Automotive

Innovative ventilation and drive solutions for passenger cars and commercial vehicles.

We bring your ideas to the road.

GREEN TECH

The engineer's choice

ebmpapst

A symbol that defines standards

Green through and through.
In order to underline our philosophy, efforts and achievements when it comes to environmental protection, we have put them all in a nutshell with GreenTech. The benefits of GreenTech mesh with one another from the initial development of our products through to their use – and they form a circuit that finishes right where it began: with the philosophy that we shall soon build another, even more eco-friendly and economical product.

Philosophy:
Each newly developed product must exceed the economic and ecological performance of its predecessor.

Development:
Materials, products and processes are selected and designed in an environmentally responsible manner using state-of-the-art methods.

Production:
State-of-the-art energy, air-conditioning and ventilation technology provides maximum energy efficiency in our plant.

Awards:
Environmental prizes, distinctions and energy values that fall below even the most stringent limits speak for themselves.

Application:
Our ultra-efficient products employ GreenTech EC technology and impress with enormous energy savings and top-class performance.

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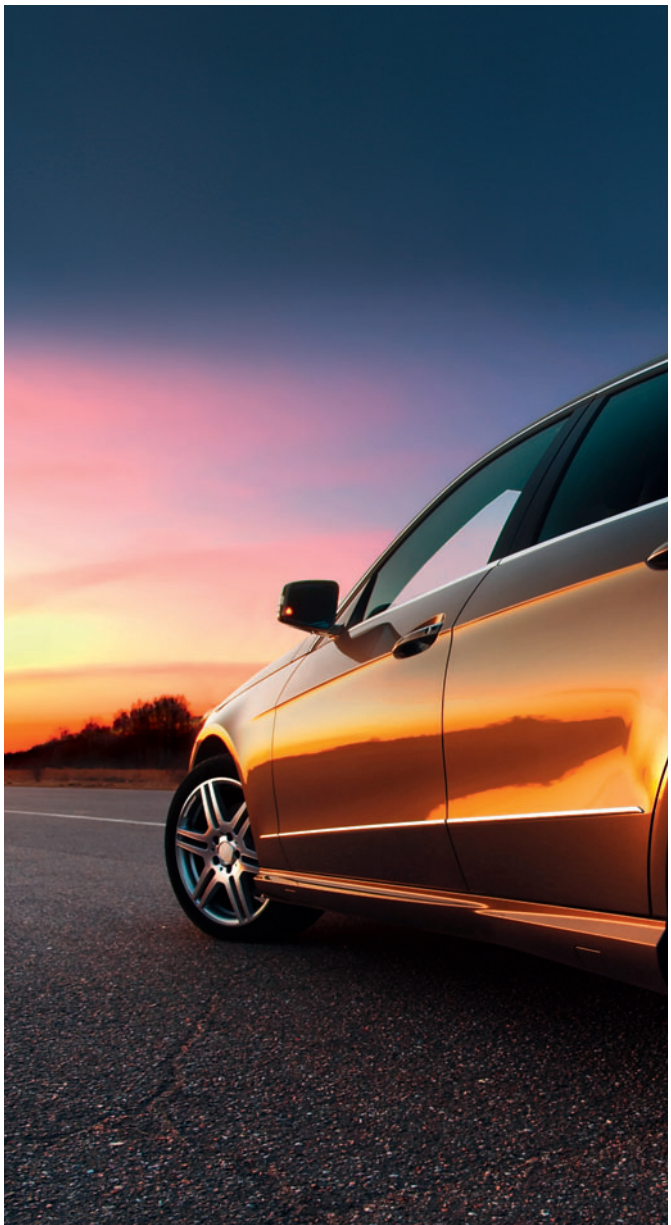

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With passion and innovative strength: We go full throttle for you.

As a highly qualified engineering partner of the automotive industry, our innovations have been helping to make the driving experience safer, more comfortable and less stressful for over a decade. A growing number of renowned manufacturers and system suppliers, in both the passenger and commercial vehicle areas, are among our customers. Their satisfaction is the result of co-operation as partners and sophisticated, highly reliable products. Whatever your project, we will go full throttle for you too!

An incomparable potential

The vehicle of tomorrow will be characterised by four chief factors: greater safety, cost-effectiveness, environmental responsibility and comfort. These are ambitious goals which, in many cases, can be reached with sophisticated electronics and the intelligent adaptation in mechanical components. The growing requirements for function and comfort, both in passenger cars and in commercial vehicles, offer unsurpassed potential for innovation – for automakers who want to gain a competitive advantage as well as the system suppliers, developers and design engineers with their ideas.

