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

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Thanks to the Sponsors!!

And to the speakers

And to the participants

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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

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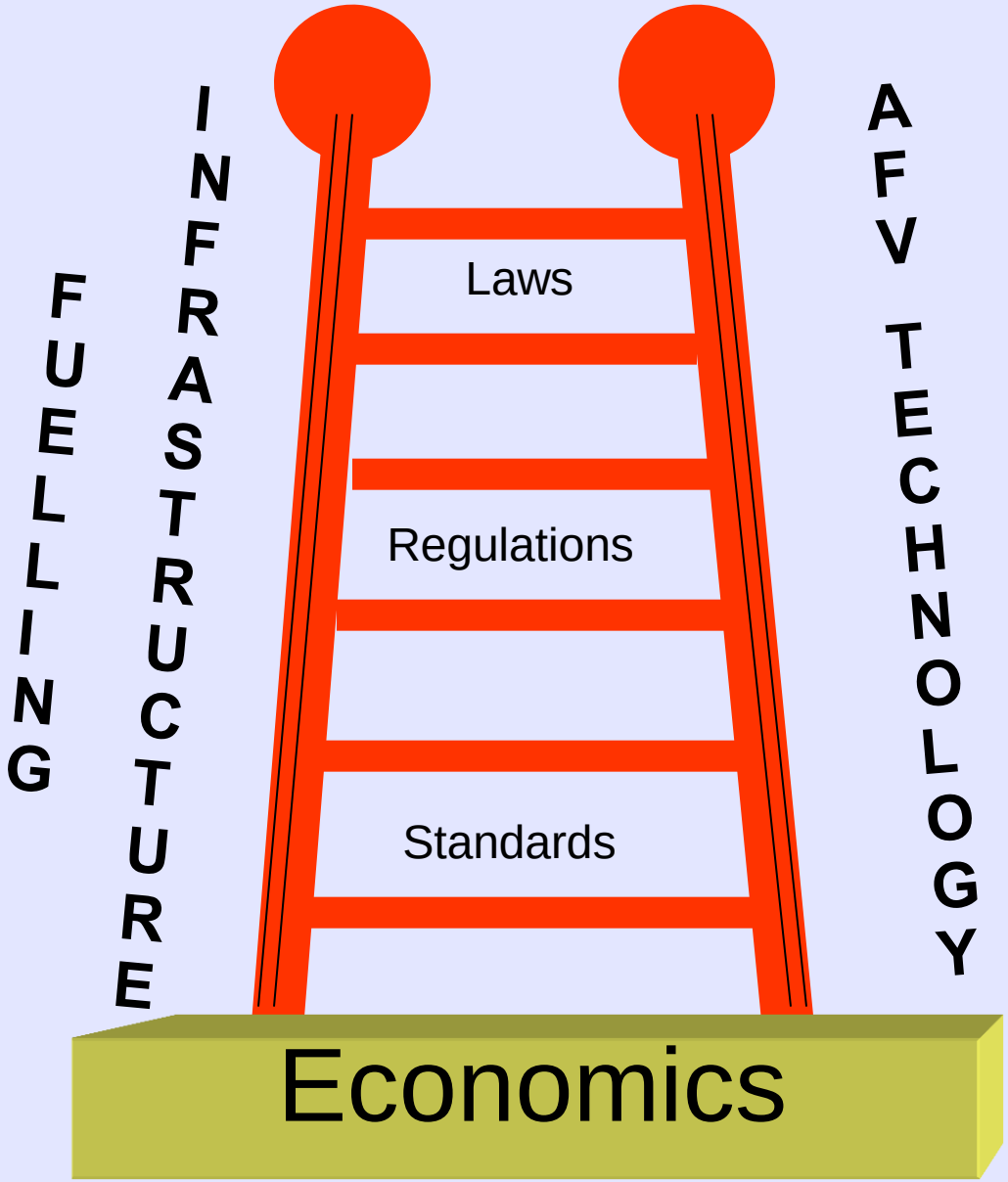
DEFINITIONS

- **STANDARDS**
  - Not ‘legal’ (i.e. not binding) but are intended to be *defacto* models for codes
  - Performance or prescriptive
- **REGULATIONS (also know as *codes*)**
  - *Dejure*/legal, with enforcement implications
  - Can adopt standards by reference or amendment

ALTERNATIVE FUEL VEHICLE TECHNOLOGIES: BUILDING A LADDER TO CLEANER AIR



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THE GLOBAL STANDARDS FRAMEWORK (STRUCTURE)

Politics + Technology (POLI-TECHS)

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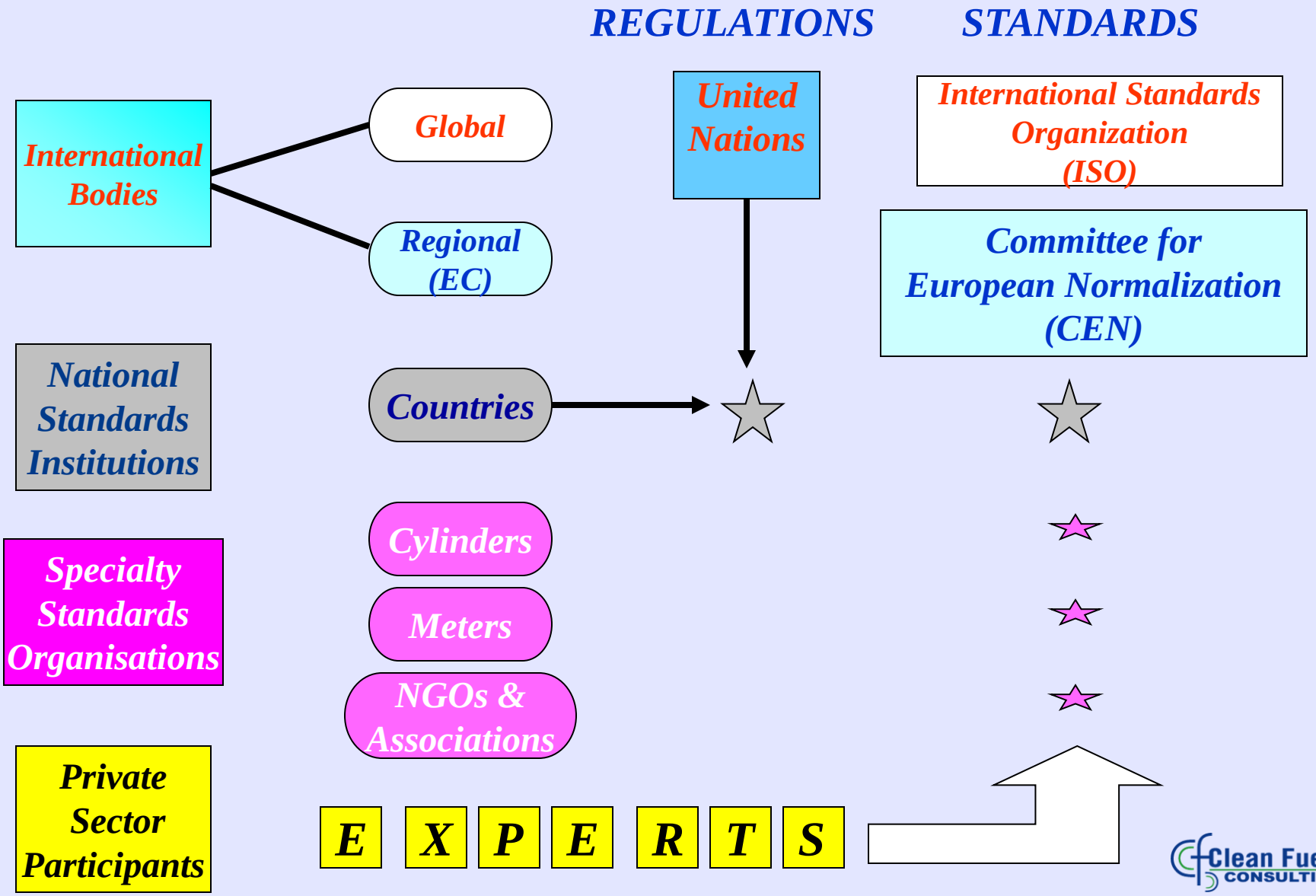
LEVELS OF STANDARDS & REGULATIONS
(The Patchwork Quilt)



