# D2.1 – Fuel Matrix for future HD engines

Research Innovation Action

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## Publishable summary

The first deliverable of the Longrun project is a report on the most promising fuels for future HD applications. One of the project objectives is to develop a robust ICE engine technology for future fuels while achieving a major well-to-wheel $CO_2$ reduction. This objective shall be reached by provision of pathways how highly efficient renewable fuels (from production and combustion side) can be used in existing fleets using also retrofit solutions.
The project partners (OEMs, engineering partners and fuel suppliers) discussed about possible sustainable fuels and combustion systems which are promising with regards to high thermal efficiency, low engine out emissions and suitability for current and modified fuel infrastructures.

The selected fuels are hydrogen, methanol and paraffinic diesel such as HVO (Hydrogenated Vegetable Oils) or synthetic diesel produced by the Fischer Tropsch synthesis. Herein, the paraffinic diesel used is "Neste My Renewable Diesel ™"

Paraffinic diesel has been chosen because it is one of the few renewable fuels compatible with current vehicle fleet and fuel infrastructure, thereby allowing an immediate impact on W2W-$CO_2$ emissions. In addition, paraffinic Diesel shows a lower sooting tendency compared to fossil Diesel, thereby allowing to optimize the engine hardware and software for improved thermal efficiency, e.g. by increased compression ratio without sacrificing engine-out soot level.

Hydrogen was selected being the only fuel allowing immediate reduction of Tank-to-Wheel (T2W) $CO_2$ emissions, which is particularly important for OEMs bearing in mind the current $CO_2$-Legislation on T2W-basis. Furthermore, $H_2$ also allows a W2W $CO_2$-neutrality with lowest energy loss in the conversion process, both on the power-to-fuel side and the fuel-to-power side. The clear shortcoming of $H_2$ is the fuel infrastructure and fuel handling. However, being a central element in the renewable energy ecosystem and therefore strongly supported by a large number of European governments, the infrastructure for $H_2$ is assumed to improve significantly in the future.

Methanol was selected being the fuel with the best compromise in the tradeoff between fuel production and transportability. In contrast to typical spark-ignited methanol combustion, a new combustion concept was selected where methanol is burned diffusively in a compression ignition (CI) engine. To enable CI of methanol, a diesel pilot is used to preheat the combustion chamber. The resulting process allows to operate on a high compression ratio thereby achieving high thermal efficiency.

It's worth mentioning here that ethers are potential fuels for CI-engines as well but were not selected here due to different reasons. In a nutshell, DME is considered in a parallel work package and results will be transferred. OME is considered as highly potential but was not selected due to the limited availability of high-quality OME allowing extensive testing and due to the several compatibility shortcomings with standard diesel injection systems. A detailed investigation of ethers as a fuel for CI engines is suggested for future projects.

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**Project partners:**

| # | Partner | Partner Full Name |
|---|---|---|
| 1 | FEV | FEV EUROPE GMBH |
| 2 | DAF | DAF TRUCKS NV |
| 3 | FPT | FPT INDUSTRIAL SPA |
| 4 | FORD | FORD OTOMOTIV SANAYI ANONIM SIRKETI |
| 5 | IRIZAR | IRIZAR S COOP |
| 6 | IVECO | IVECO S.p.A. |
| 7 | VOLVO | VOLVO TECHNOLOGY AB |
| 8 | VDL | VDL ENABLING TRANSPORT SOLUTIONS BV |
| 9 | ABEE | AVESTA BATTERY & ENERGY ENGINEERING |
| 10 | AVL | AVL LIST GMBH |
| 11 | EATON | EATON ELEKTROTECHNIKA SRO |
| 12 | GARR | GARRETT MOTION CZECH REPUBLIC SRO |
| 13 | IDIADA | IDIADA AUTOMOTIVE TECHNOLOGY SA |
| 14 | IFP | IFP Energies Nouvelles |
| 15 | AVL | AVL MTC MOTORTESTCENTER AB |
| 16 | NESTE | NESTE |
| 17 | PRIMA | PRIMAFRIO SL |
| 18 | SHELL | SHELL GLOBAL SOLUTIONS (DEUTSCHLAND) GMBH |
| 19 | SIE | SIEMENS INDUSTRY SOFTWARE SAS |
| 20 | TECHNA | FUNDACION TECHNALIA RESEARCH & INNOVATION |
| 21 | TOTAL | TOTAL MARKETING SERVICES |
| 22 | UMIC | UMICORE AG & CO KG |
| 23 | UNR | UNIRESEARCH BH |
| 24 | JRC | JRC -JOINT RESEARCH CENTRE – EUROPEAN COMMISSION |
| 25 | CHALM | CHALMERS TEKNISKA HOEGSKOLA AB |
| 26 | RWTH | RHEINISCH-WESTFAELISCHE TECHNISCHE HOCHSCHULE AACHEN |
| 27 | TU/e | TECHNISCHE UNIVERSITEI EINDHOVEN |
| 28 | TUG | TECHNISCHE UNIVERSITAET GRAZ |
| 29 | UNIAQ | UNIVERSITA DEGLI STUDI DELL'AQUILA |
| 30 | VUB | VRIJE UNIVERSITEIT BRUSSEL |

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