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PHEV

Clean Technologies

June 2015

Un terrain de jeu global favorable à l'hybride

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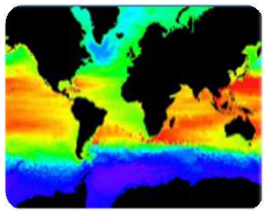

Changements climatiques

▸ Le défi environnemental

- ✓ Une réglementation exigeante
- ✓ Des clients à l'écoute de l'environnement
- ✓ Des gouvernements favorables à la "mobilité durable"
- ✓ Une raréfaction des ressources

Urbanisation

▸ Le défi de la mobilité et des infrastructures

- ✓ Population urbaine
  - 2011: 7,2 Mds ▸ 53%
  - 2050 : 9,5 Mds ▸ 65%
- ✓ Mégalopoles (+10 M)
  - 1950 : 2
  - 2011 : 23
  - 2025 : 37

Evolution des besoins

Le défi technique et industriel

- ✓ Qualité et durée de vie du véhicule
- ✓ Rapport qualité / prix compétitif
- ✓ Des véhicules toujours plus sûrs et connectés

BACK IN THE RACE

Sévérisation et convergence des réglementations

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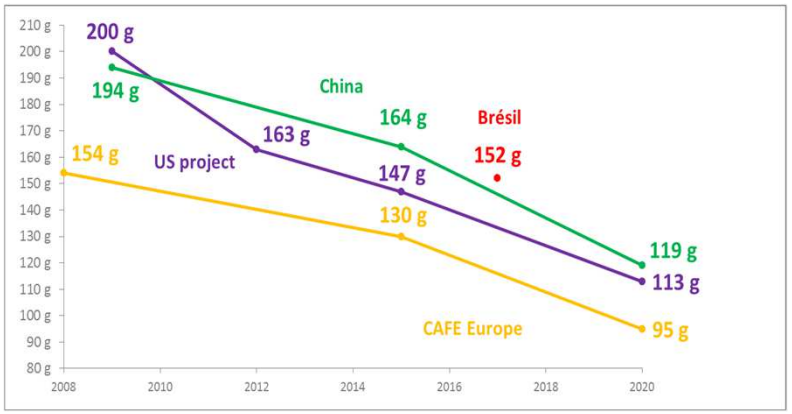
CO_2

- CAFE, CAFC…



- Incentives

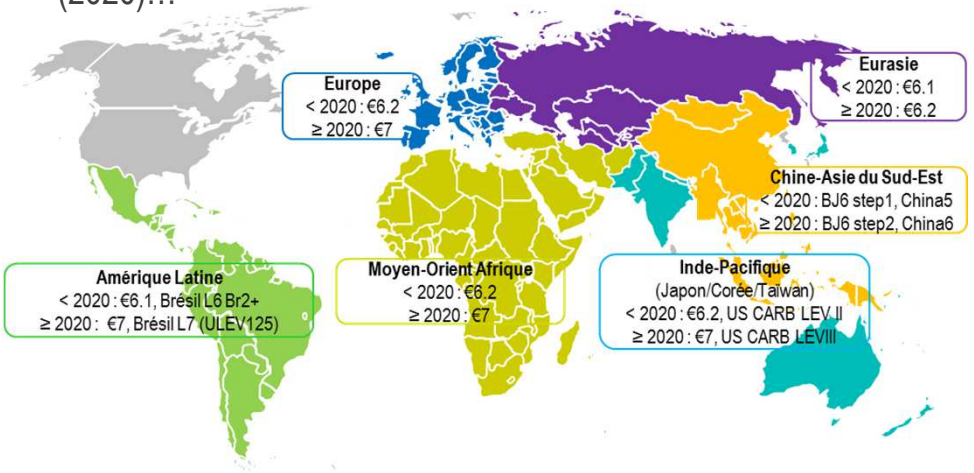
Bonus-Malus

New Energy Vehicles

Inovar Auto

Polluants

- Euro 6.2 (2017), Euro 7 (>2020) ; Beijing 6 phase1 (2017), phase2 (2020)…



BACK IN THE RACE

Aujourd'hui : PSA leader européen CO_2

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PSA Peugeot Citroën

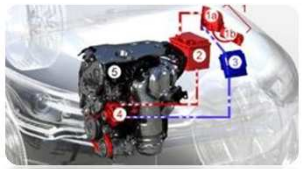
110,3 g/km CO_2

Marché: 123,7 g CO_2 /km

30% ventes
< 100 g/km CO_2

44 véhicules
"Best in Class"

CITROËN PEUGEOT

Moteurs essence	Moteurs Diesel	Hybridation	Automatismes
			 (AISIN)
1L & 1,2L PureTech **1.6L THP**	**1,6L & 2L Blue Hdi**	**Hybrid 4** **Stop & Start**	**AM6 III** **AT6 III**

Peugeot 308 , 110 ch
1,2L PureTech
95 g/km CO2

Citroën C4 Cactus, 100 ch
1,6L BlueHDi
82 g/km CO2

DS 3, 100 ch
1,6L BlueHDi
79 g/km CO2

BACK IN THE RACE

Tomorrow: new technologies for worldwide stakes

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Engine 2020

Optimized gasoline and Diesel engines

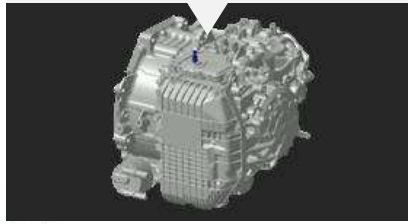
Gasoline PHEV 2019

Gasoline plug-in hybrid

BEV

Optimized BEV technologies

New generation of transmission



6-speeds MT
8-speeds AT

BACK IN THE RACE

100% PSA ecosystem committed

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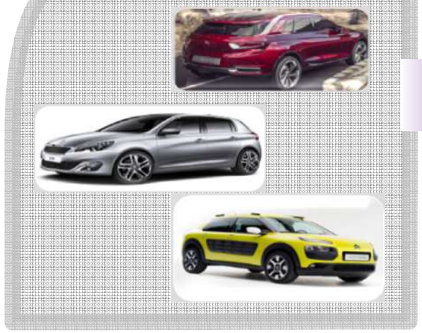
MARKETING



PROGRAM

INNOVATION

PROJECTS

SKILLS

FINANCE

PURCHASE

SUPPLY CHAIN

MANUFACTURING

BRANDS

BACK IN THE RACE

To serve our 3 Brands

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CITROËN

CREATIVE TECHNOLOGY

Optimistic

Human

Smart

PEUGEOT

MOTION & EMOTION

Exigence

Allure

Emotion

DS

CREATIVE TECHNOLOGY

Spirit

of

Avant-Garde

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Market trend

Today US market

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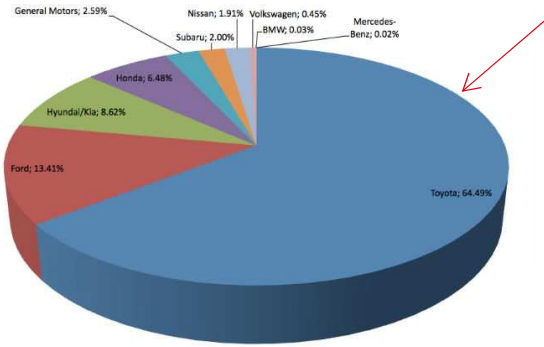
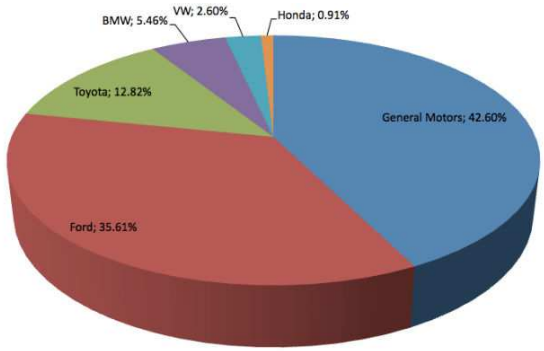
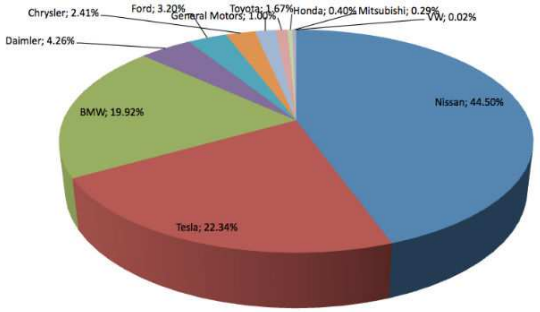
	HEV	PHEV	BEV
2013	3,2 %	0,62 %	
2014	2,8 %	0,35 %	0,36 %

