Poli-techs:
Creating a Standards & Regulatory Roadmap for Gaseous Fuel Vehicles
5th Critical Issues Workshop

26-27 March 2013
Le Chatelain Hotel
Brussels

Dr. Jeffrey M. Seisler, CEO
Thanks to the Sponsors!!

And to the speakers

And to the participants
What is Poli-techs?
A hybrid of politics & technology

‘Poli-techs’ is a process whereby standards and regulations are developed based on best available technologies and best practices in the industry, created through ‘political’ consensus within and between both industry and government.

• Complex
• Lengthy
• Consensus building essential
DEFINITIONS

• STANDARDS
  – Not ‘legal’ (i.e. not binding) but are intended to be *de facto* models for codes
  – Performance or prescriptive

• REGULATIONS (also known as *codes*)
  – *Dejure*/legal, with enforcement implications
  – Can adopt standards by reference or amendment
ALTERNATIVE FUEL VEHICLE TECHNOLOGIES: BUILDING A LADDER TO CLEANER AIR
THE GLOBAL STANDARDS FRAMEWORK (STRUCTURE)

Politics + Technology (POLI-TECHS)
LEVELS OF STANDARDS & REGULATIONS
(The Patchwork Quilt)

REGULATIONS

STANDARDS

International Bodies

- Global
- Regional (EC)

Countries

- Cylinders
- Meters
- NGOs & Associations

United Nations

- International Standards Organization (ISO)
- Committee for European Normalization (CEN)

Private Sector Participants

E X P E R T S
Critical Need for Standards & Regulations

- Safety of equipment: fabrication & testing
- Reliability of equipment & systems
- Promote best practices
- *Harmonized* standards & regulations foster economic (*not cheap*) critical mass for equipment sold across international markets.
- No regulations – no markets

= ACCOUNTABILITY  = PROFIT
OVERVIEW of POLI-TECHS

• Regulatory landscape – natural gas/LPG
  - United Nations
  - European Union
  - ISO
  - CEN

• Vehicle regulations
  - Landscape of EU regulations
  - Dual-fuel
  - LNG
  - LPG
United Nations & European Standards & Regulations for NGVs & LPG-Vs

- **European Commission**
  - Motor Vehicle Emissions Group

- **Committee for European Normalisation**
  - TC326 Gas supply for natural gas vehicles
  - Operational conditions
  - NGV filling stations
  - NGV fuel systems

- **International Standards Organisation**
  - Group of experts on Pollution and Energy
    - TC 58 SC 3 Cylinders
    - TC 22 SC 25 Road vehicles using natural gas
    - TC 193 Gas composition
    - Refuelling connector
    - Design and installation of vehicle fuel systems
    - NGV fuel system components

- **Committee for European Normalisation**
  - TC 282 Small scale LNG storage systems

- **United Nations**
  - Working Party 29

- **International Organisation of Legal Metrology**

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United Nations & European Standards & Regulations for NGVs & LPG-Vs...
European Energy & Alternative Fuel Policies 2013
The European Commission takes a bold policy step in 2013 with a European Alternative Fuels Policy that focuses on building the AFV infrastructure(s)

“If you build it... they will come.”

And they arrived in alternative fuelled vehicles!
Regulatory Landscape to Develop Engine & Emissions Certification Regulations

Heavy Duty Vehicles

European Commission

DG Enterprise/Industry

Motor Vehicle Emissions Group (MVEG)

Light Duty

Heavy Duty

Euro II

Euro III

Euro IV

Euro V Links to R.115

Euro VI

UN / ECE

Inland Transport Committee

WP29

GRPE

GRSG

(CNG/LPG Retrofit & Safety)

Informal Group Gaseous Fuel Vehicles (GFV)

OEM-Related

Retrofit

Gas Related Safety

R 85 Power Measurement

R 49 Emissions HDVs

R.115 CNG/LPG Systems, Emissions & Safety

R.110 CNG Components & installation

R-67 LPG Components & installation

LNG TASK FORCE L-NGVs

Links to R.115

Euro II

Euro III

Euro IV

Euro V

Euro VI

Delegation of work to GRSG
OVERVIEW
POLI-TECHS
(Day 2)

• Renewable gas/gas composition

• New markets for gaseous fuels
Regional Variation in Gas Composition

- Globally differences occur by region and within countries
  - changes octane behavior based on inerts and other combustibles
  - Results in calibration and drivability changes
- US Code Federal Register specifies minimum methane content must be posted
- Fuel composition specified for emission validation (ex EPA, CARB)
- SAE J1616 is a Recommended Practice for CNG Vehicle Fuel
- Opportunity to develop a clear automotive fuel specification requires industry support

Source: Various public information and fuel suppliers

THE POTENTIAL FOR BIOGAS IS GROWING BUT GAS QUALITY IS AN ISSUE

638% growth since 1997

125% growth 2006-2010
General issues for natural gas (and LPG)

• Methane content
• Wobbe index: in broad terms, heating value at the ‘burner tip’*
• Methane number: anti-knock value, i.e. octane (propensity not to self ignite)
• Water content
• Contaminants (H₂S, sulphur [incl. odorant])
• Other stuff: propane, H₂, oil, dust,

* MJ/per M³ (Btu/Scf) divided by the square root of the specific gravity
Requirements (and potential) for gas composition is very different for different stakeholders

- Energy distribution companies
- Suppliers of gaseous automotive fuel
- Needs of the vehicle manufacturers
  - cars
  - trucks
  - ships & trains
Marine Market for Gaseous Fuels

Above-ground, small scale LNG storage for ship fuelling, in Halhjem, Norway
## Global and EU Merchant Fleet in Units by Type and Region of Domicile
(Ships of 1,000 grt or more)

