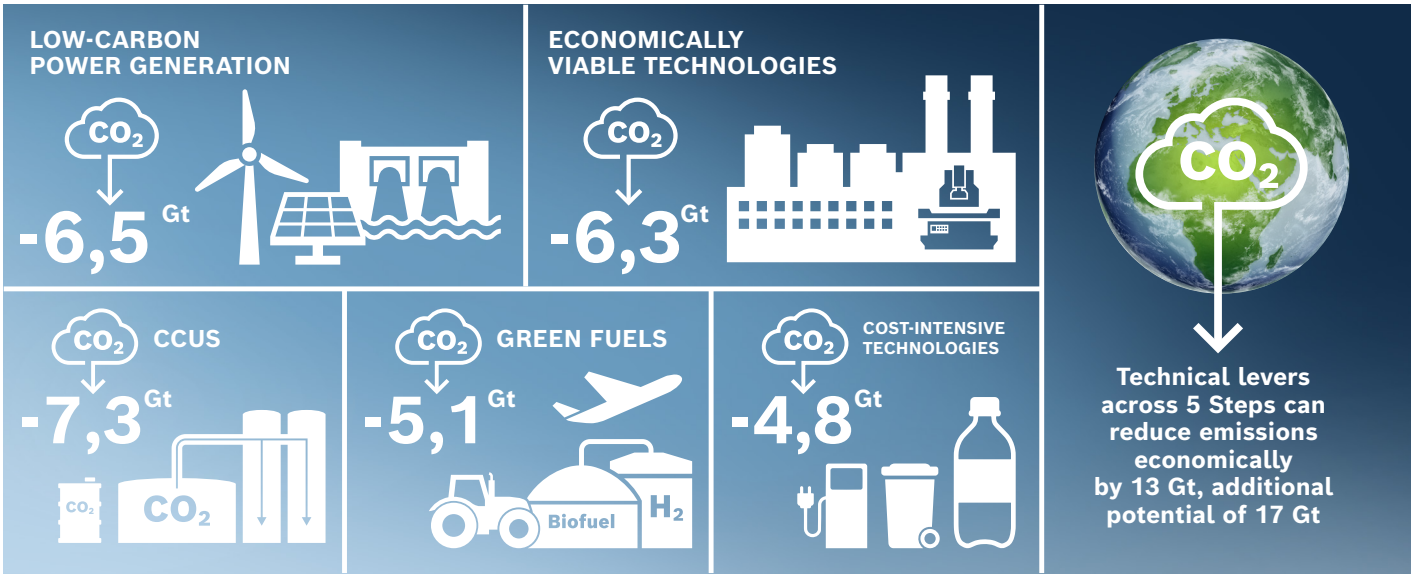
rexroth
A Bosch Company

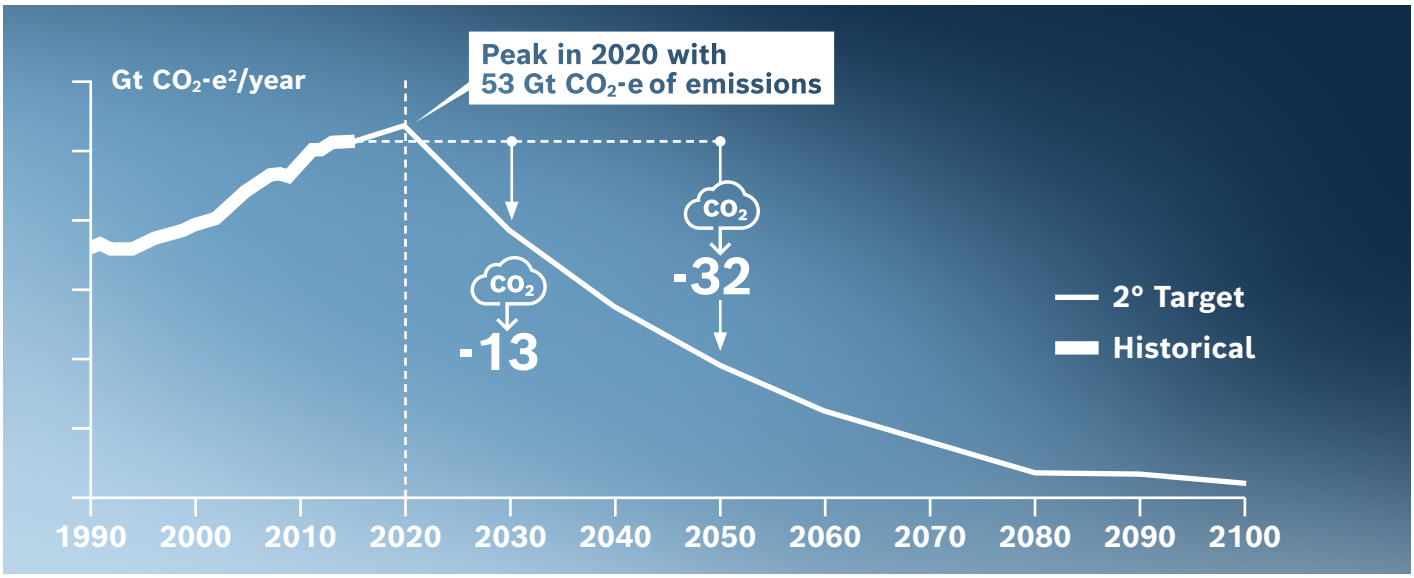
These three levers make your technology more environmentally friendly. And more economical

