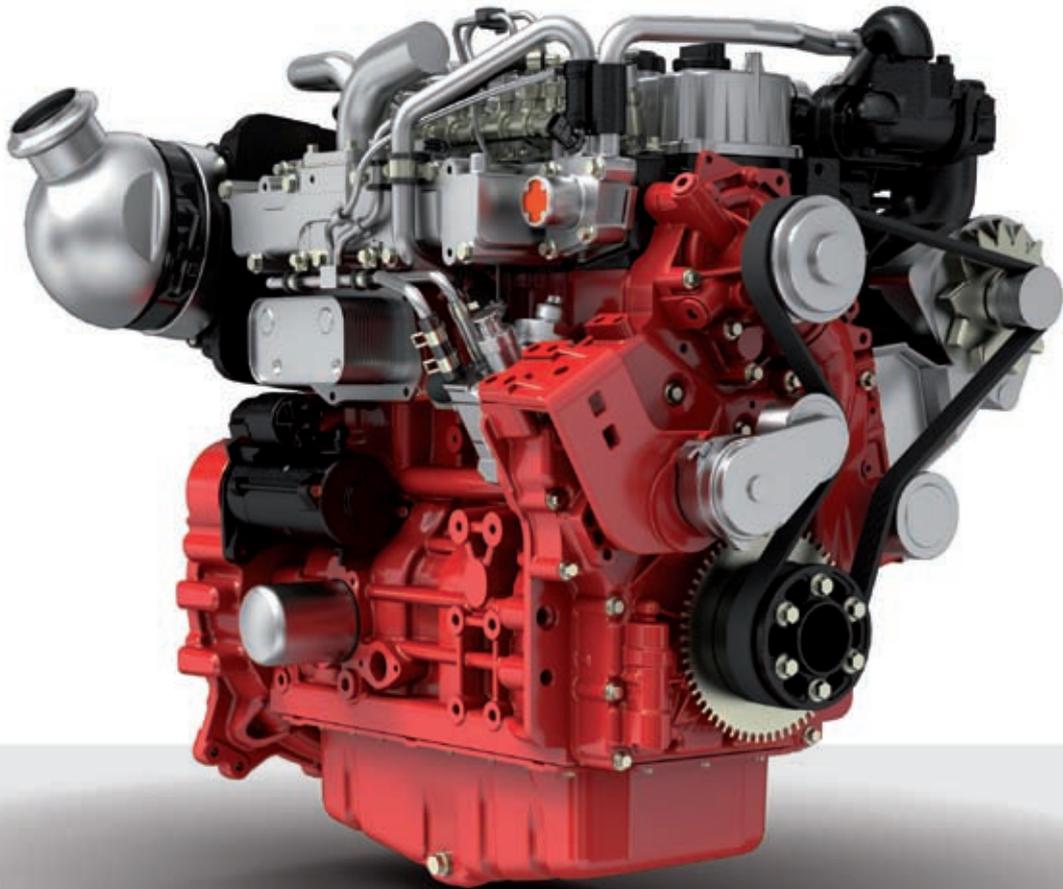


# DEVERT<sup>®</sup>

DEUTZ Variable Emission Reduction Technology

Tier 4 – our driving force, your advantage.



The engine company.



# Challenges

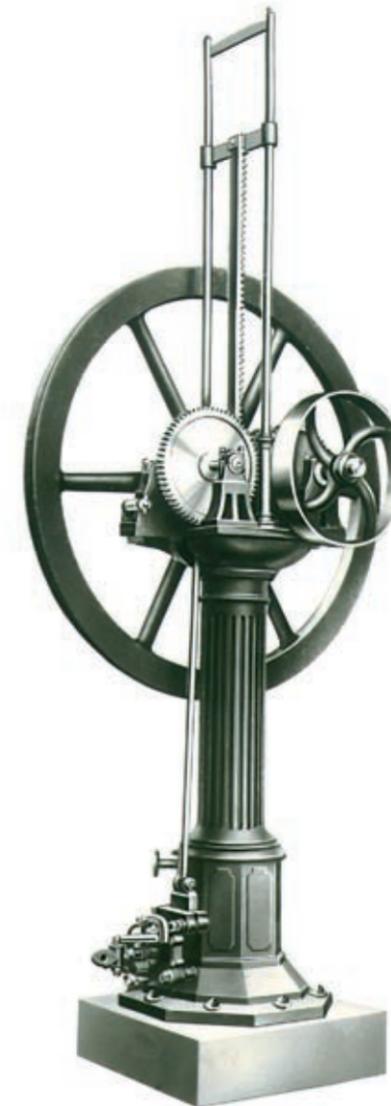
are what **drive** us  
since 1864

One of the great challenges facing diesel engine manufacturers is the implementation of the future exhaust emission regulations. Regulations for the systematic reduction of pollutants in the exhaust of diesel engines have been in force in Europe and the USA since 1996.

