



Natural Gas Vehicles, future mobility today

Energy Reflection Group
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NGVA Board of Directors (150 members)



Gas - all type of vehicles & transport modes



CNG

LNG

- Cost-effective: lowest CO₂ abatement costs (€/t CO₂)
- Immediate: solution to air quality problems, less noise
- Sustainable: Biomethane & Power-to-Gas, no blend limitations
- Intermodality: waterborne and road complement each other
- Gas is the available, economical and clean alternative

Real Driving Emissions (RDE)



European Parliament confirms Real Driving Emissions tests (Strasbourg 3 Feb 2016):

- First step, car manufacturers have to bring down the NOx discrepancy to a “conformity factor” of 2.1 (110%) for new models by September 2017 and for new vehicles by 2019.
- Second step, this discrepancy would be brought down to a factor of 1.5 (50%), by 2020 for all new models and by 2021 for all new cars.
- SCR systems on new diesel models will lead to higher costs, important mass market models in the smaller and medium segments will not be offered as diesel versions anymore.

=> CNG will play even stronger role to bring down CO2 emissions

RDE test results ADAC



- Real consumption of CNG cars closest to test bench results
- use of heat-resistant materials in engines help to maintain consumption stable, even under more demanding conditions like high-speed driving

ADAC EcoTest-Ergebnisse: VW Golf mit Elektro-, Otto-, Erdgas-, Diesel- und Hybridantrieb

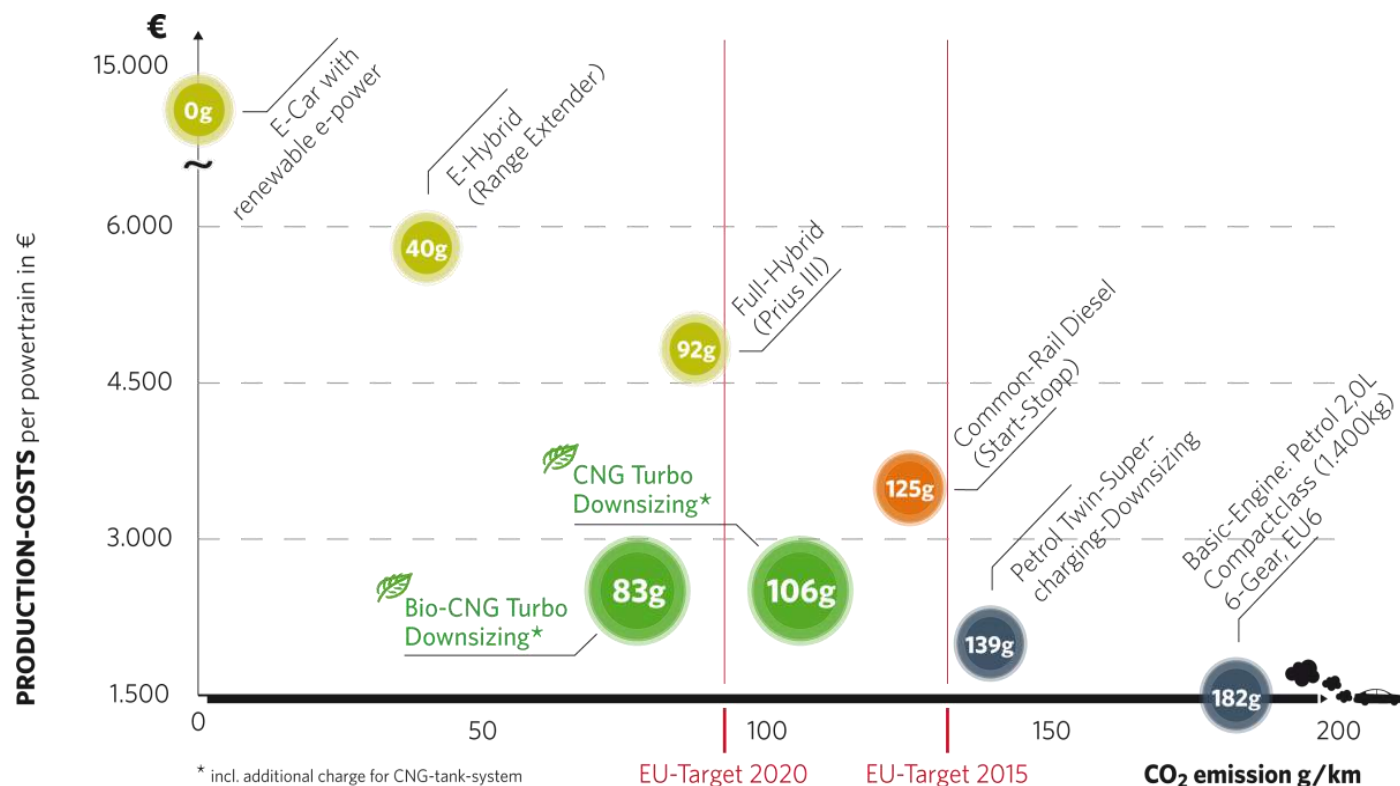
Marke/Modell	Schadstoffklasse	Leistung [kW]	Motorart	CO2 EcoTest [g/km]	Punkte Schadstoffe	Punkte CO2	Punkte EcoTest Gesamtbewertung	EcoTest Sterne
VW Golf 1.4 TGI BlueMotion Comfortline (Erdgasbetrieb)	Euro6	81	Gas	98	49	51	100	*****
VW e-Golf	Elektro	85	Elektro	102	50	49	99	*****
VW Golf 1.6 TDI BlueMotion Trendline	Euro5	81	Diesel	120	48	43	91	*****
VW Golf GTE DSG	Euro6	150	Hybrid	131	46	39	85	****
VW Golf 1.2 TSI BMT Comfortline	Euro5	77	Otto	148	49	33	82	****

