GDF SUEZ

REDÉCOUVRONS L'ÉNERGIE

Research and Innovation Division
CRIGEN

Alternative fuels: hope and issues
Focus on gaseous alternative fuels

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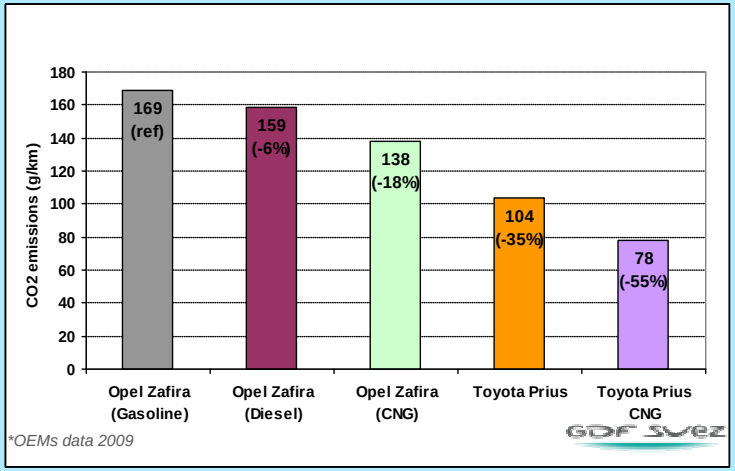
Gaseous fuels – Promising & performing alternatives

CO_2 emissions



Today

- CNG gain on CO_2 = -20% vs. gasoline
- CNG gain on CO_2 = 0 → -13% vs. Diesel

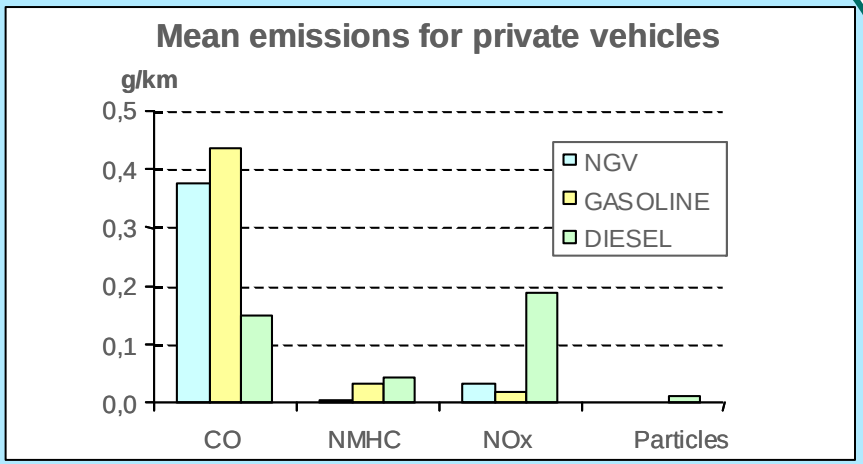
A great potential (optimised engines)

- Gain on CO_2 up to –30% vs. current CNG engines

Further potential (CNG optimised hybrid technologies)

- up to ~25% saving vs. the hybrid gasoline reference

Pollutants emissions



*From VCA Car Fuel Data for 9 different vehicles: Citroën C3 & Berlingo, Volvo S60, S80, V70, Opel Zafira and Volkswagen Caddy, Touran, Golf.

Particles

- No emission with CNG

NOx emissions

- In comparison to gasoline: similar emissions
- In comparison to diesel: 5 to 10 times inferior

Non methanic hydrocarbon emissions

- In comparison to gasoline : 6 times inferior
- In comparison to diesel : 8 times inferior

Biomethane

- GHG savings are ~80% in comparison to gasoline when biomethane is produced from municipal organic waste
- Theoretical gain on CO_2 = up to -55% vs. Gasoline & Diesel*

(**Wuppertal Institute & PSI study– International JRC Conference on Transport and Environnement - march 2007.)*

Hythane® (CNG + H_2)

