Grundfos District Heating Cases & Articles

Empowering the district heating systems of today and tomorrow

GRUNDFOS

Possibility in every drop

District heating: The smart solution for a sustainable and cost-effective energy transition

District heating has the potential to be the backbone of the green energy transition. It’s an energy-efficient, cost-effective solution that’s ready for large-scale implementation – and it can improve consumer comfort while paving the way towards a more sustainable heating future.

District heating is experiencing rapid growth currently because it offers a smart way to transition away from fossil fuels. At Grundfos, we’re ready to support that transition with more than 50 years of district heating experience – and with intelligent solutions that improve energy efficiency, reliability, and operational cost.

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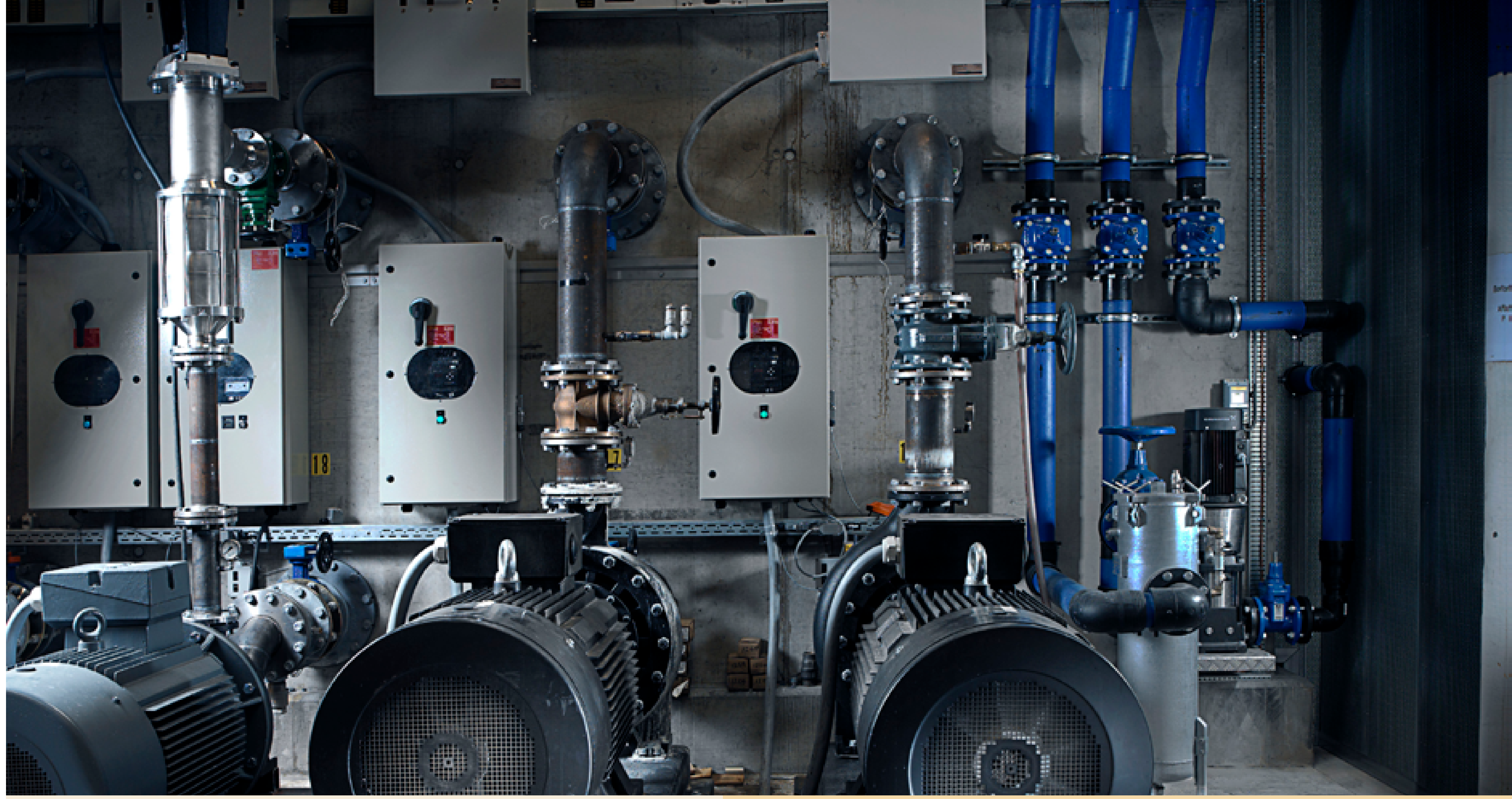
Improving system optimisation

