

Innovation in Aftermarket – KB Point of View

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Every day, more than a billion people all over the world rely on systems from Knorr-Bremse



RAIL VEHICLE SYSTEMS

- High-speed trains
- Regional & commuter trains
- Metros
- LRVs
- Monorails
- Locomotives
- Passenger cars
- Freight cars
- Off-train

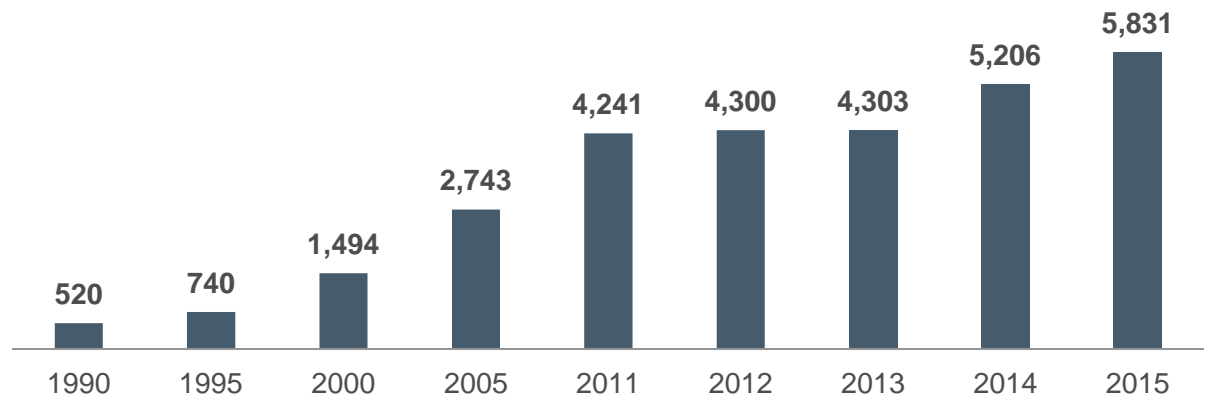
COMMERCIAL VEHICLE SYSTEMS

- Trucks
- Trailers
- Buses
- Engines
- Special vehicles

Knorr-Bremse Group – Development of sales

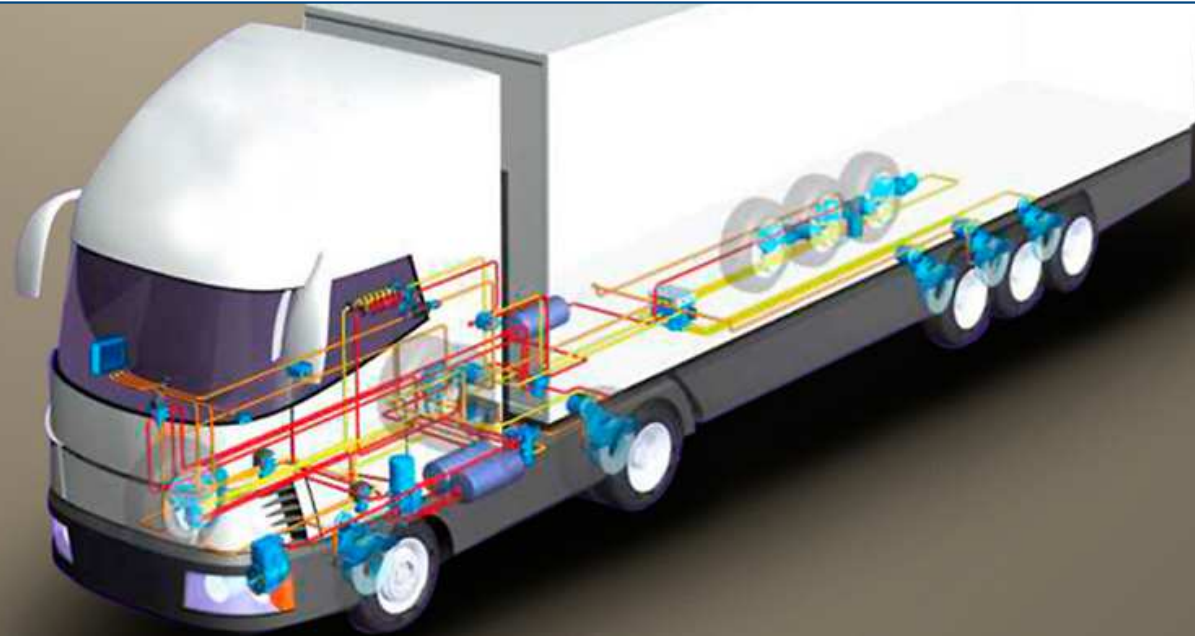


Development of sales (in € million)