Development, production and delivery from a central source

At ebm-papst, we are centrally responsible for the development and production of motors, fans, electronics and blower modules. We guarantee that all components are perfectly matched to each other and provide maximum output with minimum noise. Naturally, our deliveries and logistics operate on a just-in-time basis and are also centrally coordinated. Rely on our first-class service and our ability to respond flexibly to the requirements of global markets. For this is what ebm-papst stands for – in Germany and around the world.

Comfort, safety, efficiency: Our innovations help where they can.

Technical innovations are not always welcomed by drivers. In many cases, electromechanical components for ventilation, air-conditioning and auxiliary drives are very loud and obtrusive. Our vision of the automobile of the future, on the other hand, is very different: thanks to state-of-the-art GreenTech EC technology, the cooling and drive units we develop work almost silently. Without the driver noticing them, they enable safe and stress-free driving, and contribute in many ways to ensuring that consumption and harmful emissions are reduced – for example in exhaust gas treatment, in cooling the energy accumulators of electric vehicles or providing the process air supply for fuel cells. Many of these components are already a reality today. On this page, you see an overview of our latest innovations in the automotive area.

Compact and convenient: Drives for every requirement

Drives not only provide added comfort to drivers, they also increase their safety. The electronics integrated directly into the motor allow operating reliability, measured output and operating comfort to be optimised continuously. ebm-papst has the right drive concept for each application, based on electronically commutated direct current motors:

- **Hollow-shaft motors** as space-saving drive solutions
  Application example: Audi ADS power steering motor
  (for more information, refer to page 14)
- **External rotor motors** as compact, high-torque pump drives
  Application example: DNOX urea pump
  (for more information, refer to page 16/17)
- **Internal rotor motors** as highly dynamic actuators
  Application example: FTE clutch actuator
  (for more information, refer to page 15)

Quiet and powerful: components for moving air

In addition to electric motors, ebm-papst also develops and produces components for controlling heat and moving air. These include fans and compact fans, which find application in a wide variety of places in a vehicle for optimum electronics cooling or air-conditioning. Our fan design, patented worldwide, is compact and offers high efficiency while running extremely quietly. Here, for example:

All the facts at a glance

- Up to 10 small fans integrated in the seat and backrest guarantee maximum customised driving comfort.
- As in-vehicle “climate researchers”, sensitive sensor fans provide optimum control of the climate control system.
- Various axial and centrifugal fans cool advanced vehicle electronics efficiently and reliably.
- Fans for high temperatures were specially developed for use in the temperature range up to 100 °C, e. g. for cooling LED headlamps.

GreenTech EC motors: the technology of the future for the car of tomorrow.

For over 40 years, we have been driving the market with well-engineered solutions in EC motor technology. Our experience is based on developing thousands of applications in a wide range of industries, such as IT/telecommunications, refrigeration and air-conditioning technology or widely varying industrial applications. Many of our solutions were originally customer-specific and later developed into industry standards. GreenTech EC technology offers enormous potential for the automotive industry in particular: As a replacement for hydraulic systems, for intelligent decentralised drive tasks and many other applications with stringent requirements for dynamics, comfort and energy savings, this drive concept is the perfect choice.

Dynamics

With many applications in cars or lorries, the electric motor must be able to change its operating speed within a very short time. EC internal rotor motors from ebm-papst generate a highly dynamic torque at a simultaneously low mass moment of inertia – ideal prerequisites for applications such as active steering, clutch actuators, rear-axle steering or torque vectoring.

Comfort

GreenTech EC fans and drives also demonstrate their advantages with respect to comfort. Above all, the whisper-quiet operation and intelligent control elevate comfort and handling to a whole new level – as with the innovative head space heating system.

Energy savings

Energy savings and eco-friendliness have long since become decisive criteria when purchasing cars and commercial vehicles. ebm-papst GreenTech EC technology can contribute in a wide variety of ways to reducing energy consumption and harmful exhaust gases. For example, as a replacement for hydraulic systems: these always have a certain dissipated energy, since they have to maintain the system pressure over the entire period of operation. GreenTech EC motors, on the other hand, consume energy only if the power is actually required (power on demand). The lightweight design from using plastic materials also contributes to reducing the vehicle weight and therefore to lowering consumption.

A concrete example of innovative environmental technology is the DNOX system for catalytic reduction of nitrogen oxides in diesel vehicles, developed by Bosch in close co-operation with ebm-papst. It was implemented by using a robust, reliable and intelligent pump drive from ebm-papst (for more information, refer to page 16/17).