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

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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

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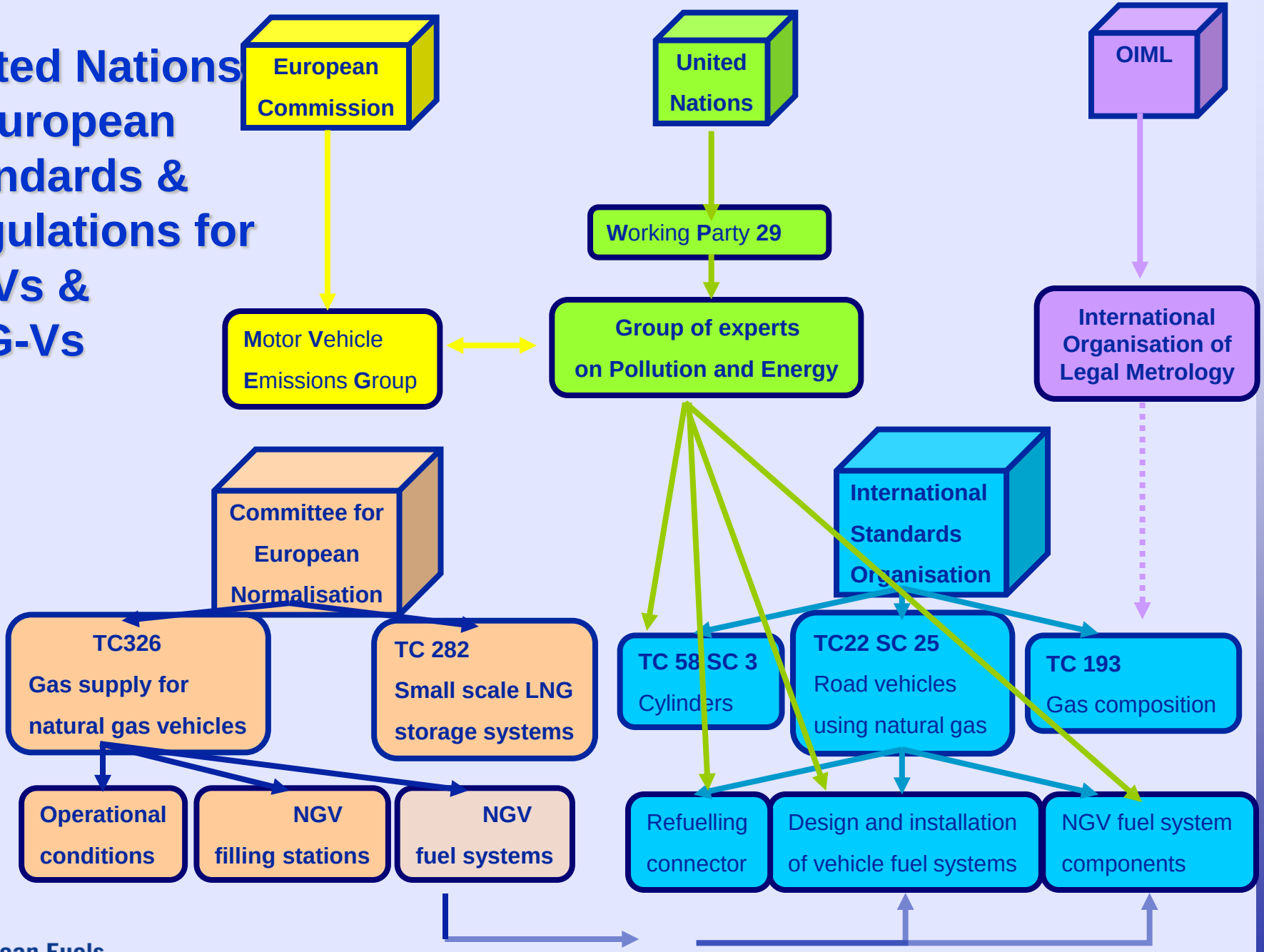
United Nations & European Standards & Regulations for NGVs & LPG-Vs



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European Energy & Alternative Fuel Policies 2013

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The European Commission takes a bold policy step in 2013 with a European Alternative Fuels Policy that focuses on building the AFV infrastructure(s)

And they arrived in alternative fuelled vehicles!