	2014	2015	Δ
Sales	€5,206 million	€5,831 million	+12%
Employees (incl. leasing; as per Dec. 31)	23,916	24,275	+1.5%

Chassis systems



AIR SUPPLY & TREATMENT

- Single- or twin-cylinder compressors
- Modular air treatment systems
- Integrated components with electronic control

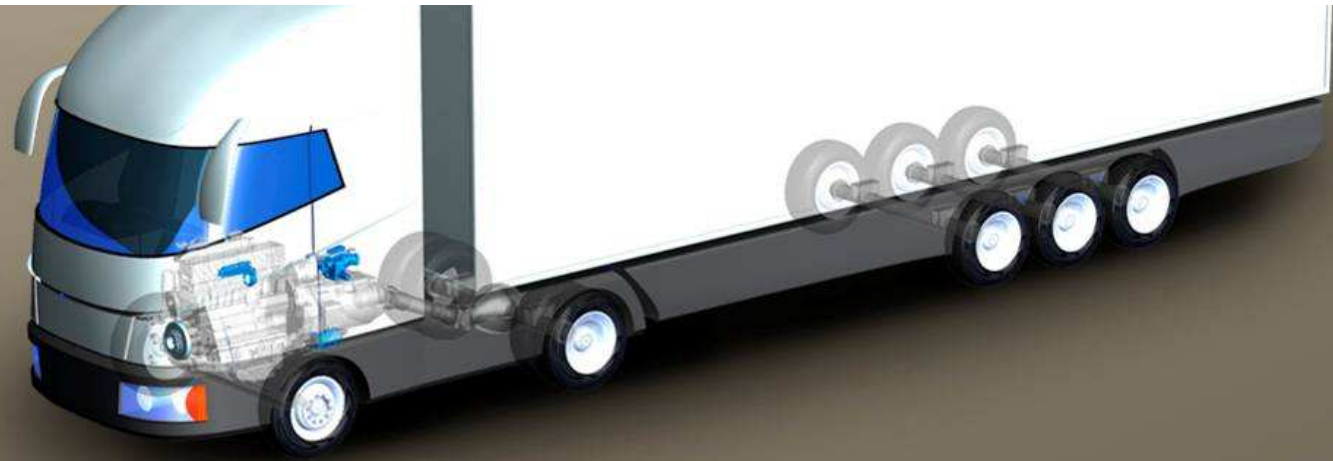
BRAKING & CHASSIS CONTROL

- Brake control (EBS, ABS) with stabilization programs for tractor and trailer
- Driver assist systems (AEBS, LDWS)
- Conventional valves
- Electronic level control

WHEEL BRAKES & ACTUATORS

- Diaphragm and combi cylinders
- Disc brake applications for tractor and trailer
- Drum brakes & slack adjusters

