

# Pollutants Emissions Global warming Potential Effect

## First Comparison using External Costs on Urban Buses

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Presented by  
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E. JOUBERT & G.PLASSAT, August 2004

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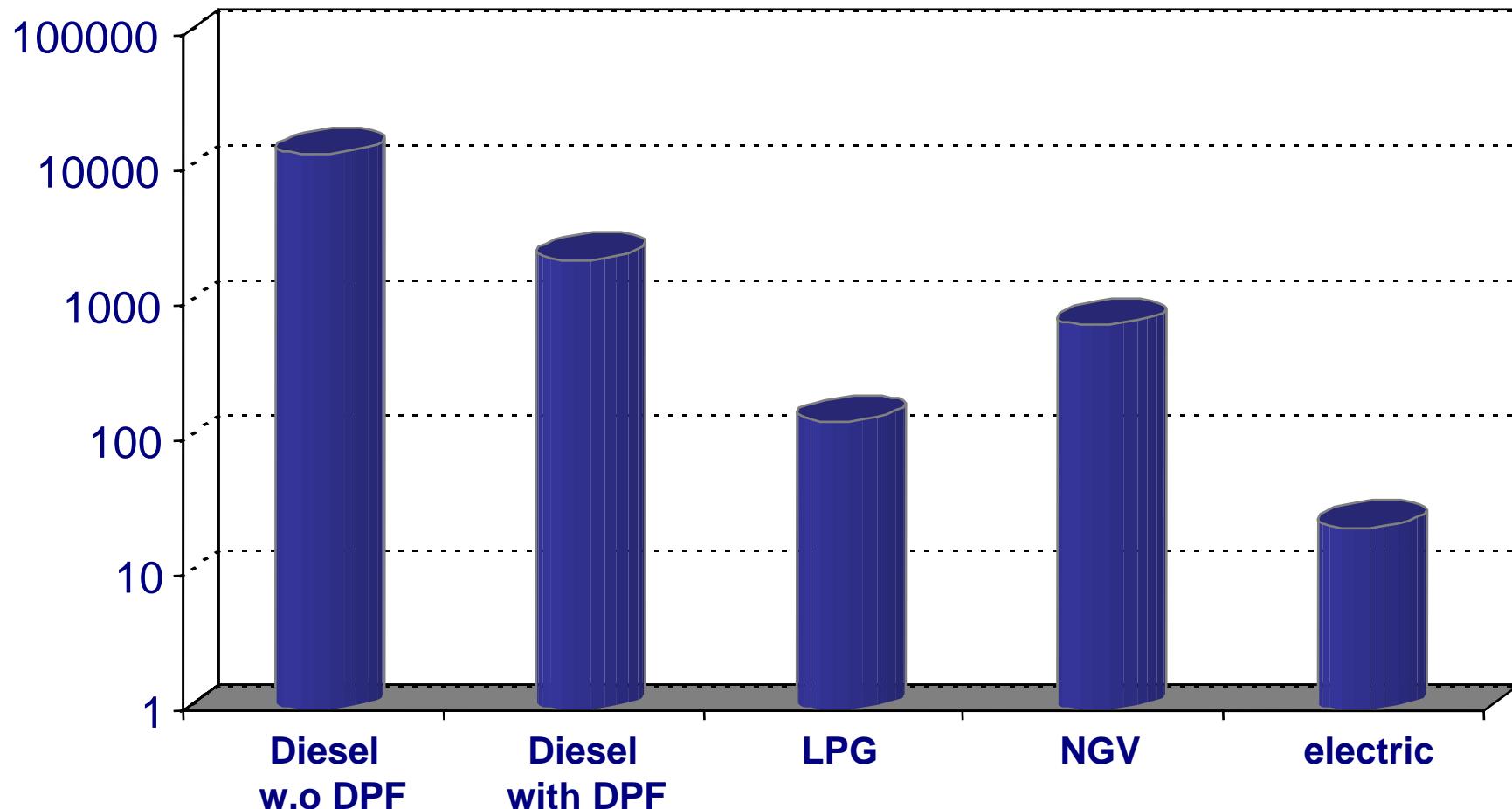