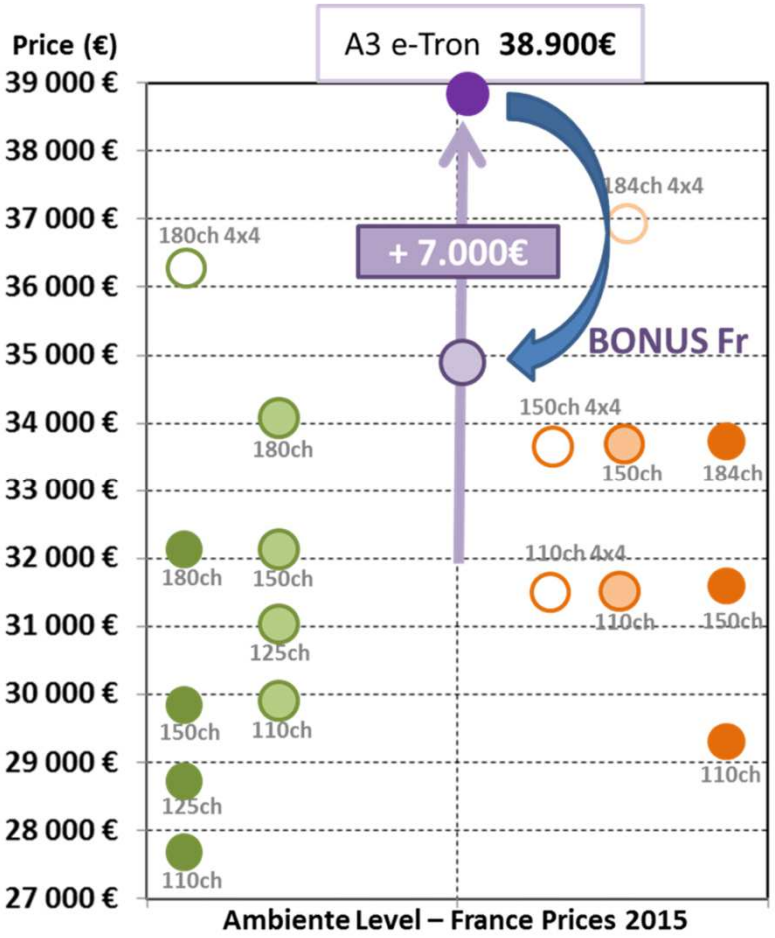






BACK IN THE RACE

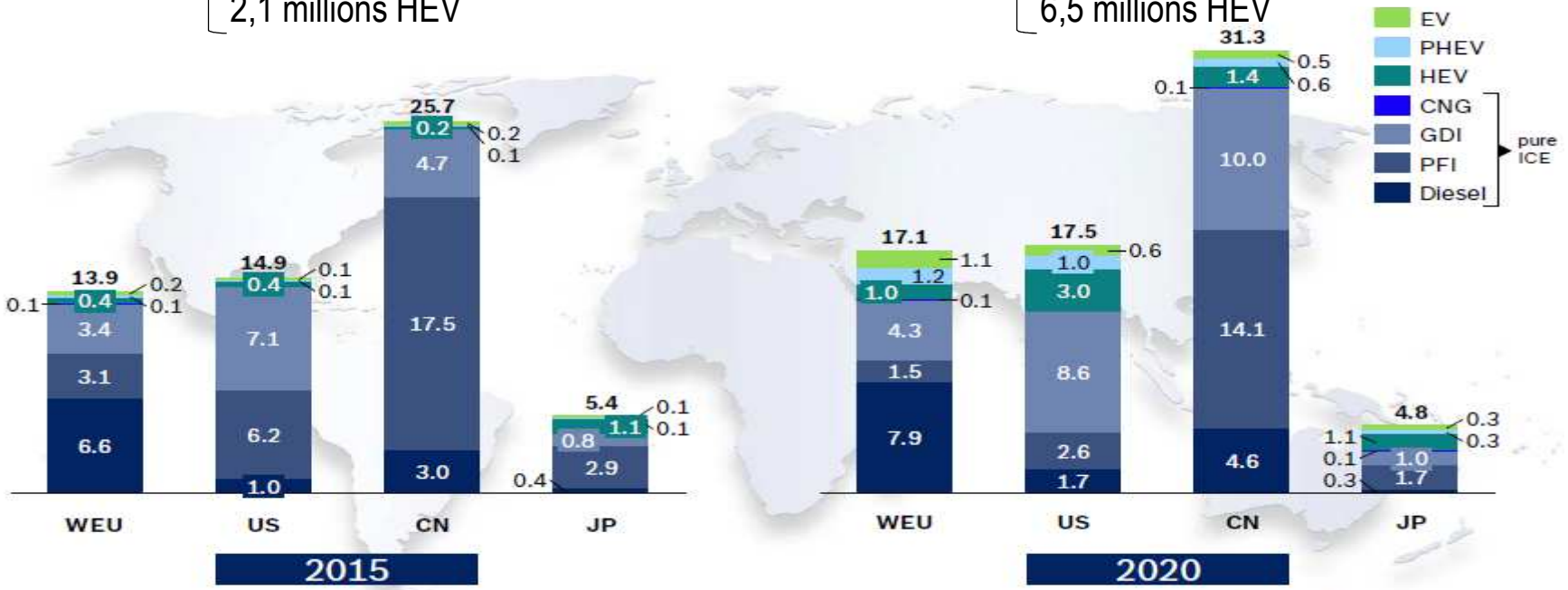
PHEV in the field China & Europe



Market forecast

3,1
- 0,6 million BEV
- 0,4 million PHEV
- 2,1 millions HEV

12,1
- 2,5 millions BEV
- 3,1 millions PHEV
- 6,5 millions HEV



Worldwide official announcement for ≈ 2020

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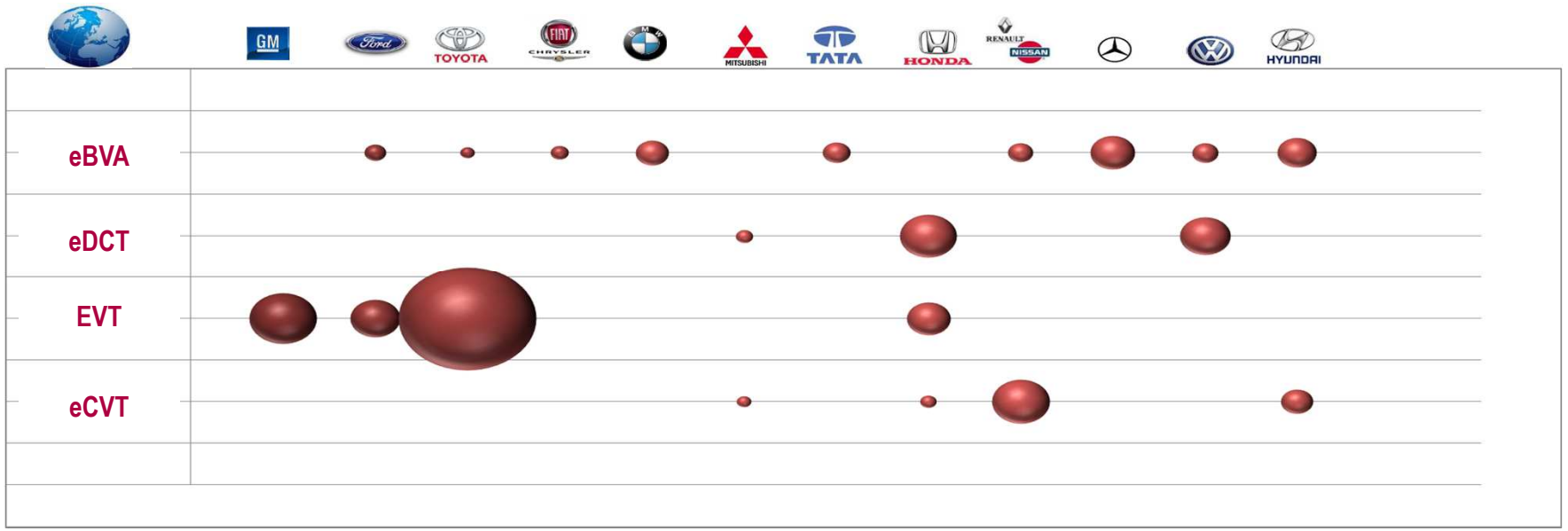
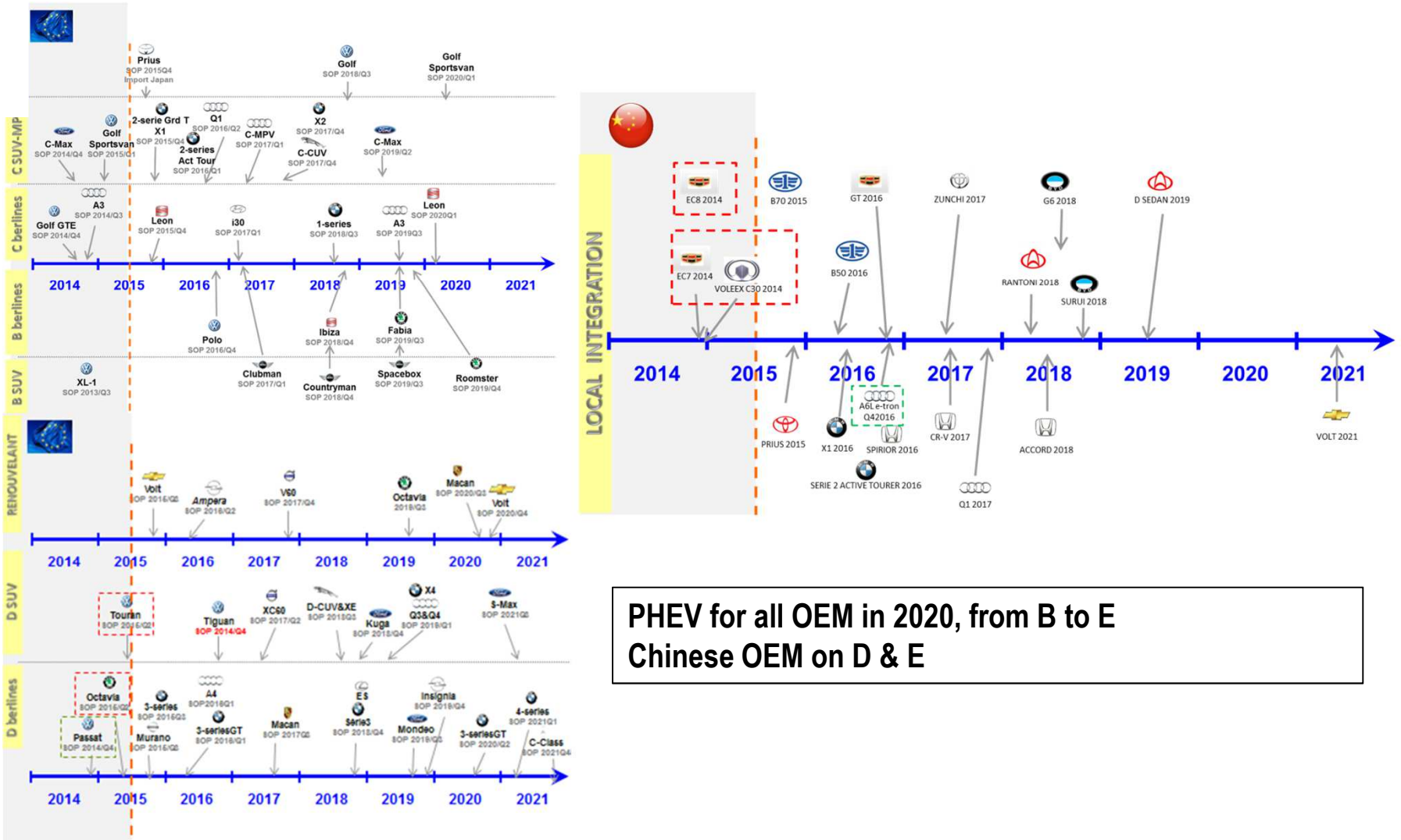
Zero Emission Vehicle	FCEV	●	●					●	
	BEV			●	●	●	●	●	●
	PHEV	●	●	●	●	●	●	●	●
	HEV	●	●		●		●	●	
	MHEV			●	●	●	●	●	