For example: How GreenTech EC technology helps save petrol
Many energy-saving technologies are not even possible unless highly advanced electric motors are used, for example: LED headlamps, which have to be cooled under the most difficult temperature conditions. GreenTech EC fans specially designed for this application have no trouble withstanding temperatures up to 100 °C and do so while operating with extreme efficiency. This is the only way the energy savings shown in the following example calculation are possible:

A normal lighting system with halogen headlamps (dipped beams) and conventional side and tail lights has a power consumption of approx. 150 watts. If you assume that a mid-class car requires an average of 6.7 hp (5 kW) to maintain a constant speed of 50 km/h, this corresponds to 3 % of the total required power.

A complete LED lighting system gets by with only 50 watts, thus 1% of the total power. By means of this, the fuel consumption can be reduced by a whole 4 %. At 100 km/h that's a good 0.85 %.

With lorries the savings are even higher, since more lighting elements have to be supplied with energy. If all of these were replaced by LEDs, the petrol savings at a constant maximum speed of 97 km/h would be between 1 % and 2 %. That pays off – and not just on paper!

Experience, expertise and passion make us an ideal development partner.

Our aspiration is to participate actively in shaping the development of automotive technology: from the mechanical system, to the electronics, to the software. Together with manufacturers and system suppliers, we develop groundbreaking solutions based on their requirements and adapt them optimally to the operating conditions. By integrating intelligently defined platform modules, we also contribute to more economic production. We coordinate all activities to accelerate development and reduce costs. No less importantly, this co-ordinated approach helps bring vehicles to market much more quickly.

We “produce” satisfaction

When people need products that do not yet exist, they come to us. They do so because we have innovative solutions to match unusual tasks. With this in mind, we have developed an enormous number of customer-specific custom solutions: starting with individual housing shapes and spanning all the way to designs for use under extreme conditions. ebm-papst stands for the highest reliability throughout all stages of product development: from the first idea, to manufacturing, to delivery of our finished products. In this way, we “produce” satisfaction and are measured by that standard every day.

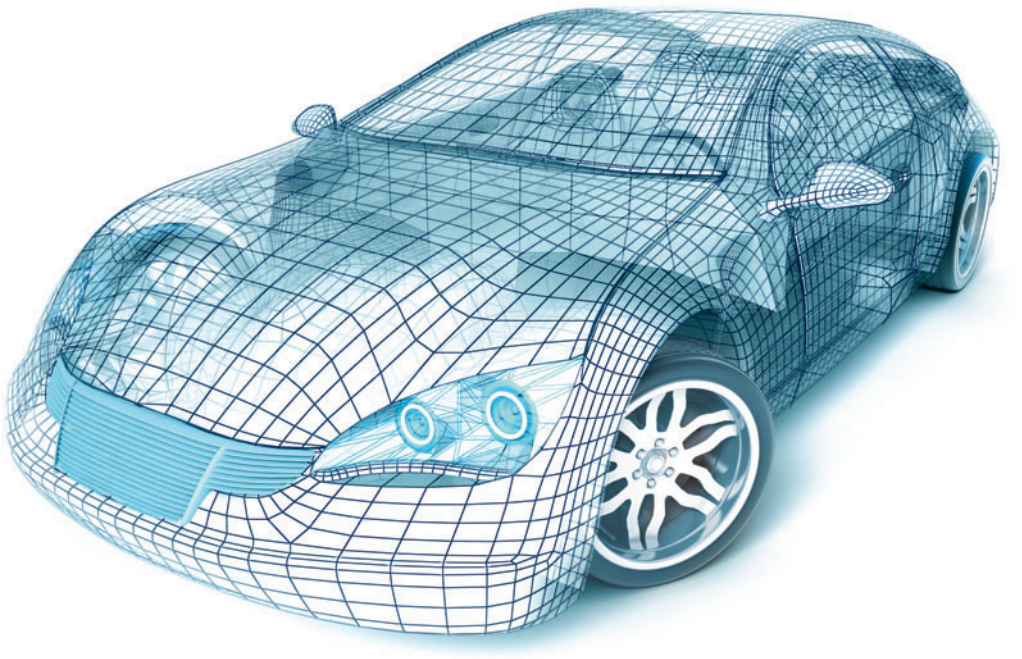
We develop holistically

With ebm-papst you can rely on over 60 years of experience. Our core competencies are in aerodynamics, structural mechanics, and acoustics as well as electronics and software development. We are a pioneer and trendsetter in developing electronically commutated motors as well as an expert in advanced design methods and material innovations. Interdisciplinary development teams are put together for each new development. This way, we can consider each product from a holistic perspective and perfectly match all components to one another, right down to software we develop in-house for optimum control of the operating electronics integrated in the motors.