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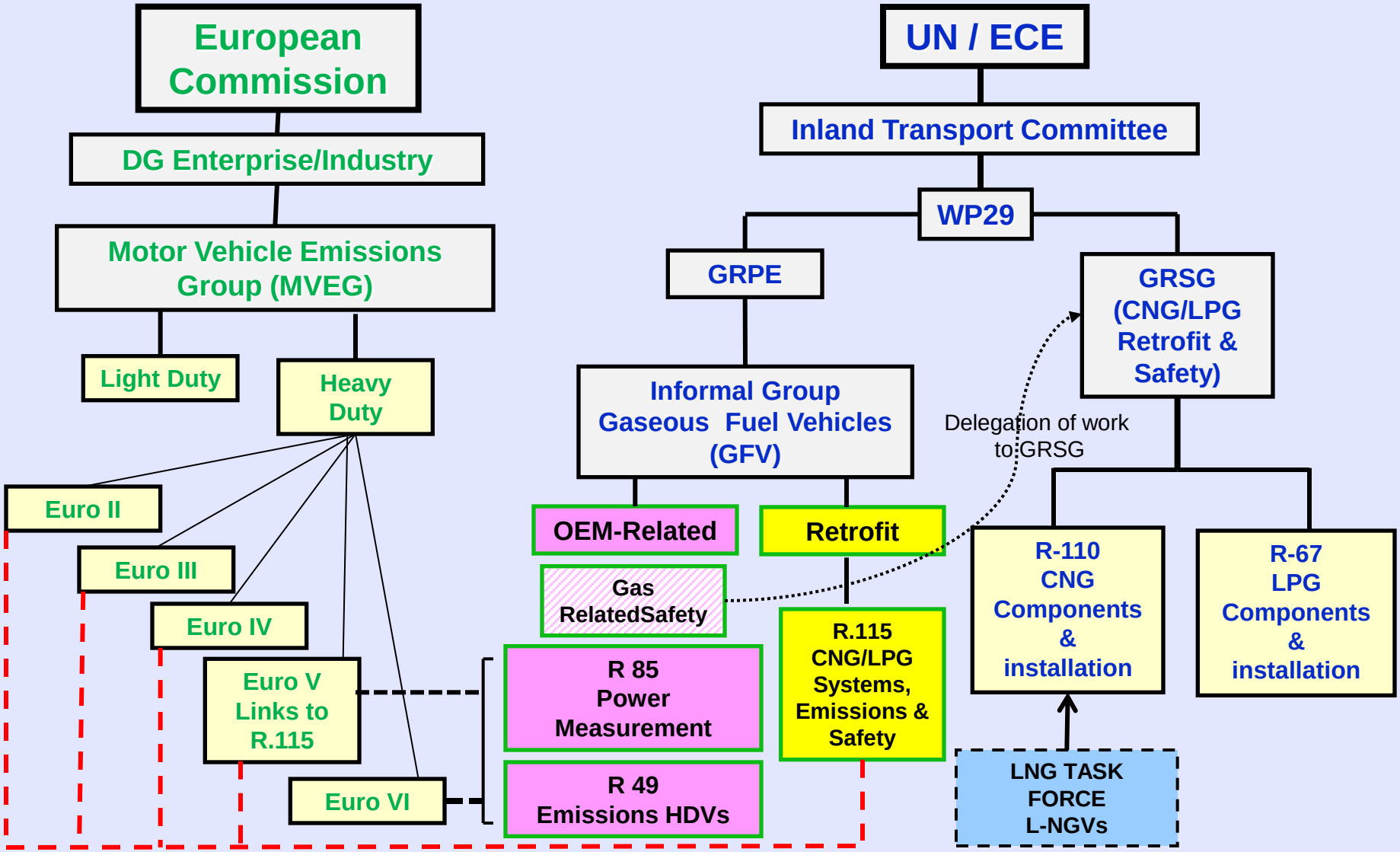
Regulatory Landscape to Develop Engine & Emissions Certification Regulations

Heavy Duty Vehicles



OVERVIEW
POLI-TECHS
(Day 2)

- Renewable gas/gas composition

- New markets for gaseous fuels

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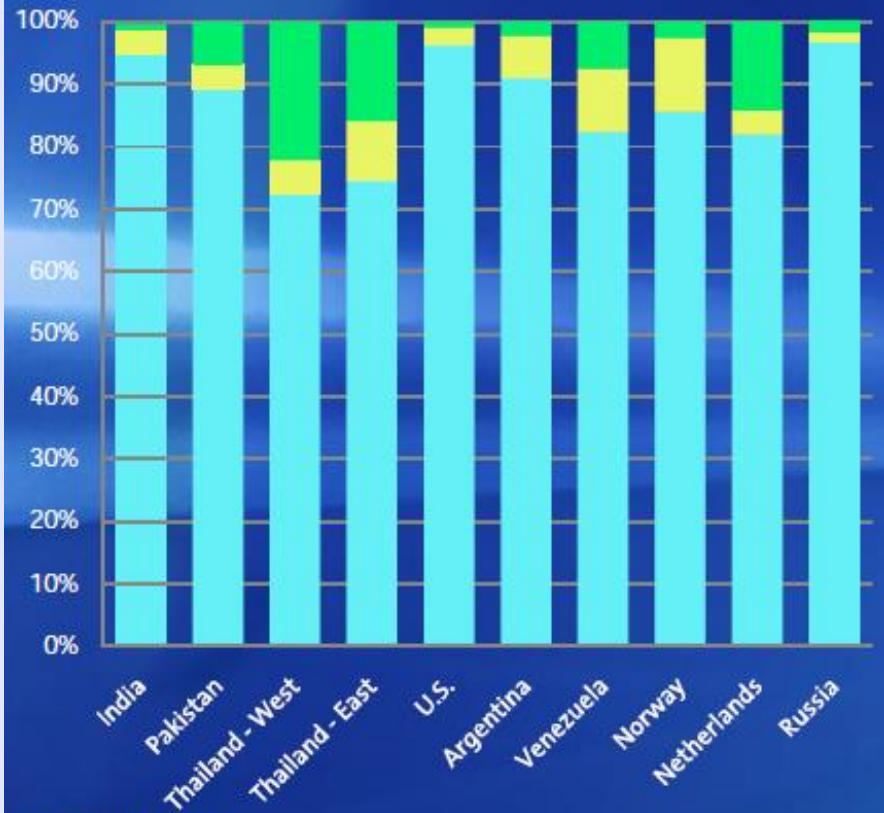
Regional Variation in Gas Composition



Source: Various public information and fuel suppliers

CNG
MINIMUM
90%
METHANE

Source: e-CFR Title 16, Part 309.17 Appendix A

- 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: Dick Kauling (General Motors Company), U.S. Light Duty CNG Vehicle Development Gaps – Currrent and Future Technology, NGV Technology Forum, 25-26 October 2011

