



2.2 Deep-dive E-Mobility

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President Business Division E-Mobility

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Dr. Jochen Schröder (47)

President Business Division E-Mobility

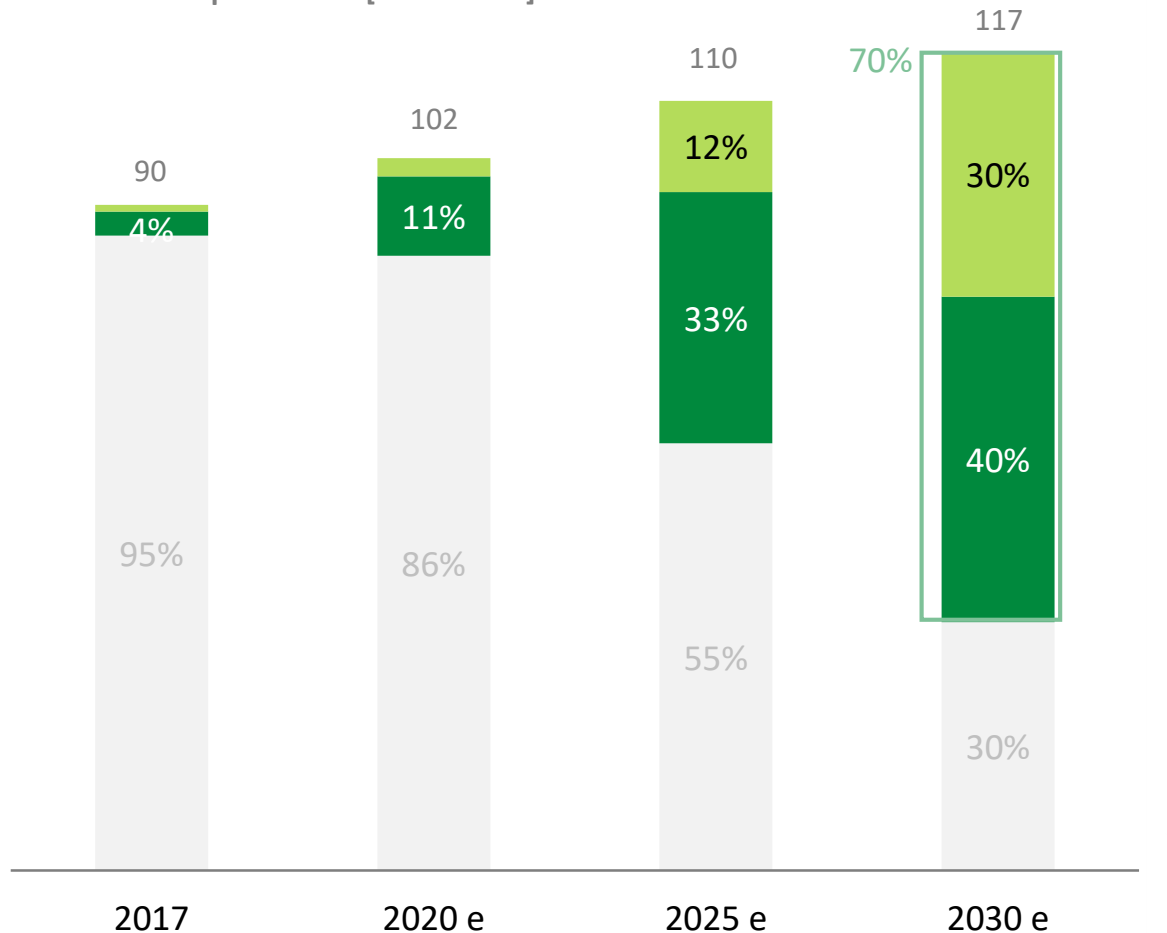
- ▶ 2001 – 2006 transmission development & head of E/E transmission at BMW AG
- ▶ 2006 – 2009 Head of Electric/Electronics at BMW-Sauber Formula 1, BMW AG
- ▶ 2009 – 2013 Head of system design & advanced development E-Drive at BMW AG / BMW-Peugeot-Citroën Electrification
- ▶ 2013 – 2016 Various leadership positions at BMW AG
- ▶ 2016 – 2018 CTO Valeo-Siemens eAutomotive
- ▶ Since 2018 President BD E-Mobility at Schaeffler

Mobility for Tomorrow – Our E-Mobility Strategy

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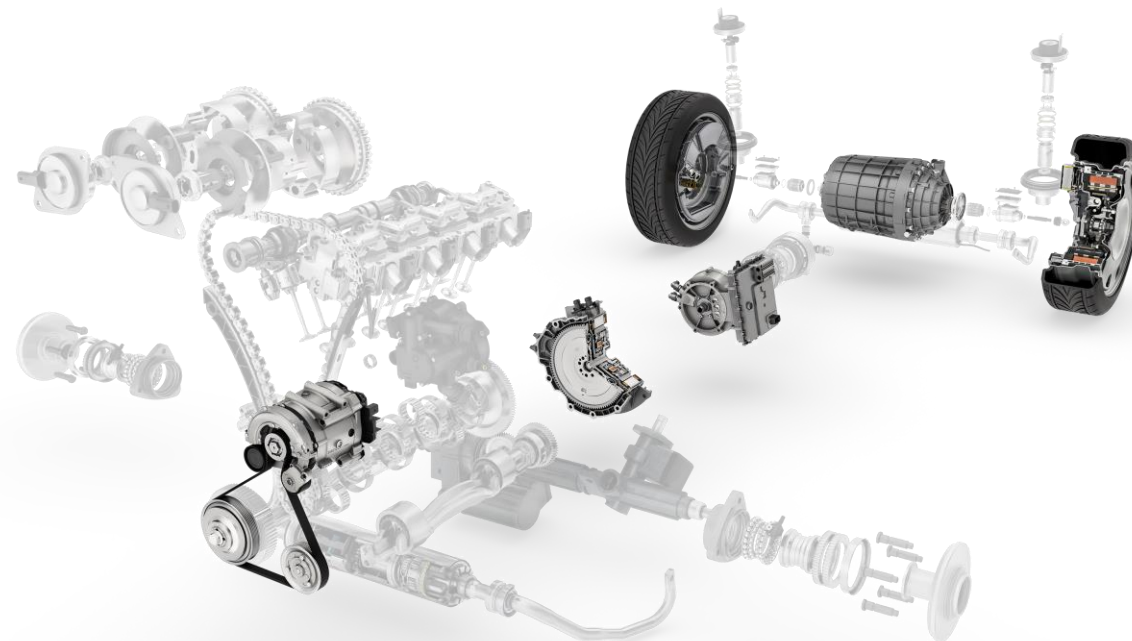
Vision Powertrain

