VTES

Electric Supercharger

Variable Torque Enhancement System

System Description

A fully integrated electric supercharger including all control and power electronics.

VTES (Variable Torque Enhancement System) is an air cooled Switched Reluctance machine, coupled to state of the art electronics and an optimised radial compressor, delivering high airflow, pressure and efficiency.

The product is designed for integration into both Otto and Diesel engines to deliver enhanced torque, emissions control and CO_2 reduction. It can be optimised to achieve effective engine boosting when used in conjunction with a turbocharger, or on its own.

VTES is optimised to use the standard 12V vehicle architecture.

The system can be applied to new or existing vehicles much more rapidly and at lower cost and investment than competitive solutions.

VTES	Performance
Maximum Pressure Ratio	1.45
Maximum Speed	70,000rpm
Time to Maximum Speed	<350ms
Peak Shaft Power	1.7kW
Current Draw – Idle	1.5 Amps
Current Draw – Acceleration	350 Amps
Current Draw – Steady State	220 Amps
Operating temperatures	-40°C to +125°C

Down-sizing applications...

Current small naturally aspirated Otto engine (<1.6l)

- 13% CO_2 reduction with no loss of performance
- 40% torque increase with no CO_2 penalty

Extreme 1.2l turbo Otto engine

- >50% stabilised torque increase at lower engine speeds
- Up to 25kW power increase below 3000rpm
- >95% of stabilised torque available at 1s (87% after 0.5s)
- >20% CO_2 reduction potential enabler

2.0l turbo Otto engine for SUV/Pick up/Minivan

- Enables >40% downsize for >15% CO_2 reduction
- Up to 25kW power increase at low rpm for launch assist

Mid-range Diesel for Light Commercial Vehicle (LCV)

- Torque increase & transient response equivalent to twin turbo system
- Delivers up to 10% CO_2 reduction in LCV

Emissions Control Application

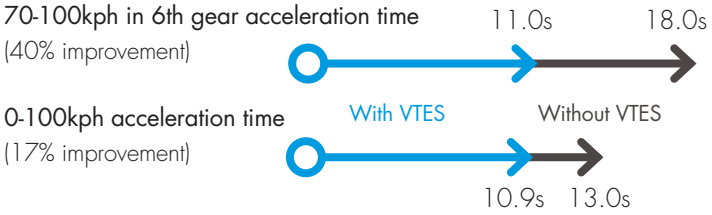
- Delivers very rapid transient air increase for particulate control
- Low pressure EGR pump opportunity for part-load NO_x control

Small capacity naturally aspirated Otto engine

Applying VTES to a small capacity Otto engine results in up to 40% torque/performance enhancement with no CO_2 penalty on NEDC.

Alternatively, the extra torque can be used to downsize and downspeed to give up to 13% CO_2 reduction without loss of performance*.

*Source SAE SETC-2003-32-0039

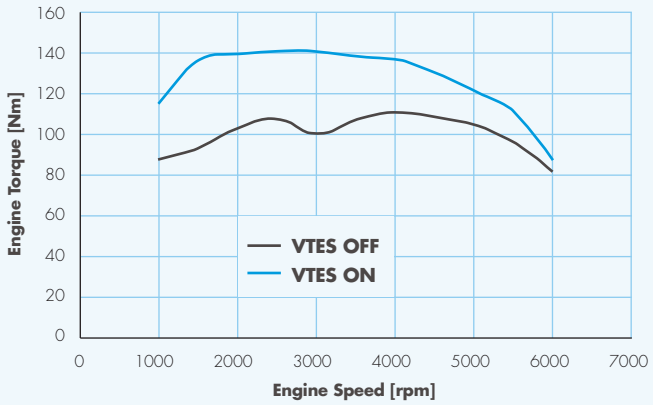


Same performance - 13% reduction in CO_2

	1.4 + VTES	1.6 naturally aspirated
Performance Index (s)	58.4	58.1
Fuel consumption [l/100km]	6.4	7.3
CO_2 [g/km]	149	173

No CO_2 penalty for increased performance

Naturally aspirated PFI gasoline engine dyno full load torque



2.0L turbo Otto Engine for SUV/MPV application

When applied to a 2.0L turbocharged DI Otto engine VTES delivers increased torque and power at low engine speeds between idle and 2000rpm. Under transient conditions 80% of peak torque is available in 1s. This performance delivers significant launch capability.