BACK IN THE RACE

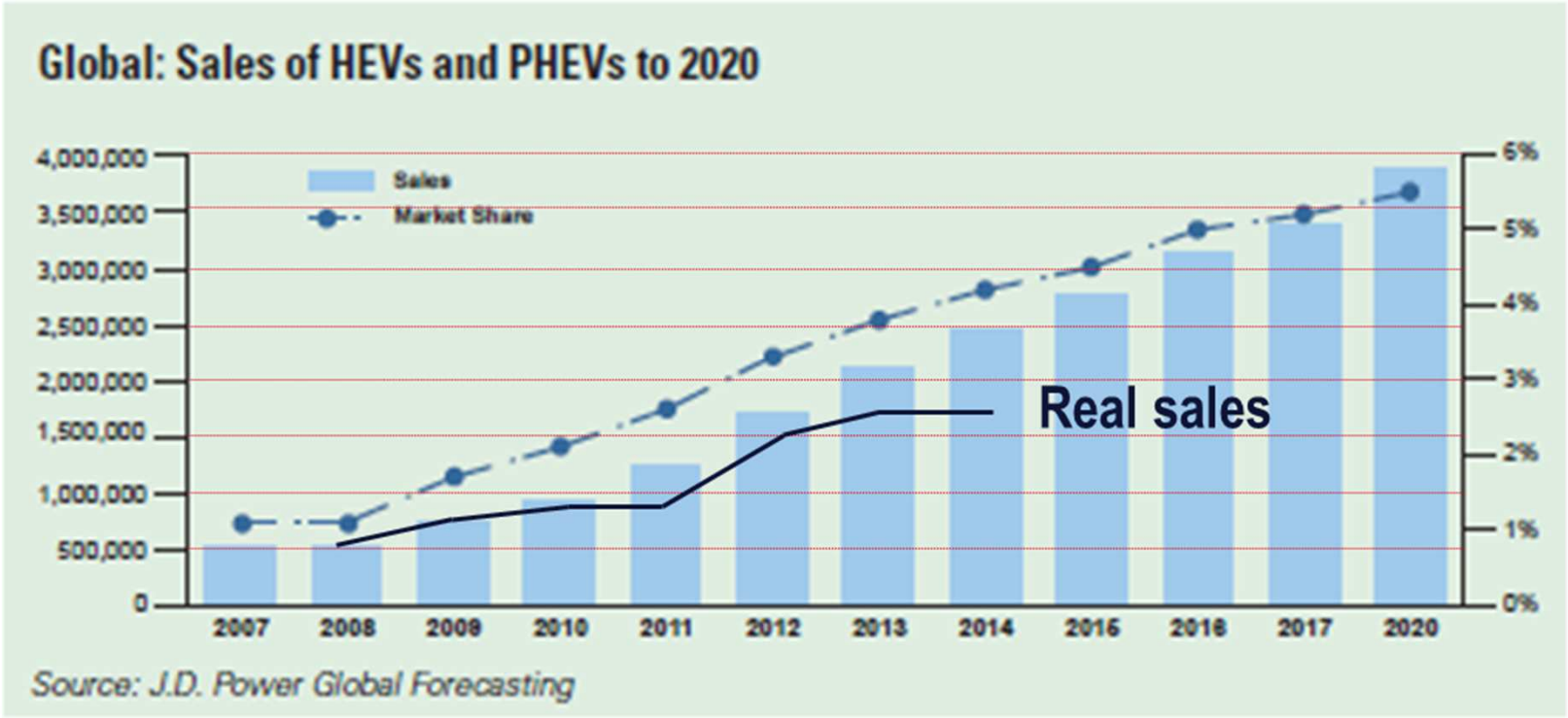
HEV/PHEV sales & technologies announcement in 2020





PHEV for all OEM in 2020, from B to E
Chinese OEM on D & E

Drive green 2020: more hope than reality?



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Technical path

Hybrid map

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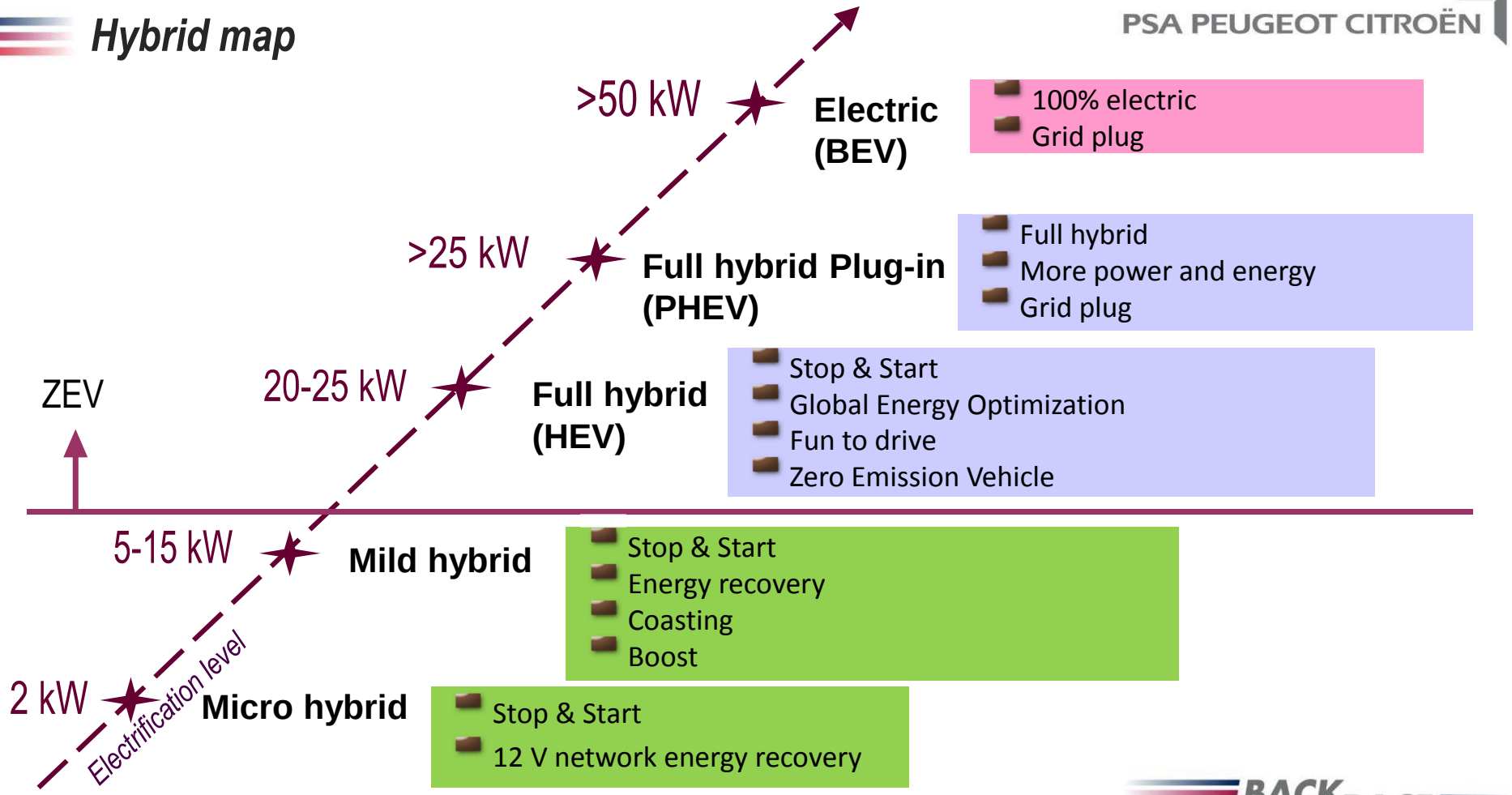

BACK IN THE RACE

Serial or parallel hybrid?

