

Ending the cheating: using real-world CO₂ measurements within the post-2020 CO₂ standards

April 2018

The biggest failure of the current car CO₂ has been the failure to deliver emissions reductions on the road. Whilst new car CO₂ emissions measured using the obsolete laboratory test (NEDC) have fallen by 31% since 2000, on the road the reduction is just, 11%. The gap between test and real-world performance has leapt from 9 to 42% weakening the regulation, increasing CO₂ emissions and raising fuel bills for drivers.

The underlying issue was basing the regulation on laboratory tests. Whilst the new WLTP addresses some loopholes, its introduction also creates new flexibilities that the car industry are planning to exploit to undermine both the current regulation to 2020/1 and proposed future regulations for 2025/30. There are two key ways the post-2020 regulation will be weakened:

1. By increasing the gap between the average WLTP test value and average real-world performance which is expected to grow from 23% in 2020 to 31% in 2025.
2. By double testing cars using the old NEDC test (for compliance with 2020/1 targets) and WLTP (to establish the baseline for proposed 2025 targets). This raises the 2020 WLTP baseline by about 10g/km, effectively halving the stringency of the proposed emission reduction.

At the heart of the problem is that all laboratory tests still include too much interpretation of the requirements and optional approaches allowing tests and vehicles to be optimised and the results massaged upwards or downwards within the letter of the rules. This can be used to produce artificially low NEDC test results to help meet 2020/1 targets; and high WLTP values for 2021 to inflate the baseline on which the Commission's proposed 2025 and 2030 percentage reduction targets are based.

By measuring real-world fuel efficiency using fuel consumption meters or real-world tests, it is possible to reduce the manipulation of regulations. The Commission's own experts recommended such an approach but the Commission failed to follow through with effective proposals. Co-decision makers in the European Parliament and Member States now need to finish the job by amending the post-2020 car and van proposals.

1. Background

The biggest failure of the current car CO₂ regulation has been the way emissions have been radically reduced in laboratory - but hardly at all on the road. Data compiled by the [European Environment Agency](#) (EEA) shows a clear trend with average CO₂ emissions of new cars in the laboratory declining by 31%, from 172gCO₂/km in 2000 to 118gCO₂/km in 2016. This is the message the car industry likes to portray. However, figure 1 also illustrates that on the road cars have improved far less. This is based upon a compilation of real-world data by the [ICCT](#). The gap between the average NEDC new car test value and average new car performance on the road has grown from 9% in 2000 to 17% in 2008 and 42% today. This has weakened the effectiveness of the regulation by the equivalent of 21g/km.

The widening gap is not the result of cars being driven in a significantly different way from the past, as motorists have minimally changed their driving style in the last 5-7 years. Nor can the widening gap be explained by the addition of auxiliary equipment (like heated seats) being fitted to the car, as this kind of

equipment is only responsible for around 4% points of the CO₂ divergence between lab tests and real-world conditions. Neither is the widening gap a statistical anomaly as the result of cars becoming significantly more efficient as the industry claims; nor does it arise from the use of an obsolete test: the test has only recently changed to WLTP and the gap is based upon the same NEDC test. The primary cause, confirmed by the current emission cheating revelations, is carmakers manipulating the undemanding and poorly prescribed emissions tests; and choosing to fit technology to improve the efficiency of the car that works much better in the test than on the road.