We make no compromises

All products must undergo the most difficult test procedures under complex real-world conditions of use, including the continuous stress test, salt spray test and vibration test.Tested characteristics include airflow, pressure increase, operating noise level, cooling efficiency and many others. For each area, we have a measurement laboratory equipped to the highest technical level. Only when all of the desired characteristics are present does the product go into production. The sum of all these details – small as they may appear – are fan and drive products with above-average service life and reliability. All of our quality efforts, for both products and services, are documented in a comprehensive quality management system.

Many automakers and system suppliers throughout the whole world trust our expertise and creativity, e. g. Daimler, Johnson Controls, Magna, Continental, FTE automotive, ZF and Hella.



Electronics cooling:
Equally quiet and effective.

Creating quiet and powerful components and systems for electronics cooling is a challenge that ebm-papst development engineers meet every day. Our experience and mastery in solving complex cooling tasks is reflected in thousands of applications. The basis for this is provided by innovative fan and blower solutions from ebm-papst that guarantee reliable cooling of electronics, even in a tightly packed instrument panel or the engine compartment of a modern vehicle.

High-tech cooling in the smallest spaces

Electronics development in the vehicle area has been offering important innovation potential for years. With the introduction of bus systems and the increasing digitalisation of the power consumer, the trend is continuing towards ever more electronics. This development applies to comfort-oriented applications such as on-board navigation systems, powerful hi-fi components, PCs and displays, and also includes complex peripherals of the vehicle management system and driver's assistance and safety systems. To this are added extreme operating conditions such as alternating ambient temperatures (summer, winter, direct solar radiation) as well as shock, vibration, dust, humidity and excess voltage. To ensure maximum operating reliability over the entire service life of the vehicle, the high-tech electronics also require high-tech cooling. And this comes from ebm-papst – whether the application is thermal management for the infotainment system, for state-of-the-art light sources or the engine control unit.

Light sources

High-performance electronics and, in particular, the ground-breaking technology behind modern headlamps demand reliable cooling to keep things functioning smoothly. System integration with a compact design is in the forefront of the challenge. We entrust this task to our quiet and reliable axial or centrifugal compact fans.

Infotainment

Heat generation in the dashboard remains on the increase as a result of the increasing integration of devices. Active air cooling from ebm-papst improves the reliability of these systems and more than copes with the ever more stringent environmental and comfort requirements, such as noise development, housing design or protection against electromagnetic emissions. We deliver intelligent thermal management solutions – as an inseparable prerequisite for the reliable functioning of modern electronic and electrotechnical products.

Engine control unit

Naturally, the problem of integration density also impacts on the control unit for the engine management system. The high ambient temperature to which the control electronics are subjected calls for active ventilation to ideally ensure no loss of functionality. Perfectly integrated into the electronics box for the vehicle's engine management system, an ebm-papst miniature centrifugal fan cools the thermal energy given off by the electronics and, with high reliability and a long service life, defies the harsh ambient conditions in the engine compartment.

Exemplary:
A cooling system for the S-Class.

Intelligent air conduction, whisper-quiet fans

In partnership with Mercedes-Benz, we developed an innovative cooling system for the S-Class that draws in cool air from the footwell of the vehicle and directs it to target the hotspots in the electronics systems. As the components to be cooled are split between the central display and instrument cluster, the cooling air conduction had to be split accordingly: this gave rise to a flow-optimised cooling system with integrated cooling air lines.

The electronically commutated centrifugal compact fan – as the central part of the solution – is temperature-regulated directly by the command electronics. The motor receives its speed information via a control line. From a component temperature of 65 °C, the motor starts up and adjusts its speed to the amount of cooling currently required. The particularly quiet and electromagnetically compatible commutation reduces both the audible and the electrical "emissions" of the fan and, in combination with the ball bearings which have been adapted for changing environmental conditions such as air humidity and temperature, delivers a service life extending well into several tens of thousands of hours.

As a supplier package, the "complete solution" implements vehicle-specific design and optimum aerodynamics of the air ducts perfectly. Sophisticated simulation programs calculate the ideal shape of the air ducts based on virtual channel and flow models and optimise the aerodynamic layout under consideration of pressure generation and air output. This cooling system, which is fully integrated into the cockpit, sets a new benchmark in car electronics cooling.

Climate control components:
The greatest possible comfort.

If all passengers in a car or commercial vehicle are perfectly comfortable, the reason could be state-of-the-art GreenTech EC technology: intelligent sensor blowers provide optimised temperature measurement to control the automatic climate control system. Decentralised climate control or booster blowers ensure ideal air distribution. Intelligent seat ventilation prevents trapped heat. And the innovative "Airscarf" head space heating system provides convertible enjoyment in any season.

