Mahindra CIE

Mahindra CIE Automotive Ltd
Mahindra Towers, 1st Floor,
Dr. G. M. Bhosale Marg, Worli,
Mumbai 400 018, India
Tel: +91 22 24931449
Fax: +91 22 24915890
www.mahindracie.com
mcie.investors@mahindracie.com

January 23, 2018

BSE Limited Corporate Relationship Department, P. J. Towers, Dalal Street, Fort, Mumbai - 400 001. **BSE Scrip Code: 532756**	**National Stock Exchange of India Limited** Corporate Relationship Department, Exchange Plaza, 5th Floor, Plot No. C/1, G Block, Bandra Kurla Complex, Bandra (E), Mumbai – 400 051. **NSE Scrip Code: MAHINDCIE**

Subject: Presentation on Technology trends in Automotive Industry

Dear Sir/Madam,

Pursuant to Regulation 30 read with Para A of Schedule III of the Securities and Exchange Board of India (Listing Obligations and Disclosure Requirements) Regulations, 2015 and our letter dated 16th January, 2018 in respect of the Invite for session on Technology trends in Automotive Industry, please find enclosed herewith presentation on the subject for your information.

The same is being uploaded on the website of the Company *http://www.mahindracie.com*

Kindly acknowledge the receipt and take the same on the record.

Thanking you,

Yours faithfully,
For Mahindra CIE Automotive Limited

Krishnan Shankar
Company Secretary & Head – Legal
Encl: As above

CIE Automotive

January 2018

Evolution in the Automotive sector

How does the urge for constant adaptation affect CIE Automotive?



TABLE OF CONTENTS

1. Taking a car to pieces
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1) Taking a car to pieces



STRUCTURE & CHASSIS

STRUCTURAL PARTS, CHASSIS & SUSPENSION



Structural components



Source: Honda

Chassis and suspension (rear)



Chassis and suspension (front)

Source: BMW

INTERIOR & EXTERIOR TRIM

INTERIOR, EXTERIOR TRIM & ROOF SYSTEMS



Exterior trim including logos, emblems, wheel covers and decorative parts, as well as roof systems

Interior trim including doors, seat, airbag, cockpit, sunshade and decorative parts



DRIVETRAIN

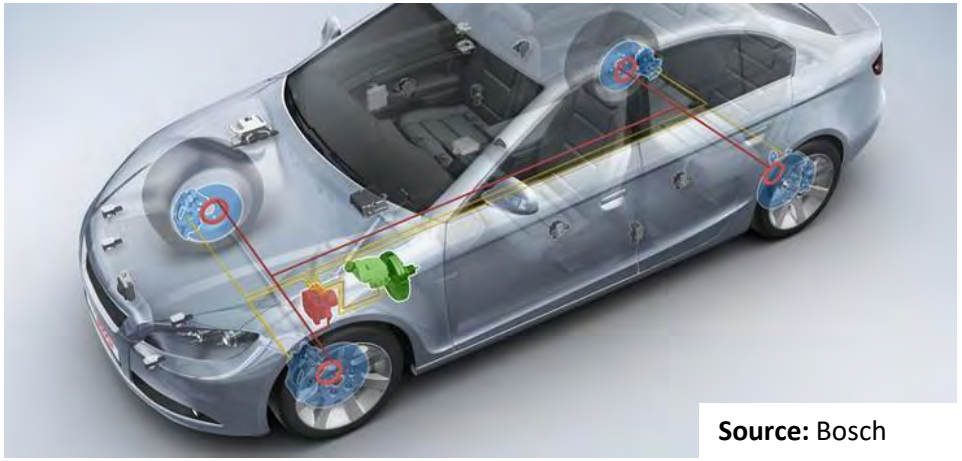
TRANSMISSION, STEERING,BRAKING SYSTEM



Source: Brose



Source: GKN Driveline



Source: Bosch



Source: GKN Driveline

Driveline plus differential, steering and braking systems

POWERTRAIN

ENGINE & GEARBOX



Engine and gearbox, up to differential

Exhaust system



Source: Faurecia

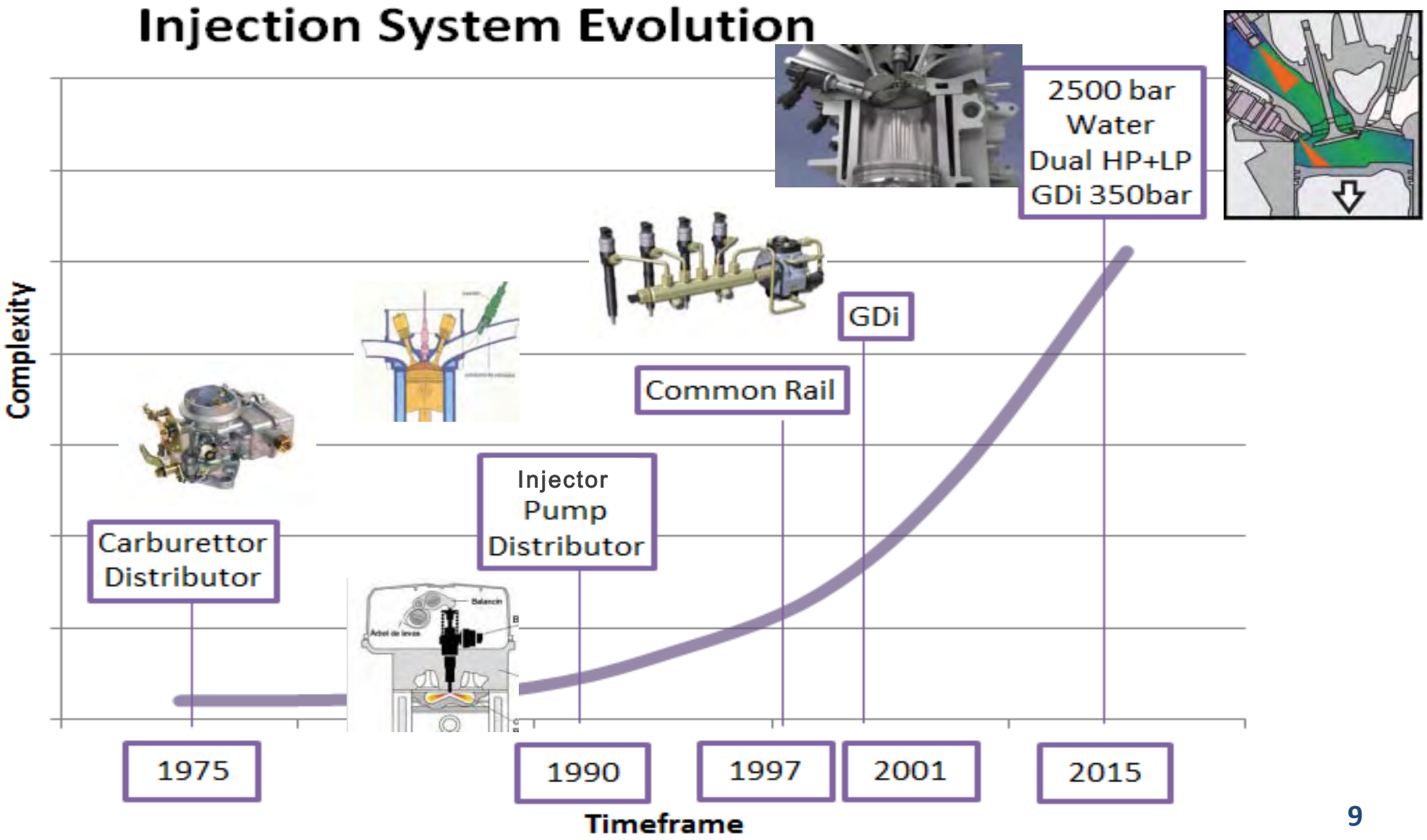
2) Evolution in the Automotive sector



CIE Automotive

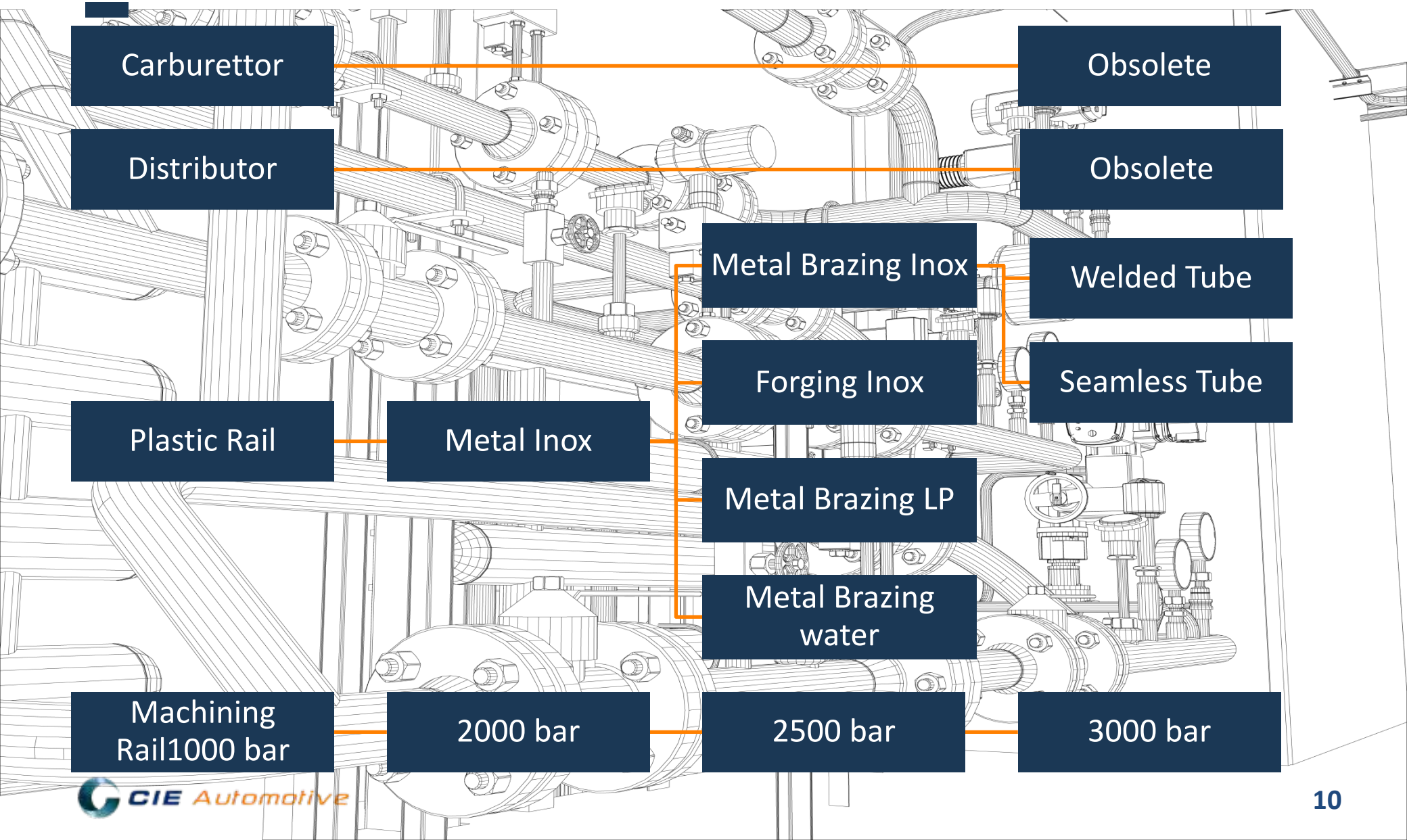
EVOLUTION IN THE AUTOMOTIVE SECTOR

CASE 1: INJECTION SYSTEM (1/2)



EVOLUTION IN THE AUTOMOTIVE SECTOR

CASE 1: INJECTION SYSTEM (2/2)



EVOLUTION IN THE AUTOMOTIVE SECTOR

CASE 2: AUXILIARIES ELECTRIFICATION (1/2)

Hydraulic Steering



Source: ZF - TRW



Electric Steering



Source: ZF - TRW



Electrification also implies more number of architectures

CIE Automotive

EVOLUTION IN THE AUTOMOTIVE SECTOR

CASE 2: AUXILIARIES ELECTRIFICATION (2/2)

Current booster



Source: Bosch

iBooster



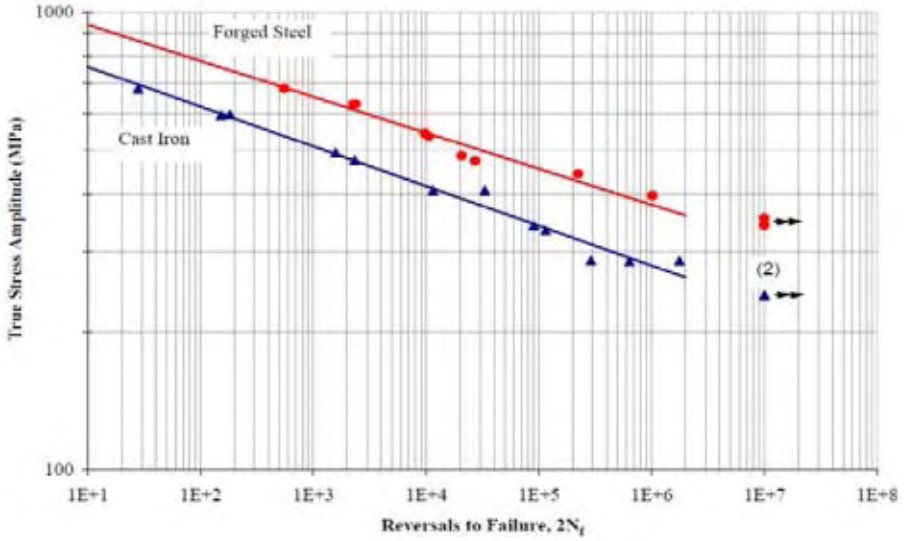
Source: Bosch

The amplification in the braking forced changing from air (vacuum) to electrically driven

EVOLUTION IN THE AUTOMOTIVE SECTOR

CASE 3: MATERIAL EVOLUTION (1/2)

There is a general trend to migrate from casted crankshafts to forged ones, however, it depends on geographical characteristics (e.g. India) or OEMs preferences (e.g. Ford). Sector in evolution and diversified.



Source: The University Of Toledo, Ali Fatemi, Jonathan Williams and Farzin Montazersadgh

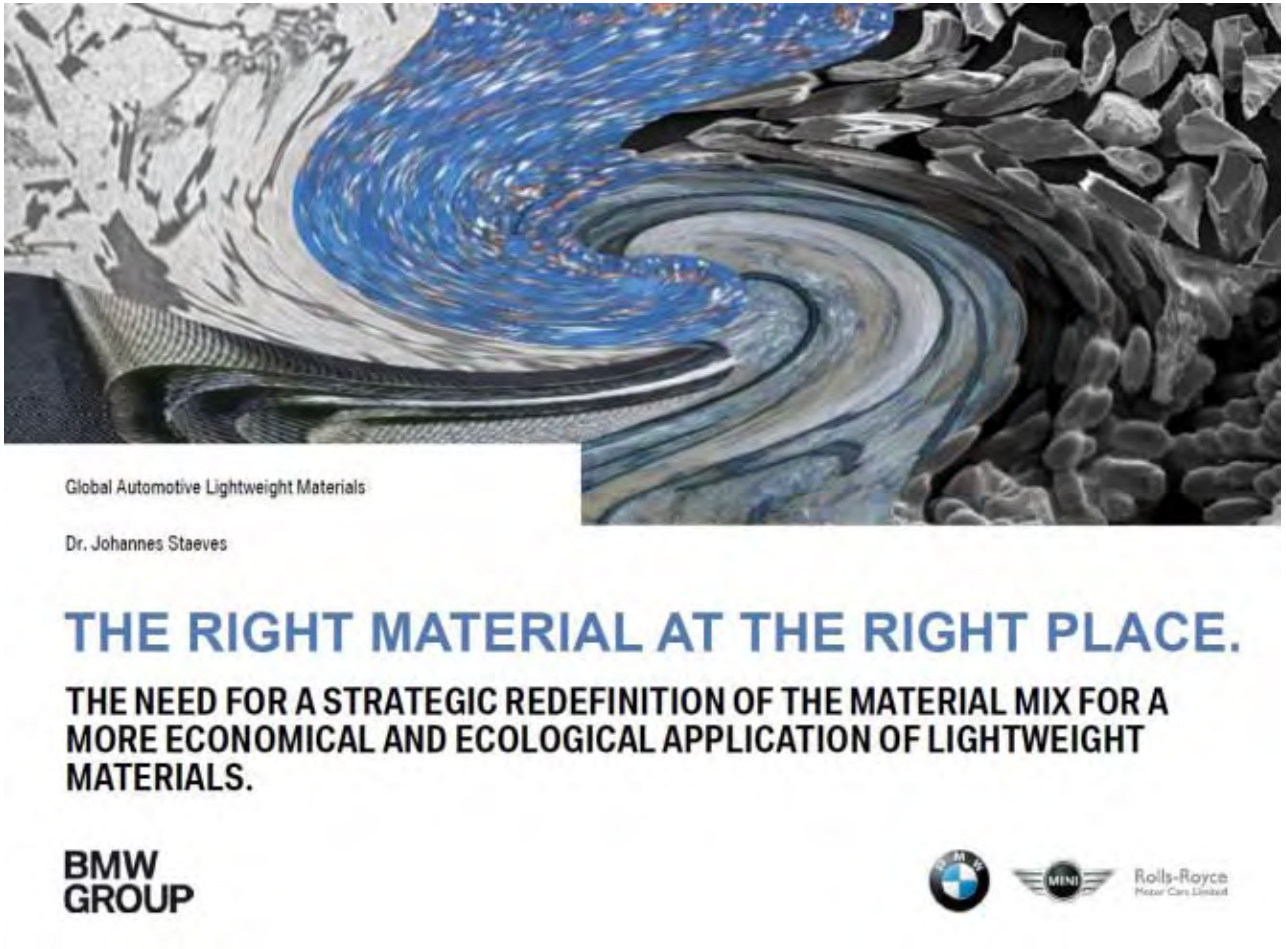
Monotonic Properties	Forged Steel		Cast Iron		Ratio
Average Hardness, HRC	23		18		0.8
Average Hardness, HRB	101		97		0.96
Modulus of elasticity, E, Gpa (ksi)	221	(32,088)	178	(25,838)	0.81
Yield Strength (0.2%offset), YS, MPa (ksi)	625	(91)	412	(60)	0.66
Ultimate strength, S_u, MPa (ksi)	827	(120)	658	(95)	0.80
Percent elongation, %EL	54%		10%		0.19
Percent reduction in area, %RA	58%		6%		0.10
Strength coefficient, K, MPa (ksi)	1316	(191)	1199	(174)	0.91
Strain hardening exponent, n	0.152		0.183		1.20
True fracture strength, σ_f, MPa (ksi)	980	(142)	658	(95)	0.67
True fracture ductility, ε_f	87%		6%		0.07