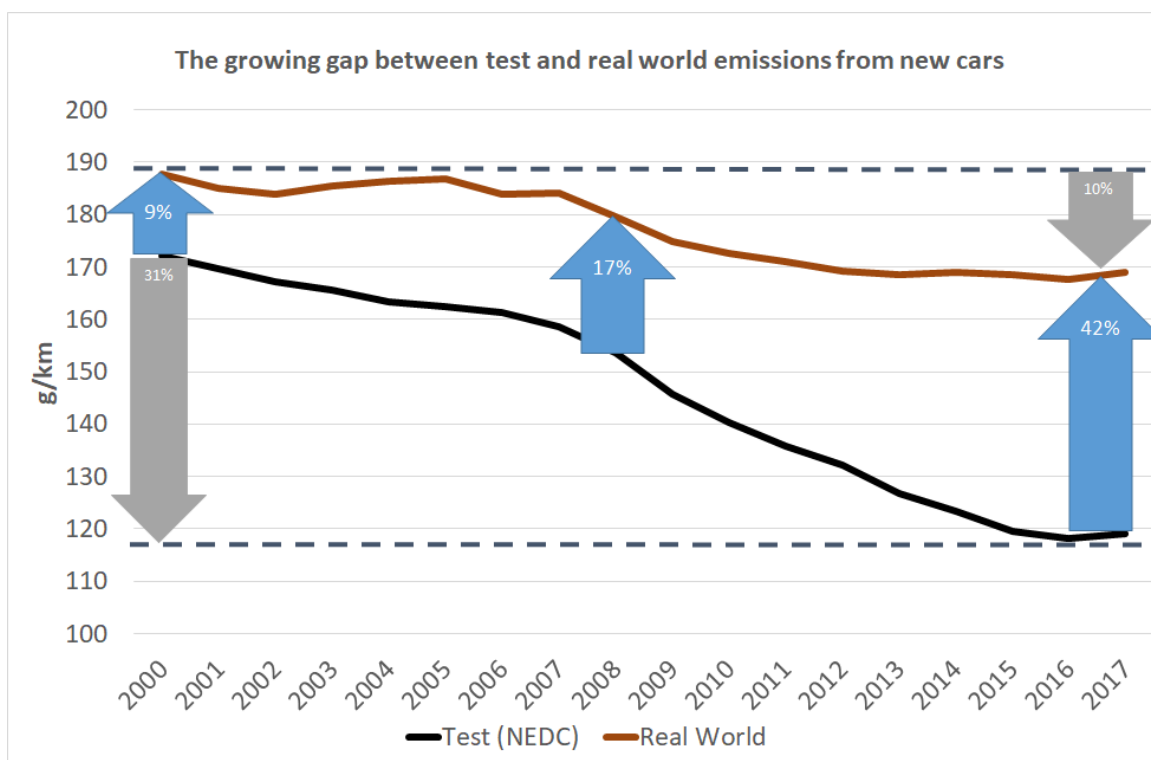


Figure 1

The manipulation of test results ranges from: taking advantage of margins in testing procedures; to blatant misuse of poorly drafted test rules (like removing parts to lightweight a car prior to test); through to modifying tyres and illegal practices of detecting test cycles. The car industry has also focused on developing and deploying technology that operates far more effectively in a test than on the road. The system of regulatory oversight - reliant on 28 national vehicle regulators - has been too weak to prevent this as exposed by the Dieseltgate scandal. Whilst new stricter rules come into force in 2020, the ability of carmakers to select their own testing services and Type Approval Authorities has not been addressed; neither was an independent EU agency established. However, there are many [improvements](#) to the way cars are tested and approved built into the final regulation. It remains to be seen how much more robust the testing system really is.

2. Why the problems will continue beyond 2020

The new WLTP test is an improvement over the NEDC, the obsolete test it replaces. But WLTP is still a laboratory test with the lack of representativeness compared to real-world driving this creates. The WLTP is much longer than the NEDC test it replaces; and the car driven much more dynamically (faster accelerations) but is still not realistic compared to real-world driving. During the WLTP, the car idles for much less of the test; and the high speed section is more representative of highway driving. Crucially, the test procedures are much more robust and eliminate many, but not all, of the practices that carmakers have used to artificially lower NEDC test results, such as charging the battery before the test, over-inflating tyres, etc. It also requires cars to be tested at the maximum and minimum weight (depending on the level of optional equipment fitted to the vehicle). All of these developments make the WLTP test results more

representative. However, real-world emissions are still estimated to be on average 23% higher than WLTP values.

Crucially the gap between WLTP test results and real-world emissions is also [expected to grow](#) to 31% by 2025. This will be driven by exploiting more test flexibilities (15%), technologies performing better in the test, like cylinder deactivation (10%) and more equipment fitted to cars (6%). Key reasons include the increasing sales of plug-in hybrids (that are not charged as much as the WLTP assumes); using special test drive modes; air conditioning; transmission optimisation; using different tyres for testing than for real-world sales; etc. To stop the gap widening, monitoring as proposed by the Commission post-2020 is not sufficient – enforcement is required.

