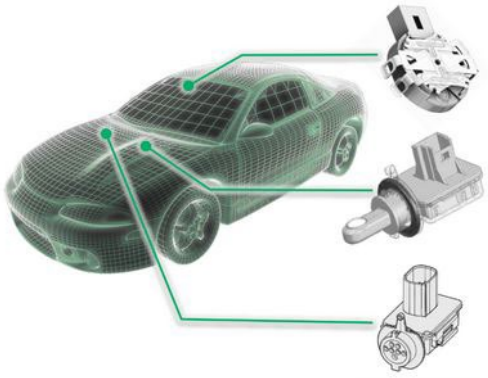
Longer range thanks to smart sensors

Sensors monitor critical areas in electric vehicles such as battery condition, indoor climate, and air quality. They contribute to improved safety, increased energy efficiency, and increased comfort. In combination with other smart technologies, the vehicle range is also increased.



Lead image: Sensors are important components for electric vehicles. They help to increase safety, range, and comfort.

Electromobility is currently gaining ground in many regions of the world. New vehicles are being launched on the market in ever shorter development cycles, setting themselves apart from the competition with longer ranges, smart functions and new comfort features. Due to the innovation-driven nature of e-mobility, new players are challenging the established industry giants by quickly and flexibly developing new technologies and bringing them to market.

Key technological drivers for the development towards ever more intelligent electric vehicles are high-performance computers, which increasingly optimise and automate the driving experience, and advanced sensors, which provide the necessary raw data. Without the accurate collection and processing of important data, the vision of the intelligent, sustainable vehicle of the future cannot be realised.

Recognising critical battery conditions at an early stage

One example of the critical role of sensors in electric vehicles is the monitoring of battery status using metal oxide (MOX) sensors: High regulatory requirements apply to batteries in electric vehicles to ensure the safety of passengers. At the same time, the batteries are exposed to high stress during rapid charging and discharging. In individual cases, this can lead to a fire in the event of a defect - as well as in the event of damage caused by an accident.

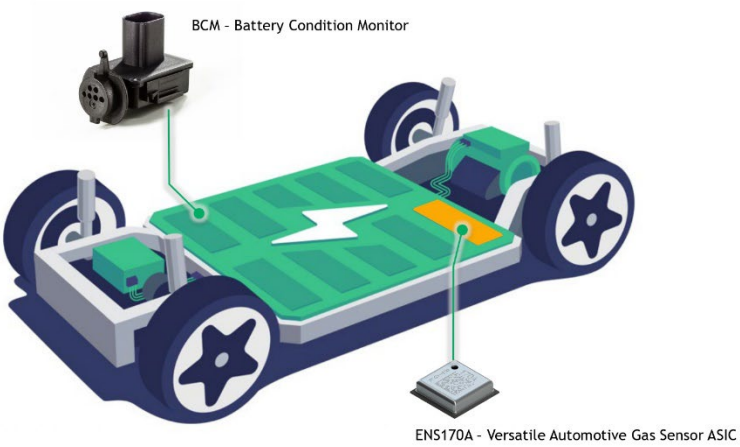


Figure 1: Metal oxide (MOX) sensors for condition monitoring of the electric car battery can be integrated at system level and in every battery module in order to detect critical conditions such as thermal runaway as early as possible.

In accordance with the United Nations Global Technical Regulation on the Electric Vehicle Safety (EVS), battery manufacturers and OEMs must take precautions to ensure that drivers and passengers can leave the vehicle in such cases before a fire or, in the worst case, a battery explosion occurs. To achieve this, uncontrolled heat development due to critical battery conditions must be recognised at an early stage. Broadband gas sensors for metal oxides (MOX) are ideally suited for this because they detect the development and outgassing of hydrogen, carbon monoxide and organic solvents during a chemical reaction before thermal runaway occurs.

In independent tests, the specially developed BCM1 sensor module for condition monitoring of Li-ion batteries from ScioSense reacted up to 40 seconds faster than sensors for temperature and battery voltage. Ideally, these sensors are installed in the individual modules of the battery so that defects are recognised before they spread to the entire battery of the vehicle (thermal propagation). This enables rapid countermeasures and early warning of the occupants.

