DU PUITS À LA ROUE, LA BALANCE ENVIRONNEMENTALE GLOBALE DE L'AUTOMOBILE

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16 Janvier 2019

Plan de la présentation

> Les enjeux environnementaux	Environmental stakes
> Les différentes technologies	Powertrain technology scope
> Les outils et périmètres de mesure	Metrics
> Quelques résultats	Some figures
> Savoir analyser de chaque point de vue	Different view angles
> Perspectives et opportunités	Perspectives & opportunities

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The car industry needs to cut its Greenhouse gases emissions by 32% in 2050 to reach COP21 objective and limit climate change to 2°C

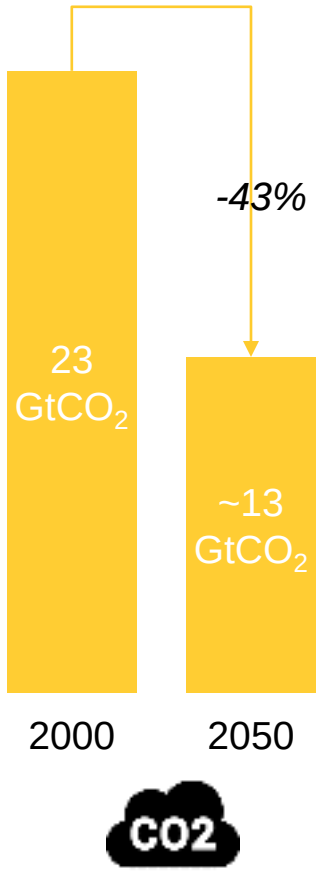
Climate change ▶ **Global GHG emissions** ▶ **Transports emissions** ▶ **PLDV emissions**

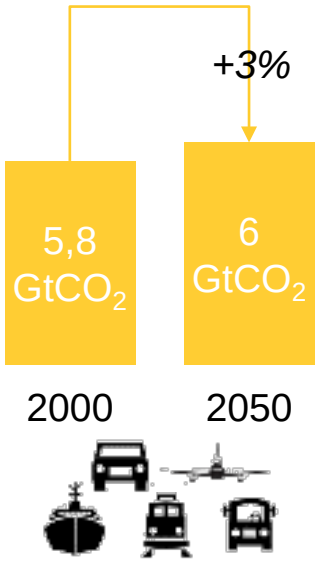
PARIS 2015

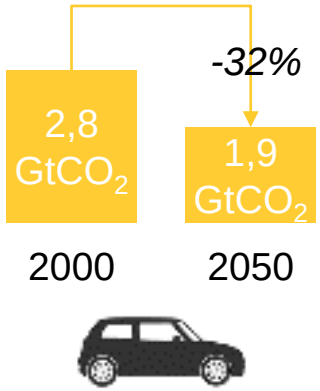
Target

+2°C

between 1990 and 2100



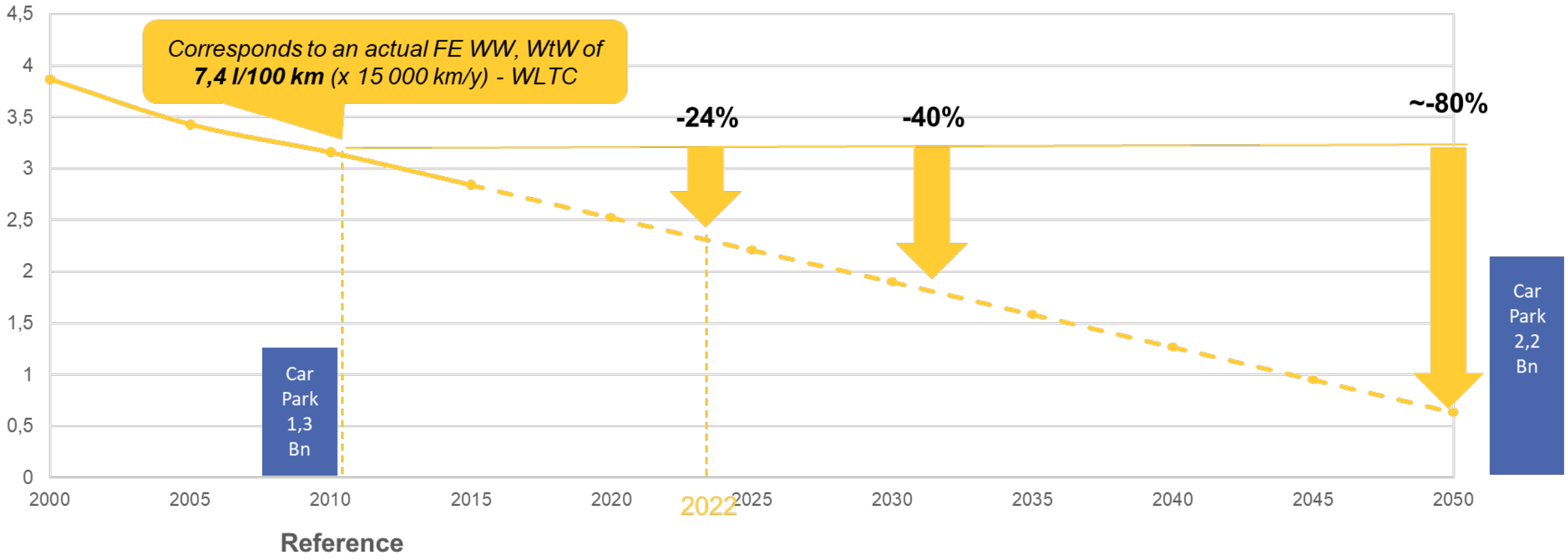




Source : IEA, IPCC

This target requires that WTW emissions of new vehicles should decrease by 24% in 2022 from 2010 while worldwide car park increase by 1,7

Industry target on its field of action (WtW tCO_2eq / veh sold / y)



Source : IEA, IPCC

Environmental stakes : resource usages are challenged economically and politically

ACCESS SCARCITY

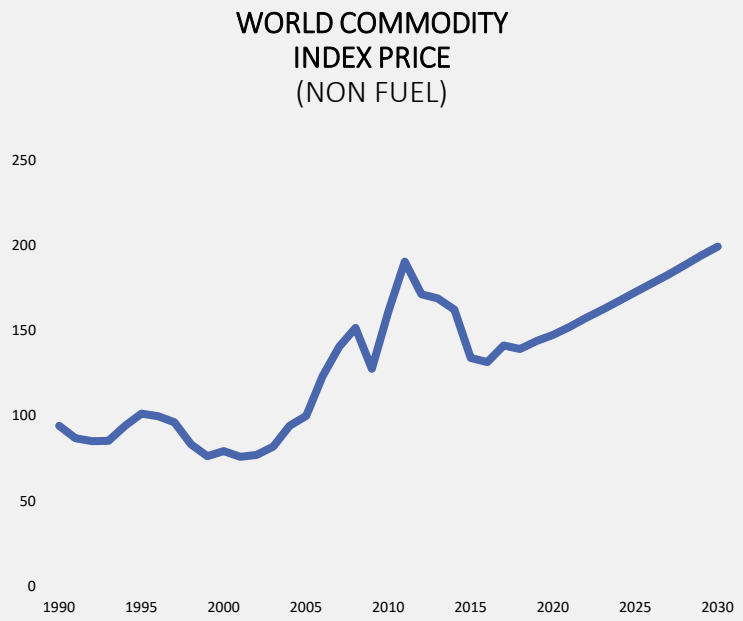
PLANET RENEWABLE RESERVE OVERUSE IN LESS THAN 1/2 YEAR

COPPER RESERVES 37 Years
1 EV = 4 X 1 ICE
(80kg engine + battery + electric cables)

Source: Deutsche Bank, United States Geological Society

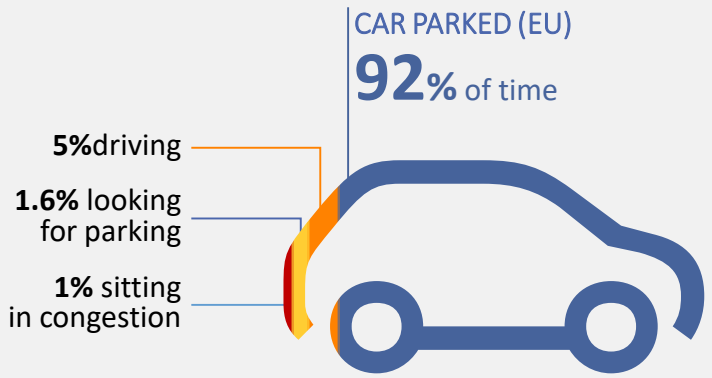
COST VOLATILITY

(CO+NI+LI) IN BAT COST



USAGE EFFICIENCY

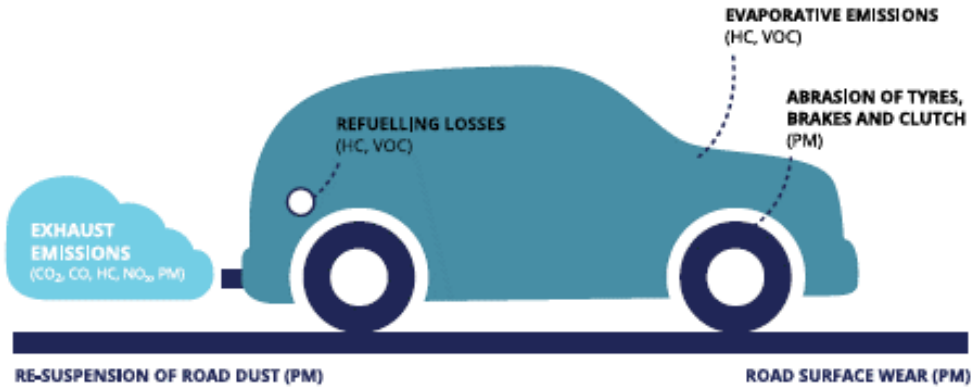
VERY LOW FOR CAR
*(When worlwide park expected to grow from **1,3 bn to 2,2 bn cars** by 2050)*

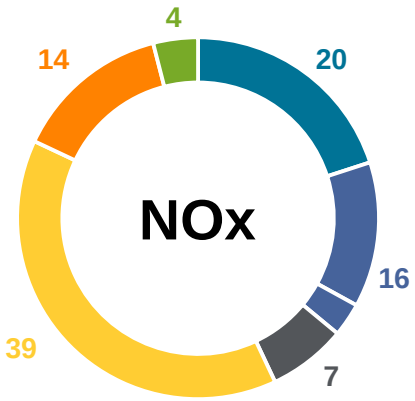


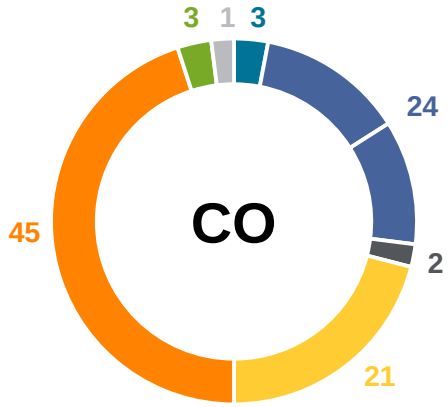
Average European car has 5 seats but carries 1.5 people/trip

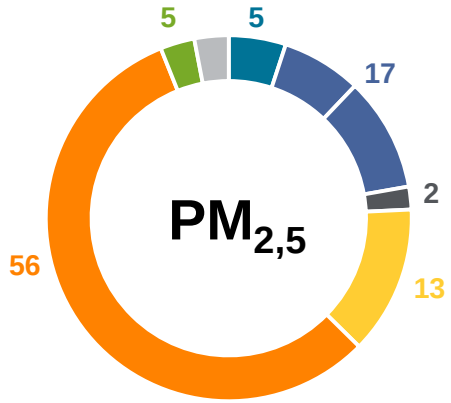
50% | **PUBLIC SPACE DEDICATED TO CARS** IN MOST CITIES (today)

