

Roadmap to Zero Emission Upgrade Solutions for Clean Air



11th VERT-Forum 25th March 2021



| 22.03.2021

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HJS International Sales Manager

Think about tomorrow.



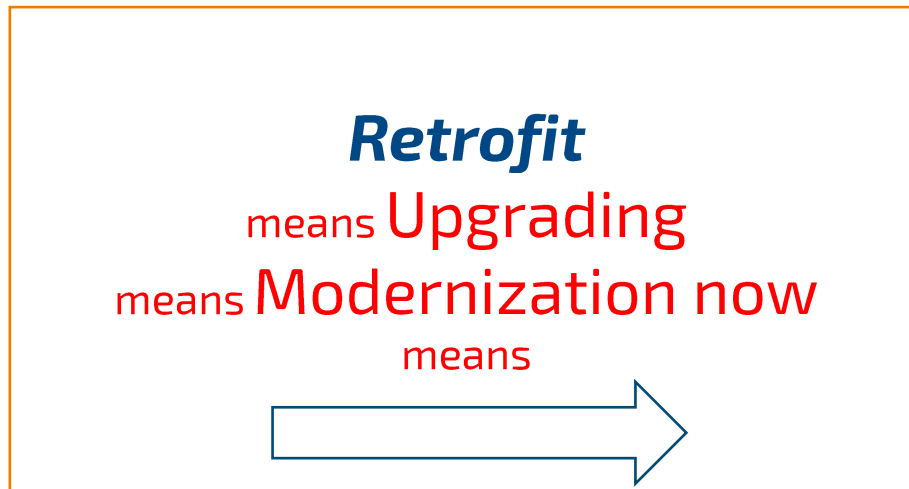
Agenda

- Introduction, Upgrading more up-to date than ever
- About HJS
- Real World Emission Reduction Technologies, Challenge and Efficiency
- Upgrading of On- and Non-Road Equipment to Euro VI or Stage V
- Certification Schemes United Kingdom, Netherlands, Germany
- Best Practice Examples for Upgrading
- Memorandum – Upgrading for Clean Air



Upgrading Technology - More up-to date than ever!

- Air pollution remains to be a major problem globally
- Air quality regulations are ramping up worldwide
- Large long-lived diesel engines have no technical solution
- Emission Control Technology offers effective outcomes



- Installation of state-of-the-art exhaust-gas aftertreatment systems
- Improved functionality and performance to the highest emission standards
- Cost-effective and immediate reduction of hazardous emissions



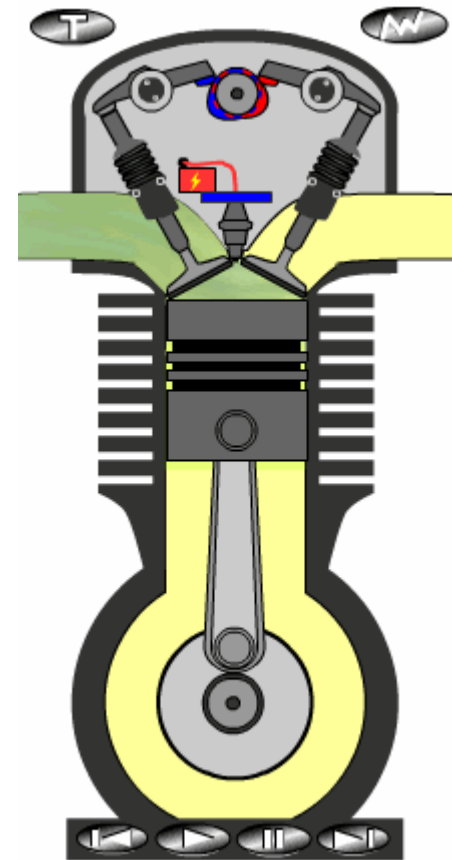
Frank Hiller - Deutz AG

The combustion engine, and especially the diesel engine, which is the most efficient of the combustion engines, is characterized by the fact that it is very powerful and autonomous at the same time.

If you look at applications in the agricultural sector, for example, such as a tractor, it is relatively difficult to imagine it being operated fully electrically today.

Here, too, the combustion engine will remain number one for a long time.