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# Buses in France

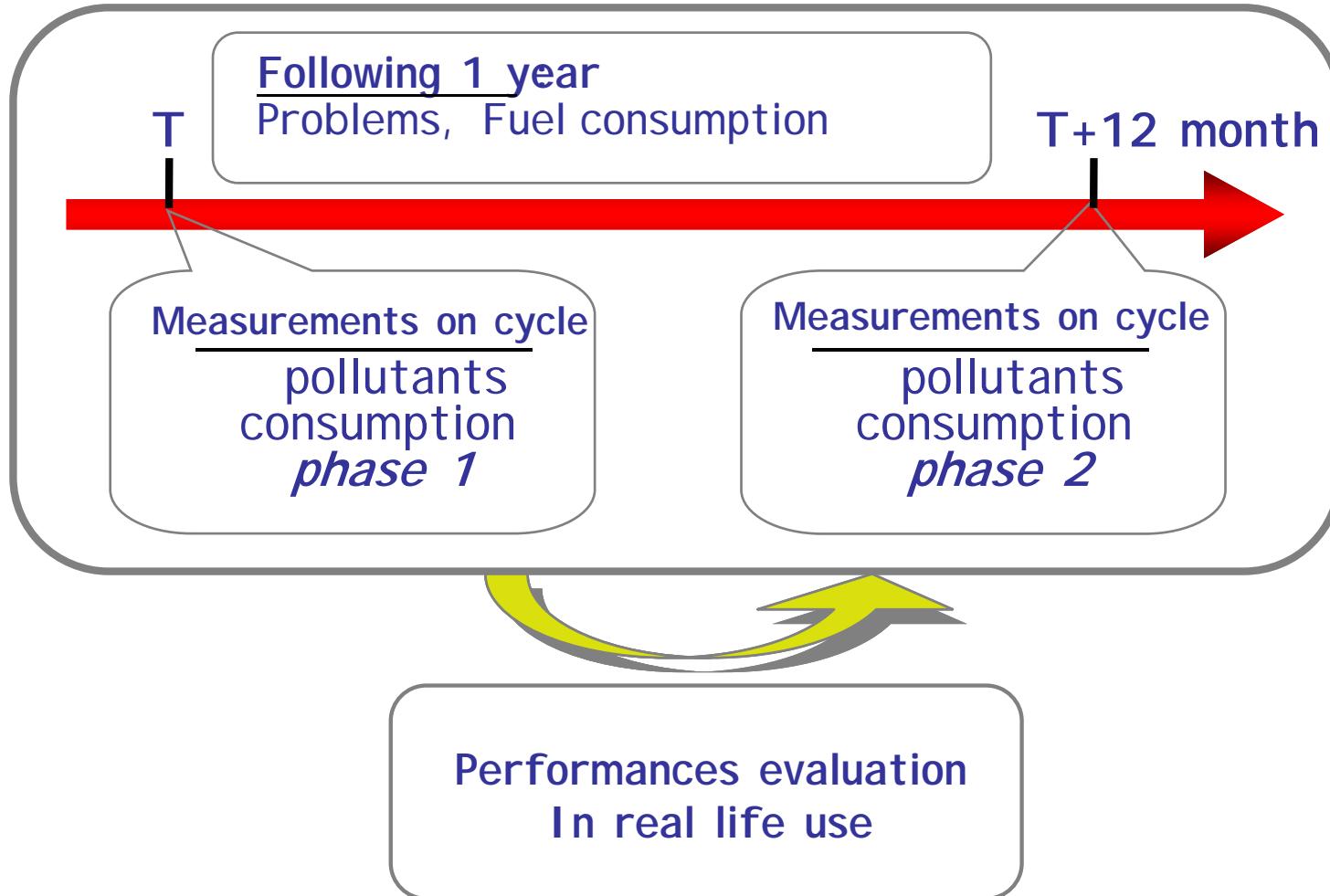


