Assessing the real world performance of autogas cars

Conclusions
- Contrary to gasoline, real driving emissions from LPG vehicles, including from the older converted car, are below the limits set out by the Euro 6 standard for all pollutants, even in the case of aggressive driving.
- NOx and HC emissions are similar to petrol, but respectively -54% and -99% than Euro 6 limits.
- To put things in perspective, extrapolating data from a ICCT study on diesel vehicles, we calculated that LPG vehicles emit in average -93% NOx and -76% CO compared diesel vehicles in similar real-driving conditions.
- Autogas has a key role to play in reducing transport emissions.

Key results for the autogas fueled vehicles compared to gasoline:

<table>
<thead>
<tr>
<th></th>
<th>Autogas</th>
<th>Gasoline</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>-13%</td>
<td>-45%</td>
</tr>
<tr>
<td>CO</td>
<td>SIMILAR</td>
<td>SIMILAR</td>
</tr>
<tr>
<td>NOx</td>
<td>SIMILAR</td>
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</tr>
<tr>
<td>HC</td>
<td>-90%</td>
<td></td>
</tr>
<tr>
<td>PN</td>
<td>-96%</td>
<td></td>
</tr>
</tbody>
</table>

What is autogas?
- LPG used as on-road engine fuel.
- Propane, butane or a propane/butane mix.

13,700+ vehicles (in EU+6, 2014)
- An environmentally friendly option for road transport.
- Safe, convenient, available, growing and clean.

About AEGPL:
- AEGPL is the sole representative of the LPG industry at European level, representing National LPG Associations as well as distributors and equipment manufacturers from across Europe.
- Our mission is to engage with EU decision-makers and the wider policy community in order to optimise the contribution that LPG - as a clean and immediately available energy source - can make to meeting Europe's energy and environmental challenges.

European LPG Association
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B - 1040 BRUSSELS
BELGIUM
AEGPL@AEGPL.BE
WWW.AEGPL.EU
OUR APPROACH

CLARIFY AUTOGAS VEHICLES’ PERFORMANCE IN TERMS OF CO₂ AND POLLUTANT EMISSIONS

- Proactive testing programme undertaken by the LPG industry, as a commitment to transparency and accuracy
- Overcome the limits of tests in laboratories by reproducing real driving conditions
- Based on state-of-the-art test procedures, RDE and WLTP/C, to become mandatory in the EU in September 2017
- Make it possible to compare the environmental performance of Autogas with traditional fuels (diesel and gasoline)
- Measure simultaneously a number of GHG and pollutants: CO₂, CO, NOₓ, HC, particle number
- For comparison purposes, one vehicle was also tested in its Euro 6 diesel version, with a particulate filter

FIVE VEHICLES TESTED BETWEEN 2015 AND 2016

ALFA ROMEO MITO
- EURO 5 HOMOLOGATED; LPG SYSTEM RETROFITTED (PORT INJECTION); MILEAGE OF 65,000 KM

FIAT 500L
- EURO 6 HOMOLOGATED; ORIGINAL LPG VEHICLE FROM MANUFACTURER (PORT INJECTION); MILEAGE OF 6,300 KM

SKODA OCTAVIA
- EURO 6 HOMOLOGATED; LPG SYSTEM RETROFITTED (PORT INJECTION); MILEAGE OF 74,000 KM

KIA SPORTAGE
- EURO 5 HOMOLOGATED; LPG SYSTEM RETROFITTED (DIRECT INJECTION); MILEAGE OF 27,000 KM

OPEL ASTRA
- EURO 5 HOMOLOGATED; ORIGINAL LPG VEHICLE FROM MANUFACTURER (DUAL INJECTORS); MILEAGE OF 71,000 KM

RDE REAL DRIVING EMISSIONS, RULED BY COMMISSION REGULATION (EU) 2016/646
WLTP/C WORLDWIDE HARMONIZED LIGHT VEHICLES TEST PROCEDURES/CYCLE
CO₂ CARBON DIOXIDE
CO CARBON MONOXIDE
NOₓ NITROGEN OXIDES
HC HYDROCARBONS
RESULTS