Modern industrial hydraulics plays a key role in achieving the 2-degree target set out in the Paris climate agreement. With three levers – reducing energy consumption, reducing fluid and saving materials – existing and new systems can be made more sustainable, thus reducing CO2 emissions while increasing cost-effectiveness.

Machine manufacturers and system operators play a key role in the fight against climate change. Through their ability to make production systems more efficient, they hold the keys to reducing industrial CO2 emissions in their hands. This applies in particular to industrial hydraulics.



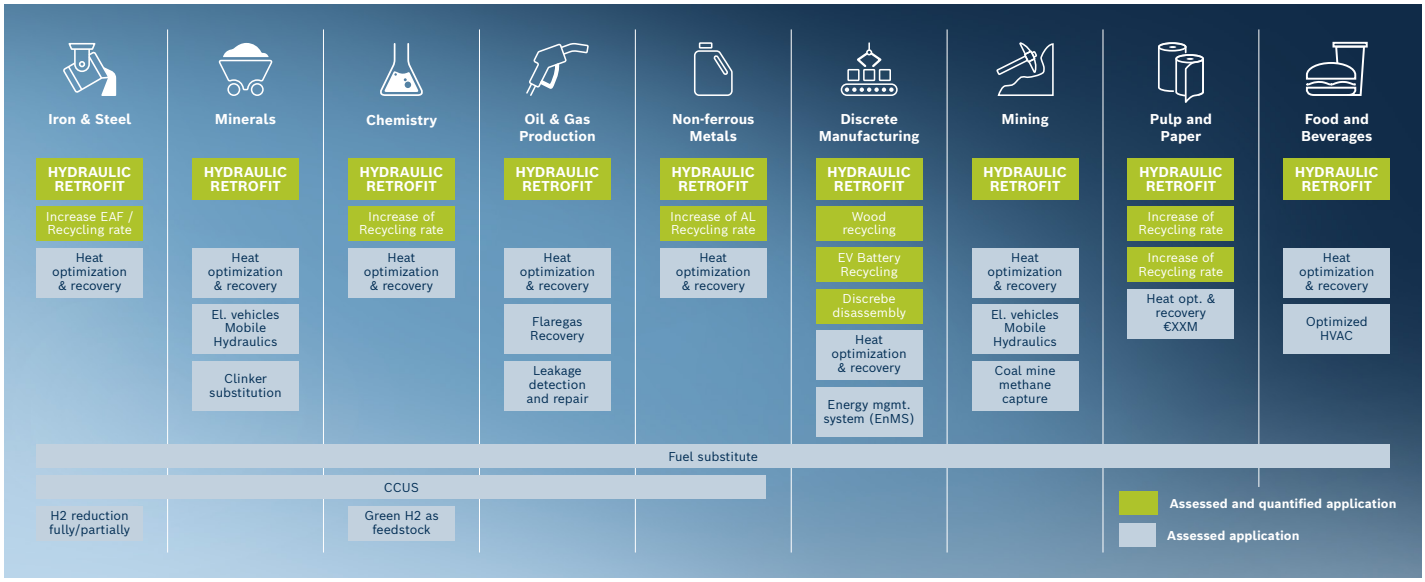
According to a joint study carried out by the Boston Consulting Group and the VDMA , global greenhouse gas emissions could be reduced by 13 gigatons by 2030 with the economically viable technologies that are already available. This represents a 25 percent reduction compared to the previous record level reached in 2020. With the help of innovative technologies, manufacturers will be able to build more environmentally friendly machines while optimizing existing systems. Most countries provide incentives for modernization in the form of subsidy programs and increasing CO2 prices. According to the study, the resulting turnover within the mechanical engineering sector could add up to €10 trillion by 2050.



