REAl World Advanced Technologies foR Diesel Engines

EUROPEAN COMMISSION
Horizon 2020
H2020-MG-2014-2015
GA No. 636380

Deliverable No.	REWARD D2.4	
Deliverable Title	Vehicle, engine and aftertreatment system simulation	
Deliverable Type	REPORT	
Dissemination level	Confidential – member only (CO)	
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Status	**Final**	2016-05-10
Checked by	Marco Tonetti (CRF) WP2 Leader	2016-05-10
Submitted to Executive Board	WP2	2016-05-10
Approved by Executive Board (EB)	Approved and accepted by all members of Executive Board	2016-05-31

H2020-MG-2014-2015 – 636380 – REal World Advanced Technologies foR Diesel Engines

Acknowledgement:

The author(s) would like to thank the partners in the project for their valuable comments on previous drafts and for performing the review.

Project partners:
1 - AVL - AVL List GmbH – AT
2 - REN - Renault SAS - FR
3 - VCC - Volvo Car Corporation - SE
4 - CRF - CRF SCpA - IT
5 - CNRIM - Instituto Motori – Consiglio Nazionale delle Ricerche (CNR) - IT
6 - JM - Johnson Matthey Plc - UK
7 - RIC - Ricardo Plc - UK
8 - SCF - Schaeffler Technologies AG & Co. KG - DE
9 - LMM - Le Moteur Moderne - FR
10 - DELPHI - Delphi Automotive Systems Luxembourg S.A. - LU
11 - UNR - Uniresearch BV - NL
12 - IFPEN - IFP Energies Nouvelles - FR
13 - VIF - Virtual Vehicle Research Center - AT
14 - CTH - Chalmers Tekniska Högskola - SE
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Disclaimer:
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 636380.

Executive summary

Recognising that real-world NO_X emissions have not decreased at the same rate as the legislated light-duty diesel (LDD) passenger car tailpipe emissions (from Euro 1 to Euro 6), the European Union is introducing the Real Driving Emissions (RDE) legislation with the aim to ensure real world and urban NO_X emissions reduction. This document details the activities within work package 2 (WP2) for the REWARD project. The main activity of this task was to review and specify the aftertreatment system for the applications within REWARD that are capable of meeting the program targets.

To provide aftertreatment recommendations a simulation approach was used that combined empirical data for engine feedgas properties and aftertreatment characteristics, as well as exhaust system thermal models and a representation of the vehicle operation. This system model was used to assess various aftertreatment systems for each application over relevant cycles to give the shortlist of recommended aftertreatment systems for further assessment. The approach chosen was to develop Simulink based models of the vehicle/engine and the aftertreatment systems using the Ricardo vehicle simulation framework (V-SIM) and utilising aftertreatment characteristic look-up maps in a separate exhaust system model. Each application had specific input data and boundary conditions that were considered during the aftertreatment system selection process.

A wide range of aftertreatment systems covering various levels of complexity and cost were simulated and the results were evaluated against a number of criteria including; emissions control capability, cost, packaging requirements, fuel consumption penalty and additional fluid consumption.

For NO_X control it was seen that Lean NO_X Trap (LNT) only systems typically struggled over aggressive RDE cycles owing to the high temperature and mass flows during the highway phase, whereas systems with active urea dosing such as selective catalyst reduction on filter (SCRF) had a wider temperature window for emissions control. The position of the SCR catalyst was found to influence the tailpipe emissions levels; a closely mounted system had a more favourable temperature profile during urban driving and therefore lower tailpipe NO_X emissions whereas conversely a system mounted underfloor and further away from the engine had better high speed emissions control owing to the reduced temperature profile.

Following reviews of the simulation results with each vertical work package within REWARD aftertreatment system recommendations were made for each application to be taken forward for assessment, as detailed below.

WP	AT Recommendation
2	LNT+SCRF
5	LNT+SCRF
6	LNT+SCRF+ u/f SCR