Environmental stakes : Air quality
Automotive industry partly contributes to air pollution by NOx, CO and PM









Source: EEA Emissions inventory 2013

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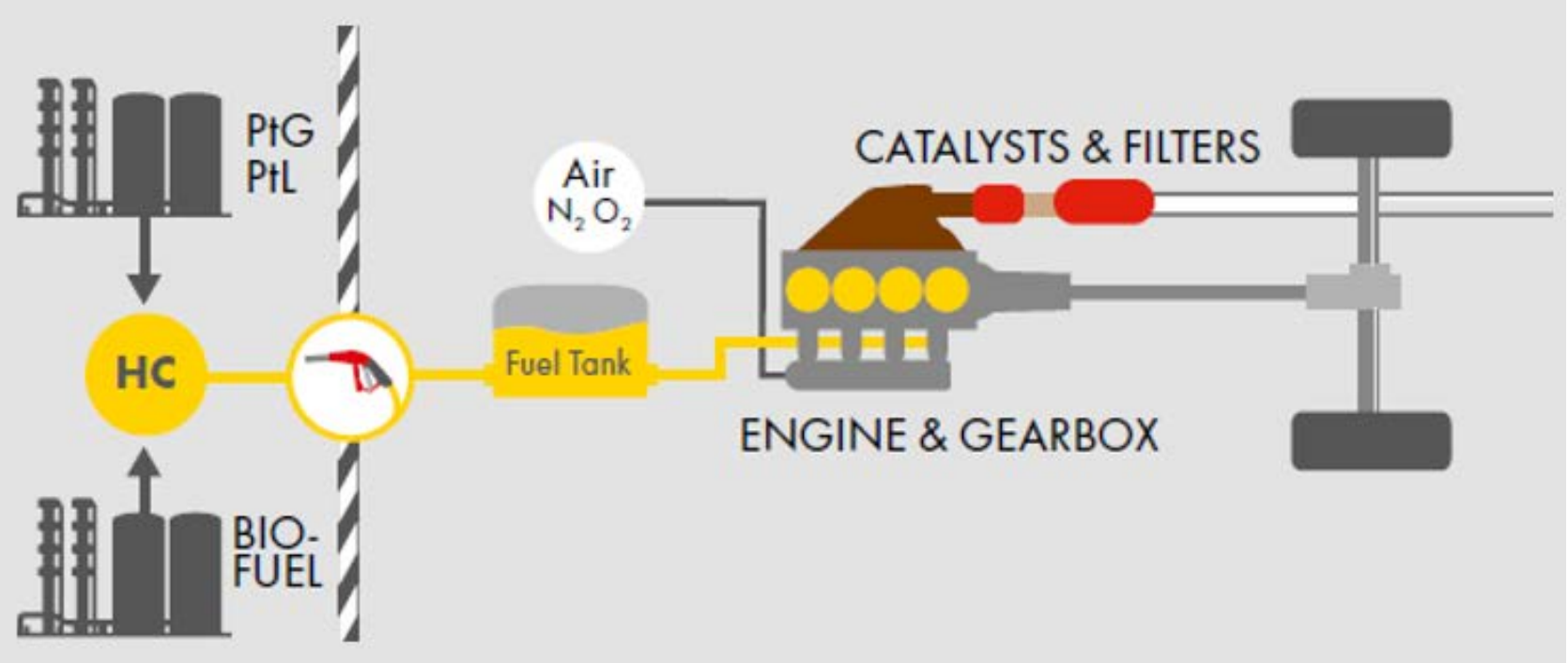
Powertrain Technology scope

