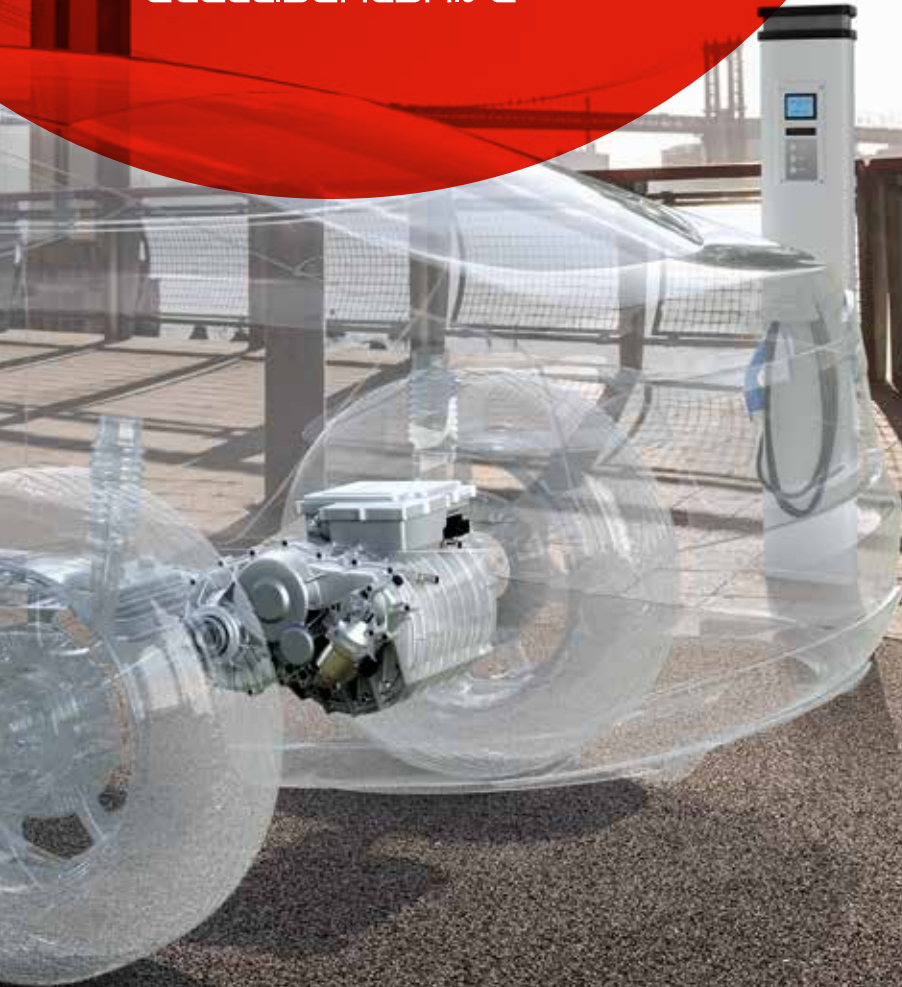


A zero-emission
future is
only impossible
until it isn't.