▲ **In order to achieve the 2-degree target, global CO2 emissions must be reduced by 13 gigatons by 2030 and by 32 gigatons by 2050. For machine manufacturers, this could generate turnover of €10 trillion.**

ENVIRONMENTALLY FRIENDLY HYDRAULICS

A wide variety of sectors and companies could improve their climate footprint and avoid financial penalties by retrofitting their existing hydraulic systems. They range from steel and metal manufacturing, mining, mineralogy and chemicals to energy and production companies including paper and foodstuffs. In addition, hydraulics specialists such as Bosch
Rexroth are working on solutions for “green” industries such as the recycling sector and the distribution and provision of environmentally friendly fuels. For example, the energy-intensive steel industry should become more sustainable through the use of green hydrogen instead of natural gas. Transporting and storing hydrogen and distributing it at filling



THE THREE HYDRAULIC LEVERS

To help make hydraulic systems more sustainable and cost-effective, manufacturers can use the following three levers: less energy, less fluid and less material.

LESS ENERGY

Less energy through optimization of systems in the development phase, variable-speed pump drives and kinetic buffering

Less power consumption
Less operating costs
Less CO_2 emissions

LESS FLUID

Reduction of the tank volume for power units at the same performance

Lower insurance costs
Less costs for fluid
Less consumption of fluid

LESS MATERIAL

Additive manufacturing methods

High efficiency factor
Less installation space
Less costs

1st LEVER: LESS ENERGY

Electricity consumption is the biggest lever when it comes to climate protection. It can be reduced significantly by designing systems more accurately with the help of simulation and other software tools and by avoiding pressure losses. Variable-speed drives are an environmentally friendly alternative to conventional throttle control systems where a great deal of energy is lost in the form of heat. In many cases, cooling systems can be dispensed with, thus saving even more energy and reducing costs. The precision and energy efficiency of existing displacement systems can be improved by retrofitting them with digital control devices which, thanks to high-precision control, allow an entirely new level of efficiency.

Kinetic buffering is another possibility. Certain systems such as presses or plastics processing machines allow the energy released during braking processes to be stored hydraulically, mechanically or electrically and then fed back into the system at an appropriate point. As a result, the system requires less energy from the grid and smaller motors and pumps may be sufficient.

A retrofit normally increases productivity and quality because the hydraulic processes can be made more precise and dynamic. A number of applications also allow some of the electricity from the grid to be replaced by stored braking energy.

1.1. VARIABLE-SPEED DRIVES

Variable-speed drives are particularly effective and can also be retrofitted easily. Unlike with conventional drives where the electric motors turn at constant speeds, the displacement control system sets the power precisely according to requirements. In rest phases, they switch to stand-by mode. With this energy-on-demand approach, energy consumption can be reduced by up to 80 percent depending on the work cycle and corresponding amounts of CO2 emissions can be avoided thanks to lower electricity consumption. Thanks to their compact, standard-based design, variable-speed drives are suitable for retrofits and new generations of machines. They are also a key component within integrated solutions, offering particularly high energy efficiency. These include intelligent compact, medium-sized and large units as well as servo-hy-

HOW A VARIABLE-SPEED DRIVE WORKS:

A variable-speed drive consists of an electric motor, a constant or variable displacement pump, a pressure sensor and a frequency converter with software which adjusts the motor speed to the optimal operating point depending on the load. Unlike a conventional hydraulic system with a constant drive which stubbornly provides the same power, a variable-speed drive works based on demand. If the connected load requires less energy, the speed and power are automatically reduced. In addition, the motors and pumps are designed to work with minimal losses and are therefore energy-efficient. This applies in particular to highly-efficient servo motors with a permanent magnet and a sleep/wake function.

1.2. OPTIMIZED SYSTEM DESIGN

The energy consumption of new and existing systems can be significantly reduced by designing the hydraulic systems as accurately as possible. This is achieved with the help of software and through the use of new production procedures (see point 3). Thanks to simulation, the individual hydraulic components can be optimally dimensioned. Certain systems such as presses or plastics processing machines can manage with less electricity from the grid if they store the energy released during braking processes hydraulically, mechanically or electrically and then feed it back into the system at an appropriate point. Thanks to this type of energy management (kinetic buffering), it may be possible to use smaller motors and pumps, thus saving energy and reducing costs.

