Current & Future NGV Market Development: Challenges to be Addressed (focus on UNECE Region)
Let's Look to the Future..........It's Now 2050 !!

The world population has expanded from 7B to 9B

The number of cars & appliances has doubled.

The energy demand has increased two/three fold.
IEA – World Energy Outlook

3.7 trillion cubic metres
Global gas demand today

5.1 trillion cubic metres
Expected demand in 2035

Energy demand by fuel
Million tonnes of oil equivalent

Projected
Oil
Gas
Coal

Biomass
Nuclear
Other renewables
Hydro

Natural gas demand by sector 2035

World primary energy demand in the Reference Scenario

Non-OECD countries account for 93% of the increase in global demand between 2007 & 2030, driven largely by China & India

Are We Entering a Golden Age of Gas?
WEO-2011 special report released 6 June 2011
Alternative Fuels – Key Messages

- No Single Alt Fuel will Replace Oil
- NGV Market growing at a faster rate
- Oil + Diesel vs Gas pricing continues to decouple
- China, India and USA will drive the market
- LNG/LCNG/CNG are and will continue to be inextricably linked
NGV Market Drivers Have Moved

2000 - Environmental

2013 - Economical
- Energy security
- Energy diversity
  (macro for governments & micro for fleet operators)

Key Drivers
- Economics
- Energy
- Environment

Key Success Factors
- Government Support & Policies
- Benefits to Key Stakeholders

Challenges
(for long term development, growth & sustainability)
- Safety
- Refueling Infrastructure
- Gas Price
- Gas Supply
- Technology & Know-how
- Awareness & Education
Natural Gas Vehicle Growth Worldwide

Actual with Projections and Trendlines to 2015

Blue bars: Natural Gas Vehicles - Annual Total
Red bars: Growth projected in 2006

Exponential Trendline (based on Actual)
Linear Trendline (based on Actual)
5-Year Moving Average

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Key Contributors to Continuous Growth

- Over Supply of Natural Gas
- Reserves of Natural Gas
- The Decoupling of Oil/Diesel vs Gas Pricing
- Gas Engine Development
- Vehicle Development
- Infrastructure Development
Oil + Diesel vs Gas Pricing Continue to Decouple and Forecast to Widen

Source: IEA Energy Outlook
Evolution: Bus Fleets moving Rapidly to AF

Alternative fuel vehicles to represent 50% of total transit bus deliveries by 2015

The trend toward cleaner transit buses will continue over the next years, and by 2015 it is forecasted that alternative fuel vehicles will represent more than half of the 64,000 total vehicles that will be delivered worldwide during that year, up from 28% of total bus deliveries in 2010. CNG, LNG and hydrogen—among other options—are gaining significant traction in this sector, which has long been an important early adopter market for low-emissions drive trains.

Alternative Fuel Adoption Evolution Cycle

- Municipal Buses
- Municipal Refuse
- Private Fleets
- Taxis
- Private cars

Time

# NGV‘s
World Area NGV’s

- Africa/Middle East
- Asia Pacific
- Eastern Europe
- Western Europe
- Latin America
- North America
Primary Markets Today ……and Tomorrow

- Road Vehicles
  - Light Duty Vehicles
  - Heavy Duty Trucks and Buses
- Non-Road Vehicles
  - Marine applications
  - Railway applications
- Off-Road Vehicles
  - Construction
  - Agricultural (also compatible w/biogas)
Light Duty Vehicles still challenged by the ‘chicken & egg’ syndrome

- OEM production expanding, particularly for Western Europe
- Retrofit suppliers filling gaps and very active in Eastern emerging economies where the first cost of OEMs is a deterrent
- To achieve 10% penetration a ‘European Solution’ will be required.*
- The current development is country-by-country.

## European fuels, fuelling stations & vehicles per station

<table>
<thead>
<tr>
<th>FUEL</th>
<th>VEHICLES</th>
<th>STATIONS</th>
<th>VEHICLES PER STATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>PETROLEUM(^1)</td>
<td>234 million</td>
<td>134,282 (+)</td>
<td>1,743</td>
</tr>
<tr>
<td>NATURAL GAS(^2)</td>
<td>1.42 million</td>
<td>Total = 3,964 (2,706 public &amp; 1,258 private)</td>
<td>358</td>
</tr>
<tr>
<td>LPG(^3)</td>
<td>7 million</td>
<td>25,519</td>
<td>279</td>
</tr>
</tbody>
</table>

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1. Europia Annual Report 2011, from the National Oil Industry Associations (NOIA)
2. Gas Vehicles Report October 2011
3. European LPG Association (AEGPL) as of 2007
Huge European NGV Opportunities

Gazprom Creates New Company to Consolidate NGV Interests
December 14, 2012 – 2:06 pm | Russia
Gazprom's push to develop the Russian natural gas vehicle (NGV) fuel market has further...