OVERVIEW

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METHODOLOGY

TESTS UNDERTAKEN BY INDEPENDENT EXPERTS IN TWO DIFFERENT COUNTRIES:
THE UNIVERSITY OF APPLIED SCIENCES IN SAARBRÜCKEN, GERMANY, AND THE ENGINEERING CONSULTANCY V-MOTECH IN FRANCE

✓ Emission data collected by a Portable Emission Measurement System (PEMS) fitted on the cars

✓ Series of at least three tests on each model and in each fuel mode (LPG, gasoline and diesel) to guarantee quality, according to the provisions of the RDE Regulation, following a specific route with urban, rural and motorway segments

✓ Series of tests on WLTP/C for comparison purposes

LOCATION DATA FROM GPS

EXTERNAL CONDITIONS FROM MOBILE WEATHER STATION

ON BOARD GAS ANALYSER

SAMPLE OF EXHAUST ANALYSED

FLOW METER

VOLUME OF EXHAUST MEASURED

VEHICLE DATA FROM ENGINE CONTROL UNIT

FIVE VEHICLES TESTED BETWEEN 2015 AND 2016

EURO 5 HOMOLOGATED; LPG SYSTEM RETROFITTED (PORT INJECTION); MILEAGE OF 65,000 KM

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FIAT 500L

Car #1

PN = 8.6 TIMES THE EURO 6 LIMIT

Car #2

NOx = 5.8 TIMES THE EURO 6 LIMIT

Car #3

PN = 8.3 TIMES THE EURO 6 LIMIT

Car #4

Car #5
OVERVIEW

RESULTS

EMISSION LEVELS IN COMPARISON WITH EURO 6 LIMITS

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FOR COMPARISON PURPOSES, ONE VEHICLE WAS ALSO TESTED IN ITS EURO 6 DIESEL VERSION, WITH A PARTICULATE FILTER.

RESULT OVERVIEW

METHODOLOGY

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WLTP/C WORLDWIDE HARMONIZED LIGHT VEHICLES TEST PROCEDURES/CYCLE

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FIAT 500L

Car #5

NOxPN

CO

HC

LPG

GASOLINE

EURO 6

PN = 8.3 TIMES THE EURO 6 LIMIT

PN = 8.6 TIMES THE EURO 6 LIMIT

PN = 8.3 TIMES THE EURO 6 LIMIT

*PN limit applicable to new vehicles with direct injection engines from 1 Sep 2017
CONCLUSION

AUTOGAS VEHICLES, EVEN OLDER CONVERTED CARS, BRING SIGNIFICANT REDUCTIONS IN NOx AND PARTICLES EMISSIONS WHEN COMPARED TO EQUIVALENT DIESEL AND GASOLINE MODELS RESPECTIVELY.

✔ The WHO’s air quality guidelines clearly identify NOx and particles emissions from transport as causes of negative health effects.

IN ADDITION, AUTOGAS CARS ALSO BRING A 10-20% CO₂ GAIN COMPARED WITH GASOLINE EQUIVALENTS, HELPING EUROPE REACHING ITS CLIMATE CHANGE OBJECTIVES.

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WHILE THIS RESULT CANNOT BE GENERALISED, THE SINGLE SERIES OF TESTS COMPARING AUTOGAS AND DIESEL (SAME CAR MODEL, SIMILAR ENGINE) SHOWS THAT LPG BRINGS A 98% REDUCTION IN NOx EMISSIONS IN REAL DRIVING CONDITIONS.

AUTOGAS IS A PROVEN SOLUTION TO REDUCE TRANSPORT EMISSIONS, FOR REAL.
Assessing the real world performance of autogas cars

Conclusions

- Contrary to gasoline, real driving emissions from LPG vehicles, including from the older converted car, are below the limits set out by the Euro 6 standard for all pollutants, even in the case of aggressive driving
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<tr>
<td></td>
<td>-17% to -19%</td>
<td>-60% to -97%</td>
<td>similar</td>
<td>similar</td>
<td>-96%</td>
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What is autogas

- LPG used as on-road engine fuel
- Propane, butane or a propane/butane mix
- The most commonly used alternative fuel in the Europe: 14,7 million vehicles, served by over 46,000 filling stations (EU28 + 7 neighbouring countries, 2015)
- More than 80 LPG models available from a dozen car brands in Europe
- An environmentally friendly option for road transport

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