- ICE
- HEV
- PHEV
- BEV
- FCEV

Powertrain Technology scope

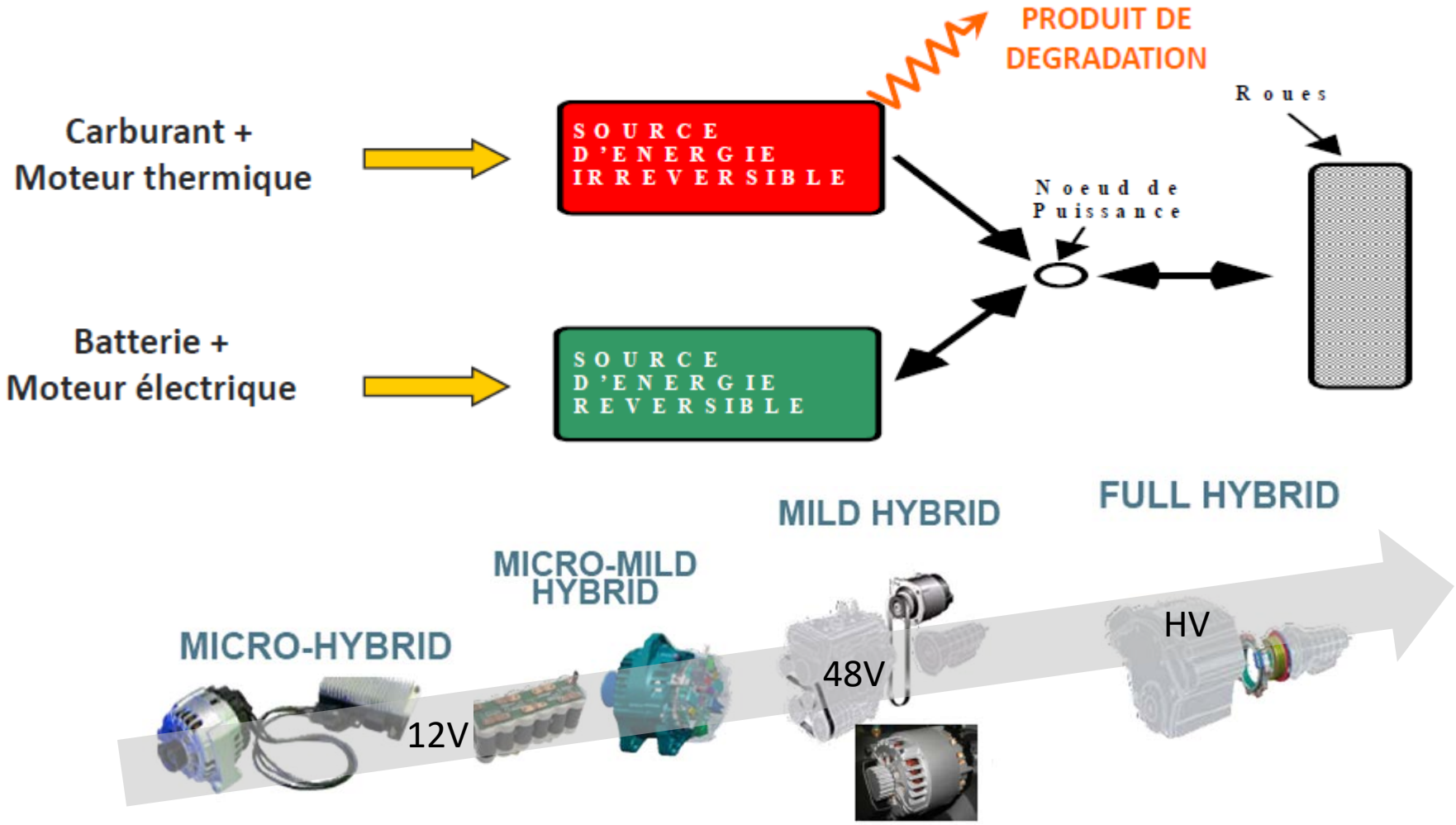
> ICE

- From liquid or gazeous HC
- From Bio fuels



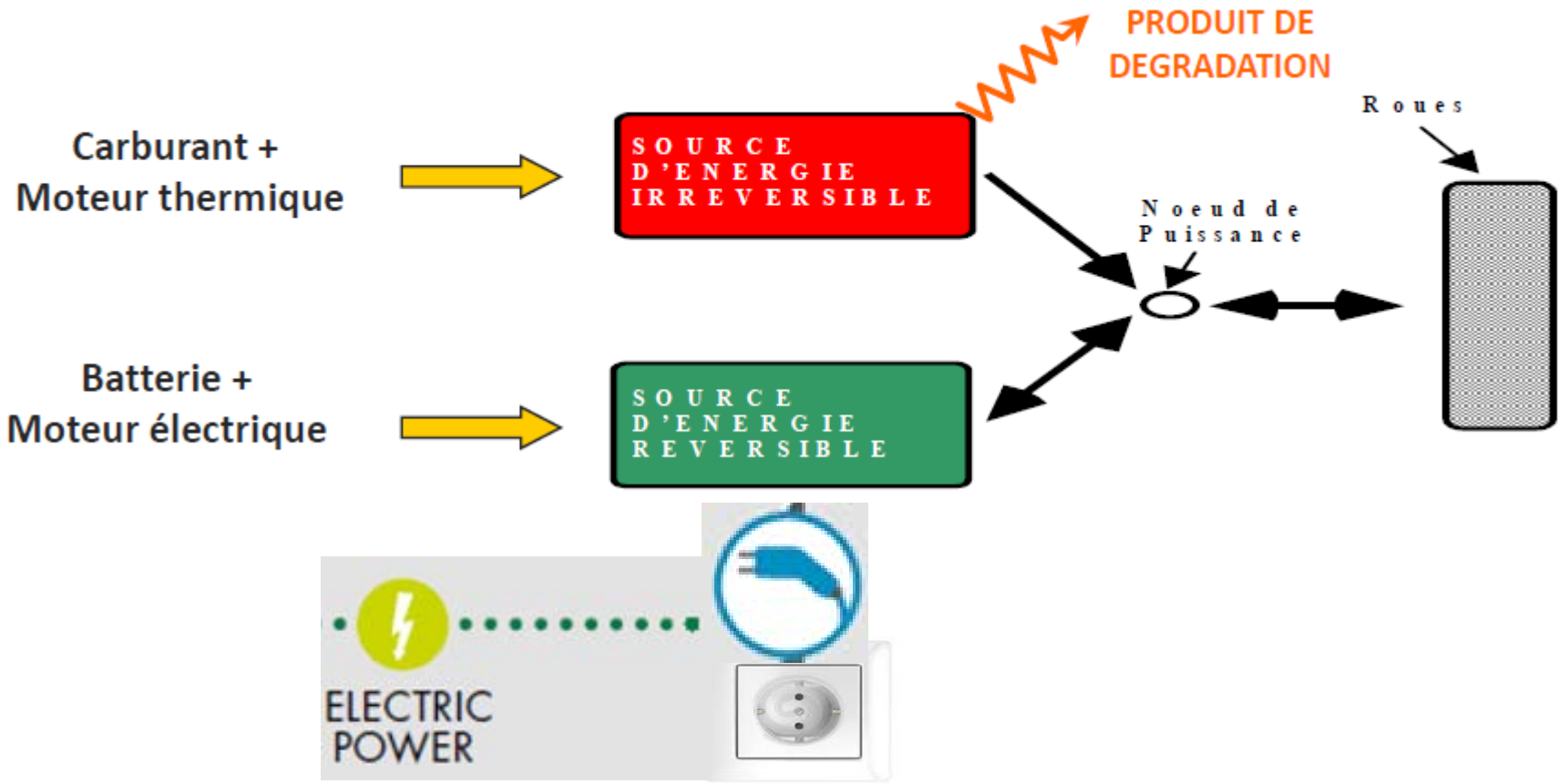
Powertrain Technology scope

> HEV Technology



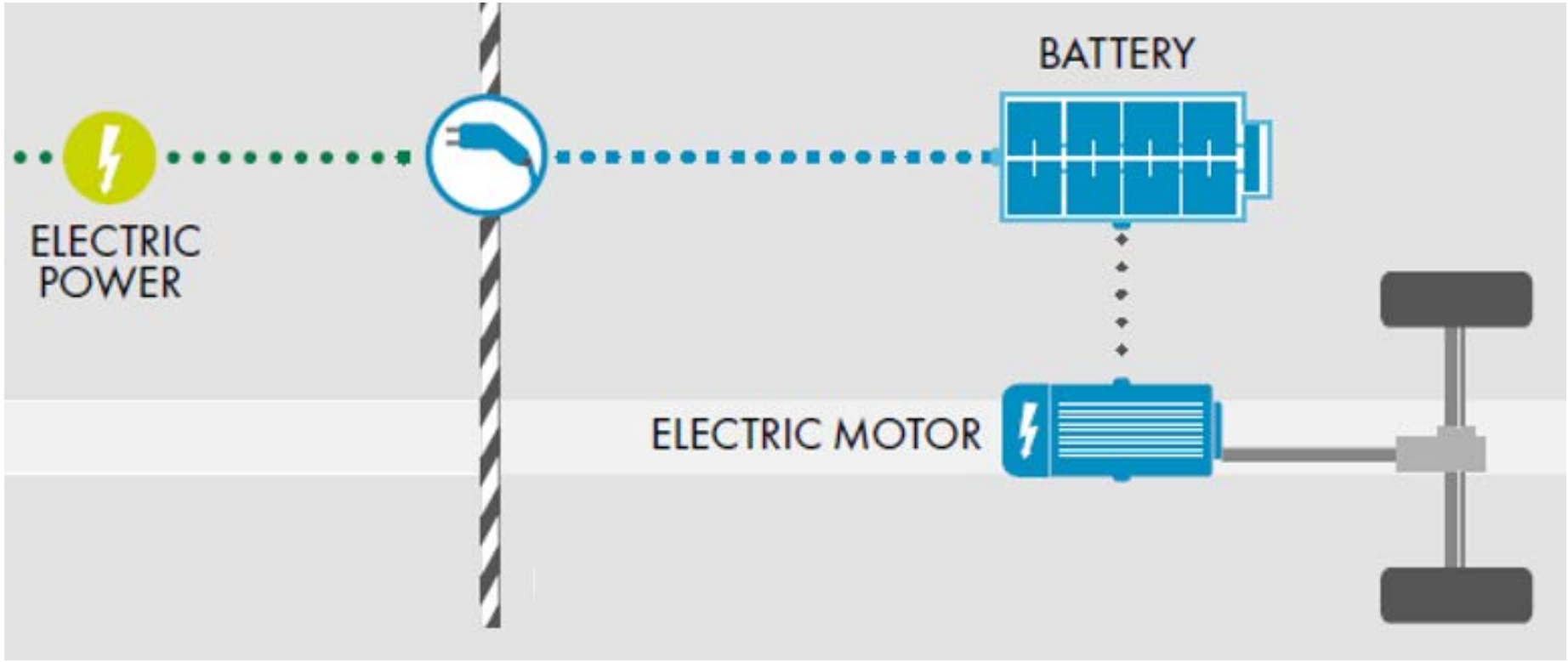
Powertrain Technology scope

> PHEV Technology



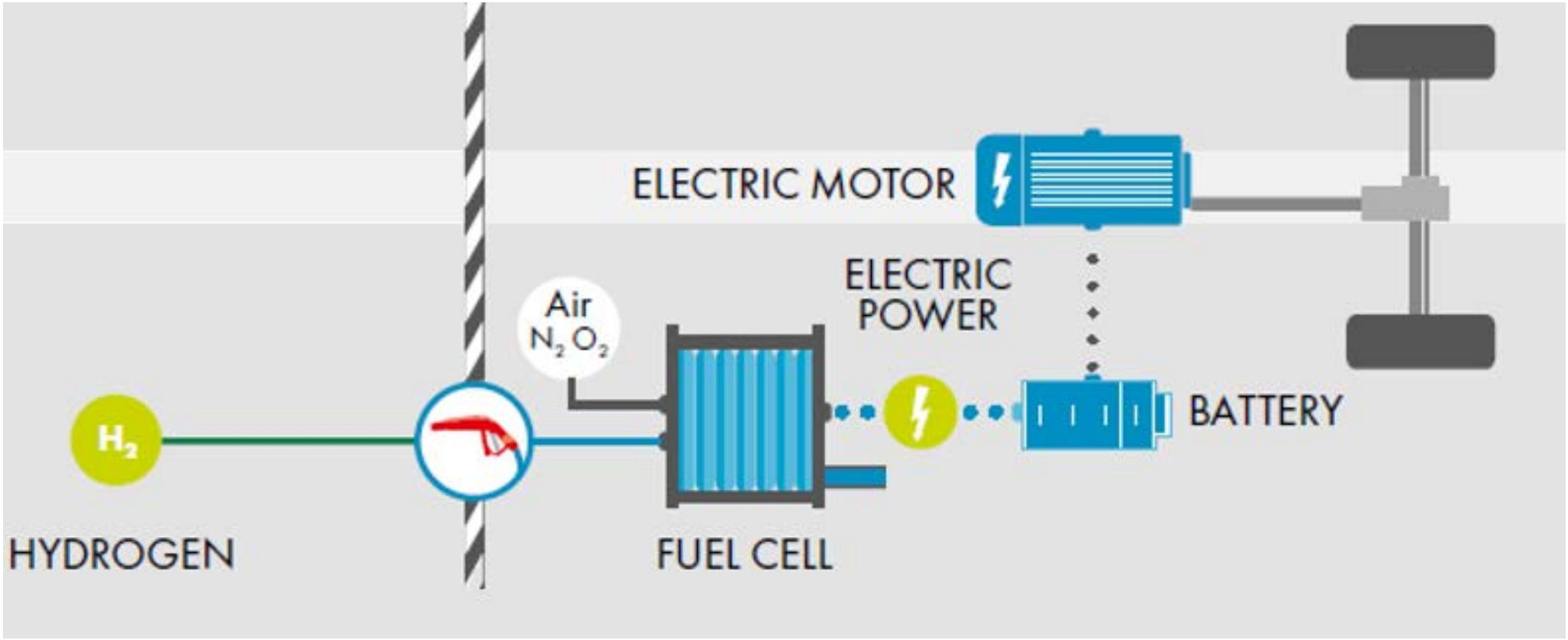
Powertrain Technology scope

> Pure BEV Technology



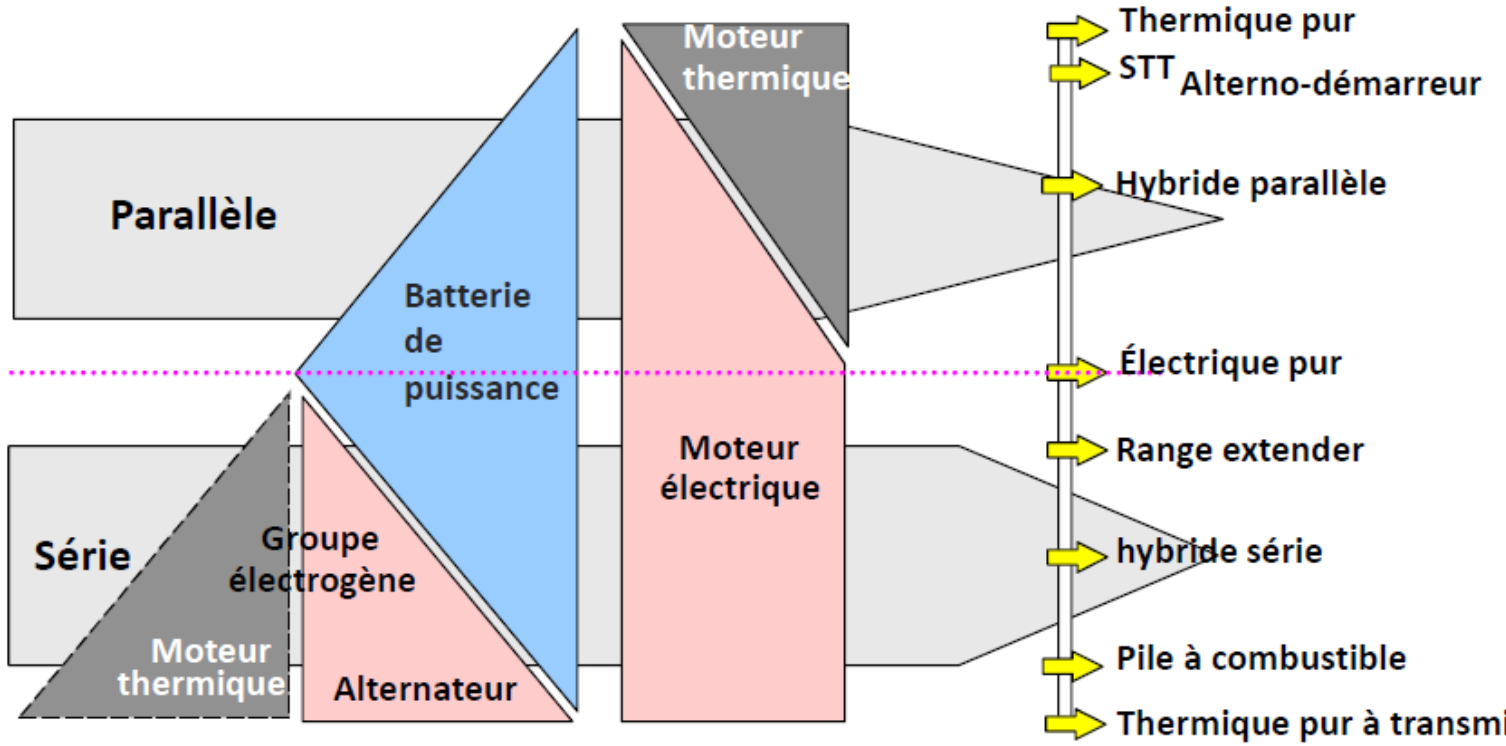
Powertrain Technology scope

> FCEV Technology



Powertrain Technology scope

> Synthesis of electrification configurations
  - Many solutions existing
  - The story is at its very beginning



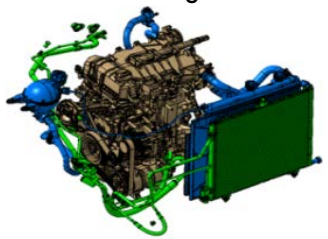
Powertrain Technology scope
A global strategy for energy efficiency

SOCIÉTÉ DES INGÉNIEURS DE L'AUTOMOBILE

Powertrain Optimization
- downsizing
- Transmissions
- Hybridation, electrification

+ 10% η = -10g/km

Thermal management



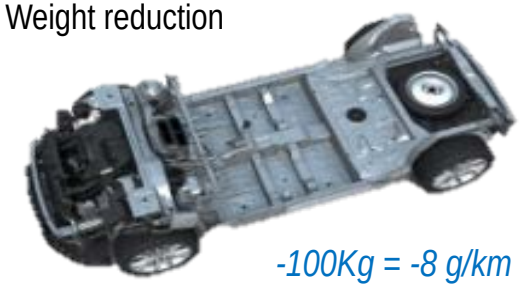
ADAS / eco-driving

Electric consumption

-100W = -2.5g/km

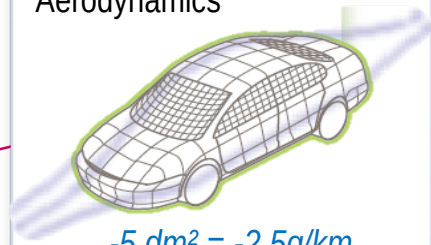
Rolling resistance

Weight reduction



-100Kg = -8 g/km

Aerodynamics



-5 dm² = -2.5g/km

PSA GROUPE — GROUPE RENAULT

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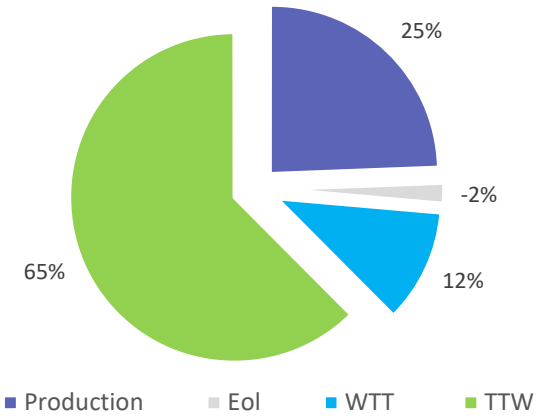
DEFINITIONS : the different scale to evaluate the CO2 emission of a vehicle