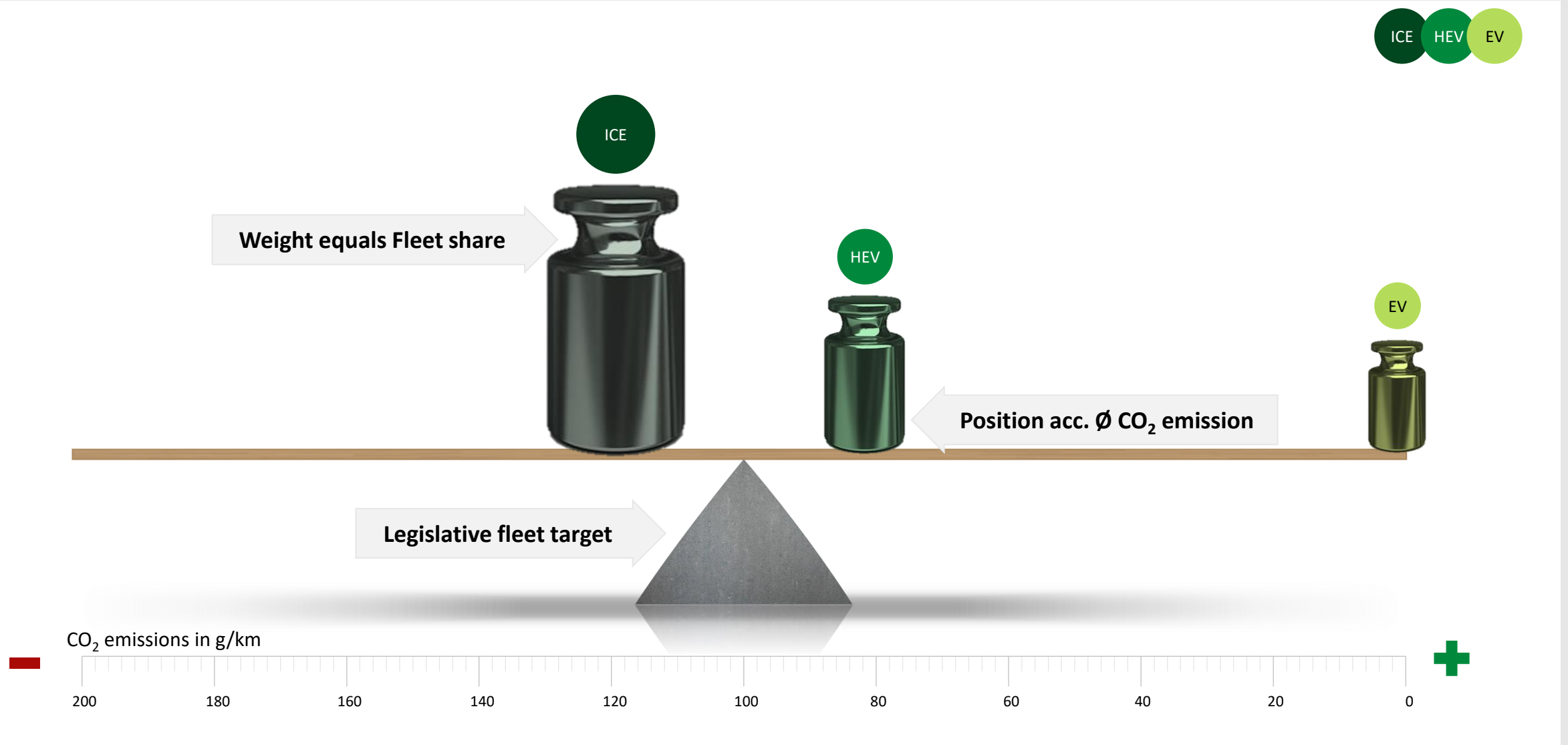
Global vehicle production [in mn units]



Source: IHS and Schaeffler Assumptions / Values based on Light Vehicles < 6 tons only, ICE = Internal Combustion Engine; HEV = Hybrid Electric Vehicles ranging from 48V Mild Hybrid to PHEV, BEV = Battery Electric Vehicles (incl. Fuel Cell Electric Vehicles)

Electrified Drivetrain Portfolio



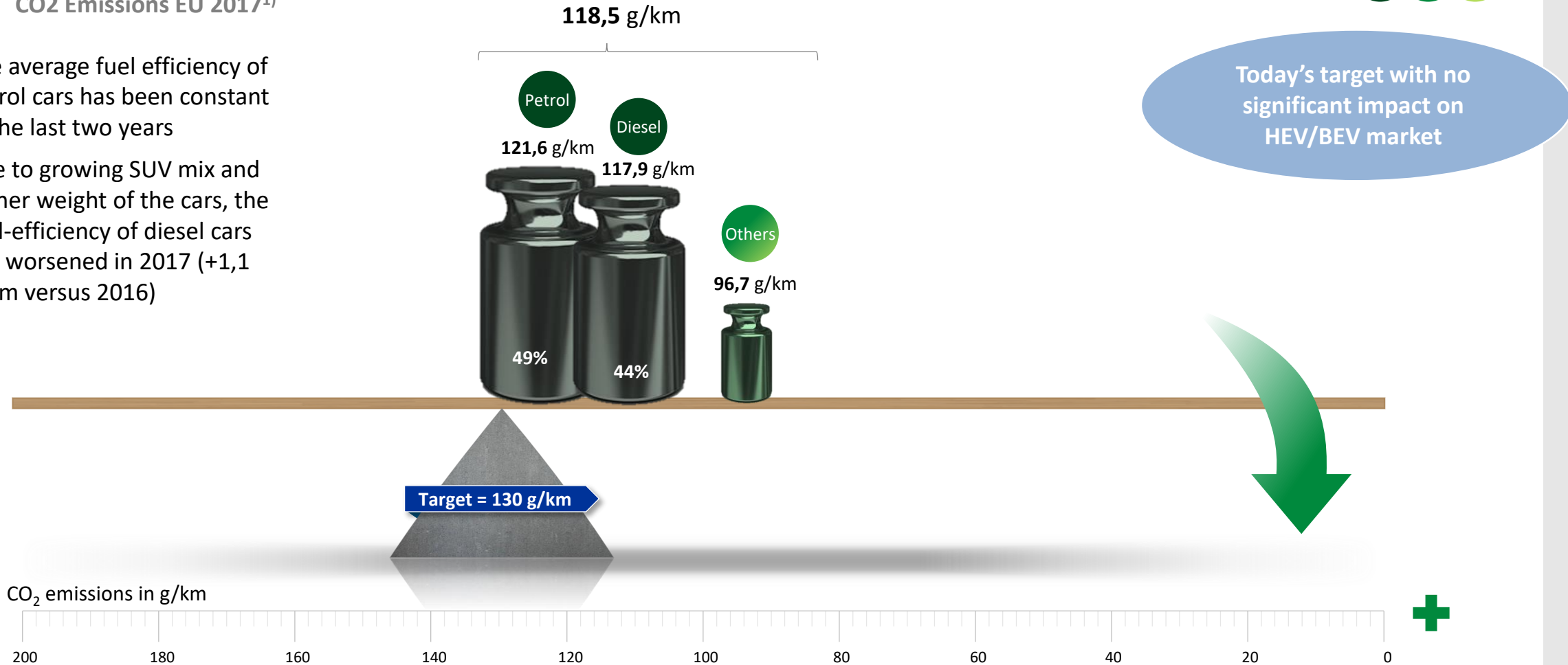


Powertrain Scenario – More than just assumptions



Balancing the scale – No regulatory impact CO₂ Emissions EU 2017¹⁾

- ▶ The average fuel efficiency of petrol cars has been constant in the last two years
- ▶ Due to growing SUV mix and higher weight of the cars, the fuel-efficiency of diesel cars has worsened in 2017 (+1,1 g/km versus 2016)