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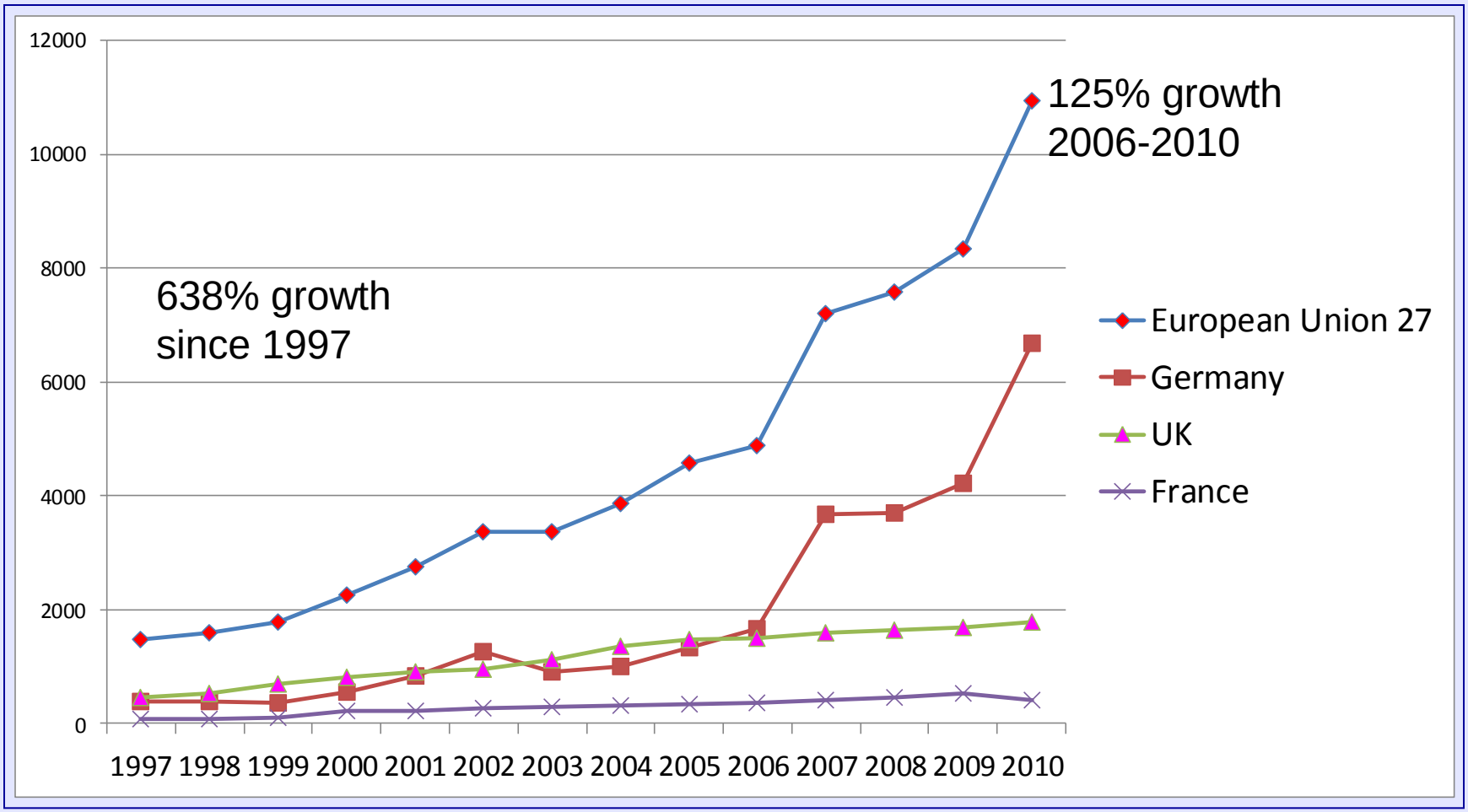
THE POTENTIAL FOR BIOGAS IS GROWING BUT GAS QUALITY IS AN ISSUE



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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 **(H_2S, sulphur [incl.odorant])**
- Other stuff: propane, H_2, oil, dust,

*MJ/per M^3 (Btu/Scf) divided by the square root of the specific gravity

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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

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Marine Market for Gaseous Fuels

Above-ground, small scale LNG storage for ship fuelling, in Halhjem, Norway

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Global and EU Merchant Fleet in Units by Type and Region of Domicile

(Ships of 1,000 grt or more)

	Global	EU	% EU
Total	**37,299**	**11,164**	**31**
Tankers	9,972	3,061	31
Bulk Carriers	7,374	2,080	28
Containers	4,677	2,460	53
General Cargo	13,059	3,285	25
Passenger & Passenger/Cargo	2,217	728	33

Source: *EU Transport in Figures Statistical Pocketbook 2012*, European Commission (P. 95)
grt = gross registered tonnes

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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)

	Global	EU	% EU
Total Passenger & Passenger/ Cargo Ships	**4,486**	**1,393**	**31**
Cargo passenger and Ro-Ro Passenger Ships	2,624	878	33
Passenger (Not Ro-Ro)	1,571	418	27
Cruise Ships	291	97	33

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

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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

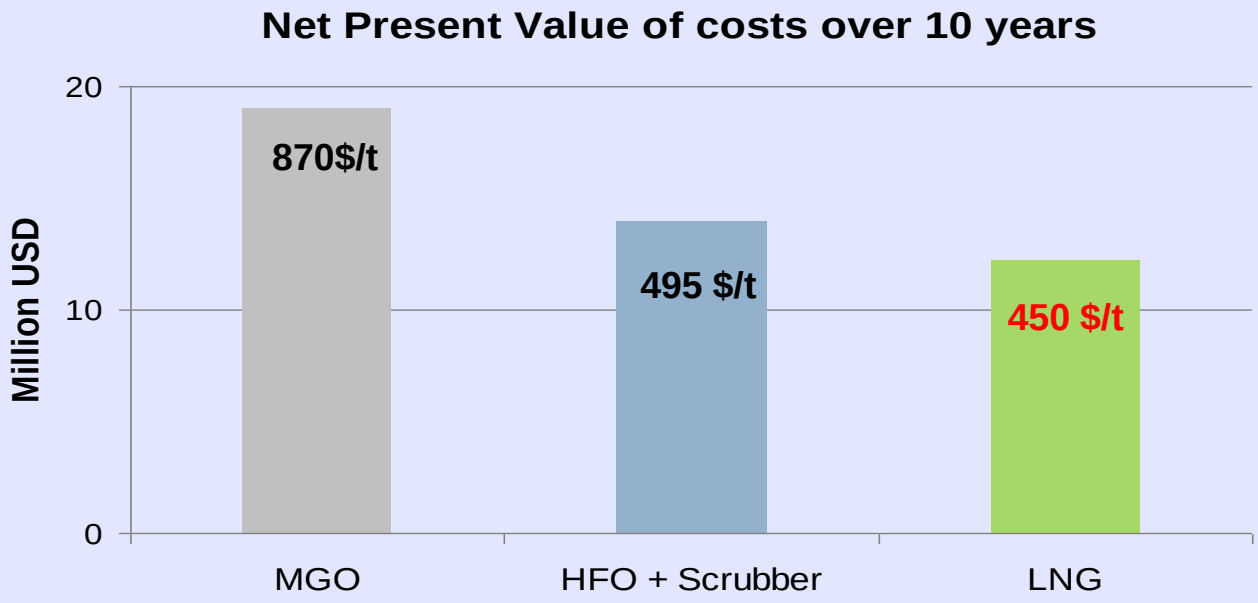
	SOx	NOx	CO2	Particle emissions
With LNG fuel:	**0**	**31**	**5 500**	**0**
With low-sulphur HFO (LS380 with 1% sulfur):	**50**	**180**	**7 250**	**4**

