
Mind
the
GAP
2015

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Mind the Gap 2015

Closing the chasm between test and real-world car CO_2 emissions

September 2015

Summary

The system of testing cars to measure fuel economy and CO_2 emissions is utterly discredited. The gap between test results and real-world performance has become a chasm, increasing from 8% in 2001 to 31% in 2012 and 40% in 2014.[1] Without action this gap will grow to nearly 50% by 2020. On average, only one-third of the improvement in emissions claimed in tests has been delivered on the road since regulations were introduced in 2008. The claims of the car industry that they are making a disproportionate effort to reduce emissions compared to other sectors is fiction. Since 2012 the average emissions of new cars driven on the road have increased marginally.

Carmakers, not drivers, are the cause of the problem as obsolete official test results are being manipulated. Exploiting testing loopholes accounted for a gap of just 5 percentage points between test results and real-world performance in 2002. This grew to 15 points in 2010; and 24 points in 2014. Technology that reduces emissions more in the test than on the road contributes about 3 percentage points to the gap; the failure to switch on auxiliary equipment during tests added around 8 points.

Mercedes cars have the biggest average gap between test and real-world performance, with real-world fuel consumption exceeding test results by nearly half. None of the improvement in emissions measured in tests of Opel/Vauxhall cars since 2008 has delivered improvement on the road, and their real-world fuel economy is actually getting worse. Just a fifth of the apparent improvement in emissions from the launch of the Mark 7 VW Golf (Europe's best-selling car) have been achieved on the road.

Distorted test results deceive drivers who achieve much poorer fuel economy than is promised in glossy marketing materials, costing a typical motorist around €450[2] a year in additional fuel costs compared to what might be expected from official test results. The more money drivers spend on fuel the less is available to buy other goods and services, reducing growth and employment. By 2030, the widening gap will require drivers to cumulatively spend €1 trillion more on fuel and the EU to import 6 billion extra barrels of oil, worsening energy security and the EU's balance of payments. The distorted test results undermine EU regulations designed to lower CO_2 emissions, adding 1.5bn tonnes of CO_2 to the atmosphere by 2030 as a result of the widening gap, increasing the prospects of dangerous and uncontrollable climate change. They also reduce government car tax receipts, distorting sales in favour of the carmakers best able to manipulate tests rather than those making the most efficient cars.

On average, two-thirds of the gains claimed to have been made since 2008 when car regulations were introduced have been delivered through manipulating tests with only 13.3 g/km of real progress on the roads set against 22.2 g/km of 'hot air'. Without exploiting test flexibilities only Toyota would have met its 2015 target whereas on paper all the major carmakers have comfortably achieved their limits.[3] By manipulating tests the car industry has probably reduced

[1] ICCT, 2015, *From Laboratory to Road*

[2] €1.35/l, 20k kmpa, gap 31g/km 2013

[3] T&E 2015, How Clean are Europe's cars?

[4] Assumes 13 million sales per year

[5] Worldwide Harmonised Light vehicles Test Procedure

the costs of complying with the regulations by at least €7 billion. The bill for drivers in additional fuel will be five times this amount – around €35 billion.[4]

T&E tests and analysis from the ICCT indicate that for non-hybrid drive trains, it is possible to explain deviations up to 40-45% with factors currently known, including known test flexibilities. Mercedes cars have an average gap between test and real-world performance of 48% and their new A, C and E class models are producing a gap of over 50%. The BMW 5 series and Peugeot 308 are just below 50%. Such gaps do not prove the use of 'defeat devices' by any manufacturer. However, they do make it imperative to extend the scope of investigations into the use of this illegal technology to cover CO2 tests.

The proposed solution is to introduce a new global test, the WLTP[5] from 2017 but this will be only a partial fix. The gap between WLTP test results will still be 23% in 2020 (compared to 49% estimated for the NEDC test). But the gap will increase to an estimated 31% by 2025 as carmakers exploit flexibilities in the new test and sales of plug-in hybrid vehicles increase. The introduction of the WLTP will also require revisions to the 95g/km 2020/1 car CO_2 target to maintain equivalent stringency with the current system that uses the NEDC test. But the methodology proposed by the European Commission to do this accounts for unfair test flexibilities that increase by 10g/km the average correlation between measurements made on the WLTP test compared to the NEDC, effectively weakening the regulation through the back door. In effect the Commission is replacing a robust target (95g/km) and weak test (NEDC) with a weak target (c120g/km) and strong test (WLTP). The Commission, Member States and the European Parliament need to take a strong position on what are legitimate flexibilities for the purpose of assessing "equivalent stringency".

The robust implementation of WLTP must be complemented by measures to address serious weaknesses in the EU system of testing cars:

• Establishing a European Type Approval Authority to ensure tests are performed consistently and independently, preventing carmakers selecting their examiners;

• Testing production cars on the road for CO2 emissions in a similar way to the new tests being introduced for air pollution.

These changes would align the EU testing system with that in the US that is far more effective in identifying and addressing abuses of the tests.

To deliver real-world CO_2 improvements the Commission should also propose a 2025 car CO_2 target based on the WLTP test. This should be set at a level to ensure the existing 95g/km target for 2020/1 is delivered (on average) on the road by 2025. By 2021, emissions on the road will still be around 150g/km – a reduction of just 2g/km per year compared to the 4.5g/km per year envisaged in the regulation. This means there remain considerable opportunities to continue to improve efficiency using conventional technology.

The Commission also needs to bring forward proposals to ensure consumers are provided with more robust information about fuel economy and CO_2 emissions on the road as drivers cannot choose efficient vehicles based upon flawed data.

This report definitively shows current systems for vehicle testing of fuel economy and CO_2 emissions don't work and the proposed introduction of the new WLTP test seems likely to deliver limited and only temporary improvements. Systematic changes to the way cars are tested, regulated and taxed are needed to ensure cars are decarbonised on the road and not just in laboratories. The technologies to reduce emissions are available – what is missing is a robust policy framework to ensure these are delivered.

[4] Assumes 13 million sales per year
[5] Worldwide Harmonised Light vehicles Test Procedure

1. The widening gap between official CO_2 and fuel consumption data and performance on the road

The gap between official test results for fuel efficiency and CO_2 emissions and real-world performance on the road continues to grow rapidly.[6] The International Council on Clean Transportation (ICCT) analysed results for 600,000 cars across the EU from 11 different datasets to compare real-world fuel economy with official test results. The trend is consistent and for private motorists the gap has grown from 8% in 2001 to 36% in 2014. For company car drivers the gap is now even larger at 45%. The average gap is now 40% and has increased by 9 percentage points in the past two years alone – by far the fastest rate of increase to date. Official test results no longer have any credibility – the gap with real-world performance is now a chasm. The Spritmonitor data analysed by the ICCT showed that in 2001, 14% of drivers could match official test results for fuel economy but by 2014, practically nobody could drive their car this economically. At the other end of the spectrum, the least economical drivers now report using virtually twice as much fuel as the official figures suggest they should.

