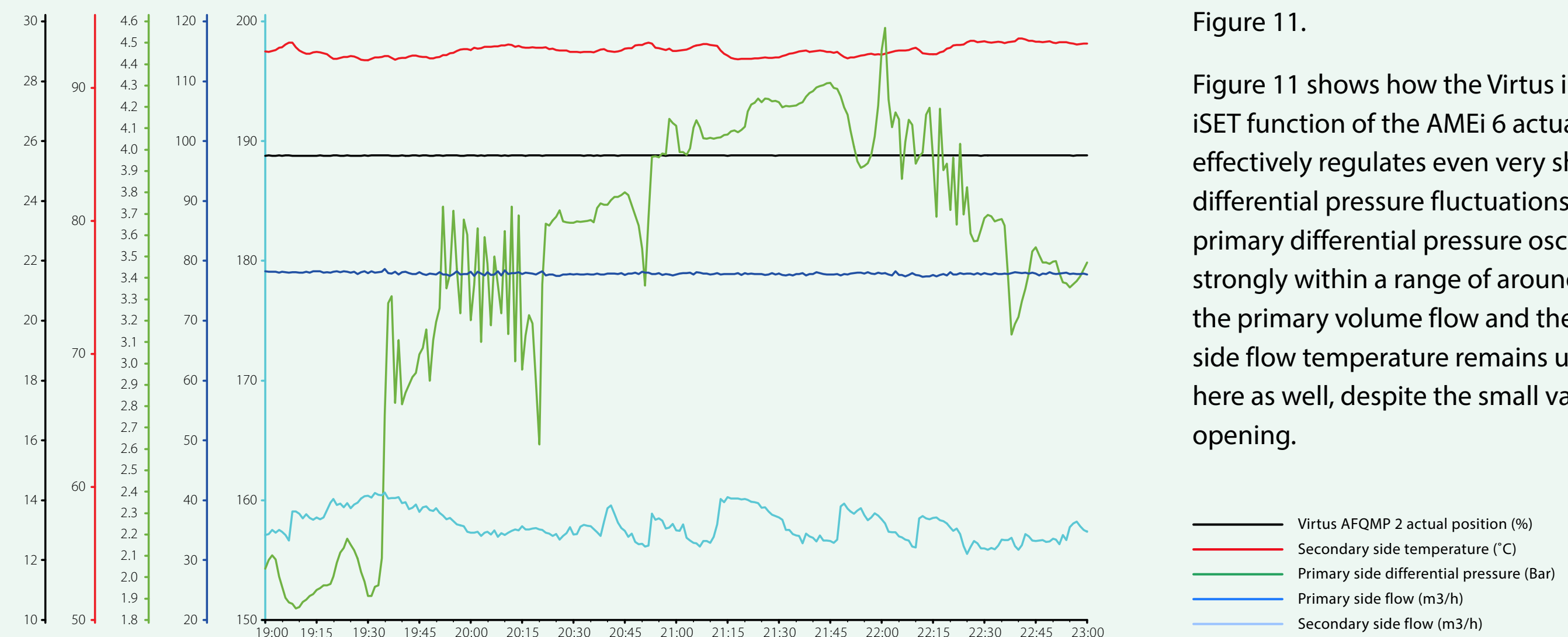


Figure 11.

Figure 11 shows how the Virtus intelligent iSET function of the AMEi 6 actuator effectively regulates even very short-term differential pressure fluctuations. While the primary differential pressure oscillates strongly within a range of around 2.5 bar, the primary volume flow and the secondary side flow temperature remains unchanged here as well, despite the small valve opening.

Future steps

A Scalable Model for Smart District Heating

The implementation of intelligent hydronic control is an important step towards district heating networks that remain efficient and resilient, even with decentralized energy sources, thereby facilitating the comprehensive integration of renewable energy sources into district heating supply.

The installation of intelligent Danfoss Virtus controllers with iSET actuators also enables seamless integration of network stations into digital grid management, paving the way for further modernizations.

Fernwärmeverbund Duisburg/Dinslaken GmbH & Co. KG is setting benchmarks for hydronically optimized district heating supply with this solution.



Learn more about
Danfoss Virtus
heavy-duty pressure
and flow
controllers on
virtus.danfoss.com



Image source: Mauritius Images GmbH, Hans Blossey

“To effectively manage today’s increasingly complex district heating networks, we need innovative approaches like Danfoss’. Our technicians are very satisfied, and the service has convinced us completely.”

— Frederik Schlaves, Group Manager, District Heating Operation, Stadtwerke Dinslaken GmbH

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