# ENERGETICS

## Ammin/Wartsila - Oil transport in combustion chamber phenomenology for carbon neutral fuels in internal combustion engines for marine applications

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| **Context of the research activity** | Eliminating GHG as well as reducing combustion emissions from Internal Combustion Engines (ICEs) in marine transportation and stationary powerplants (for grid balancing with intermittent renewable power generation) is of paramount strategical importance for OEMs to contribute achieving global warming targets.<br>Considering the emerging engine combustion technologies exploiting alternative fuels, the need for further understanding of the phenomenology of oil entrainment and transportation in the combustion chamber has become imperative. The importance of oil amount and location in the combustion chamber is already widely recognized as a crucial factor affecting abnormal combustion phenomena, such as back fire and pre-ignition, in pre-mixed LNG and H2 fuelled ICEs. Currently, limited knowledge is only available in literature for oil entrainment and transport from the piston top land and liner wall, and the link with the onset of abnormal combustion phenomena triggered by oil particles is still missing for a robust combustion design of a new generation of hydrogen fuelled engines. The abovementioned abnormal combustion phenomena involve a wide range of factors, such as: a) local air/fuel ratio, b) local temperature of mixture or components, c) flow velocity field and d) local concentration of oil vapor and oil combustion products.<br>The synergic exploitation of CFD analyses and “ad hoc” experimental tests can offer a deeper and better understanding of oil transport in combustion chamber phenomena, paving the way for the development of a new generation of marine and stationary engines fuelled with carbon neutral fuels. |
| | The objectives of the research proposal are to develop a methodology that can provide a better understanding of how the top land/liner oil interact with air flow during the induction and compression stroke and how the above-mentioned parameters affect the oil entrainment and transportation into the combustion chamber, then triggering autoignition and other abnormal combustion phenomena.<br>One stream of the research activity will focus on the methodology |

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| **Objectives** | development in CFD environment.<br>A second stream of the research activity will aim to gather a deeper understanding of the impact of different parameters and engine design features. The parameters of interest are:<br>- Oil characteristics in the top land area: i.e. oil amount, temperature.<br>- Location of the oil in the top land area: i.e. single zone high concentration, multi spot concentration, even oil amount distribution<br>- Top land geometry: i.e. top land height, liner gap<br>- Inlet flow characteristic: i.e. quiescent chamber, swirl chamber or tumble chamber, influence of inlet port and flame plate design<br>- Oil film thickness on the liner walls.<br><br>The two above-mentioned streams are meant to be brought forward in parallel. |

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| **Skills and competencies for the development of the activity** | - Excellent knowledge of fluid-dynamics and engine thermodynamics<br>- Knowledge of 1D/3D CFD simulation codes (such as GT-SUITE, CONVERGE CFD) |