

HIGHLY EFFICIENT, COST EFFECTIVE & COMPACT EXHAUST AFTERTREATMENT FOR HYBRID ENGINES

ECT 2025 TECHNICAL PRESENTATION

New Delhi, October 2025

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Confidential

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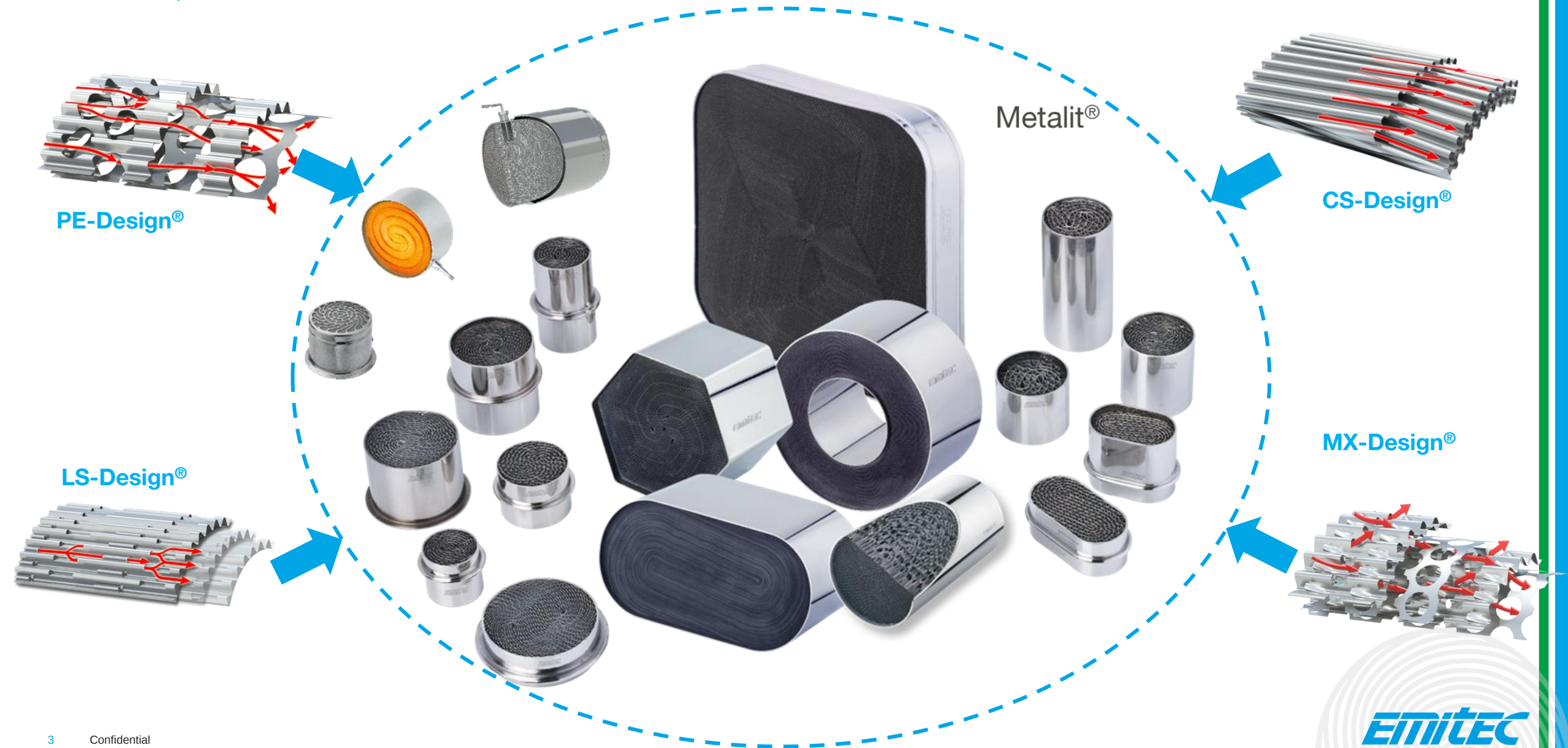
🌀 DEDICATED EXHAUST AFTERTREATMENT TECHNOLOGIES FOR PHEV APPLICATIONS

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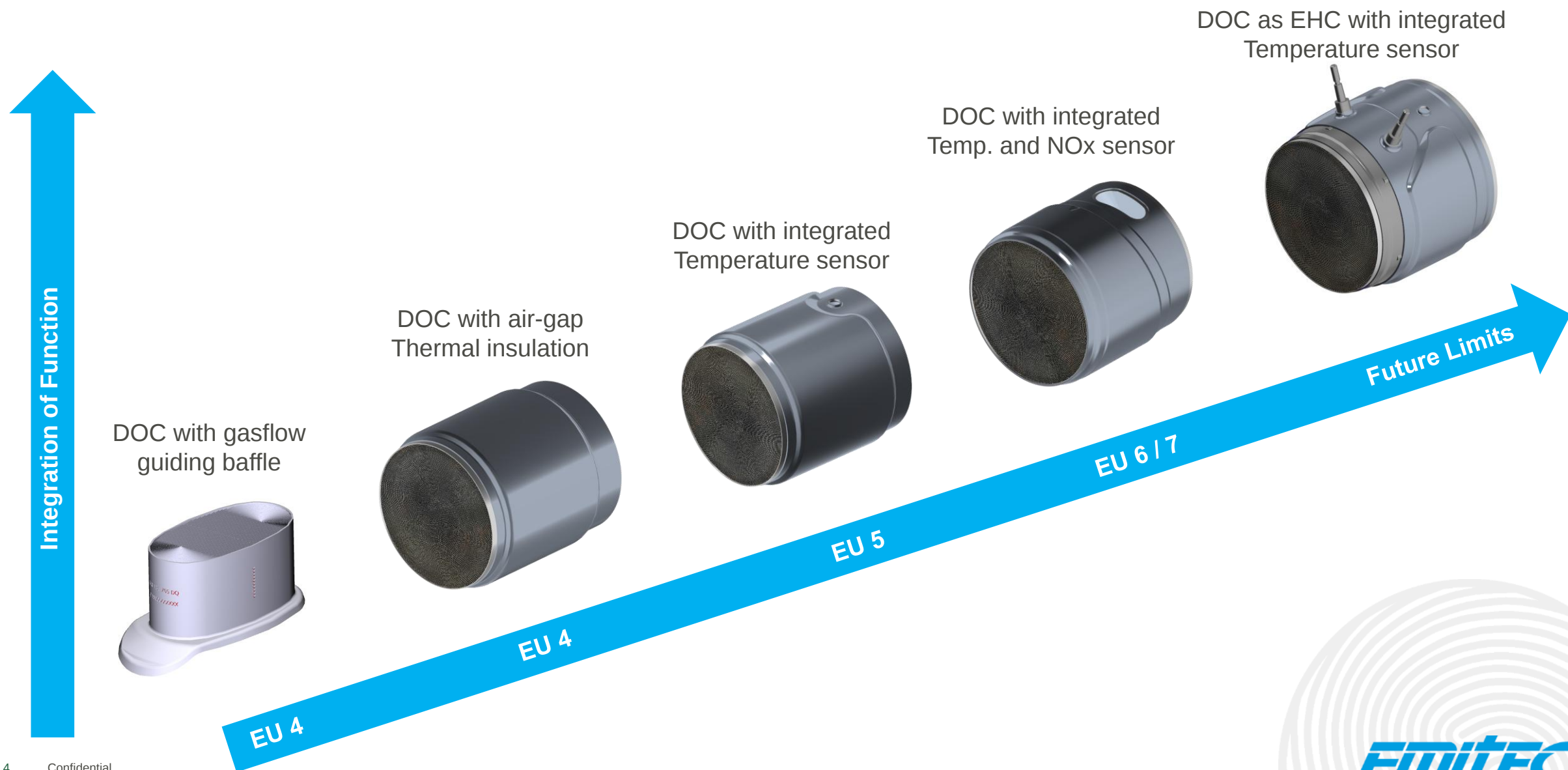
METAL SUBSTRATES PRODUCTION – PORTFOLIO

SHAPES, SIZES AND PACKAGING – FROM CHAINSAW TO LOCOMOTIVE



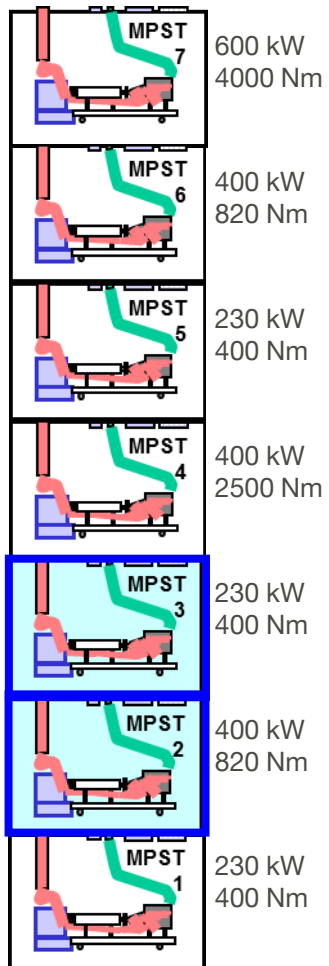
EMITEC DOC DEVELOPMENT FROM EU4 TO FUTURE EMISSION LIMITS

INTEGRATION OF FUNCTIONS (INSULATION, SENSORS, HEATING)

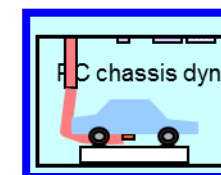
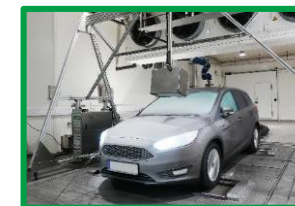
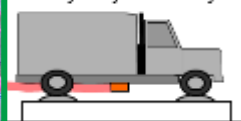


