

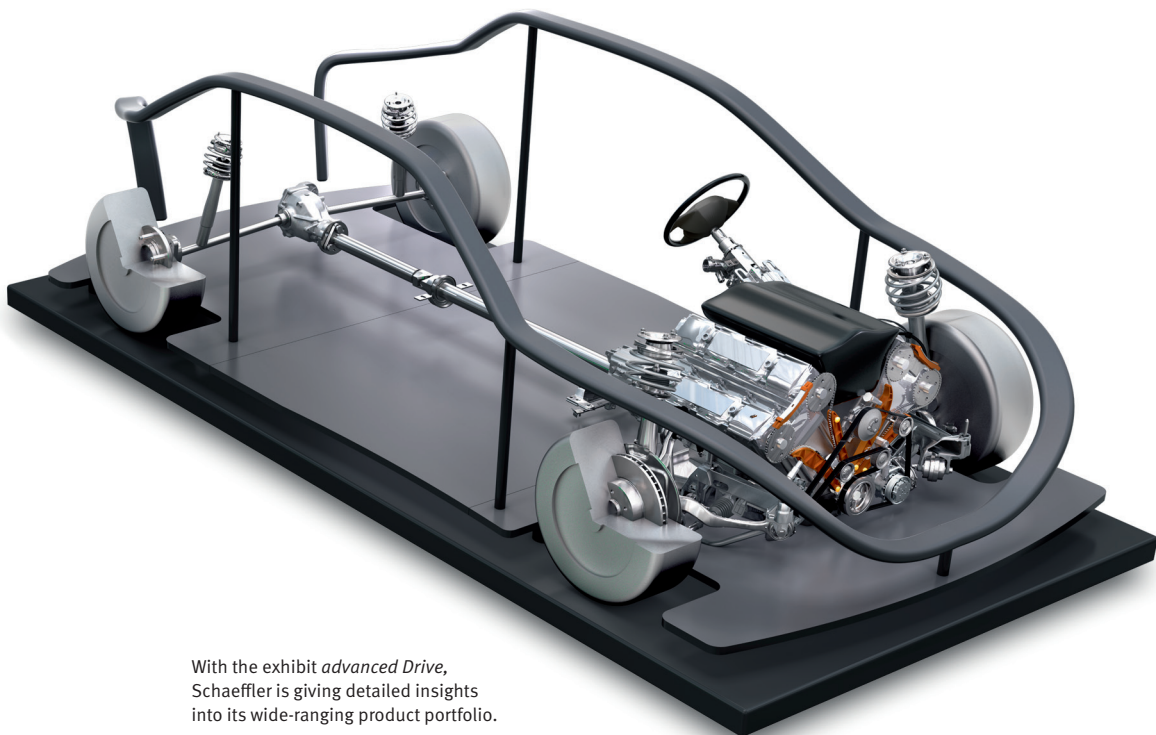
SCHAEFFLER



NAIAS 2013 Press Kit

www.schaefflergroup.com/press-NAIAS/Detroit





With the exhibit *advanced Drive*, Schaeffler is giving detailed insights into its wide-ranging product portfolio.

About Schaeffler

Schaeffler with its product brands INA, LuK and FAG is a leading provider of rolling bearing and plain bearing solutions and of linear and direct drive technology, as well as a renowned supplier to the automotive industry of high-precision products and systems for engines, transmissions, and chassis applications. The globally active group of companies generated sales of approximately 10.7 billion euros in 2011. With approximately 76,000 employees worldwide, Schaeffler is one of the largest German and European industrial companies in family ownership. With 180 locations in over 50 countries, Schaeffler has a worldwide network of manufacturing locations, research and development facilities, sales companies, engineering offices, and training centers.

Our main customer is the automotive industry with around 60 percent of our sales. Schaeffler is a renowned development partner to the industry with system expertise

Efficient Future Mobility: Schaeffler's drive train innovations offer up to 15 percent reduction in fuel consumption

Schaeffler's *Efficient Future Mobility North America* Demonstration Vehicle Displays Bundled Technologies for Reduced Fuel Consumption and Answers to the CAFE Challenges

4

Customized start-stop solutions for the North American vehicle market

Schaeffler Offers Comprehensive Solutions to Support North American Vehicles Adapt Start-Stop Systems by 2020

8

Schaeffler AWD disconnect clutch significantly reduces fuel consumption

Schaeffler Offer Friction Reduction Technologies for AWD Vehicle Drive Trains

12

Innovative thermal management module improves CO₂ footprint

Schaeffler Thermal Management Module Optimizes Temperatures of Engines, Transmissions as well as Hybrid Components and Batteries

14

Higher fuel economy, lower emissions, improved safety and greater driving pleasure

Schaeffler Automotive

18

for the entire drive train. Precision products for engines, transmissions and chassis applications ensure reduced energy consumption and lower emissions as well as increased driving comfort and safety.

To serve the North American automotive market, Schaeffler operates development centers in: Troy, Mi.; Fort Mill, S.C.; Wooster, Ohio; and Puebla, Mexico. The company's 400 North American engineers and technicians, who are supported by a team of more than 5,500 global engineers, drive development in the region utilizing state-of-the-art test and measurement equipment, computational tools and CAD systems. Schaeffler Automotive has headquarters in Fort Mill and manufacturing facilities in: South Carolina; Missouri; Ohio; Ontario, Canada; Puebla and Irapuato, Mexico.

