Science Based Targets (SBTs): How intelligent pump technology can help you achieve net zero by lowering your CO_2 footprint

Politics and the private sector must work together to keep on top of greenhouse gas emissions as companies are increasingly interested in sustainability as a business model.

The Science Based Targets initiative (SBTi) now has more than 4,000 partners (as of January 2023), all working to limit global warming to 1.5°C (the 'Paris Agreement') with a science-based approach. The focus is on delivering real results, not just wishful thinking. Grundfos has a sustainability strategy that has been formulated and implemented over many years, making it a natural partner of the SBT initative. In turn, Grundfos supports its business partners and customers with efficient solutions based on SBTs. This is a win-win for Grundfos as well as for operators – an opportunity to take responsibility in the climate crisis and to communicate this in the market.

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Possibility in every drop

Clean air and clean water, protection of resources and the struggle against the man-made climate crisis: no reasonable person can doubt that any initiative in this area must be supported. However, even the best of intentions do not guarantee success. Booming sales of green products and technologies attract imposters and 'greenwashing' is rife in many industries worldwide.[1] Here's just one of many examples: oil and gas company BP was accused of promoting its low-carbon energy production much more than its traditional oil and gas business, even though BP invests significantly less in clean energy. BP withdrew its advertising campaign in response.[2]

Science-based targets are an antidote to this kind of greenwashing. Since it was established in 2015, the Science Based Targets initiative (SBTi) – a global coalition of national and international organisations and companies – has set the ambitious goal of demonstrating pathways and solutions to its partners to achieve the 1.5°C target of the Paris Agreement. Teams of experts from the initiative use structured methods and best practices to reduce CO_2 emissions from production, supply chains or facility management to net zero by 2050.

SBTs are a way of specifying emissions reduction targets for companies in concrete terms. A Net-Zero Standard helps to achieve this by providing a clear and science-based definition of net zero. Net-Zero Standard is the world's first private-sector framework for setting long-term, ambitious net-zero targets that are grounded in science.

At the end of 2022, Grundfos became the world's first company in the pump industry with a focus on connected water technologies to take part in this initiative. To achieve this long-term net-zero goal, the SBTi also approved Grundfos' near-term CO_2 emissions reduction targets. Grundfos commits to reduce Scope 1 and Scope 2 Greenhouse gas (GHG) emissions 50% and reduce Scope 3 GHG emissions 25% by 2030 from a 2020 baseline year.

Explanation:

In order to effectively limit the global temperature increase to 1.5°C, rapid and far-reaching measures are needed to reduce emissions across the value chain. That's why the Net-Zero Standard covers a company's entire value chain, with Scope 1, Scope 2 and Scope 3 emissions. The inclusion of indirect emissions (Scope 2 and Scope 3) requires most companies to achieve a deep decarbonisation of at least 90% in order to achieve the Net-Zero Standard.

Scope 1 emissions come from sources that are under the direct responsibility of or are directly controlled by the company. Scope 2 emissions are indirect greenhouse gas emissions from purchased energy (electricity, steam, district heating or district cooling) that are generated outside the company's own system boundaries but consumed by the company. Scope 3 covers all indirect emissions that occur along the value chain (they can be upstream and/or downstream emissions produced by the customer).

