Conceptual **hybrid**

THE INDUSTRY HAS BEEN WORKING HARD TO PROVIDE THE PERFECTLY OPTIMIZED IC ENGINE, READY TO ACCEPT A 48V MILD-HYBRID SYSTEM FOR INCREASED EFFICIENCY AND DRIVEABILITY

To achieve legislated fleet fuel consumption of 95g/km CO_2 by 2020, various electrification measures will have to be introduced, in addition to engine measures, to reduce the overall energy demand of a vehicle. 48V architecture represents an appealing compromise between the standard 12V system and high-voltage hybrid systems.

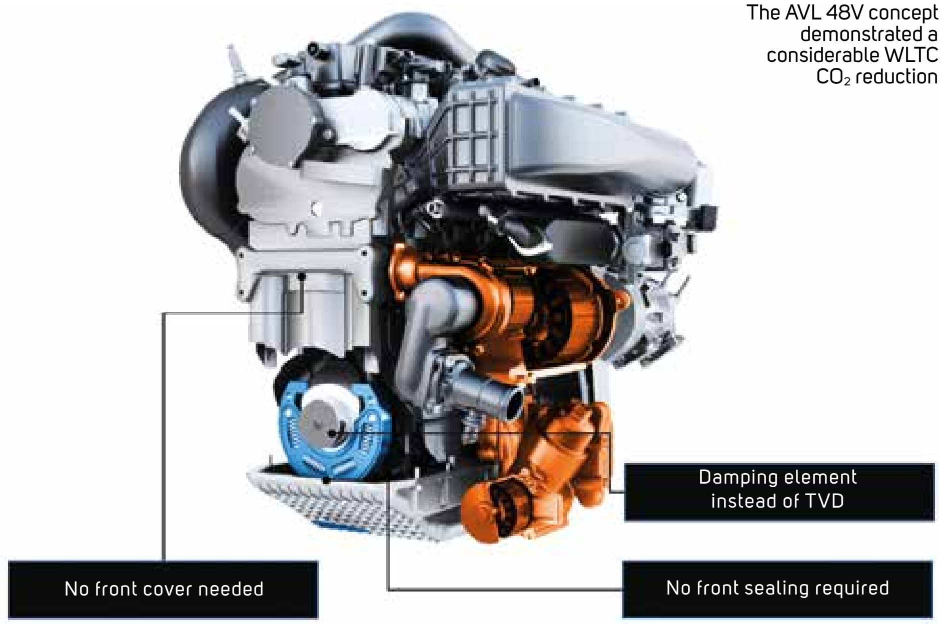
A 48V system offers attractive performance potential for moderate hybridization, in addition to opening up opportunities for further electrification of the ICE and its auxiliaries, as well as other vehicle components with high power demand.

With increasing power levels required for 'e-machines', it is important to assess the optimum configuration for a 48V system. Traditionally 12V and 48V systems have been part of the front-end accessory drive (FEAD), as it is a straightforward upgrade to an existing engine architecture with the lowest impact on vehicle package, costs and production.

Current belt starter-generator systems already realize direct recuperation and torque boost functions. They can also support a highly effective electrical supercharging system that offers superior transient response times over current multistage turbocharging concepts.

Electrified turbochargers, with additional recuperation functionality, are in early advanced development as a promising next step. However, future applications that use clean-sheet designs will give more flexibility in terms of configuration to determine the ideal position of the 48V electric motor.

The combination of substantial fuel savings, the potential for temporary deactivation of the ICE to allow electric driving in coasting mode, city driving and at low speed for parking and pulling away, as well as using the gear ratio of the transmission and eliminating the conventional alternator, indicates that the flywheel-side P2 configuration is ideal to reduce base engine complexity. To avoid an increase in powertrain length and enable use of a high-speed electric motor, the parallel P2 configuration is the ideal solution for transverse design powertrains.



The AVL 48V concept demonstrated a considerable WLTC CO_2 reduction

On a base engine, electrification of auxiliaries enables its simplification and progress toward being a beltless engine (above). Demand controlled, electrical auxiliaries are already partially in volume production for cooling systems, vacuum systems and air conditioning. Additional options such as electric oil pumps have also been evaluated.

AVL has compared the options on the base engine and evaluated them in terms of function, added value and system cost, with the aim of minimizing overall complexity through the (application dependent) balanced distribution of electrical and mechanical functions.

The optimum balance of electrical and mechanical functions on a base engine and its peripherals requires an application-dependent evaluation with the aim of minimizing overall system complexity and adding customer value.

Extending this approach further would see the integration of the ideal 48V powertrain with an optimized engine. Additional opportunities are opened up in regard to functionality and packaging through increased flexibility in the position of auxiliaries, as well as function integration. Optimized vehicle thermal management, including partial encapsulation and controlled cooling air shutters, will give further efficiency improvement.

In comparison with the baseline powertrain, the simulation shows that the AVL 48V concept has a major WLTC CO_2 reduction potential of up to 20.5%. This is achieved by a 13% CO_2 reduction for the 48V hybridization and a further 7.5% CO_2 reduction from the additional measures.

The overall approach of 48V integration is key when considering energy demands, costs, thermal management, aerodynamics and acoustics. AVL engineering has evaluated these processes to assess the balance between technology options and vehicle attributes.