Rapid urbanisation is putting more pressure on district heating networks. By upgrading and optimising old systems, utilities can increase energy efficiency while ensuring uninterrupted, effective, comfortable and reliable heating for their customers.



The challenge
With rapid urbanisation accelerating the growth in population and the number of residential buildings, China's demand for heat is outstripping its capacity to supply heat. We worked with a customer in a major Chinese city to upgrade their old and energy-intensive district heating facilities that were struggling to meet even the most basic demand for heating from local residents.

The solution
After conducting a detailed analysis, we helped the provider replace their original pump system with a prefabricated pump system with a remote monitoring and smart control system. The integrated and intelligent pump system comes with enhanced mechanical efficiencies that help enhance heating efficiency and stability.

The outcome
With the installation of the intelligent pump system, the heating in the region has greatly improved. Issues like pipe leakages, insufficient pressure and overall poor heating effects have been significantly reduced and the heating comfort for the residents has improved overall. The upgrade has also reduced energy consumption and operational costs.

Technical insights
Every aspect of the pump system is monitored and controlled by a microcomputer, which automatically adjusts the pressure and flow of hot water according to real system demand, outdoor weather conditions and other pre-set parameters. This helps the pump system continuously adapt to changing demands, improve overall system efficiency and guarantee the quality of heating.

7.2% heat savings through flow optimisation

4.9% decrease in water loss through pipe leakages

8.53% pump energy savings through pumping system optimisation

Above figures are based over one heating season.

All numbers and facts come from actual Grundfos customer cases.

Optimising for grid flexibility and lower carbon footprint

To efficiently and securely integrate renewable energy sources, district heating utilities must upgrade and expand their networks. Installing intelligent pumps and controllers can significantly reduce both energy bills and CO_2 emissions.

The challenge

Our customer was building a temperate water loop on behalf of public and private clients. The temperate water loop was supplemented by heat pumps for a thalassothermal complex and was to supply over 3000 homes with heating and cooling. The ambition was that the system would be 66% powered by water from the Mediterranean and 34% by electricity to lower the carbon footprint.

The solution

We delivered a complete pumping solution: a compact setup with NB/NBG monobloc pumps selected for the best efficiency (hydraulic and electrical), along with variable speed drives that optimise management of the pump cascading so they always offer the best operating balance to meet fluctuating requirements.

The outcome

The motors in our pumps have simplified installation by allowing low-speed operation of close to 25% (12.5hz), which helps avoid the need for a jockey pump for low-flow periods. A Control MPC cabinet with the CU352 controller integrates the pump cascade manager and, based on a constant comparative study of motor efficiencies, guarantees the best combination of pumps in operation.

5-15% reduction in annual energy bills for the connected customer

1,800 tonnes of CO_2 emissions saved

Simplified operation with low speed operation (12.5 Hz/25%), without requiring jockey pump for low flow conditions

Above figures are based over one heating season.

Technical insights

Grundfos offers the opportunity to conduct an energy study. By assessing your operations based on the actual load profile you provide, we can better understand your installation's performance and your pumps' actual energy consumption.

All numbers and facts come from actual Grundfos customer cases.

Energy efficiency is key to solving the climate crisis

The climate crisis is getting worse, and the global 1.5°C temperature goal agreed upon by the world's leaders is all but out of reach. But we know how to stop that number from rising. We need to become more energy efficient.

To meet the growing demand for heating and cooling without fuelling the climate crisis, we need energy-efficient solutions that can heat and cool our buildings.

Energy efficiency has a particularly big potential in the buildings where we spend most of our time because buildings account for 40% of the world's energy consumption[1] – and a lot of this energy consumption goes towards heating and cooling our buildings.