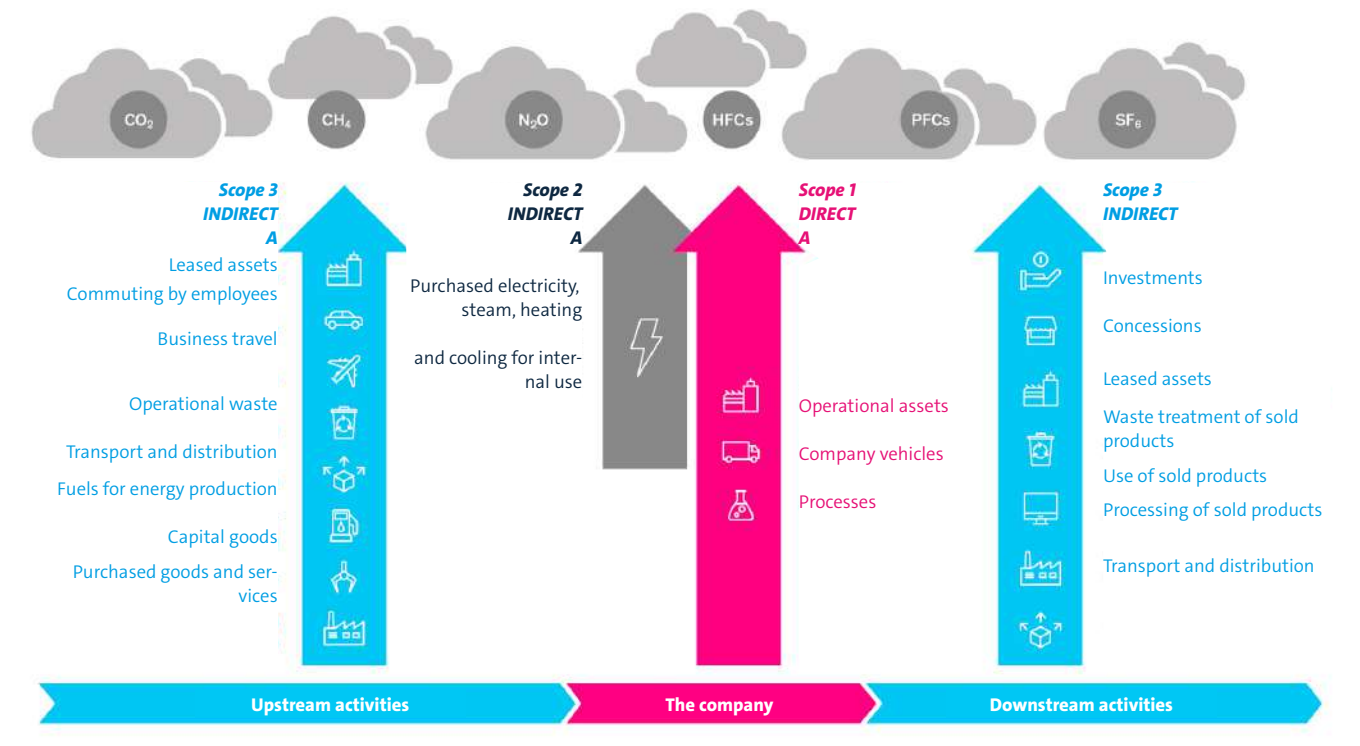

Figure 1: *The Net-Zero Standard covers a company's entire value chain, with Scope 1, Scope 2 and Scope 3 emissions.*
Photo: myclimate Deutschland gGmbH

Poul Due Jensen, Group President & CEO of Grundfos, puts it this way: “This is the most significant long-term climate commitment in our sustainability journey at Grundfos, one that highlights our leadership in taking climate action across our footprint and deep into our value chain – access to water, energy and water conservation, and the circular economy.”

The Scope 3 commitment concerning indirect emissions is particularly important. Grundfos recognises that the use of its products by customers (residential, commercial, industrial) is the largest source of greenhouse gas emissions, accounting for 99% of the company’s total greenhouse gas emissions. It's important to remember that Grundfos’ Scope 3 targets also help end customers achieve their own Scope 1 targets. In this way, Grundfos solutions support operators in a wide variety of industries as they do what they can to minimise their emissions or bring them all the way towards ‘zero’. This is a win-win for Grundfos as well as for operators – an opportunity to take responsibility in the climate crisis and to communicate this to the market.

Figure 2: *You can only improve something if you're able to measure it. After all, you can only monitor operating states, optimise processes and thus exploit potential energy savings if you have subjected your system to rigorous measurement.*

Photo: Grundfos

Grundfos is rising to the challenge in terms of technology as well as social responsibilities: In terms of technology, Grundfos has a broad-based, energy-efficient and digital product portfolio, alongside smart treatment techniques for industrial, municipal and agricultural water reuse. In terms of social responsibilities the company joined the UN Global Compact initiative in 2002, focusing in particular on Goal 6 (‘Management of Water and Sanitation’) and Goal 13 (‘Climate Action’). This is where smart pump and water solutions have the greatest impact.

