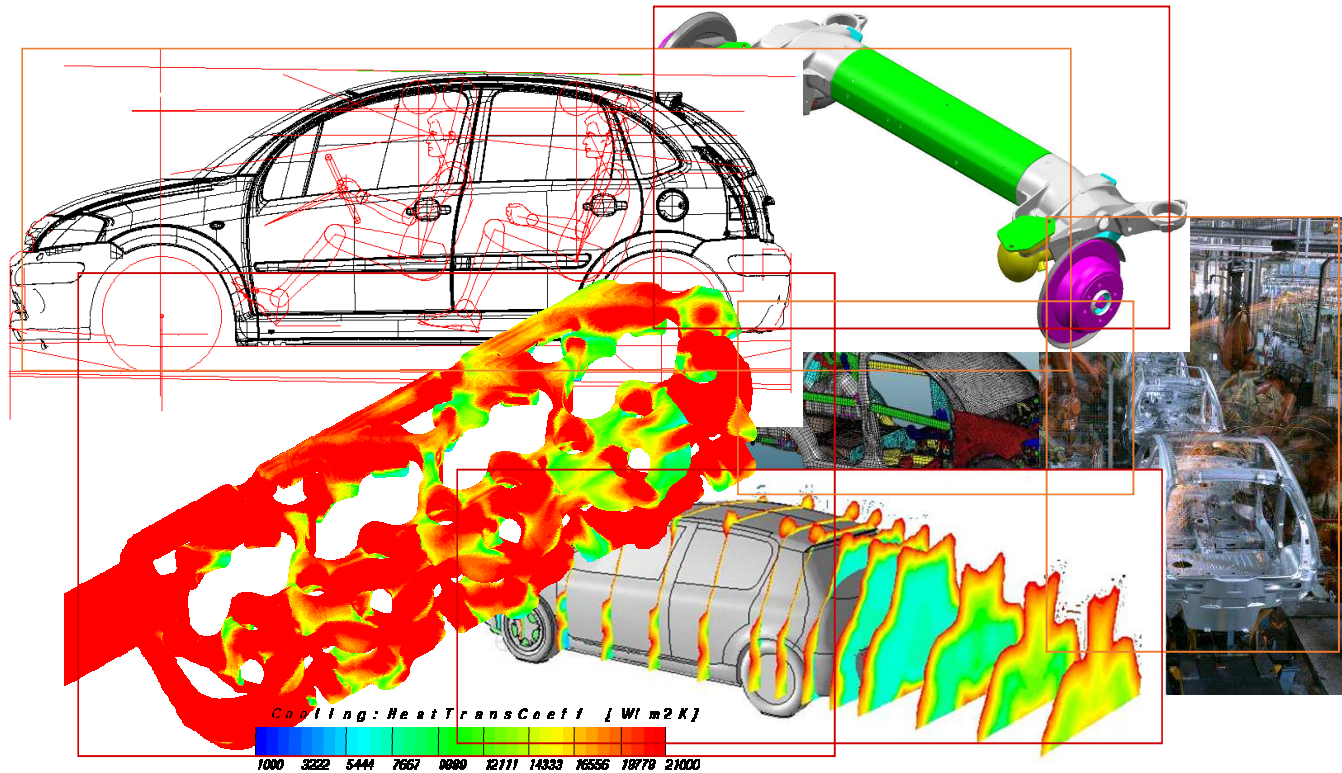
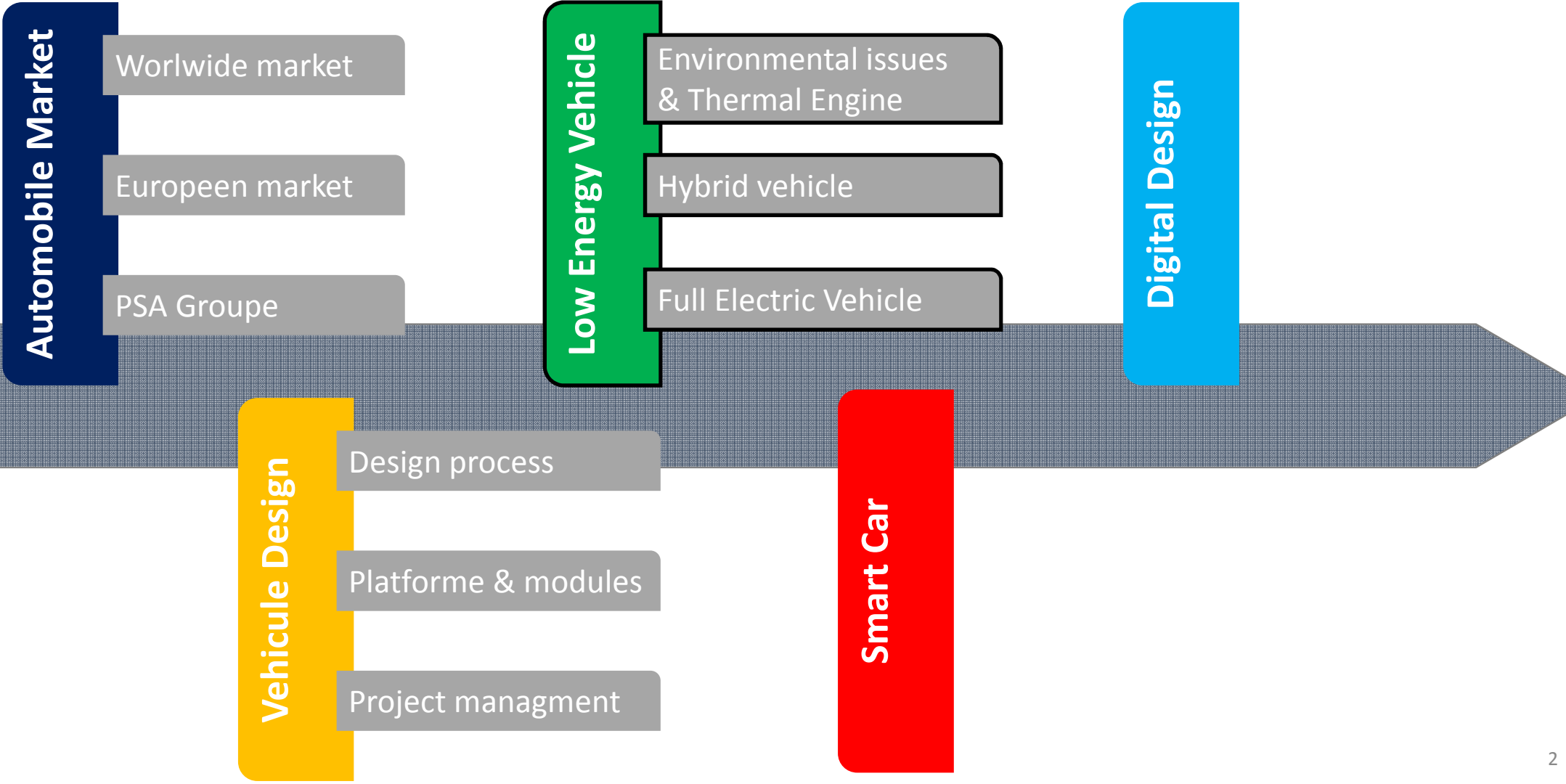


Vehicle System Design



Module description



Summary



- 1- Air Pollution
- 2- Thermal Engine
- 3- Hybrid vehicles
- 4- Electrification of vehicles
- 5- Other solutions

Summary



1- **Air Pollution**

2- Thermal Engine

3- Hybrid vehicles

4- Electrification of vehicles

5- Other solutions

Air pollution

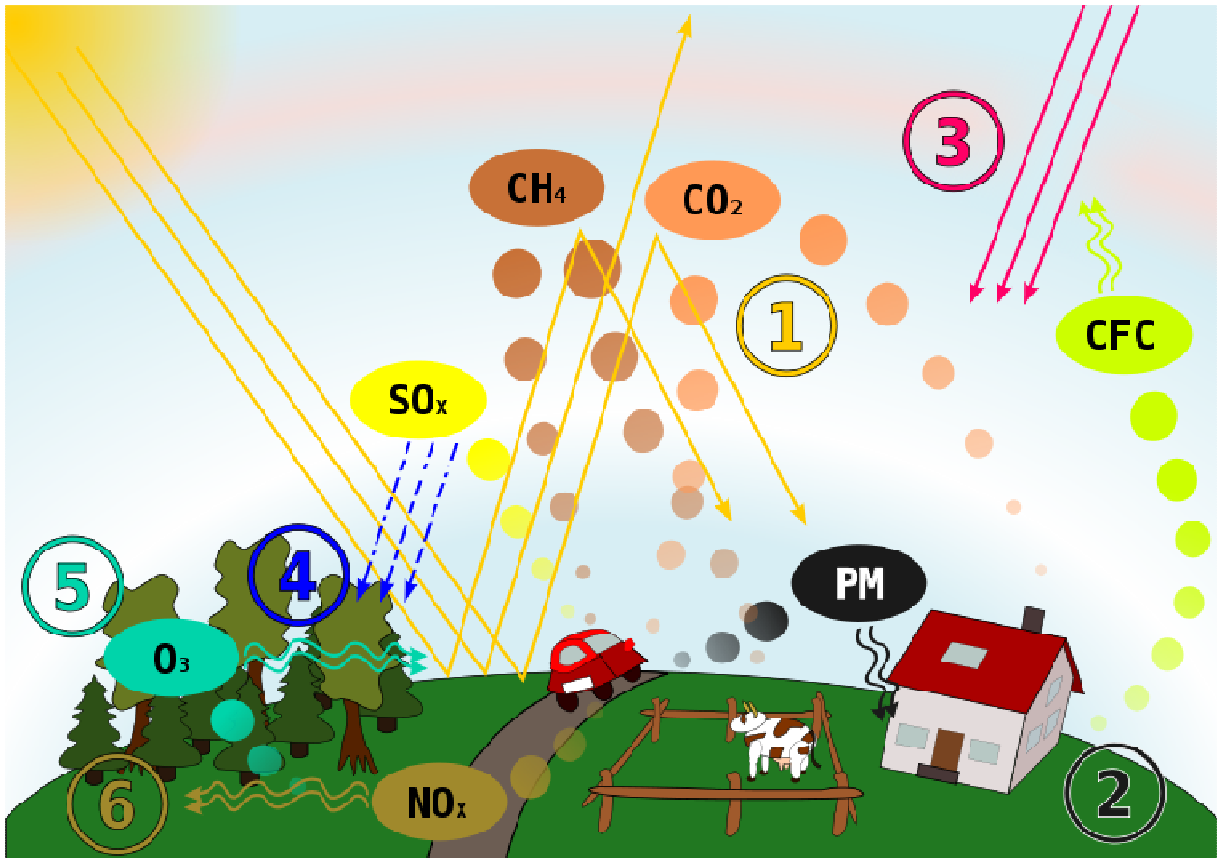
Carbon dioxide (CO₂)

Sulfur oxides (SO_x)

Nitrogen oxides (NO_x)

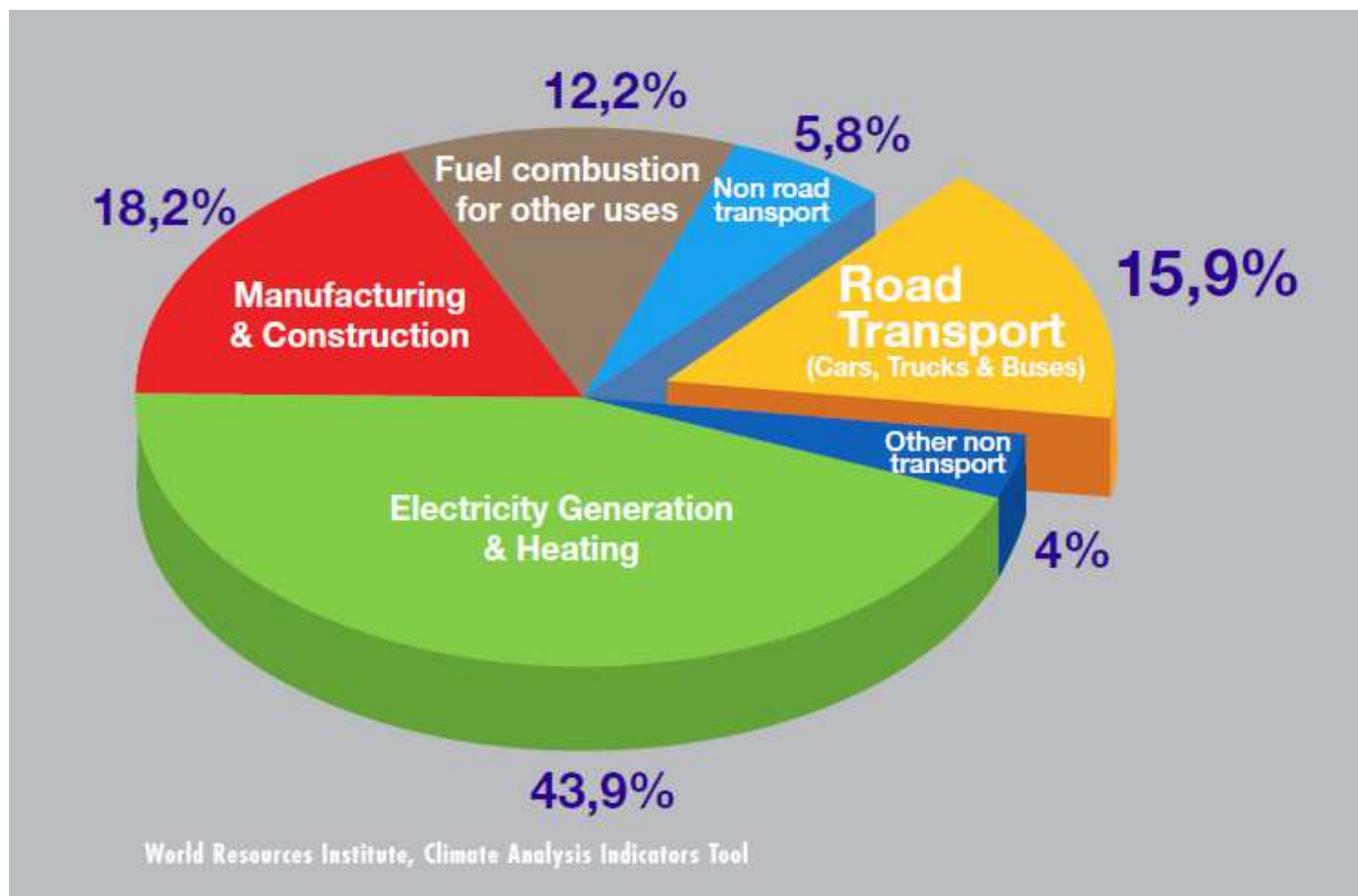
Carbon monoxide (CO)

Particulates
(Particulate Matter)