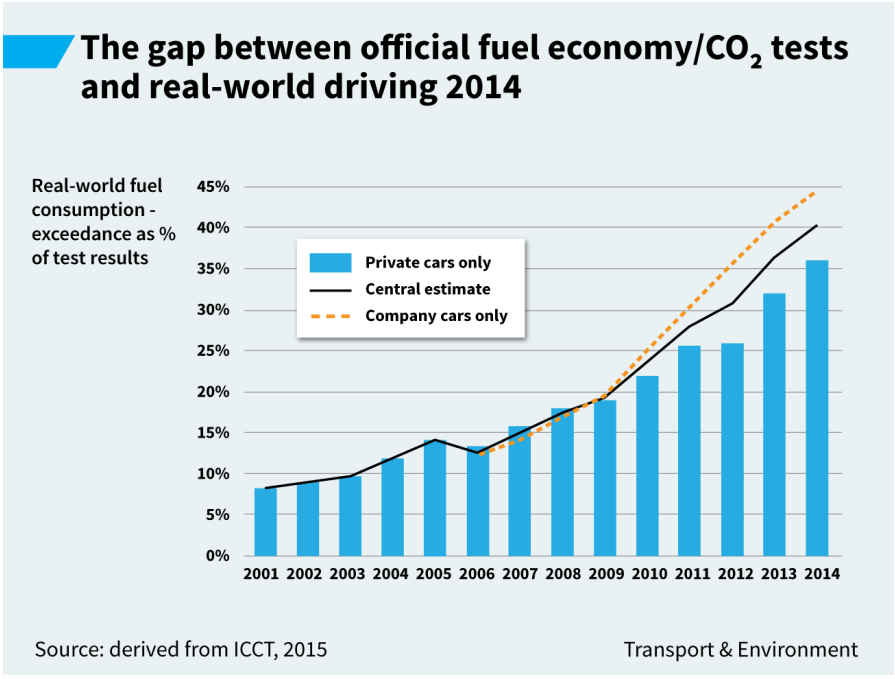


Fig 1: The gap between official fuel economy and CO_2 tests and real-world driving 2014 (derived from ICCT, 2015)

1.1. The causes of the widening gap

The ICCT[7] has examined the contribution of the widening gap between test and real-world results. The widening of the gap is not caused by the unrepresentative test cycle (as that has remained unchanged); nor by the way cars are driven (which does not appear to be significantly different). Instead it results from carmakers:

1. Increasingly exploiting loopholes and flexibilities in the testing procedure including "cycle beating" techniques to unfairly reduce emissions during a test
2. Deploying technology on cars that has benefits principally in the test but not on the road
3. Fitting increasing amounts of equipment to cars that is switched off during the test – such as air conditioning

The ICCT analysis has quantified the contribution of each of these elements to the widening gap. This included separating the use of flexibilities in the laboratory test and road load determination, which is used to configure the chassis dynamometer (rolling road) to account for air and rolling resistance. Figure 2 illustrates the contribution of each flexibility in different years and test cycles. The overall estimated gap corresponds closely to the top-down estimates from real-world emissions data described above.

[6] http://www.theicct.org/laboratory-road-2015-update

[7] ICCT, 2015, *Quantifying the impact of real-world driving on total CO_2 emissions from UK cars and vans*, for UK Committee on Climate Change

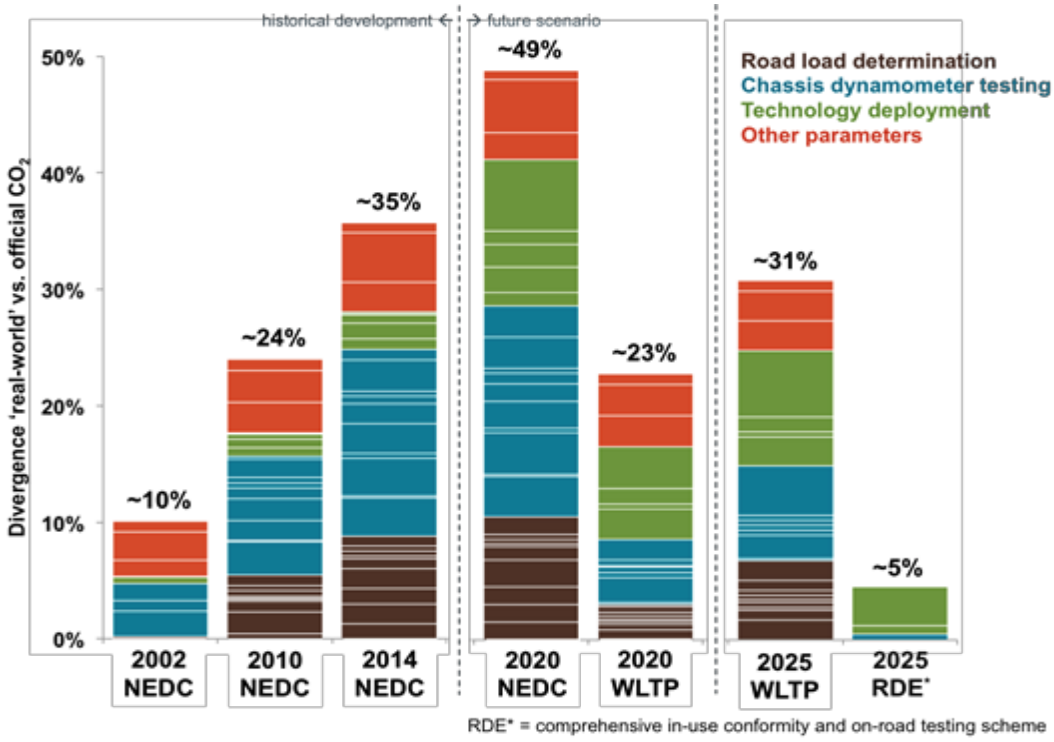


Fig 2: Causes of the gap between CO_2 test results and real-world driving

The ICCT estimate test flexibilities in 2002 contributed 5 percentage points to the divergence between test and real-world results. By 2010, this had grown to 15 percentage points; and by 2014, 24 points. In contrast the effect of technology that overperforms in the test is still relatively low at around 3 percentage points; and auxiliary equipment increased slightly from around 5 to 8 percentage points. Test flexibilities are now the dominant cause of the growing gap. The ICCT has forecast that all the test flexibilities currently deployed will continue to increase to 2020 if the NEDC procedures continue to be used, reaching 49%.

ICCT's work also suggests that the real-world discrepancy for hybrids is even greater than for conventionally-engined cars, and may well be even more so for plug-in hybrids. This reflects particularly favourable testing assumptions under the NEDC, but also a lack of understanding about how hybrids will be used in future, and how and when plug-ins will be recharged. Expert opinion suggests that the assumptions made for hybrid vehicles under the WLTP will substantially reduce the size of the real-world gap, but it is likely that further work will be needed to reflect the actual on-road use patterns of hybrids as this market develops.

The introduction of the WLTP test will reduce, but far from eliminate, the gap between test and real-world, indicating that this is only part of the solution. Once introduced there will continue to be a divergence between the WLTP test and real-world performance of around 23% in 2020. This is mainly due to the inappropriate test procedures for plug-in hybrid vehicles. However the contribution to the gap from testing flexibilities in WLTP will fall to around 10%. There is also a strong likelihood that manufacturers will then begin to exploit new flexibilities in the WLTP procedure. By 2025 the gap between WLTP and real-world performance is expected to have increased again to around 31% – only marginally better than the current position. Three key conclusions can be drawn from the analysis:

1. The widening gap since 2008 when regulation was introduced is mainly due to the way tests have been manipulated;
2. The gap will keep growing – largely due to the increasing share of plug-in and hybrid cars that have a particularly wide gap;
3. The WLTP will not entirely resolve the issue of a large and growing divergence between test and real-world conditions – although it will help.