Powertrain systems



TRANSMISSION AND CLUTCH

- Clutch actuators
- Pneumatic and electronic transmission control

ENGINE AIR MANAGEMENT

- Retarders
- Pneumatic booster system
- Exhaust gas recirculation valves

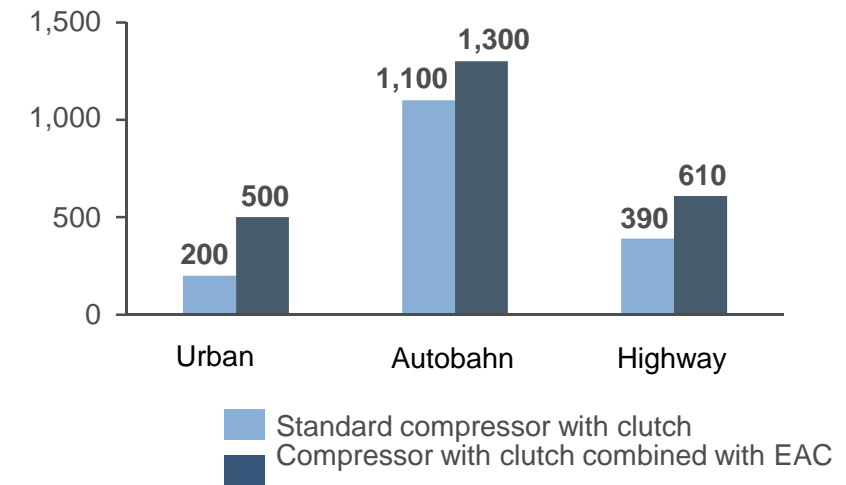
ENGINE

- Vibration dampers

Fuel economy through linking EAC and compressor with clutch



Fuel savings in l/a*

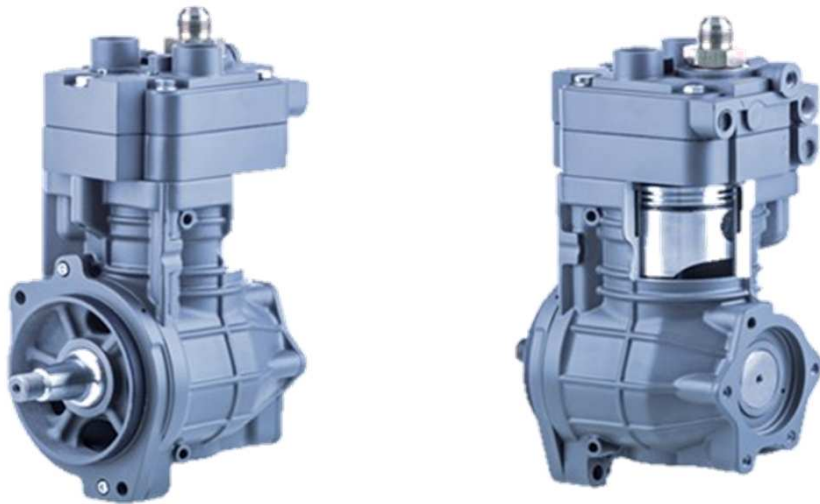


COMPRESSOR WITH CLUTCH

- Automatic decoupling of compressor and engine when no compressed air required
- Fuel savings compared with a conventional compressor without energy saving system: up to 1,300 liters per year or 1% of average annual fuel consumption
- Emission reduction: 9 g/km CO₂
- Longer service life

*Compared with compressors without energy saving system. Data based on HD Truck test run. Annual fuel savings calculated for 70,000 / 230,000 / 117,500 km per year

Innovative choice of materials reduces weight



COMPRESSOR MADE OF ALUMINUM

- Weight reduced by approx. 40% (single cylinder)
- Increased payload
- Benchmark for oil carry-over thanks to cylinder casing cooling
- High performance energy-saving system significantly increases efficiency

Optimal fuel savings through intelligent compressor control



ELECTRONIC AIR TREATMENT UNIT EAC

Fuel savings through

- Intelligent regeneration
- Use of engine overrun
- Intelligent control of the compressor with clutch
- Intelligent compressor control in hybrid vehicles

Integration of additional functions such as electronic parking brake

Electronic parking brake increases functionality and reduces costs



EAC WITH INTEGRATED ELECTRONIC PARKING BRAKE

- Integration of components reduces system costs
- Increased design freedom by removal of pneumatic units from cab

Improved functionality through

- Automatic application and release of parking brake
- “Hill holder“ in combination with EBS
- Graduated auxiliary braking function