Life Cycle Analysis (LCA) (ISO 14040)

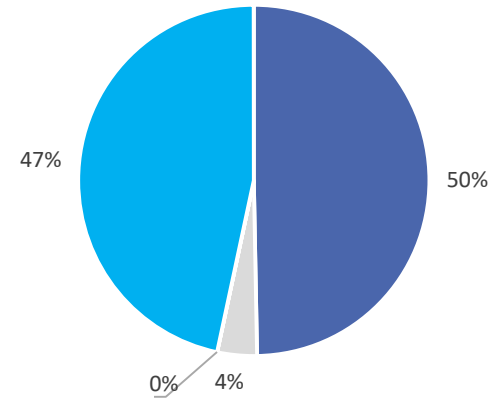
CO2 LIFE CYCLE (150 000 km)

Car/battery Production *(Incl. material extract)*	WELL to WHEEL		Car/battery End of life *(Incl. material reuse)*	CO2 emissions + Pollutants impact (on air &water) + Resources depletion Impact
	Well to Tank	Tank to Wheel		
	Fuel/electricity production (needed for vh usage) (CO2 g/km)	Vehicle usage (CO2 g/km)		

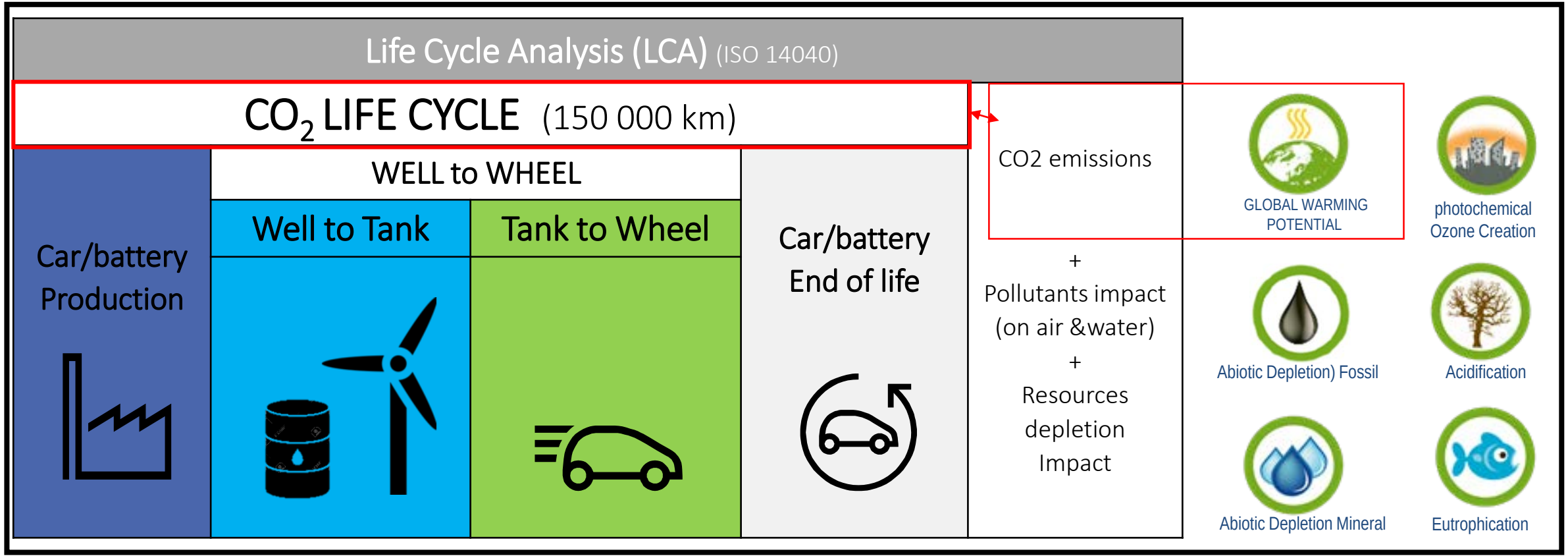
ICE B Segment (gasoline)



EV B segment 40kWh EU



DEFINITIONS : the different scale to evaluate the CO_2 emission of a vehicle



DEFINITIONS : each scope of CO2 environmental impact evaluation underpins different public policy topics and customer concerns

	TTW	WTW	LCA
CAFE	target WLTP 2021		
FISCALITY	Thresholds	Subsidy Amont	Powertrain discrimination
NEV mandates		Formula / eq EV (China)	
LOW EMISSION ZONE	Emission norm		Pwt discrimination
TCO	Purchase Inc Tax & incentive		

TTW: Tank To Wheel ; WTW: Well To Wheel ; LCA: Life Cycle Assessement ; CAFE: Corporate Average Fuel Economy ; WLTP: Worldwide harmonized Light vehicles Test Procedures

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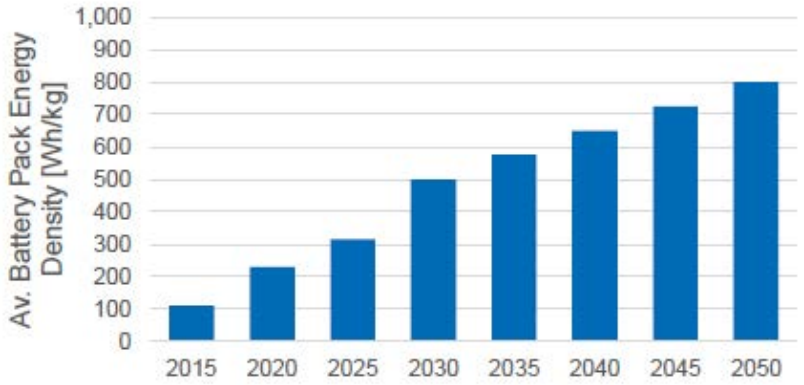
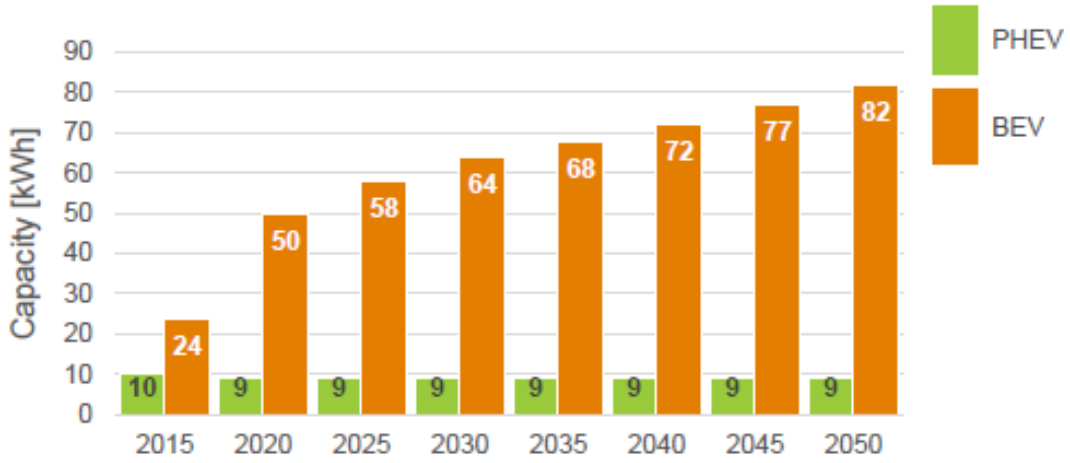
Some general figures

> Evolution of battery energy til 2050

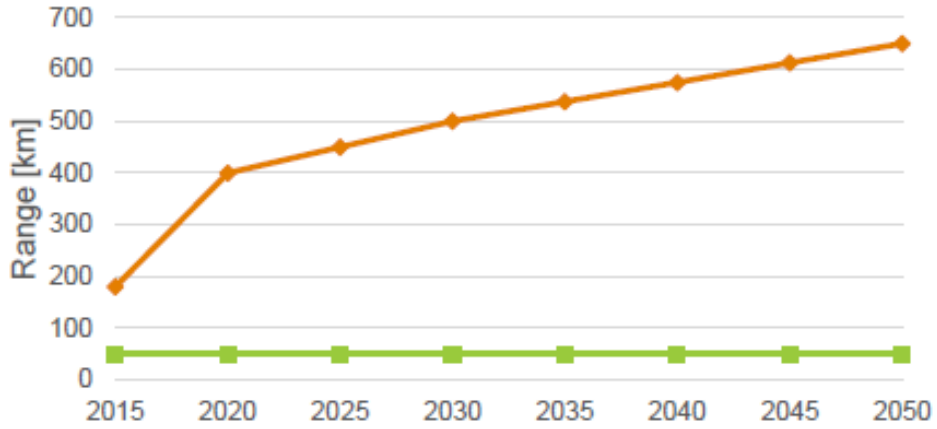
Battery Energy Density



Battery Capacity



Electric Range



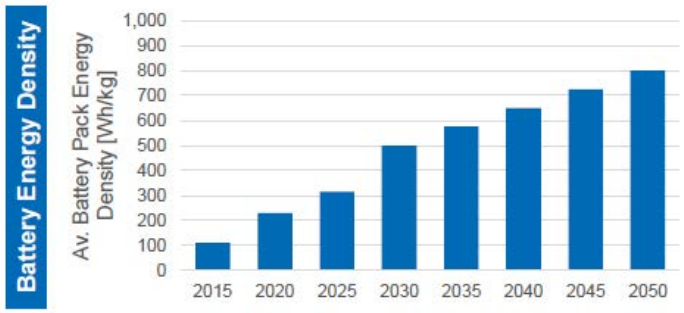
Concawe
Environmental Science for European Refining
RICARDO