etelligentDRIVE



 **MAGNA**

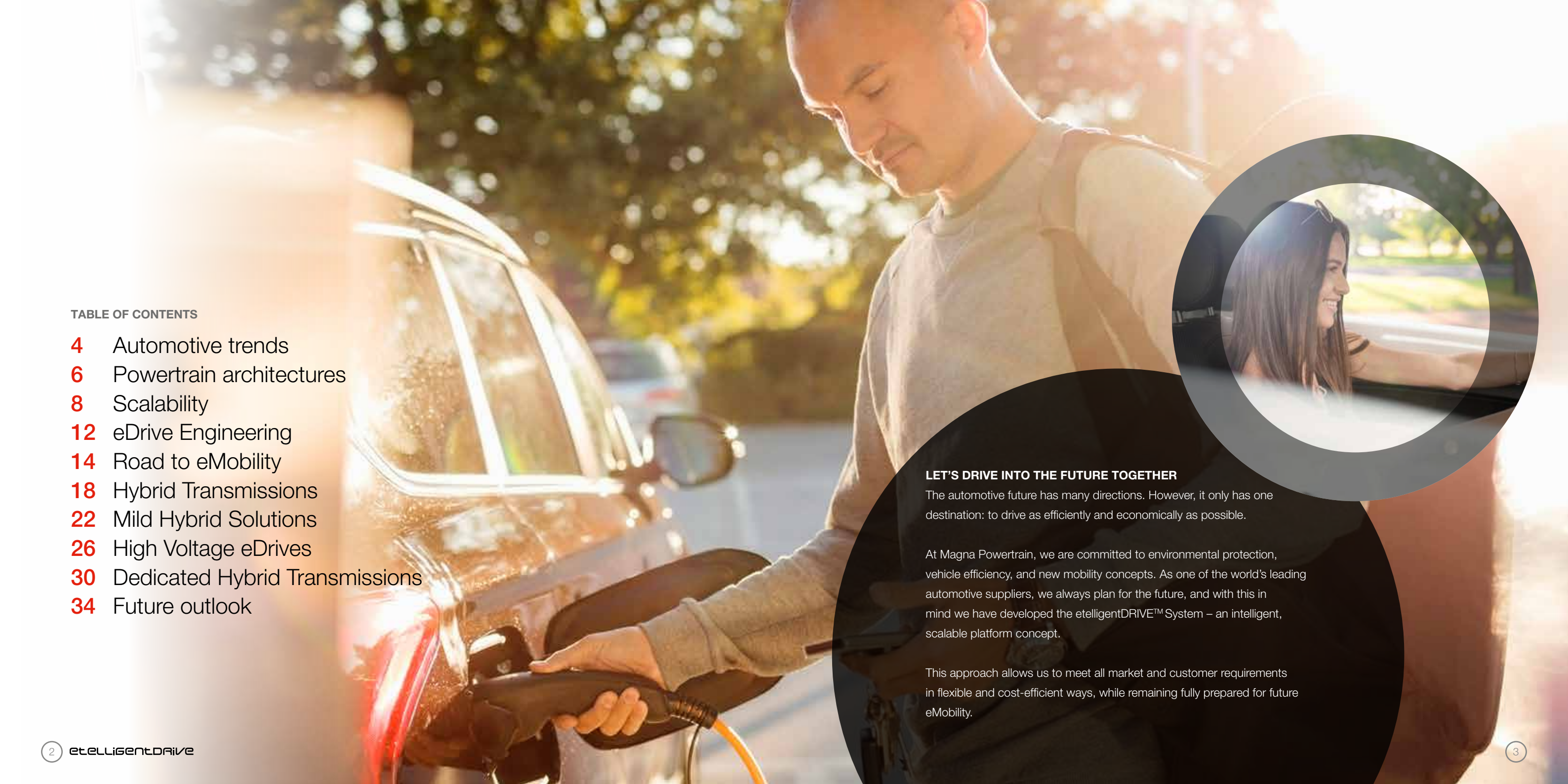


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LET'S DRIVE INTO THE FUTURE TOGETHER

The automotive future has many directions. However, it only has one destination: to drive as efficiently and economically as possible.

At Magna Powertrain, we are committed to environmental protection, vehicle efficiency, and new mobility concepts. As one of the world's leading automotive suppliers, we always plan for the future, and with this in mind we have developed the etelligentDRIVE™ System – an intelligent, scalable platform concept.

This approach allows us to meet all market and customer requirements in flexible and cost-efficient ways, while remaining fully prepared for future eMobility.

AUTOMOTIVE TRENDS

Guided by global trends. Driven by etelligence.

We are guided by global automotive trends, and have reached many milestones on our way to powertrain electrification. We actively seek out these trends and respond to them with our innovative etelligentDRIVE™ solutions. By continually confronting the challenges of the future, we strive to be the first on the road and the first to cross the finish line of the eMobility race. For us, the following four main trends shape the road to the automotive future and subsequently determine our direction.

ENVIRONMENTAL IMPACT

INDIVIDUAL CUSTOMER REQUIREMENTS

URBANIZATION & NEW MARKETS

CONSERVING RESOURCES

Individual customer requirements

Even though the mobility needs of customers are becoming increasingly individualized, we have noticed clear trends leaning towards heightened safety, increased flexibility, added automation and stronger mobile service connectivity. There is no one customer of tomorrow, all OEMs and end consumers define their individual needs depending on the regional market.

Environmental impact

Federal CO₂ regulations and additional local requirements will significantly change future vehicle architectures and individual driving behavior. Beginning 2021, the permitted emissions for all new vehicles in Europe may not exceed 95g CO₂/km. A proposal for a further reduction by 35% until 2030 is currently reviewed.

Urbanization & new markets

Increasing urbanization and the rise of megacities, especially in Asia, are creating the need for new mobility concepts. Concepts that ensure a high quality of urban life by providing low-noise, zero-emission vehicles. As one of the expanding automotive markets, China alone has increased the number of electric and plug-in hybrids by more than four times from 2015 to 2017.

Conserving resources

On the one hand, the rising demand for crude oil and the increasing difficulties in supplying it force us to deal more consciously and efficiently with existing fossil fuels. While on the other hand, other resources like rare earth metals or lithium need to be considered when talking about electrification. The advances in mobile technology and a rapidly expanding public infrastructure of charging stations facilitate convenient access to eMobility that will speed up the availability of clean transportation solutions.

POWERTRAIN SET-UP

eMobility is our future. Reducing the number of powertrain architectures is the key.

There are more than 40 different variations of powertrain architectures emerging on the market. Each with the goal of meeting the tightening emission standards and fulfilling consumer demands for comfort, performance and overall driving pleasure. These different variations of powertrain electrification offer numerous ways to achieve cost targets and CO₂ savings.

The increasing diversification and complexity of powertrain architectures, combined with uncertainties in production volumes, demand new strategies and solutions. Standardization and platform concepts for different drivetrain architectures are the key to cost efficiency and future success.

P0

P1

- P0: e-machine is connected to the crankshaft by belt
- P1: e-machine is assigned to the transmission input shaft between ICE and coupling
- No electric driving possible
- e-machine is connected with a belt drive to the ICE
- Recuperation
- Start-Stop functionality

P2

- e-machine is assigned to the transmission input shaft between coupling and transmission
- Boosting for improved acceleration
- Recuperation
- Start-Stop functionality
- Pure electric driving enabled in certain driving situations

P2.5

- e-machine is integrated in the hybrid transmission
- No change in installation length
- No additional clutch between ICE and transmission required
- Boosting for improved acceleration
- Torque fill capability
- Recuperation
- Start-Stop functionality
- Pure electric driving enabled in certain driving situations

