A paradigm shift in chilled water systems

Grundfos Distributed Pumping

Better system design

Improved indooor climate

Up to 54% energy savings

GRUNDFOS

Possibility in every drop

A smart evolution in HVAC systems

Distributed Pumping enables high-performance buildings

Accurately controlled cooling systems are crucial to maintaining an efficient, comfortable building. But this accuracy can be difficult to achieve with standard valve-based chilled water systems. These systems face challenges with balancing and poor dynamic flow regulation, which leads to severe energy loss, inadequate climate control and an often-uncomfortable indoor environment.

The balanced solution
That's why building owners and operators around the world are turning to a more intelligent way to balance their chilled water systems: Distributed Pumping. Distributed Pumping solutions replace larger centralised pumps and energy-consuming balancing and control valves with smaller intelligent pumps placed on each floor of the building. This means the system is equipped only with components that generate pressure only when and where needed, automatically balancing the system.

The result is substantial energy savings and a more comfortable indoor climate.

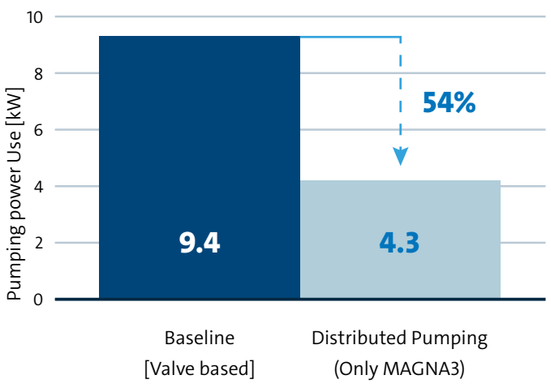
- Better system design
- Improved indoor climate
- Up to 54% energy savings

The sustainable HVAC system
Intelligent pumps from Grundfos provide auto-balancing and variable speed, which delivers better energy transfer to any load and ensures perfect conditions for terminal units and chillers. If you are planning to refurbish or build a new HVAC system, or you want your HVAC system to support your building's LEED certification, Grundfos Distributed Pumping is one of the most sustainable system you can choose.

Substantial energy savings achieved with Distributed Pumping

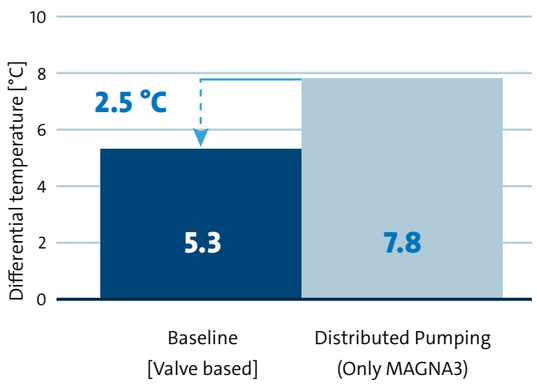
These figures are based on a mixed-use building in Singapore.
(See case on page 6)

Average pumping energy savings (3 weeks)



Replacing the balance and control valves with distributed pumps reduced the total pump energy consumption for the chilled water loop by 54%.