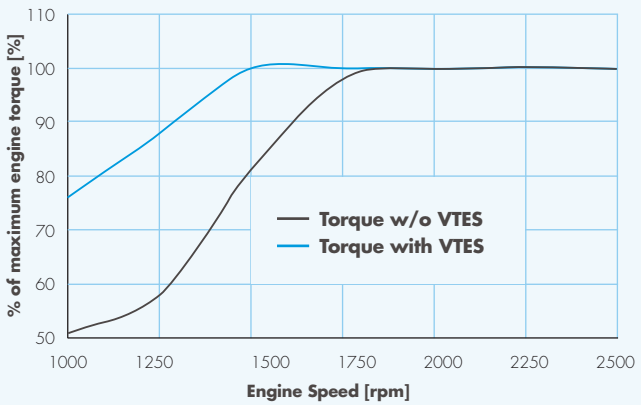
Thus, VTES enables up to 45% downsizing in SUV/Minivan applications particularly in the launch performance sensitive US market with automatic transmissions. This is achieved using existing 12V vehicle architecture and is an economic alternative to higher voltage ISG based torque assistance.

Up to 15% CO_2 reduction potential in this application*.

* Source, ACEA downsizing study

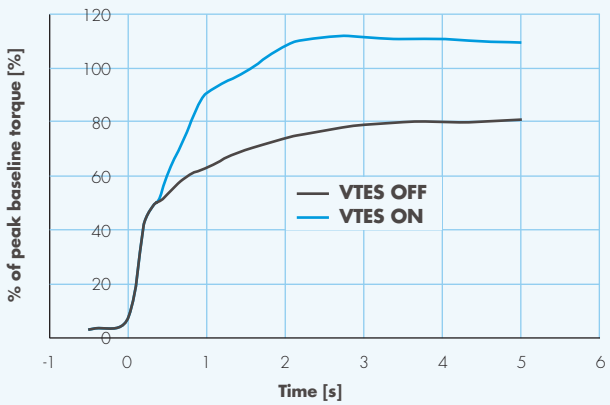
Up to 25kW power increase

Turbocharged DI gasoline engine stabilised torque



>80% of peak torque available in 1s

Turbocharged DI gasoline engine 1500 rpm transient torque step



1.2L turbo Otto in European application

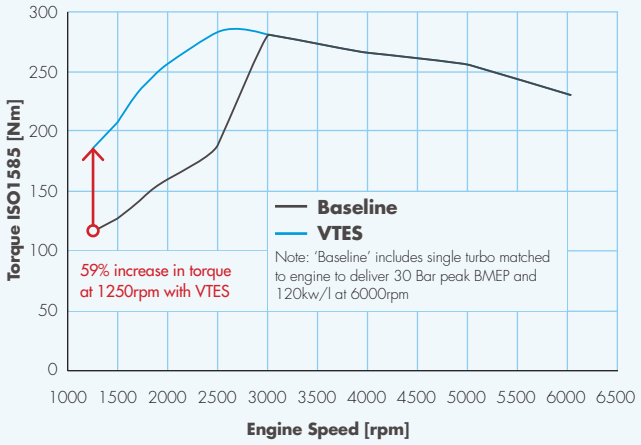
When applied to a 196PS/285Nm (equivalent to typical 2.5l gasoline engine) 1.2L turbocharged DI Otto engine, VTES delivers increased torque and power at engine speeds below 3000rpm, at which speeds there is insufficient turbine power to deliver the required performance.