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ECO Test Switzerland (VCS)

Rang	Marke	Modell	Hubraum in cm ³	Leistung in kW / PS	Getriebe	Fahrzeugklasse	Lärmwert in dB(A)	Treibstoffart	Verbrauch in l/100 km Erdgas: kg/100 km	CO2 in g/km	Emissionsklasse	Energie-Etikette 2016	Gesamtpunkte	Bewertung grafisch
1	VW	eco up! 1.0 BMT Erdgas CH	999	50 / 68	m5	Mini-Klasse	69.0	Erdgas CH	2.9	63	Euro6	A	88.2 *****	
1	Skoda	Citigo 1.0 Green tec CNG Erdgas CH	999	50 / 68	m5	Mini-Klasse	69.0	Erdgas CH	2.9	63	Euro6	A	88.2 *****	
1	Seat	Mii 1.0 MPI Ecofuel CNG Erdgas CH	999	50 / 68	m5	Mini-Klasse	69.0	Erdgas CH	2.9	63	Euro6	A	88.2 *****	
2	Audi	A3 Sportback 1.4 TFSI g-tron S-tronic Erdgas CH	1395	81 / 110	a7	Untere Mittelklasse	69.0	Erdgas CH	3.3	71	Euro6	A	84.2 *****	
3	VW	Golf 1.4 TGI BlueMotion DSG Erdgas CH	1395	81 / 110	a7	Untere Mittelklasse	69.0	Erdgas CH	3.4	74	Euro6	A	83.0 *****	
4	Lexus	CT 200h Hybrid	1798	100 / 136	as	Untere Mittelklasse	67.7	Benzin	3.6	82	Euro6	A	81.4 *****	
5	Seat	Leon 1.4 TGI CNG Erdgas CH	1395	81 / 110	m6	Untere Mittelklasse	70.0	Erdgas CH	3.5	76	Euro6	B	79.8 *****	
6	Suzuki	Celerio 1.0 Unico	998	50 / 68	m5	Mini-Klasse	68.5	Benzin	3.6	84	Euro6	A	78.8 *****	
7	Lancia	Ypsilon 0.9 TwinAir NP Erdgas CH	875	59 / 80	m5	Kleinwagen	72.5	Erdgas CH	3.1	69	Euro6	A	78.4 *****	
8	Fiat	Panda 0.9 TwinAir NP Erdgas CH	875	59 / 80	m5	Mini-Klasse	73.5	Erdgas CH	3.1	68	Euro6	A	76.8 *****	
9	Toyota	Auris 1.8 VVT-i Hybrid	1798	100 / 136	as	Untere Mittelklasse	71.0	Benzin	3.5	79	Euro6	A	76.3 *****	
10	Citroen	C1 VTi 68 S&S 5T	998	51 / 69	m5	Mini-Klasse	69.0	Benzin	3.8	88	Euro6	A	75.8 *****	
10	Peugeot	108 PureTech 68 S&S	998	51 / 69	m5	Mini-Klasse	69.0	Benzin	3.8	88	Euro6	A	75.8 *****	