The need for energy in buildings is only going to increase. People around the world want more comfort in their homes, and a growing middle class is expected to triple cooling demand by 2050.[2]

Energy efficiency is key to increasing comfort while reducing energy consumption and CO_2 emissions. It's also key to accelerating the global green energy transition. Succeeding with this transition won't be possible without district heating and cooling, which can enable grid optimisation and make it possible to integrate renewable and surplus energy sources that are currently going to waste.

The problem with today's district heating and cooling setup

But we're not there yet. Today's district heating and cooling systems are not always designed and operated efficiently and face issues like energy and pressure losses and uneven energy distribution.

As an example, district heating systems run with setpoints that serve the buildings with the highest demands. This is a problem because it means the buildings with the highest temperature demand determine how the entire grid should be operated. And the higher the temperature, the less energy-efficient and high-performing the system will be. This ultimately results in uneven heat distribution and big heat losses.

Another key issue with a lot of today's district heating is that, despite the potential for energy-efficient, cost-effective and flexible large-scale use of low-carbon energy for heating, there is still a high reliance on fossil fuels.

The intelligent approach to district heating

District heating is ready for large-scale implementation right now. But to tap into its huge potential, we need to take an intelligent approach. That's why we have worked for many years to create intelligent solutions that contribute to the sustainable expansion of grids around the world.

A central theme of our approach is lowering temperatures in district heating grids. It's the key to all the benefits. By lowering temperatures in the grid, you can reduce heat loss through the pipes and thermal stress on the pipework while increasing capacity and reducing leakages.

We're also focused on optimising networks through a digital approach with connectivity and data. By seamlessly integrating connectivity into our intelligent pumps and components, we unlock a new realm of valuable data interaction and key insights.

A closer look at Grundfos' key solutions

One of our key offerings that can help transition district heating into the fourth generation is Grundfos iGRID, one of our most advanced district heating solutions.

Grundfos iGRID optimises and controls temperatures in district heating based on demand-driven distribution and supply. Utilising demand-response control makes it possible to deliver only the required pressure in the grid or zone.

Decentralised and distributed mixing loops ensure that pressure is only added when needed, ultimately enabling lower system pressure from the heating plant and reducing leakages. With real-time monitoring and data on temperature, flow, pressure, and delivered heat, you get the perfect overview for potential optimisation areas.

Grundfos iGRID also makes it possible to reduce carbon emissions with low-temperature zones that make it possible to utilise more renewable energy. However, the lower the temperature in the system, the more flow is needed to deliver the same amount of energy. That's why demand-driven distribution is a game-changer, as it can deliver on demands without increasing residual pressure.

To reduce the heat loss in the grid as much as possible, the temperatures are optimised based on real-time data from iGRID measure points that are placed close to the consumers. The data is used for the iGRID Temperature Zone that utilises a mixing loop and an iGRID Temperature Optimiser to lower the supply temperature to meet exactly the required level.

iGRID also results in automatic balancing of the zone based on real-time data instead of manually changing setpoints based on theoretic hydraulic models.

In addition to iGRID, we also have a range of high-quality pump solutions and components that can improve district heating. Our pumps, including MAGNA, TPE and CRE offer consistent quality, strength and reliability, which is key. Otherwise, you'll often have to replace your pumps and equipment, resulting in significant costs and downtime.

That's why our main pumps, the most essential part of any district heating system, are built to perform and last. Our high-efficiency e-pump solutions are powered by IE5 MGE motors and intelligently controlled with our CUE variable speed drive.

The future of district heating

Ultimately, our ambition is a system that is always able to deliver on demands and minimise the amount of wasted heat and energy. So we always supply exactly what's needed. No more, no less.

In the future, district heating and cooling will continue to become increasingly digitalised. This means we'll get access to data and actionable insights that can help continuously optimise grids around the world and allow customers to make better and more informed decisions.

