Continental
The Future in Motion

BS VI After-Treatment Technologies

ECT 2016 - New Delhi
November 9th, 2016

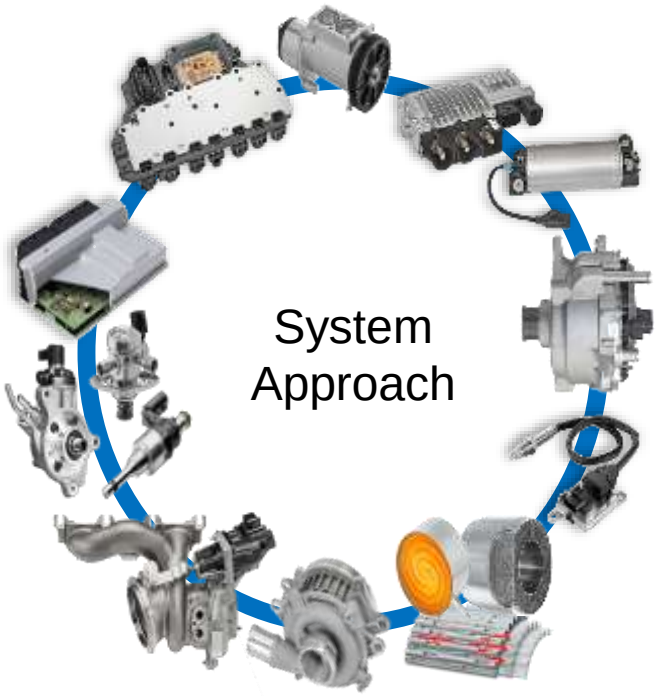
Agenda

Powertrain – Clean Power

Green Strategy for Ultra Low Emissions

CO_2 Reduction

Pollutant Emission Reduction



- **Gasoline Engines**: Direct Injection and Turbo as mainstream + GPF
- **Diesel Engines**: SCR will become mandatory

Efficiency

Powertrain – Clean Power

Green Strategy for Ultra Low Emissions

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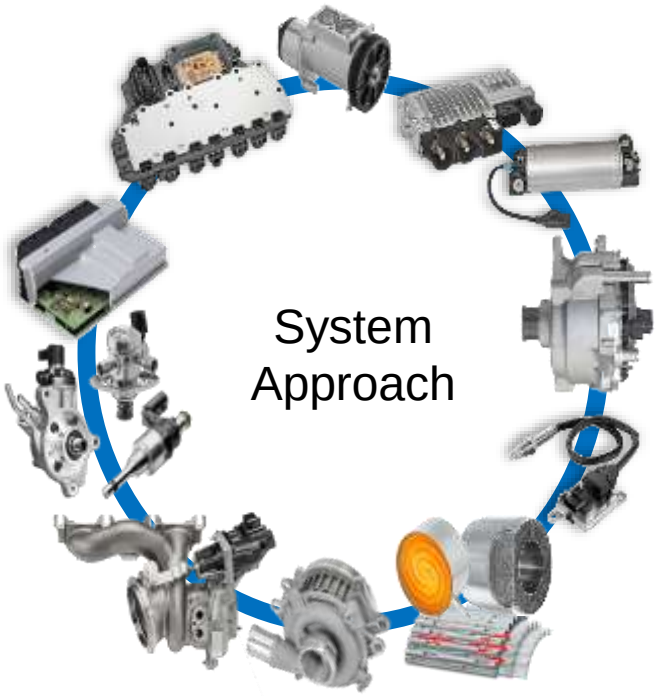


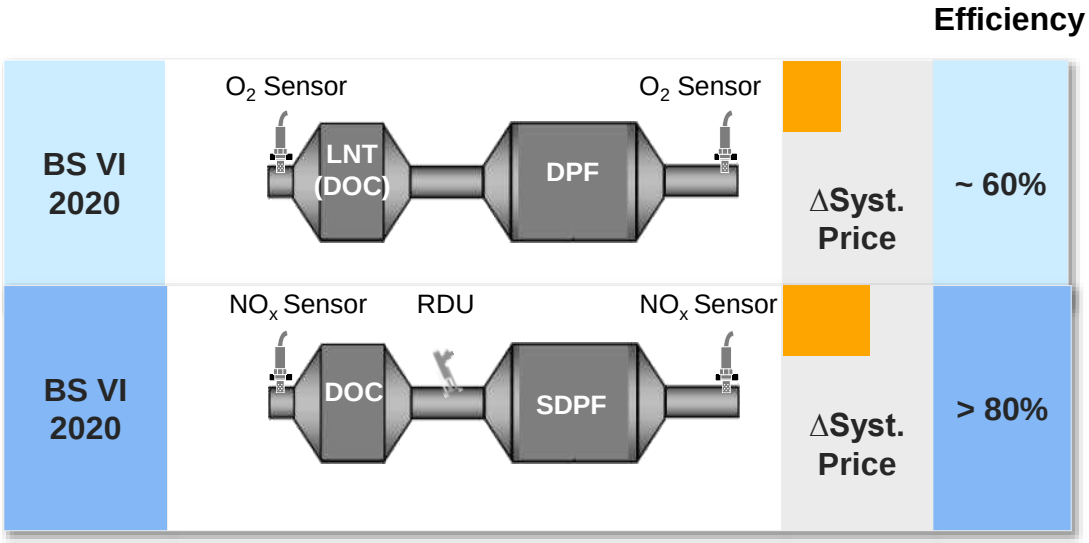
- **Gasoline Engines**: Direct Injection and Turbo as mainstream + GPF
- **Diesel Engines**: SCR will become mandatory
- Innovative **Exhaust Aftertreatment** Solutions

Efficiency

Emission Compliance Strategy

Diesel Exhaust System Configuration

- Clear path for diesel compliance
  - LNT for cold start NO_X
  - Standalone SCR
- Advanced OBD control for NO_X
  - Mass air flow plus humidity for EGR control
  - NH_3 sensor to control slip to SCR catalyst
- Electrically Heated Catalyst (EHC) allows earlier Adblue injection and conversion in city driving; fast light off in hybrid vehicles.



„RDE“ Comparison LNT / SCR EU VI Pass. Cars

NOx g/km

	Vehicle A LNT	Vehicle B SCR	Vehicle C LNT	Vehicle D LNT	Vehicle E LNT	Vehicle F LNT	Vehicle G SCR
Highway max. 130 km/h	0,368	0,064	0,310	0,413	1,478	0,442	0,101
City	0,132	0,020	0,143	0,386	0,703	0,140	0,051
Extra Urban	0,221	0,104	0,175	0,265	0,993	0,217	0,111
Conformity Factor	**3,31**	**0,99**	**2,75**	**4,13**	**14,16**	**3,63**	**1,25**

