SCALABLE OPTIMISED AFTERTREATMENT SYSTEMS FOR TREM V

ROLF BRÜCK, PARESH LADDHA

ECT 2023; New Delhi, 2/3.11.2023

AGENDA

- **NEW EMITEC TECHNOLOGIES GMBH**
- EMISSION LEGISLATION NRMM
- ADVANCED METAL SUBSTRATE TECHNOLOGY
- TRACTOR APPLICATION – CHALLENGE AND EXHAUST SYSTEM LAYOUT
- EMITEC SOLUTIONS FOR TREM V
- CONCLUSION

START OF „EMITEC TECHNOLOGIES GmbH“

Change of Ownership

yesterday

vitesco TECHNOLOGIES

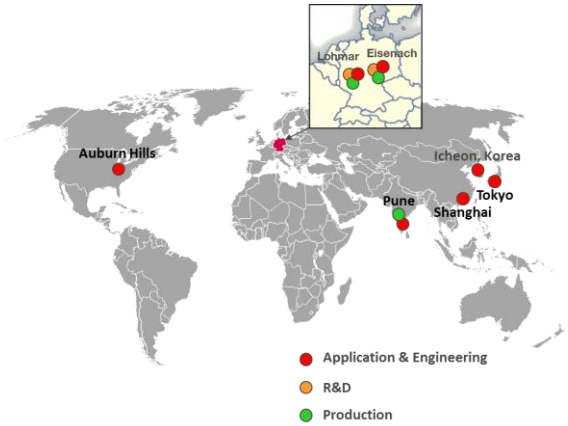
100%

EMITEC

Lohmar, 1986 – HQ - CTF

Eisenach, 2001 - CTF

Pune, 2006 - CTF



START OF „EMITEC TECHNOLOGIES GmbH“

Change of Ownership

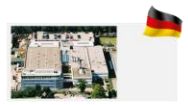
Today!!! (as of 1st of August)

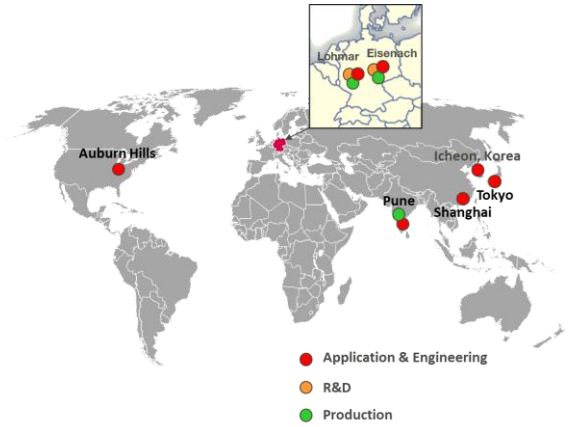
Lenbach Equity Opportunities II GmbH & Co. KG

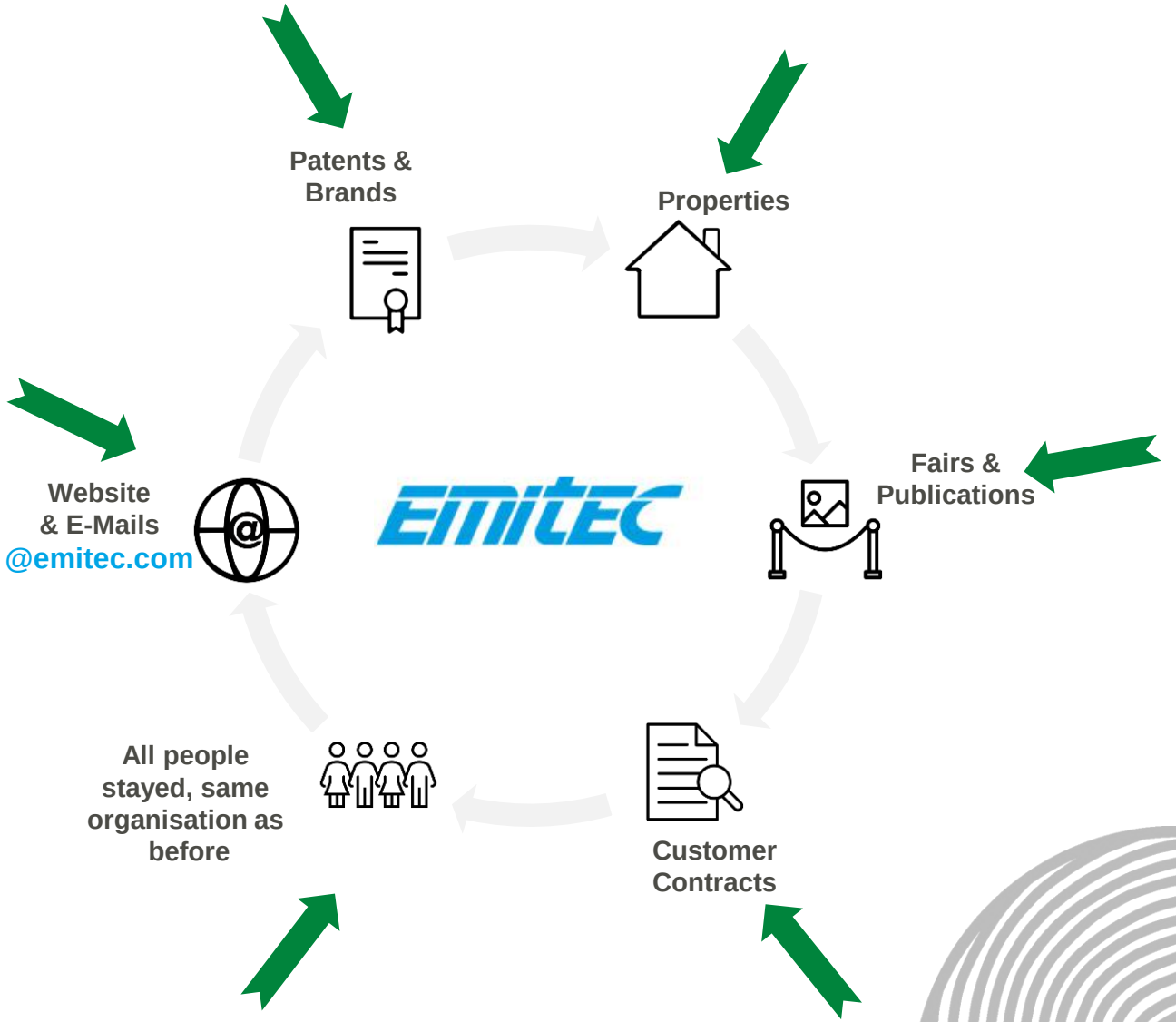
DUBAG GROUP

100%

EMITEC







EMITEC TECHNOLOGIES GMBH

SAME NAME NEW MEANING

EMITEC

Emission **Tec**hnologies

Mission: trusted partner of choice **for solutions across** and beyond **emission technologies**

