Electrification Trends in AWD

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BorgWarner

Agenda

- Trends impacting the Propulsion Technology
- Evolution of Propulsion System Architectures
- Resulting trends for AWD Systems
- BorgWarner’s Answer for e-AWD
- Outlook

Unique Propulsion Systems around the World

Photo Credit: Mascarinas, Erwin M.

Photo Credit: Prokhorova, Maya

Photo Credit: Hyundai

Trends Impacting Propulsion Technology

efficiency/CO_2 emissions

- Regulatory compliance continues to drive technology roadmaps until 2025
- Key markets US, EU, China require different technology solutions

autonomous driving

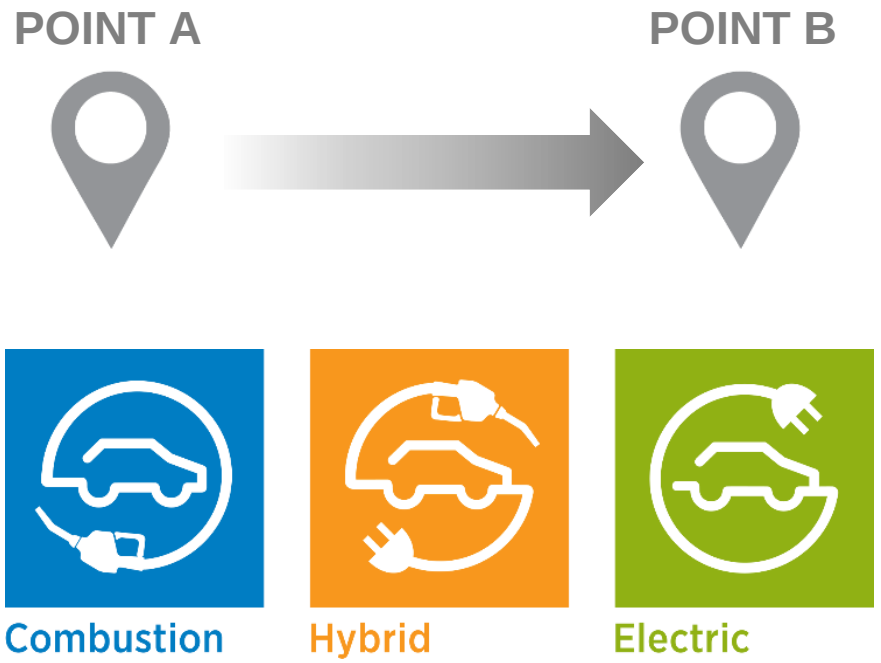
shared cars and rideshare

connected cars

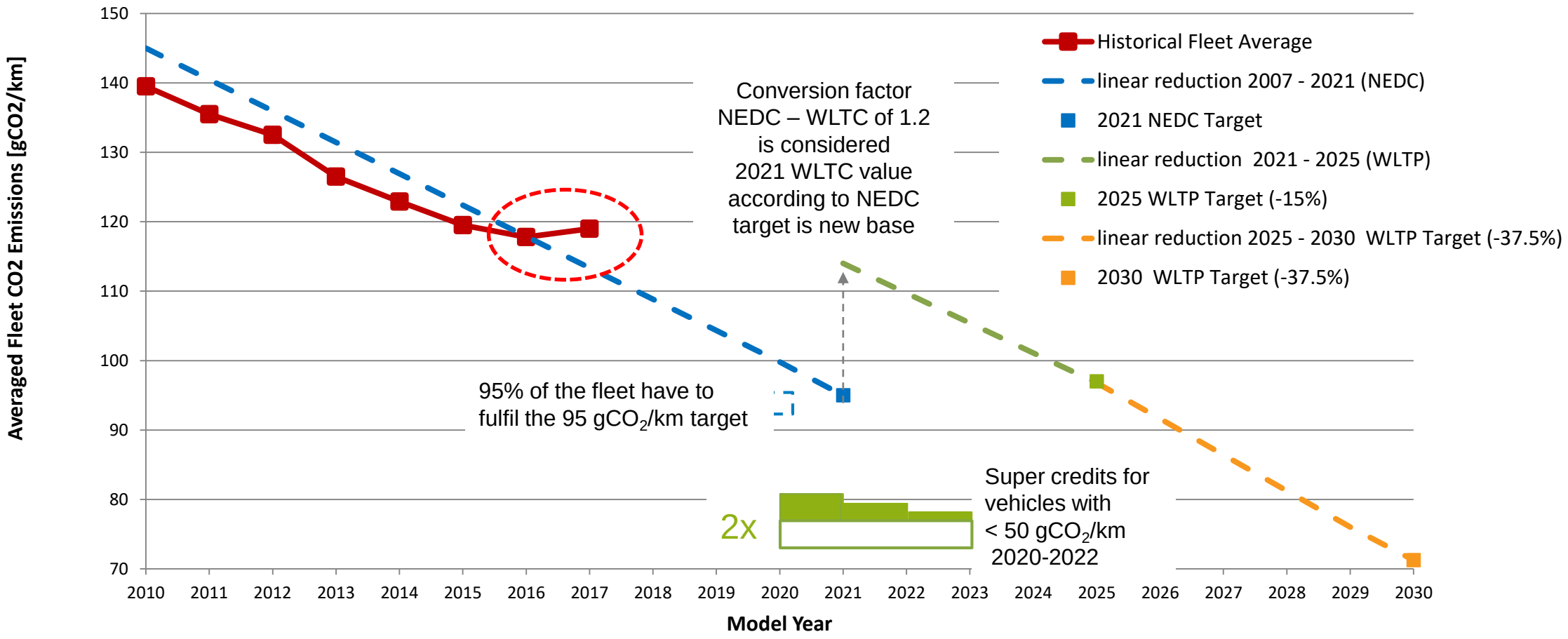
The BorgWarner Alphabet

A → B

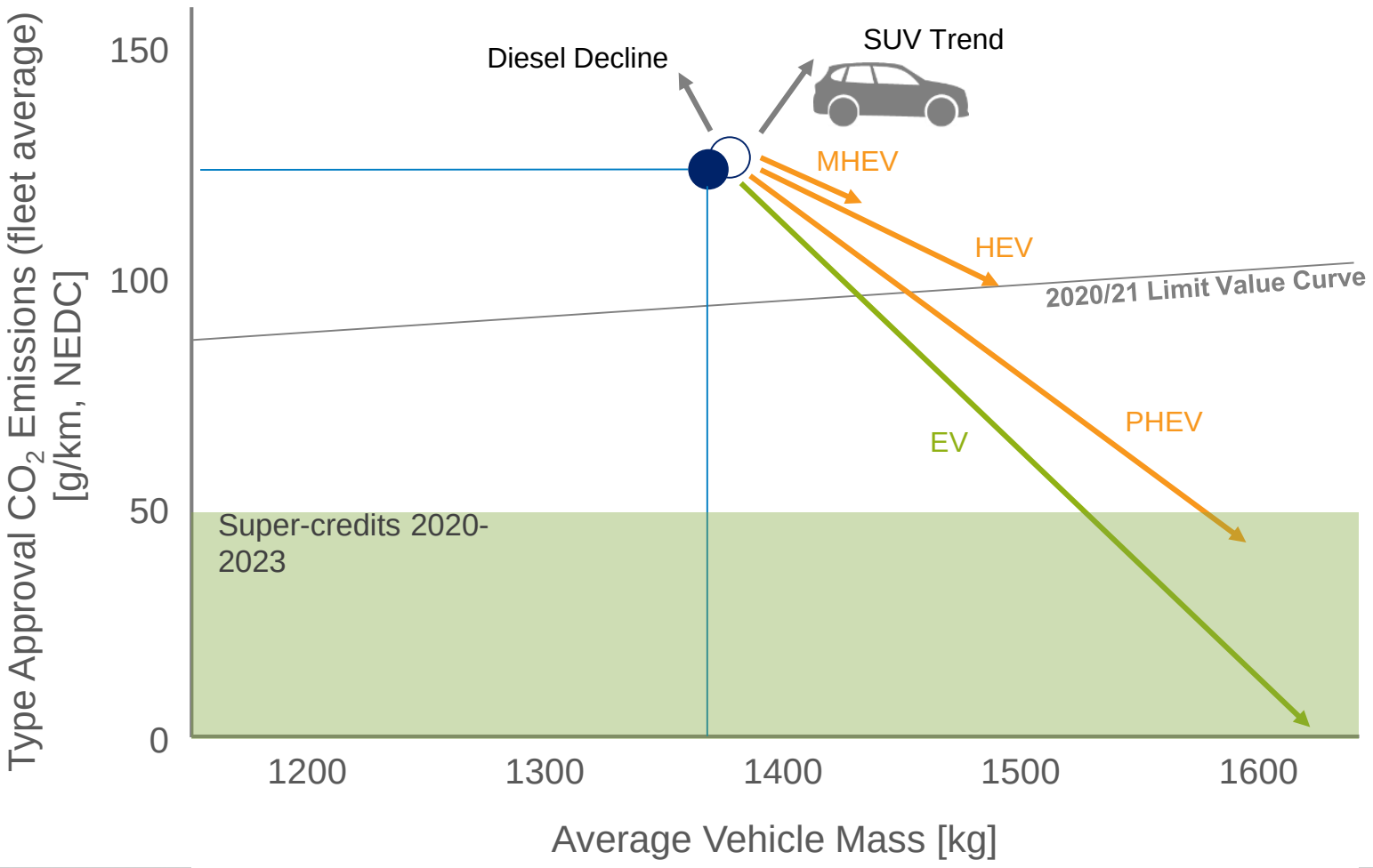
C, H, E



EU CO_2 Targets for Pass Cars

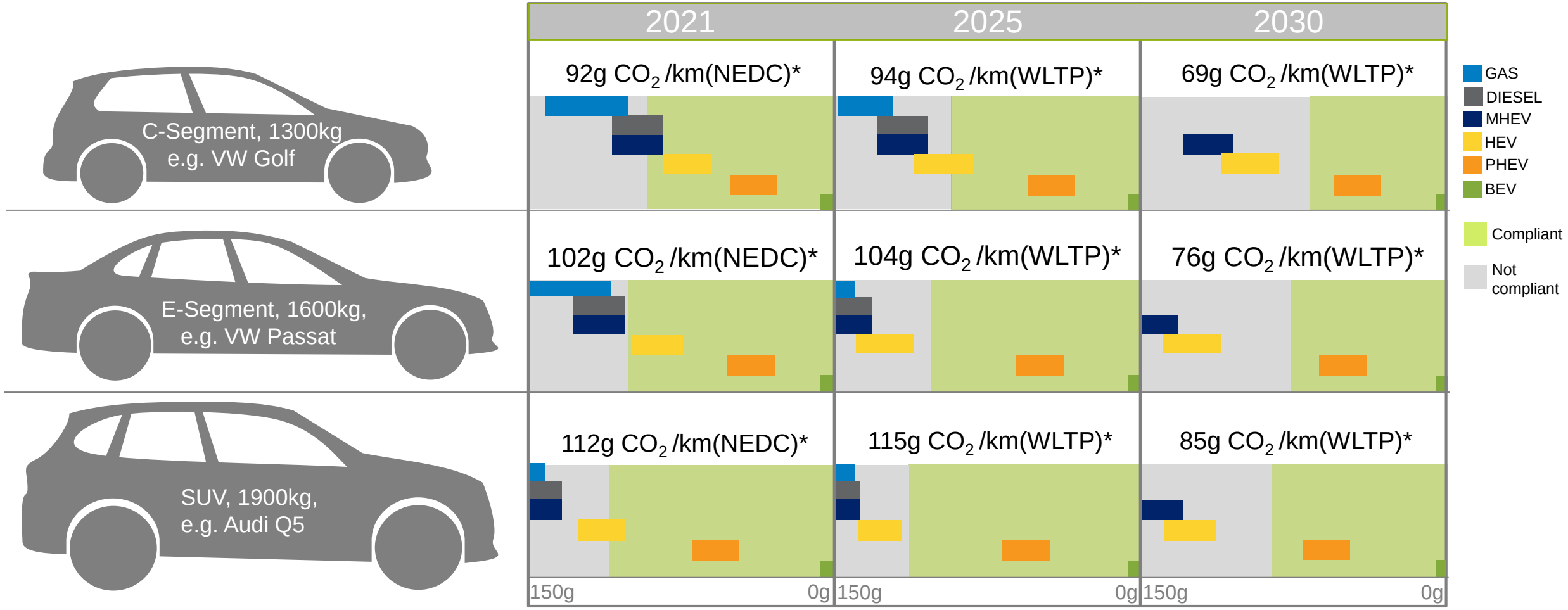


Impact for Representative EU Fleet



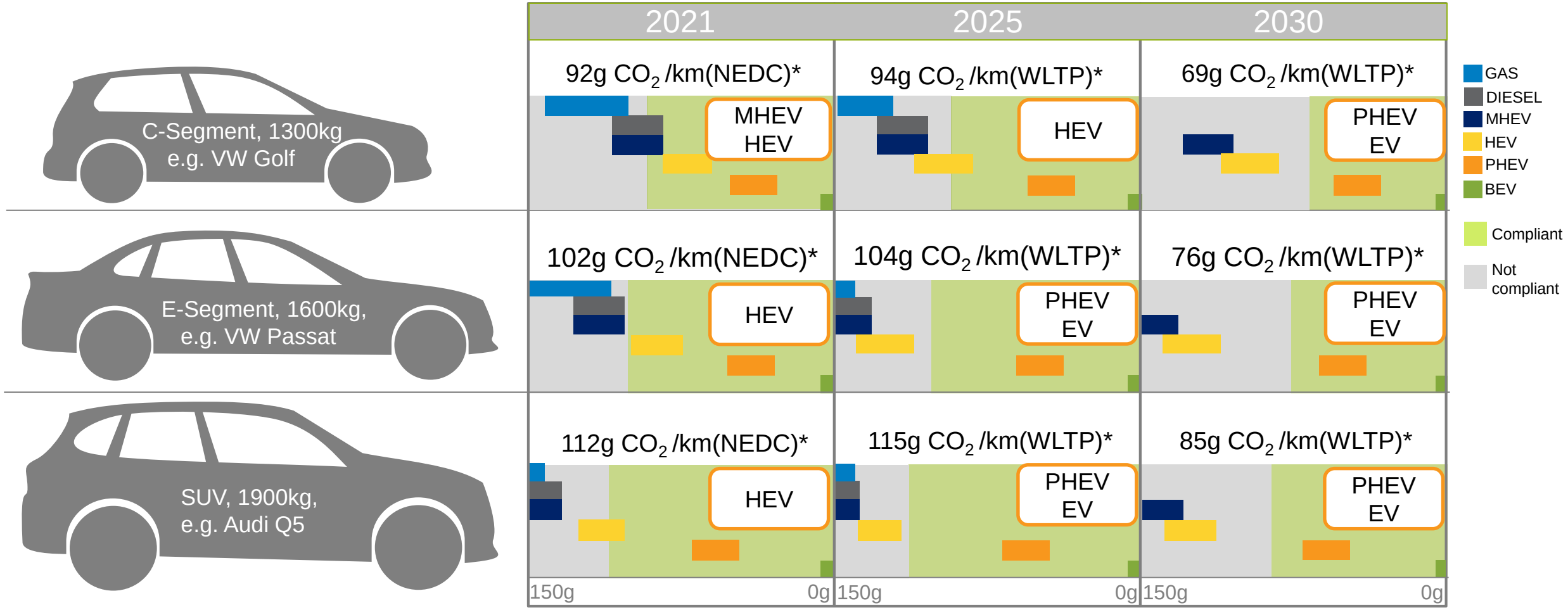
Source: ICCT

Propulsion System Compliance in the EU



