



Thematic
Equities

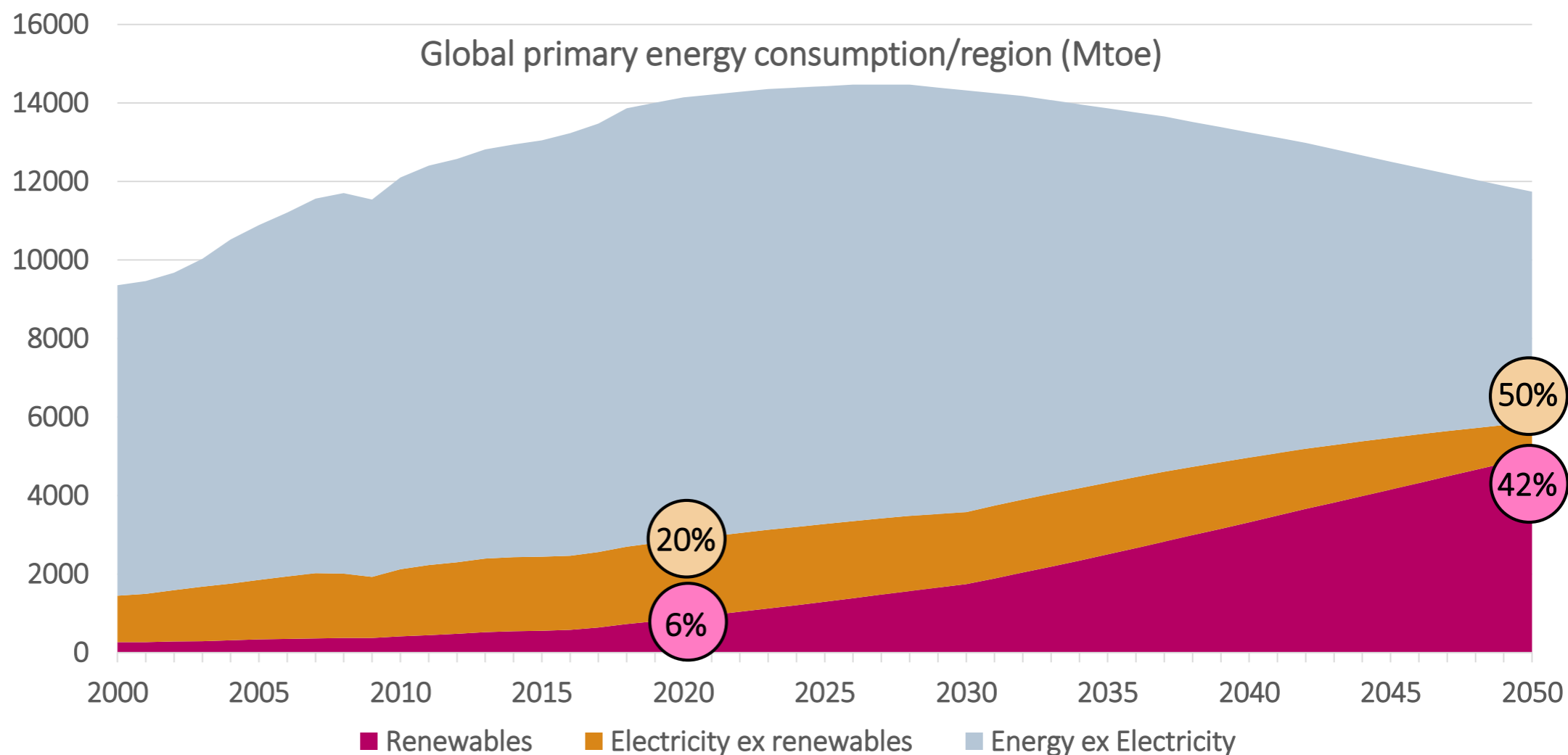
Smart Mobility: the investor standpoint

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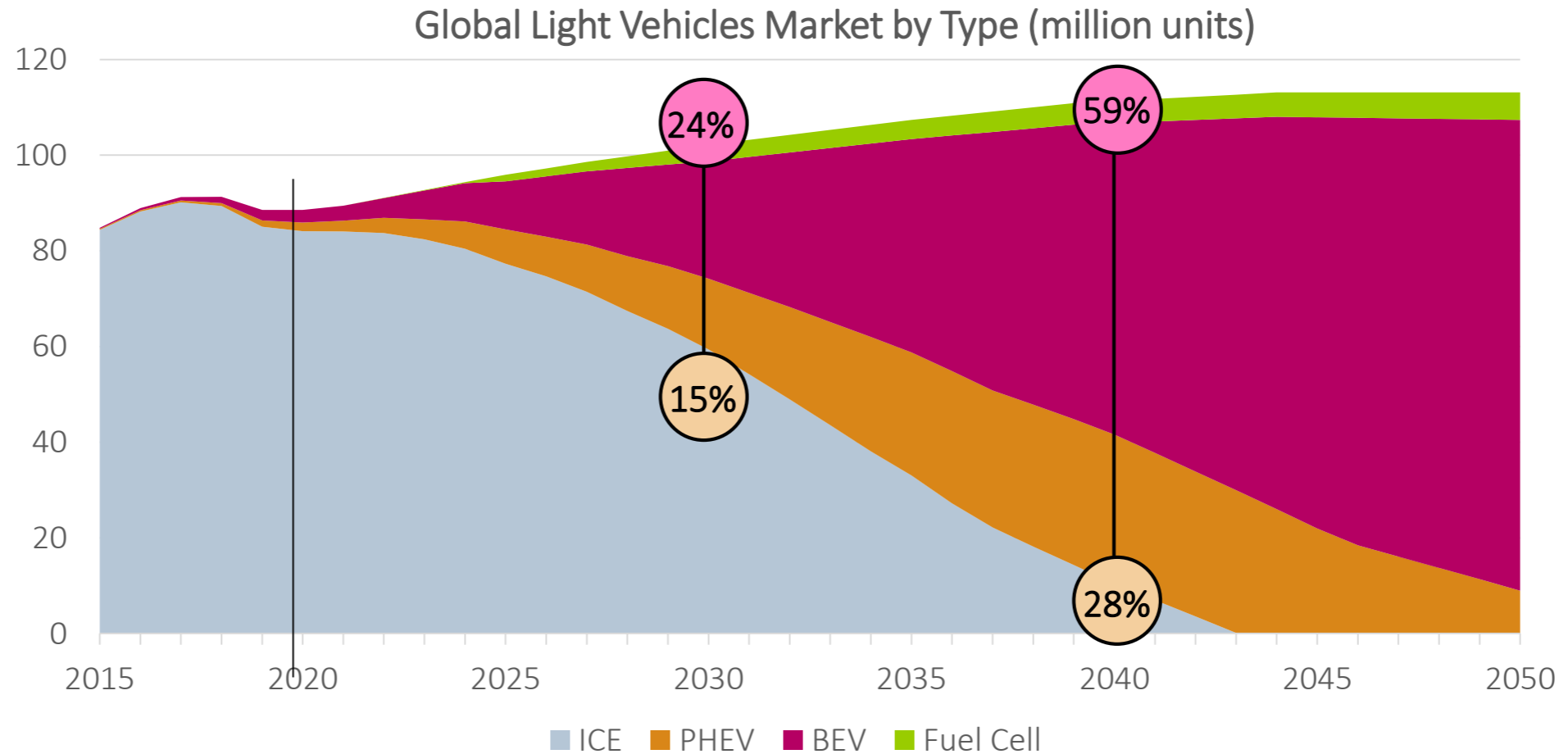
Electrification and renewables strongly reduce CO2



- Share of electricity as % of global energy consumption to grow to 50%
- Renewable electricity to reach 85% of total electricity produced by 2050

Source: RobecoSAM, : BP Statistical Review 2018

Electric vehicles: ~40% of new cars sold electrified by 2030!