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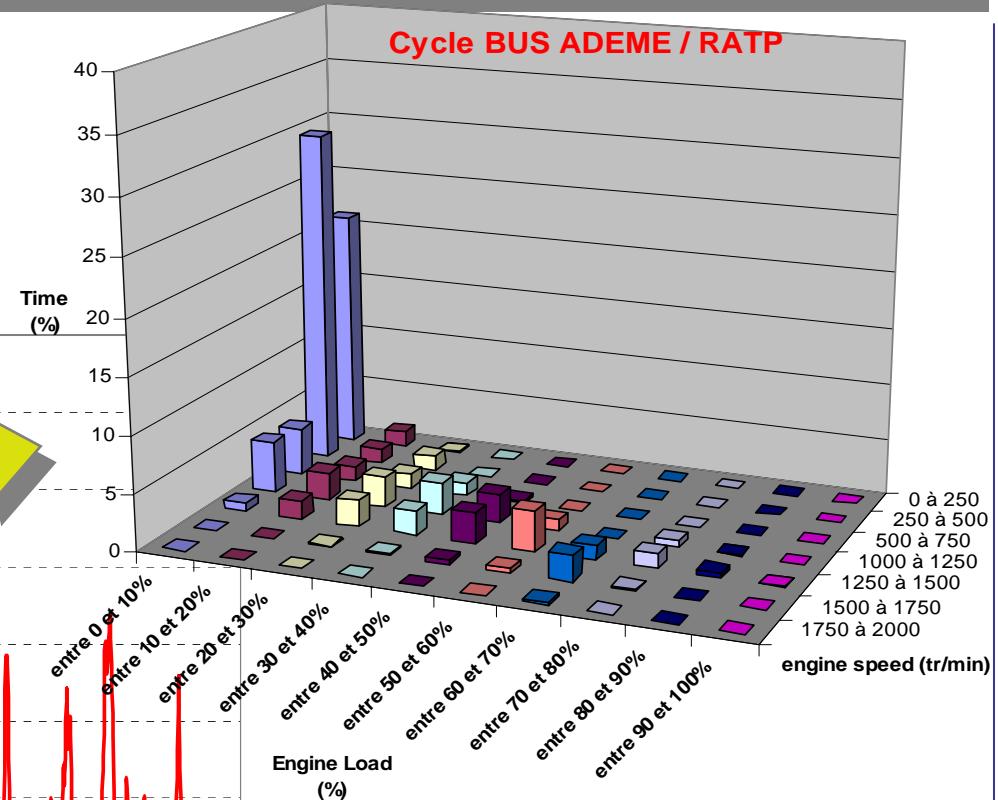
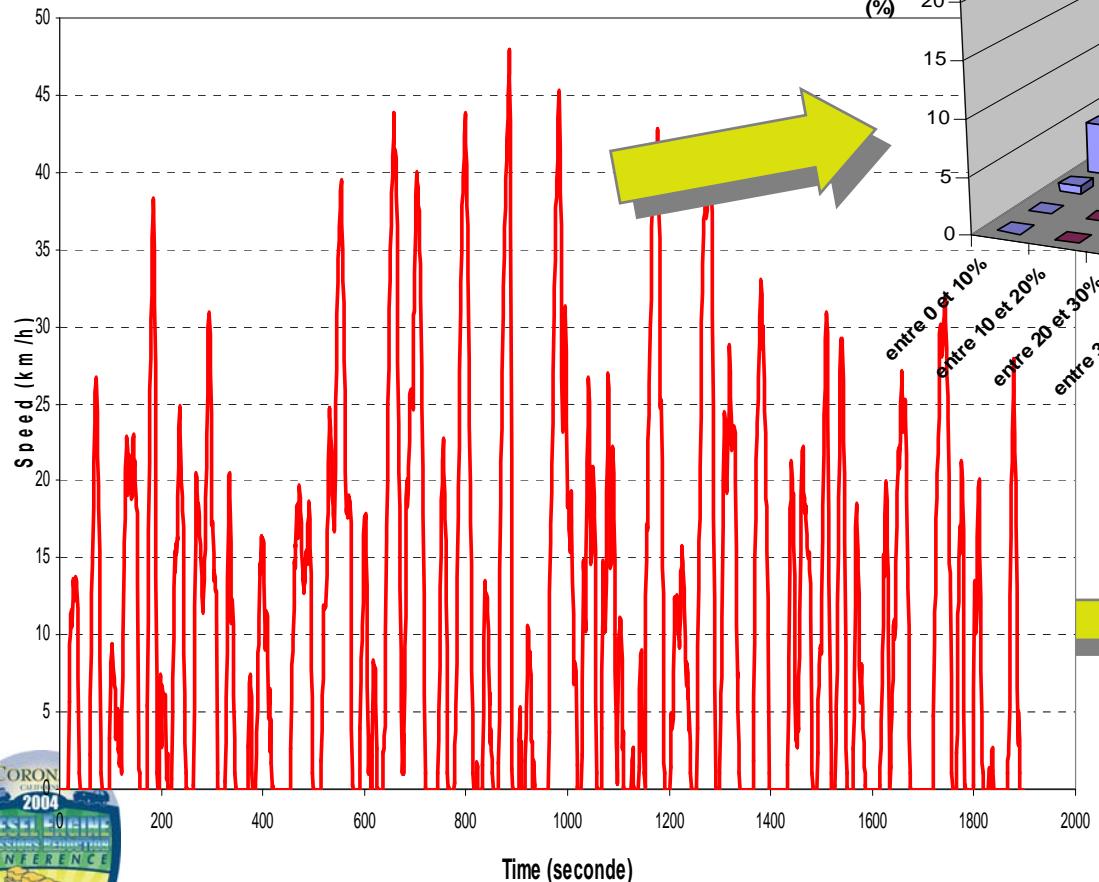