Original drive solution:

Displacement pump, pressure control valve, two manifolds

Work process:	**67.000 kWh/a**
Auxiliary process (Cooling):	**45.000 kWh/a**
Energy consumption:	**112.000 kWh/a**

Rexroth 4EE automation solution

- Variable speed pump
- Energy recovery through drive unit
- Highly efficient synchronous motors

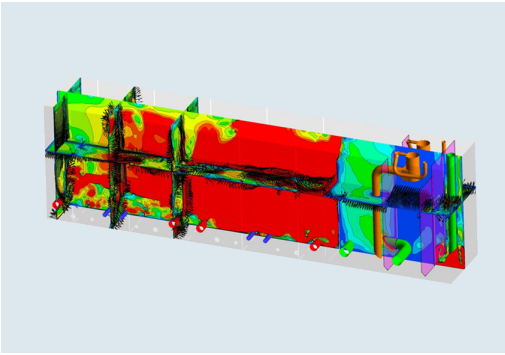
Work process:	**17.700 kWh/a**
Auxiliary process (Cooling):	**7.300 kWh/a**
Energy consumption:	**25.000 kWh/a**

Energy saving:	**87.000 kWh/a**
Monetary saving:	**12.180 €/a ****
CO_2 reduction*:	**53,3 t/a**

-78 %

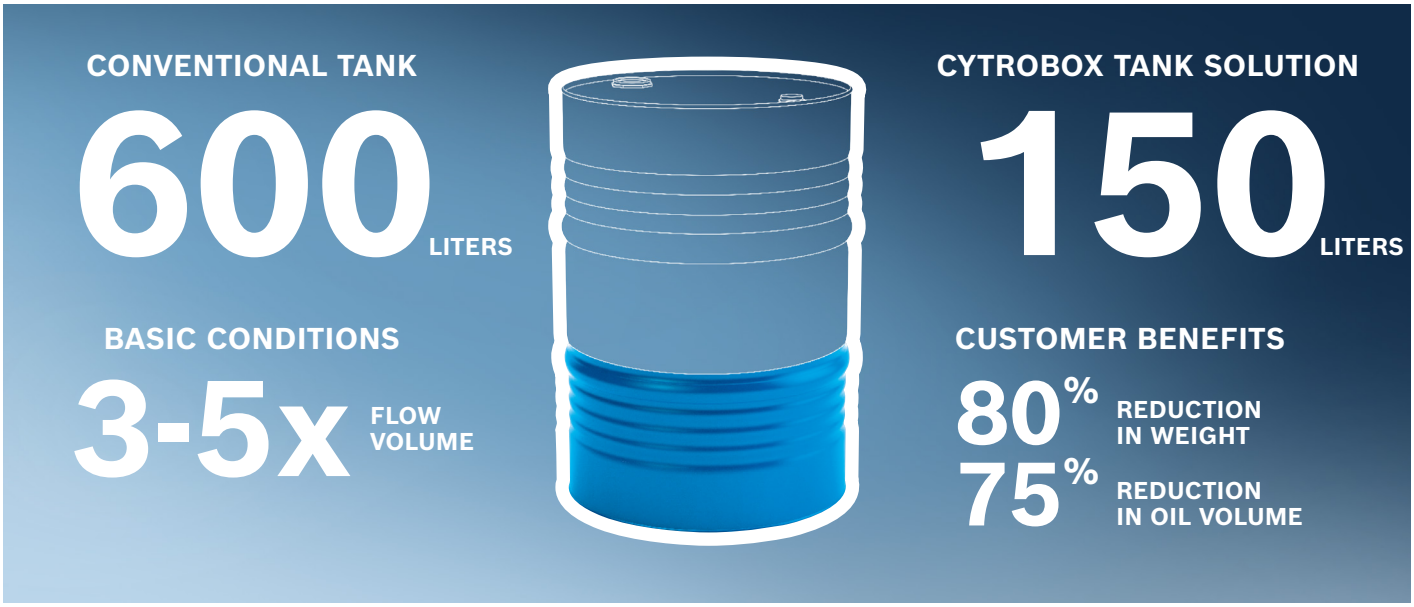
2nd LEVER: LESS FLUID

The second lever for sustainable hydraulics targets consumable materials. The main factors (volume flows, degassing behavior of the fluid, introduction of air into the system, positioning of the inlet and outlet pipes and internal tank design) influence the tank volume and oil quality. In order to reduce fluid consumption on a permanent basis, units for new and existing systems with optimized flow and degassing can be designed using CFD simulation. These produce the same power output but with much smaller tanks and with much less hydraulic oil. When it comes to the tank volume, the rule of thumb was always three to five times the volume circulating. Thanks to an accurate, application-dependent estimate and innovative degassing, this factor can now be reduced to two.