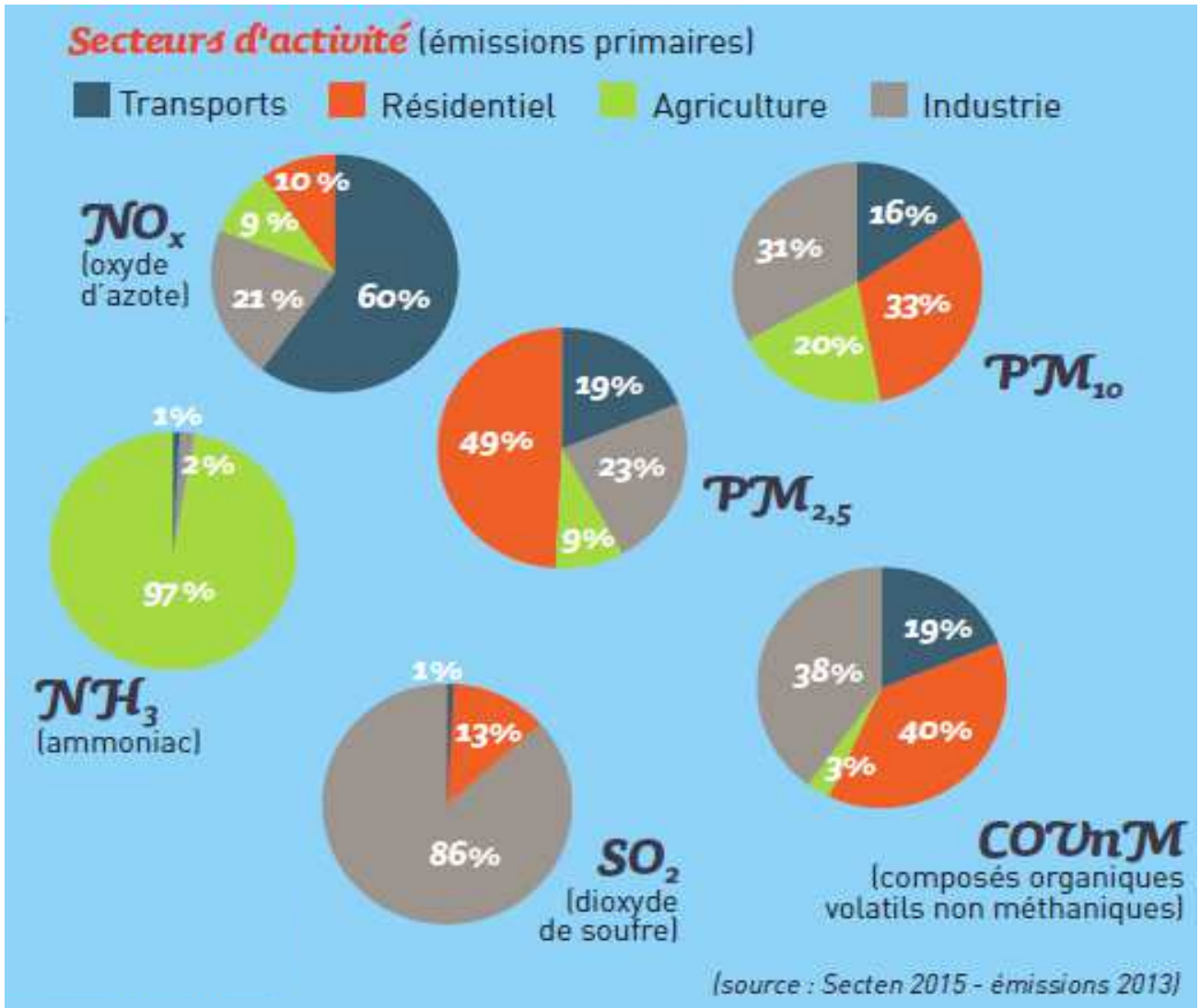


By chris - This file was derived from: Luftverschmutzung-Ursachen&Auswirkungen.svg

Air pollution – transport part

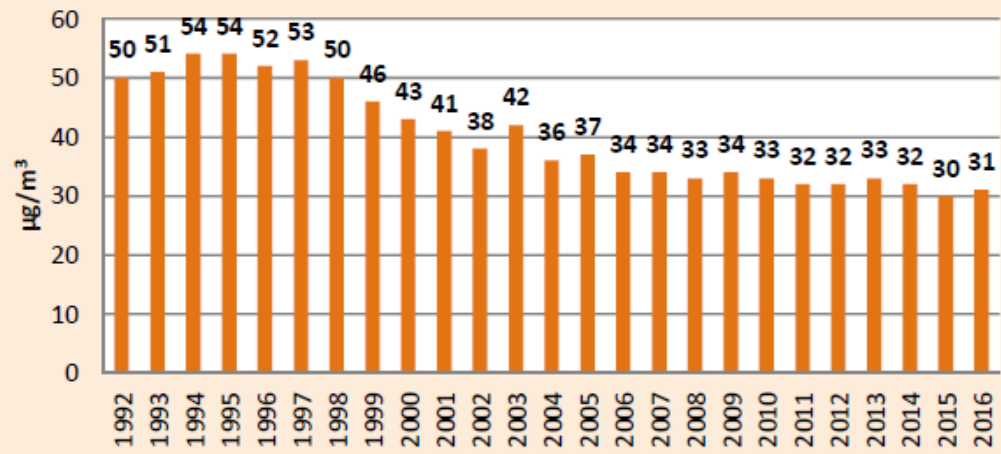


Air pollution – Transport part

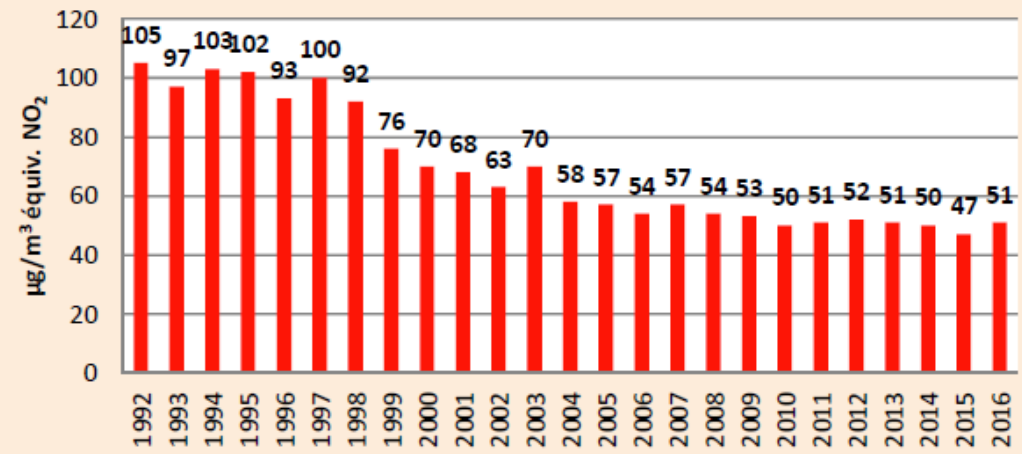


Air pollution – Evolution (Paris)

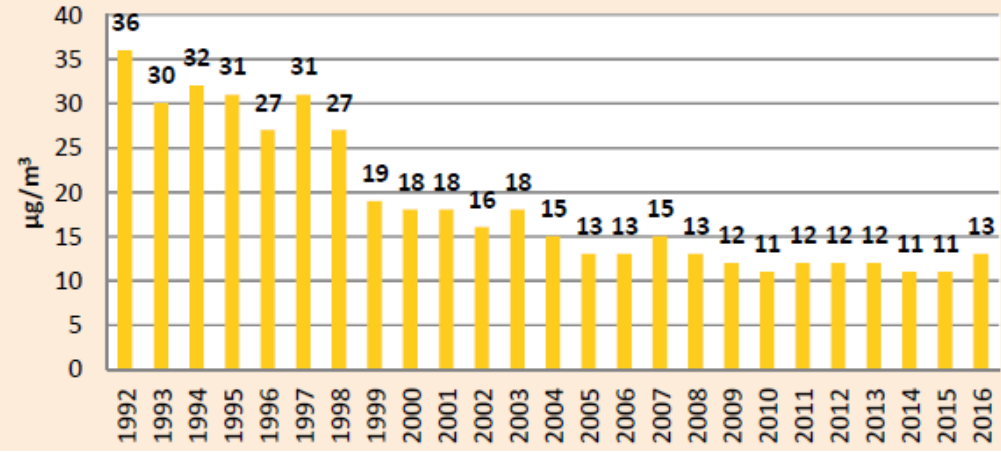
Dioxyde d'azote NO₂



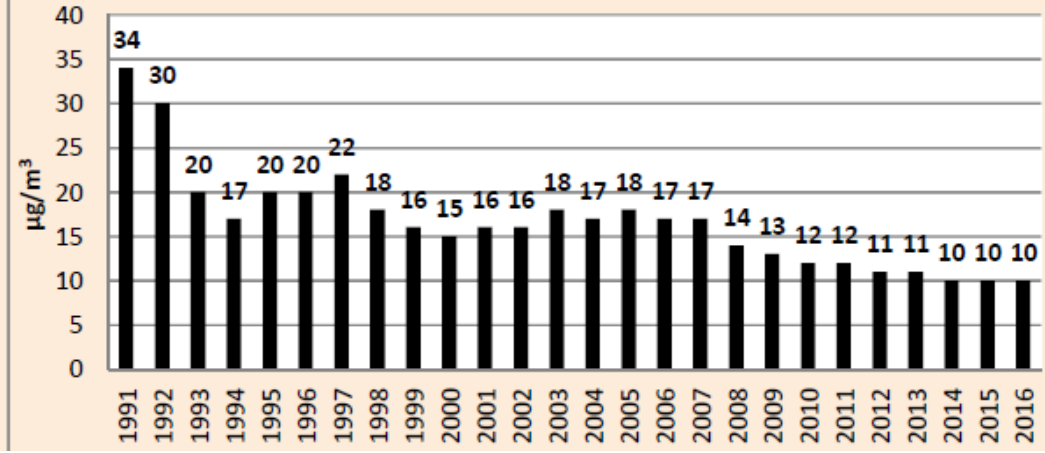
Oxydes d'azote NOx



Monoxyde d'azote NO



Fumées noires



Summary



1- Air Pollution

2- **Thermal Engine**

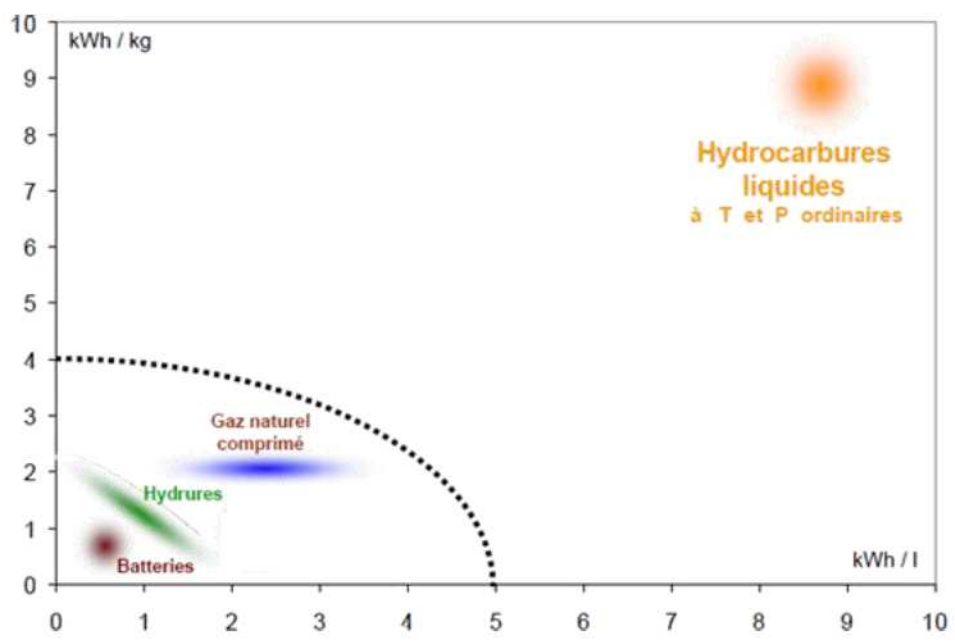
3- Hybrid vehicles

4- Electrification of vehicles

5- Other solutions

Thermal Engine

Why a reminder about thermal Engine



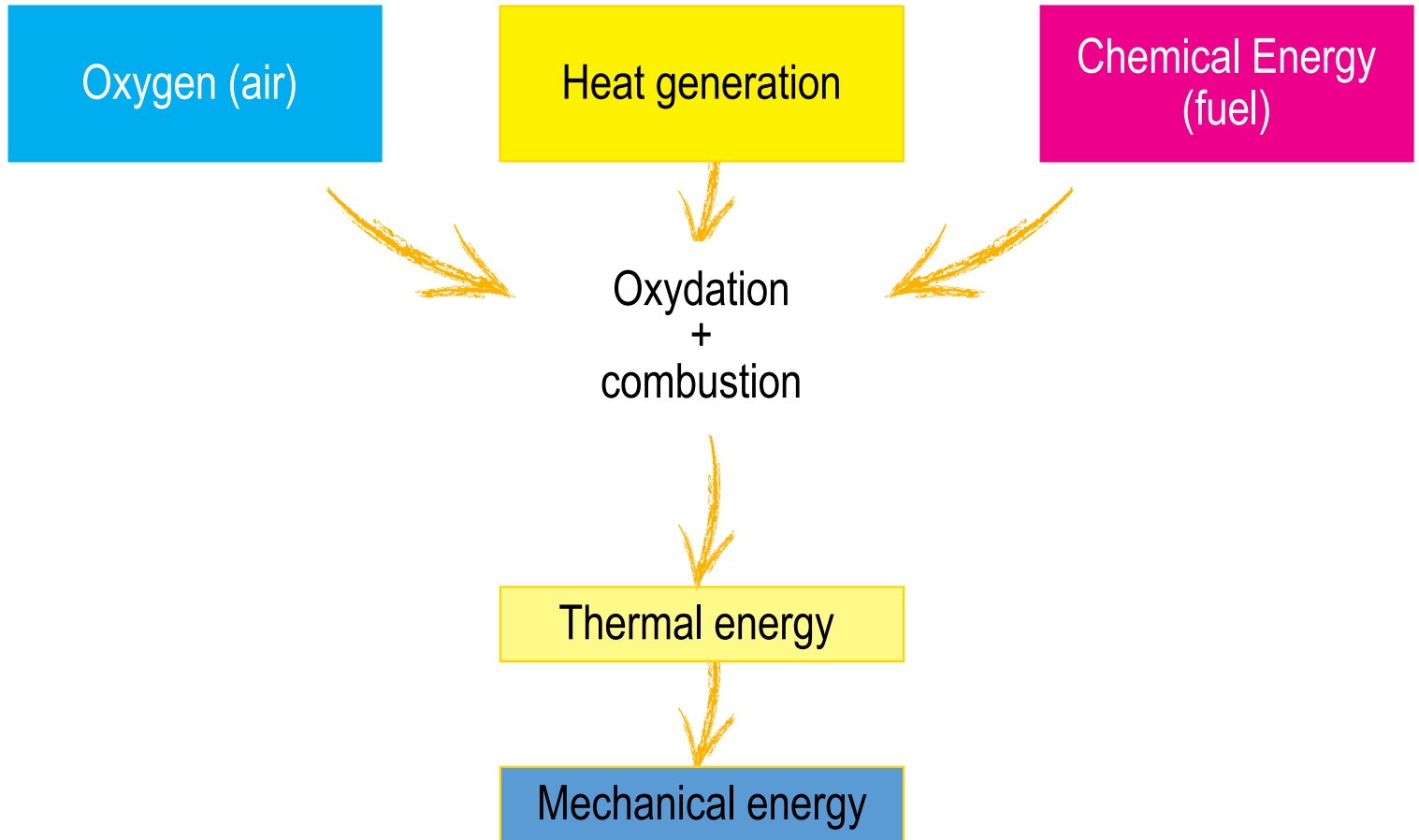
➔ Because it is not completely the end

Thermal Engine

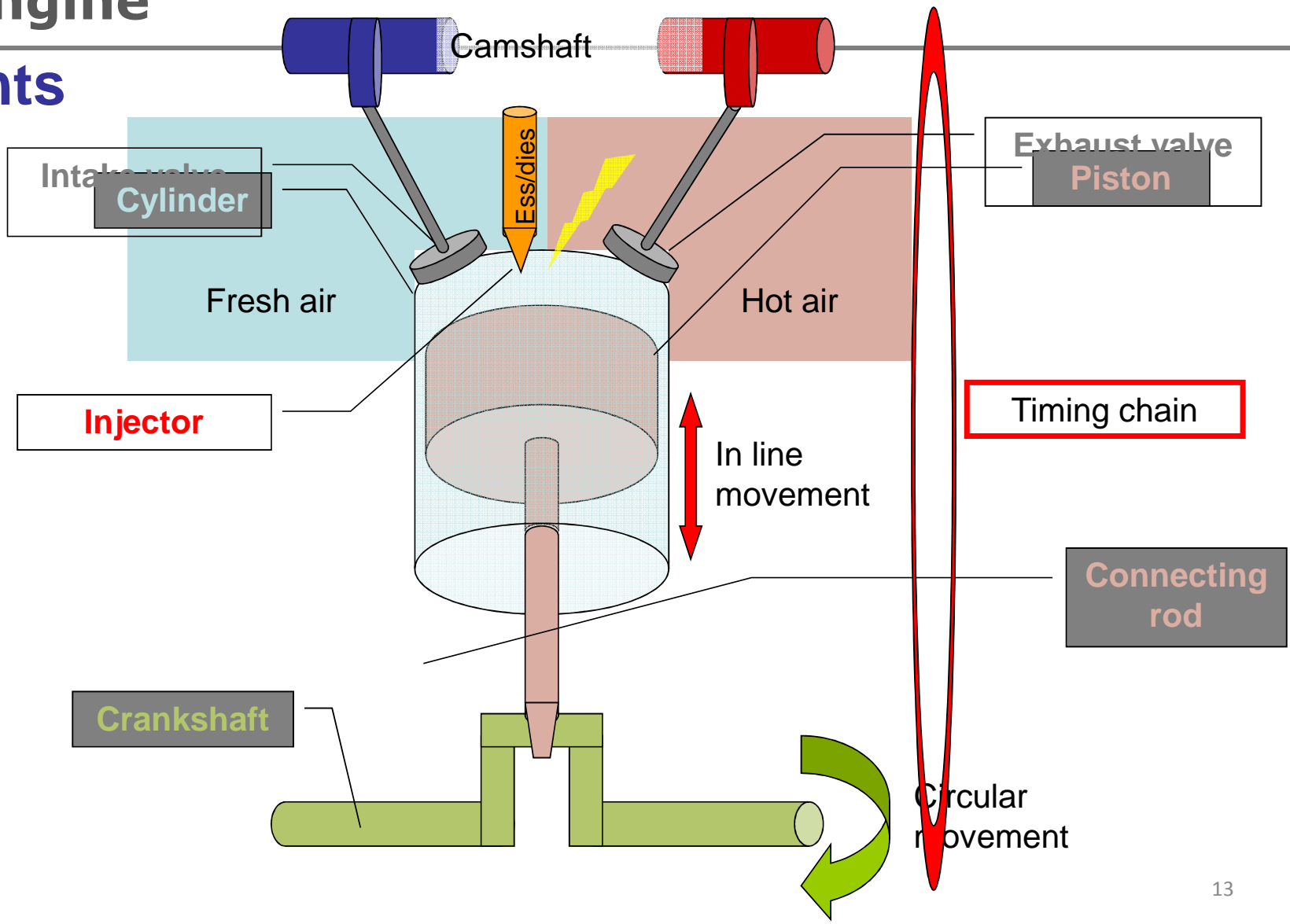
- To change chemical energy of gasoline in mechanical energy :
 - ➔ Combustion Engine

- To to that, we must have in the combustion chamber at the same moment :
 - ➔ Fuel (Gasoline, Diesel ...)
 - ➔ Combustion air
 - ➔ Heat source.