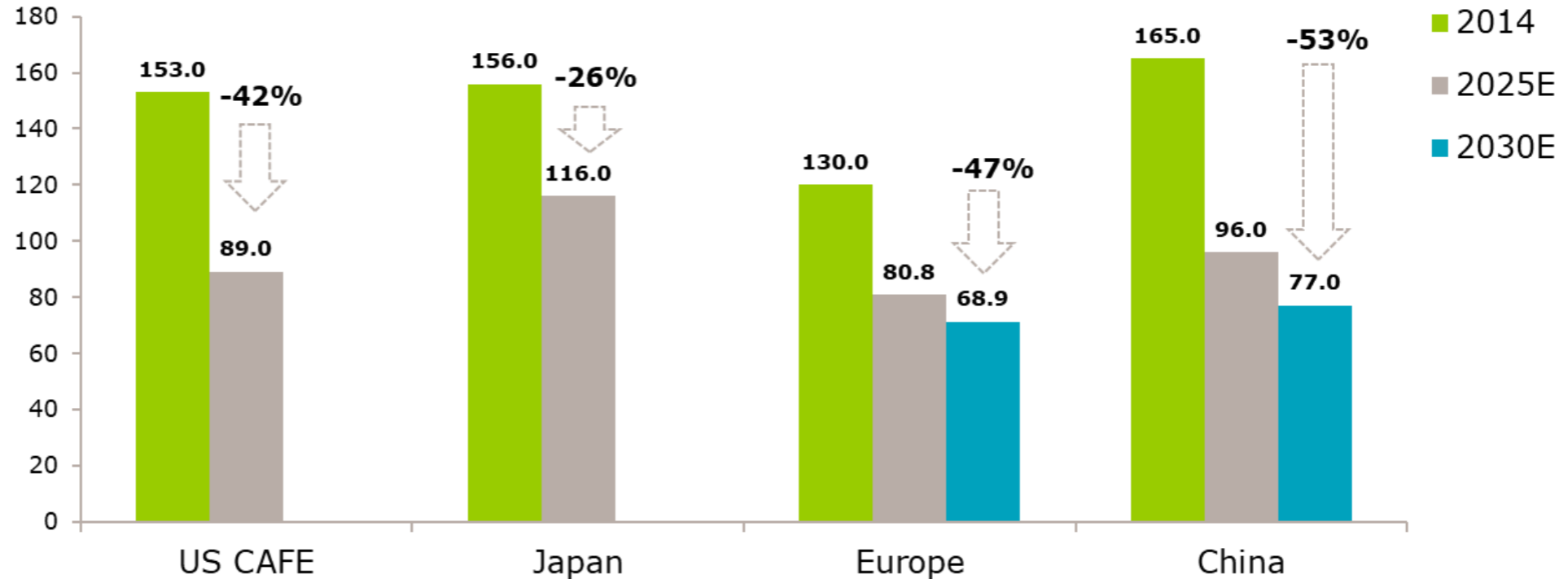


- Global EV market close to 2mio units, or 2.3% of the total market (of estimated 85mio cars)
- Growth rates have been in the >50% y/y range over the last five years
- Pure electric vehicles with stronger growth rates than PHEVs

Source: RobecoSAM; ICE: Internal combustion engine; PHEV: Plug-in hybrid vehicle; BEV: Pure battery electric vehicle

1/Automotive emission regulations becoming tougher

CO₂ emission standards in major markets (in g/km)



- Europe 2021: target of 95g CO₂/km, vs. currently >115g CO₂/km. Penalties set at € 95/g.
- ⇒ Threat of huge penalty payments (in Europe for the year 2021: ~€35bn).
- ⇒ Car manufacturers will push and possibly subsidize (plug-in) electric vehicles

Source: Volvo, iCET, Goldman Sachs Global Investment research, 2018

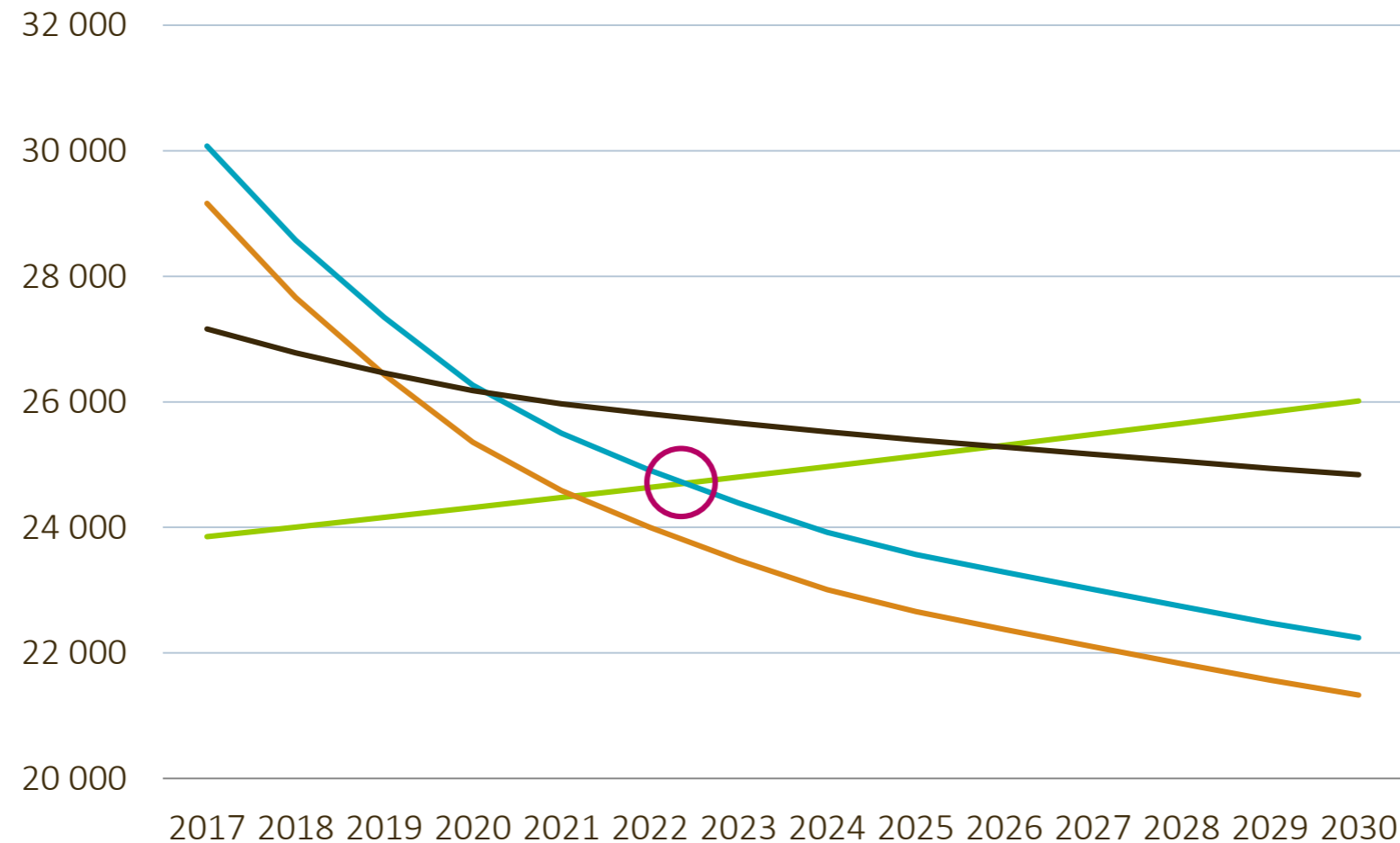
2/Electric cars to become cheaper than conventional cars