Schaeffler's *Efficient Future Mobility North America* Demonstration Vehicle Displays Bundled Technologies for Reduced Fuel Consumption and Answers to the CAFE Challenges

Efficient Future Mobility: Schaeffler's drive train innovations offer up to 15 percent reduction in fuel consumption

DETROIT/HERZOGENAURACH, January 14, 2013. During its press conference at the North American International Auto Show (NAIAS) in Detroit, Schaeffler will present a new concept vehicle. The *Efficient Future Mobility North America* vehicle is based on a mid-size SUV and shows the range of Schaeffler solutions for optimizing North American internal combustion engine drive trains. All of the showcased solutions are cost-effective, close to volume production and, when integrated into an all-wheel drive (AWD) vehicle, make a valuable contribution to reducing fuel consumption. The overall potential for savings is up to 15 percent, bringing North American vehicles closer to fulfilling the increasingly stringent Corporate Average Fuel Economy (CAFE) standards.

"Schaeffler's meticulously detailed work on drive trains based on internal combustion engines offers significant potential for reducing fuel consumption and emissions," summarizes Prof. Peter Gutzmer, CTO of Schaeffler AG. In keeping with Schaeffler's established concept vehicles, the *Efficient Future Mobility North America* vehicle plays a key role in development and serves as a demonstration vehicle for the components and systems that are bundled within it. "Even with the efficient platform we selected, we still see further potential for optimization. Here the solutions on display take the market-specific demands and customer requirements in North America into account."

Accordingly, the concept vehicle is based on the current version of a mid-size SUV that is popular in North America and - as is the case with the majority of North American vehicles - features an automatic transmission with a torque converter. Overall, the detailed solutions displayed in the *Efficient Future Mobility North America* vehicle make it possible to achieve additional fuel savings of up to 14 to 15 percent, depending on the utilization profile. Schaeffler solutions such as the thermal management module and AWD separating clutch play a role as do Schaeffler's engine start-stop innovations, such as the permanently engaged starter with a wrap spring one-way clutch. The fuel savings improvements are the result of friction optimization work being carried out on belt drives and valve trains, as well as advancements to balancer shafts and wheel bearings – a mechanism for aerodynamically optimized closing of radiator grills – and the optimization of the torque converter.

The new AWD separating clutch, which decouples the unused drive axle from the drive train depending on the driving situation to provide a savings contribution of up to six percent (on the highway), is an example of the drive train optimization potential achievable with Schaeffler's advanced technologies. The savings that can be achieved in city traffic are approximately two percent. However, the permanently engaged starter generator with a wrap spring one-way clutch can offer additional city driving improvements. In addition to a considerable increase in comfort, due to the smooth engine start-stop function, and a significant improvement in so-called "change of mind" situations (in which the engine is already switched off, but the driver quickly decides to drive on), this innovation helps to achieve fuel savings of up to six percent in city traffic.

This new engine start-stop solution also delivers fuel consumption benefits on the highway, as it provides additional functions such as "sailing" where the drive train decouples and the internal combustion engine switches off as the vehicle is moving at high speed. An additional one percent reduction in fuel consumption and an important emissions contribution can be achieved through the integration of a thermal management module. This module allows the optimum engine operating temperature to be reached in the shortest time possible and the temperature balance, into which components such as transmission and hybrid elements are also integrated, to be precisely controlled.

The Schaeffler demonstration vehicle, which was developed in North America, demonstrates ways in which future CAFE requirements can be met using existing cost-effective technology. "The project is structured in two phases," explains Jeff Hemphill, CTO of Schaeffler North America. "The objective of phase one is to fulfill the requirements for the year 2020. In the second phase, we will add hybrid systems with the aim of fulfilling the requirements for the year 2025."

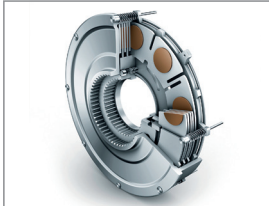
"Schaeffler is an established and globally oriented development, industrialization, and manufacturing partner for automobile manufacturers," explains Dr. Juergen M. Geissinger, CEO of Schaeffler AG. "With a total of 180 locations in more than 50 countries and a global network of 40 research and development centers, we are true to our 'In the region, for the region' motto. Our customers benefit locally from our regional strength. At the same time, Schaeffler's regional expertise strengthens the global network – which benefits our customers who also operate globally and to whom we provide decisive support in creating advanced solutions for modern, energy-efficient mobility."

Images/Captions *Efficient Future Mobility North America*



Schaeffler *Efficient Future Mobility North America* displays drive train innovations for reduced fuel consumption and answers to the CAFE Challenges.

Schaeffler's solutions make it possible to achieve further reductions in fuel consumption of 14 to 15 percent, depending on the utilization profile. Schaeffler solutions such as the thermal management module and all-wheel drive (AWD) separating clutch play a crucial role here, as do engine start-stop innovations from Schaeffler, such as the permanently engaged starter with a wrap spring one-way clutch.



Schaeffler All-Wheel Drive Disconnect Clutch (AWD Disconnect).



Schaeffler Permanently Engaged Starter Generator (PES).



Schaeffler Latching Valve.



Schaeffler Thermal Management Module.