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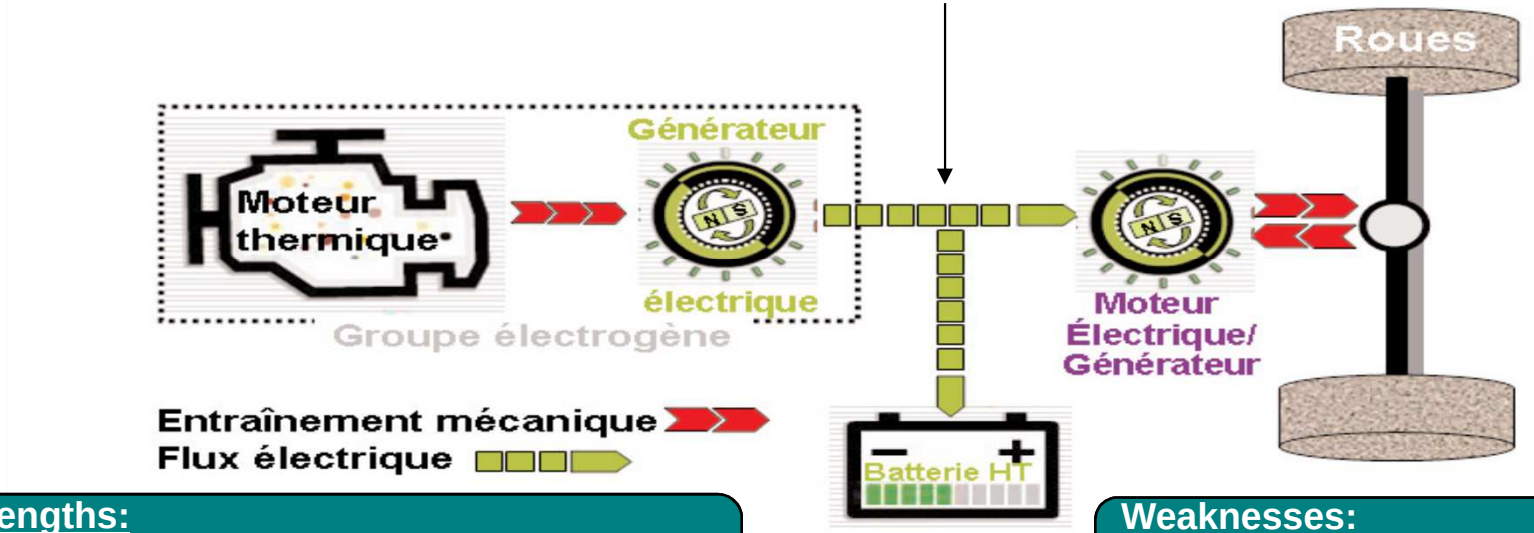
Serial Hybrid

Electrical path for power addition



Strengths:

- Electrical skills
- Emission
- Driving comfort

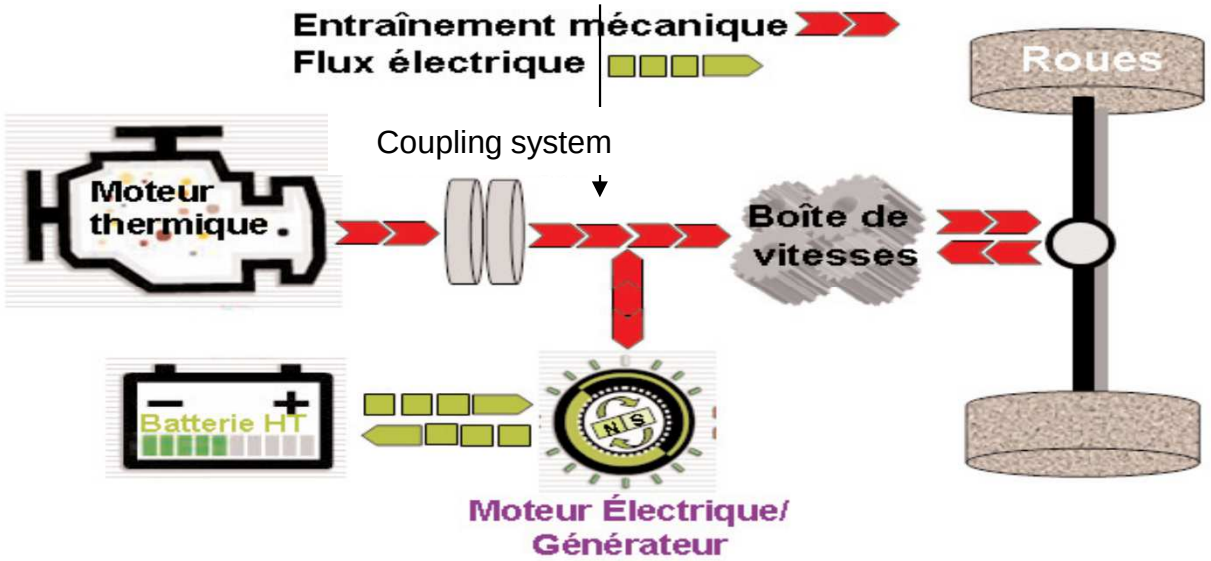
Weaknesses:

- Cost
- Performance
- Efficiency

BACK IN THE RACE

Parallel hybrid

Mechanical path for power addition



Strengths:
- Multipurpose vehicle
- Efficiency and fuel consumption
- Industrial synergies and dimensioning

Weaknesses:
- Design complexity
- Many choice open (almost) like any other

A large set of technical options

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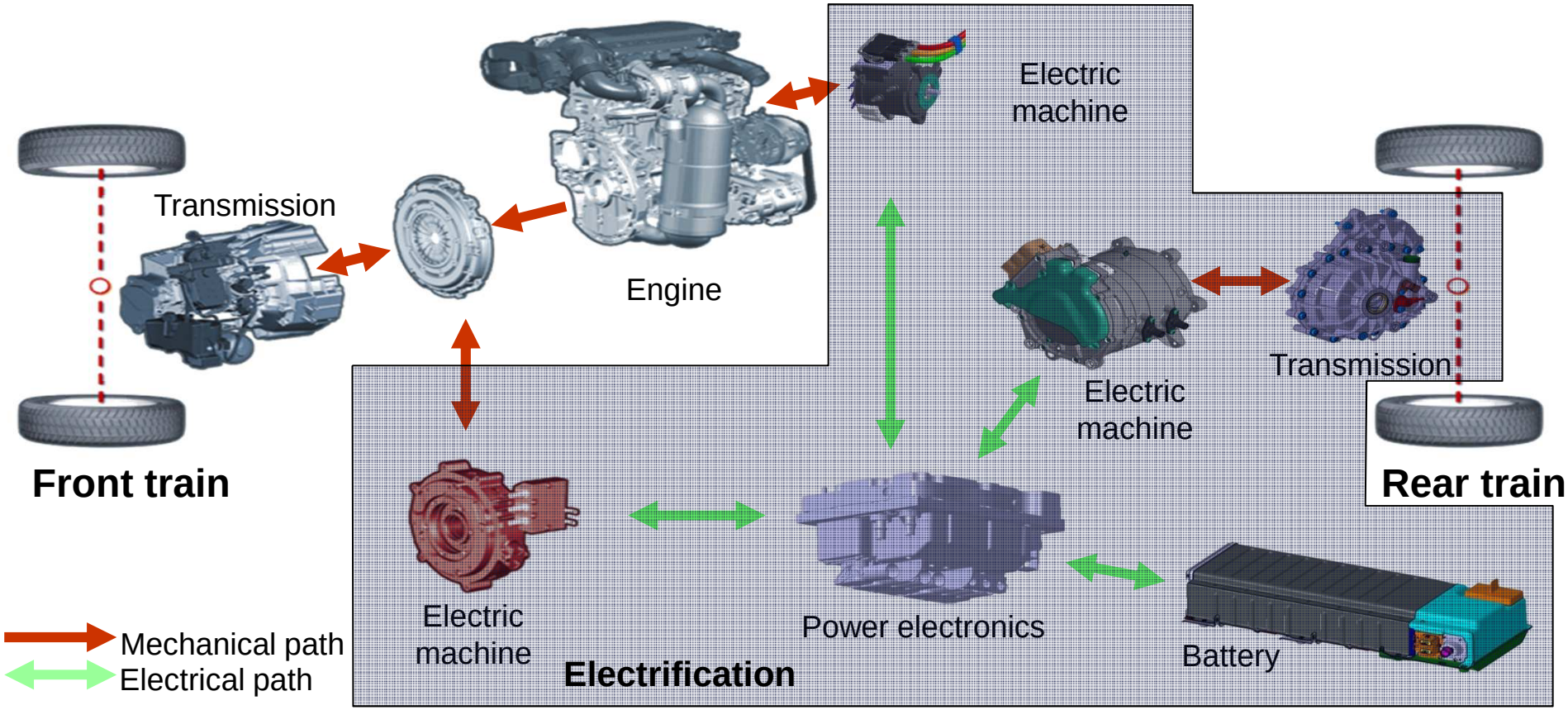
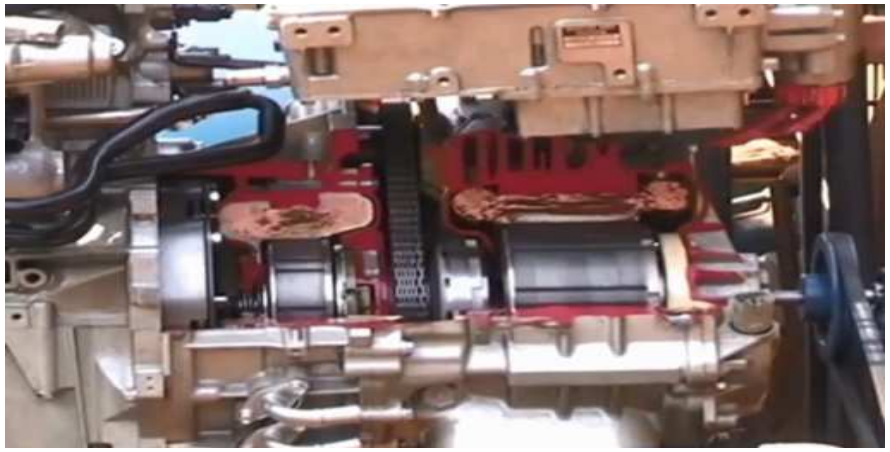
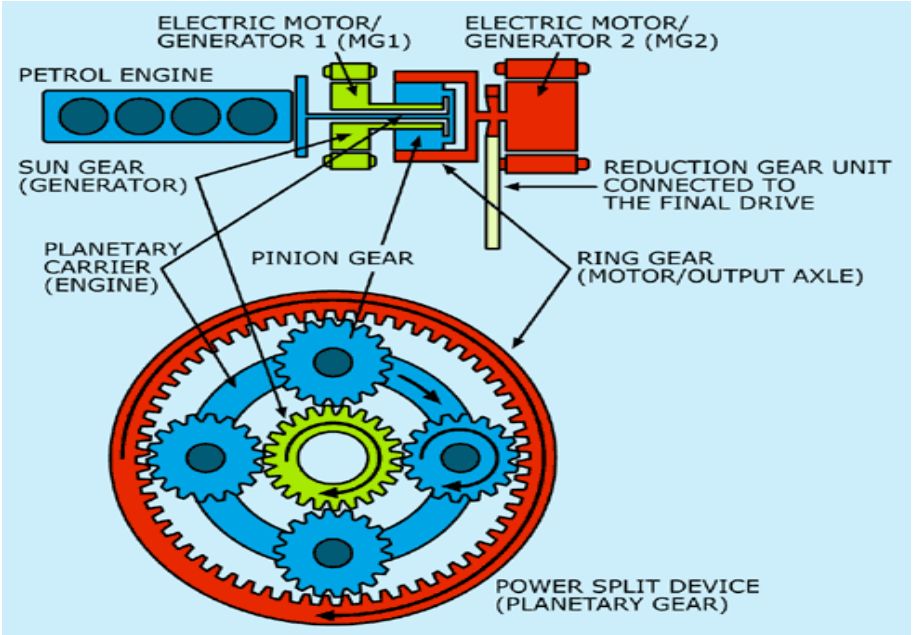