Sensor blowers: Perfect climate, automatically

Whether in heat or cold, rain or dust: climate control systems mean a level of comfort that a customer wants to feel directly on his or her skin – without delay. Particularly for automatically controlled climate control systems, absolutely reliable operation and the fastest possible response time is critical. Our compact sensor blowers with integrated or external measuring sensors provide the economical, effective and comfortable answer here.

All the facts at a glance

- Economical, as one modular system enables installation in every climate control panel without exception, and in almost any position in the vehicle – and we can produce even customised application requests in series.
- Effective, as our sensor blowers supply your climate control systems with optimum measurement data in real time, whatever the temperature.
- Comfortable, as our fan works almost free of noise over the entire service life.

Booster blowers: Feeling comfortable in every seat

Achieving the perfect "wellness climate" in a vehicle requires individual climate control of the entire passenger compartment. To do so, it is necessary to meet the needs of each individual passenger and to treat each passenger's space as a microclimate zone. Decentralised centrifugal blowers with GreenTech EC technology ensure low-noise and energy-efficient distribution of air in the passenger compartment: perfectly quiet, controllable and proven in real-world use.

Seat ventilation: Never stick to the seat again

In co-operation with DaimlerChrysler, ebm-papst developed the first seat ventilation for cars for the S-Class back in 1998: integrated into the seat back and bottom cushion, up to 8 small fans with a diameter of just 40 mm ensure a pleasant seat climate that can be adjusted to individual preferences. Thanks to the tried-and-tested brushless GreenTech EC motors, the fans feature outstanding durability, robustness and absolute low-noise performance. So, it is no surprise that the little climate machines quickly became established in both premium-class and mid-class cars. Today, they are the new standard in commercial vehicles such as lorries or construction equipment.

Head space heating: A new way to catch some fresh air

Think convertibles are only for spring and summer? With the Airscarf head space heating system, these limits are finally a thing of the past. Developed jointly by engineers from Mercedes-Benz and ebm-papst, this system offers convertible drivers previously unheard-of climate comfort, particularly during the cool seasons. At the touch of a button, it forms a soft and gentle Airscarf around the head, neck and shoulders, where the blower speed is always adapted to the outside temperature and the driving speed.

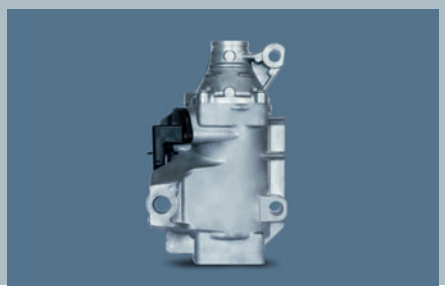
Custom applications:
Equally reliable and robust.

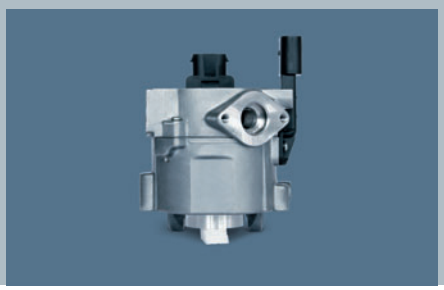
Automotive engineering components must withstand enormous loads. Depending on the application, for example, temperature fluctuations between –40 and +125 °C have to be withstood. Shock and vibration resistance and electromagnetic compatibility are equally important. Not to forget the fluids commonly used in the car, such as motor oil, petrol, diesel fuel, biodiesel, radiator fluid, battery acid and windshield wiper fluid, which pose a constant challenge to fans and drives. We accept this challenge with enthusiasm. No matter how difficult the ambient conditions, we find a solution. Of course, we subject each new product to rigourous testing in our in-house testing and measurement laboratories. Only when they have passed all endurance tests with flying colours do our automotive products enter series production. Here are a few examples:

Controlled Piston (CP): Small consumption for large vehicles

When V8 lorries, SUVs or sportscars become real gas sippers – at least relative to their size and horsepower – they probably incorporate GreenTech EC technology from ebm-papst. In this case, the specific innovation is known as the Controlled Piston (CP) from FTE automotive. Wherever automation of hydraulic clutch operations is required, the electrohydraulic actuator unit provides high efficiency over a wide pressure and volume range. The heart of the system is a brushless GreenTech EC motor from ebm-papst. It is highly dynamic and thus can move to positions with great accuracy – putting the “Controlled” in Controlled Piston.

In lorries, the fully automatic clutch ensures dramatically faster, more precise and smoother gear shifts than for predecessor models. This is not only more pleasant for the driver, it also saves fuel. For example, the gear shift mechanism allows downshifting at an early stage when driving uphill, making it possible to maintain speed without using more petrol.