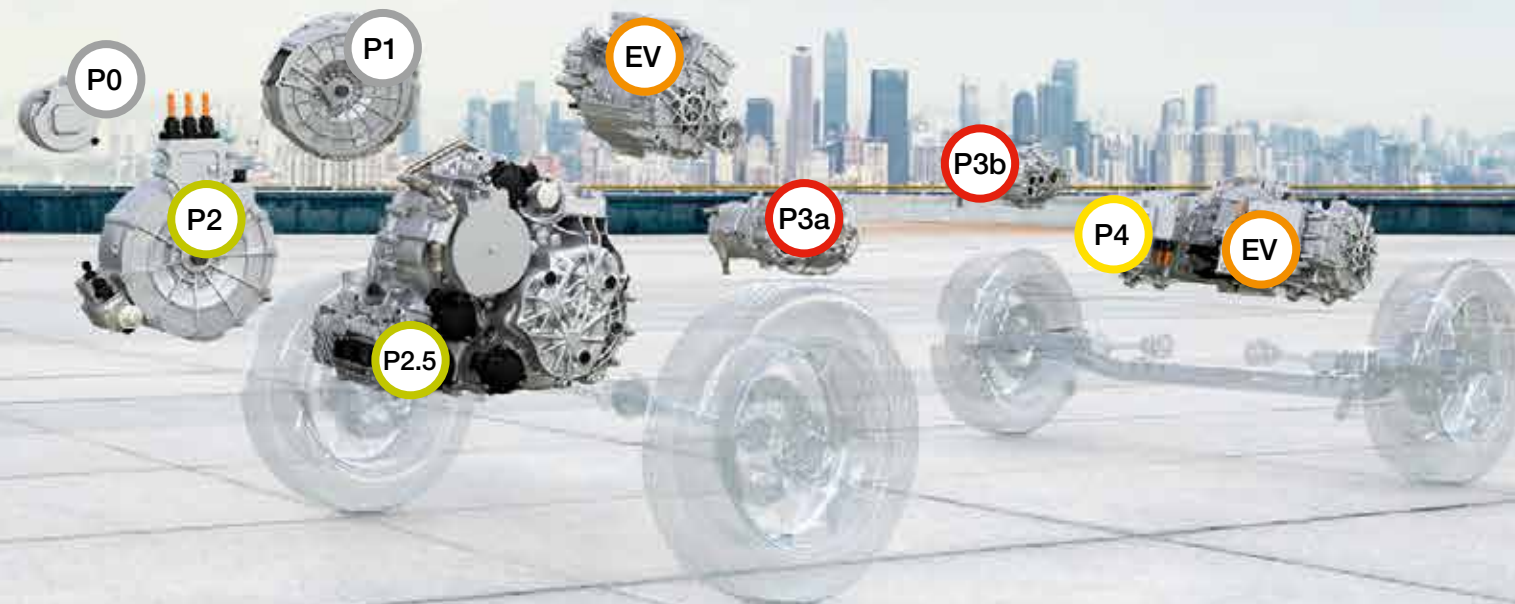
P3

- P3a: e-machine is assigned to the transmission output shaft (post transmission)
- P3b: e-machine is assigned to the cardan shaft (on rear axle)
- Enables improved driving dynamics
- Pure electric driving enabled in certain driving situations
- Recuperation

P4

EV

- For Hybrid (P4) or Battery Electric Vehicle (EV) applications
- Axle drive with integrated e-machine and optionally integrated inverter
- Enables improved driving dynamics through eAWD functionality
- Pure electric driving enabled
- Recuperation
- CO₂ reduction potential from 10-12 % for 48 Volt systems through 25 % for high voltage solutions to 100 % for BEV applications



SCALABILITY

Scalable powertrains: Maximum flexibility, minimum complexity.

Due to emission legislations and varying consumer expectations, multiple vehicle types and powertrain architectures are required. Through a scalable and modular powertrain platform, Magna is able to master the challenges of efficiency, performance and dynamics required for future powertrains. These scalable systems allow the OEM brand, model and powertrain differentiation to be possible in different competitive market environments.

**BRAND
DIFFERENTIATION**



The background image shows a hand holding a smartphone over a road with cars. A diagram is overlaid on the image, consisting of a red circle with a white step-down graph inside it. The graph has a vertical axis and a horizontal axis, with a dashed line showing a step-down pattern. The word 'SCALABILITY' is written below the graph.

SCALABILITY

**POWERTRAIN
DIFFERENTIATION**

**MODEL
DIFFERENTIATION**

SCALABILITY

Configure your powertrain of the future.

With flexible building blocks.

Until today, vehicle performance was determined by scalable ICEs. But now, by integrating electrified systems with scalable building blocks like e-machines or inverters, Magna is able to deliver a revolutionary concept. While reducing the number of ICE variants at the same time.

This innovative approach allows automotive manufacturers to retain their variety of vehicle configurations due to the fact that our building blocks can be scaled to fit any vehicle segment.

OEM Benefits

- Reduced complexity and variants for ICE and transmissions
- Scalability of CO₂, driving performance and gradeability
- Scalability of software functions to support diverse OEM branding
- Packaging advantage due to highly integrated components
- Minimum engineering implementation effort and cost – solutions with high re-use of content
- Improved vehicle performance: acceleration, traction on snow
- Optimized environmental impact: CO₂ savings

100 kW ICE



Hybrid Transmission
15-85 kW e-machine



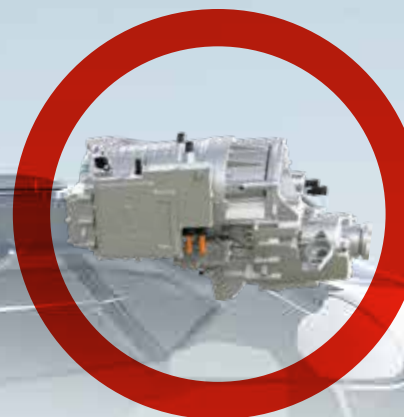
Plug-in Hybrid / BEV
60-170 kW e-machine



Mild Hybrid Traction Assist
25 kW e-machine



Plug-in Hybrid / BEV
with torque vectoring
160-250 kW e-machine



eDRIVE ENGINEERING

**Our engineers
are visionary.**

But visions are nothing
without expertise.