*Target CO_2 number based on vehicle mass (conversion factor between NEDC and WLTC is considered to be 1.2)

Propulsion System Compliance in the EU



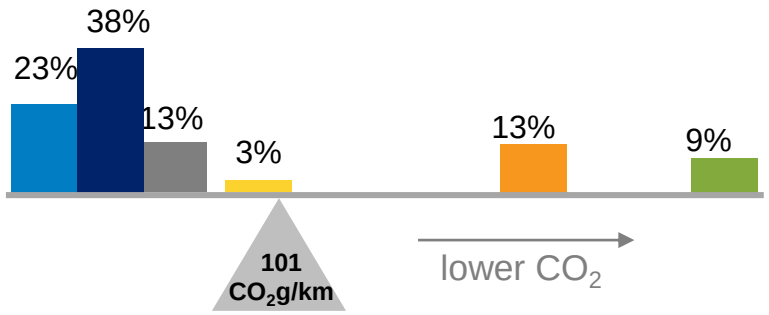
*Target CO_2 number based on vehicle mass (conversion factor between NEDC and WLTC is considered to be 1.2)

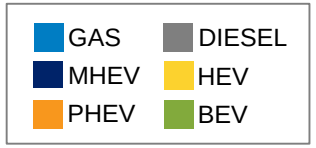
Market Scenarios for 2025 and 2030

2025 (-15% vs, 2021, WLTP)

Scenario I

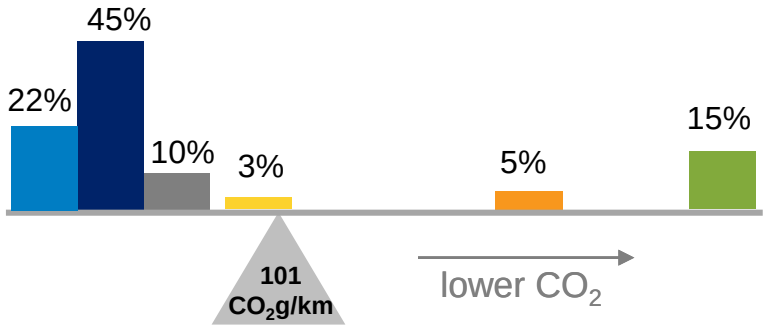
20% Plug In Vehicles





Scenario II (EV):

