



From ICE to BEV

Scalable Drive Solutions for a Diversified
Sustainable Electrification Landscape



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2026 Technical Paper

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From ICE to BEV



Increasing drive diversity

The electrification of vehicles is proceeding, but in more diverse ways than expected a few years ago. Not only is the proportion of purely electric drives (BEV) growing, but the proportion of mild, full and plug-in hybrids (MHEV, FHEV and PHEV) will also increase by 2030. In addition, series and series-parallel hybrids, designed as Range-Extended Vehicles (REEVs), have also gained importance, particularly in China, and are increasingly being adopted in Western markets. Together, hybrids and purely electric drives could account for almost three quarters of global vehicle production by 2030, while purely ICE-based drives could fall from 56% today to around one quarter.

History of market leadership, driving Magna Powertrain into the future

To address those market trends as best as possible, Magna Powertrain offers its customers a product portfolio that spans “from ICE to BEV”. Built on decades of leadership

in AWD/4WD and transmission systems, Magna powers the global shift with advanced hybrid and BEV innovations from its EtelligentDrive and EtelligentHybrid Portfolio. OEMs around the globe have been relying on our products for decades – constantly ranking us among the top 3 globally for transmissions and AWD/4WD products. With this true basis for our excellence, Magna fuses decades of powertrain expertise into an efficient BEV portfolio. Successful eDrive launches across the globe in low, mid and high-power range are testament to our balanced portfolio and understanding of powertrain platforms.

- Partner to 50+ OEM brands
- #1 in 4WD/AWD
- 16M+ Dual-clutch and hybrid transmissions since 2010
- #2 in Transmissions
- Local for local: engineering and production close to our customers in all regions

From conventional to hybridized DCT

Magna's DHD family and Eco hybrid transmission families offer highly efficient products based on field-proven technologies and are scalable from 48V mild hybrid to 800V high voltage systems, spanning A to E vehicle segments.

Looking back, Magna launched its first dual-clutch transmission (DCT) for a German premium manufacturer in 2007. The DCT has been continuously refined in various versions and significantly outperforms conventional automatic transmissions in terms of efficiency and CO₂ emissions. In 2022, the first hybridized DCTs, the 7HDT300 and 7HDT400, entered series production, followed by the

7HDT400. HDT stands for Hybrid Drive Transmission, 300 and 400 for the respective torque capacity (Nm). Both are 48V mild hybrid transmissions that are used in existing ICE-oriented vehicle platforms. The HDT Eco is also available for small applications up to 250 Nm.

Magna's high-voltage hybrid transmissions are positioned above the 48V HDT series. Like its siblings, the HDT Eco HV is a hybridized DCT, but with increased electrical power for both HEV and PHEV applications. The DHD Eco and the DHD Plus (DHD = Dedicated Hybrid Drive) are dual-clutch transmissions that launch electrically and enable fully electric drivability with a 120 kW electric motor.



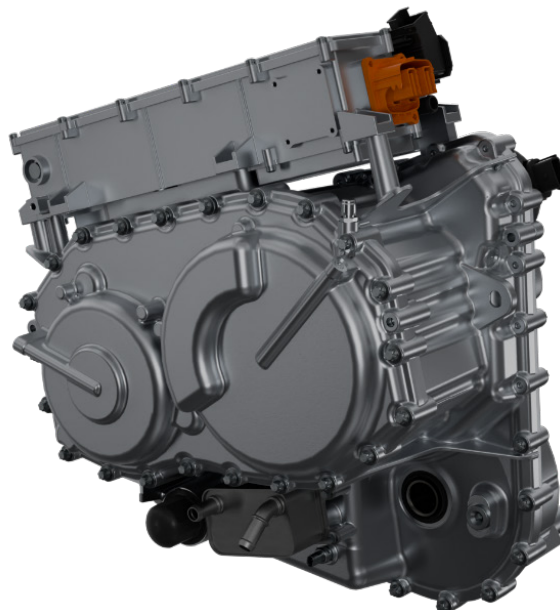
IntelligentHybrid - Maximum efficiency and flexibility with Magna's DHD Duo

The latest DHD, the DHD Duo, is a trendsetter for state-of-the-art hybridization. The drive is designed with BEV benefits in mind and enables uncompromised efficient operation in three operating modes: purely electric, serial, and parallel. Designed to work with internal combustion engines in existing vehicle platforms, the DHD Duo features a two E-machine architecture in a P1/P3 layout. This means that the P1 e-motor serves as a generator, which can be used to produce electricity for the battery or serial driving. The electric P3 traction motor is directly coupled to the differential. There is also an optional P2/P3 design, where the generator can be decoupled, allowing the power of both electric motors to be combined during electric driving without losses from the ICE.