EFFICIENT FUTURE MOBILITY NORTH AMERICA

Schaeffler's demonstration vehicle features tailored solutions for the North American market to optimize internal combustion engine drive trains. All of the technologies make a valuable contribution to reducing fuel consumption. The overall potential for savings is up to 15 percent.

SCHAEFFLER

LUK INA FAG

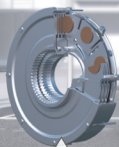
Thermal Management Module

It allows the optimum engine temperature to be reached in the shortest time possible and the temperature balance, into which components such as transmissions and hybrid elements are also integrated, to be precisely controlled.



AWD Disconnect Clutch

It decouples the unused drive axle from the drive train – depending on the driving situation – providing a fuel saving contribution of up to six percent (on the highway).



Permanently Engaged Starter

In addition to a considerable increase in comfort created by the engine start-stop function and a significant improvement in so-called "change of mind" situations, this innovation helps to achieve fuel savings of up to six percent in city traffic.



Latching Valve

Stores hydraulic pressure and provides automatic vehicles with energy for a faster start-up after the engine has been stopped.



Fuel reduction in %

Technology:	City	Highway
Belt Drive Friction Optimization	1.0	1.0
Valvetrain Friction Optimization	0.5	0.5
Balance Shaft Bearings	0.6	1.0
Thermal Management Module	1.0	1.0
Adaptive Grill Shutters	0.2	0.8
Engine-Start-Stop	6.0	2.0
AWD Disconnect	2.0	6.0
Wheel Bearings Optimization	0.5	1.0
TC with Centrifugal Pendulum-type Absorber	3.0	1.0
Total:	15	14

Schaeffler Offers Comprehensive Solutions to Support North American Vehicles Adapt Start-Stop Systems by 2020

Customized start-stop solutions for the North American vehicle market

DETROIT/HERZOGENAURACH, January 14, 2013. Drawing on energy only when needed is one of the obvious approaches to optimizing drive trains equipped with internal combustion engines. Accordingly, engine start-stop (ESS) systems are on the brink of implementation across a range of modern vehicles being produced for all of the world's key markets. The increasingly stringent Corporate Average Fuel Economy (CAFE) regulations and the long-term efforts to reduce fuel consumption and emissions mean that ESS systems are also becoming increasingly prevalent for the North American market.

Among the exhibits on display from Schaeffler at the 2013 North American International Auto Show (NAIAS) in Detroit are two solutions for ESS systems that have been developed, successfully tested in North America and are customized to suit the automatic transmissions that are dominant in the North American market. The solutions include Schaeffler's: latching valve, which is controlled by pressure pulses; and wrap spring one-way clutch for permanently connecting a starter to the housing of the torque converter. Both products give automobile manufacturers the opportunity to further optimize the performance of their current ESS systems.

"It is expected that, by the year 2020, start-stop systems will be part of the standard equipment of all vehicles to allow them to meet the required fuel consumption standards," explains Jeff Hemphill, CTO of Schaeffler North America. "This presents a new challenge for the North American market, where approximately 95 percent of vehicles are equipped with an automatic planetary transmission. Schaeffler has expanded its product portfolio especially for this market by adding products with which even vehicles with automatic transmissions can be equipped with ESS systems in an efficient and cost-effective manner. Further, Schaeffler is providing innovative solutions for concerns surrounding hydraulic pumps driven by the engine. These new developments focus on seamless transitions, particularly during the starting procedure, to make engine changes transparent to vehicle occupants."

Current ESS solutions are based on a two-stage multi-functional torque converter concept. In this concept, the engine and the transmission are decoupled when the

engine is restarted. This allows the engine to be switched off when the engine is idling, which allows the vehicle to be driven for longer with the engine switched off to provide additional fuel savings. Electrically driven pumps and accumulators have thus far been commonly used to ensure a prompt engine restart even after the application pressure of the oil pump (driven by the internal combustion engine) has been lost, e.g. at a traffic light. However, when considering cost, benefits and design envelope, electric pumps and accumulator solutions are not ideal.

However, these solutions can be efficiently replaced by innovations from Schaeffler, such as the company's latching valve. This valve, developed by Schaeffler, is activated by a hydraulic pressure pulse before the engine stops, which causes a small volume of pressurized oil to be stored in one of the transmission's switching elements for the subsequent start-up operation, thus allowing a more rapid closure and helping to ensure that the vehicle has the necessary acceleration capability. Since the signal is given hydraulically, there is also no need for plug connectors or wiring.

A further requirement placed on modern start-stop systems is a quick and comfortable engine restart. This applies not only to starting after an extended standstill period with the engine switched off, but also (and in particular) to so-called "change of mind" starts, i.e. when the driver quickly decides that she/he wants to accelerate again while switching off the engine. Schaeffler's new developments offer attractive solutions for optimization in these situations. Schaeffler's wrap spring one-way clutch for permanently engaged starters is a solution developed by the company for integration into the housing of the torque converter. This allows fast and silent re-starting, and also supports additional functions, such as "sailing" or driving at high speeds with the drive train decoupled and the internal combustion engine off. The permanently engaged starter generator encircles the torque converter by means of a wrap spring. This means that only a small amount of axial space is required. A spring-based, one-way clutch is used to engage the torque converter when the starter is activated. When the engine is running, it is decoupled from the torque converter (thus preventing wear) and the starter remains at a standstill despite being permanently connected to the drive train.

