

## Objectives

### Engine Integrated SCR

- Investigation of High Pressure SCR process; injection, mixing, decomposition and flow distribution with the aim of making the SCR components compact while still maintaining the same high performance as best available technology today
- Designing of engine integrated High Pressure SCR with system with unaffected engine footprint and only slightly affected gallery arrangement around the engine
- Testing of compact High Pressure SCR component performance on 4T50ME-X test engine

### Combined DPF and SCR

- 80% PM reduction with after-treatment system (based on IMO Tier II engine out emissions)
- 80 % NO<sub>x</sub> reduction with after-treatment system to reach IMO Tier III limits
- Reduce the necessary installation space for after-treatment system SCR on DPF within IMO Tier III (SCR only) system
- Adaption and integration of the after-treatment system (SCR on DPF) on a marine Diesel engine

# WP8: Engine Integrated SCR and combined SCR and DPF

## WP Leader

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## Partners

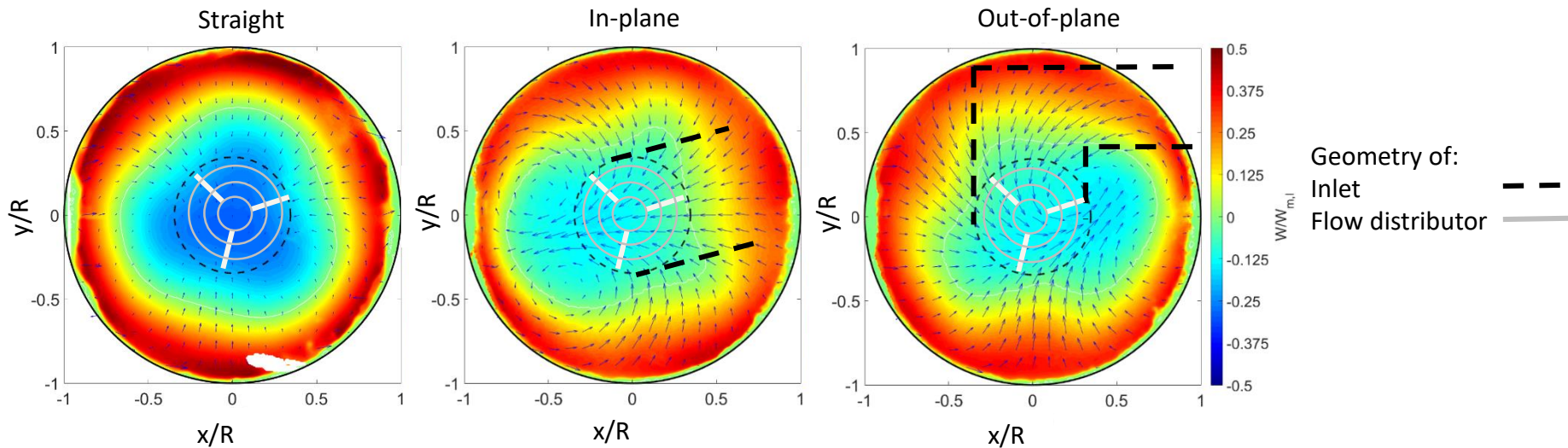
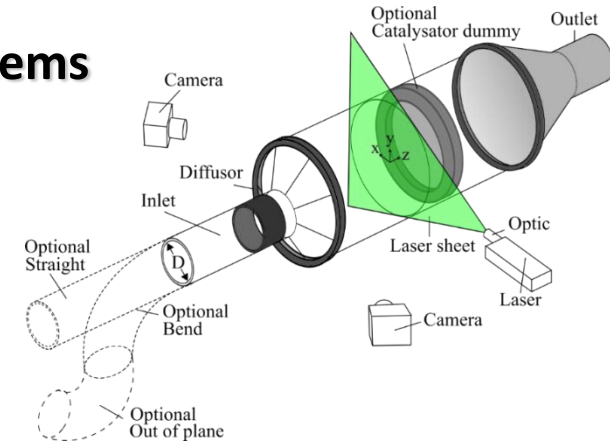
- LUH: Leibniz University Hannover (Hannover)
- DTU: Technical University of Denmark (Copenhagen)
- MDT: MAN Diesel & Turbo

## Roles

- LUH: Test rig for investigation of urea injection and decomposition
- DTU: Investigations of SCR mixing and flow distribution.  
Development of mechanism for  $\text{NH}_3$  measurements.
- MDT-CPH: Compact mixer, Integrated SCR design and  $\text{NH}_3$ -slip investigation.
- MDT-Aug: Catalyst coating and filter test bed. Selection & design of SCR on DPF prototype. Modelling of urea injection and decomposition.

