Do gas trucks reduce emissions? Your questions answered

T&E briefing on responses to its paper

September 2019

Summary

On 19 September T&E published its paper 'Do gas trucks reduce emissions?' discussing air pollutant and greenhouse gas emissions from diesel and gas-powered trucks. Most of the findings were based on on-road tests commissioned by the Dutch government, performed by TNO. [1]

After the publication, different stakeholders, mainly from the gas lobby questioned our results and reacted in press releases and media outlets. In this briefing, T&E responds to the claims made by those stakeholders.

1. Testing conditions

The results presented in T&E's paper, both for the NOx emissions as well as CO2 equivalent emissions, are all on-road test results in comparable conditions performed by TNO. All the six Euro VI diesel trucks as well as the three gas trucks were tested on-road, on the same N3 test routes, with the same PEMS device with a medium payload.

TNO's statement on the testing conditions for the Volvo HPDI truck: *'To date, six Euro VI diesel trucks and two trucks with spark ignited LNG engines were tested with PEMS on N3 test routes and are in the dataset. The test vehicle (VO180) was tested over the 'old N3 route' which is the route that was also used for earlier tested vehicles from the dataset.'*[2]

TNO's statement on testing conditions for the Scania and Iveco LNG trucks: *'The results are used to make a comparison with the emissions of baseline Euro VI diesel trucks that were tested earlier in the framework of the programme under the same Dutch real-world conditions.'*[3]

In other words, the results of all the tests are comparable.

[1] https://www.transportenvironment.org/publications/do-gas-trucks-reduce-emissions

[2] http://publications.tno.nl/publication/34633965/pl7KqC/TNO-2019-R10193.pdf p. 26

[3] https://publications.tno.nl/publication/34625802/QoDRSe/TNO-2017-R11336.pdf p. 5

Table 1: Overview of types of emissions data obtained for the comparison between LNG and diesel within the framework of the Netherlands in-service testing programme for heavy-duty vehicles.

	Diesel Euro VI	LNG Euro VI
Vehicles	5 tractor semi-trailers 1 rigid + trailer	2 tractor semi-trailers
Gaseous emissions measured with PEMS	CO_2, NO_x, NO_2,THC, CO	CO_2, NO_x, NO_2,THC, CO
Particle measurement	Data set with anonymised results of PN measurements of chassis dyno measurements with 4 Euro VI HDVs (Source: JRC)	PN emissions measured with PEMS
Fuel consumption measurement	– carbon balance	– carbon balance – Coriolis fuel meter
Real-world trips and payloads	Reference trip N3 trip 10% and 55% payload	Reference trip N3 trip Representative trip for supermarket supply 10% and 55% payload

Only for the particle emissions, the diesels were tested in a lab, and the three LNG trucks on-road. T&E clearly acknowledges this in the press release. Because of the different testing conditions, our statement is also more cautious: 'The on-road tests also show that all three gas trucks tested produce levels of particle emissions comparable to diesel trucks.' T&E did not make any absolute direct comparisons between the levels of particles emitted by diesel and gas vehicles as was the case for NOx and CO2 eq. Our conclusion that the claims by the truckmakers are false ('particle emissions are almost completely eliminated') is correct.

2. NOx emissions

2.1 Is it fair and relevant to also consider NOx emissions in urban and combined driving?

It is true that LNG trucks are optimised for motorway driving but this does not mean they don't drive in cities. On the contrary, LNG trucks are also used to do urban deliveries in France[4], Germany[5], Spain[6], Italy[7] and the Netherlands.[8] In France, trucks running on natural gas even get the so-called v*ignette Crit'Air 1* which allows them to enter the low-emission zones in cities.[9] Hence, it is fair and justified to also discuss the air pollutants when the trucks are driving in urban areas.