BACK IN THE RACE

Toyota HEV legacy



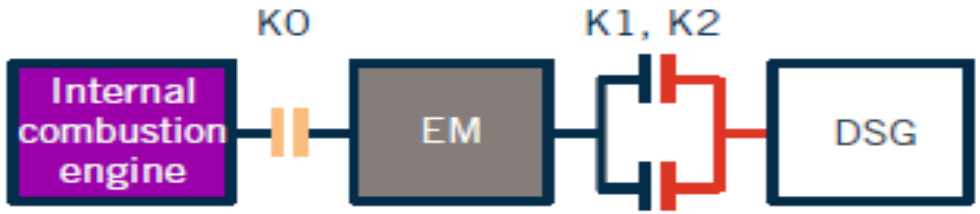


Since 1997 (Japan, 2001 US, 2003 Europe), kaizen improvement

1,2 million vehicle en 2014

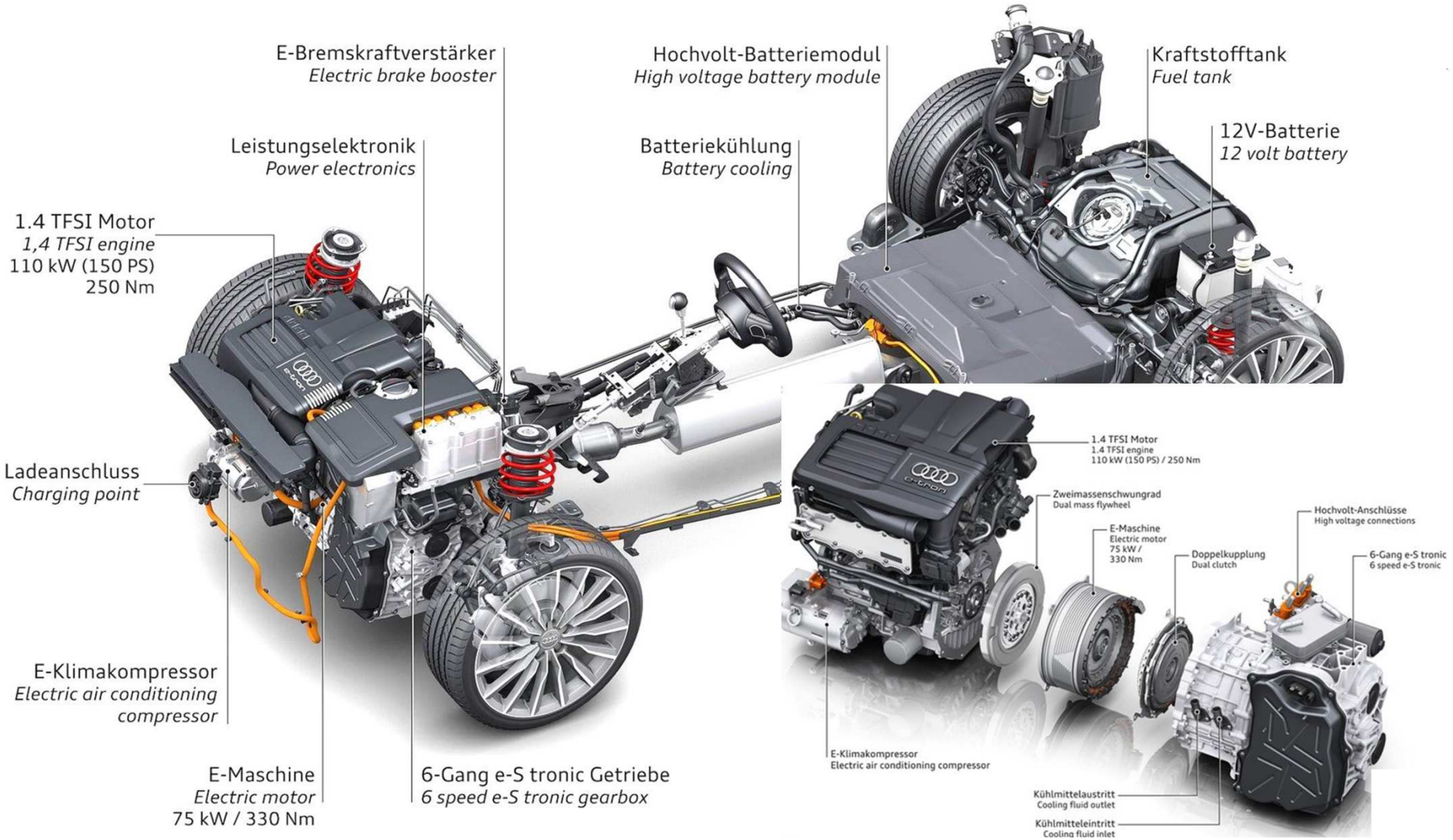
From B to D-SUV, including PHEV

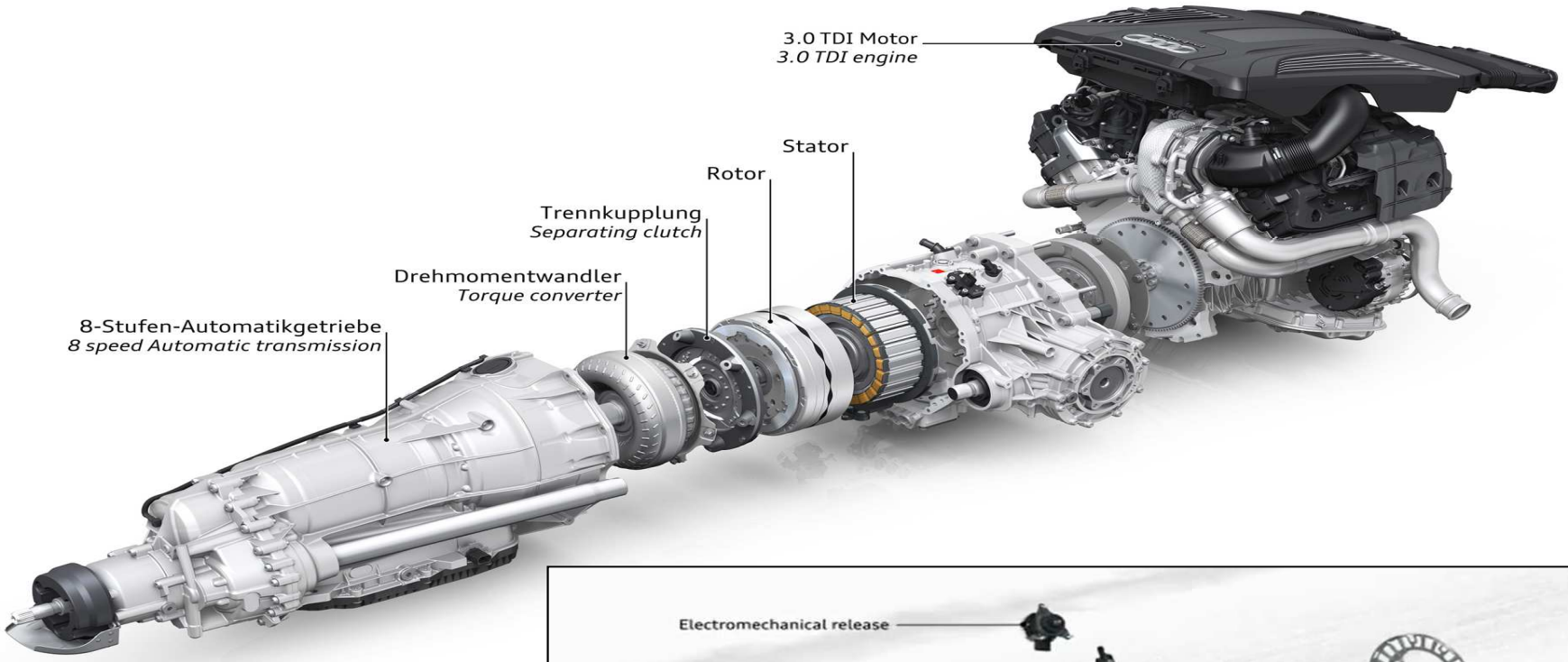
VAG modular policy

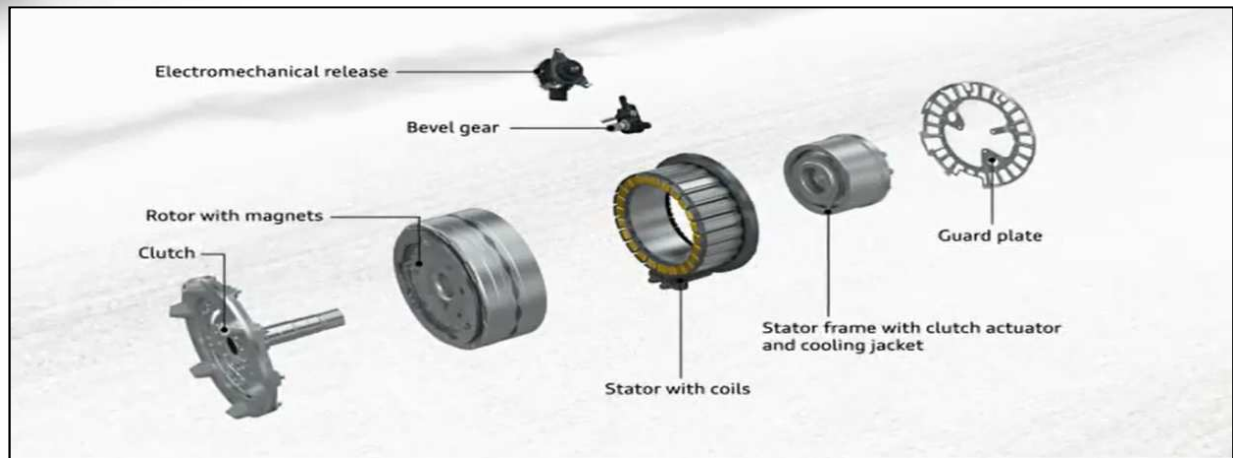


Assembly kit for hybrid drive systems

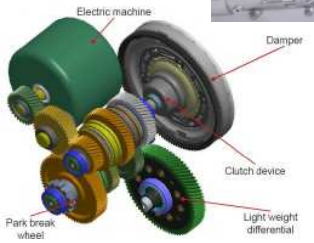
Engine	Electric machine	Gearbox	Battery	Power electronics
2-cylinder in-line TDI	HEM 20	DQ200E	HEV	Power electronics
3-cylinder in-line TSI/TDI	HEM 60			
4-cylinder in-line TSI/TDI	HEM 80	DQ400E	PHEV	

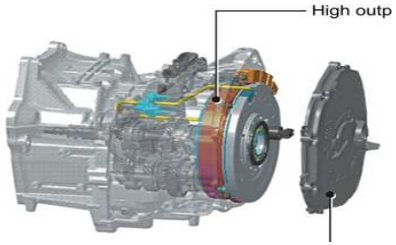

E-Bremskraftverstärker
Electric brake booster
Hochvolt-Batteriemodul
High voltage battery module
Kraftstofftank
Fuel tank
Leistungselektronik
Power electronics
Batteriekühlung
Battery cooling
12V-Batterie
12 volt battery
1.4 TFSI Motor
1,4 TFSI engine
110 kW (150 PS)
250 Nm
Ladeanschluss
Charging point
E-Klimakompressor
Electric air conditioning compressor
E-Maschine
Electric motor
75 kW / 330 Nm
6-Gang e-S tronic Getriebe
6 speed e-S tronic gearbox
1.4 TFSI Motor
1.4 TFSI engine
110 kW (150 PS) / 250 Nm
Zweimassenschwungrad