Images/Captions Solutions for Engine Start-Stop Systems



Permanently Engaged Starter (PES): Provides a tangible increase in comfort and ensures the shortest possible restarting times in “change of mind” situations.



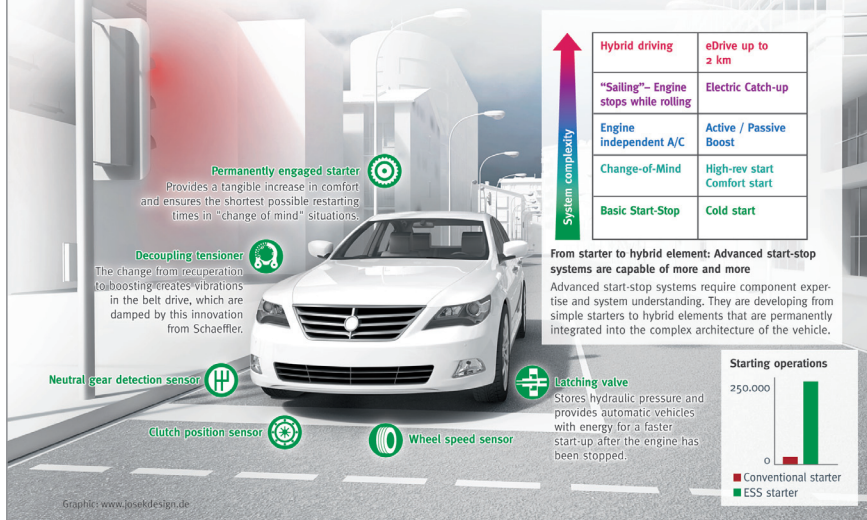
Latching Valve: Stores hydraulic pressure and provides automatic vehicles with energy for a faster start-up after the engine has been stopped.

UNDERSTANDING START-STOP SYSTEMS

Start-stop systems are on the verge of being integrated into all automobiles worldwide. Schaeffler's comprehensive and ever-expanding product range offers numerous engine start-stop (ESS) solutions.

SCHAEFFLER

LUK INA FAG



Schaeffler Offer Friction Reduction Technologies for AWD Vehicle Drive Trains

Schaeffler AWD disconnect clutch significantly reduces fuel consumption

DETROIT/HERZOGENAURACH, January 14, 2013. Schaeffler will present its all-wheel drive (AWD) disconnect clutch developed to support automakers optimize drive trains to reduce fuel consumption and emissions by up to six percent during the 2013 North American International Auto Show (NAIAS) in Detroit.

The market for AWD vehicles is growing in popularity. As technologies for these vehicles evolve, the traction and driving safety advantages are offset by the additional weight and increased frictional resistance associated with new AWD drive trains. This is where Schaeffler's innovation comes into play: the AWD disconnect clutch decouples the AWD drive train to minimize friction losses.

"A conventional AWD system can increase the fuel consumption of a vehicle by up to ten percent if the friction losses in the drive train and the mass of the components are taken into consideration," explains Prof. Peter Gutzmer, CTO of Schaeffler AG. "Our AWD disconnect clutch reduces this additional friction by more than half by decoupling the secondary drive train and to improve its energy efficiency. Suppliers and the automotive industry have been working to uncover the smallest potential for optimization for many years. The AWD disconnect clutch makes a significant contribution to optimizing the drive train, which, in turn, helps automotive manufacturers meet the increasingly stringent fuel consumption standards."

Modern AWD vehicles typically have permanent all-wheel drive, in which the drive power for the rear axle is transferred to the wheels via the rear differential by means of a power transfer unit (PTU). In real driving conditions, one driven axle is sufficient to ensure safe and comfortable driving in most situations. During normal driving, the secondary axle is also engaged without transferring any force to the road via the rear wheels. However, a significant proportion of the energy is lost due to friction.

The Schaeffler AWD disconnect clutch decouples the drive train from the rear axle at the PTU. A second disconnection point is located in the rear axle to prevent torque from being transferred via the rotating rear wheels to the drive train, which is decoupled at the front of the vehicle. The AWD disconnect clutch comprises a

hydraulically operated synchronizer clutch integrated in the input shaft on the PTU and electrically operated dog clutches on the rear axle.

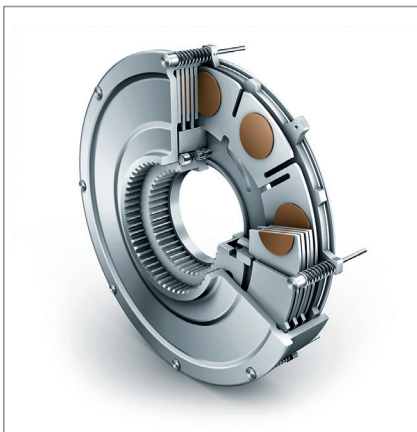
The clutch located on the PTU has two functions: axial disk surfaces with a high friction coefficient are used to absorb synchronization energy; while a self-energizing, bi-directional wedge clutch supports high drive train torques.

The disconnect clutch system includes continuous monitoring of driving conditions and the drive train environment to ensure lightning fast switches to AWD mode if required.

“Our system offers potential fuel savings to enable AWD vehicles to achieve similar fuel consumption as front-wheel drive vehicles without impairing driving behavior,” explains Jeff Hemphill, CTO of Schaeffler North America.