EMITEC DEVELOPMENT

VIEW INTO THE TEST CENTER



Heavy Duty chassis dymo



Flow Bench



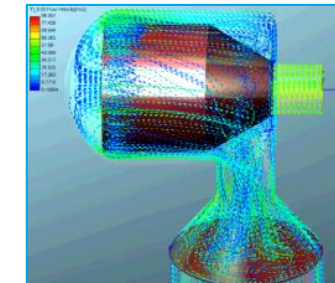
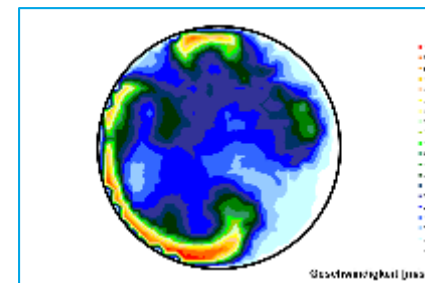
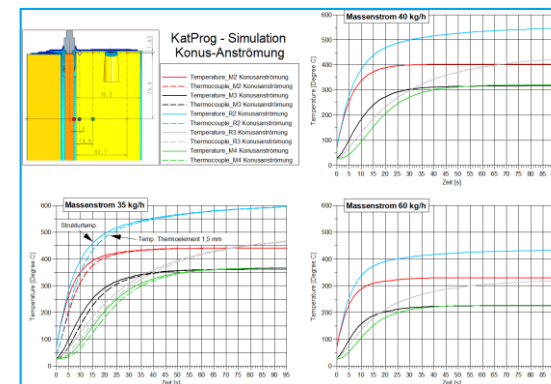
DEVELOPMENT SUPPORT BY EMITEC TECHNOLOGIES

LAYOUT, DESIGN, CALCULATION, MEASUREMENT, DURABILITY

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)

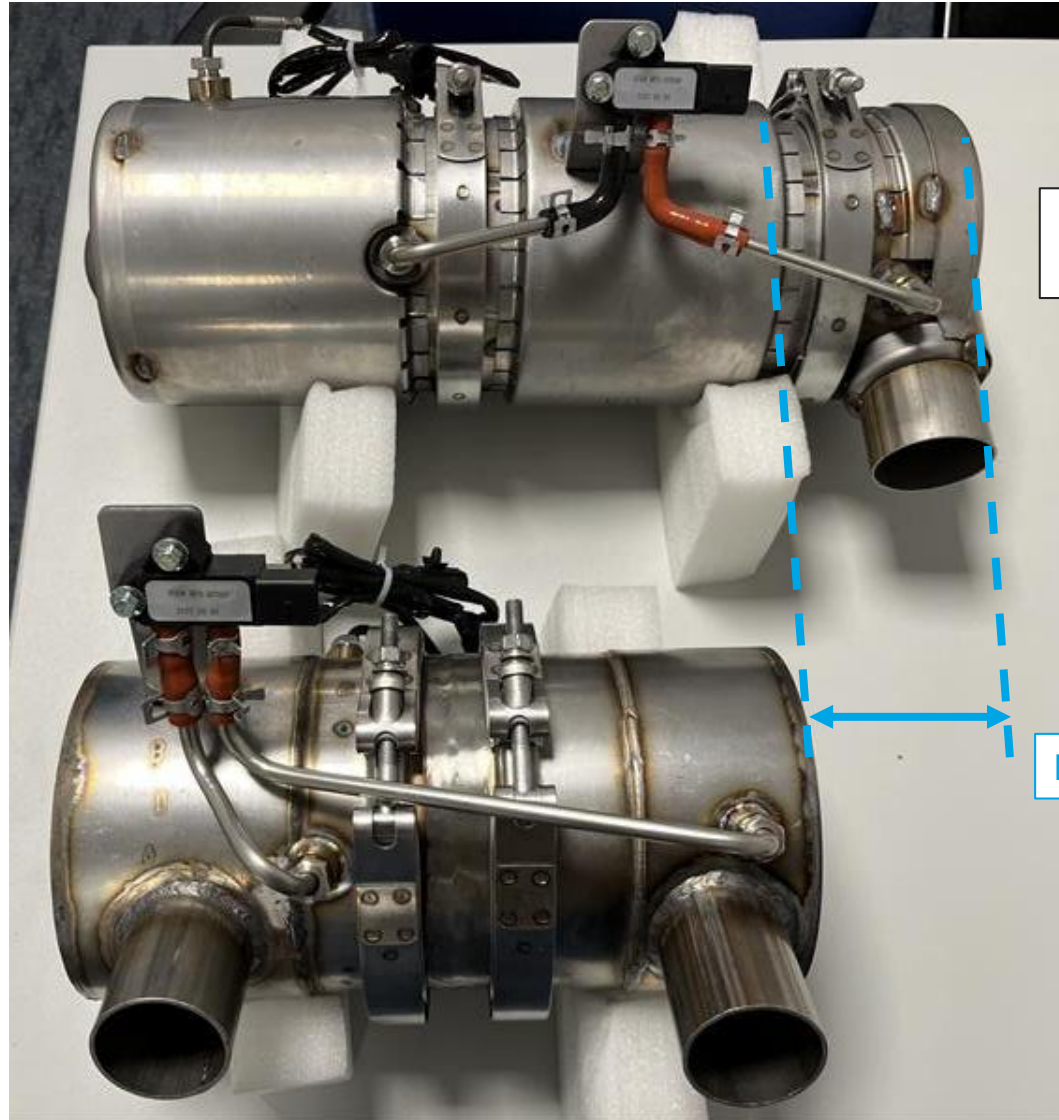


Detailed reporting of test and analysis
results

Test Report	Analysis Report
Test Report Test Object: Exhaust System Test Date: 12.12.2023 Test Location: EMITEC Test Center Test Results: Exhaust Gas Temperature: 450°C Exhaust Gas Flow: 100 l/min Exhaust Gas Pressure: 1.2 bar Exhaust Gas Composition: 15% O₂, 10% CO, 5% H₂, 1% CH₄, 79% N₂ Exhaust Gas Analysis: 15% O₂, 10% CO, 5% H₂, 1% CH₄, 79% N₂ Exhaust Gas Flow: 100 l/min Exhaust Gas Pressure: 1.2 bar Exhaust Gas Composition: 15% O₂, 10% CO, 5% H₂, 1% CH₄, 79% N₂ Exhaust Gas Analysis: 15% O₂, 10% CO, 5% H₂, 1% CH₄, 79% N₂ Exhaust Gas Flow: 100 l/min Exhaust Gas Pressure: 1.2 bar Exhaust Gas Composition: 15% O₂, 10% CO, 5% H₂, 1% CH₄, 79% N₂ Exhaust Gas Analysis: 15% O₂, 10% CO, 5% H₂, 1% CH₄, 79% N₂	Analysis Report Analysis Object: Exhaust System Analysis Date: 12.12.2023 Analysis Location: EMITEC Test Center Analysis Results: Exhaust Gas Temperature: 450°C Exhaust Gas Flow: 100 l/min Exhaust Gas Pressure: 1.2 bar Exhaust Gas Composition: 15% O₂, 10% CO, 5% H₂, 1% CH₄, 79% N₂ Exhaust Gas Analysis: 15% O₂, 10% CO, 5% H₂, 1% CH₄, 79% N₂ Exhaust Gas Flow: 100 l/min Exhaust Gas Pressure: 1.2 bar Exhaust Gas Composition: 15% O₂, 10% CO, 5% H₂, 1% CH₄, 79% N₂ Exhaust Gas Analysis: 15% O₂, 10% CO, 5% H₂, 1% CH₄, 79% N₂ Exhaust Gas Flow: 100 l/min Exhaust Gas Pressure: 1.2 bar Exhaust Gas Composition: 15% O₂, 10% CO, 5% H₂, 1% CH₄, 79% N₂ Exhaust Gas Analysis: 15% O₂, 10% CO, 5% H₂, 1% CH₄, 79% N₂

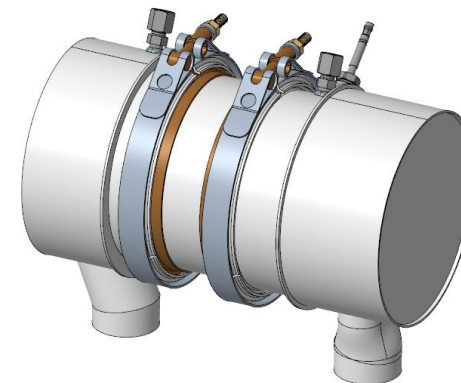
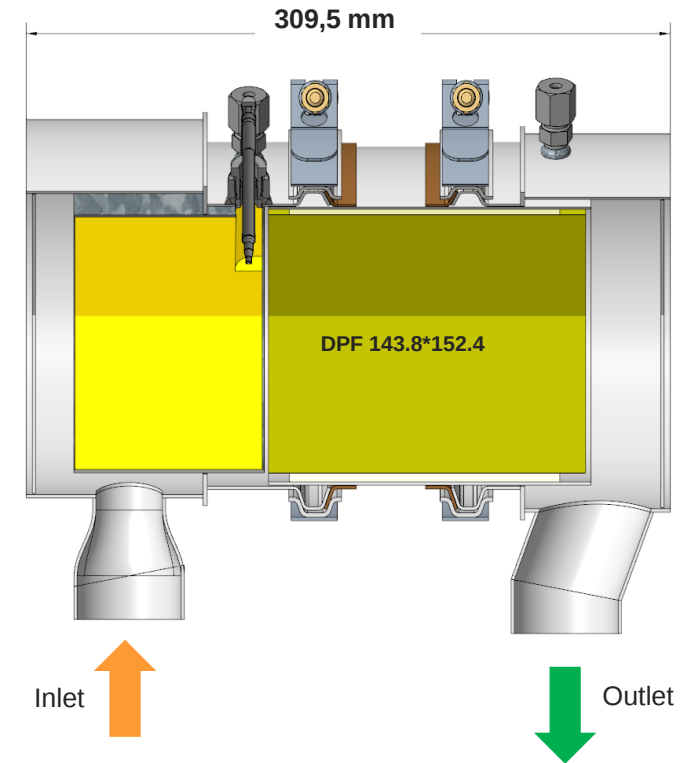
COMPACT EXHAUST SYSTEM FOR TRACTOR

