From battery cell to electric motor
Bosch paving the way to electromobility
21 projects with 13 automakers by 2013

- Systems competence is a success factor
- Joint venture set up to develop and manufacture electric motors
- SB LiMotive driving development of lithium-ion batteries forward
- Bosch opening up new business areas in electromobility segment

An innovative supplier with a 125-year history, Bosch is playing a decisive role in paving the way to electromobility. Technologies, components, and systems for electrical drives are now being developed under the double-armature brand, and in some cases already being manufactured. At the Bosch location in Hildesheim, for example, efficient electric motors are being made – for hybrid vehicles and, in a joint venture with Daimler, for electric vehicles. Series production of power electronics components has started in Reutlingen, and SB LiMotive, our joint venture with Samsung SDI, has been producing lithium-ion cells for electric vehicle batteries in Ulsan, South Korea, since 2010. Some 400 million euros goes into the electrification of automotive drives each year, with 800 Bosch associates around the world working on this issue that is so crucial for the future of mobility. Out of a global total of some 103 million newly produced vehicles in 2020, Bosch expects to see some three million electric vehicles and plug-in hybrids, as well as roughly six million hybrid cars. From 2025, electrically driven vehicles will become an increasingly common sight on the world’s roads.

Bosch systems competence as a success factor
As we move toward the all-electric car, hybrid technology in its various forms is an important transitional technology.
Bosch is currently focusing on two full hybrid designs that make it possible to travel short distances using purely electrical power: the parallel full hybrid and the axle-split hybrid. Both designs support internal-combustion engines in certain driving situations by way of a boost function. This enables the downsizing of spark-ignition and diesel engines. On the basis of present technology, this means that consumption and CO₂ emissions can be reduced by between 25 and 30 percent, without any further changes to the engine itself. In the parallel full hybrid, the electric motor is integrated into the powertrain between the internal-combustion engine and the transmission. The axle-split hybrid features an internal-combustion engine on the front axle and an electrical drive for the rear axle. The positive side-effect of this configuration is four-wheel drive.

Bosch’s systems competence is the basis for controlling the complex interplay of internal-combustion engine, electric motor, and clutch, which results in additional benefits such as coasting and boosting. Coasting means that the internal-combustion engine is stopped and the vehicle coasts along without burning fuel. All safety and comfort systems continue to be fully operational. Boosting is when the internal-combustion engine is briefly supported by the electric motor when there is a need for extra power – when overtaking, for example. Bosch has been supplying the parallel full hybrid technology for the Porsche Cayenne and the Volkswagen Touareg since 2010, and now also for the Porsche Panamera. This year PSA will launch the Peugeot 3008 HYbrid4, the world’s first diesel hybrid, which features Bosch’s innovative axle-split hybrid technology. By 2013, Bosch will have started series production of core components such as electric motors, power electronics, and battery technology for 13 automakers in 21 different projects. Daimler AG and Robert Bosch GmbH are also working to set up a joint venture that will develop and manufacture electric motors. Called EM-motive GmbH, it will supply traction machines for Mercedes-Benz and smart electric vehicles from 2012. Bosch will be responsible for sales of these motors to other automakers.

**Plug-in hybrid as a promising solution**

The plug-in hybrid is an especially interesting approach. While its design is basically the same as the systems named above, a battery charger allows it
to be recharged at any household power socket. In addition, its battery has a greater capacity. As a result, the distance the hybrid vehicle can travel all-electrically increases to some 40 kilometers per battery charge. In conurbations, this means that eco-friendly, all-electric, and locally zero-emission driving is possible for weeks on end. But at the same time, plug-in hybrids can cover long distances too with their internal-combustion engine – for instance when going on vacation.

**Cost reduction as the key to success**

Technically speaking, it is not a big step from the hybrid to the electric car. Cost-wise, however, there are still some major challenges to overcome. Bosch expects electric vehicles to cost around 45 percent more than comparable vehicles with internal-combustion engines in 2020. One of the most important questions in the further development and production of components for electrical drives is therefore how to reduce their system costs. Moreover, as volumes grow, prices drop, and as prices drop, acceptance grows. This is true of all projects in the field of electromobility: from e-bikes to hybrids and plug-in hybrids to the all-electric vehicle. This is why cost reduction is at the top of Bosch’s to-do list.