Science Based Targets:
Measurement and documentation are key

You can only improve something if you're able to measure it. After all, you can only monitor operating states, optimise processes and thus exploit potential energy savings if you have subjected your system to rigorous measurement. This is achieved with sensors – fundamental elements which obtain information from the environment and process this information electronically. Grundfos produces very small sensors for exactly this purpose: a silicon-based 3-in-1 sensor that detects flow, pressure, or differential pressure. The sensors can also measure temperature. The innovative sensor technology is special because not only is it very small, but it's also extremely robust and therefore suitable for use in harsh industrial environments with hot liquids, vapours and acids, as well as high pressures.

This development, called a 'Direct Sensor’, is a micromechanical semiconductor sensor (MEMS, Micro-ElectroMechanical System). The sensor is produced in our own wafer factory, which meets Class 10 clean room requirements. This semiconductor manufacturing plant in Farum (Copenhagen) is the result of years of joint development work by Grundfos and the Microelectronics Research Centre of the Technical University of Denmark.

Figure 3: *Grundfos has its own wafer factory, which meets Class 10 clean room requirements for making semiconductors and other items.*

Photo: Grundfos

Once collected, the data needs to be interpreted

Collecting data is relatively easy. But here's the thing – diligent smart field devices generate data, but often the analysis of this data is lacking. Generally speaking, operators make effective use of less than 1% of available data from field devices according to the International Data Corporation.[3] As a result, predictions, prioritisation and planning all suffer from decisions which are not supported by the data.

One solution has been available for years: Supervisory Control And Data Acquisition (SCADA) systems. These systems monitor and control facilities across multiple locations and collect and record data about how they are running, giving plant managers a clearer picture of the ongoing processes. However, this solution has a serious drawback for smaller operators. Traditional SCADA systems are complex to use and expensive to buy.

To supplement communication with SCADA, Grundfos provides an Electrical, Instrumenation and Controls (EI&C) tool on its website. System integrators can use the tool to find out about a potentially suitable communication module and obtain all the information they need for their specific project, enabling them to rapidly integrate the pump into a BUS system and thereby include it in a system concept. The EI&C tool can also be used to simplify integration, even without SCADA.

In one simple step, select the pump you want to install and the desired BUS protocol type. In addition to the appropriate communication module, the tool provides other information such as an interface description and resource files, a circuit diagram, external libraries and information about commissioning. The function blocks for Siemens S7 are particularly useful – available free of charge as sample programs.

The selection tool actively supports EI&C technicians as they implement Pump 4.0 solutions in the desired BUS system, making engineering faster and more efficient.

From product supplier to solution provider

Are we seriously able to say with any certainty what world will look like in the years ahead? Obviously not. But we can work on the basis of more or less 'solid' expectations. As the population grows, more water, food and energy will be needed. The amount of waste is growing – recycling (including water treatment and reuse) will become more important. Last but not least, climate change will continue to challenge us for many years to come. According to a study by the VDMA Working Group for Large-Scale Plant Engineering,[4] the technology-enabled business models, which currently dominate with a share of around 60%, will become considerably less important by 2025. Digital, data-driven services ('open digital'), on the other hand, will significantly increase their market share by 2025.

What does this mean for a pump manufacturer? So far, the relevant suppliers have mainly been concerned with hardware improvements targeting availability (resilience) and energy efficiency. Robust and reliable pump technology is and remains a central basic requirement for every customer. But these days, companies can no longer define themselves purely by the hardware – the pump – if they want to stay in the game. Beyond this, the quality of cooperation is more important than ever – from consulting, through installation, to services. The global economy demands ever closer cooperation and coordination between all partners. This is only possible if the entire workflow is digitised, both inside and outside the companies.