2. Why test manipulation must be stopped

Official figures on new car fuel economy and CO_2 emissions[8] show steady progress year on year from 2008 (when regulations were introduced). This is represented by the solid blue line in Figure 3. If the gap between these official figures and real-world results had remained as it was in 2008 there would have been a corresponding improvement from over 180 g/km to nearly 145 g/km in real-world emissions as well (the dotted blue line in Figure 3).

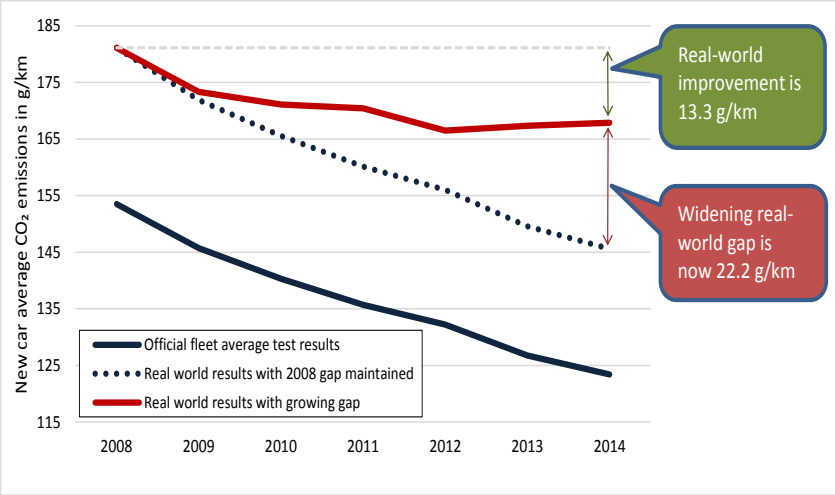


Fig 3: Official CO_2 test results *versus* the real-world outcomes in 2014 for private motorists (derived from ICCT, 2015 and EEA official CO_2 data)

Instead, this progress on paper was accompanied by a marked and rapid increase in the size of the gap between test and real-world emissions (see Figure 1). Combining these two trends using the ICCT data for private motorists (a more conservative estimate of the size of the gap) shows that a good improvement in 2009 has been followed by slowing progress ever since. The net result is that nearly two-thirds of the gains claimed to have been made since 2008 have been purely theoretical ones, with only 13.3 g/km of real progress on the roads set against 22.2 g/km of 'hot air' caused by carmakers' manipulation of the test procedures. The red line on the graph also illustrates that since 2012 real progress has stagnated completely, and may have gone into reverse. The lack of real progress is important for four main reasons:

- Fuel is the biggest cost of running a car and drivers are not getting the benefit of the fuel economy that they have been promised. Projecting forward to 2030 the cumulative additional fuel consumption arising from the widening gap will be nearly 600 billion litres[9] costing motorists around €1 trillion.[10]
- More oil is imported into Europe – by 2030, because of the widening gap, 6 billion additional barrels of oil must be imported into Europe costing €360 billion at current prices,[11] with a large proportion of this going to Russia;[12]
- CO_2 emissions are significantly raised. The Car CO_2 Regulation is a major plank of the EU's climate policy, and has been rendered much less effective by the manipulation of the test procedure. As a

[8] http://www.transportenvironment.org/publications/how-clean-are-europe%E2%80%99s-cars-2014-%E2%80%93-part-1
[9] 13k km pa; 2.481kgCO2/l; assumes the gap grows to 50% by 2030 and 225k km lifetime mileage
[10] €1.6/l
[11] $50bbl
[12] $60/bbl; 55% road transport fuel per barrel.

result, by 2030 the widening gap will cause 1.5bn additional tonnes of CO_2[13] compared to if the gap had remained at 15% in 2008;

- If car buyers cannot get reliable information about fuel economy, they cannot make informed choices about the cars they buy. Drivers and the media are increasingly aware of the growing discrepancy between labelled fuel economy and what happens on the road, leading to a loss of credibility for the whole of the EU's car labelling and regulatory system. This is not in the interests of consumers, policymakers or the environment – and ultimately not of the car industry either.

VW claims[14] each gram of CO_2 emissions it is required to reduce by costs it €100 million.[15] On this basis VW alone has saved around €1.7 billion by test manipulation and, by extrapolation, the entire car industry has saved at least €7 billion. This cost is met by carmakers' customers who as a result are paying on average around €2,800[16] for additional fuel that is being burned over the lifetime of the car. In one year the cumulative cost of additional fuel consumed by newly manufactured cars is around €35 billion.[17] Carmakers are effectively cheating their own customers. VW's figures show the costs of making cars more efficient is five times less than the cost of the additional fuel that will otherwise be burned.

Assuming by 2021 the gap has grown to 50%, the cumulative additional cost of fuel that motorists are required to buy as a result of test manipulation will amount to nearly a trillion euros in 2030 – oil the EU must import, damaging balance of payments and lowering growth as the expenditure on oil reduces expenditure and jobs in their sectors. Carmakers' manipulation of tests is therefore also damaging the EU economy. Society also pays a price for carmakers achieving targets by manipulating tests. The cumulative CO_2 emissions arising from test manipulation by 2030 are estimated to be about 1.5 billion tonnes. Test manipulation is increasing the risk of dangerous climate change.

3. Features of the widening gap

3.1. How much of the claimed improvement is actually achieved on the road?

An expert study for the European Commission[18] and a report by T&E[19] demonstrates the many ways carmakers are able to manipulate test results (Figure 8). By testing a 'golden vehicle' and creative interpretation of the test procedures, carmakers are able to achieve multiple small improvements that lower the test results. Cars tested using the official procedure without utilising flexibilities or specially preparing the car produce results 19-28% higher than type approval values.[20]

[13] 225k km lifetime mileage; 2.481kg CO2/l

[14] http://www.reuters.com/article/2014/10/02/autoshow-paris-carbon-idUSL6N0RX5S520141002

[15] VAG sells about 3 million vehicles in Europe each year. A cost of €100 million is therefore equivalent to an average of €30 per gram per vehicle. Reducing emissions by 35g/km to meet 95g/km will therefore cost about €1,050 – very similar to the estimate of the European Commission.

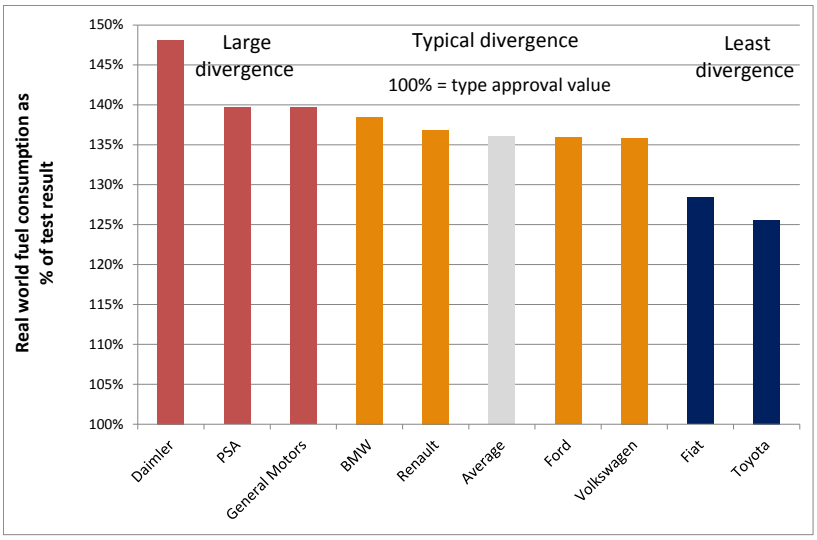
[16] Assumes the gap remains at current levels; fuels costs €1.6/l; 250,000km vehicle lifetime.