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

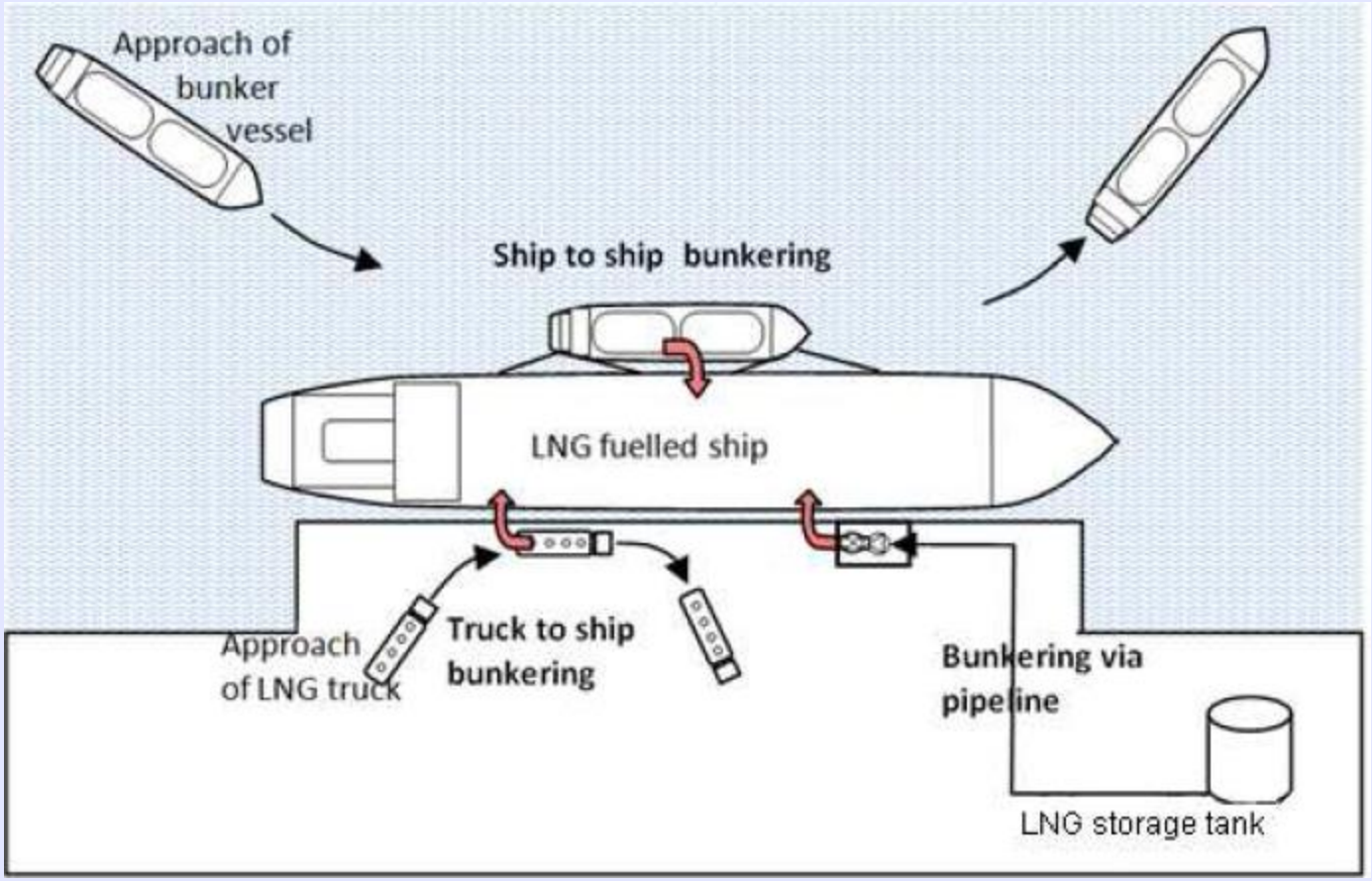
LNG is better economically – over 10 years

- 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



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

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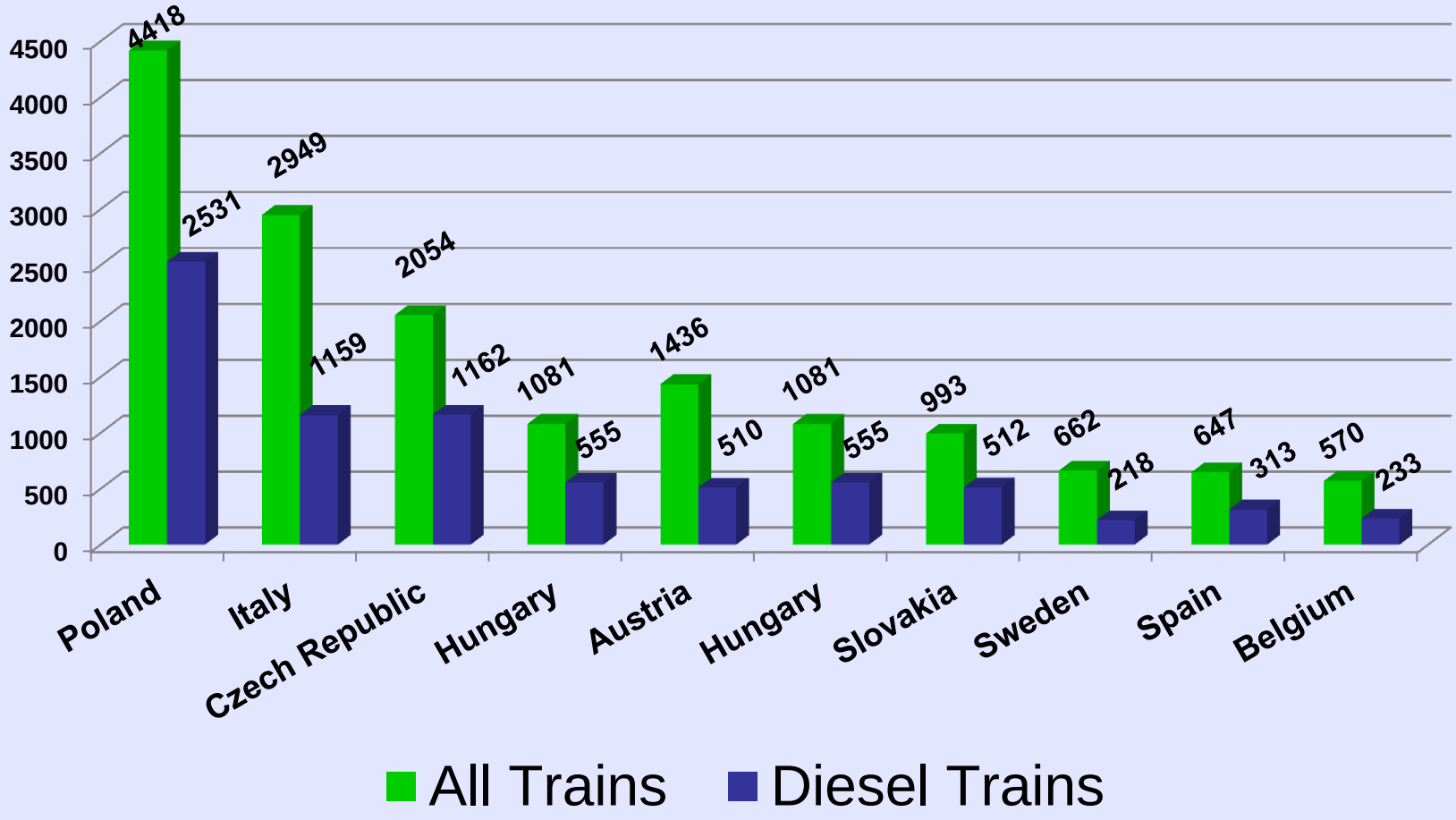
Rail