Grundfos supports its customers with holistic, smart solutions as they optimise processes and help them to achieve set targets (which ideally are already SBTs). Of course, this is no simple feat and cannot be achieved in one go. It is a marathon, not a sprint. This starts with continuous collection of data, which is then used in the progressive energy optimization of the facility which is aided by intelligent pumps and networked applications. The technology does not necessarily have to come from Grundfos' product range: open control technology and neutral, non-proprietary systems are also used. The main focus is always on the process improvement.

For continual process improvement, Grundfos assembles teams of experts, drawing expertise from all parts of the company and applying it to specific applications. This results in customer-focused solutions that create trust and consequently broad acceptance of new technologies. For example, a "Digital Task Force" has been set up, in which top people from the Group address digitalisation and all that comes with it – including network-compatible products with smart apps, digital ordering and fulfilment processes, and digitally-enabled services.

Figure 4: *In a "Digital Task Force", leaders and experts from the Grundfos Group address digitalisation and all that comes with it – including network-compatible products with smart apps, digital ordering and fulfilment processes, and digitally-enabled services.*

Photo: Grundfos

Figure 5: *Intelligent control modes ensure secure integration of NKE and NBE standard pumps and end suction pumps, for example, with TPE inline pumps in cooling water circuits.*

Photo: Grundfos

Example 1: Smart Engineering Solutions - Keeping Things Cold with Less Energy

Industrial refrigeration applications rarely have a constant load. As soon as the load reduces, a direct temperature control solution is the best option. Take a standard heat exchanger, for example. There are three main ways to control the temperature, and each solution has the same goal: to maintain a constant temperature from the heat exchanger.

Option one consists of a regulating valve and a pump that runs constantly at full speed. Option two also regulates the temperature with a valve, but it uses a pump and an external frequency converter to maintain a constant differential pressure. The benefit of this solution is that it avoids excess pressure in the system and saves energy compared to the first setup. However, it still has the problem of pressure losses through the valve, and investment costs are higher because a regulating valve as well as a frequency converter are required. In addition, the system is made more complex as two control operations are needed for one operating point. Option three takes a more direct approach. No regulating valve is required because a sensor measures the temperature at the most important point (in the heat exchanger) and sends the signal directly to the pump, which has an integrated frequency converter. The pump speed changes depending on the flow required to maintain the correct temperature. The advantage is that additional control cabinets for external converters are no longer required, nor are regulating valves, so there will be no pressure losses from the valve. The variable speed pump will maintain high efficiency regardless of load fluctuations, and will consume less energy.

It is also possible to monitor and store temperature data, something that is especially useful for the pharmaceutical and the food and beverage industries where everything has to be documented.

Example 2: Smart Engineering Solutions - Steam Supply with Direct Water Level Control

A steam supply with variable speed pumps and direct water level control in the boiler reduces the number of system components required. The Grundfos solution removes the need for certain system components and pipes because the pump itself performs the control function, making valves unnecessary. Because there are fewer components (valves, bypasses and mixing circuits to limit the flow), the operator benefits from lower energy and maintenance costs.

A boiler feed system with variable speed pumps and direct water level control offers several advantages. The water level in the boiler is controlled directly and kept constant by variable speed pumps without the need for a feed valve. The pump is controlled by a 4-20 mA water level sensor fitted to the boiler. The water supply is continuously adapted to the steam consumption. The pumps are ramped up to full speed when the water level is low, and slowing down as the water level increases. At the maximum water level, the pump simply stops running – no bypasses are required.

