

medium-duty trucks stabilised following sharp decreases in previous years. DEUTZ's revenue in the Asia-Pacific region rose by 15.9 per cent thanks to the positive impact of new customer projects.

RESEARCH AND DEVELOPMENT

Research and development expenditure (after deducting grants)¹⁾

€ million (R&D ratio in %)

2016	50.4	(4.0)	
2015	40.8	(3.3)	
2014	53.1	(3.5)	
2013	52.6	(3.6)	
2012	62.1	(4.8)	

¹⁾ Spending on research and development after deducting grants received from major customers and development partners.

R&D spending stepped up as planned Expenditure on research and development in 2016 amounted to €53.5 million (2015: €49.5 million). After deducting grants received from major customers and development partners, expenditure was €50.4 million (2015: €40.8 million). The R&D ratio (after deducting grants), i.e. the ratio of net development expenditure to consolidated revenue, increased as planned to 4.0 per cent (2015: 3.3 per cent). The rise in R&D expenditure compared to the low level of spending in the prior year was largely attributable to the expansion of our product range and the continuous improvements to current engine series. In the year under review, 18.1 per cent of development expenditure after deducting grants was capitalised (2015: 31.9 per cent).

R&D spending by the DEUTZ Compact Engines segment after deducting grants came to €47.7 million (2015: €38.2 million) and that of the DEUTZ Customised Solutions segment came to €2.7 million (2015: €2.6 million).

Stage V ready In previous years, we had completely overhauled our engine portfolio in connection with the introduction of the EU Stage IV/US Tier 4 emissions standards. Our latest 'Stage V ready' TCD engines in the 2.9 to 16.0 litre capacity range are already equipped to meet the next European emissions standard, EU Stage V¹⁾, which comes into effect in 2019. The diesel particulate filters needed to ensure compliance are now available as standard or as an option for engines with a capacity up to 7.8 litres. A diesel particulate filter meeting the new emissions standard will be introduced for all the other engines that will not require much additional space for installation. It is not yet known whether a further emissions standard will be introduced in the USA.

Expansion of the product portfolio We plan to enhance our product range with further developments. One of these is the D/TD/TCD 2.2, a three-cylinder engine that we are developing on the basis of the existing four-cylinder engine with a 2.9 litre capacity. In addition, we will offer smaller engines not only in a diesel variant but also in a liquefied petroleum gas (LPG) variant. The latter is a particularly interesting option for forklift trucks and other material handling applications. We are also currently developing a completely new 5 litre engine with four cylinders. The TCD 5.0 will supplement the DEUTZ product range in the 100 to 150 kW power range and is, at the same time, the first step in renewing our medium-duty engine series. The design of the engine's underlying technology features minimum pipework, fewer components, strict separation between the hot and cold sides to avoid the need for heat protection measures and a reduction in performance losses from the oil and water circuits. Another feature is its overhead camshaft.

Preliminary development work at a high level Exhaustive research and development will continue to form the basis for innovative products and services from DEUTZ in future. We have recently expanded our activity in the field of alternative fuels. As well as looking at natural gas, we are also focusing on hydrogen and fuels that are generated from renewable sources, and we have taken steps to expand our work with universities and other research institutes. A key focus of our preliminary development work is the combination of internal combustion engines and electric motors (hybridisation). We have also continued to concentrate on data transfer and analysis (Industry 4.0) so that we can offer our customers new services in the future.

Intellectual property rights safeguard our know-how We protect our know-how from unauthorised outside use by means of patents, patent applications and utility models. In 2016, we submitted 14 new patent applications, eight of which were in Germany. We now hold a total of 147 patents registered in Germany and 178 registered elsewhere.

PROCUREMENT

Last year was characterised by an overall recovery in the commodities markets. Key purchasing objectives were achieved, such as reducing costs, ensuring continuity of supply, optimising quality and implementing embedded material group strategies.

Commodity prices rising While prices had continued to fall in the primary markets in 2015, the trend was reversed in 2016. Overall, all the average prices for the year were slightly higher than the ranges that had been forecast. However, commodity prices have only a limited influence on the price at which DEUTZ procures parts from suppliers because there is a very high element of value added.

¹⁾ Regulation (EU) 2016/1628 of the European Parliament and of the Council dated 14 September 2016.