“The Schaeffler AWD disconnect clutch can be integrated in conventional all-wheel drive trains without major modifications.”

Images/Captions AWD Disconnect Clutch



Our AWD disconnect clutch reduces friction losses in the drive trains of all-wheel drive vehicles and therefore contributes to reducing fuel consumption and emissions.

Schaeffler Thermal Management Module Optimizes Temperatures of Engines, Transmissions as well as Hybrid Components and Batteries

Innovative thermal management module improves CO₂ footprint

DETROIT/HERZOGENAURACH, January 14, 2013. Schaeffler is helping to unlock greater potential through the optimization of internal combustion engines with its thermal management module. This innovative module is key to reducing fuel consumption and CO₂ emissions by up to four percent.

The Schaeffler thermal management module is a temperature control unit for the entire drive train. It is integrated in a compact component manufactured from high-strength plastic and combines numerous functions. While engine temperature has traditionally been controlled in a rudimentary manner by a thermostat located close to the engine, this modern thermal management module controls the temperature conditions in the vehicle more precisely and enables operation in the optimal temperature window in the fastest possible time. This means that the cold running phase is significantly reduced by completely blocking off the cooling jacket. Additionally, the individual components can be operated at higher temperatures than would be possible with a system controlled by a thermostat. The engine temperature can also be reduced under full load and the tendency for knocking and enrichment of the mixture under full load can be reduced.

The opportunities to increase efficiency by precisely controlling temperature range from the engine and heating system to the transmission and turbocharger. Controlling the temperature of alternators, hybrid modules and batteries is one of a range of possible tasks that can be performed by this sensor controlled component. They can also be efficiently cooled and heated according to requirements using the thermal management module from Schaeffler.

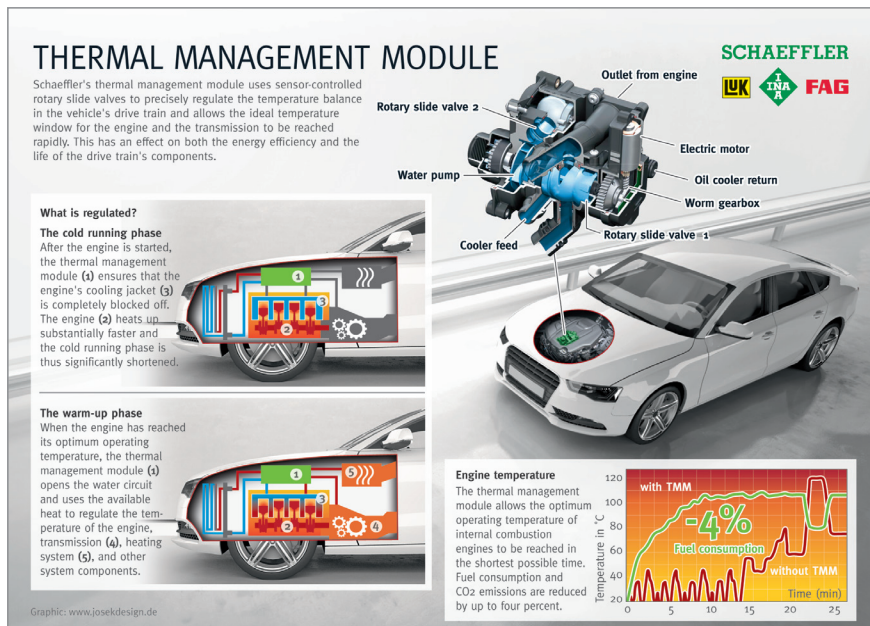
Precise control by means of a rotary slide valve enables the ideal temperature window for the engine and transmission to be reached rapidly. This has a positive effect on both the energy efficiency and life of components in the drive train. After cooling of the thermally stressed exhaust gas turbine can be individually controlled in the case of a turbocharger whose temperature is controlled by the thermal management module.

“The performance of the thermal management module makes this component particularly suitable for use in engines for start-stop operation,” says Prof. Peter Pleus, member of the executive board responsible for engine systems at Schaeffler.

The individual components of the module are also optimized for reduced friction in accordance with Schaeffler’s energy efficiency requirements. This means that the thermal management module can be directly connected to the engine control unit without additional power stages due to its low power consumption.

The thermal management module also removes the design constraint of having to fit the component in close proximity to the engine block, as was traditionally the case with a thermostat located on the engine. Standardized, non-interchangeable hoses reduce assembly times and ensure a high level of seal integrity. This means that Schaeffler’s thermal management module also makes a valuable contribution to quality.

Images/Captions Thermal Management Module



Images/Captions Thermal Management Module



The Schaeffler Thermal Management Module optimizes not only the temperatures of engines and transmission but also hybrid components and batteries.



The innovative Thermal Management Module from Schaeffler reduces fuel consumption and CO₂ emissions by up to four percent.

Schaeffler Automotive

Higher fuel economy, lower emissions, improved safety and greater driving pleasure

DETROIT/HERZOGENAURACH, January 14, 2013. Schaeffler is a renowned supplier to the automotive industry worldwide. Sales from Schaeffler's Automotive division account for around 60 percent of the company's sales. Schaeffler's reputation in the Automotive division is based on a wide range of innovative products and components. The product range includes wheel bearings, chassis, steering and transmission components and developments and engine components and valve control systems. Schaeffler innovations are helping to prepare the automobiles of today and tomorrow for the challenges of the future. Schaeffler is making a substantial contribution to the successes of modern automotive manufacturing; especially in terms of energy efficiency and therefore in minimizing fuel consumption and emissions.