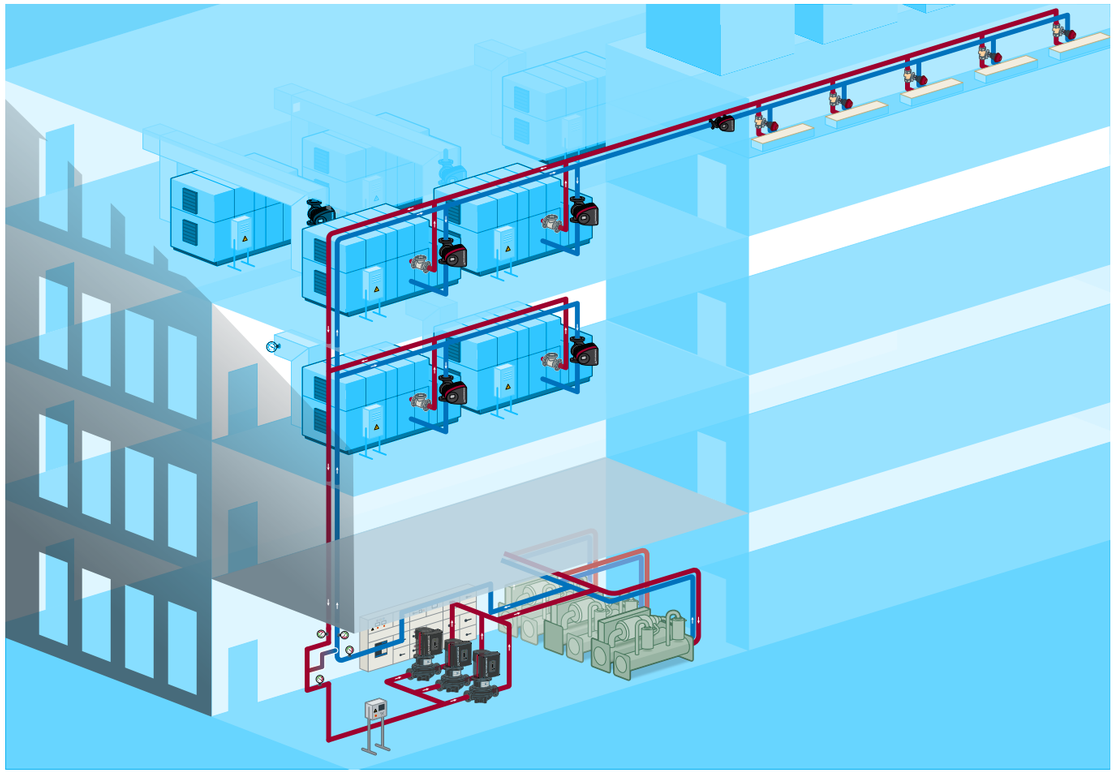
Average differential temperature (3 weeks)



The design Delta T is 7 °C. Before the Distributed Pumping concept, its Delta T was 5.3 °C, which increased to 7.8 °C after introducing the concept.

How Decentralised Pumping saves energy

Decentralised Pumping improves chiller performance in several ways that lead to reduced energy use and a more balanced, comfortable indoor climate. Explore the details here.



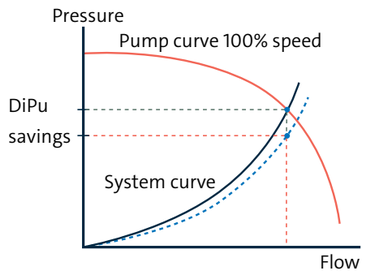
Easy commissioning
Traditional balancing and control valves are replaced by intelligent pumps that generate flow and pressure only where and when needed. Pump settings are easily being done during installation and finetuning of setpoints can be done via BMS.

Automatic balancing
During operation, the distributed pump serving each circuit, continuously measure the air duct temperature and automatically adjust the pump speed to achieve the desired temperature. Each circuit is always being supplied to demand.

Improved Delta T
An unbalanced water loop can lead to a low Delta T, causing the chillers to work outside the best efficiency point (BEP) and over pumping the loop. Distributed Pumping improves Delta T (see case on page 6), which ultimately reduces energy.

Seamless integration
Distributed Pumping easily integrates with your Building Management System. Other control options can be discussed during the design process to ensure seamless integration based on your operation sequence.

Minimum pump pressure
Demand-driven distribution ensures minimum pump pressure, resulting in reduced energy use.



A tale of two systems

As building owners and operators look for more sustainable heating and cooling solutions, the inefficiencies of traditional valve-based chilled water systems are beginning to leak. Compare a typical valve-based system with a Grundfos Distributed Pumping System to see why the industry is moving towards this new paradigm.

The valve-based chilled water system

To properly control the flow and pressure of each terminal unit of the system, balancing and control valves are used to set and regulate the water loop's various pressure losses. The balancing process is very time consuming and costly, but it is needed to ensure correct flow in the loops and control the temperature in the coils of the air handling units (AHUs) according to the design set point.