Exhaust emission reduction is extremely complex and increasingly requires innovative measures in engine design, fuel injection, combustion and turbocharging technology. The use of exhaust aftertreatment is now necessary to meet engine emission limits.

After successfully implementing the first steps of the European and US emission reduction regulations we have now turned our attention to the future exhaust stage 4. This represents the greatest challenge to engine manufacturers so far and will lead to the application of further technology modules.

The basic philosophy of DEUTZ: we will only introduce technology into the engine design and complexity that is necessary for the safe implementation of legislation and customer requirements. In the meantime we will keep our sights set firmly on the economy and reliability of the DEUTZ engine.



# Lower Emissions

In comparison with the previous exhaust emissions stage, the NO<sub>x</sub>/HC and particle emissions have been reduced considerably. This has come about as a result of the European emission stage III B and the US emission stage Tier 4. Several procedures are available to achieve this.

The particles can be broken down by a particle filter system. The NO<sub>x</sub> values are reduced as a result; this occurs both through the improvement of the combustion process and through cooled exhaust gas recirculation.

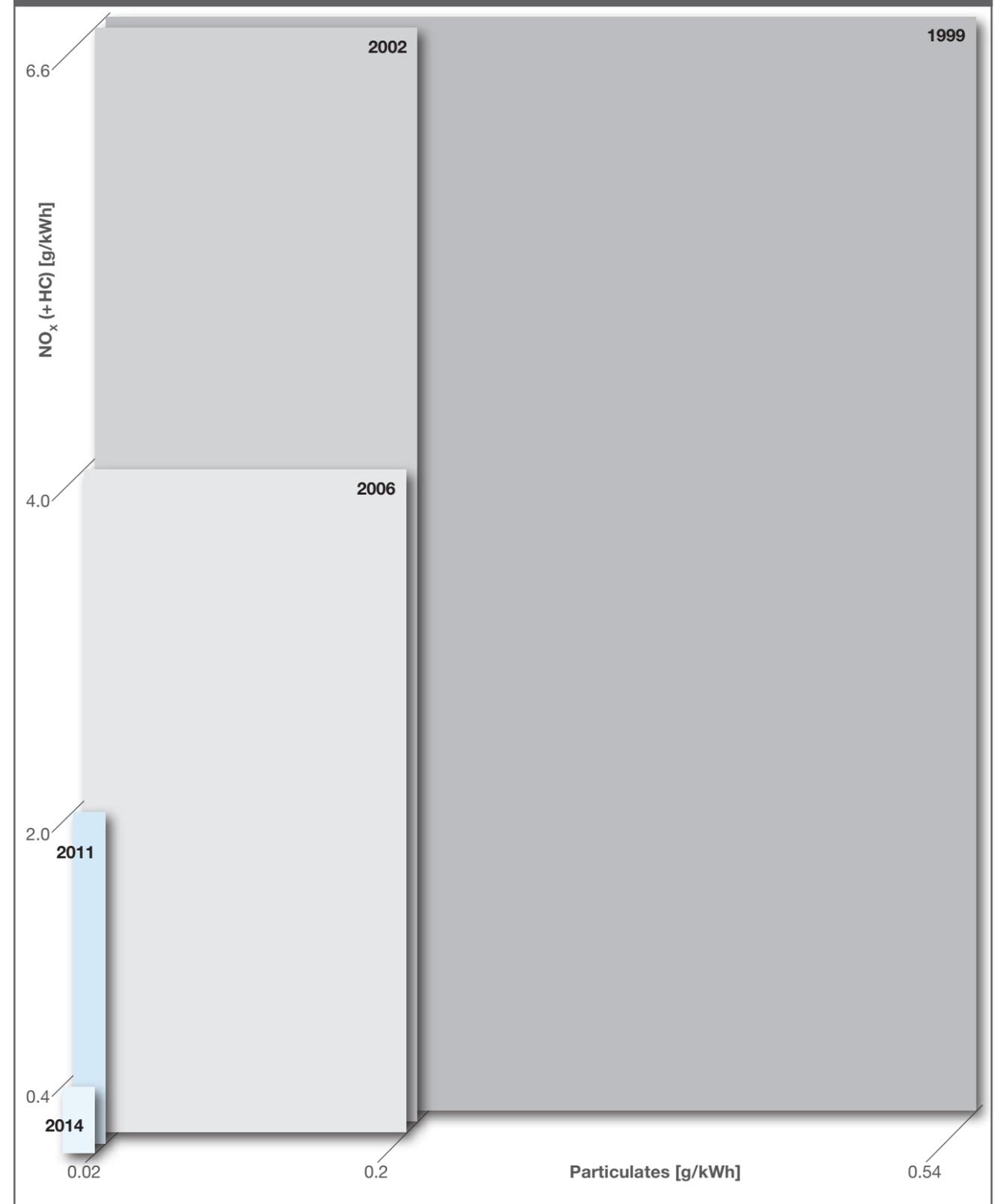
An alternative measure is the reduction of the NO<sub>x</sub>/HC emissions via the use of SCR technology combined with engine optimized particle emission reduction.