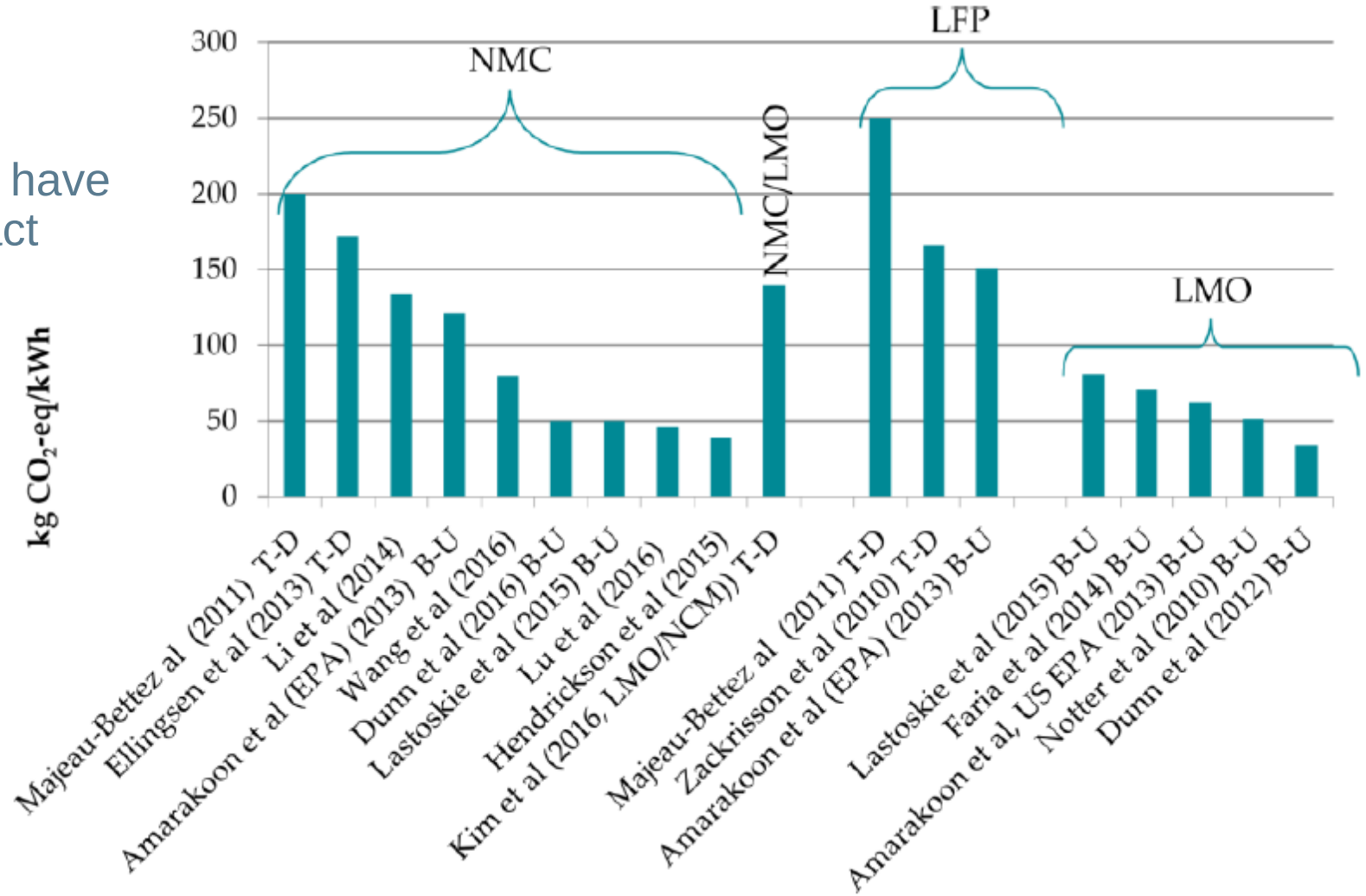
CONCAWE – Public Domain

Some general figures

> Electrochemical storage

- Li-ion technologies do not have the same production impact





Some general figures

> French mix of electrical energy production in 2015

Figure 12 : Mix électrique 2015

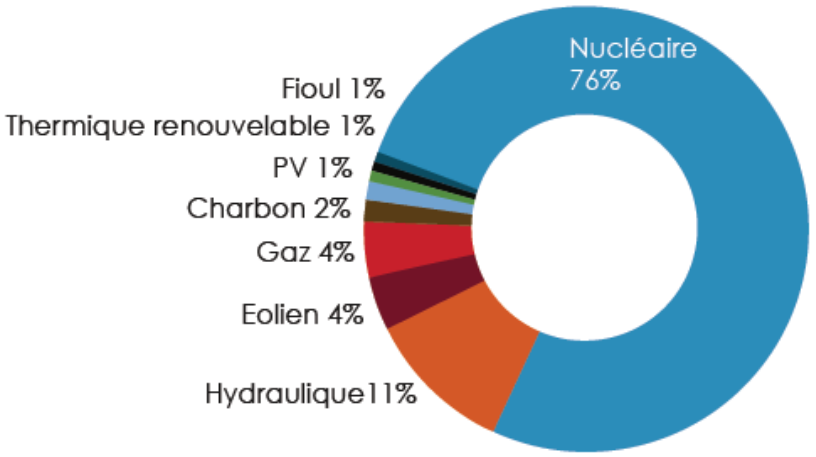
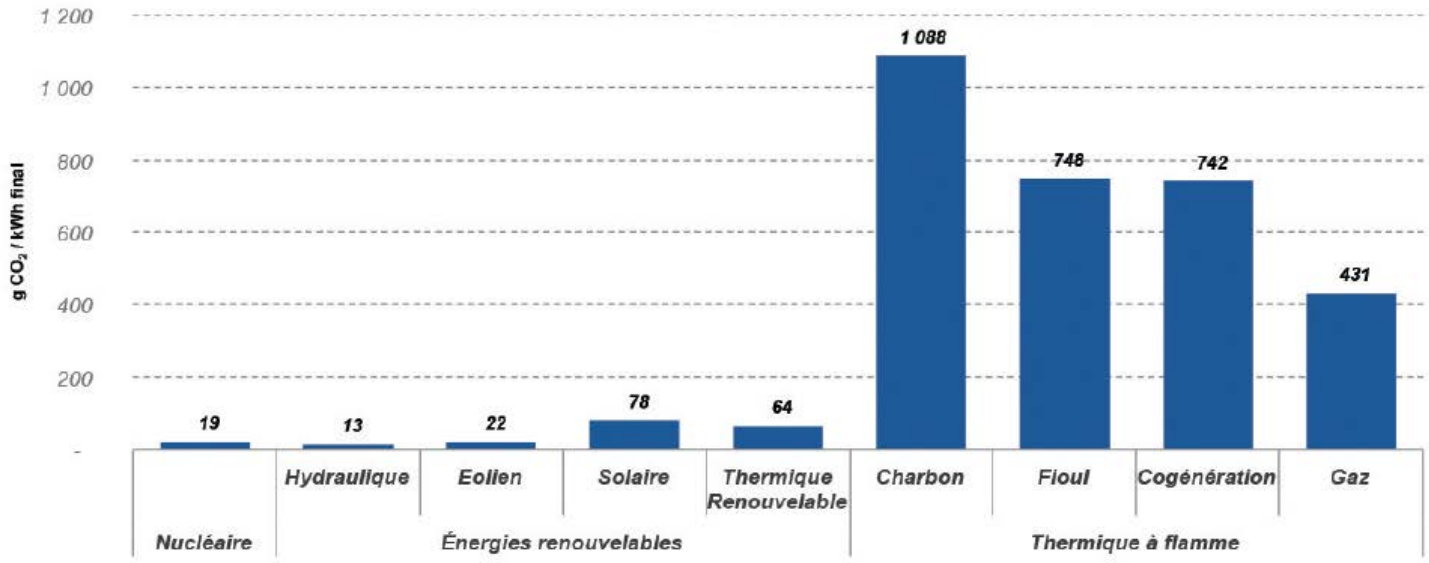


Figure 17 : Facteurs d'émissions par filières de production électrique



Some general figures

> Evolution forecast of the french electrical production

Figure 13 : Mix Ambition Transition énergétique 2030 (39% ENR)

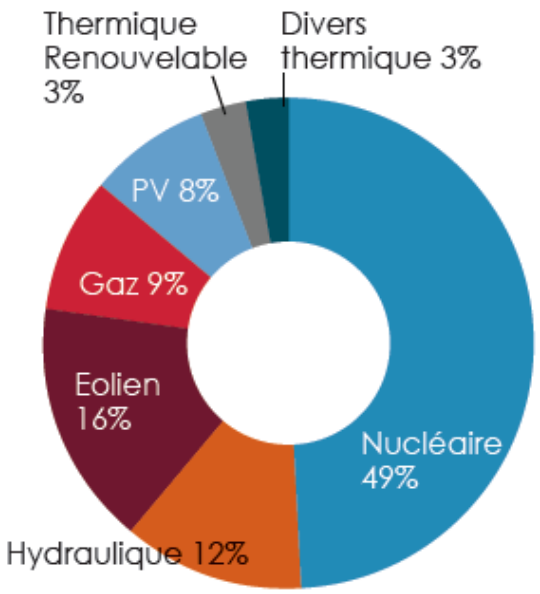
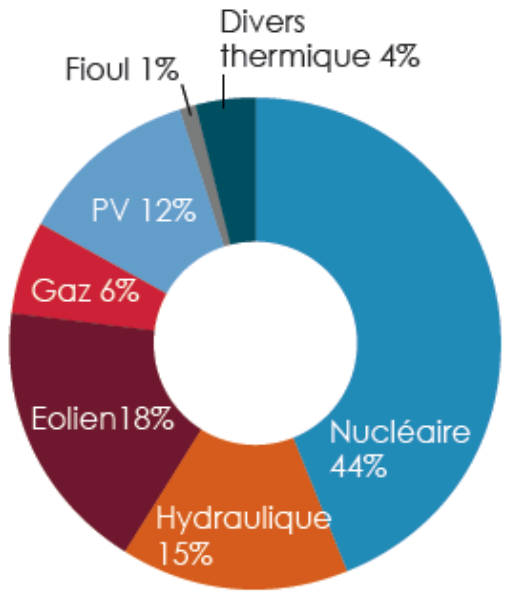
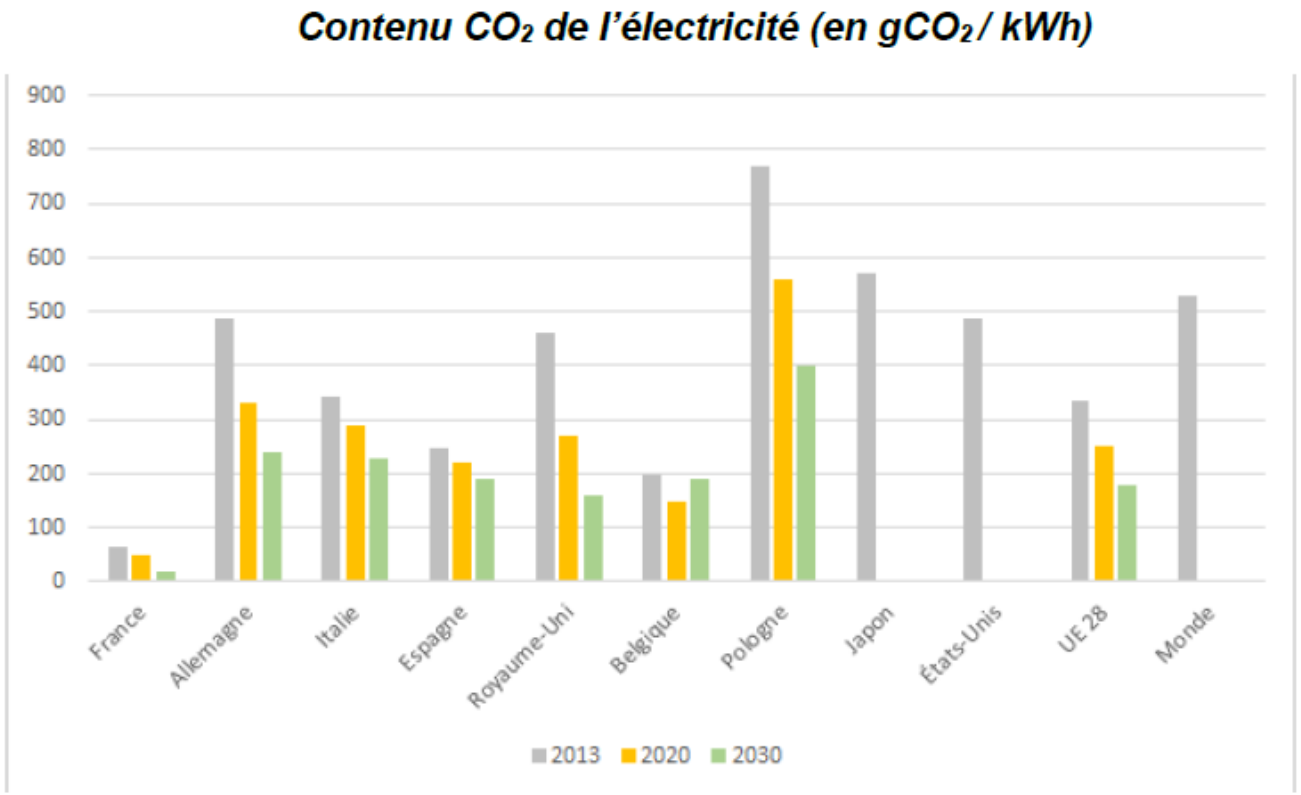