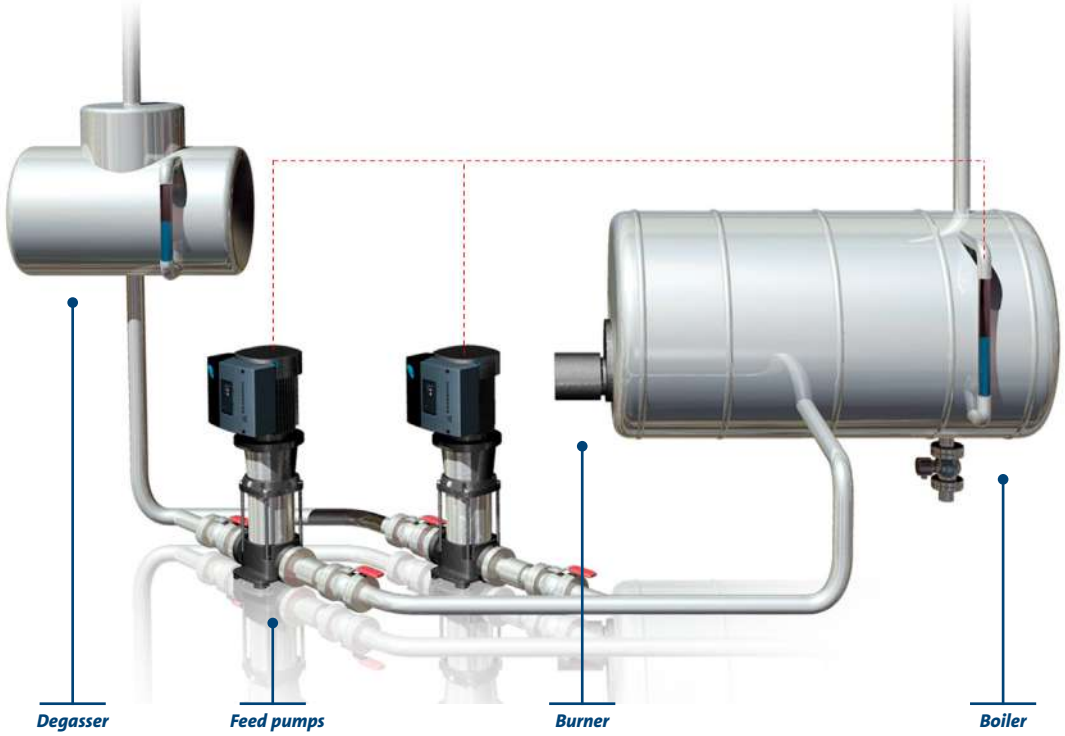

Figure 6: *A steam supply with variable speed pumps and direct water level control in the boiler reduces the number of system components required (boiler supply without feed valve).*

Photo: Grundfos

Efficiency: An Essential Part of the Energy Transition

In markets like Germany for example, the German Renewable Energy Sources Act (EEG) (in force since 1 January 2023) is consistently geared towards achieving the 1.5°C pathway under the Paris Agreement. As the rollout of renewable energies picks up pace, their proportion in gross electricity consumption is set to increase to at least 80% by 2030.

But there's no getting away from it: energy efficiency projects offer the most achievable, quick wins in terms of the energy transition and energy security. This is because the most environmentally friendly energy is energy that is not consumed in the first place. That makes energy efficiency the essential building block for reducing CO_2 consumption and achieving SBTs.

This is equally true for Grundfos in addressing the Scope 3 targets and the customers and operators in addressing Scope 1 targets.

In addition to binding energy efficiency improvement targets, the Energy Efficiency Act announced by the German government also contains rules on exploiting potential energy efficiency improvements and the use of waste heat in companies. In the future, initiatives offering clear financial benefits for individual companies already identified through energy audits/energy management systems will become mandatory. According to the German Industry Initiative for Energy Efficiency (DENEFF), this will also boost companies' competitiveness.[5]

Don't forget that pumps 'consume' 30% of the electricity used in industry. Refrigeration, compressors and fans together account for 34%. In total, rotating equipment 'consumes' two thirds of the electricity used in industry.[6] The Energy Efficiency and Process Acceleration for the Chemical Industry (EnPro initiative) - coordingated by DECHEMA under the heading of 'energy efficiency' - is clearly of great importance for the process industry and being followed closely. DECHEMA, the German Society for Chemical Engineering and Biotechnology, is based in Frankfurt am Main and has a membership comprising more than 5,800 scientists, engineers, companies, organisations and institutions.

Energy Audit: A Solid Foundation of Data for Smart Solutions

Grundfos specifically addresses the topic of energy efficiency by offering an energy audit. The audit is an inventory of energy consumption, and produces data that forms the basis for smart solutions aimed at achieving the operator's central SBTs.