With the introduction of the emission stage EU IV and US EPA Tier 4, the limit values for engines > 56 kW are so low that exhaust aftertreatment of the nitric oxides (NO<sub>x</sub>) and the diesel soot (PM) will be necessary.

The diagram opposite shows the proportional reduction of emissions. The performance of our engines has not been reduced by this, rather in most cases it has actually been increased.

# better Performance

**History of Emission Legislation**  
for engines > 130 kW



■ = EU Stage I / US EPA Tier 1; ■ = EU Stage II / US EPA Tier 2; ■ = EU Stage III A / US EPA Tier 3;  
■ = EU Stage III B / US EPA Tier 4 interim; ■ = EU Stage IV / US EPA Tier 4

# From Theory

There are a number of frequently asked questions related to Tier 4 engines. We would like to address the most important of these here.

## Installation

More stringent exhaust limitations require the installation of emission reduction components. Therefore installation space to fit Tier 4 engines is critical. Installation space is usually limited inside a given machine, a problem which particularly affects our OEM customers. Alternative routes have to be explored to cope with these space limitations.

The DEUTZ application engineering teams are skilled in configuring the engine and the exhaust aftertreatment system in close cooperation with customers during the design phase of a new machine. The DVERT®'s modular design structure is especially useful in optimizing the engine compartment.

## Performance

DEUTZ engines with modern exhaust emission technology generally have even better performance characteristics than engines with lower emission limits. The “downsizing” trend, familiar from the EU automotive industry, is also becoming an increasingly important feature for many DEUTZ engine models. For you as customers this may mean that you get the same performance from a smaller Tier 4 engine that replaces a larger Tier 3 model.

The fitting of a more compact engine means that there is additional space available in the same engine compartment for optimized cooling packages and mandatory exhaust aftertreatment components.

## Consumption

A large portion of an engine's operating cost is fuel consumption. DEUTZ engines are traditionally characterized by low levels of fuel consumption and this is also true of our new Tier 4 engines. Utilizing the latest common rail fuel injection equipment and electronic combustion management, performance and torque are increased while fuel consumption is reduced. Depending on the application and duty cycle, the amount of fuel saved can be up to 10% or higher compared to Tier 3 engines.

## Servicing

Engines complying with exhaust EU stage III B/US EPA Tier 4 interim do not generally require more servicing than comparable engines with a lower exhaust stage. All relevant components of the DVERT® systems have the same durability as the engine itself. Additional aftertreatment maintenance is only required for closed diesel particulate filters. A filter change for ash cleaning needs to be performed after 3,000 hours at the earliest for standard applications below 130 kW | 174 hp, depending on the engine load, and in the class above 130 kW | 174 hp not before 4,500 h.

A warning signal alerts the owner that the filter is due for replacement. To enable our customers to change the filter easily and quickly, the proven DEUTZ Xchange® program has been extended by the diesel particulate filter product range.

## Regeneration

Particulate filter systems can achieve optimum regeneration results with minimal fuel consumption, low maintenance costs and long service life.

Three systems have established themselves in practice.

### a. Open (DOC only) system

As standard equipment on our new < 4 litre engines, the DOC only system utilizes ultra-low engine exhaust emissions in conjunction with an optimized open aftertreatment system. This simple system requires no regeneration and offers the benefit of a compact and effective solution under every operating condition.

### b. Passive regeneration

Passive systems feature regeneration of the filter under certain operating conditions, i.e. without a forced oxidation process. This includes diesel particulate filters (closed DOC and DPF system) optimized for continuous regeneration (CRT). The advantage of the passive regeneration is that these systems can be operated without an external energy supply. Static regeneration may be required during certain conditions for very low load profiles.