EMITEC TECHNOLOGIES GMBH

SAME NAME NEW MEANING

EMITEC

Emission **Tec**hnologies

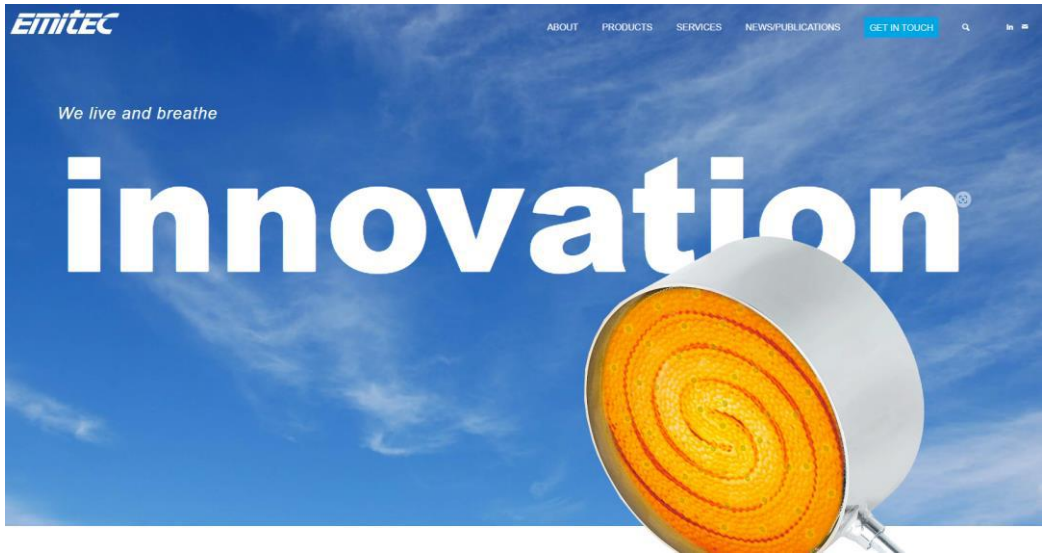
EMITEC **Technologies**

Products **beyond** Automotive Emission Technologies

Mission: trusted partner of choice **for solutions** across and **beyond emission technologies**

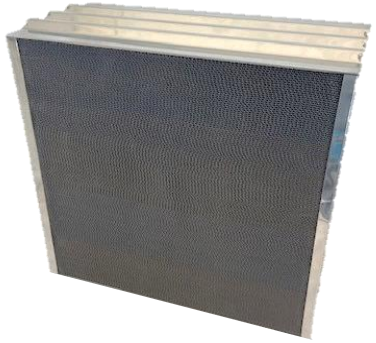
EMITEC BEYOND AUTOMOTIVE EMISSION TECHNOLOGY

ACTUAL EXAMPLES



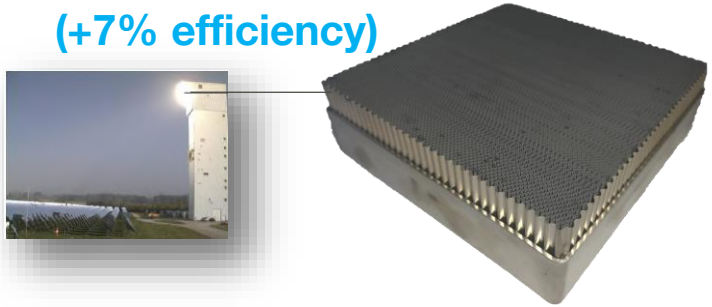
https://emitec.com/
Emitec.com – we live and breathe innovation

Stationary, Industrial Catalyst



Wooden Fire Filter Catalyst

Solar Receiver (+7% efficiency)



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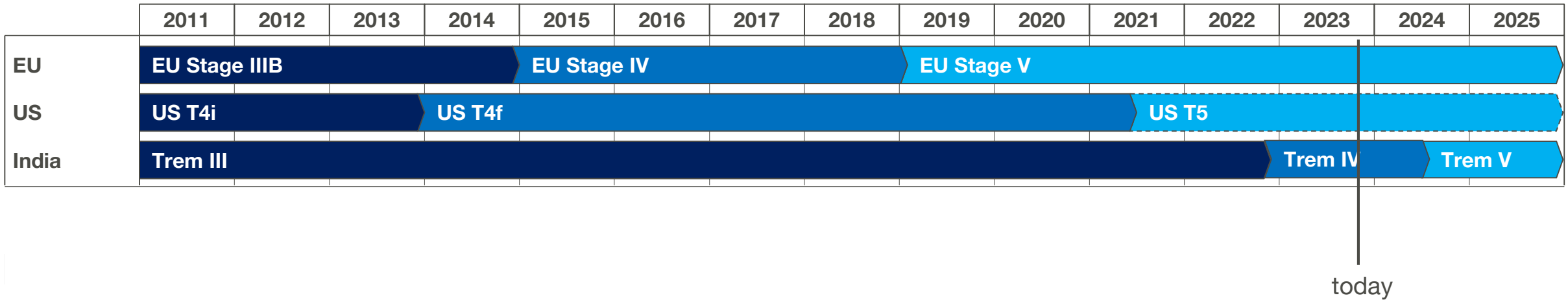
NRMM EMISSION LEGISLATION

OVERVIEW TIMING



NRMM EMISSION LEGISLATION

OVERVIEW EMISSION LIMITS

Europe Stage V emission standards

Power kW	Date	CO g/kWh	HC g/kWh	NOx g/kWh	PM g/kWh	PN 1/kWh
P < 8	2019	8.00	7.50[a,c]		0.40[b]	-
8 ≤ P < 19	2019	6.60	7.50[a,c]		0.40	-
19 ≤ P < 37	2019	5.00	4.70[a,c]		0.015	1×10^{12}
37 ≤ P < 56	2019	5.00	4.70[a,c]		0.015	1×10^{12}
56 ≤ P < 130	2020	5.00	0.19[c]	0.40	0.015	1×10^{12}
130 ≤ P ≤ 560	2019	3.50	0.19[c]	0.40	0.015	1×10^{12}
P > 560	2019	3.50	0.19[d]	3.50	0.045	-

[a] HC+NOx
[b] 0.60 for hand-startable, air-cooled direct injection engines
[c] A = 1.10 for gas engines
[d] A = 6.00 for gas engines

India Trem and CEV Stage IV - V emission standards

Power kW	Date	CO g/kWh	HC g/kWh	NOx g/kWh	PM g/kWh	PN 1/kWh
Trem Stage IV and CEV Stage IV						
37 ≤ P < 56	CEV: 2021.04 Trem: 2022.10	5.0	4.7*		0.025	-
56 ≤ P < 130		5.0	0.19	0.4	0.025	-
130 ≤ P < 560		3.5	0.19	0.4	0.025	-
Trem Stage V and CEV Stage V						
P < 8	2024.04	8.0	7.5*		0.4	-
8 ≤ P < 19		6.6	7.5*		0.4	-
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P ≥ 560		3.5	0.19	3.5	0.045	-

* NOx + HC

- Trem: the agricultural machinery standard
- CEV: the construction equipment vehicles standard

NRMM EMISSION LEGISLATION

OVERVIEW EMISSION LIMITS

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* NOx + HC

- Trem: the agricultural machinery standard
- CEV: the construction equipment vehicles standard

Focus on 37 kW < P < 56 kW engines

NRMM EMISSION LEGISLATION

OVERVIEW EMISSION LIMITS

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› Trem: the agricultural machinery standard
› CEV: the construction equipment vehicles standard

37 kW < P < 56 kW			
	CO [g/kWh]	HC [g/kWh] + NOx [g/kWh]	PN [1/kWh]
India TREM V	5	4,7	$1x10^{12}$
EU Stage V	5	4.7	$1x10^{12}$

In this engine class
a DOC + DPF System is needed to fullill the worldwide limits