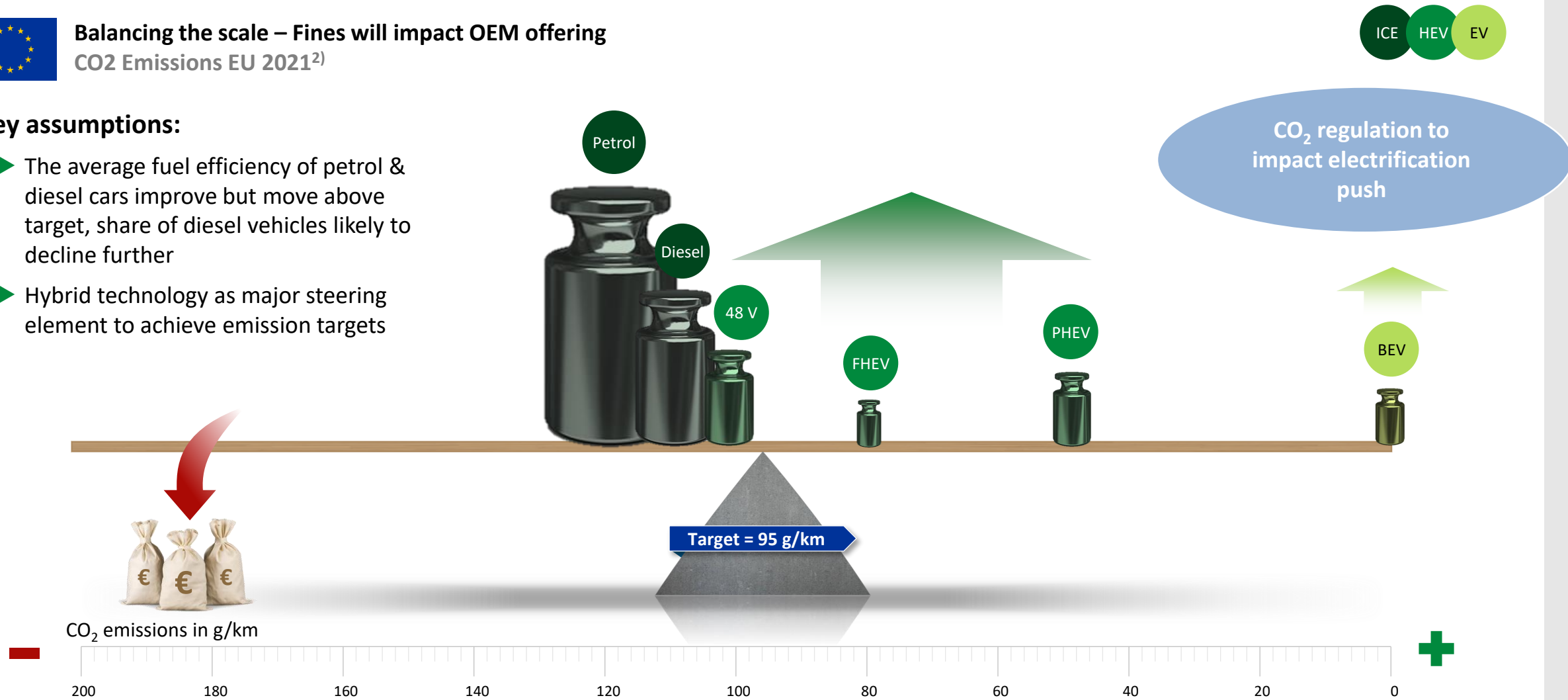
¹⁾ Data Source: EAA (European Environment Agency): "Monitoring of CO₂ emissions from passenger cars - Data 2017 - Provisional data"



Balancing the scale – Fines will impact OEM offering CO₂ Emissions EU 2021²⁾

Key assumptions:

- ▶ The average fuel efficiency of petrol & diesel cars improve but move above target, share of diesel vehicles likely to decline further
- ▶ Hybrid technology as major steering element to achieve emission targets