Frank Hiller, CEO, Deutz AG, Cologne, Interview Deutsche Welle
24 February 2020 (Extract)



HJS Company Profile



- Headquarters in Menden, Germany
- Number of employees 500, family business
- Wide range of emission control technologies
- Specialist in diesel exhaust aftertreatment
- High competence in research and development
- Flexible manufacturing structures and capacities



International Partners



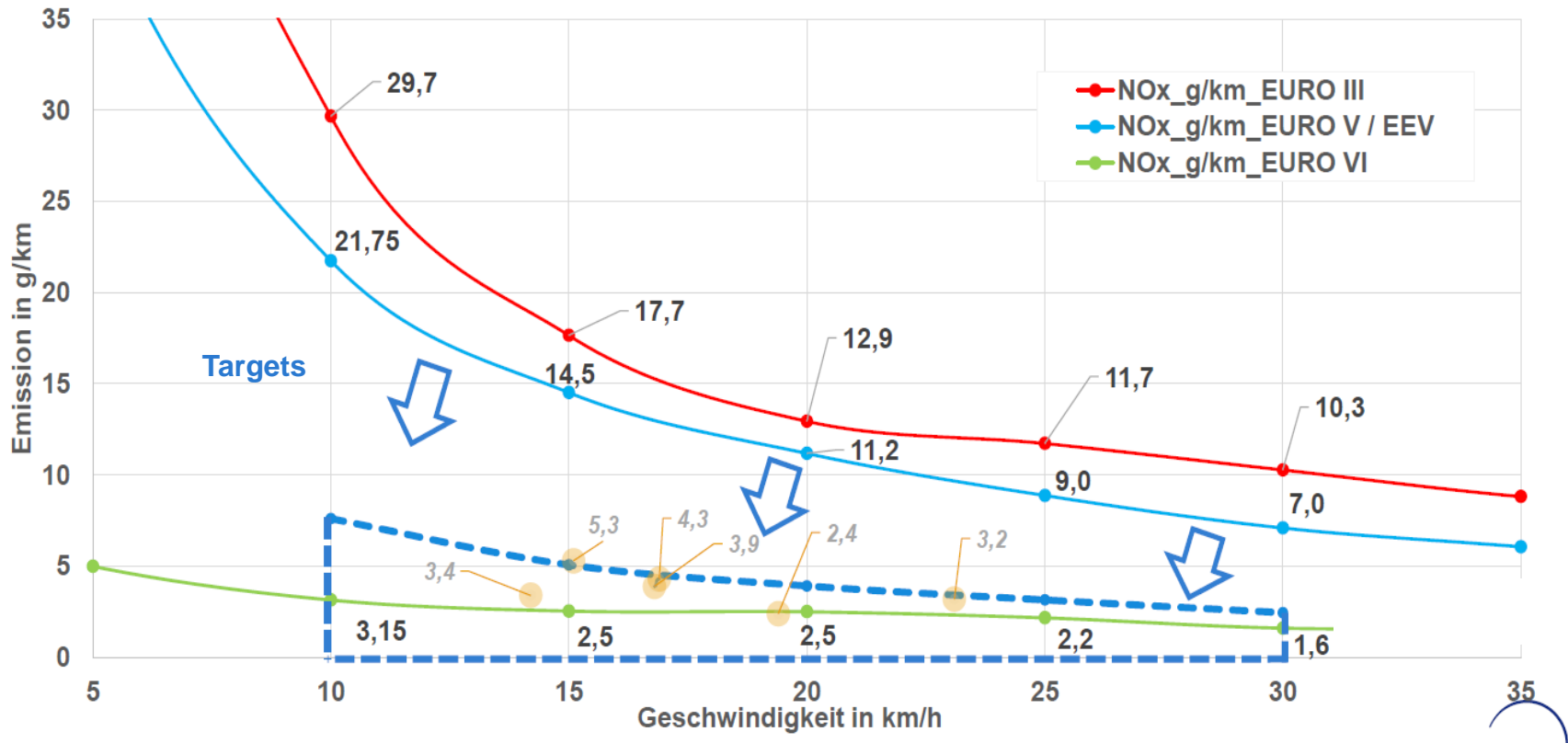
Think about tomorrow.