Additionally, >90% of the available torque is delivered in 1s thus enabling installation into larger, heavier vehicles with a CO_2 reduction potential > 20%.

Also applicable to aggressively downsized Diesel engines

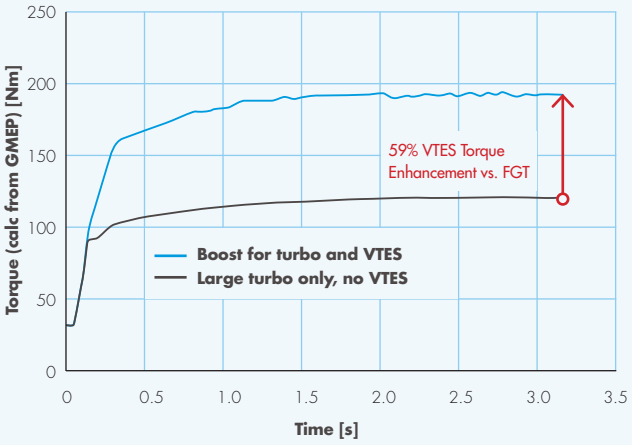
>50% torque increase at lower engine speeds

1.2L I3 High Performance Turbo DI Otto Engine



>90% of peak torque available at 1s

1.2L I3 High Performance Turbo DI Otto Engine (1250rpm)



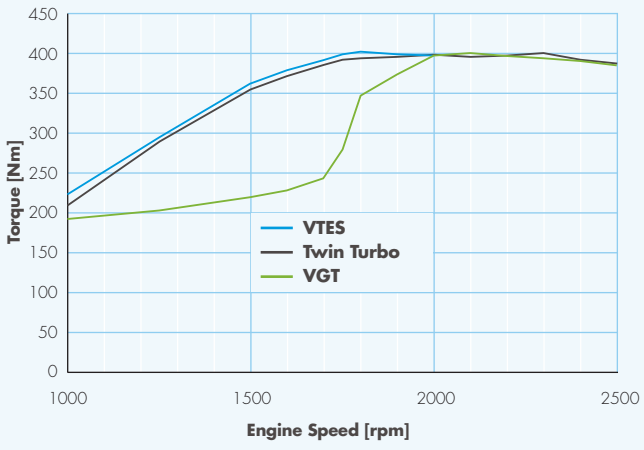
2.0L turbo Diesel in Light Commercial Vehicle

Low speed torque/power increase enables downsizing in Light Commercial Vehicle applications resulting in up to 10% CO_2 improvements.

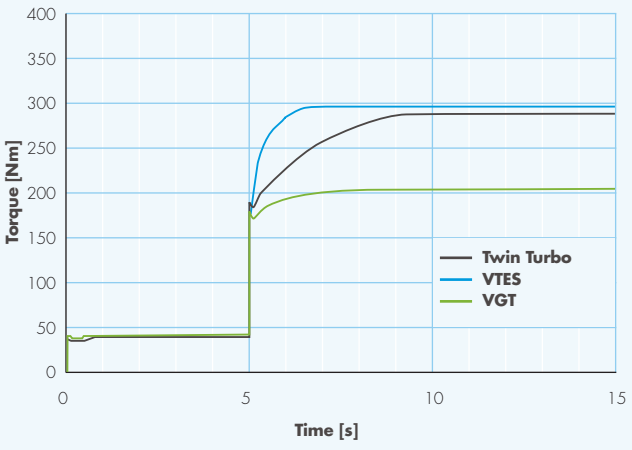
Aids launch performance & urban driveability.