In addition to reducing fuel consumption and emissions, Schaeffler's innovations make an important contribution to increasing safety and driving pleasure. Above all, this involves chassis, steering and transmission components. Innovative spirit and manufacturing expertise ensure that Schaeffler is one of the most important companies in the automobile industry.

As a reliable engineering partner, Schaeffler makes a convincing case for its customers with its outstanding innovative ability, customer proximity and availability worldwide. The permanent focus on the highest-possible quality and the ability to react quickly to individual requirements are the acknowledged advantages Schaeffler offers.

Close cooperation with renowned automobile manufacturers has a long tradition at Schaeffler. It continuously leads to innovations that numerous manufacturers translate into competitive advantages.

UniAir, camshaft phasing systems, belt drive systems and overrunning alternator pulleys, lightweight differentials with face spline, dual mass flywheels and lightweight balancer shafts, fundamental components for CVT, dual clutch transmissions and direct-shift transmissions, twin tandem bearings or wheel bearings with face spline – Schaeffler's product range based on its extensive know-how is immense.

Elements and systems from Schaeffler's various brands (LuK, INA, FAG) can be found in the vehicles of almost all manufacturers, whether in Europe, Asia, South or North America. On average, every car worldwide contains around 60 components from Schaeffler.

Images/Captions Schaeffler



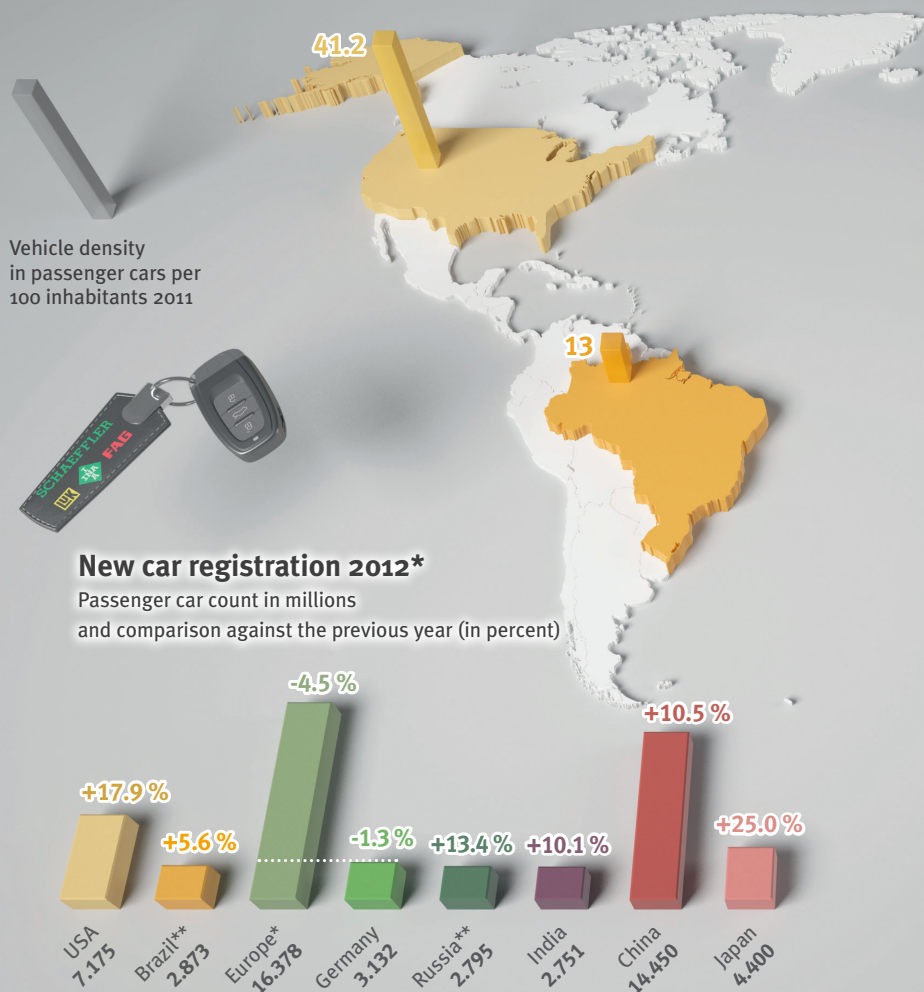
One of the Schaeffler locations in North America is the research and development center in Troy, just outside Detroit. It is one of 40 Schaeffler R&D centers worldwide.