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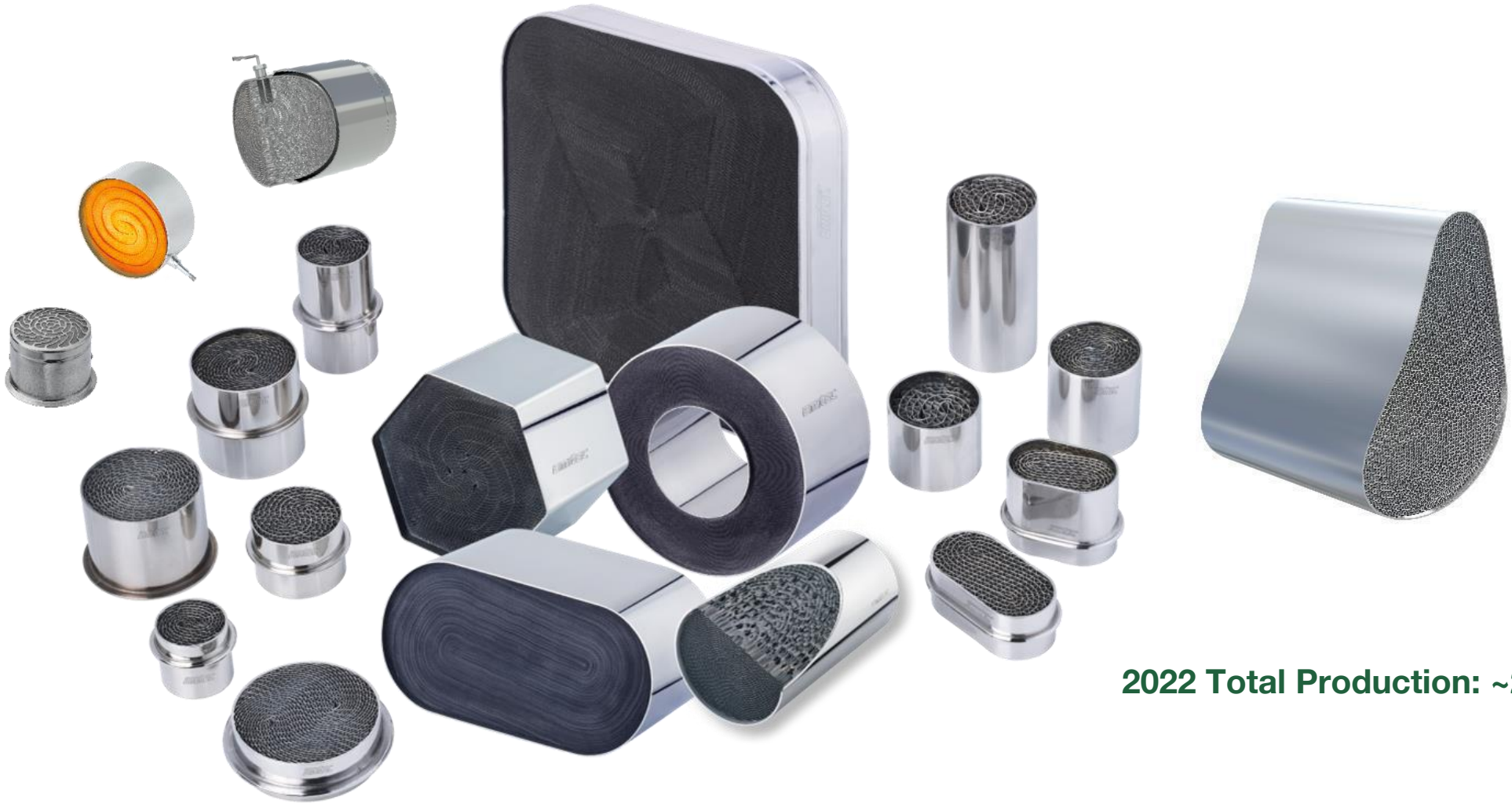
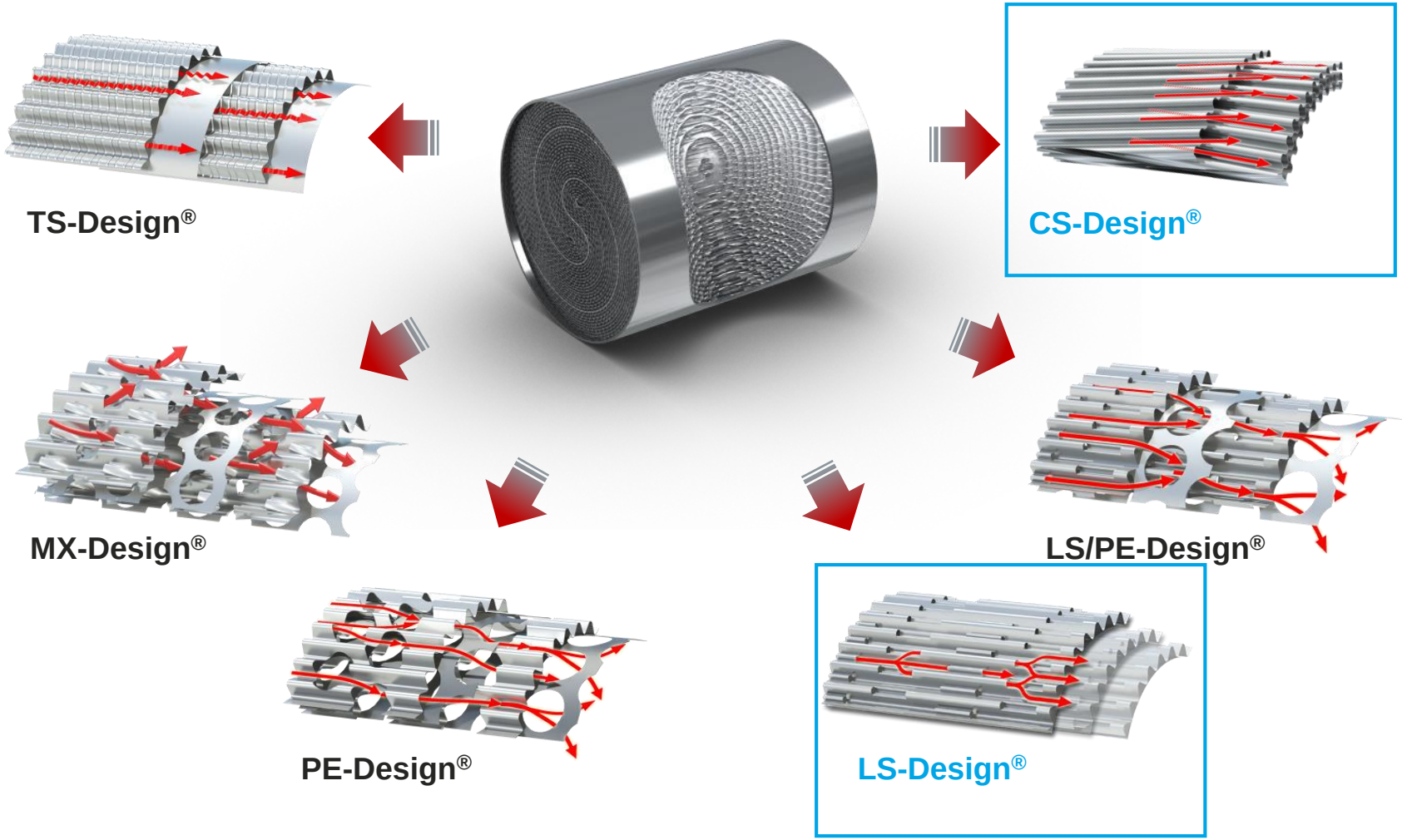
METAL SUBSTRATES PRODUCTION-PORTFOLIO