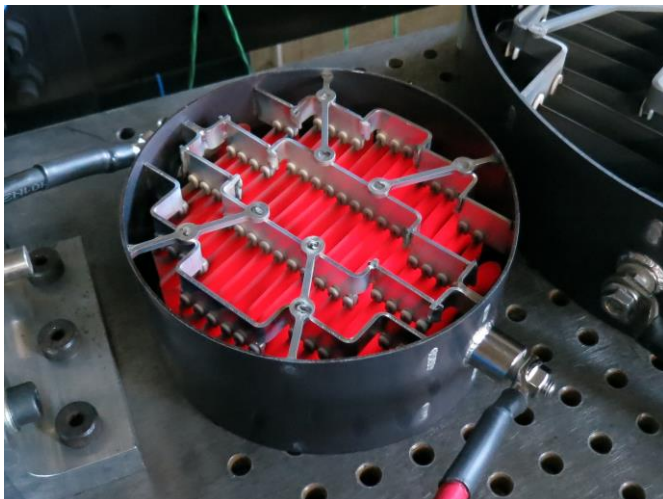
Challenge Real Driving Emission



NOx-Emissionen (Bus; EURO III bis EURO VI)



Active Regeneration and Thermal Management



Electrical Heater

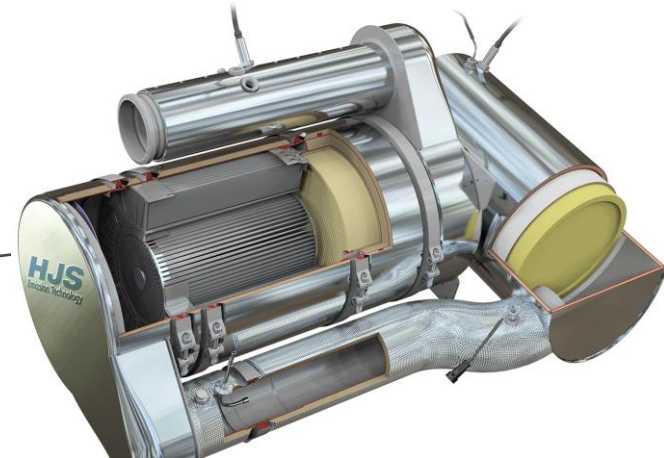
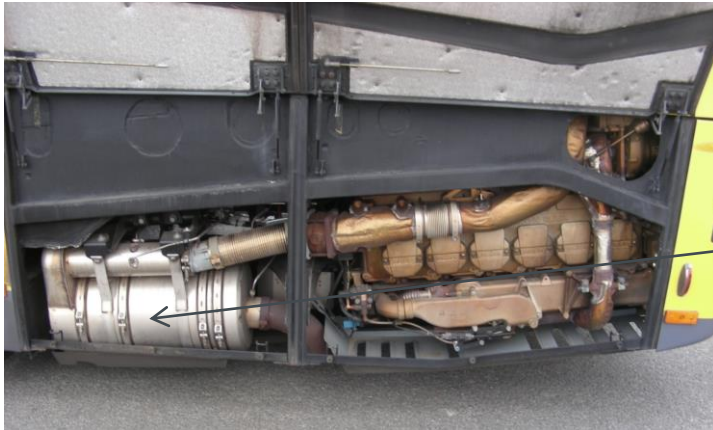
- Up to 50°C Temperature increase in Low Load Cycle
- Avoids temperature drops in stop & go traffic
- Significantly improved NOx conversion

For 7 kW (@48 Volt): Ø 5.66" - 7.5"
For 10 kW (@48 Volt): Ø 7.5" - 9.5"
For 15 kW (@48 Volt): Ø 9.5" - 10.5"
For >20kW (@48 Volt): Ø 13"