[17] Assumes 13 million sales per year

[18] TNO 2012, Supporting Analysis regarding Test Procedure Flexibilities and Technology Deployment for Review of the Light Duty Vehicle CO_2 Regulations: Note on options for reducing test cycle flexibilities, Framework Contract No ENV.C.3./FRA/2009/0043, European Commission DG Clima, Brussels

[19] T&E 2013, Mind the Gap

[20] TNO 2012a, Road load determination of passenger cars, TNO report TNO 2012 R10237, Delft



All carmakers have been exploiting ever more flexibilities in the current official tests during 2013 and 2014, but detailed results from Spritmonitor in Germany (Figure 4) show that cars produced by Daimler, PSA and GM exhibit the largest real-world gaps, around 40%. However, in the past two to three years *all* major carmakers (with the possible exception of Fiat) have become more adept at using flexibilities in the tests such that all carmakers now have an average gap of 25% or more (as against a maximum gap of only 10% in 2001).

3.2. The gap for specific car models

ICCT also analysed the gap between test and real-world performance of a growing range of individual car models on the basis of Spritmonitor data from Germany. The results for major models based upon 2014 data are illustrated in Figure 5. This shows there are substantial variations in the size of the real-world gap, both between manufacturers and between individual models produced by each manufacturer. Only for Mercedes do all the main models exceed a 50% exceedance of real-world fuel consumption over the test results: for others it is less and sometimes much less, but still quite variable between different car models. The data is striking for two reasons:

Fig 4: Difference between manufacturers test results and average real-world driving in 2014 (derived from ICCT, 2015)

1. It indicates there is considerable opportunity for most carmakers to achieve an even bigger gap in the future by exploiting all flexibilities on all models;
2. It shows test flexibilities are massively distorting the car market since competing vehicles have widely varying gaps and are therefore marketed and taxed on a completely unfair basis.

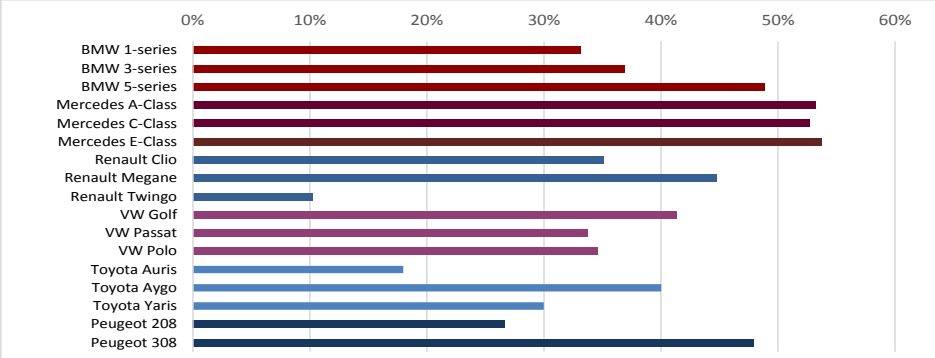
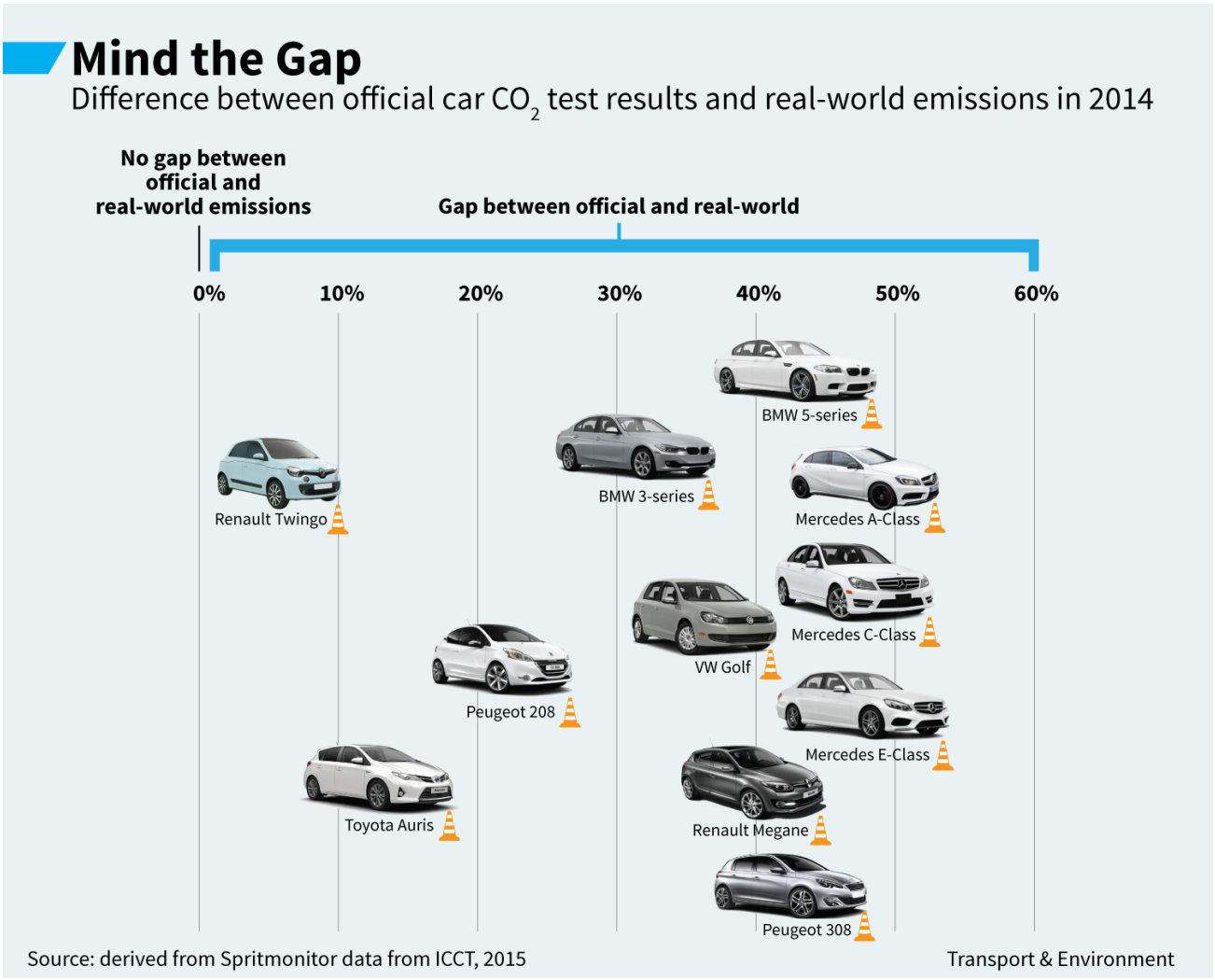


Fig 5: Real-world 'gap' for most popular car models in 2014 (derived from Spritmonitor data from ICCT, 2015)



Analysis of the growing gap over time shows that the date of recent model upgrades (when type approval tests are usually updated) resulted in large increases in the gap between test and real-world performance as shown in Figure 6. For example, the average gap for the VW Golf jumped from 22% in 2012 to 41% in 2014, coinciding with the launch of the Mark 7 at the end of 2012. Similarly, the gap for the Mercedes C Class rose from 37% to 53% from 2013 to 2014, seemingly on the launch of the latest version, the W205, in 2014. The new Renault Clio IV came onto the market at the end of 2012, and its real-world gap duly rose substantially from 19% in 2012 to 34% in 2013.[21]