The First Russian Turbo Gas Locomotive

Source: Gas Vehicles Report

All Trains and Diesel Trains with Fleet of 500+ 2009



Source: Eurostat

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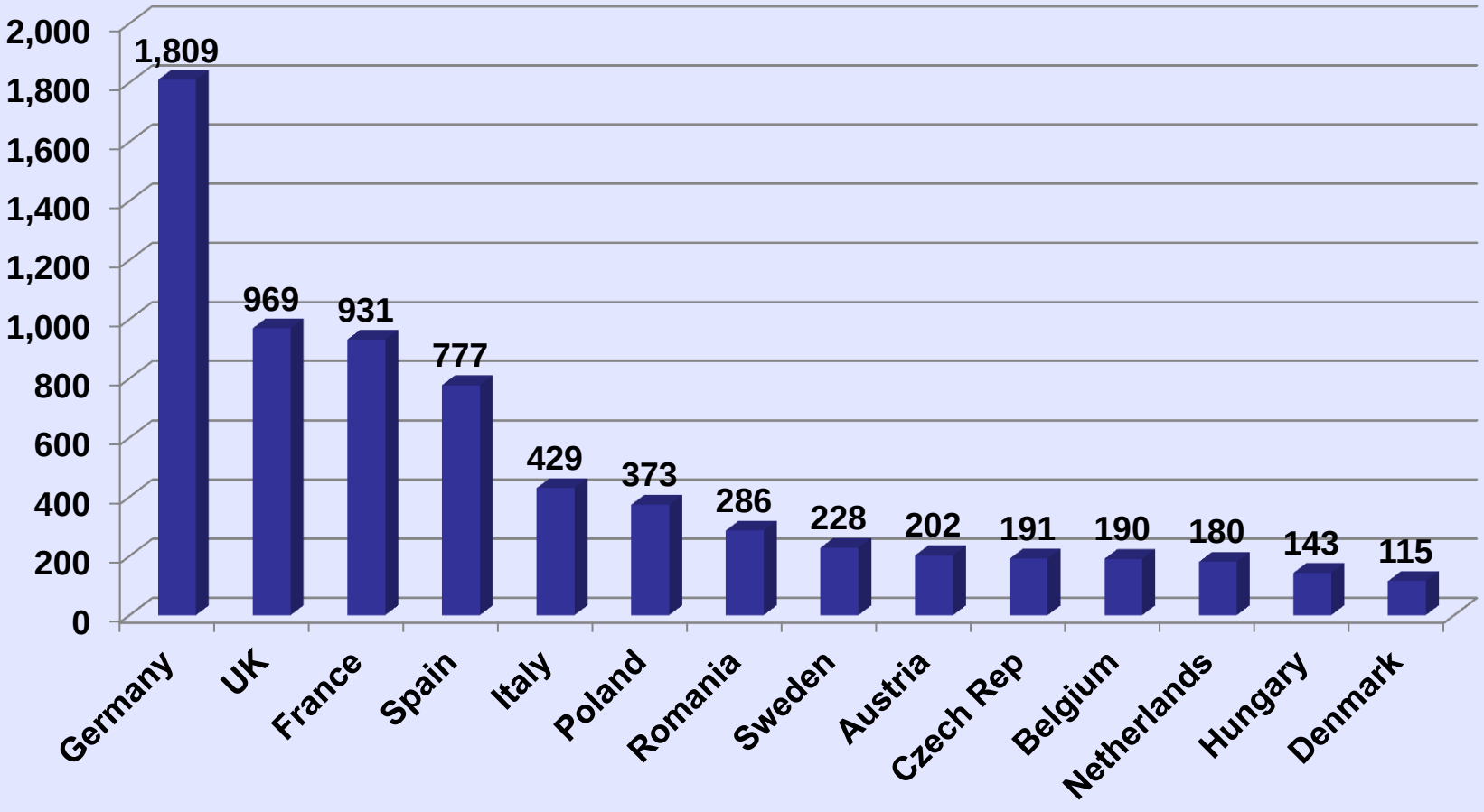
Energy Consumption of Railways in Europe in 2011 in Thousand Tonnes of Oil Equivalent (TOE) (Countries Over 100 TOE)



Source: Eurostat

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Average Railway Energy Consumption in the EU by Train Type & Traction 2009

Train Traction & Type	PJ Consumed	% of Energy Consumed
Passenger Electric	127.89	57
Passenger Diesel	40.81*	18
Freight Electric	33.09	15
Freight Diesel	22.8**	10

*974,730 TOE
**544,568 TOE

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

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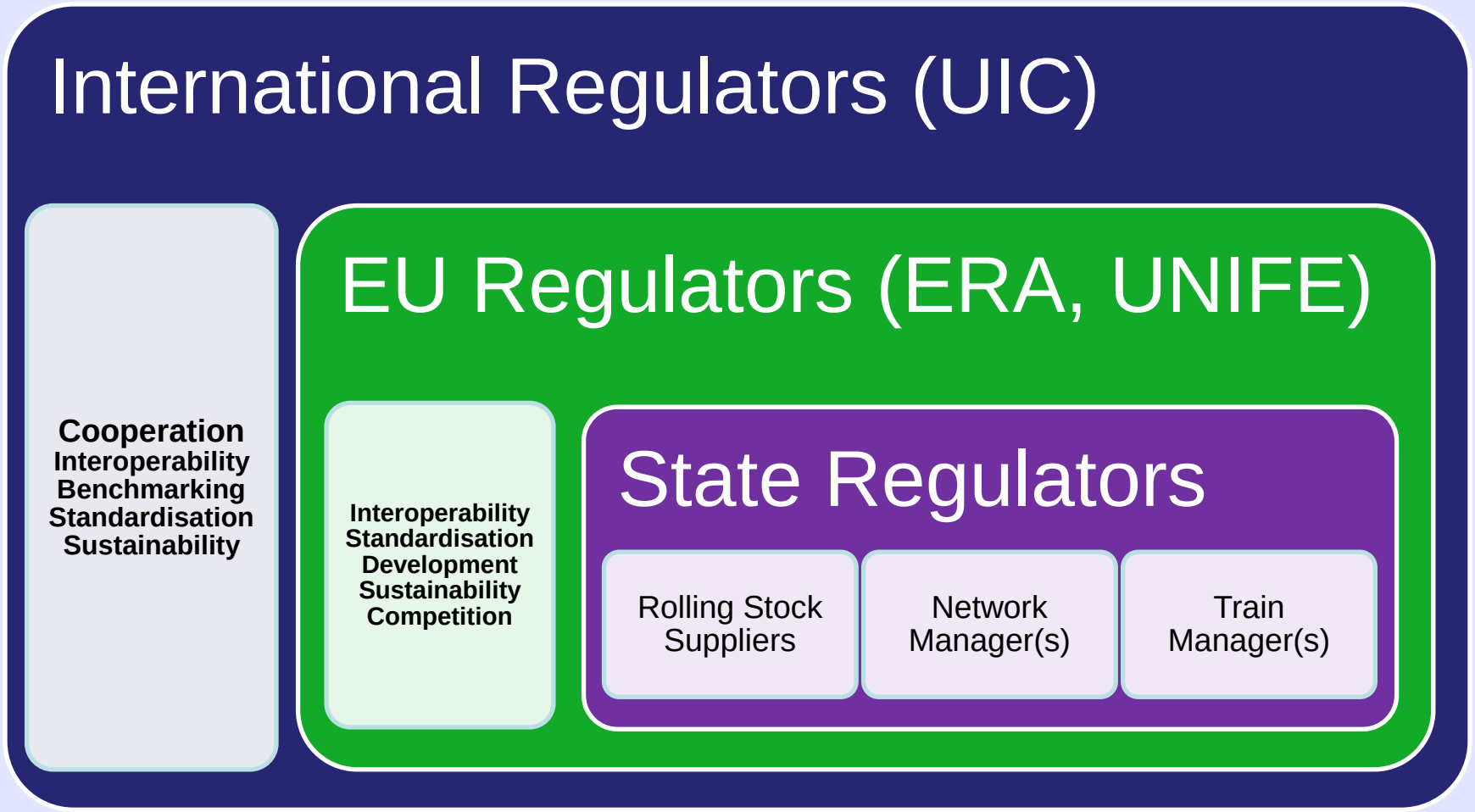
EU Railways Regulation Structure