SMF[®]-AR-System

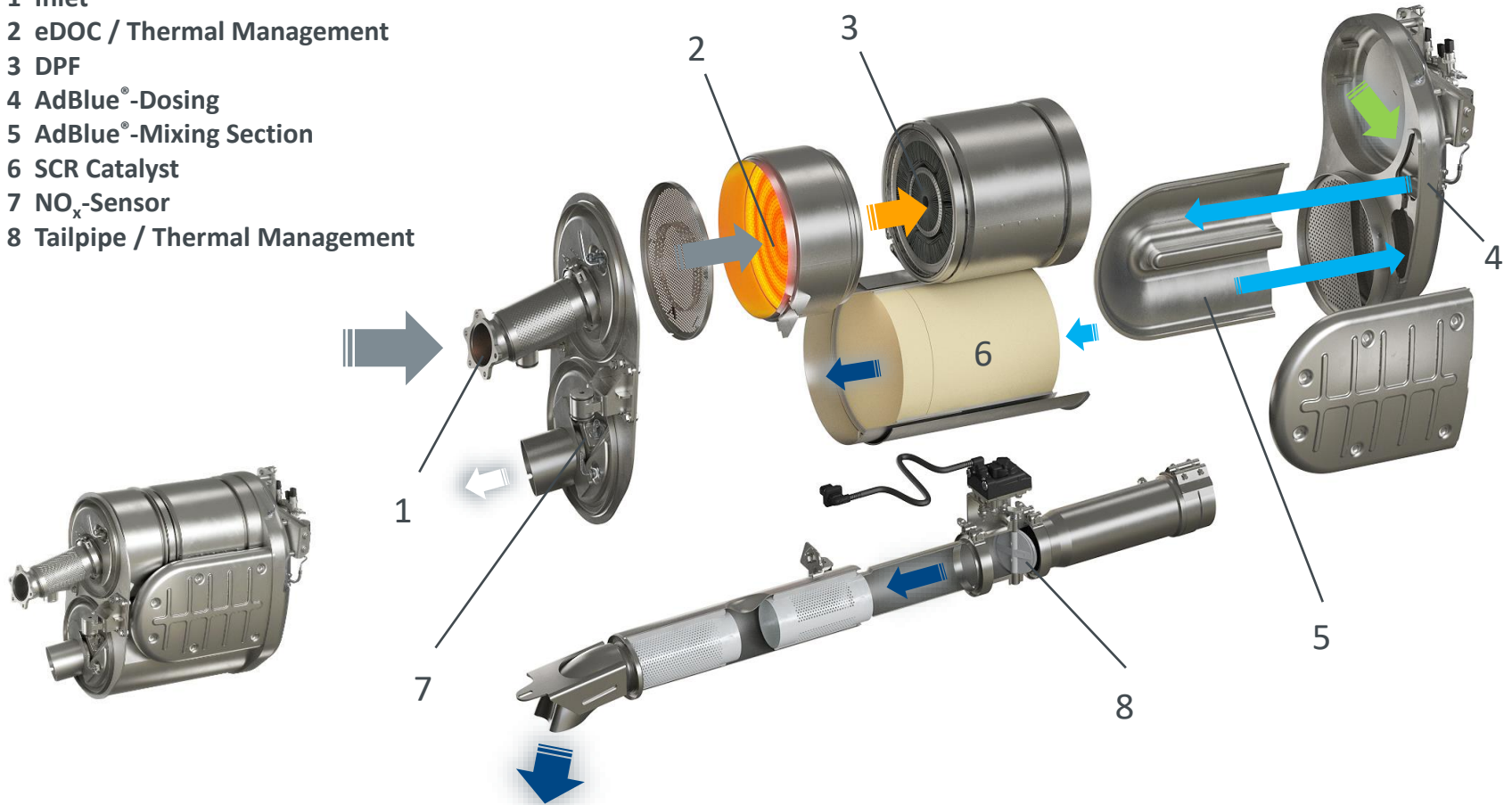
SCRT® Upgrade Technology for City Bus



Compact HJS EURO VI Truck / Bus Solution

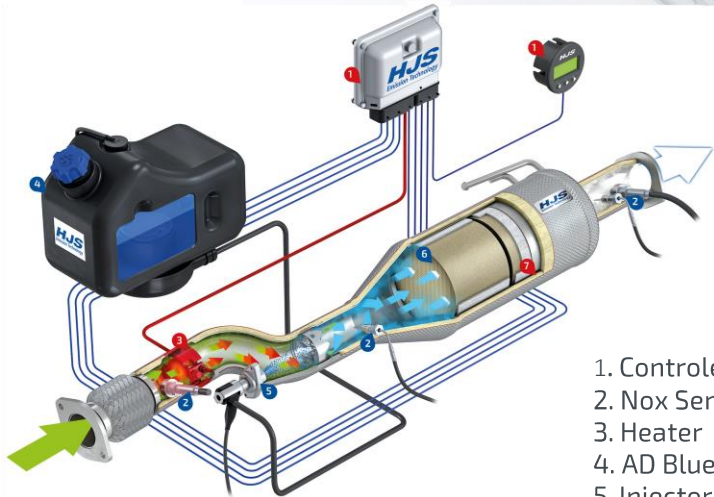
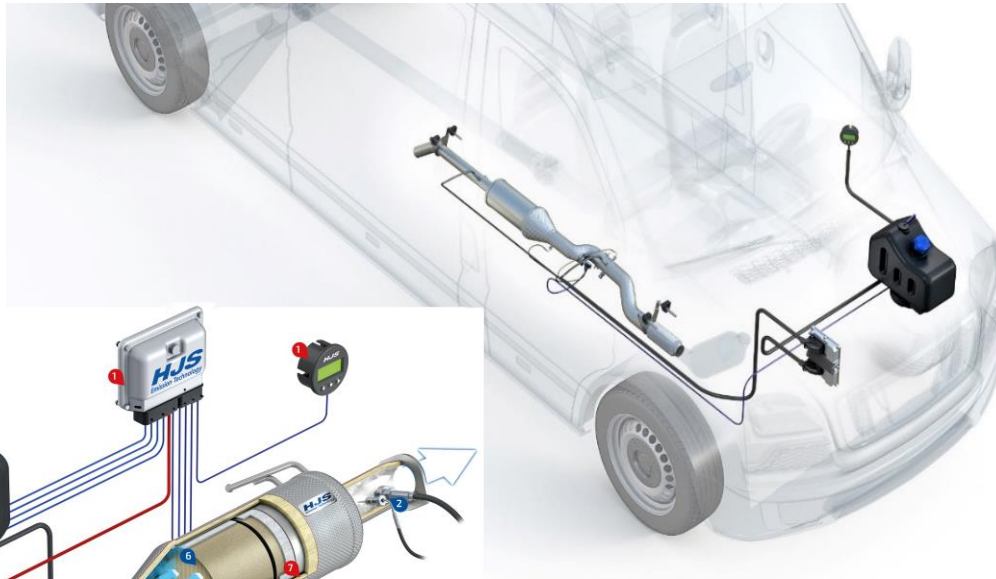
SCRTTM with Active Thermal Management

- 1 Inlet
- 2 eDOC / Thermal Management
- 3 DPF
- 4 AdBlue[®]-Dosing
- 5 AdBlue[®]-Mixing Section
- 6 SCR Catalyst
- 7 NO_x-Sensor
- 8 Tailpipe / Thermal Management



Upgrading Light Commercial Vehicles (LCV)

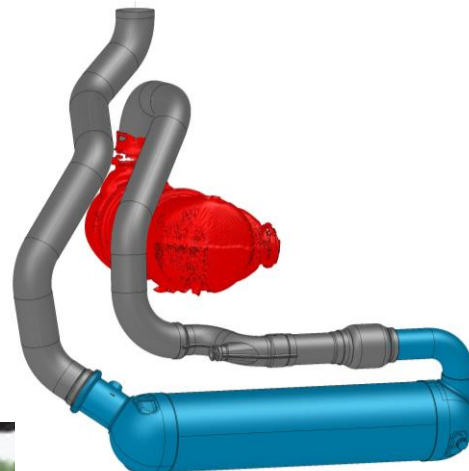
Solutions for Light Commercial Vehicles (LCV)