We'll be increasingly renovating and expanding the current networks and start to see more sector coupling. The more we can make district heating an integrated, collective part of our energy infrastructure, the stronger the setup will be. We'll hopefully continue to see more secondary heat sources integrated, such as waste heat from data centres, industry or nuclear power plants. These can either be directly integrated or supported by heat pumps and storage systems.[1]
The digital aspect is set to be the area where most innovation will take place. But to truly harness the potential of district heating and cooling, we are going to need improved collaboration, transparency and communication between all the players in the field. If we manage to work together to push district heating and cooling forward, it can be a huge enabler of the green energy transition.

Did you know?

- Buildings account for 40% of the world's energy consumption.
- 90% of the heat supplied to district heating is produced through fossil fuels[3]

Reduced heat loss and easy control with low-temperature zones in Denmark

Lowering system pressure and outgoing temperature can be an effective way of improving reliability, energy efficiency and heat loss. The lower temperature also makes it easier to utilise sustainable energy sources and surplus heat from surrounding areas.

The challenge
Several Danish district heating providers were looking to lower outgoing temperatures from as high as 80–100°C to 60–65°C in certain zones, as this is all that's needed in residential zones. The challenge was that the networks were older and supplied much higher temperatures than necessary.

The solution
The solution was Grundfos iGRID Temperature Zone, an off-the-shelf solution that makes it easy to introduce low-temperature zones across district heating networks. Along with monitoring and control, the new solution adjusts temperatures to meet exact consumer needs on a real-time basis, lowering heat loss and costs. This means different, lower levels of heat can be supplied to different zones within a district, as opposed to one blanket temperature for the entire network.

The outcome
The new setup has given the district heating providers the ability to lower temperatures in a smart, cost-effective way. It has helped lower energy consumption in the supply area, and the lower return temperature means lower temperature to power stations and waste incinerators – which ultimately means better utilisation of energy, along with reduced CO_2 emissions.

Technical insights
Grundfos can supply prefabricated Grundfos iGRID units. iGRID includes a digital customer platform and pre-engineered Temperature Zones. These come with intelligent algorithms that secure precise temperature adjustments.

Estimated **50% reduction in heat losses**

Future-proof solution that lets the grid connect to low-temperature sources like **renewables and surplus heat**

Quick return on investment, as low as 3.5 years

All numbers and facts come from actual Grundfos customer cases.

Above figures are based over one heating season.

Security of supply is a crucial part of heating homes and buildings

Geopolitical tensions and the need to phase out fossil fuels means security of supply has become a key priority.

A flexible heating solution

Currently, 90% of the heat supplied to district heating is produced through fossil fuels.[3] We need to replace this with renewable energy sources like geothermal energy, solar power, and wind power, as well as surplus energy sources like waste incineration and heat from industrial processes.

One of the main advantages of district heating compared to other heating solutions is precisely that it allows more than one type of fuel. District heating networks are not constrained to using a single type of fuel like coal, oil or natural gas, which can leave consumers vulnerable to fluctuations in price like we've seen with the war in Ukraine and Covid-19.

District heating can handle different energy sources at the same time, and the production is very flexible, ultimately increasing the security of supply and production efficiency. If one energy source breaks down, alternatives are available – and district heating utilities can at any time choose the cheapest energy source, driving down costs.

District heating also makes it possible to store heat, both day-to-day and from season to season. This means that district heating networks are less vulnerable to breakdowns in specific energy sectors.

The many challenges of maintaining security of supply

System failures are always a risk in district heating systems. Ageing infrastructure, general wear and tear and inadequate maintenance can lead to infrastructure breakdowns that can affect production plants, distribution pipes or substations and severely disrupt heating supply to large areas.

The increasing intelligence of district heating networks also means that these can potentially be exposed to cybersecurity threats. In the worst case, cyberattacks can disrupt district heating operations, manipulate control systems or even cause system damage.

District heating and security of supply

District heating can handle different energy sources at the same time, and the production is very flexible, which helps increase the security of supply. District heating also makes it possible to store heat, both day-to-day and from season to season, which means that networks are less vulnerable to breakdowns in specific energy sectors.

District heating networks are also exposed to the threat of extreme weather events. Severe cold can strain the capacity of heat production plants, reducing heat supply or causing outages. Heatwaves can overload cooling systems and lead to lower heat production and outages. Storms and floods are also a risk, potentially damaging critical infrastructure.