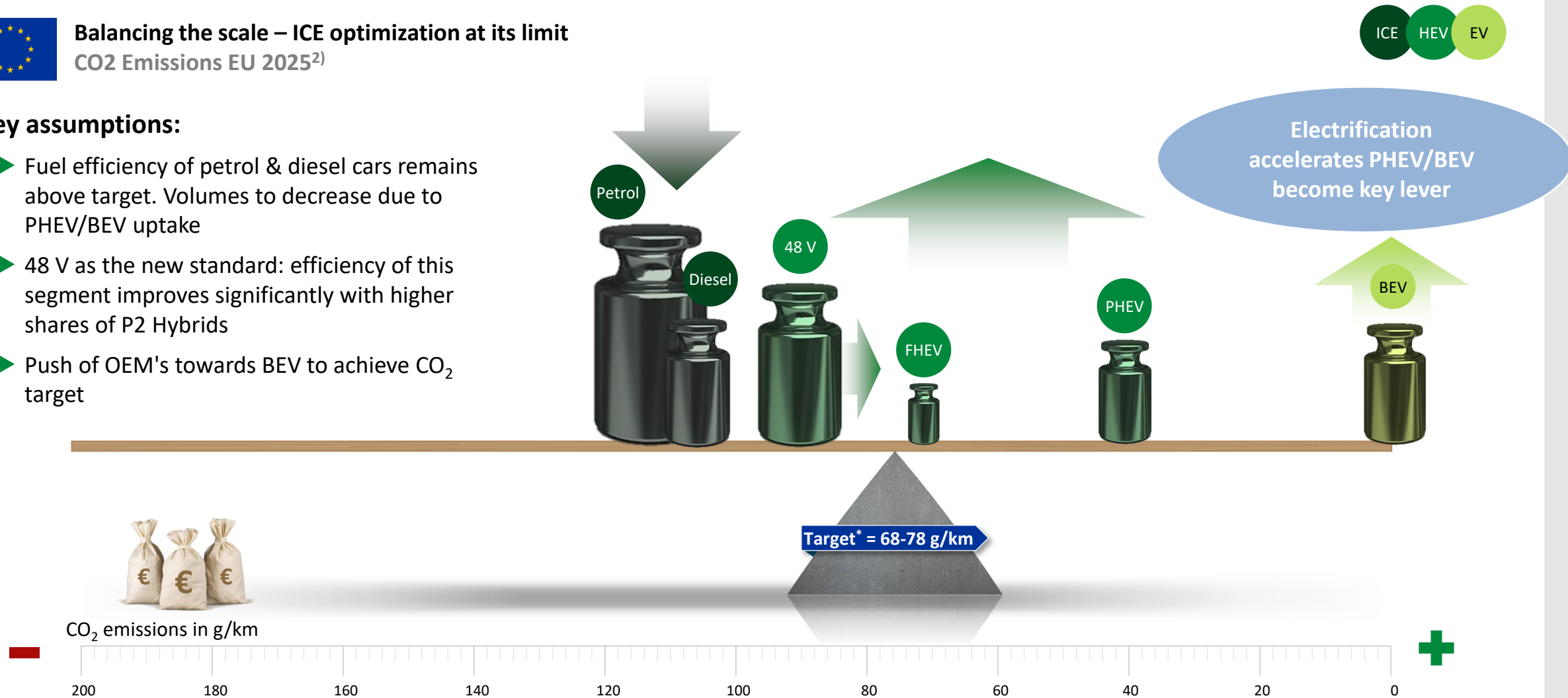
2) Qualitative presentation only



Balancing the scale – ICE optimization at its limit CO₂ Emissions EU 2025²⁾

Key assumptions:

- ▶ Fuel efficiency of petrol & diesel cars remains above target. Volumes to decrease due to PHEV/BEV uptake
- ▶ 48 V as the new standard: efficiency of this segment improves significantly with higher shares of P2 Hybrids
- ▶ Push of OEM's towards BEV to achieve CO₂ target

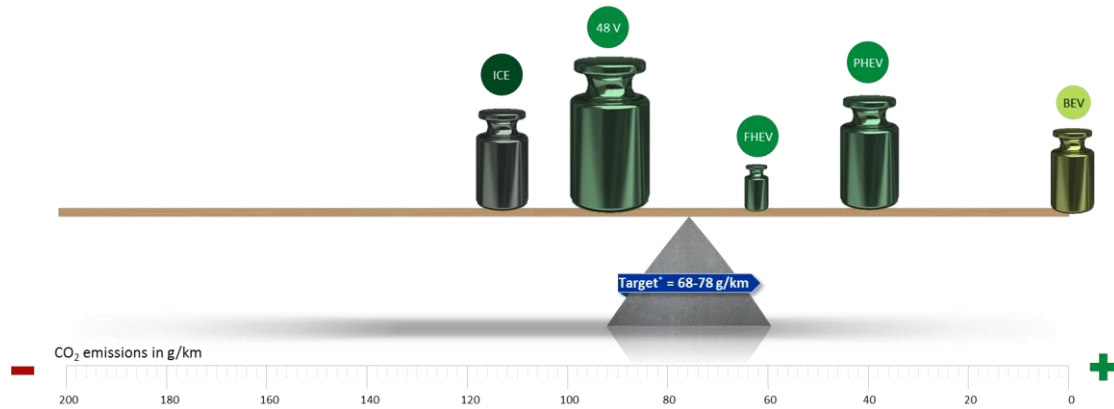


²⁾ Qualitative presentation only | * Target 2025 currently in discussion. Latest proposal is -30% in 2030 compared to 2021 (~66 g/km in 2030)

Powertrain Scenario – Different approaches per OEM and Region

OEM A

Full powertrain mix strategy

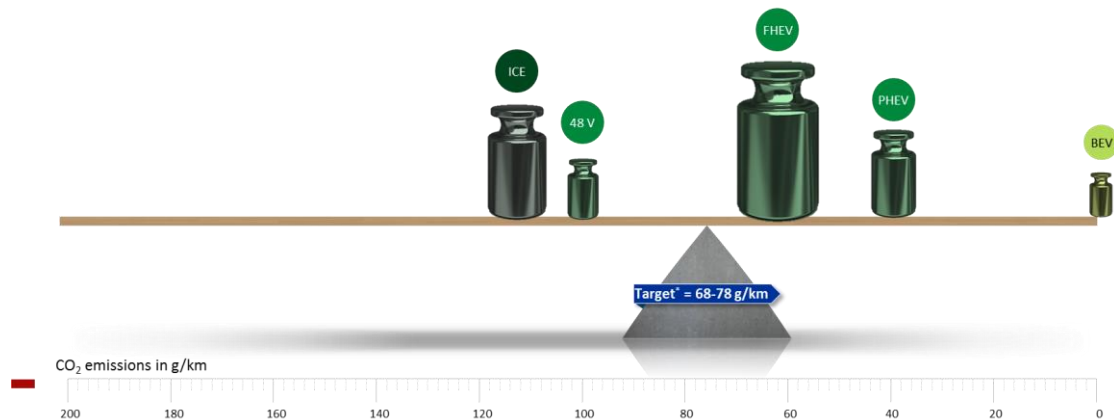


Key aspects

- ▶ CO₂ and Emission Targets can be achieved with many different strategies
- ▶ Even a Hybrid-only strategy could lead to target achievements
- ▶ Penalties vs. additional costs per Powertrain is key aspect of OEMs strategy