Cyclic Properties	Forged Steel		Cast Iron		Ratio
Fatigue strength coefficient, σ_f', MPa (ksi)	1124	163	927	(134)	0.82
Fatigue strength exponent, b	-0.079		-0.087		1.10
Fatigue ductility coefficient, ε_f'	0.671		0.202		0.30
Fatigue ductility exponent, c	-0.597		-0.696		1.17
Cyclic yield strength, YS', MPa (ksi)	505	73	519	(75)	1.03
Cyclic strength coefficient, K', MPa (ksi)	1159	168	1061	(154)	0.91
Cyclic strain hardening exponent, n'	0.128		0.114		0.89
$S_f = \sigma_f'(2N_f)^b$ at $N_f = 10^8$, MPa (ksi)	359	(52)	263	(38)	0.73
Average E' Gpa (ksi)	204	(31,437)	174	(25,229)	0.85

Comparison between mechanical properties of forged and casted crankshafts

EVOLUTION IN THE AUTOMOTIVE SECTOR

CASE 3: MATERIAL EVOLUTION (2/2)

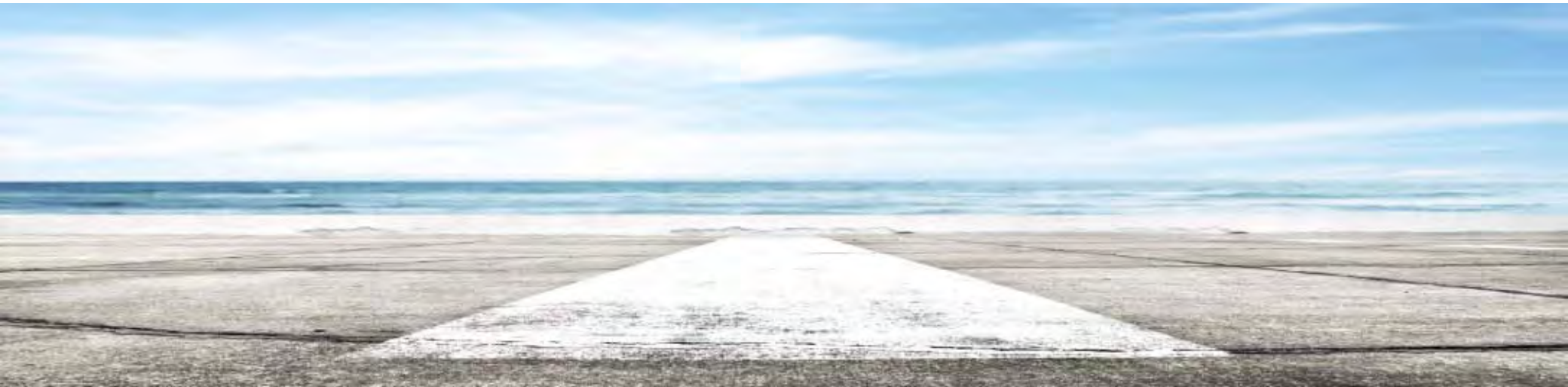


Source: BMW Group, Dr. Johannes Staeves, GALM, 24.04.20

EVOLUTION IN AUTOMOTIVE SECTOR

CONCLUSIONS

SECTOR	CIE AUTOMOTIVE
➢ It is **not the first time** the sector evolves.	➢ *CIE has **always been on track**.*
➢ The **rhythm of the evolution** depends on the market and segments.	➢ *CIE is **present in all main geographical markets and several segments**.*
➢ Evolution breaks the **maturity cycle** of the components.	➢ *For CIE, it means **higher profitability** as it moves away from commodities.*



3) From ICE to EV



VW Golf (ICE)

Source: UBS Report - Q-Series UBS Evidence Lab Electric Car Teardown – Disruption Ahead? (May 2017)

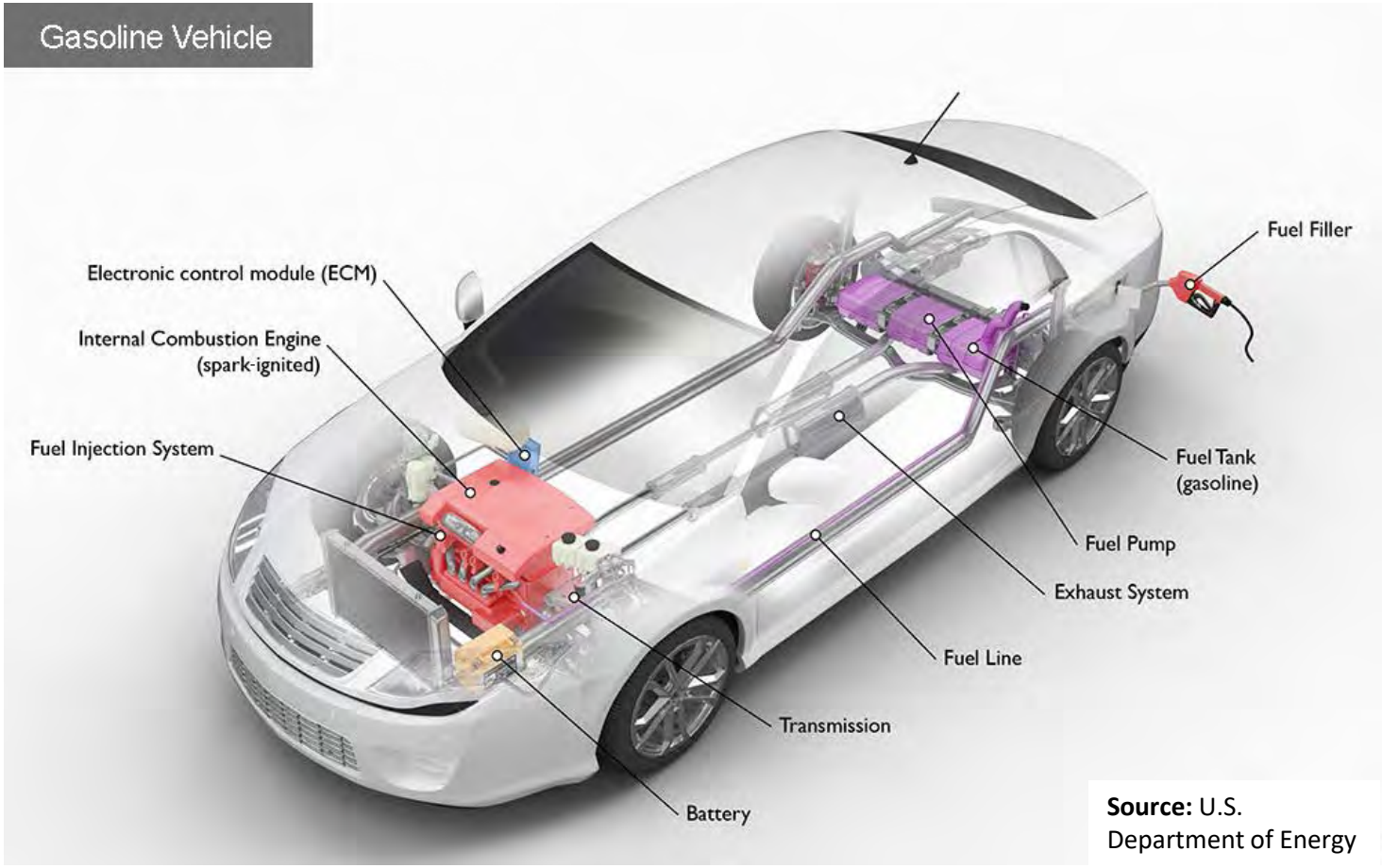


General Motors Chevrolet Bolt (EV)

Source: UBS Report - Q-Series UBS Evidence Lab Electric Car Teardown – Disruption Ahead? (May 2017)

INTERNAL COMBUSTION ENGINE (ICE)* VEHICLE

POWERTRAIN



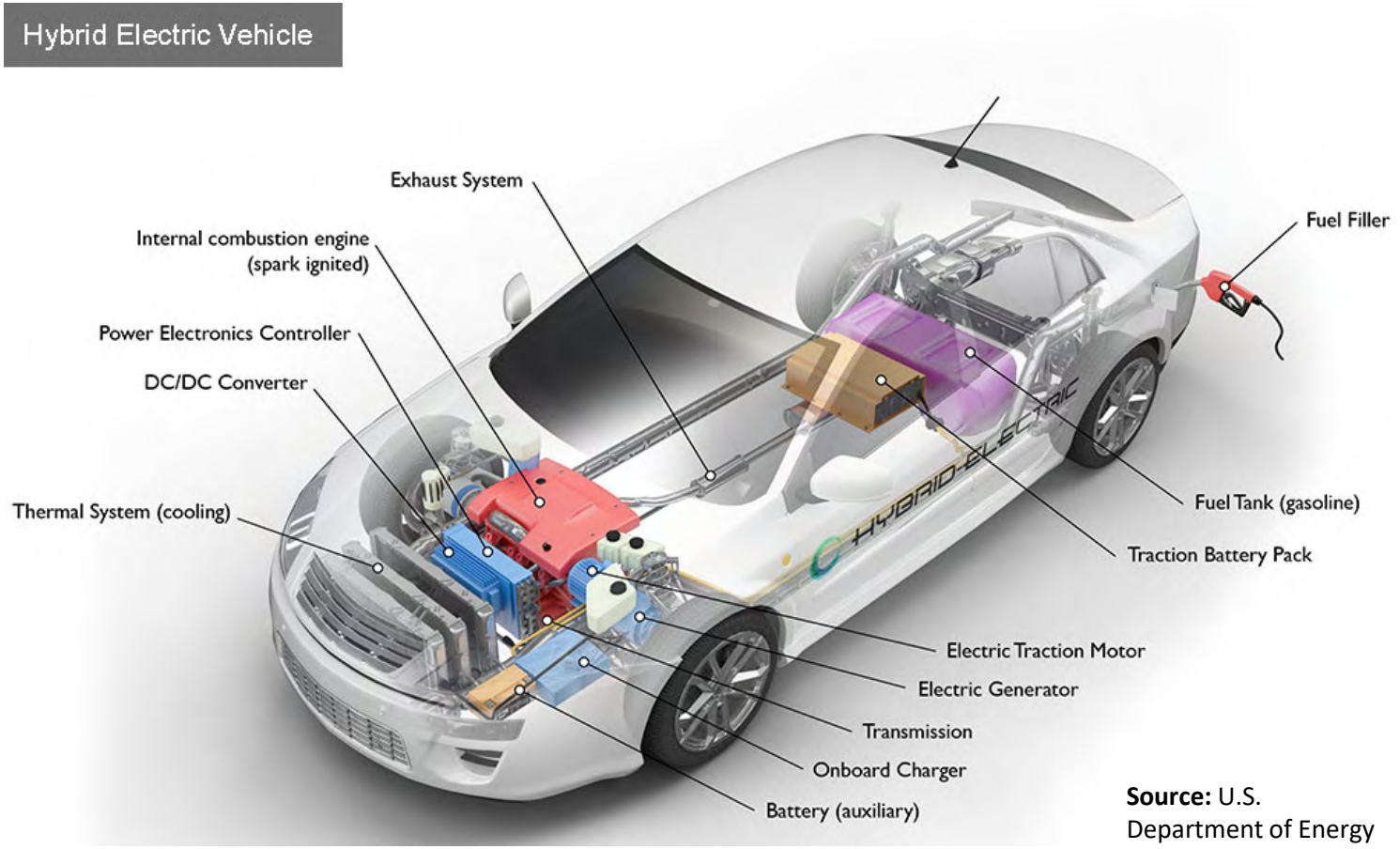
Source: U.S. Department of Energy

***Abbreviations:**

ICE: Internal Combustion Engine (operates on fuel).
HEV: Hybrid Electric Vehicle (operates on ICE plus an assisting battery charged by braking energy for short distances).
PHEV: Plug-in Hybrid Electric Vehicle (same as HEV but battery can be charged by plugging).
FCEV: Fuel Cell Electric Vehicle (operates on electricity produced using a fuel cell powered by hydrogen, rather than drawing electricity from a battery).
BEV: Battery Electric Vehicle (fully operates on battery electric power).

HYBRID ELECTRIC VEHICLE (HEV)*

POWERTRAIN



Source: U.S. Department of Energy

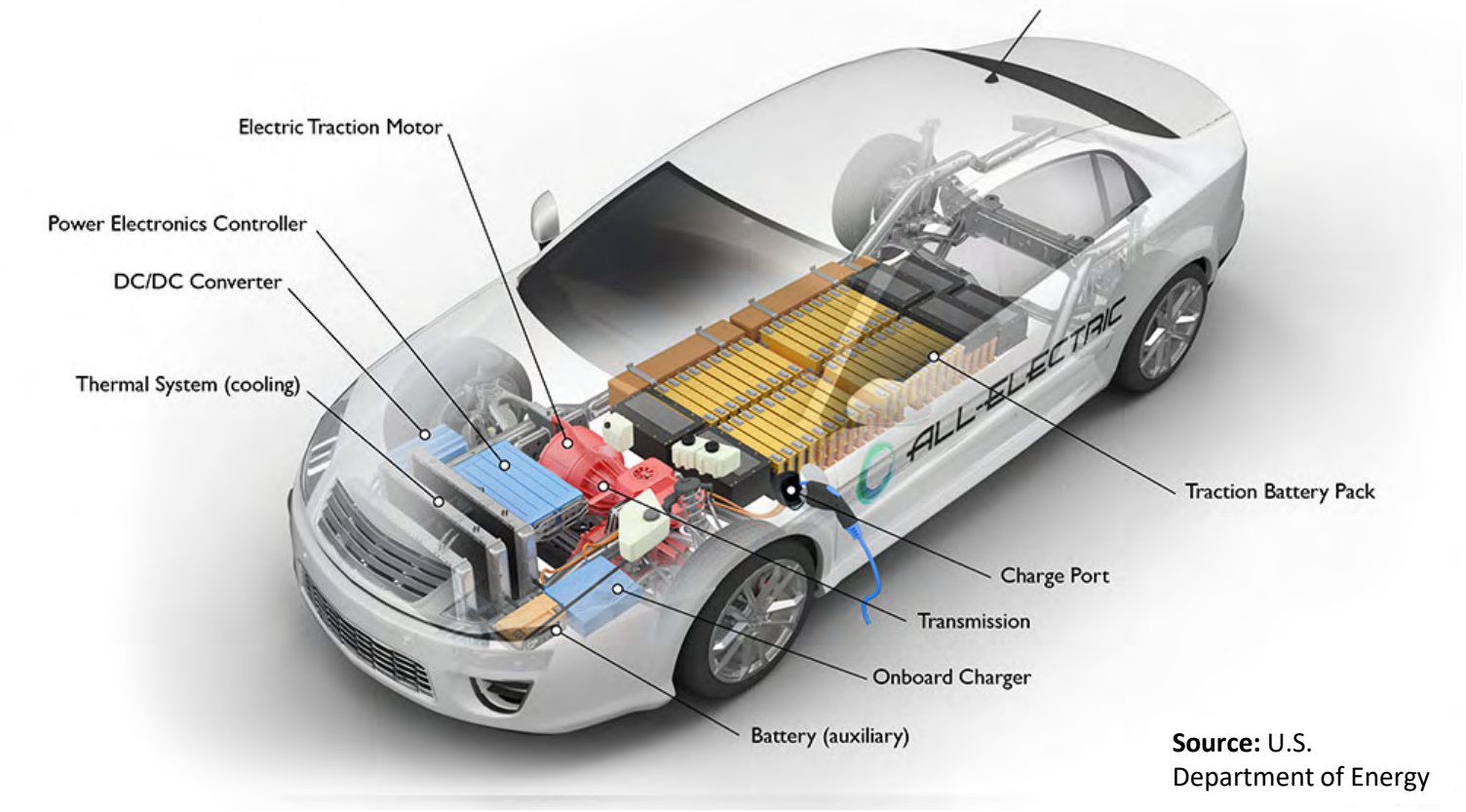
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BEV: Battery Electric Vehicle (fully operates on battery electric power).

