



Eni Divisione Gas & Power

Development of NGV Standards and Technology

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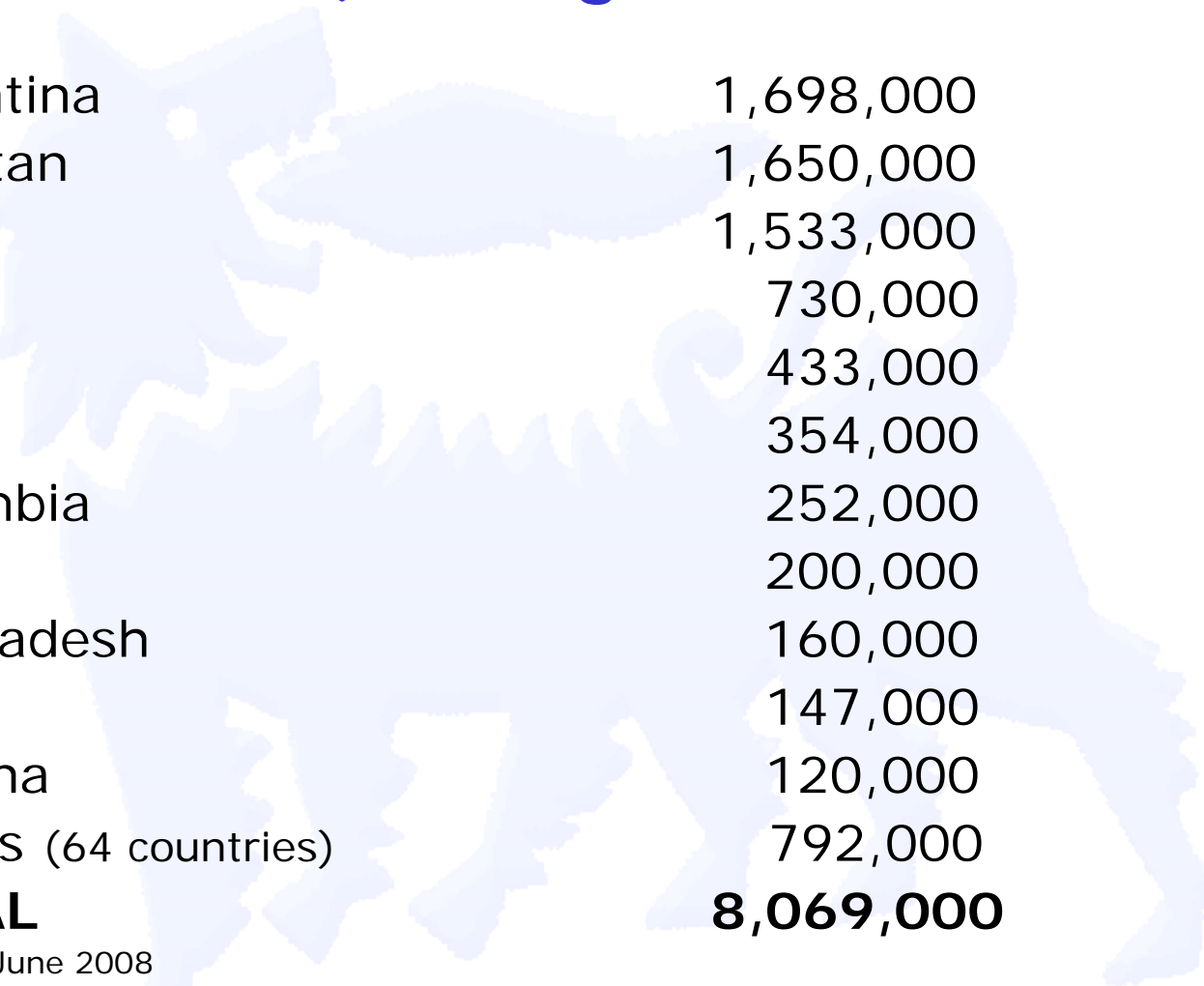
Bratislava, 18 – 19 September 2008





What is the present NGV market situation

NGV worldwide (the larger 10 national fleets)



Source: GVR June 2008

TREND: average **18%** growth increase over the last 10 years.
This way, at 2020 → over **60 million** NGV in the world



**What needs to be done for further
development**

NGV technology can keep pace with automotive technology. But we need:

- NGV sector full coverage with good **norms**;
- **Harmonisation** of norms worldwide
- **Training** on its use and solutions
- Wider **application**

Hence:

