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Evaluating Synergies between Fuels and Near Term Powertrain Technologies through Vehicle Drive Cycle and Performance Simulation

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ABSTRACT

The main focus nowadays for the development of future vehicle powertrain systems is the improvement in fuel efficiency alongside the reduction of pollutant emissions and greenhouse gasses, most notably carbon dioxide.

The automotive community is already engaged in seeking solutions to these issues, however, the ideal solution, namely zero emission vehicle is still regarded as being a long way from fruition for the mass market. In the meantime steps are being taken, in terms of engineering development, towards improved fuel efficiency and sustainability of relatively conventionally powered vehicles.

One approach to the decarbonisation of road vehicles is to supplement existing fossil fuels with sustainable biofuels.

The present study examines the effect of a variety of gasoline/alcohol fuel blends on the performance of spark ignition engine vehicles and the potential of suitable ‘near to market’ technology, using a combination of dynamometer measurements for a high technology downsized engine, running on a variety of fuel blends, and a detailed vehicle simulation model. Fuel consumption, and hence CO2 emissions, results are presented for the technology and fuel combinations over a number of legislative and ‘real world’ drive-cycles.

Vehicle simulation was also used to investigate vehicle transient response, which is key to successful engine downsizing. A model was developed, and is presented here, to enable the assessment of the influence of the torque build-up of a turbocharged engine upon vehicle performance. The successful implementation of this model allowed results from transient engine dynamometer testing to be translated into vehicle acceleration times.

The outcome of this analysis provides a recommendation for suitable fuel and technology combinations for the development of passenger car engines, for the near to mid-term time frame, that deliver a significant reduction in CO2 while maintaining “drivability”.

It is shown that tank-to-wheel reductions of up to 38% in CO2 emissions are possible with currently available technologies across the NEDC drive-cycle. The correct biofuel blends with RON levels between 100 and 102 offer the majority of the benefits and are shown to enable significant further tank-to-wheel CO2 reduction potential.