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Dynamic Downsizing Gasoline Demonstrator

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Abstract

Gasoline engine downsizing is already established as a technology for reducing vehicle CO_2 emissions. Further benefits are possible through more aggressive downsizing, however, the trade-off between the CO_2 reduction achieved and vehicle drive-ability limits the level of engine downsizing currently adopted by vehicle manufacturers. This paper will present the latest results achieved from a very heavily downsized engine, and resulting demonstrator vehicle, featuring eSupercharging in combination with a conventional turbocharger.

The original 1.2 litre, 3-cylinder, 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 driveability characteristics, clearly demonstrating eSupercharging as a key technology for enabling further engine downsizing.

The resulting heavily downsized engine has been installed into a demonstrator vehicle that also features an advanced 48 V lead-carbon battery pack and a 48 V belt-driven 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 resulting demonstrator vehicle will be described and vehicle performance and driveability metrics will be discussed in the context of controlling the various torque sources and boosting system devices available during a ‘tip-in’ event. The drive-cycle CO_2 performance is presented for a variety of cycles (NEDC, WLTP and RDE).