### Main results achieved during 3<sup>rd</sup> year – Flow in SCR systems

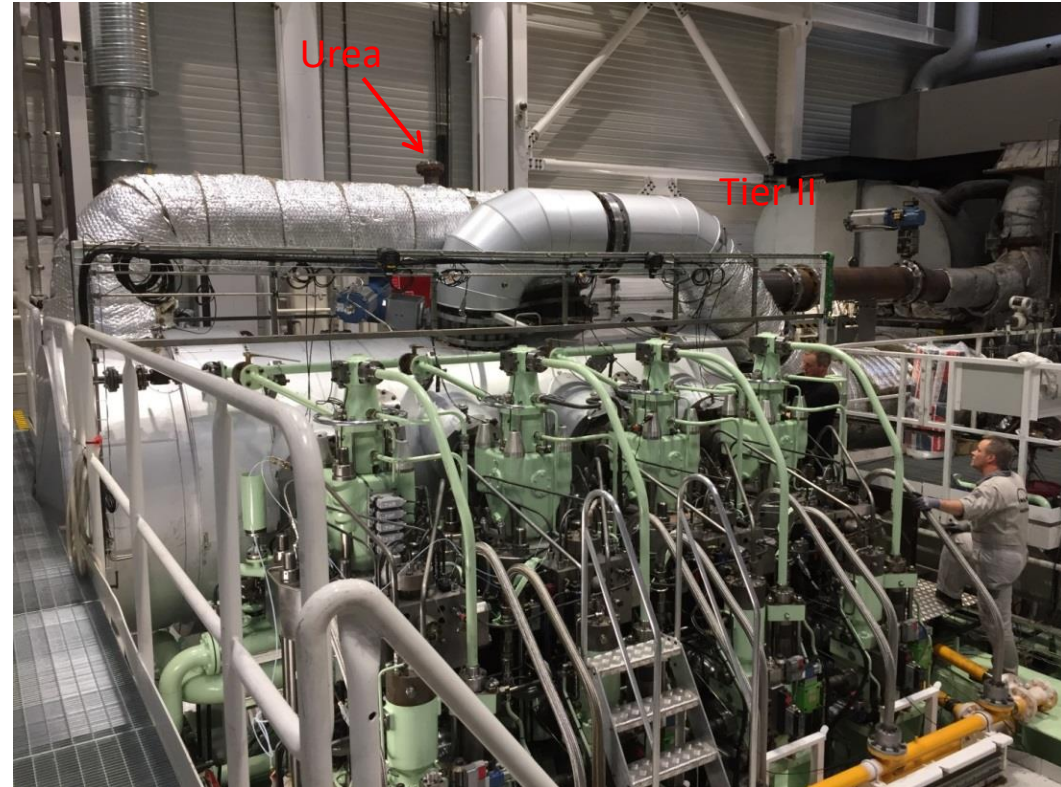
- The effect of different inlet conditions to the reactor is investigated for A straight pipe, in-plane bend and out-of-plane bend.



- Ongoing experiments, with pulsation flow in the straight pipe case:
  - Vortex shedding from flow distributor
  - Vortex breakdown due to catalysator dummy

### Main results achieved during 3<sup>rd</sup> year – Engine integrated HP SCR

- Manufacturing of new receiver
- Assemble new receiver
- Installation of new receiver
- commissioning engine with Integrated HP SCR
- Test integrated HP SCR system

