

# WP7: On-engine aftertreatment systems

## Objectives

- Integration of SCR (Selective Catalytic Reduction) with the existing strong Miller cycle 4-stroke diesel engine and combining it with particulate emission (PM) abatement technology would enable to achieve more than 80% NOx emission reduction and 25% reduction in PM. Also a combination of integrated SCR and EGR (Exhaust Gas Recirculation) is to be developed. Feasible solutions of combining the above mentioned technologies having as a target the near zero emission engine are also studied.
- Integrating methane and ethane abatement technology into lean burn 4-stroke gas engines will enable compact solutions to reduce methane and ethane slip. The objective is a catalytic system working with the engine and optimization of the engine performance. Also the knowledge on deactivation & regeneration strategies for integrated catalyst solutions and methane formation and location in the engine exhaust system should increase. Target is a greenhouse gas emission decrease up to 15% and fuel savings up to 5%.

WP Leader: Jukka Leinonen



Partners:  WÄRTSILÄ  VTT  Vaasan yliopisto  
UNIVERSITY OF VAASA  PAUL SCHERRER INSTITUT  
PSI

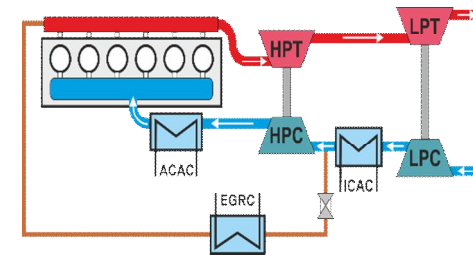
### Subprojects

- 7.1 Combined on-engine aftertreatment solutions for 4-stroke diesel engines
- 7.2 SCR reduction agent injection solutions
- 7.3 Integration of methane and ethane abatement technology with gas engines
- 7.4 Emission measurement systems for integrated after treatment technologies

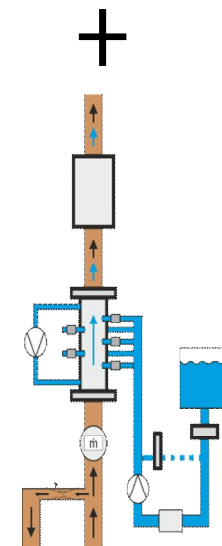
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## Progress update

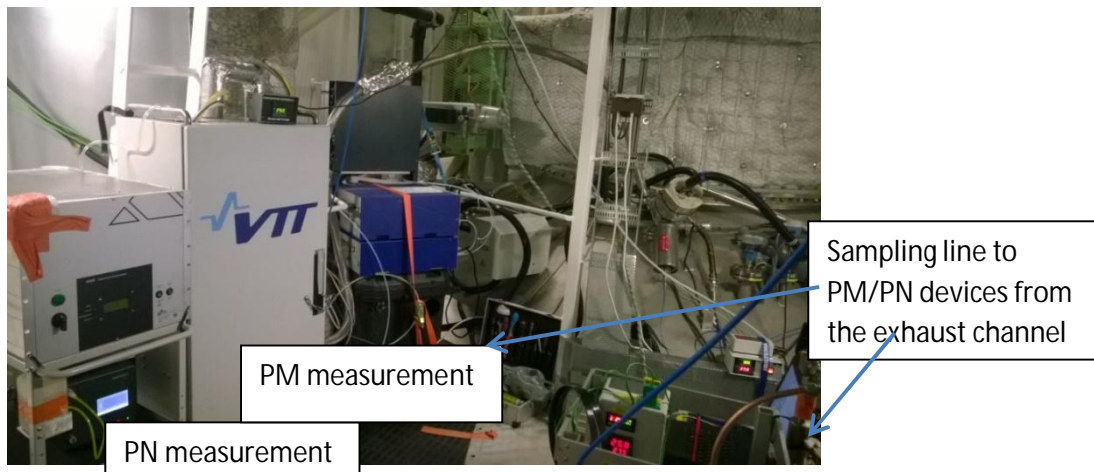
- PSI, Feasibility and demonstration of NOx and particulate reduction with pre-tests on test engine was completed and analysis & evaluation of available data has been evaluated and Analyzed. Work will continue due to plan.
- WFI, Activities are ongoing within schedule. PM measurement has been completed and reporting is started. SCR reduction agent injection solutions research work has been completed as a Thesis work.
- WSP, Feasibility and demonstration of integrated methane and ethane abatement with gas engine testing continues as planned.
- UV, Feasibility and demonstration of methane catalyst element has been continued with regeneration method study and experimental study has started.
- VTT, NH3 sensors test results are still under analysis. PM emission testing has been completed and results are under analyzes. Project schedule were update and delivery date of D7.2 was moved 6 months