# Methodology



# Bus Cycle vehicle and engine

0 ADEME  
0 RATP  
(public transport in Paris)

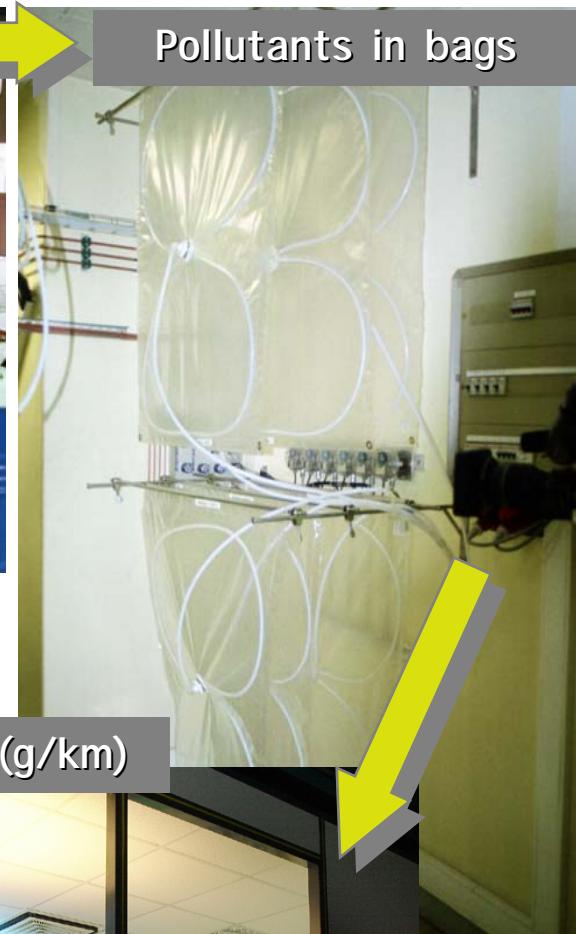
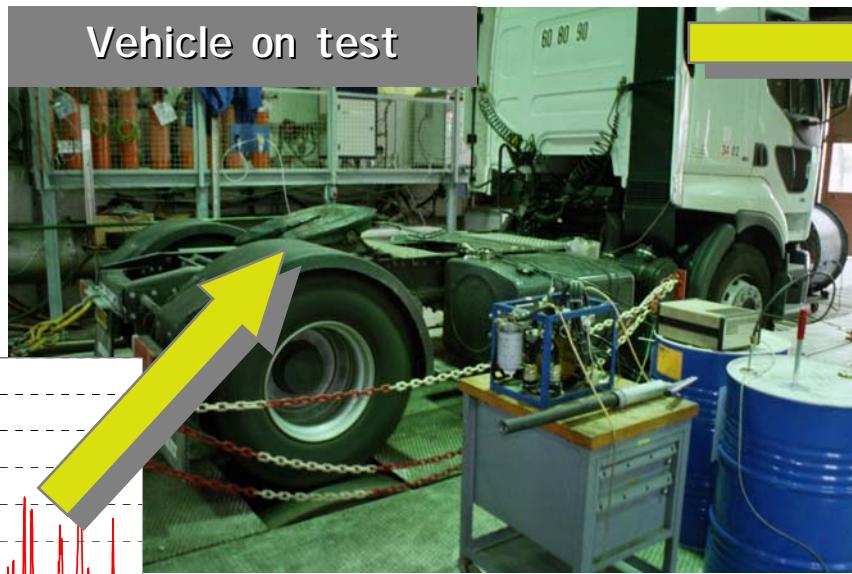
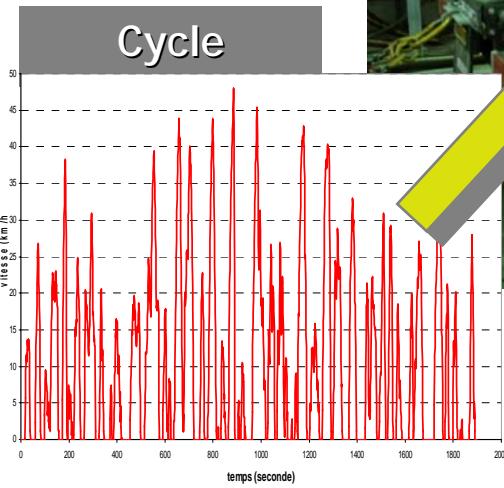


Cycle  
representative  
by professionals

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# Measurements on test bench



Results (g/km)

- o Consumption
- o CO<sub>2</sub> and GHG
- o Pollutants regulated : CO, HC, NOx, particles
- o Pollutants unregulated : benzene, 1-3 butadiene, aldehydes