The three operating modes of the DHD Duo enable the lowest possible power and fuel consumption in all driving

situations. In serial operation, primarily at lower loads and speeds, the ICE can be operated continuously at the optimum operating point. Parallel operation via the transmission enables optimum efficiency and tractive power at all times. For parallel mode, the DHD Duo can be designed with one to four gears, allowing it to be tailored to practically all requirements in the B to E segment and for SUVs. Finally, purely electric operation with the P3 engine decoupled from the gearset enables performance and efficiency that are on par with a BEV, without any restrictions.

The DHD Duo is currently unrivaled in terms of enabling genuine electric driving and efficient hybrid operation. The term EREV has become established in the industry for this – the Electric Range Extended Electric Vehicle, which, unlike the classic plug-in hybrid, is designed with electric drivability and efficiency in mind.



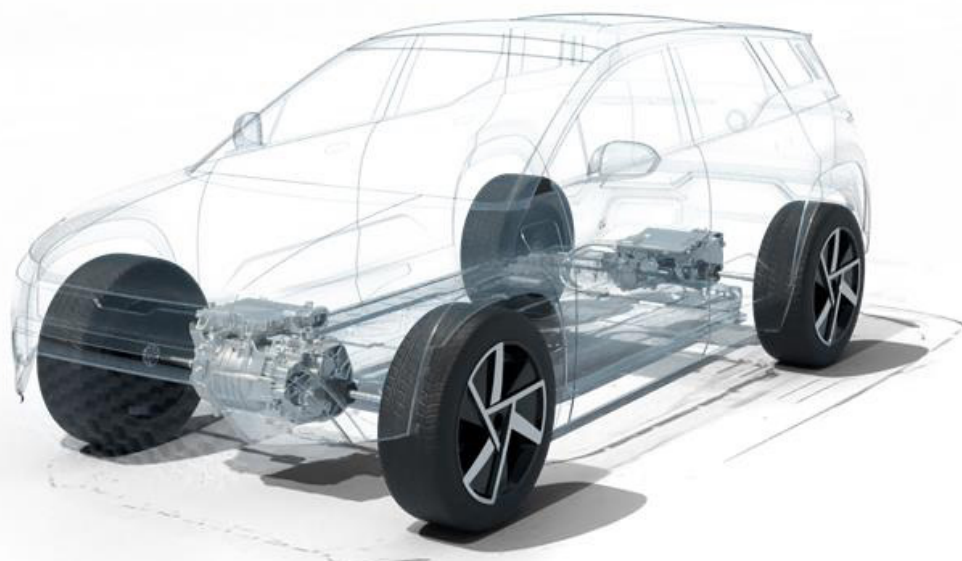
EtelligentDrive - Scalable eDrive portfolio for BEVs

Similar to the EtelligentHybrid family solutions, Magna offers a complete portfolio of eDrives that cover 90% of the market requirements with its EtelligentDrive family. The eDS Low, eDS Mid, eDS High and eDS Duo cover a power range from 80 to 250 kW. They can be used as primary and secondary drives, as well as complementary drives, i.e., drives of the same type are used on the front and rear axles.

The compact eDS Low with 80-120 kW is primarily intended for applications in electric all-wheel drives or as a secondary or auxiliary drive, and hybrid applications. The eDS Mid (120-150 kW) offers more power and additional options, such as a decoupling system, allowing it to be decoupled as a secondary drive during operation to reduce drag losses, increasing overall efficiency of the vehicle. The eDS High, with 250 kW output and excellent efficiency, is the

industry's first eDrive that can be rotated around the axle to facilitate integration on both the front and rear axles. Another advantage is the lower proportion of heavy rare earths (HRE) in its permanent magnet synchronous motor (PMSM).

