# Application of 2-stage turbocharging to large diesel engines: Recent developments and new perspectives

# Anwendung der zweistufigen Aufladung auf Grossdieselmotoren: Aktuelle Entwicklungen und neue Perspektiven

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Abstract: The development of emissions regulations, specifically the introduction of ever more stringent NOx emission limits, has triggered the re-consideration of 2-stage turbocharging concepts for large medium- and low-speed diesel engines and concepts are developed in order to overcome issues related to low-load performance and load acceptance. The potential for obtaining significant NOx reductions by combining high-pressure turbocharging with early intake (4-stroke) respectively late exhaust (2-stroke) valve closure has been shown in the context of tests on various prototype installations. Even if this potential may not be sufficient for achieving compliance with the most challenging standards in the industry, the very attractive NOx / fuel consumption trade-off levels make 2-stage turbocharging an essential part of integrated concepts for this purpose. Generally, its application offers new opportunities for further optimizing performance and for realizing maximum overall efficiencies of highly integrated systems. Finally, the feasibility of a very compact 2-stage turbocharged production engine design without compromises in terms of performance, reliability or serviceability has been demonstrated.

Key Words: 2-stage turbocharging, large diesel engine, NOx emissions, NOx / fuel consumption trade-off, load acceptance

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