Summary table of parameters contributing to the real-world CO_2 emissions gap
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General remarks:
-- The objective of this table is to summarize the various influencing parameters which contribute to the 'gap' between type-approval and real-world CO_2 emissions of the new vehicle fleet in Europe.
-- The list of parameters below might not be complete and the quantitative estimates provided might not be fully accurate, but given the level of information available they provide a best-guess estimate based on literature data as well as vehicle testing experts' feedback.
-- The estimated contribution of each parameter is expressed in percentage points of the overall gap (for example, if the overall gap is 30% and parameter A has an effect of 2%, it means that the remaining 28 percentage points are caused by other parameters than A); for aggregating, the influences of each factor are multiplied to result in an overall estimate.
-- Some parameters might have a constant effect in absolute terms but are increasing in percentage terms because of the overall reduction in CO_2 emissions for new vehicles (for 2002 an average real-world CO_2 emission value of 182 g/km is assumed, for 2014 162 g/km [see Figure 27: ICCT, 2014a]).
-- For the scenario "2025 with CO_2-RDE^{pro}" it is assumed that there will be a comprehensive in-use conformity testing of randomly selected production vehicles, plus CO_2 on-road testing and/or a real-world adjustment factor

Estimated contribution to real-world CO_2 emissions gap of the EU new vehicles' fleet

Parameter	Description	General estimate	2002	2002	2010	2010	2014	2014	Δ2002-2014	Δ2002-2014	2020 without WLTP			2020 with WLTP			2025 with WLTP only			2025 with CO_2-RDE^{pro}			UK specific estimate			PC-S	PC-S	PC-M	PC-M	PC-L	PC-L	LCV	LCV	
Use of flexibilities in the test procedure																																		
Road load determination																																		
Tyre selection	According to regulation, for NEDC type-approval testing, the 2nd worst tyre on offer for a vehicle model has to be used (if more than 3 different tyre versions are on offer). However, independent test data suggests that the rolling resistance of tyres typically used for type-approval testing is significantly lower than the resistance of tyres of vehicles of offer and vehicles in the fleet. With respect to tyre selection, experts suggest that there is a lack of enforcement, thereby allowing vehicle manufacturers e.g. to select narrow, A-label tyres for type-approval testing while selling a set of tyres with a higher resistance to customers. In addition, customers might opt to replace the original tyres with e.g. winter tyres, thereby further increasing the gap between type-approval and real-world CO_2.	More than 50% of tyres sold in the EU in 2014 were of label efficiency category 'E' or worse, only about 10% of tyres were of category 'B' or better [tyre industry data, analyzed by ICCT]; the CO_2 impact from going from one tyre label category to another is estimated to be around 2% [ICCT calculations]; [TNO] estimates that the real-world rolling resistance of production vehicle tyres in the EU is about 11kg/ton, with type-approval rolling resistances often being as low as 6kg/ton; [TNO] quantifies the resulting CO_2 difference to be around 11g/km; this difference is not only due to tyre selection, but also tyre preparation (see below) and track choice (see below) and is likely not to be expected for 100% of the fleet; for the analysis it is therefore assumed that in 2014 75% (2002: 0%, 2010: 25%, 2020: 100%) of tyres used for type-approval testing on average are classified one label category lower than in real-world (effect for per vehicle is about 3g/km or a 2 percentage points gap contribution effect).	0.0%	<0.5%	0.5%	~0.5%	1.5%	~1.5%	1.5%	~1.5%	2.0%	~2.0%	Some more potential assumed until 2020; mostly because vehicle testing experts' feedback suggests that not yet all manufacturers are fully exploiting this flexibility today	1.0%	~1.0%	WLTP will define vehicle specific tyre specifications for testing, but there will still be a lack of enforcement regarding in-production and in-use application of tyres; hence in principle it will still be possible for manufacturers to sell different tyres than used for testing and/or customers to select a different tyre than the one the vehicles has been tested with. For the analysis it is estimated that the effect with WLTP will be half of the effect without WLTP.	2.0%	~2.0%	Feedback from vehicle