Dual mass flywheel
E-Maschine
Electric motor
75 kW /
330 Nm
Doppelkupplung
Dual clutch
Hochvolt-Anschlüsse
High voltage connections
6-Gang e-S tronic
6 speed e-S tronic
E-Klimakompressor
Electric air conditioning compressor
Kühlmittelaustritt
Cooling fluid outlet
Kühlmitteleintritt
Cooling fluid inlet

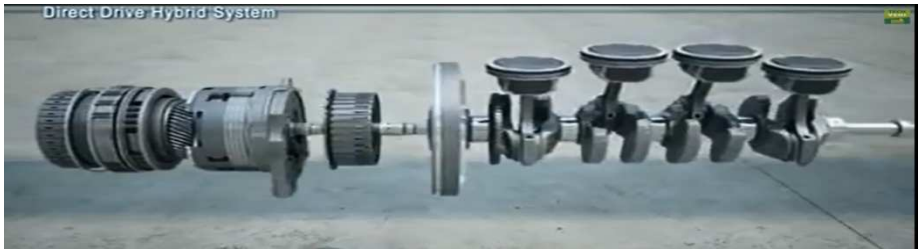

3.0 TDI Motor
3.0 TDI engine
Stator
Rotor
Trennkupplung
Separating clutch
Drehmomentwandler
Torque converter
8-Stufen-Automatikgetriebe
8 speed Automatic transmission

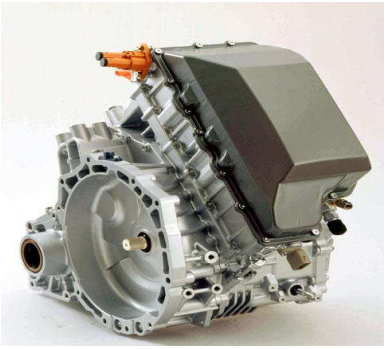

Electromechanical release
Bevel gear
Rotor with magnets
Clutch
Guard plate
Stator frame with clutch actuator and cooling jacket
Stator with coils

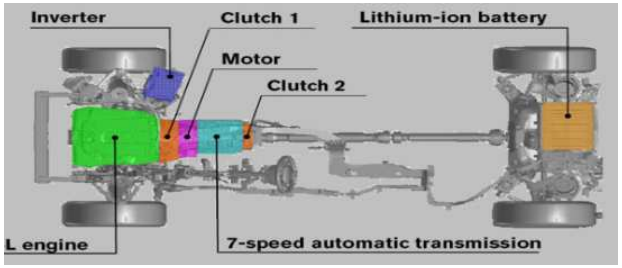
Many choice open (almost) like any other











HYbrid4

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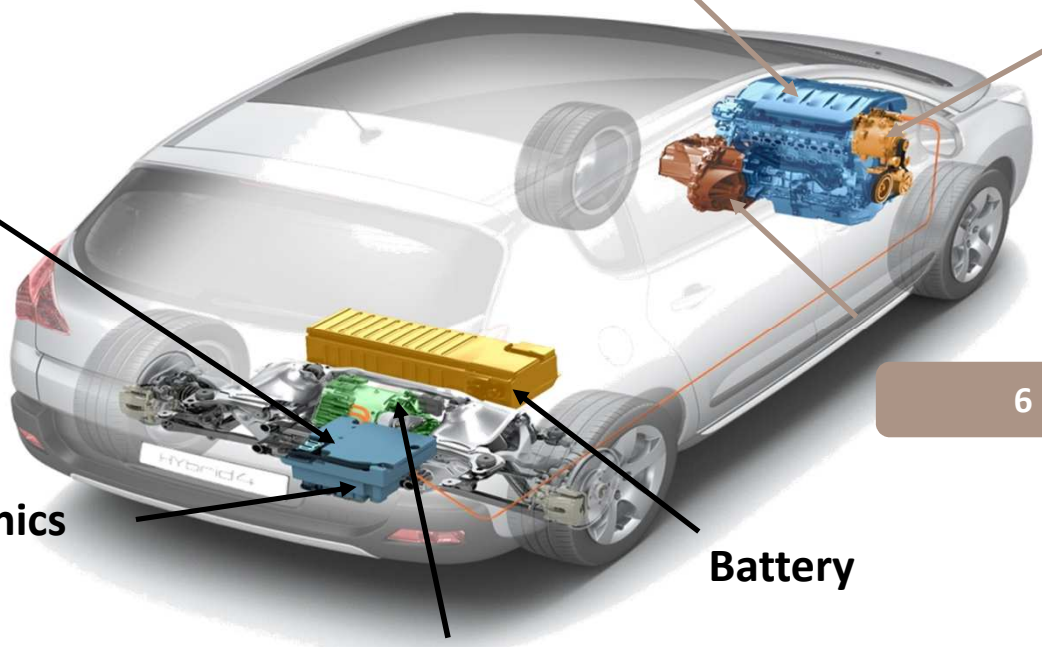
200 hp - AWD - 85 g CO_2 /km

e HDI



Previously existing components

BACK IN THE RACE

Breakthrough on battery technology…

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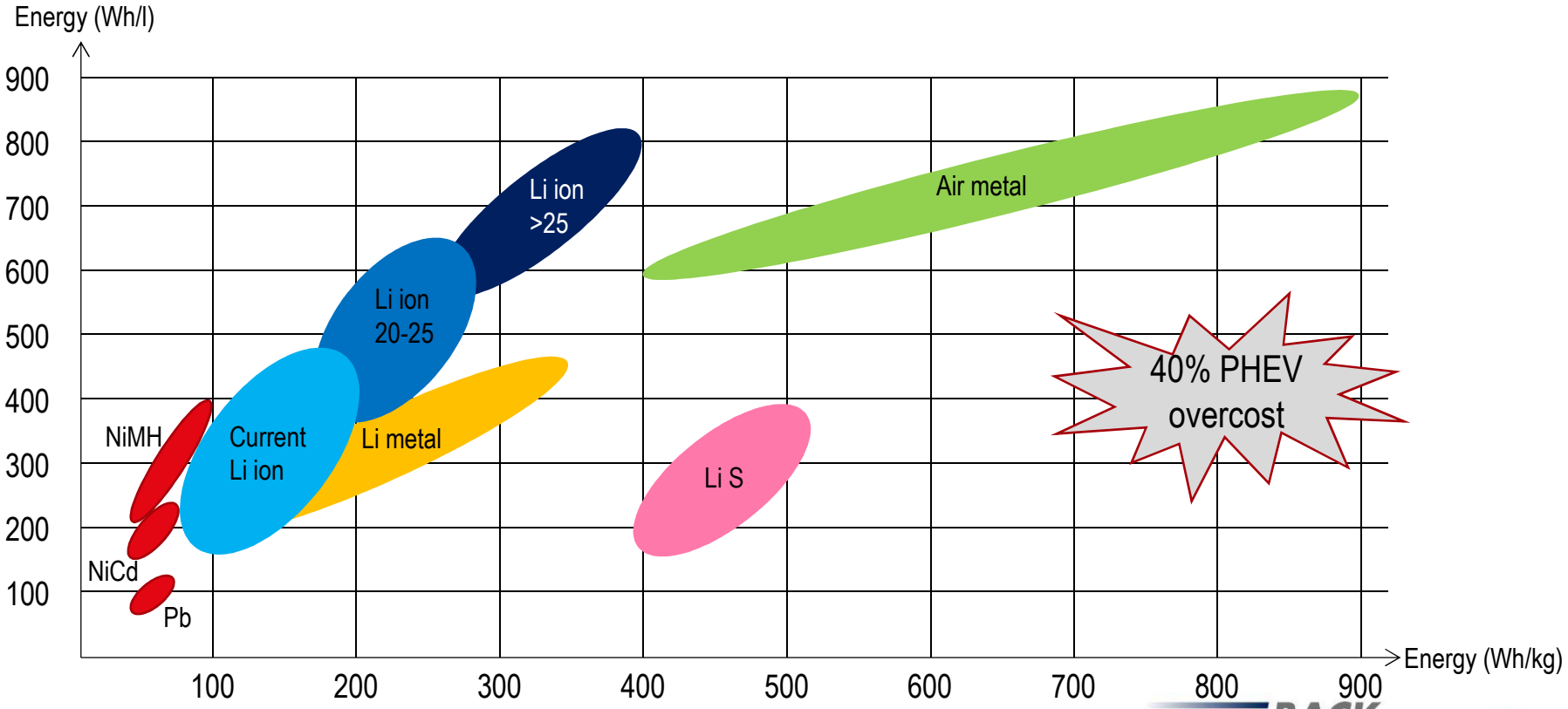
… and cost: #10³€ / kWh NiMH 2010 → #10² € / kWh Li-ion 2020 → ?