*Semi-short route EGR setup*



*In-line Water-Fuel Emulsifier*



### Deliverables and Plan for future work

- Literature review regarding SCR engine integration and particulate abatement.
- Emission measurement systems for SO<sub>3</sub>, NH<sub>3</sub> and PM emissions to support integrated after-treatment technologies
- Experimental assessment of integration of methane and ethane abatement technology into gas engine structure
- Experimental assessment of SCR reduction agent injection systems with sensors for feedback control



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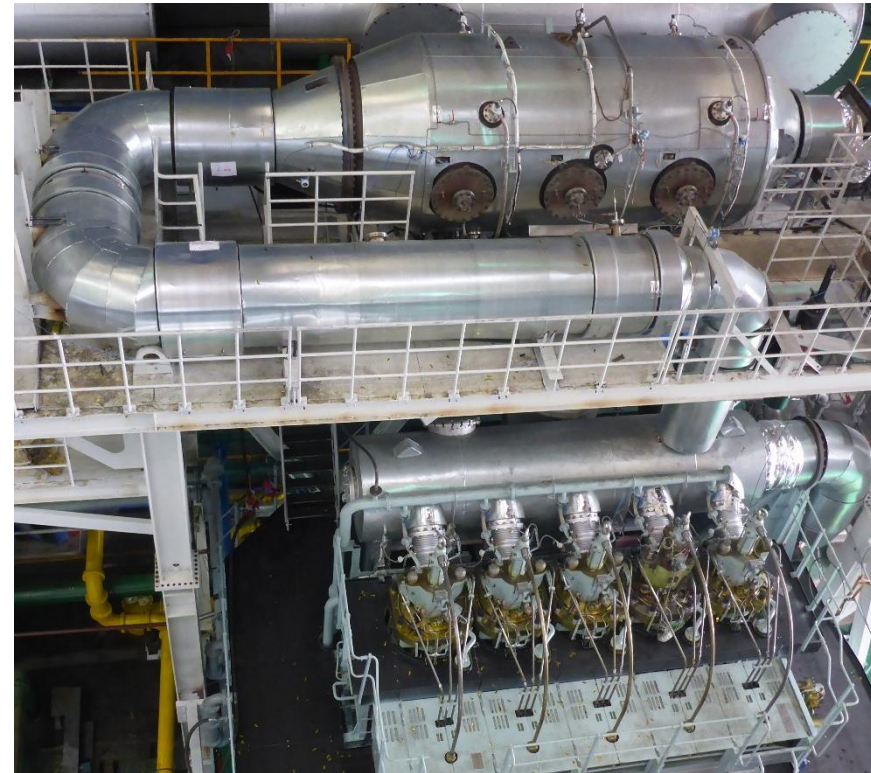
### Objectives of Work Package

Development of key technology for integration of the currently separated SCR aftertreatment into existing 2-stroke engine structure, which enables widespread installation of SCR systems on all ship types and additionally increase overall NOx removal efficiency above 80%, reduce overall hydrocarbon emissions (HCs) by 50% or more, reduce PM emissions and lead to potential fuel savings of up to 5%.

### Subproject

7.5 Robust catalysts for pre-turbo SCR

WP deputy: Daniel Peitz



WinGD pre-turbocharger SCR system

Partners:



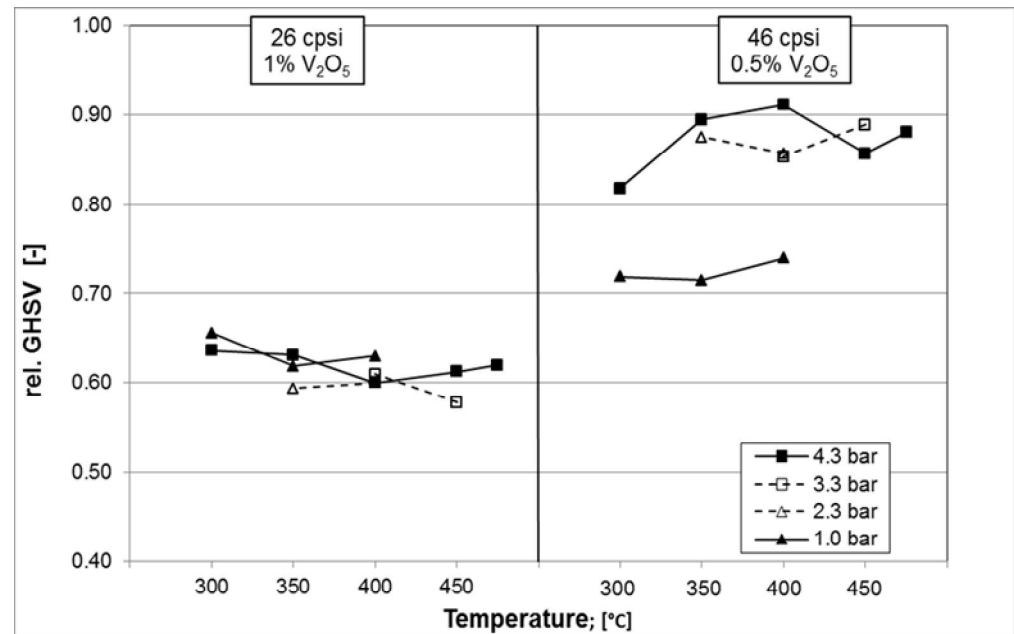
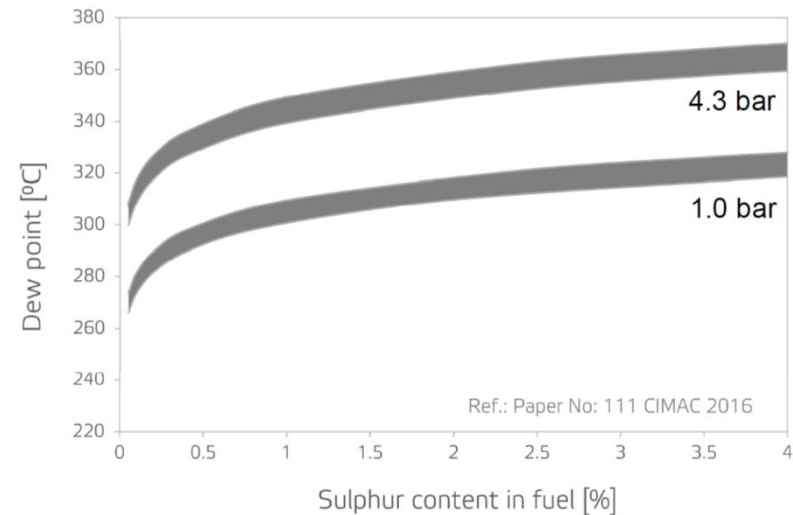
Johnson Matthey



## WP7: On-engine aftertreatment systems

Main results achieved during 2<sup>nd</sup> year  
WinGD/PSI

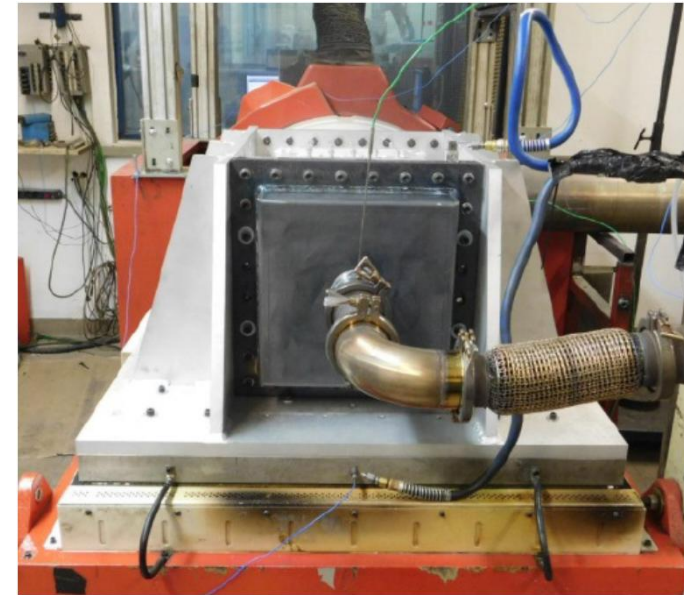
- Vibration test cycle specification for SCR components in future 2-stroke marine diesel engine SCR applications
- SCR catalyst durability against ammonium bisulphate (ABS) deactivation from high sulphur fuels investigated
- Safe operating temperatures for SCR defined from slip stream SCR tests
- Investigation of SCR reaction kinetics under elevated pressure



## WP7: On-engine aftertreatment systems

Main results achieved during 2<sup>nd</sup> year  
Johnson Matthey

- Vibration resistant catalyst modules were designed and manufactured
- Hot gas vibration test bench testing started, first vibration resistant designs identified
- Finishing of vibration test campaign delayed due to limited availability of test bench



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Main results achieved during 2<sup>nd</sup> year  
Dinex Ecocat

- Catalyst support designs were tested on cold-shake vibration test bench
- Designed catalyst metallic supports withstand vibration requirements
- Washcoat adhesion was further investigated, including alternative coating procedures





### Deliverables and Plan for future work

- Hot shake test of newly produced coated prototypes, supply of samples for field testing.
- Finish vibration tests and supply prototypes for field testing.
- Document and publish SCR reaction kinetics.
- Vibration testing of prototype SCR catalysts on engines operating in the field.