ICE : Internal Combustion Engine

PHEV : Plugin Hybrid EV 15kWh

EV : Pure Electric Vehicle 60kWh

Example Europe: 3-years total cost of ownership (EUR)



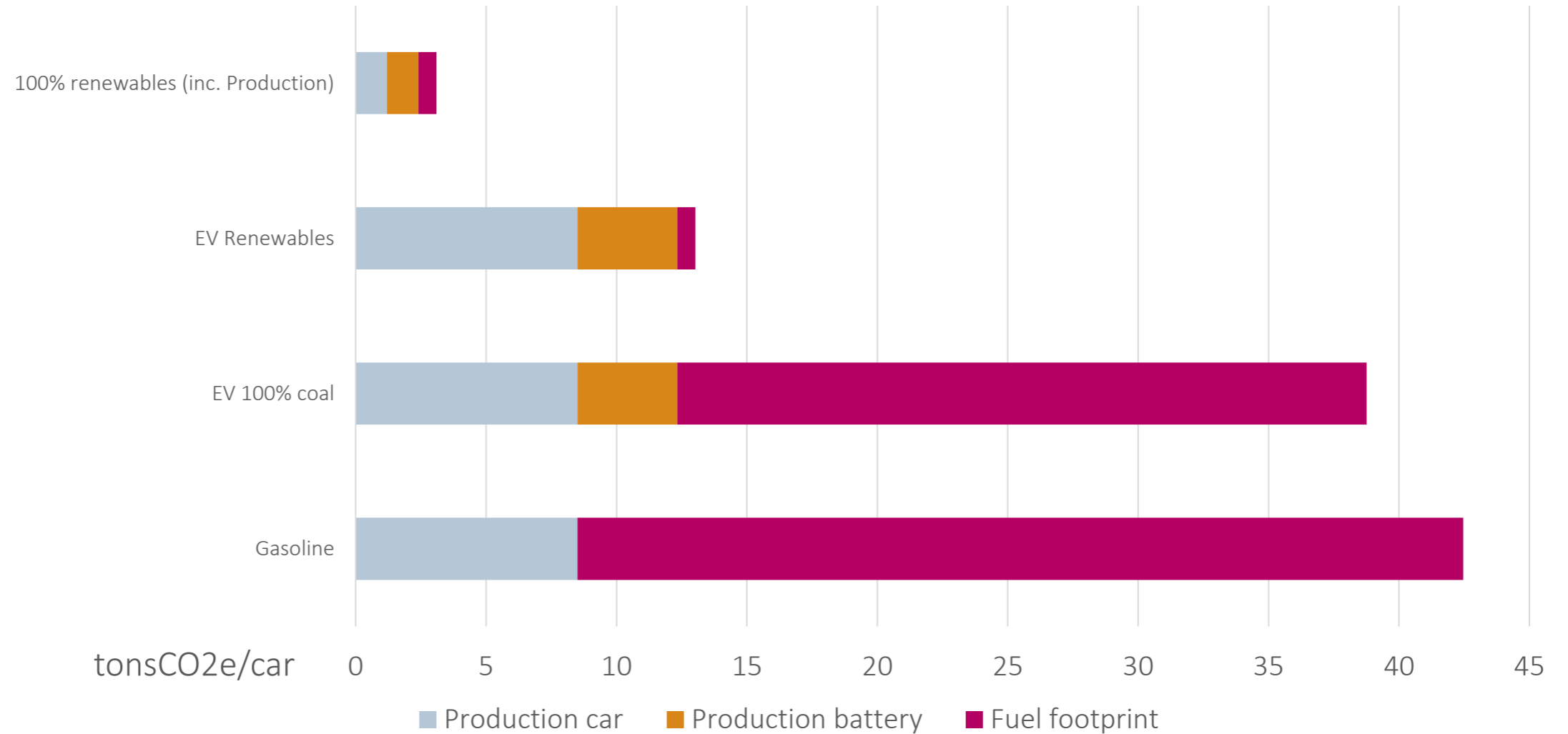
Cost crossover with ICE (gasoline) vehicles already to be expected in 2022 in Europe. Asia and the US will see the cost crossover 3-4 years later

Access to cheap renewable electricity further improves economics for EVs

ICE (gasoline)
EV
EV solar home
PHEV

3/Electrification of transport does cut CO2 footprint

Further overall carbon reduction if production becomes CO2 free



Source: Bloomberg New Energy Finance 2019

Electric vehicles structurally cheaper

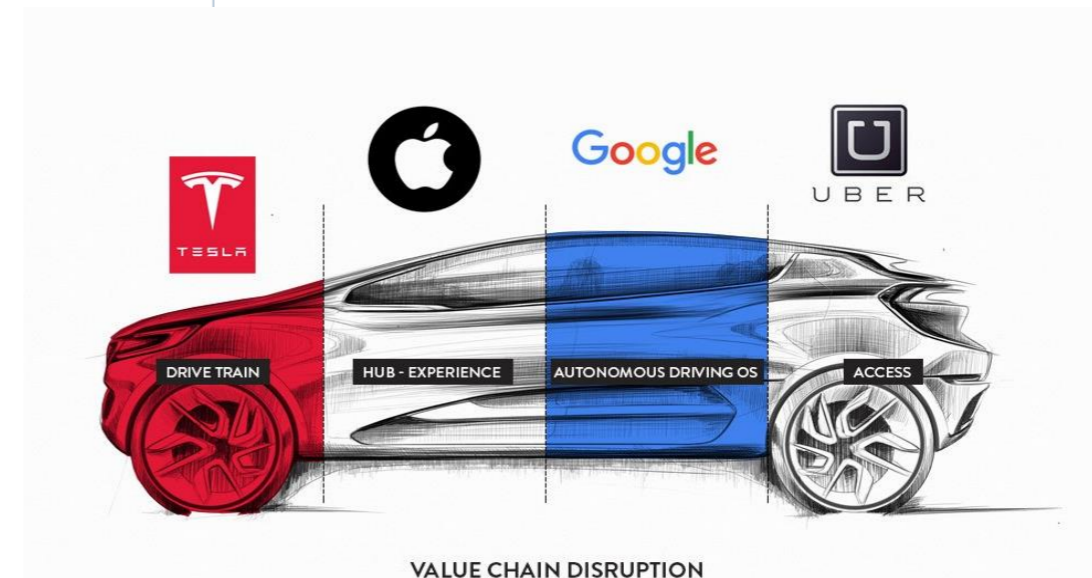
Internal Combustion Vehicle*



Electric Vehicle**



Connected Autonomous Shared Electric (C A S E) Vehicles



Source: Prathyushdevadas.wordpress.com

* Source: Audi **Source: Tesla
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RobecoSAM Smart Mobility