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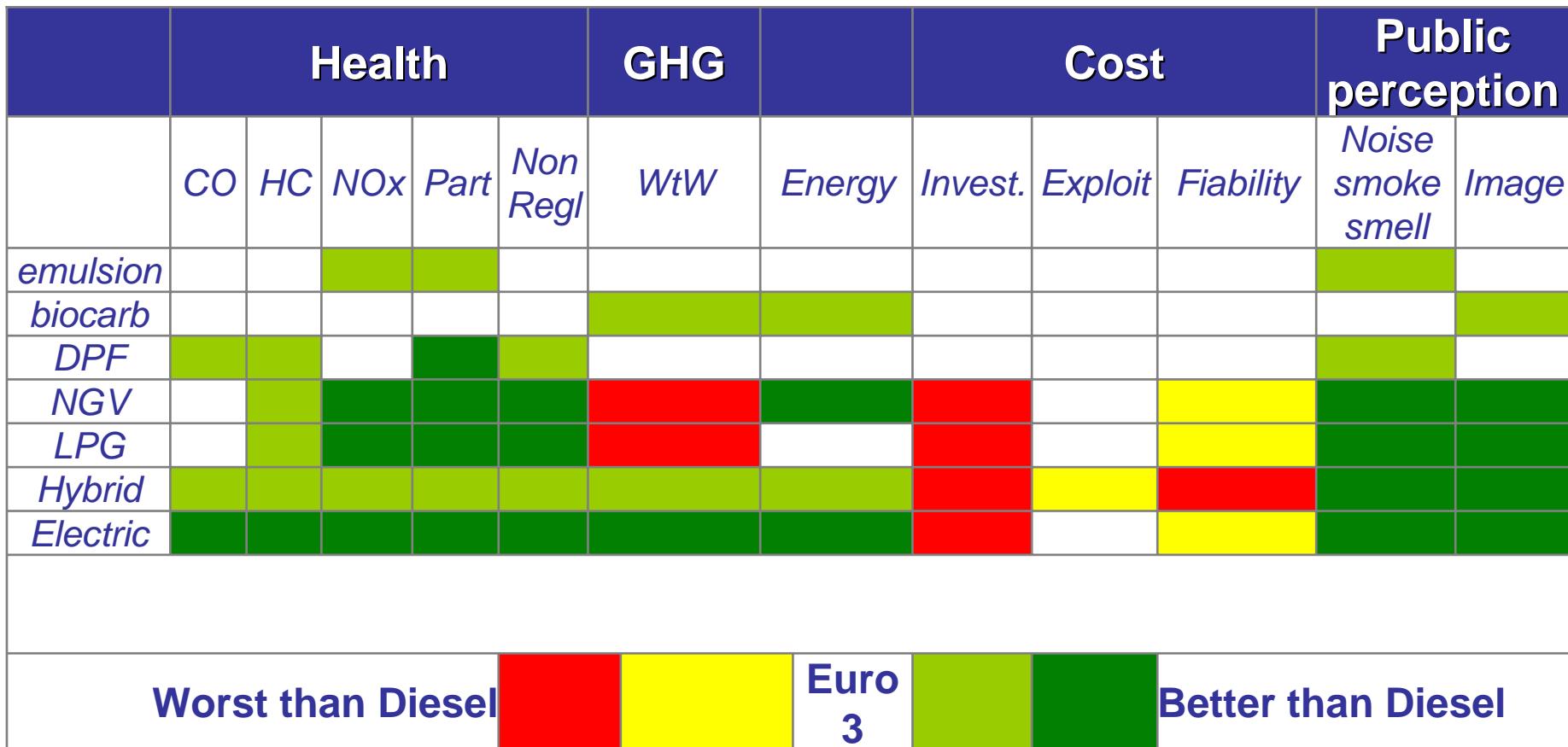
# Clean Buses Program

Pathways	Technology	Complete tests evaluation
LPG	Stochiometric	✓
NGV	Stochiometric	✓
	Lean Burn	✓
Diesel with DPF	Eminox (CRT)	✓
	Engelhard	✓
	Airmeex	✓
	Comela	✓
	Recycl'air	✓
Diesel with DPF / DeNOx	EGR, urea, ...	06/2004
Diesel with Water	Aquazole (Total)	With / W.O DPF
	GECAM	
	Aspira (BP)	
Diesel with RME (30%)		With / W.O DPF
Hybrid Electric	Hybrid	Pb, NiMH ✓

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# Comparaison Buses multicriteria



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## Buses Comparaison by external costs

*European Project : Cleaner Drive*  
[www.cleaner-drive.com](http://www.cleaner-drive.com)

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# GT & Buses Comparaison by external costs

A « well to wheel » calculation

Carte pollution air



Cadastre population



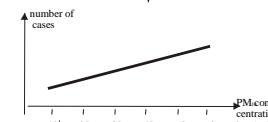
Air Pollution

## Cost for pollutants €/ ton

CO	HC (HC no CH <sub>4</sub> )	NOx	Particles	GHG (CO <sub>2</sub> , CH <sub>4</sub> )
3,5	2000	8200	126 900	46



Exposition population



Fonctions exposition-risque

External cost reflects the overall damage to the environment and to human health caused by emissions