1. Controller ECU and monitor
2. Nox Sensors
3. Heater
4. AD Blue Tank
5. Injector
6. SCR

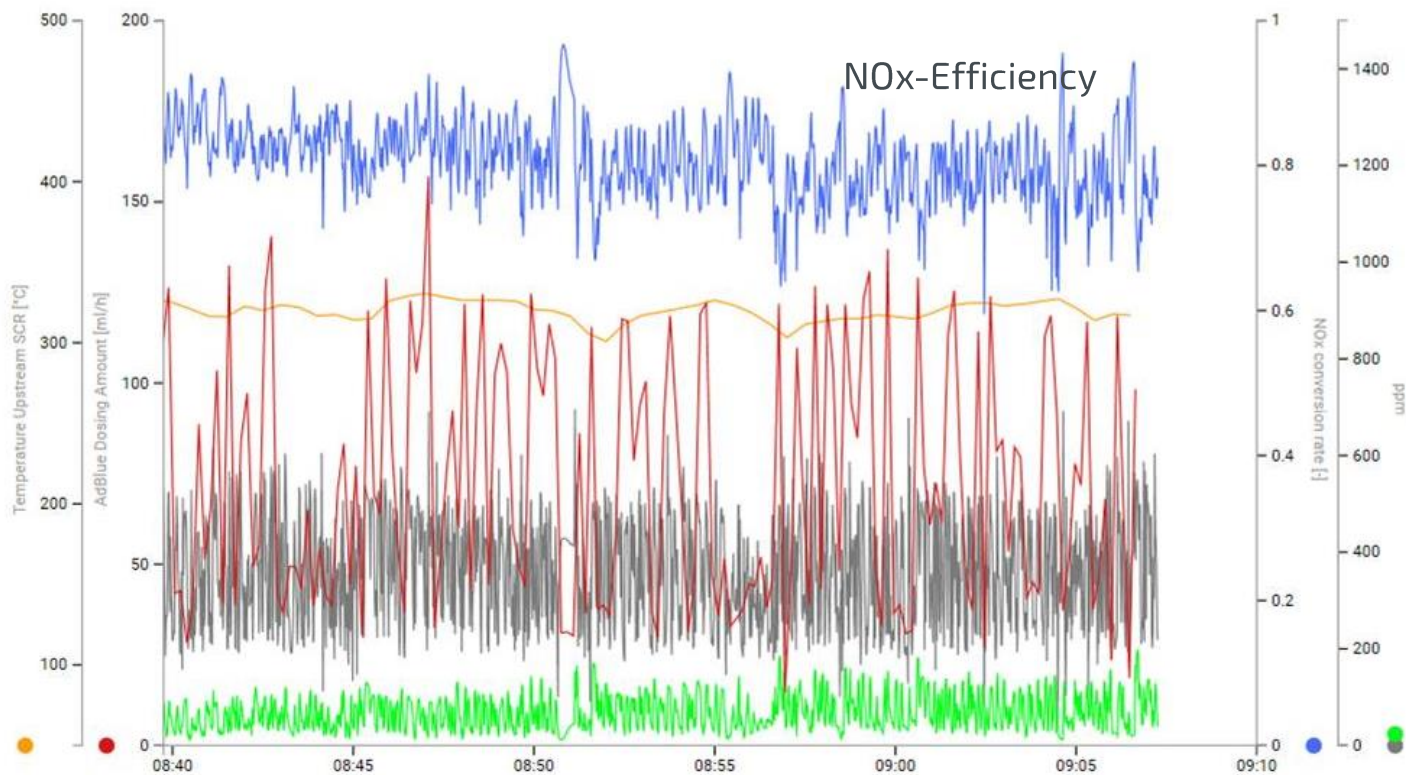


Upgrading of Loader AHLMANN AZ95F - Netherlands



Upgrading of Loader AHLMANN AZ95F – Netherlands

- Engine: Deutz TCD 2.9, 55 kW, Stage V
- SMART-SCR-Airless-System behind original DPF
- NO_x-Reduction about 80% on average



Upgrading of Construction Machinery

Piling Rig BAUER BG40 – UK



Piling Rig Bauer BG40

RDE NOx Reduction 90 %



OEM - Erstausrüstung

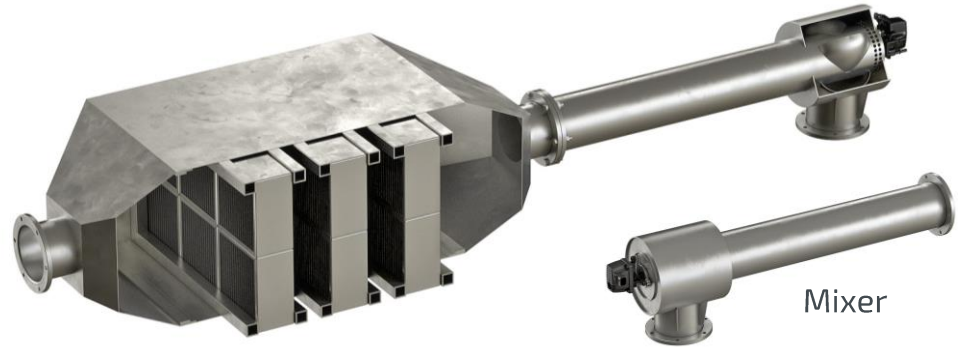
SCRT® for Industrial Applications

Compact design 13" and 15"