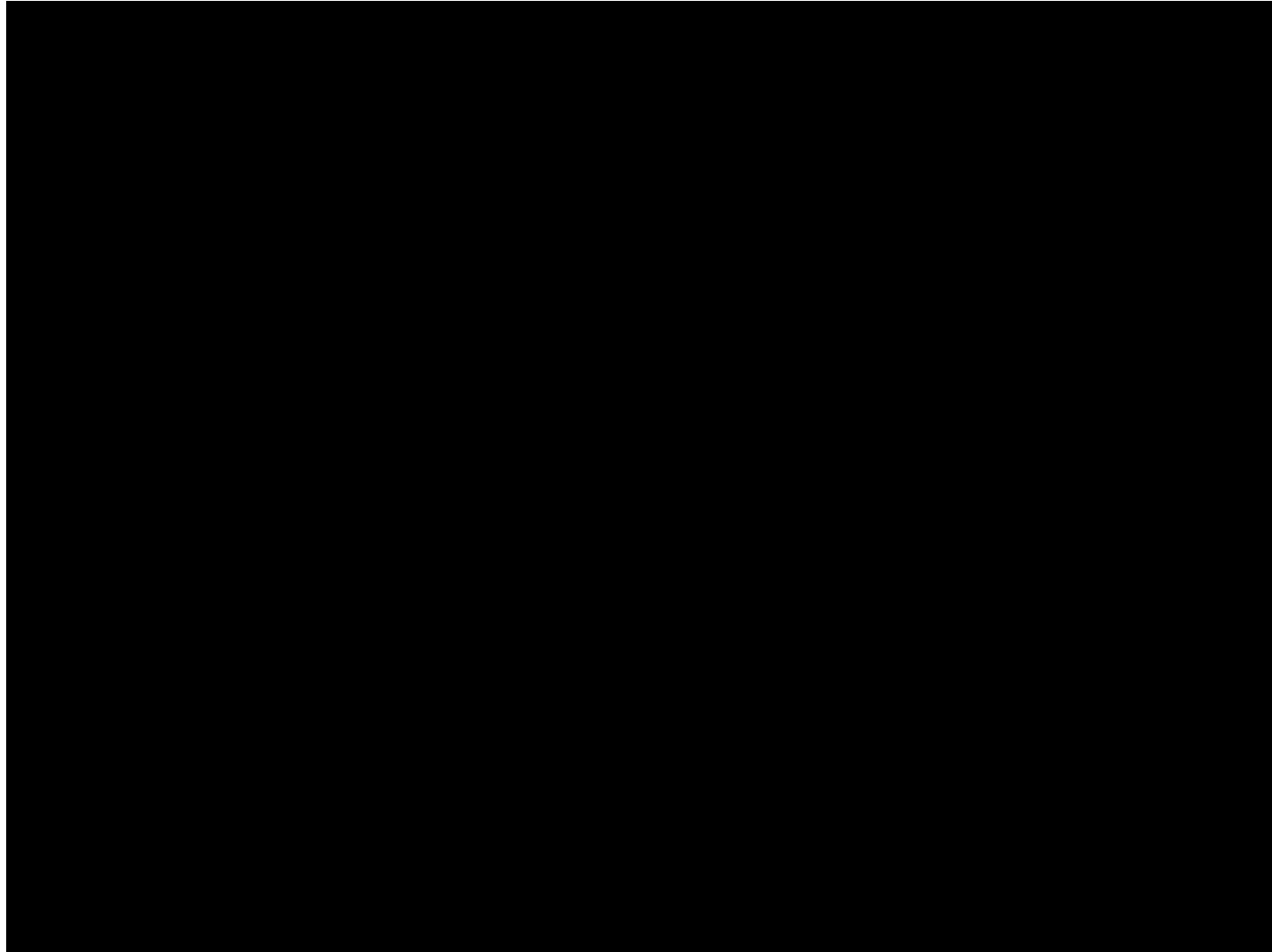
Thermal Engine



Thermal Engine Components

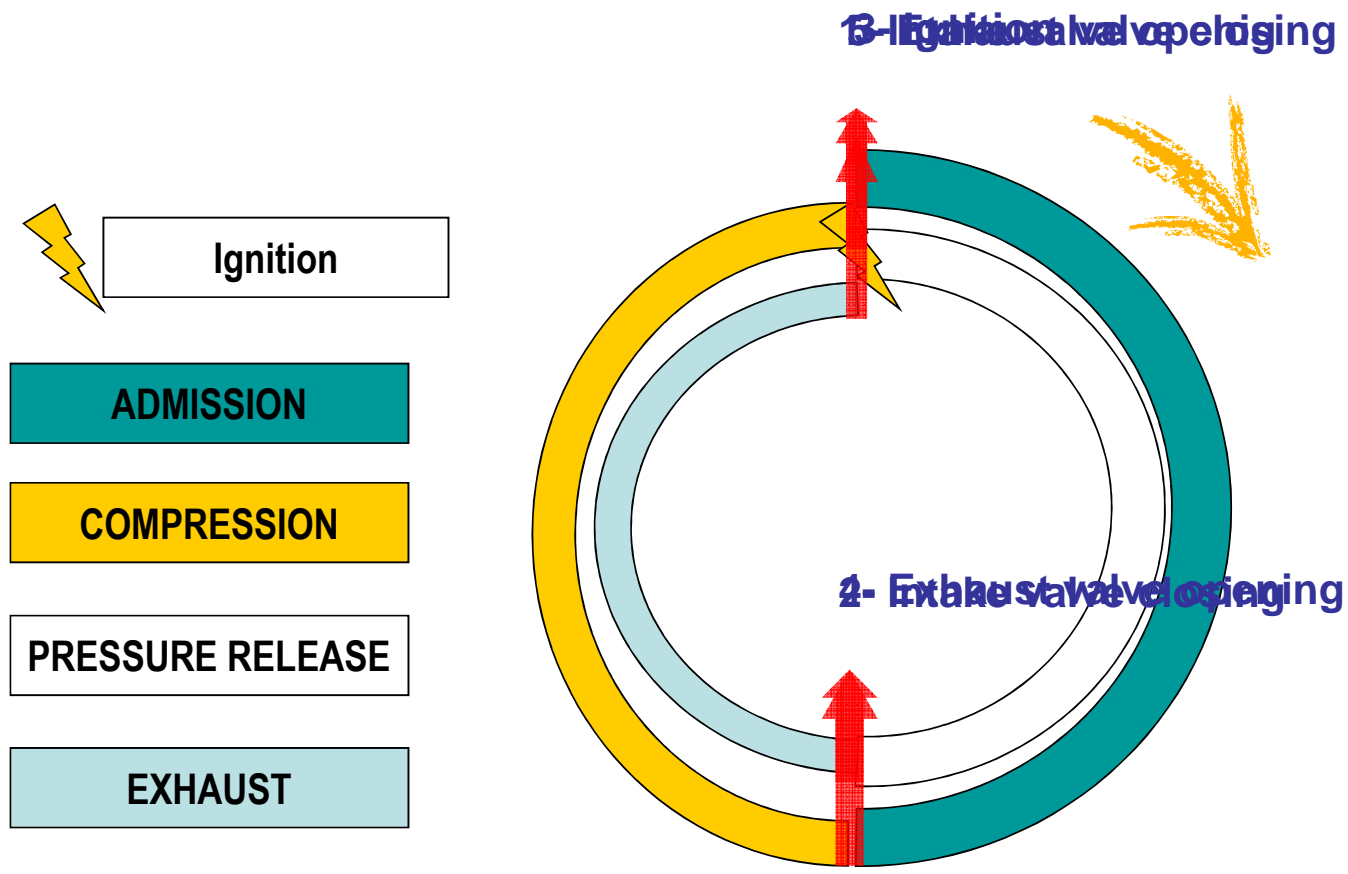


Thermal Engine

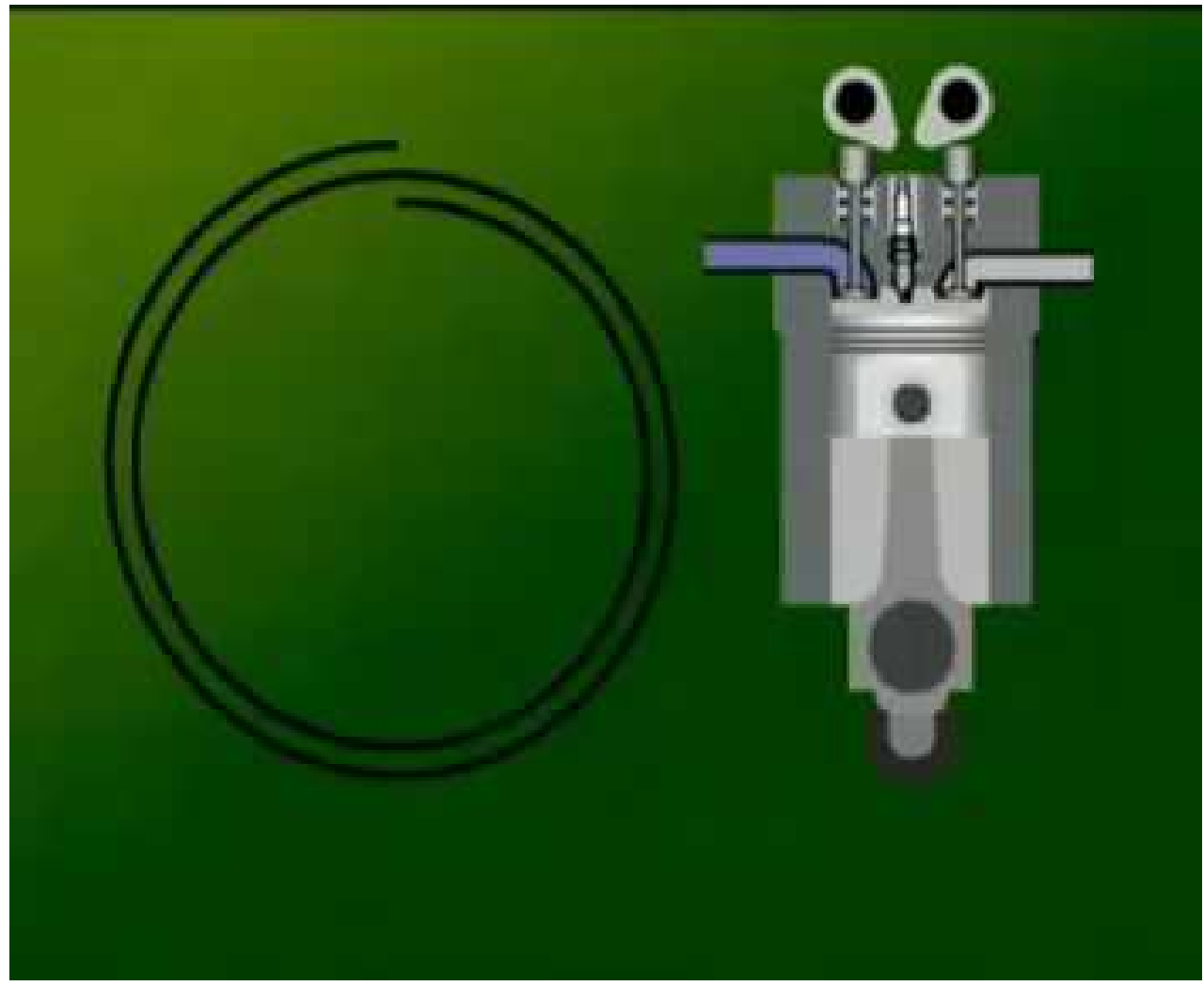


Thermal Engine

Timing circular diagram (Theoretical)



Thermal Engine



Thermal Engine

Injection

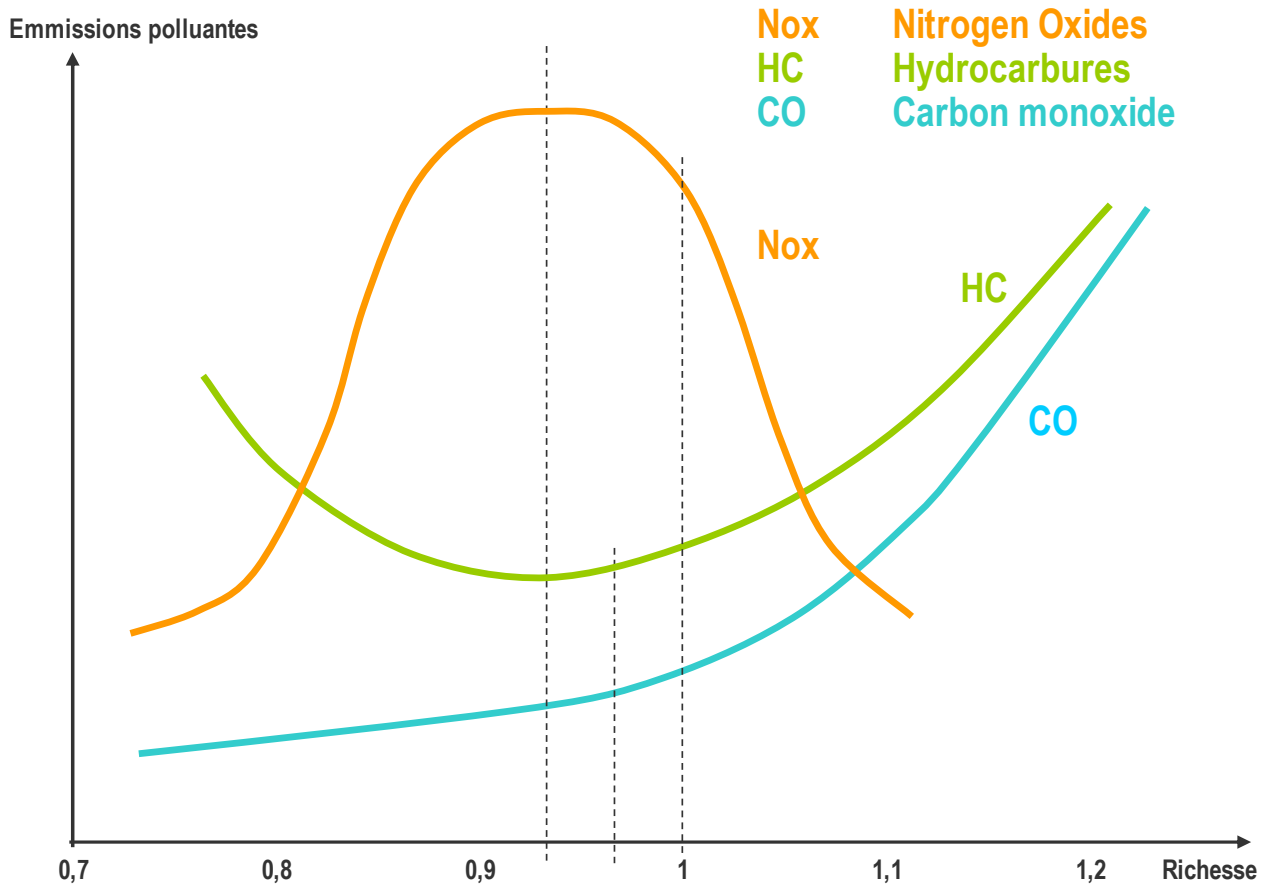
Air / Gazoline metering

- ➔ Ideal combustion (complete) of hydrocarbons in the engine should release only $\text{CO}_2 + \text{H}_2\text{O} + \text{N}_2$
- A good metering :
 - Leads to burn completely the mixture
- A gaz mixture:
 - Allows a fast burning
- An homogenous mixture :
 - Allows a fast and complete burning of the mixture






Thermal Engine

Pollution / richness



Thermal Engine - Depollution

Depollution at the source

- Injection : to minimize the consumption of gasoline (common rail) 
- Advance admission / Retarded exhaust 
- EGR : exhaust gas recirculation 
- But also : Friction, mass, SCx optimization ...