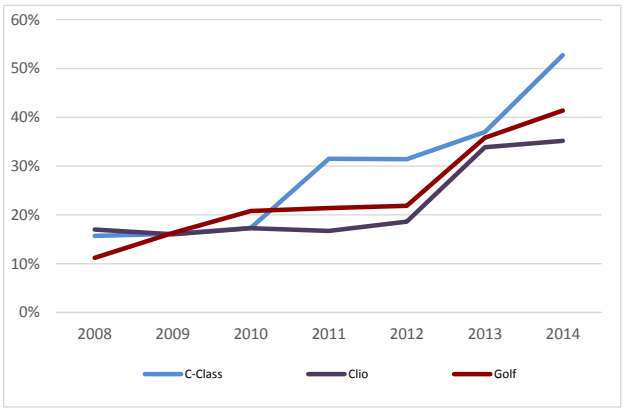


Fig 6: Change in average real-world driving 'gap' over time for three selected models (derived from ICCT, 2015)

Combining the changing gap with the reported improvements in official average CO_2 over the same period, the VW Golf analysis (left part of Figure 7, below) shows the growing gap size is almost a perfect mirror image of the improvement in the reported average test CO_2 emissions. As a result, the apparent improvement in fuel economy has been largely illusory, with real emissions reduced by less than 5 g/km (the solid red line), rather than the 23 g/km suggested by the official test results in

[21] These results are based upon Spritmonitor data

the solid blue line. The figure on the left shows an almost identical pattern for the Renault Clio, although the net improvement calculated for real-world emissions is slightly greater in this case.

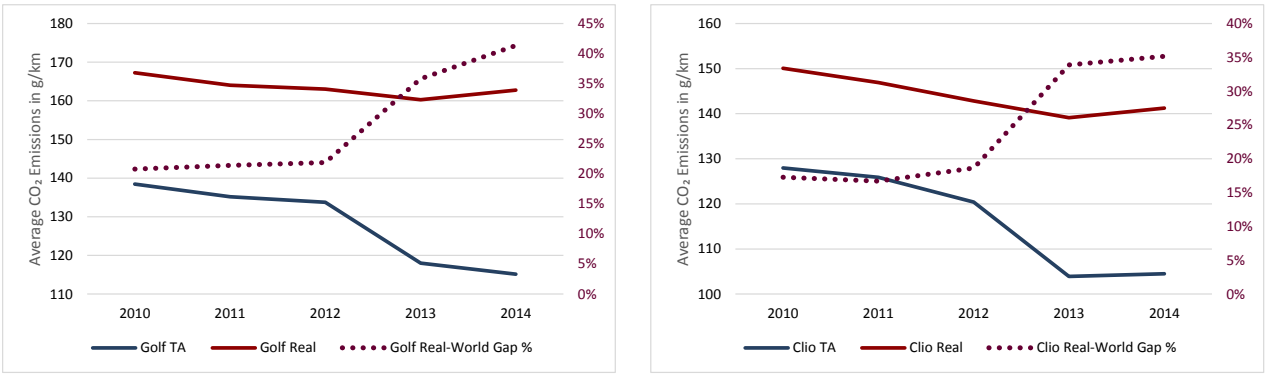


Fig 7: Change in average real-world driving 'gap' over time set against improvement in reported test results for the VW Golf and Renault Clio

It should be stressed that these two models were highlighted because both are popular and well-known, and as a result we have a good sample size to estimate the real-world gap reliably: it is not implied that they are any worse (or better) than any other new models coming into the market.

In 2013, six modern (Euro 5 and 6) cars were tested on behalf of T&E. The tests repeated official CO_2 tests using the current NEDC test cycle and procedures on six new (Euro 5 and 6) vehicles without exploiting test flexibilities. The tests produced results 19-28% higher than the official test results (average 23%). This suggests a gap of up to 30% can be explained through manipulating test procedures as illustrated in Figure 8 and illustrated in Figure 2 (that independently arrives at a similar figure). But some individual car models are now producing a gap between test and real-world performance of 50% or more. Such large gaps cannot be explained through known test flexibilities and suggests another reason – such as, for example, the use of a "defeat device" intended to produce artificially low test results by modifying the way the engine operates. This is entirely plausible; some cars are now equipped with "eco-modes" that alter the way the engine performs at the choice of the driver. A "defeat device", which detects a test is being conducted, could therefore be used more widely than exposed recently in by the Volkswagen scandal. The scope of investigations to determine the extent to which "defeat devices" are in use should be extended to cover CO_2 tests.

