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## Drive management

Electric motors offer interesting possibilities for intelligent drive management. Audi is making use of these in two fields of technology – energy recovery and quattro permanent all-wheel drive.

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Energy recovery is an important feature for reducing energy consumption in hybrid and electric vehicles. In the deceleration phases the electric drive motor functions as a generator, converting the mechanical power from the wheels into a three-phase current; the power electronics then turns this current into a high-voltage DC current, which it then stores in the high-voltage battery.

The energy recovery software controls the distribution of deceleration between the electric motor and the mechanical wheel brakes. The electric motors always receive the greatest possible share. Nevertheless, the brakes also play an important role in hybrid and electric vehicles, for several reasons.

At a standstill the electric motors cannot generate any static braking torque without a supply of energy. In sharp deceleration, their braking torque does not suffice. In addition, the availability of electrically motorized braking depends on numerous factors, such as the current speed and the battery's state of charge – a fully charged battery would suffer damage in recuperation.

Audi is working hard on developing new concepts in this field of technology. Depending on the vehicle these systems can come with partially or fully electrical braking, or with electromechanical brake servos. In both cases, brake operation is uncoupled from the mechanical brake – enabling the free distribution of torque and the smooth transition from electrical to mechanical braking.

In most cases of practical automotive operation, these brake systems allow deceleration by the electric motor. The wheel brakes come into play in only a few situations. Should the vehicle threaten to become unstable, the electric motor operated braking is immediately reduced; the individually controlled wheel brakes handle deceleration and stabilization.

The electric drives of the future are also offering entirely new possibilities for permanent all-wheel drive, one of Audi's core competencies: quattro becomes e-quattro. The brand with the four rings is hard at work on a number of different technologies. One of these is a solution in which each wheel is driven by a separate motor. The Audi e-tron Spyder



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concept car presents another variant: here an electric motor powers the front wheels, while a combustion engine drives the rear wheels.

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