We deliver complete eDrives.

Magna Powertrain is one of the preferred partners for all electrified powertrain systems. With our wide experience and innovative technologies, we are driving the transformation towards electrification in the automotive industry. Our complete system expertise is based on a unique combination of engineering, development and manufacturing know-how.

eDRIVE ENGINEERING

Driven by experience. System competence for the electrical future.

Complete eDrives from a single source

Our serial production competence covers all key components for modern eDrive systems. Our diverse product portfolio includes the full range of transmissions, gearboxes, axles, eMotors, inverters, control software and engineering solutions. With our profound manufacturing and development expertise we are able to deliver a modular, scalable kit for electric drives according to the specifications of our global customers.

Our cross-platform and cross-systems approach provides a safeguard against volume volatility in the eMobility market. With our World Class Manufacturing standards and our global footprint, we meet customer requirements in the key eMobility markets of Europe, Asia, and North America.

eDRIVE ENGINEERING

- Complete system knowledge (motor, inverter, gearbox, software, vehicle integration): well-balanced eDrive system with highest customer benefit
- Advanced, fully-linked virtual tool chain on system level: cost, weight, efficiency and NVH optimized eDrive system
- NVH development process from simulation to verification in the vehicle (in the loop): eDrives with best NVH behavior
- Full vehicle integration know-how and capabilities: transfers customers' perspective to system level
- Consistently and fully linked testing chain on high performance test benches: well verified eDrive systems ready for the market

CUSTOMER BENEFITS

- Complete system solutions with platform modules
- Serial production competence for eMotor, main transmission, gearbox / axle and inverter
- One stop shop (vehicle system architecture, vehicle integration, eDrive systems and sub systems)
- Deep vehicle know-how
- eDrive System expertise
- Global footprint
- Reduced development times
- Fewer interfaces
- Vast vehicle dynamics capability



eTELLIGENTDRIVE

On the road to eMobility. With Magna Powertrain.

Magna Powertrain offers you exactly the right driveline solution for all eMobility applications. In addition, we deliver electrified internal combustion engine and transmission components that operate in a fuel-efficient, on demand basis, providing significant emission reduction and fuel savings. We explore Dedicated Hybrid Powertrain with our holistic system know-how.

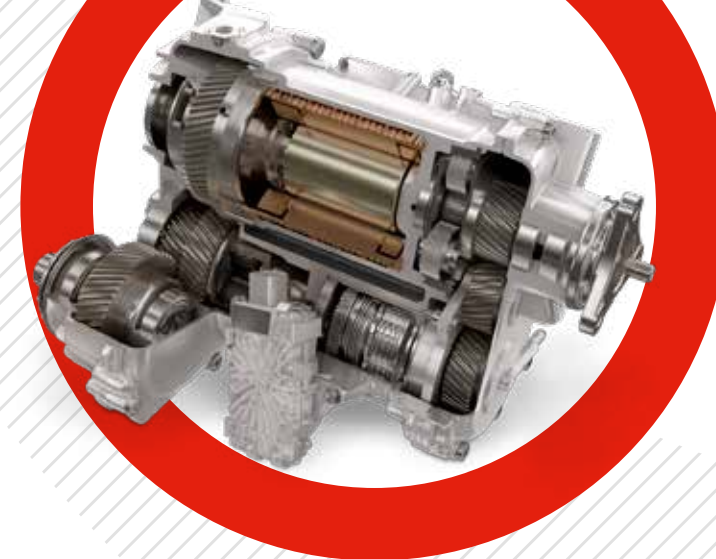
Our broad engineering and production expertise give us the ability to develop and produce complete eDrives from a single source. With our wide product portfolio and comprehensive driveline and transmission experience, we can make your road to electrification a smooth one.



For further product information
please visit our website:
electrification.magna.com



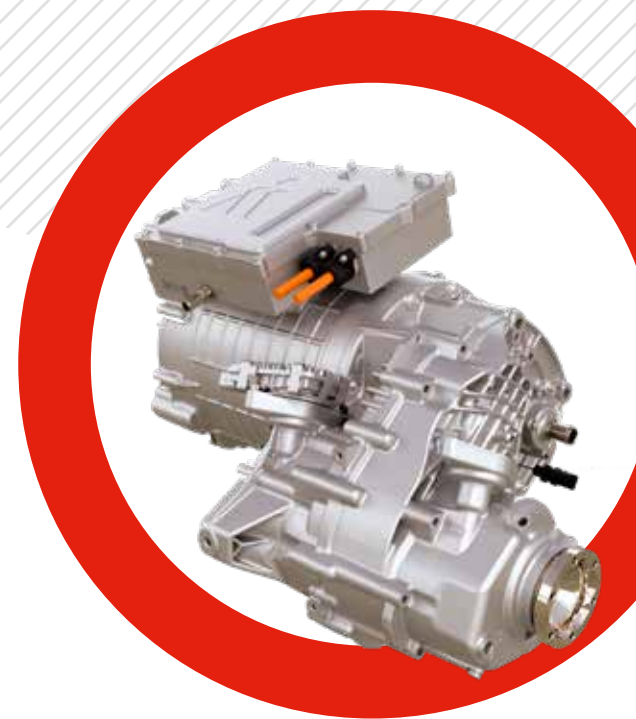
Hybrid
Transmissions



Mild Hybrid
Solutions



Dedicated
Hybrid Transmissions



High Voltage
eDrives

HYBRID TRANSMISSIONS

Zero emission is a long distance run.
We have the experience and endurance.