Source: Auto Motor Sport 11/2016

Emission Compliance Strategy
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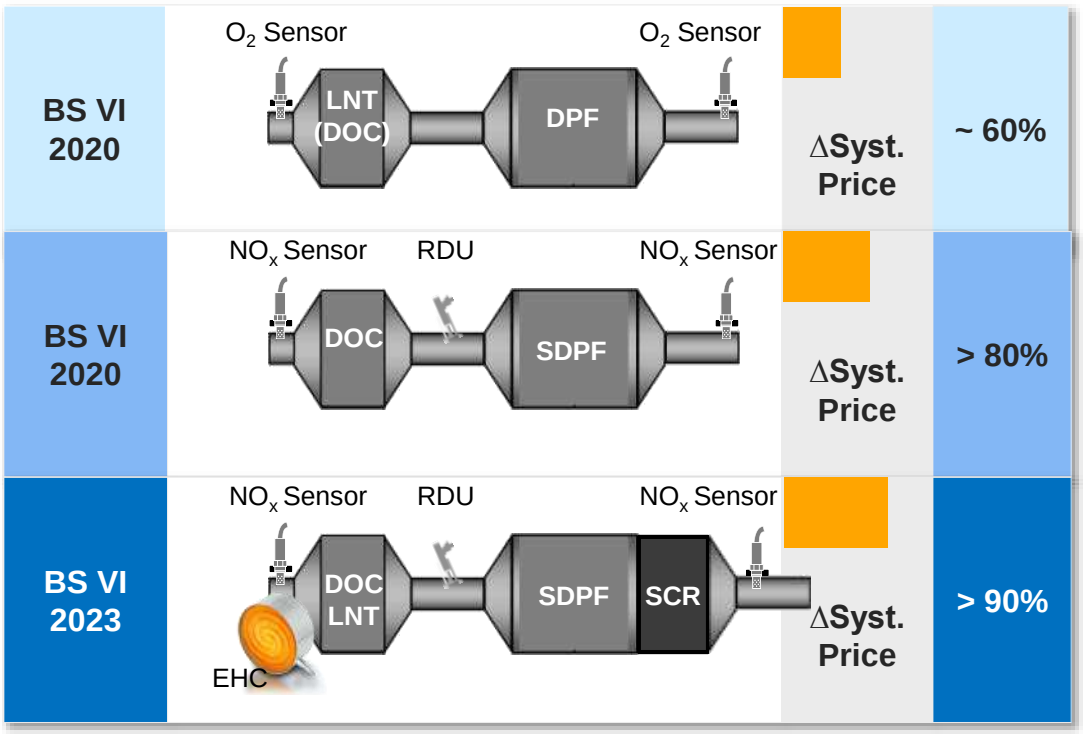
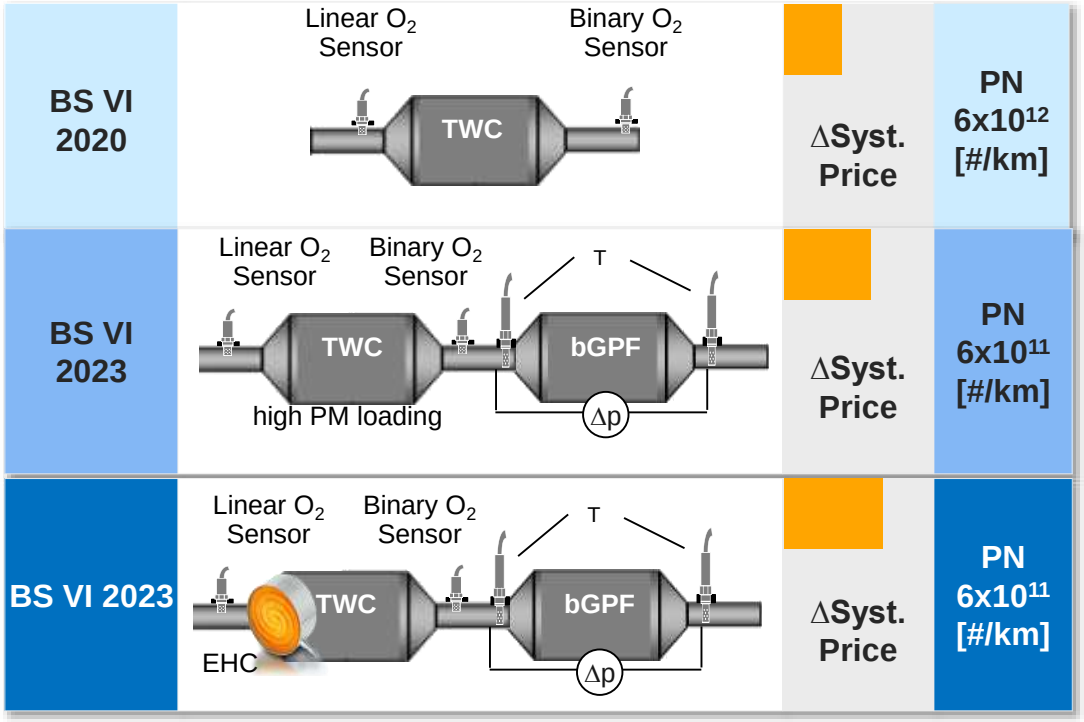
Introduction of RDE
CF= ??



Emission Compliance Strategy
Gasoline Exhaust System Configuration

- GPF appears to be unavoidable for all direct injection applications
- Potential to avoid Secondary Air Injection (SAI) by Electrically Heated Catalyst (EHC)
- EHC for MHEV powertrain to reduce catalyst heating with engine measures and/or reduce PGM

Introduction of RDE
CF= ??



TWC: Three Way Catalyst
bGPF: bare Gasoline Particulate Filter EHC: Electrically Heated Catalyst

Agenda

1 Introduction

2 Light Duty After-Treatment

3 Heavy Duty After-Treatment

4 Summary

Global Strategy for automotive Catalysts with respect to Perfomance and Costs - LDV

Diesel:

1996

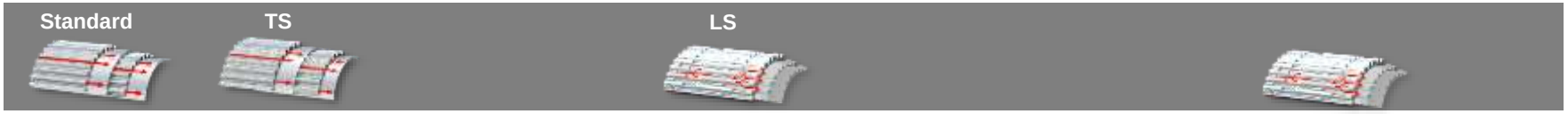
Underfloor catalyst

2006

2012

Stage 1

Stage 2

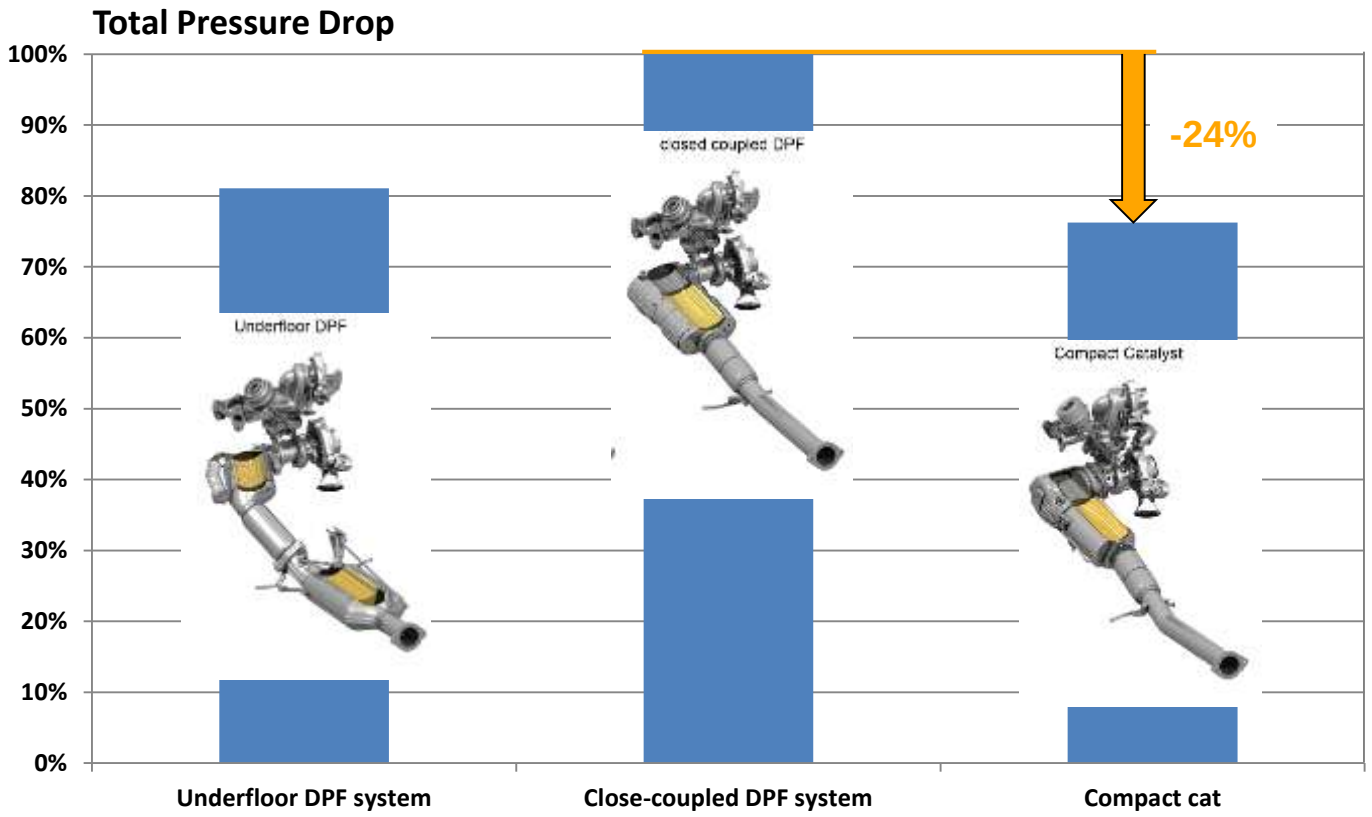


Compact Catalyst for Gasoline and Diesel

Exhaust Gas Management

- **Unique/Common Catalyst System for different Vehicle Platforms with Gasoline and Diesel Engines**
- **Target: Large Catalyst Space in Close Coupled Position to Fullfill Worldwide Emission Standards**

The Compact Catalyst Shows Significant Back-Pressure Benefits



Source: Volvo; Aachener Motorenkolloquium

Compact Catalyst for Gasoline and Diesel

Exhaust Gas Management

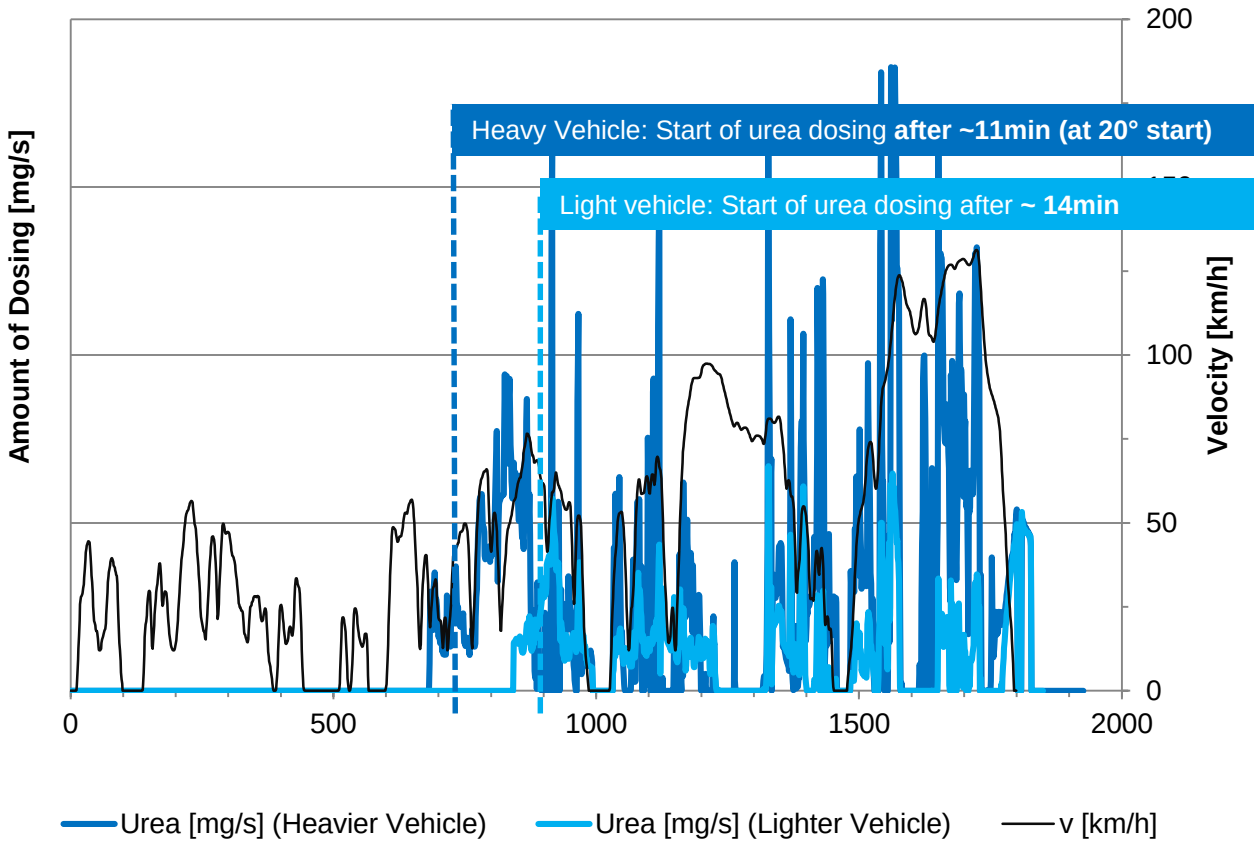
Diesel Euro 6b / LEV / PZEV

- **Unique/Common Catalyst System for different Vehicle Platforms with Gasoline and Diesel Engines**
- **Target: Large Catalyst Space in Close Coupled Position to Fullfill Worldwide Emission Standards**
- **Main Advantages:**
  - Scalability ; Total Cat Volume: 0.5 to 4.5 Liter
  - **Modularity; Same subcomponents for different variants**
  - Flexibility; large variety of markets and emission legislations Benefits