In this audit, all the costs of a pump system are calculated over its entire service life, also known as life cycle costs (LCC). The audit takes into account not only the investment costs, but also the costs for installation, maintenance and energy consumption. The only 'unknown' variable for the operator is energy consumption – and that is checked by Grundfos service personnel using mobile measuring equipment. Based on the results of the measurement of relevant system parameters such as delivery rate, total dynamic head and energy consumption (in addition to the supply/return temperature difference for heating and cooling systems), precise information on the efficiency of the systems can be obtained, especially about the potential reductions in energy consumption. The operator can then choose the most efficient new system based on individual system requirements. Thanks to the measurements, a precise payback period can also be calculated for return on investment (ROI).

Arla Foods: Savings of 10 GWh

Danish dairy group Arla Foods recently commissioned Grundfos to identify, document and ultimately realise energy saving opportunities in its 60 dairy sites worldwide. The aim was to improve the core systems by replacing old pumps with highly efficient systems that include modern motors, pumps and control systems. As of November 2022, based on established and validated energy measurements, Grundfos was able to evaluate two-thirds of Arla Foods sites, identifying annual potential savings of 7 GWh. The expected total savings are up to 10 GWh.

The cornerstone of every LCC analysis is the load profile: the distribution over time of the required pumping capacity. Once this profile has been established, it is then possible to select the most suitable and efficient pump system based on experience and expertise. The ultrasonic flow meter used is a contactless, precise and maintenance-free tool. The sensors are fitted on the outside of the pipe. With this offering, the installation is easy. Energy consumption is determined by means of an energy measuring device positioned directly on the pump control box. For multi-pump systems, the total energy consumption of all pumps is measured, including the energy required for switching the individual pumps on and off. Through this approach, the system efficiency is also determined under different operating conditions and stored in the data logger.

Pump manufacturers and service providers have known for some time about the enormous potential for savings with old pumps, but they also speak about significant resistance - especially on the part of large operators. But things are changing. Until recently, operators in many industrial companies regarded a three year payback period as too long. However, with the payback period of a pump system analysis is now often just under one year (due to vastly increased energy costs), many customers are now more likely to commission an audit than before.[7]

iSolutions - A New Measure of Intelligence

iSolutions is a Grundfos concept describing the interaction of technical components (pumps, drives, sensors, platforms for data processing and data evaluation) and their result-oriented smart engineering. This new measure of intelligence helps customers achieve key SBTs, gain a competitive advantage, prepare for the future and stay one step ahead of more stringent government regulations.

Figure 7: *The Grundfos team advised Arla Foods on the selection of smart pumps and controls, and delivered a turnkey end-to-end system for cooling and ice water. This included the installation, pipework and commissioning, and validation of the savings.*

Photo: Grundfos

Figure 8: *Regardless of the sector the operator is active in, Grundfos Machine Health can offer real benefits in any installation. The solution provides user-friendly, actionable insights that help users anticipate problems before they lead to outages.*

Photo: Grundfos

It is a holistic system approach in which pumps and systems equipped with intelligent I&C technology can be adapted to the conditions of particular applications such as water treatment, cleaning processes (Cleaning in Place, CIP), temperature control, pressure maintenance, etc. in order to optimise flow, increase overall efficiency and maximise reliability. The pump systems are Industry 4.0 ready thanks to wireless technology or an Ethernet bus. That means smart pumps can perform specific functions functions, in addition to monitoring other process parameters over additional free interfaces.

The ultimate goal of digitalisation is operations excellence: quality and efficiency based on stable process control, facility uptime and flexibility.

Grundfos also offers digital-based business concepts and cloud solutions tailored to specific applications. Cloud-based data acquisition and monitoring is implemented with CIM/CIU control modules and CIM/CIU control devices for remote management (remote monitoring) as well as system integration (energy consumption optimisation).

Cloud functionality also offers attractive service and help functions. For example, the manufacturer is able to examine the current settings of a pump via the cloud and work with the operator to correct the configuration or access other functions.

Sustainability as a Business? It Really Works!

The French writer Victor Hugo knew it back in the 19th century: “Nothing else in the world is so powerful as an idea whose time has come.”