Experience intelligent Hybrid Transmissions

The automotive market requires different levels of hybridization to cover global demands. Magna Powertrain's Hybrid Transmissions take on these different tasks such as supporting acceleration via boosting, recuperation or charging a battery – through to pure electric driving.

Magna Powertrain offers a variety of tailored solutions for future green mobility, without compromising driving pleasure, performance or safety. The scalable hybrid transmission solutions from mild to plug-in, range from various hybridized dual-clutch to cost-efficient hybridized manual transmission solutions. Our systems provide the highest fuel efficiency, driving satisfaction, performance, and safety. Magna Powertrain's platform approach allows for peerless flexibility when meeting our customers' requirements.

Hybrid Transmissions

HYBRID DUAL-CLUTCH TRANSMISSIONS

Based on proven Magna dual-clutch transmissions, our hybrid DCTs feature side-by-side mounted e-motors integrated into the transmission housing. Using very compact 15 to 85 kW high-speed e-motors enables scalable electrification without affecting installation length.



Intended for different vehicle segments and torque requirements, we offer 6HDT200, 7HDT300 and 7HDT400 versions. All sharing the same side-by-side “torque split” electrification and a large pool of common parts, including core electrification components like e-motors and power electronics.

This portfolio offers solutions for mild, full or plug-in hybrid requirements, relying on an efficient system of modular and scalable hybrid transmissions.



HYBRID MANUAL TRANSMISSIONS

For many markets, manual transmissions remain efficient and cost-effective solutions. However, there is an increasing need for affordable hybrid manual transmissions, especially for low-cost cars and light commercial vehicles.

The 6HMT215 is for small to mid-size applications, a cost-effective hybrid manual transmission. It is also an option for both 48V mild hybrid drives and high voltage electrification. The P3 arrangement of the e-motor allows for extremely efficient recuperation in hybrid mode and best electric driving efficiency.

The new 6AHT425 with an integrated 350V e-motor is designed for light commercial vehicle applications, enabling fully electric driving in zero-emissions zones. Its dual-mode allows for efficient mixed traffic driving for longer distances – including electric as well as hybrid operation.



MILD HYBRID SOLUTIONS

**We love to
breathe cleaner.**
Inside cities and outside.



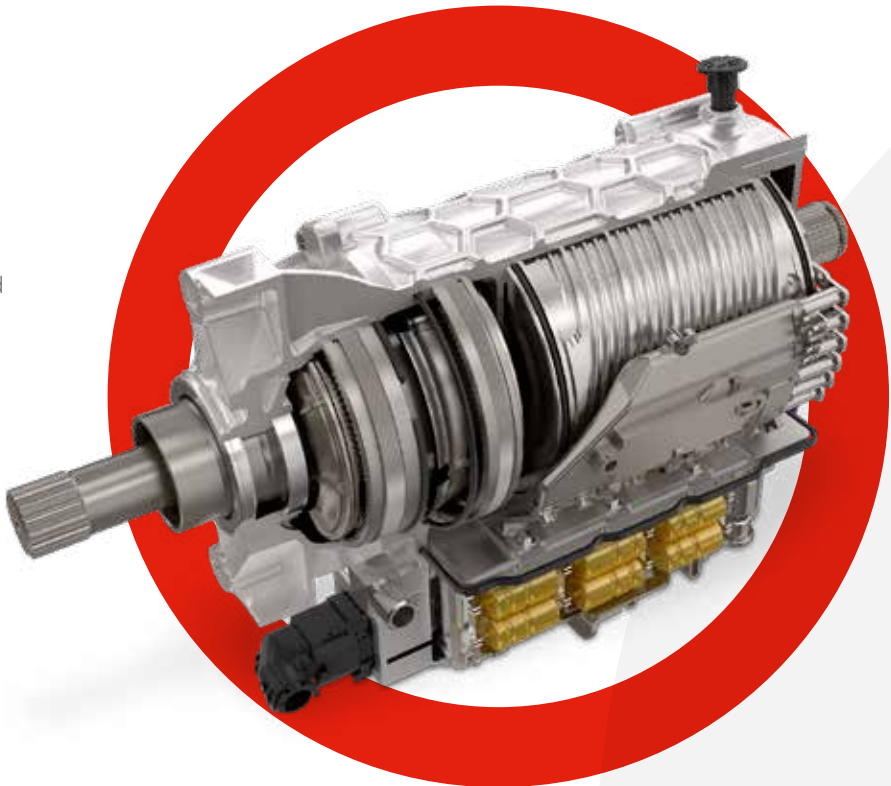
Discover intelligent Mild Hybrid Solutions

Mild Hybrid systems by Magna Powertrain provide an answer to multiple existing challenges like legislation driven CO₂ reduction and high cost pressures. Such systems support high-volume applications of electrified drivelines as well as fleet average targets at reasonable costs. Mild Hybrid systems also achieve improved driving dynamics through electric torque vectoring and traction support. These systems even enable functions like autonomous electric parking.