Charging networks: towards a global standard



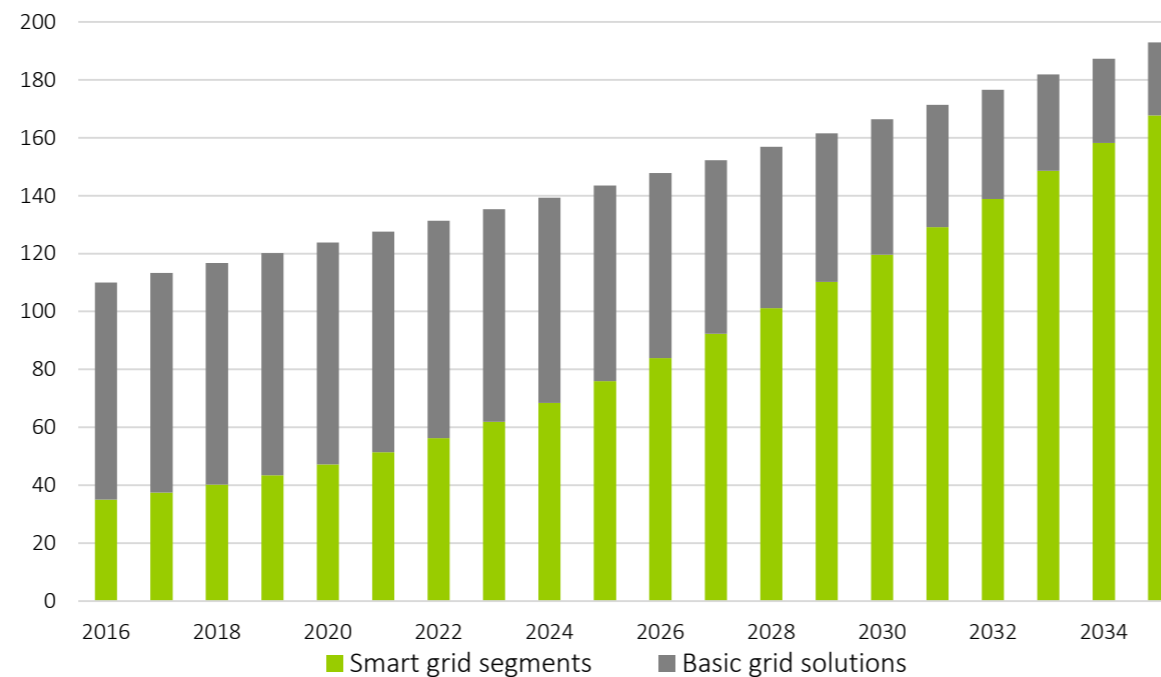
- All aspects to be covered (coupler systems, charging communications, interoperability, grid integration)
- Ultra-fast chargers with a capacity of up to 350kW (DC)
- Scope includes buses/trucks, as well as inductive charging

Source: Electrek, CharIN, 2018

Required infrastructure investments constrain growth

An important part for EV adoption, but relatively low investments required

Electrical grid market size (bn USD)



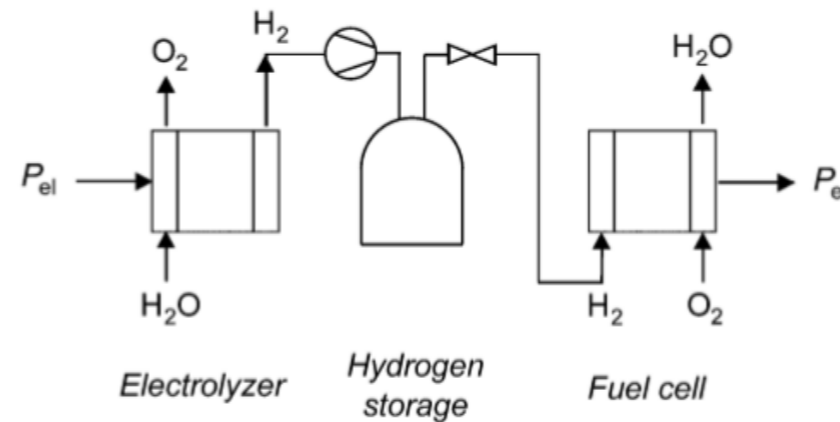
← bidirectional energy flow →

- Vehicle-to-grid: while stationary, the vehicle provides services for the power grid (grid stabilization) or the home
- Charging is preferred when energy price is low, and when power is from renewables
- Storage capacity EV: ~60-80kWh vs. household electricity consumption per capita: ~40kWh/week.

Source: ABB, Itron, RobecoSAM, 2018

Hydrogen as complementary storage technology

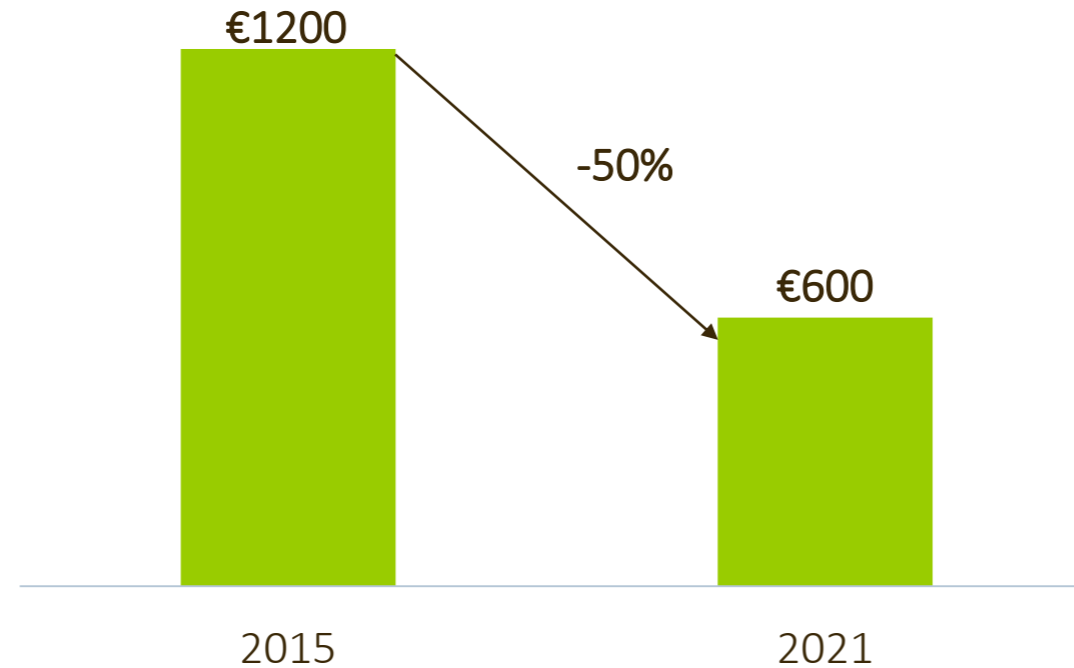
- Hydrogen can provide storage applications complementary to Li-ion (power to gas)
- High energy density and fast fueling capability of Hydrogen well suited for heavy transportation



