ELECTRIC BITURBO

With the electric biturbo, Audi is taking another major step forward in its TDI engines. In this forward-looking technology an additional compressor assists the turbocharger in the lower rev range.
Almost a quarter of a century ago, Audi delivered a major boost to diesel engine development worldwide. 1989 saw the debut in the Audi 100 of the first direct injection compression ignition engine with turbocharging and electronic control, since when the TDI has enjoyed an impressive and ongoing success story.

The full potential of forced induction is particularly evident in combination with the diesel engine. It increases performance and reduces consumption and emissions considerably; compared with earlier naturally aspirated engines, this is downsizing at its very best. As a factor of displacement, TDI engines have increased their output by more than 100 percent and torque by 70 percent since 1989; within the same period, emissions have fallen by 95 percent.
The latest development iteration from Audi is the 3.0 TDI biturbo – it delivers 230 kW (313 hp) and a maximum torque of 650 Nm between 1,450 and 2,800 rpm. It has a specific power output of 77.5 kW (105.5 hp) per liter. Yet, in the A6 it consumes an average of just 6.4 liters of fuel per 100 km and emits 169 grams of CO_2 per km.**

All turbocharged internal combustion engines share one characteristic – that turbochargers are driven by energy from the exhaust gas. For this reason, the charge pressure, and thus torque, does not begin to rise sharply at the lowest end of the rev range until exhaust gas energy increases.

The electric biturbo, however, offers a significant improvement. Specialists from Audi's Advanced Diesel Engine Development department in Neckarsulm have built and calibrated a 3.0 TDI with this configuration. The conventional turbocharger operates together with a supplementary, electrically driven compressor. This facilitates a rapid build-up of charge pressure and high torque from the very lowest revs, independent of the available exhaust gas energy.
Instead of a turbine driven by the flow of exhaust gases, the new component incorporates a small electric motor that runs the compressor rotor up to a very high speed in an extremely short space of time. The electrically driven compressor, which looks very similar to a conventional turbocharger from the outside, is positioned downstream of the turbocharger and charge-air cooler and is bypassed under most operating conditions. However, when the energy on the turbine side is low, the bypass valve closes and the charge air is directed into the electrical compressor, where it is compressed for a second time.

The effect of the new concept is impressive. When pulling away and accelerating at very low revs, torque build-up takes place significantly earlier, meaning that a high level of pulling power is quickly on call in every situation. Under full acceleration from a standstill, the electric biturbo delivers an advantage of around two vehicle lengths in the first three seconds compared with a conventional engine.
The energy required to drive the electric compressor is derived largely from recuperation under

trialing throttle conditions, making it consumption neutral. A further key feature of the concept is the flexible and compact charge line; its heat capacity is reduced as a result, ensuring that the catalytic convertor quickly reaches operating temperature following cold start.

**Figures depend on the tires/wheels used.

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