Thermal Engine - Depollution

Exhaust gaz depollution

- Catalytique convertor (HC & CO)
- Particule filter (particulates)
- SCR (Nox)



Summary



1- Air Pollution

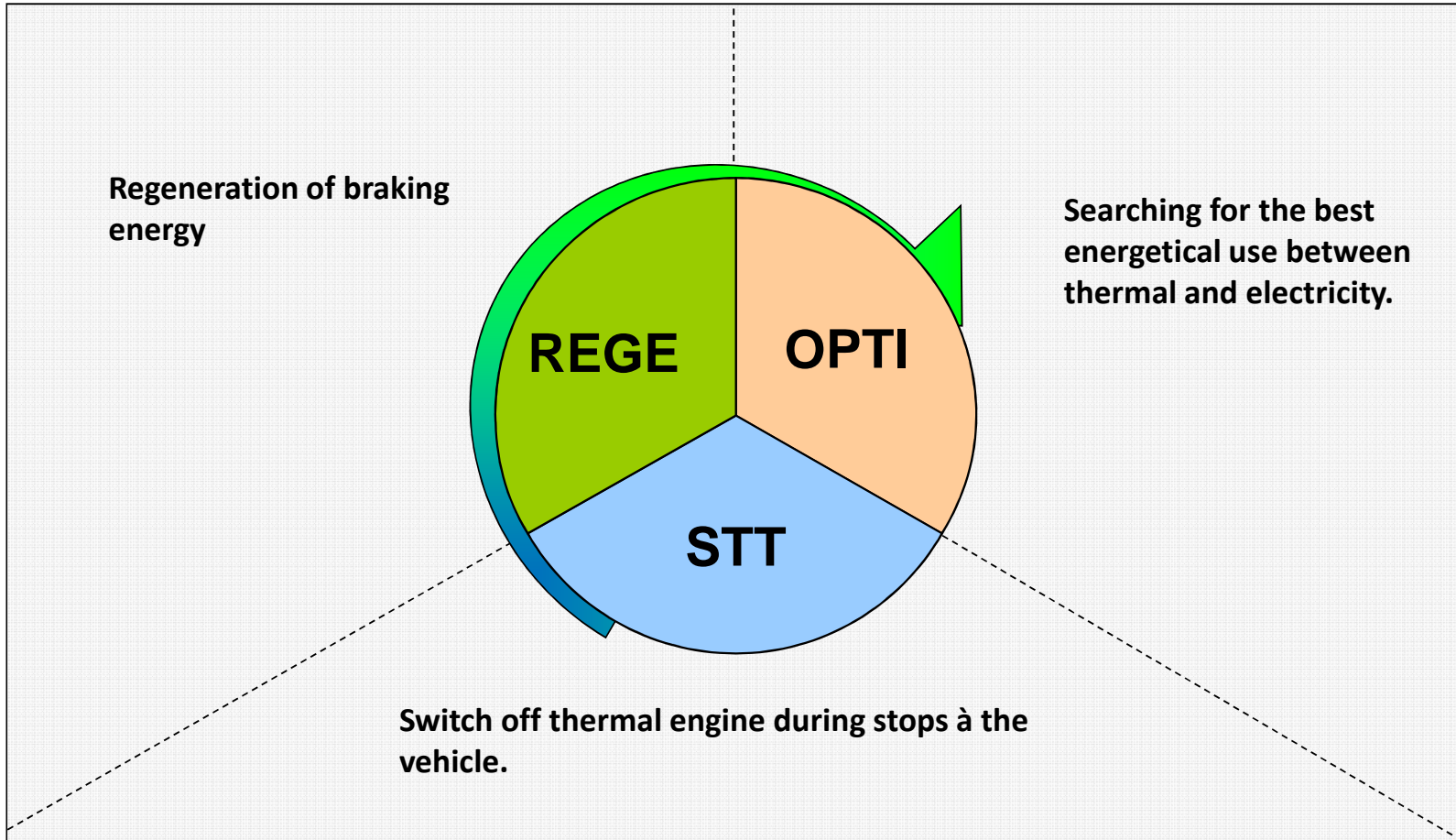
2- Thermal Engine

3- Hybrid vehicles

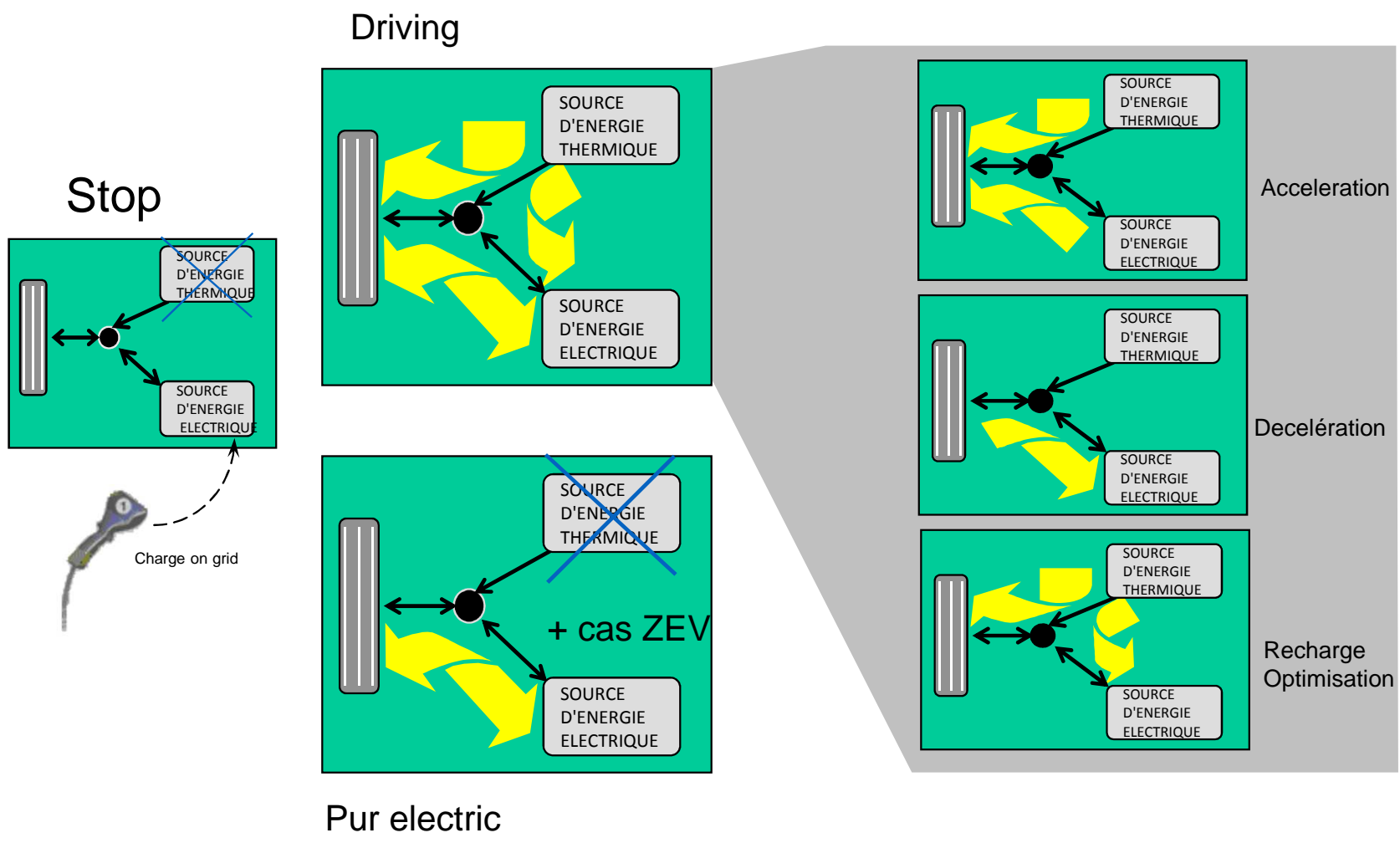
4- Electrification of vehicles

5- Other solutions

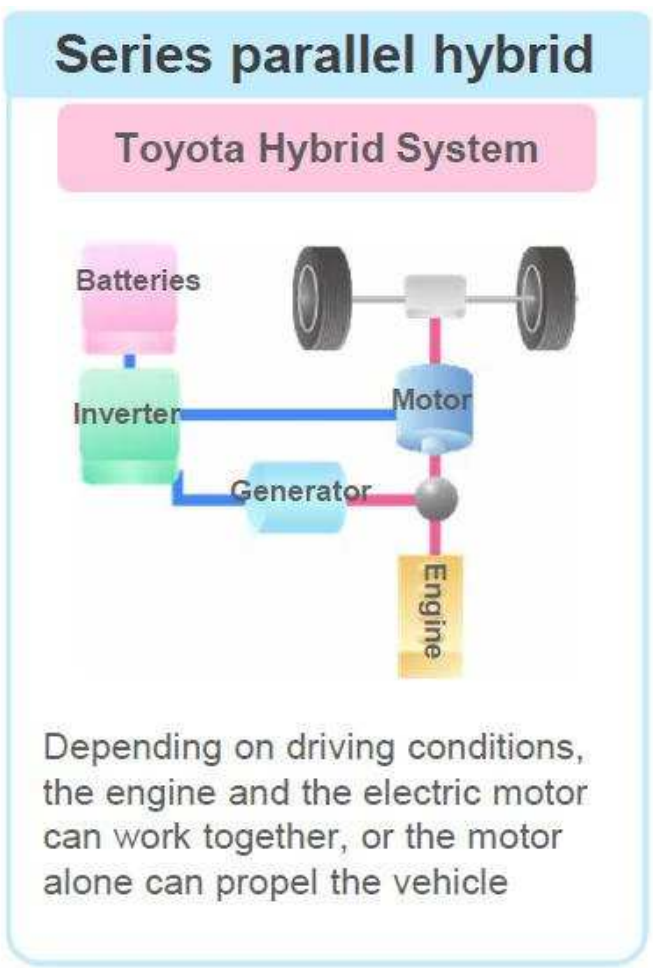
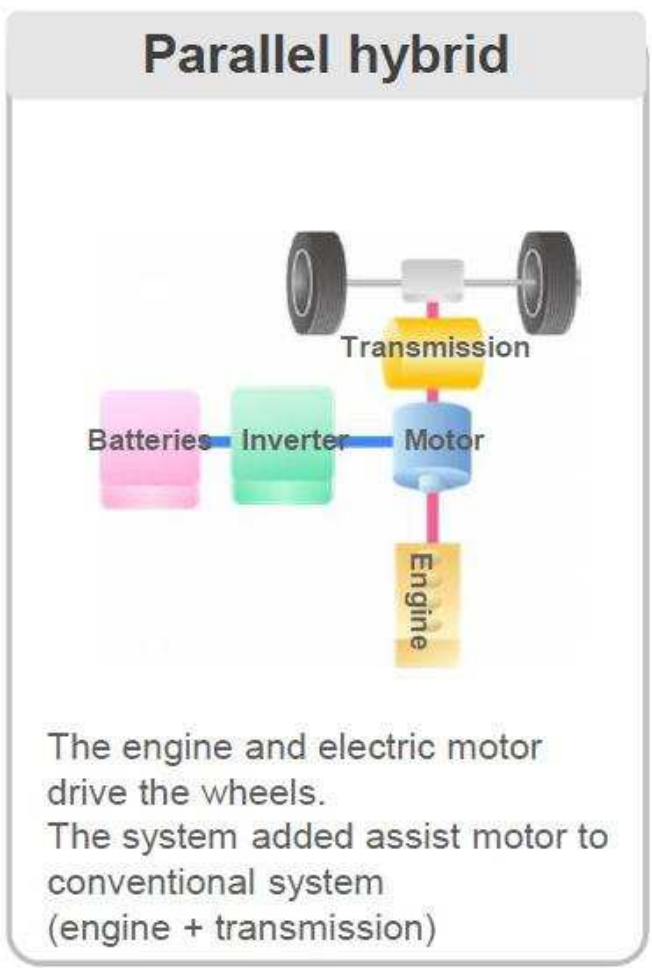
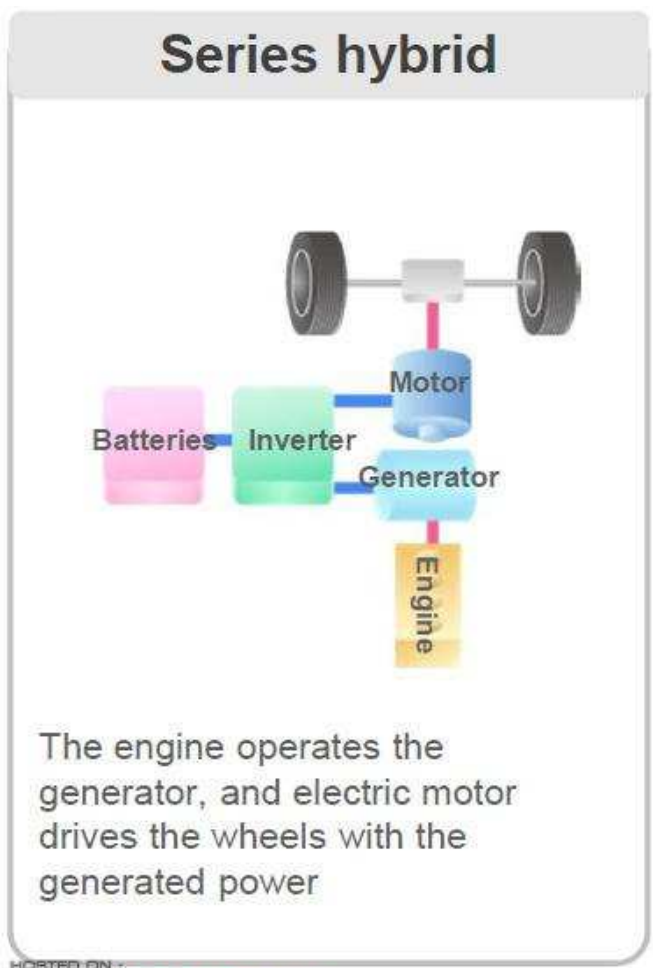
Hybrid vehicles