Machine Health: Preserving Value in Asset Management

Impressive life cycle costs are only possible if pumps are reliable in the long term. One important factor is energy input, which is also impacted by detectable wear of pump.

The Grundfos Machine Health (GMH) system has been up and running at BMW M since March 2020. Grundfos has access to one of the world’s largest databases of typical machine noises and vibration profiles, which enables extremely precise diagnostics. What’s more, machine data is turned into recommendations for action thanks to real-time notifications and algorithms that suggest suitable repairs and maintenance activities to prevent issues before they happen.

What impressed everyone was that GMH produced initial recommendations for maintenance and action just a few days after commissioning. An important feature of GMH is that the database used can draw conclusions about the condition of the system soon after the sensors and receivers are installed. The AI algorithms do not have to be trained first, as is often the case. Thousands of stored noise and vibration patterns can be immediately compared against the installed machines. Not only does GMH work on any brand of pump, but it can also monitor virtually any piece of rotating equipment, including compressors and fans.

Grundfos’ industry experience shows these potential benefits: 45% increase in uptime; up to 75% fewer outages; up to 30% lower maintenance costs; up to 20% reduced energy consumption.*

* Results may vary based on application, plant sizes, and other factors.

If you look around the world, it’s clear that climate and environmental protection goals are important as social issues. This requires us to depart from the familiar, and embrace new ways of thinking. We are in the middle of a process of change. In the broadest sense, it is also about the ‘purpose’ question – what do we want to achieve as a company? What is the mission of the company?

And there’s more: “Commitment to the Sustainable Development Goals is not only about philanthropy – sustainability is our business! This is because it’s important to identify and develop solutions that are scalable and can be used for other applications. We demonstrate what is technologically possible – and have a realistic chance of marketing such solutions globally.” The takeaway: philanthropy and profitable business do not have to be mutually exclusive!

Brussels also plays a part here. The Sustainable Products Initiative (SPI) is the European Commission's approach to regulating energy efficiency and resource protection requirements for a large number of product groups. Unlike the existing Ecodesign Directive, the new regulation will apply not only to energy-related products, but to almost all physical products. The regulation is intended to provide the future legal framework in which requirements concerning environmental and resource protection can be imposed on products. What is new is that the entire life cycle of the products will be considered when new environmental protection requirements arise.

The 27th UN Climate Change Conference in Egypt ended in November 2022 without any substantial new voluntary commitments regarding CO_2 reductions. Instead, many decisions were postponed for future consideration. There were some positives though. Virtually no one now questions the need for action. According to the non-profit climate protection organisation myclimate, the talk now is not about 'if' but 'how'. The crisis has evidently been acknowledged and there's a genuine will to change.

The plea of climate advocates, though, is not simply to wait for politics to catch up. Instead, we should also motivate businesses to do more for climate protection because of the huge leverage this can provide companies.

Industrial companies that are committed to CO_2 reduction benefit from sustainability and climate protection initiatives in a number of ways. First, they can save energy which in turn saves costs. This also drives innovation, improving the company's competitive advantages within their respective markets. Increasingly, however, the market expects companies not only to set qualitative goals. By simply committing to Science Based Targets, companies are demonstrating how serious they are about taking responsibility. This is also important with regard to investors and financial institutions, which are increasingly taking CO_2 reduction targets into account in line with climate science. Companies setting and achieving climate targets also help to mitigate their future risks, including preparing for new and more stringent emissions-related relations.

"We believe in the idea of sustainability and strongly believe that in the future, customers and operators will measure every company against its sustainability targets."

Martin Palsa
Managing director of Grundfos GmbH, Erkrath, and Area Managing Director D-A-CH in Grundfos

The Science Based Targets initiative is an important movement in respect to setting quantitative emissions reduction targets for companies. SBTs focus on the quantity of emissions that must be reduced in order to meet the goals of the Paris Agreement: limiting global warming to 1.5°C. The Net-Zero Standard, launched in October 2021, provides companies with a science-based framework for setting ambitious and effective climate targets with the long-term goal of net-zero emissions.