ELECTRIC VEHICLE (EV)*

POWERTRAIN

All-Electric Vehicle



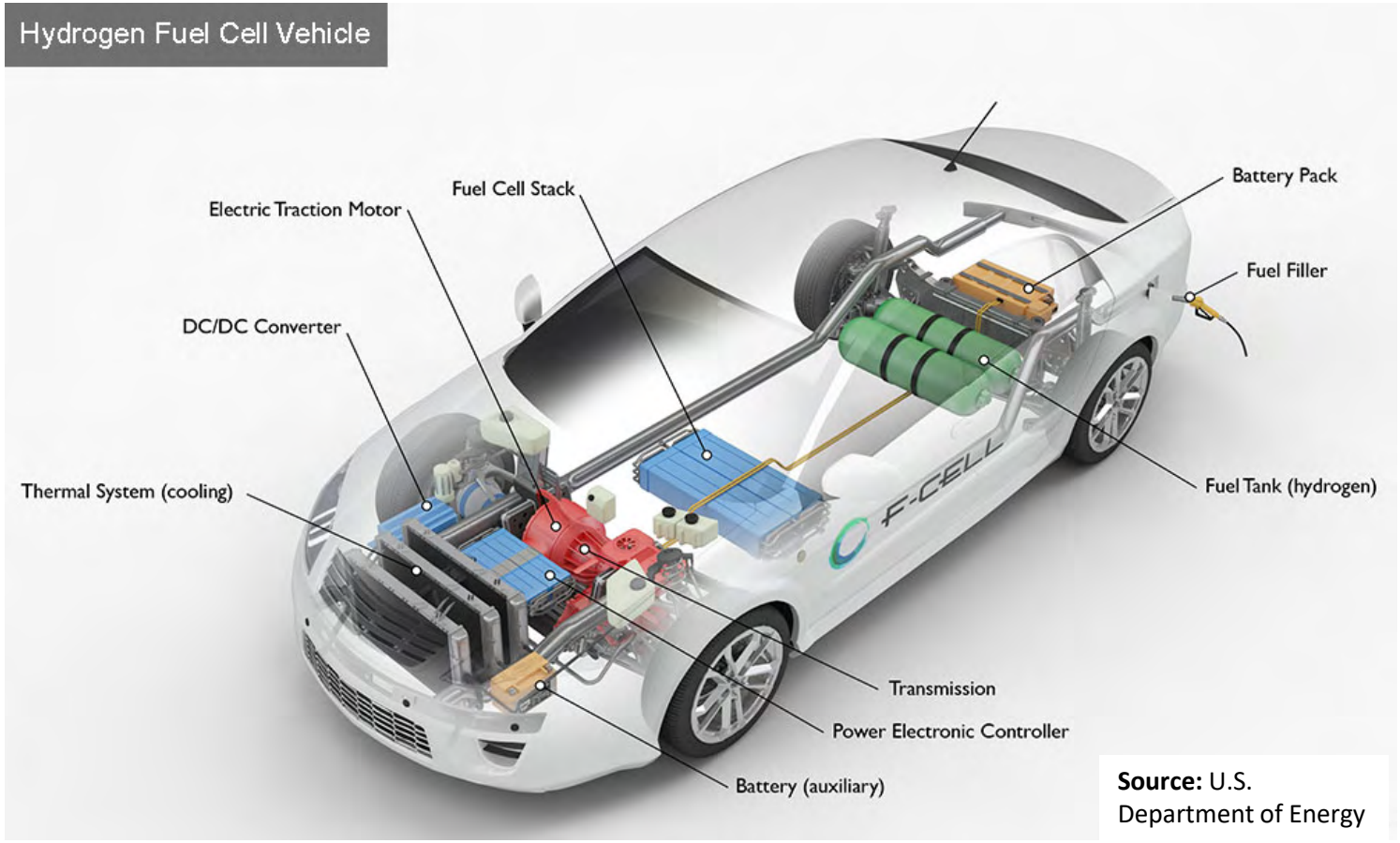
Source: U.S. Department of Energy

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FUEL CELL ELECTRIC VEHICLE (FCEV)* (HYDROGEN)

POWERTRAIN



Source: U.S. Department of Energy

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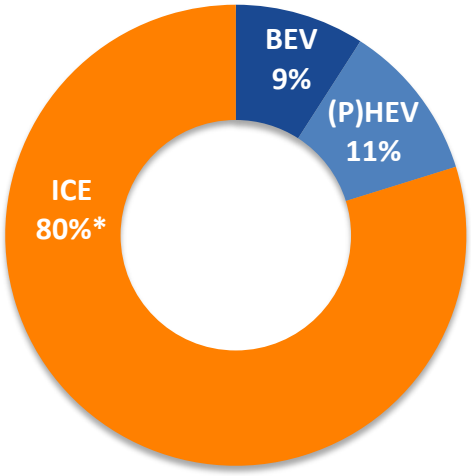
4) Electrification: Scenarios



ELECTRIC VEHICLE PENETRATION

FORECASTS 2025

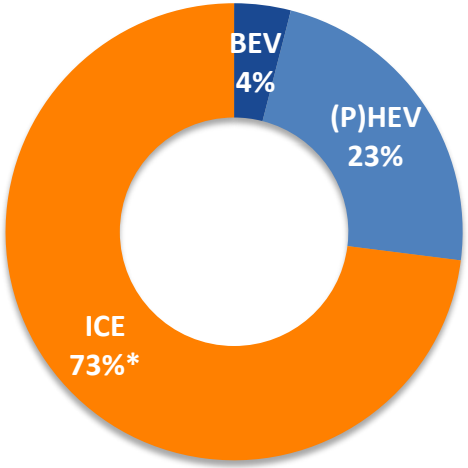
UBS



*Includes Mild Hybrid

Source: UBS Q-Series Report; May 2017.

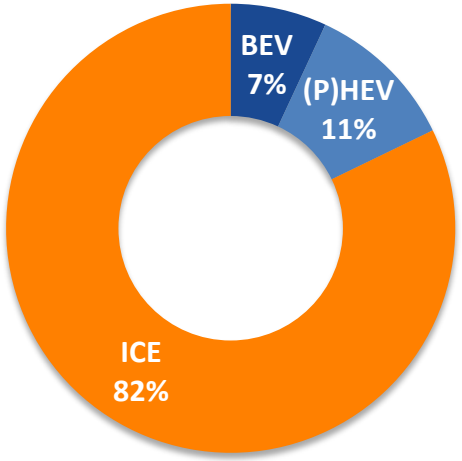
IHS



*Expects 58% of ICE to be gasoline and 15% to be Diesel.

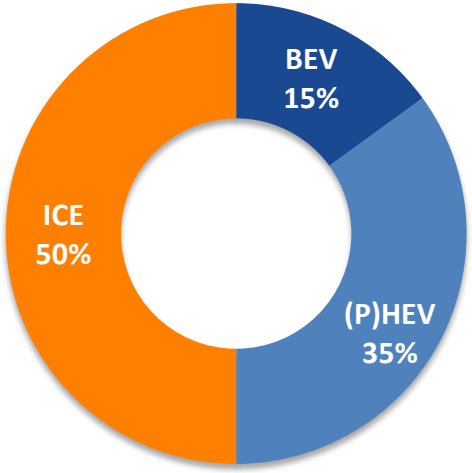
Source: IHS 2017.

Bosch



Source: Bosch Innovation Day 2017.

Schaeffler (Accelerated Scenario)



Source: Schaeffler 2017 Global Auto Industry Conference.

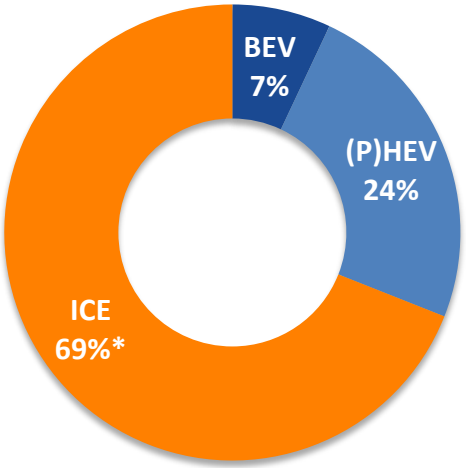
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ELECTRIC VEHICLE PENETRATION

FORECASTS 2025

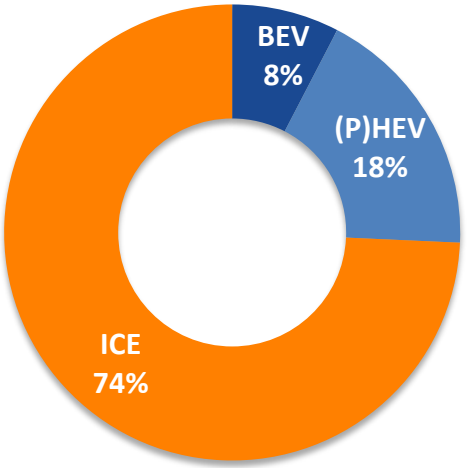
Faurecia



*Expects 57% of ICE to be gasoline and 12% to be Diesel.

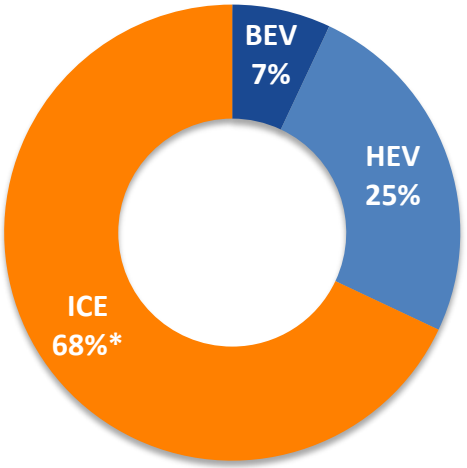
Source: Faurecia Investor's Day, June 2017.

Continental



Source: UBS Q-Series Report; May 2017.

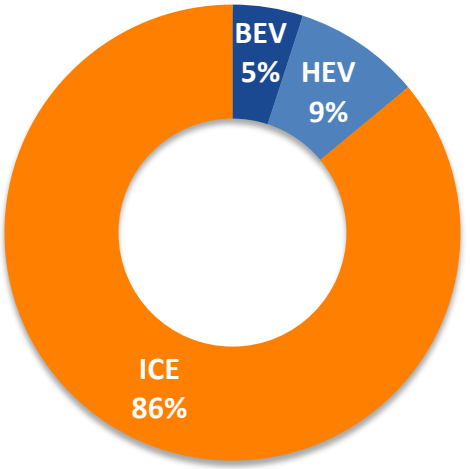
Roland Berger



*Expects 56% of ICE to be gasoline and 12% to be Diesel.

Source: Faurecia Investor's Day, June 2017.

MCPI Energies



Source: MDPI Energies Journal 2017.

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The diversity of forecasts for short and medium term reflects how sensible the EV growth is to a large number of uncertainties.

5) Uncertainties concerning EVs

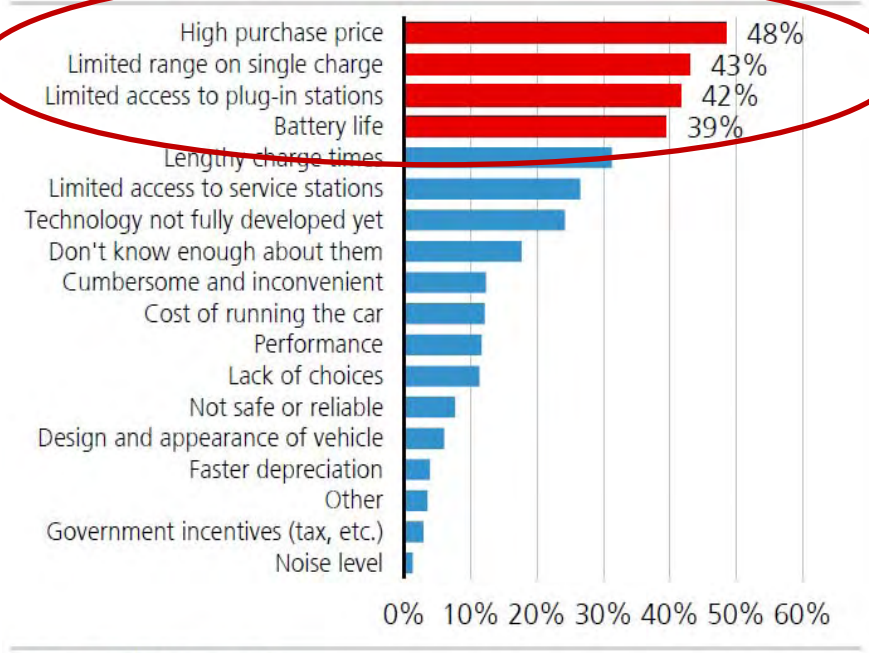



Consumer concerns
Grants
Battery costs
ELECTRIFICATION IS A REALITY.
BUT THERE IS A WIDE RANGE OF UNCERTAINTIES THAT CAN ACCELERATE MORE OR LESS THE DEVELOPMENT AND COMPETITIVENESS OF THE EV.
Fuel ban on cities
Raw material availability
Profitability
Raw material costs
Required investment

UNCERTAINTIES

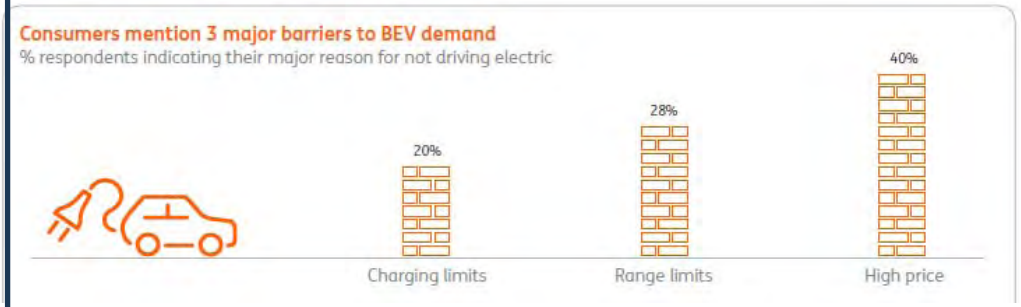
CONSUMER CONCERNS

Figure 36: Key concerns of consumers about BEVs



Source: UBS Report - Q-Series UBS Evidence Lab Electric Car Teardown – Disruption Ahead? (May 2017)

Source: Breakthrough of electric vehicle threatens European car industry by ING Economics Department, July 2017



"The car industry is at a turning point. Battery electric vehicles (BEV) are becoming increasingly competitive. **The major barriers to demand – charging infrastructure, range and pricing - are about to be broken**":

- **"Charging infrastructure:** ultra fast charging of batteries will enable a 300km charge in 20 minutes. This will further improve over time."
- **"Range anxiety:** New battery technology should improve range to increasingly meet consumer expectations from 2020 onwards."
- **"Pricing and total cost of ownership:** Battery costs continue to decline. Although purchase prices will remain relatively high for quite some time, electric vehicles have low costs of operation. This should enable a high range battery electric vehicle to become cost competitive (on total cost of ownership) with a comparable petrol car in 2024."

Price, range anxiety and charging time are key consumer concerns

UNCERTAINTIES

RAW MATERIAL AVAILABILITY

> Los vehículos eléctricos son el futuro. Son limpios, divertidos de conducir y pueden funcionar con energía renovable de bajo coste, pero tienen un enorme apetito que solo se sacia con el litio"

Transporte sostenible

El atasco en el suministro de litio frena al coche eléctrico

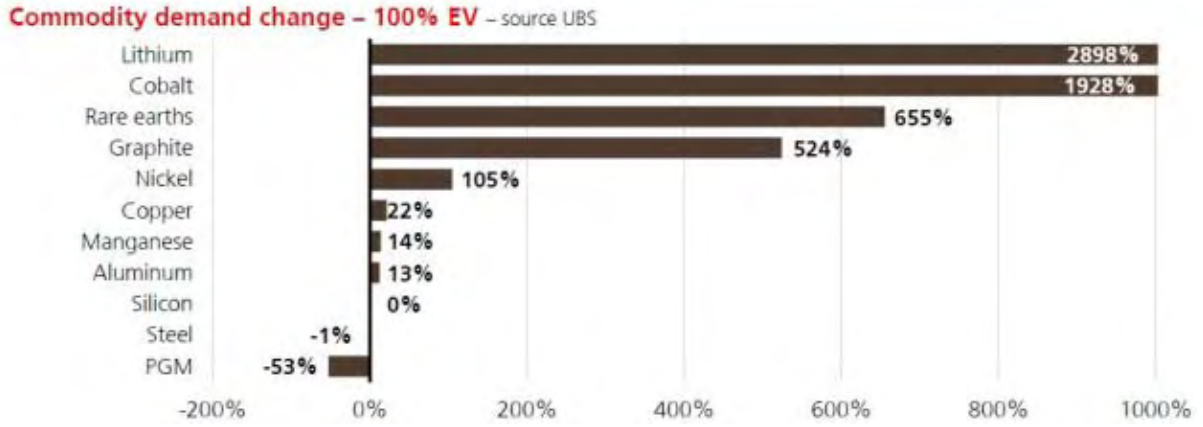
Por José Ángel Plaza López

— **Se necesitan nuevos métodos para extraer y procesar de manera más rápida, barata, eficiente y ecológica el metal con el que se fabrican las baterías de estos vehículos**

Source: El País (November 2017)

Is Lithium supply as easy to ramp up as it is abundant?

Lithium is relatively abundant. Yet successfully designing, building, commissioning and maintaining output from brine and hard-rock deposits is more technically challenging than many other mineral commodities. A shortage of experienced knowhow, lengthy development timelines, process plant issues and quality differentials present challenges likely to result in more gradual supply growth than developers may wish for.