Hybrid vehicles

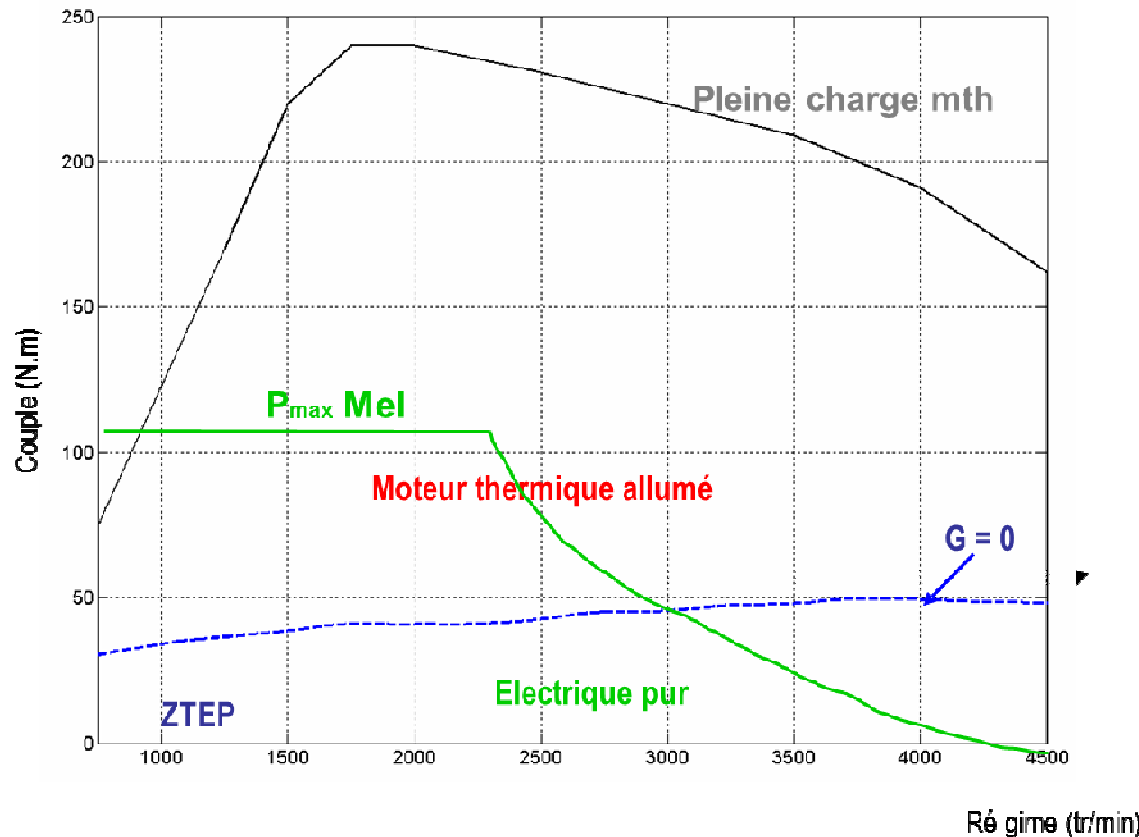


Hybrid architectures



Hybrid vehicles – Energy optimization

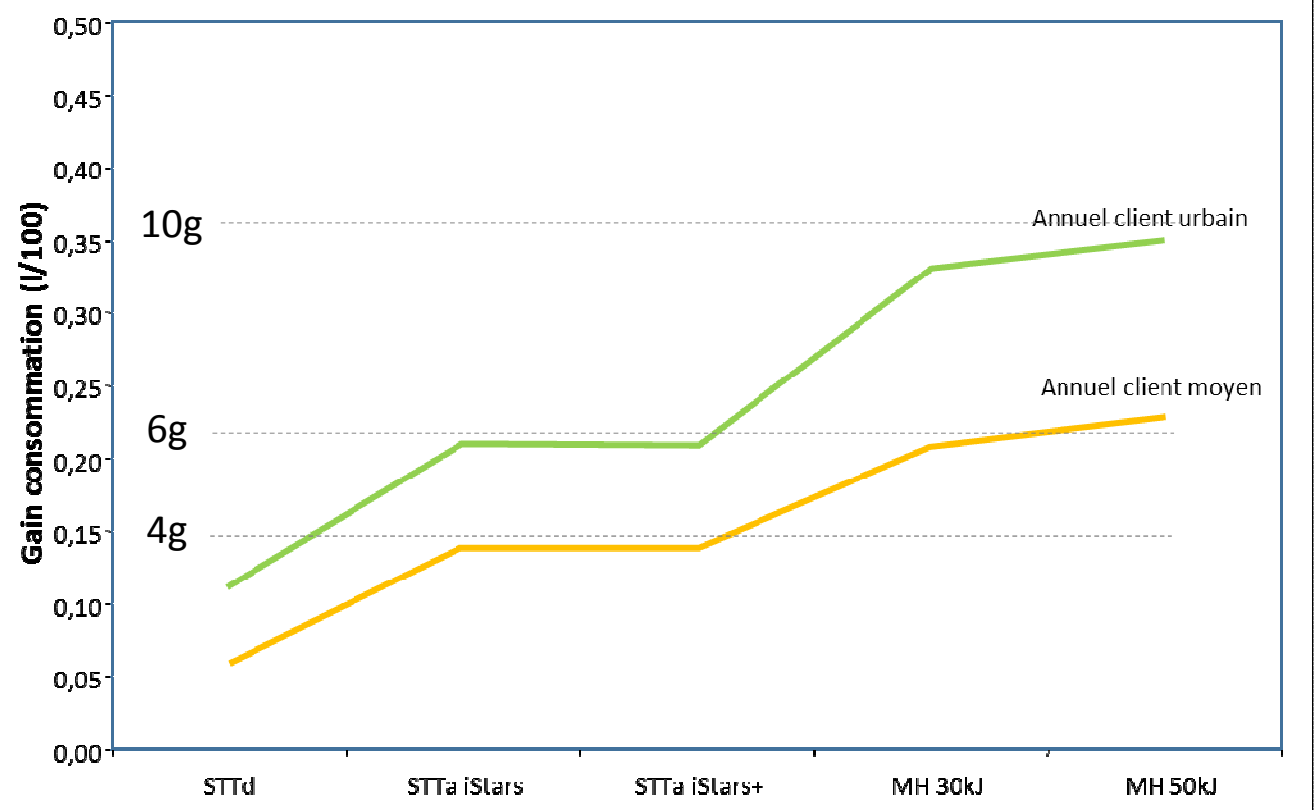
- Intest of optimization :
 - ZTEP characterize the interes of an engine to be hybrided
 - The limit define the most enegertically profitable zone between thermal and electric driving.



- A thermale engine has a bad efficiency when it is not charged
- ZTEP = Interesting zone for pur electric driving.
- The mare efficient is the thermal engine the smaller is the ZTEP

Hybrid vehicles – Consumption decrease

Gains consommation UH et STT, motorisation DW10C



Summary



1- Air Pollution

2- Thermal Engine

3- Hybrid vehicles

4- **Electrification of vehicles**

5- Other solutions

Electrification of vehicles – Is it for you ?

Do you use your car to go to work ?

Any week-end with more than 100 km ?

Traffic jam during holidays ?

How many km per day / week / year ?

What is your driving distribution ? City / roads / highway ?

Electrification of vehicles – Battery sizing exercise

3 groups

1- Define the needs

- a- Range
- b- Power

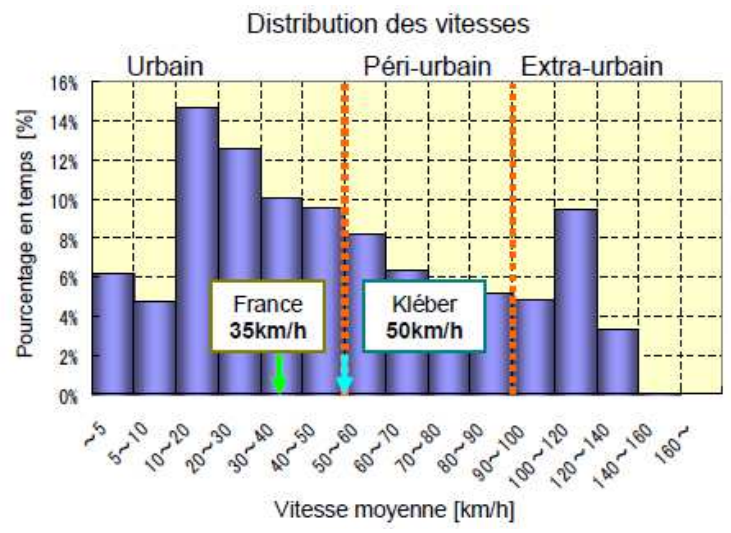
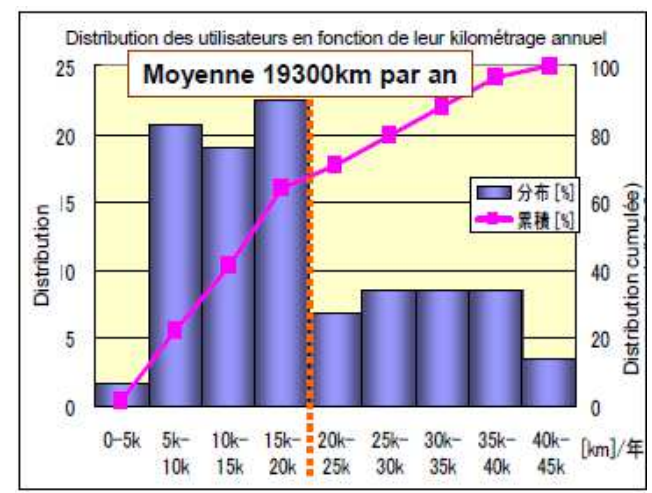
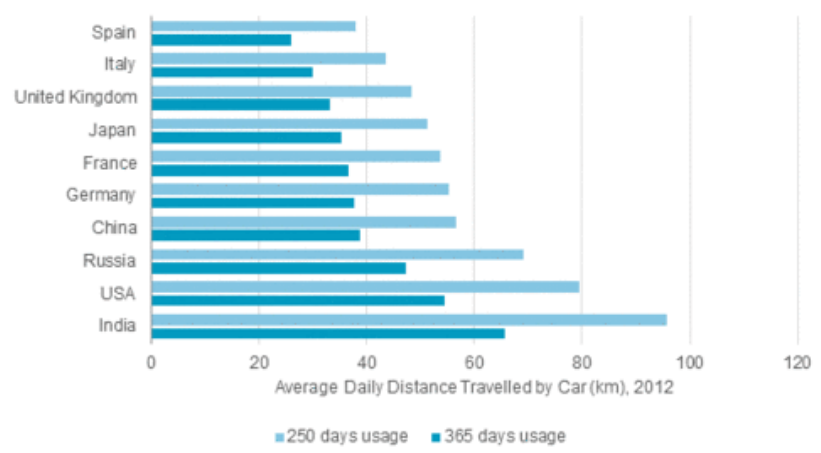
2- Sizing of the battery for:

- a- 70 % of uses (P, E)
- b- 100 % of uses (P, E)

3- Charging time

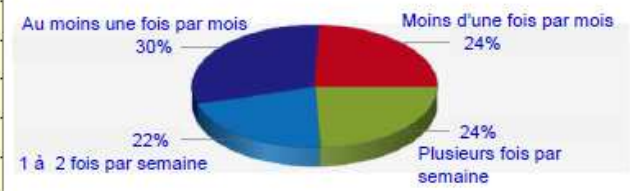


Electrification of vehicles – Customer use



Questionnaire

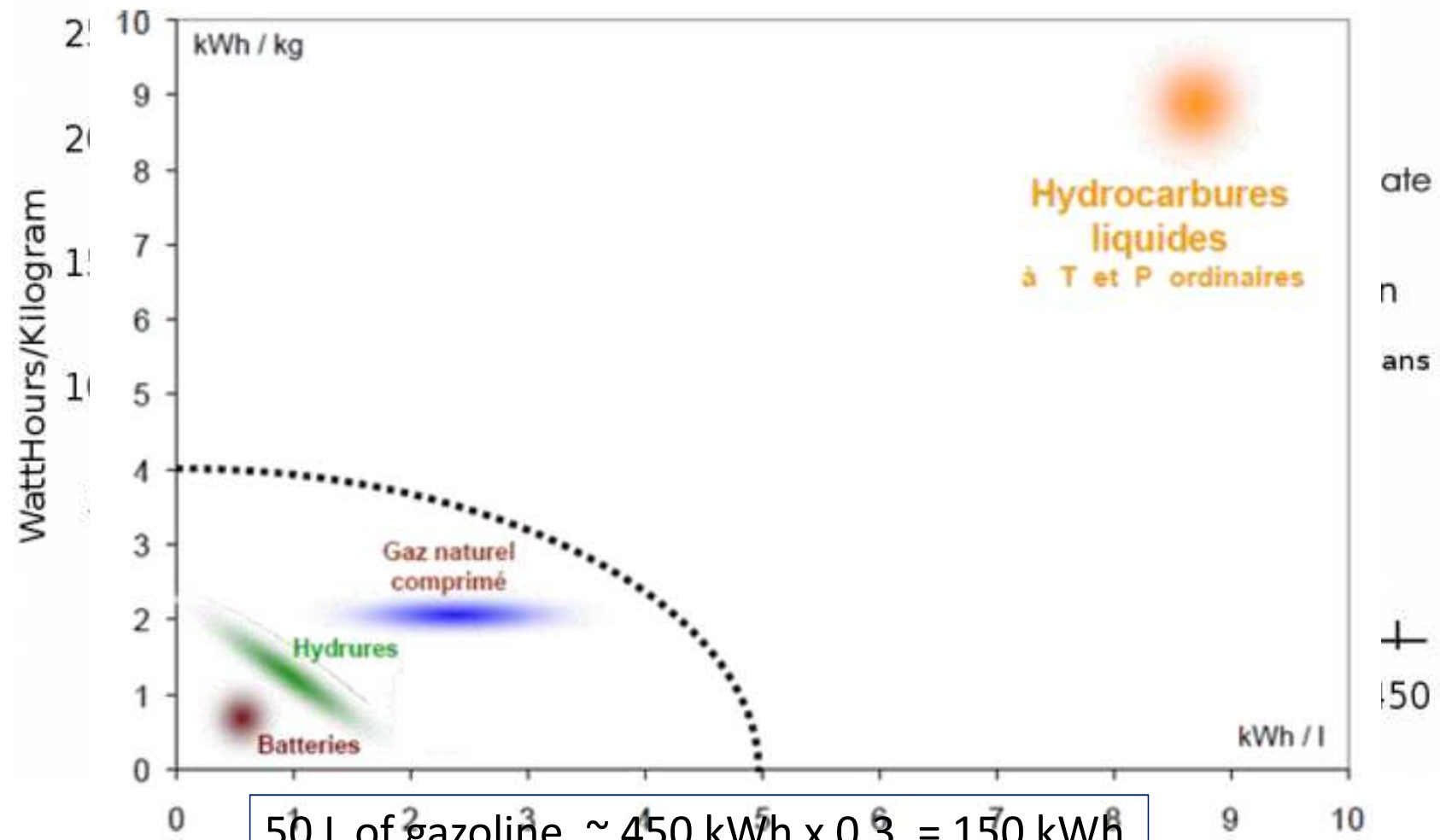
• A quelle fréquence conduisez-vous sur plus de 100 km?