[4] https://www.afgnv.info/attachment/696388/

[5] http://www.ngvglobal.com/blog/lng-powered-scania-trucks-x100-for-kp-logistik-0402

[6] https://www.lngworldnews.com/spanish-supermarket-chain-mercadona-to-add-40-lng-powered-trucks-to-its-fleet/

[7] https://www.globalcoldchainnews.com/lidl-chooses-iveco-for-italys-largest-lng-truck-fleet/

[8] https://www.iveco.com/netherlands/pers/persberichten/pages/bakker-groep-kiest-12x-iveco-stralis-np-voor-duurzame-supermarktdistributie.aspx

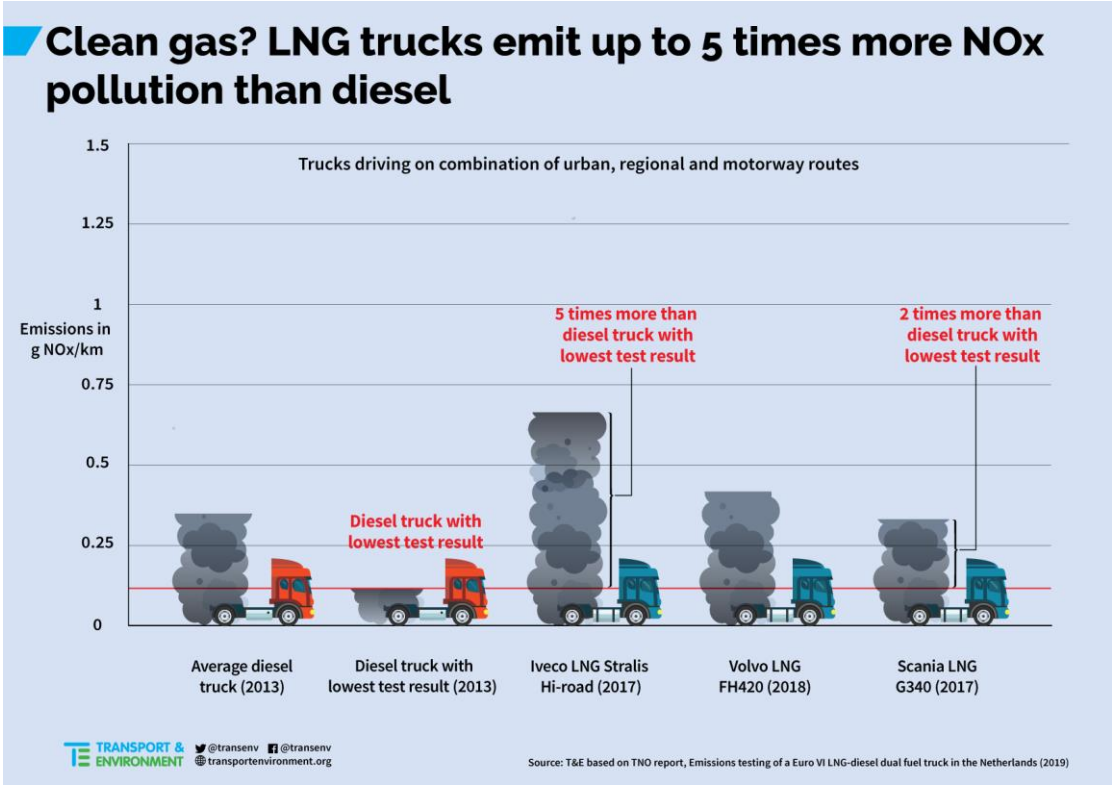
[9] https://www.otre.org/wp-content/uploads/2018/11/Gaz-naturel-v%C3%A9hicule-GNV-le-carburant-pour-un-transport-routier-durable.pdf

This is confirmed by TNO: 'As mentioned before, in the Netherlands the companies providing transport services for Ahold use the tested vehicle models not only for inter-distribution centre operation with a large share of motorway, but also for supply trips to supermarkets. These vehicles therefore do drive a significant share of their kilometres in cities.'[10]

It is also in cities that air pollution has the biggest impact because of the health issues. On top of this, the NOx emissions are much higher when doing urban driving which is an additional argument why this needs to be taken into account too.[11] So only looking at motorway driving would not be fair.

T&E also notes here that during the combined test cycle, urban/rural/motorway are weighted with a 15%/25%/60% ratio. In this way the combined cycle is a good representation of the overall performance for both the diesel as gas powered trucks. TNO stated in their report, 'to obtain an average emission figure that indicates average usage of a long haulage truck in the Netherlands, the parts were weighted with a distribution of 15, 25 and 60% respectively.'[12]

It is important to note here that the TNO results show that in combined driving the NOx emissions of the average diesel truck are on a par or lower than the LNG vehicles. The NOx emissions of the diesel truck with the lowest test result are lower compared to the three tested LNG trucks.



