# REWARD

REal World Advanced Technologies foR Diesel Engines

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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 AG - 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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## Publishable Executive summary

Low and ultra-low viscosity lubricants have a high potential to reduce hydrodynamic friction in combustion engines. At the same time, the exposure of metal-metal contact between the contacting components increases which leads to a high wear risk. Therefore, this study focuses on the evaluation of the potential fuel savings and $CO_2$ reduction by making use of (ultra)low viscosity engine oils. In addition, a numerical analysis is performed to assess critical lubricated contacts in terms of wear risk when using thinner oils.

An approximative approach relating the engine friction reductions to actual fuel savings and $CO_2$ reductions in the WLTP driving cycle is presented. For this evaluation, the engine friction losses are needed for a wide range of operation conditions (speed and load) which can either be gathered from measurement or simulation. In this study, the approach is applied to the measurement results obtained previously in this project (see Deliverable D3.10 and Sander et al. "*Friction reduction tested for a downsized diesel engine with low-viscosity lubricants including a novel polyalkylene glycol*." Lubricants 5.2 (2017): 9.). The evaluation of 0W20 and 0W16 (polyglycol based lubricant) compared to a standard 0W30 engine oil for the WLTC driving cycle show a clear benefit.

To assess the corresponding wear risk by using (ultra)low viscosity lubricants, elasto-hydrodynamic simulations are conducted for the critical lubricated contacts: main bearings, big end bearings and piston. Detailed oil models are included in the simulation which consider the temperature, pressure and shear rate dependency of viscosity and density. Oil grades from 0W20 to 0W8 are investigated. The investigations show an up to four times higher wear risk for the 0W8 engine oil compared to the 0W20 engine oil.

To summarize the findings in this subtask, it can be concluded that the common way of reducing engine friction by utilizing lower viscous oils appears to reach its limits. The obtainable benefit is not only shrinking in comparison to previous lubricant developments, but also the inherent wear risk is increasing at the same rate. While the usage of these ultralow viscosity oils might still bring a small advantage for fuel economy, the associated friction as well as the wear under full load operation will increase significantly and might affect engine lifetime negatively.