



Power to the Wheels

Wege zur skalierbaren Mobilität

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Director Global Product Management,
Magna Powertrain

- Future Regulation and impact
- Different customer expectation
- Manage complexity by Building Blocks
- Magna Scalability approach
- e2- Demonstrator
- Summary & Outlook

- **Future regulation triggers electrification.**
- **Considering segmentation of the market several solutions from Mild Hybrid up to BEV will need to satisfy different consumer expectation**
- **Complexity of powertrain solutions**
- **The obvious increase of Powertrain solutions needs to be managed.**
- **How Magna sees the reduction in complexity by our scalability approach: from Mild hybrid to BEV with scalable building blocks**

Legislative Uncertainties and Consumer Preferences

MAIN SOURCES OF FOSSIL FUEL CONSUMPTION

POWER GENERATION INDUSTRY TRANSPORTATION (LIGHT DUTY VEHICLES) SHIPPING AIRCRAFT



GLOBAL

- Near term goal: Hold the increase in global average temperature to well below 2°C
- Long term goal: Net-zero emissions between 2052 and 2100
- Primary focus on reducing use of fossil fuel

REGIONAL

- Regulations/plans supporting GLOBAL and REGIONAL objectives
- Vehicle regulations reducing consumption

GLOBAL

- World Health Organization Guidelines (WHO)

REGIONAL

- Ambient Air Quality Regulations, other reducing common elements of enforcement – construction and operating permits, reports, surveillance and penalties
- Vehicle regulations for tailpipe exhaust emissions
- Quotas for zero-emissions vehicles

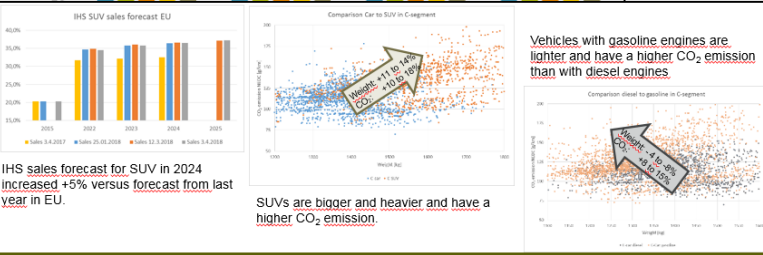
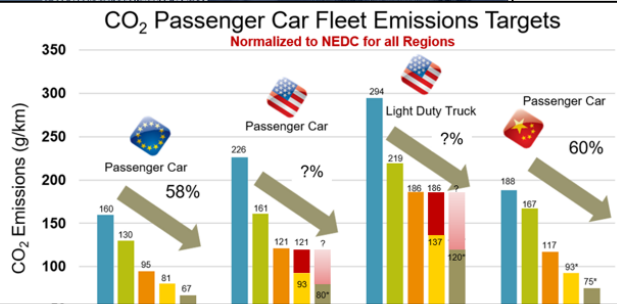
Media speculation

Proposed relaxed U.S. Federal standards "Freeze" at current 2020 levels through 2026

California plans to continue with current standards through 2025, and more stringent standards from 2025

California and 16 other U.S. states have filed a lawsuit against EPA's finding that current standards are not appropriate and must be changed

EC Proposal:



SUV boom and reduction of diesel share in EU will require more electrification of the powertrain.
 EU Fleet performance 2017 amounts to 118,5 g/km, first time increase versus previous year.

Air Quality Concerns drive Zero Emission Powertrains

- Transition from fossil fuels to renewable energy sources reduces NO_x and PM
- Less fossil fuel consumption reduces quantity of all pollutants

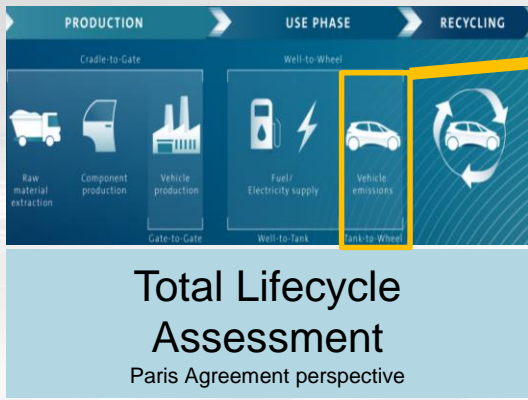
There is significant uncertainty in regional legislation

- Global platform approach is questionable for powertrain systems
- Number of powertrain architectures will expand to ~50 globally
- Modular and scalable powertrain products are needed to support the wide range of architectures that will emerge

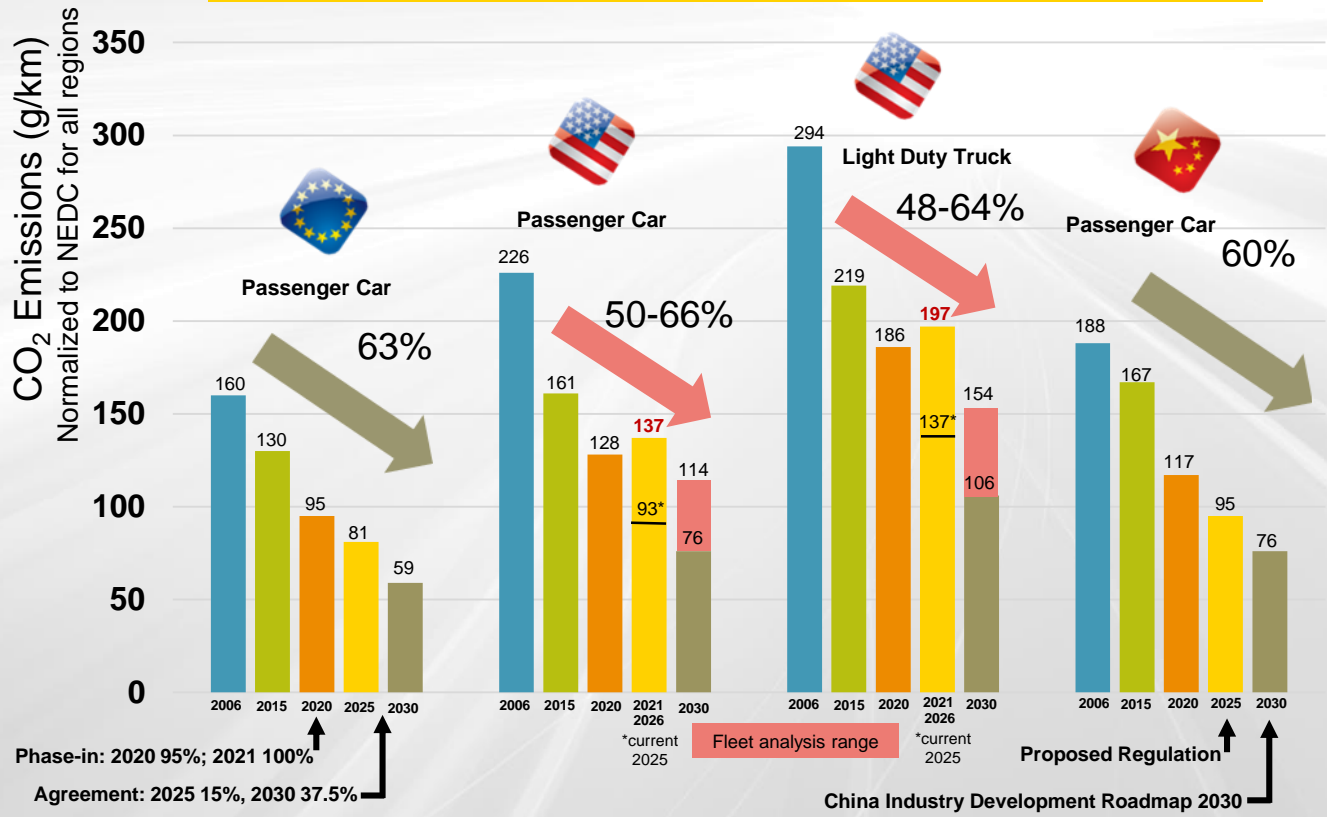
Consumer buying preferences will also drive electrification

- SUV boom (heavier vehicles with more power needed)
- Diesel shares are dropping, resulting in higher fleet CO₂
- 2017 Fleet Performance increased in 2017 vs. 2016