### c. Active regeneration

For engines >130 kW DEUTZ offers active regeneration solutions as standard where the filter is regenerated by a partial flow diesel burner combined with a catalytic reaction in the diesel oxidation catalyst (DOC). The burner creates a primary flame that is used to combust fuel additionally injected into the exhaust. This mixture produces a thermal reaction downstream in the diesel particulate filter which ensures that the temperature of the exhaust is increased to the level necessary for regenerating the DPF (>600° C | >1112° F).

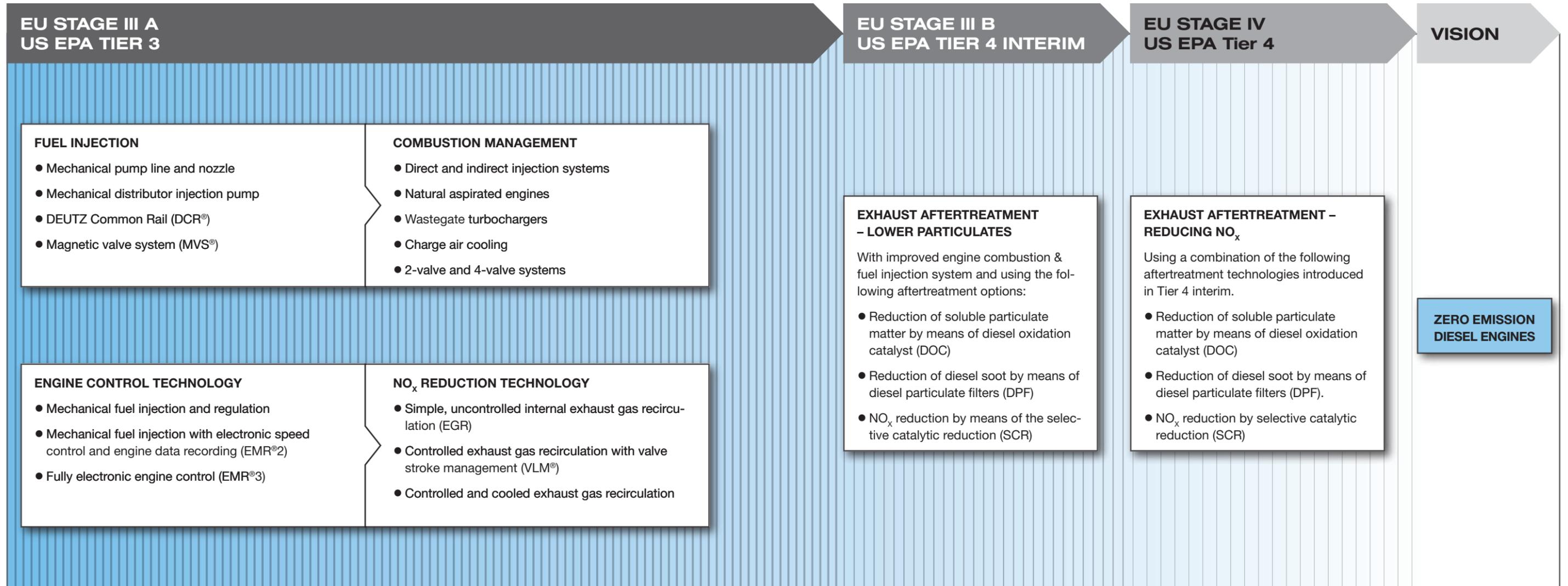
#### The advantages of this solution are:

- Regeneration is triggered automatically during the application cycle.
- Overloading of the particulate filter and increased gas back pressure are reliably prevented especially during low load engine operation.
- This solution enables regeneration of the diesel particulate filter at all times and for all load patterns with no effect on machine performance.

The modular DVERT® system kits provide a cost effective solution with only limited installation impact for the equipment manufacturer.

# to Practice

# Are you ready **4** facts?



DVERT<sup>®</sup> is our answer to the problem of harmonizing future emission regulations with our customers' requirements.

DVERT<sup>®</sup> stands for a modularly structured system which is incorporated into different configurations of our engines.

The basic principle is:

**“As much technology as necessary and not as much as possible.”**

Almost all the elements of the DVERT<sup>®</sup> system kits can be combined with each other to ensure the desired result with regard to engine performance, observance of emission limits and competitiveness. We have a number of technologies which meet the specified emission limits. With our flexible modular system we can ensure that “overengineering” is avoided and only as much technology as is necessary and useful is used.