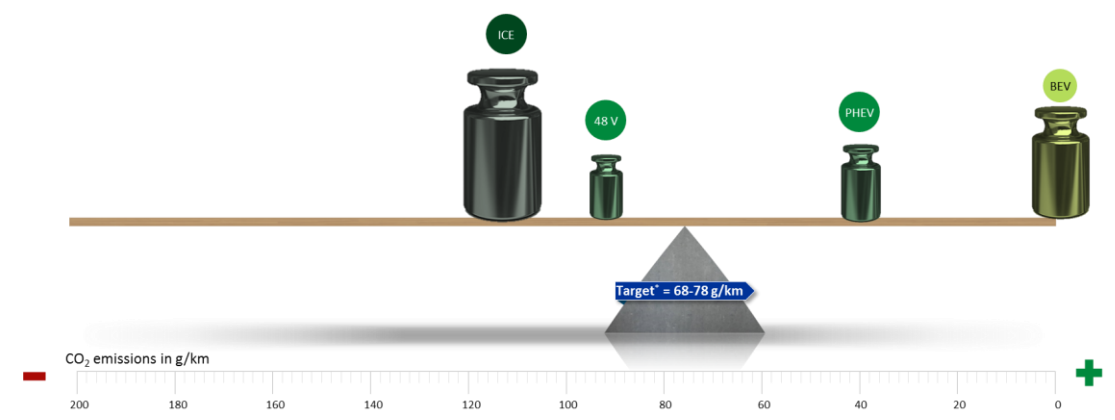
OEM B

Hybrid focus

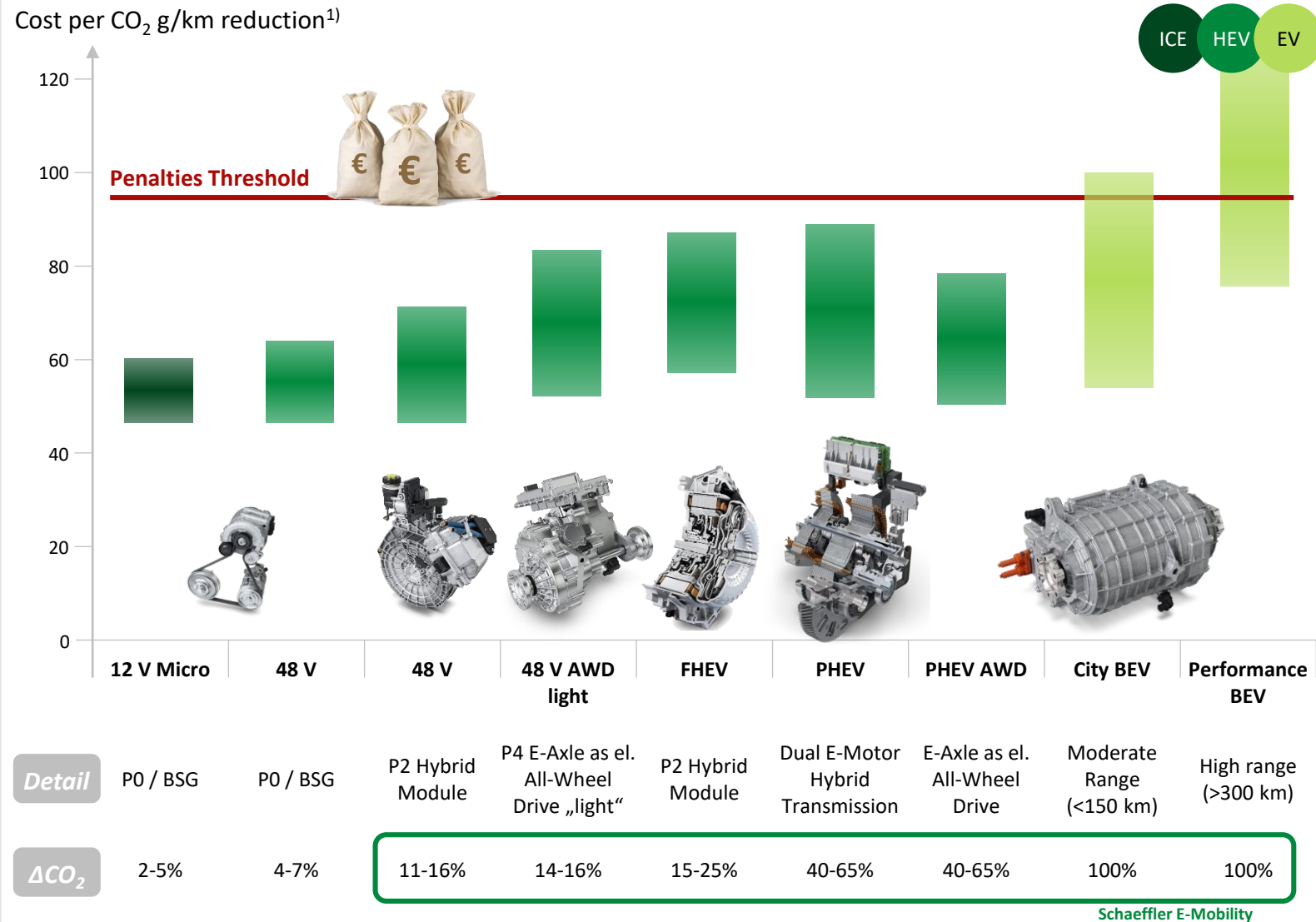


OEM C

Battery-electric focus



Powertrain Scenario – Cost per CO₂ reduction is key factor for successful business



Key aspects

- ▶ Hybrid share becomes major lever for OEM to balance CO₂ scale
- ▶ Strong future potential with 48 V P2 architectures at good cost-to-benefit ratio
- ▶ All of Schaeffler E-Mobility portfolio allows for CO₂ emission reductions below the penalty threshold (95 EUR/g)

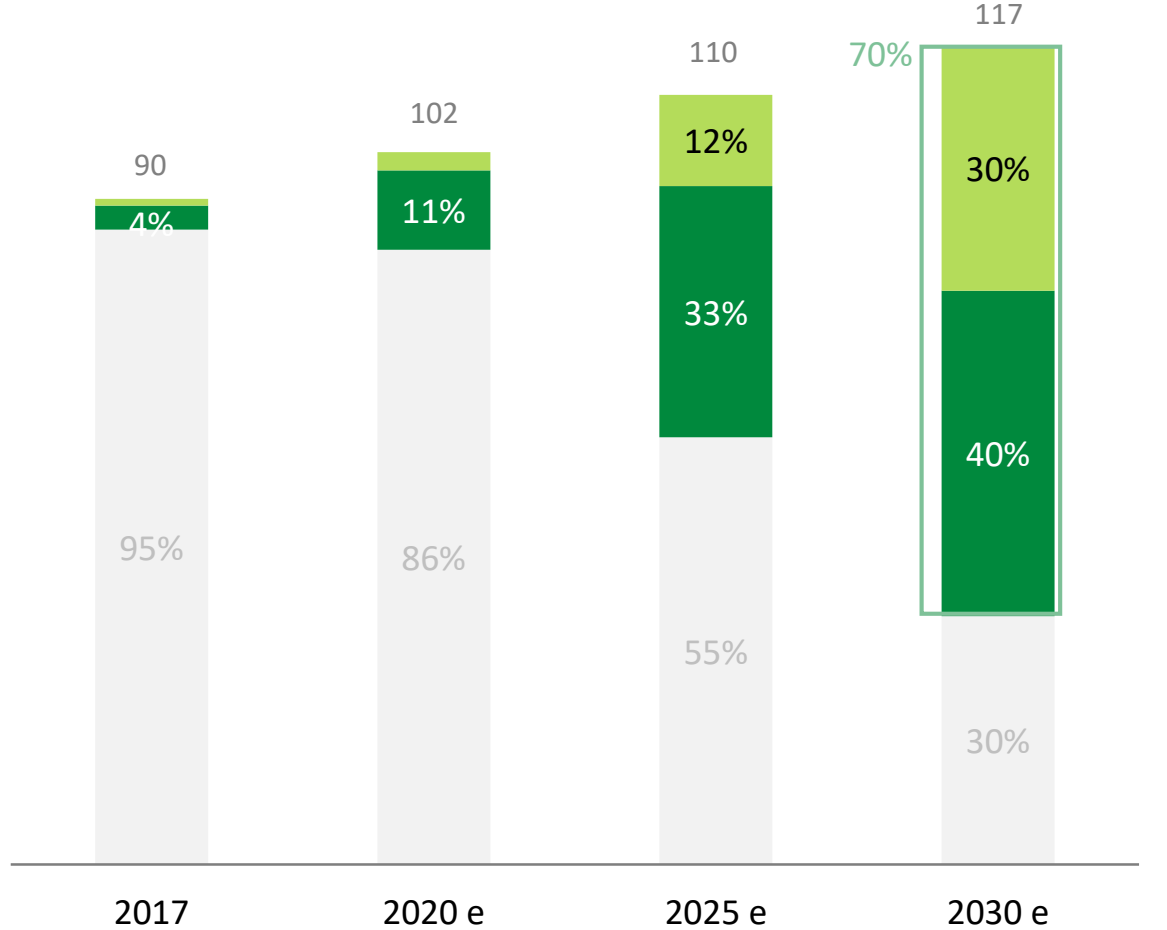
Portfolio with focus on high-efficiency solutions below penalty threshold