2.2 Is the statement 'NOx emissions up to 5 times more' incorrect?

In our paper, T&E is looking at both the average diesel as well as the diesel with the lowest test result to compare this with the emissions from the LNG trucks. The NGVA is ignoring this notwithstanding the fact that T&E mentions this very clearly in the press release, all infographics and the paper.

[10] https://publications.tno.nl/publication/34625802/QoDRSe/TNO-2017-R11336.pdf p. 21
[11] https://publications.tno.nl/publication/34625802/QoDRSe/TNO-2017-R11336.pdf
[12] http://publications.tno.nl/publication/34633965/pl7KqC/TNO-2019-R10193.pdf p. 26

The data in the infographic above show that our statement 'In combined driving (urban, regional and highway) the LNG trucks emit 2 to 5 times more NOx than the diesel truck with the lowest result' is fully correct.

2.3 What's the relationship between NO and NO2?

The NGVA and others claim that NO2 is much more important when assessing NOx emissions from vehicles and that T&E has not taken this into consideration given that the NO2 levels of the tested gas trucks were lower than for the diesels.

T&E stresses the fact that both NO and NO_2 are regulated as part of a total NO_x limit because, once emitted, a significant proportion of NO is converted to NO_2[13], thereby increasing the amount of NO_2 pollution, which have serious health effects including on the respiratory and cardiovascular systems. As such, any increase in the emissions of total NO_x, and not just of NO_2, are of grave concern for air quality. In short, measuring and lowering NO emissions are also very relevant to addressing the air quality impact of trucks.

TNO confirms this: 'As NO is converted in the air to NO2, the NO/NO2 ratio in the direct emissions of vehicles has a limited impact on the overall NO2 concentrations at the city or regional level. '[14]

2.4 Are other on-road tests proving us wrong?

T&E is aware of the other on-road tests such as *Projet Equillible*, which claims 'NOx emission reductions in favour of natural gas trucks, ranging from 40% to 60% compared to diesel, have been measured.'[15]

T&E stresses here that, first of all, many partners in this project were not independent. For instance, it involved AFGNV (the French lobby group that pushes for fossil gas in transport, and which counts energy companies such as Gazprom among its members) and GRDF (a French natural gas distribution company). This already casts doubt on the objectivity of this study.

Moreover the study also lacks technical details and accuracy: about the type of vehicles (model years, engines etc.) that have been selected for the tests; about the devices that were used for measuring the emissions; about how the vehicles that were selected (taken from the road, did they get an update before being tested, …?); and about the quality of the fuel that was used, etc.

Having a closer look at the detailed results also raises some more questions:

[13] https://uk-air.defra.gov.uk/assets/documents/reports/cat06/NewMethodforNOxtoNO2(Final).pdf

[14] https://publications.tno.nl/publication/34625802/QoDRSe/TNO-2017-R11336.pdf p . 5

[15] https://www.ngva.eu/medias/comments-on-the-te-report-do-gas-trucks-reduce-emissions/

