NGVA Europe

for sustainable mobility

Comments on the T&E report "Do gas trucks reduce emissions?"

19 September 2019

The paper *"Do gas trucks reduce emissions?"* just published by T&E (Transport & Environment) gives us the right opportunity to rectify some aspects and explain some elements and details about gas in transport.

T&E conclusions are mainly based on different campaigns of emissions measurement run by TNO, the Netherlands Organisation for Applied Scientific Research. The scope was to compare the performance of Euro VI Diesel and equivalent LNG trucks, these typically used for long haulage freight transport missions.

Let's see the different points:

1. T&E statement on NOx:

Trucks powered by liquified natural gas (LNG) pollute the air up to five times more than Diesel trucks.

Reality:

All the analysis and conclusions are based on TNO Report 2019 R10193 and TNO Report 2017 R11336, without considering Report 2018 R11448[1] which precisely address NOx emissions from one of the tested trucks.

1. Measures of NOx emissions have been reported in Report TNO 2018 R11448 following the calibration dataset upgrade to the Euro VI Step D level and led to the results shown below:

[1] See 'Iveco Euro VI LNG PEMS test report'

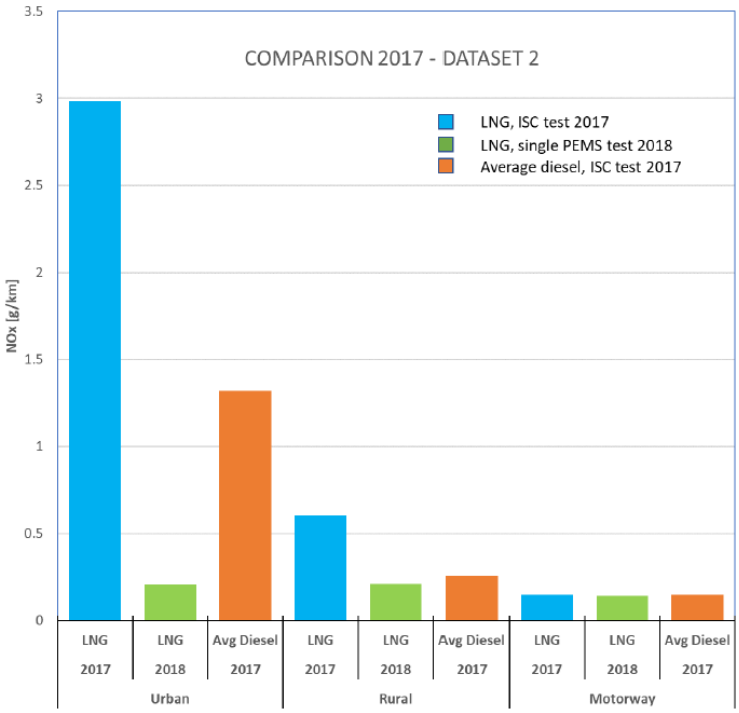


Figure 11, Comparison on NO_x, ISC testing 2017 vs dataset 2

Some comments about these results:

- The first set of measures in the 2017 report shows:
  a. Same level of emissions as Diesel under "motorway" conditions
  b. The NOx emissions level is double as high as Diesel (under urban & rural conditions)
     ➔ **NOT 5 TIMES MORE!**

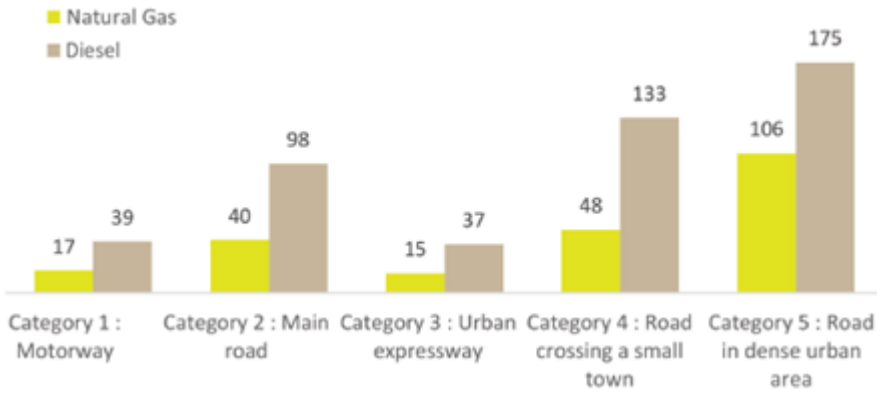
- Measurements from the 2018 report led to the following conclusions:
  a. **NOx emissions are cut by a factor 6,5 compared to Diesel under urban driving conditions**

2) Moreover, T&E avoids highlighting a very important aspect of natural gas technologies as the contribution of NO_2 to the overall NOx emissions is negligible with natural gas technologies as stated in the same TNO report 2018 R11448: ***"The share of NO_2 on street level in the NOx emissions is very low for all tests"*.**

   This is a huge difference compared to Diesel emissions, as NO_2 is responsible for human health diseases of the respiratory system and also is very reactive to form ground level ozone.