CNG – cost effective way to reduce CO2



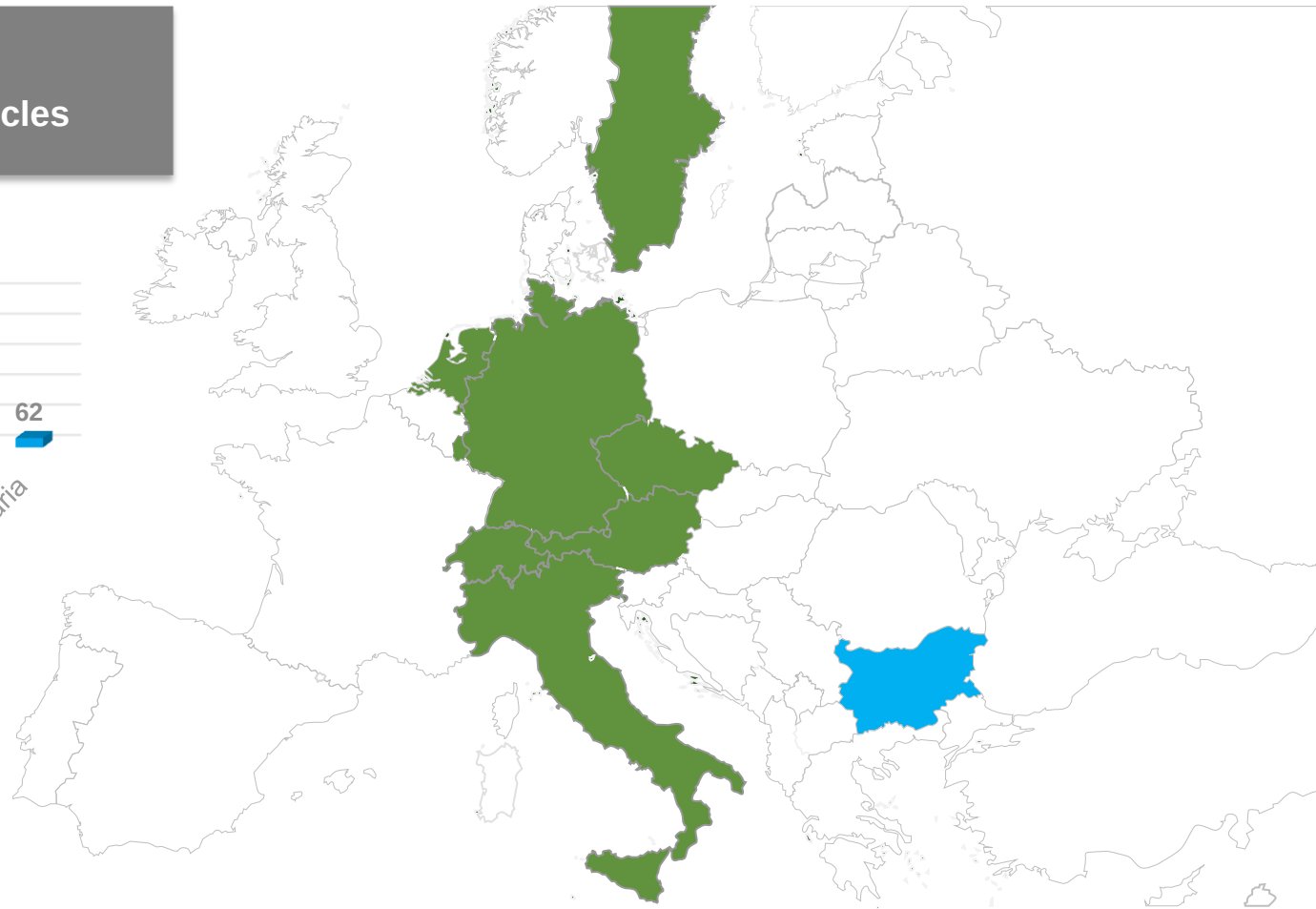
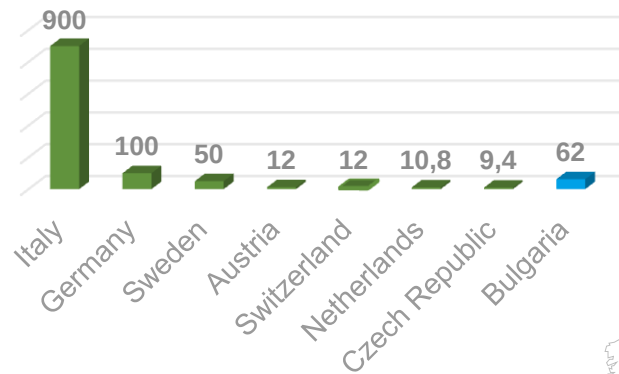
When comparing the CO₂ emission reduction potential related to production costs per powertrain, Natural Gas Vehicles will comply with the 2020 target of 95 g/km with a price advantage of min. 2.000 € - 3.500 € (hybrid) or 12.000 € (BEV) per car.

Current European CNG Market

EU (main countries)

25,000 Buses and Trucks
1,2 million Light Duty Vehicles

Expressed on thousand vehicles



Source: NGVA Europe, statistical update mid 2015

Directive on alternative fuels (2014/94/EU)



Member States present National Policy Frameworks 18 November 2016

Target Area	Objective	Timeline	NGVA recommendation
CNG, incl. L-CNG, in urban/suburban and other densely populated areas	Appropriate number of refuelling points (undefined)	31 December 2020	1 station/100.000 inhabitants (max. 5 km) - minimum bus population (1 station/50 units)
CNG, incl. L-CNG, for vehicles along the TEN-T core network	Appropriate number of refuelling points (approx.150 km)	31 December 2025	10% share of petrol stations. One station every 50-100 km*
LNG for heavy-duty vehicles along the TEN-T core network	Appropriate number of refuelling points (approx.400 km)	31 December 2025	One station every 200-300 km**
LNG at TEN-T maritime ports	Appropriate number of refuelling points (undefined)	31 December 2025	All TEN-T maritime ports
LNG at TEN-T inland ports	Appropriate number of refuelling points (undefined)	31 December 2030	All TEN-T inland ports
Common technical standards	CNG/LNG refuelling stations, connectors and receptacles	31 December 2016	UNECE/ISO compatible