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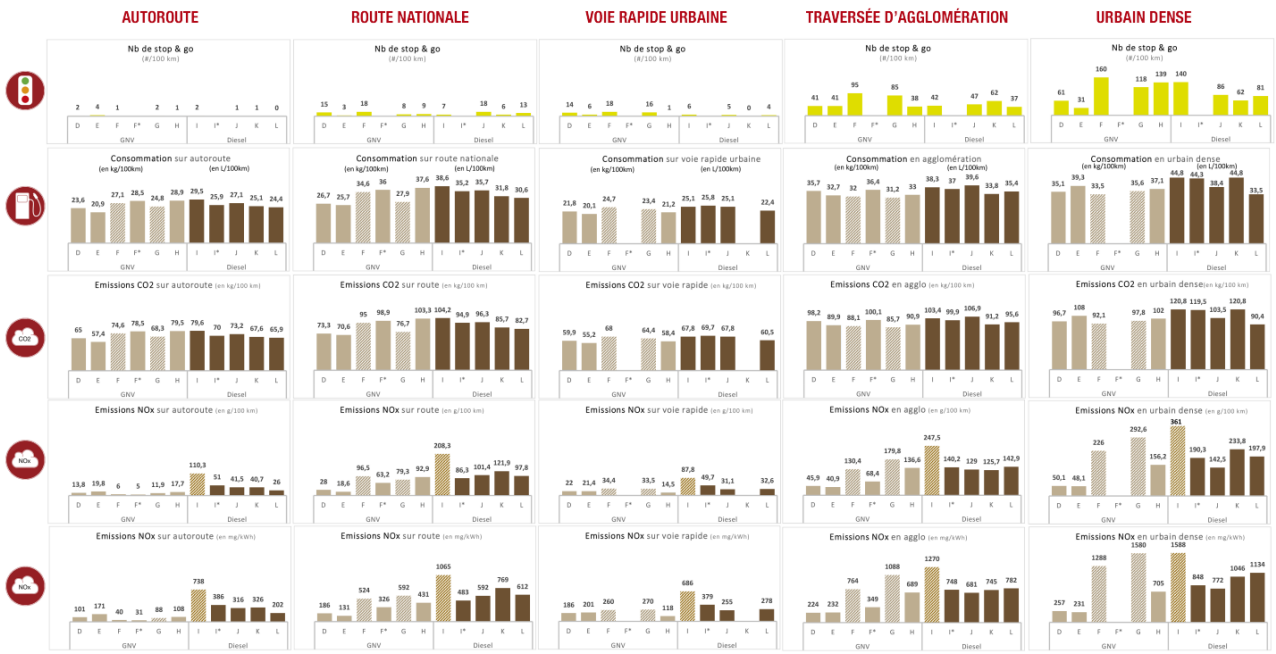


- First of all, when results were too high, the manufacturers were contacted to see what was wrong:

  "Au regard des mesures réalisées pendant le projet et des résultats anormalement élevés sur les émissions de NOx, les véhicules F, G et I ont nécessité une intervention du constructeur suite à une alerte remontée par le projet Equilibre"

  Two of those vehicles (F and G) were in fact LNG trucks. The fact that the manufacturers were contacted to "fix" the vehicles doesn't seem scientifically rigorous, as it doesn't reflect real-driving conditions.

- Secondly, when calculating weighted averages for the combination of LNG trucks that are presented in the graphs used in the NGVA and AFGNV press releases, the dirtier trucks (F and G) were not taken into account. Also, the cleaner LNG trucks drove many more kilometers, reducing the weighted average emissions data. As a result, LNG vehicles seem cleaner than they are, because of this biased approach.

- Thirdly the table clearly shows that results for LNG trucks differ. For instance, in urban conditions, where NOx emissions matter most, trucks F and G (LNG trucks) are worse than trucks J, K and L (diesel). So, as stated in our paper, LNG trucks can be worse than diesel.

T&E is happy to collaborate with independent parties to conduct tests on 2019 trucks using different powertrains.

2.5 Why did we not consider the Iveco truck tested in the TNO Report 2018 R11448?

In 2018 Iveco took exactly the same truck as tested in 2017, and did seven different on-road tests with different settings to address the NOx issue detected in 2017. In the seventh test they managed to get the lower NOx results presented by the NGVA.

However, the settings in the seventh test are not representative of the calibration used on the truck bought and used by the transport buyer. The calibration of the truck bought by the transport operator is the one from 2017, i.e. with the higher NOx emissions, and not from 2018. Hence, the NOx performance of test number 7 in 2018 is not representative of the performance of Iveco trucks that were sold on the EU market and driven on the road.

Iveco informed TNO that a recall and re-homologation process will be undertaken. T&E would welcome information on this recall process and the rectification/re-calibration of the trucks in question, and whether it will extended to the full EU market after all trucks sold on the Dutch market are re-calibrated.

3. Particles

3.1 Is T&E mixing up particle matter (PM) and PN (particle number)?

The answer is no. In both the Scania and Iveco articles quoted in our paper, at no point was PM specifically mentioned. Both truckmakers only refer to particles in the general sense, with neither particle number or particle mass specified.[16] If these articles meant to refer to PM only then this should have been clearly stated in the article while making these kind of strong claims.[17]

So it is not T&E but rather the truckmakers in question that are using language loosely, accidentally or otherwise.

3.2 Are gas trucks emitting lower PN emissions?

Because of the different tests used in the comparison of particles, T&E did not make any absolute direct comparisons between the levels of particles emitted by diesel and gas vehicles – unlike in the cases of NOx and CO2 eq. The tests used to compare NOx and CO2 eq. were directly comparable.