<table>
<thead>
<tr>
<th></th>
<th>Global</th>
<th>EU</th>
<th>% EU</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>37,299</td>
<td>11,164</td>
<td>31</td>
</tr>
<tr>
<td><strong>Tankers</strong></td>
<td>9,972</td>
<td>3,061</td>
<td>31</td>
</tr>
<tr>
<td><strong>Bulk Carriers</strong></td>
<td>7,374</td>
<td>2,080</td>
<td>28</td>
</tr>
<tr>
<td><strong>Containers</strong></td>
<td>4,677</td>
<td>2,460</td>
<td>53</td>
</tr>
<tr>
<td><strong>General Cargo</strong></td>
<td>13,059</td>
<td>3,285</td>
<td>25</td>
</tr>
<tr>
<td><strong>Passenger &amp;</strong></td>
<td>2,217</td>
<td>728</td>
<td>33</td>
</tr>
<tr>
<td><strong>Passenger/Cargo</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: EU Transport in Figures Statistical Pocketbook 2012, European Commission (P. 95)*

grt = gross registered tonnes
## Global and EU Passenger & Passenger Cargo Ships in Units by Registered Flag

(Ships of 300 grt or More & Cruise Ships of 1,000 grt or more)

<table>
<thead>
<tr>
<th></th>
<th>Global</th>
<th>EU</th>
<th>% EU</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Passenger &amp; Passenger/Cargo Ships</strong></td>
<td>4,486</td>
<td>1,393</td>
<td>31</td>
</tr>
<tr>
<td><strong>Cargo passenger and Ro-Ro Passenger Ships</strong></td>
<td>2,624</td>
<td>878</td>
<td>33</td>
</tr>
<tr>
<td><strong>Passenger (Not Ro-Ro)</strong></td>
<td>1,571</td>
<td>418</td>
<td>27</td>
</tr>
<tr>
<td><strong>Cruise Ships</strong></td>
<td>291</td>
<td>97</td>
<td>33</td>
</tr>
</tbody>
</table>

**Source:** *EU Transport in Figures Statistical Pocketbook 2012, European Commission (P. 95)*
Four Options for Shipping

• Switch to Marine Gas Oil (MGO)
• Install scrubbers (not option for smaller ships)
• Shift to LNG
• Shift to LPG
A typical Baltic Sea cargo ship

Yearly emissions, tonnes/year

<table>
<thead>
<tr>
<th></th>
<th>SOx</th>
<th>NOx</th>
<th>CO2</th>
<th>Particle emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>With LNG fuel:</td>
<td>0</td>
<td>31</td>
<td>5,500</td>
<td>0</td>
</tr>
<tr>
<td>With low-sulphur HFO (LS380 with 1% sulfur):</td>
<td>50</td>
<td>180</td>
<td>7,250</td>
<td>4</td>
</tr>
</tbody>
</table>

547 TEU container vessel (5000 GT) Propulsion power 3960 kW

Tor Svensen, (President DNV), *The age of LNG is here: Most cost efficient solution for ECAs*, 8 June 2010
LNG is better economically – over 10 years

- Alternatives to meet the future ECA requirements
  - Low sulphur fuel (0.1% sulphur), install scrubbers, switch to LNG
- LNG saves
  - 35% lower than Marine Gasoil
  - 12% lower than Heavy Fuel Oil with scrubber

Net Present Value of costs over 10 years

Source: Tor Svensen, (President DNV), *The age of LNG is here: Most cost efficient solution for ECAs*, 8 June 2010, referencing, DNV Baltic Report
Various LNG Bunkering Solutions but standards & regulations are needed

North European LNG Infrastructure Project: A feasibility study for an LNG filling station infrastructure and test of recommendations, Final Report, May 2012
The First Russian Turbo Gas Locomotive

Source: Gas Vehicles Report
All Trains and Diesel Trains with Fleet of 500+ 2009

Source: Eurostat
Energy Consumption of Railways in Europe in 2011 in Thousand Tonnes of Oil Equivalent (TOE) (Countries Over 100 TOE)

Source: Eurostat
### Average Railway Energy Consumption in the EU by Train Type & Traction 2009

<table>
<thead>
<tr>
<th>Train Traction &amp; Type</th>
<th>PJ Consumed</th>
<th>% of Energy Consumed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Electric</td>
<td>127.89</td>
<td>57</td>
</tr>
<tr>
<td>Passenger Diesel</td>
<td>40.81*</td>
<td>18</td>
</tr>
<tr>
<td>Freight Electric</td>
<td>33.09</td>
<td>15</td>
</tr>
<tr>
<td>Freight Diesel</td>
<td>22.8**</td>
<td>10</td>
</tr>
</tbody>
</table>

*974,730 TOE  
**544,568 TOE

**Source:** Railway Handbook 2012, Energy Consumption and CO2 Emissions, UIC (P.33)
EU Railways Regulation Structure

International Regulators (UIC)

EU Regulators (ERA, UNIFE)

State Regulators

Cooperation
Interoperability
Benchmarking
Standardisation
Sustainability

Interoperability
Standardisation
Development
Sustainability
Competition

Rolling Stock Suppliers
Network Manager(s)
Train Manager(s)

Source: 2013, UIC, ERA, UNIFE, FS (Italian State Company)
Agricultural Market
Total Number of Tractors Per Country in 2009 (With Total Fleet Over 30,000)

Source: Eurostat
Total Number of Road Tractors and Number of Tractors 10 Years Old or More (With Total Fleet Over 30,000)

Source: Eurostat
Number of New Registrations of Road Tractors by Country in 2009 (above 1000)

Source: Eurostat
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