

MAHLE Powertrain Modular Hybrid Powertrain

Powertrain modularity in multiple applications

Reduced complexity for lower costs

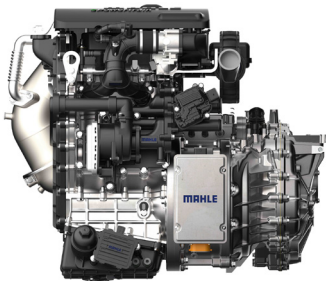
Low, weighted drive cycle CO2



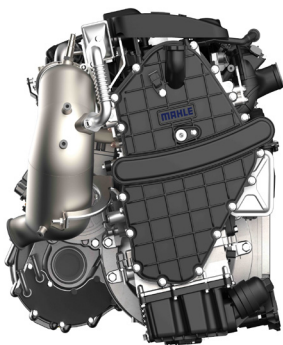
Modular Hybrid Powertrain

Electrification and hybrid technologies are now widely accepted as the preferred approach to achieving future vehicle emissions targets. In Europe, for example, OEMs must comply with a fleet average CO2 emissions target of <60 g/km by 2030.

So, there is an urgent need for the rapid adoption of appropriate, scalable solutions across a broad spectrum of vehicle segments to meet these objectives. In response, MAHLE has developed the Modular Hybrid Powertrain concept using a dual-mode (series and parallel) configuration to provide the best features of both series and parallel architectures.



>> Powertrain front view



>> Powertrain left view

- Dual mode plug-in hybrid (PHEV) powertrain
- Integrated series - parallel hybrid electric drive
- Dedicated Hybrid Internal Combustion Engine (DHE)
- Scalable across multiple vehicle applications
- Improved emissions & reduced after treatment complexity
- Seamless torque delivery provided by the traction motor
- Low, weighted drive cycle CO2 (< 2030 proposed target)
- Increased efficiency with parallel hybrid direct drive mode

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Benefits

- IC engine, traction motor, generator & transmission arranged in compact, fully integrated package
 - › Vehicle operates in different modes according to battery charge & driving speed
- Traction motor connected directly to wheels
 - › Engine de-coupled by transmission & so runs at limited speed / load range ensuring low fuel consumption & CO2 emissions
- Engine, motor & HV battery all scaled easily to different outputs
 - › Caters for wide range of vehicle applications from B- to J-segment across multiple platforms
- MHP offers several advantages:
 - › Scalability
 - › Fuel efficiency
 - › Low emissions
 - › Reduced weight
 - › Easier packaging & low production costs

Hybrid Electric Drive and transmission

- Direct drive HV MAHLE traction motor with optimised cooling
- HV MAHLE generator mounted on transmission input shaft
- MAHLE Inverters integrated into motor and generator housing
- Simplified transmission - no torque interruption
- Traction motor provides full vehicle dynamic performance
- No clutch as neutral selection decouples DHE from driveline
- 1, 2 and 4 speed transmission family use common ratios & main casing for modular approach
- Low cost, compact & adaptable unit



>> Dedicated hybrid engine

Dedicated Hybrid IC Engine (DHE)

- Parallel twin cylinder, with contra-rotating balancer shaft
- 2 valves per cylinder, SOHC, fixed valve event timing
- Port fuel injection with MAHLE Jet Ignition (MJJ[®])
- Turbocharger with MAHLE electronic wastegate actuator
- Miller-cycle operation with high geometric compression ratio
- Limited speed / load range operation for fuel efficiency
- Minimum BSFC = 207 g/kWhr (target < 200g)
- Compact, light weight & low cost engine
- Low technology requirement
- Very low specific fuel consumption & emissions
- Readily scalable for multiple vehicle applications
- Potential for higher efficiency with ultra-lean MJJ[®]



>> Hybrid electric drive & 2 speed transmission