T&E did state that PN emissions are at a comparable level to the diesel trucks and that the claims by certain OEMs that gas trucks produce -95% particles compared to diesel are simply not correct. The TNO findings support these statements.

[16] Quote Scania article: 'The Scania Truck powered by liquefied natural gas (LNG) drives with significantly lower CO2 and virtually without nitrogen oxide (NOx) and particulate emissions.'
https://www.volkswagenag.com/en/news/2017/09/scania_lng_trucks.html

[17] Quote Iveco article: 'Natural gas is an absolutely clean fuel thanks to its emissions of particulate (-95% in comparison to diesel) …'
https://www.cryogas.pl/pliki_do_pobrania/artykuly/Cryogas_IVECO_Report._Polish_road_tests_.pdf

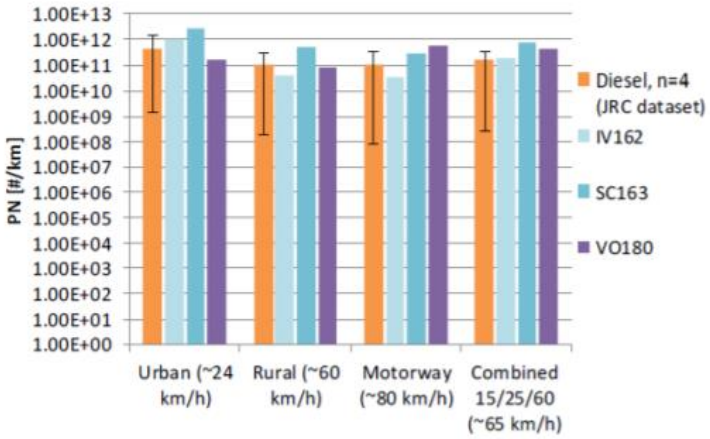


Figure 13: Particle number emissions of the LNG-diesel vehicle and two vehicles with LNG SI engines at medium payload as measured with PEMS (TNO 2017 R11336) and average results for four diesel vehicles as tested on a chassis dynamometer (Source: JRC chassis dyno measurements) over different trips that 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.

Secondly, a report published by the JRC shows that the emissions of particles from gas heavy duty vehicles are not any lower than for diesel vehicles fitted with a DPF[18].

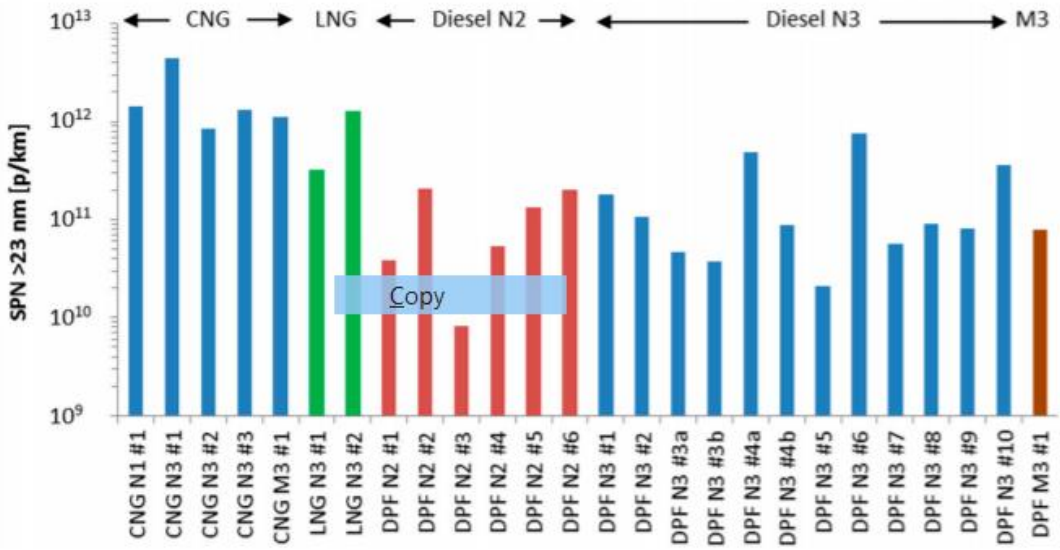


Figure 2. Weighted SPN emissions of test fleet (14% cold start, 86% mean of urban, rural, motorway). The small letters "a" and "b" indicate testing of the same vehicle after approximately 3–6 months.

