

## 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



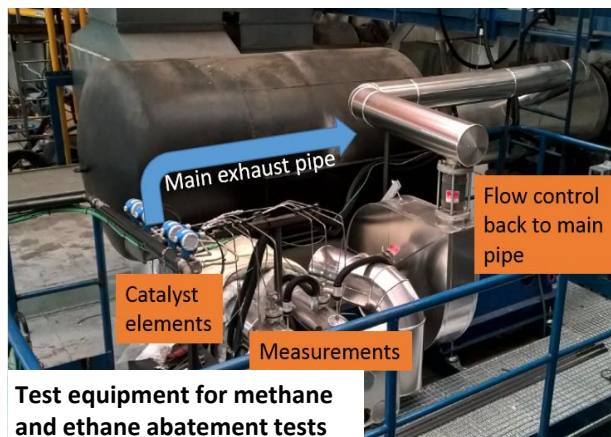
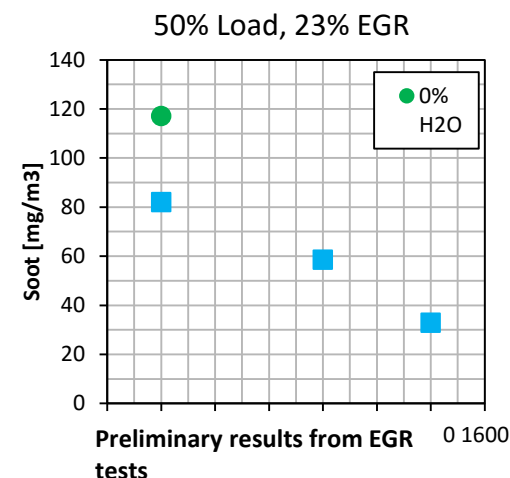
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### Subprojects

- 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

## Progress update

- PSI, Feasibility and demonstration of NO<sub>x</sub> and particulate reduction with pre-tests on test engine was completed and analysis & evaluation of obtained data is started. Work will continue due to plan.
- WFI, Activities are ongoing within schedule. PM measurement tests are ongoing and first results are under analysis.
- WSP, Feasibility and demonstration of integrated methane and ethane abatement with gas engine testing continues as planned.
- UV, First deliverable D7.1 regarding literature reviews ready and approved in schedule. Work will continue due to plan.
- VTT, NH<sub>3</sub> sensors testing was started due to plan and first results are under analysis. PM emission testing plans was updated and testing will be completed at the end of the second year of the project.



### 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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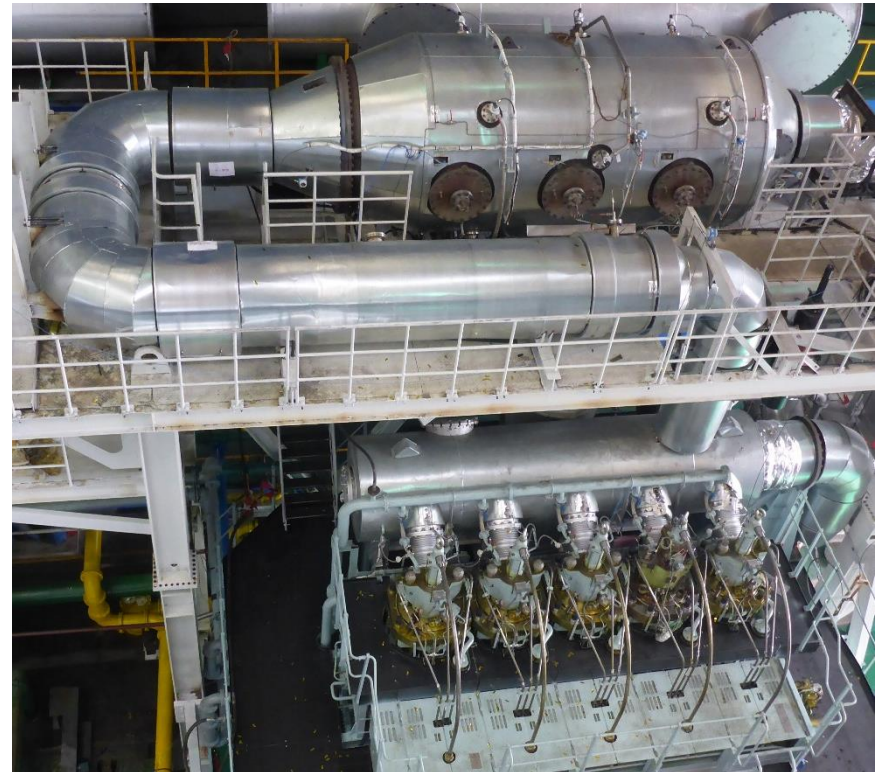
## Objectives of Work Package

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 NO<sub>x</sub> 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:

**WIN GD**  
Winterthur Gas & Diesel

**dINEX**  
**ECOCAT**  
Fresh Ideas - Cleaner Future®

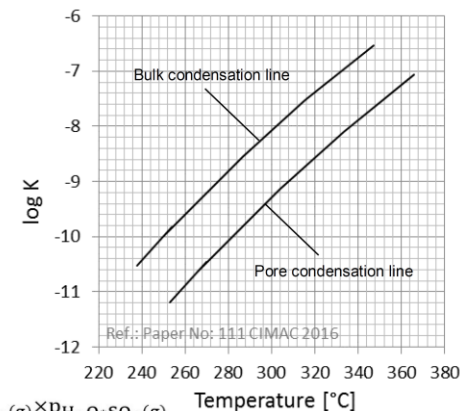
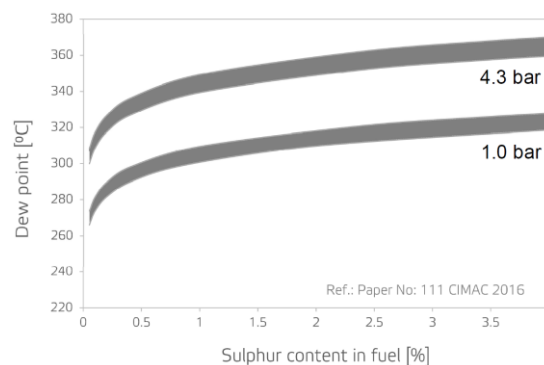
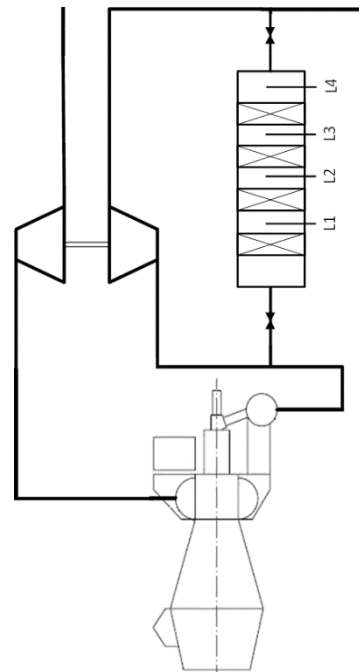
**JM**  
Johnson Matthey

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**PSI**



### Results for WinGD/PSI

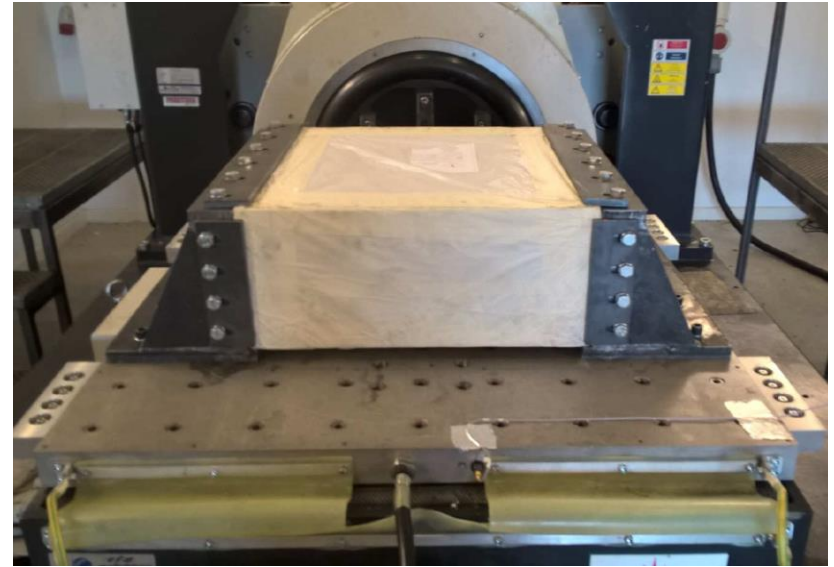
- Vibration test cycle specification for SCR components in future 2-stroke marine diesel engine SCR applications
- SCR catalyst durability against ammonium bisulphate (ABS) deactivation from high sulphur fuels investigated
- Safe operating temperatures for SCR defined from slip stream SCR tests



$$K = \frac{p_{\text{NH}_3(\text{g})} \times p_{\text{H}_2\text{O} \cdot \text{SO}_3(\text{g})}}{a_{(\text{NH}_3 \cdot \text{H}_2\text{SO}_4)(\text{cd.})}}$$

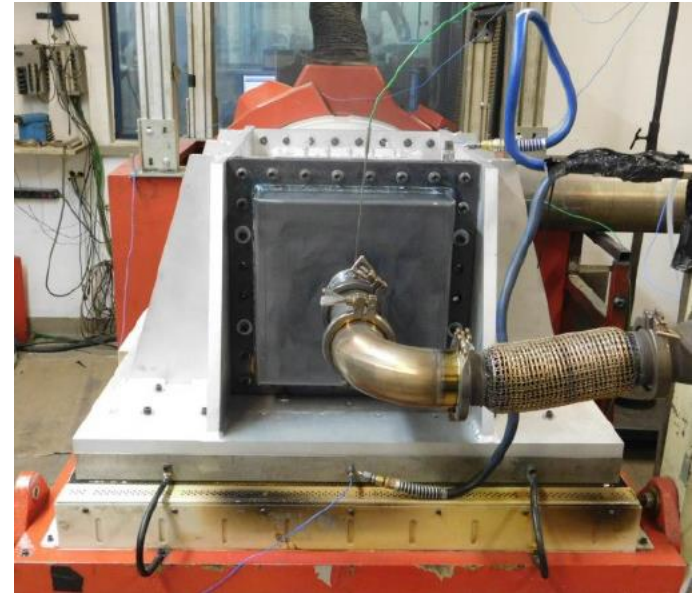
### Results for Dinex Ecocat

- Catalyst support designs were tested on vibration test bench
- Designed catalyst support prototypes withstand vibration requirements
- Washcoat adhesion will be further investigated and improved



### Results for Johnson Matthey

- Vibration resistant catalyst supports were designed and manufactured
- Hot gas vibration test bench testing started, but delayed due to test bench downtime and sample holder malfunction
- Sample holder to be reworked and test bench back in operation in October





### Deliverables and Plan for future work

- Further investigate Washcoat adhesion and produce prototypes for field testing.
- Re-weld hot gas vibration test bench, finish vibration tests and produce prototypes for field testing.
- Laboratory testing of catalyst performance and catalyst deactivation assessment.
- Vibration testing of prototype SCR catalysts on engines operating in the field.