The following EAT variants will show you how we have solved this issue for the entire power range – because we are the business of creating facts.

Fact #

# DOC

- 15% more power than Tier 3 equivalents
- Average fuel consumption up to 10% lower
- Maintenance-free, compact & mounted EAT system
- Tier 4 ready in combination with SCR system (> 56 kW)

Tier 4 interim/Tier 4:  
TCD 2.9 L4



Tier 4 interim:  
TCD 3.6 L4



Fact #

# DPF

- Performance improved by up to 25% compared to Tier 3 equivalents
- Fuel consumption up to 5% lower
- Compact EAT system & variants designed for easy installation
- Ready for environmental zones
- Burner regeneration w/o operation interference under every operating condition

Tier 4 interim:  
TCD 4.1 L4  
TCD 6.1 L6



TCD 7.8 L6



Fact #

# SCR

- Ultra-clean, > 90% efficient EAT system
- Maintenance free – Diesel Emission Fluid (DEF) dosing system
- Engine performance improved by up to 8%\*
- Average fuel consumption up to 5% lower

Tier 4 interim:  
TCD 4.1 L4\*



TCD 6.1 L6\*



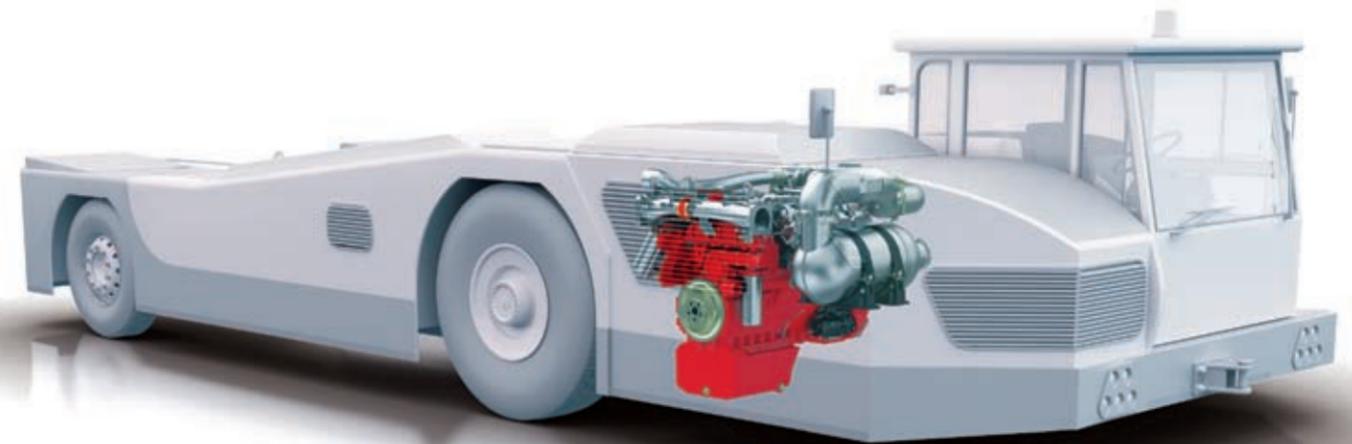
TCD 7.8 L6\*



TCD 12.0 V6  
TCD 16.0 V8



\*Agricultural engines only



Fact #

# DOC+SCR

- Up to additional 10% increase in power and more torque
- Lower noise and fuel consumption
- Proven and robust SCR technology
- Durable design for all applications and markets

Tier 4:  
TCD 3.6 L4



Fact #

# DPF+SCR

- Close-coupled EAT for optimized installation and system performance
- Reduced exhaust noise > 25 db (A), eliminates the need for an additional muffler
- Lower fuel consumption
- Proven and robust SCR technology