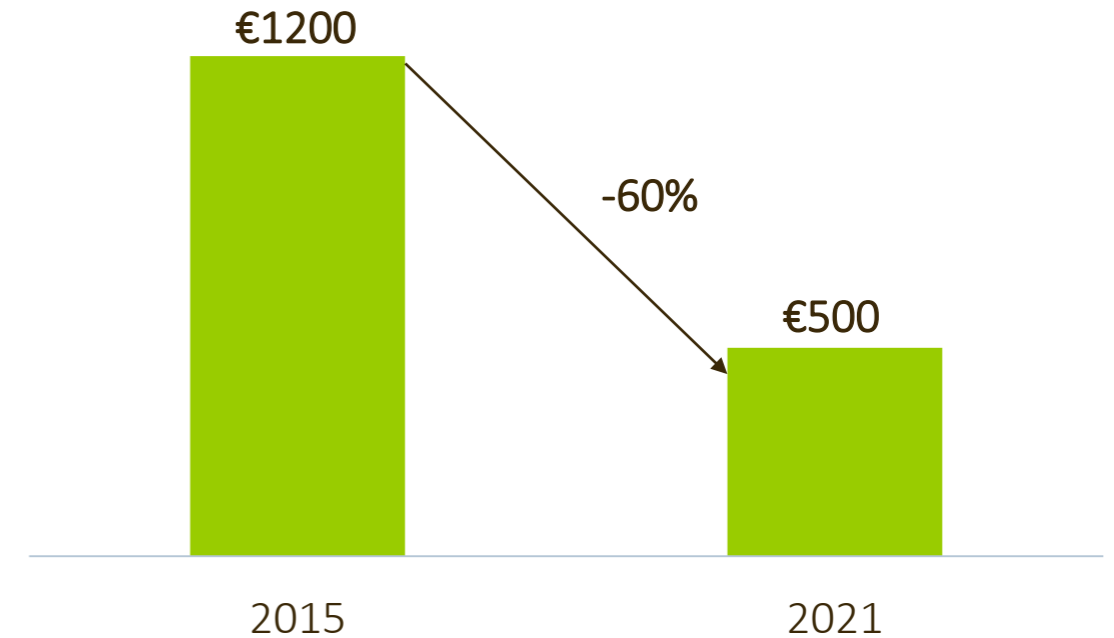
Source: The Royal Society of Chemistry, California Energy Storage Alliance, Nikola Motor, Alstom, Norwegian

Cost curve e-motor and inverters

Electric motor costs (100kW EV motor)



Main power inverter costs (for 100kW conversion)

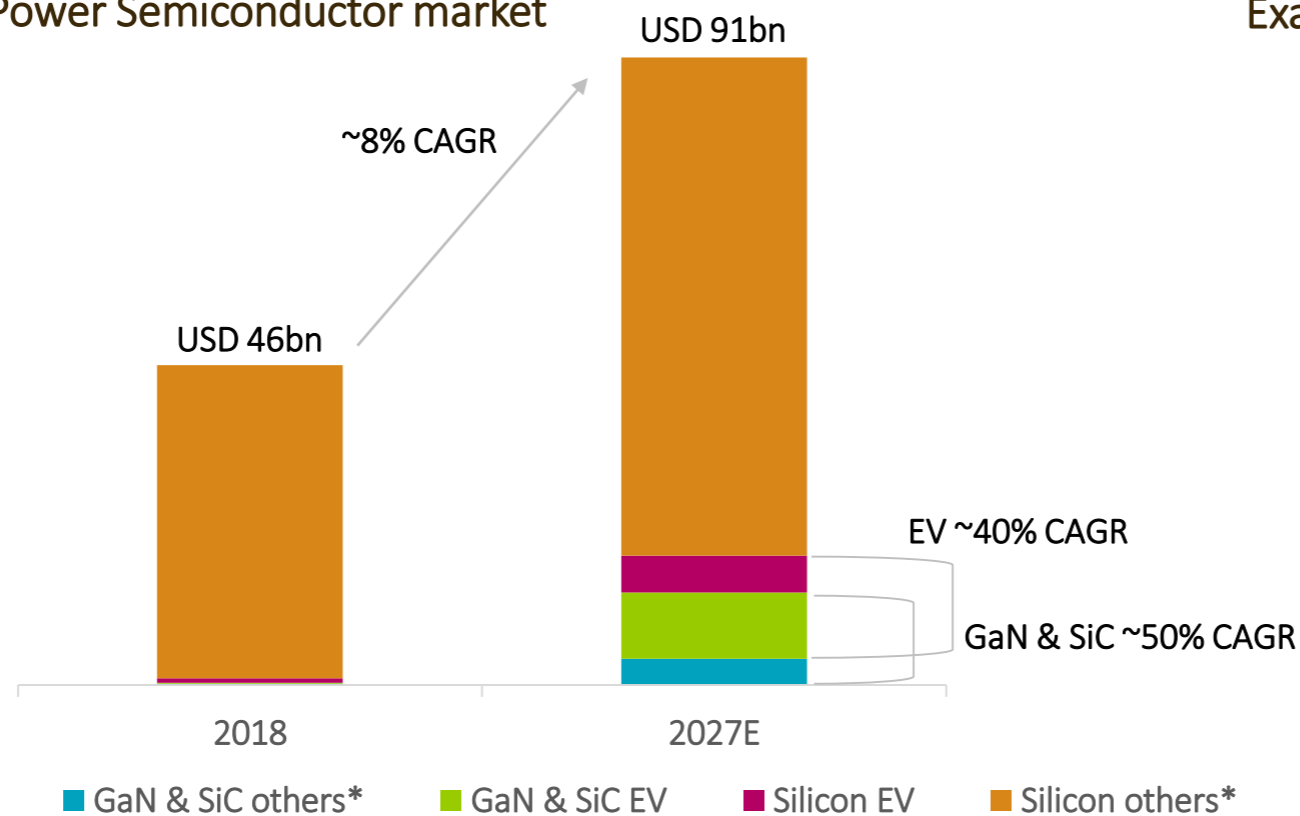


- The next years will show significant cost reductions in the overall electric powertrain
- Further system integration (i.e. integrating the power inverter into the motor) will lead to further cost and weight savings, whilst increasing the already high overall system efficiency