SHAPES, SIZES AND PACKAGING – FROM CHAINSAW TO LOCOMOTIVE



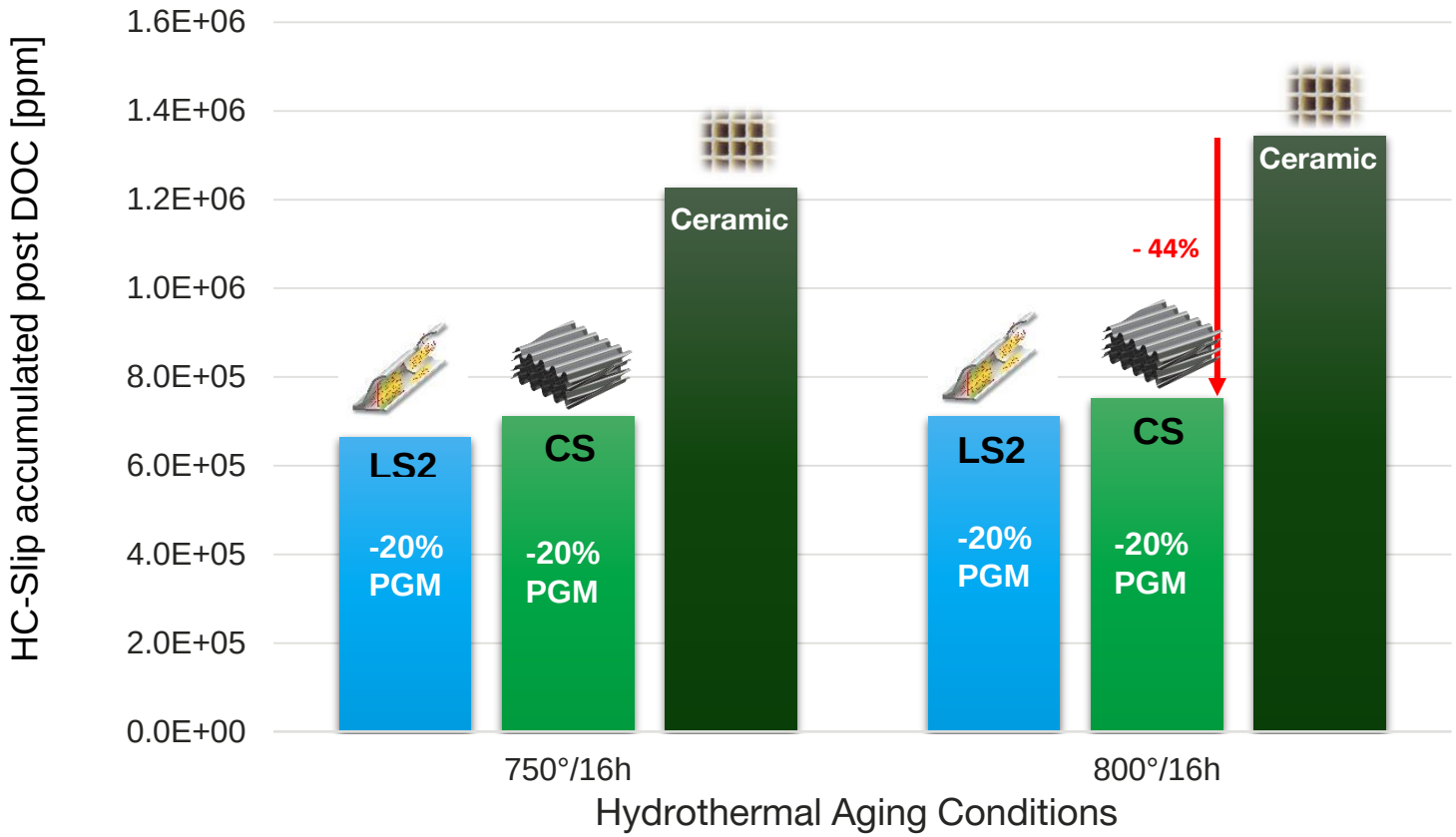
2022 Total Production: ~26 million pcs

METALIT®: TURBULENCE GENERATING STRUCTURES



HC-SLIP DURING ACTIVE REGENERATION

OPEN CELL STRUCTURE COMPARED TO STRAIGHT CHANNEL SUBSTRATES



Lower HC-Slip gives advantage against White Smoke risk

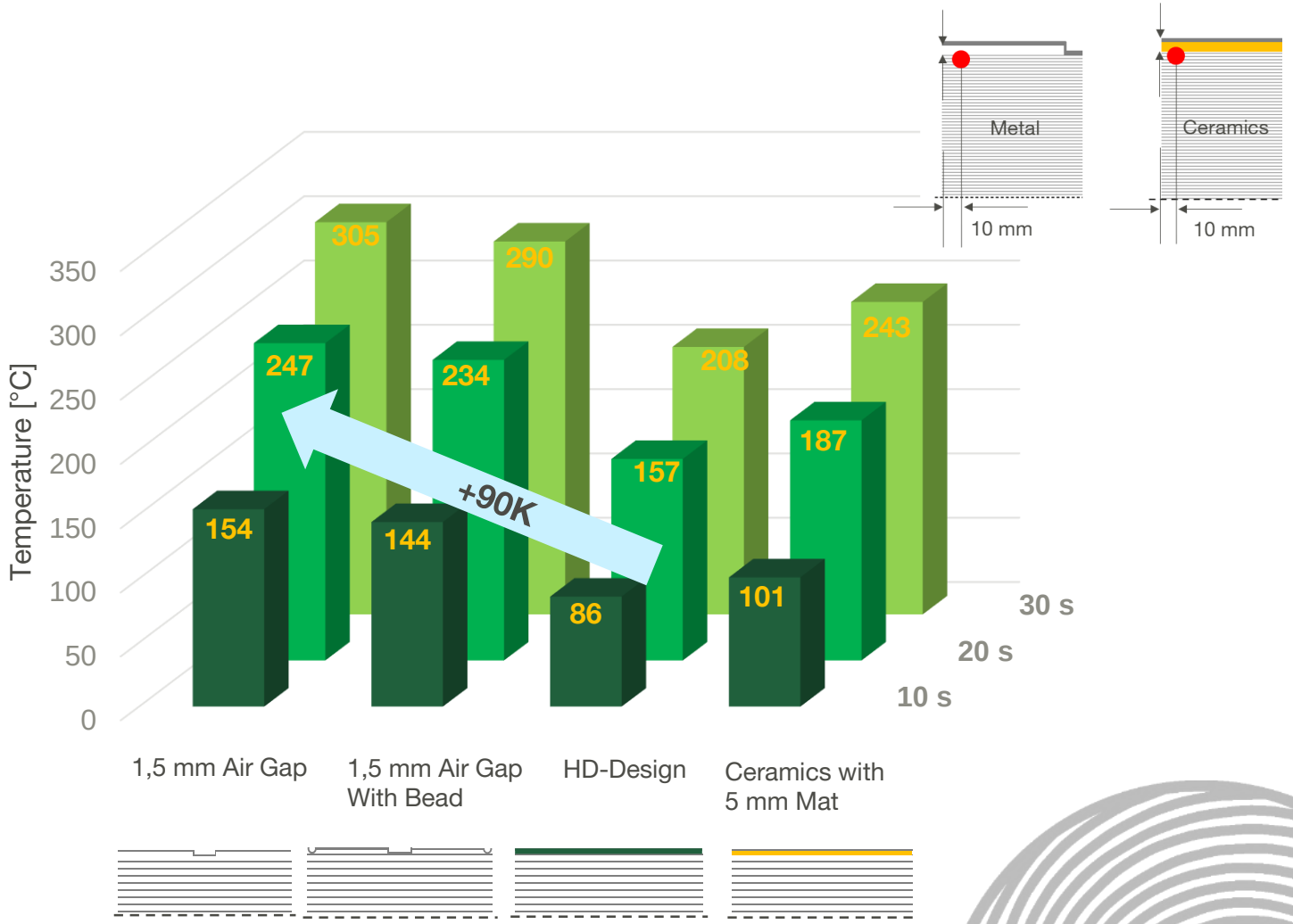
~20% lower Precious Metal (PGM) on Metal Substrates

NEW CATALYST DESIGN

SUBSTRATE WITHOUT MANTLE

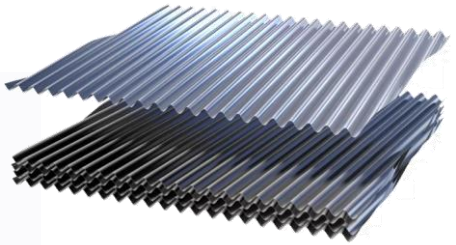
INFLUENCE OF NEW SUBSTRATE DESIGN ON EDGE TEMPERATURE

COMPARISION OF VARIOUS DESIGNS; DIA 115 X 120 mm / 600 cpsi / 40µm; Ce: 600/4 mil