Source: UBS Report - Q-Series UBS Evidence Lab Electric Car Teardown – Disruption Ahead? (May 2017)

As demand these materials grows, their availability is questioned

UNCERTAINTIES

RAW MATERIAL COSTS

Table 1. Overview of electric vehicles commercially available in 2016

Vehicle Segment	Brand	Model	Model Year	Battery Energy Content (kWh)	Range (km)
Small	Smart	Fortwo	2014	17,6	160
	Toyota	iQ EV	2012	12	85
	Fiat	500e	2015	24	135
	Citroen	C-Zero	2014	14,5	150
	Peugeot	iOn	2014	14,5	150
	Mitsubitshi	i-MiEV	2014	16	160
	VW	e-up!	2013	18,7	160
	Chevrolet	Spark Ev	2015	18,4	130
	Bollore	Bluecar	2015	30	250
	Mitsubitshi	MinicabMiEV	2014	16	150
Average				**18.2**	**153**
Median				**16.8**	**150**
Medium-Large	BMW	i3	2014	22	190
	Renault	Zoe	2015	22	240
	Volvo	C30 Electric	2015	24	145
	VW	e-Golf	2016	24,2	190
	Nissan	Leaf (2016)	2014	30	250
	Honda	FIT EV	2012	20	130
	Renault	Fluence Z.E.	2015	22	185
	Ford	Focus EV	2015	23	162
	Kia	Soul Electric	2015	27	212
	Mercedes	B-class El.Dr.	2015	36	230
	BYD	e6	2015	61,4	205
	Nissan	e-NV200	2015	24	170
	Toyota	RAV 4 EV	2014	41,8	182
	Tesla	Model S	2015	75	480
	Tesla	Model X	2015	90	489
Average				**36.2**	**231**
Median				**24.2**	**190**

Source: MDPI Energies Journal 2017



Asian battery makers eye nickel top-up as cobalt price bites

REUTERS

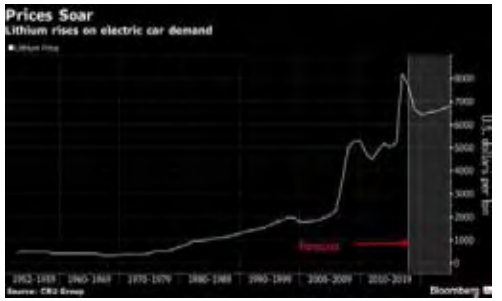
With forecasts for electric vehicle (EV) battery demand to jump 20-fold over the decade to 2025, manufacturers are looking to cut back on more expensive components. Cobalt has more than doubled in price over the past year on strong demand and a supply shortage.

Source: Reuters (August 2017)



Source: LME (Nov 2017)

Lithium Price Evolution



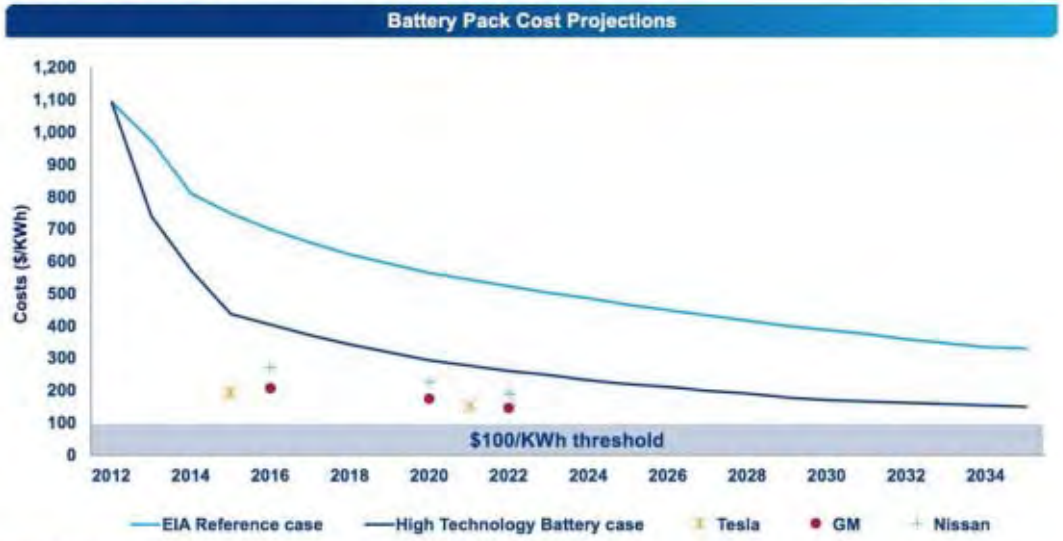
Source: Bloomberg/CRU Group (August 2017)

As demand these materials grows, their price increases significantly

UNCERTAINTIES

BATTERY COSTS

2012 cost projections for 2030 have already happened: Long term implications on renewables, transport electrification



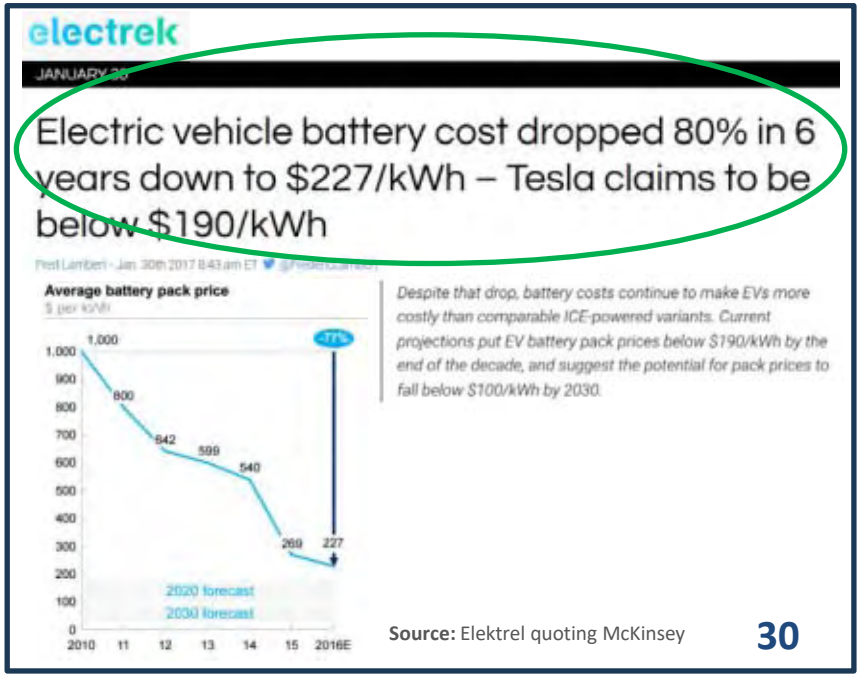
"While policy and consumer behaviour are difficult to predict, battery costs are coming down fast. We're already ahead of lithium-ion battery costs projected for 2030. And with 10 battery gigafactories under development around the world, battery costs and prices are expected to further outpace projections."

Source: Wood Mackenzie, July 17
https://www.greentechmedia.com/articles/read/everyone-is-revising-electric-vehicle-forecasts-upward#gs.Sy=GPno

Battery costs are expected to be reduced



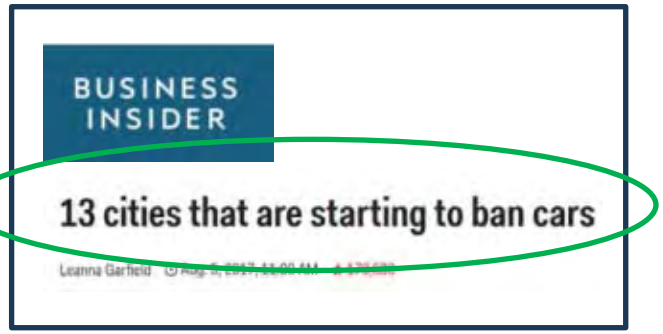
Source: MDPI Energies Journal 2017



Source: Elektrel quoting McKinsey

UNCERTAINTIES

FUEL BAN IN CITIES: STRONGER FUEL CONSUMPTION AND ZERO EMISSION MANDATES











Legislation evolution can affect the penetration of EVs

UNCERTAINTIES

GRANTS ON HEV & EV

What Could Happen To Electric Car Sales If The $7,500 Tax Credit Dies

MENU G1 SÃO PAULO

21/08/2015 18h26 - Atualizado em 14/09/2015 12h51

Prefeitura de SP vai desconto no IPVA de carros elétricos e híbridos

Prefeito assinou nesta sexta-feira decreto que prevê 50% de abatimento. Gestão Haddad também estuda deixar carros não-poluentes fora do rodízio.

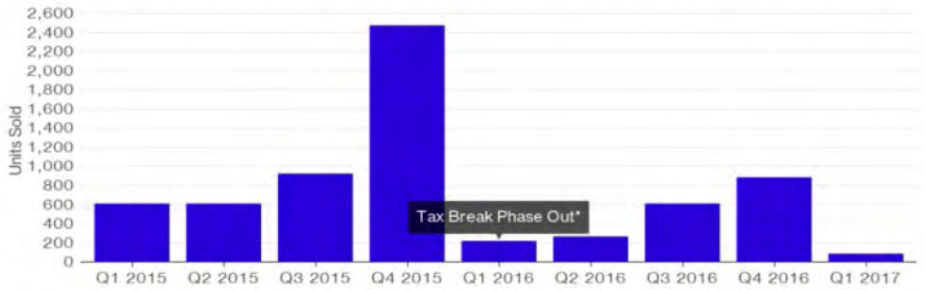
LIBREMERCADO Libertad Digital

Dinamarca reduce las subvenciones al coche eléctrico y las ventas se hunden

Tesla sufre en sus propias carnes la dependencia de las ayudas públicas. Hong Kong: 2.939 unidades en marzo, cero en abril

Out of Favor **Evolution of BEV Sales in Denmark:**

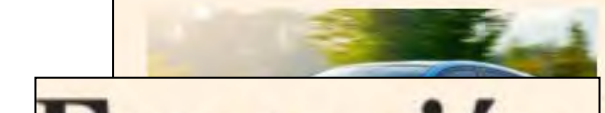
Sales of electrically chargeable vehicles have plummeted amid confusion over tax breaks



Source: ACEA
* Deadline has since been extended

Source: Bloomberg Markets, June 2017

Bloomberg



Expansión

MOTOR

Los coches híbridos y eléctricos sólo copan el 5% del mercado

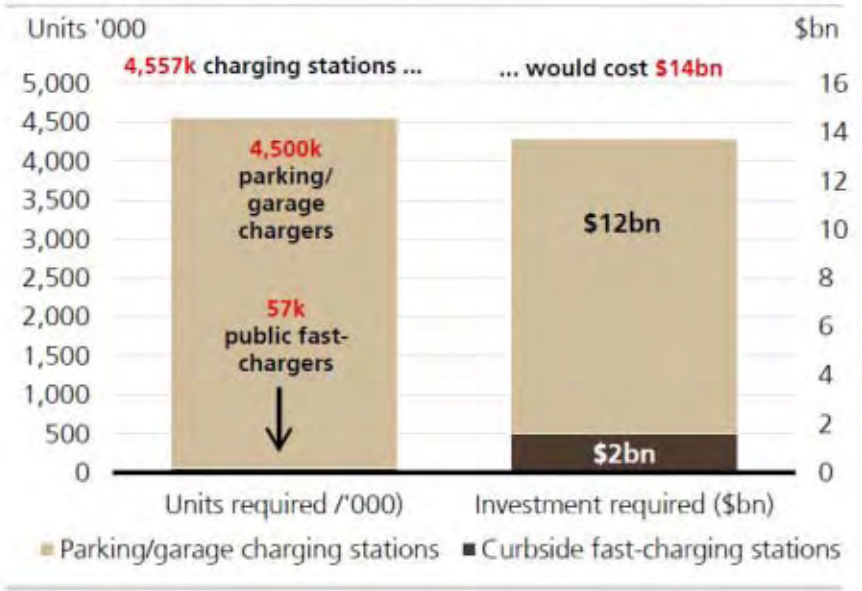
De ahí que el Gobierno español pretenda impulsar sus ventas con el Plan Movalt por el que se darán ayudas a la compra de vehículos impulsados por energías alternativas. Dichas ayudas, estarán disponibles desde la semana que viene. Por ejemplo, un vehículo eléctrico se beneficiará de 5.500 euros de ayudas, más 1.000 euros adicionales que aportará el concesionario para instalar un punto de recarga de baterías en el garaje del cliente.

Grants evolution can change the buyer decisions. (Anticipation, postponing, cancelling…)

UNCERTAINTIES

HUGE INVESTMENT IN CHARGING INFRASTRUCTURES

Figure 31: Required investment in charging infrastructure in Europe



Source: UBS Report - Q-Series UBS Evidence Lab Electric Car Teardown – Disruption Ahead? (May 2017)



Source: Cinco Días https://cincodias.elpais.com/cincodias/2017/04/21/companias/1492777826_740308.html (April 2017)

Infrastructure requirements are huge and their returns uncertain

UNCERTAINTIES

HUGE INVESTMENT IN BATTERY FACTORIES

Battery factories investment requirements are huge

Automotive News

NEWS BY BRAND | DEALERS | OEM/SUPPLIERS | MOBILITY | SPECIAL REPORTS | OPINION | VIDEO | DATA | WEBINARS | EVENTS

You are here: Home » Manufacturing »

Industry needs 40 more gigafactories, VW says

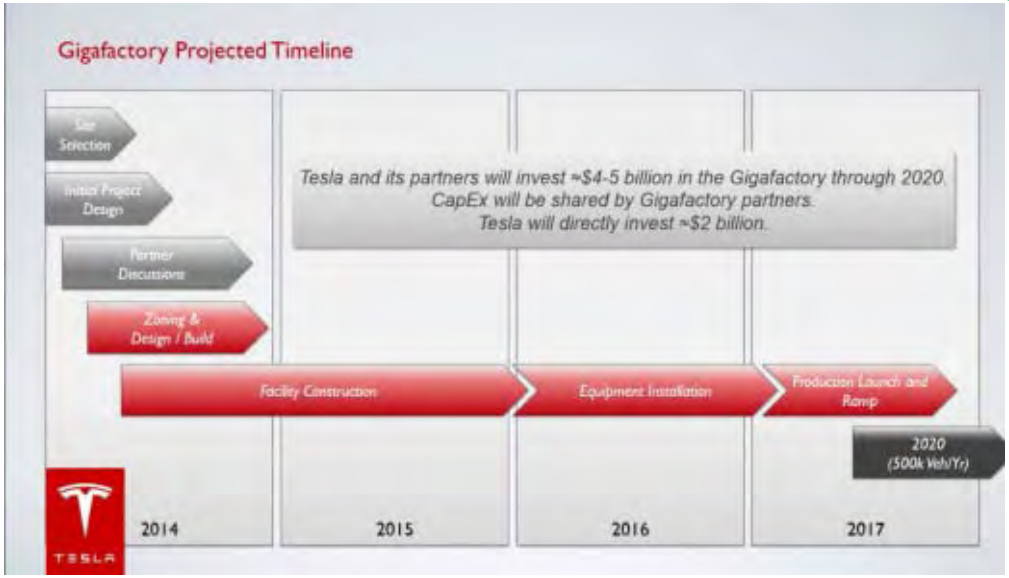
Company sees huge shortage of batteries by '25

EHRA-LESSIEN, Germany — A massive shortage of lithium ion battery cells could plague the global car industry in the coming decade if capacity equivalent to 40 Tesla gigafactories is not added by 2025, according to estimates from Volkswagen Group.

Ulrich Eichhorn, head of r&d for the world's largest carmaker, increased projections made just 13 months ago for his company's needs in 2025. Eichhorn's forecast is based on targets that a quarter of its group volume will come from the sale of electric vehicles by then.

"We will need more than 200 gigawatt-hours," Eichhorn told reporters on June 30 during a presentation here at the group's otherwise highly secretive proving ground a half hour drive north of Wolfsburg.

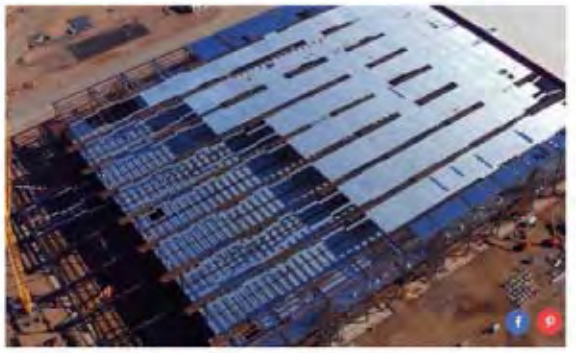
Tesla in 2013 said…:



10 Battery Gigafactories Are Now in the Works. And Elon Musk May Add 4 More

Could a gigafactory glut lead to oversupply?

JASON DEIGN | JUNE 29, 2017



Source: Wood Mackenzie, June 17
https://www.greentechmedia.com/articles/read/10-battery-gigafactories-are-now-in-progress-and-musk-may-add-4-more#gs.em7MLmw

UNCERTAINTIES

REAL EMISSIONS

Expansión

MOTOR

Coches eléctricos: no tan 'verdes' como parecen

- Fomento destinará 2,5 millones de euros a impulsar la infraestructura del coche eléctrico y el vehículo autónomo
- Los coches híbridos y eléctricos sólo copan el 5% del mercado

El humilde Mitsubishi Mirage no tiene los sellos distintivos de un coche futurista y respetuoso con el medio ambiente. Funciona con gasolina, tiene un motor de combustión interna y expulsa emisiones a través de un tubo de escape.