This is illustrated in the [Figure 2](#) below that shows both why the gap between test and real-world emissions grew so quickly and why the same problem will occur with the WLTP test. Potentially the gap to NEDC could grow further to 49% particularly through exploiting flexibilities in the way cars tested. But the WLTP gap will also grow and this needs to be prevented through specific requirements in the post-2020 car CO₂ regulation being currently agreed. Testing flexibilities are the most important reasons for the growing gap for both NEDC and WLTP. Technology that under-delivers emissions reductions on the road compared to the test (like stop, start, plug-in hybrids and cylinder deactivation are also significant. Other parameters are equipment switched off during the test – like air conditioning.

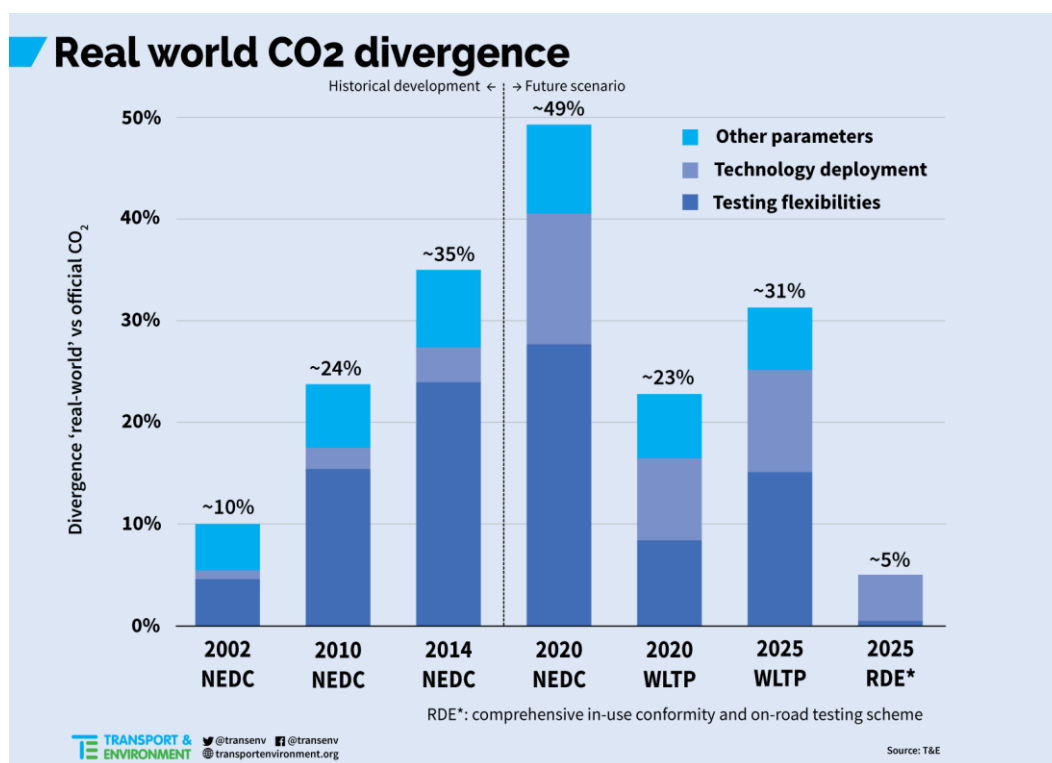


Figure 2

3. Manipulation of the 2021 baseline

The switch over from the NEDC to the WLTP creates a number of issues for assessing compliance against the 2020/1 target; and setting post-2020 targets. The 2020/1 95g/km target is based upon the NEDC test but the new WLTP test is now being used to measure car CO₂ emissions. To manage the transition it has been agreed to convert the WLTP test results into an NEDC equivalent value using a tool known as CO₂MPAS that was developed by the Joint Research Centre of the European Commission. The CO₂MPAS tool is designed to “maintain regulatory stringency” throughout the process of introducing the new test. T&E believes that, given the choices made in the design of the tool and which flexibilities in the testing procedure were incorporated into the correlation, that regulatory equivalence has been achieved. This means that the NEDC

values computed using the CO₂MPAS tool after 2017 should be broadly similar to those made using the modified NEDC, and should in turn lead to WLTP values about 110-115% of the NEDC value.

There is insufficient data at present to determine whether this is the case or the target has, in effect, been made more or less stringent through the introduction of the new test. However, there are indications that the car industry is aiming to take advantage of the switchover. Vehicles have been tested on new WLTP from 2017 and then for the NEDC values to be derived using the CO₂MPAS tool to assess compliance against the 2020/1 targets. The WLTP test values would be used to define the baseline in 2021 for the post-2020 targets (as well as being an input to the CO₂MPAS tool).