NEW CATALYST DESIGN

SUBSTRATE WITHOUT MANTLE AND CS-FOILDESIGN



EMICAT® „EHC“ AND HEATING DISC „EHD“

PROVEN DESIGN

Electrically Heated Catalyst EHC

- Proven design
- more than 160.000 pcs in the field since 2014

Electrically Heated Disk EHD

- Based on proven EHC design and production machines and process for PC, Trucks and NRMM

Heating power:
Pass Car: up to 6 kW
Truck: up to 10 kW

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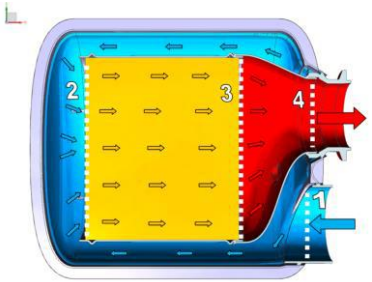
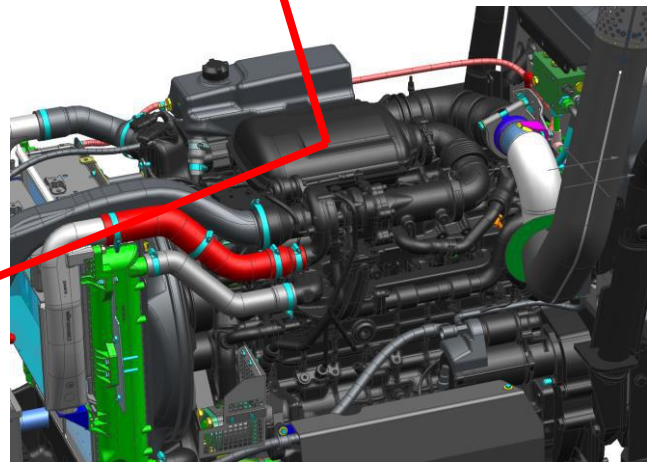
MORE STRINGENT EMISSION LEGISLATION

CHALLENGES FOR ENGINE AND EATS APPLICATION

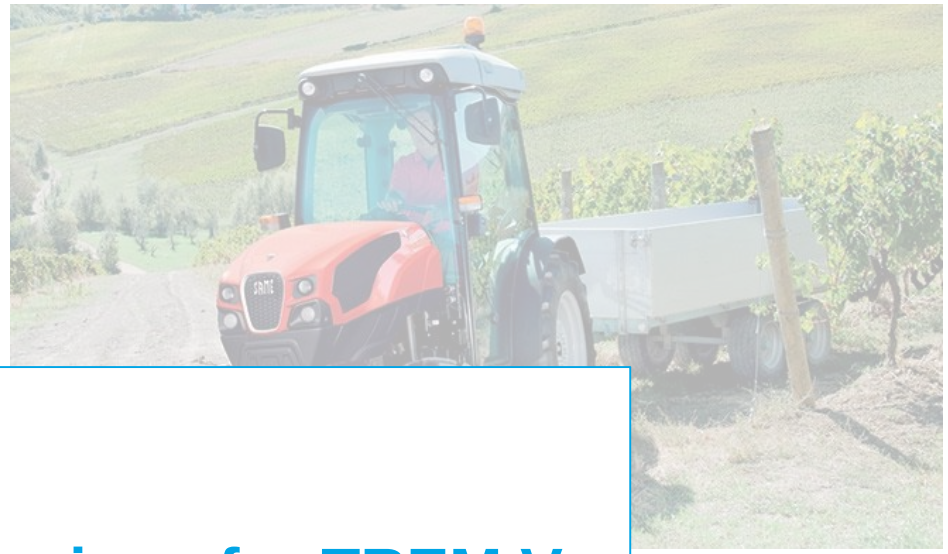
Scalable DOC solution for Stage V with optimized Thermal management





MORE STRINGENT EMISSION LEGISLATION

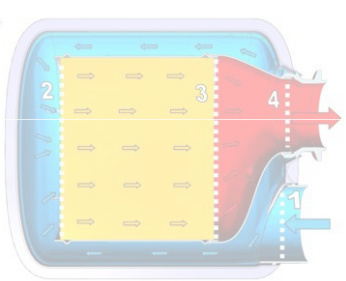
CHALLENGES FOR ENGINE AND EATS APPLICATION

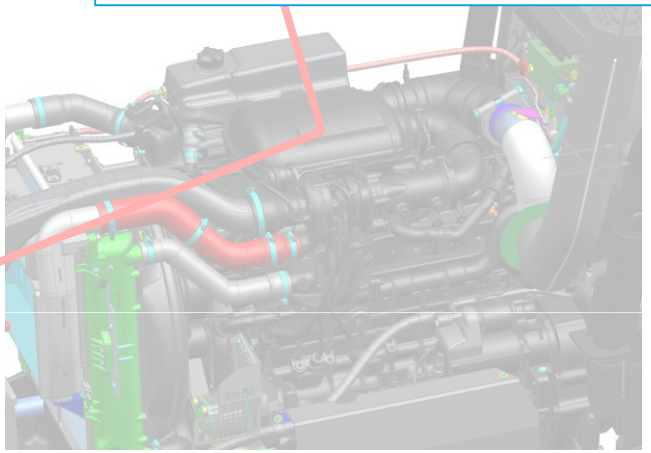


Target:

Transfer of proven designs for TREM V

Scalable DOC solution for Stage V with optimized Thermal management





TODAYS ACTUAL TREM IV EXHAUST SYSTEMS WITH DOC

37 < P < 56 kW; DOC System

TODAYS ACTUAL TREM IV EXHAUST SYSTEMS WITH DOC

37 < P < 56 kW; DOC System

Challenge:

Installation of TREM V DOC + DPF System in the given space under the hood

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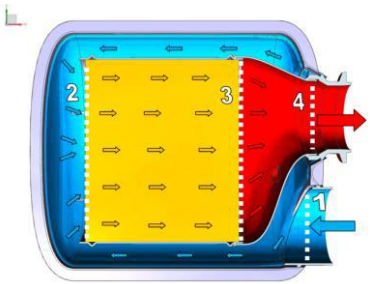
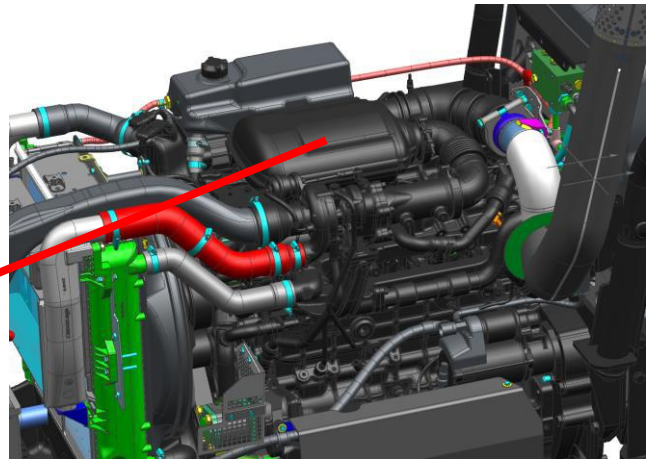
INTEGRATED INLINE METALIT SOLUTIONS