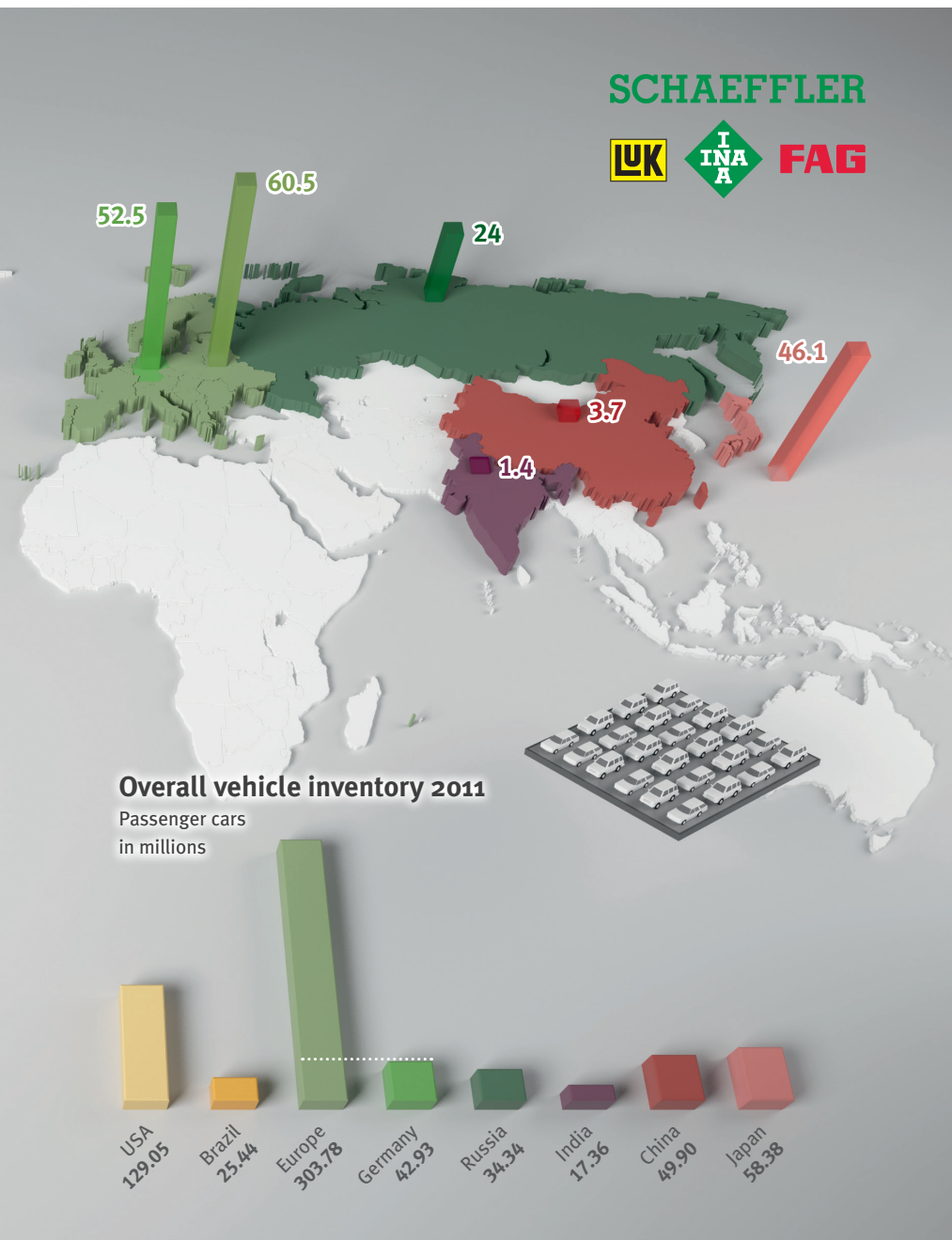
Schaeffler has a global network of more than 180 locations. The company is headquartered in Herzogenaurach, Germany.