**SB LiMotive: development of the lithium-ion battery is progressing**

Battery cost is a decisive factor for the success of electrical drives. SB LiMotive, the Bosch and Samsung SDI joint venture, has set itself the target of 350 euros per kilowatt-hour by 2015, and hopes to bring this down to 250 euros by 2020. Technically as well, lithium-ion cells are becoming increasingly mature. The key parameters, such as energy and power density, are being gradually improved, as are service life and cycle durability. By 2015, a 35 kWh battery made by SB LiMotive will have a range of 200 kilometers and a service life of at least 12 years, as demanded by the automotive industry. In the three years since it was founded, SB LiMotive has succeeded in gaining several major customers, and now has some 850 associates. For example, the company will supply lithium-ion cells for BMW’s i3 and 1 Series ActiveE. Fiat’s all-electric 500 EV will feature a complete SB LiMotive battery system. In addition, a U.S. consortium of Chrysler, GM, and Ford has awarded SB LiMotive a contract worth 8.4 million dollars to develop lithium-ion battery cells and systems.
By 2015, SB LiMotive intends to boost annual cell production capacity in Ulsan, South Korea, to a good four gigawatt-hours – enough for some 180,000 electric vehicles. Since more and more European automakers are planning to work with SB LiMotive, a manufacturing facility is likely to be set up in Europe after 2013.

**New business areas in the electromobility age**

Electromobility holds out great potential for Bosch – not only for its traditional systems and components business, but also when it comes to opening up new business areas. One example is the establishment of charging infrastructure. Bosch Software Innovations GmbH is developing a software platform for charging electric vehicles as well as for reserving charge spots and billing for the energy used. Bosch Software Innovations charge spots interface both with the electricity provider’s grid and with the end user. Since June 2011, the software and charge spots have been in use in a pilot project in Singapore. Bosch Car Service repair shops and the Automotive Aftermarket division are also preparing for the coming market. Bosch supports car repair shops with diagnosis systems for hybrid vehicles and practical training. No other supplier in the field of electromobility has such a broad range of components, systems expertise, and services to offer. As electromobility only makes sense if the energy for it comes from renewable sources, Bosch has made energy conversion its task as well. The Bosch Solar Energy division is one of the major manufacturers of cells and modules for solar arrays. Its other activities in this market of the future include gearboxes for wind turbines and projects for marine power stations.

**Press photo:** 1-UBK-17898, 1-UBK-17899, 1-UBK-17900

**Contact person for press inquiries:**
Michael P. Mack, phone: +49 711 811-6282

*Automotive Technology is the largest Bosch Group business sector. In 2010, its sales came to 28.1 billion euros, or 59 percent of total group sales. This makes the Bosch Group one of the leading automotive suppliers. The roughly 167,000 Automotive Technology associates worldwide work in seven areas of business: injection technology for internal combustion engines, powertrain peripherals, alternative drive concepts, active and passive safety systems, assistance and comfort functions, in-car information and communication, as well as services and technology for the automotive aftermarket. Bosch has been responsible for important automotive innovations, such as electronic engine management, the ESP® anti-skid system, and common-rail diesel technology.*
The Bosch Group is a leading global supplier of technology and services. In the areas of automotive and industrial technology, consumer goods, and building technology, some 285,000 associates generated sales of 47.3 billion euros in fiscal 2010. The Bosch Group comprises Robert Bosch GmbH and its more than 350 subsidiaries and regional companies in over 60 countries. If its sales and service partners are included, then Bosch is represented in roughly 150 countries. This worldwide development, manufacturing, and sales network is the foundation for further growth. Bosch spent 3.8 billion euros for research and development in 2010, and applied for over 3,800 patents worldwide. With all its products and services, Bosch enhances the quality of life by providing solutions which are both innovative and beneficial.