These issues can lead to reduced indoor comfort and potential damage to equipment in buildings that rely on district heating. Businesses that rely on district heating for temperature control in places like storage facilities can also face economic disruption. In the worst cases, it can cause public health concerns, particularly for vulnerable populations.

That's why it's key that district heating infrastructure is designed, operated and maintained at high standards. A focus on resilient design can be a good strategy, making sure that systems are equipped with redundancy measures, backup systems and distributed production less vulnerable to disruption.

This is also where diversifying fuel sources, including renewable energy sources and waste energy sources, is useful, as this means district heating networks are less reliant on a single fuel source.

The intelligent approach to district heating

- Our variable speed pumps adjust to changes in heat demand and flow.
- Highest effieciency powered by MGE IE5-rated motors.
- Decentralised mixing loops deliver temperatures according to needs.
- iGRID enables low-temperature water supply.

A closer look at Grundfos' key solutions

At Grundfos, we offer many different solutions that help ensure security of supply in district heating. Our variable speed pumps are powered by high-efficiency MGE IE5-rated motors. A key advantage of variable-speed pumps is its flexibility. A variable-speed pump always pumps at the rate required, making it perfect for variations in heat demand and flow.

Another approach we work with is decentralised mixing loops. A mixing loop can zone the temperature in a district heating network. These different zones typically have different needs, and to avoid delivering the highest temperature needed in one zone to all zones, you need a mixing loop to control the flow temperature of a zone.

Grundfos iGRID is one of our most advanced solutions for district heating – and it showcases the true potential of the fourth generation of district heating. A key feature of iGRID is low-temperature water supply, which means less energy is required to heat water. This leads to less energy getting lost in the distribution networks because of thermal losses – and pipes and critical components are less prone to thermal stress, reducing leakages and increasing the overall lifetime of the system.

We also offer a portfolio of services that help ensure reliable operation. In a typical district heating grid, optimal operation is typically prevented by just a few buildings. This could be due to poor balancing or installation issues that lead to high return temperatures. We offer services that use data analytics, physical building balancing and reporting to offer lower return temperatures, lower supply temperatures, higher operational efficiency and reduced heat losses in the district heating grid.

In total, the combination of intelligent solutions like iGRID and the integration of renewable energy sources, seasonal storage and high-quality, reliable variable-speed pumps means you get a solution that significantly improves security of supply.

What does security of supply look like in the future?

The demand for district heating is growing. In Europe, the demand is increasing drastically because the level of urbanisation is expected to grow to almost 84% in 2050.[4]

District heating has the potential to significantly enhance the security of supply of heating. The diversification of fuel sources will continue to support the integration of more renewable energy sources like solar, thermal, and wind power, which will reduce reliance on fossil fuels and increase future resilience. Large-scale storage solutions like seasonal thermal energy storage will also help increase flexibility and ensure consistent heat supply all year round.

Did you know?

In Europe, the demand for district heating is increasing drastically because the level of urbanisation is expected to grow to almost 84% in 2050.[4]

With more district heating networks being renovated and constructed, utilities will be able to design for redundancy, backup systems and distributed production, all of which will help minimise the impact of disruptions caused by infrastructure failures, extreme weather events and cyberattacks.

The regulatory landscape will be interesting to follow as well. It's likely that governments will increasingly seek to adopt policies and frameworks that can help incentivise actors to expand and modernise existing district heating systems, including more renewable energy integrations. And move away from reliance on fossil fuel imports.

Above all, collaboration between utilities, energy providers, municipalities and research institutions can help expand knowledge about best practices and lead to new innovations that create better and more sustainable district heating systems.

At Grundfos, we want to contribute to advancing district heating – and we are ready to build on more than 50 years of district heating experience.

Reduced OPEX and lifecycle costs

How can district heating utilities lower lifecycle costs and OPEX while maintaining efficient, comfortable operations? A cost-effective solution can be to integrate energy from sources like wastewater treatment that would otherwise go to waste.

The challenge
We worked with a customer whose main challenge was to recover as much energy as possible from used hot water. Once consumed, the hot water is pumped back to a wastewater treatment plant, but until now it had simply dissipated and not been re-covered. The ambition was to recover as much energy as possible during the wastewater treatment cycle and return it to the district heating grid.