45 % des utilisateurs effectuent plus d'un trajet dépassant les 100 km par semaine ⇒ la possibilité de réaliser sans souci les parcours de longue distance est un des avantages du VHR

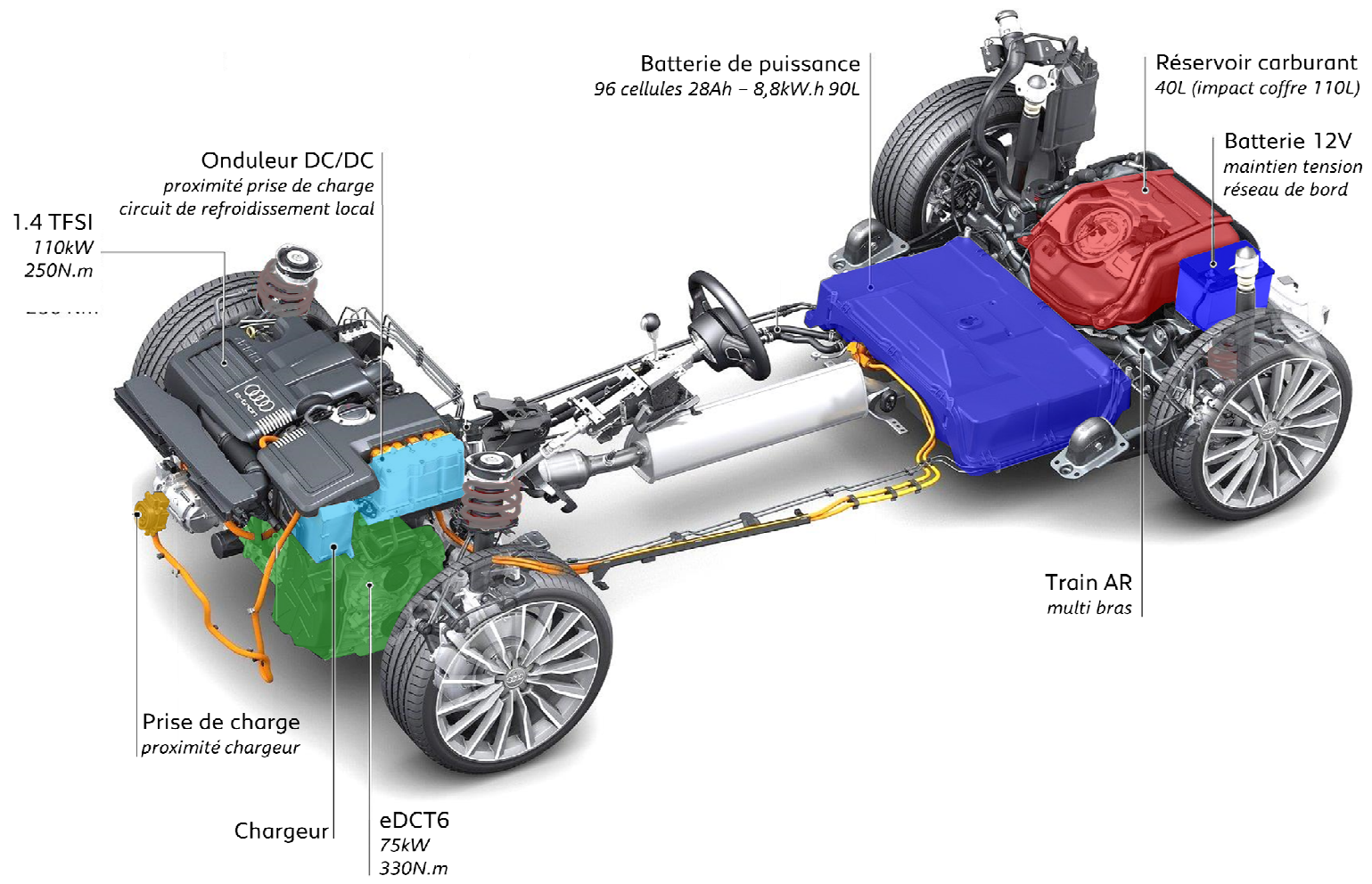


Electric vehicles



50 L of gasoline $\sim 450 \text{ kWh} \times 0,3 = 150 \text{ kWh}$
 $150 \text{ kWh} / 0,9 = 160 \text{ kWh} \Leftrightarrow 640 \text{ kg of cells}$

Hybrid vehicles – Plug-in



PSA

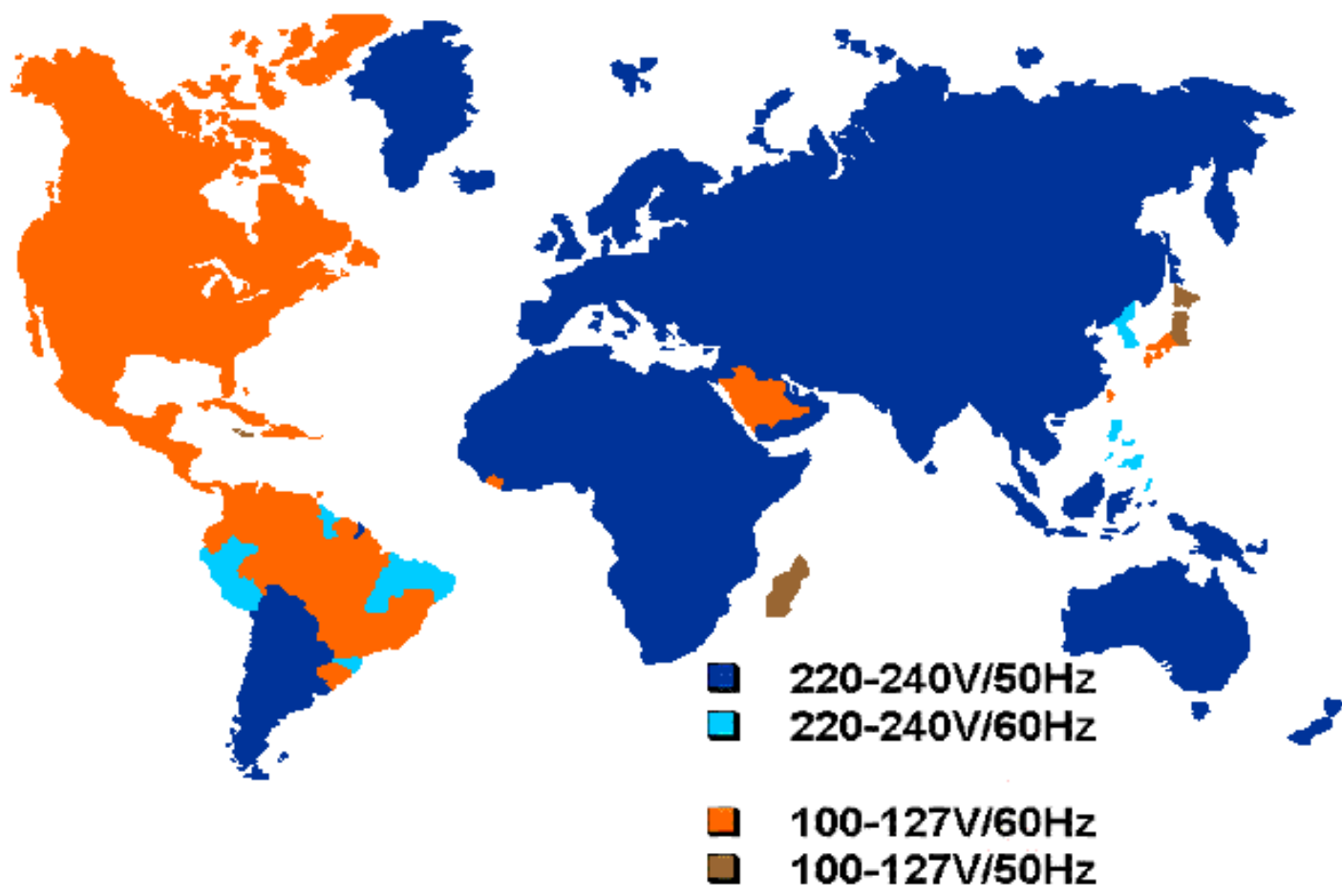
GROUPE

PSA

GROUPE

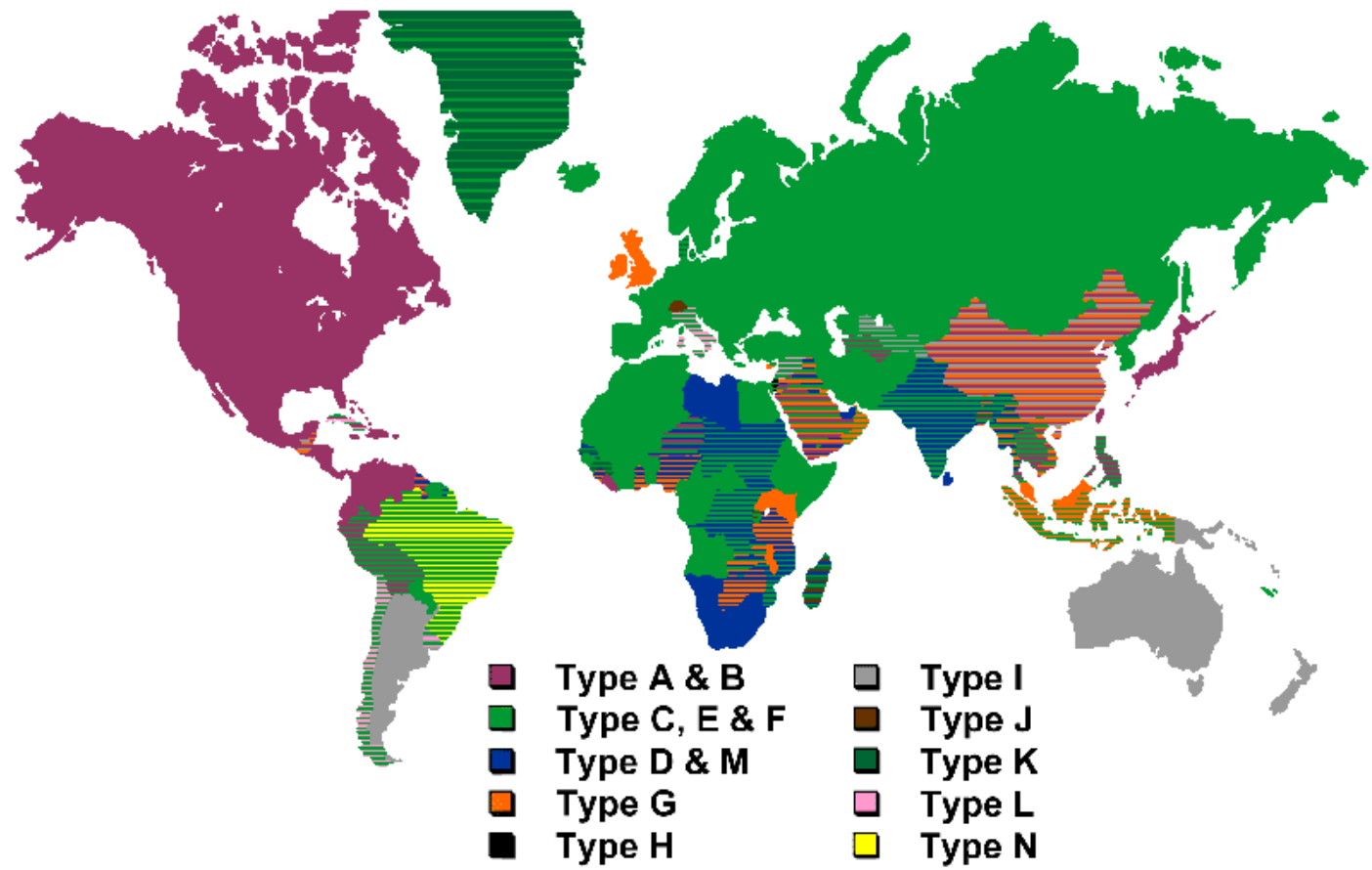
Electrification of vehicles – Charging

Electric network characteristics :



Electrification of vehicles – Charging

Plug types :



Electrification of vehicles – Charging time

Ex = France:

	Voltage	Current	Power
Everybody's plug	220 V	8-10 A	1,7 – 2,2 kW
Green-up		14 A	3 kW
Wall-box		32 A	7 kW
Tesla SuperCharger			120 kW
Ultra Rapid Charge			350 kW

Electric vehicle

The way the electricity is produced has a direct impact on global pollution of a vehicle :

Intensité d'émission de CO2 (gCO2/kWh)

	Intensité d'émission	
	gCO2/kWh	g/km
Éolien	5.5	0.9
Hydro-électrique	18	2.9
Nucléaire	60	9.6
Gaz naturel à Cycles Combiné	461	74
Gaz naturel	653	104
Charbon	1075	172

Émissions de CO2 du puit à la roue d'un véhicule tout électrique

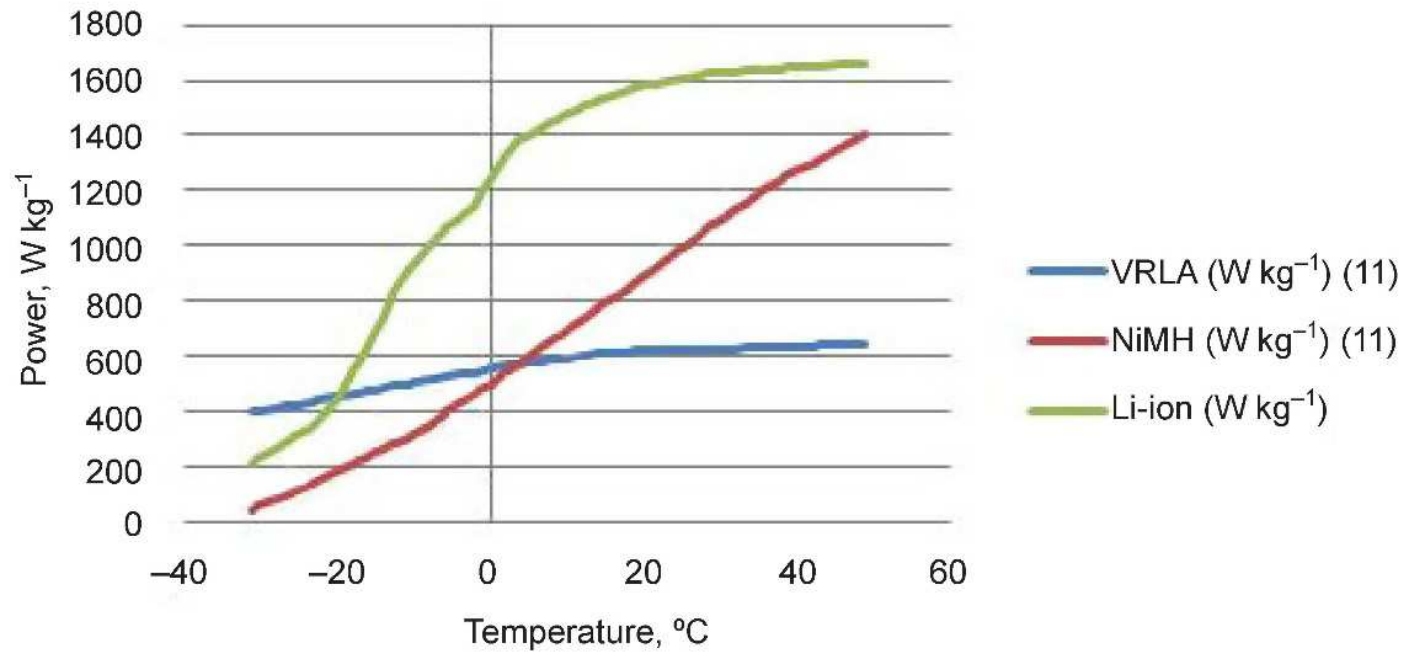
	% d'électricité sans CO2	Intensité d'émission (gCO2 / kWh)	Émissions du puit à la roue d'un véhicule électrique * (g/km)
France	90%	75	20
Canada	59%	267	43
Californie	44%	470	75
Etats-Unis	31%	710	114
Chine	20%	950	160

* Équivalent à un véhicule thermique consommant = 9l/100 km => 244g/km

- Les États-Unis, l'Allemagne et la Chine utilisent surtout le charbon pour produire de l'électricité avec respectivement 40%, 45% et 70% de leur production électrique
- Le nucléaire et les énergies renouvelables (y compris l'hydroélectricité) sont les seules alternatives pour produire de l'électricité sans émettre de CO2

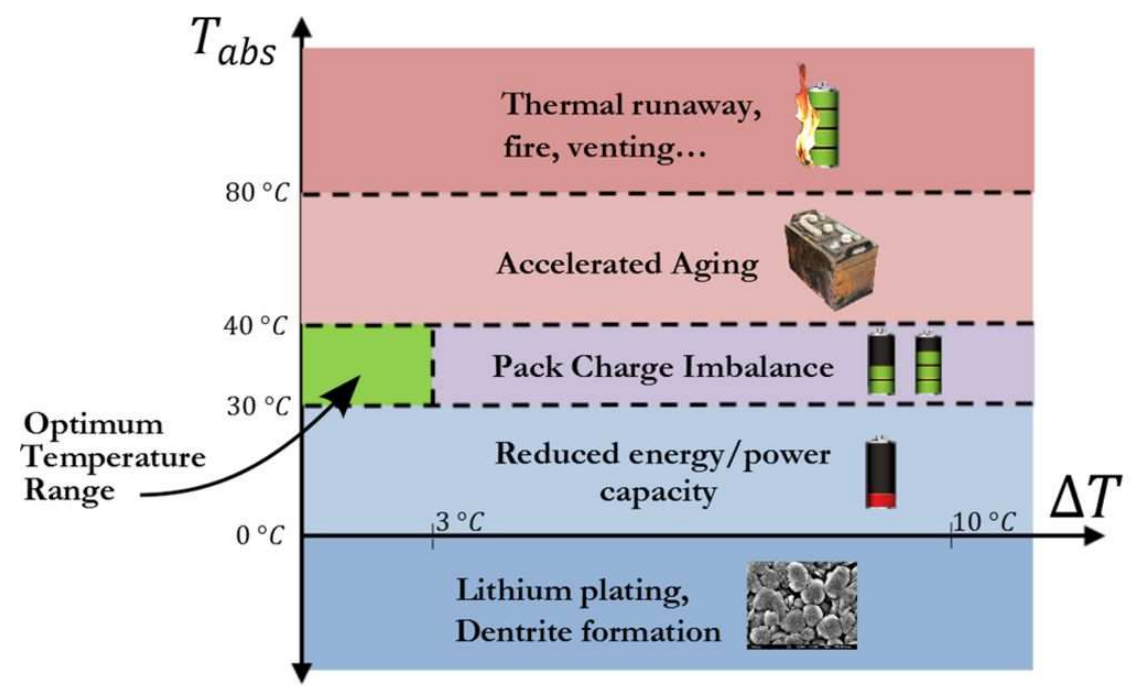
Electrification of vehicles – Li-Ion limits

- **Cold battery performances**
→ Battery heating syst ?