1) Compared to C-Segment basic ICE vehicle. Battery price as per expectation 2020

Mobility for Tomorrow – Our E-Mobility Strategy

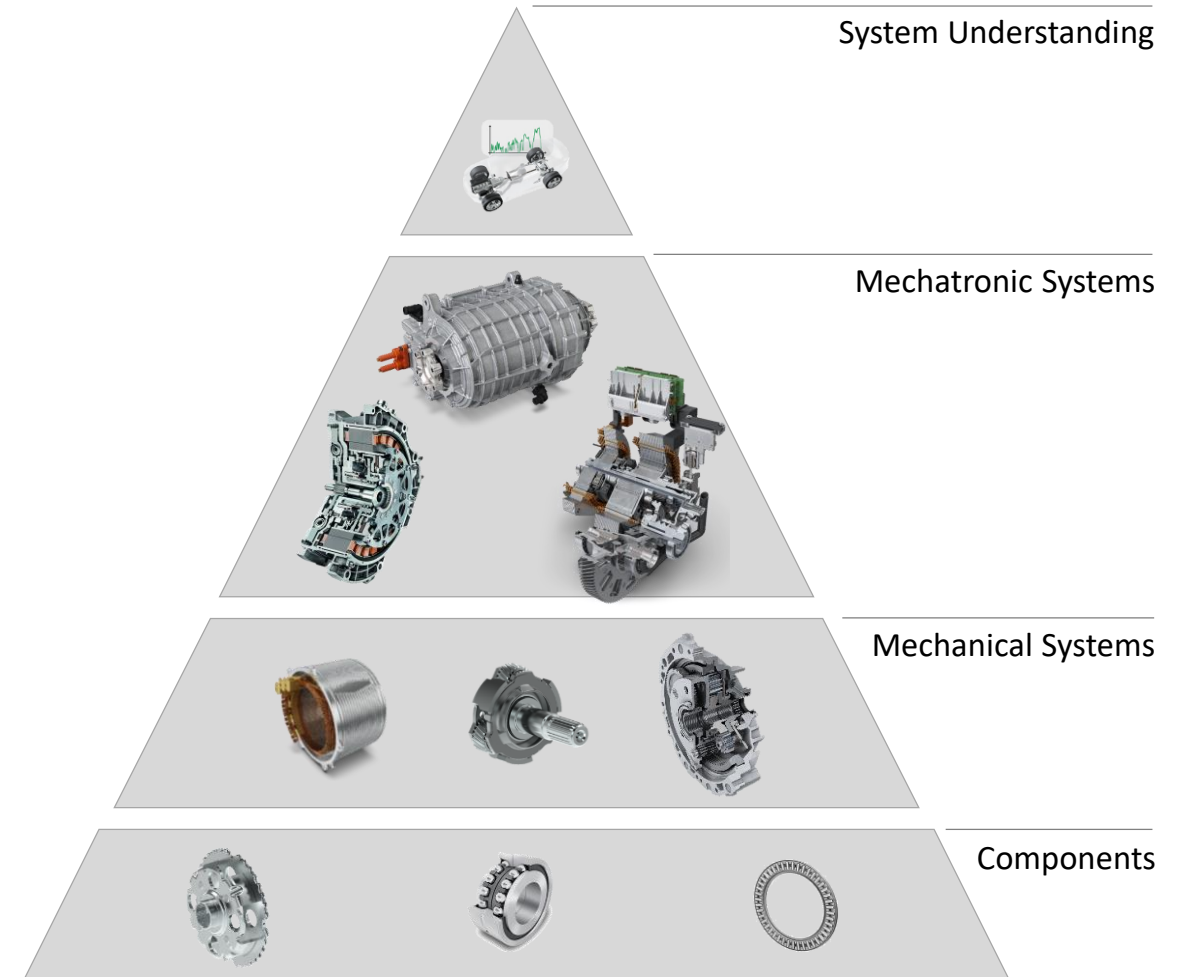
Vision Powertrain

Global vehicle production [in mn units]