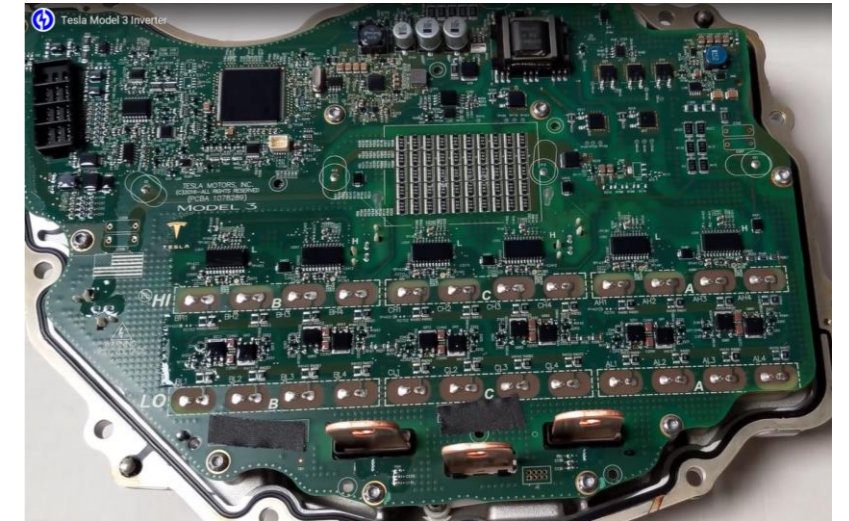
Source: FEAAM, Exane BNP Paribas, Oak Ridge National Laboratory, RobecoSAM, 2017

New materials and electric vehicles major growth drivers

Power Semiconductor market



Example: Tesla Model 3 main power inverter board

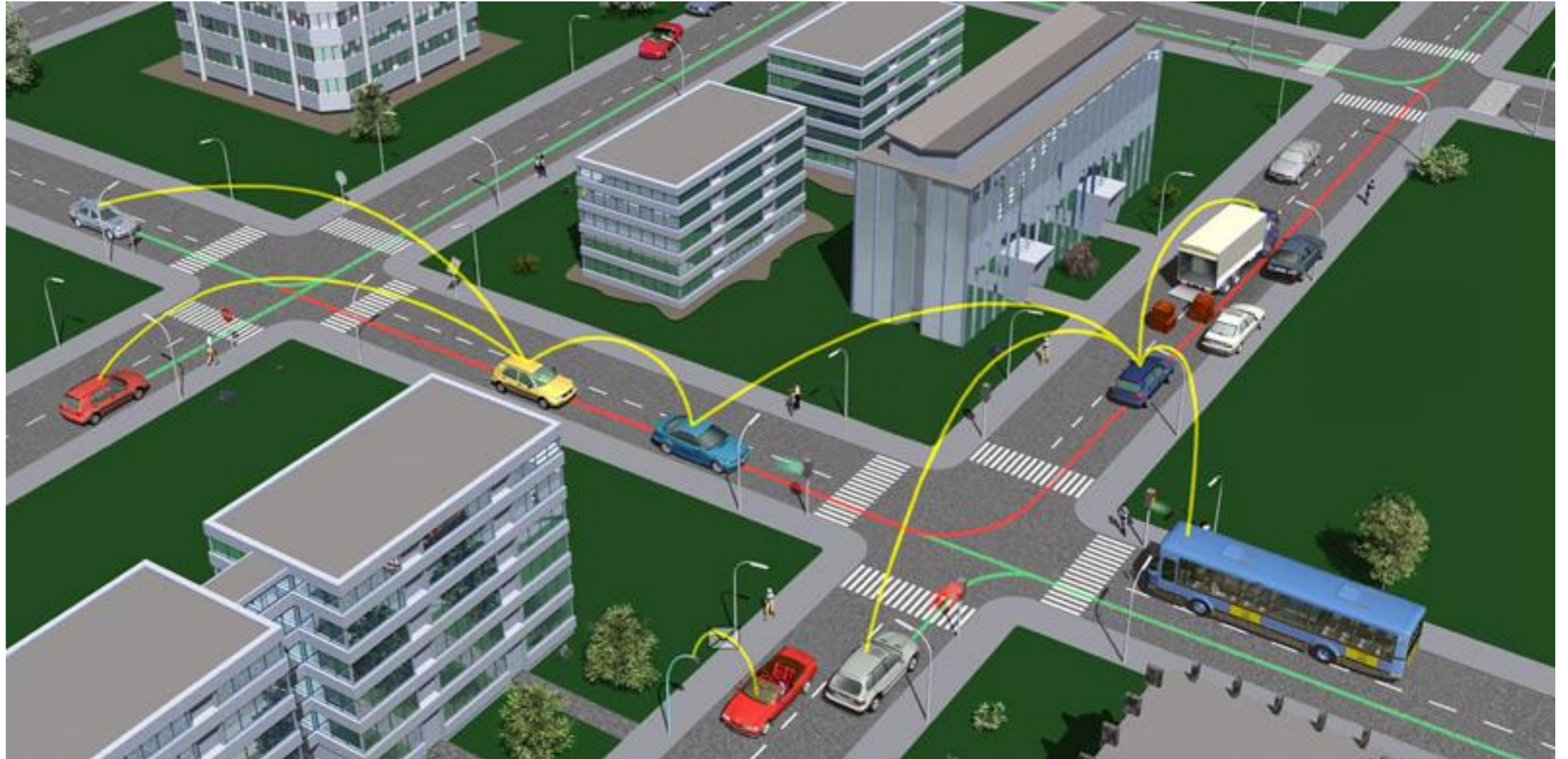


- The silicon/semiconductor content in EVs is much higher than in traditional cars – and rising
- Huge business opportunities for semi companies with efficient power management solutions

Source: RobecoSAM, IHS Markit

* Others including solar inverters, wind converters, industrial motor drives, EV charging stations, power supplies, chargers, etc.