The solution
The pumps supplied, including large-diameter S2-type pumps and NK/NKG single-stage pumps, support the energy recovery process in reprocessed wastewater, where temperatures are moderate and more stable than air. Calories are extracted using closed-loop heat exchangers, after which they are transported by a fluid to substations at the foot of the buildings that need to be supplied.

The outcome
The project will produce 20 megawatts of heating and 15 megawatts of cooling per year. The new pump setup has delivered greater energy efficiency through optimised hydraulic and electrical efficiencies with our S2 ranges meeting the need for high flow rates at the best operating point with high water quality while aquastable pressure maintenance brings stability and precision to network expansion management.

Technical insights
Our pumps, like NK and NKG, stand out because they can optimise performance with high-efficiency IE4 motors and P1 electrical power precisely calibrated to the expected points.

20 megawatts of re-use heating produced per year

15 megawatts of cooling produced per year

Solutions for high flow rates with optimised hydraulics for the best efficiency at operating point

Above figures are based over one heating season.

All numbers and facts come from actual Grundfos customer cases.

Intelligently increasing network capacity and efficiency with Grundfos iGRID in Poland

By using intelligent solutions, district heating grids can be expanded to include more sustainable energy sources like renewables and surplus heat – which helps lower costs and reduce emissions.

The challenge
A district heating operator in northern Poland wanted to reduce their carbon footprint and deal with energy prices and supply in the region due to the ongoing geopolitical situation. To reduce heat loss and leakage, increase network capacity and efficiency, and use cheaper and more effective sources of energy, the network had to be upgraded.

The solution
Experts from Grundfos Poland consulted with the customer to deliver an intelligent mixing loop solution tailored to the exact requirements. Along with iGRID Temperature Zone, two skids were installed, including a controller, pump and various sensors.

iGRID intelligently monitors and controls pressure and temperature according to real-time demand in the district heating network.

The outcome
The project has resulted in reduced emissions and energy savings that can reduce heating costs for end users and increase resources for further efficiency projects on the network. With lower temperatures, the system is now also future-ready, as the new conditions make it possible to connect to low-temperature sources such as renewables and surplus heat.

Technical insights
The array of metering points and sensors around the system combine with the advanced algorithms of the iGRID solution to enable automatic, real-time adjustments in the temperature zone while also sending data back to the customer's SCADA system for monitoring on the wider network.

Optimised iGRID temperature mixing loops with fully integrated controls and monitoring

Short payback time of 1.5 years

Simple and fast comissioning with off-the-shelf temperature & pressure zones

All numbers and facts come from actual Grundfos customer cases.

Above figures are based over one heating season.

The renewable potential of district heating

In 2022, almost 90% of global heating was produced with fossil fuels.[3] Many utilities are already integrating surplus heat and renewable energy sources, but there's still huge untapped potential.

Renewables are on the rise

Renewables represent only around 5% of district heating supplies on a global scale.[3] In some countries, this number is much higher, but the global integration of renewable energy has not taken off. But things are also changing. Geothermal energy and heat pumps are elements that are receiving growing interest within district heating, and the possibility of low-temperature zones through intelligent pump solutions also makes it possible to integrate even more renewable energy sources.

In fact, renewable energy consumption in district heating and cooling is expected to grow by more than 40% globally, with markets like China, Germany, Denmark and France, in particular, leading the way.[3] A big reason for this is that district heating has the potential to be one of the most effective ways of harnessing renewable energy because it makes it possible to integrate renewable energy storage and allow for sector coupling of heat and power.

The evolution of district heating

At Grundfos, we have been working with district heating for more than 50 years. Our journey has taken us from the first-generation oil-fired district heating systems to today's fourth-generation intelligent district heating systems.

The most important characteristic of fourth-generation district heating is the low-temperature supply of water. More and more buildings around the world are becoming energy-efficient, and this makes it possible to lower the temperature of the water without compromising consumer comfort. Today, for example, supply water is usually 90°C degrees, but the temperature can be reduced to as little as usually 50°C degrees to reduce heat losses.