3) Benefit from natural gas in terms of NOx emissions have been also recently demonstrated through an extended study – *Projet Equilibre*[2]*.*

The experiment was performed over two years testing period under operating conditions and involved three 19-tonne natural gas HDVs. Also, nine 44-tonne natural gas and Diesel tractors were tested. Emissions, in particularly NOx and CO2, have been extensively measured on road under different vehicles mission profiles.
The overall average results are as follows (NOx emissions in g/100km):



The resulting measures clearly show a constant reduction in NOx emissions in favour of natural gas trucks, ranging from 40% to 60% compared to Diesel.

[2] See www.projetequilibre.fr

3. T&E statement on Particles:

Truckmakers claim that by using LNG, "particle emissions are almost completely eliminated" - or reduced by 95% compared to diesel.[xxxix xl] The TNO reports show that these claims are not true. In fact, the Scania and Iveco trucks tested emitted quite large numbers of particles per kilometer during urban driving conditions. These emissions during urban driving are particularly worrying as they can have a significant impact on air quality in towns and cities.

Reality:

The statement is not correct as it confuses PM (Particle Matter, measured as weight) and PN (Particle Number). The declaration of 95% reduction is referred to PM emissions and this reflects the comparison of data from public homologation data.

TNO reports only refers to PN measurement.

From report TNO 2017 – R11336 we find the following conclusions (page 5):

"The real-world particle number emissions of the LNG vehicles as well as the Diesel vehicles are on average very low and are lower than the level of the Euro VI limit that applies to an engine test. The particle number emission of four tested Diesel heavy-duty vehicles is about 1x108 to 1x1012 particles/km, while for the two tested LNG vehicles the level is about 1x1011 to 1x1012 particles/km. For Diesel engines this is achieved by the application of Diesel particle filters, which are needed to fulfil the EU particle number requirements that entered into force as of Euro VI (2014). Spark ignited LNG engines emit less particles than Diesel engines, which means that no particle filter is needed to achieve low particle emission levels. The tested LNG vehicles were therefore not equipped with a particle filter".

In report TNO 2019 – R10193 particle numbers have been measured on board under real driving conditions and results are as shown in the following figure:

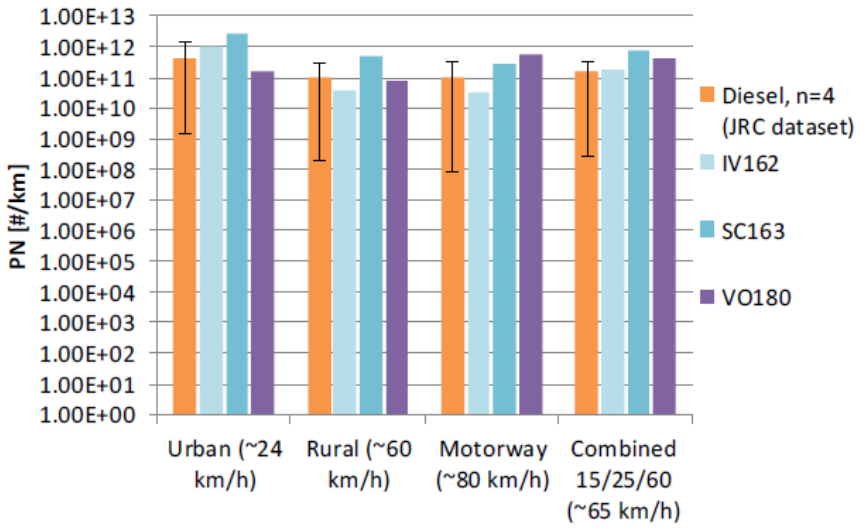


Figure 13: Particle number emissions of the LNG-diesel vehicle and two vehicles with LNG SI engines at medium payload as measured with PEMS (TNO 2017 R11336) and average results for four diesel vehicles as tested on a chassis dynamometer (Source: JRC chassis dyno measurements) over different trips that also contain urban, rural and motorway operation. Due to differences in the measurements and instruments, the results of individual vehicles can't be compared. The error bars represent the minimum and maximum values from the four diesel vehicles.

Conclusions from the TNO Report 2019 R10193:

"The measured PM number emissions of VO180 are at a comparable level of the four Diesel vehicles that are in the dataset from JRC as presented in [TNO 2017] and the two LNG vehicles. The results represent low concentrations (post DPF) and are in most cases, except the motorway trip of the first N3 (9.6x1011), lower (see paragraph 3.2.1) than the level of the applicable limit value of 6.0 x 1011 #/kWh for an engine WHTC test. No conclusions can be drawn about the observed differences between vehicles or fuels as the Diesel vehicles were tested in the lab while for the three LNG trucks particle numbers were measured on the road. Also, the test trips were not the same and the number of tests and vehicles is too low to draw generalised conclusions. Additionally, the instruments of road and lab test differ".