Audi celebrates topping-out ceremony for its cutting edge e-gas plant in Germany

Logistics with CAP Dual-Fuel for Ham Group
December 5, 2012 – 11:06 pm | United Kingdom and Spain
Clean Air Power, developer of dual-fuel combustion technology that enables heavy-duty diesel engines to operate on a combination of diesel and natural gas, last month received a Genesis Edge systems order from Spain's Ham Group, a European logistics operator. Ham ordered 50 Renault Magnum compatible Genesis Edge Dual-Fuel™ retrofit system systems in April 2012 and has now followed this with an order for another 30 systems. Read More »

UK firms are committed to the widespread adoption of biomethane for HGVs

Growing NGV Refueling Stations Sweden
December 11, 2012 – 5:43 am | Sweden
Fordon, a new supply gas vehicle station, has opened in September. The product is produced from livestock manure, sewage sludge, grass and other organic waste. It results in reduced use of gasoline and diesel in transport. It is expected to supply approximately 19 GWh of biogas per year, representing approximately 2.1 million gallons of gasoline. Read More »

European natural gas vehicle market continues to grow despite economic crisis

Gas Natural Fenosa Reports on EC GARneT Project for LNG Refuelling Infrastructure
November 30, 2012 – 11:58 pm | Spain
Gas Natural Fenosa, the multinational energy firm based in Spain, and HAM Criogénica, part of Spain's Ham Group, presented the European GARneT (Gas as an Alternative for Road Transport) project this week in Brussels at a conference organised by the European Commission. The project allows for the creation of a network of liquefied natural gas (LNG) stations that provide service to long-distance vehicles that use this fuel. Read More »

New encouraging statistics for the industry
27.12.12 Markets

Deutsche Bank's analysts are upbeat about the European natural gas vehicle (NGV) market as a result of the growing number of NGV refuelling stations. The German bank has raised its price target for the sector and rated it 'buy.' The report is based on a visit to Austria, where the NGV market is growing rapidly.
## Current Global View: HDV NGVs

<table>
<thead>
<tr>
<th>REGION</th>
<th>TOTAL NGVs</th>
<th>MD/HD BUSES</th>
<th>MD/HD TRUCKS</th>
<th>% MD/HDV of TOTAL NGVs</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASIA</td>
<td>9,733,192</td>
<td>390,849</td>
<td>155,207</td>
<td>5.6%</td>
</tr>
<tr>
<td>EURASIA</td>
<td>336,862</td>
<td>32,200</td>
<td>52,760</td>
<td>25.2%</td>
</tr>
<tr>
<td>AFRICA</td>
<td>188,220</td>
<td>1,463</td>
<td>85</td>
<td>0.82%</td>
</tr>
<tr>
<td>EUROPE*</td>
<td>1,426,494</td>
<td>245,934</td>
<td>141,530</td>
<td>27.2%</td>
</tr>
<tr>
<td></td>
<td>(1,038,494)</td>
<td>(13,146)</td>
<td>(5,737)</td>
<td>(1.8%)</td>
</tr>
<tr>
<td>S &amp; CENTRAL AMERICA</td>
<td>4,608,799</td>
<td>13,920</td>
<td>9,660</td>
<td>0.51%</td>
</tr>
<tr>
<td>N. AMERICA</td>
<td>131,036</td>
<td>13,230</td>
<td>2,506</td>
<td>12.0%</td>
</tr>
<tr>
<td>WORLDWIDE</td>
<td>16,424,603</td>
<td>697,596</td>
<td>361,748</td>
<td>6.45%</td>
</tr>
</tbody>
</table>

* UKRAINE 388,000 232,788 35,793 95%

Source: Gas Vehicle Reports, Aug/September 2012
Typical Operating Cost Breakdown: US Class 8 Truck Fuel is the Largest Expense

Source: Advancing Technology for America’s Transportation Future: Fuel and Vehicle System Analysis,
Natural Gas Analysis, (Draft) National Petroleum Council, August 1, 2012
Payback Case Study #1: UPS

- Largest private fleet in USA – environment, energy security concerns
- 82 new LNG tractors – operating between Los Angeles, Las Vegas and Salt Lake City Distribution Centres
- 688 mile (1107 km) corridor with 3 fuel stations
- ~5100 tonne annual GHGe reductions
- 4 fuelling stations – public access
- Cost reductions result in ~13 month payback
Payback Case Study #2: Vedder Transport

- Largest fleet in British Columbia, Canada – high environmental commitment
- 50 new LNG tractors
- Hauling milk, food, forestry and waste products in dedicated service
- 3500 tonne annual GHGe reduction from implementation
- Cost reductions result in ~16 month payback
Heavy Duty NGVs require fleet-based fuelling or “fuelling corridors” (likely LNG or L-CNG)

- EU sponsoring ‘Blue Corridor’ LNG project
- Russian Blue Corridor yet-to-be-created
- LNG growth and availability will foster greater development of HD NGVs
- HD OEM L-NGVs provides a market-opener
L-NGV regulatory activities will have a positive effect on HDV growth

- New UNECE rules being developed for dual-fuel trucks (also running on LNG) will facilitate the market
- Amendments to UNECE Regulation 110 lays the foundation for putting LNG components on trucks
- ISO rules developing for LNG fuelling stations and will facilitate LNG and L-CNG outlets
Marine & Rail Potential is huge: Standards & Regulations required to advance these markets

- International Maritime Organization (IMO, within the UN structure) will need advocacy from the NGV stakeholders to create a full suite of standards and regulations for fuelling; fuel connectors; bunkering; fuel storage on-board ships; etc; etc;
- Inland shipping regulations need to be examined
- Role for UNECE might be to perform a ‘gap analysis’ of maritime & railway regulatory requirements for the sector
- Full study of the market potential (European & globally) also is required
People don’t know you can run a vehicle on natural gas

- When the going gets tough, the tough advertise!
- The unknown is un-liked. Make the unknown known and it will be liked!
- Gas industry can be the intellectual leaders and market drivers of a long-term revolution in the vehicle transportation market.
- UNECE might want to create a ’model’ NGV Roadmap for its gas industry members.
Evolution or Revolution?

Evolution: Takes to long
- USA took 20/30 years to arrive at current growth

Revolution: Imperfect but pragmatism has its place
- India
- Iran
- China
Phil Fathers
Vice Chairperson, NGV Global

Thank you
Any Questions

Current & Future NGV Market Development:
Challenges to be Addressed