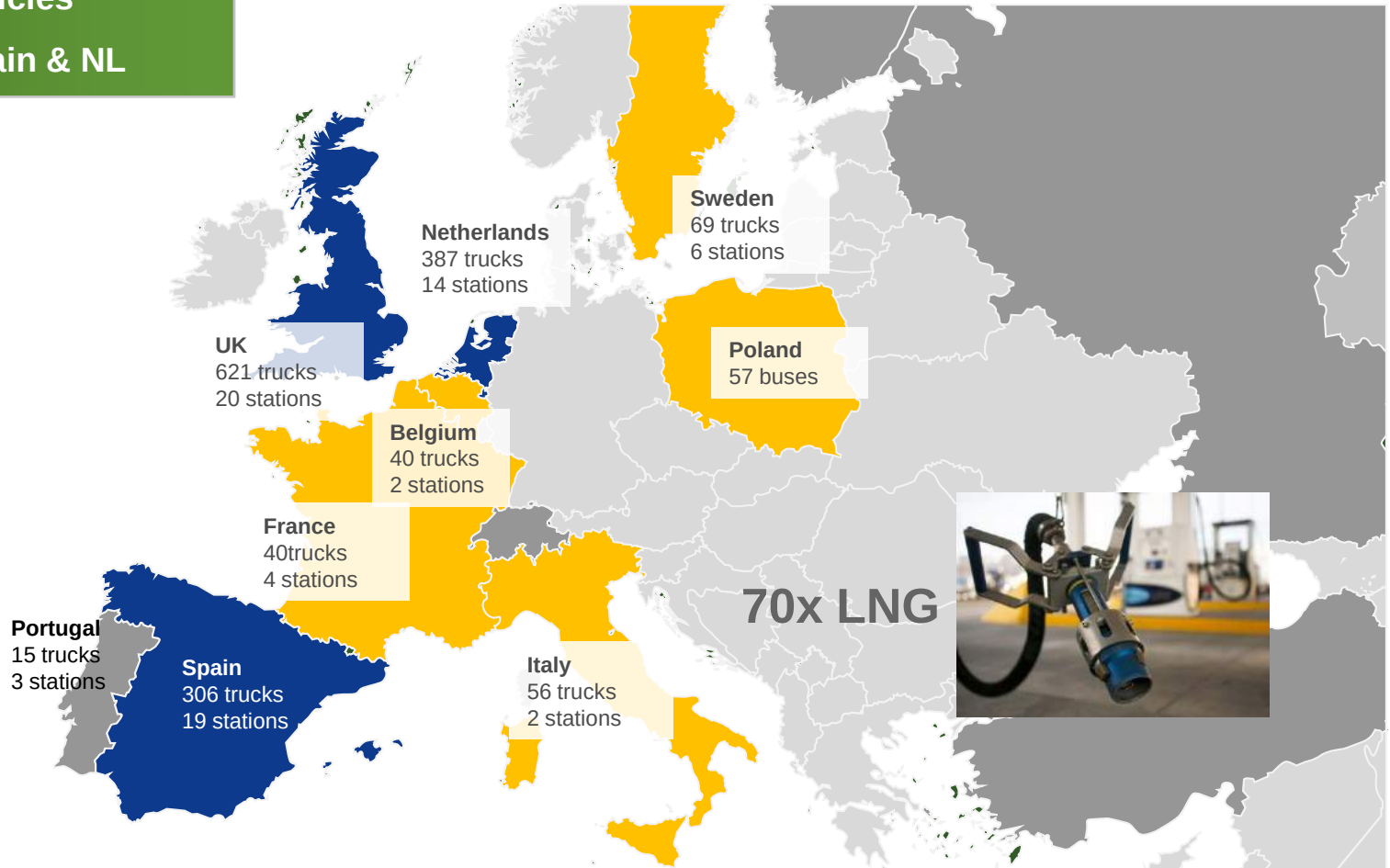
* The Natural Gas grid can vary from country to country, L-CNG stations provide flexibility.