Figure 14 : Mix vers 100% ENR (43%) ENR)



Some general figures

> Electrical energy CO2 footprint in main countries

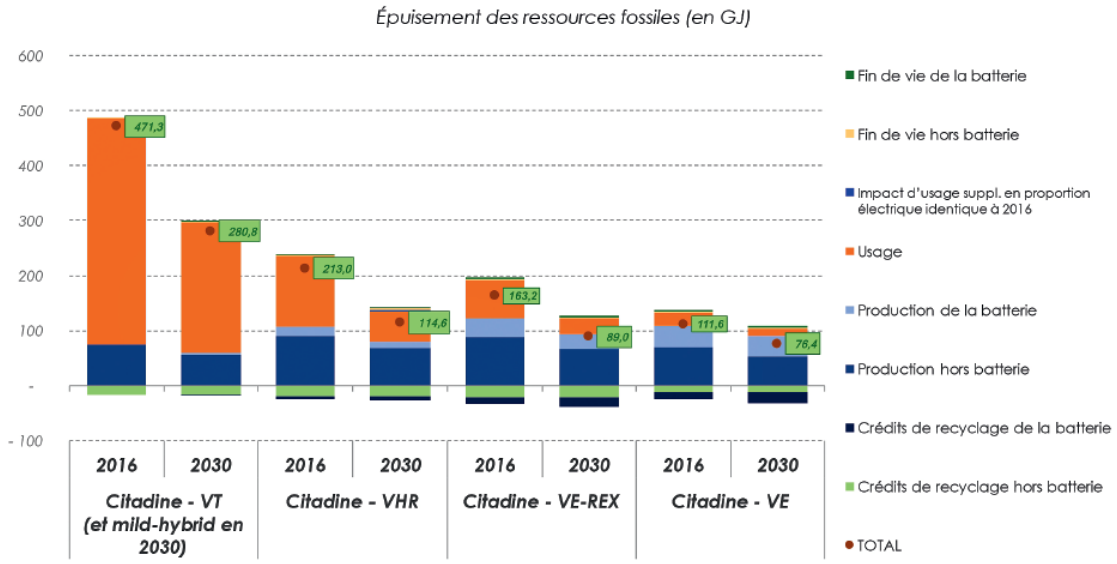


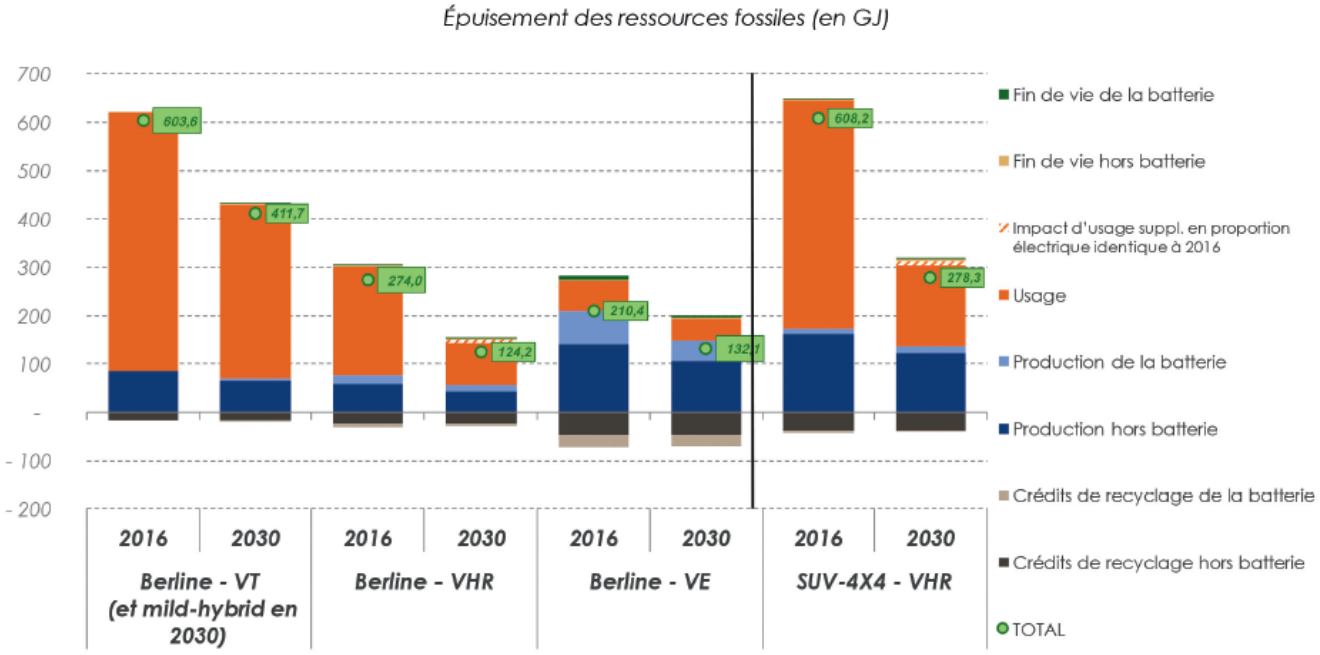
Source : Données AIE 2015 et « EU energy, transport and GHG emissions trends to 2050 – référence scenario 2013 »

Some general figures

> Typical example of « cradle to grave » evaluation comparison

Figure 2 : Consommation de ressources fossiles : résultats 2016-2030 comparés sur le segment des citadines





Rapport Avere – Dec. 17

Other studies & figures - ICCT- Effects of battery manufacturing

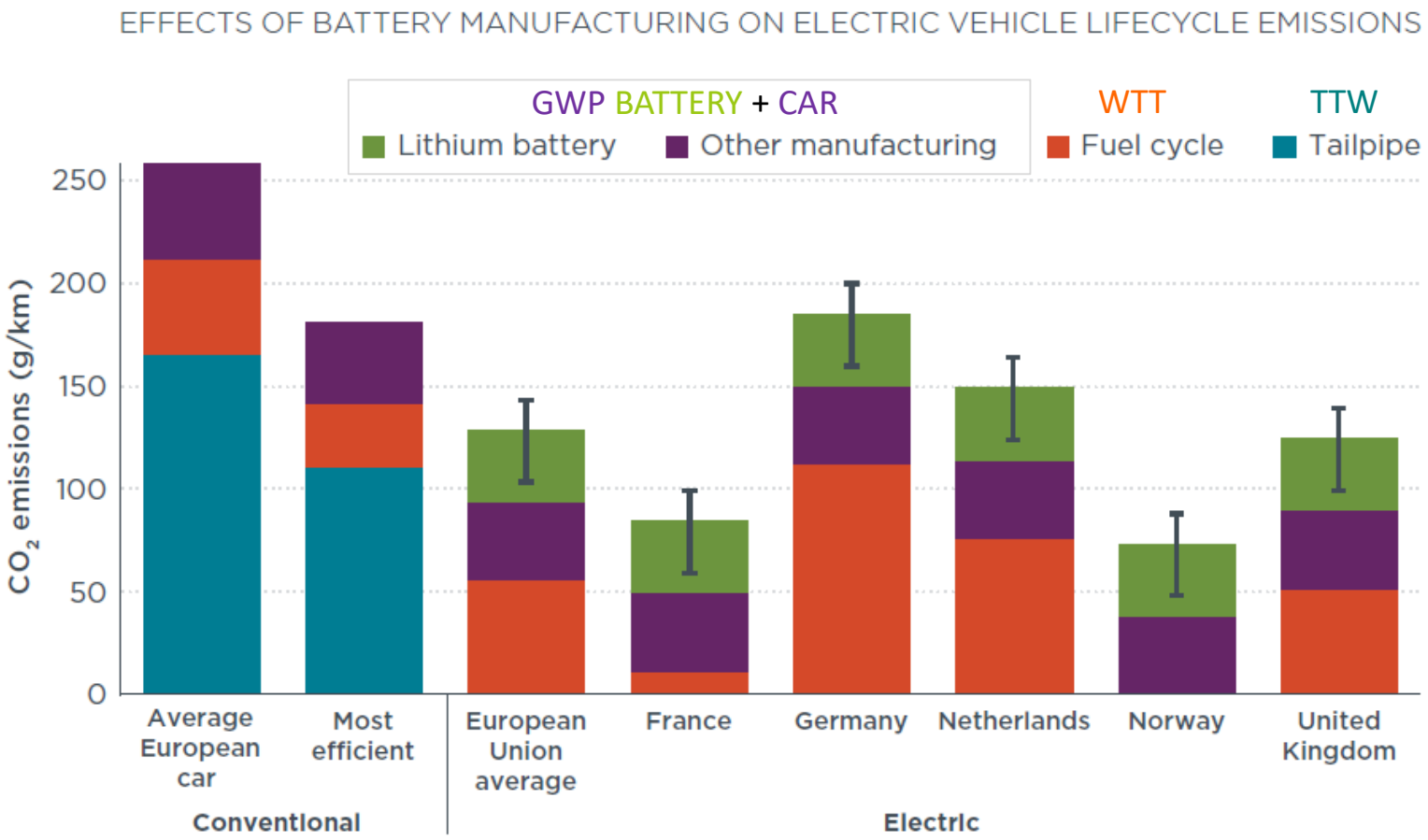


Figure 1. Life-cycle emissions (over 150,000 km) of electric and conventional vehicles in Europe

theicct.org

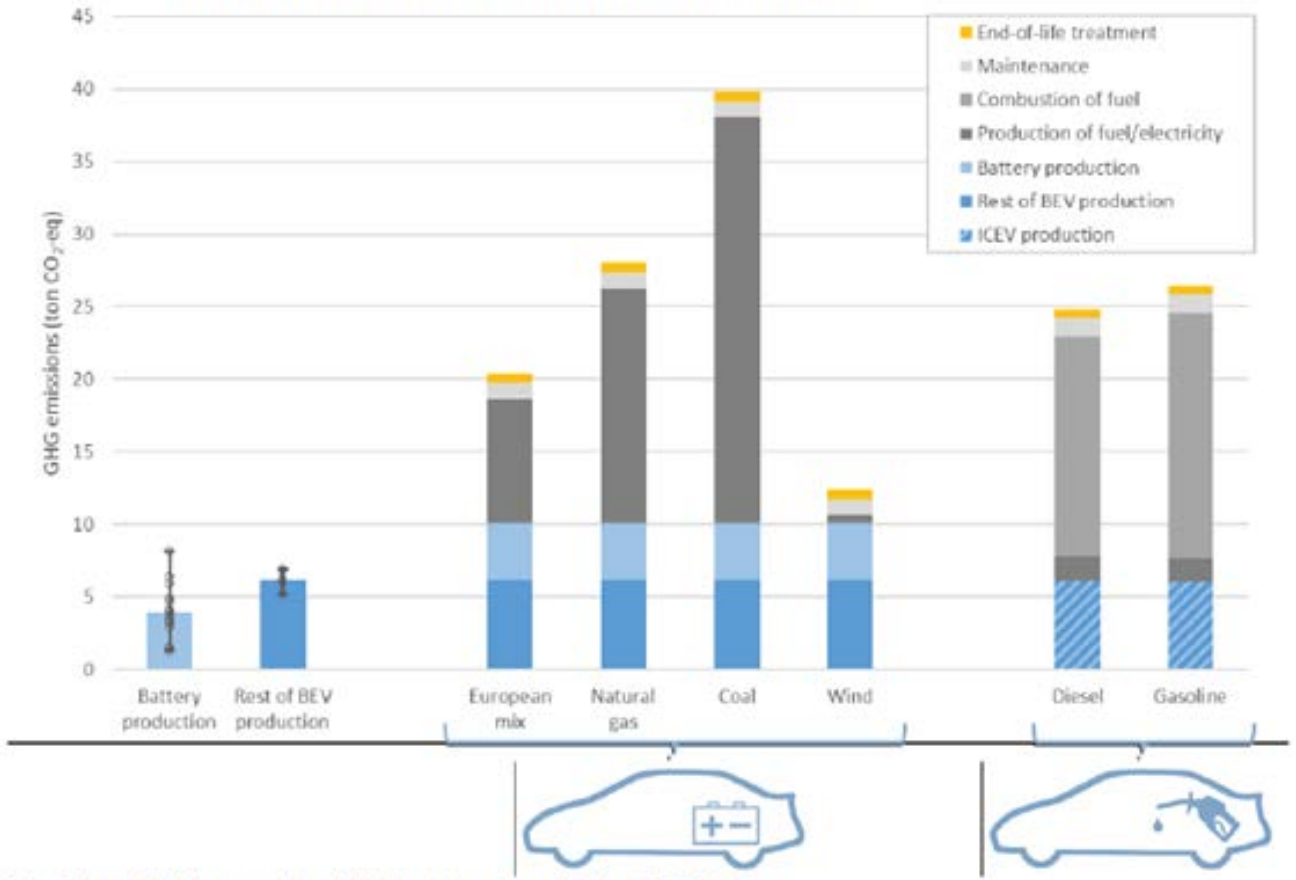
IEFING

FEBRUARY 2018

Effects of battery manufacturing on electric vehicle life-cycle greenhouse gas emissions