Pero si se miden las emisiones de CO2 del Mirage a lo largo de su ciclo de vida (desde la obtención de los componentes y el combustible, al reciclaje de sus piezas) puede ser un coche más ecológico que un modelo de Tesla, el pionero estadounidense en los vehículos eléctricos.

Según los datos del Laboratorio Trancik del Instituto de Tecnología de Massachusetts, un sedán Tesla Model S P100D conducido en el Medio Oeste de Estados Unidos produce 226 gramos de CO2 (o equivalente) por kilómetro a lo largo de su ciclo de vida, lo que supone una reducción significativa con respecto a los 385g de un BMW Serie 7 de lujo. Pero el Mirage sólo emite 192g.

Source: Expansión, 11/11/2017.

motor.es

"Los vehículos eléctricos también contaminan" ¿Es eso cierto?

"Los vehículos eléctricos también contaminan", lo habrás escuchado miles de veces, en ocasiones para zanjar debates entre los vehículos de combustión y de propulsión alternativa. Pero ¿qué hay de cierto? ¿Por qué contamina un coche eléctrico? Y sobre todo, ¿cuánto?.

Durante la fabricación de un vehículo eléctrico se emite más emisiones de CO2 pero estas se compensan en cuanto empieza a rodar

Source: Motor.es, July 2017.

Union of Concerned Scientists
Science for a healthy planet and safer world

Over their lifetime, battery electric vehicles produce far less global warming pollution than their gasoline counterparts—and they're getting cleaner.



Source: Union of Concerned Scientists.

EV do produce pollution but studies show that they do far less than equivalent ICE vehicles

CIE Automotive

UNCERTAINTIES

PROFITABILITY IN RISK



MOTOR

ALFREDO ALTAVILLA

Presidente ejecutivo del Grupo FCA en la región EMEA. El directivo italiano hace un repaso de la situación de las marcas del grupo, donde destacan la buena salud de Fiat, Jeep y Alfa Romeo, esta última en fase de completar su relanzamiento.

«No hay ningún modelo de negocio que funcione bien con los eléctricos»

SERGIO PICCIONE FRANCFORT

Alfredo Altavilla es el hombre al frente de la región EMEA (Europa, Oriente Medio y África) dentro del Grupo FCA (Fiat-Chrysler Automóviles). En sus 27 años de actividad profesional en Fiat ha estado destinado en China, Turquía, ha sido responsable de las relaciones con General Motors, dirigido la división de motores Fiat Powertrain y la de camiones, Iveco.

Pregunta.– ¿Cuál es su previsión para el fin del año en Europa y en la región EMEA?

Respuesta.– No podría darle cifras precisas, pero sí decirle que hasta ahora llevamos un buen año y creo

encabezaría el Panda. Pero con lo quiere decir que tenga que derivar estilísticamente de él. Lo importante es que responda a un concepto funcional, como ocurre con el Tipo.

P.– A esta familia de coches funcionales pertenecía el Freemont, que ha dejado de fabricarse. ¿Tendrá sucesor? Y en el caso que así fuera, ¿se fabricaría en Europa?

R.– A mí me gustaría que hubiera un sucesor para el Freemont, pero tenemos que estudiarlo. En cuanto a dónde se produciría, sólo puedo decirle que cuando desarrollamos un modelo en FCA lo hacemos pensando que pueda hacerse en Europa, EEUU, Brasil o donde convenga.

P.– De todas formas, ¿cuál es el

Source: El Mundo

CHRISTIAAN HETZNER

Daimler reveals the dark secret behind EVs

September 12, 2017 06:01 CET

Daimler has revealed the dark secret that explains exactly why the German auto industry has been so loath to embrace electric cars until now, years after Elon Musk founded Tesla and Carlos Ghosn pushed electrification at Nissan and Renault.

The German automaker on Monday acknowledged that a roll out of EVs, even those with its iconic three-pointed star on the hood, will cannibalize sales from their combustion-engine lineup and, perhaps most importantly, will be half as profitable.

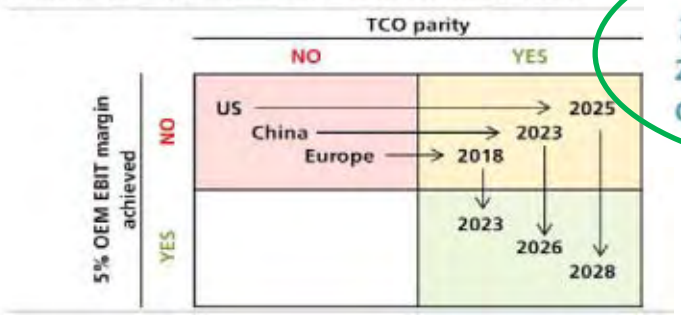
Once its family of EQ battery electric vehicles start selling in large quantities come early next decade, Daimler's Mercedes-Benz passenger car division could see two full percentage points knocked off of its operating margin. As a result, it plans to cut costs by 4 billion euros - twice the size of its initial two-year program through 2014, when it was still trying to catch up with more profitable rivals.

While not your classic profit warning (as no specific time from was given), the comments confirm that EVs currently reduce the structural profitability of a company like Daimler in a material way as many investors had feared. For at least another eight years, the equation will remain skewed against EVs and only in 2025 does Daimler expect a rising cost curve for combustion cars to intersect with a declining curve for EVs.

Source: Automotive News

EV needs volume to be profitable

Figure 18: TCO parity matrix – Chevy Bolt vs. VW Golf by region

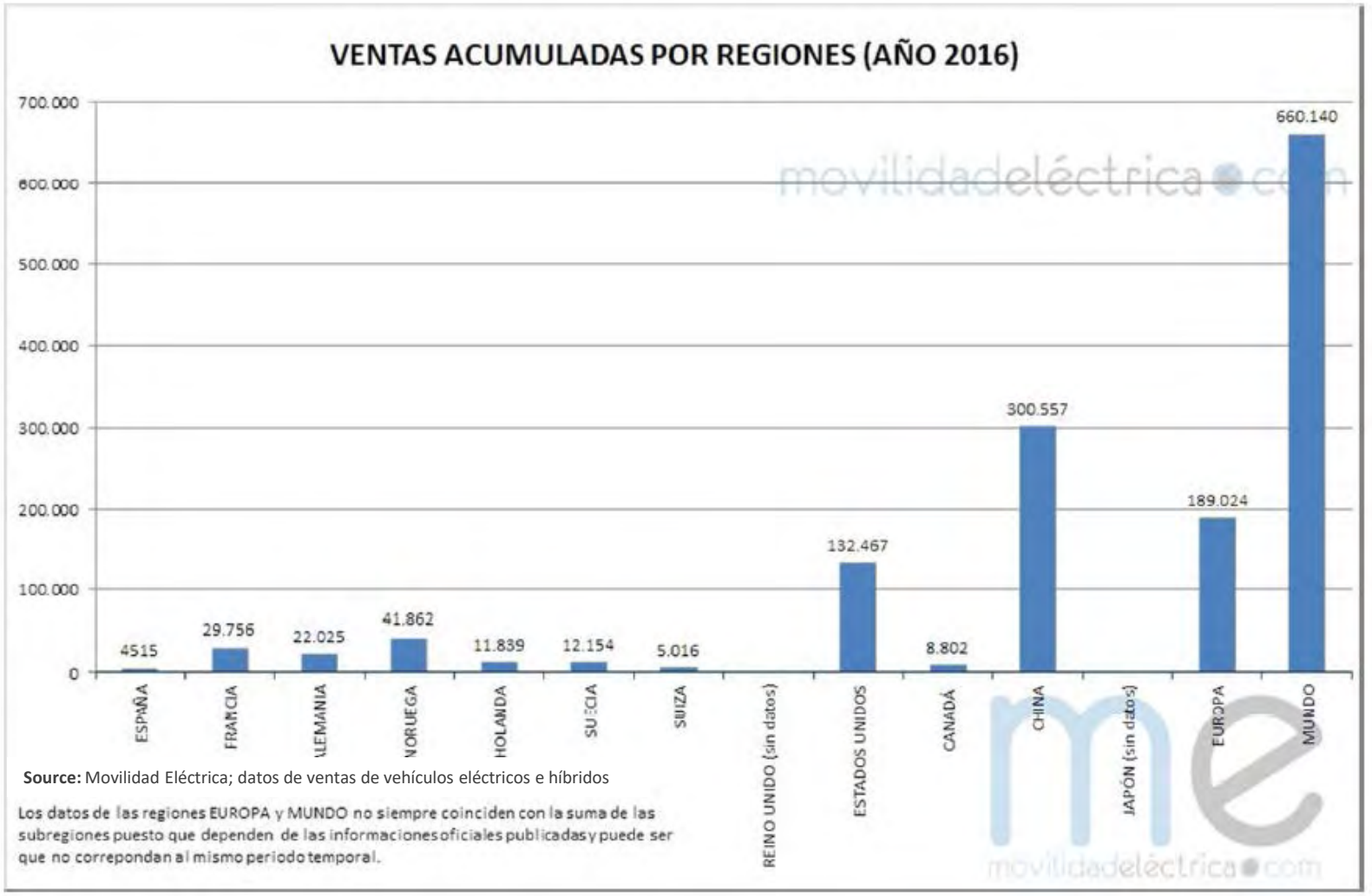


True cost parity to be reached by 2023E in Europe and 2026E in China

Source: UBS Report - Q-Series UBS Evidence Lab Electric Car Teardown – Disruption Ahead? (May 2017)

UNCERTAINTIES

DIVERSIFIED WORLD: EV SALES DATA IN 2016



The majority of worldwide sales of EV are concentrated in China and Europe, followed by the US

UNCERTAINTIES

DIVERSIFIED WORLD

Electrification is expected to occur in the first place in China and Europe – as well as US if Trump is successor is “greener”. The rest of the world will probably take longer due to the fact that they have less incentives (governmental legislation, subsidies, etc.).

THE ECONOMIC TIMES

Policy

Nov 8, 2017, 03.51 PM IST

Airbags, other safety features mandatory for new cars from October 2017

By Rajat Arora

Mandatory ABS for Commercial Vehicles in India from midnight

Autocar Pro News Desk

The first day of the new fiscal year (2015-16) tomorrow will also herald an important step towards increasing road safety on Indian roads. And it couldn't have come sooner.

Effective midnight of April 1, 2015, the Ministry of Road Transport and Highway (MoRTH) has made the anti-lock braking system (ABS) mandatory for commercial vehicles (CVs). Initially, all new trucks launched in the N3 category (above 12 tonnes Gross Vehicle Weight) and buses in the M3 category (above 5 tonnes GVW and carrying nine passengers) will have to be compulsorily fitted with ABS at the time of manufacturing. It will not available as a retrofitment for existing vehicles.

US buyers were expected to switch to smaller cars but low fuel prices have stopped the trend:

BUSINESS

Buyers Go Big As Sales Of Small Cars Slump

January 25, 2017 · 5:05 AM ET

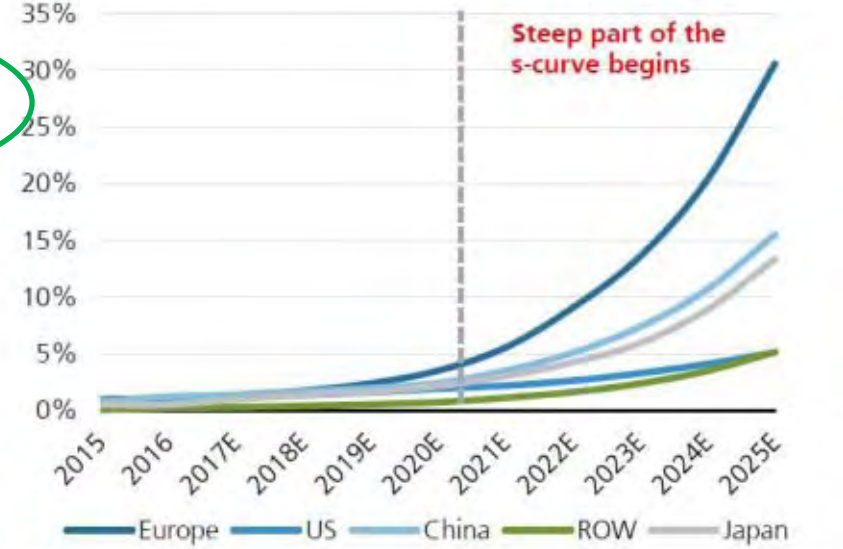
Heard on Morning Edition

Figure 22: EV sales by region (m units)



Source: UBS estimates

Figure 23: EV share by region (% of total car sales)



Source: UBS estimates

Source: UBS Report - Q-Series UBS Evidence Lab Electric Car Teardown – Disruption Ahead? (May 2017)

6) Other Trends

Diesel &
Autonomous Car



DIESEL VEHICLES

COMMUNICATING VESSELS

There is a clear trend to decrease Diesel engine, demand is falling. So far, Diesel and Gasoline volumes are communicating vessels

Headline of the news

REUTERS

#ENVIRONMENT OCTOBER 23, 2017 / 1:29 AM / 17 DAYS AGO

London introduces vehicle pollution levy in new blow to diesel

Body of the news

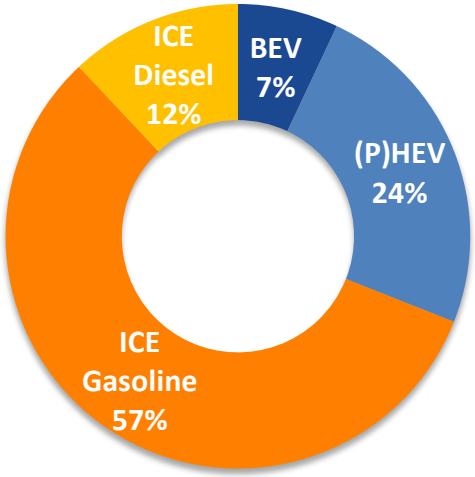
LONDON (Reuters) - London brought in a new levy on the oldest and most polluting cars entering the city center from Monday, almost doubling how much motorists have to pay in the latest blow to diesel.

Drivers are already charged 11.50 pounds ($15) to enter the financial district and parts of west London under a congestion charge. But those driving petrol and diesel vehicles typically registered before 2006 will need to pay an additional 10 pounds.

DIESEL VEHICLES

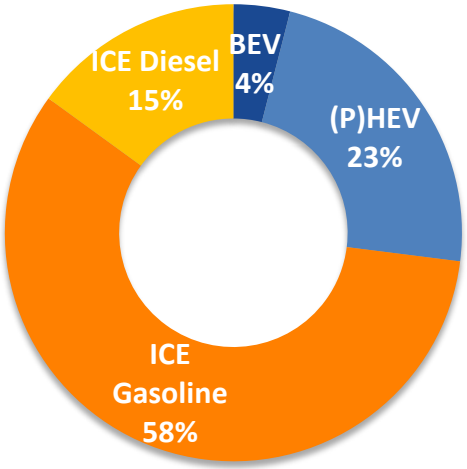
FORECASTS 2025

Faurecia



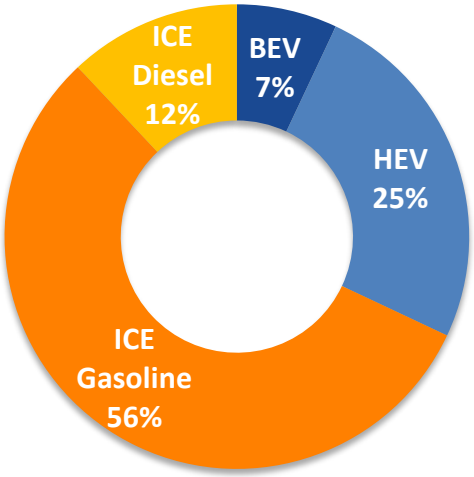
Source: Faurecia Investor's Day, June 2017.

IHS



Source: IHS 2017.

Roland Berger



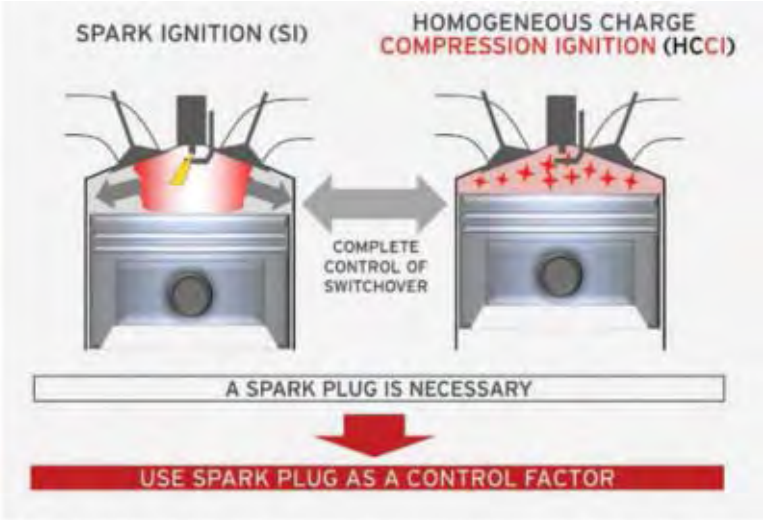
Source: Faurecia Investor's Day, June 2017.

***Abbreviations:**

ICE: Internal Combustion Engine (operates on fuel).
HEV: Hybrid Electric Vehicle (operates on ICE plus an assisting battery charged by braking energy for short distances).
PHEV: Plug-in Hybrid Electric Vehicle (same as HEV but battery can be charged by plugging).
BEV: Battery Electric Vehicle (fully operates on battery electric power).