Overall, that means that you need less energy to heat water, reducing both costs and CO_2 emissions. Another benefit of the low-temperature water supply is that it enables district heating utilities to increase the use of renewable energy sources. Low-temperature sources like geothermal energy can be integrated, and the efficiency of solar thermal collectors, wind energy and surplus heat from industrial processes is increased.

Fourth-generation district heating not only makes it possible to integrate surplus heat, however. It's also possible to store this surplus heat over long periods of time. This could be seasonal storage in large, insulated underground pits that allow networks to harvest solar energy during the summer and use it during the winter. This aspect of district heating is key because it means grids can utilise a lot of energy that would otherwise simply go to waste.

A closer look at Grundfos' key solutions

One of our key solutions developed to support more sustainable district heating is Grundfos iGRID, which uses low-temperature zones. By dividing district heating grids into smaller zones with similar building characteristics, it's no longer the building with the highest temperature demand that determines how the entire grid should be operated.

For a pilot project in the city of Gdynia, Grundfos and the regional district heating operator OPEC, installed the intelligent mixing loop solution iGRID Temperature Zone on a subsection of the heating grid to deal with OPEC's two main challenges: Gdynia's mayor's commitment to reducing the city's carbon footprint by 43% by 2030, and concerns over energy prices and supply in the region.[5]

With automatic temperature reduction and control, the new solution has reduced heat losses and lowered the flow temperature while maintaining comfort for residents and businesses. The project has delivered energy savings that means more resources can be put toward efficiency projects on

The growth of renewables in district heating

In 2022, almost 90%[3] of global district heating was produced with fossil fuels, and renewables represent only around 5%[3] of district heating supplies on a global scale. However, renewable energy consumption in district heating is expected to grow by more than 40% globally.[3]

the network, increasing the use of more environmentally friendly sources of heat energy.

A key point of the iGRID solution is that, while flow within the zone itself has been increased, monitoring data has shown that the flow rate into the substation from the main network has been reduced by 30%, thus increasing the total capacity of the whole network.[5]

The new installation has also helped OPEC achieve a ‘White Certificate’, government-issued financial instruments that are essentially commodities that can be traded on the Polish Power Exchange. In total, the projected annual savings amount to 984 GJ in this section of the heating network.

Can district heating become even more sustainable in the future?

In the future, our ambition is that there will be an even broader focus on developing scalable solutions and business models that can help accelerate the deployment of low-temperature district heating grids and networks.

If we manage to come up with more solutions that can easily be implemented around the world and that are cost-effective and energy-efficient, more and more governments and municipalities will start to implement these solutions.

One of the key trends to watch is the increased integration of renewable energy. From solar thermal and geothermal to biomass, this move will help reduce the reliance on fossil fuels and contribute to more sustainable district heating. The use of surplus heat will also continue to grow – and overall, increasingly intelligent solutions will improve the energy efficiency of district heating systems, optimising heat transfer and reducing energy consumption and CO_2 emissions.

The main benefit of integrating more renewable energy sources and reducing CO_2 emissions is, of course, that district heating can contribute to getting the world back on track towards a future that’s sustainable for generations to come. But transitioning away from fossil fuels and consuming less energy also has other benefits.

It will also help improve air quality, for example, by significantly reducing pollutants like nitrogen oxides, sulfur oxides and particulate matter. The integration of surplus heat means district heating can also contribute to a global circular economy, helping conserve valuable resources.

In summation, there is huge untapped potential in district heating – and we can start tapping into this potential today, paving the way for a more sustainable heating sector.

Did you know?

The integration of surplus heat means district heating can also contribute to a global circular economy, helping conserve valuable resources.

Sources

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[3] https://www.iea.org/energy-system/buildings/district-heating

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Grundfos is one of the world's leading suppliers of solutions across the full range of pump applications – all the way from water supply to district heating. We think beyond the pump, and our goal is to provide you with intelligent solutions that achieve a higher level of performance in your systems. This approach has made us a preferred partner for contractors, consulting engineers and installers looking to build the most sustainable and efficient buildings and systems in the world.

Click here to learn more about district heating

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Possibility in every drop