Other studies & figures - UE Parlement- 2018

Figure E1: Lifecycle GHG emissions of mid-sized 24 kWh battery electric (left) and internal combustion engine (right) vehicles.



Note: The vehicle's operational lifetime is assumed to be 150 000 km.

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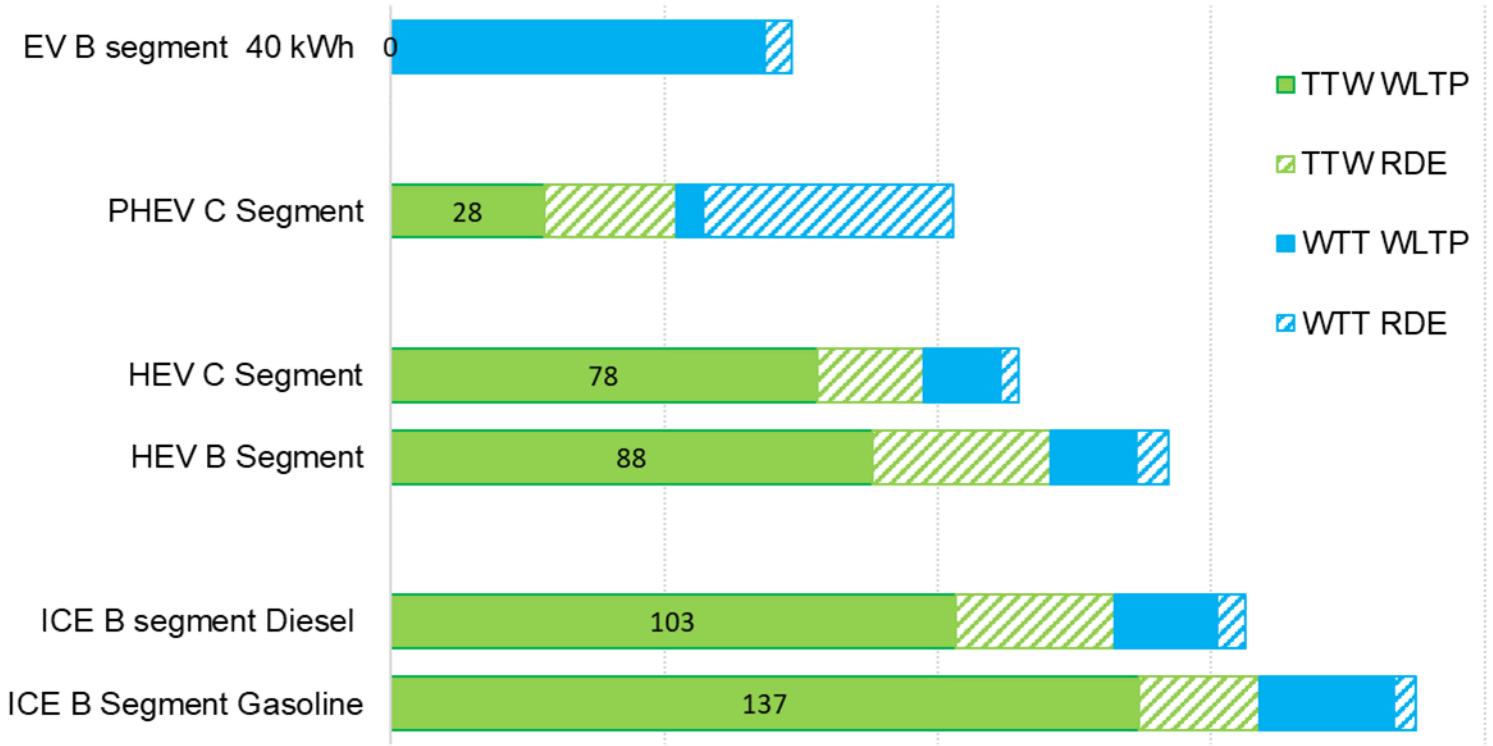
DIFFERENT VIEW ANGLES
WTW IN RDE CYCLE

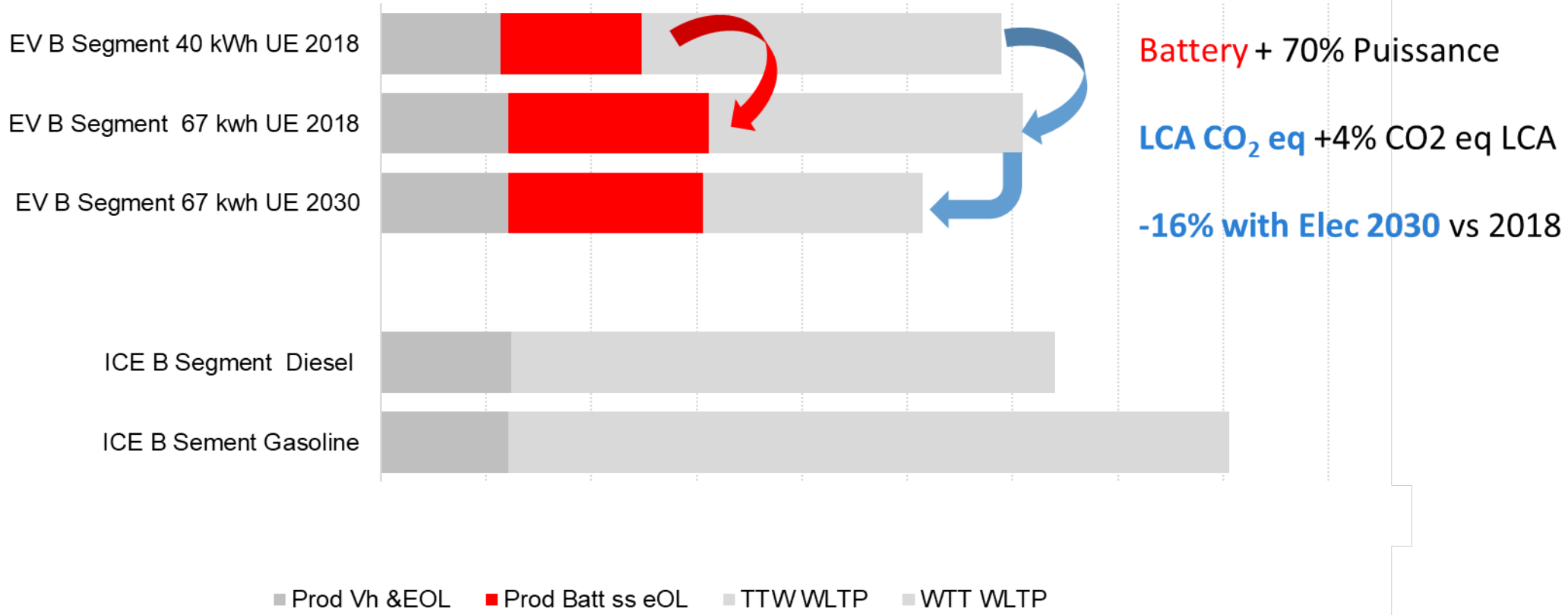
WTW & RDE EV, PHEV, HEV, ICE 2018 (gCO_2 eq/km)



Hyp: UE 2017 - RDE (NCBS)

TTW: Tank To Wheel ; WTW: Well To Wheel ; RDE : Real Drive Emission

DIFFERENT VIEW ANGLES
NEW TECHNOLOGY : more performance less CO_2



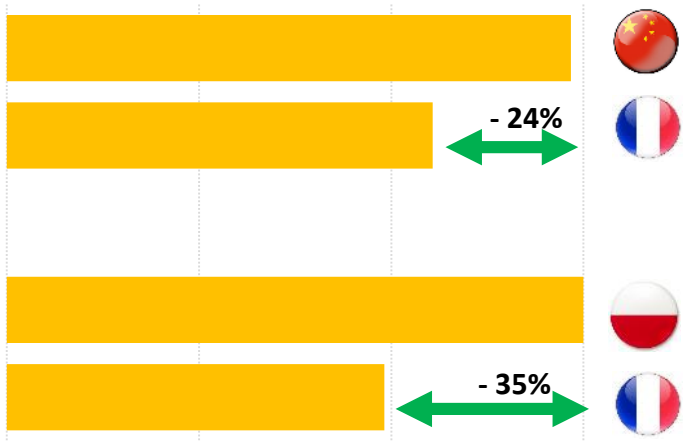
Battery + 70% Puissance

LCA CO_2 eq +4% CO2 eq LCA

-16% with Elec 2030 vs 2018

DIFFERENT VIEW ANGLES
LOCALISATION : more French less CO_2

CO_2-eq battery (Production) sourcing variation



NMC, Cells & modules manufacturing & assembly sourcing variation
Mix elec pays 2017 : kg CO_2-eq/kWh: PL: 0,996; CN: 0,868; KR: 0,602; FR: 0,056

DIFFERENT VIEW ANGLES SECTORS

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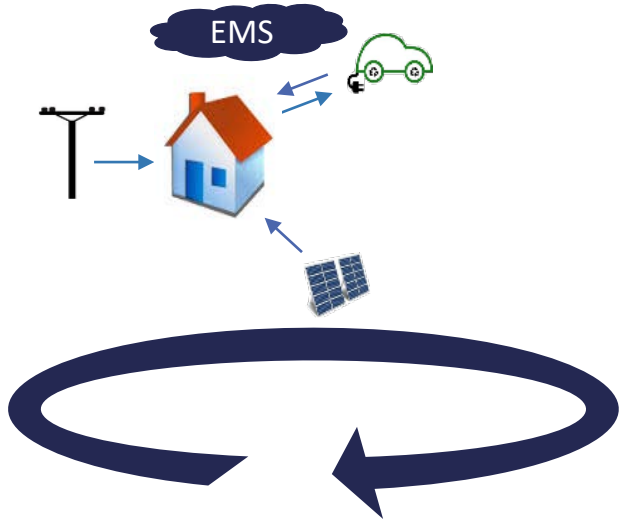
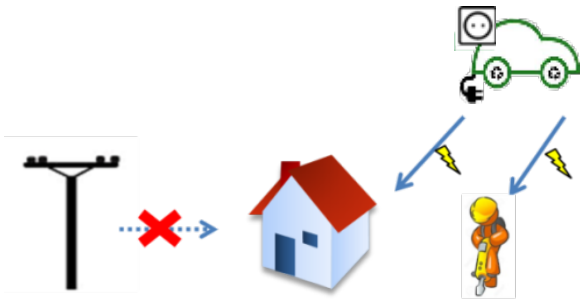
The opportunity of a smart grid approach