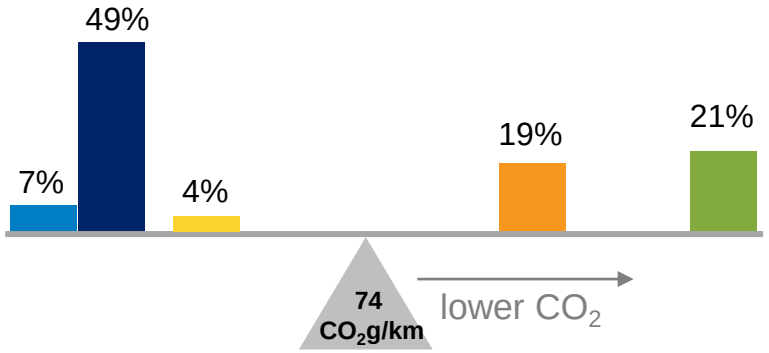
High EV enables more MHEV and less PHEV



2030 (-37.5% vs, 2021, WLTP)

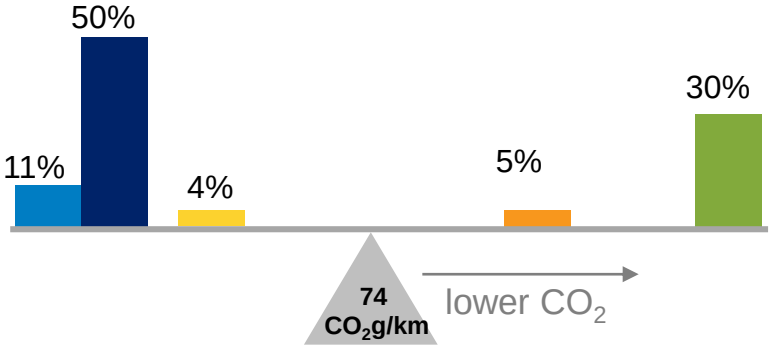
Scenario I

40% Plug In Vehicles



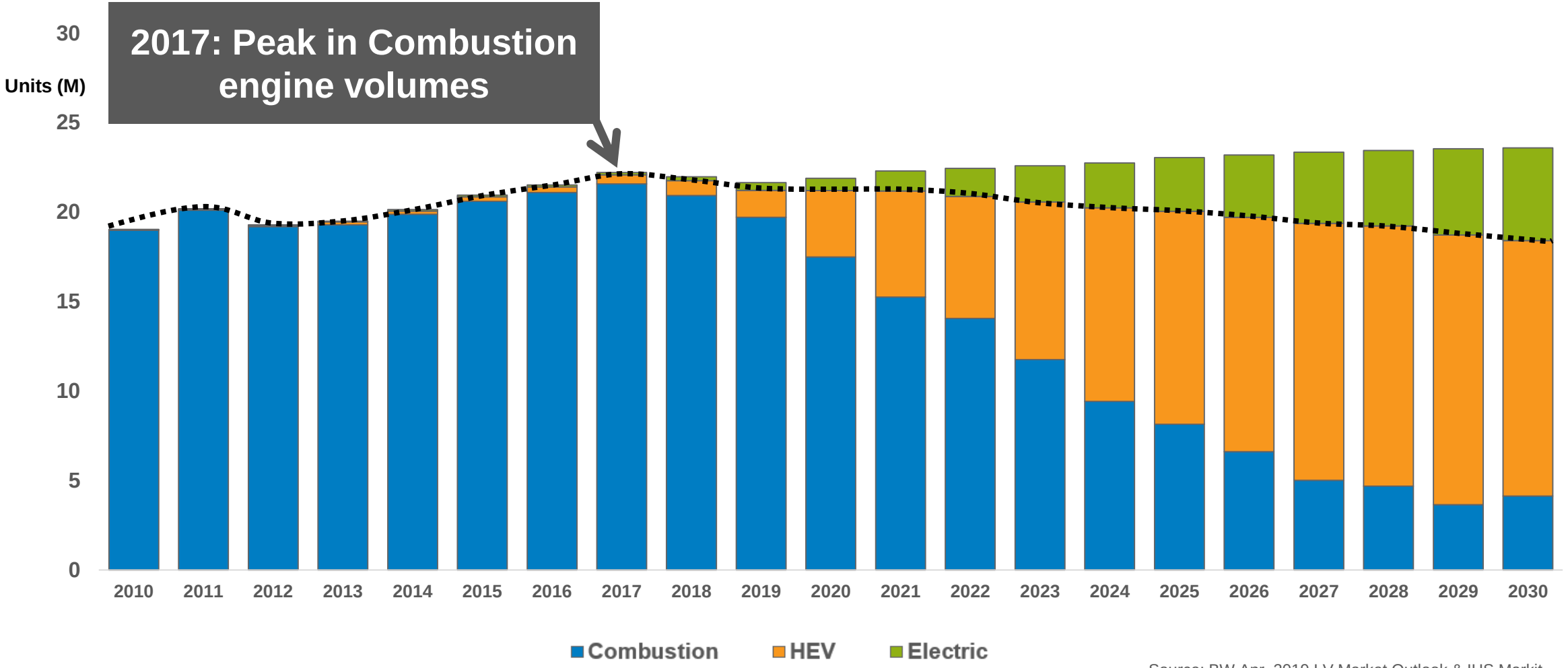
Scenario II (EV)