Regional Legislation CO₂ Fleet Average Emissions Standards



Co₂ regulation for USAGE of vehicles



Powertrain Share 2025

Global and 3 Major Markets

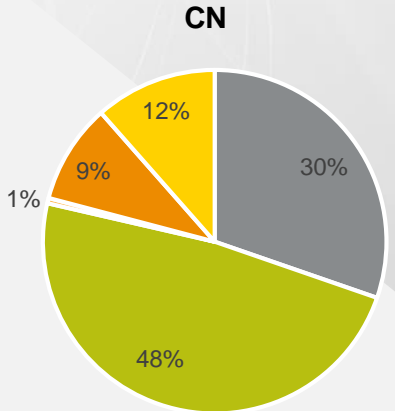
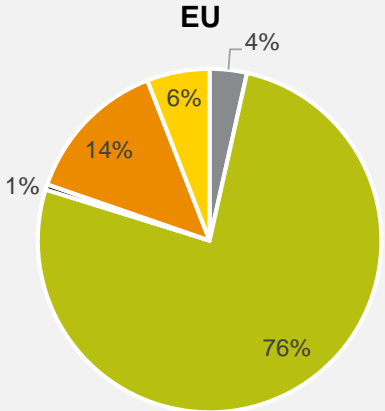
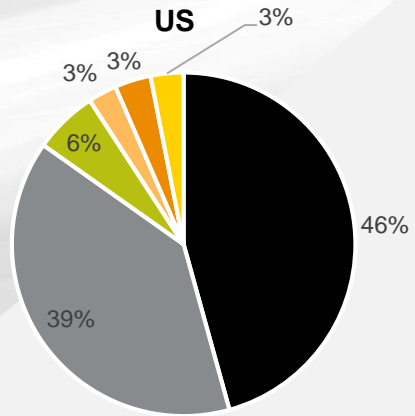
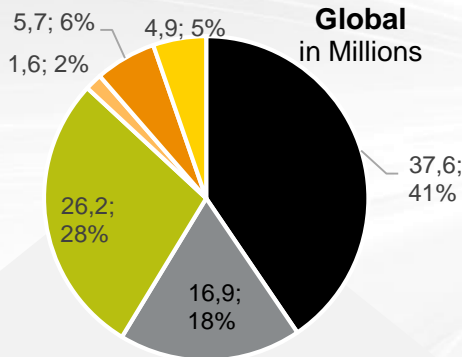


Source: Magna Fleet Analysis, 11.2018

Global 2025

Powertrain Technology share
For Passenger Cars and
Light Duty Trucks

Powertrain share: average out of considered scenarios



Summary:

Market Trends and Electrification of the Powertrain



Market: Magna and other forecasting agencies foresee market growth through 2025 (1.5% - 2.5% CAGR)

- Most significant growth will occur in China (+6M units 2018 – 2025)
- China market has unique legislation and consumer preferences which impacts local product requirements

Legislation: Increasing uncertainties and regional differences on regulation: Powertrain suppliers must:

- Build scale on key building blocks (eMotor, Inverter, Software) as market shifts towards electrified products
- Focus on modular & scalable platforms based on modular & scalable building blocks for all new products

Magna Fleet Analysis tool enables MPT & OEMs to jointly analyze powertrain architecture options

- Analysis based on compliance with regional legislation and OEM forecasted segment / model mix
- Collaborative studies can lead to significant findings regarding optimum powertrain product portfolio

Powertrain Evolution



Internal
Combustion
Engine
including
Stop / Start

42 Electrification
Architectures

Mild Hybrids

21

Hybrid Electric Vehicle /
Plug-in Hybrid Electric
Vehicle

17

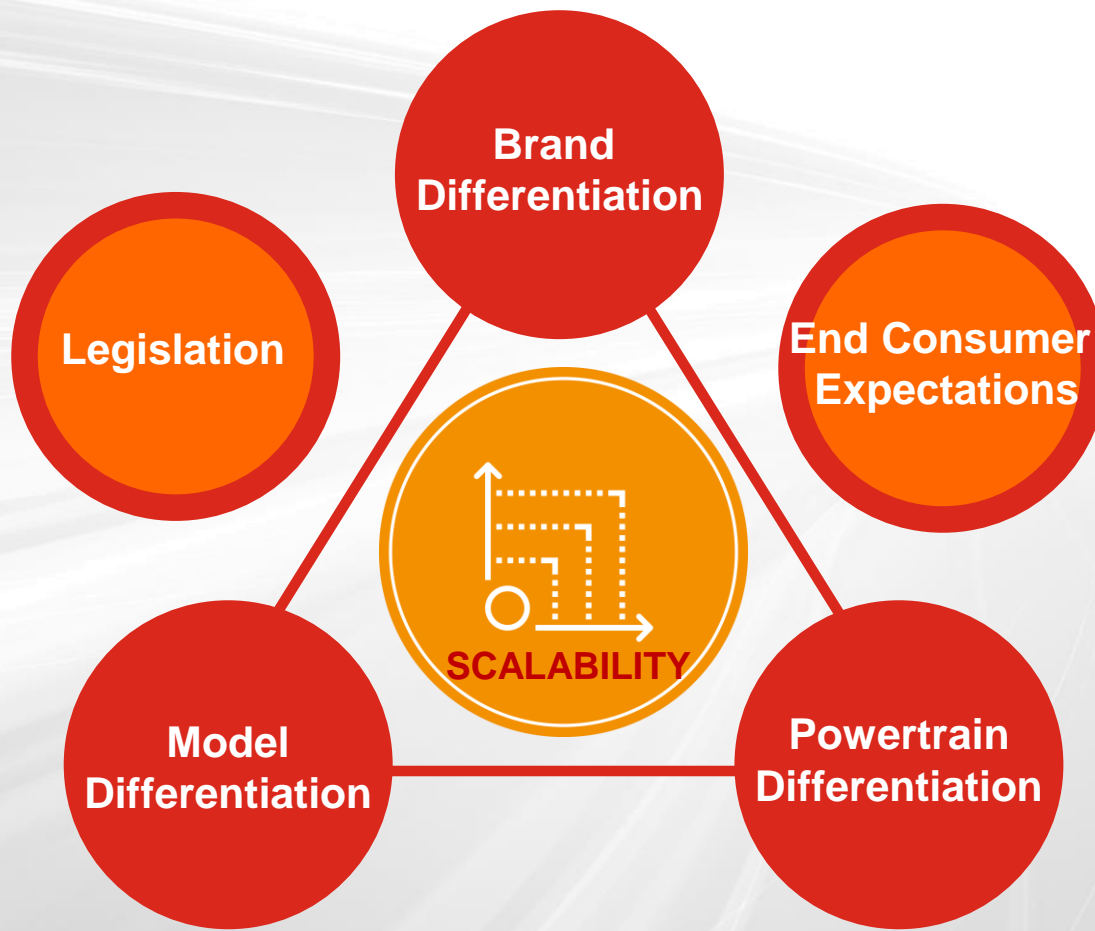
Battery
Electric
Vehicle

4



Magna Powertrain's
products support **29**
out of **42** possible
electrified
powertrain
architectures.