System supplier for optimally balanced wheelend solutions



DISC BRAKE

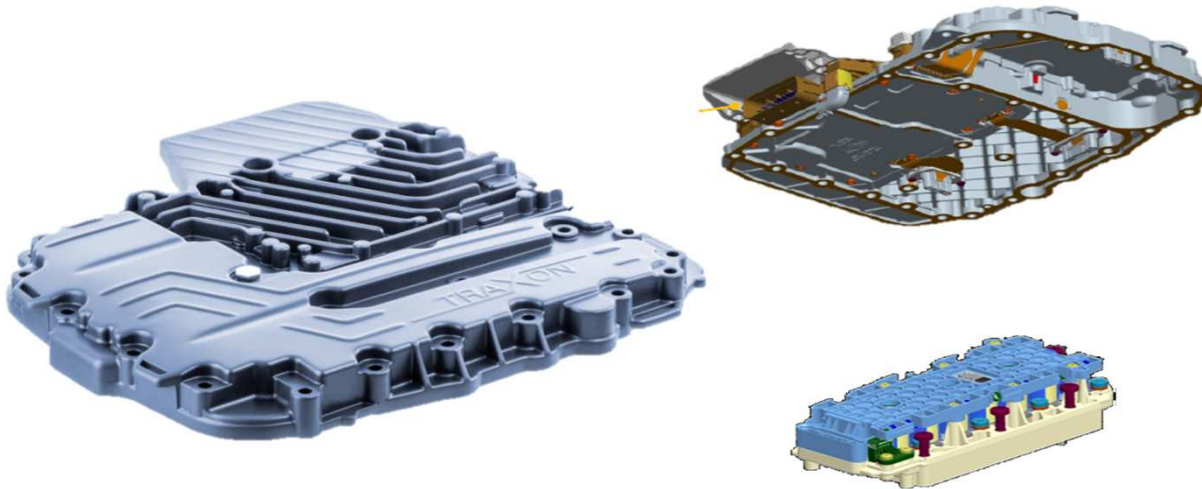
- Proven technology – more than 28 million units in operation
- Full range of all brake classes for trucks, buses, and trailers (17.5", 19.5", 22.5"; radial and axial)
- System supplier for optimally balanced overall system covering actuator, wheel brake, brake pads, and discs
- Systematic further development reduces TCO

iTAP – digitalization of products and services



- The iTAP (Intelligent Trailer Access Point) enables a wide variety of trailer functions to be easily controlled using a smartphone or tablet
- The iTAP with FleetRemote function won Knorr-Bremse and TIP Trailer Services a “Trailer Innovation Award 2015” in the “Smart Trailer” category

Transmission control for AMT increases efficiency and reduces CO₂ emissions



MECHATRONIC TRANSMISSION CONTROL MODULE FOR AMT – FULLY AUTOMATED GEAR SHIFTING

- Shifting strategy reduces fuel consumption
- Optimized shifting minimizes powerflow interruption
- Enhanced safety thanks to reduction of driver's tasks
- Sets new standards in service life and availability

From the brake system to automated driving



TODAY: 2015

- **2001 LDWS** lane departure warning
- **2007 ACC** adaptive cruise control
- **2015 AEBS** for emergency braking behind stationary vehicles

TOMORROW: up to 2020

- **2018 Overvue** all-round vision
- **2019 Turning Assist**
- **2019 Lane Keep Assist**
- **2020 Traffic Jam Assist**

FUTURE: from 2020

- **2023 Highway Pilot**
- **2025 Platooning 2.0**
- Automated driving relieves the driver, saves fuel, and improves road safety

Knorr-Bremse awarded as “Best Brand”



for **10 times** in a row by the readers of lastauto omnibus, transaktuell and Fernfahrer!

Now also and brand new by the readers of PROFI Werkstatt!



TruckServices



- Our service offering

We support vehicles throughout the entire service life cycle – providing you and your customers with high-quality aftermarket products and first-class services.

- New service products for young vehicles
- Genuine remanufactured products for the repair and maintenance of older vehicles
- Product repair kits for vehicles in all stages of operation
- Accompanied by technical training programs, advice and many additional services

TruckServices – Your benefits:

- ✓ Greater competitiveness through high-quality aftermarket products and services throughout the entire vehicle life cycle from the original manufacturer and with the familiar Knorr-Bremse quality
- ✓ Cost efficiency and simplified handling through standardized product programs
- ✓ High availability of products through efficient and well-established logistics
- ✓ Continuous expansion of our product and service offerings



TruckServices – your benefits:

- ✓ Greater competitiveness through high-quality aftermarket products and services throughout the entire vehicle life cycle from the original manufacturer in the familiar Knorr-Bremse quality
- ✓ High service quality and efficiency through comprehensive technical services
- ✓ High availability of products through an excellent European distributor network