DIESEL VEHICLES

ICE IS ALSO MOVING



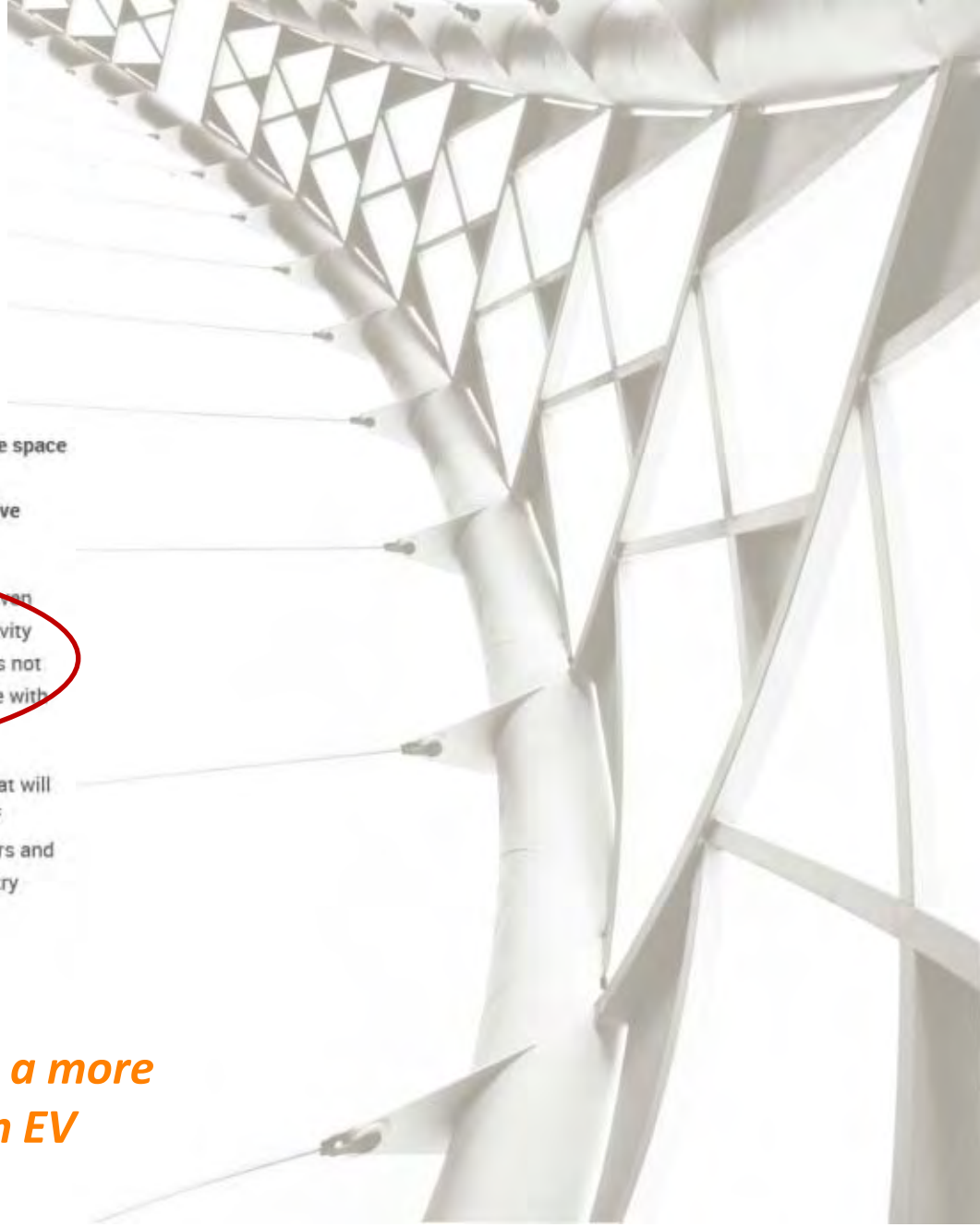
Mazda's SpCCI combustion strategy centers around the use of the spark plug as a means to enhance the effective compression ratio and "stimulate" the compression-ignition process.



Source: Automotive Engineering, October 2017.

The perfect mix between the advantages of the diesel and gasoline engines

AUTONOMOUS VEHICLE



ACEA European Automobile Manufacturers Association

Connected and automated driving promises to revolutionise individual mobility within the space of just a few years. It will offer new mobility solutions that are cleaner, safer and more consumer-focussed than ever, but equally create new areas of business for the automotive industry.

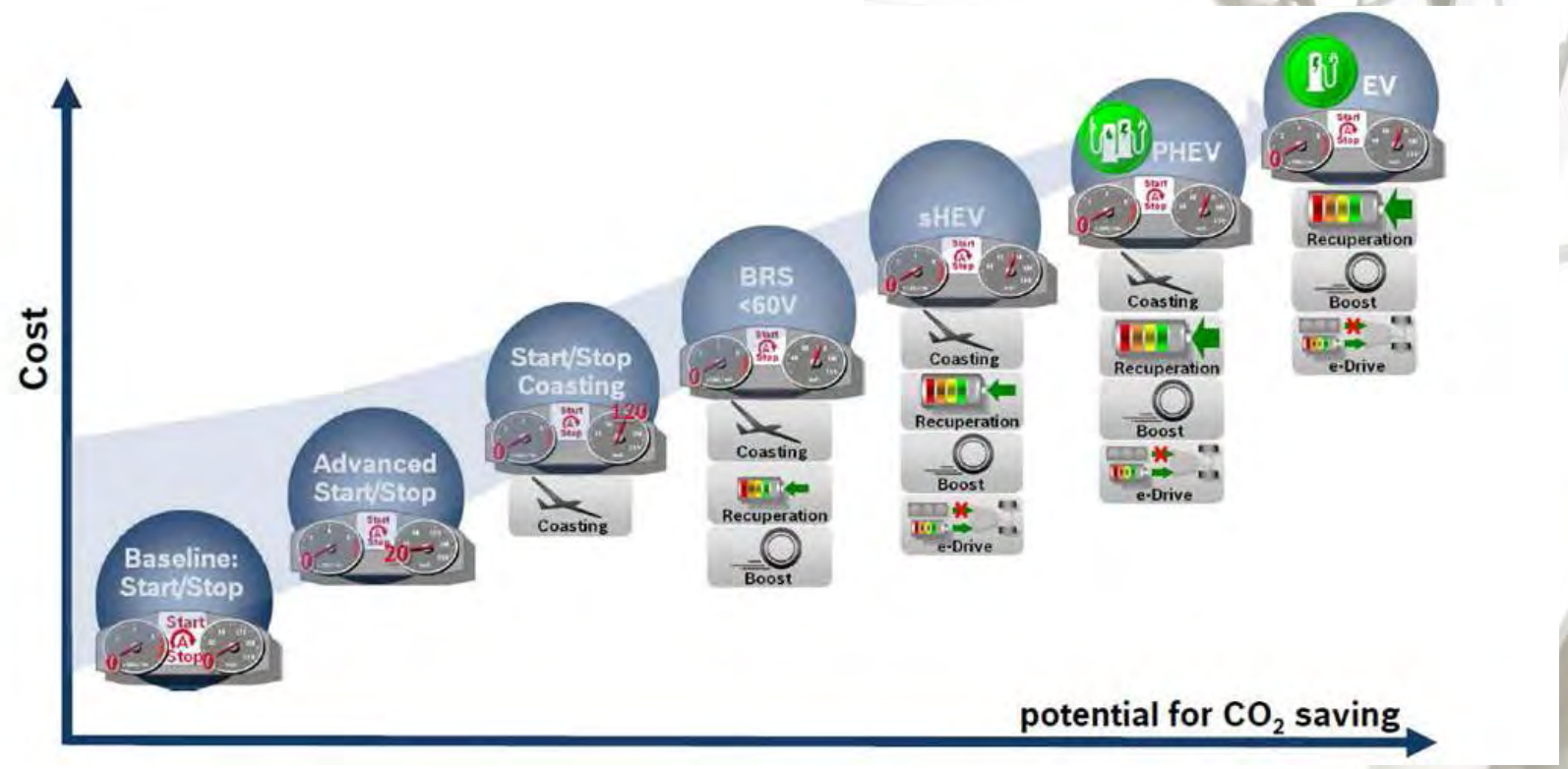
Fuel consumption – and with that CO2 emissions – will be reduced, traffic will become even safer, and roads can be used more effectively, thereby reducing congestion. Car-connectivity and automation will also bring considerable economic gains for society at large. And let's not forget how these developments will improve access to mobility for the elderly and people with disabilities, or those who live in remote areas such as the country side.

At the same time, connected and automated driving will create new areas of business that will change traditional automotive business models. Manufacturers will become providers of innovative mobility solutions, rather than 'just' being producers of vehicles. Manufacturers and suppliers are therefore spending a big part of the €50.1 billion that the automotive industry annually invest in R&D, on connected and automated driving.

Source: ACEA (European Automobile Manufacturers Association).

Autonomous vehicle could even become a more effective way of emission reduction than EV

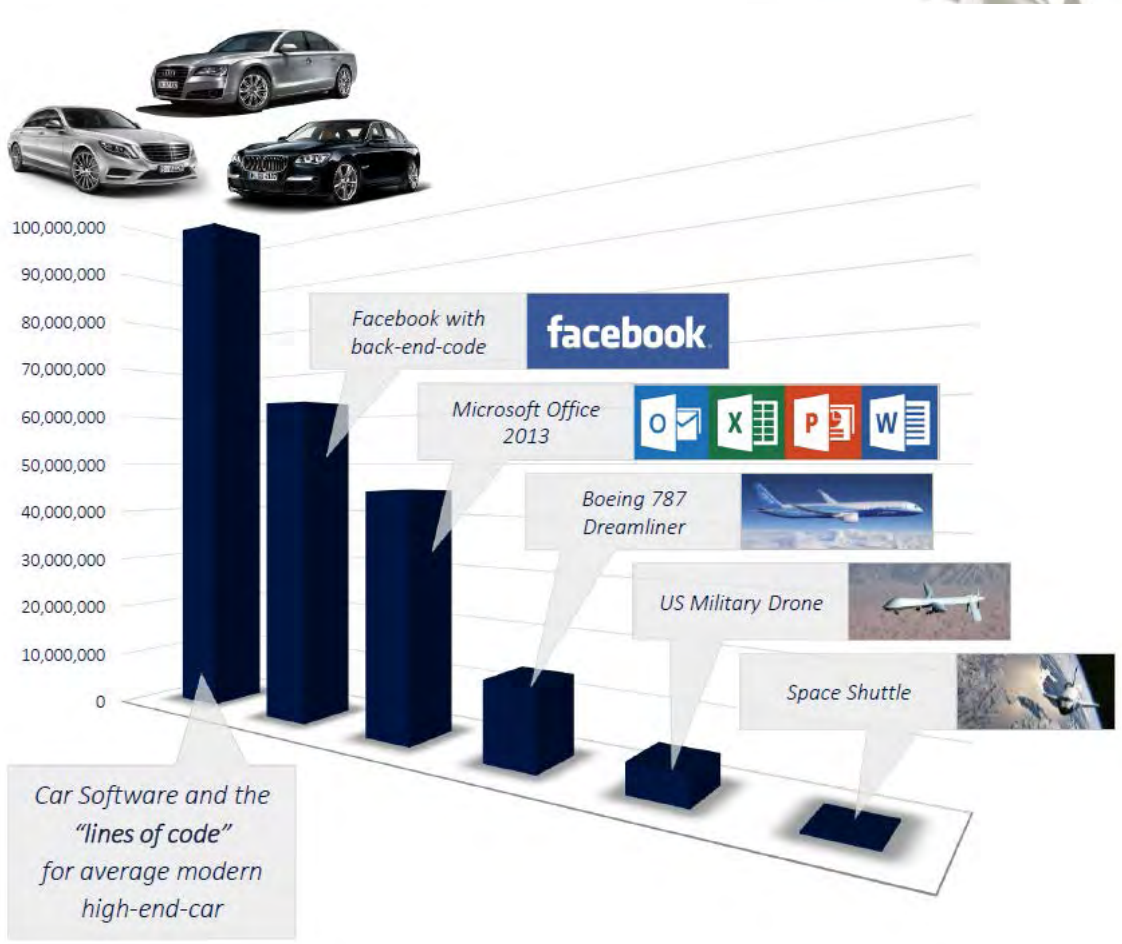
AUTONOMOUS VEHICLE



Source: Bosch Innovation Day 2017

First step in the autonomous road map implies a drastic emissions reduction, without added cost.

AUTONOMOUS VEHICLE



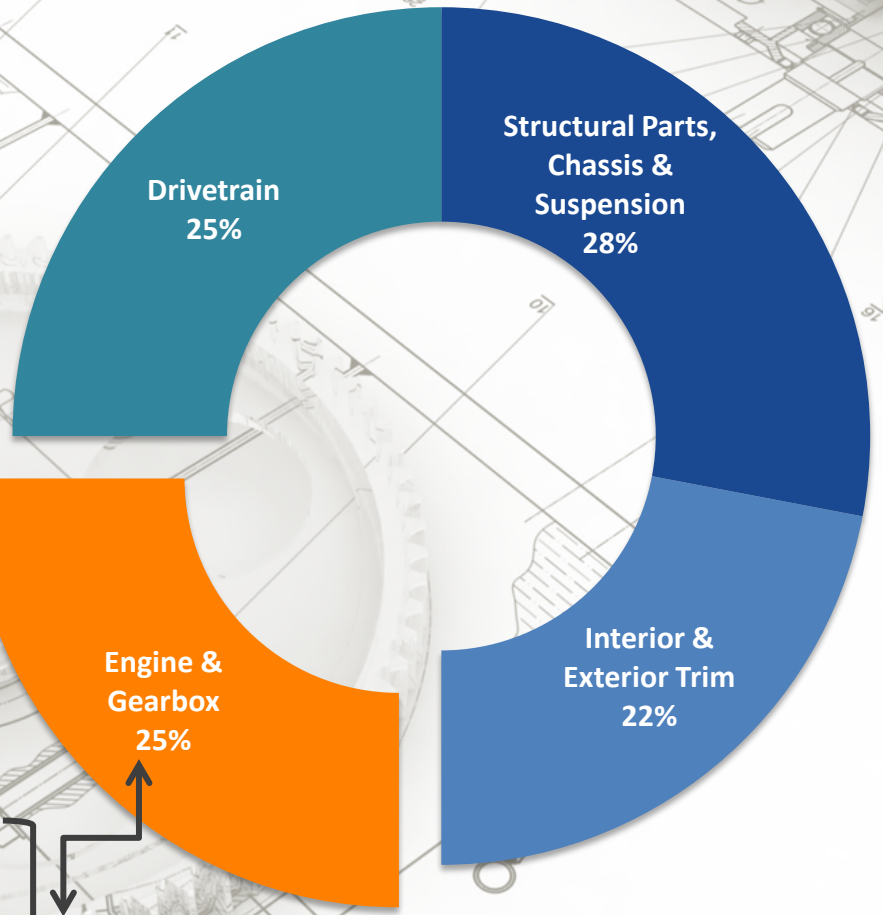
Source: Prime Research, "Smart Efficiency and Digital Intelligence".