- ➔ It is not clear where T&E found the elements for their conclusions.
- ➔ The results confirm that natural gas spark ignited engines, even without any filtration device, guarantee the same low level of PN as a modern Diesel engine, equipped with DPF. This thanks to the fuel characteristics of natural gas.

4. T&E statement on GHG emissions:

Greenhouse gas emissions: Tested LNG trucks with spark ignition engines record tailpipe emissions 3 to 5% lower than the diesel truck with lowest test result. Volvo's LNG truck with High Pressure Direct Injection (HPDI) records tank-to-wheel emissions 14% less compared to the tested diesel vehicle that had the lowest GHG emissions. However, well-to-tank emissions from the production and transport of gas are on average 26% higher in the EU than fossil diesel.[v] T&E analysis shows that when considering the full emissions cycle, spark ignition LNG trucks are worse for the climate than the diesel truck that showed the lowest values in the test, while HPDI gas trucks hardly deliver any benefit.

Reality:

1) The statement is not correct when looking to the original measurements within the TNO 2019 R10193 report:

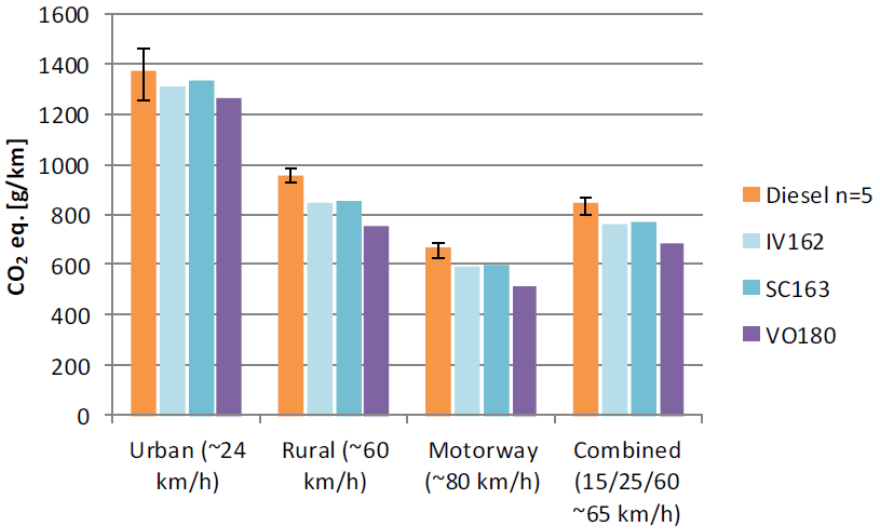


Figure 9: CO_2 equivalent emissions (including tail pipe CH_4) of the LNG-diesel truck at medium payload compared to the average results for 5 tested diesel vehicles (MY around 2013) and the two LNG vehicles (MY around 2016) with SI engines (TNO 2017 R11336). The error bars for the diesel trucks represent the minimum and maximum values from the database.

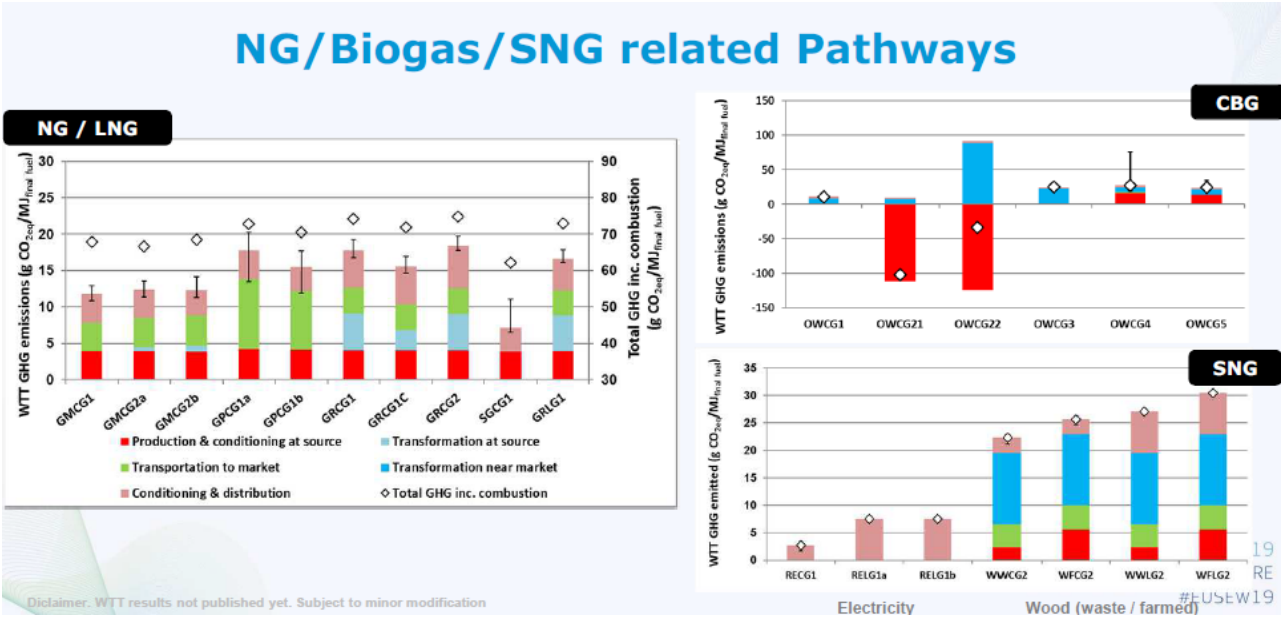
The overall "combined" results show an 8% tailpipe CO_2 equivalent emissions reduction for spark ignited engines, moving up to 20% with the HPDI technology (indicated as V0180).