** Kilometre indications is a relative benchmark, infrastructure is needed where traffic flows.

Source: European Commission, NGVA

Current LNG market

1.500 LNG Vehicles
Mainly UK, Spain & NL



Source: NGVA Europe

Brussels, 25 March 2016

The LNG Blue Corridor project

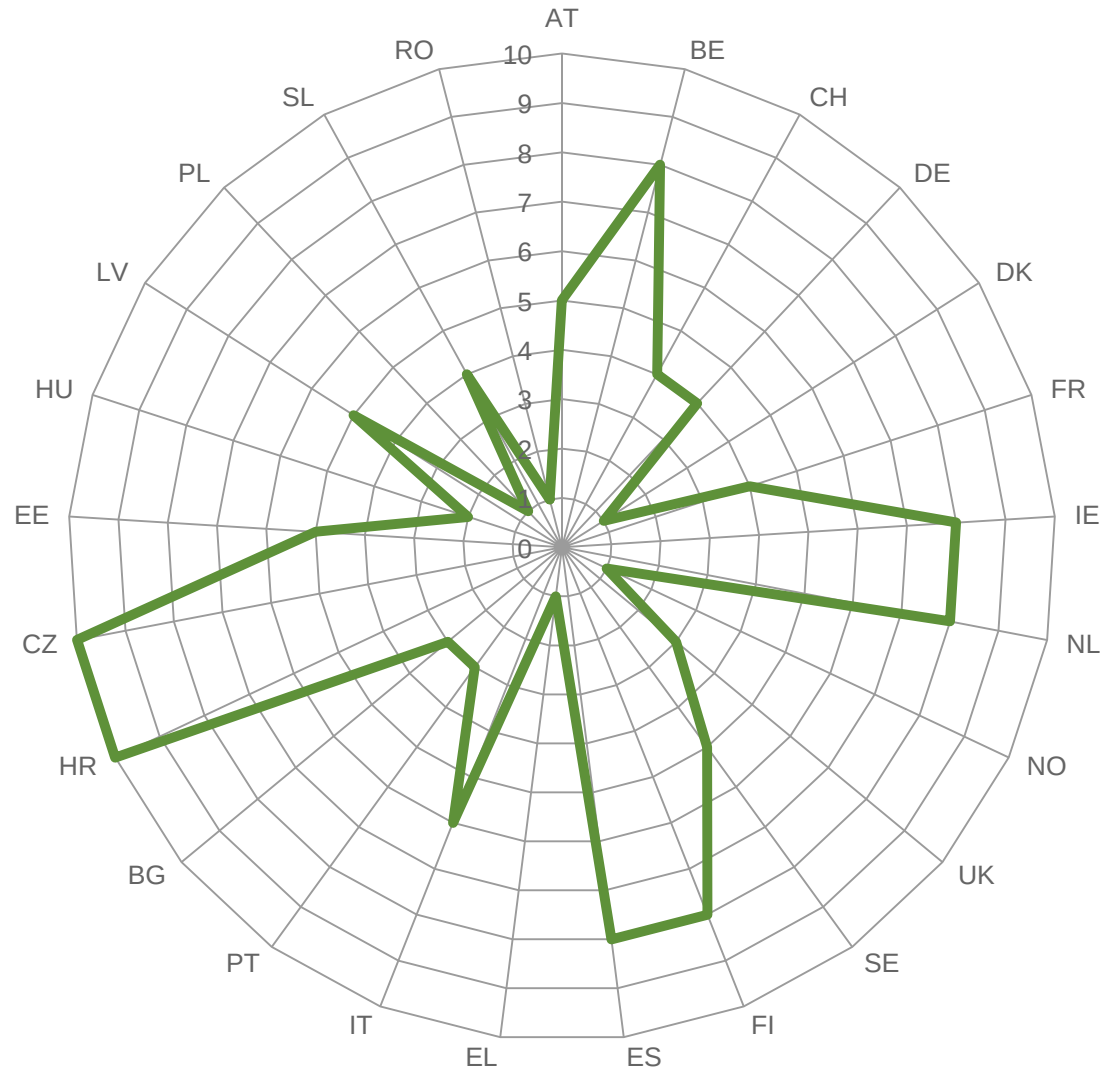


The LNG Blue Corridors project

- ▶ 14 new LNG stations
 - ▶ more than 100 trucks
 - ▶ 27 partners
 - ▶ Total investment: 14.33 M€
 - ▶ European funding: 7.96 M€
 - ▶ 13 stations built/under construction
-
- ▶ new funding opportunities and financial tools available (e.g. CEF/TEN-T and ESFI)