BACK IN THE RACE

Breakthrough on powerelectronics technology…

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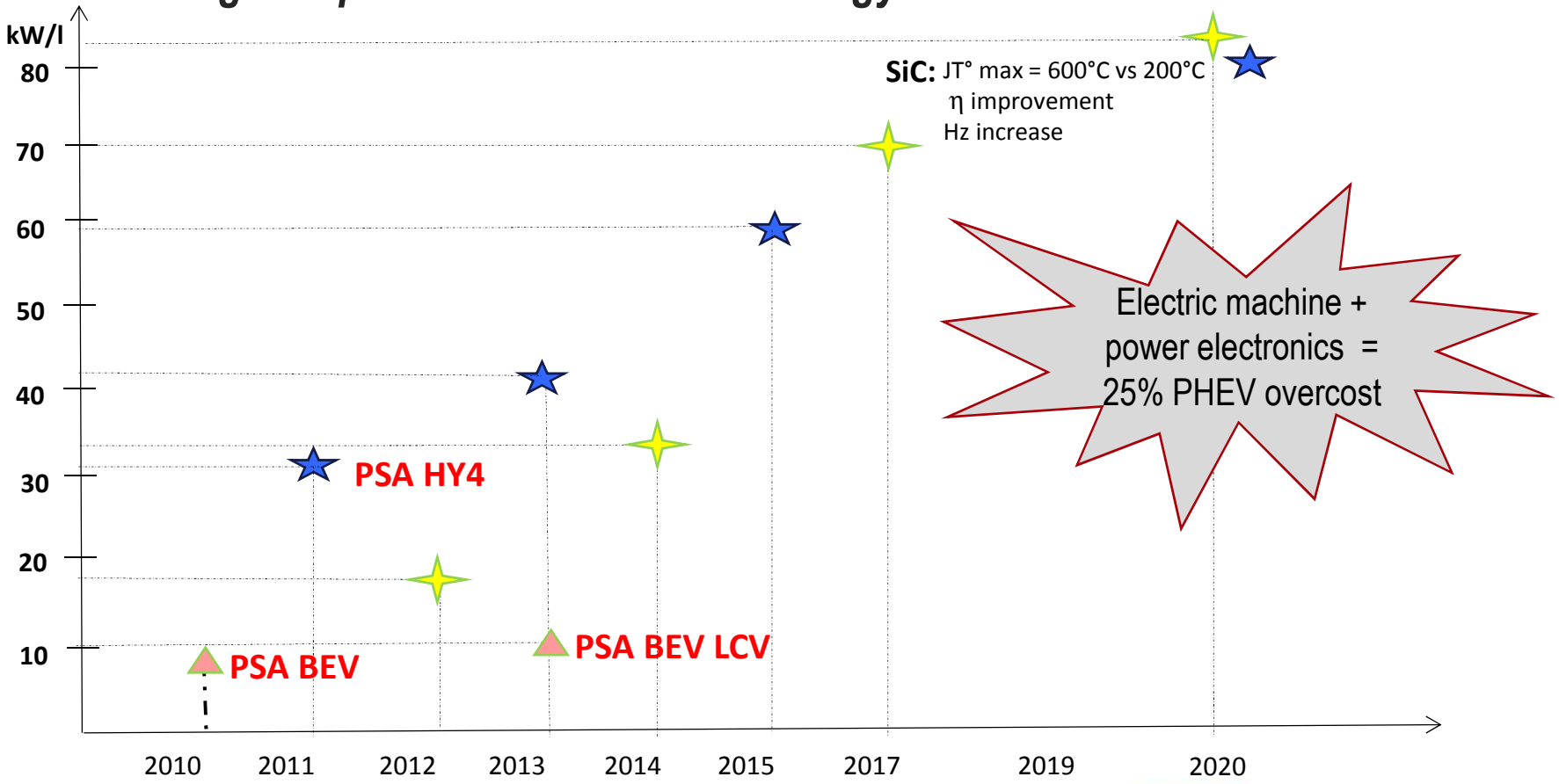

BACK IN THE RACE

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TF1 3D | 2DF HD | CCTV 中国中央电视台

$ media $

CUSTOMERS

OEM

« not for profit » organisations

ISO FOR SAFER CARS EURO NCAP
www.euroncap.com
ADAC
ICRT
INTERNATIONAL CONSUMER RESEARCH & TESTING
FIA
Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE
Ministère de l'Écologie, du Développement durable et de l'Énergie
Thatcham
Representing British Motor Insurers

SUPPLIERS

ZF
DENSO
BOSCH
Continental
Panasonic
MAGNA
GETRAG
MAGNETI MARELLI
Valeo

Customer driven

Techno push

BACK IN THE RACE

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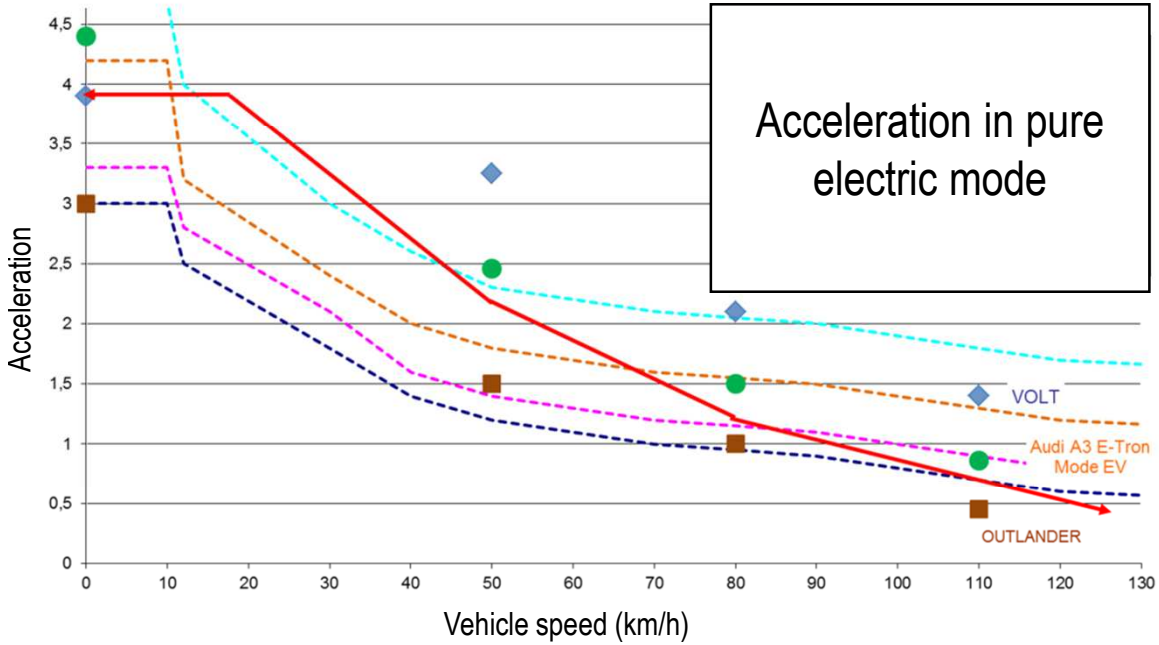
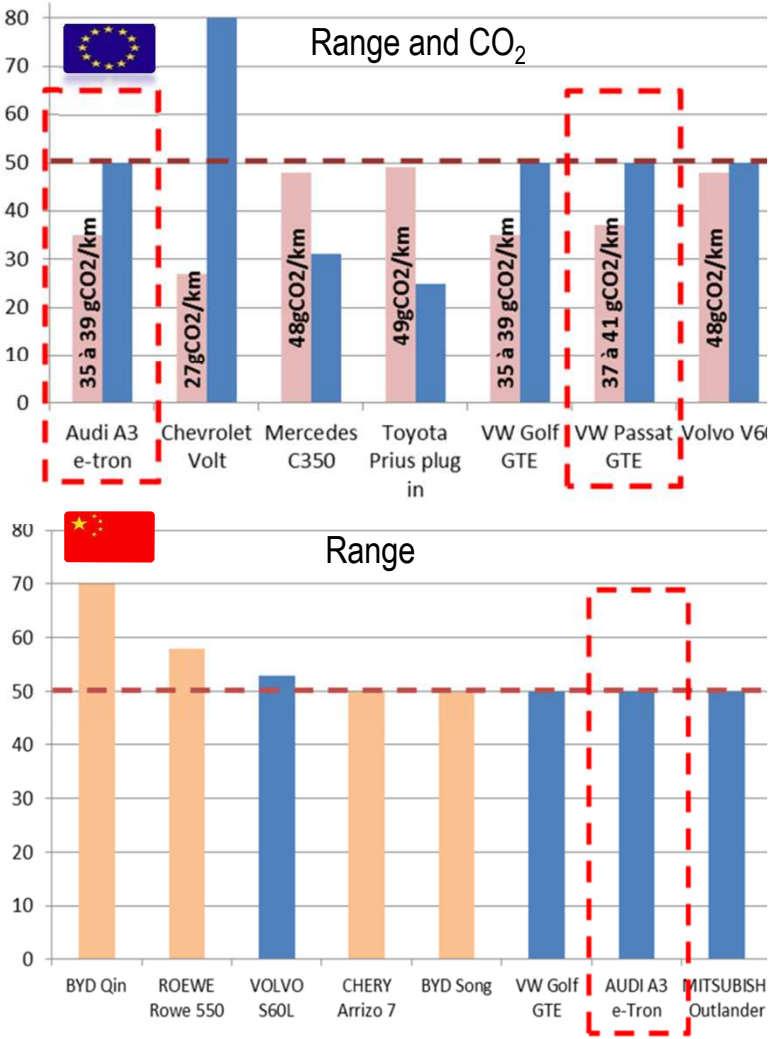
Customer expectation