Epidemiology



Nombre de cas de mortalité  
et de morbidité

Perte production  
Coûts traitement  
Douleur et souffrance

Coûts santé par cas



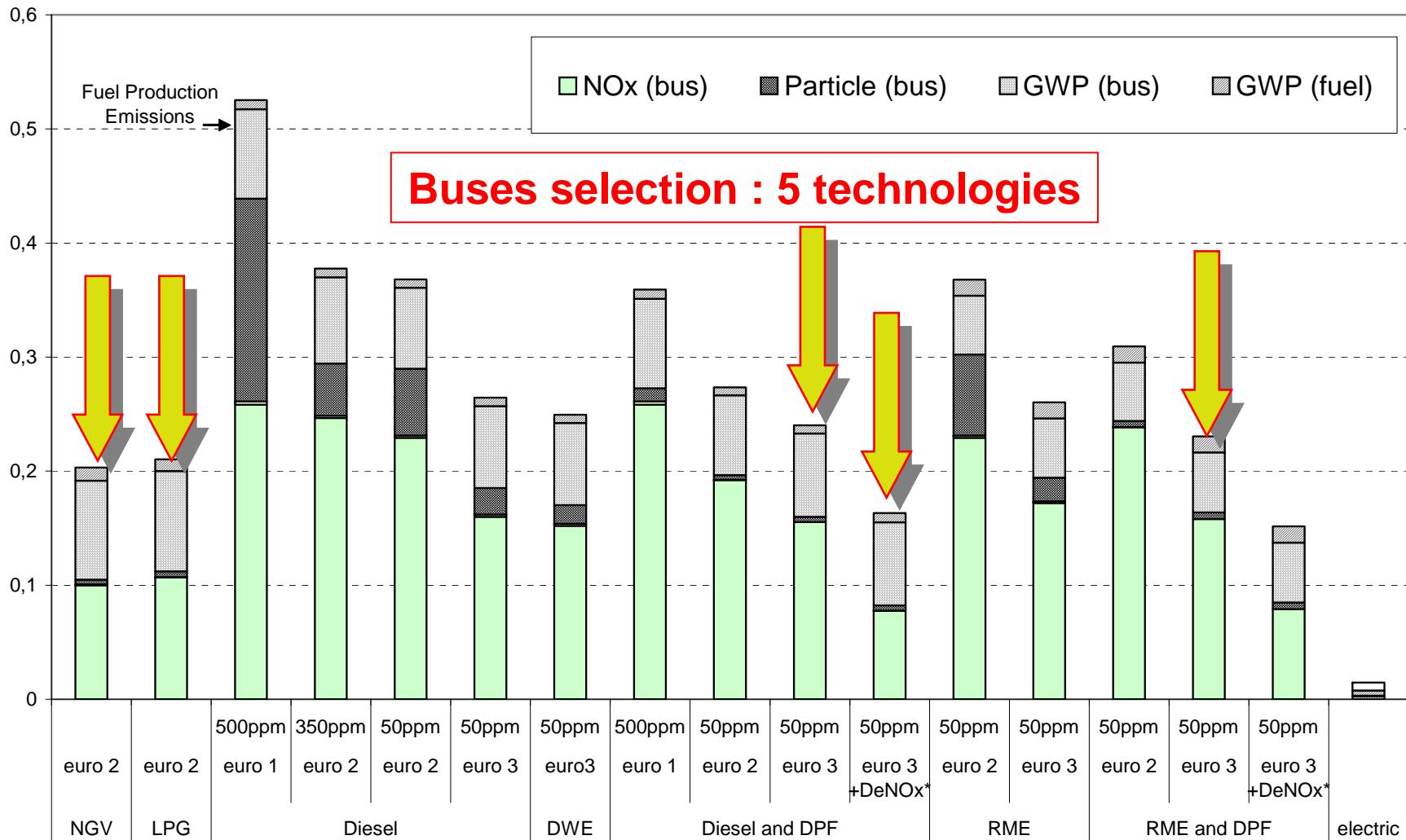
Coûts externes santé  
liés à la pollution

Economy

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# Buses Comparaison by external costs



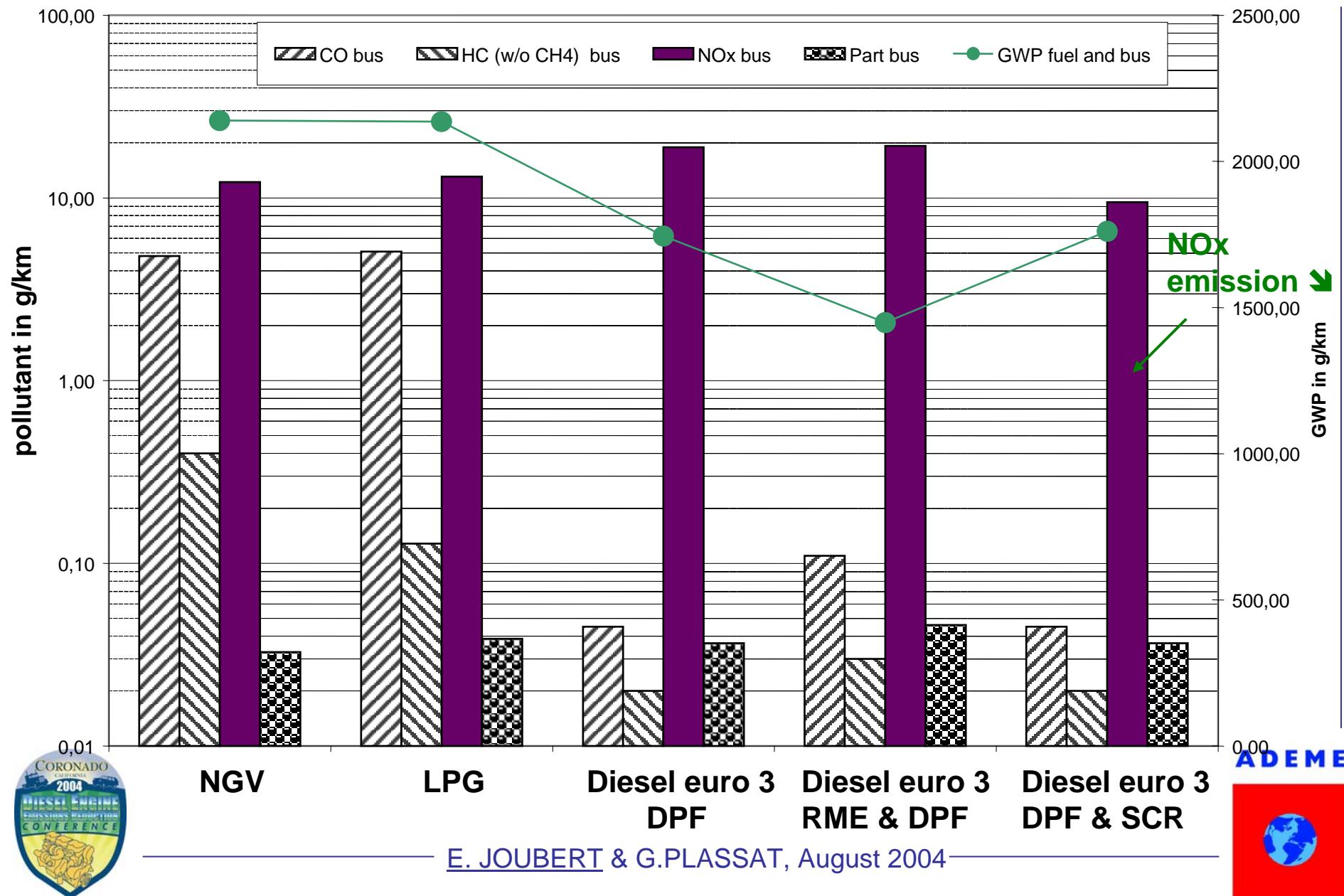
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Fuel & Bus emissions cost comparison in €/km