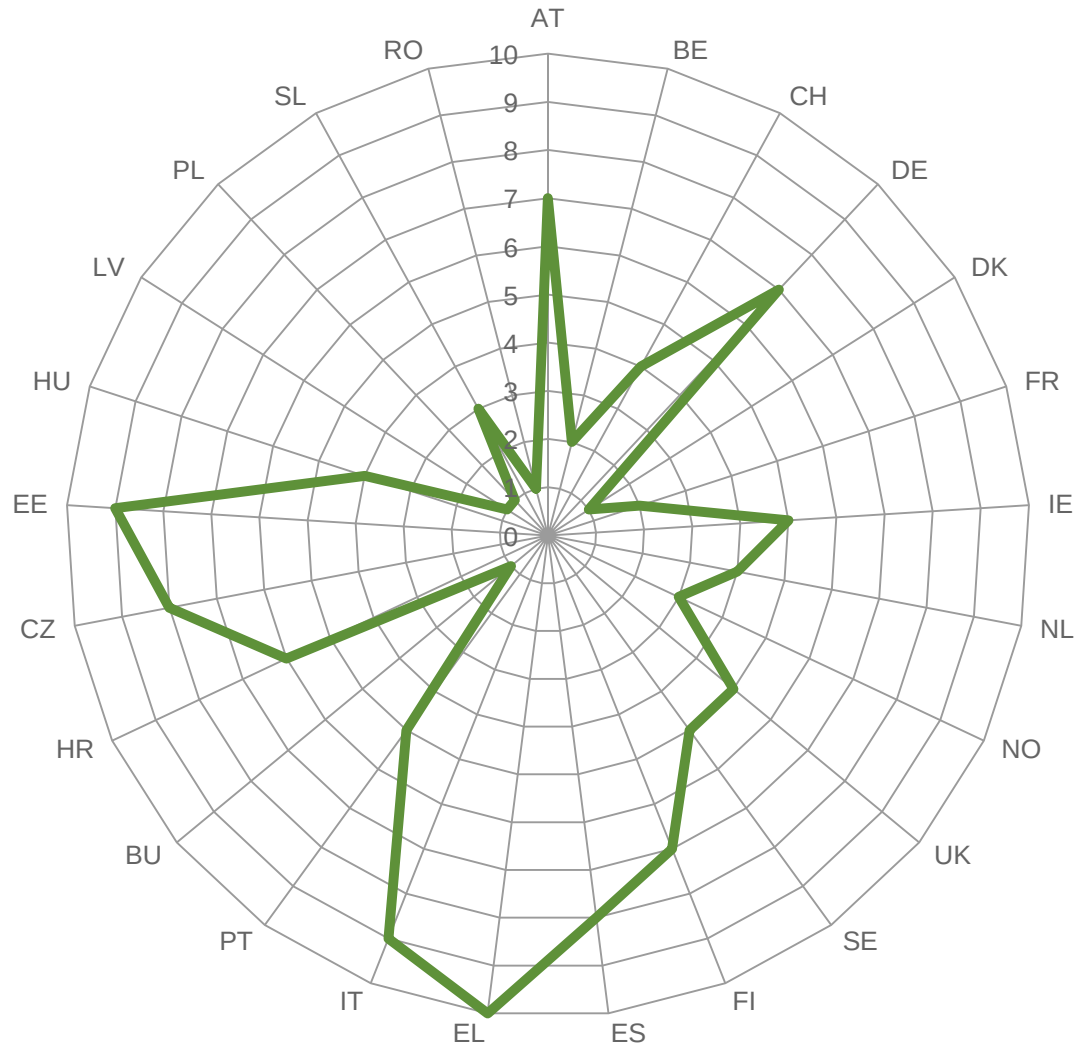
<http://lngbc.eu/>

How advanced is your country on the NPF?



Source: NGVA Europe

How favourable is the price delta on gas?



Source: NGVA Europe

Commission work plan 2016-2017

Actions	Responsible party	Timetable
Review of Regulations setting emission performance standards to establish post-2020 targets for cars and vans	Commission	2016 - 2017
Establishing a monitoring and reporting system for heavy duty vehicles (trucks and buses) with a view to improving purchaser information	Commission	2016-2017
Review of Directive on the Promotion of Clean and Energy Efficient Road Transport Vehicles	Commission	2017
Communication on decarbonising the transport sector, including an action plan on second and third generation biofuels and other alternative, sustainable fuels	Commission	2017
Renewable Energy Package: including a new Renewable Energy Directive for 2030; best practices in renewable energy self-consumption and support schemes; bioenergy sustainability policy.	Commission	2015-2017