LEARNING FROM PASS CAR PRODUCTION **SYSTEMS I**

Scalable Canning
with optimized
Thermal Management





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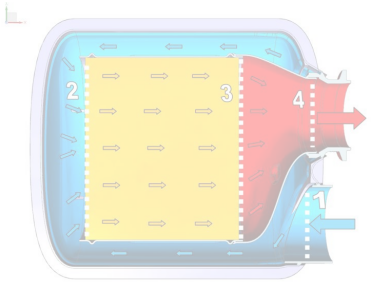
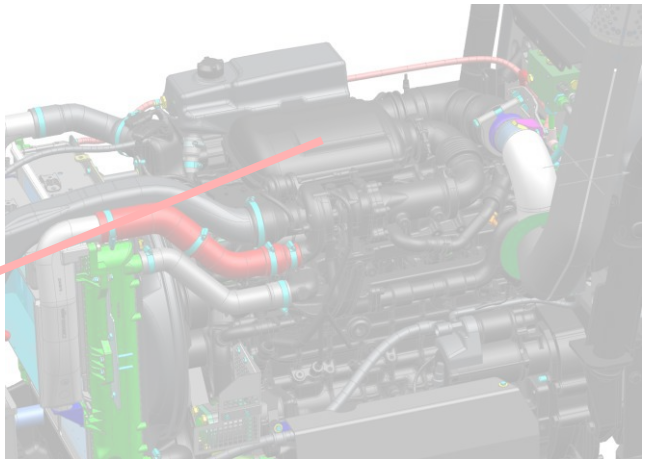
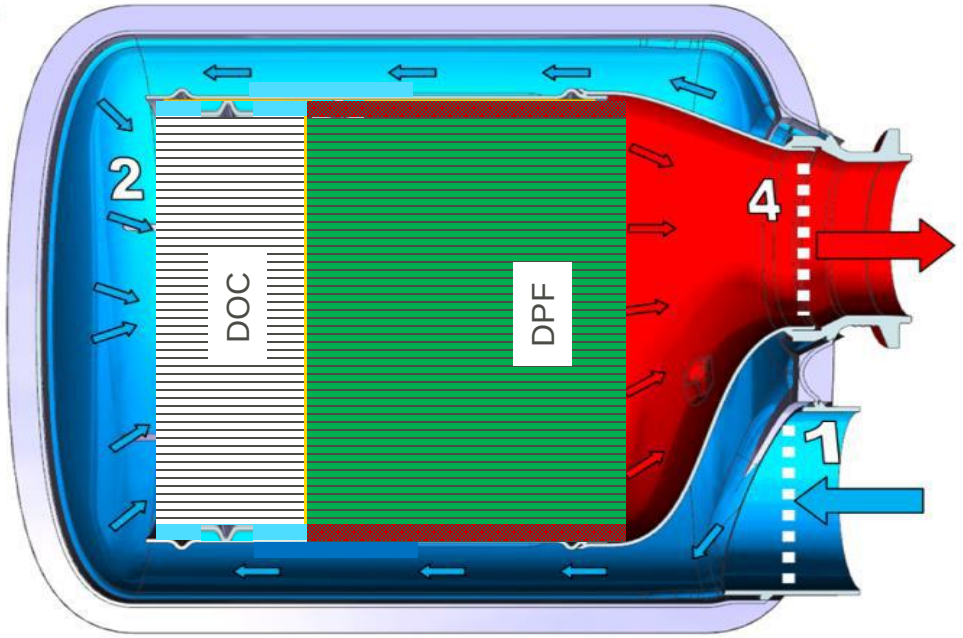




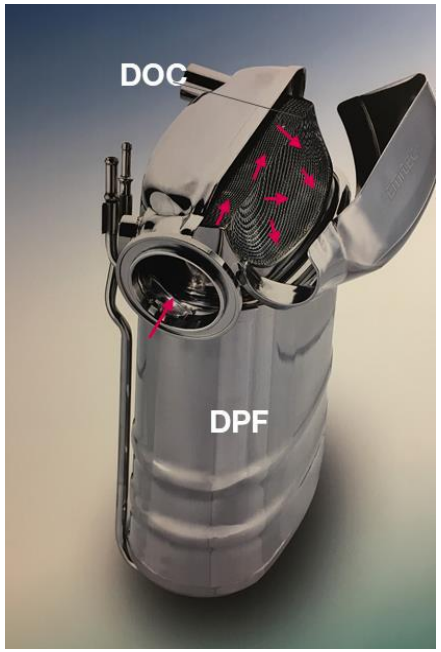
Inline System

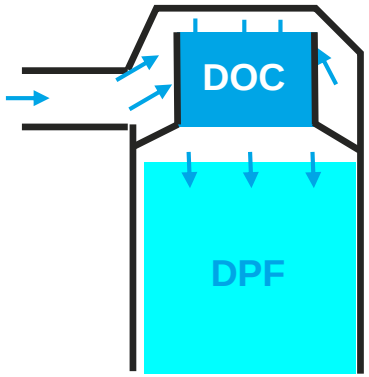


Gas inlet and gas outlet on one side

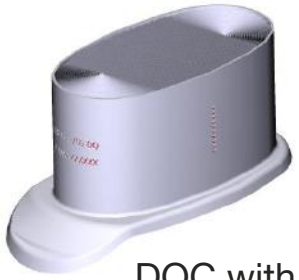
INTEGRATED COMPACT METALIT SOLUTIONS

LEARNING FROM PASS CAR PRODUCTION **SYSTEMS II**





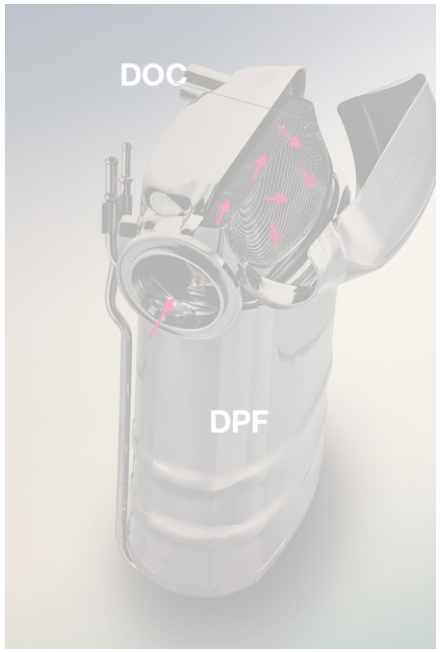
Passenger cas system with integrated flow path
→ DOC „bedded“ in housing and heated by gas