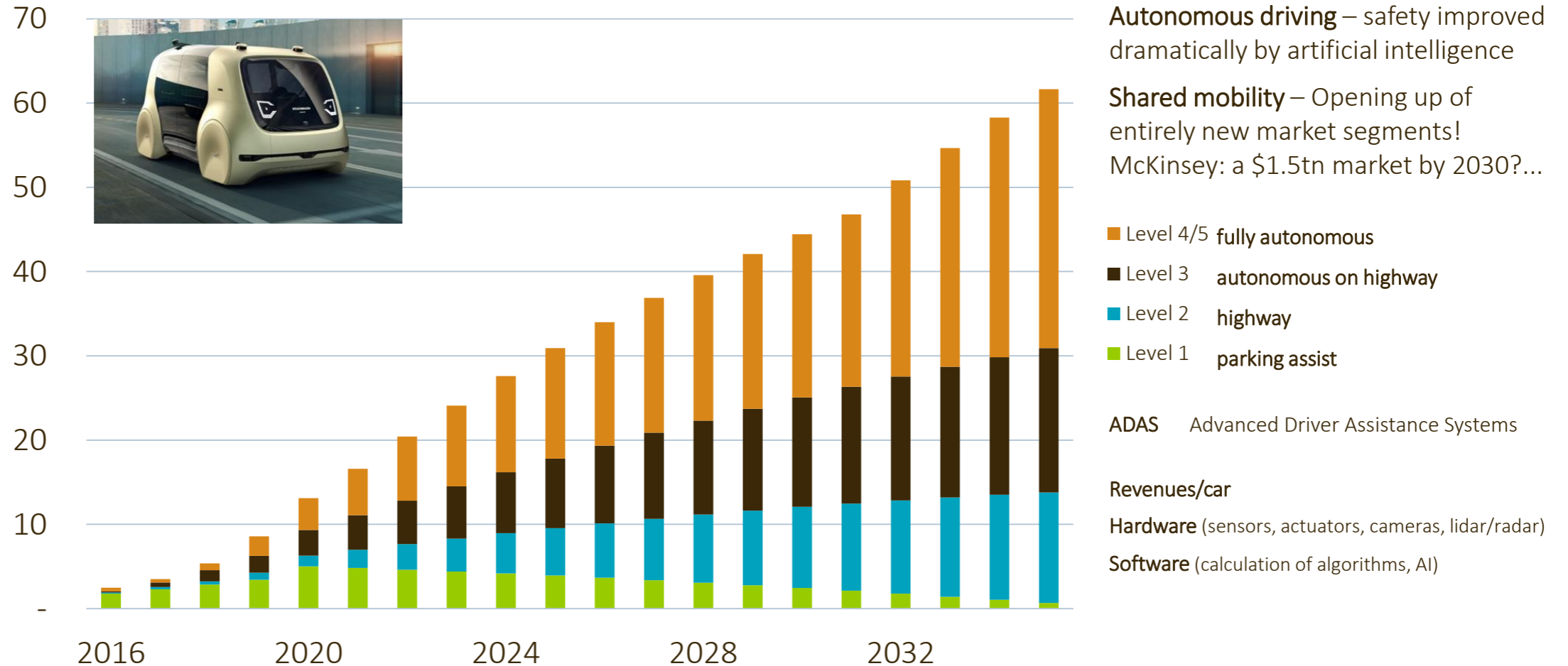
Car-to-car communication to improve safety



Source: car-2-car.org

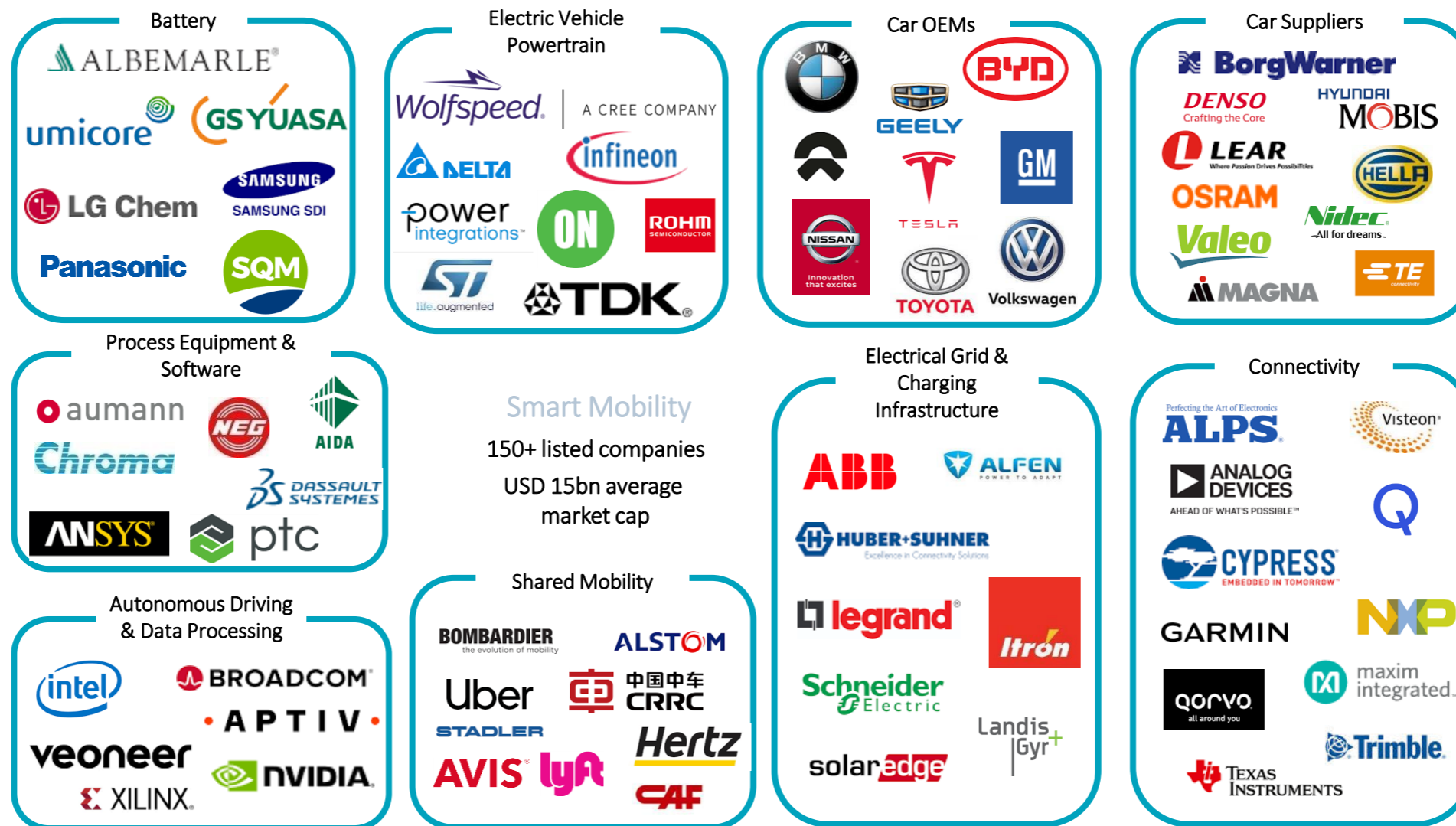
Connectivity and autonomous driving: New markets with extraordinary potential

Market size ADAS (bn USD)