Entry of new players coming from software sector is not so clear as some sources expects. Automotive sector has already a high content of software developments

7) CIE Automotive: constant adaptation

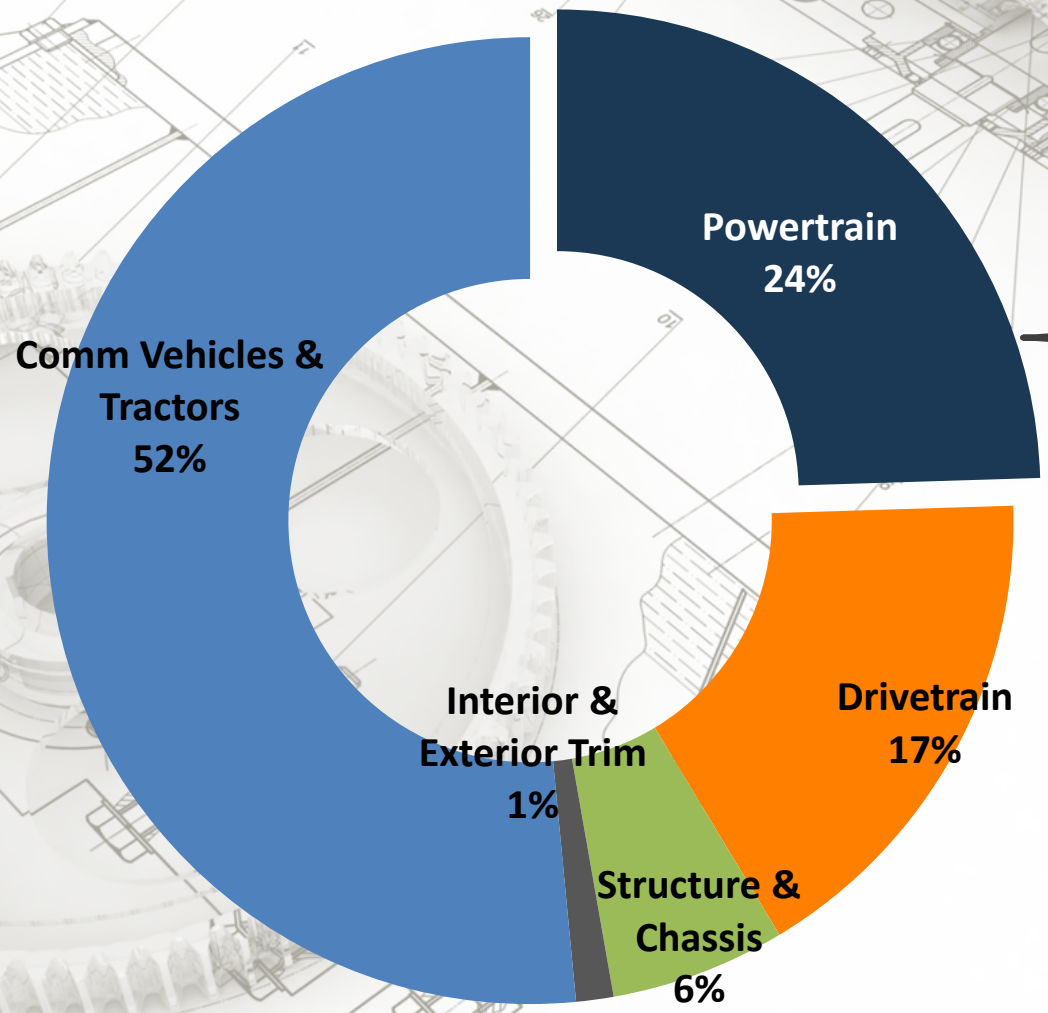


CIE SALES PIE BY VEHICLE AREA CIE GROUP



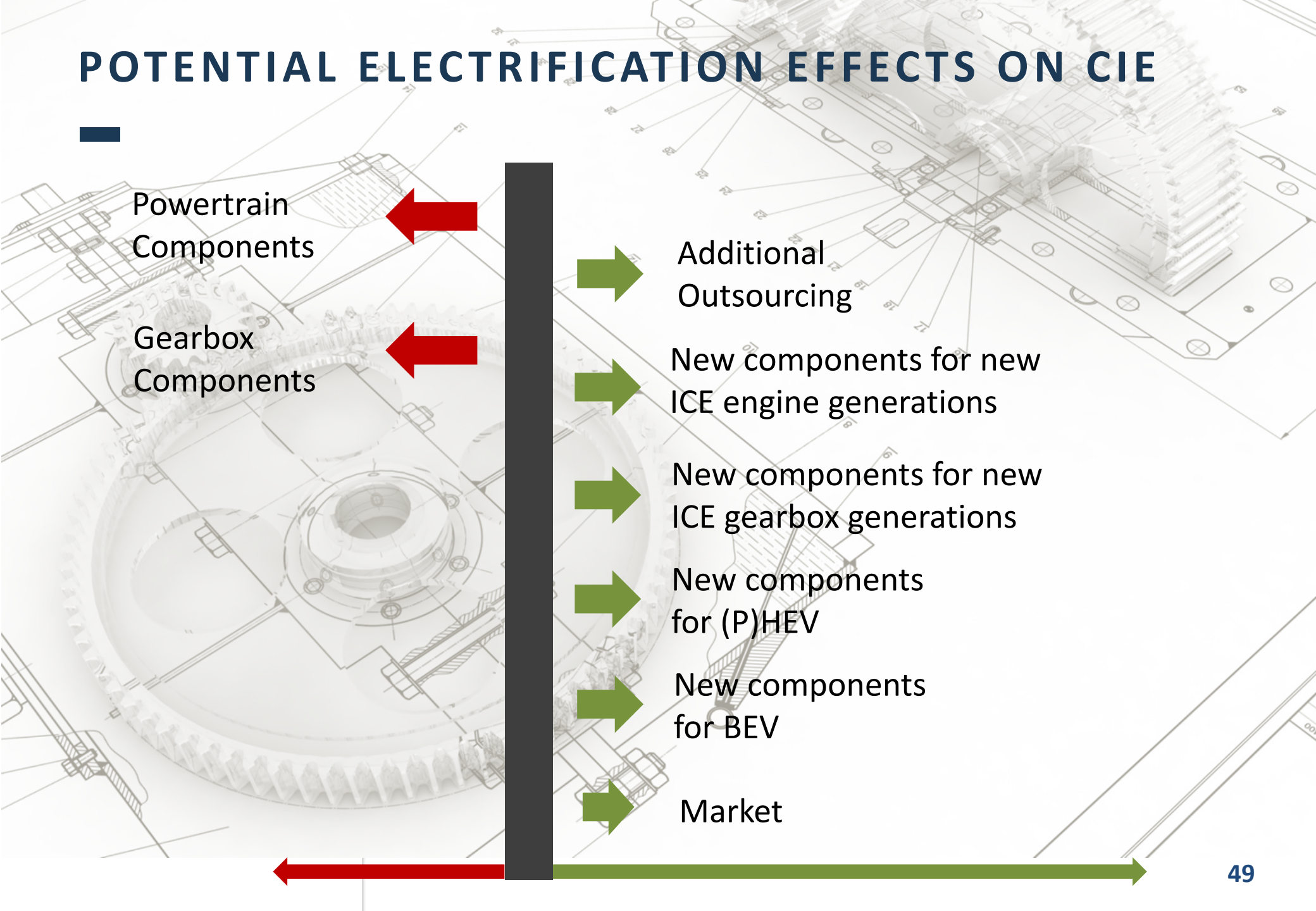
- Includes MHCV, Two-wheeler and Tractors.
- Different pace in different geographies.
- Small yearly commercial effort (2%).

CIE SALES PIE BY VEHICLE AREA MAHINDRA CIE



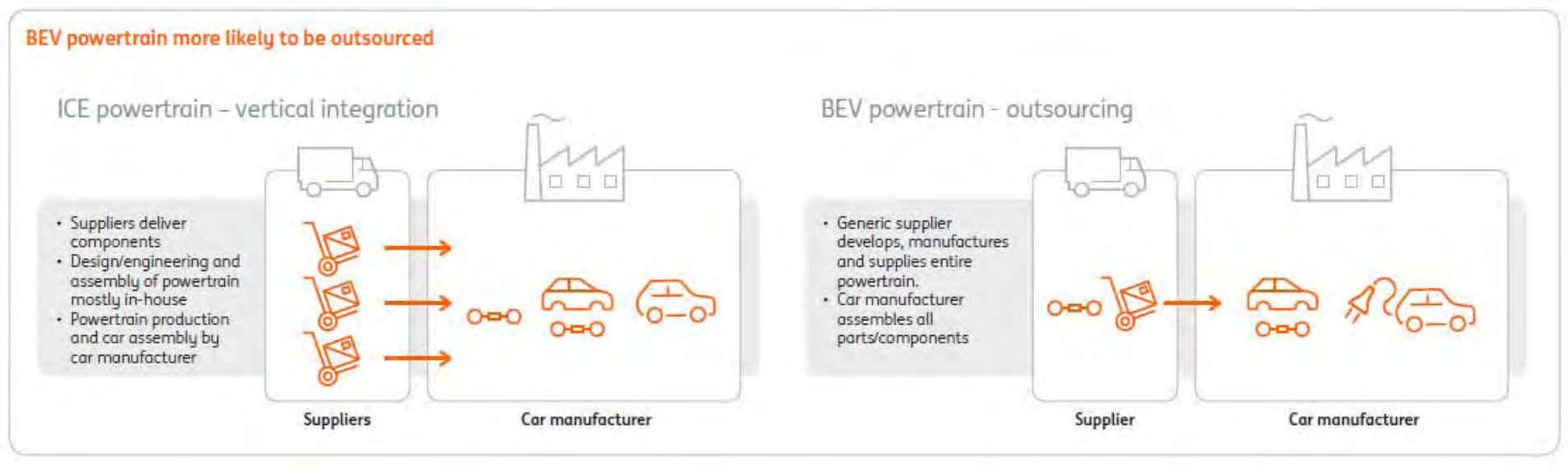
- Includes Two-wheelers.
- Different pace in different geographies.

POTENTIAL ELECTRIFICATION EFFECTS ON CIE



OPPORTUNITIES

ADDITIONAL OUTSOURCING



Source: Breakthrough of electric vehicle threatens European car industry by ING Economics Department, July 2017

New developments and technologies (EV, batteries, connectivity, autonomous,…) will need an enormous effort from OEM and main Tier1 (resources and Capex). Traditional technologies could be outsource to reduce efforts

ALREADY THERE

ALREADY IN SERIAL PRODUCTION

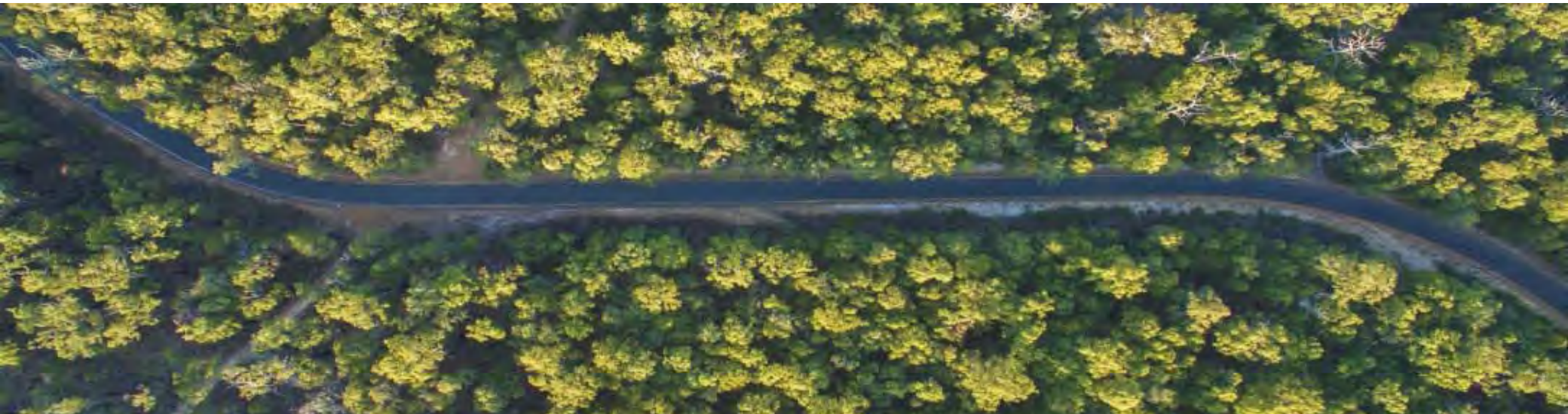
OEMs and Tier1

- Renault
- Nissan
- Tesla
- M&M Reva
- Borg Warner

Technologies

- Stamping
- Plastic
- Aluminium & Machining
- Forging

CIE Automotive is already working with the key players

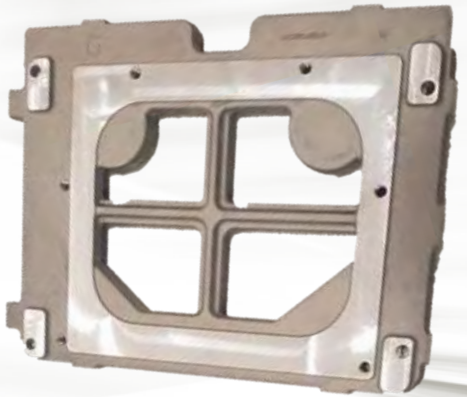


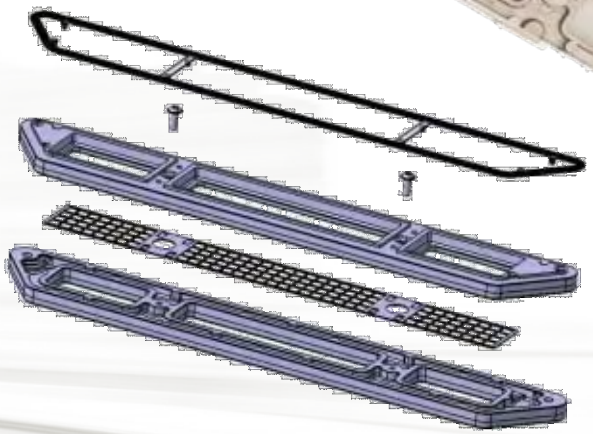
ALREADY THERE

RENAULT

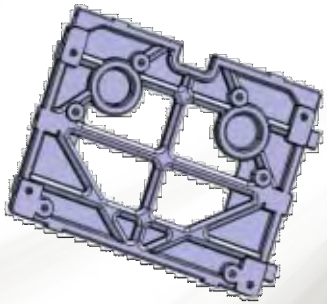
Platine assembles

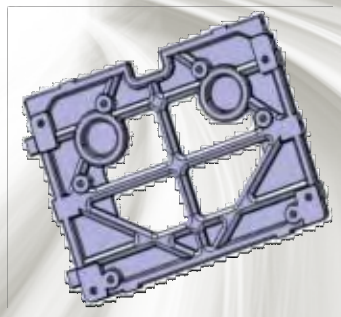
Aluminium





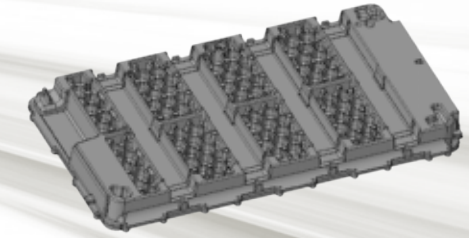






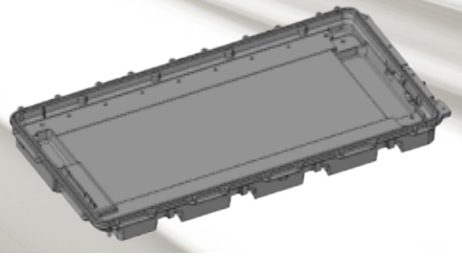
End plate

Aluminium



Battery support

Aluminium



ALREADY THERE

RENAULT



Battery structure

Metal stamping



Winding hub

Metal stamping



Carter battery charger cover

Metal stamping



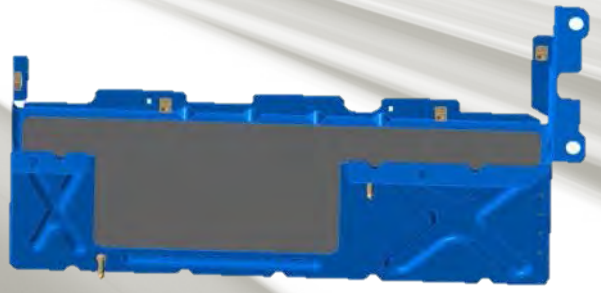
Lower carter battery cover

Metal stamping



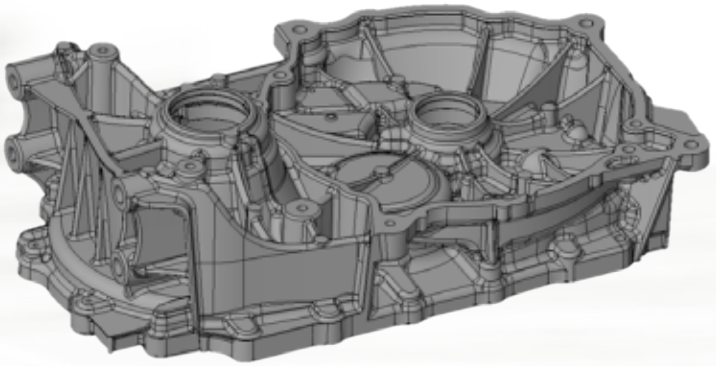
Upper carter battery cover

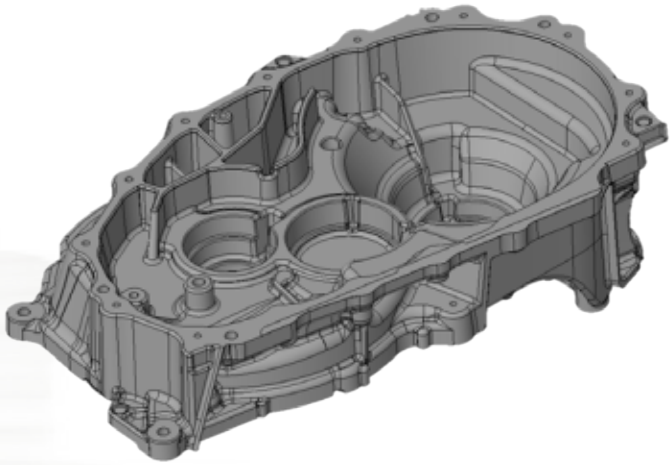
Metal stamping



ALREADY THERE

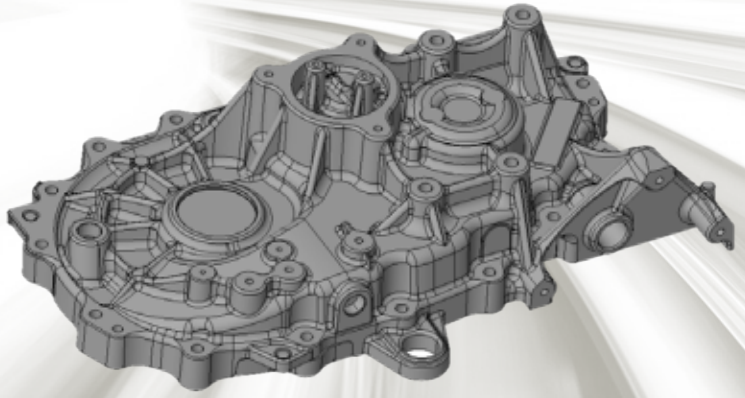
NISSAN

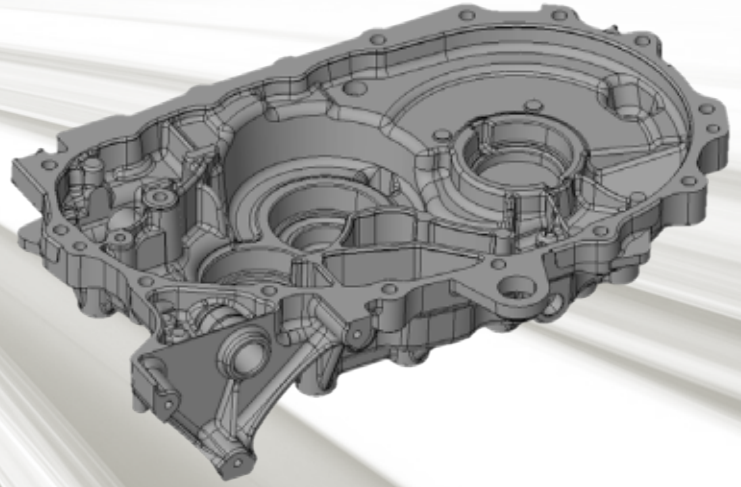




e-Reducer Housing Clutch

Aluminium





e-Reducer Housing Trans Case

Aluminium

ALREADY THERE

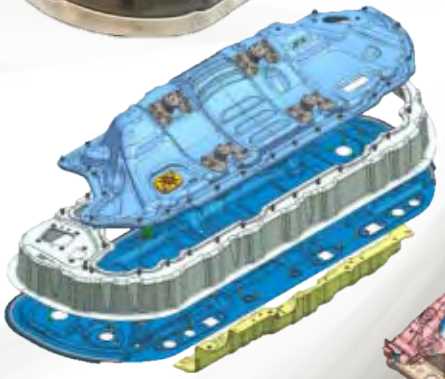
TESLA

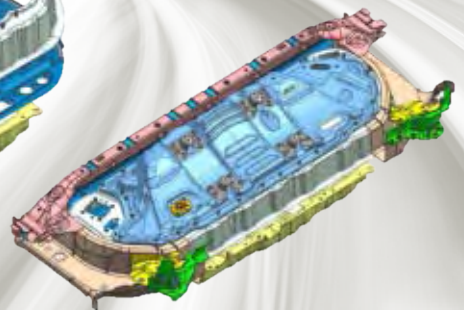
Aluminium battery cover

Stamping & welding











Wall (battery parts)