When looking to the typical mission profile of an LNG truck ("Motorway"), reductions measured are of 10% for spark ignited engines and 22% for HPDI technologies.

2) **About Well-to-Tank (WTT) emissions**:

We are glad that T&E mentions the WTT dimension as it is key to assess the overall performance of vehicles. Here, the use of renewable gas, as bioCNG and/or bioLNG, is a quick win to decarbonize the transport sector.

The last updated dataset of GHG performance elaborated by the JEC Consortium (JRC/Eucar/Concawe), presented during the last EUSEW[3] shows the WtW (Well-to-Wheel) performance obtained when using renewable gas (CBG), leading close to **carbon neutrality** and, when looking to biomethane issued from liquid manure, even to a negative emission balance.



A LNG truck running over one year on bioLNG produced out of liquid manure (WTW = -28,5 gCO2/MJ) leads to a CO_2 saving by 42 t CO2/year, equivalent to approximately 7 hectar of forestry!

[3] See presentation 'EU SUSTAINABILITY WEEK, 17-21 June 2019'

5. T&E statement on methane emissions:

Apart from air pollutants, TNO also measured and compared the greenhouse gas emissions (GHG) from diesel and LNG vehicles. In their assessment TNO measured tank-to-wheel (or direct) vehicle emissions, mainly focusing on CO_2 emissions and methane emissions from the truck. Both greenhouse gasses have a major impact on climate change, with fossil methane having a global warming potential 30 times higher than CO_2 for a time horizon of 100 years.[xliii]

Reality:

1) Yes, methane is a greenhouse gas. This is why it is a great idea to capture it, for example during agricultural/farming activities and convert it into a fuel (biomethane) that can be used – for example in the transport sector.
2) The global warming potential is not 30, it is between 25 and 28 times higher compared to CO_2. This is according to the different standards proposed by IPCC (AR4 / AR5).
3) Concerning the methane emissions as unburned gas, the TNO Report 2019 R10193 shows in Table 11 the CH_4 emissions measured at the exhaust. The average value from the seven tests result in 0,17% w/w, meaning that 0,17 g CH_4 are emitted as unburned over 100 g consumed. This very positive result is due to the dedicated aftertreatment solutions used by modern NGVs.

6. T&E statement on air quality from renewable gas:

It is also important to underline that one of the three truckmakers discussed here confirmed in writing that "biomethane will not make any difference when it comes to NOx emissions from the engine". The actual fuel characteristics of bio-LNG and fossil LNG are practically the same, and thus so are the tailpipe emissions.[xxxviii] Put simply, trucks using biomethane have approximately the same NOx emissions as fossil gas.

Reality:

This is true.
All kind of renewable gas produced as from anaerobic digestion, gasification or Power to Methane process leads to the same molecules. This is 100% compatible with the current vehicle technologies and refuelling infrastructure. Therefore, these are ready to provide the same benefit in terms of air quality and to accelerate the decarbonisation process!

About NGVA Europe

The Natural & bio Gas Vehicle Association (NGVA Europe) is an European association that promotes the use of natural and renewable gas as transport fuel. Founded in 2008, its 127 members from 28+3 countries include companies and national associations from across the entire gas and vehicle manufacturing chain.

NGVA Europe is a platform for the industry involved in producing and distributing vehicles and natural gas, including component manufacturers, gas suppliers and gas distributors. It defends their interests to European decision-makers to create accurate standards, fair regulations and equal market conditions.

NGVA Europe creates networks among interested stakeholders to reach consensus on positions and actions to expand the market for the natural gas transport system. It also collects, records and communicates reliable facts and significant developments in the market.