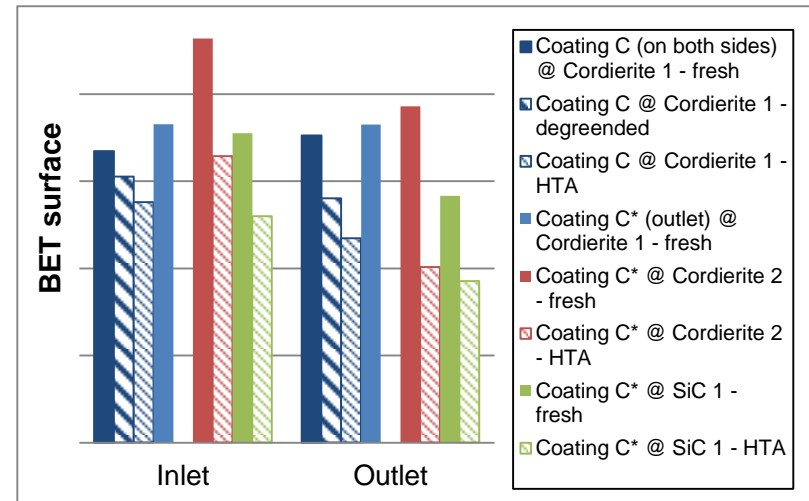


New receiver mounted on engine 4T50ME-X

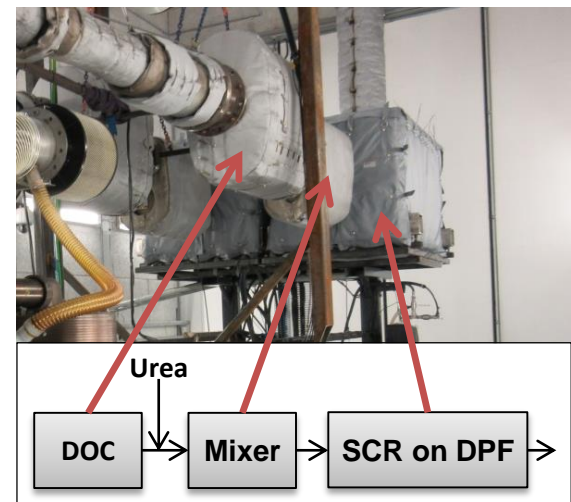
## WP8.2: Combined SCR and DPF

### Main results achieved during 3<sup>rd</sup> year

- Investigation of SCR coated Diesel particulate filters (DPF) in laboratory scale
  - SCR performance test including hydrothermal aging
  - BET surface of fresh and aged samples
  - Optical investigation with SEM/EDX
- Endurance test of Diesel oxidation catalysts (DOC) on engine test bed with marine distillate fuel
- Installation and validation of the EAT system comprising DOC, mixing unit and the benchmark system of SCR coated DPFs in full scale on an engine test bed



BET surface of SCR coated DPF



EAT system at engine test bed

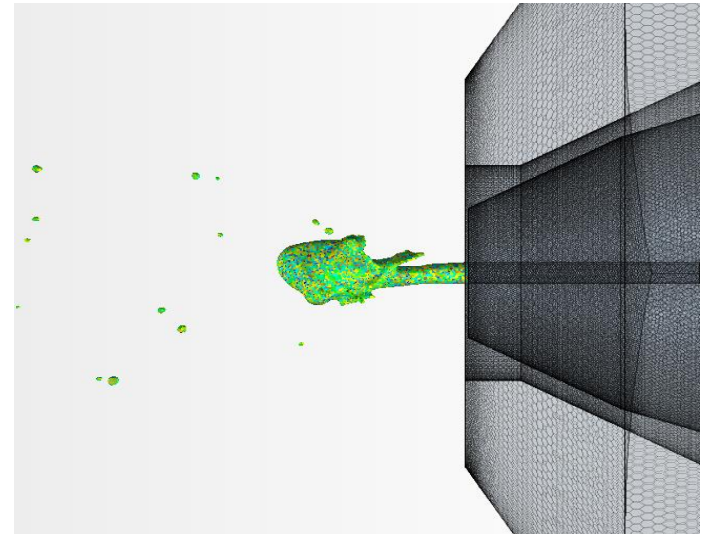


### Main results achieved during 3<sup>rd</sup> year

- Parametric study for PDA measurements
- Alternative urea decomposition
- Experimental study of urea spray breakup for various settings and new operating conditions
  - Improved nozzle configuration
  - Validation data for simulations
- Primary urea spray-break up in CFD simulation
  - Qualitative validation of spray with high-speed shadowgraphs



Instantaneous image of spray breakup



Simulated spray break-up

## Future Work

- Results from test with engine integrated HP SCR on 4T50ME-X
- Experiments with catalyst-like dummy (able to breakdown vortices)
- Endurance test of the DOC system on engine test bed with marine distillate fuel
- Investigation of the EAT system on engine test bed using different marine fuels
- Measurements on the hot gas test rig with alternative configurations
- Modelling of improved mixers and alternative configuration
- CFD simulation for air-assisted urea spray break up and its validation with experimental results