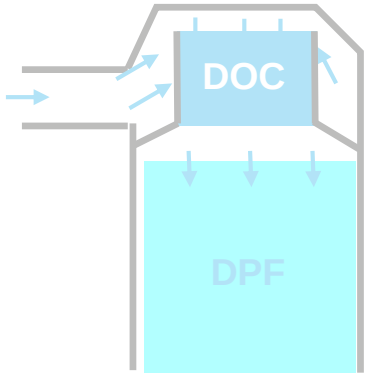


DOC with integrated gas flow guiding baffle

INTEGRATED COMPACT METALIT SOLUTIONS

LEARNING FROM PASS CAR PRODUCTION **SYSTEMS II**

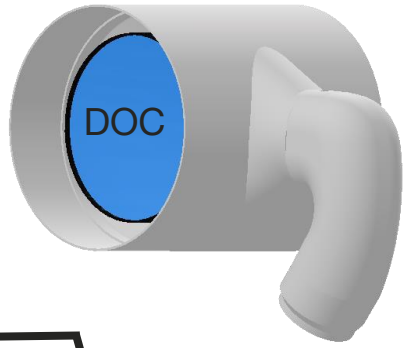


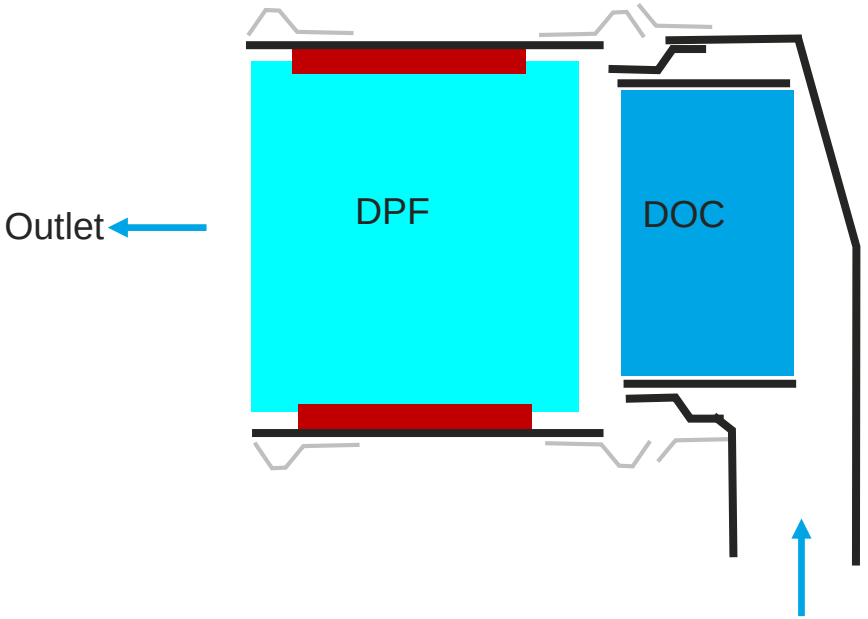


Passenger cas system with integrated flow path
→ DOC „bedded“ in housing and heated by gas

DOC with integrated gas flow guiding baffle

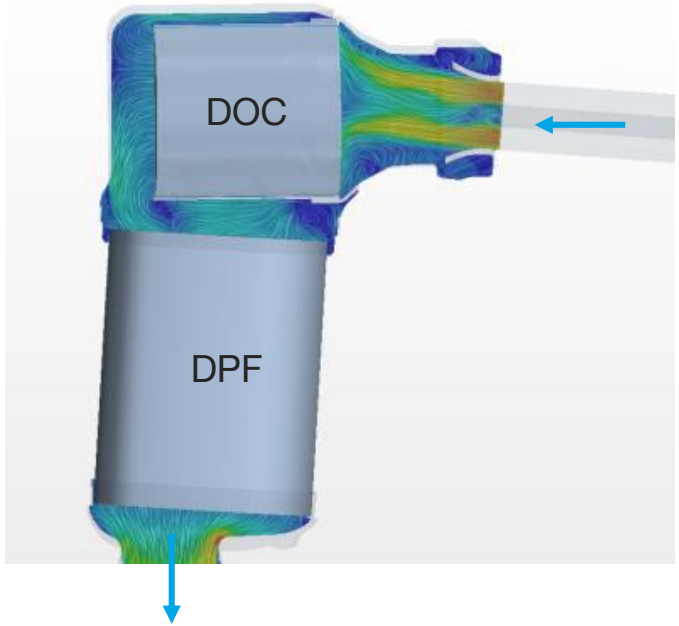
Inline Assembly with T-Gasflow





COMPACT CATALYST METALIT SOLUTIONS

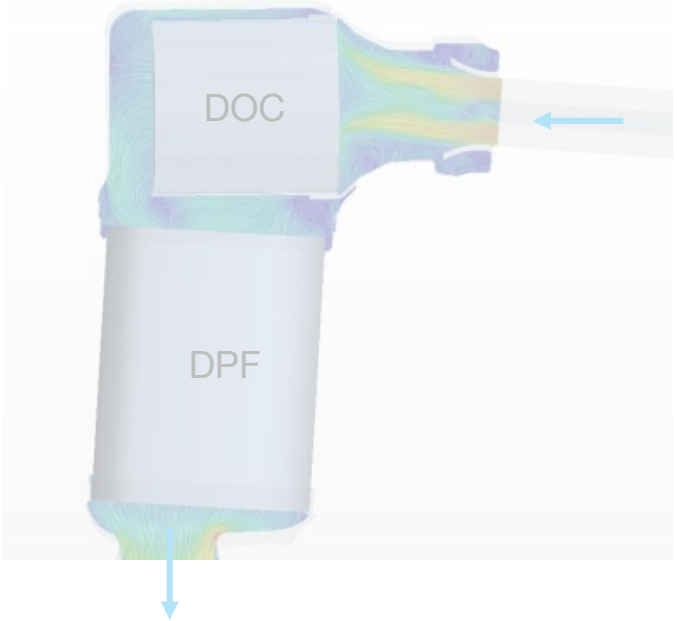
LEARNING FROM PASS CAR PRODUCTION **SYSTEMS III**

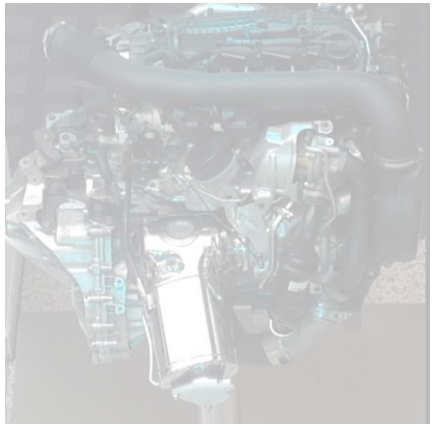


Passenger cas system with gas-flow arround the DOC for optimum temperature distribution

COMPACT CATALYST METALIT SOLUTIONS

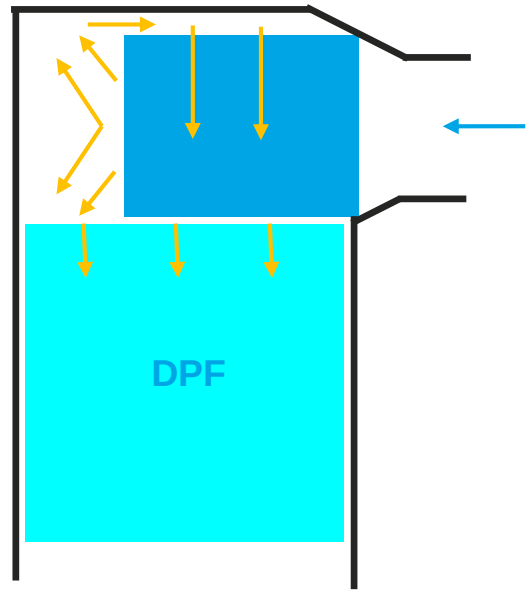
LEARNING FROM PASS CAR PRODUCTION **SYSTEMS III**





Passenger cas system with gas-flow arround the DOC for optimum temperature distribution