Torque increases and transient performance matches twin turbo system

Stabilised Torque enhancement

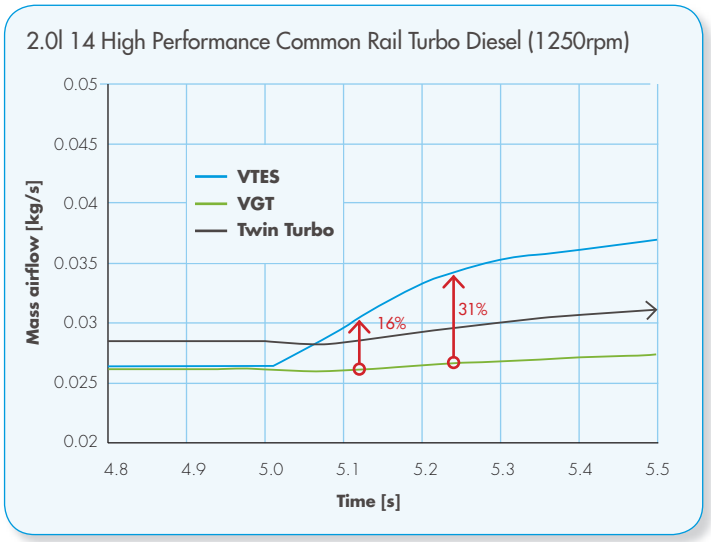


Transient torque response at 1250rpm



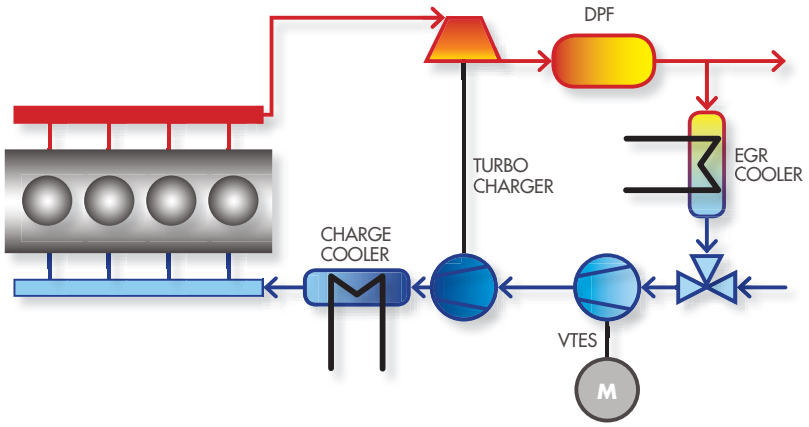
Emission Control Application

At low engine speeds VTES delivers additional airflow in the first few hundred milliseconds following a transient torque demand. This can be used to control particulate emissions and hence optimise Diesel Particulate Filter (DPF) sizing and loading strategies.



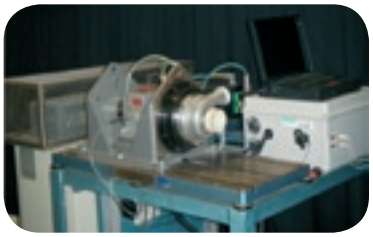
In addition to delivering increased airflow for torque enhancement and particulate control, VTES can also be configured to pump low pressure, cleaned, cooled EGR from the exhaust system post-DPF.

VTES can also be used to purge EGR from the intake system during load changes. This enables part-load NO_x with reduced soot deposition issues.



Application support

CPT offers a comprehensive range of application engineering support.



Production Intent Hardware

The VTES product is production ready. An evaluation programme may require:

- VTES Electric Supercharger unit & cooling enclosure
- Mounting brackets and ducting
- By-pass valve (for applications >1.5litre/110PS)
- 12V VRLA Battery

CONTROLLED POWER TECHNOLOGIES

Controlled Power Technologies offers a family of evolutionary CO_2 reduction powertrain products based on switched reluctance motor technology. All have been developed for full integration into existing 12V underhood architecture and support micro, mild and full hybrid powertrain strategies. Development and application engineering is carried out from a dedicated, purpose specified facility.

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