Truck Race – Jochen Hahn

Extension of sponsoring

- 15 years of partnership and cooperation
- Knorr-Bremse is one of the main sponsoring partners since 2003
- Extension of sponsorship in 2016:
 - Re-branding of Race Truck to blue-white
 - Support by TruckServices as additional sponsor



Knorr-Bremse <http://www.knorr-bremsecvs.com/>

The screenshot shows the Knorr-Bremse website interface. At the top, there is a navigation bar with the Knorr-Bremse logo and menu items: GROUP, PRODUCTS, ACTIVE SERVICE, QMPAD, BRANDS, CONTACTS. Below the navigation bar is a search bar and a language selector set to English. The main content area features a large video player with a play button overlay. To the right of the video player, there is a text box that reads: "5 metres that saves lives! Our developers shorten the braking distance of a 40 tonne truck from 50 to 45 metres." Below the video player, there are sections for "Quicklinks" and "Systems for commercial vehicles". The "Quicklinks" section includes "Survey tool concept", "Product Search", and "Active Service Line". The "Systems for commercial vehicles" section contains a paragraph of text. In the bottom right corner, there is a calendar for June 2015.

Knorr-Bremse Worldwide | Homepage | Contact | Site Map | Download & Services | Calendar | English | Search

KNORR-BREMSE GROUP PRODUCTS ACTIVE SERVICE QMPAD BRANDS CONTACTS

Genuine Remanufacturing. READY FOR ROUND TWO

5 metres that saves lives! Our developers shorten the braking distance of a 40 tonne truck from 50 to 45 metres.

Quicklinks

- Survey tool concept
- Product Search
- Active Service Line

Systems for commercial vehicles

Knorr-Bremse is the world's leading manufacturer of braking and control systems for commercial vehicles and supplies all the world's leading commercial vehicle manufacturers. Apart from complete braking systems, its product range includes Driver Assistance System solutions all around the power train as well as related aftermarket service. With its production, sales and service centers, the field of systems for commercial vehicles is represented in over 20 countries.

June 2015

Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	2	3	4	5	6	7
8	9	10	11	12	13	14



Remanufacturing Movie



Knorr-Bremse Remanufacturing Portfolio for Commercial Vehicles



SPRING BRAKE ACTUATORS



OIL SEPARATOR CARTRIDGE (OSC)



EBS COMPONENTS

- ▶ One and Two-Channel Pressure Modulators
- ▶ Foot Brake Modulators
- ▶ Trailer Control Modules



ELECTRONIC AIR CONTROL (EAC)



COMPRESSORS

- ▶ Single and Twin Cylinder
- ▶ Splitblock and Monoblock Variants



CALIPER FOR TRAILERS



Genuine Remanufactured Calipers for Trailers



The image shows two grey metal trailer brake calipers. One is positioned on a blue cylindrical pedestal, and the other is on a white cylindrical pedestal. Both pedestals are wrapped in a patterned paper with the Knorr-Bremse logo and the text 'Genuine Remanufactured' and 'www.knorr-bremse.com'. The background is a simple grey gradient with a spotlight effect on the calipers.