testing experts suggests that vehicle manufacturers could make use of this flexibility in the future, using specially prepared pre-certification vehicles and calibrations in the absence of an effective in-use enforcement program in the EU	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	1.5%	~1.5%	The manufacturers' optimisation strategies and customer behaviour are expected to be similar throughout Europe	1.7%	~1.5%	1.5%	~1.5%	1.7%	~1.5%	0.8%	~1.0%	The CO_2 effects scales %-wise, a similar effect for all car segments is therefore expected; for vans, a lower effect is expected because often default road load values are used instead of carrying out individual road load determination
Tyre preparation	For testing, manufacturers can use especially prepared tyres that are hardened in an oven and have a shaved down tread. In reality a vehicle equipped with such specially prepared tyres could not be safely and comfortably driven on the road.	[TNO, 2012] estimates that this flexibility was regularly used in 2010, with an overall effect of 2%; for 2002 no effect is assumed; more recently, [TNO] quantifies the resulting CO_2 difference to be around 11g/km altogether for tyre preparation, tyre selection (see above), and track choice (see below).	0.0%	<0.5%	2.0%	~2.0%	2.0%	~2.0%	2.0%	~2.0%	2.0%	~2.0%	Upper realistic bound already reached according to [TNO, 2012]	0.5%	~0.5%	WLTP is more specific about the definition of allowed tyre pre-treatment; tyre baking is not allowed anymore, shaving is still allowed to some extent (if copying the original shape of the tyre followed by a run-in on the road); some other flexibilities are expected to remain (for example raising the tyre temperature).	1.0%	~1.0%	Exploitation of some more flexibilities is likely, for example the maximum tyre pressure allowed in the user manual might be changed to enable again using higher pressure during testing	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	2.0%	~2.0%	The manufacturers' optimisation strategies are expected to be similar throughout Europe	2.2%	~2.0%	2.0%	~2.0%	1.8%	~2.0%	1.0%	~1.0%	The CO_2 effects scales %-wise, a similar effect for all car segments is therefore expected; for vans, a lower effect is expected because often default road load values are used instead of carrying out individual road load determination
Aerodynamics	Manufacturers can base CO_2 type-approval testing on a vehicle version with especially good aerodynamic features; in reality most customers will likely decide for a vehicle version with less favorable aerodynamic features. Furthermore, for testing, manufacturers can use flexibilities to enhance the aerodynamic of the vehicle, such as taking off one side mirror.	[ICCT internal data] indicates that real-world Cd*A values tend to be 10-20% higher (within a segment) than according to manufacturers' official data; a 10% higher Cd value results in 2% higher CO_2 [TNO, 2012; LAT]; a 10% difference in Cd*A is assumed for 2020, with a lower degree of use of this flexibility in previous years.	0.0%	<0.5%	1.0%	~1.0%	1.6%	~1.5%	1.6%	~1.5%	2.0%	~2.0%	Some more potential assumed until 2020	0.0%	<0.5%	WLTP will apply individual aerodynamic parameters for each vehicle and will limit allowed flexibilities during testing. Ideally WLTP will therefore eliminate this flexibility	0.0%	<0.5%	No further change assumed	0.0%	<0.5%	No further change assumed	1.6%	~1.5%	The manufacturers' optimisation strategies and customer behaviour are expected to be similar throughout Europe	1.3%	~1.5%	1.6%	~1.5%	1.9%	~2.0%	2.4%	~2.5%	Data from [LAT] shows a larger effect for larger vehicle segments
Test track design	For testing, manufacturers can choose a test track that has an especially smooth surface and a downward slope (in NEDC there is a calculation error included, averaging the coast down times instead of the forces). In reality road surface will be less optimal.	[TNO, 2012] estimates that this flexibility was regularly used in 2010, with an overall effect of 0.3%; other experts and more recent data from [TNO] suggest that the effect is much higher (2-4 g/km only for the slope effect + an additional impact of the track smoothness); for this study an effect of 2% is assumed for 2014, for 2002 no effect assumed.	0.0%	<0.5%	0.2%	<0.5%	2.0%	~2.0%	2.0%	~2.0%	3.0%	~3.0%	Some more potential assumed until 2020; mostly because vehicle testing experts' feedback suggests that not yet all manufacturers are fully exploiting this flexibility today	0.3%	<0.5%	WLTP is more specific about the definition of allowed track surface and also corrects the gradient calculation error; some flexibility regarding track surface remains	0.3%	<0.5%	No further change assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	2.0%	~2.0%	The manufacturers' optimisation strategies are expected to be similar throughout Europe	2.2%	~2.0%	2.0%	~2.0%	1.8%	~2.0%	1.0%	~1.0%	The CO_2 effects scales %-wise, a similar effect for all car segments is therefore expected; for vans, a lower effect is expected because often default road load values are used instead of carrying out individual road load determination