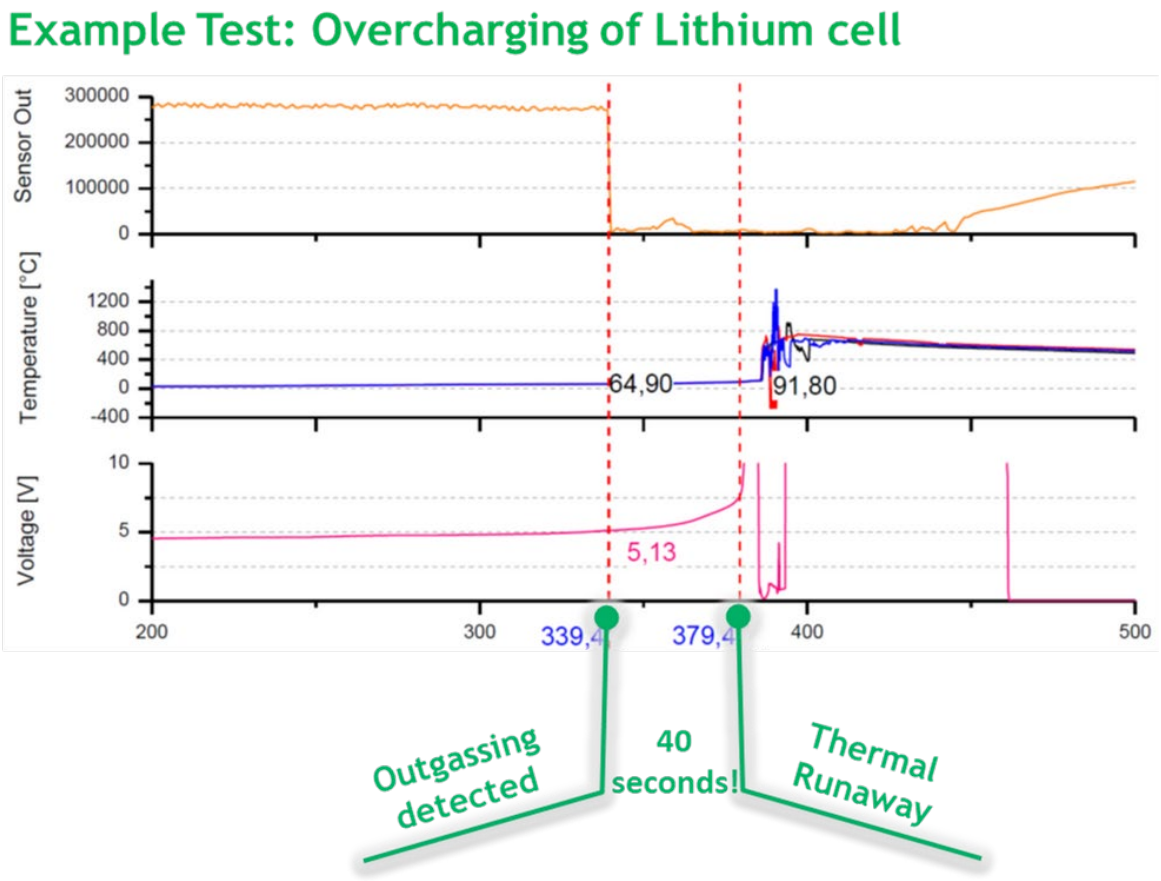


Figure 2: In independent tests, ScioSense MOX sensors were able to detect gas leakage from a Li-ion battery 40 seconds faster than conventional sensors for temperature and battery voltage. This helps to counteract thermal propagation.

Optimised climate control increases range

Air quality and environmental sensors play a decisive role in the air conditioning of electric vehicles. The aim of monitoring the interior climate is to regulate the temperature optimally through smartly controlled circulation of outdoor and indoor air, while at the same time preventing the windows from fogging. When cooling the vehicle at warm outside temperatures, the sensors also have the role of ensuring that the performance of the air conditioning compressor and heat pump are ideally coordinated in order to achieve the best possible cabin climate with the lowest possible energy consumption.

In this way, the air quality and environmental sensors enable the temperature and humidity in the vehicle to be optimised, thereby increasing comfort. At the same time, they help to increase the efficiency of the air conditioning system. This reduces energy consumption and has a direct impact on the range of the vehicles. An independent study conducted by “Car and Driver Magazine” in 2020 found differences in range of up to 13 per cent, depending on the air conditioning settings. This shows the importance of monitoring and data collection by sensors in both the air conditioning system and the vehicle cabin.

Sensors working together
Ideally, the data from several sensors is combined in a smart system to optimise climate control: Modules for classifying the outside air are used to control air inlet valves and mixers with the recirculated cabin air, optionally with dew point detection.

Sensors upstream of the air conditioning compressor measure the temperature and humidity of the air, which is then released into the cabin. The data can be supplemented with additional sensors, which are then installed at various positions in the passenger compartment or directly on the windscreen, for example. This enables individual fine-tuning of the air conditioning or reliable and energy-saving defrosting of the windscreen.