In hybrid sportscars, the CP is responsible for switching between the electric drive and combustion engine – quickly, accurately and so smoothly that the passengers do not notice it at all. This is made possible by a fully integrated, four-wheel drive compatible control of the entire powertrain, which is one-of-a-kind on the European market.

It is easy to understand that these applications place enormous mechanical and thermal loads on the drive and electronics – but this is not a problem for our ECI motors.

Active steering: Makes driving BMWs and Audis even more fun

In the new BMW 3 Series, brushless GreenTech EC motors from ebm-papst provide active driving pleasure. The AFS (Active Front Steering) improves both driving safety at high speeds and handling when parking. In the one case, the electric drive must provide particularly sensitive action, while in the other, dynamic start-up is required. Our drives master both these tasks perfectly. The control electronics provide full road contact at all times and thus ensure authentic steering feedback.

Audi also makes use of ebm-papst's expertise in the active steering booster. Here, a hollow-shaft motor provides added driving safety in the ADS.

The applications are virtually unlimited

We can offer many other examples of how ebm-papst drive engineering contributes to safe driving while coping effortlessly with all adverse ambient conditions. For example, in rear-axle steering, in which a hollow-shaft motor serves as the actuator that adjusts the rear wheels. Or in torque vectoring, in which the individual power distribution to the individual wheels is controlled by an asynchronous squirrel-cage motor – which, thanks to the fully encapsulated stator winding, is immune to even aggressive transmission oil.

Pumps and pump drives:
Equally compact and high-performance.

The most cost-effective way to move fluids

Potential savings exist in many areas of automotive technology – including pumps. GreenTech EC technology provides savings wherever it is used: whether as a drive for the oil and urea pump or as a complete water pump solution. Compared to conventional pump drives, brushless GreenTech EC motors need approx. 15% less energy at the same pump output – with almost twice the pressure build-up. The compactness and high running smoothness are also features that speak clearly for our external rotor motors – whether for battery cooling in hybrid vehicles, for auxiliary heaters, for gearbox cooling or as a trailing pump drive for AGR cooling. We are sure to also have the right drive for your application.

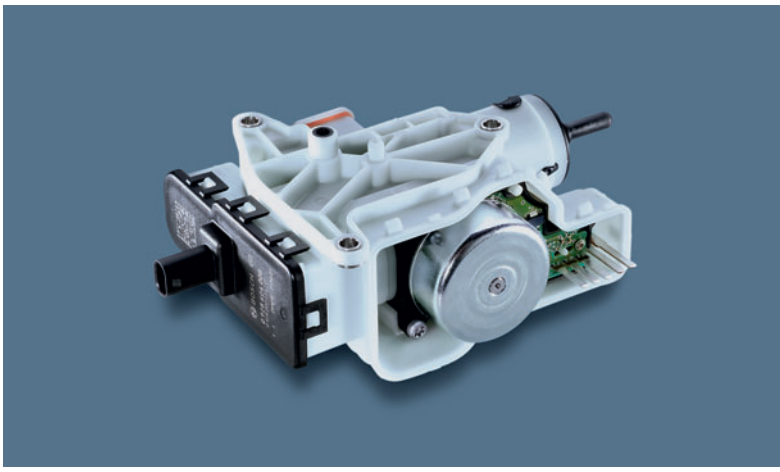
Exemplary:
A drive for the DNOX system.

The Euro 6 standard will take effect soon, drastically limiting the permitted level of harmful emissions from diesel engines – including both carbon particles and nitrogen oxides (NOX). These stringent limits cannot be met just by improving combustion in the engine. Therefore, many manufacturers of commercial vehicles and passenger cars use what is known as Selective Catalytic Reduction (SCR). In this form of exhaust gas treatment, nitrogen oxide emissions are reduced by adding an ultrapure urea solution. For this purpose, Bosch has developed a pump that injects a precisely metered amount of the urea additive. The high-performance and reliable pump drive comes from ebm-papst.

Real GreenTech

The development of what is called the DNOX system is a prime example of innovative automotive engineering. For the Bosch engineers, it was important to have a partner that combines motor and electronics expertise. The task is a demanding one: The quantity of additive that the pump injects directly into the exhaust gas system must be adapted exactly to the amount of nitrogen oxide in the exhaust gas. In addition, the pump must work reliably over a wide airflow range and for the entire service life of the vehicle. These requirements resulted in a modular drive concept with a GreenTech EC motor. Modular means that the pump, hydraulic and electronic components can each be replaced separately. This way, the exhaust gas treatment system can always be adapted to the current state of legal requirements. The heart of the pump is our electronically commutated external rotor motors. They are renowned for their outstanding synchronous running and high torque, even at start-up, and have been further optimised for mobile use and designed for a long service life in the required temperature range. Moreover, the fully automated manufacturing with 100-percent quality control guarantees that the stringent requirements of the automotive industry for supplier component are fulfilled ideally.