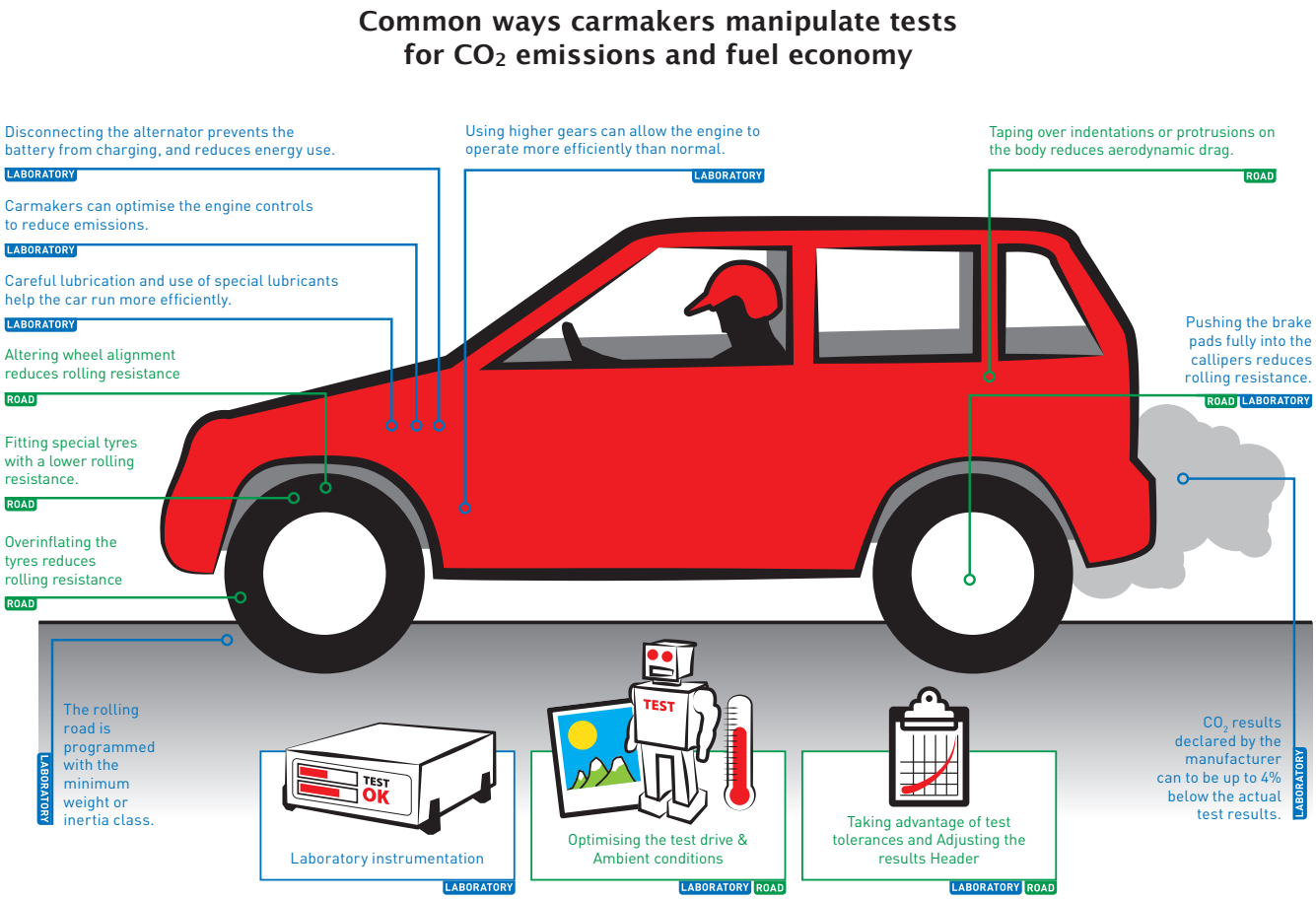


Fig 8: Common ways carmakers manipulate tests for CO_2 emissions and fuel economy

3.3. The gap for specific engine types

The ICCT data also provide estimates of the different size of the gap for different engine/fuel configurations.

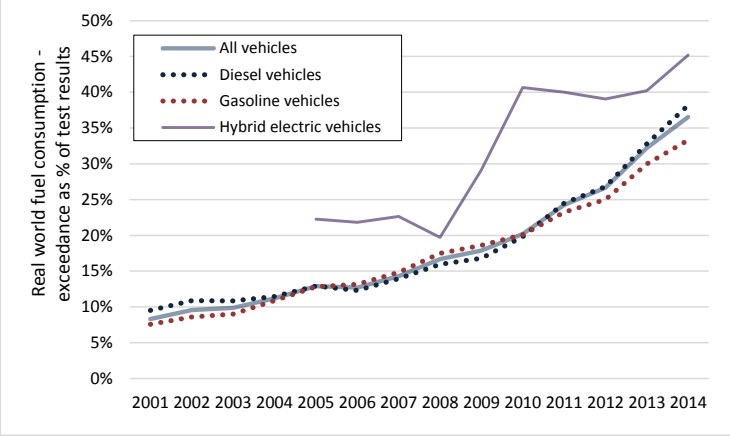


Fig 9: Size of the real-world gap for different engine/fuel types

For petrol and diesel, Figure 9 illustrates that the relative gap size has changed over time. In the early 2000s, diesel vehicles exhibited a larger real-world gap than petrol. This situation reversed around 2005 but then switched again after 2010, since which time diesels have been showing a steadily growing excess relative to petrol cars – growing to 5 percentage points, with the average gap for petrol engines 33% but that for diesel 38%. This is important, because over the same period the supposed CO_2 advantage of diesel as measured in the new car test results has been shrinking to virtually nothing, reaching approximately 123 g/km (for diesel) against 126 g/km (for gasoline) in 2014. If the growing gap is factored into the analysis, real-world CO_2 emissions of all the diesels sold in 2014 was

170 g/km, and that of petrol only 168g/km – a gap of more than 2 g/km in favour of petrol. While this is in part the result of differences in market segmentation (more, larger diesel cars) it illustrates that the real-world benefits of diesel are less than claimed relative to gasoline cars.

Sales of hybrid vehicles are relatively small and still developing, so it is difficult to draw firm conclusions from the rather erratic time track of gap size to date shown in Figure 9. Nonetheless, it seems clear that the gap is consistently larger for all hybrids, and early indications suggest that the same is particularly true for plug-in hybrids. It is essential that test procedures are updated with more realistic use cycles and procedures for these vehicles.

3.4. How much of the claimed improvement is actually achieved on the road?

T&E has reanalysed the latest Spritmonitor data to compare how much of the improvement in emissions claimed by the main manufacturers between 2008 and 2014 has actually been delivered on the road (Figure 10). There are substantial differences between carmakers with GM's emissions actually increasing on the road (and hence the negative index); while less than 20% of the progress reported by Daimler is achieved on the road. In contrast Fiat and Toyota have improved their real world performance in recent years and continue to deliver more than two-thirds of their claimed improvements on the road.

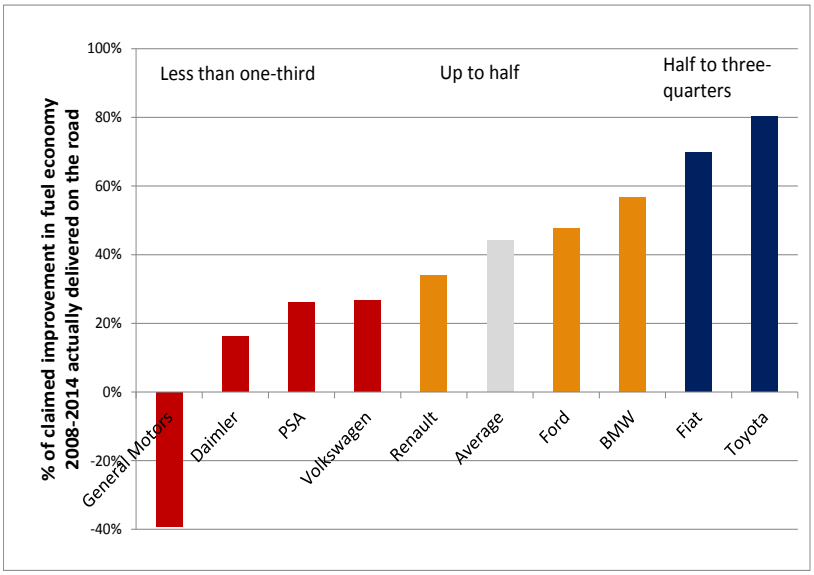


Fig 10: Percentage of the actual improvement in emissions 2008-2013 realised on the road

3.5. How much progress would be made towards 2015 targets without test flexibilities?

All the major carmakers have comfortably achieved their 2015 CO_2 targets according to official test results.[22] But T&E has reanalysed the data to assess whether carmakers would still be on track to achieve their 2015 targets on the road *without exploiting test flexibilities.* On average, two-thirds of the gains claimed to have been made since 2008 have been through using test flexibilities with only 13.3 g/km of real progress on the roads set against 22.2 g/km of 'hot air'.

Analysis of what progress carmakers would have made towards achieving their targets if their real-world gaps had remained at the level in 2008 shows only Toyota would still meet its target without abusing test flexibilities. It is therefore entirely possible to achieve the regulatory targets on the road without manipulating test results excessively – but now almost all companies appear to be relying heavily on measures that help then to achieve their targets in the laboratory but not on the road, rather than delivering truly more efficient vehicles.

[22] T&E 2015, How Clean are Europe's cars?

