

Heavily Downsized Gasoline Demonstrator

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Abstract

Gasoline engine downsizing is already established as a proven technology to reduce automotive fleet CO₂ emissions by as much as 25 %. Further benefits are possible through more aggressive downsizing, however, the trade-off between the CO₂ reduction achieved and vehicle drive-ability limits the level of engine downsizing currently adopted. This paper presents results showing the benefits of adding an eSupercharger to a very heavily downsized engine. Measurements are presented from a 1.2 litre, 3-cylinder, engine fitted with an eSupercharger in addition to a conventional turbocharger.

The original MAHLE downsizing engine has been re-configured to enable a specific power output in excess of 160 kW/litre. Of key importance is a cost effective, efficient and flexible boosting system. The Aeristech eSupercharger, operating at 48 V, enables the transient response and low speed torque to be more than recovered, enabling both very high specific output and specific torque characteristic with excellent transient response and drive-ability characteristics, clearly demonstrating eSupercharging as a key technology for enabling further engine downsizing.

The resulting heavily downsized engine is to be installed into a demonstrator vehicle. The vehicle will feature an advanced 48 V lead-carbon battery pack and a 48 V belt-integrated starter generator (BiSG). The battery and BiSG have been selected to enable the continuous high-output (>6 kW) operation of the eSupercharger to support prolonged operation of the engine at low-speed and high-torque output. The 48 V architecture also enables the use of electrical machines and energy storage systems to reduce drive-cycle CO₂ through the recuperation of energy during deceleration events.

The eSupercharging concept described in this paper also provides the potential to enable greater ability to operate with low levels of valve overlap, to help minimise emissions at low engine speeds. The resulting engine layout achieves 193 kW from a 1.2 litre swept volume and 317 Nm torque is available from 1250 min⁻¹, whilst excellent fuel economy and drivability characteristics are retained.