However, the early indications are that the WLTP producing much higher test values than expected. In one member state the CO₂ emissions of over 100 newly registered cars were found to be significantly higher than the average 110-115% difference between NEDC and WLTP that experts had been expecting. The wide gap is likely to have arisen from not optimising either the vehicle and test conditions to artificially increase test values.

High WLTP values will also result in high NEDC equivalent values derived using the CO₂MPAS tool and would put at risk compliance with 2020/1 targets. However, the regulation allows double testing (testing on both NEDC and WLTP) where the CO₂MPAS tool is not representative (such as for hybrid cars) and many companies plan to make use of this loophole. By double testing, a carmaker will be able to manipulate the NEDC test result by optimising the test conditions in order to produce a very low NEDC value to comply with the 2020/1 target (the current approach). However, the carmaker will also be able to optimise the WLTP test value and artificially inflate it to achieve a high starting point for the post-2020 regulations (and thus an easier target for 2025 and 2030). This is easy and carmakers are permitted to “declare” a different CO₂ value to the one that has been measured. Whilst there are limits on declaring a low CO₂ value using the WLTP test there are no limits on declaring higher values.

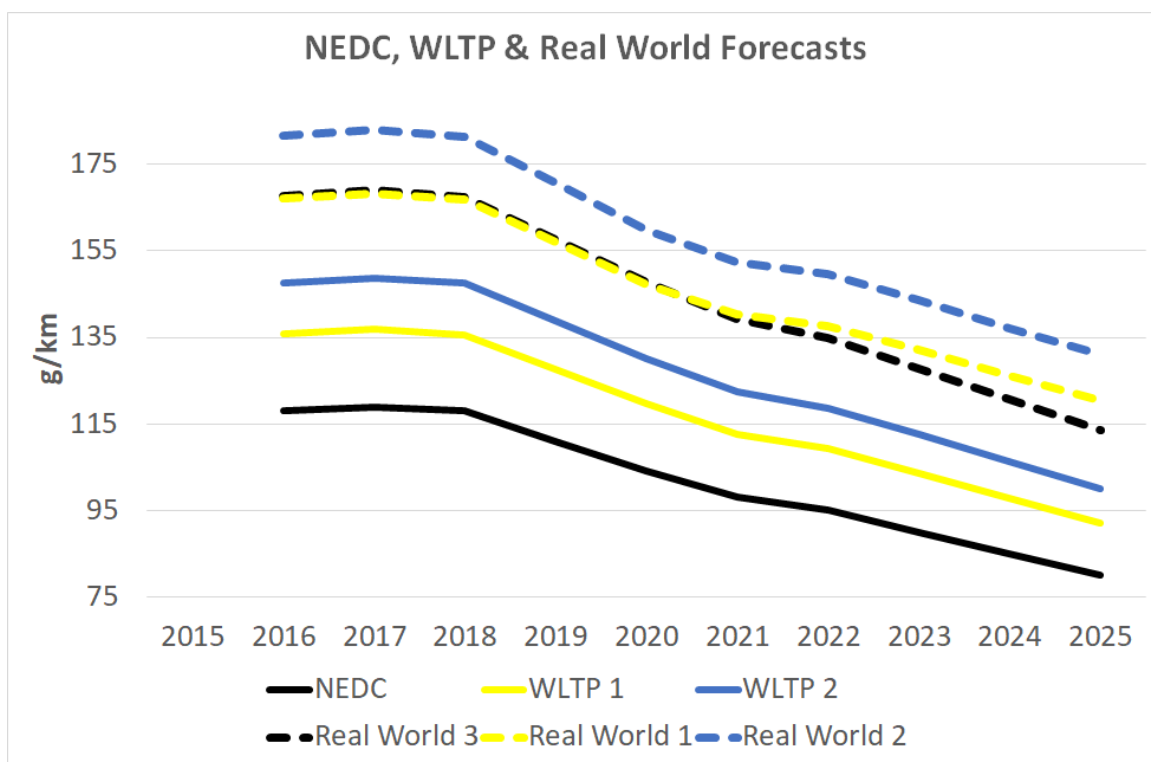


Figure 3

The Figure 3 above shows anticipated changes in NEDC, WLTP and real-world emissions from 2015 to 2025. It is based on a number of assumptions detailed in the Table 1 below that also summarises the results for 2021 and 2025.