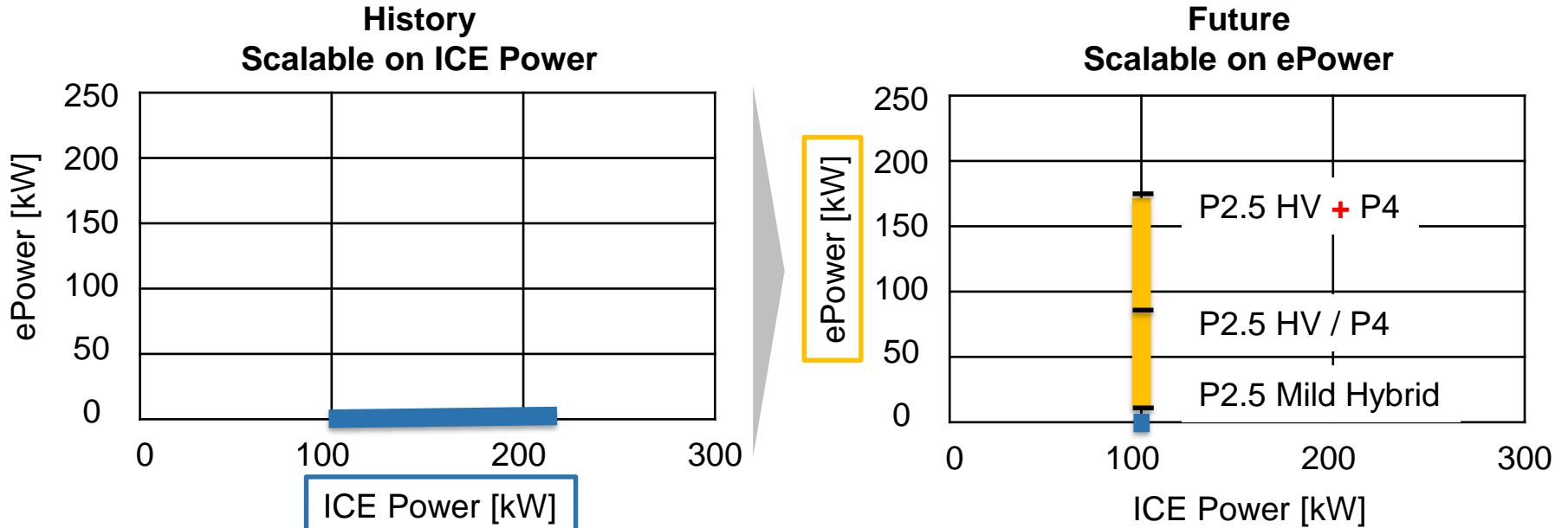
The variety and complexity of the powertrain increases with electrification.



WE MASTER COMPLEXITY

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Performance Path ICE and Hybrids



Shift from scalable ICE power to scalable ePower

Our Solutions



We are setting **new benchmarks** with our broad **electrification portfolio** that includes **highly integrated systems** from 48V to High Voltage.



Electric Drive Units



48V Mild Hybrid Solutions



Twin eDrive Systems (Torque vectoring)

etelligentDRIVE



eClutches

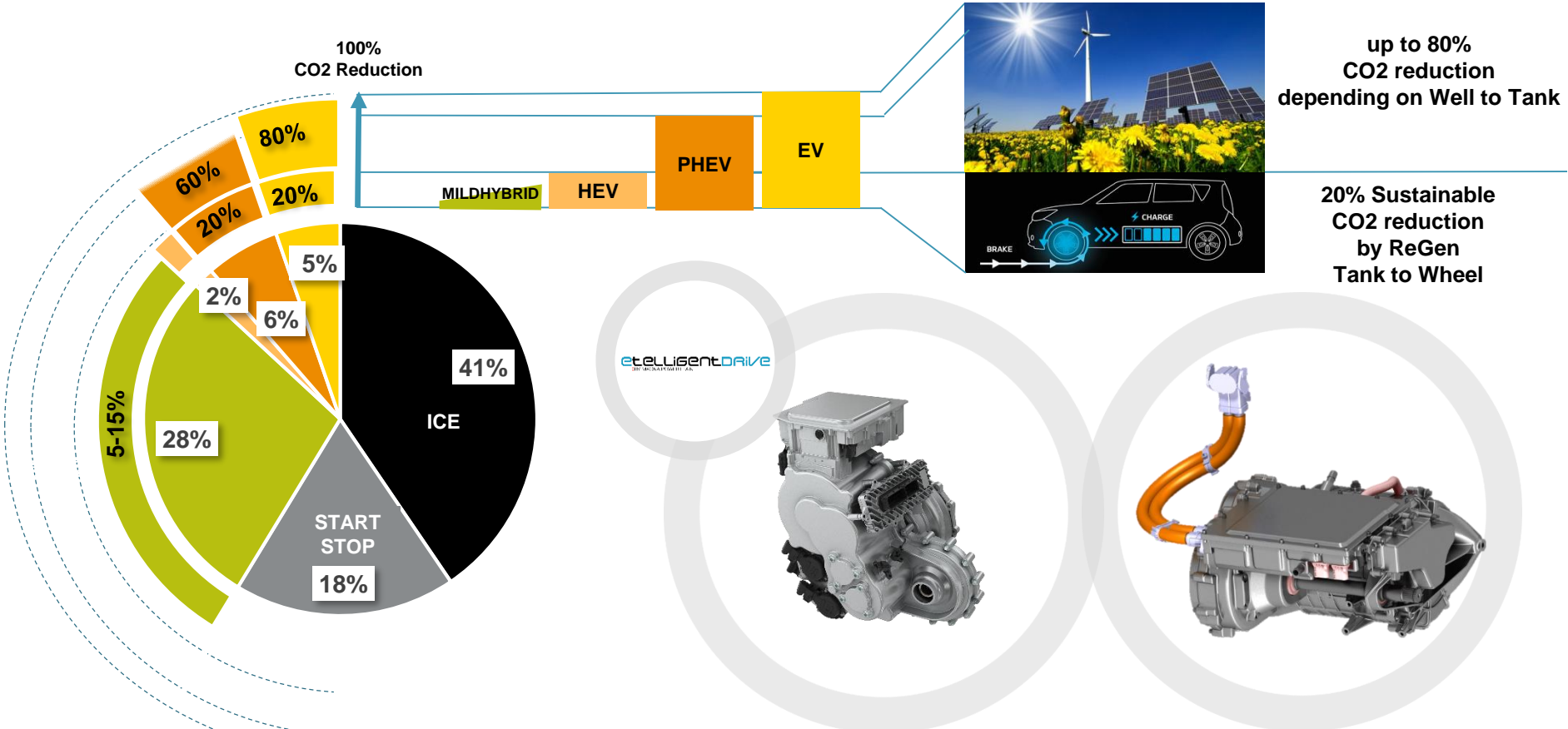


Highly Integrated eDrive Systems

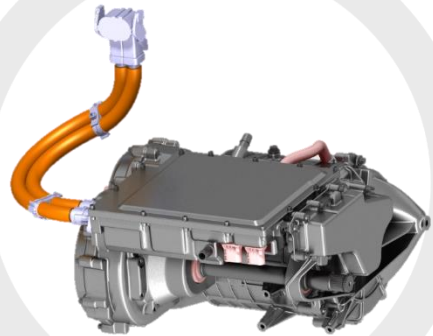


Plug-in Hybrid Dual-Clutch Transmissions

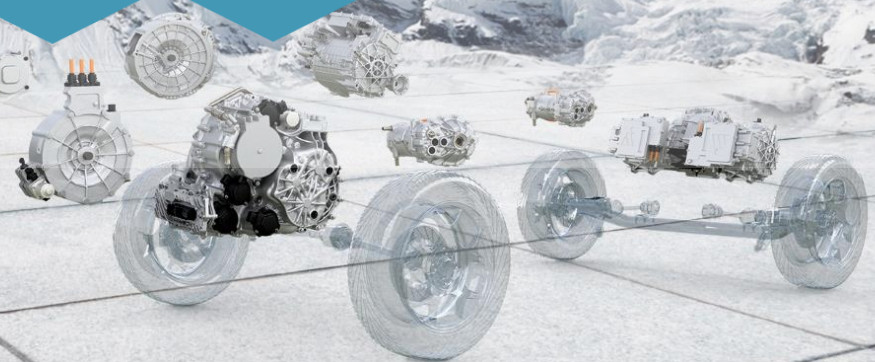
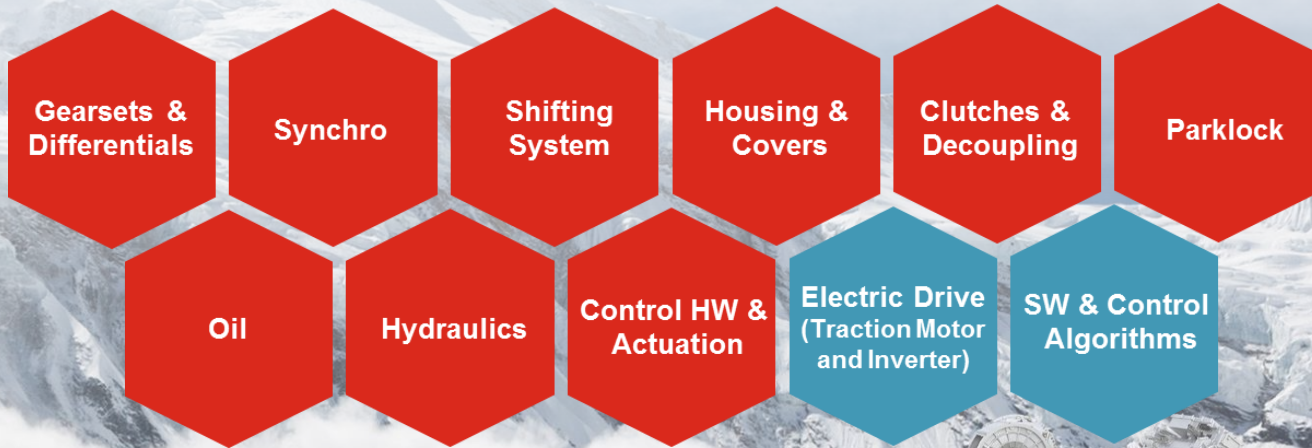
Well to Wheel