Metal Substrate Design with integrated Air gap insulation and Integrated Sensor

Powertrain Development: Focus Pollutions

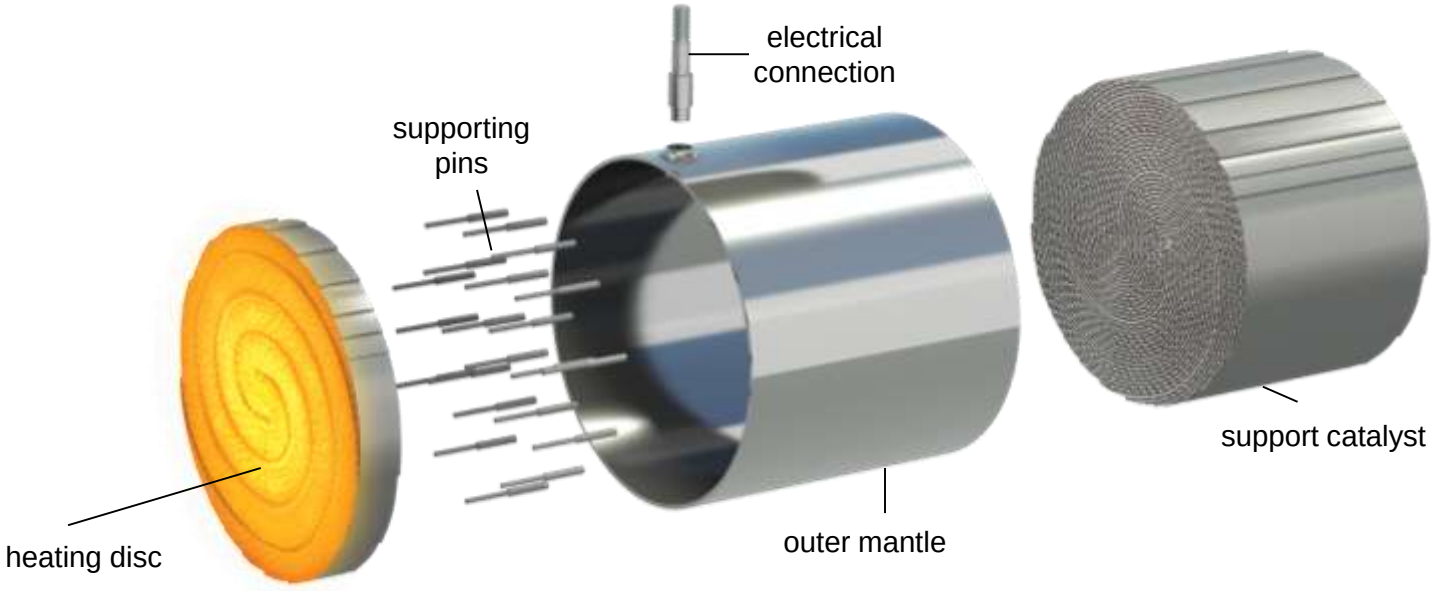
Diesel SCR; WLTC, 20°C Operation, Vehicle Weight Impact



- **SCR** system needs approx. **250°C** to operate at high efficiency (>90%)
- **Lean NO_x Trap (LNT)** is currently the preferred solution for reasonable NO_x conversion rates at cold conditions
- Future solution: **electrically heated catalyst** in particular for extended cold temp. conditions (-7°C)

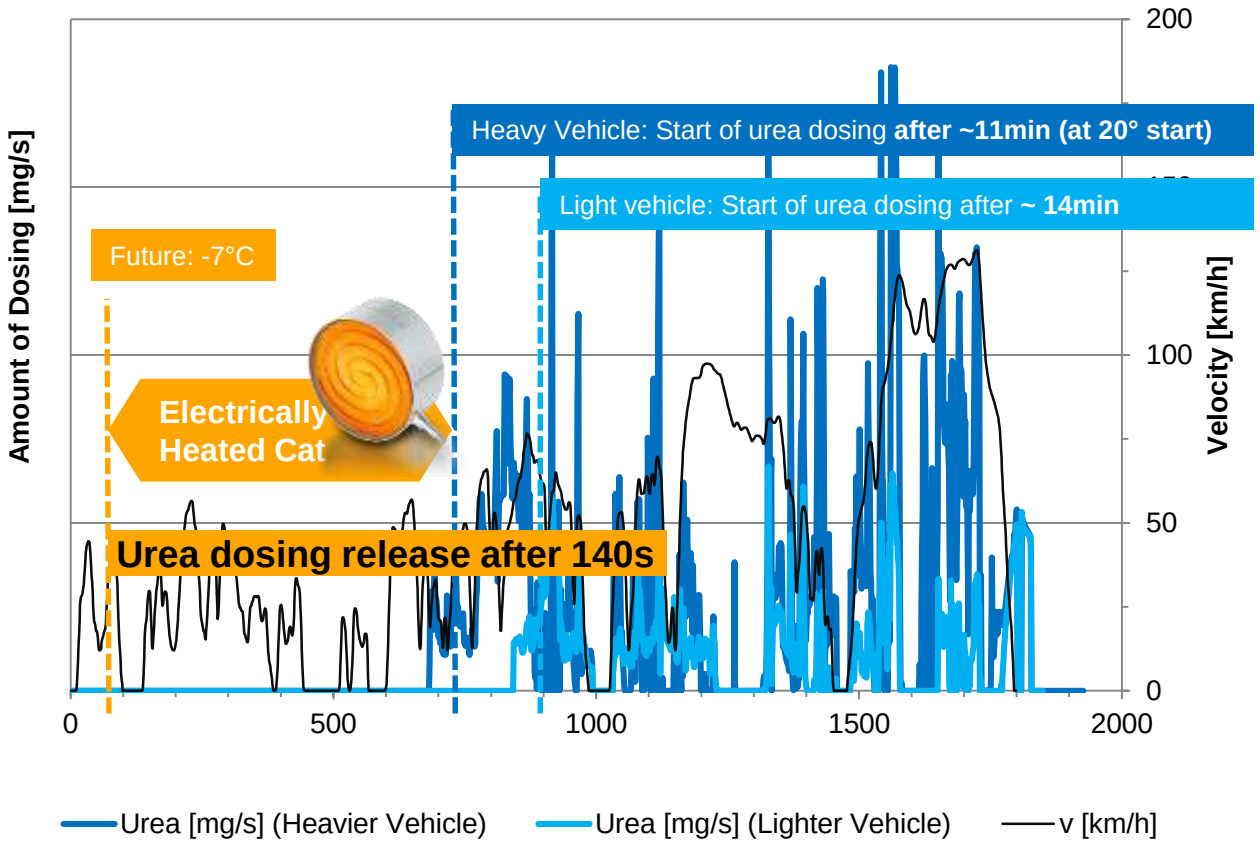
Electrically Heated Catalyst EMICAT®

In Production on several Diesel Vehicles in Europe and US



Powertrain Development: Focus Pollutions

Diesel SCR; WLTC, 20°C Operation, Vehicle Weight Impact



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Overview – Benefits to 12/48 volt Electrically Heated Catalyst

For diesel application:

→Earlier start of AdBlue injection to dramatically reduce tailpipe NOx values during certification cycle and real life driving.

→Fuel savings (CO_2) and time benefit during Diesel Particulate Filter (DPF) regeneration cycles.