Fully automatic air quality control
Air quality monitoring goes one step further, a comfort function that is currently in demand in the luxury segment in particular. Intelligent sensors measure the air quality in the vehicle and its surroundings with the aim of controlling the air conditioning system fully automatically. ScioSense has developed a reference design based on MOX sensors that measures the concentration of volatile organic compounds (VOCs) in the air. This allows conclusions to be drawn about the air quality.

Unpleasant odours in the environment, e.g. from exhaust fumes, industrial plants or agriculture, can be detected, as can odours from food or cigarette smoke indoors. By comparing the air quality, systems can control the air exchange and circulation as well as active air purification fully automatically. The result is optimised air in the passenger compartment with minimum energy consumption.

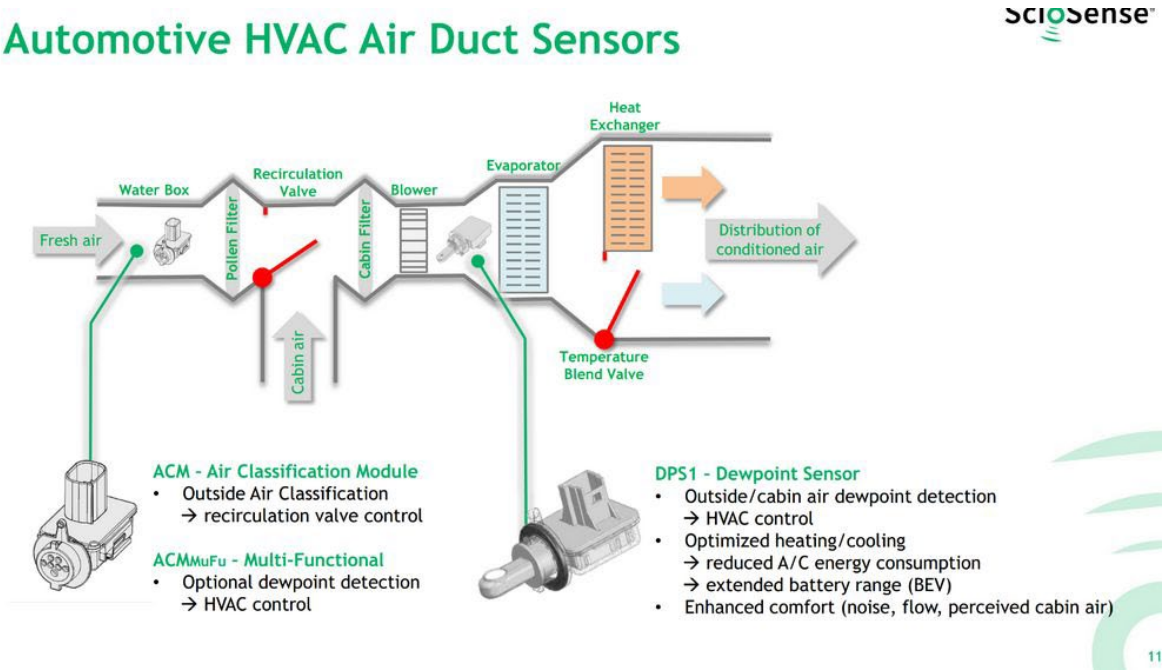


Figure 3: Sensors for measuring the quality of ambient and cabin air enable optimum control and automation of ventilation and air conditioning systems.

Challenges for OEM integration
Condition monitoring for e-car batteries is already an important safety feature today and its importance is increasing with the demand for ever more powerful batteries and higher charging speeds. Sensors for air and environmental monitoring offer great potential for climate control in e-mobility, as the efficiency of heat and ventilation management has a direct impact on the range of the vehicles.

Due to the high safety requirements, the ever-shorter innovation cycles and the sometimes very complex certification processes, suppliers and vehicle manufacturers in the automotive industry are well advised to deal with smart sensors and their design-in at an early stage. On the one hand, it makes sense to be one step ahead before the sensors become a standard requirement in the industry, and on the other hand, factors such as energy efficiency and range are important elements for vehicle manufacturers to assert themselves in global competition.

ScioSense supports companies worldwide in the introduction of the technology with over 25 years of experience in the field of sensor technology for the automotive industry. Customers and partners benefit from the fast and agile development of customised product variants and integration support from the engineering team - at seven locations worldwide, with headquarters in the Netherlands and a local-for-local approach for direct contact between customers and the development team.