Source: 2013, UIC, ERA, UNIFE, FS (Italian State Company)

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Agricultural Market

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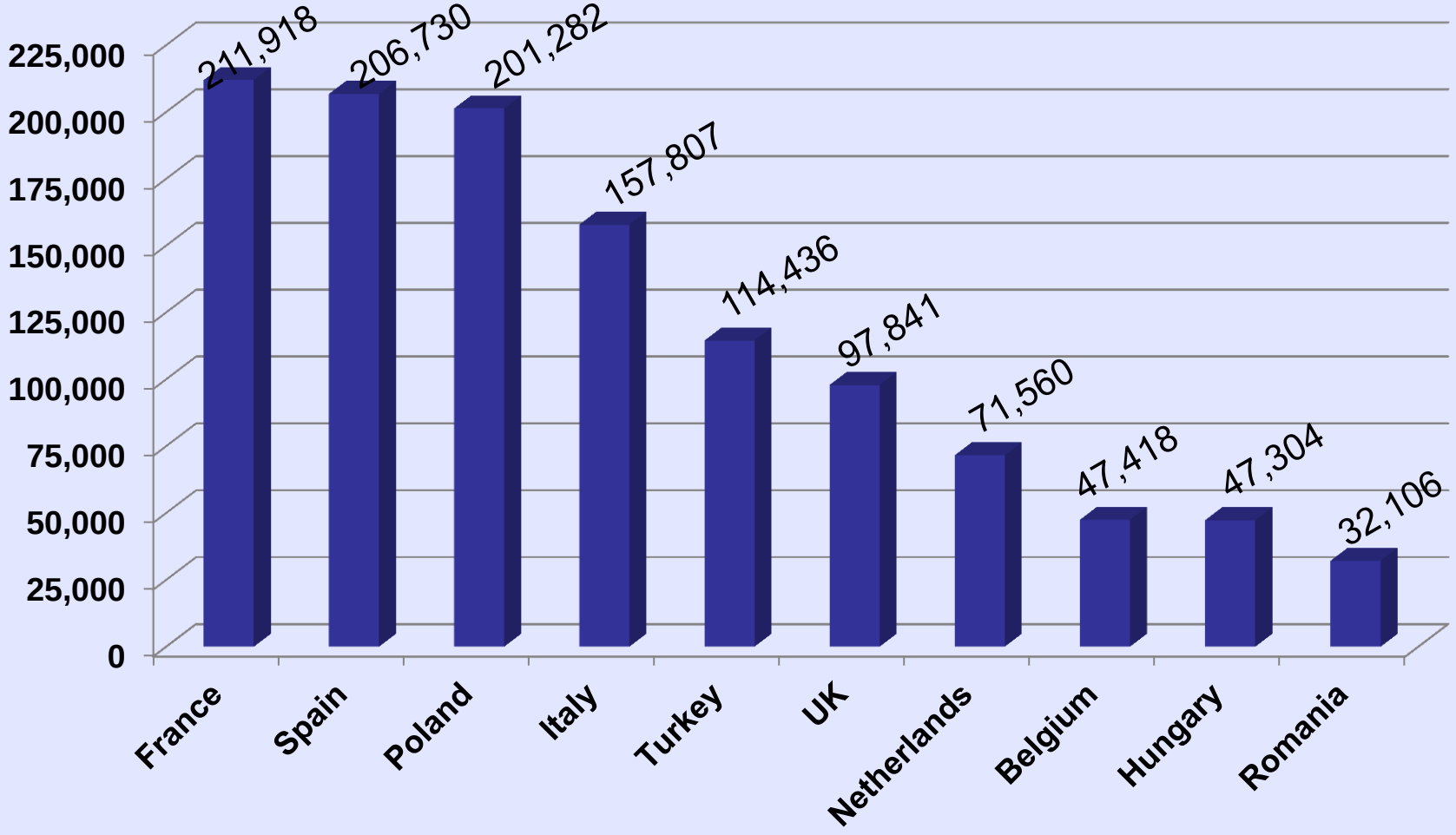
Total Number of Tractors Per Country in 2009 (With Total Fleet Over 30,000)