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E-Mobility Pyramid

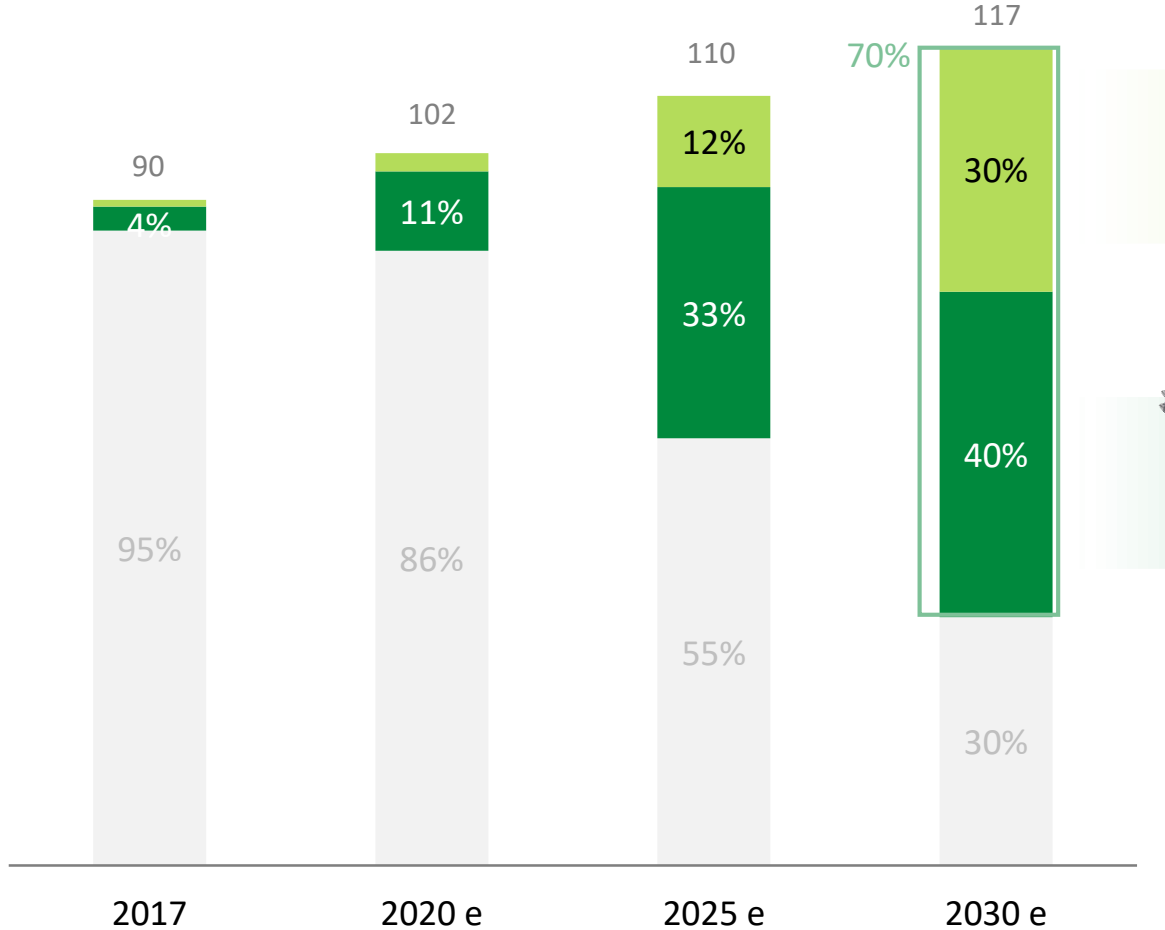


Mobility for Tomorrow – Our E-Mobility Strategy

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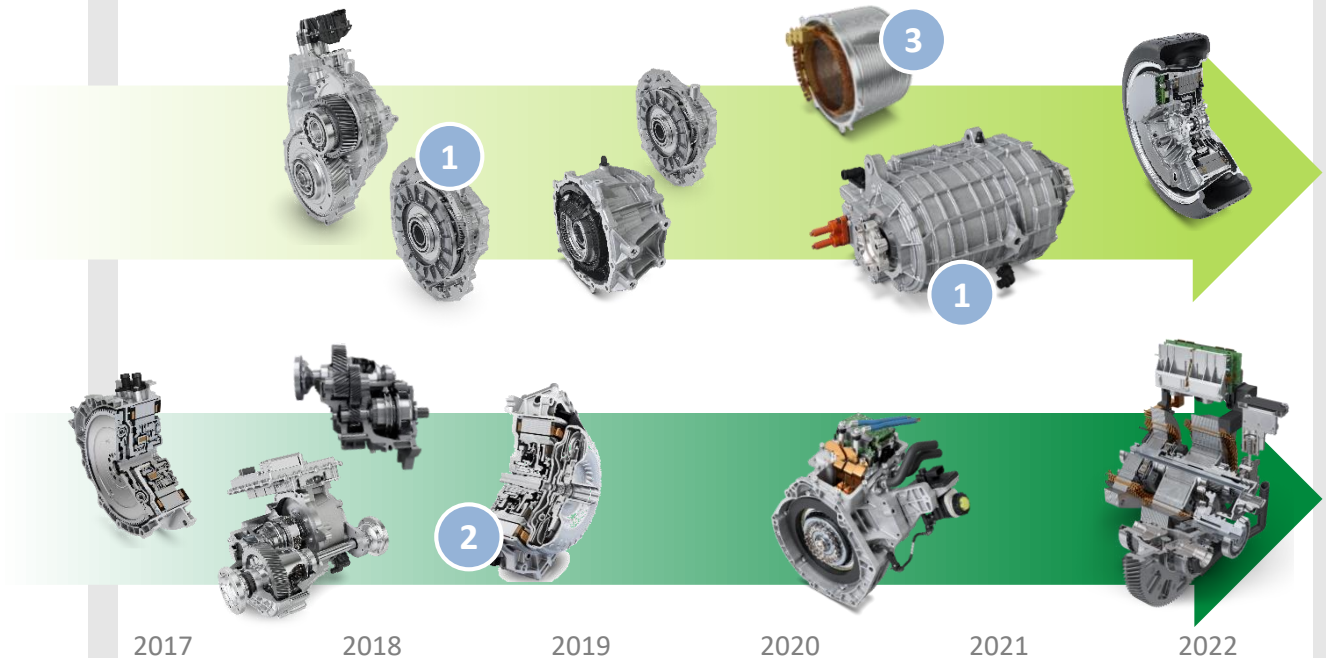
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E-Mobility Production Roadmap

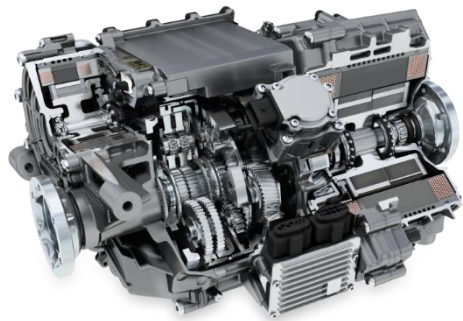


- ▶ Hybrid Module Gen.2 and 2-speed E-Axle Transmissions for HEV applications in Series production
- ▶ Coaxial and parallel design 1-speed E-Axle Transmission for BEV application Europe SOP in process
- ▶ Hybrid Module Gen.3 with integrated Torque Converter to follow 12/2018

1 Evolution of Schaeffler E-Axle System Portfolio

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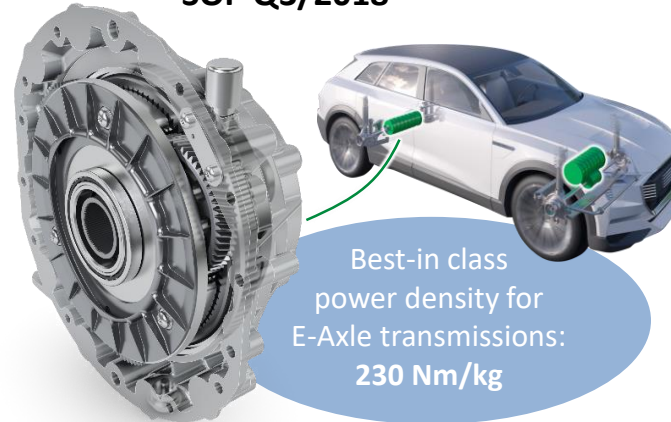
2011-2014: BEV Concept Car Active-E-Drive