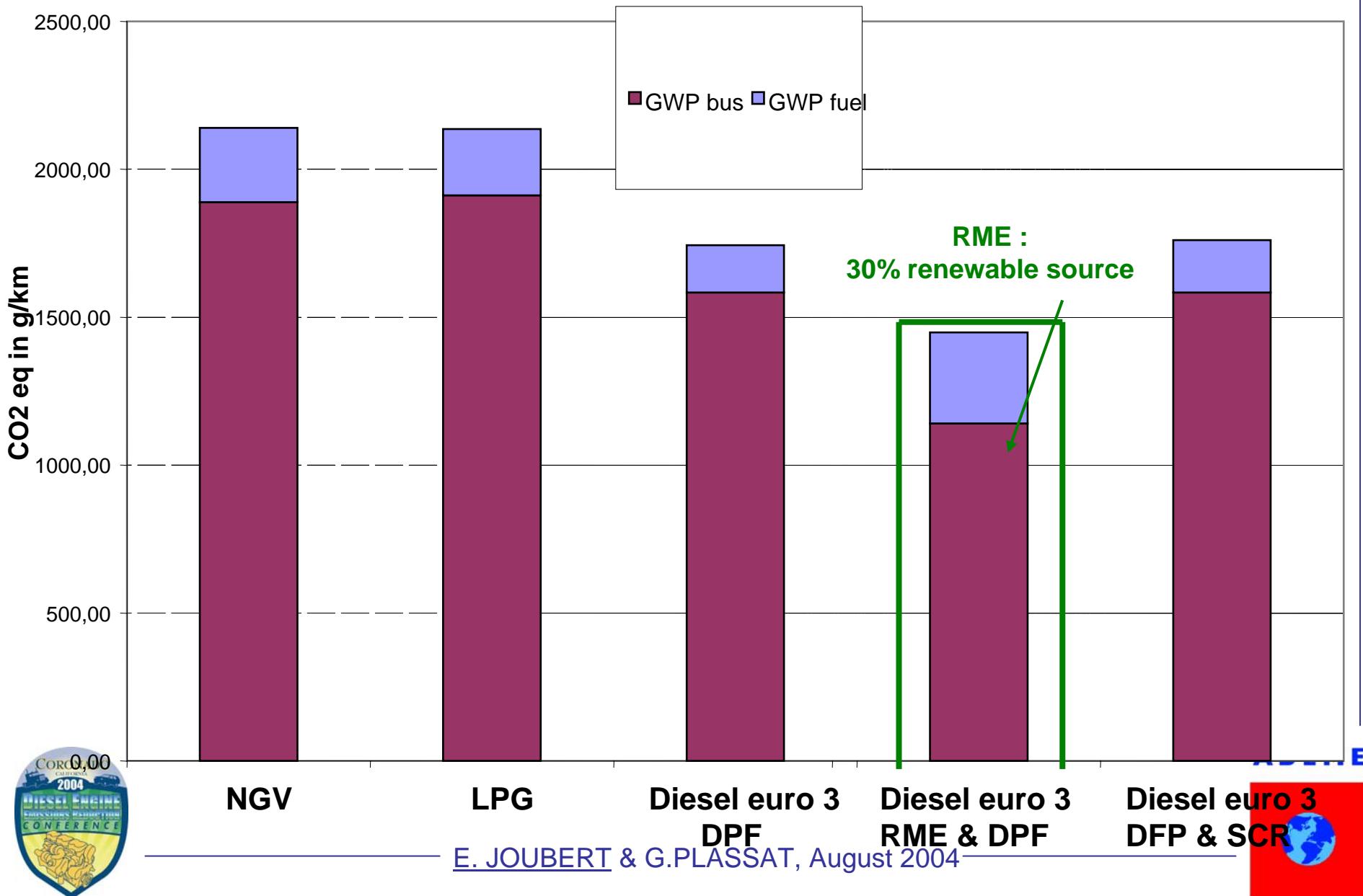
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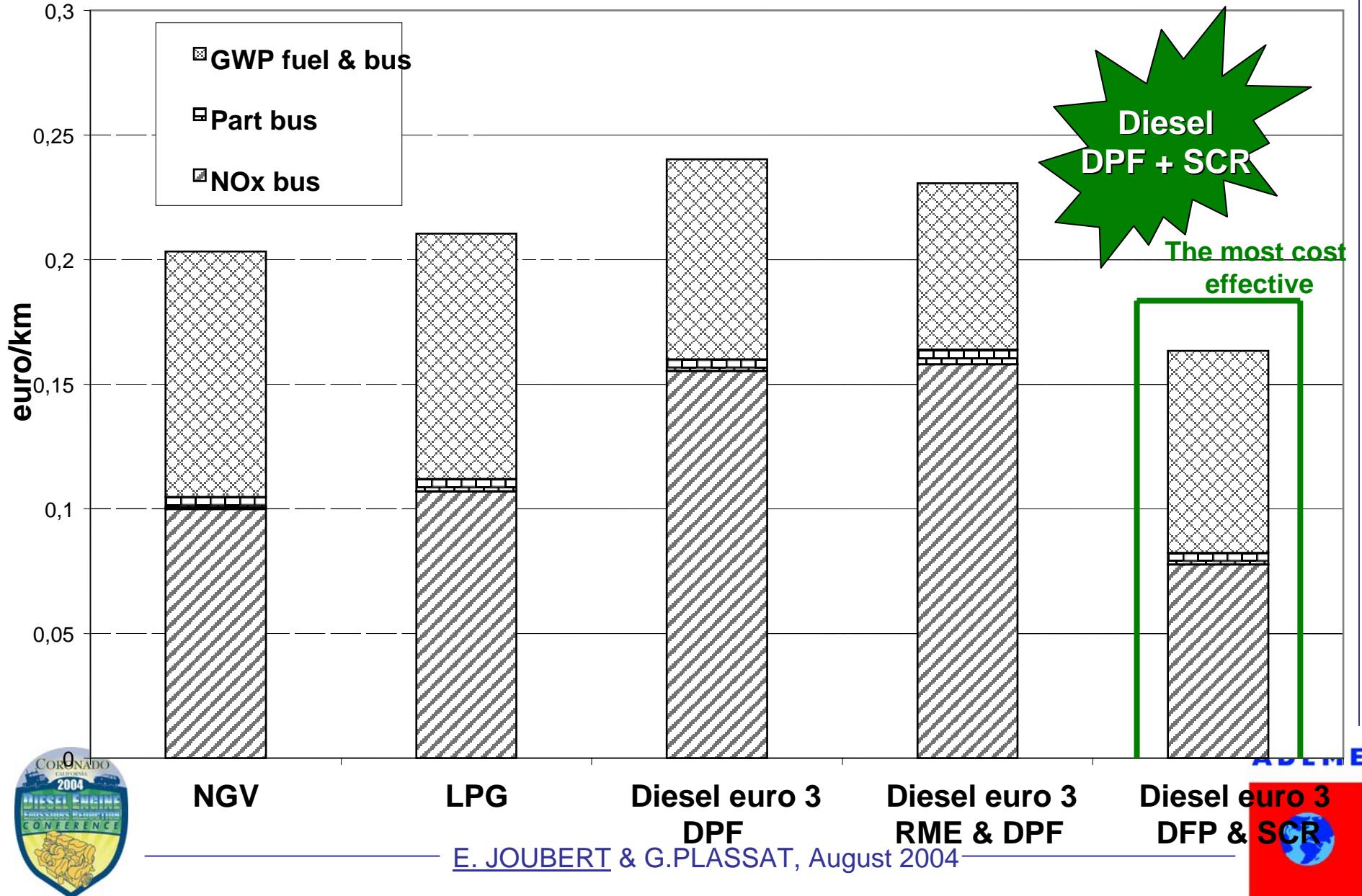
# Buses Comparaison : pollutants emissions source



# Buses Comparaison : GHG



# Buses Comparaison : cost comparison



# Conclusions (1)

- o External cost methodology is useful to compare different technologies with different pollutants and GHG emissions.
- o Strength & Weakness of each technology can be identify.
- o Other parameters should be included : Noise, Unregulated pollutants and economic parameters (investments, ...)



## Conclusions (2)

- o Best technologies are :
  - NGV, LPG
  - Diesel with DPF + SCR
  - Diesel with DPF and RME
- o NOx : Diesel > NGV, LPG > Diesel + SCR  
GHG : NGV, LPG > Diesel
- o **Association DPF + SCR technology allows Diesel engine to be the most cost effective**
- o NGV, LPG must progress on GHG (fuel and bus).



Thank you  
for  
your attention



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# APPENDIX



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# EMISSION DATA FUEL CYCLE

► **Fuel Cycle emission include those produced during :**

- Fuel extraction
- Refining
- Transport and distribution

GWP (g eq CO <sub>2</sub> / MJ)				
Diesel	Bio Diesel 30% RME	Diesel with 10% water	NGV	LPG
7,5	12,3	6,5	9,2	7,5



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