Source: Eurostat

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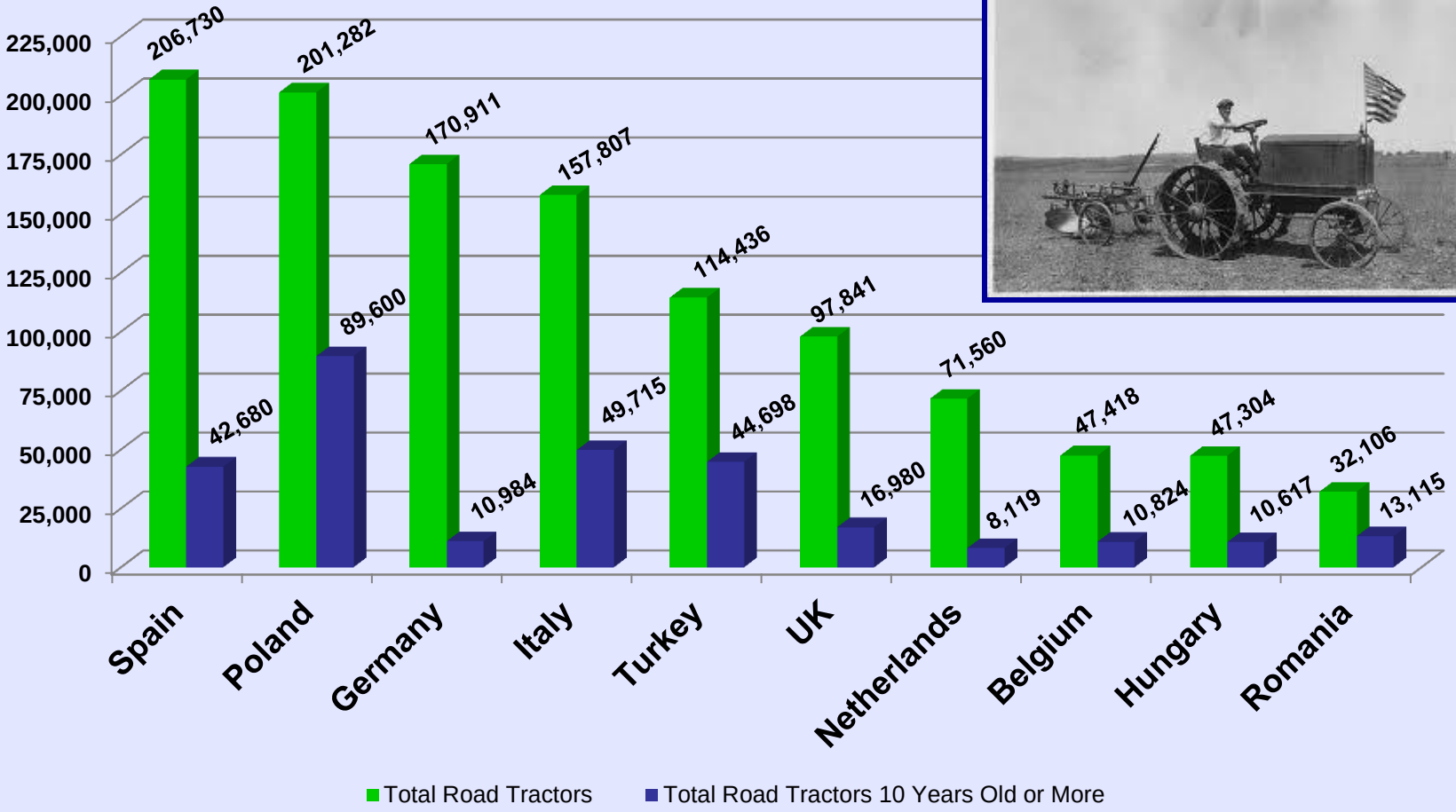
Total Number of Road Tractors and Number of Tractors 10 Years Old or More (With Total Fleet Over 30,000)



Source: Eurostat

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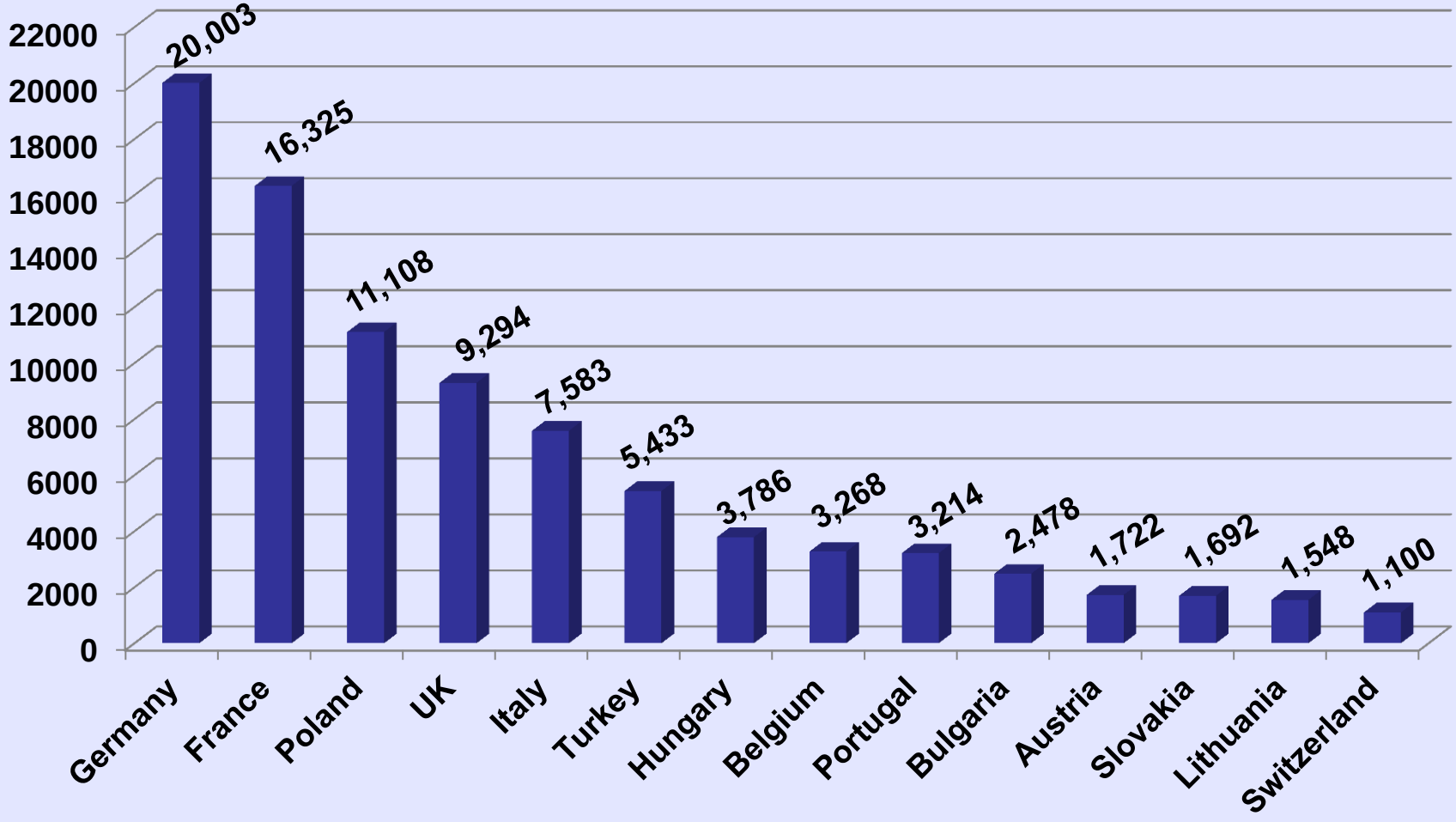
Number of New Registrations of Road Tractors by Country in 2009 (above 1000)



Source: Eurostat

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