~~Second time winner!~~ *life*

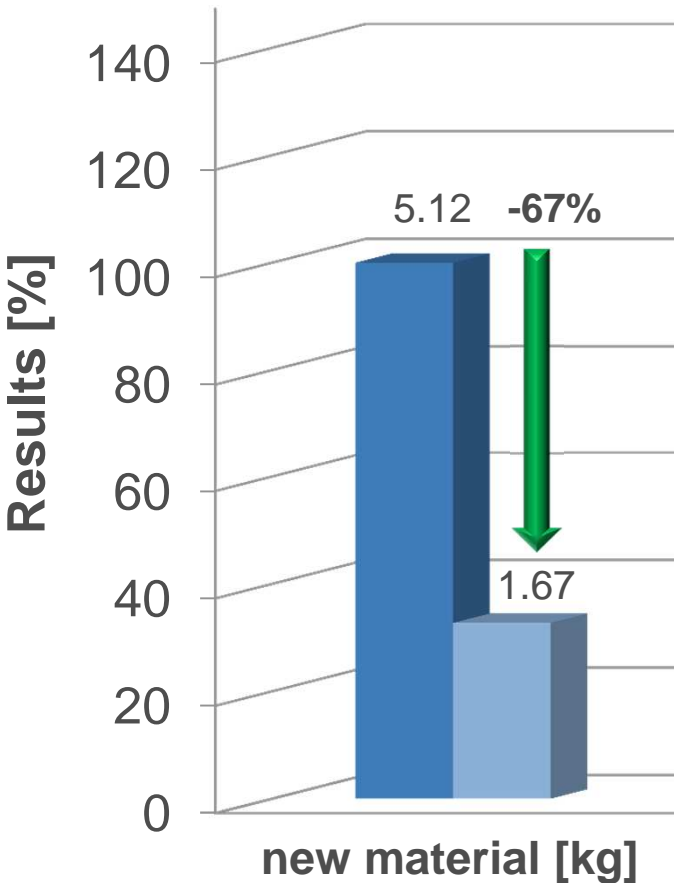
NOW'S THE TIME
FOR OUR GENUINE REMANUFACTURED TRAILER BRAKE CALIPERS

Remanufacturing – Differentiation to original Knorr-Bremse products

	KNORR-BREMSE RATIONALIZED CALIPER	KNORR-BREMSE GENUINE REMANUFACTURED CALIPER
Warranty	Extended 24-month warranty	12-month warranty (standard IAM warranty)
Lead time	4 calendar weeks	6 calendar weeks
Technology	Latest OE standard	Conforms as closely as possible to latest OE standard, using genuine remanufactured components
Life expectancy	As per OE parts	Shorter than for new products
Manufacturing process	Assembled on the same production lines as new OE parts	
Testing	Tested and inspected to the same specifications and standards as new OE parts	
Quality management system	Knorr-Bremse Quality Management System	
Recommended for	All repairs	Value-based repairs for older trailers
Available product types	The full Knorr-Bremse product range	Genuine Remanufactured SN6 and SK7 trailer calipers

LCA-Study¹⁾ – Knorr-Bremse Remanufacturing saves 13.6 kg CO₂e²⁾ per EAC1

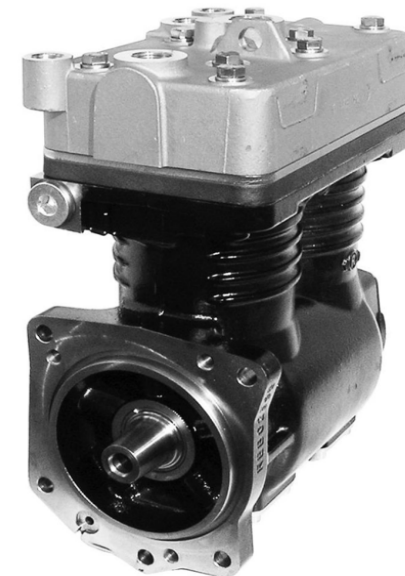
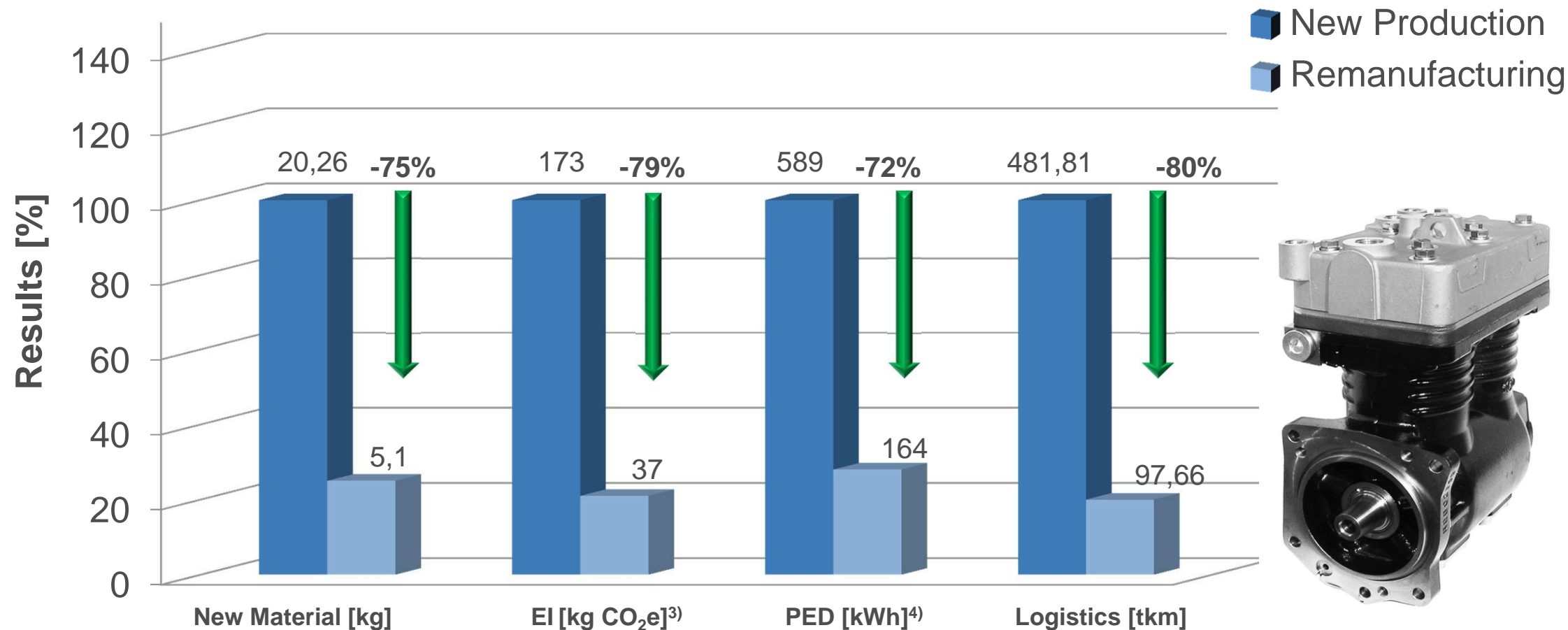
- New Production
- Remanufacturing