High EV penetration limits HV HEV/ PHEV



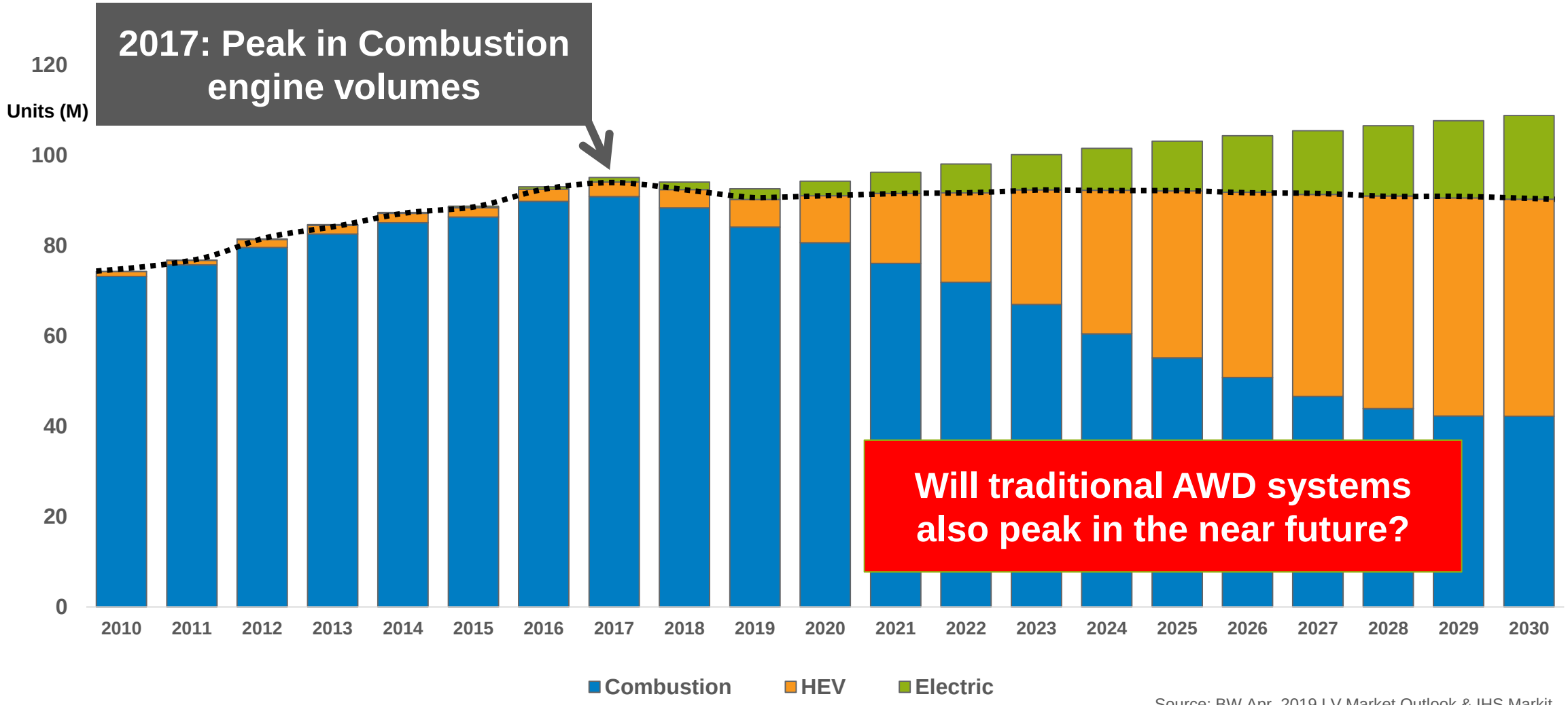
Significant share of PHEV/EV required in 2025+, higher EV share shrinks the total ICE market

LV Propulsion Outlook – Europe



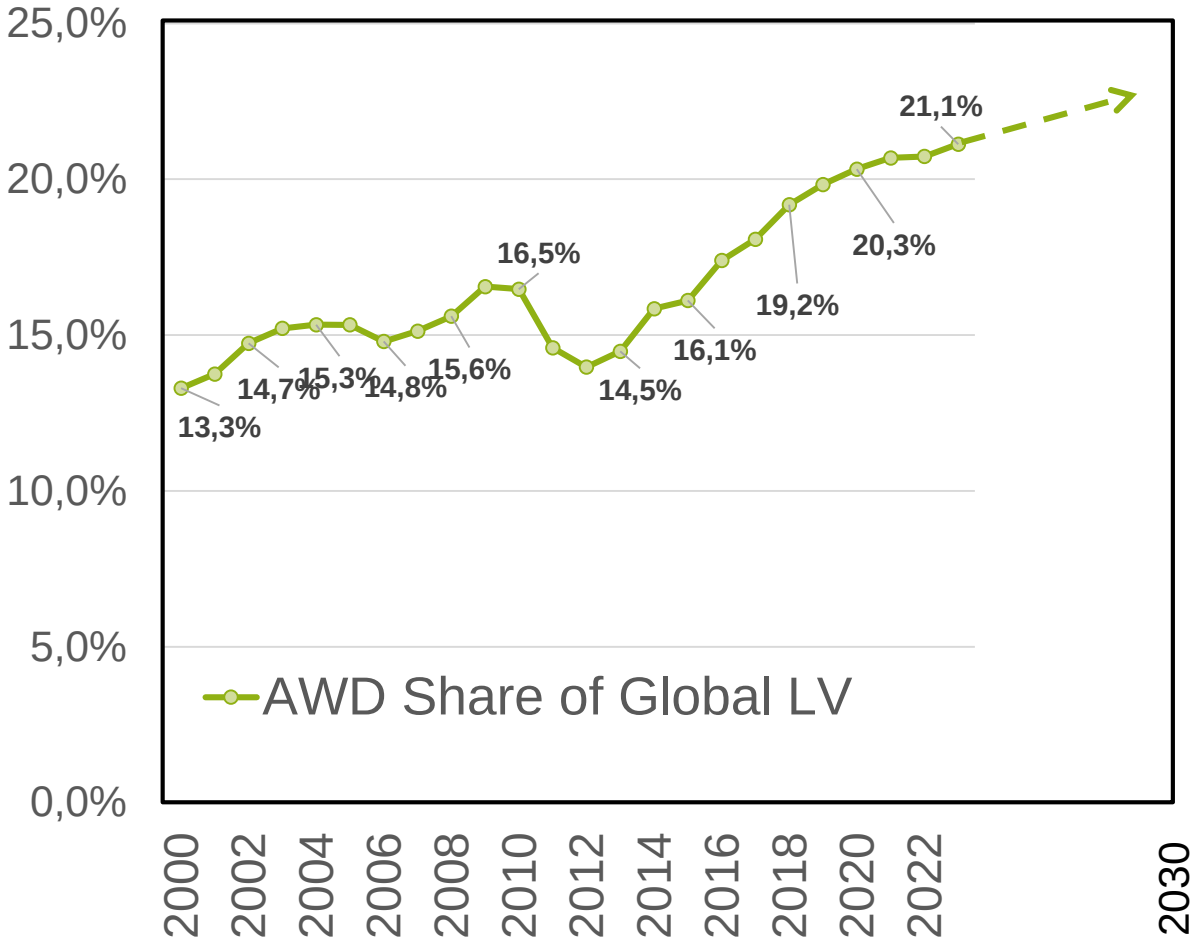
Source: BW Apr. 2019 LV Market Outlook & IHS Markit