Brakes	For testing, manufacturers can adjust the brakes to lower parasitic drag. During real-world driving this would require customers to manually push back the brake pads everytime they have pushed the brake pedal (which is completely unrealistic).	[TNO, 2012] states that this flexibility cannot readily be quantified; feedback from vehicle testing experts suggests a value of about 1% for 2014, with increasing exploitation over time.	0.0%	<0.5%	0.1%	<0.5%	1.0%	~1.0%	1.0%	~1.0%	1.5%	~1.5%	Some more potential assumed until 2020; mostly because vehicle testing experts' feedback suggests that not yet all manufacturers are fully exploiting this flexibility today	0.2%	<0.5%	WLTP allows no manual adjustment of brakes. Ideally WLTP will therefore eliminate this flexibility	0.5%	~0.5%	Feedback from vehicle testing experts suggests that vehicle manufacturers could make use of this flexibility in the future, using specially prepared pre-certification vehicles and calibrations in the absence of an effective in-use enforcement program in the EU	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	1.0%	~1.0%	The manufacturers' optimisation strategies are expected to be similar throughout Europe	1.1%	~1.0%	1.0%	~1.0%	0.9%	~1.0%	0.5%	~0.5%	The CO_2 effects scales %-wise, a similar effect for all car segments is therefore expected; for vans, a lower effect is expected because often default road load values are used instead of carrying out individual road load determination
Ambient conditions	For testing, manufacturers can choose a test track up to ~500m above sea level and up to 21.5°C ambient temperature to keep driving resistances as low as possible. In reality the average temperature for most customers will be lower.	[TNO, 2012] assumes zero effect as a correction formula is applied to normalize test results to 20°C and 100kPa; however, even 20°C is still above average temperature in the EU (about 12°C); also humidity has a further effect; it is difficult to quantify the effect, but it is expected to be less than 0.5%, with a slight increase over time due to more manufacturers selecting optimized testing facilities.	0.2%	<0.5%	0.2%	<0.5%	0.3%	<0.5%	0.1%	<0.5%	0.3%	<0.5%	No further change assumed	0.3%	<0.5%	WLTP will define similar similar ambient conditions for coast down testing, i.e. no change with respect to real-world conditions is expected	0.3%	<0.5%	No further change assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	0.3%	<0.5%	The manufacturers' optimisation strategies are expected to be similar throughout Europe; average temperature in the UK similar to the EU average	0.3%	<0.5%	0.3%	<0.5%	0.3%	<0.5%	0.2%	<0.5%	The CO_2 effects scales %-wise, a similar effect for all car segments is therefore expected; for vans, a lower effect is expected because often default road load values are used instead of carrying out individual road load determination
Preconditioning	For coast down testing, the vehicle has to be brought to normal running temperature immediately prior to the test, i.e. the test is always carried out in 'hot' mode. In reality, a vehicle will also be driven in 'cold' or 'warm' mode. Furthermore, some vehicle components (such as bearings, gear box oil etc.) may still have a higher temperature during coast down testing if the vehicle has been driven at high speeds just before the coast down testing begins, thereby causing lower friction losses	[TNO, 2012] estimates that this flexibility was regularly used in 2010, with an overall effect of 0.5%; for 2002 no effect assumed	0.0%	<0.5%	0.5%	~0.5%	0.5%	~0.5%	0.5%	~0.5%	0.5%	~0.5%	Upper realistic bound already reached according to [TNO, 2012]	0.4%	~0.5%	WLTP definition is more specific (warm-up >20 min at 118 km/h); some difference to average real-world driving conditions expected to remain as the vehicle is still tested in 'hot' mode and as it is still allowed to accelerate sharply before each coast down test to increase the temperature of the vehicle components	0.4%	~0.5%	No further change assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	0.5%	~0.5%	The manufacturers' optimisation strategies are expected to be similar throughout Europe	0.6%	~0.5%	0.5%	~0.5%	0.5%	~0.5%	0.3%	<0.5%	The CO_2 effects scales %-wise, a similar effect for all car segments is therefore expected; for vans, a lower effect is expected because often default road load values are used instead of carrying out individual road load determination