4. Policy conclusions

4.1. Solution 1 – Robust introduction of the WLTP test

A new global testing system (the World Light Duty Test Cycle and Procedures – WLTC/P) has been under development at the United Nationals Economic Commission for Europe (UNECE) for many years and will be finalised in Autumn 2015. This test cycle is more representative of real-world driving and the test procedures are more robust when compared to Europe's NEDC.[23] The European Parliament[24] and European Commission have proposed this new test be introduced in 2017 and this is essential to prevent carmakers continuing to manipulate the obsolete NEDC test.[25]

The introduction of WLTP requires the 95g CO_2/km average target for new cars in 2020/21 to be modified because this is based on the NEDC test. The approach proposed by the European Commission to correlate between the NEDC and WLTP tests is to use a computer simulation tool.[26] The proposal is that from 2017 CO_2 measurements are conducted using the WLTP test. In addition the simulation tool will derive an NEDC equivalent CO_2 value for each car sold. In 2020 all new cars registered will have both a WLTP measured CO_2 value and simulated NEDC equivalent. From this it will be possible to calculate the average CO_2 emissions for each manufacturer based on both measured and simulated values. The simulated values will be compared to the present company targets to assess compliance with regulation. It will also be possible to derive a WLTP equivalent target for use after 2020 (based on the measured WLTP value and ratio of the NEDC simulated average CO_2 value and the company NEDC target).

How the simulation tool operates fundamentally affects the assessment of compliance with regulations and setting equivalent WLTP-based targets. Which flexibilities in the NEDC procedure are allowed for by the simulation tool will therefore significantly influence the stringency of the regulation. The Commission has committed to ensuring "equivalent stringency" between the current NEDC based targets and new WLTP target but is interpreting this to mean every flexibility in the NEDC test is included in the correlation method and new WLTP-based targets, effectively weakening the regulation. Analysis by the ICCT[27] and T&E shows legitimate differences between the NEDC and WLTP test cycle and procedures are leading to a 10g/km difference between the two tests. But the Commission and some Member States want to include three unfair abuses of the NEDC test procedure that will increase the average correlation by an additional 10g/km thereby weakening the regulation. The unfair flexibilities are:

1. **Wrongly setting the rolling road (using inertia classes)**
   Modern chassis dynamometers (rolling roads) are programmed with the inertia of the vehicle and computer-controlled. Traditionally "dynos" were mechanical devices and relied upon adding physical weights forming inertia classes. The system of inertia classes became obsolete when mechanical dynos were replaced but carmakers continue to use the approach in order to artificially lower the inertia weights in the tests, thereby producing test results about 4% lower.

2. **Externally charging the battery**
   The NEDC test has no specific rules about charging the starter battery. This omission is exploited by manufacturers to externally recharge the battery fully prior to every NEDC test. This gaming reduces CO_2 during the test by negating the need to use the engine and alternator to maintain the battery charge. This lowers the test result by about 2%.

[23] New European Drive Cycle – the current obsolete test
[24] http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2012/0190(COD)&l=en
[25] ACEA 2013, ACEA views on COM paper "Options for Correlating CO2 Emission Targets"; WLTP TWG Correlation, 18 December 2013
[26] European Commission, 2015, DISCUSSION PAPER – NEDC/WLTP CORRELATION METHODOLOGY; Expert Group on CO2 emissions from light duty vehicles, meeting May 2015.
[27] http://www.theicct.org/wltp-how-new-test-procedure-cars-will-affect-fuel-consumption-values-eu

3. **Deducting 4% from measured results**
   Bizarrely the NEDC procedure allows carmakers to actually declare (use) a value 4% lower than the one measured. The provision is designed to minimize the testing burden but is being abused by carmakers to declare lower test results systematically.

Including these illegitimate differences in the test would increase the difference between the simulated NEDC and measured WLTP test by a further 10 g/km – effectively weakening the regulation through the back door.

Other ways the correlation exercise is also proposed to unfairly benefit vehicle manufacturers is by continuing with the NEDC test as the basis for earning supercredits and allowing additional credits to be earned. The Commission has proposed to continue to use the NEDC test for assessing whether emissions are below 50g/km and qualify for supercredits. As noted above, the NEDC test is particularly inappropriate for plug-in hybrid vehicles. For example, the most popular plug-in vehicle in the EU (Mitsubishi Outlander) has emissions of 49g/km measured by the NEDC test but three times higher than this on the road. The WLTP test is more but not fully representative. Manufacturers and the German authorities argue that as the WLTP equivalent targets are higher they should be allowed more supercredits to compensate. The Commission has acceded to this demand in the way supercredits will be taken into account for WLTP equivalent targets.

At present there is a robust target (95g/km) and weak test (NEDC). With the correlation there will effectively be a weak target (equivalent to 120-124g/km) and strong test (WLTP).

The Commission, Member States and the European Parliament need to take a strong position on what are legitimate flexibilities for the purpose of assessing "equivalent stringency".

4.2. Solution 2 – Strengthening the testing framework

The problems with the NEDC test have been exacerbated by a number of serious failings in the overall framework by which vehicles are tested. These include:[28]

1. That carmakers test prototype or pre-production cars that are unrepresentative of production vehicles and have been specially prepared to produce very low test results;
2. There are no effective checks to ensure that vehicles actually sold achieve similar results to those of the tested vehicles;
3. Carmakers pay the Type Approval and Testing Services that oversee the test and usually perform these in their own laboratories. Since the organisations overseeing the test are in competition with other testing organisations across Europe they are not sufficiently independent or demanding in terms of scrutinising how the test is performed;
4. During the test, energy-hungry accessories such as air-conditioning, navigation and media systems, and heated screens and seats remain switched off, thereby giving lower test results than would be found in real-world conditions.

These issues will not be addressed by the introduction of the WLTP but must be to reduce future systematic abuse of the tests.

[28] http://www.transportenvironment.org/publications/mind-gap-why-official-car-fuel-economy-figures-don%E2%80%99t-match-reality

In the US, Hyundai-Kia, Ford, Mercedes and recently BMW-Mini have all been caught by the US Environmental Protection Agency (EPA) providing incorrect fuel economy information. Some have been required to compensate drivers, and huge fines have been levied where wrongdoing was clearly apparent. The US system works because there is an effective system of checking test results and accurate fuel economy information. In the US the focus is on surveillance testing of sold vehicles to ensure these comply with regulations. In the EU the focus is on initial Type Approval, which is more open to abuse.

The USEPA is still strengthening its system of oversight and plans to issue revised guidelines clarifying how automakers should conduct the testing, and to continue more intensive audits of the carmakers' own tests. It conducts its own random retesting programme at its laboratory at Ann Arbor, and also checks the test results on models for which it receives a significant number of complaints from motorists. Overall it has increased the share of audits of manufacturer test results, to the extent that 15-20% of models are now retested by the EPA. At the start of 2015 the EPA issued revised rules for the conduct of coastdown tests. It may also require manufacturers to verify their own pre-production test results using production models[29]. The EPA response is proactive and comprehensive in contrast to the slow and piecemeal progress in the EU.

The European system could be improved by:

- Establishing a European Type Approval Authority to ensure tests are performed consistently and independently and end the market in which testing services compete to offer carmakers the most highly optimised service. This could be a part of the proposed European Roads Agency that is intended to improve enforcement of freight transport rules. By levying a charge of €20 per vehicle sold the Authority could be funded and the contractural link between the manufacturers and testing organisations broken;
- Strengthening the system of conformity of production checks to ensure production cars match emissions measured during type approval. This should include tests performed on the road using Portable Emissions Monitoring Systems (PEMS) to extend the air pollution emissions tests. These tests, which could include approaches to normalise the data to account for different routes and driving conditions, should require road and laboratory test results to be within a given margin of tolerance;
- Requiring increased surveillance and in-service conformity checks to ensure vehicles continue to perform on the road in a similar way to models being type approved for a minimum of 100,000 km.

Carmakers should not be allowed to select their examiners. Testing services and national type approval authorities should not be directly contracted by carmakers.