→Reduction in Noble Metal loading on DOC and LNT

Overview – Benefits to 12/48 volt Electrically Heated Catalyst

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→Reduction in Noble Metal loading on DOC and LNT

For Gasoline and Hybrid application:

→ Quick warm up of catalyst independent from the engine, minimizing Particulate Number (PN) during the cold start and improving CO_2 emissions

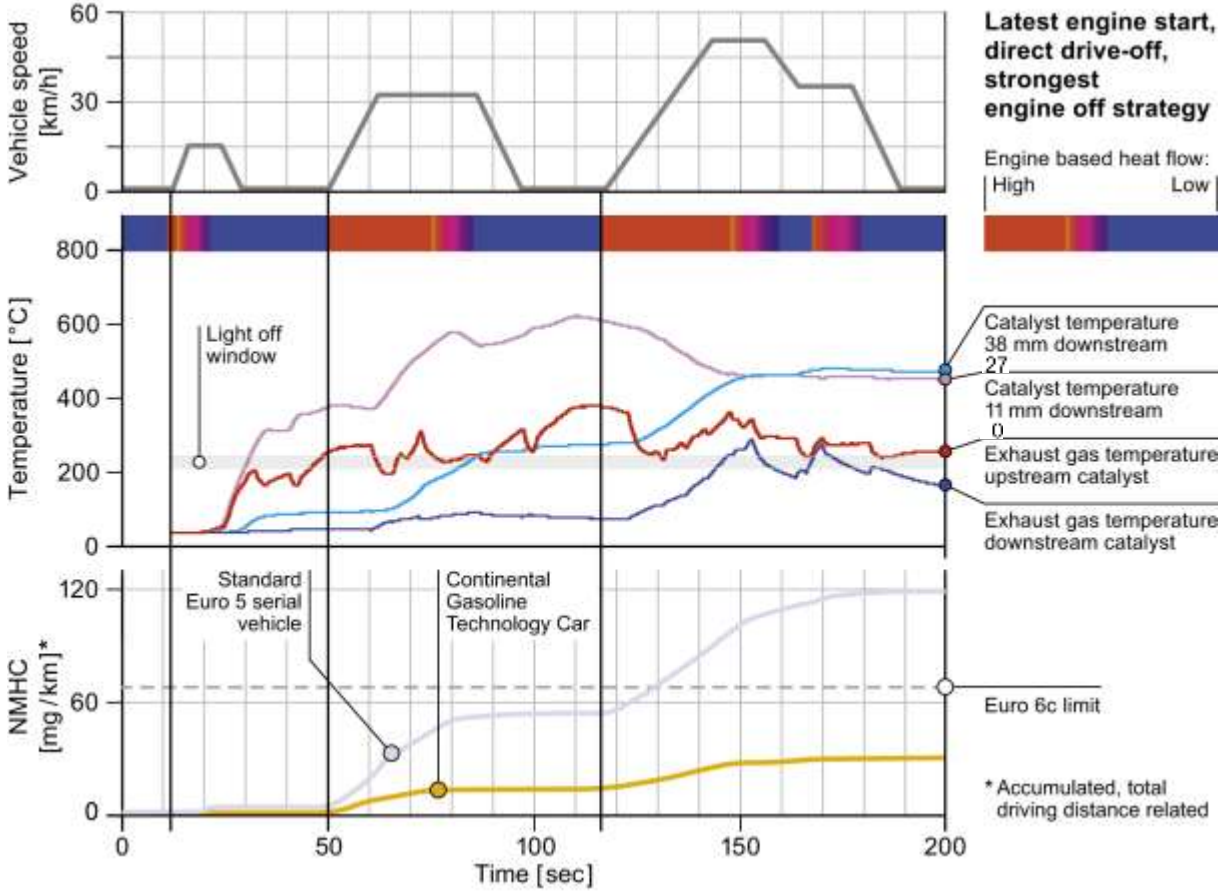
→ Engine independent temperature management of the catalyst system

→ Compensation of catalyst aging and thus reduction in PGM loading

Electrically Heated Catalyst on 48V Hybrid

NMHC Emissions with EHC at NEDC

- With the EHC it is possible to keep the emissions below the Euro 6c limits with the consequent Engine-Off strategy.
- A high possible benefit is offered in short real driving cycles for the car owner
- Average CO_2 reduction in NEDC is more than 4 %



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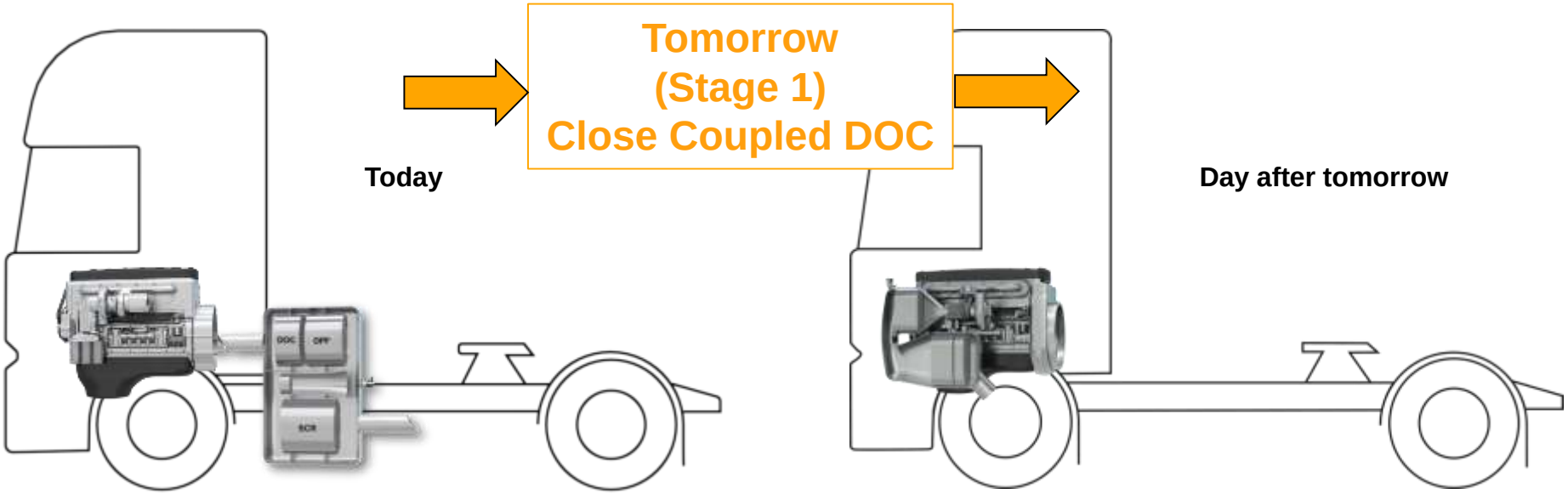
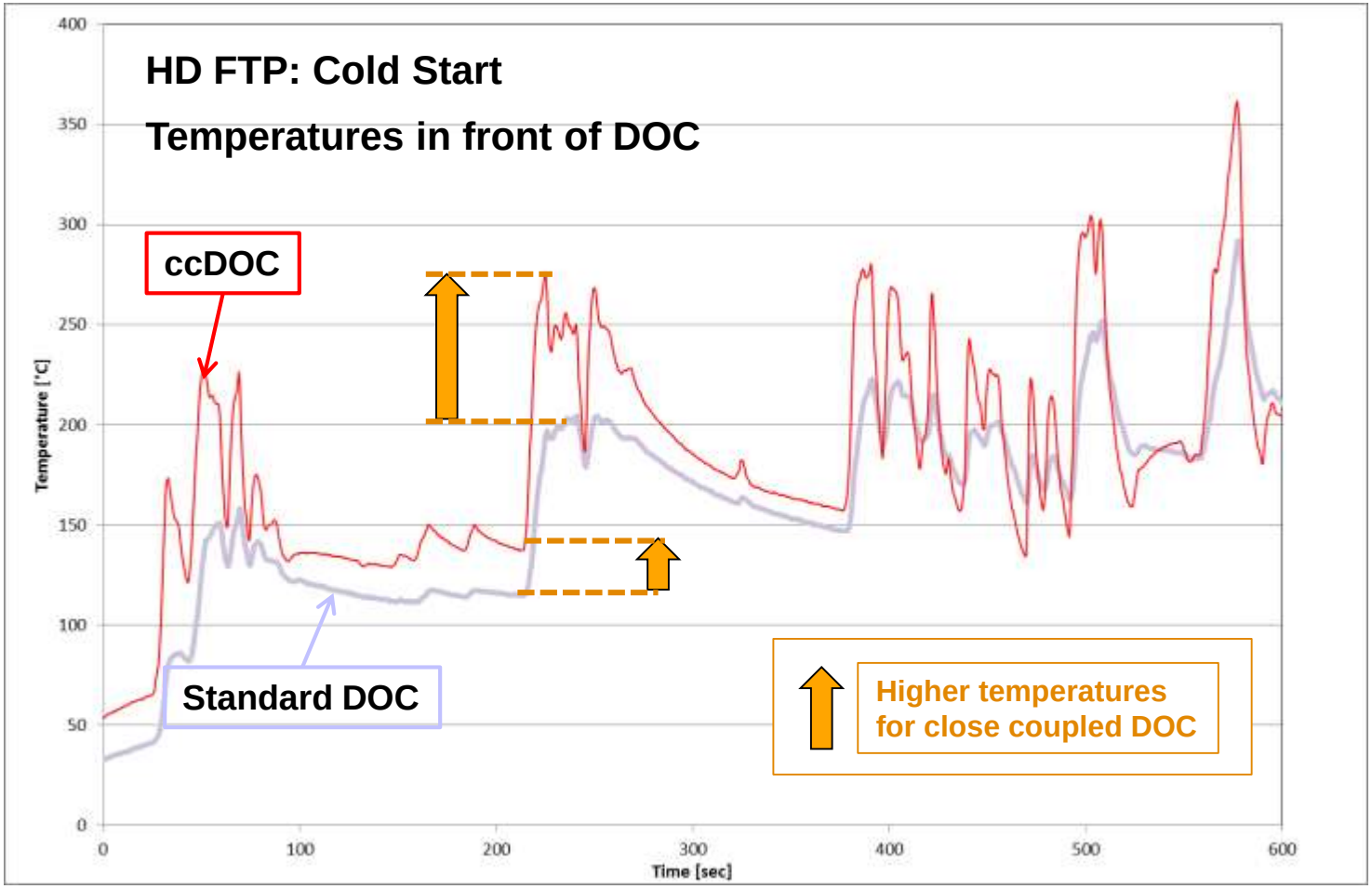
Global Strategy for automotive Catalysts with respect to Perfomance and Costs – HD Onroad