- **Scale** effect, Thus: more finance for **R&D**

virtuous circle: **More apples→more seeds→more trees→more apples**

NGVA Europe (ex ENGVA) has been fostering this sector, and needs to carry on with it; main activity:

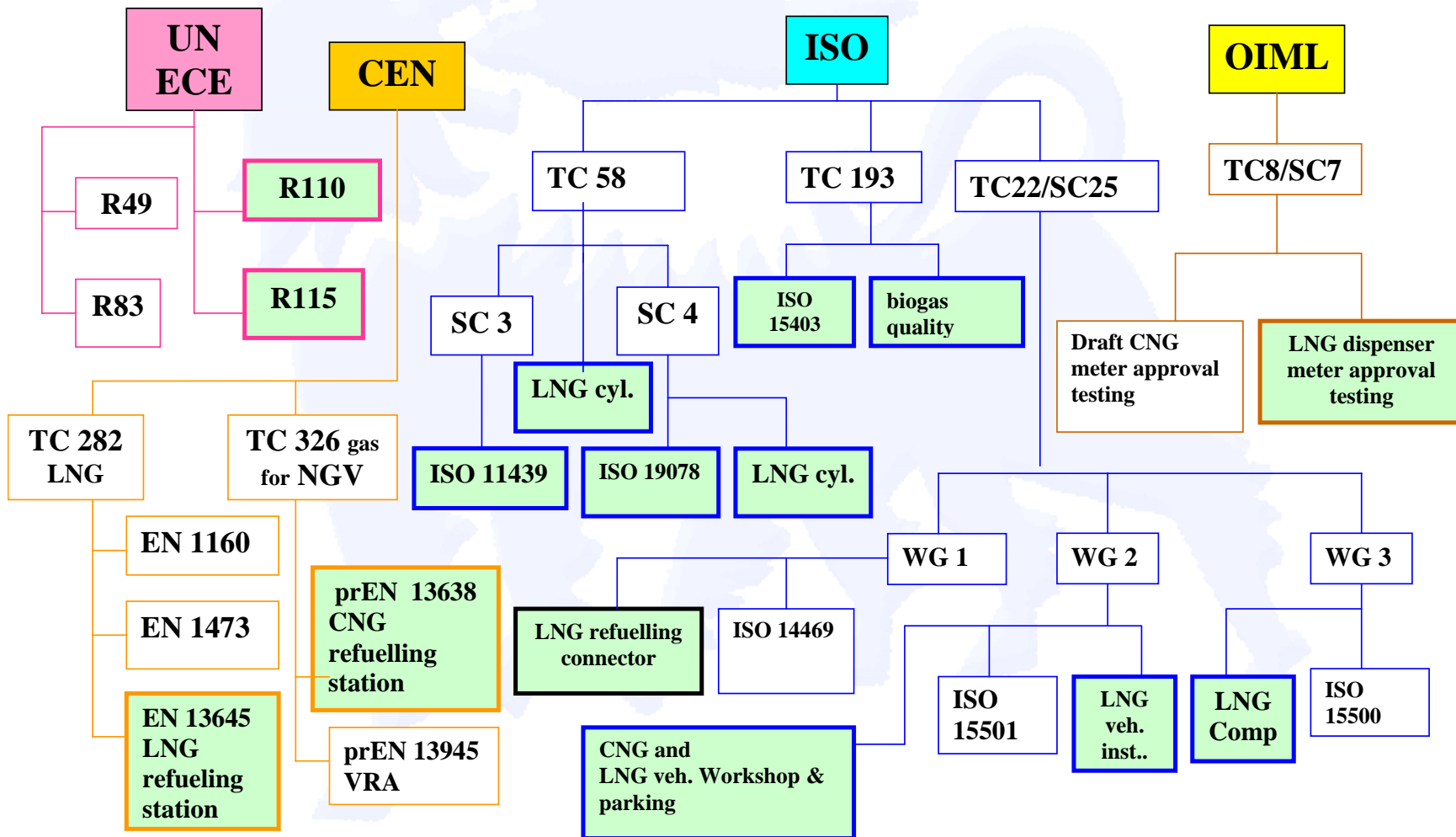
- government lobby
- Technology monitoring, standards
- Marketing
- Communication
- Country representatives
- Case studies and projects
- Exchange of information, problem solving

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What has been done so far by the NGV sector experts

INTERNATIONAL NGV STANDARD PANORAMIC (green box= gaps still left)