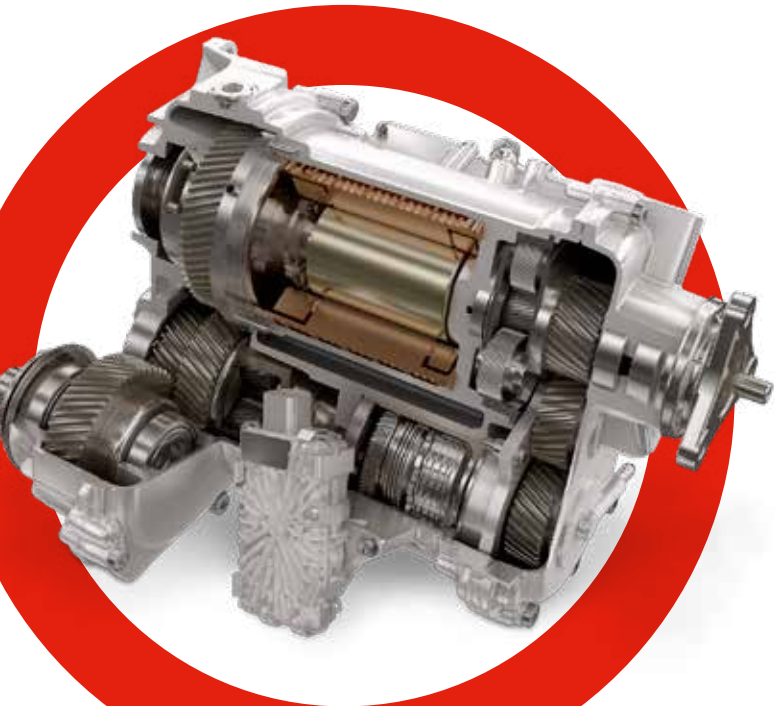
EDS 48 V COST EFFICIENT HYBRID

Magna's cost efficient ePowersplit4 supports P3 hybrid architectures. It offers improved recuperation potential compared to standard BISG systems and helps to reach future emission targets. The system consists of a 48 Volt motor / powertrain generator with single-speed power mechanics and a decoupling unit. With different possible powertrain arrangements, either after the main transmission or on the rear axle, it allows for highest flexibility with minimum adjustments in design or packaging.



EDS 48V HIGH PERFORMANCE TRANSFER CASE

Magna's high performance ePowersplit4 combines enhanced electric torque vectoring and traction with the highest CO₂ reduction potential. The system offers true longitudinal torque vectoring and optimized self-steering behavior for best vehicle dynamics, enabling the realization of different vehicle dynamic modes. In four-wheel drive mode, precise and seamless torque distribution provide benefits during dynamic driving situations and to overall traction. While in two-wheel drive mode recuperation, boosting, e-driving and e-sailing are enabled.



EDS 48V TRACTION ASSIST AXLE

Magna's 48 Volt torque assist e-axle with a high-speed e-machine offers significant CO₂ reduction potential, all due to its high recuperation capability and a minimized efficiency chain. The system allows for electric comfort functions like parking and sailing, limited pure electric driving functionality and all-wheel drive support in low-friction conditions.

The combined integrated power electronics, thermal management, and disconnect system, helps OEMs to reach future emission targets while increasing safety and comfort.



HIGH VOLTAGE eDRIVES

**When emissions
dissolve.**
And emotions and fun
to drive remain.

Explore intelligent eDrives

Magna Powertrain's high voltage portfolio covers the entire range, from single components to complete systems – from mechanical eAxes up to highly integrated eDrives. Variations are available for plug-in hybrids as well as for pure electric vehicles. The eDrive provides 100 % of its torque immediately, without the lag found in the torque curves of conventional boosted or non-boosted ICE platforms. Thus, driving fun and dynamics are perfectly combined with zero-emission driving.

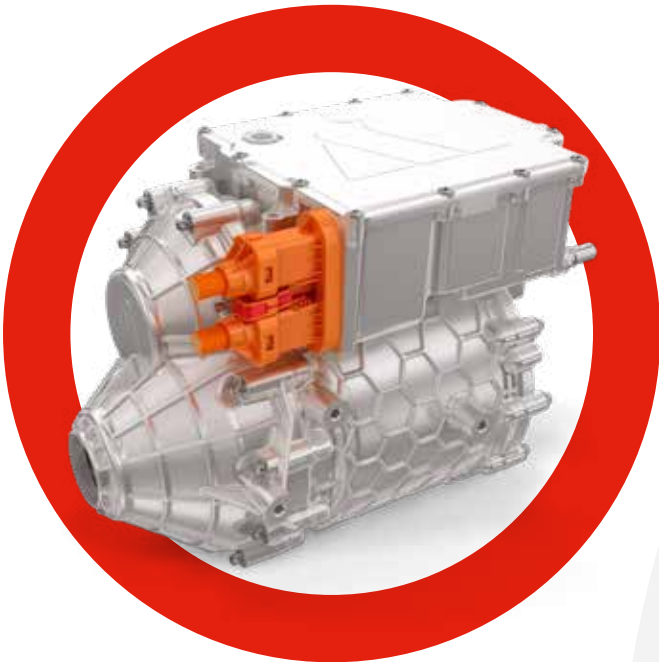
Magna Powertrain's eDrive platform approach provides the highest flexibility using cross-project synergies and complete scalability from 60-250 kW.



High Voltage eDrives

HIGHLY INTEGRATED eDRIVE SYSTEMS

Highly integrated eDrive systems by Magna Powertrain offer tailored solutions for future green mobility without compromising driving fun, performance or safety. The system supports pure electric driving, eAWD, torque vectoring and boosting. The highly integrated concept consisting of an e-motor, inverter, gearbox and overall system controls within compact housing enables significant packaging advantages. Magna Powertrain's eDrive platform approach provides the highest flexibility using cross-project synergies with maximum scalability in the e-machine.