Images/Captions New Car Registration & Vehicle Inventory

New Car Registration & Vehicle Inventory



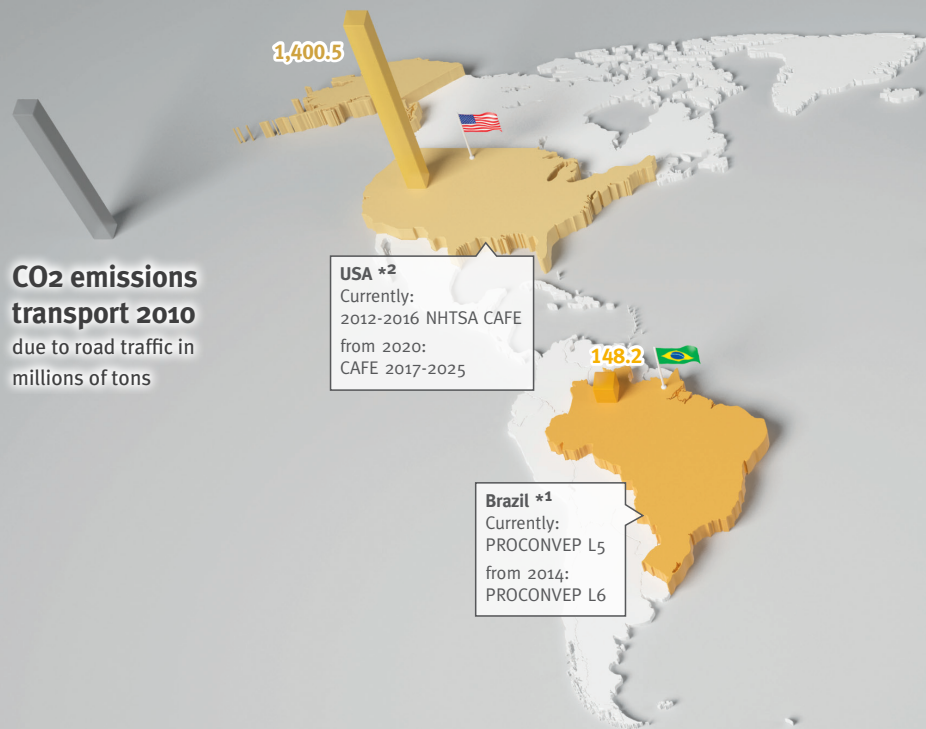
* without Malta, ** light vehicles

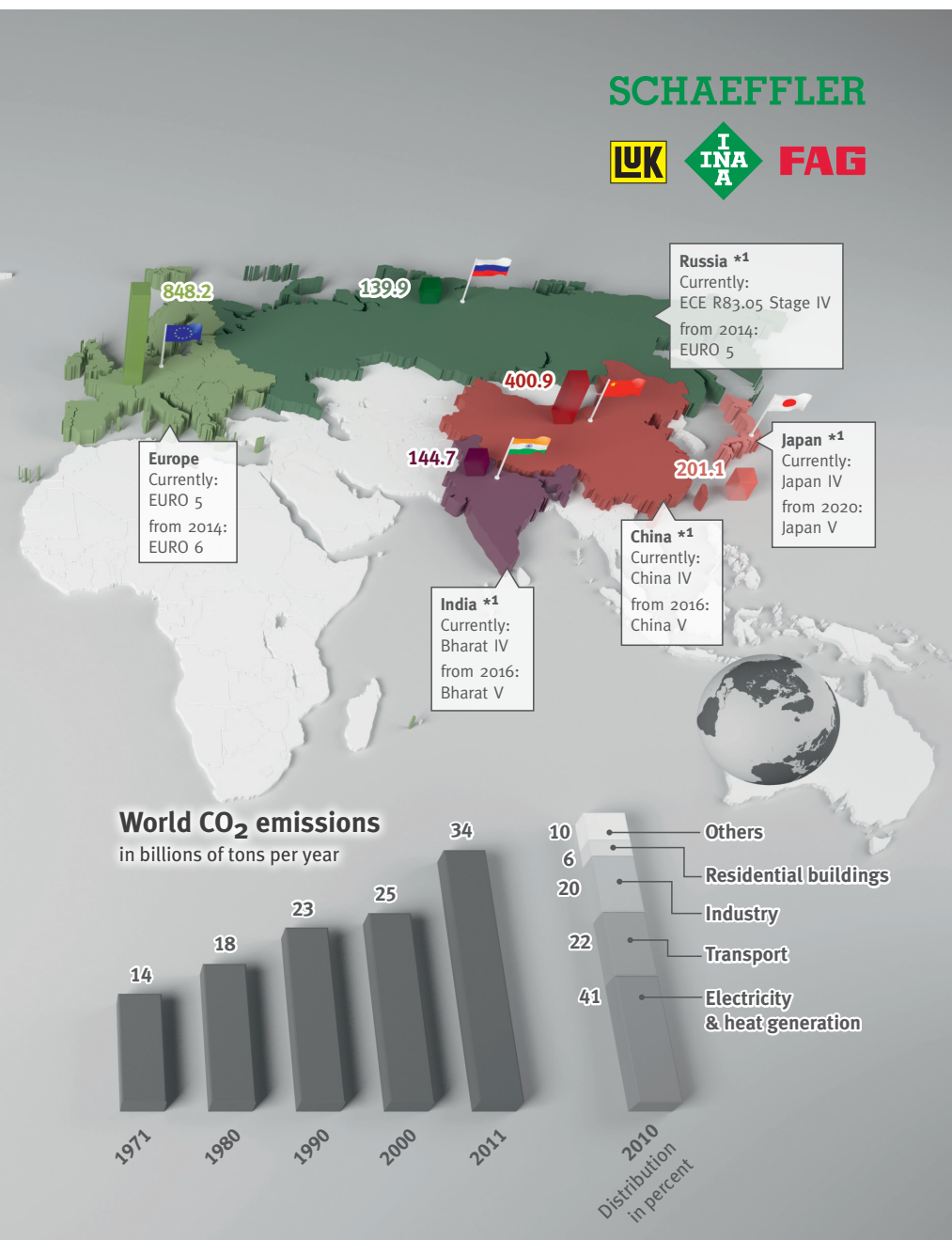


Source: WINFOR-International Database / R.L. Polk & Co., Human Development Report 2011, VDA

Images/Captions Development & Comparison of CO₂ Emissions

Development & Comparison of CO₂ Emissions





Source: European Commission, Delphi, DieselNet, IEA, ICCT

SCHAEFFLER

Contacts

Jörg Walz
Schaeffler AG
Head of Communication
Schaeffler Automotive
Industriestraße 1-3
91074 Herzogenaurach
Germany

Tel.: +49 9132 / 82-7557
Fax: +49 9132 / 82-3584
E-Mail: joerg.walz@schaeffler.com

Richard Neilson
Schaeffler Group USA Inc.
Marketing Manager
North American Automotive Center
1750 E. Big Beaver Road
Troy, Mi. 48083

Tel.: +1 248 / 528-4822
E-Mail: richard.neilson@schaeffler.com

Photos available at:
www.schaefflergroup.com/press-NAIAS/Detroit