Thirdly and finally, the EU has recently (as part of Euro VI Step E) decided to introduce an on-road (RDE limit) for particulate number for diesel and gas trucks. However, the introduction of the on-road limit has been delayed by two years for gas trucks at the request of the truckmakers themselves because they state that a

[18] Barouch Giechaskiel, Solid Particle Number Emission Factors of Euro VI Heavy-Duty Vehicles on the Road and in the Laboratory, International Journal of Environmental Research and Public Health, 2018

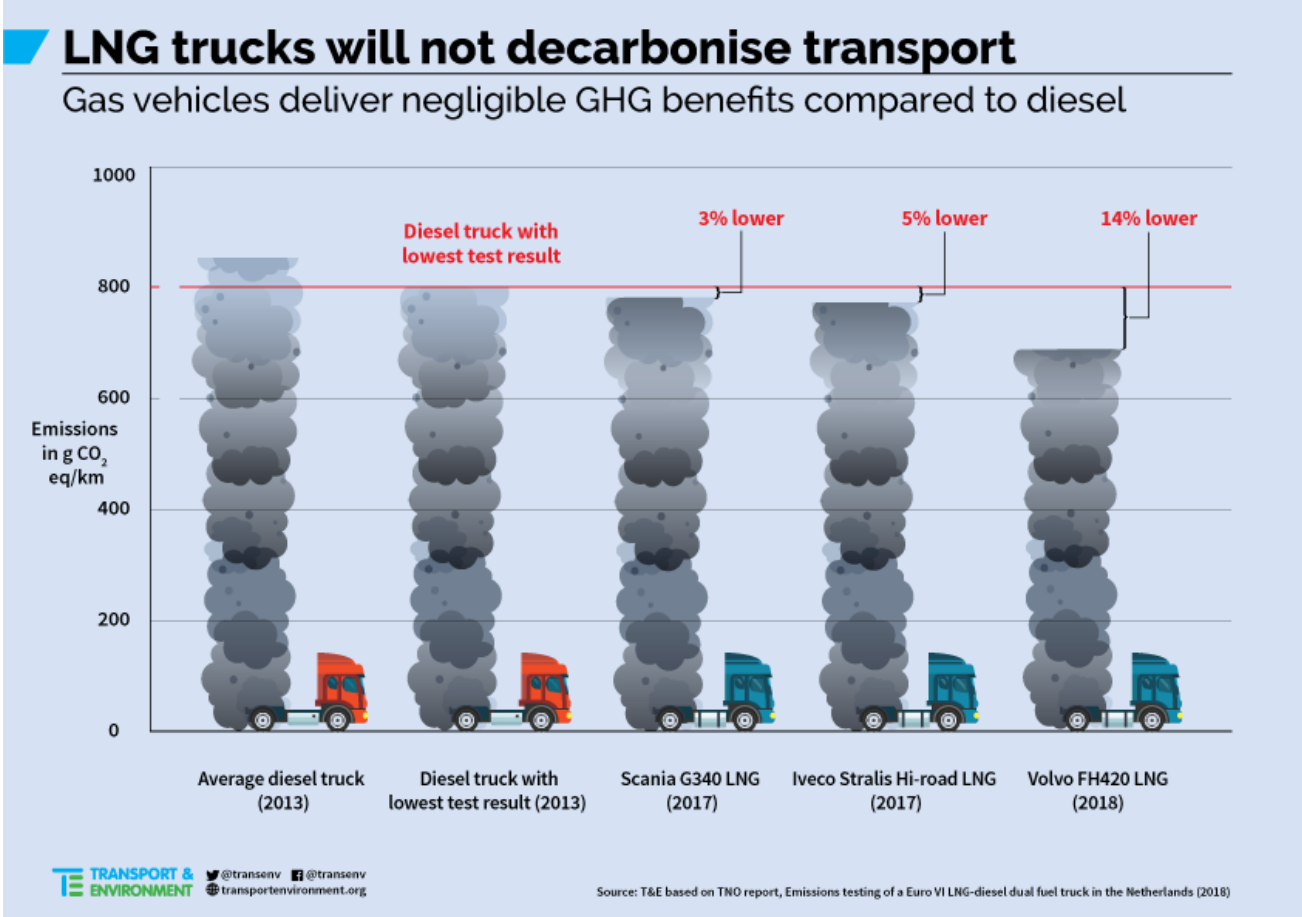
PN limit cannot be respected by some gas trucks being produced today without significant changes to their design[19]. This delay alone, which is supported by ACEA[20], suggests that on-road emissions of particles from gas vehicles are high and that, for some makers of gas trucks, significant design changes are necessary in order to ensure that they comply with the particle number emission limits on the road.