▲ **CDF simulation of flow and degassing behavior**

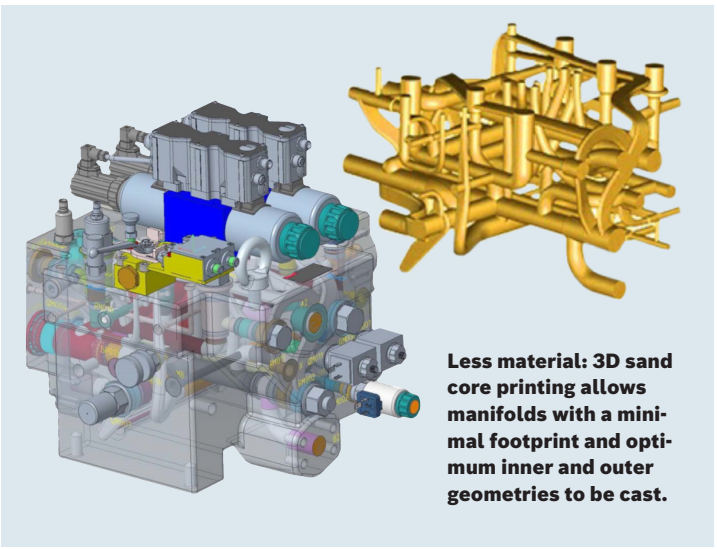
The effect is greatest with integrated solutions. For example, the tank volume of Bosch Rexroth's CytroBox compact power unit was reduced from 600 to 150 liters. The tank volume of the large ABMAXX modular unit was halved, from 12,000 to 6,000 liters. Active degassing using so-called degassing modules is another possibility. These control the oxygen content in the oil via a constant pressure regulating system which automatically switches the degassing pump on and off depending on the current gas content. A smaller quantity of fluid means a smaller tank, lower costs when replacing the fluid and lower fluid consumption. This not only reduces the footprint of a unit – it also reduces operating and insurance costs.



▲ **Thanks to CFD simulation and automatic degassing, Bosch Rexroth was able to reduce the tank volume of the CytroBox compact power unit by 75 percent. An image of the degassing simulation could be inserted here.**

3rd LEVER: LESS MATERIAL

The third lever for greater sustainability addresses the use of materials. Thanks to a combination of CFD simulation and additive manufacturing, hydraulic components with a smaller footprint and innovative geometries can be manufactured. Manifolds cast with a 3D-printed sand core benefit from this. Inside, optimum flow conditions can be achieved without right-angled channel bores and functions can be integrated directly. In turn, the tailored outer contour ensures that the compact component fits into the available space and can be connected in the optimum manner. The individually designed blocks are up to 30 percent lighter than conventional designs. At the same time, fewer materials are required for piping, connections and screw joints.



Less material: 3D sand core printing allows manifolds with a minimal footprint and optimum inner and outer geometries to be cast.

Following intensive basic research, hydraulic valve manifolds can now be printed. Additive manufacturing saves even more material and ensures optimum flow characteristics. Working together with the Center for Smart Manufacturing (CSM) at the University of Applied Sciences Upper Austria, Bosch Rexroth's Linz plant manufactures valve manifolds made from stainless steel. Thanks to selective laser melting on a TruPrint machine from Trumpf, the weight of a typical component has been reduced by 74.4 percent – from 4.18 kg to 1.07 kg.

CONCLUSION AND OUTLOOK

The existing technologies in the area of industrial hydraulics offer machine and system manufacturers a range of options for helping their customers to achieve their climate goals. Even without state subsidies, significantly reduced electricity costs and process improvements ensure a quick return on investment. Innovative technology partners such as Bosch
Rexroth which offer not only sector expertise but also analytical know-how and a knowledge of the subsidy system ensure the greatest possible benefits for machine manufacturers and system operators.

In order to further increase the potential for climate protection thanks to a more sustainable hydraulic the individual components should be connected even more intelligently in the years ahead. This will allow the system pressure to be regulated on a load-dependent basis even in complex hydraulic systems. If this is the case, the three hydraulic

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