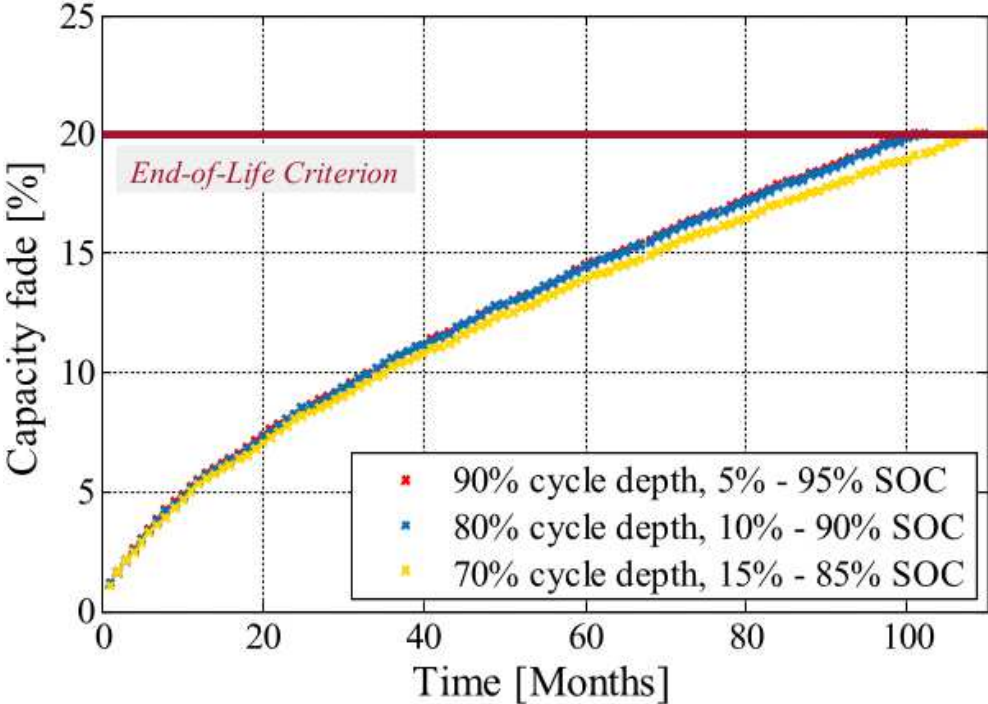
Electrification of vehicles – Li-Ion limits

- **Hot performances / safety**
→ Battery cooling syst



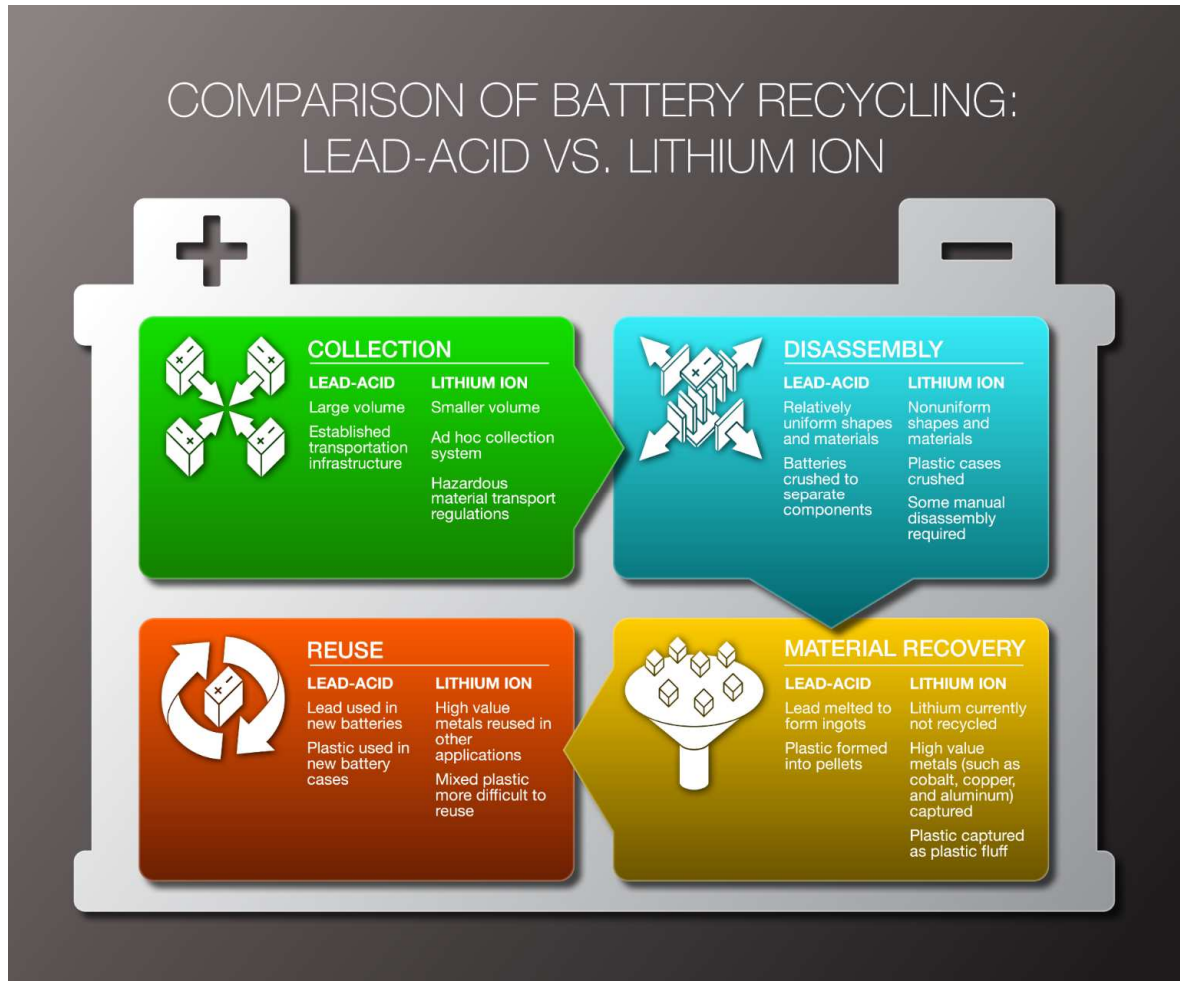
Electrification of vehicles – Li-Ion limits

- **Battery ageing**



Electrification of vehicles – Li-Ion limits

- Battery recycling



Electrification of vehicles – Conclusion

Forces :

Wicknesses :