DOC + DPF; USAGE OF SENSOR CATALYST



Standard Design

Emitec Design

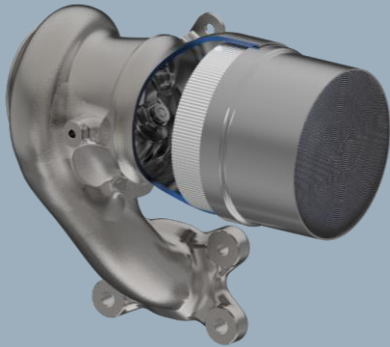


EMITEC UNIQUE TECHNOLOGIES

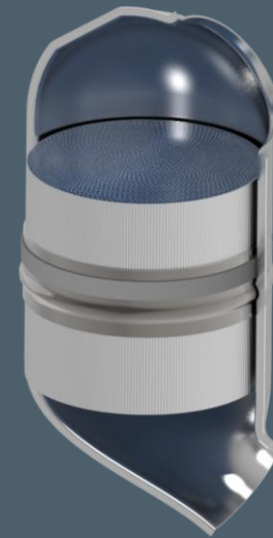
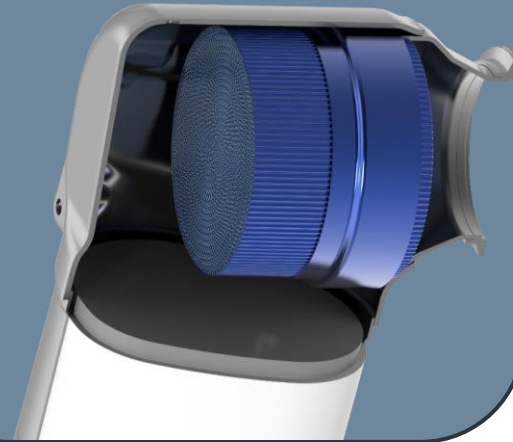
COMPACT CANNING POSSIBILITIES FOR HYBRIDS AND REX



Utilize **Close Coupled** opportunities



Find **Compact** integration solutions



Develop **Cost optimized** manufacturing

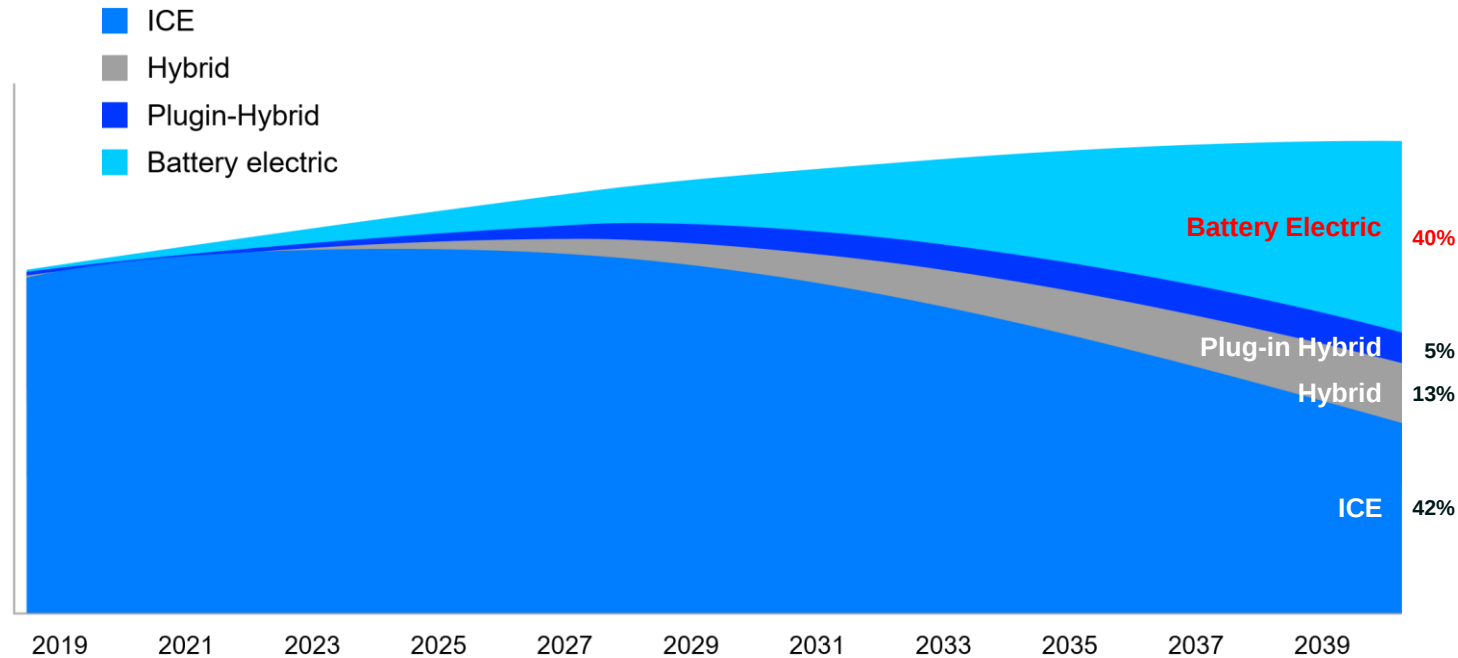
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- CONCLUSION



GLOBAL PASSENGER VEHICLE FLEET BY DRIVETRAIN

NUMBERS OF CARS IN OPERATION



Source : Bloomberg NEF Electric Vehicle Outlook 2024 Q4

Actual Trend in the world:

- PHEV (and RexV) share likely to grow, reducing BEV share.
- HEV, PHEV and RexV will stay longer in the marketplaces in large numbers

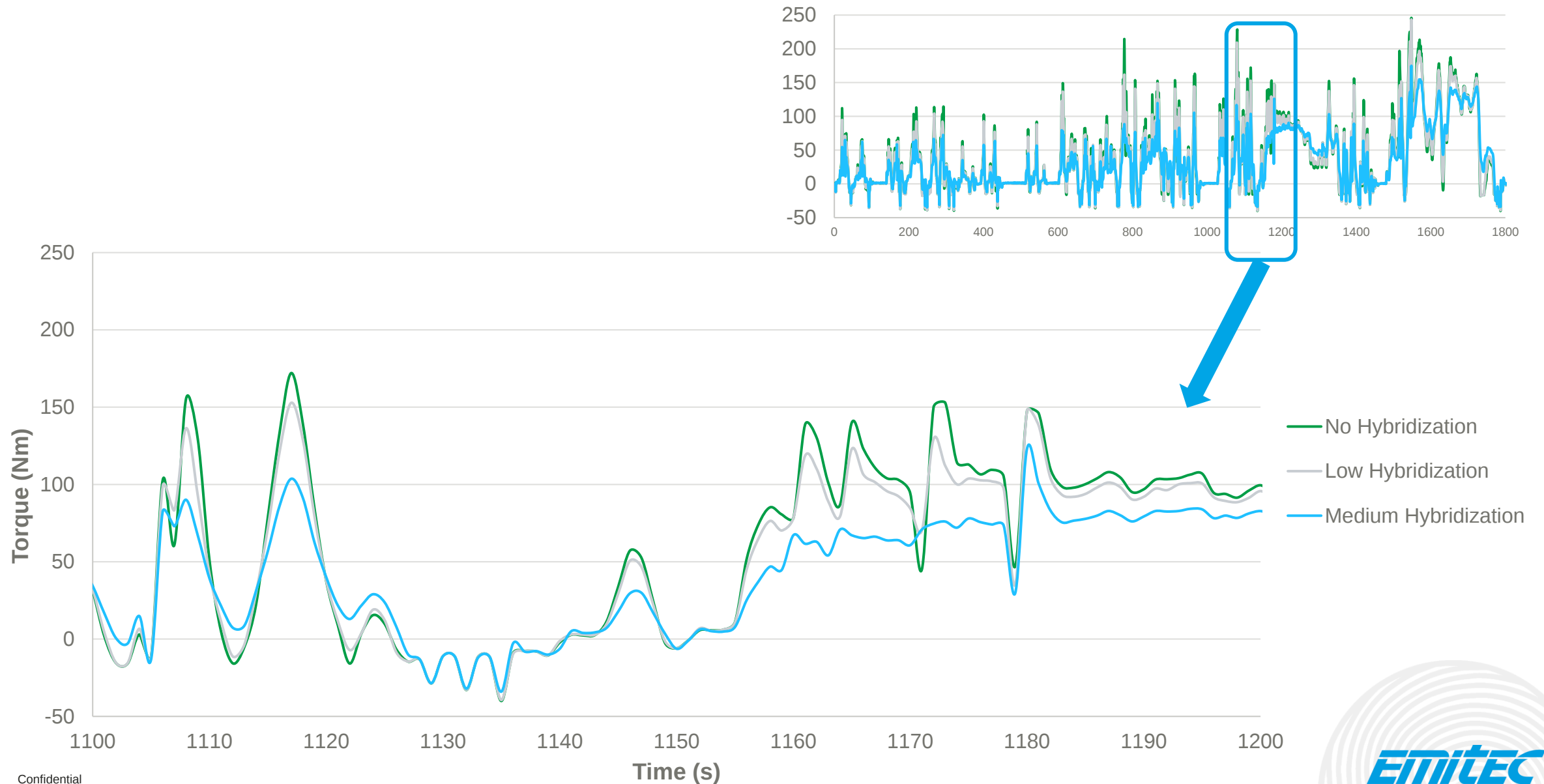
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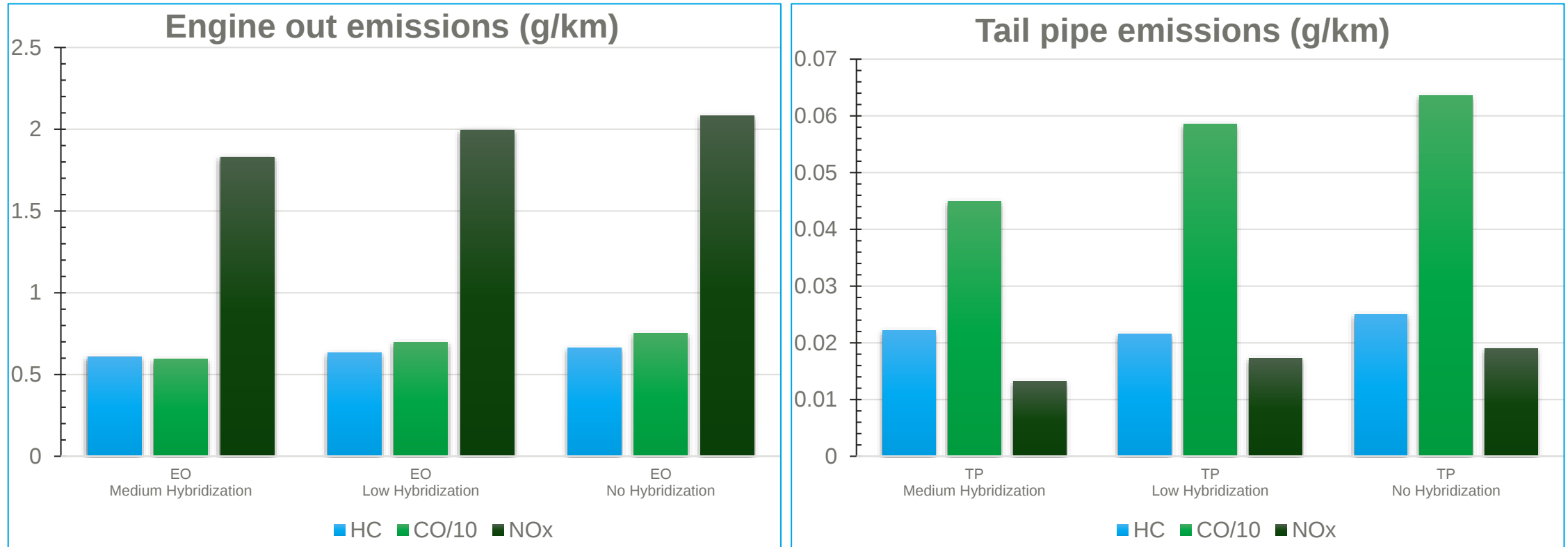
ICE TORQUE DEMAND