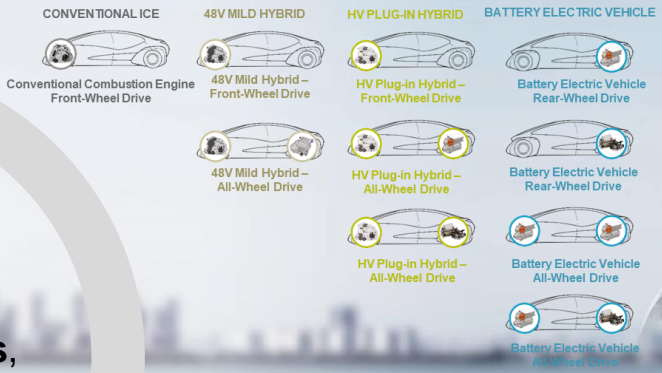
etelligentDRIVE
an innovation by AL



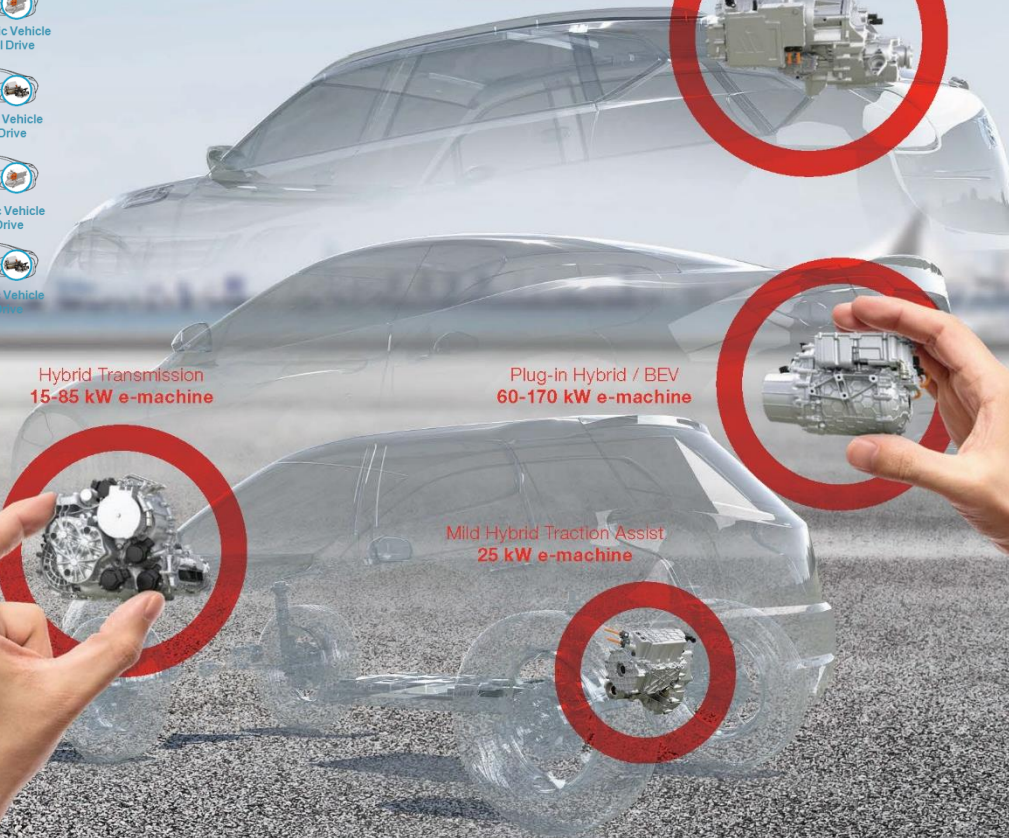
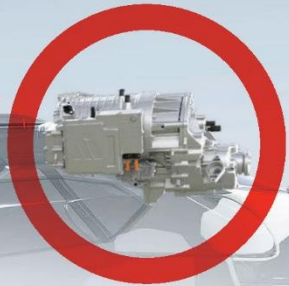
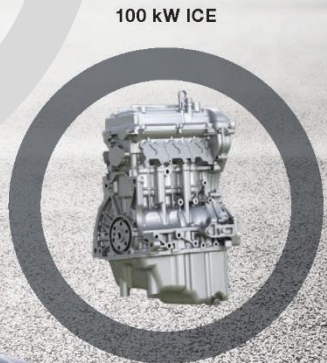
11 MPT Building Blocks defined



Scalability Approach

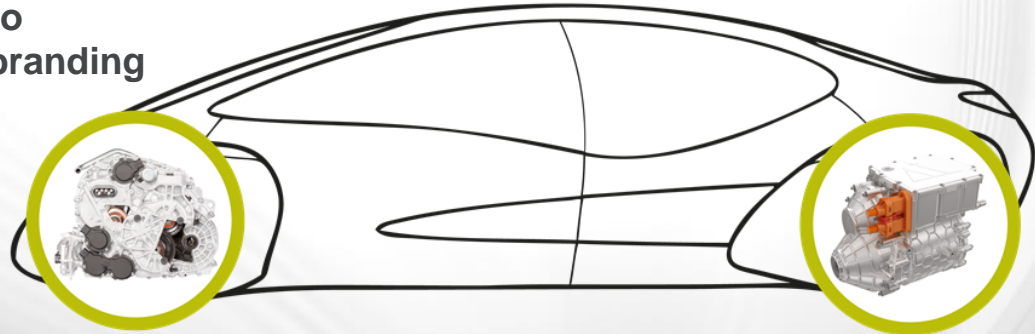


offering electrified systems with **scalable building blocks**, is key to reflect **varying customer requirements**.



Driveline Layout

- Scalable CO₂ benefits
- Scalable lateral dynamics
- Scalable longitudinal dynamics
- Scalable All-Wheel Drive
- Scalability SW functions to support diversified OEM branding



Hybrid DCT

- Scalable functionality from mild to plug-in (400V)
- Scalable eMachine from 48V to HV Systems (15kW – 120kW)
- Exclusive torque-split concept for hybridization

Highly Integrated eDrive System

- Scalable PSM Motor from 48V to HV Systems (25 - 160 kW)
- Up to 15,000 rpm
- AWD Functionality
- Optional Torque Vectoring -function

Scalability Approach

SYSTEM POWER

LEVEL OF ELECTRIFICATION



Low Power ICE
+ DCT



Low Power ICE
+ HDT/P4 Low
48V



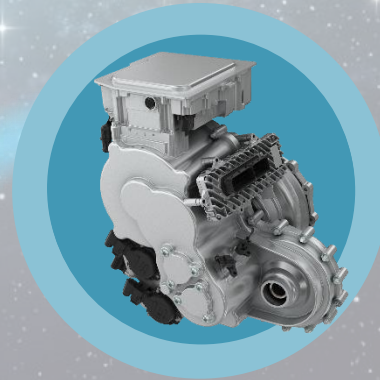
Low Power ICE
+ HDT and P4
Low 48V



Low Power ICE
+ HDT or P4
MID HV

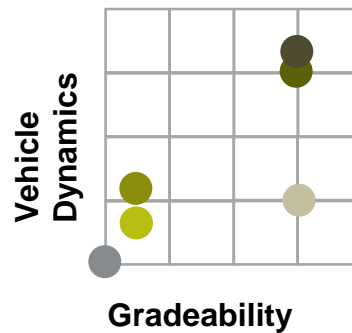
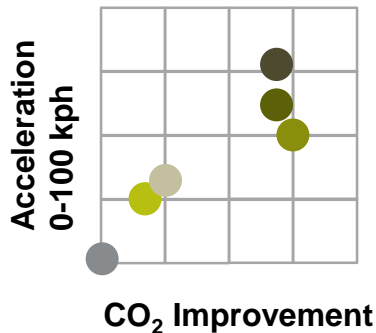
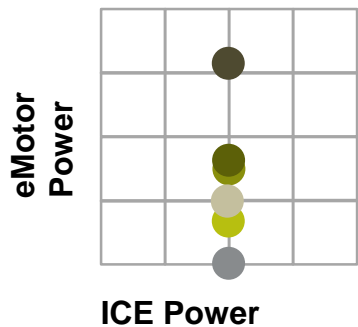