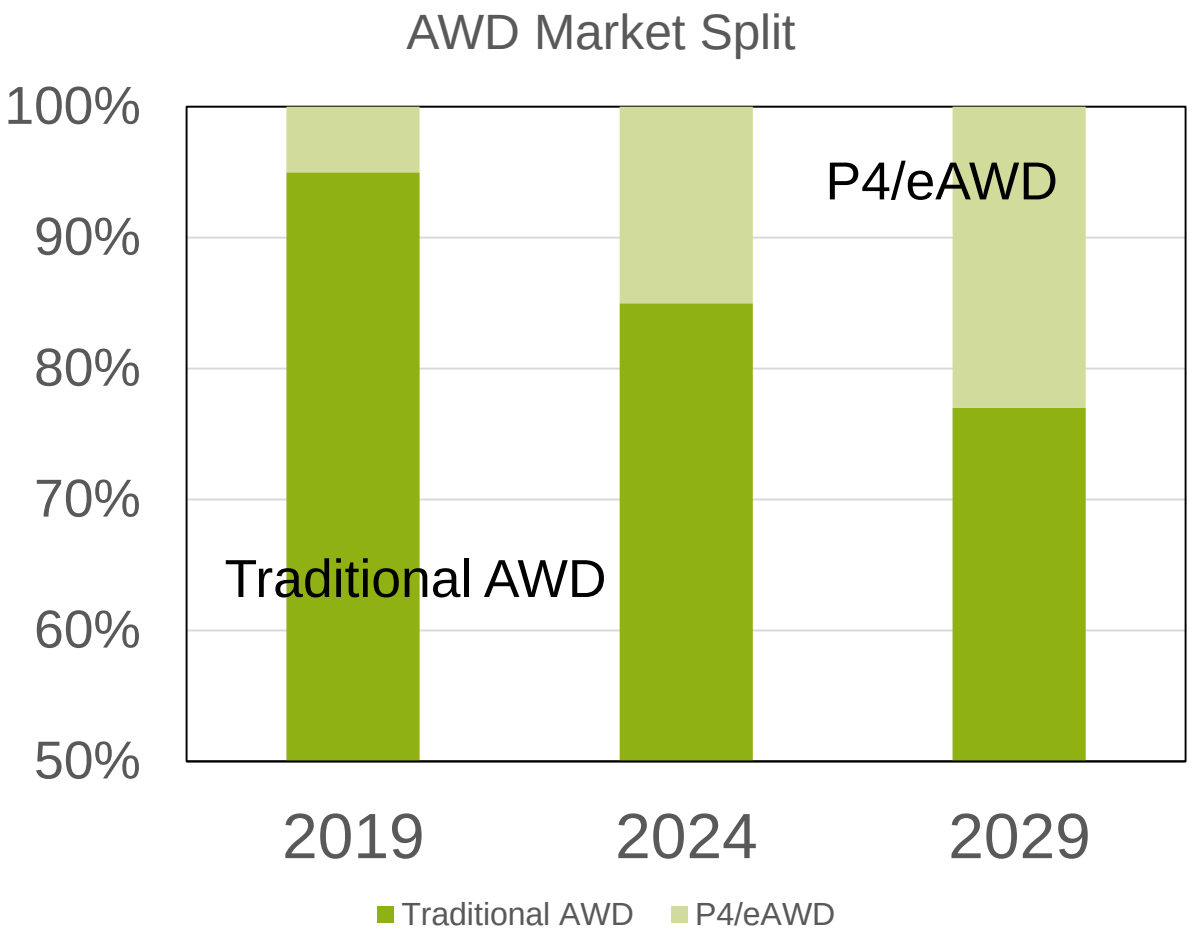
LV Propulsion Outlook – Global



Source: BW Apr. 2019 LV Market Outlook & IHS Markit

AWD Market Share for LV

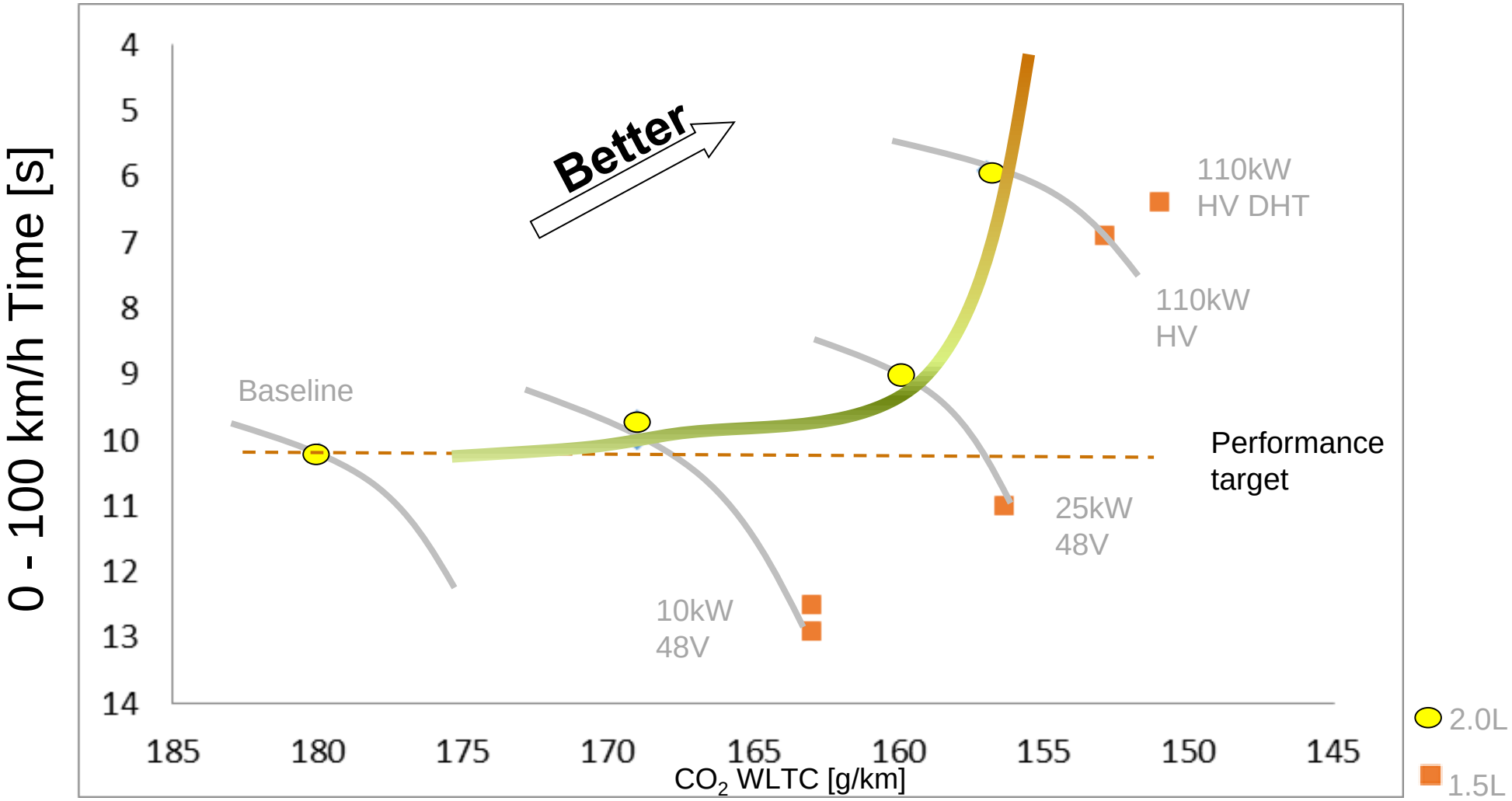




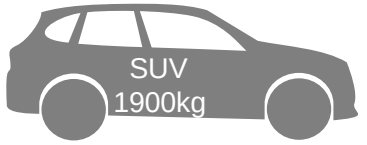