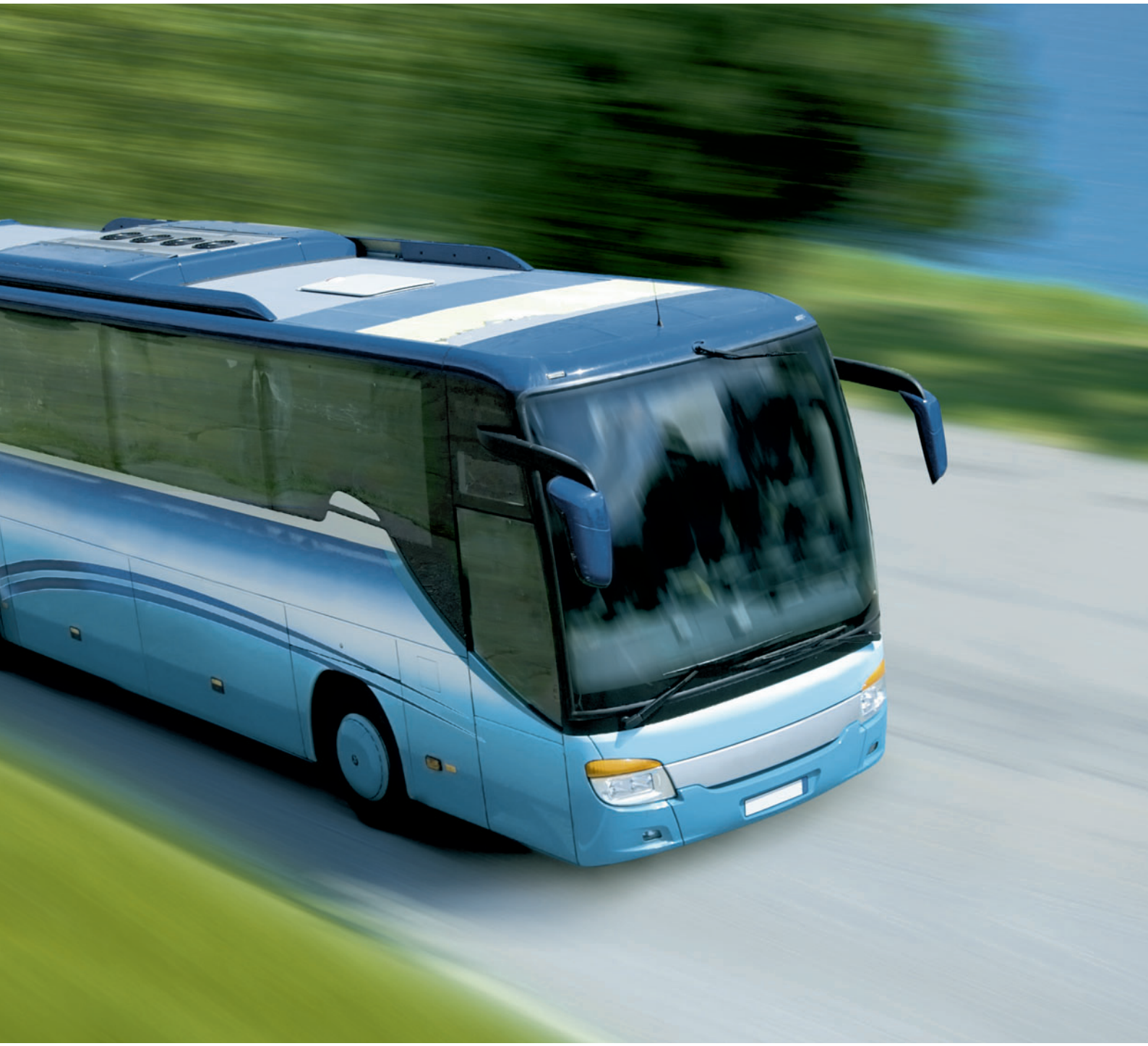
Automotive industry insiders are sure that SCR systems such as these will become the standard soon – particularly for commercial vehicles. A great thing for the environment!



GreenTech EC technology for commercial vehicles: Equally durable and economical.

A comfortable climate is especially important when the driver's seat is also one's workplace. After all, a pleasant driving feel, even over long distances, has a direct effect on driving safety and, no less important, on the driver's health. Therefore, both passenger transportation in buses and coaches and trucking that is as free of stress and fatigue as possible place high demands on vehicle technology, particularly climate control, ventilation, and air-conditioning.