Electric vehicles are a part of the solution

Summary



1- Air Pollution

2- Thermal Engine

3- Hybrid vehicles

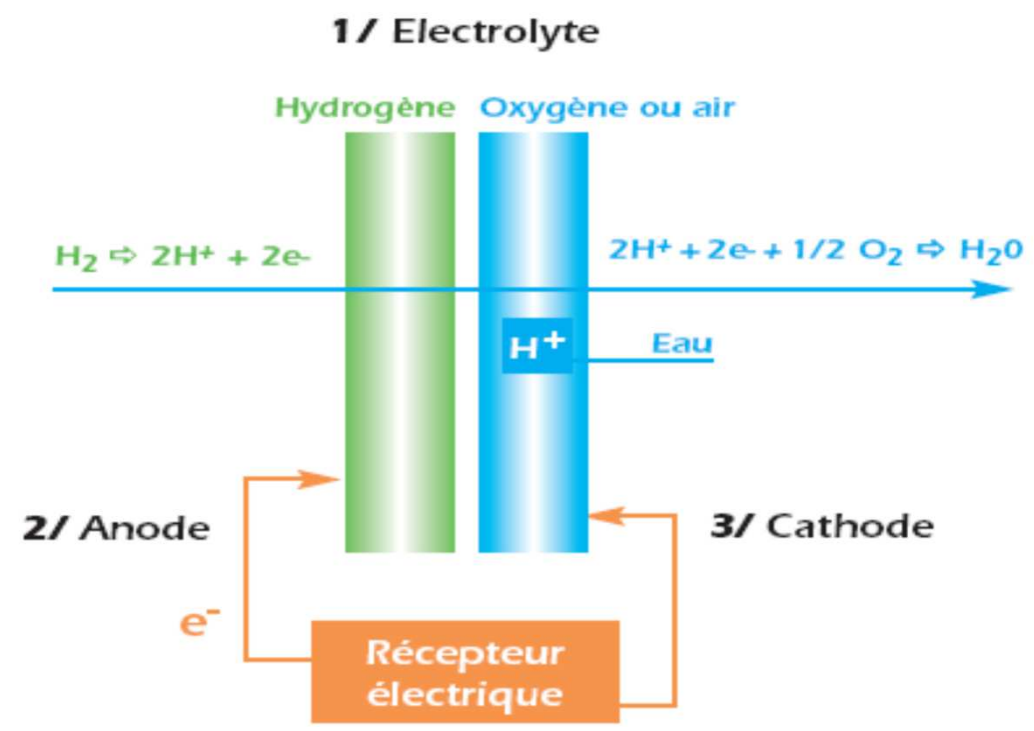
4- Electrification of vehicles

5- **Other solutions**

Other technologies – Fuel Cell

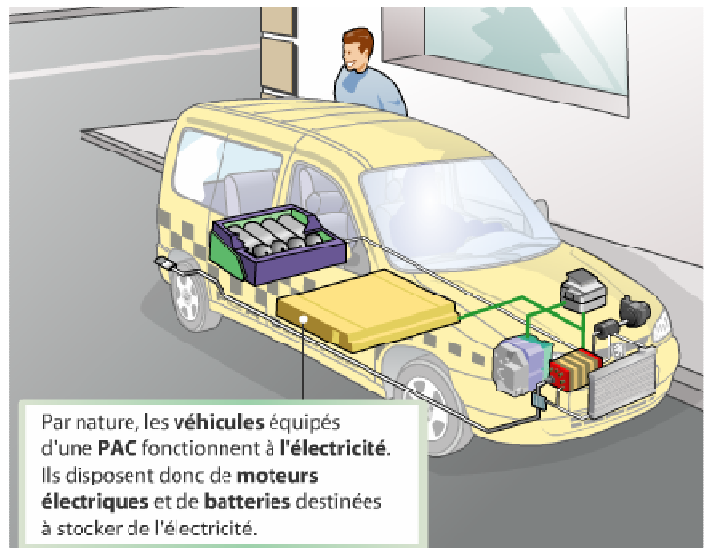
Principle

Hydrogen + Oxygen → Water + Heat + Electricity

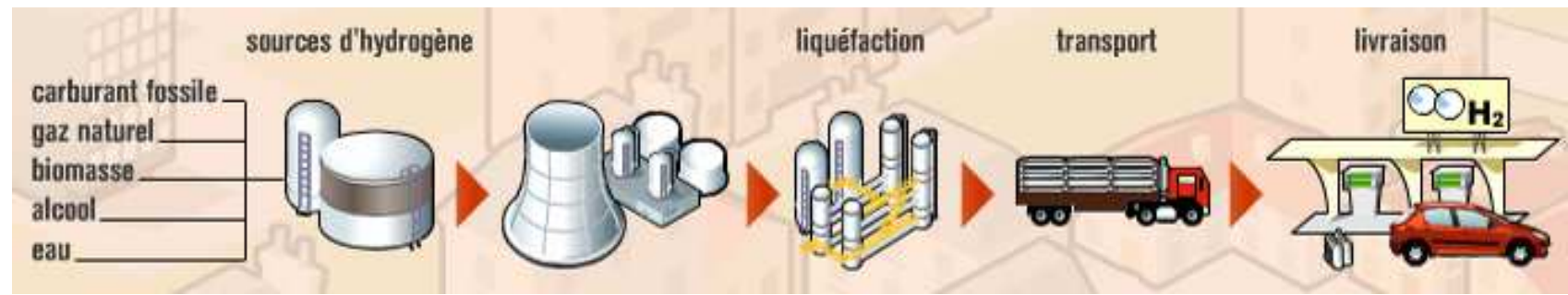


Other technologies – Fuel Cell

Vehicle architecture



Global vision



Other technologies

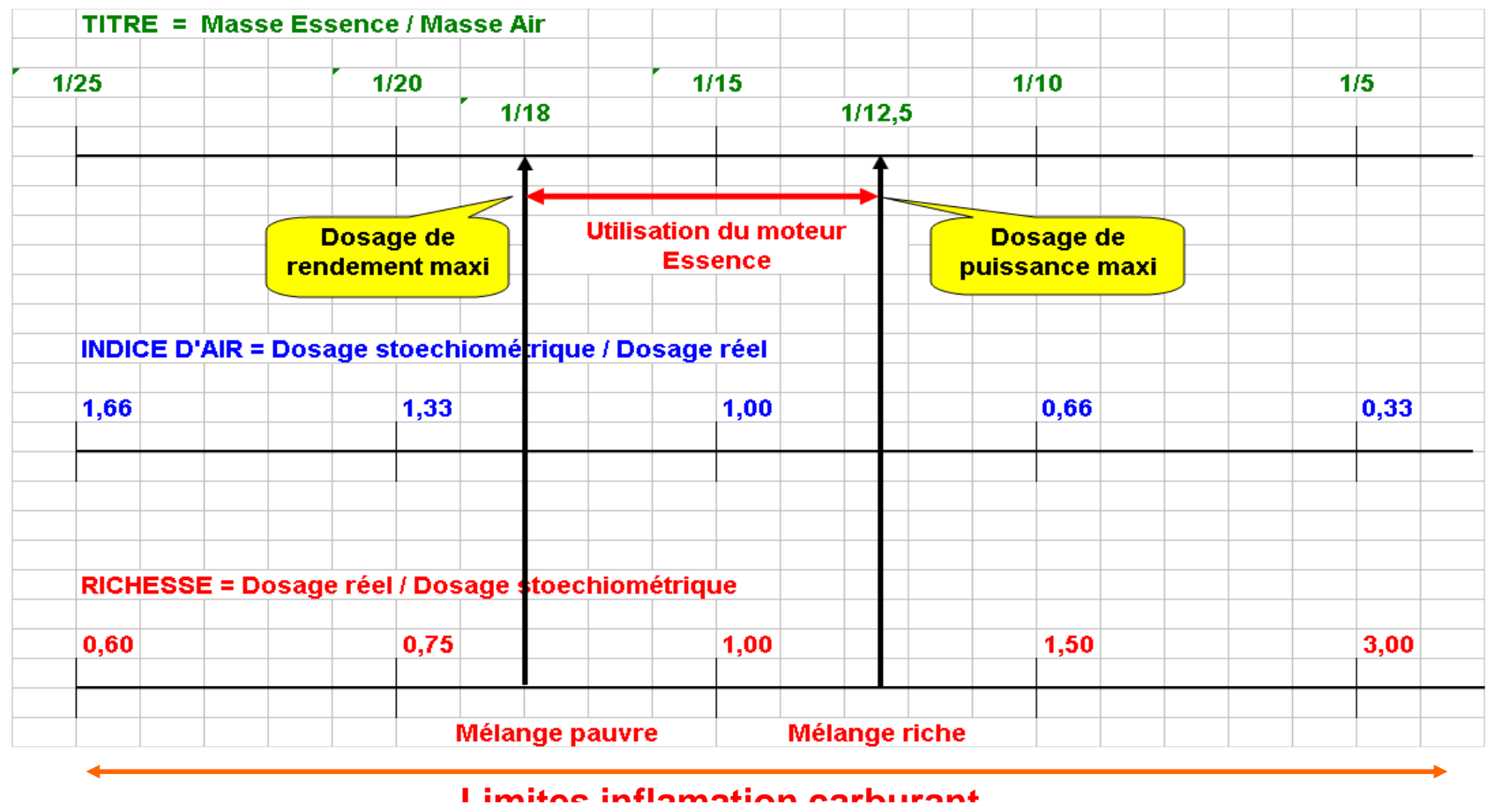
Air ~ Full hybrid alternative

Thermal Engine



Injection

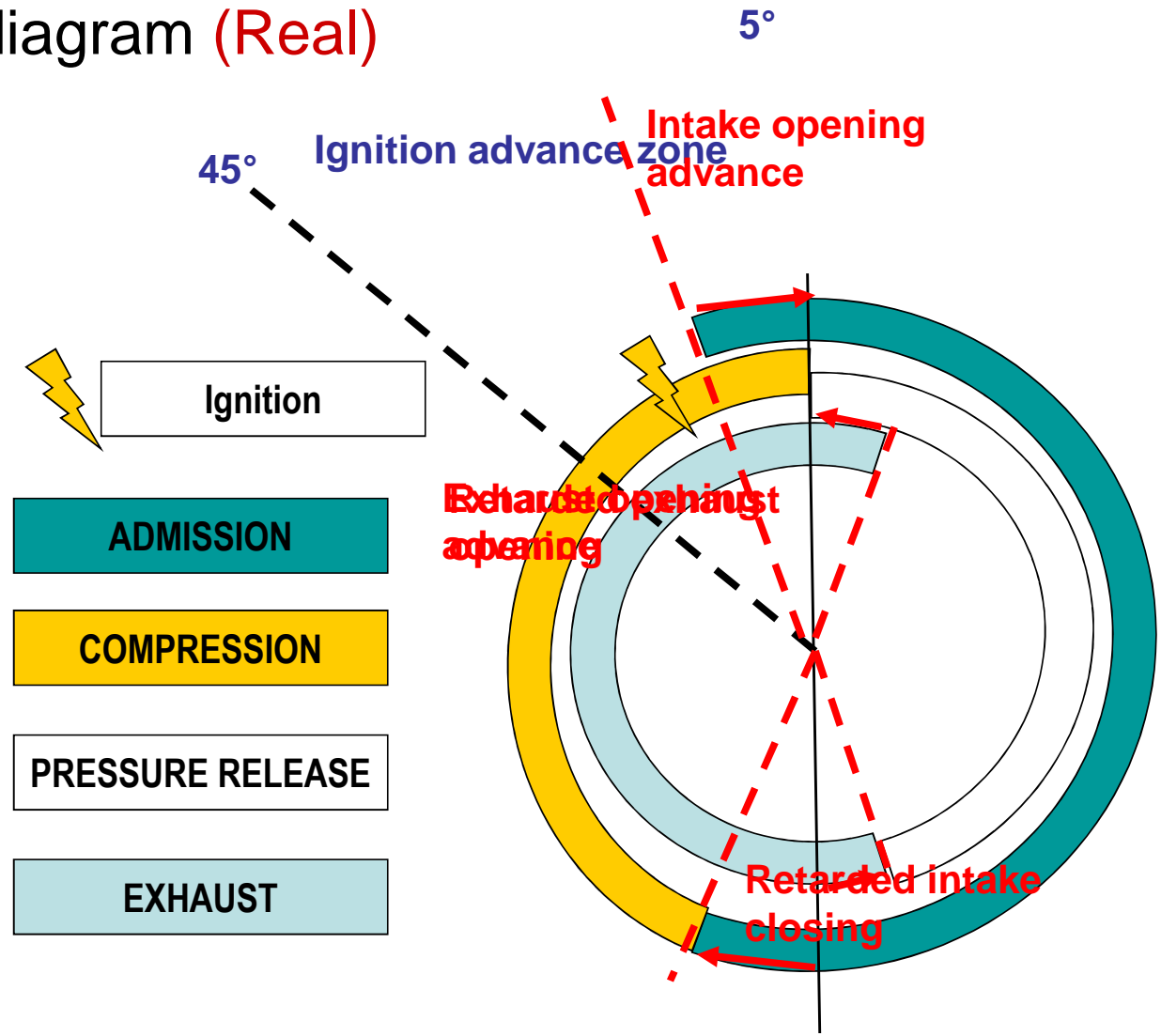
Titre - Indice d'air - Richesse



Real circular diagram



Timing circular diagram (Real)

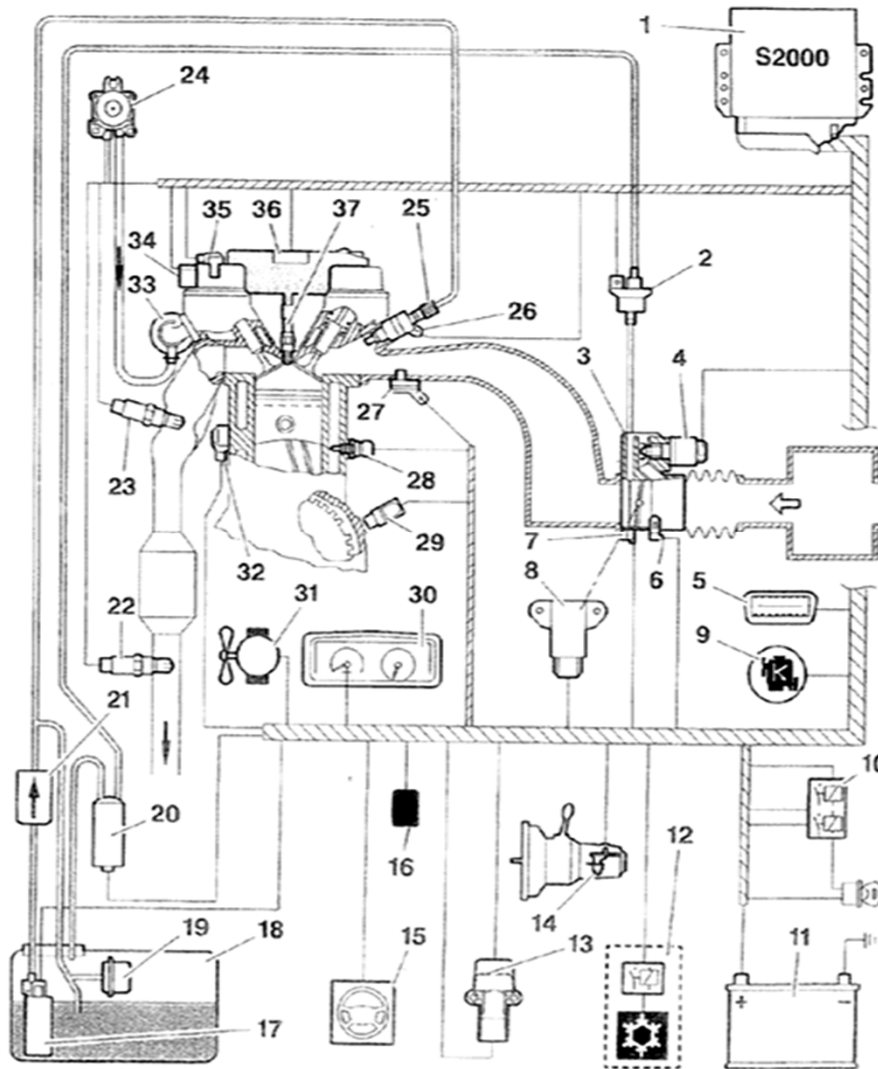


Injection

To define the right quantity of gasoline to inject and the good time to light the spark plug, some sensors are necessary :

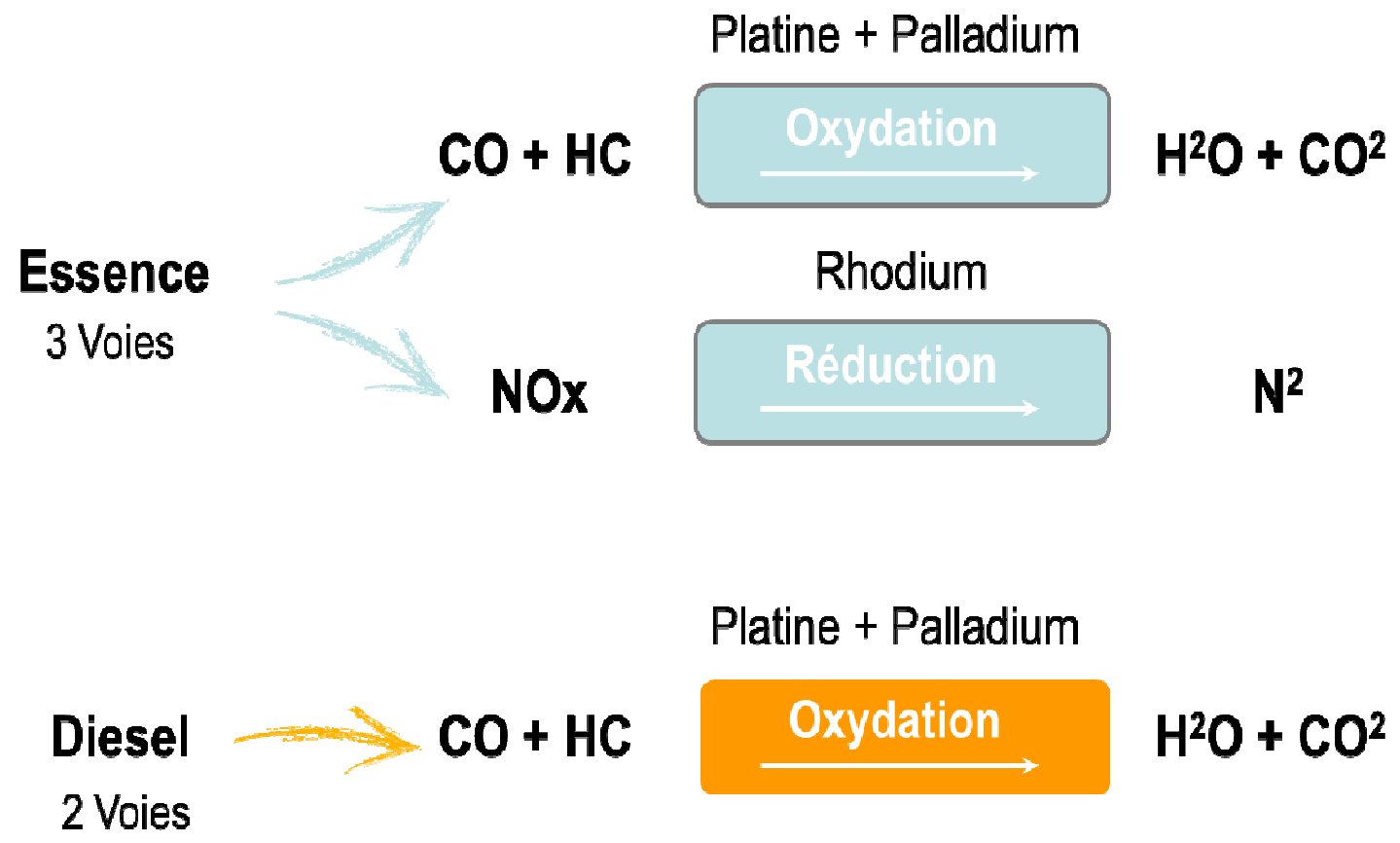
- Admission pressure, position of the throttle.
- Engine speed/ camshaft position
- Engine water temperature
- Admission air temperature
- Noise sensor (cliquetis)
- Lambda sensor or O₂ sensor
- Etc.

Injection

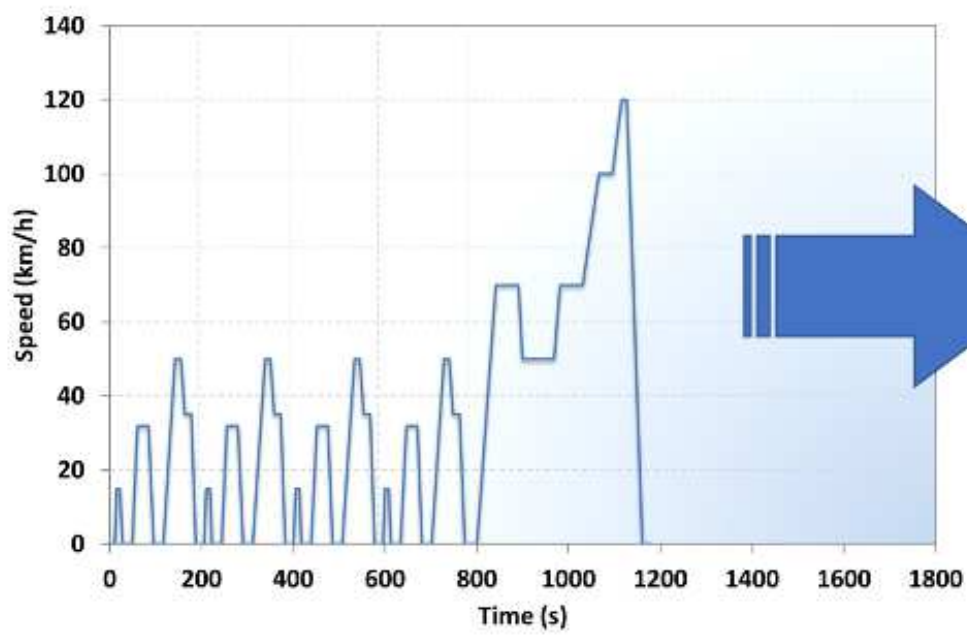


- 1 Calculateur de contrôle moteur
- 2 Electrovanne purge canister
- 3 Boîtier papillon
- 4 Moteur pas-à-pas régulation ralenti
- 5 Connecteur diagnostic
- 6 Capteur de température d'air d'admission
- 7 Résistance de réchauffage du boîtier papillon
- 8 Capteur position papillon
- 9 Voyant test injection allumage
- 10 Relais double multifonctions
- 11 Batterie
- 12 Relais climatisation
- 13 Interrupteur à inertie
- 14 Capteur vitesse véhicule
- 15 Capteur de pression de direction assistée
- 16 Centrale de protection de l'habitacle
- 17 Ensemble pompe et jauge à carburant
- 18 Réservoir carburant
- 19 Régulateur de pression d'essence
- 20 Réservoir canister
- 21 Filtre à carburant
- 22 Sonde à oxygène aval
- 23 Sonde à oxygène amont
- 24 Pompe à air secondaire
- 25 Rampe alimentation injecteurs
- 26 Injecteurs essence
- 27 Capteur pression air admission
- 28 Capteur de température d'eau
- 29 Capteur régime moteur
- 30 Compte-tours
- 31 Motoventilateurs
- 32 Capteur de cliquetis
- 33 Clapet d'admission d'air
- 34 Capteur de position arbre à cames
- 35 Electrovanne EGR (*)
- 36 Bobine d'allumage
- 37 Bougies d'allumage

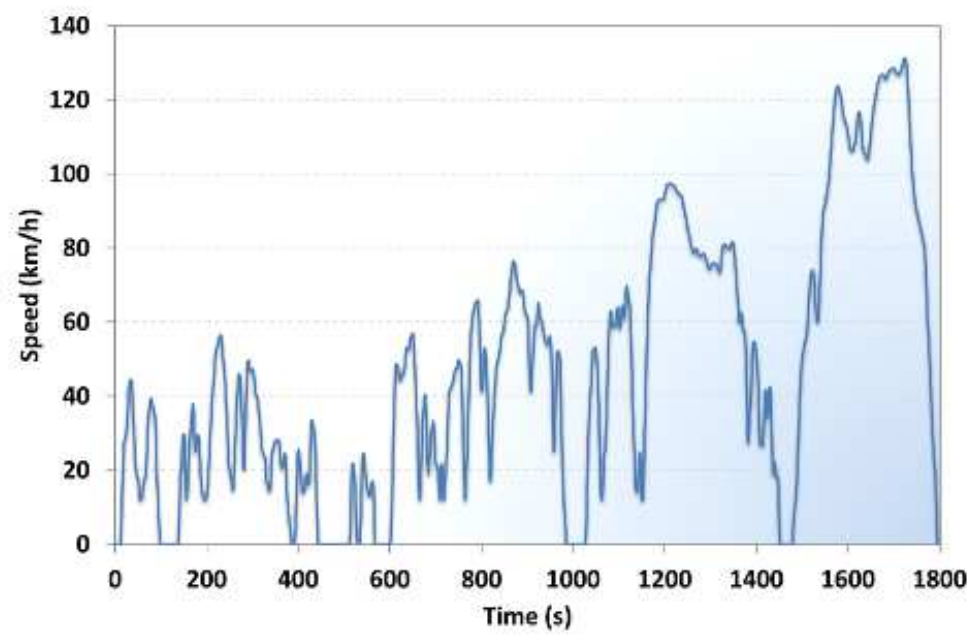
Catalytic convertor



Homologation cycles



Cycle NEDC
(jusqu'à septembre 2017)



Cycle WLTP
(à partir de septembre 2017)