EAC1 Remanufacturing saves 48% of CO₂e compared to new production

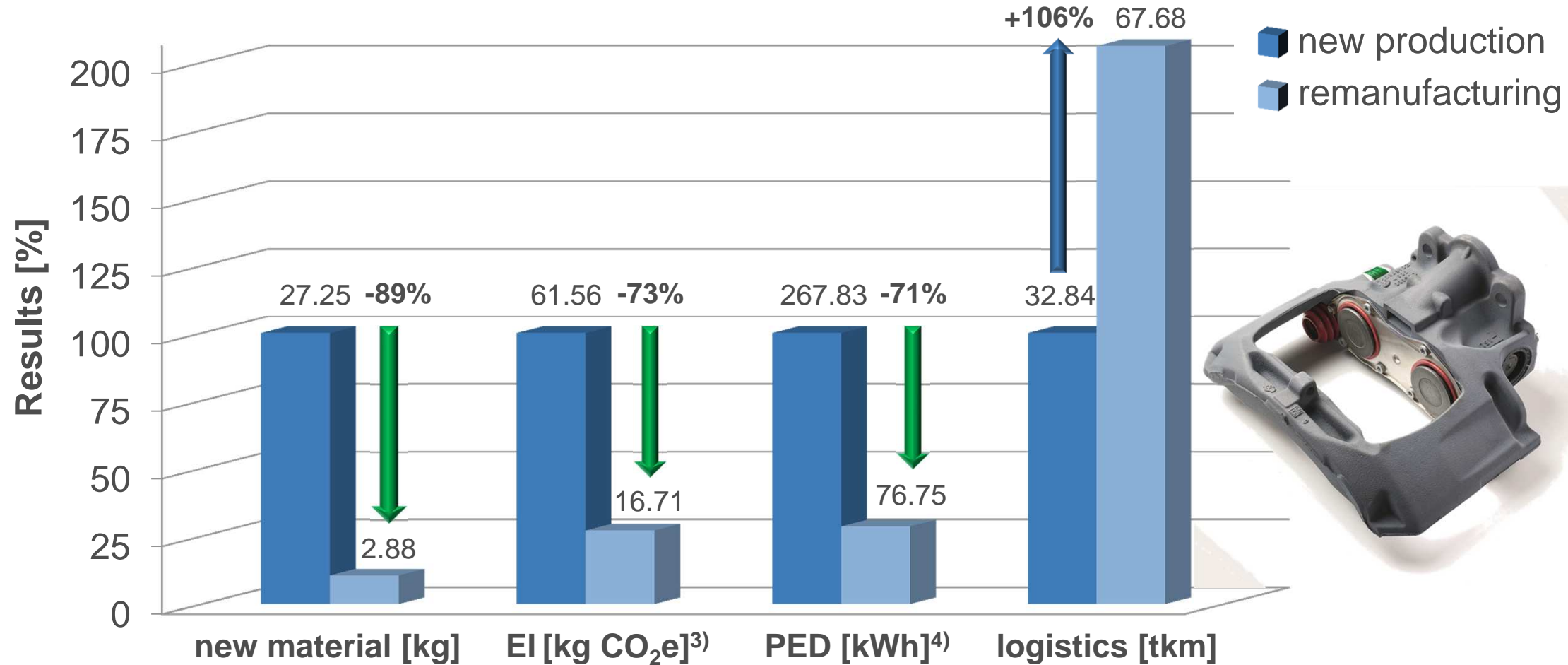
1) Life Cycle Assessment (LCA) methodology according to DIN EN ISO 14040 and 14044; scope: cradle-to-gate study; impact category: climate change with characterization factor GWP100; major processes and its in-/outputs are measured and investigated with industry partners; additional processes modelled with ecoinvent 2.2 and Gabi 6 PE-international datasets; year of study 2014; functional unit: finished product EAC1 in saleable status; Oil Separation Cartridge (OSC) excluded
 2) CO₂e indicator: CO₂ equivalent in terms of global warming potential (GWP) over a time horizon of 100 years; used in Kyoto-Protocol
 3) Environmental Impact (EI); measured according to 1) + 2)
 4) Primary Energy Demand (PED); quantity of energy withdrawn from hydrosphere, atmosphere, geosphere or energy source w/o any anthropogenic change; calculated with Gabi 6 (Modelling Principles 2013)

