CNG/LNG fuelled vehicles

The European perspective

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NGVA Europe
NG supply to Europe (Pipelines & LNG)
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Worldwide gas reserves (Unit = $10^9$ m$^3$)

**Gas consumption worldwide**

2010 3.200 billion m$^3$

Europe
Total 522 billion m$^3$
NGVs 1.8 billion m$^3$

Reserves
World 537 years
Europe 161 years

Source: Data BGR, graph works NGVA Europe
Decoupling of Oil and Gas prices

Growing spread between oil and gas
1.5 Mio NGVs in Europe vs 500,000 end of 2003 market share 0.5%, some ~500 LNG units only

Natural gas vehicles

1.470.800 LDVs
EU/EFTA: 1.025.500

46.100 Buses
EU/EFTA: 13.100

50.700 MD + HD Trucks
EU/EFTA: 5.650

800 other NGVs
EU/EFTA: 700

LD: cars, small commercial vehicles
HD: trucks, buses (urban and medium/long distance)

Source: NGVA Europe, 01.01.2012
Natural gas has major environmental benefits compared to other fuels

<table>
<thead>
<tr>
<th>CNG</th>
<th>LNG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Used in passenger cars, light duty vehicles, busses up to heavy duty in medium range applications</td>
<td>Heavy duty vehicles, vessels and maritime applications</td>
</tr>
</tbody>
</table>

- Significant reduction/avoidance of CO2 emissions when using NG/biomethane
- Almost total reduction of NOx
- Particle emissions are avoided
- Reduction in noise levels by 50%, especially in inner-city applications
Range in kilometres for 10 € fuel costs

- **CNG**: 220 km
- **LPG**: 167 km
- **Diesel**: 164 km
- **Gasoline**: 103 km

Ass: Fiat Punto EVO (comparable motor, 70 to 77 PS), average consumption and fuel price

Cost advantage of natural gas today not transparent, due to wrong labelling
Methane & CO$_2$ – The cleanest fuel on a WTW basis

THG-Emission WTW in gCO$_2$ äq/km

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Emission (gCO$_2$ äq/km)</th>
<th>Reduction (%)</th>
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</thead>
<tbody>
<tr>
<td>Fossil fuel:</td>
<td></td>
<td></td>
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<tr>
<td>Petrol</td>
<td>164*</td>
<td></td>
</tr>
<tr>
<td>Diesel</td>
<td>156</td>
<td></td>
</tr>
<tr>
<td>LPG</td>
<td>141</td>
<td></td>
</tr>
<tr>
<td>Biogenic fuel:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CNG</td>
<td>124</td>
<td>-24%</td>
</tr>
<tr>
<td>BIO-CNG (20%)</td>
<td>100</td>
<td>-39%</td>
</tr>
<tr>
<td>BIO-CNG (100%)</td>
<td>5</td>
<td>-97%</td>
</tr>
<tr>
<td>Ethanol (Basis: Wheat)</td>
<td>114</td>
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</tr>
<tr>
<td>Biodiesel (Basis: Rape)</td>
<td>95</td>
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<tr>
<td>Electricity:</td>
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<tr>
<td>Hydrogen Fuel Cell (Basis: EU-Mix)</td>
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<td></td>
</tr>
<tr>
<td>Hydrogen Fuel Cell (Basis: Wind energy)</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>E-Mobility (Basis: EU-Mix)</td>
<td>5</td>
<td></td>
</tr>
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</table>

*Best values of all fossil fuels CO$_2$, C$_m$H$_n$, > 130 octane

Source: DENA; EUCAR-CONCAWE
New CNG models 2012: Low emission champions

Eco up! wins Germany’s “Green car of the Year”

New Audi A3 TCNG. Cleanest combustion engine with e-gas

Downsized & turbo charged engines + CNG is ideal (Fiat Panda)

More attractive OEM models. Range 500 km + (Opel Zafira Tourer & Mercedes-BENZ B-Class)
LNG in shipping
Marine fuel sulphur limit of 0,1% in ECA´s
LNG trucks for long distance transport

**Diesel vs. CNG / LNG**

- Diesel
  - 1 Liter
- CNG
  - 5 litre
- LNG/LBG
  - 1.8 litre

Two technologies are available for heavy engines:

- Dedicated, using 100% natural gas
- Dual fuel, using diesel injection for ignition and natural gas as the main fuel

LNG opened the way for the medium and long distance road transport
The LNG Blue Corridors Project

FP7 project on European LNG Blue Corridors

The intention is to define at least three initial pan European routes with strategically placed LNG filling stations that would allow the heavy, long distance truck transport throughout Europe:

- Portugal-Spain to France, Netherlands, UK
- Portugal-Spain to France, Germany, Denmark, Sweden
- Mediterranean arch to Italy and Slovenia

Source: LNG Blue Corridor project
TEN-T funding available for CNG & LCNG filling stations & LNG shipping infrastructure

CNG station. Dats 24, Brussels, Belgium

L-CNG station. Indox, Lleida, Spain

LNG bunkering & refuelling (Bit Viking converted to LNG)

- 3 winning LNG-projects (road & maritime) 2012 call
- New TEN-T guidelines & corridors to be adopted by European Parliament soon.

LNG figures China. 2015 forecast

Source: ENN
Europe & North America forecast

- Market share in 2050 EU/EFTA: 13% passenger, 33% freight
- North American forecast 37% oil replacement vs NGV

Source: Eurogas, EIA
• Communication on an alternative fuels strategy
• Proposal for a Directive on the deployment of alternative fuels infrastructure (harmonised standards & targets for rollout of consolidated alternative fuels)

- **150 km max. distance between CNG and 400 km max. distance between LNG stations** at national level Europe-wide to be implemented by 2020.
- Action plan for the development of LNG in shipping, proposing to install **LNG refuelling stations in all 139 maritime and inland ports**.

Conclusions

• Constantly rising fuel costs for oil based fuels
• Significant macro-economic savings when using NG as a fuel
• Infrastructure support (TEN-T) for CNG and L-CNG filling stations is key
• Tax support for NG main driver during infrastructure build-up phase
• Pricing based on energy content will push the NGV market
• NG in transport is the quickest and most cost-effective way to reduce emissions from transport
Thank you for your attention

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