AS A FUNCTION OF DEGREE OF HYBRIDIZATION



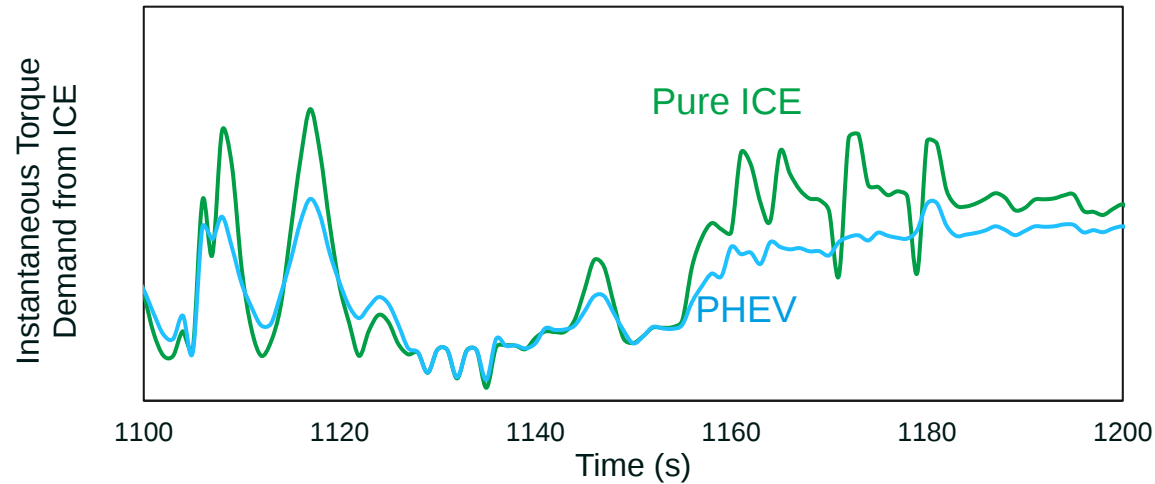
WLTC EMISSIONS WITH AGED CATALYST

AS A FUNCTION OF DEGREE OF HYBRIDIZATION

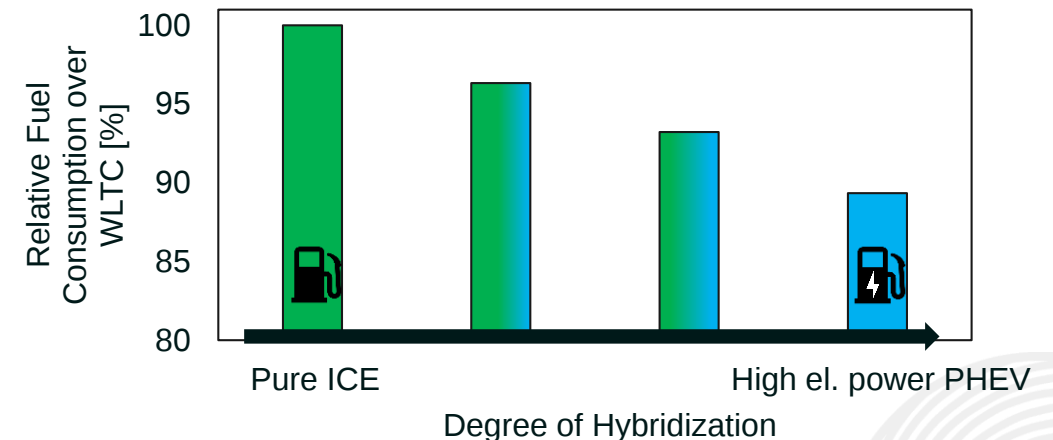
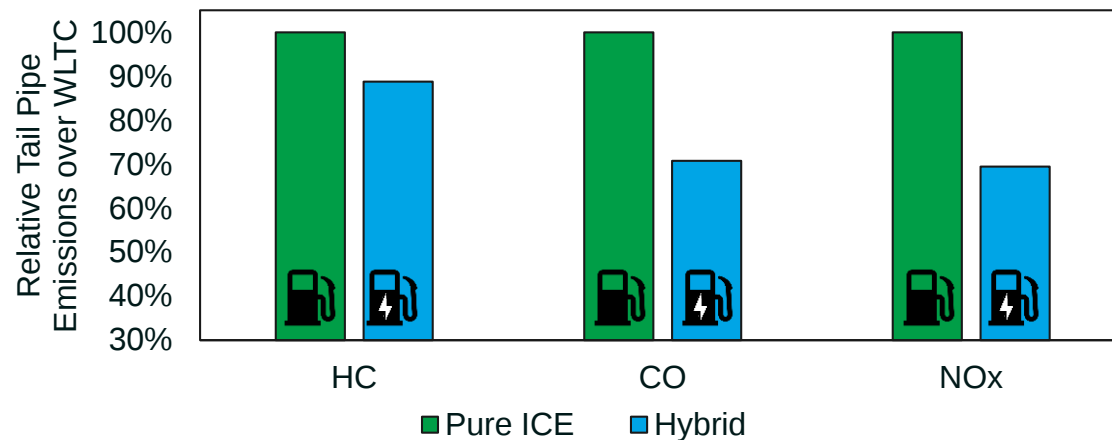


MEASURED PHEV ADVANTAGES DURING RDE CYCLES

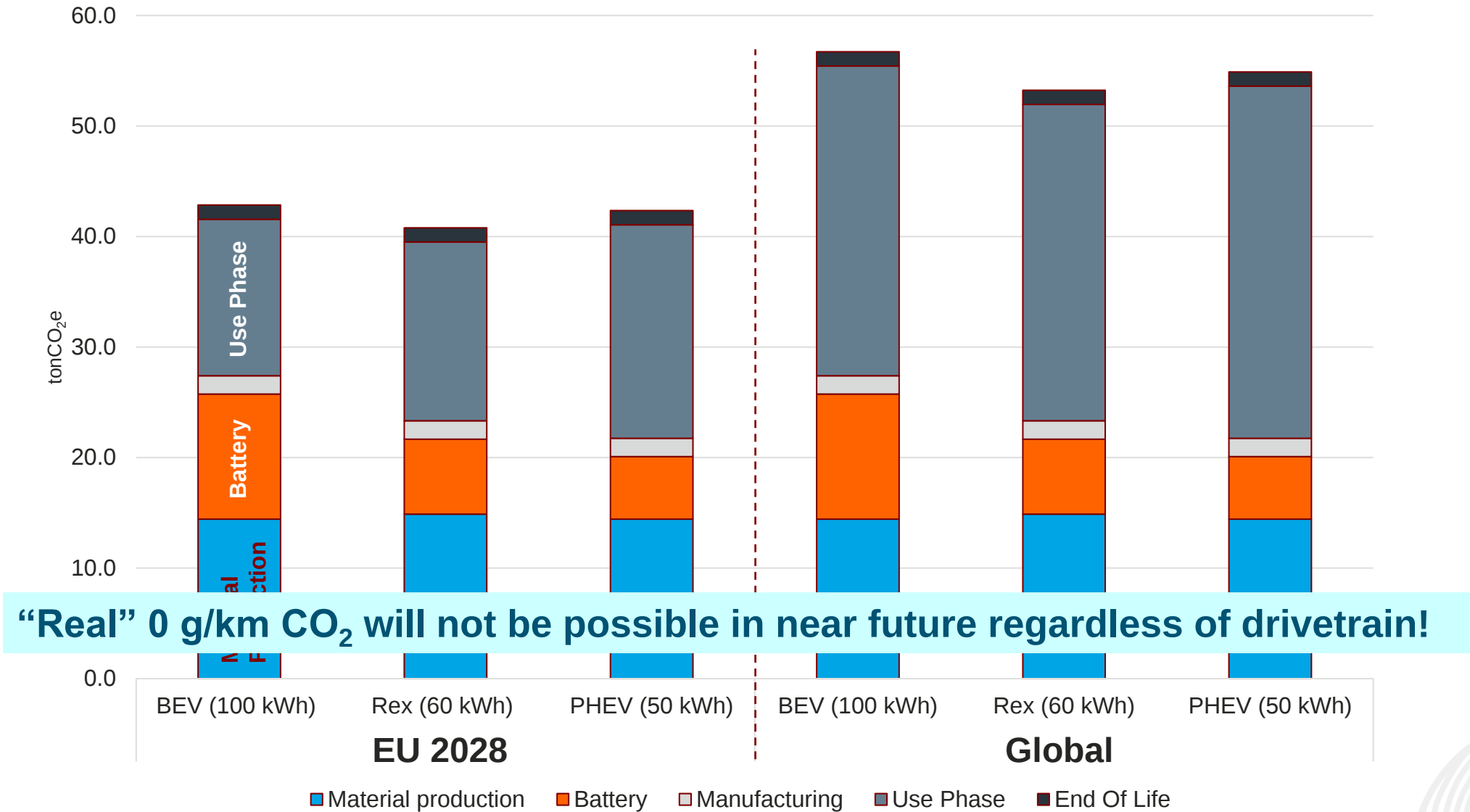
ICE TORQUE DEMAND, FUEL CONSUMPTION, TAILPIPE EMISSIONS



- ICE on PHEV has lower Torque Peaks
- The ICE has lower “dynamic load demand” and can be better controlled
- Lower CO₂ and regulated pollutants emissions