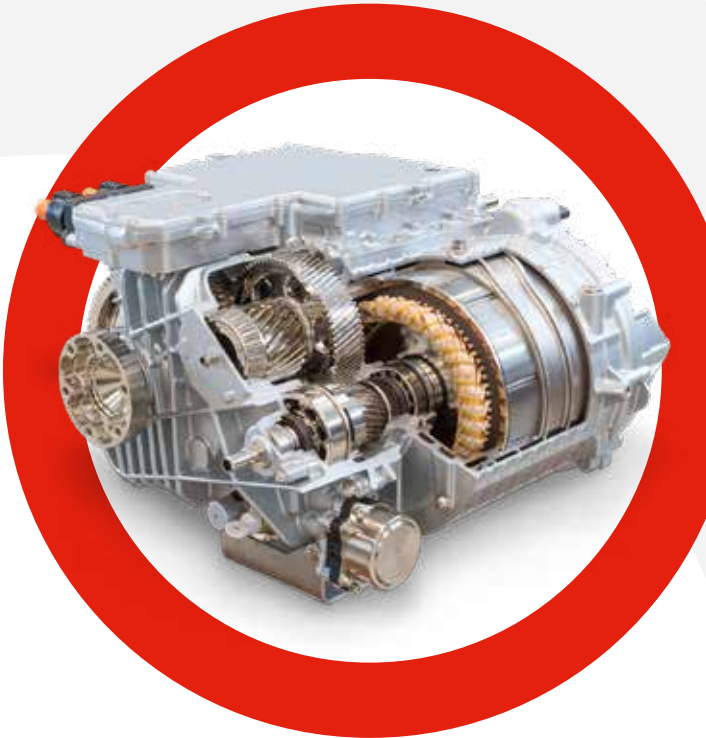


With three different power classes, Magna Powertrain supports the whole range of vehicle segments with eDrive systems for full hybrid and battery electric vehicles.

The Highly Integrated eDrive System Low is a small e-drive system that contains either an ASM or a PSM e-machine, an integrated single-speed gearbox and a high voltage inverter. The system's power ranges from 60 to 90 kW.

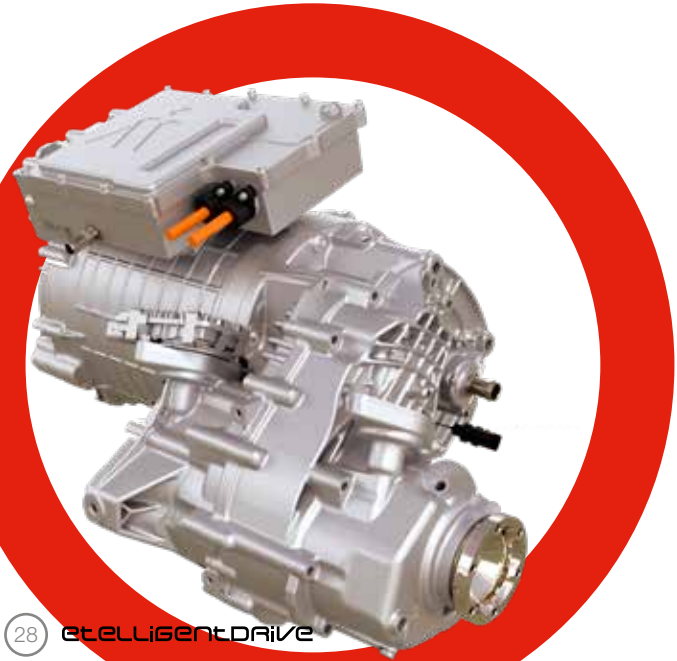
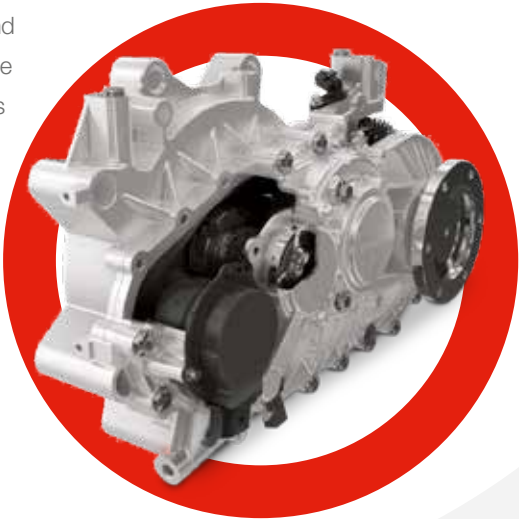
The Highly Integrated eDrive System Mid includes a gearbox, a PSM e-machine with 90-170 kW power and an inverter. It can be utilized as a primary axle for battery electric vehicles or as a secondary axle for full hybrid and battery electric vehicles.

The Highly Integrated eDrive System High is a very powerful electric axle drive. With its 160-250 kW power PSM e-machine, inverter, and a torque-vectoring optional gearbox, it meets the demands for highest performance and driving satisfaction concerning battery electric vehicles.



ELECTRIC DRIVE UNITS

Magna Powertrain's electric drive units are cost-efficient gearboxes for mid-size up to premium class vehicles as well as sport cars with maximum scalability from 50 to 150 kW. The electric drive units like 1eDT200, 2eDT200 and 1eDT350 allow for park-by-wire with an integrated actuator. They are suitable for pure electric vehicles and can be used as a rear drive unit for hybrid vehicles. The entire portfolio is weight and NVH optimized and offers an eCoupling function especially for P4 applications.



DEDICATED HYBRID TRANSMISSIONS

Sometimes it's better
to take the easy way.



Master complexity with etelligent Dedicated Hybrid Solutions

Usually in hybrid architectures, to enable boosting and recuperation, an e-machine must be added to the transmission or engine. However, this also leads to a critical cost-benefit question. With the new Dedicated Hybrid Transmissions (DHT) we simplified our existing hybrid concepts and utilized our long-term development experience with hybridized dual-clutch transmissions. We have shifted the dynamic operation towards the addition of a strong e-machine, while at the same time standardizing engine operation, and reducing the number of gears.