Tier 4:  
TCD 4.1 L4  
TCD 6.1 L6  
TTCD 6.1 L6\*



TCD 7.8 L6  
TTCD 7.8 L6\*



TCD 12.0 V6  
TCD 16.0 V8



\* Agricultural engines only



# Standards and Options

| Overview of DEUTZ product line-up – Tier 4 interim                         |       |                                 |                        |                                     |              |                         |
|--|-------|---------------------------------|------------------------|-------------------------------------|--------------|-------------------------|
| Technology: Electronic controlled high pressure common rail (HPCR) engines |       |                                 |                        |                                     |              |                         |
| Model  | ceEGR | Diesel Oxidation Catalyst (DOC) | Wall-Flow System (DPF) | Selective Catalytic Reduction (SCR) | DEUTZ Burner | Heat Management System* |
| <b>19 – 55.4 kW</b>  |       |                                 |                        |                                     |              |                         |
| D 2.9 L4   | ■     |                                 |                        |                                     |              |                         |
| TD 2.9 L4  | ■     |                                 |                        |                                     |              |                         |
| TCD 2.9 L4   | ■     |                                 |                        |                                     |              |                         |
| TD 3.6 L4  | ■     |                                 |                        |                                     |              |                         |
| <b>56 – 520 kW</b>   |       |                                 |                        |                                     |              |                         |
| TCD 3.6 L4   | ■     | ■                               | ▲                      |                                     |              | ▲                       |
| TCD 4.1 L4   | ■     | ■                               | ■                      | ●                                   | ▲            | ■                       |
| TCD 6.1 L6   | ■     | ■                               | ■                      | ●                                   | ▲ ■**        | ■                       |
| TCD 7.8 L6   | ■     | ■                               | ■                      | ●                                   | ■            |                         |
| TCD 12.0 V6  |       |                                 |                        | ■                                   |              |                         |
| TCD 16.0 V8  |       |                                 |                        | ■                                   |              |                         |

■ = Standard; ▲ = Option; ● = Agricultural engines with SCR only

\* Regeneration support by engine internal measures; \*\* TCD 6.1 L6 > 130 kW Burner standard

| Overview of DEUTZ product line-up – Tier 4                                 |       |                                 |                        |                                     |              |                         |
|--|-------|---------------------------------|------------------------|-------------------------------------|--------------|-------------------------|
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| Model  | ceEGR | Diesel Oxidation Catalyst (DOC) | Wall-Flow System (DPF) | Selective Catalytic Reduction (SCR) | DEUTZ Burner | Heat Management System* |
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| D 2.9 L4   | ■     | ■                               |                        |                                     |              |                         |
| TD 2.9 L4  | ■     | ■                               | ▲                      |                                     |              | ▲                       |
| TCD 2.9 L4   | ■     | ■                               | ▲                      |                                     |              | ▲                       |
| TD 3.6 L4  | ■     | ■                               | ▲                      |                                     |              | ▲                       |
| <b>56 – 520 kW</b>   |       |                                 |                        |                                     |              |                         |
| TCD 3.6 L4   | ■     | ■                               | ▲                      | ■                                   |              | ▲                       |
| TCD 4.1 L4   | ■     | ■                               | ■                      | ■                                   |              | ■                       |
| TCD 6.1 L6***  | ■     | ■                               | ■                      | ■                                   |              | ■                       |
| TCD 7.8 L6***  | ■     | ■                               | ■                      | ■                                   |              | ■                       |
| TCD 12.0 V6  | ■     | ■                               | ■                      | ■                                   |              | ■                       |
| TCD 16.0 V8  | ■     | ■                               | ■                      | ■                                   |              | ■                       |

■ = Standard; ▲ = Option

\*\*\* Agri high performance version with dual stage TC → TTCD 6.1/7.8

As an engine system supplier, we take pride in being specialists at solving complex drive requirements. Our job is to meet and exceed current and future exhaust regulations safely, effectively and economically. By developing customized solutions for our customers, DEUTZ has set a high standard with DVERT®, and by using modular solutions, all engines meet the latest emissions regulations.

Though the future brings change, two things will remain the same: our focus on customers' satisfaction and the world-class reputation of DEUTZ engines: superior performance, economy, reliability and durability. DVERT® provides innovative modular solutions for the next generation of engines.

# The 4 front of emission technology

Powerful

With its DVERT® optimized and tailored solutions, DEUTZ offers improved performance giving more power, better dynamic response and lower noise levels.

Reliable

The DVERT® solution also lowers operating costs thanks to improved fuel consumption and reduces servicing requirements by offering compact and flexible installation and simple DOC, DPF and SCR mounted modular systems for all engine series.

Fuel saving

The DVERT® DOC only (DOC-SCR Tier 4 > 56 kW) solutions on the < 4 lt models offer a compact 'smart and simple' solution with no need for static regeneration during low load operation.

Economical

'Green Zone' compliant variants are available along with the renowned DEUTZ technical assistance which enables you to make the right system choice for your machine and application requirements. In addition, the design and machine integration support that we provide emphasises our commitment to quality and total customer satisfaction.

Efficient



Maintenance free

## **worldwide:**

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