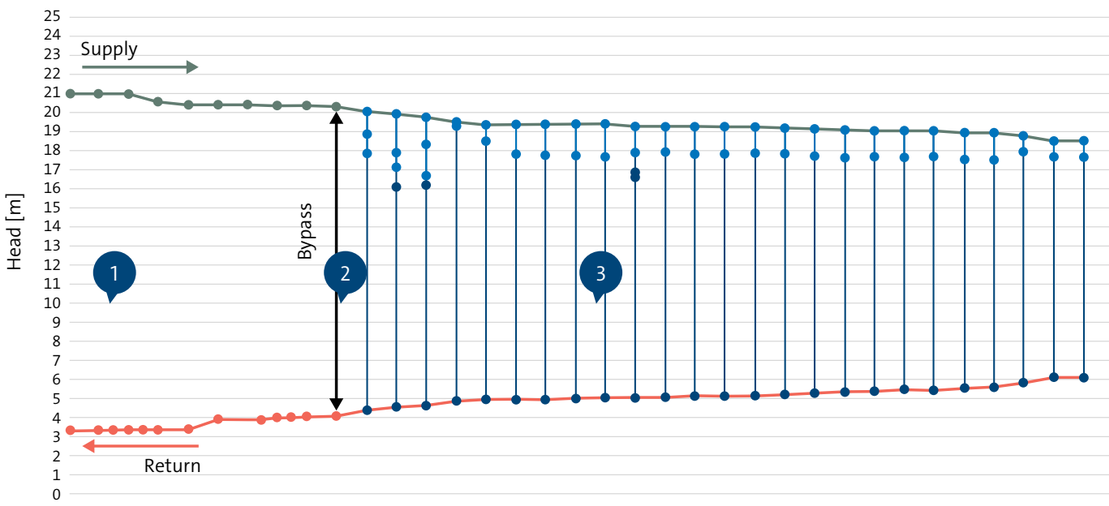
During the balancing process, the balancing valves are adjusted to compensate for the various pressure losses in each loop. This helps to create a fair distribution of the chilled water into the various terminal units located at each loop. In order to have a functional and reliable system, the system components need to be correctly sized to meet the building's cooling load.

The valve-based pressure gradient
In the below figure we can see the simulation of a pressure gradient for a conventional (Variable Primary Only) HVAC system. The graph shows that the overall pressure required to overcome the friction losses for the critical loop is very high (the difference between the red and blue lines). This creates a demand for higher pump power. Also, the non-critical loops require less pressure and will throttle the excess pressure in valves (purple line), which results in excess energy consumption.

Energy savings at part load
Simulation of 25 floor riser at part load

Total pumping power = 54.6 kW

Pressure:
- Air handling units
- Control & balancing valve



1 Big primary pumps

2 High system pressure

3 Huge pressure loss by valves and timeconsuming balancing process

Grundfos distributed pumping system

Replacing balance and control valves with distributed pumps reduces the time spent on balancing the system, as once the correctly sized pumps are selected, there are no valves needed to balance the system. Additionally, the main pumps can be downsized as each loop generates the needed pressure individually, saving pump energy that way as well.

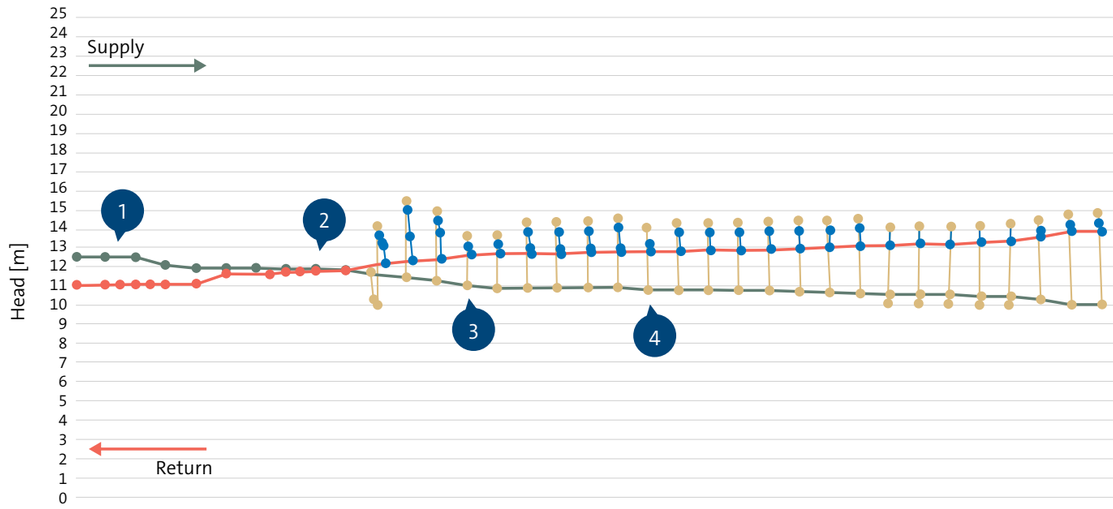
Dedicated distributed pumps are installed with a non-return valve at each AHU. The non-return valve prevents backflow in case the AHU must be shut down. The distributed pumps measure the air temperature using the AHU air duct sensor and will automatically regulate the speed to achieve the desired temperature.