The latest product in the portfolio is the eDS Duo, which is in series production in a premium off-road vehicle from Mercedes-Benz. The eDS Duo can also be rotated around its drive axle, allowing it to be used at both the front and rear. It features two electric motors, each equipped with its own two-speed gearbox, providing better traction off-road. The e-motors and gearbox are nested inside each other, allowing the eDS Duo to be easily installed within narrow ladder frames. As each of the four wheels can be driven individually, there is maximum flexibility for off-road vehicle applications.



Focus on sustainability

Magna is continually working to enhance the efficiency and sustainability of its drive solutions. This affects all eDrive components, such as electric motors or inverters, and including hybrid drives. We use various levers to increase the efficiency of the drives and thus reduce CO₂ emissions.

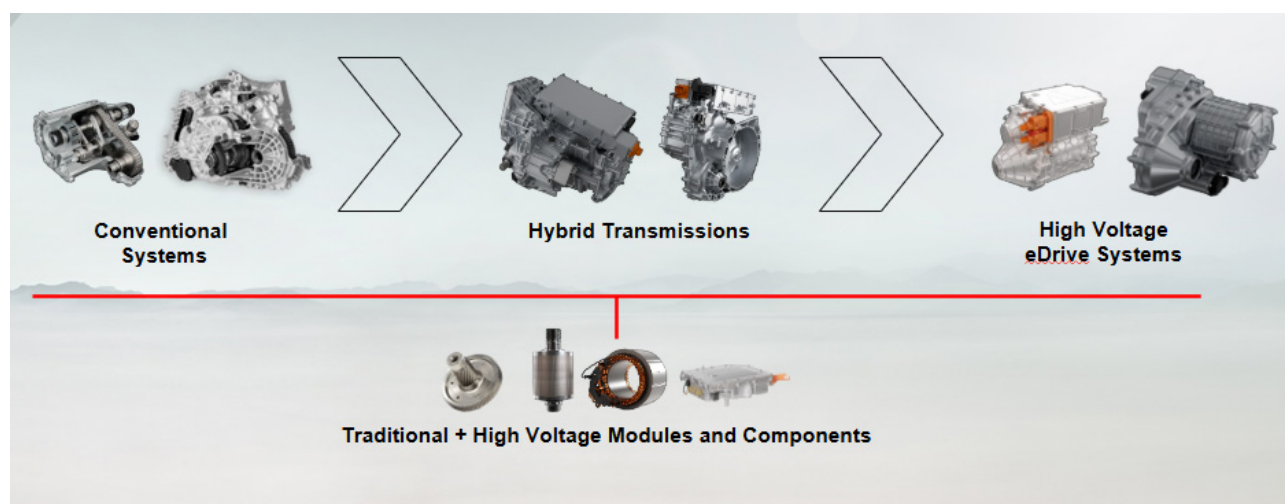
In power electronics, for example, both silicon (Si) and silicon carbide (SiC) semiconductor chips are currently used, depending on the target application. SiC is more expensive than Si but enables significantly higher switching speeds when converting direct current to alternating current and vice versa. Moreover, Magna has a software-based solution in use that both increases running smoothness and further minimizes losses.

A further focus is on minimizing heavy rare earths (HRE) in PMSMs to reduce dependence on raw materials. Magna has already significantly reduced the proportion of HRE. At the same time, the cooling systems for the drives are being

improved to ensure high thermal stability and high efficiency despite a lower proportion of HRE in the magnets.

With a view to 2030, Magna is consistently improving its drive technologies. One area of development, for example, concerns synchronous motors such as the WRSM (magnet-free wound rotor synchronous motor), which does not require any HRE at all, but enables similar levels of efficiency to a PMSM. We are also continuing to develop inverter technologies to achieve nearly loss-free power conversion with the aid of new semiconductor materials and topologies, among other advancements. All these developments benefit both the purely electric and hybrid drives in the portfolio

Magna's experience, expertise, and product mix make it the preferred partner to all global OEMs, able to support their diverse and evolving powertrain strategies - from "ICE to Hybrid to BEV".





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Transforming mobility. Making automotive technology that is smarter, cleaner, safer and lighter. That's what we're passionate about at Magna Powertrain, and we do it by creating world-class powertrain systems. We are a premier supplier for the global automotive industry with full capabilities in design, development, testing and manufacturing of complex powertrain systems. Our name stands for quality, environmental consciousness, and safety. Innovation is what drives us and we drive innovation. Dream big and create the future of mobility at Magna Powertrain.