Standard ISO TC 22 – TC 58 – TC 193

- ISO 11439 **cylinders** CNG type 1-2-3-4
- ISO 14469 parts 1 to 3 refuelling **connectors**
- ISO 15500 parts 1 to 20 on-board CNG **components**
- ISO 15501 parts 1 and 2 on-board CNG **systems**
- ISO 15403 parts 1 and 2 **quality** of CNG
- ISO 19078 CNG cylinder **periodic test**
- ISO CD 22302 calculation of **methane number**
- ISO AWI 12614 LNG on-board components
- ISO AWI 12617 LNG connector

AWI = approved work item

CEN norms

- EN 13423:2000 “**operative conditions**” (vehicle instructions, workshop, parking) published
- prEN 13638 “CNG refuelling **stations**” (self-service; temperature compensation; indoor refuelling; break-away) long process, still pending; additional delay due to PED compliance assessment
- prEN 13945 “Vehicle refuelling **appliances**” (limits: flow rate < 20 Nm³/h; storage < 0,5 Nm³) long process; still pending; additional delay due to inclusion of indoor installation, and compliance with the relevant European Directive (Machine Directive)

Certification/training of retrofit professionals (conversion workshops)

- **CUNA** NC 120-01 in Italy approved by Ministry of Transport, early 2008
- **TUV** – DECRA in Germany
- Affect of UN ECE Regulation **R115**

Aim:

- Increase professional level and skills
- Update on modern technology
- Handle ever more sophisticated engines (MPISF - OBD)
- Increase the quality of service
- Liability - get responsibility of product and service
- End target: certified operators, able to certify their conversions → quality & customer confidence

Standard harmonisation → Comparison between ISO and UN - ECE regulation R110

- 62 basic **discrepancies** identified, between the UN ECE regulation and the ISO standard.
- Many countries do not follow UN ECE regulations and require components meeting ISO. So manufacturers must carry out for each component **2 different set of tests** for compliance with the two standards, which adds to manufacture cost and timing.
- **Alignment** of ISO and UN ECE → beneficial to NGV sector.
- **NWI** vote in ISO was positive, and this activity started in April 2008 – chair: Diego Goldin, Argentina (with 5 years revision).

European Regulation 715/2007 - EURO 5 Emissions (it is not UN ECE regulation)

- **NMHC** included in Euro 5 regulation (**0,068** g/km) → good.
- **THC** limit still applicable as well (**0.1** g/km) → problems for **retrofit** NGV (as in case of EURO 4)
- Strategy for the THC/NMHC problem for retrofit: amendment to Reg. **ECE 115** (with rationale)
- Ad Hoc **Group GFV** (gaseous fuel vehicles) created in GRPE in 2007, to improve UN ECE regulations
- UN ECE R110 → **R83** (right now, R83 goes up to Euro 4)
- Euro 5 / 6 are in EU Reg. 715/2007 (not yet in UN ECE)
- **Emissions** → GRPE (Chairman: Bernard Gauvin - France)
- **Safety** → GRSG (Chairman: Antonio Erario - Italy)

GRPE = group rapporteur pollution et energie (emissions)

GRSG = group rapporteur suretè generale (safety)

Amendments to ECE/UN Regulations (Group of Experts on Pollution & Energy) R110 – R 115

- Amend **wrong** requirements (copied from LPG Regulation)
- Modification **3 → 4 years** CNG cylinders test interval
- Harmonization of CNG NGV-1 **filling connector** → amend Reg. R110 (January 2007) to include ISO 14469-1
- **Welded** CNG liners – German proposal – amendment accepted– (ground for debate.....)
- Cylinder Assemblies: reduction of the **number** of automatic **shut-off valves** - required safety analysis – issue set aside
- **Temperature** ranges for component certification (-40°C or -20°C) - issue not raised yet
- Substantial amendments needed for **PRD** requirements

PRD

- Bus **fires** → cylinder rupture in Germany (2003) and France (2005)
- Evaluation of available **reports** (TUV; French Authorities) → good components, but solution/location/installation/maintenance can/need be improved
- Prepare **Guidelines** (now missing) for PRD application, installation, principles of operation →
- **Amendments** to UN ECE R 110
- (Option: improve ISO standards and then include them in R110 in place of the present wording)

UN ECE R 83

- **OBD** compliance for retrofit: delicate issue
- Master/slave system
 - In **gasoline** mode, only the original OBD (master) is active
 - In **CNG** mode, retrofit OBD (slave) is active, but it's only controlling the CNG system; all other components are still controlled by the original OBD

LNG standards

- Many countries interested: Italy, Norway, Czech Republic, Spain, UK, Switzerland
- **ISO** AWI → LNG components:
 - LNG tank: NWI → ISO/TC220
 - LNG connector: NWI → ISO/TC22/SC25 WG4 (AWI 12617)
 - LNG on-board components: NWI → ISO/TC22/SC25 WG4 (CD 12614)
 - The same committee deals also with H₂ and CNG/H₂ blends: NWI → ISO/TC22/SC25 WG5
- **CEN** NWI → LNG refuelling stations → CEN TC 326 → NWI proposal
- There is a German standard on LNG refuelling stations (can be used as basis?)
- There are standards in USA; mostly recommendations, not prescriptive (can be used as basis?)

