Thermal management

Thermal management for the future is a highly complex concept with promising new solutions. Audi has stepped up the pace of development in this area.

The technical field of thermal management extends beyond the aspect of battery cooling to encompass the entire vehicle. The system in the Q5 hybrid quattro already includes the electric motor and power electronics – these are supplied via the coolant circuit of the combustion engine and a dedicated low-temperature circuit, respectively. The compressor for the air conditioning system has an electric drive so that it can continue running even when the combustion engine is switched off.

In purely electric vehicles such as the R8 e-tron, every joule of energy used to heat the interior detracts from the range. That’s why Audi has chosen the ideal solution of the heat pump here – a principle familiar in building heating. Capable of using air or water, the heat pump acts as a high-efficiency heating and cooling system.

The design of the heat pump is based on the classical refrigerant circuit, supplemented by an additional condenser, among other things. In the condenser the refrigerant compressed to high pressure and temperature levels is cooled, condensed and super-cooled. Following expansion the coolant absorbs the heat from the surroundings in the other condenser, which acts as an evaporator.

The heat pump is able to capture the waste heat from various components in the electric vehicle. In fast driving the electric motor(s), the battery and the power electronics together radiate about 5 to 15 kW of heat. For generating 4 kW of heat output, the heat pump need only invest 1 kW of output for the compressor. Thanks to this high efficiency, the heat pump decreases the range of an electric car such as the Audi R8 e-tron by only about 10 percent at -10 degrees Celsius (14 degrees Fahrenheit). A conventional electrical heating element would need approximately three times more energy. For operating heat pumps efficiently, a highly complex and highly variable control strategy is required. Audi will gain experience with this type of control strategy in the R8 e-tron.

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