Low Power ICE
+ HDT and P4
MID HV

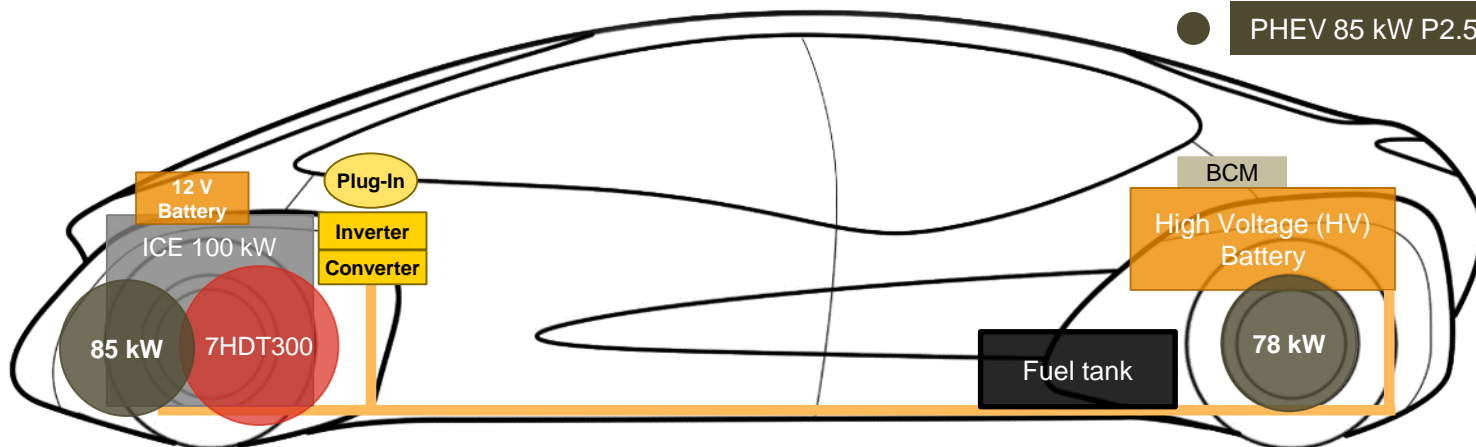


PERFORMANCE

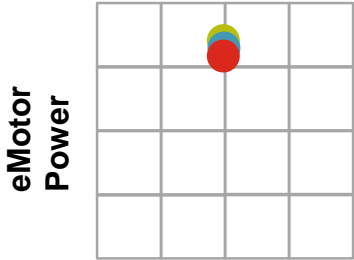
Hybrid Scalability: Performance PHEV P2.5+P4



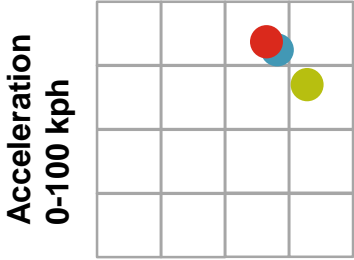
- Conventional ICE
- 48V Mild Hybrid
- PHEV 25 kW P2.5+P4 25 kW
- PHEV 85 kW
- PHEV 78 kW P4
- PHEV 85 kW P2.5+P4 78 kW



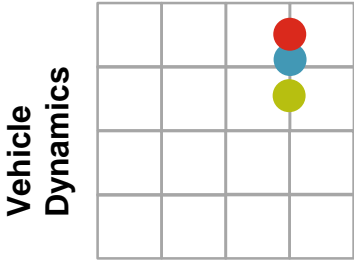
Hybrid Scalability: Differentiation by Software Application



ICE Power



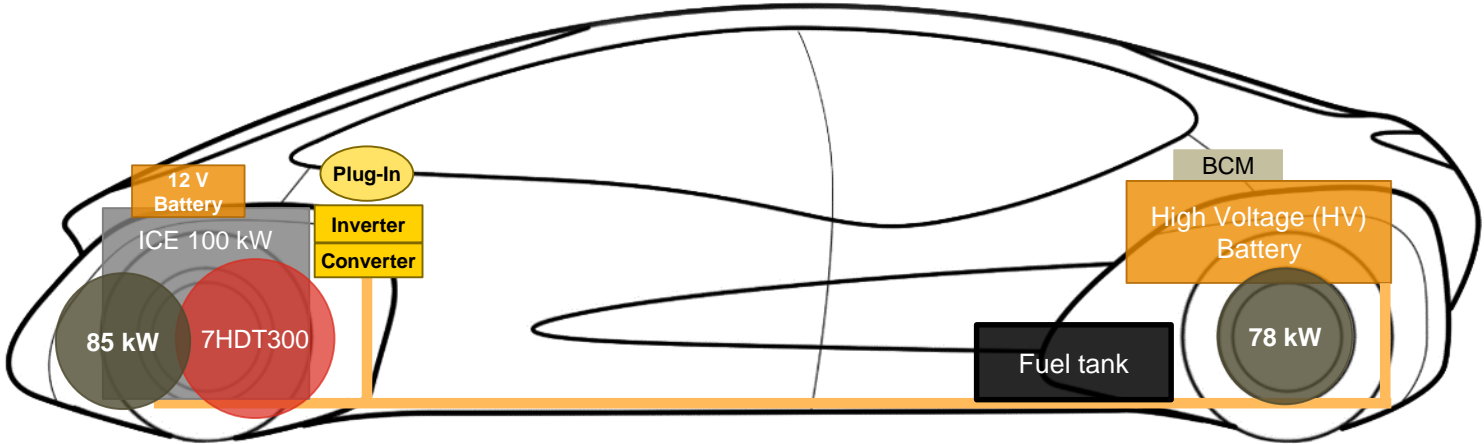
CO₂ Improvement



Gradeability



- PHEV P2.5+P4 Eco
- PHEV P2.5+P4 Auto
- PHEV P2.5+P4 Sport

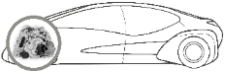


e2 Demonstrator
nominiert

Österreichischer Staatspreis Mobilität 2019

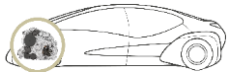


CONVENTIONAL ICE



Conventional Combustion Engine
Front-Wheel Drive

48V MILD HYBRID



48V Mild Hybrid –
Front-Wheel Drive

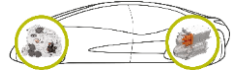


48V Mild Hybrid –
All-Wheel Drive

HV PLUG-IN HYBRID



HV Plug-in Hybrid –
Front-Wheel Drive

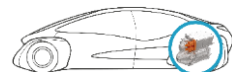


HV Plug-in Hybrid –
All-Wheel Drive



HV Plug-in Hybrid –
All-Wheel Drive

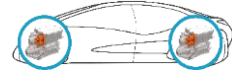
BATTERY ELECTRIC VEHICLE



Battery Electric Vehicle
Rear-Wheel Drive



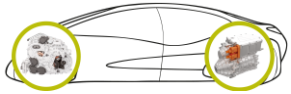
Battery Electric Vehicle
Rear-Wheel Drive



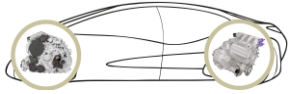
Battery Electric Vehicle
All-Wheel Drive



