Heavy Duty Gas Engines integrated into Vehicles

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Project partners:
1 - AVL - AVL List GmbH - AT
2 - BWR - Borgwarner Ludwigsburg GmbH - DE
3 - BOSCH - Robert Bosch GmbH - DE
4 - DAI - Daimler AG - DE
5 - DINEX - Dinex Ecocat OY - DK
6 - FPT - FPT Industrial S.p.A. - IT
7 - IDIADA - Idiada Automotive Technology S.A.- ES
8 - IVECO - Iveco España SL - ES
9 - MAN - MAN Truck & Bus AG - DE
10 - POLIMI - Politecnico di Milano - IT
11 - RCD - Ricardo UK Limited - UK
12 - SAG - SAG Motion GmbH - AT
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Executive summary

NG has been considered a viable alternative to diesel fuel in HD applications for the past twenty years. Its advantages are mainly related to lower emission levels of such pollutants as nitrogen oxides (NO_x) and particulate matter (PM) and to lower combustion noise. Thanks to these advantages, NG engines were used at first in urban applications such as urban buses and garbage collection trucks, but then the interest in such vehicles has grown, and the use in mid-range mission (e.g. distribution) has become common. The lower cost of the fuel, compared to diesel fuel, certainly helped the diffusion. Now, market is ready to extend the use of NG vehicles also to long-haul mission.

NG has other advantages in comparison to diesel fuel: gas fields are more widespread on Earth than oil fields and, due to the highest H/C ratio, it is the hydrocarbon which produces less kg of CO_2 per kg of fuel. Therefore, trying to shift a relevant part of energy production from diesel fuel to NG will diversify the countries from which EU members buy their energy raw materials, thus reducing EU dependence from oil and its derivative. And it will reduce CO_2 production, helping EU countries to meet the limits imposed by GHG treaties.

On the other hand, NG has two main disadvantages: at ordinary temperature conditions, it is a gas, so the content of energy per unit of volume is lower than liquid fuels and, secondly, distribution network is still not developed homogenously in all EU countries. But, if NG engines must effectively be an alternative of diesel ones also in log-haul missions, these disadvantages can be overcome. LNG has an energy density 3.5÷4 times higher than CNG, therefore the distance covered by such NG vehicles becomes comparable to the range of diesel vehicles.

EU launched in 2013 the “Blue Corridors” project, followed by 15 other projects, all aimed at developing a network of LNG filling stations all over the EU: this network will aid the diffusion of LNG, making it an “ordinary” fuel, just like diesel fuel, and paving the way for the use of NG vehicles in long-haul missions. About 150 LNG trucks have been monitored and are currently running across Europe to demonstrate the viability of this technology for long distance applications. Iveco has recently launched Stralis NP version (equipped with Cursor 9 NG) selling already more than 1000 units over the past 6 months.
Moreover, in 2015 the EU launched the HDGas project, to design, build and test the basic components of a new generation of NG vehicles: LNG tanks, ATS and engines.

HD NG engines are currently derived from parent diesel engines, in order to exploit common components, thus keeping the engine cost as low as possible. By doing so, however, some basic components, such as the cylinder head, turbine, injection system and after treatments have to be developed specifically.

WP4 of the HDGas project is devoted to the design, building and testing of a new SI engine, specifically destined to the use of NG as its fuel, in order to bring the thermal efficiency of the NG engine as close as possible to the limit imposed by Thermodynamics. Aiming at this goal, the HDGas engine has been completely redesigned, introducing, for the first time on a HD engine, technical solutions that are the state of the art of SI engines, and that involve the combustion system (combustion chamber and intake ports), fuel direct injection, valve timing. An innovative ignition system is also present, in order to improve thermal efficiency, mainly when working at partial load.

This report describes the work carried out to design the main sub-components of FPT HDGas engine.