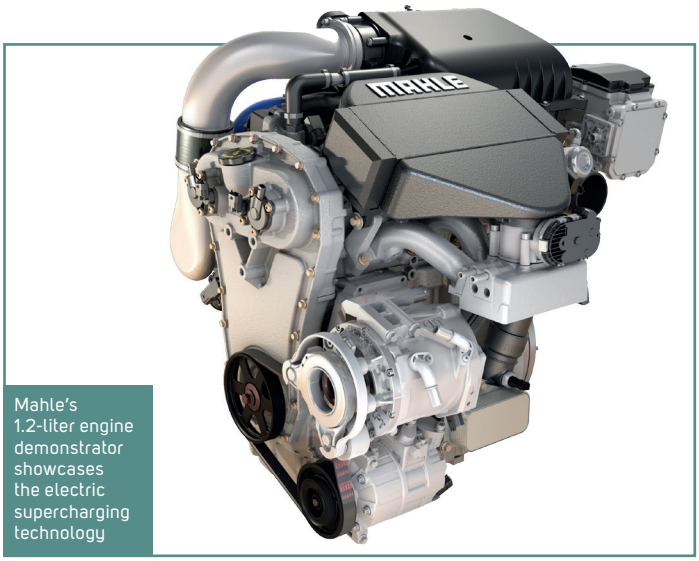
# Powering the future

In the face of increasingly stringent worldwide legislation, the auto industry continues to explore ways to reduce fuel consumption and $CO_2$ emissions

One new technology trend gathering considerable momentum for passenger car applications is the integration of 48V electrical systems. Existing 12V electrical systems are reaching their power limits in modern cars, partially due to the migration of mechanical systems to electrical power, such as electric power-assisted steering (ePAS), and partially due to increased levels of infotainment and passenger comfort devices. One favored solution to address this power drain is the introduction of a secondary, subsidiary electrical system running at 48V, to complement the traditional 12V supply. A 48V system minimizes component losses within the electrical system relative to a 12V system, owing to lower current levels. The higher-voltage system also enables use of smaller cross-section cables, making the electrical architectures lighter and easier to package, as well as providing savings through reduced copper content – helping to offset the additional battery cost.

In a typical 48V installation, the 12V network is retained and supplemented by an additional 48V system (with a separate battery), and the two architectures are usually linked through a DC-DC converter. The 12V network supplies the conventional ignition, lighting and audio and entertainment systems along with numerous electronic modules. The 48V network supports the more power-hungry systems such as starter generators, air-conditioning compressors, active suspension control and ePAS systems. The DC-DC converter allows electrical power to flow in either direction so the two systems are able to support each other according to the usage profiles.




Mahle's 1.2-liter engine demonstrator showcases the electric supercharging technology

With a power-dense 48V system onboard, there are numerous opportunities for additional functionality within the powertrain to achieve significant vehicle efficiency and performance benefits. Crucially, regenerative braking systems are able to harvest energy more efficiently through the 48V system's higher capacity for fast charging. Equally, the operating envelope of stop/start systems can be expanded (activated at lower temperatures, for example) and they can respond more quickly in the restart phase with the extra power now available. Fuel gains of up to 10% are potentially achievable through the careful application of these enhanced functions.

Considerable performance benefits can also be achieved when a 48V system is employed as an 'enabler' in mild hybrid (that is, non-plug-in) applications. The established trend toward engine downsizing has highlighted the need for enhancing low-speed torque to preserve good launch performance and transient acceleration capability. In a vehicle without electric traction motors, this torque-assist functionality can be delivered either by means of advanced motor-generators (which can charge both the 12V and 48V systems without the need for a separate DC-DC converter) or through the use of 48V electric motor-driven boosting devices.


Aeristech's 48V eSupercharger is a powerful enabler for torque assist

Recent work at Mahle Powertrain has demonstrated that engine power outputs of up to 160kW/liter can be achieved reliably through the application of 48V e-supercharging combined with regular turbocharging. Here the higher voltage enables the e-supercharger to respond rapidly to torque demand and maintain continuous boost at high levels for longer periods. The resulting high torque is available at low engine speeds, benefiting performance and driveability as well as fuel economy.

Many hybridization advantages could be delivered by 48V systems without the complexity of a much higher voltage architecture. Such systems can maximize the use of regenerated electrical energy, provide more power to support higher electrical system demands, further enhance vehicle performance and contribute significantly toward achieving lower $CO_2$ emissions levels.


Very high engine outputs are achievable with a 48V system on board

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