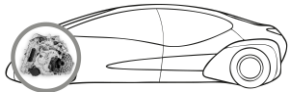
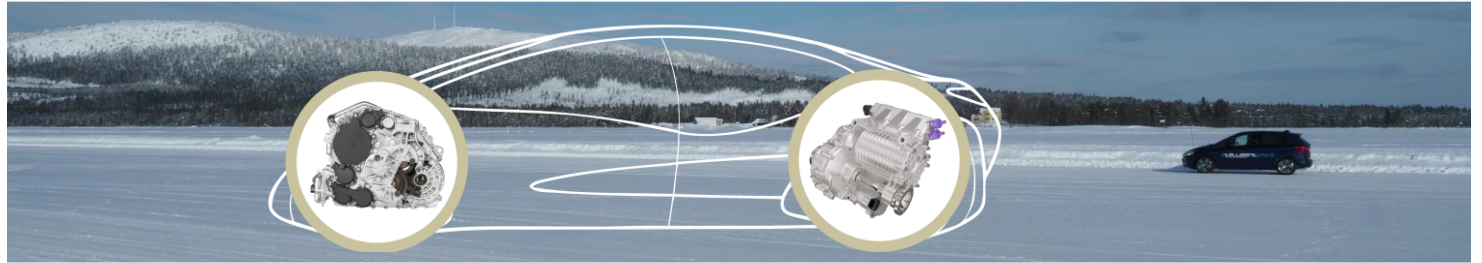
Battery Electric Vehicle
All-Wheel Drive