Parameter	2021 value (gCO ₂ /km)	2025 value (gCO ₂ /km)	Basis
NEDC	98	80	NEDC test results stabilise to 2018 and then decline to 98g/km in 2021, in line with T&E's 2021 projection from our car CO₂ report (the remaining 3g/km needed to reach the target are achieved through super-credits). The NEDC values then decline by 15% from 95g/km (2022) to 2025 in line with the Commission proposal.
WLTP 1	113	92	Assumes the anticipated 15% gap between NEDC and WLTP.
WLTP 2	123	100	Assumes the 25% gap between NEDC and WLTP that appears to be emerging from initial tests. In effect exaggerated WLTP values
Real World 1	140	121	The real-world emissions assuming the gap with WLTP 1 increases from 23% to 31%.
Real World 2	153	131	The real-world emissions assuming the gap with WLTP 2 increases from 23% to 31%.
Real World 3	139	114	The real-world emissions assuming a gap of 42% between NEDC and real-world emissions

Table 1

Figure 3 and Table 1 show:

1. If through double testing and use of declared values, carmakers are able to inflate the gap between NEDC and WLTP from 15% (anticipated) to 25%, this will raise the WLTP baseline in 2021 by 10g/km to be 123g/km new car CO₂ emissions. By adapting WLTP testing after 2021 to reduce the gap with NEDC back to the anticipated 15%, they could gain 8g/km of free credits they could use to meet the 2025 target.
2. If the baseline can be manipulated by 10g/km, this reduces the stringency of the 2025 target by around half since overall the 15% reduction is only likely to be equivalent to about 21g/km WLTP.
3. The Real World 1 and Real World 3 (representing the current situation) are very similar and suggest the 15% gap is more appropriate while a larger (25%) gap is likely to be the result of manipulations.
4. Sticking with the NEDC (assuming the gap remains at 42%) actually produces the lowest real-world emissions in 2025 (114g/km). The flexibilities made possible through introducing WLTP are actually slowing down improvements in real-world emissions!

4. Fixing the problems

Given the failure of the current regulation to deliver the expected emissions reductions on the road, it was both extremely surprising, and disappointing, that the European Commission proposal for post-2020 standards fails to address the problem of failing to deliver emissions reductions on the road. Particularly since the Commissions own [Scientific Advisory Mechanism](#) recommended they do so.

The Commission have proposed some in-service conformity tests, however these will only check that the laboratory tests have been correctly performed and are unlikely to be able to prevent the gap between test and real-world emissions growing, as test manipulation is only part of the reason for the growing gap. [ICCT analysis](#) (Figure 2) indicates 10% of the 23% gap between WLTP and real-world emissions in 2021 is due to

test manipulation; while 8% arise from technologies that perform better in the test than on the road; and 5% from disabling auxiliary equipment during the test (5%).

The Commission also proposes to monitor the gap between the new test and real-world performance using fuel consumption meters, but will only consider the data in a 2025 review - too late to act to address any issues which emerge from the analysis. In addition, given the emerging evidence that the manipulation of the WLTP 2021 baseline could potentially half the stringency of the 2025 target, a regulatory mechanism in the car CO₂ regulation is clearly needed to fix both problems.

Enforcement can be achieved through setting a Not-To-Exceed (NTE) limit between the WLTP test value and the real-world emissions. Real-world emissions can be derived using either a real-world test, similar to that implemented for NO_x emissions and developed by [T&E, FNE and PSA Group](#) or the existing one developed by the European Commission. The fleet average real-world emissions for each manufacturer could then be calculated during type-approval along with the WLTP values.

An additional control could be to use the real-world fuel consumption data obtained from Fuel Consumption Meters (FCMs). These can be used to calculate CO₂ emissions and would provide detailed information on the gap between the new WLTP test and real-world performance of new cars sold to customers. The Commission intends that all new cars will be fitted with a FCM for this purpose. These will then provide data, hopefully from 2021, on the real-world CO₂ emissions and therefore average gap for each carmaker in the base year, based upon the data compiled from individual models. The Commission plan only to monitor the gap but a simple extension to control the gap can then be fixed. Carmakers would then be required to ensure the gap does not grow in the future – if it did, the company 2025 (and future) targets would be adjusted accordingly to ensure the anticipated CO₂ reductions remained constant. The Figure 4 illustrates how in practice the system would operate.