Fuel consumption, range, fun to drive



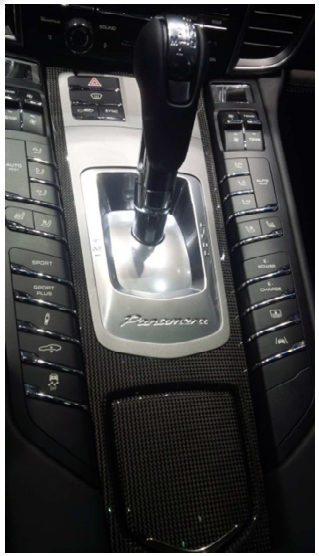
Acceleration in pure electric mode



Easy to use?


Power cable with household plug
Interchangeable power cable via connector on the control unit
Control unit with graphic display
Power cable with industry plug
Vehicle cable


GTE Variant



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How to deal with the « 4 C »?

Customer

Constraint

Competitor

Company

PHEV set based

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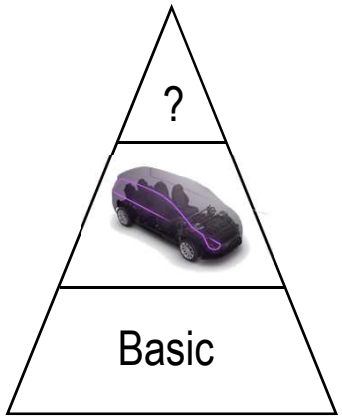
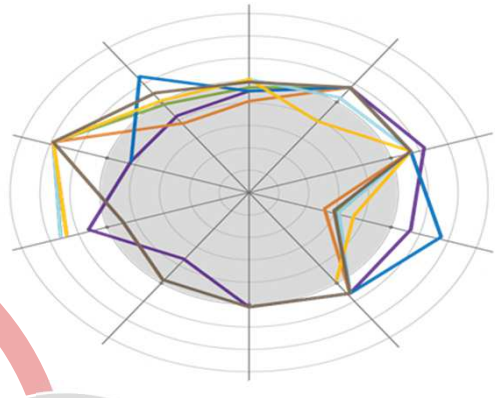




Customer expectation

Company profile

PHEV modular program

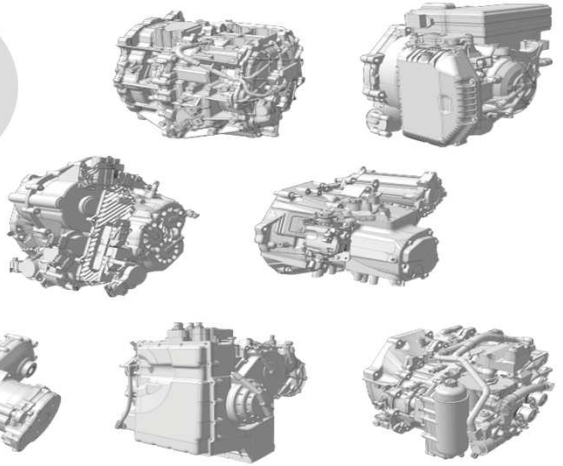
Constraint & incentive

Competitor & Supplier

€, ¥, $, …

PEUGEOT

CITROËN



BACK IN THE RACE

PHEV modular design based on HY4 architecture

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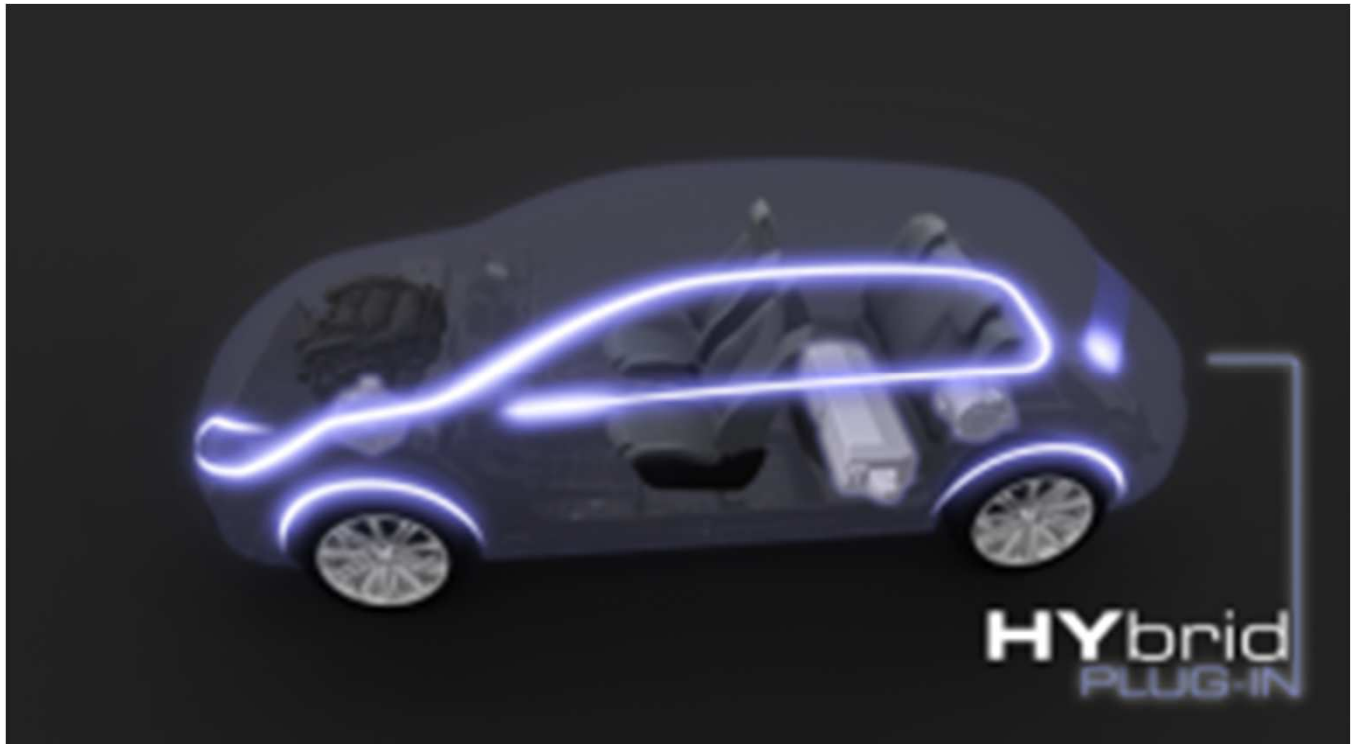

BACK IN THE RACE

Conclusion

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- **L'électrification des véhicules porte en elle un potentiel de progrès énorme: c'est une tendance profonde qui se déclinera à différents niveaux des micro-hybrides aux véhicules électriques sur l'ensemble des plaques géographiques, les véhicule conventionnels restant cependant durablement majoritaires.**

- **De nouveaux leviers sont disponibles sur les technologies clés (batterie, électronique de puissance, machine) pour améliorer les performances et les investissements importants des différents consortiums vont permettre d'acquérir rapidement maturité industrielle et réduction des coûts.**

- **Les incertitudes restent néanmoins nombreuses sur le développement des marchés et les besoins clients, l'agilité est indispensable pour pouvoir s'adapter aux évolutions.**

- **Pour l'horizon 2020, PSA poursuit le large déploiement des micro-hybrid et a construit un programme modulaire plug-in monde et sortira en 2019 ses premières applications.**

→ Rendez-vous en 2019!

BACK IN THE RACE

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Annexes

FCEV - PHEV - BEV

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	FUEL CELL	PHEV :	BEV :
CO2 (TtW)	0 g/km	≈ 30 g/km	0 g/km
CO2 (WtW)	From 0 g/km to more than ICE	From 30 g/km to close HEV	From 0 g/km to more than ICE
Pwt Cost	High (>> 10k€) (Fuel cell pack)	High (≈ 8k€)	High (≈ 10k€) (battery)
Infrastucture	Network & Fuel Stations (1M€/fs)	Existing for Fuel Regular Plugs or CS	Charging Points & Stations (0,3M€/fs)
Fuel Cost	H2 10€/kg → 10€/100km	EV mode 2€/100km HEV mode 6-7€/100km	Electricity 0,13€/kWh → 2€/100km
Charging Duration / Range	3' / 500 km	Elec <3h / 50km Fuel 3' / 500km+	30' to 8h / 150 km

BACK IN THE RACE