- Gain on CO_2 up to –30% vs. Diesel* *(*GDF SUEZ 2009)*

Gaseous Fuels – Remaining issues

In France, CNG/biomethane/Hythane® are not put forward within the texts that founded the energetic policy for transport sector;

In France, the development of these alternative gaseous fuels on the mass market (private vehicles) remains confidential:

- It suffers from a lack of public refuelling stations
- It suffers from the current strong focus on electric vehicles

These alternative gaseous fuels are established on professional & local authorities markets where the growing potential is high, but to go further on, efforts have to be engaged to:

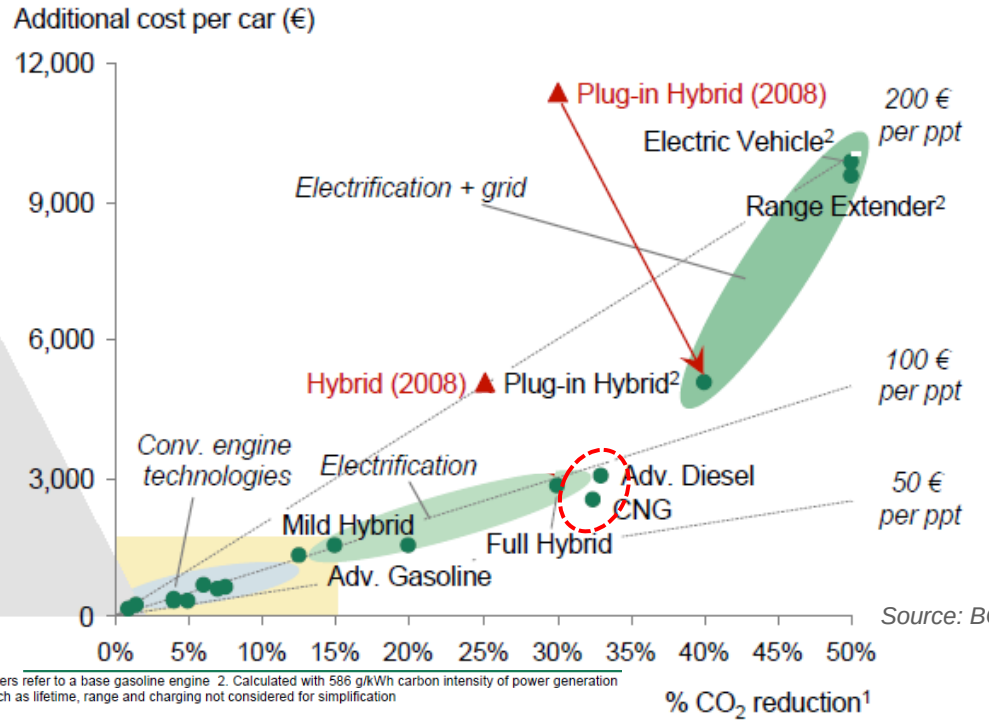
- develop of optimized/dedicated engines (with technologies such as downsizing, direct injection, etc.)
- apply the hybrid technologies (mild-hybrid or full-hybrid) to these gaseous fuels

Consumers have a lack of knowledge about CNG, mostly due to a lack of information or due to negative connotations* *(*Mc Kinsey - 2009)*

- Less well known than FC (50% vs. 66%)
- 10% fear frequent stops at gas stations and/or missing infrastructure (but 60% usually use same gas station)

Environmental benefits – A cost issue

➢ CNG technologies offer one of the best compromises between CO_2 reduction and cost



Source: BCG – November 2009

1. All CO_2 improvement numbers refer to a base gasoline engine 2. Calculated with 586 g/kWh carbon intensity of power generation
Note: Other battery issues such as lifetime, range and charging not considered for simplification
Source: BCG analysis

➢ Additional cost per vehicle could reach 200€/ppt CO_2 reduction in the case of electrified technologies (EVs, HVs/PHVs)

Thank you for your attention !

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