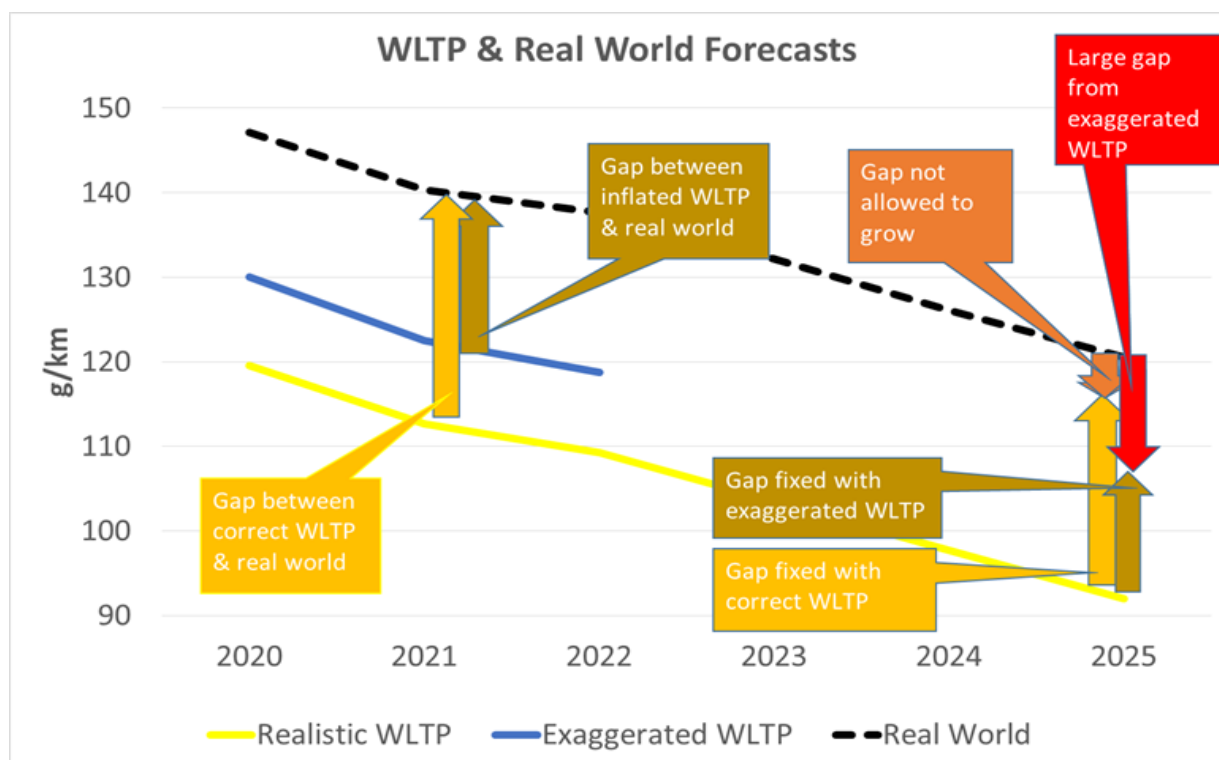


Figure 4

In the case of using fuel consumption meters, the Commission proposal includes a requirement to report the data and to review the gap in 2025, but do nothing to use the data to stop the gap growing. T&E proposes that, in 2021, fleet average emissions are measured for all new cars on a real-world basis and the average real-world emissions calculated for each manufacturer.

Beyond 2021, carmakers would be required to ensure that the gap between their fleet average WLTP values and fleet average real-world emissions (measured using a real-world test and/or fuel consumption meters) is constant or reduces (but cannot increase). This has two key benefits:

1. Carmakers could not manipulate the baseline 2021 WLTP values using double testing of cars on the NEDC and WLTP tests and high WLTP declared values. This is a serious risk as most carmakers plan not to use the CO₂MPAS tool in order to derive NEDC equivalent values. If through double testing carmakers inflate WLTP values, the gap with real-world emissions (which cannot be changed or manipulated as are an absolute) will be small and they will struggle to retain this gap after 2021.
2. It encourages carmakers to fit technology to the cars that delivers savings on the road, not only in the laboratory and would drive the deployment of technologies that deliver emissions reductions on the road better than the current system of eco-innovations. This is essential as some technologies will deliver much bigger improvements in the lab than on the road (such as stop-start and [cylinder deactivation](#)).