4. Greenhouse gas emissions

4.1 Is T&E biased by focusing on combined driving?

In our paper, T&E is looking at both the average diesel as well as the diesel with the lowest test result to compare this with LNG trucks. The NGVA is ignoring this notwithstanding the fact that T&E mentions this very clearly in the press release, infographics and paper.

The exact data, presented in the infographic below show that our calculations regarding the tank-to-wheel CO2 eq. savings are correct notwithstanding the fact that NGVA claims that our results showing 3%, 5% and 14% lower CO2 equivalent savings are wrong.



19 https://ec.europa.eu/transparency/regcomitology/index.cfm?do=search.documentdetail&Dos_ID=17776&DS_ID=62755&Version=2

20 https://ec.europa.eu/info/law/better-regulation/initiatives/ares-2019-3257202/feedback/F464281_en?p_id=5513873

T&E also notes here that the combined test cycle used by TNO gives a good impression of the fuel consumption and CO2 emissions of gas and diesel trucks, rather than focusing on motorway only. In this combined cycle, urban/rural/motorway are weighted with a 15%/25%/60% ratio. In this way the combined cycle is a good representation of the overall performance for both the diesel and gas-powered trucks.

TNO confirms this: ‘‘To obtain an average emission figure that indicates average usage of a long haulage truck in the Netherlands, the parts were weighted with a distribution of 15, 25 and 60% respectively.’ (TNO 2019, p. 26)

4.2 What’s the role of renewable and biogas?

This T&E report does not cover biomethane from a GHG point of view. It focuses only on air quality. Still, in different reactions, the gas lobby continues to try to promote biomethane/biogas.

In short T&E doesn’t question the fact that the use of renewable gas lowers the carbon footprint. Last year T&E published a report on the use of natural gas in transport, which contained a substantial section on renewable methane. It also included references to different pathways, all of which were better than fossil LNG and diesel. T&E has always been clear about this fact.

However, what T&E questioned in our report last year, and we still question today, is the availability of feedstocks to produce biomethane in a sustainable way. When the numbers are run, it is clear that there is not (and will not be) enough biomethane (at any reasonable price or environmental footprint) to decarbonise sectors already using natural gas today (e.g. industry and heating), and even less for new users of natural gas, such as heavy-duty vehicles. For more details, see section 6 of the T&E report mentioned above.

Moreover, our LNG paper questioned the air quality benefits of biomethane (which are the same as for fossil LNG) and not the GHG benefits of renewable methane. This statement has not been questioned by the NGVA.

4.3 How harmful is methane?

Based on IPCC AR5 chapter 8, page 714, T&E uses 30 as global warming potential (GWP) on a 100-year time-frame (see page 17 of the same report mentioned above). If we would have used values including feedbacks, or in a 20-year framework (GWP20) to reflect the urgency of fighting climate change, the global warming potential would be even higher.

The NGVA attempts to divert attention from the real issues around the GWP of methane by focusing on the limited emissions measured at the exhaust.

In this LNG paper T&E mainly refers to methane leakage as part of the well-to-tank GHG emissions of fossil gas. This is where the biggest methane leakage problem lies. The fact that the NGVA frames the methane question as a tank-to-wheel issue and ignores the elephant in the room – methane leakage during the well-to-tank phase – confirms our findings that the gas industry wants to divert our attention from the real methane problem.

4.4 Well-to-tank emissions

To calculate WTT differences we used data from the Joint Research Center, the official EU agency calculating this value. We used GRLG1 (*Remote LNG, use as LNG in vehicle*), with a value of 19.4 g CO2 eq./MJ fuel, versus the value used for COD1 (*conventional diesel*), with a value of 15.4 g CO2 eq./MJ fuel. The difference is +26%. Values for average grid gas cannot be used – as trucks use LNG, which is a more energy-intensive product. For more details check section 3.1 of this T&E study.

Further information

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