Packaging of a Close Coupled DOC

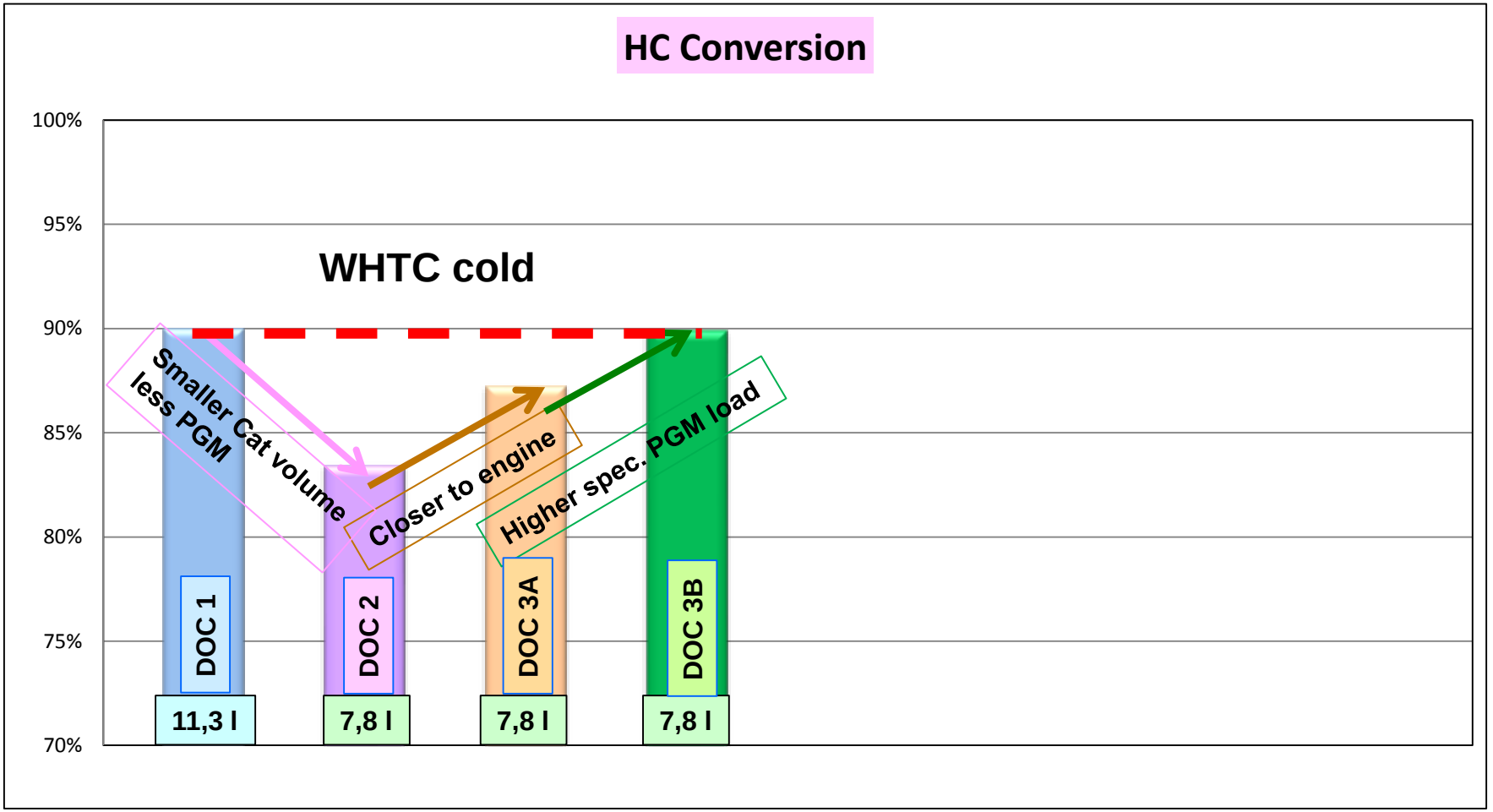
Temperature Advantage for close coupled DOC Second 0 - 600



Details of Tested DOCs

Component	Volume [l]	Location	PGM [%]	Remark
DOC 1 „standard EU-VI“	11,3	„Frame“	100	Reference
DOC 2 „cc-Volume“	7,8	„Frame “	69	Reference position with reduced volume of close coupled system
DOC 3A close coupled (cc)	7,8	close coupled	69	Close coupled position
DOC 3B close coupled (cc)	7,8	close coupled	93	Close coupled with increased PGM load

