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Responsiveness of a 30 Bar BMEP 3-Cylinder Engine: Opportunities and Limits of Turbocharged Downsizing

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ABSTRACT

Thanks to direct injection and turbocharging, downsizing technology has found widespread acceptance in series production engines. Fuel consumption for NEDC and also real world driving conditions can be reduced significantly depending on the extend of downsizing. For future applications 3 cylinder gasoline engines have already been announced for up to 140 kW by premium OEMs.

Recent developments focus on well-adjusted downsizing rates taking into account merits and demerits of conventional charging technologies. One of the biggest challenge in the development process is to meet the customer's demands regarding vehicle driveability for downsized turbocharged gasoline engines for real world driving conditions.

Scavenging has proven to be very beneficial to meet the required vehicle responsiveness. Pressure charged production engines are now delivering more than 200 % of the BMEP that was typical for naturally aspirated engines a few years ago. With the introduction of direct injection the way was cleared for scavenging combustion method without an increase in engine-out hydrocarbon emissions. Today with respect to real world vehicle test procedures, emission analysis for the whole operating region needs to be considered. Latest disclosure of the European Commission can be concluded as follows:

- there has been little change in total NO_x emissions during the last 15 years
- 69 % of NO_2 and NO_x emissions are caused by local traffic
- RDE test procedures for gaseous emissions will be introduced in September 2017 [1].

A distinction of diesel and gasoline application cannot be expected in context of future emission legislation.

The Institute for Internal Combustion Engines and Powertrain Systems (VKM) of the TU Darmstadt started a measurement campaign - steady state as well as transient - in order to investigate the different options namely standard scavenging, stoichiometric scavenging and electrified air path way to investigate the capability of passing real world driving emission test procedures of extreme downsizing concepts.

The research activities on downsizing engines and engines for hybrid drive trains are carried out together with project partner, MAHLE International GmbH.