The gap between the real-world and WLTP values is fixed in 2021 and cannot grow after this. In the figure the forecasted additional gap (orange arrow) would not be permitted to increase. Carmakers that failed to deliver the required emissions reductions on the road would need to reduce their fleet average emissions more in the laboratory to make up the difference. For example, if the measured gap between WLTP and real-world performance in 2021 was 15%, and by 2025 this had grown to 20%, the manufacturer fleet average emissions would be uplifted by 5%, or the difference. They would therefore need to reduce their emissions by an additional amount in the laboratory or pay a penalty.

5. Conclusion

Basing car CO₂ regulations on laboratory tests has created substantial loopholes that carmakers have effectively exploited to substantially weaken 2020/1 targets. This paper has exposed that the introduction of the new WLTP test, rather than fixing the problems, is creating new loopholes that the car industry are planning to exploit to weaken 2025 and 2030 targets. The Commission proposal for post-2020 regulations completely fails to address this. At the heart of the problem is that laboratory tests still contain too much room for interpretation, meaning test results can be massaged upwards or downwards within the letter of the rules, such as by using declared values. This can be used to produce artificially low NEDC test results to help meet 2020/1 targets; and high WLTP values for 2021 to inflate the baseline on which the Commission's proposed percentage reduction targets for 2025/30 are based. The briefing shows that by measuring real-world fuel efficiency using fuel consumption meters or real-world tests - via a not-to-exceed limit - it is possible to reduce the manipulation of regulations. The Commission's own experts recommended such an approach but the Commission failed to follow through with concrete proposals. The annex to this paper proposes amendments that would close the loopholes. Co-decision makers in the European Parliament and Member States now need to finish the job by amending the proposals for post-2020 car and van CO₂ standards in the way suggested.

Further information

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Annex

Article 12 of the proposed regulation for post-2020 CO₂ standards for new passenger cars and light commercial vehicles should be amended as follows (in bold italics):

Article 12

Real world CO₂ emissions and energy consumption

1. The Commission shall monitor and assess the real world representativeness of the CO₂ emission and energy consumption values determined in accordance with Regulation (EU) 2017/1151. It shall ensure that the public is informed of how that representativeness evolves over time.
 - 1.a ***In order to ensure the representativeness of the CO₂ emissions and energy consumption values determined in accordance with Regulation (EU) 2017/1151, the Commission shall introduce a not-to-exceed (NTE) limit for each manufacturer to apply from 2025 onwards. The NTE limit shall be calculated as the average percentage difference between the manufacturer's specific CO₂ emissions measured at type approval and the average CO₂ emissions measured in real-world driving conditions of their passenger cars and light commercial vehicles sold in 2021.***
 - 1.b ***For the purposes of measuring the real-world driving emissions in line with the above paragraph, the Commission shall develop a real-world CO₂ emissions test by 31 December 2019 in order to supplement the procedures established under Regulation (EC) No 715/2007. Those measures shall be adopted by way of delegated acts in accordance with Article 16.***
2. ***As an alternative to 1.b above, manufacturers may use the averaged CO₂ emissions data from fuel consumption meters fitted to the passenger cars and light commercial vehicles in accordance with Regulation (EU) 2018/XXX (new WLTP 2nd act) and sold in 2021 in order to calculate the NTE limit to apply from 2025 onwards.*** the Commission shall ensure the availability, from manufacturers or national authorities, as the case may be, of robust non-personal data on real world CO₂ emissions and energy consumption of passenger cars and light commercial vehicles.
 - 2a. ***new The manufacturer shall ensure that the specific real-world CO₂ emissions of their vehicle types from 2025 do not exceed the NTE limit set pursuant to paragraph 1.a.. If the NTE limit is exceeded, the specific CO₂ emissions used for the purposes of compliance with this Regulation shall be adjusted upwards by the exceedance identified.***
3. The Commission may adopt the measures referred to in this Article by means of implementing acts in accordance with the examination procedure referred to in Article 15(2).