The valve-based pressure gradient
Distributed Pumping offers a completely different picture on the pressure diagram for the same system. The overall pressure is significantly lower as each pump generates only the amount of pressure that is needed (the difference between the red and blue lines). The valves have been removed completely from the system leaving only the AHU coils as the main source of pressure drop. This design results in much lower energy usage and lower total expenditures.

Energy savings at part load
Simulation of 25 floor riser at 50% max flow

Total pumping power = 15.5 kW

Pressure:
- Air handling units
- MAGNA3



1 Small primary pumps

2 Primary/Secondary Bypass/Deco upler Line

3 Low system and differential pressure

4 Each pump adjust to heat load

Singapore project case Ngee Ann polytechnic

Located in Singapore, Block 22 is a mixed-use building certified by The Singapore Building Construction Authority as a Green Mark Platinum building.

Consisting of 10 AHUs and five FCUs, the building's air conditioning system is served by three chillers with a total cooling capacity of 570 RT (2005 kW). The system is configured with two working chillers and one chiller as standby. Four chilled water pumps were originally installed to distribute the chilled water in the facility in a Variable Primary Only System.

To uphold the building's Green Mark credentials and push the limits of energy conservation, Grundfos retrofitted Block 22 with a Distributed Pumping system. During installation, the initial pump setting was done via the Grundfos GO REMOTE app and the flow limits were adjusted directly in the BMS for each pump. This delivered significant time savings compared to using traditional balancing valves, control valves or PICVs (pressure independent control valves).

During operation, the distributed pumps continuously measure the air duct temperature and automatically adjust the pump speed to achieve the desired temperature – the system is auto-balancing any load, providing optimal comfort for tenants. Reducing the pressure-consuming devices and replacing the balance and control valves with distributed pumps reduced the total pump energy consumption for the chilled water loop by 54%.

Explore our Distributed Pumping products

Distributed pumping systems consist of five key components: primary pumps, distributed pumps, primary pump controller, non-return valves and sensors located throughout the building. The primary pump controller uses a control algorithm to manage the primary pumps, which are variable speed pumps that are regulated by sensor measurements from the decoupled line to avoid over or under pumping the system. See our range of Distributed Pumping products here.

Distributed pumps: MAGNA3

Intelligent MAGNA3 pumps ensure optimum flow and pressure for each terminal unit while continuously keeping the system in balance, based on input from the sensors. MAGNA3 is a wet-runner pump with no shaft seals. The non-leakage design makes the pump maintenance-free, allowing you to simply install it without worrying about its future condition.

- High-efficiency motor and hydraulics
- FLOWLIMIT and AUTOADAPT reduces energy and installation costs
- Delta T control mode reduces energy and sensor costs
- Logging and BMS communications aid system optimisation

Primary pumps: TPE3

The primary pumps provide supply pressure for the primary side only.

- High-efficiency motor and hydraulics
- Delta T control mode reduces energy and sensor costs
- Control influence based on several analogue and digital inputs
- Logging and BMS communication aid system optimisation

MPC controller

The Controller minimises the flow in the bypass line, prevents the primary pumps from over pumping and ensures that the flow for the chillers is always above their minimum constraints. The controller is connected to the sensors.

Sensors & valves

Non-return valves

- The non-return valves ensure that there is no backflow in the loops where the terminal units are off.

Sensors

- A variety of sensing elements can be used for operation of the controller.
- Air temperature measurement ensures that the MAGNA3 adjusts according to the variable load demand.

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 wastewater discharge. In Grundfos Commercial Buildings, we think beyond the pump. Our goal is to understand the building as a whole in order 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 building owners looking to build the most sustainable and efficient commercial buildings in the world.

To learn more, go to www.grundfos.com

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