T-Shape Assembly with T-Gasflow

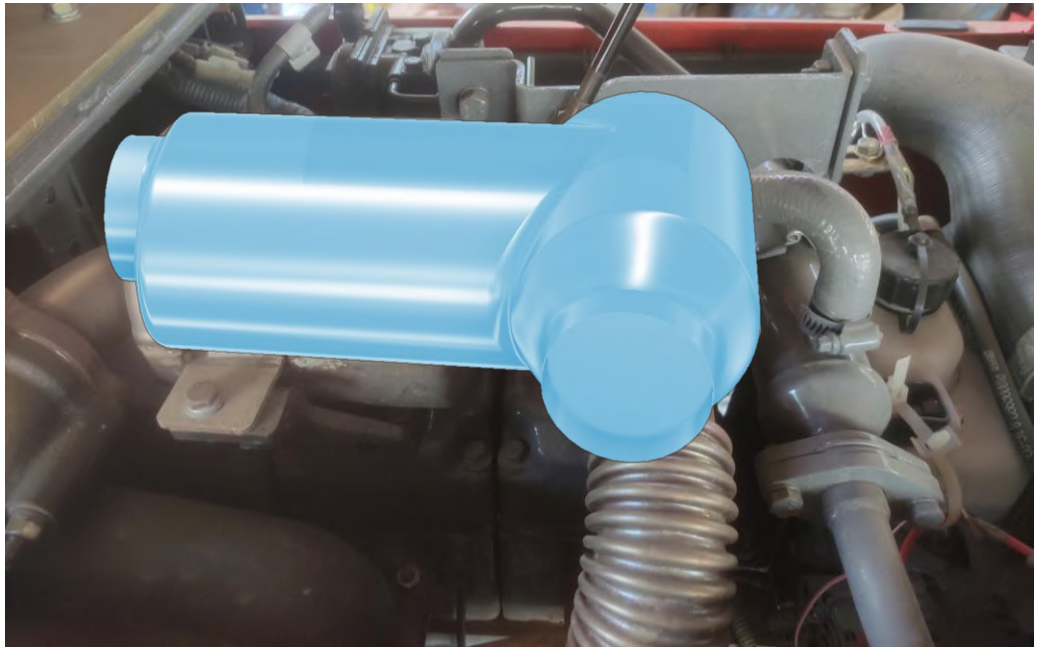


TRANSFER FROM PROVEN EU-DESIGNS TO TREM V APPLICATIONS

EUROPE => INDIA TREM V

Engine Specification

Power : 63 HP (48.47 kW @ 2100 rpm)
No. Of Cylinders : 3
Displacement 3478 cc



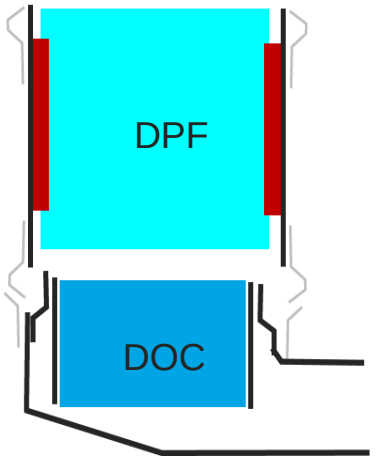
T-Shape Assembly with T-Gasflow

TREM V DOC + DPF fits in the same assembly space as the TREM IV System

TRANSFER FROM PROVEN EU-DESIGNS TO TREM V APPLICATIONS

EUROPE => INDIA TREM V

Inline System with T-Gasflow



Engine Specification:

Power : 63 HP (46 kW @ 2100 rpm)
No. Of Cylinders : 3

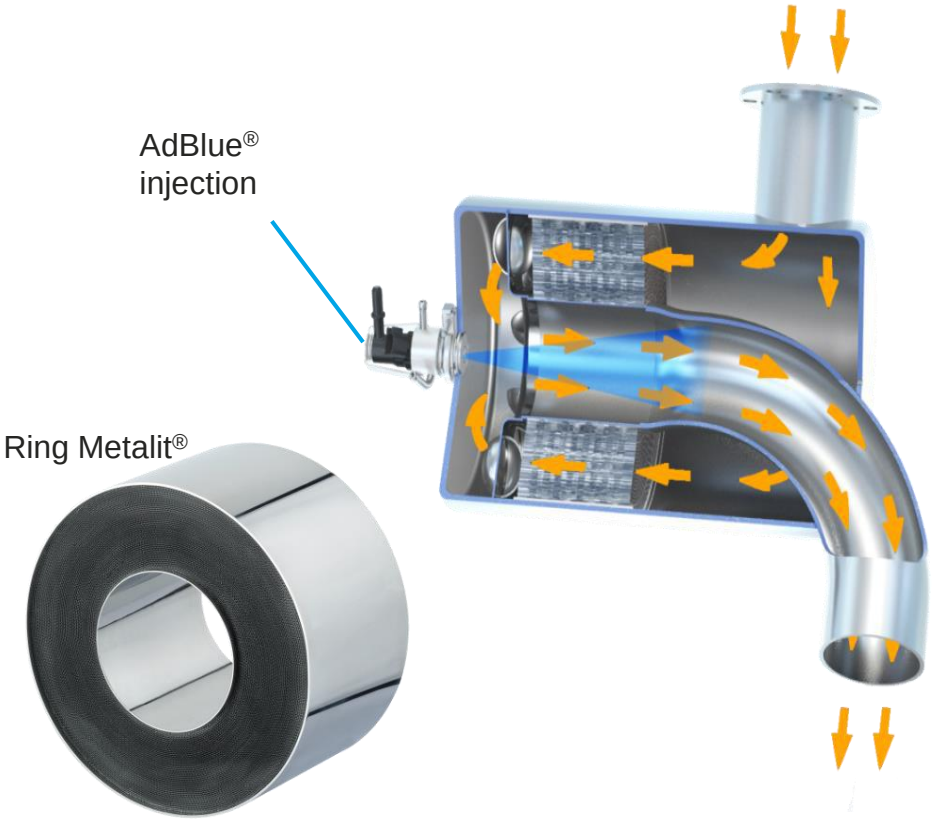
Actual system in the Tractor

AGENDA

- NEW EMITEC TECHNOLOGIES GMBH
- EMISSION LEGISLATION NRMM
- ADVANCED METAL SUBSTRATE TECHNOLOGY
- TRACTOR APPLICATION – CHALLENGE AND EXHAUST SYSTEM LAYOUT
- EMITEC SOLUTIONS FOR TREM V
- **CONCLUSION**

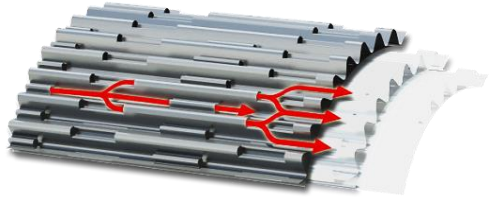
COMPACT EMISSION CONTROL SYSTEM ALSO FOR SCR

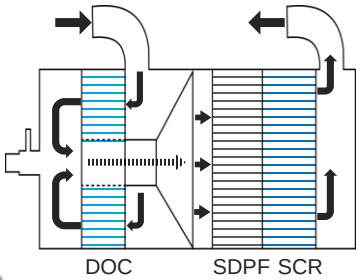
WITH RING METALIT® CATALYST AND ADBLUE® INJECTION; >150.000 Systems produced



Ring Metalit®

LS-Design®

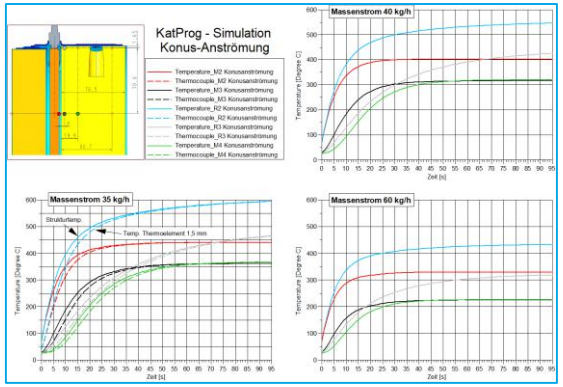




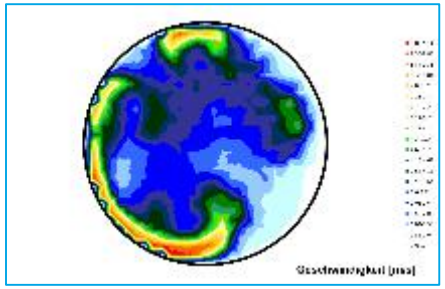
Concept with Baffle Plate: Donaldson, Dr. Korneel de Rudder

DEVELOPMENT SUPPORT BY EMITEC TECHNOLOGIES

Development Service
(CAD / CAE / Concept Development)



Rapid-Prototyping
(as plastic part for pre examinations
e. g. flow distribution)



Functional samples from metal e.g. casted, metal printed,
Complete exhaust systems für test on engine test bench
or vehicle testing)

Detailed reporting of test and analysis
results