4.3. Solution 3 - A Commission proposal for a 2025 CO_2 target

The failure of the current testing system makes setting a 2025 car CO_2 target essential. This is because if the Commission's current proposal for the introduction of WLTP is accepted by Member States and the European Parliament, unfair test flexibilities will continue to be accounted for even after the introduction of the WLTP test until a new regulation is adopted.

In practice only a third of the measured improvement in emissions delivered through regulation has been achieved on the road. This has created a huge benefit for carmakers who in practice have been able to deploy much less technology on vehicles to achieve their targets, saving an estimated €7 billion in costs.

[29] http://www.autonews.com/article/20141018/OEM11/310209867/epa-plans-more-scrutiny-of-mpg-tests

As Figure 11 illustrates, by 2020/1 emissions on the road will still be around 150g/km – a much more modest on-the-road reduction in overall emissions than was envisaged when the regulation was adopted when the then gap indicated emissions of around 110g/km on the road by 2020. There is therefore a significant opportunity to continue to reduce emissions using conventional technology.

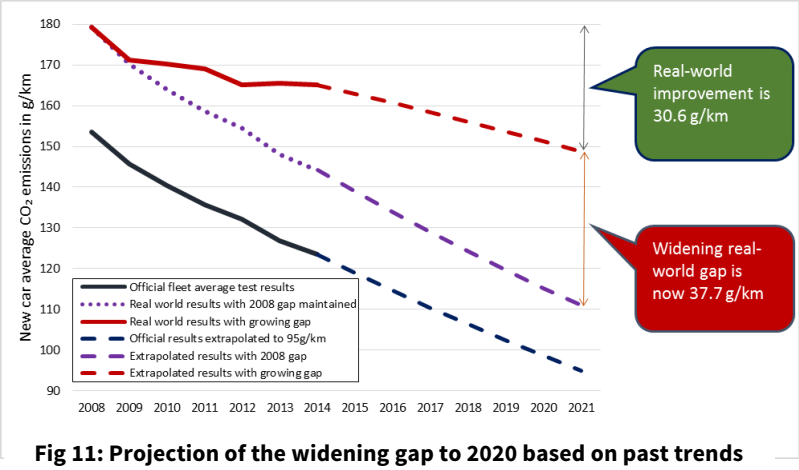


Fig 11: Projection of the widening gap to 2020 based on past trends and bottom-up analysis

If carmakers are successful in delaying post-2020 targets, emissions will not begin to fall on the road until after 2025. This creates a significant risk that 2030 climate goals will be missed. It is therefore essential to set a 2025 target measured using the WLTP test. This should be set at a level to ensure the existing 95g/km target for 2020/1 is delivered (on average) on the road by 2025. Such a target makes beginning to close the still widening gap before 2021 essential.

The new regulation should be based upon the WLTP test but should also be designed in a way to ensure a similar rate of real-world improvement. Figure 2 illustrates that the introduction of the WLTP test in not a panacea. Although it is likely to result in the gap between test and real-world performance being reduced from around 50% to 23% the gap will continue to widen again after the introduction of WLTP. By 2025, the ICCT estimates (Figure 2) it will be 31% higher than the test average if there are not specific interventions to prevent this. There are three primary reasons:

1. Carmakers will learn how to optimise the WLTP test and will utilise these new and additional flexibilities. Section 4.3 outlines ideas to prevent this;
2. Cars will be fitted with different "driving modes" including an eco-mode that is more fuel-efficient, but may be less attractive to use in other respects. There is a danger that tests will exaggerate the use of this eco-mode compared to real driver choices on the road;
3. The real-world performance of plug-in hybrid vehicles will be significantly poorer than the WLTP test result.

There needs to be a concerted effort by carmakers, the Commission and Member States to ensure the gap between test and real-world performance is not allowed to grow both before and after the introduction of the WLTP test. This requires a number of policy interventions that could include:

- Taking account of auxiliary equipment that is not switched on during the test;
- More effective driver awareness of the impact of driving styles on emissions – particularly for business drivers that have a higher gap than private motorists;
- Higher fuel taxes – to compensate for low oil prices – and encourage more efficient driving;
- An end to the production of ever higher performance cars that encourages excessive acceleration and higher emissions;
- Better enforcement of speed limits – such as by using connected vehicle technology, or automated cameras;
- Tax incentive schemes to encourage users of plug-in hybrid vehicles to recharge their vehicles frequently. This could initially apply to company car tax schemes;

- Taxing vehicles based upon their average emissions *in use*. With technology to constantly monitor fuel consumption this is now practicable. A higher rate of circulation or company car taxation or a supplementary tax bill for drivers with a particularly wide gap between test and real-world performance would act as a powerful incentive for drivers to moderate their driving style and companies to train their drivers.

These proposals are complementary to those in Section 4.2 addressing the inadequate testing framework. The new 2025 regulation also needs to ensure any widening gap between test and real-world performance can be accounted for through a strengthening of the target if it is demonstrated the new target is being met, in part, through new test flexibilities. The regulation could also be designed in a way to discourage fitting of technology that performs significantly better in tests than on the road. This would be through a system of eco-debits that increases the official CO_2 emissions of vehicles fitted with specific over-performing technologies in the same way eco-innovations give additional allowances to vehicles fitted with technology that improves emissions more on the road than during tests. Consideration could also be given to requiring a minimum level of eco-innovations to ensure on the road emissions in addition to those in tests.

4.4. Solution 4 – A Commission proposal to improve consumer information

The Commission also needs to bring forward proposals to ensure consumers are provided with more robust information about fuel economy and CO_2 emissions. Figure 2 illustrates that WLTP test results for fuel consumption are estimated to be about 23% lower (in 2020) than are typically achieved in real-world driving; and this gap is forecast to grow. Drivers will not be motivated to buy the most fuel-efficient vehicles if the official data is not considered representative. Proposals to reduce the gap (described in the sections above) are unlikely to ever completely align test and average real-world performance. The Commission should therefore examine how to produce an adjustment factor that can be used for the purposes of vehicle labelling, advertising and potentially vehicle taxes levied by EU Member States.

Such a factor should aim to represent average emissions as indicated by real-world databases such as Spritmonitor. It should certainly account for emissions arising from the use of auxiliary energy demands on the vehicle such as lights, air conditioning and heating; and the likely increasing use of test flexibilities. For plug-in vehicles it will need to accurately represent the average balance of driving performed on the electric motor and combustion engine. It might also reflect the very different road, driving and climatic conditions in each Member State which have an effect on real-world fuel consumption.

The update to the obsolete Car Labelling Regulation[30] should encompass online information and ensure information is easily understandable for car buyers. It should ensure comparisons are on a absolute emissions basis and benefits in terms of lower running costs are emphasised.

4.5. Solution 5 – An investigation into the use of defeat devices to distort CO_2 tests

The data presented on the gap between test and real-world performance for some individual models is suspicious. T&E testing and work by the ICCT suggests a gap of 30% can be achieved through test manipulation – but some models now achieve gaps much more than this, over 50%. Such a large gap cannot be explained through known test manipulations and suggests another cause; such as, for example, a technology being used to artificially lower the test results – a "defeat device" intended to produce artificially low test results by modifying the way the engine operates. The largest gaps are observed on Mercedes A, C and E class vehicles, the BMW 5 series and Peugeot 308. The scope of investigations to determine the extent to which "defeat devices" are in use following the Volkswagen scandal should be extended to cover CO_2 tests beginning with these models.

[30] http://ec.europa.eu/clima/policies/transport/vehicles/labelling/docs/directive_en.pdf