D-SEGMENT VEHICLE – LIFECYCLE CO₂

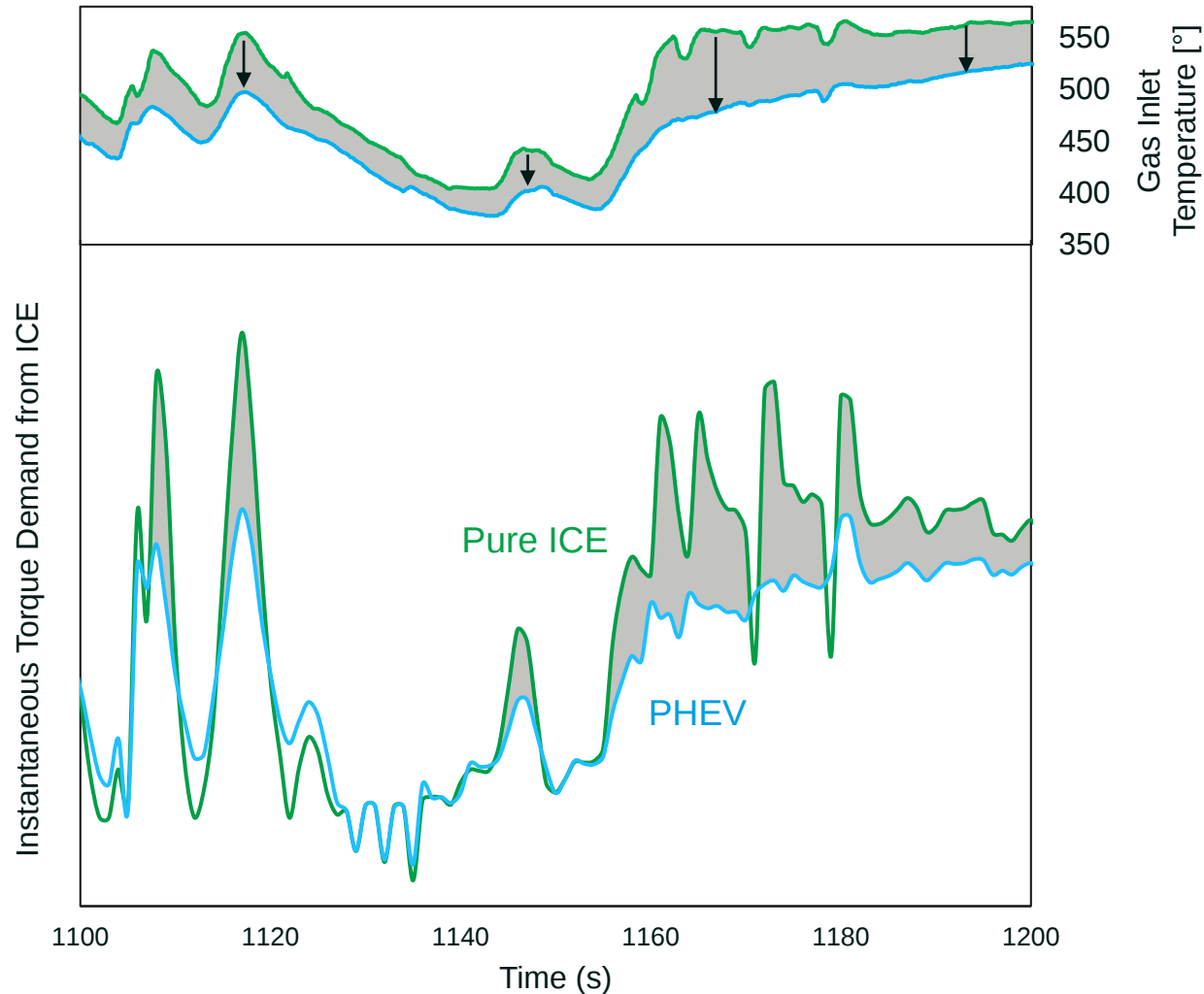


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EXHAUST GAS TEMPERATURE AS A FUNCTION OF HYBRIDISATION



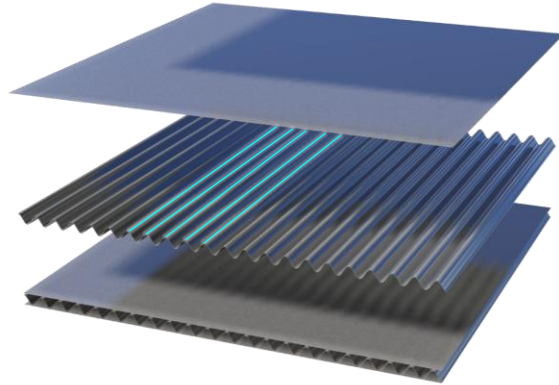
- ICE on PHEV has lower Torque Peaks
- ...and also a lower Inlet Temperature
- Raising the need for a dedicated EATS

NEW HIGH EFFICIENT CS-DESIGN

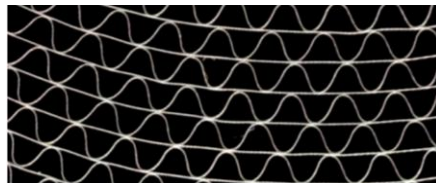
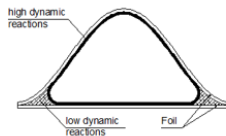
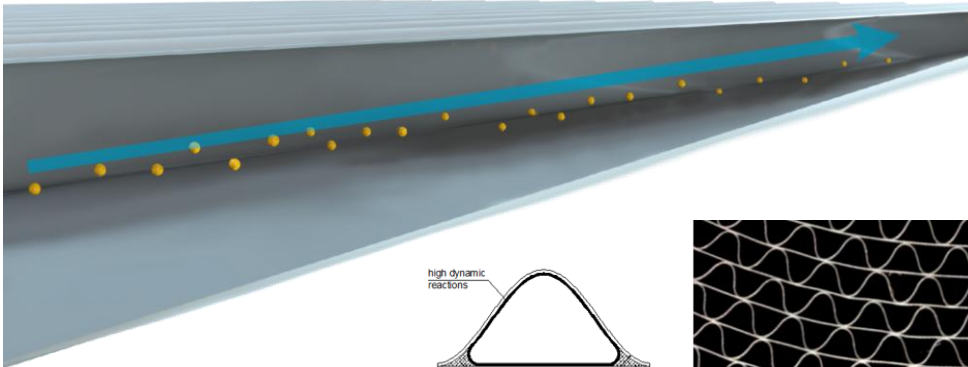
DESIGN CHARACTERISTICS BUILDING THE SUBSTRATES

Standard Design

Stacking of flat and corrugated
Layers to create a honeycomb body
=> **Contact lines**