Sources: RobecoSAM, VW, McKinsey, 2017

Smart Mobility investment universe

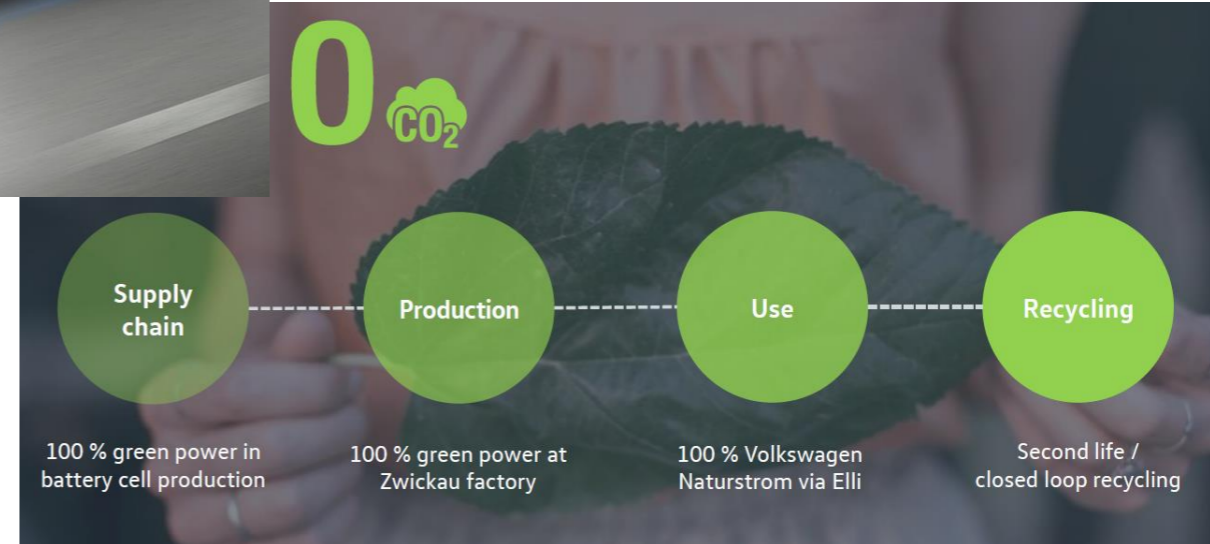
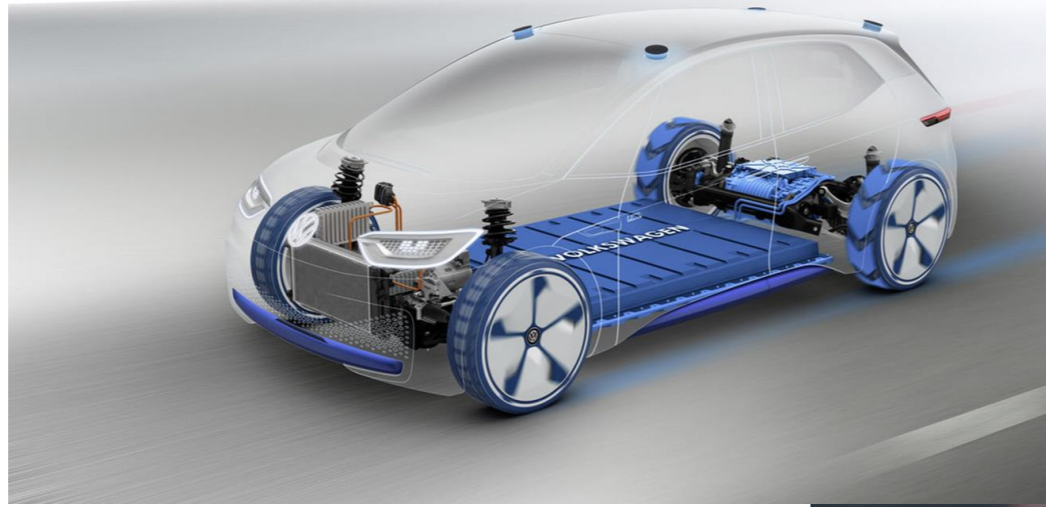


Data as of 30 June 2019

For illustrative purposes only, company logos are not meant as an investment advice.

Source: Logo's from Company website.

VW ID. family: unique platform exclusively for EVs



- 2020: first ID. member to go on sale, costs about the same as a Golf
- 27 pure-electric MEB models to be on sale by the end of 2022, 50 by 2025
- In total, 10mio vehicles will be based on first wave of the MEB platform (3mio in 2025 only)
- VW ID. objective: climate-neutral balance over life cycle

Source: VW

Conclusion

The future of mobility is electric

- Regulation and economics drive the electrification of the transportation sector
- Electric vehicles (EV) to be 39% of all new cars sold in 2030 (2018: 2.3%)
- The total EV market will reach up to \$ 1.4 trillion by 2030 (CAGR: ~30%)*

Connectivity & autonomous driving enable new business models

- Megacities will increasingly promote shared mobility services based on EVs
- Connectivity & shared mobility may add up to annual revenues of \$ 1.5 trillion by 2030**

Over the next decades we will see a nearly complete electrification of the transportation sector, affecting cars, buses, trucks, ferry boats, and even small planes

Source: * RobecoSAM, **McKinsey 2017. CAGR: compound annual growth rate



Appendix

Trend selection and investment scope

EV Component Suppliers



- Batteries
- Electric powertrain
- Lightweight materials
- Lighting

EV Car Manufacturers & Subsystem Suppliers



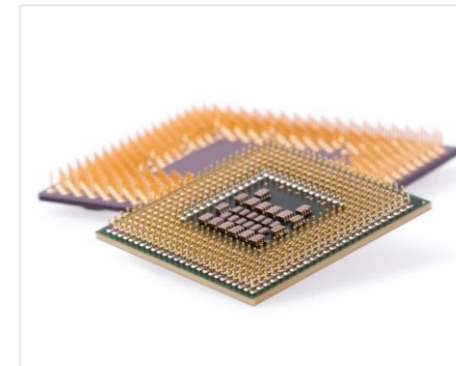
- Original equipment manufacturer
- Car supplier
- Process equipment
- Production software

Electrical Grid & Charging Infrastructure



- Smart grid supplier
- Smart meters
- Charging technology

Connectivity & Autonomous Driving



- Data transmission
- Semiconductors & artificial intelligence
- Shared mobility

Source Picture: Battery (GM), Car (BMW)

Portfolio top 10 holdings

RobecoSAM Smart Mobility Fund (30.09.2019)

Company	Country*	Company focus	Weight
Cypress Semiconductor Corp	United States	Connectivity	5.24%
Schneider Electric SE	France	EV chargers, electrical grid	4.20%
Maxim Integrated Products Inc	United States	Battery mgt, autonomous driving	4.07%
TDK Corp	Japan	High-voltage capacitors for EVs and sensors for ADAS	3.85%
ON Semiconductor Corp	United States	Power semiconductors, connectivity	3.64%
TE Connectivity Ltd	United States	Connectors and sensors	3.63%
ABB Ltd	Switzerland	EV chargers, electrical grid	3.55%
Samsung SDI Co Ltd	Korea	EV battery producer	3.42%
Aptiv PLC	United States	Electric drivetrain, autonomous driving	3.40%
Renesas Electronics Corp	Japan	Microcontrollers for automotive applications	3.33%
Total			38.33%

*Company Domicile

Source: RobecoSAM. Data as of 30.09.2019

The data stated above may differ from data on the monthly factsheets due to different sources.

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More than USD 300 billions in electrification investments

Electric car announcements

GM	20 pure EVs by 2023, 2 by 2019
Volvo	Electrify entire line by 2019
Jaguar Land Rover	Electrify (HEV/EV) all lineup by 2019
Ford	40% of models to be electrified by 2020
Hyundai	31 electrified models by 2020
Toyota & Mazda	US-based EV plant by 2021
Daimler	Electrify entire portfolio by 2022
Renault/Nissan	12 All-Electric cars by 2022
BMW	25 electrified models by 2025
VW Group	All 300 models electrified by 2030



Source: Company reports

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