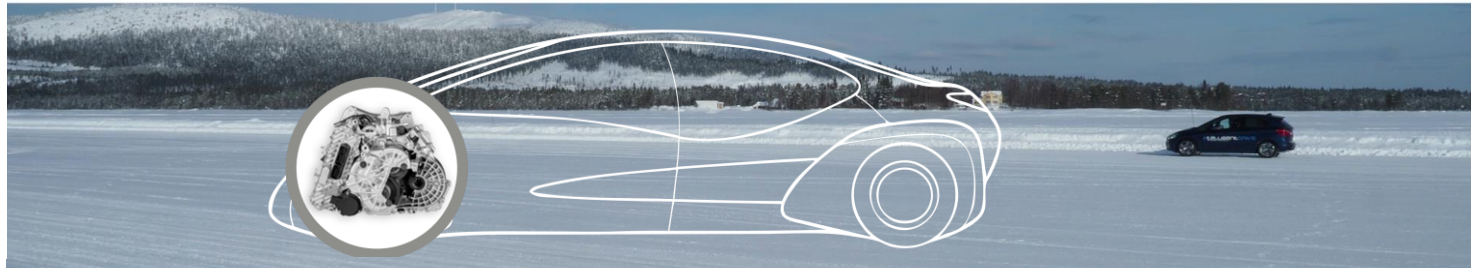
**HV Plug-in Hybrid –
All-Wheel Drive**

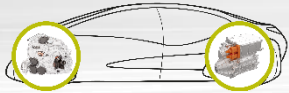


**48V Mild Hybrid –
All-Wheel Drive**

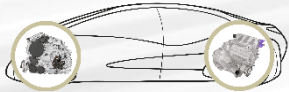


**Conventional Combustion Engine
Front-Wheel Drive**

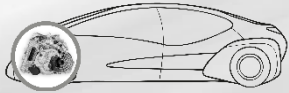




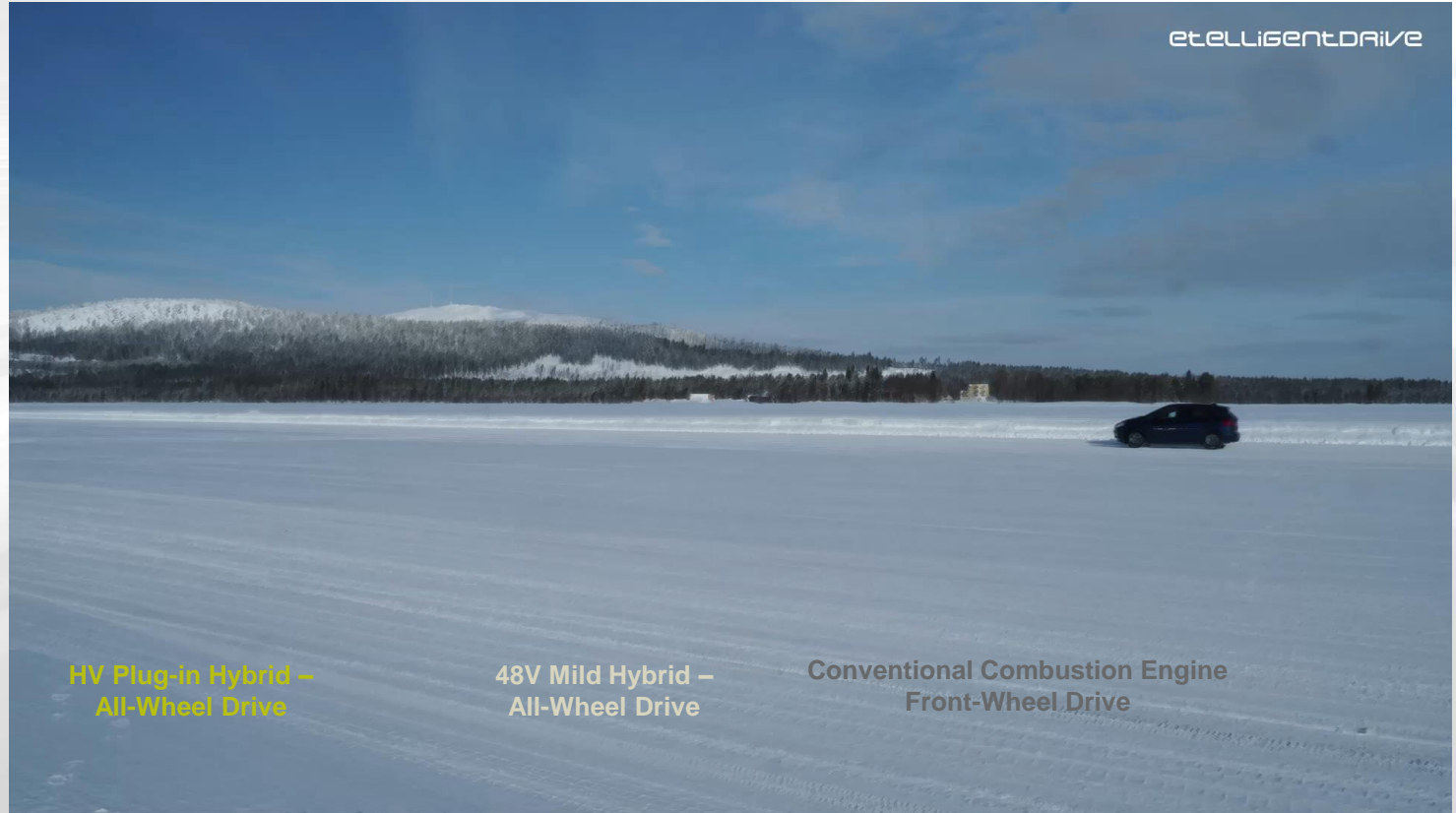
**HV Plug-in Hybrid –
All-Wheel Drive**



**48V Mild Hybrid –
All-Wheel Drive**



**Conventional Combustion Engine
Front-Wheel Drive**

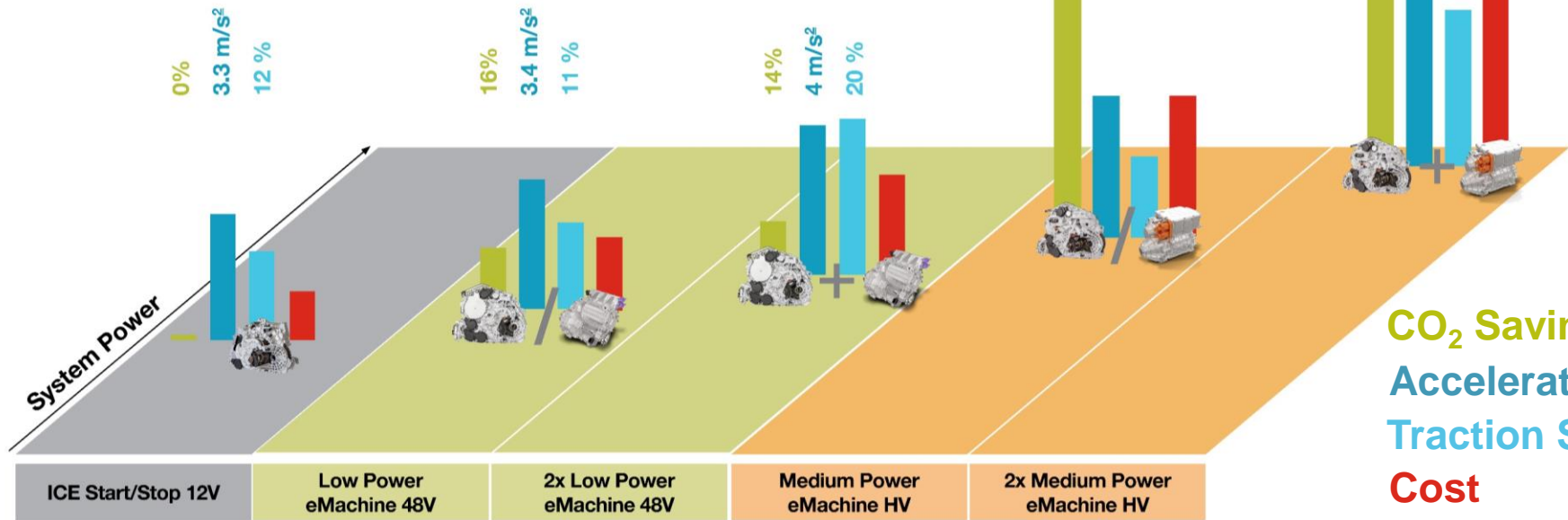
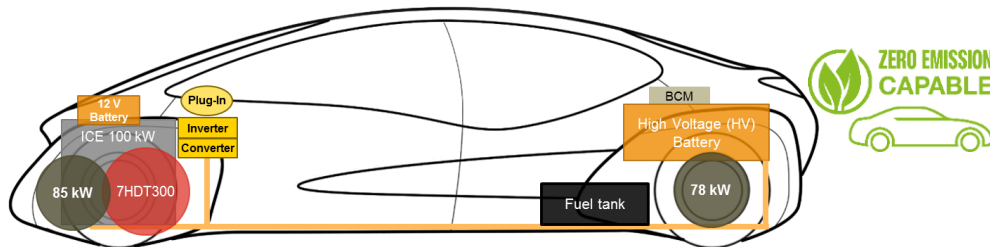


**HV Plug-in Hybrid –
All-Wheel Drive**

**48V Mild Hybrid –
All-Wheel Drive**

**Conventional Combustion Engine
Front-Wheel Drive**

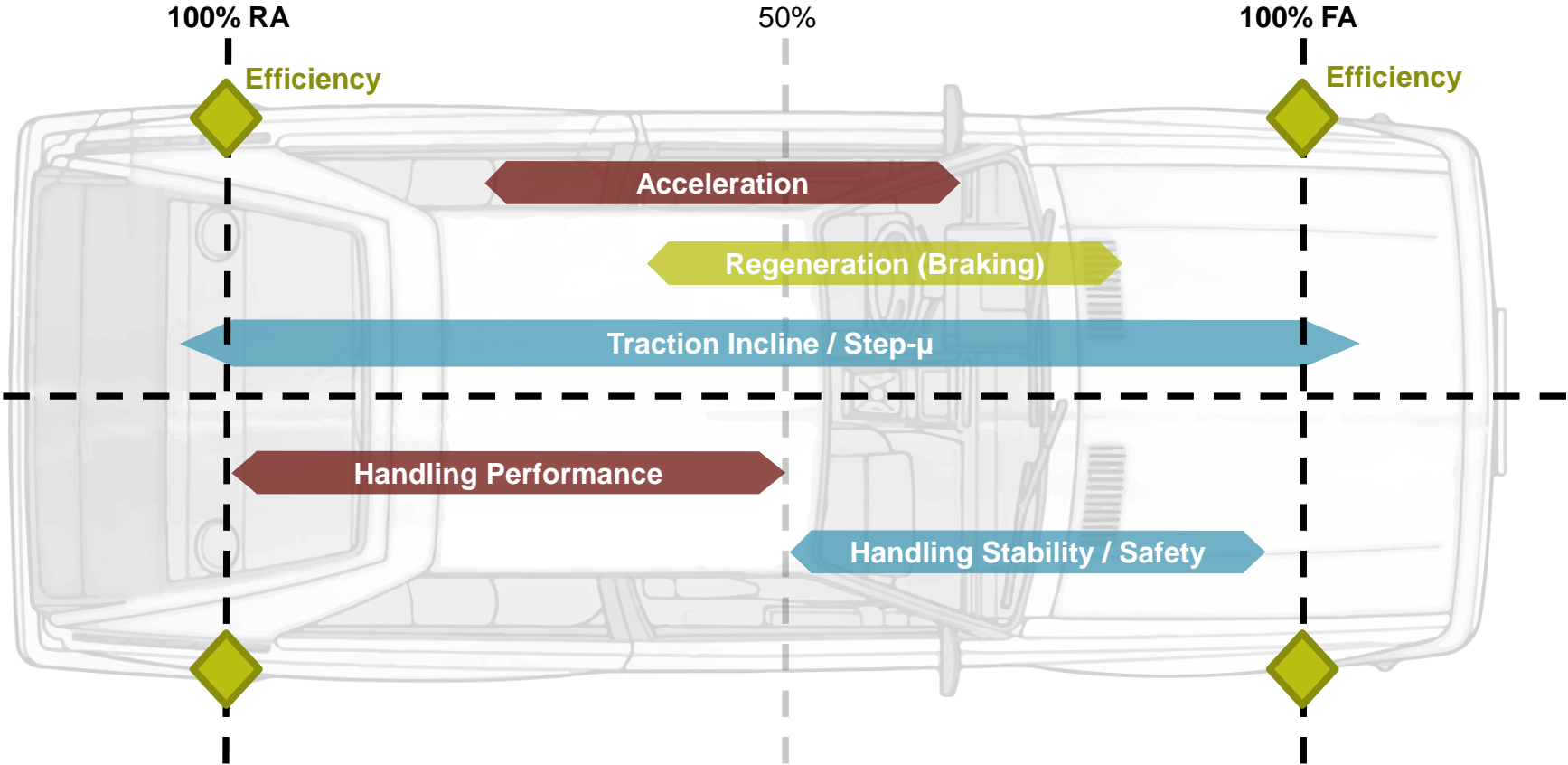
Hybrid Scalability: Performance PHEV P2.5+P4