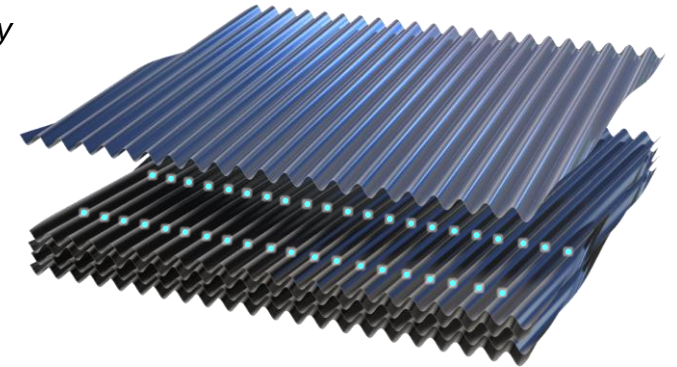


Laminar Flow through cell channels

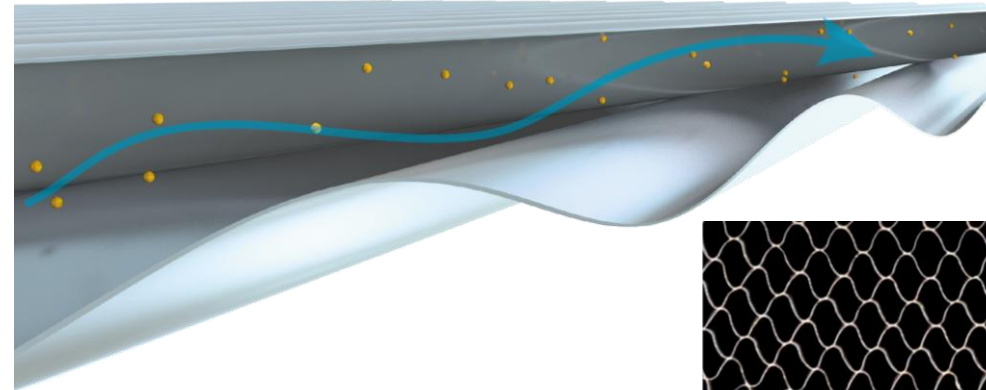


CS-Design

Alternating stacking of diagonally
corrugated layers
=> **Contact points**



Improved mass transfer through exchange with other cell channels



CS-METALIT® TEST PROGRAM - GASOLINE 2.0L

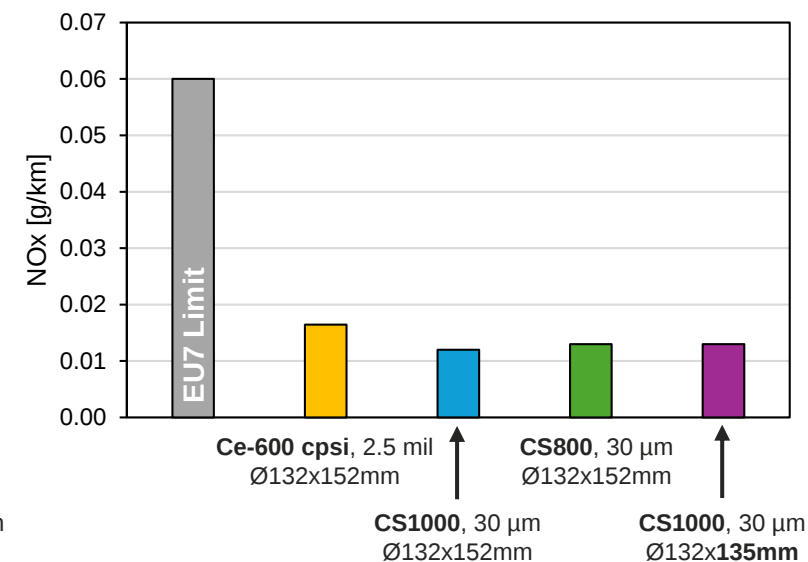
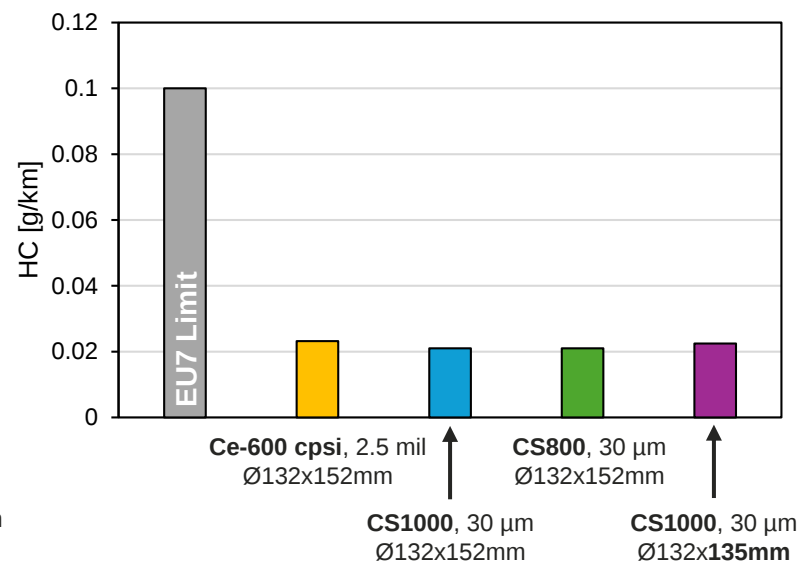
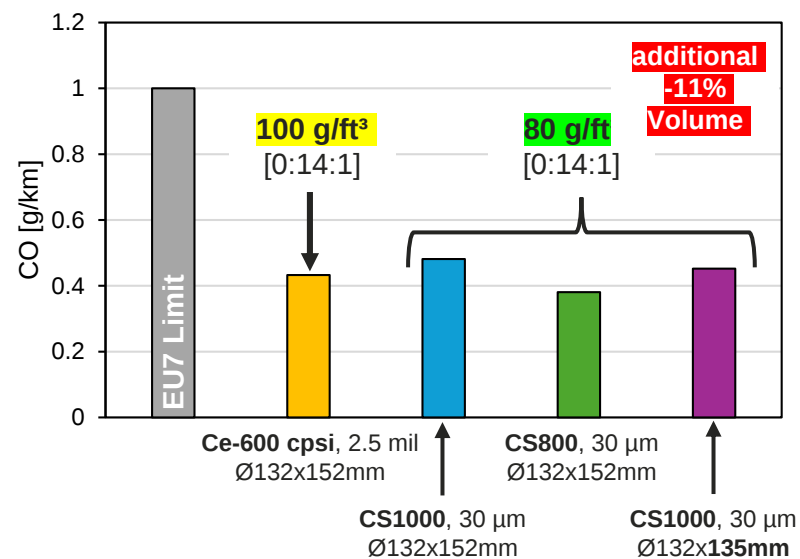
REDUCTION OF CATALYST VOLUME AND PGM



	STD Keramik, STD Canning Ø132x152mm	CS Metalit, STD Canning Ø132x152mm	CS Metalit, STD Canning Ø132x152mm	CS Metalit, STD Canning Ø132x135mm
Cell Density [cpsi]	600	CS 800	CS 1000	CS 1000
Wall Thickness [mil/μm]	2.5 mil	30 μm	30 μm	30 μm
Dimensions [mm]	Ø 132x152	Ø 132x152	Ø 132x152	Ø 132x135
Volume [L]	2,08	2,08	2,08	1,847
GSA [m²]	6,48	6,7	7,45	6,62
β x GSA [m³/s]	1,10	1,81	1,95	1,88
Thermal Mass [J/K]	983	968,1	1023,5	909,1
PGM [g/ft³]	100 [0:14:1]	80	80	80

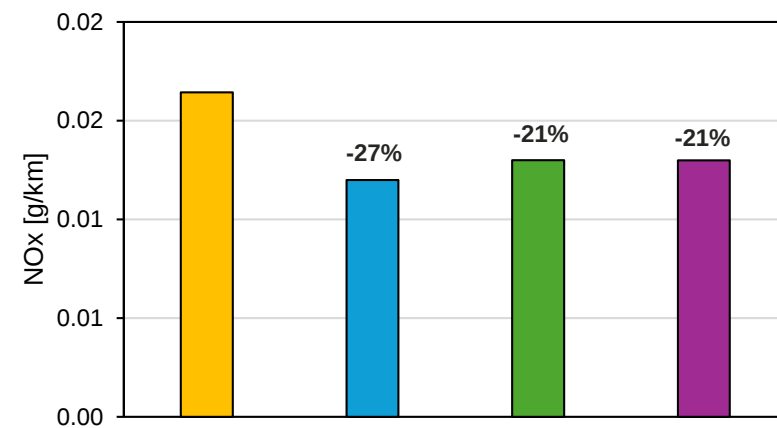
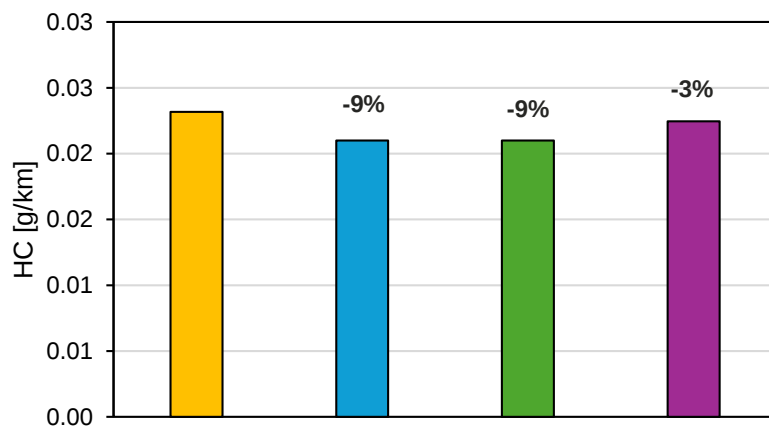
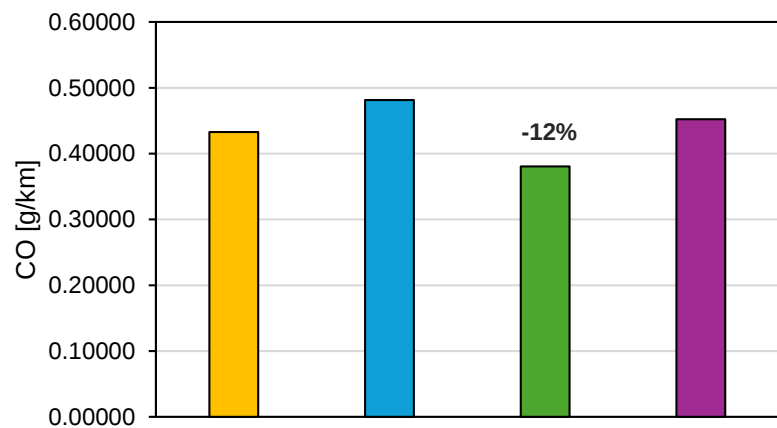
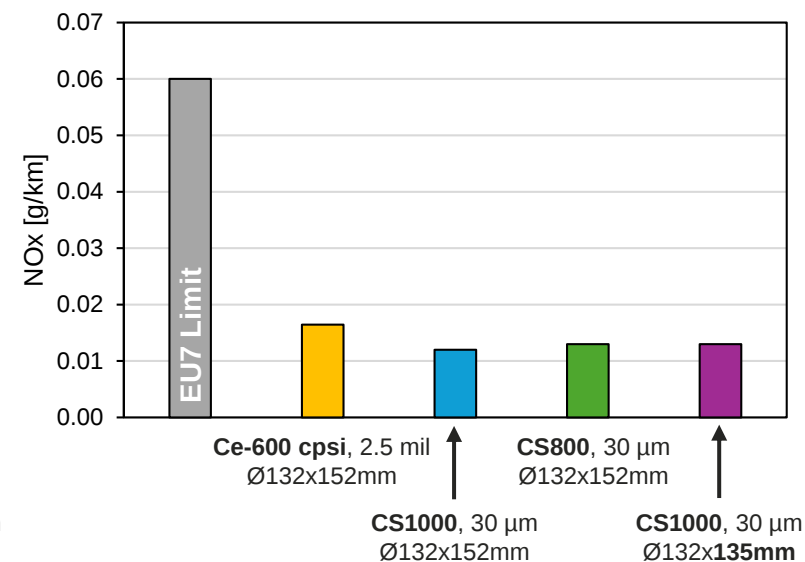
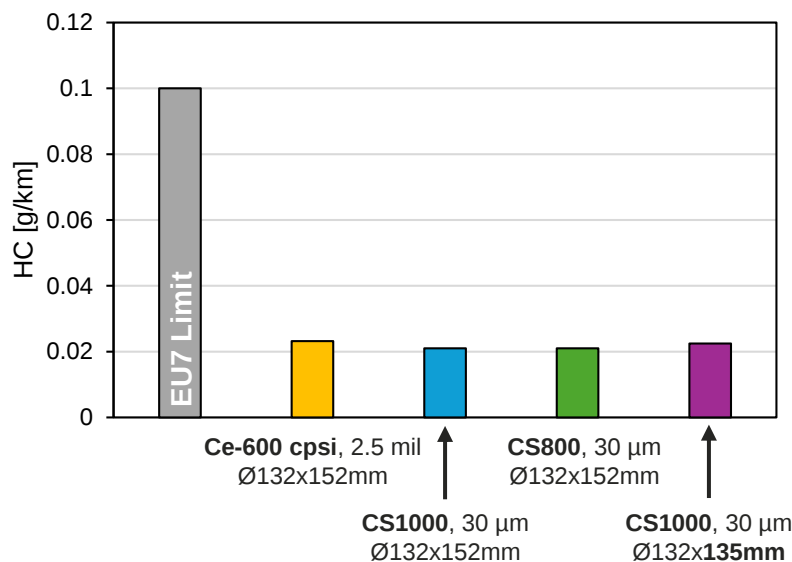
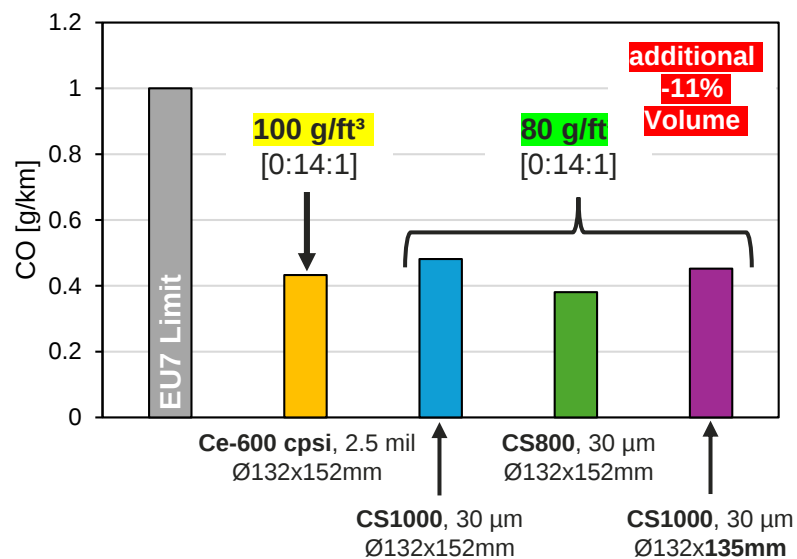
CS-METALIT® - GASOLINE 2.0L – RDE; AGED