Conversion Efficiency of Tested DOCs



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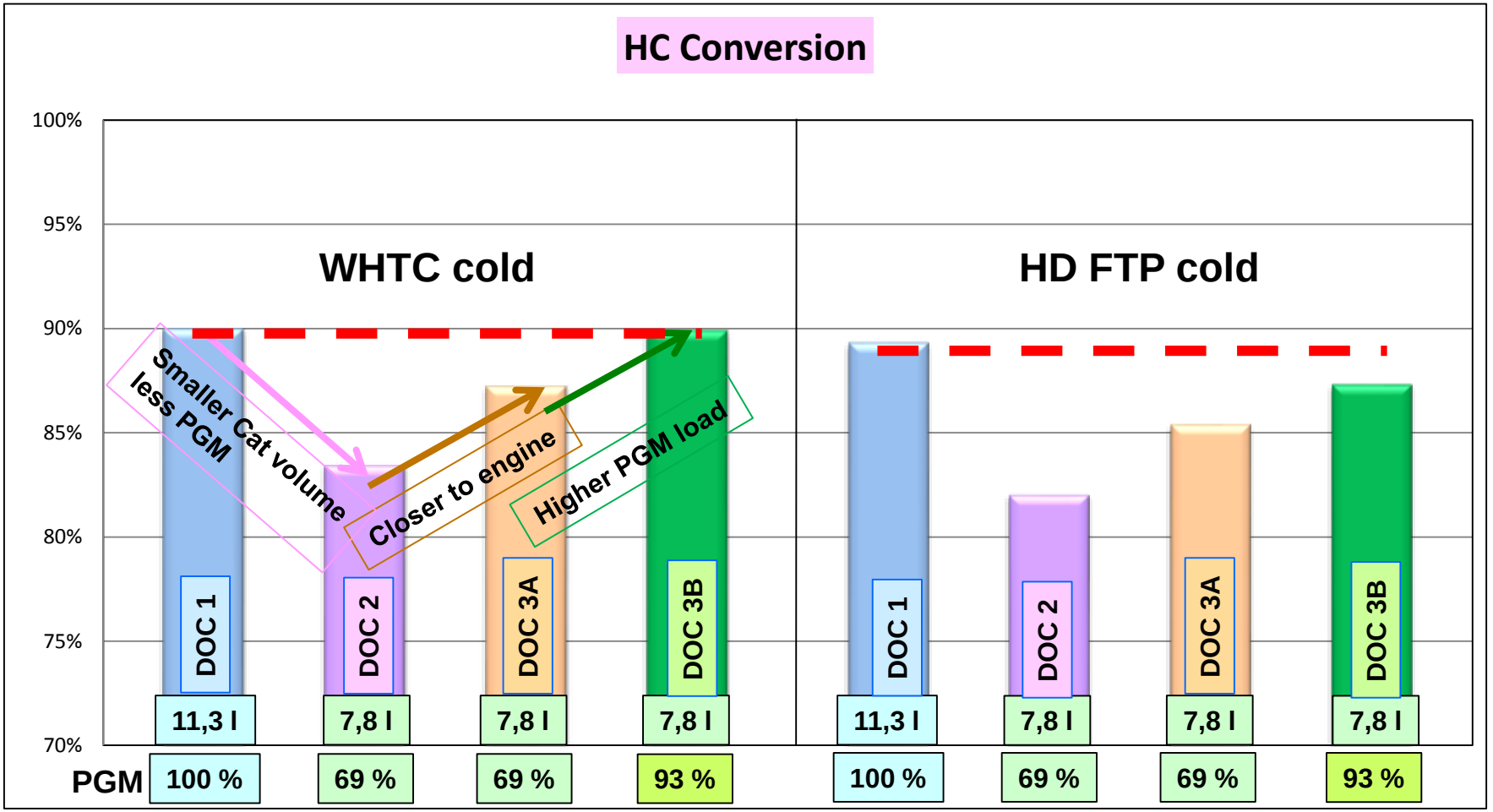
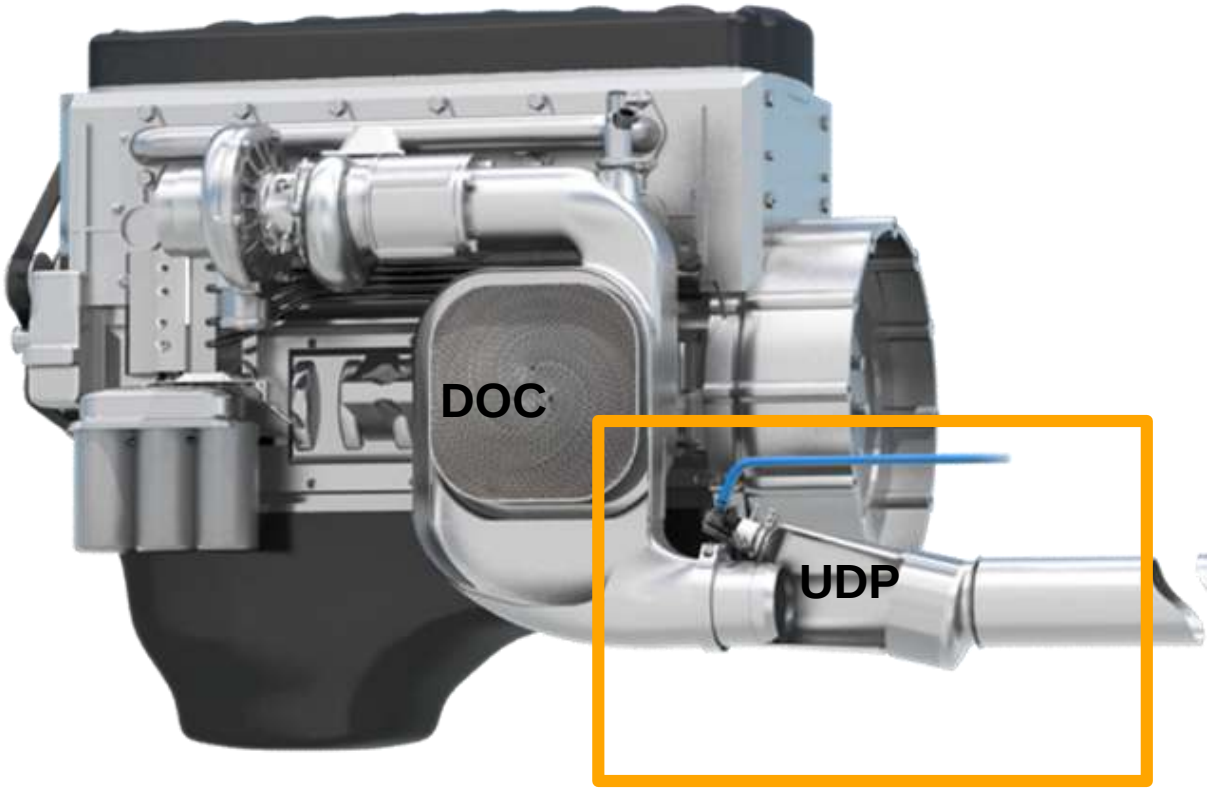