E-Axle System solution
with 2-speed transmission
and torque vectoring unit

2018 Schaeffler E-Axle Transmissions

SOP Q3/2018



Best-in class
power density for
E-Axle transmissions:
230 Nm/kg

Modular design kits



Schaeffler E-Axle System Solutions 2020+



Weight and material reduced by **~15 kg**



Peak Torque **x2** and
peak Performance **x2.5**



Additional **cost benefits** due to
modular design kits

2 Hybrid solutions for all relevant core markets, tailored to customer's strategy

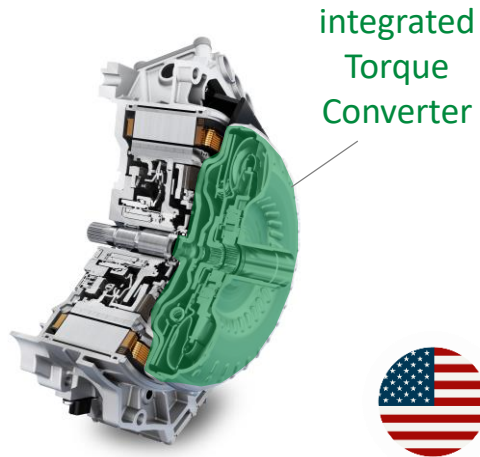
2017/2018 Schaeffler Hybrid Modules in Series Production

Gen. 2 Hybrid Module



SOP Q4/2017

Gen. 3 Hybrid Module

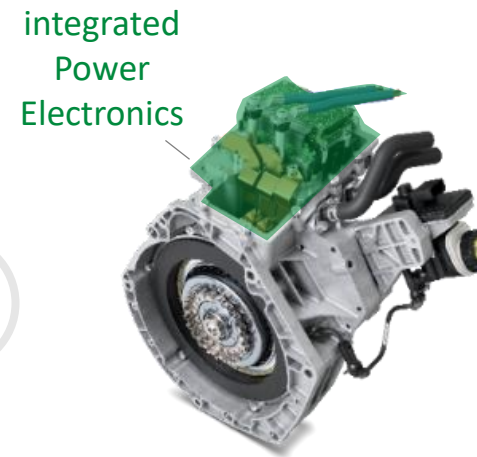


SOP Q4/2018

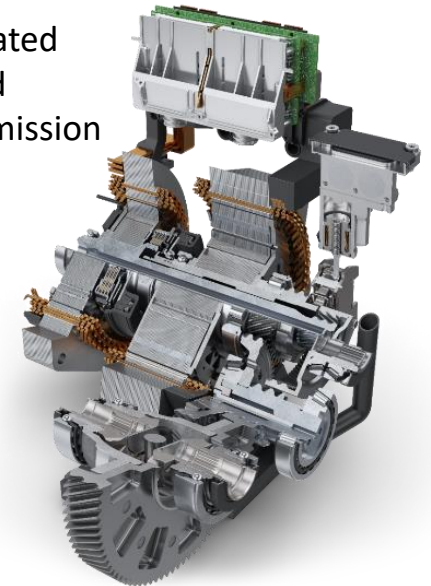
Market specific solutions based on Schaeffler core Know-How in Transmission Systems

Schaeffler Hybrid System Solutions 2020+

Gen. 4 Hybrid Module



Dedicated Hybrid Transmission



Hybrid Modules with integrated Power Electronics, as well as full dedicated Hybrid Transmissions (DHT) to meet future CO2 requirements at attractive costs, for all global markets.



Additional Content potential per vehicle of up to **+100%** compared to Gen. 2 Hybrid Modules

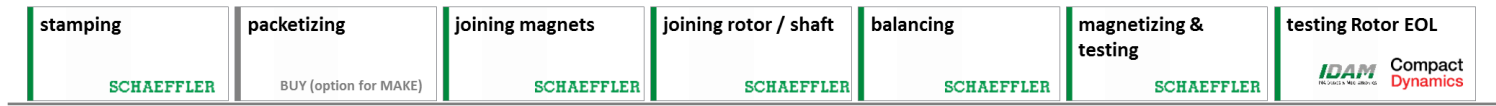
3 E-Motor – Production expertise in place. Ready to produce!

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Stator Manufacturing Processes*

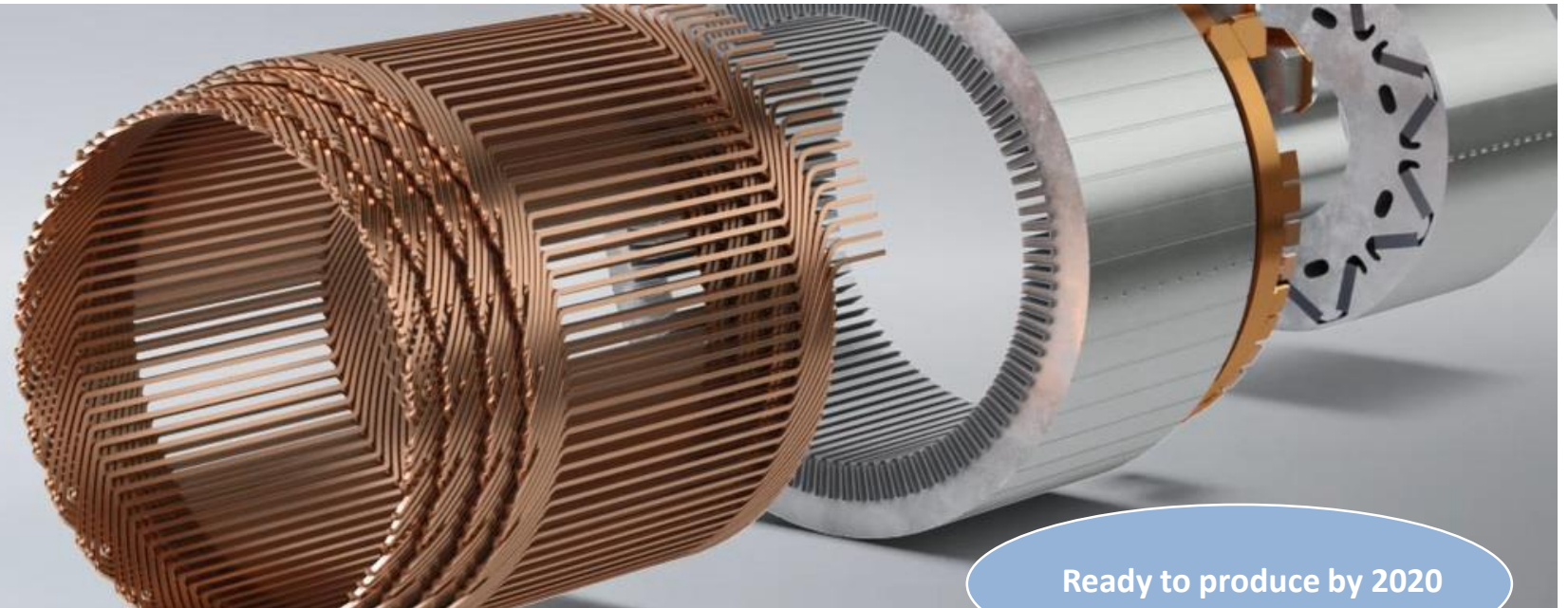


Rotor Manufacturing Processes*



- in series production at Schaeffler today
- prototyping machines available at Schaeffler
- ext. supplier technology as of today

SCHAEFFLER E-Motor
with wave-winding technology



Ready to produce by 2020