Hydrothermal ageing 3-Way-Cat
980°C, 16 h, 10 Vol. -% Wasser



CS-METALIT® - GASOLINE 2.0L – RDE; AGED

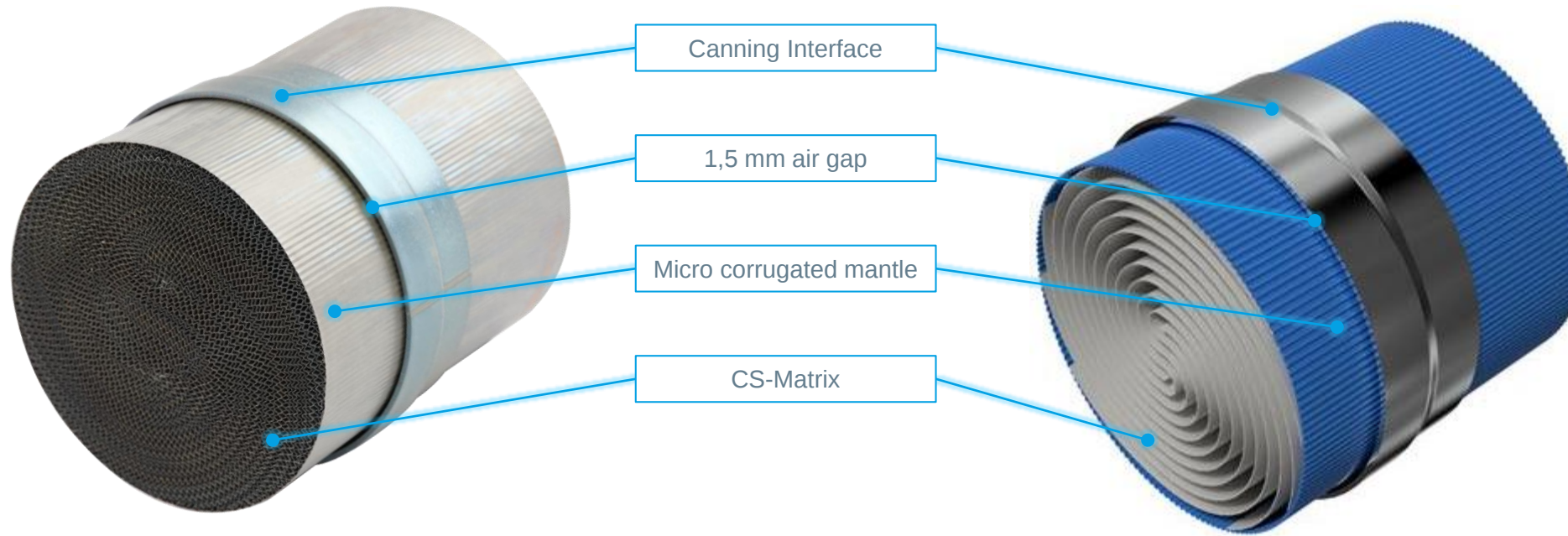
Hydrothermal ageing 3-Way-Cat
980°C, 16 h, 10 Vol. -% Wasser



CS1000, 30µm Ø132x135mm
-11% Volume
-20% PGM

OPPORTUNITIES OF A CHANGING ACRC HITECTURE

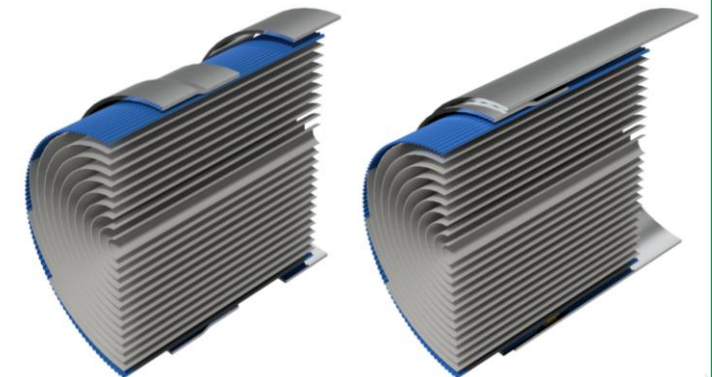
INTRODUCING AN ADVANCED BUT SIMPLIFIED SUBSTRATE BM-DESIGN



Substrate decoupled to mantle by in-built air gap insulation:

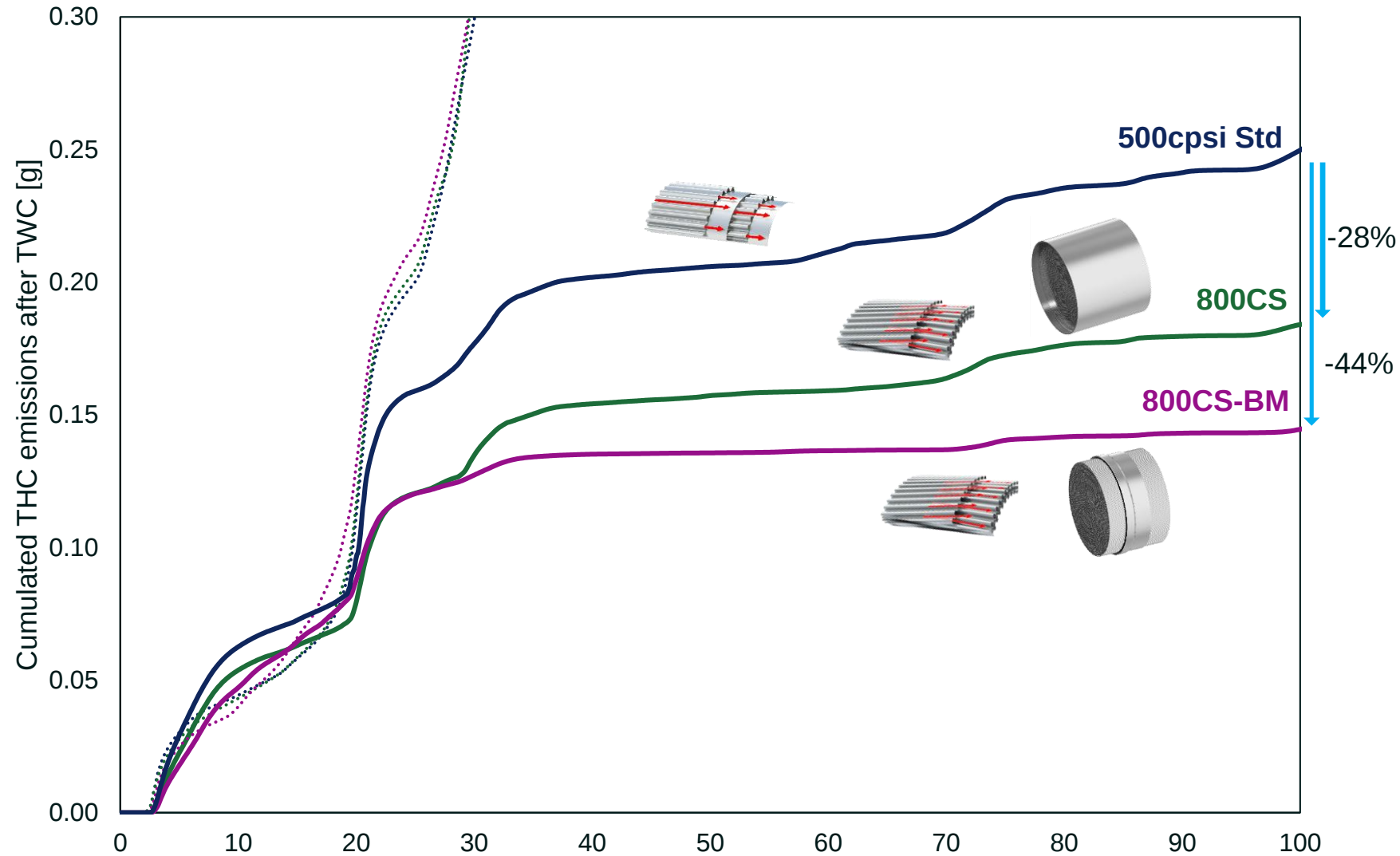
=> improved light-off behavior

=> opportunity for new, cost optimized canning methods



CUMULATED HC TAILPIPE EMISSIONS

BM FURTHER INCREASES EFFICIENCY IN COLD START



- CS-Design improves cold start emissions by 28%
- BM-Design gives an add. 16% improvement