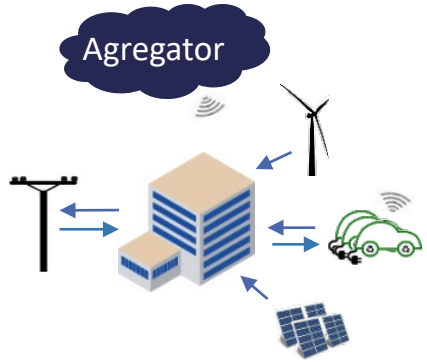
Vehicle-to-home (V2H)



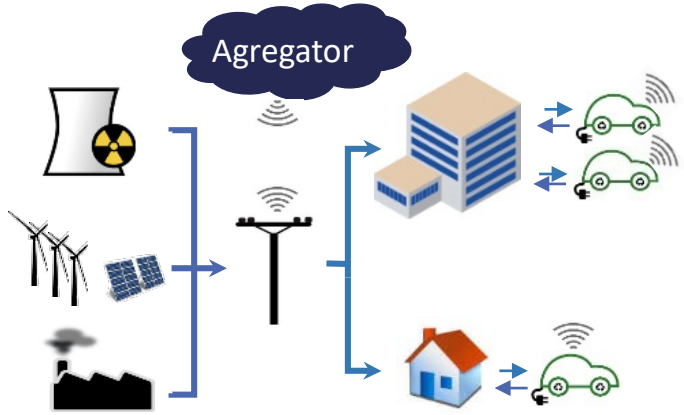
Vehicle-to-load (V2L)



Vehicle-to-building (V2B)



Vehicle-to-Grid (V2G)

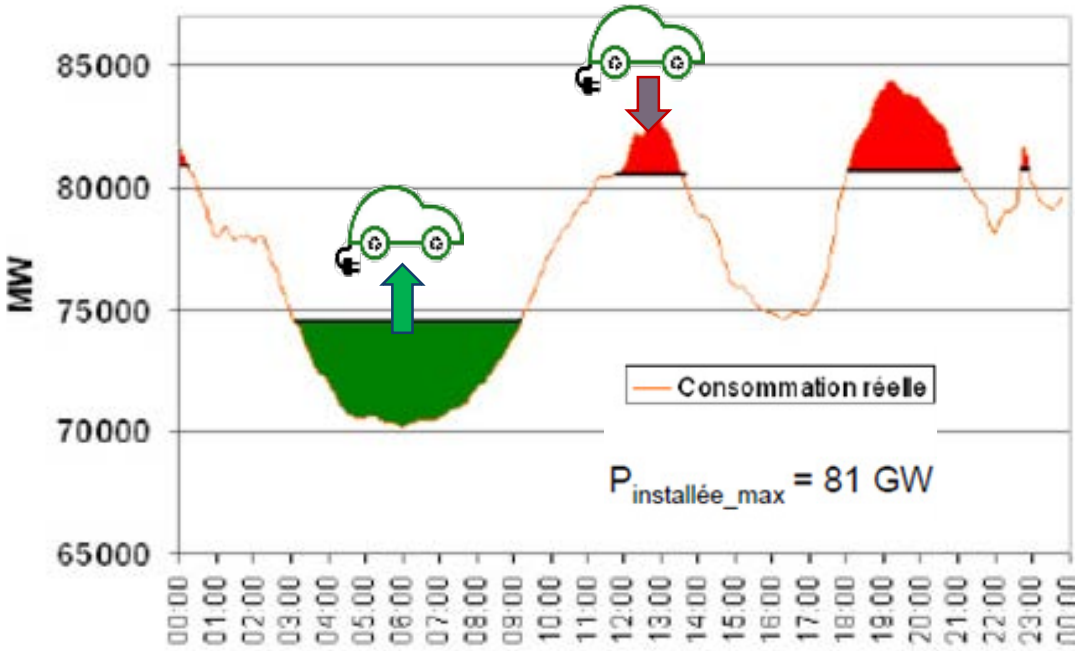


- An opportunity to offer services and generate values for customers
- Need of a bi-directional charger
- The battery needs to be compatible with specific charging / discharging profiles

The charging challenge

- Increase of BEV mix → potential local grid issues
- V2G offers an opportunity for smart management of energy
  - Increasing renewable energy sources compatibility

Electric production vs consomption
(French typical day 2015)



Charging demand increasing
- → Power issues : local grid congestion
- → But controllable (Smart-Charge)

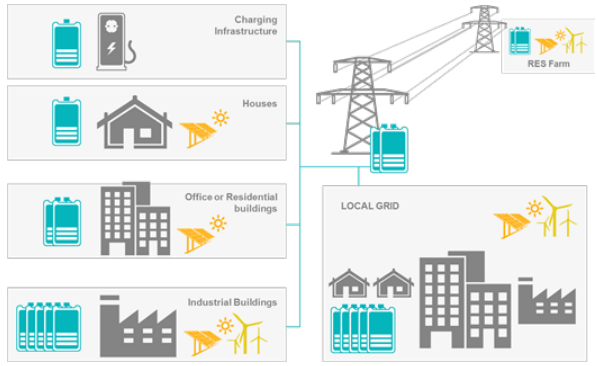
Battery Storage capacity increase
- → Not an Energy Issue
- → Distributed energy storage potential opportunity (Smart-Grid response/demand support)

LI-ION BATTERIE LIFE CYCLE & USE OPTIMISATION

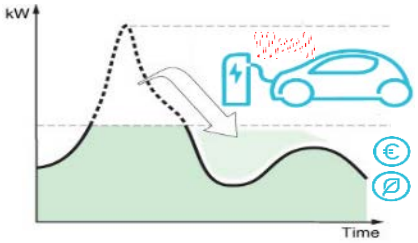
batteries provide electricity stoking services during and after their automotive use before being recycled

→ CO_2 REDUCTION POTENTIAL

2ND LIFE STATIONARY STORAGE :
PROVIDING GRID SERVICES (FREQ. REGULATION)
- SUPPORT RENEWABLE USE
- LIMIT THE USE OF PEAK POWER PLANTS

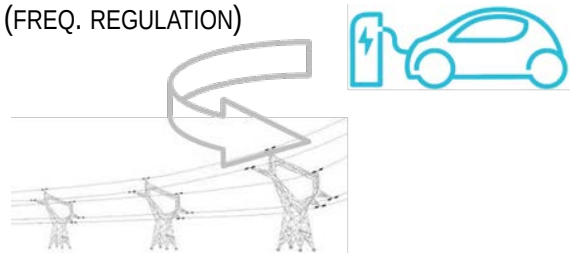


PRODUCTION: BASED ON NMC CONTENT
- RENEWABLE ENERGY USE (REFINING)

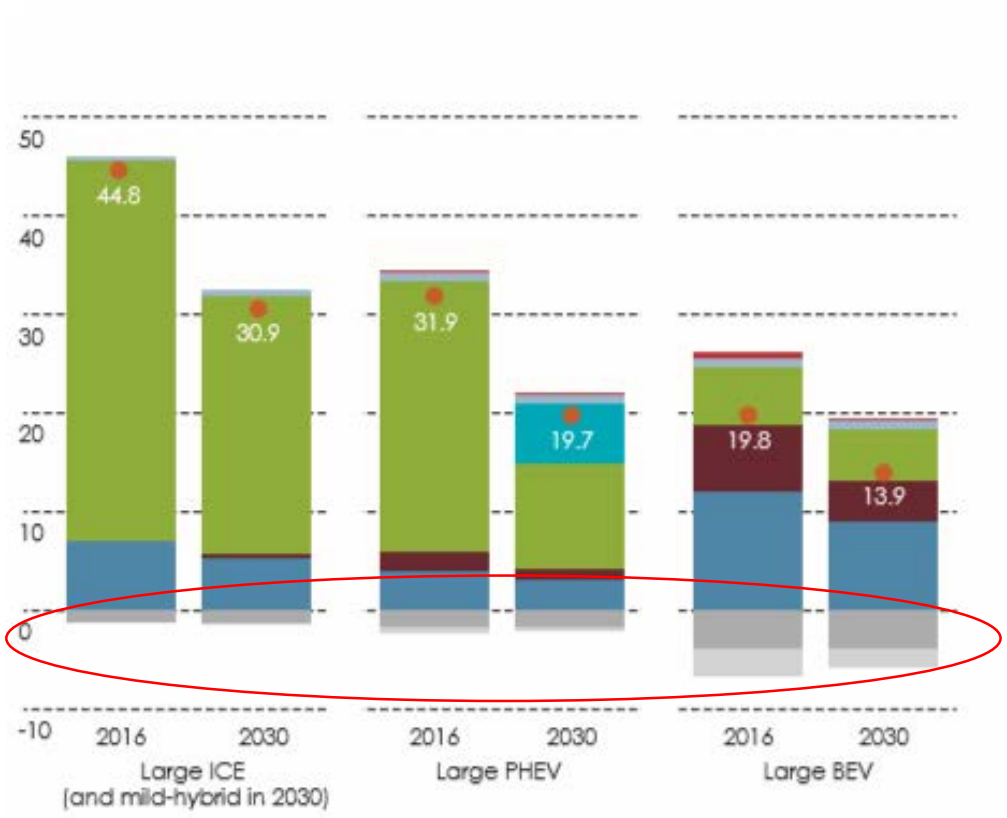


SMART CHARGING* : CONTROLLED CHARGING TO OPTIMIZE
- RENEWABLE ENERGY USE
- GRID INFRASTRUCTURE INVESTMENT

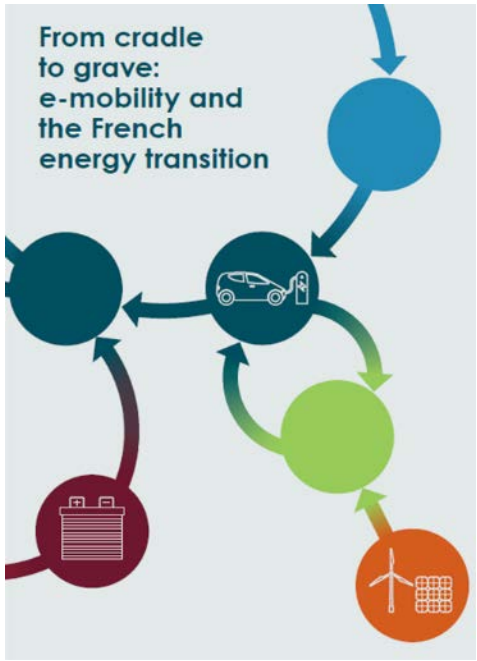
VEHICLE TO GRID*: PROVIDING GRID SERVICES (FREQ. REGULATION)
- SELF CONSUMPTION
- MICROGRIDS CONSUMPTIONS



RECYCLING CO_2 benefit



Global warming potential: 2016-2030 results compared for the saloon car sector (t CO2–eq.)



European Climate Foundation

FONDATION NICOLAS HULOT POUR LA NATURE ET L'HOMME

reseau action climat france

WWF

Climate and energy: the advantages of e-mobility in the energy transition

Synthesis

- Environnemental stakes: Climat , ressources, efficiency
- Technologies scope : ICE HEV PHEV BEV FCEV
- Metrics : TTW WTW LCA
- Results : dependance on technologies, on energy production mix
- Anlyse with different view angles : RDE, TCO, techno trend
- Perspectives & opportunities : Smart grid services, second life, recycling

MOVING FORWARD TOGETHER*

*PROGRESSONS ENSEMBLE

Coordonnées de la personne qui fait la présentation

À contacter

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