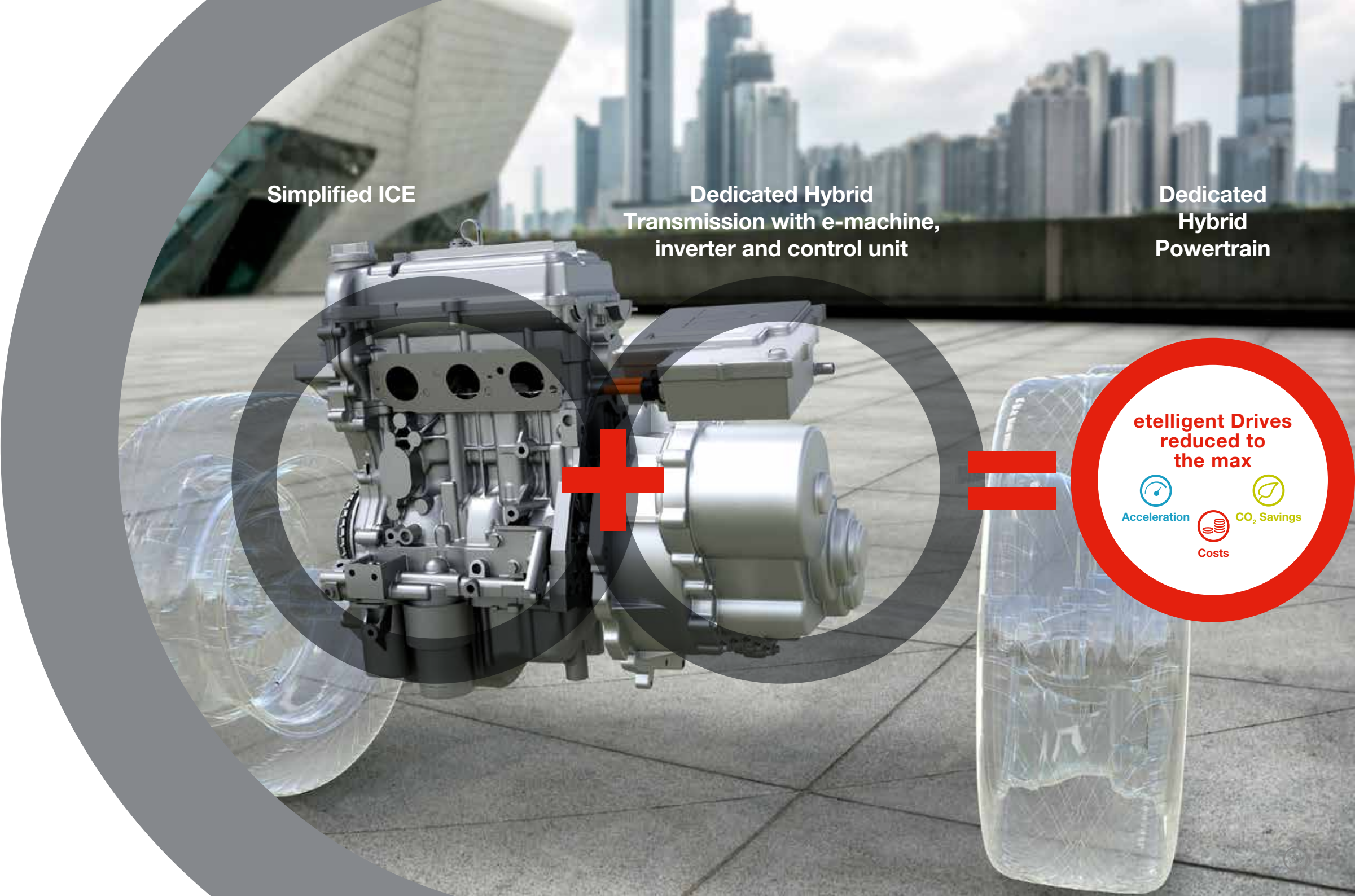
The result is a DHT design that is considerably less complex and less expensive than an add-on solution, where the mechanical functionalities are replaced by the use of the e-motor. Significantly reducing the number of physical gears and parts, without changing the base technology. This makes our approach efficient, fast and flexible for various DHT customer requirements.

Maximum flexibility with less components

The next generation of powertrain development will focus on further improving technical features such as efficiency, power density, energy density, modularity and scalability.

Along with developing our new Dedicated Hybrid Transmissions (DHT), Magna utilizing its system and integration competence is also exploring a complete system approach to Dedicated Hybrid Powertrains (DHP). Within a Dedicated Hybrid Powertrain, the optimized transmission, driveline components, and engine are meticulously scaled to their hybrid functions.

This unique combination not only saves costs and reduces CO₂ emissions, but also allows for considerable customer value, such as drivability and performance.



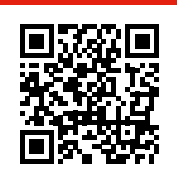
FUTURE OUTLOOK

We are speeding up eMobility today. With future proven, scalable eDrive concepts.

Automotive manufacturers are always thinking miles ahead – in development as well as in production. To best support automakers with future eMobility solutions, suppliers need to develop completely new ways and mindsets. Magna Powertrain has already passed important milestones on the road to eMobility, with maximum scalability according to different market and customer requirements.

Drawing on their extensive vehicle know-how and eDrive experience, our research and development teams are powering ahead. New innovations such as Dedicated Hybrid Powertrains and a variety of scalable solutions are just around the corner. The need to improve mobility for everybody is driving us to think beyond tomorrow.

etelligentDRIVE



electrification.magna.com