For many years, ebm-papst fans have provided the greatest possible driver and passenger comfort in bus air conditioning systems and for air-conditioning and ventilation of lorry driver's cabs. Numerous manufacturers of climate control systems rely on our experience and exceptional level of expertise in ventilation and drive engineering.



Meeting high demands with new technology

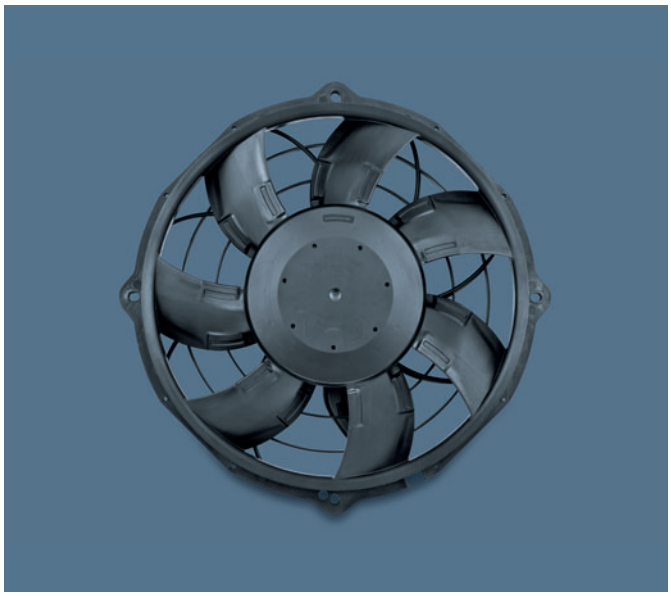
Nothing exists that does not have room for improvement. Who knows this better than the innovation leader in the area of fans and drives? Not least because of our pioneering and development work, smart GreenTech EC technology has taken hold almost completely, even in the demanding bus and lorry areas.

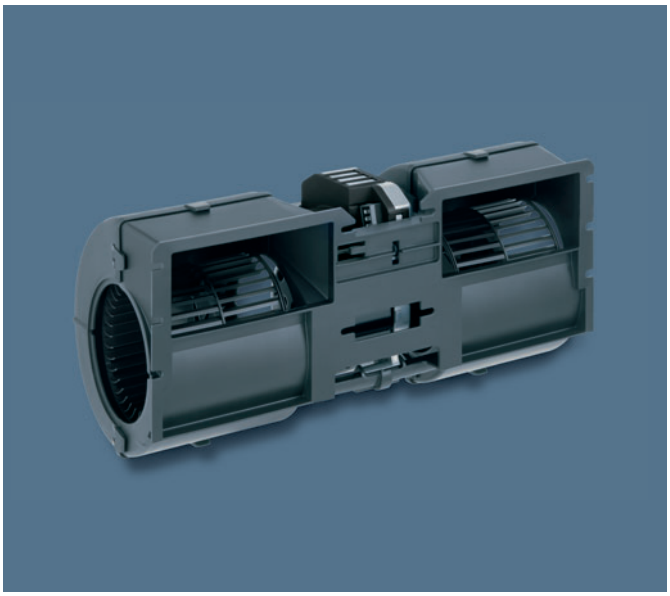
Our axial fans and dual centrifugal blowers in GreenTech EC technology are trendsetters in commercial vehicle air-conditioning. For many manufacturers of climate control systems for the commercial vehicle industry, they have replaced the brush motors used previously. The GreenTech EC fans make no compromises when it comes to durability and reliability. In typical climate control system applications, they reach a service life of over 40,000 hours in real-world operation. In contrast, commutator motors wear out after 3,000 to 8,000 operating hours at the latest.

This significant extension of maintenance intervals is not only a convincing argument for bus companies. It also plays a key role for commercial vehicle export to hot countries. For example, our GreenTech EC fans have also been tested under extreme real-world conditions in buses in Asia and South America, where they have performed exceptionally well.

In addition to the significantly longer service life, our intelligent EC fans guarantee extended open and closed loop control options. Moreover, they also consume far less energy, have very good electromagnetic compatibility and operate extremely quietly.

We will be glad to work with you to take on the challenge of replacing the old technology in existing compact air-conditioning units with modern ones in the most economical way possible.





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Technology in vehicles is becoming ever more sophisticated. A great number of innovative details are intended to provide greater safety and comfort while also doing their work in as reliable, efficient and unobtrusive a manner as possible. It is precisely these properties that have characterised the fans and drives of ebm-papst for many years. With our highly advanced GreenTech EC technology, we set new benchmarks time and again – including in the automotive sector, as numerous examples show. This is because we approach each new challenge with all of our innovative strength and passion – and will gladly do the same for your next project.

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