GAS QUALITY

- OEM → "pure methane" ← **debate** → Gas industry → omnivorous engine (self-adaptive to cope with variation of gas composition)
- Standard ISO 15403 CNG part 1 – part 2 revised in 2006
- German OEM and Environment Agency → mandate to DIN for standard on gas quality, July 2006
- For **Germany** → Norm **DIN 51624** (published in February 2008)
 - Limits to **S, H₂O, oil, particles**
 - Limit to **MN (70)**: **problem** for the gas industry
 - Limit to higher hydrocarbon content: problem
- **EU** wants a norm for gas quality; basis:
 - EASEE Gas common business practice (?)
 - European Fuels Directive (gasoline and Diesel) + CNG (?)
 - New ISO standard (?)
 - CEN NWI (?)
- Biomethane quality ?

Note: EASEE = European Association for Streamlining of Energy Exchange - gas



What will we do in the near future

Technology themes in the scope of the NGVA Europe activity

- **Gas/Biogas fuel quality**→monitoring standard activity on gas fuel quality (DIN; CEN; MARCOGAS)
- **CNG/LNG/LCNG standards** (refuelling station; tank; system; component)→fostering of standardisation activity (CEN; ISO)
- **identification of potential conflicts** in proposed changes to RCS (regulation, code, standard)→gap analysis; monitoring of standardisation activity; amendment to existing standards; new standards
- **On-board system safety**→improvement of existing RCS; looking for the better/proper combination of maximum safety level, and wide agreement on safety concepts/solutions to adopt

Main fields of future activity of NGVA Europe

- **Position papers** – NG and CO₂; Biomethane → NGV; NGV in Euro 6
- **Case studies** – succes stories; experiences of market, network development
- **Fact sheet and market data** – NGV; CO₂; LPG; statistics
- **Medium term development of NGV** – LNG → long haul; hythane
- **Consultancy** – problem solving; standards; procedures
- **Exchange of information** – data; statistics; software

Other themes of general interest

- Higher service **pressures** (200→300 bar) → longer range; but more standards and higher costs
- Direct **injection** CNG engines
- Harmonisation of CNG cylinder **periodic test** requirements – include **ISO 19078** into R 110
- Proposal for **Natural Gas Directive**, similar to Biofuels Directive

Innovative systems for CNG cylinder in-service inspection

- Progress of the new technologies for cylinder inspection and in-service monitoring systems ("cylinder OBD"):
 - Laser;
 - Acoustic emission;
 - Optic fibres (e.g. Braggs reticules; light reflection);
 - Other methods (e.g. acoustic sensors);
- CRF in Italy is doing R&D on this field

Stationary CNG cylinder 10 years periodic test

- Problem: station break down time during testing, and testing media for the hydrostatic strength test (water/oil). In the station all cylinders must be tested every 10 years (PED); a complete inspection of the station has to be carried out.
- Aim: develop a scheme for this complete testing.
- GASCOM: method based on **laser** light focused on cylinders subject to a pressure in excess of normal service pressure (+10 bars). No evidence for the reliability of such test was offered. Possible actions devised on this item:
 - ask the OEM their opinion about this laser test;
 - limit the stationary cylinders service life to 20 years, without periodic test, other than visual test;
 - require periodic test once every 20 years, not 10.

Norms OIML METERING - DISPENSER

- Harmonisation of metering units: **m³; kg; MJ; kWh**
- OIML (Organisation Internationale Metrologie Legale)
 - standard for meters (ENGVA and IANGV) – OIML Draft Recommendation Compressed gaseous fuel measuring systems for vehicles
- Development of legal metering method
 - Dispenser metering **accuracy** is among the last standards for NGV which are still to be prepared
- Problem: measuring **discrepancies** between gas inlet and dispenser, when done with two different measurement systems. Coriolis system mass dispensers expensive but lasting longer in time.
- There is a certain lack of norms, and the OIML standard in process seemed slow progressing towards the final approval and publication. Now it seems to have gained new momentum

Thank you