CLOSE COUPLED CATALYST WITH NEW BM-DESIGN

CANNING DESIGN FOR NATURAL ASPIRATED ENGINES

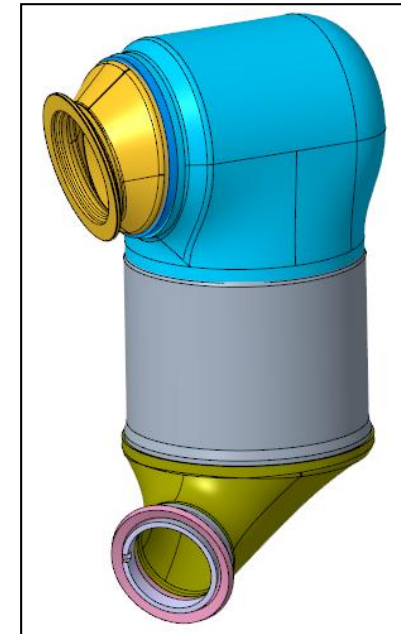
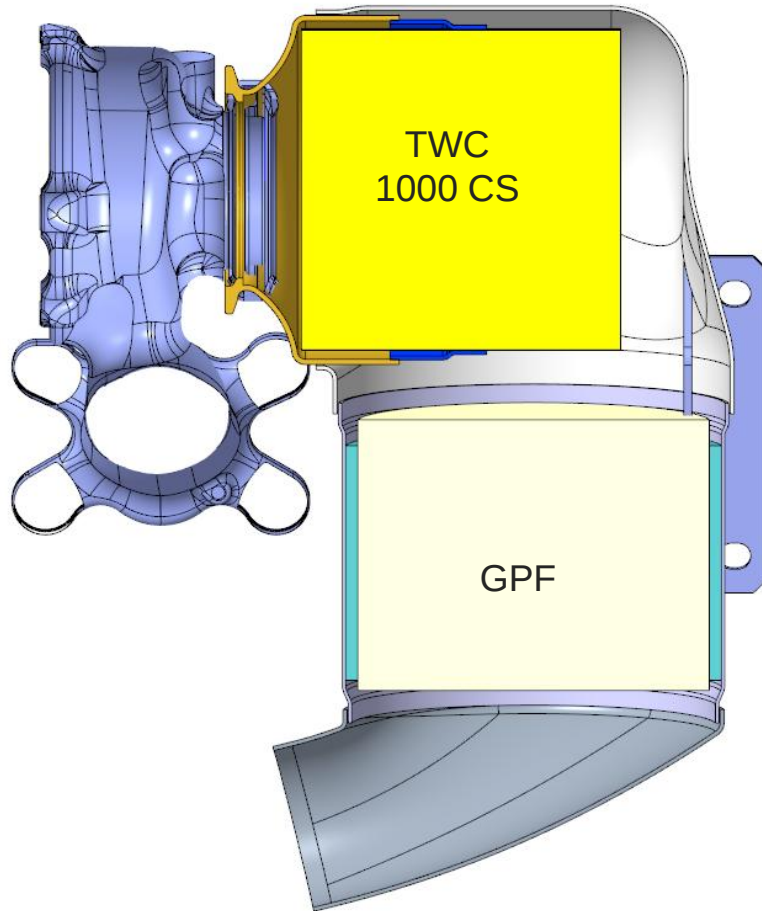


Emitec Approach:

Using a specially designed manifold
(cast iron or sheet metal) to integrate the
Belt Mantle metal substrate in the manifold with 1 welding seam

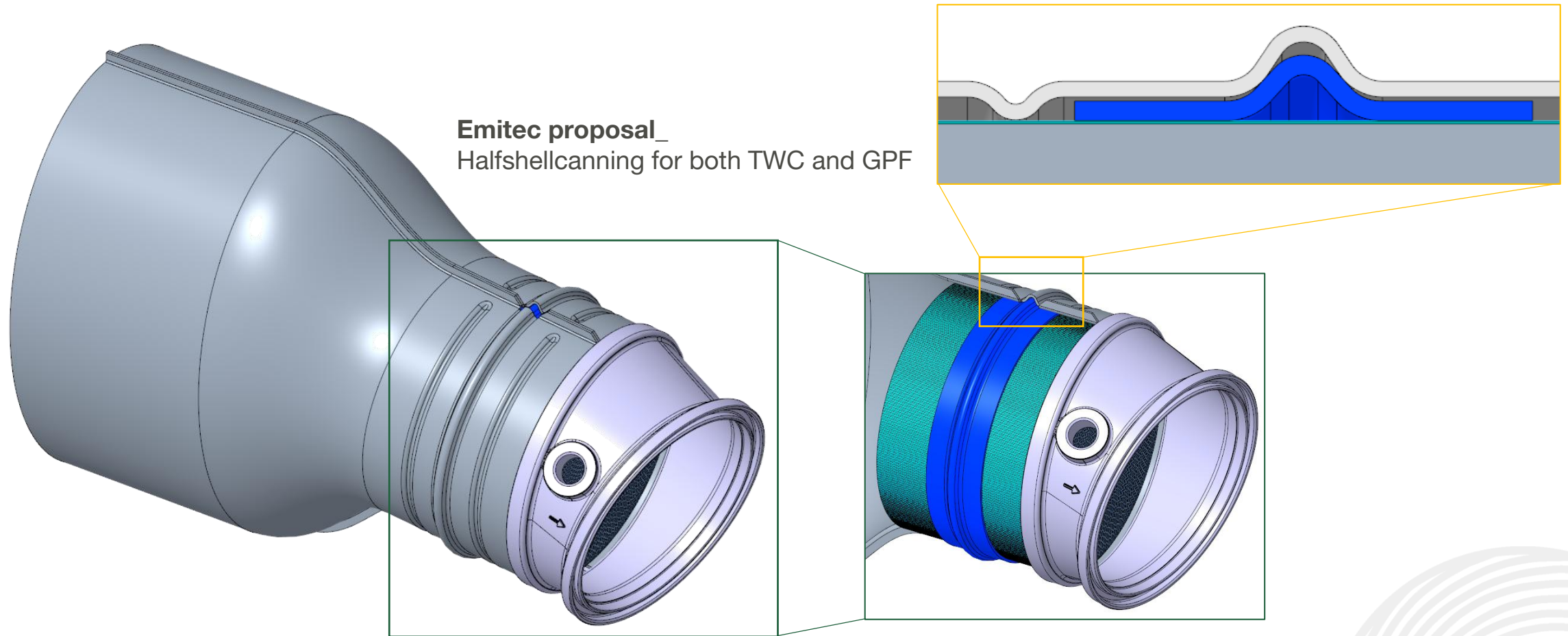
CLOSE COUPLED CATALYST WITH NEW BM-DESIGN

TWC + GPF CANNING FOR TURBO ENGINES



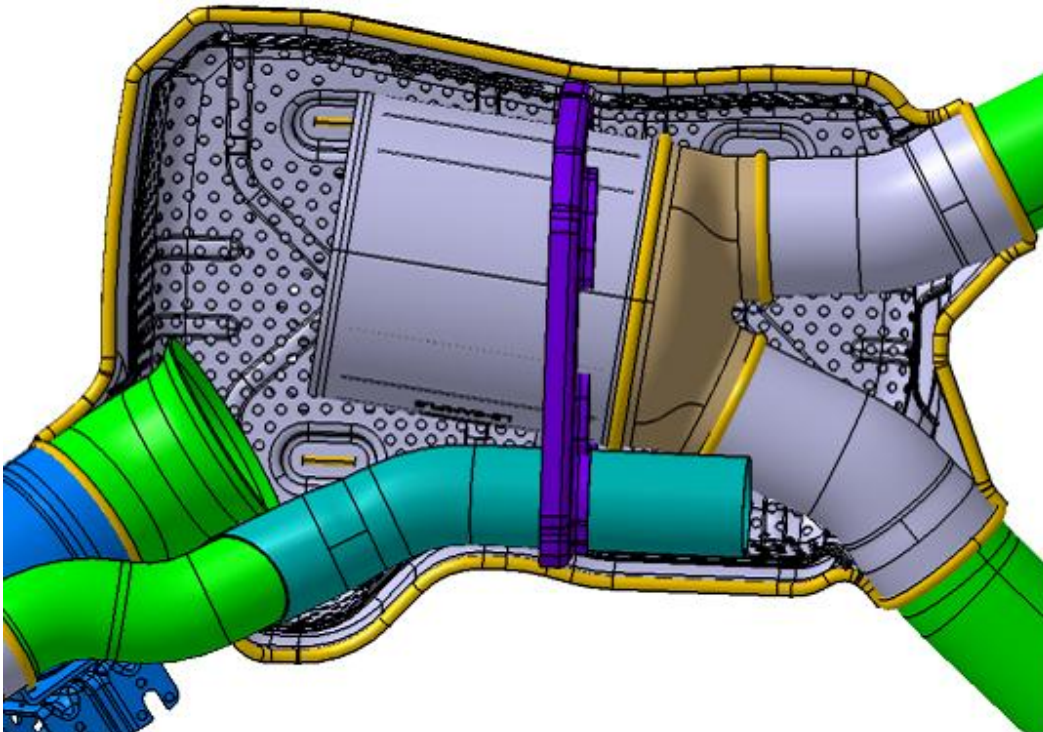
CANNING DESIGN PROPOSAL WITH BM-METALIT

EASY ASSEMBLY WITH HALF SHELL CANNING; TWC + GPF

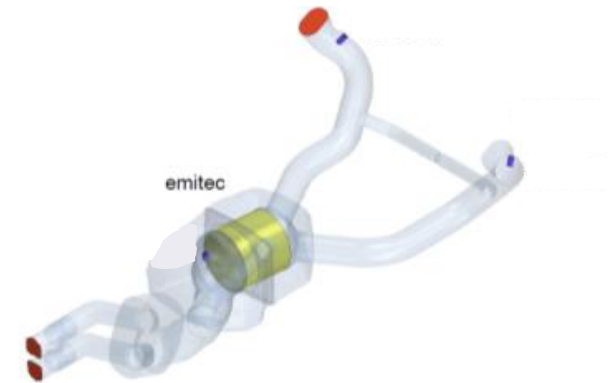


METAL CATALYST INTEGRATED IN MUFFLER

CONCEPTS FOR RANGE EXTENDER APPLICATIONS; ALSO WORKS WITH BM-METALIT



proven in motorbike and
sport car applications

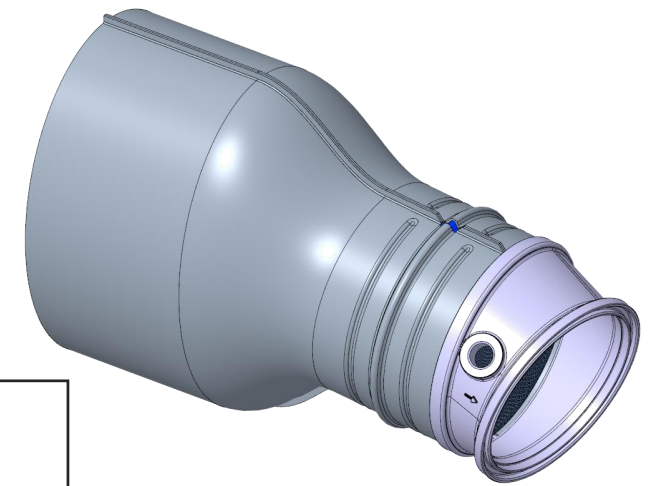


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- **CONCLUSION**



SUMMARY



- Combined CS-and BM-Design shows a significant potential to reduce emissions for future legislations
- or, in combination with reduced PGM loading, cost saving potential
- Hybrid and Rex applications have high demands on construction space
- The new BM-design offers multiple opportunities for a compact catalyst system layout
- Heat loss during cold start, operation and soak time is minimized to increase catalyst temperature