Includes: T-Cases, Couplings, eAxles & Integrated Transmissions

Source: BW Apr. 2019 LV Market Outlook & IHS Markit

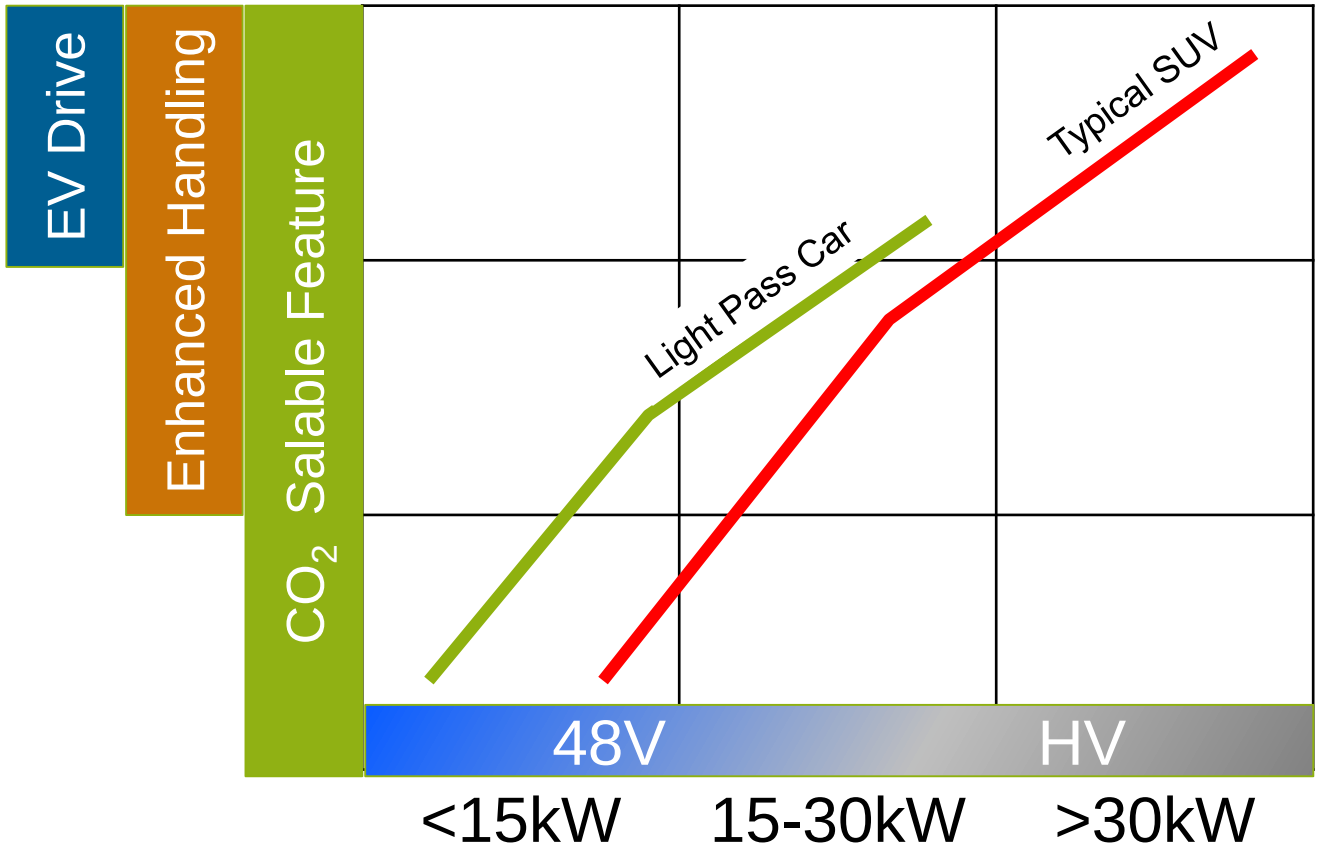
Impact of Electrical Power on Performance & CO_2