Stamping & riveting



Corners (BIW)

Stamping & welding



Skid plate (BIW)

Stamping & ecoat (painting)



Floor (battery parts)

Stamping, riveting, welding & painting



Cross member (battery parts)

Stamping & welding

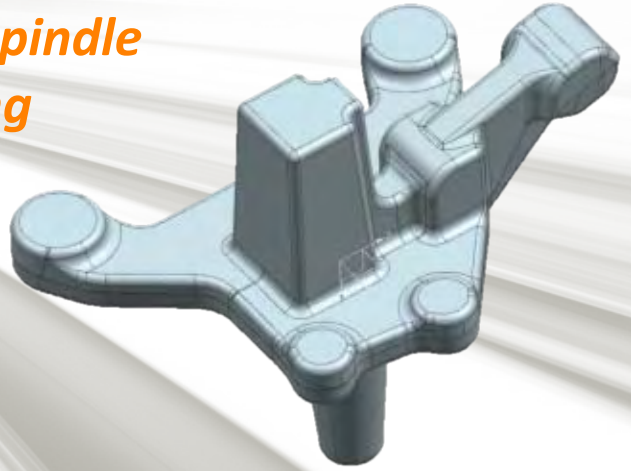
ALREADY THERE

M&M REVA





Rear spindle Forging



Battery pack Composites



ALREADY THERE

BORG WARNER



Source: Autogreen Magazine



Rotor components
Forging and machining

ALREADY THERE

INTEGRATED FROM VERY EARLY STAGES

Diversity of partners & new players

- **Working with OEMs, Tier 1 in electric motors, electronics, Technological Centres, and Universities in R&D projects.**

RENAULT

Mercedes-Benz

BOSCH

GKN Driveline

Infineon

MAGNETI MARELLI

REPSOL

FUCHS

tecnalia

RWTH AACHEN

Romax TECHNOLOGY

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

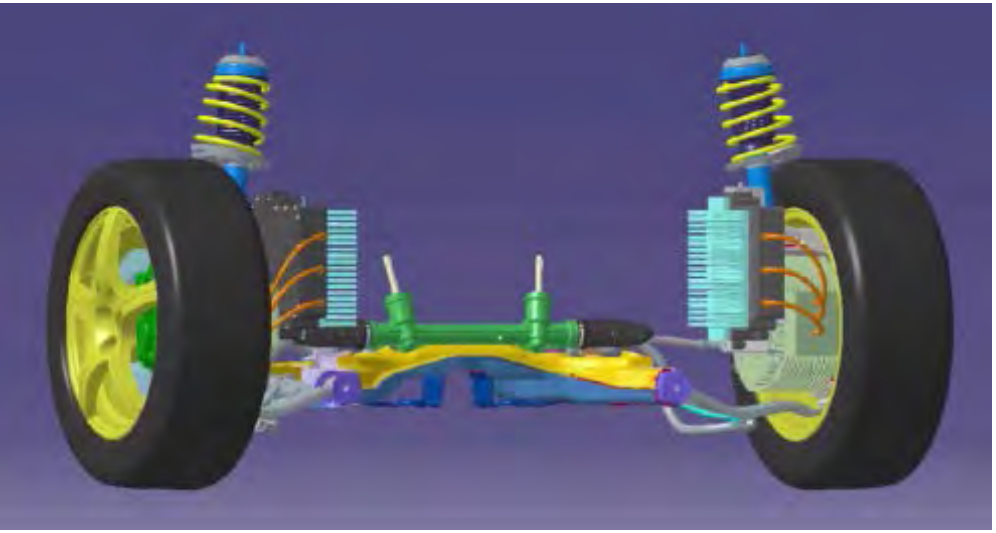
IVL

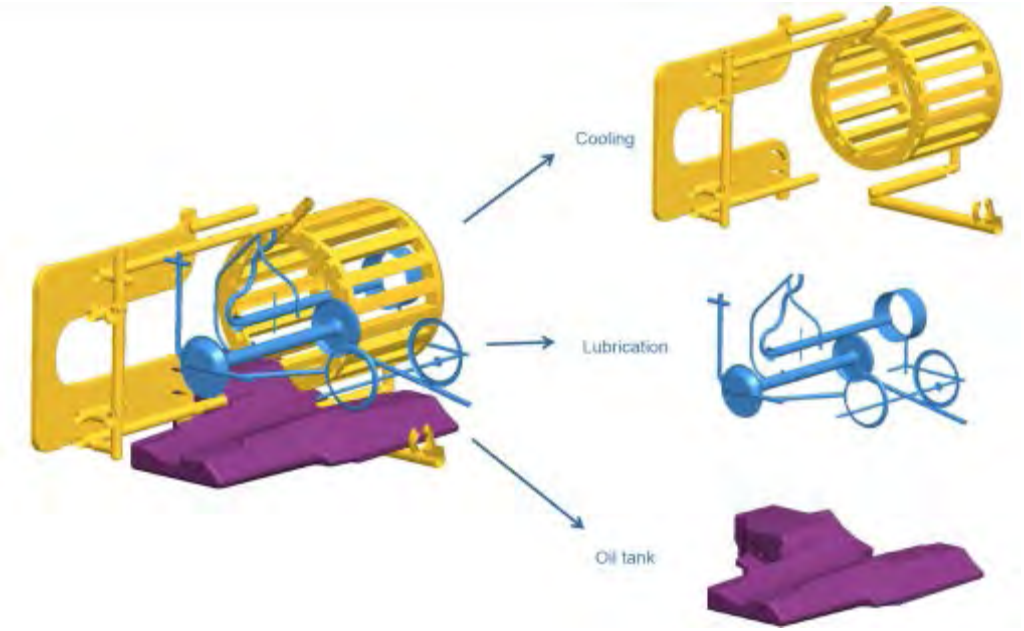
ALREADY THERE

INTEGRATED FROM VERY EARLY STAGES

Analysing different type of architectures







Multi-technological environment

ALREADY THERE

REAL EXAMPLES

Demonstration in real car

- R&D projects involving customers.
- Integrated in a ZOE vehicle.
- Tested in Renault test circuit at Paris.
- Exceeding the requirements.



GKN Driveline

RENAULT

FUCHS

BOSCH

CIE Automotive

ISEA RWTH AACHEN

Romax TECHNOLOGY

OPPORTUNITIES

NATURAL EVOLUTION

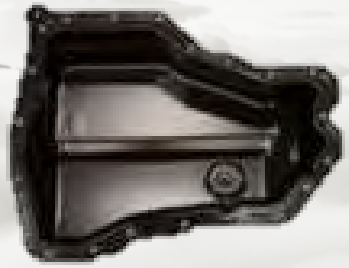
Some components could have direct substitute in the new powertrains





ICE component

EV component





OPPORTUNITIES

NEW PARTS



Source: Renault

Inverter (DC/AC)



Source: Toyota (Prius 3rd Gen)

Motor controller



Source: Delphi

Converter (DC/AC)



Source: EV-Guide (Delphi 2,2 kW)

Charger

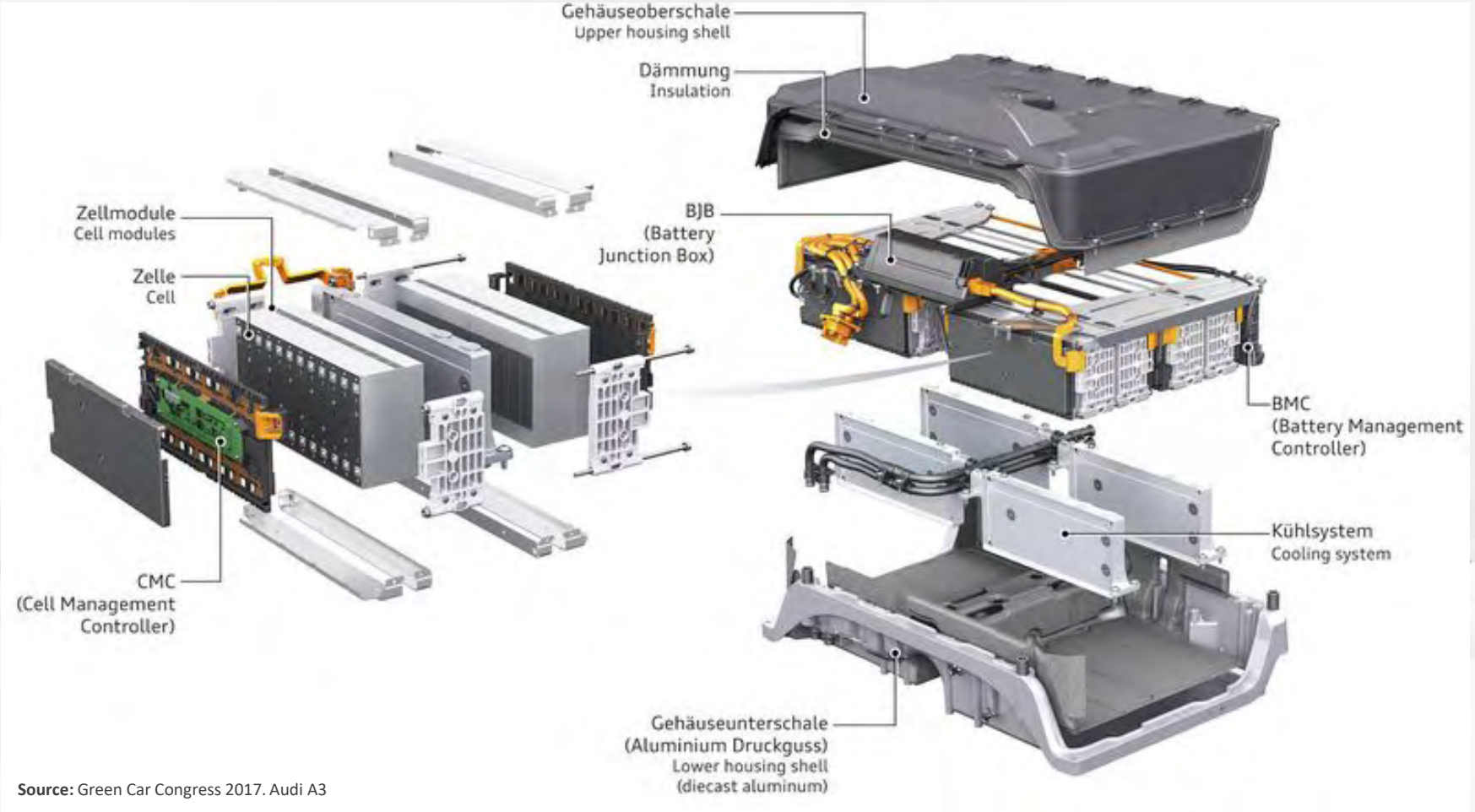


Source: Delphi

OPPORTUNITIES

NEW PARTS

Battery module

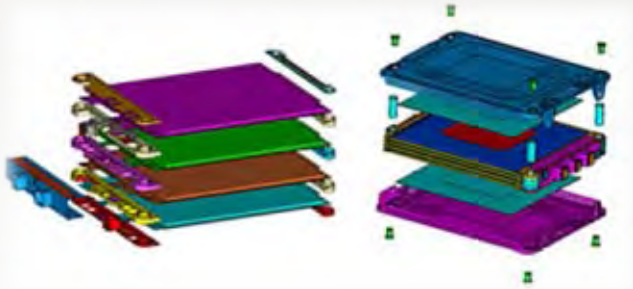


Source: Green Car Congress 2017. Audi A3

OPPORTUNITIES

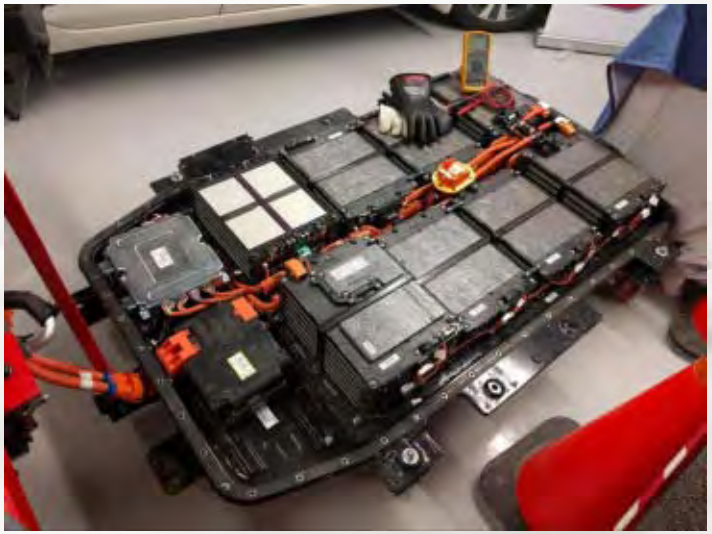
NEW PARTS

Battery cells stacking



Source: Automotive Energy Supplier Corporation

Battery module. Plastic



Source: KIA

Battery module. Metal



Source: Toyota

Running project at CIE



Examples

OPPORTUNITIES

NEW PARTS

Charging port



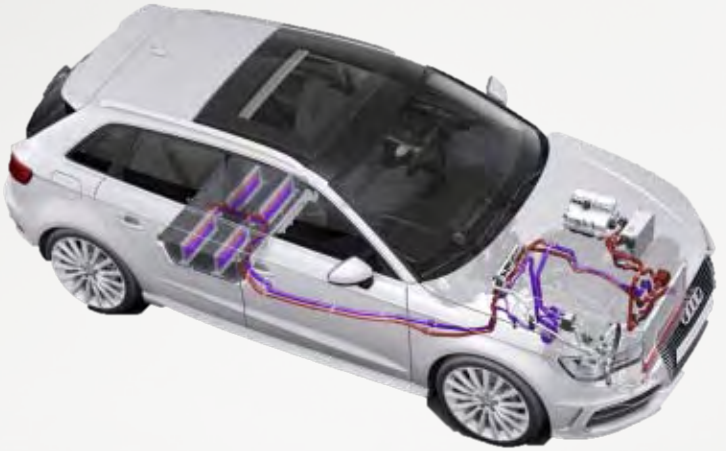
Source: EV-Guide

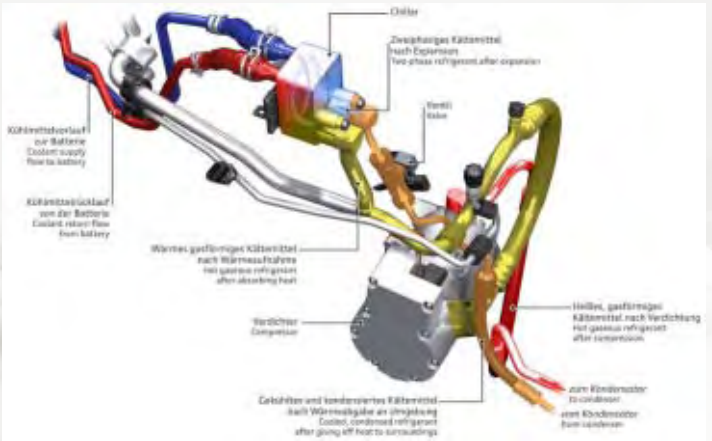
Charging port



Source: Delphi

Battery cooling





Source: Green Car Congress 2017. Audi A3



CIE Automotive

Managing high value added processes