CNG vehicles – low emissions champions

Golf VII TGI
Best selling car of its class



Skoda Octavia g-tec. Downsizing & turbo charging + CNG is ideal



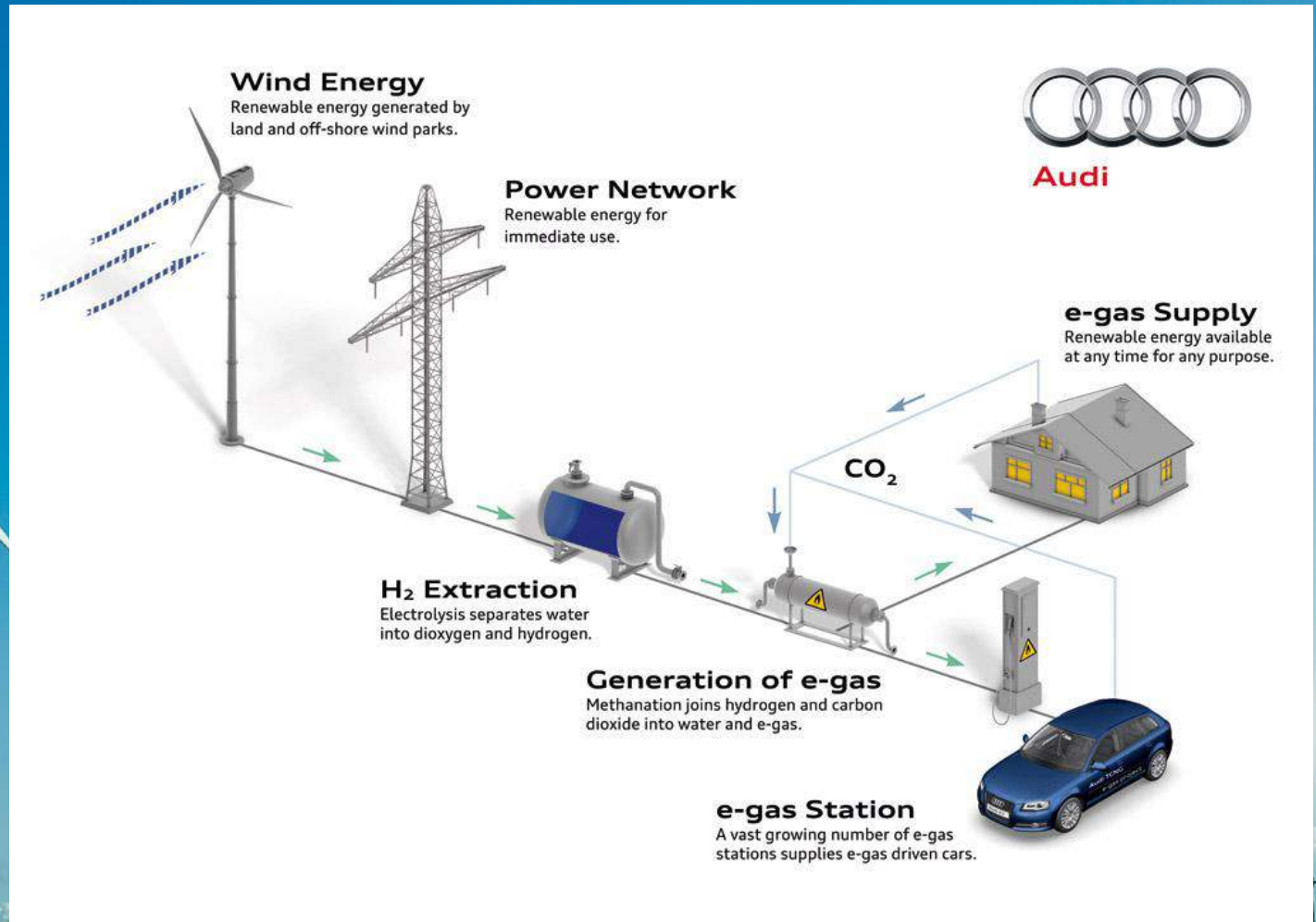
New Audi A4 TCNG. Cleanest combustion engine with e-gas



Fiat 500 L & Mercedes-BENZ B-Class Family Vans (up to 500 km on CNG)

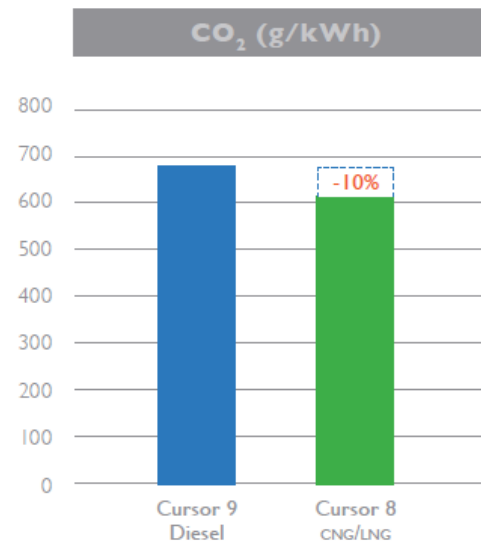
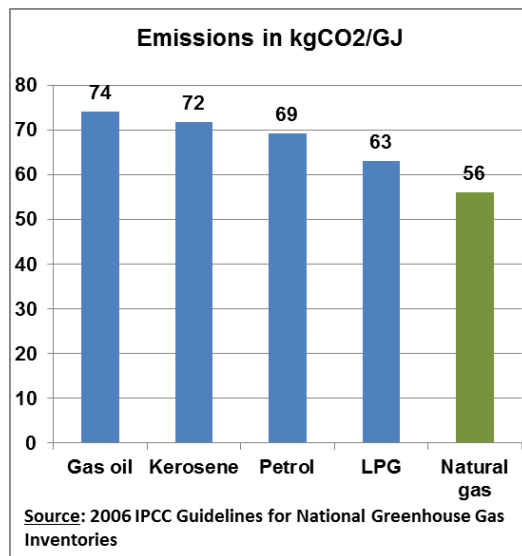


Renewable electricity stored in the gas grid with power-to-gas technology.