As a partner of the SBTi, Grundfos not only supports industrial and municipal operators in overcoming the energy bottleneck with creative solutions – the expertise of the Science Based Targets initiative also aids in the climate-neutral transformation.

A practical example of how Grundfos can help an operator is illustrated by this project at the Mercedes-Benz plant in Kassel. Energy managers in Daimler Truck work tirelessly to make production more efficient and climate-friendly. Their objective is to reduce the consumption of water, energy and raw materials. The 'Cooling Water Plant Hall 55' project reveals the potential of cooling water management systems. Four 45 kW motor pumps from 2011 (two cooling tower and two system pumps) were retrofitted with frequency converters. A review came to the conclusion that the pumps and control concept needed to be updated.

Grundfos proposed and implemented a solution: there are now three system pumps and two cooling tower pumps installed, each with one frequency converter directly on the pump. Instead of the four high-power pumps previously installed, there are now five lower-power pumps. In other words, where previously there were four 45 kW pumps (180 kW), there are now five 15 kW pumps (75 kW).

Furthermore, the entire piping system was adapted to the reduced pump power and volumes of cooling water. Pipe lines were reduced to a minimum size, and unused sections were capped. One important aspect of the system optimisation was the installation of numerous measuring points. The system's energy manager now knows the actual data for temperature and volume flow at every relevant point and can even see their history. The conversion to the redesigned system concept saves significant amounts of energy, more closely adapts pump operation to real conditions, and establishes constant operating conditions all while making the system much easier to use. Daimler Truck published its first sustainability report in June 2022 with a clear focus on a holistic understanding of sustainability and a commitment to CO_2 neutrality by 2039.

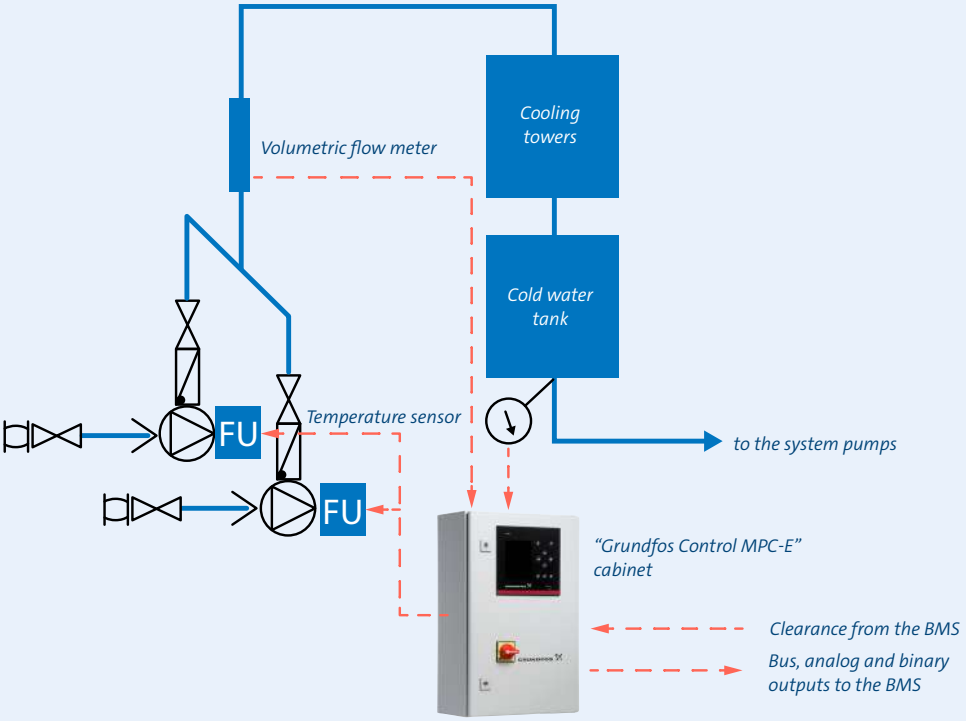

Figure 9: *The new facility control system at Daimler Truck.*

Photo: Grundfos

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