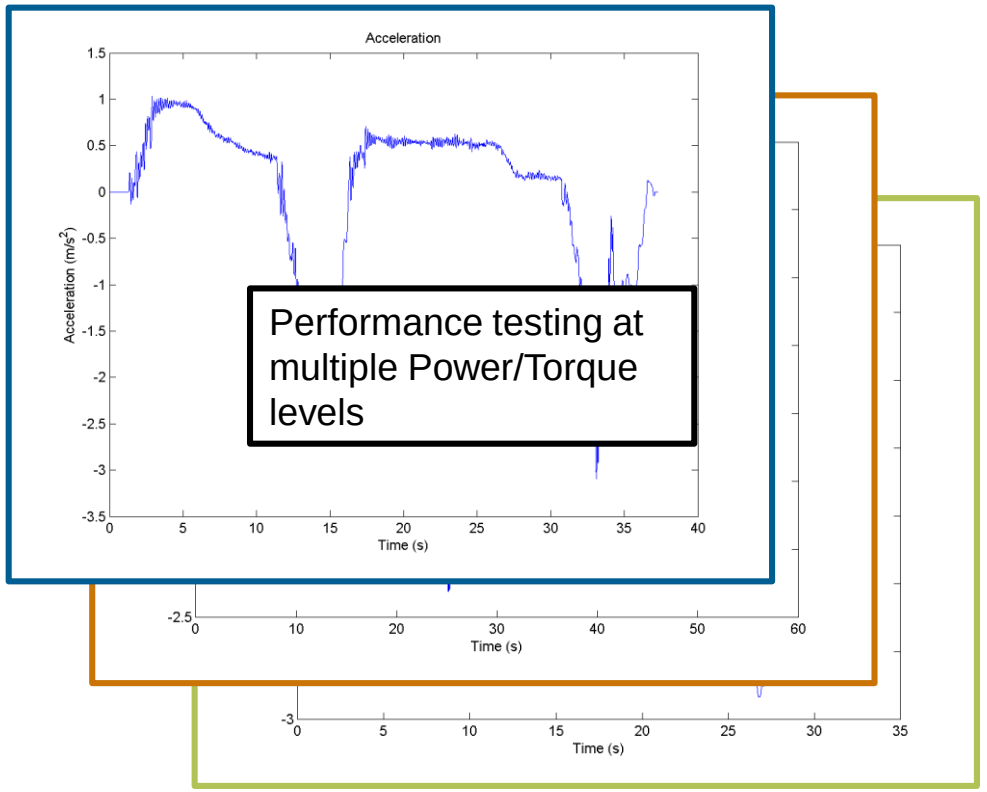


2.0L Miller engine
140 kW, 320 Nm
220 g/ kWh best BSFC



Performance Levels of Electrified AWD





48V and High Voltage P4 Offerings

48V P4 Module

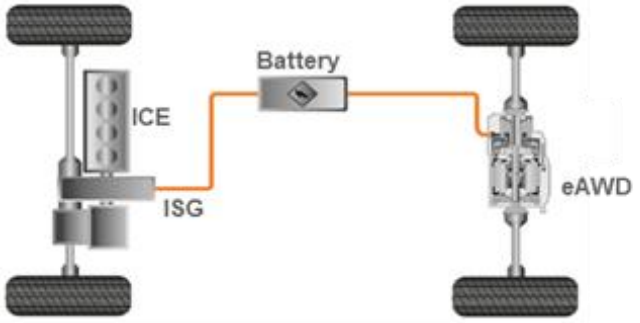
High Voltage Integrated Drive Module

eAWD – P4

48V eAWD (P4)

DESCRIPTION

- Secondary electric drive axle capable of regeneration/boost and limited AWD (P4 HEV)
- Leverage lower cost 48V infrastructure
- 1 or 2-Speed function for enhanced AWD and regen
- Deliver improved FE/CO2 improvement



BENEFITS

- 7% FE gain in addition to 48V BAS equipped vehicle (simulated)
- Cost neutral to conventional mechanical AWD
- Launch assist (engine downsizing enabler) and creep capable for extended S/S
- Highway sailing sustained torque of 340 Nm

	48V eAWD
Continuous Power	8 kW
Peak Power	12.5 kW
Continuous Output Torque	875 N-m
Peak Output Torque	1,450 N-m
Status	POC

Integrated Drive Module iDM

Fully Integrated Drive Module

DESCRIPTION

- Drive Module with fully integrated Electrical Machine and Power Electronics
- Operating Voltage: 250-450 V_{DC}

BENEFITS

- Easy Vehicle Integration
- Scalable and Modular Architecture
- Optimized System Efficiency → World Class Battery Energy Consumption
- State of the art Torque and Power Density
- High Speed Electrical Machine
- Water Cooled
- Optional e-Park Lock System

Wheel Output	iDM 90	iDM 120	iDM 160
Continuous Power	45 kW	65 kW	85 kW
Peak Power	90 kW	120 kW	160 kW
Continuous Torque	1,400 Nm	1,800 Nm	2,000 Nm
Peak Torque	2,500 Nm	3,000 Nm	3,800 Nm
Status, SOP	2022	Q4 2021	2022
Samples Available	2020	Q4 2019	2020

Outlook

- **AWD** will continue to **grow**
- **Increase** in **electrified AWD** solutions but the peak for traditional AWD system is yet to come
- **BorgWarner** will continue to be a **Leader in AWD Solutions** for traditional AWD as well as e-AWD systems

Thank you!