Reducing CO2 emissions from HDVs

Commission Communication on reducing CO2 emissions from Heavy-Duty Vehicles:
http://ec.europa.eu/clima/policies/transport/vehicles/heavy/documentation_en.htm



Principal sources of biomethane



House waste

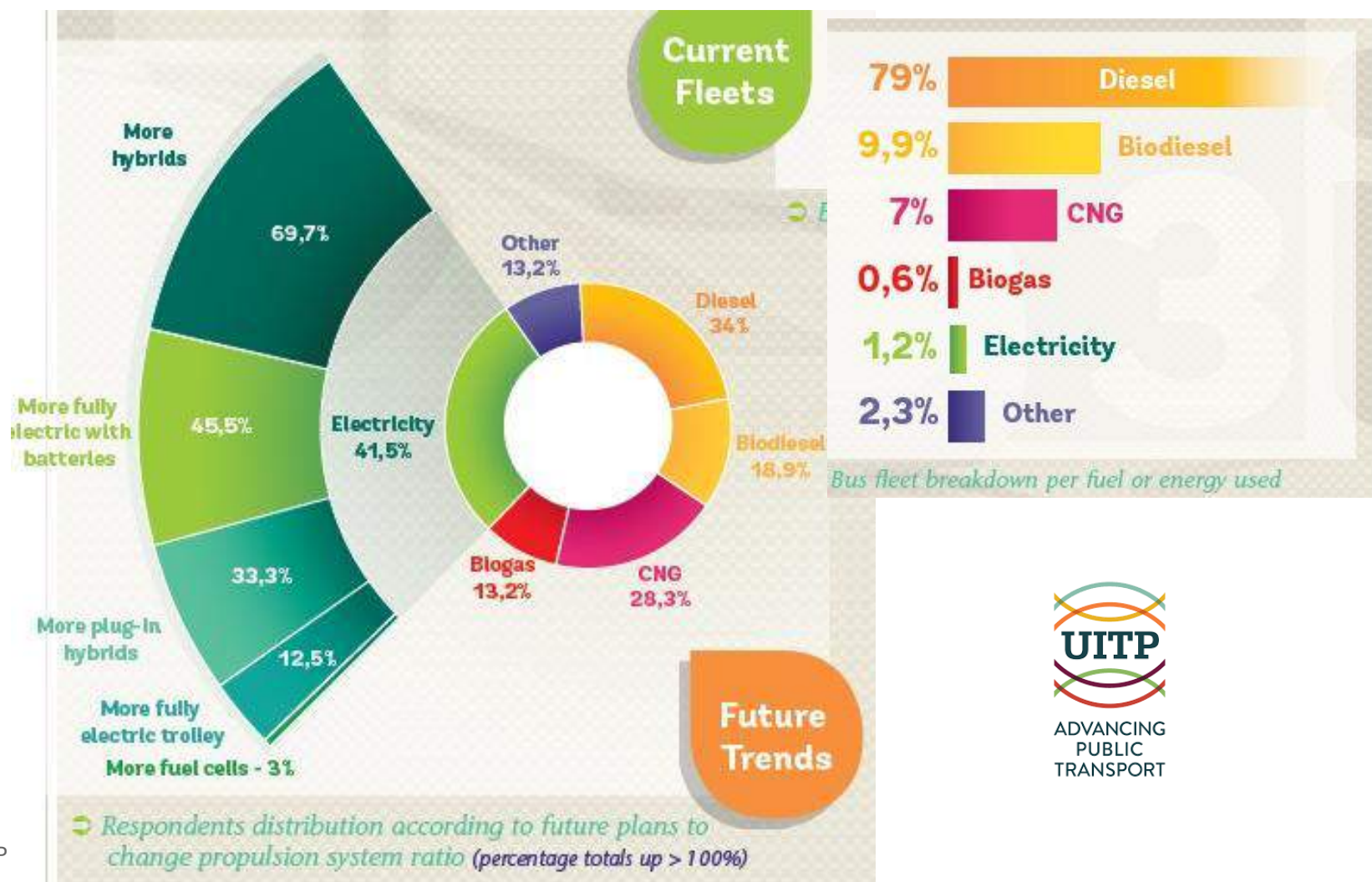


Landfill



Source: European Commission, CNH

CNG buses – market potential



NGV forecast 2030

- ▶ 20% of the total new LDV and HDV sales NGV
- ▶ 50% of new bus sales NGV
- ▶ 20 Mio CNG cars
- ▶ 300.000 CNG buses
- ▶ 400,000 NGV trucks (300,000 LNG, 100,000 CNG)
- ▶ 4,000 L-CNG refuelling points (1,000 stations à 4 dispensers)
- ▶ 10.000-15.000 CNG stations
- ▶ gas sales around 40 bcm (50:50 CNG and LNG)
- ▶ The share of bio-methane has the potential to increase to 10-20%

Gaps – possibilities to influence

Factors
influencing
further
growth
of NGVs
in the EU

EU

- Maintain level playing field for alternatives fuels.
- Create minimum level of ambition to develop CNG and LNG network.
- Implementation project “NGV Blue Corridor II” (LNG+CNG trucks/vans).
- WTW acknowledgement for natural gas/biomethane blends.

Member State

- Long term alternative fuel targets, NGVs, others.
- Involve key industry in NPF development (round tables).
- Sustained tax regime as prerequisite for further NGV growth.
- Soft adoption measures: road toll, polluters-pay-principle, public procurement, etc.
- Communication campaign: media / workshops.

Industry

- Technical standards CNG & LNG refuelling stations, gas quality.
- Deploy full potential of NGV engines (efficiency, horse power).
- Improve NGV product portfolio, additional manufacturers needed.

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