Urea Decomposition Just Behind DOC



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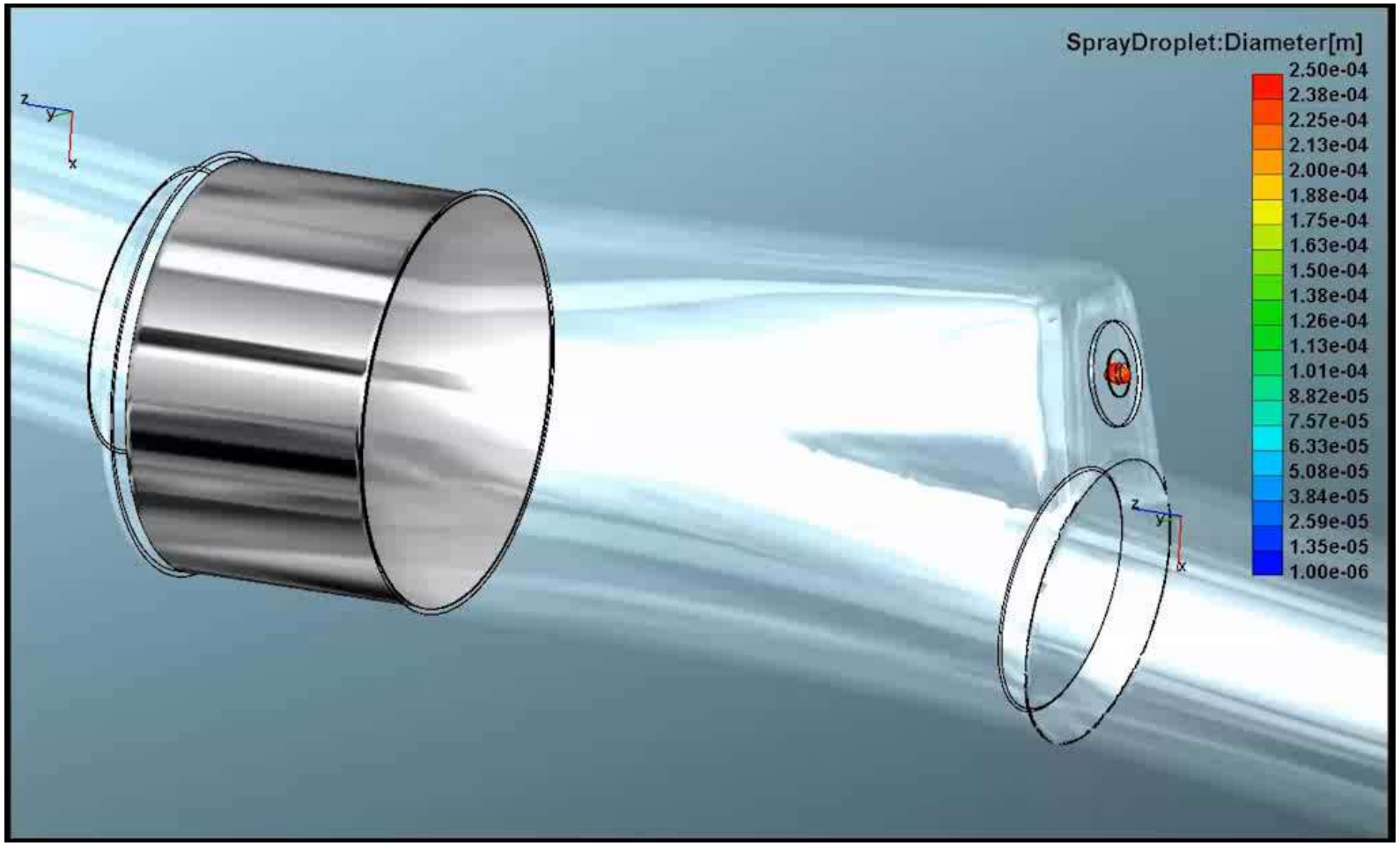
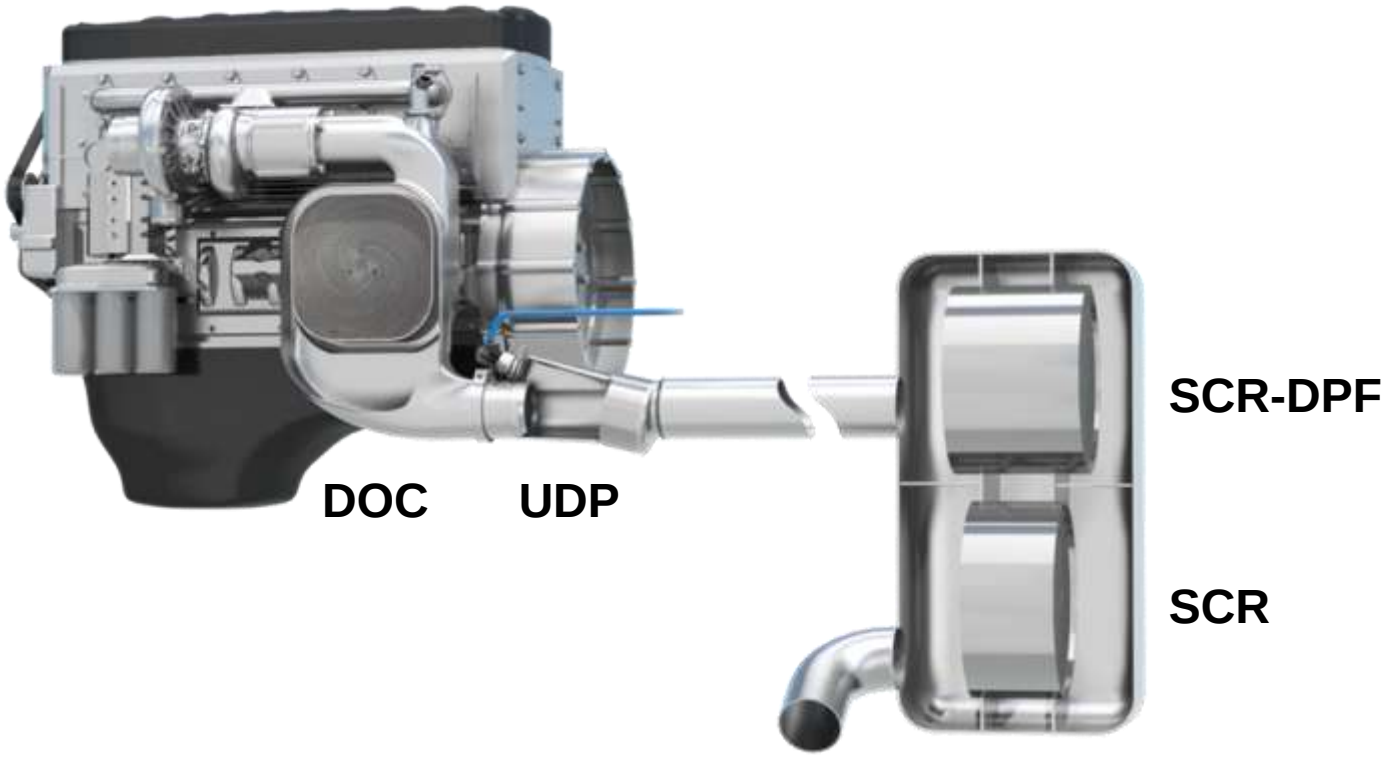


Advanced System: ccDOC, UDP and SCR-DPF



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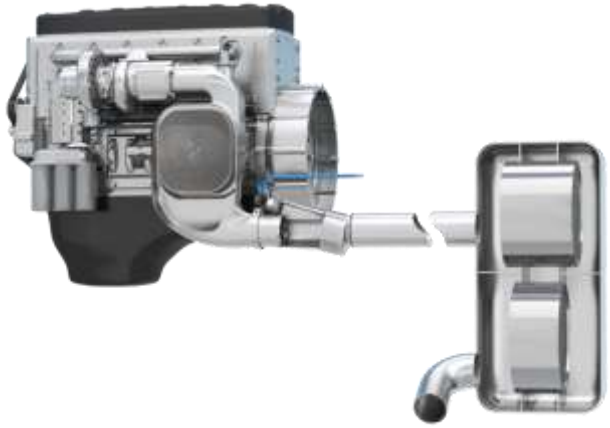
Catalyst Solutions to Achieve BSVI Emission Legislation with Metal Substrates; Passenger Car + Truck

Truck



Pass. Car