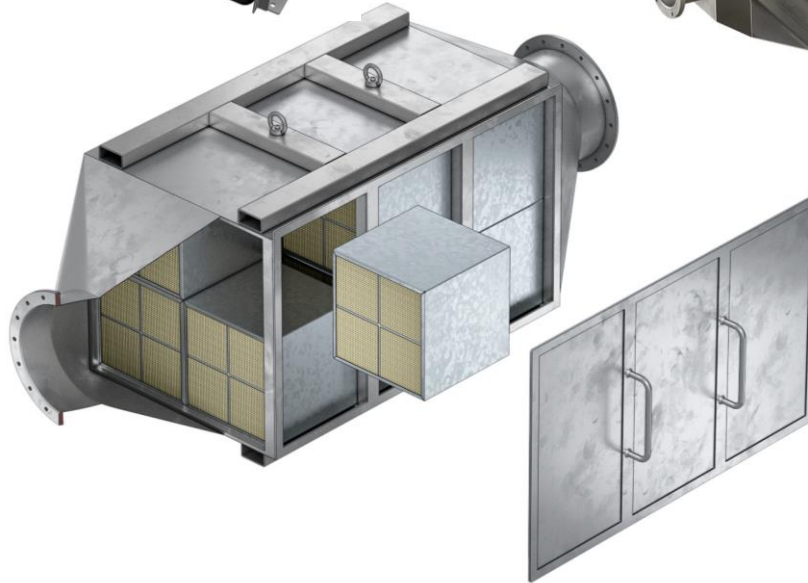
Single and double flow



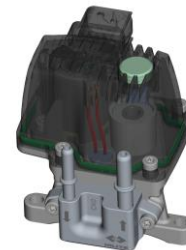
SCRT® for Stationary and Maritime Applications



Mixer



Controller

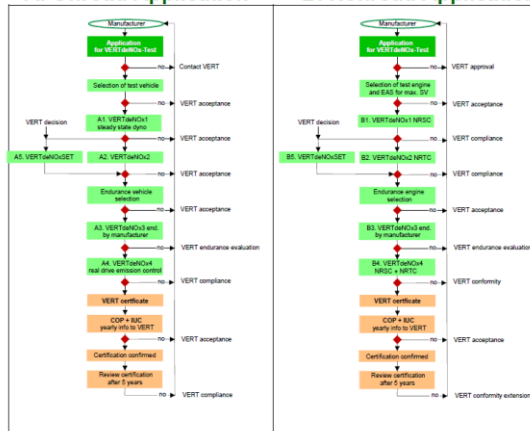


Certification Procedure VERT

VERT - CERTIFICATION of deNOx – EAS

A. Onroad Application

B. Nonroad Application



NRSC and NRTC

International standard for Engine emission test e. g. Stage V

VERT NRMM

1. VERT deNOx1: Definition of Light-Off Temperature
2. VERT deNOx2: Cold (10 %) and warm (90 %) NRTC
3. VERT deNOx3: 200 h endurance run with remote monitoring
4. VERT deNOx4: Repetition VERT deNOx1 und VERT deNOx2
5. VERT deNOx5: Secondary emission test, only if no standard elements as SCR-catalysts used.