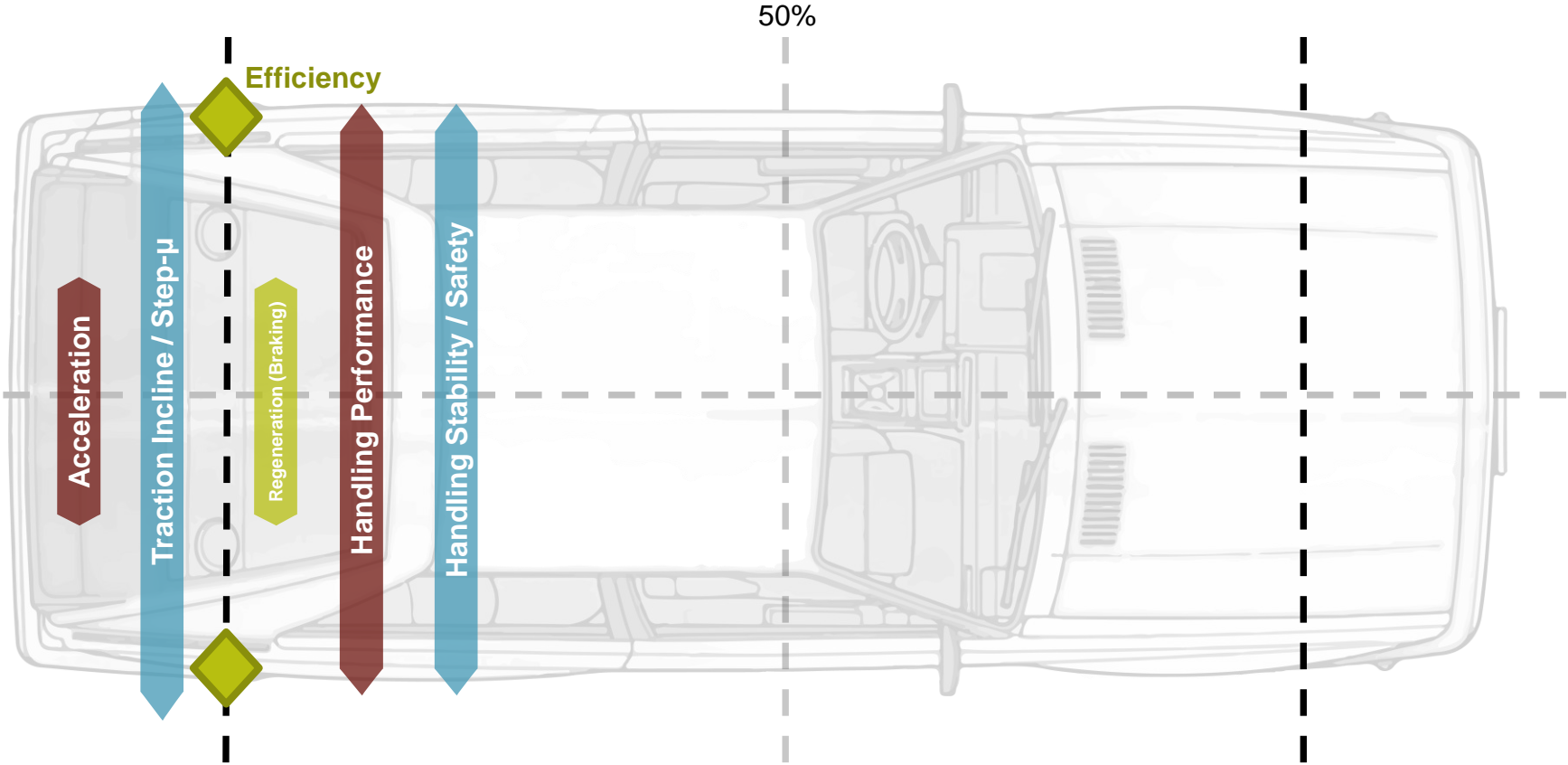
CO₂ Savings
Acceleration
Traction Snow
Cost

Scalable functions on modular platform architectures

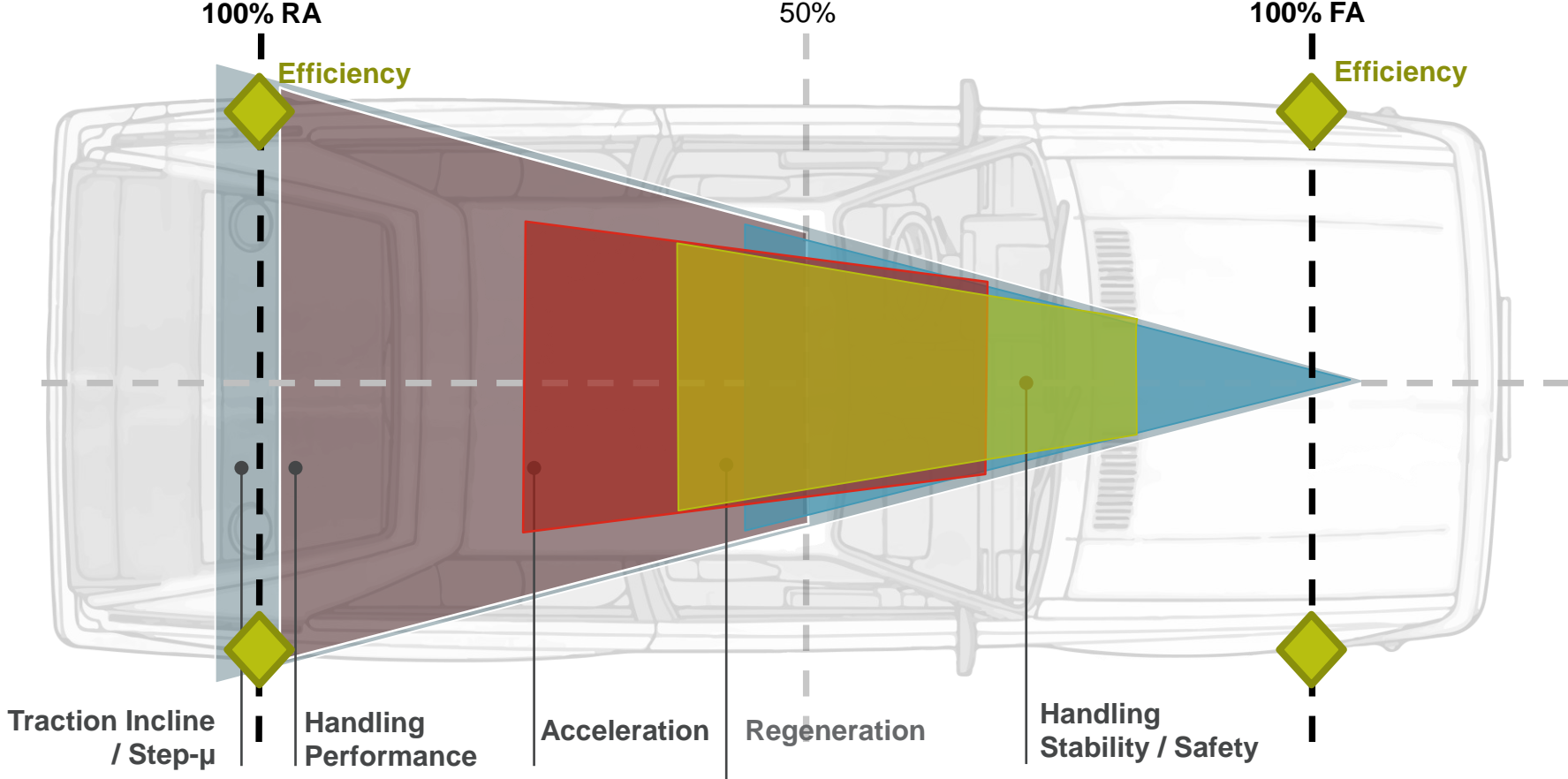
Vehicle Dynamic 4WD TV Longitudinal



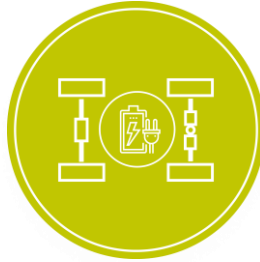
Vehicle Dynamic RWD + TV Lateral



Vehicle Dynamics 4WD TV Longitudinal+ TV Lateral



POWERTRAIN ELECTRIFICATION



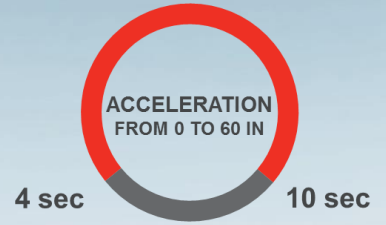
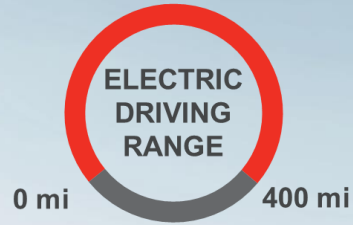
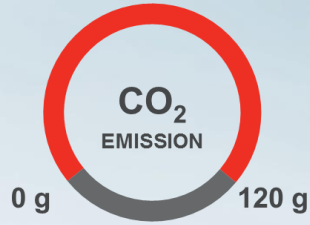
**Delivering a
scalable modular
platform for driving
performance and
CO₂ reduction**



MASTERING COMPLEXITY



SHAPING THE FUTURE



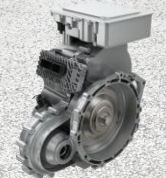
7DCT300



7HDT300 48V



4HDT230 HV



eDS HV Low



eDS 48V Traction



eDS HV Low



eDS HV Mid



eDS HV TV





DRIVING **EXCELLENCE.**
INSPIRING **INNOVATION.**