LCA-Study¹⁾ – Knorr-Bremse Remanufacturing saves 136 kg CO₂e²⁾ per Compressor



1) Life Cycle Assessment (LCA) methodology according to DIN EN ISO 14040 and 14044; scope: cradle-to-gate study; impact category: climate change with characterization factor GWP100; major processes and its in-/outputs are measured and investigated with industry partners; additional processes modelled with ecoinvent 2.2 and Gabi 6 PE-international datasets; year of study 2015; functional unit: finished product Scania 600cc compressor (compared to a complete Air Disc Brake ADB without brake pads and carrier) in saleable status;
 2) CO₂e: category indicator result in kg CO₂-equivalents; methodology uses Global Warming Potentials (GWP100) to calculate the potency of greenhouse gases over a timescale of 100 years; used in Kyoto-Protocol
 3) Environmental Impact (EI); measured according to 1) + 2)
 4) Primary Energy Demand (PED); quantity of energy withdrawn from hydrosphere, atmosphere, geosphere or energy source w/o any anthropogenic change; calculated with Gabi 6 (Modelling Principles 2013)

LCA-Study¹⁾ – Knorr-Bremse Remanufacturing saves 44.9 kg CO₂e²⁾ per Caliper



- 1) Life Cycle Assessment (LCA) methodology according to DIN EN ISO 14040 and 14044; scope: cradle-to-gate study; impact category: climate change with characterization factor GWP100; major processes and its in-/outputs are measured and investigated with industry partners; additional processes modelled with ecoinvent 2.2 and Gabi 6 PE-international datasets; year of study 2015; functional unit: finished product SK7 rationalized Caliper (compared to a complete Air Disc Brake ADB without brake pads and carrier) in saleable status;
- 2) CO₂e: category indicator result in kg CO₂-equivalents; methodology uses Global Warming Potentials (GWP100) to calculate the potency of greenhouse gases over a timescale of 100 years; used in Kyoto-Protocol
- 3) Environmental Impact (EI); measured according to 1) + 2)
- 4) Primary Energy Demand (PED); quantity of energy withdrawn from hydrosphere, atmosphere, geosphere or energy source w/o any anthropogenic change; calculated with Gabi 6 (Modelling Principles 2013)



Thank you for your attention!

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