Main criteria and limits:

- **PN** > 98% for solid particles 10–500 nm in all operation points, max 200 mb
- **NOx**-conversion during NRTC
 - Class: > 85%
 - Class: 75–85 %
 - Class: 65–75 %
- 50% NOx-conversion = < 230°C after SCR
- NH3 < 20 ppm at all operation points
- NH3 < 20 ppm in average over each NRTC



Certification Procedure Bus Upgrade - Germany

- Step 1 • Installation NO_x System
- Step 2 • 1st PEMS Test (125min +/- 5min)
- Step 3 • 2nd PEMS Test (125min +/- 5min)
- Step 4 • 3rd PEMS Test (125min +/- 5min)
- Step 5 • Evaluation
- Step 6 • Certificate

	Class (km/h)	Area (km/h)	NO _x limit value (g/km)
	10	7,5 – 12,5	7,5
	15	>12,5 – 17,5	5
	20	>17,5 – 22,5	4
	25	>22,5 – 27,5	3
	30	>27,5 – 32,5	2,5



Certification Procedure Millbrook - United Kingdom

CVRAS = Clean Vehicle Retrofit Accreditation Scheme

- Step 1 • Installation NOx Reduction System
- Step 2 • Preliminary dynamometer warm-up cycle
- Step 3 • 1st dynamometer test
- Step 4 • 2nd dynamometer test
- Step 5 • 3rd dynamometer test Emissions limits applying to buses
- Step 6 • Evaluation
- Step 7 • Certification

Exhaust emission parameter		Maximum permitted limit	Reduction performance
Primary emissions			
Mixed oxides of nitrogen	NOx	500mg/km	>80%
Nitrogen dioxide	NO ₂	100mg/km	
Particulate matter (PM)	PM	10mg/km	
Number of particles (PN)	PN	6 x 10 ¹¹ /km	
Secondary emissions			
Nitrous oxide/methane	N ₂ O/CH ₄ (as CO ₂ e)	< 5% of CO ₂	> 80% daily average
Carbon dioxide	CO ₂	< 1% increase	
Ammonia	NH ₃	10ppm average 25ppm peak	
In service			
Mixed oxides of nitrogen	NOx		> 80% daily average



Result Table Transport for London - CVRAS* Euro VI

Vehicle	Engine	Standard	Cycle	Institute	NO _x Original	NO _x Retrofit	NO _x Reduction
Enviro 400H	Cummins 4.5 H	EURO V	MLTB	Millbrook Proving Ground	10.42 g/km	0.38 g/km	96%
Enviro 400	Cummins 6.7	EURO V	MLTB	Millbrook Proving Ground	10.34 g/km	0.08 g/km	99%
Enviro 200	Cummins 4.5	EURO V	MLTB	Millbrook Proving Ground	8.63 g/km	0.27 g/km	97%
Volvo	B5LH	EURO V	MLTB	Millbrook Proving Ground	7.45 g/km	0.35 g/km	95%
Volvo	B9TL	EURO V	MLTB	Millbrook Proving Ground	9.21 g/km	0.20 g/km	98%

* Clean Vehicle Retrofit Accreditation Scheme



Best Practice Exempels, Estimates



▪ Switzerland	50 k	Construction Machines
▪ USA California	400 k	Trucks and Buses
▪ Korea	400 k	Trucks
▪ Japan	180 k	Trucks and Buses
▪ Europe	100 k	Trucks
▪ UK, D, E, DK, E	80 k	Buses
▪ Germany, DK; BLX	2500 k	Pass Cars
▪ Israel	15 k	Buses
▪ Mexico, Chile, Brazil	10 K	Buses
▪ China	120 K	Pass Cars

- Less than 1 % upgraded, so high potentials



Telematic Remote Monitoring




Memorandum Upgrading for Clean Air

- The **Memorandum Upgrading for Clean Air** summarizes essential opportunities for reducing pollutant emissions from urban transport vehicles and mobile machinery.
- It also highlights policy measures that may be required to make progress on the **Roadmap to Zero Emission**.


Copy available
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Memorandum
November 2019



Upgrading for Clean Air

Comprehensive Diesel Emission Aftertreatment Solutions



Reduction of Diesel Emissions

Medium-Duty and Heavy-Duty Engines

HJS Emission Technology GmbH & Co. KG
Dieselweg 12, Menden/Sauerland, Germany
www.hjs.com



Upgrading Benefits - Summary



- ✓ Immediate reduction of pollutant emissions at source
- ✓ Field tested, advanced, available, affordable, time saving
- ✓ Cost-effective **alternative to buying a new vehicle**
- ✓ Role model in health and environmental protection
- ✓ In keeping with the time – and more up to date than ever !



Thank you for your attention



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