Running in period	For testing, the manufacturer can select a vehicle that has already been driven for many kilometers, thereby having lower friction losses than a brand new vehicle. In reality, customers buying a new vehicle will have higher friction losses in the beginning.	In NEDC, the test vehicle has to be run-in for at least 3,000km, [TNO, 2012] states that most test vehicles are run-in for about 5,000km and estimates the effect to be 1.7% in 2010; on the other hand, on average the mileage of vehicles covered by websites like Spritmonitor and HonestJohn will likely be higher than 5,000km, i.e. the effect should be smaller for private cars and might be larger for company cars (which usually have a lower starting mileage); also the effect reduces over time with increasing km of a vehicle; more recent analysis from [TNO] suggests that the effect for running-in in general is smaller, 0.5-1% for going from 500km to 3,000km; for this study, an overall effect of 0,5% is assumed.	0.0%	<0.5%	0.5%	~0.5%	0.5%	~0.5%	0.5%	~0.5%	0.5%	~0.5%	No further change assumed	0.5%	~0.5%	WLTP will define vehicle run-in period to be 2,000-8,000km (3,000-15,000km upon request by manufacturer) and tyre tread depth to be 80-100%, i.e. more specific but with no significant change compared to average real-world situation	0.5%	~0.5%	No further change assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	0.8%	~1.0%	The manufacturers' optimisation strategies and customer behaviour are expected to be similar throughout Europe; for emission factors (which focus on new vehicles rather than vehicle stock) the effect will be higher because of the low mileage of new vehicles	0.5%	~0.5%	0.5%	~0.5%	0.6%	~0.5%	0.5%	~0.5%	Company cars with their generally lower starting mileage are likely more affected, i.e. effect for larger segments probably larger; for vans a similar effect as for average cars is expected
Other vehicle preparation	For testing, manufacturers can for example carefully adjust the ride height, set wheel camber and toe-in to zero to ensure low rolling and aerodynamic resistance.	[TNO, 2012] estimates the maximum effect to be 2%, with about 50% of it used up in 2010	0.0%	<0.5%	1.0%	~1.0%	1.0%	~1.0%	1.0%	~1.0%	2.0%	~2.0%	Some more potential assumed until 2020	0.2%	<0.5%	It is expected that WLTP will largely eliminate these flexibilities	1.0%	~1.0%	Feedback from vehicle testing experts suggests that vehicle manufacturers could make use of this flexibility in the future, using specially prepared pre-certification vehicles and calibrations in the absence of an effective in-use enforcement program in the EU	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	1.0%	~1.0%	The manufacturers' optimisation strategies are expected to be similar throughout Europe	1.1%	~1.0%	1.0%	~1.0%	0.9%	~1.0%	0.5%	~0.5%	The CO_2 effects scales %-wise, a similar effect for all car segments is therefore expected; for vans, a lower effect is expected because often default road load values are used instead of carrying out individual road load determination
Alternative testing options	For NEDC, coast down testing has to be carried out on a test track (if manufacturer decides to carry out testing instead of using table values from the regulation). For WLTP, alternative options will be allowed.	Instead of test track coast down testing, WLTP will allow manufacturers to use wind tunnel and flat belt measurements; it is expected that especially the large manufacturers will make use of these new options; the flexibilities associated with these options are not known yet and there is mixed views among experts about whether these new options will allow for more direct oversight of the manufacturer and new flexibilities (for example, the flat belt might be smoother than normal road surface), as the testing will then likely be carried out on manufacturer premises instead of on an external test track.	0.0%	<0.5%	0.0%	<0.5%	0.0%	<0.5%	0.0%	<0.5%	0.0%	<0.5%	n/a, as only allowed in WLTP	0.0%	<0.5%	For 2020, soon after introduction of WLTP, no exploitation of flexibilities assumed	2.0%	~2.0%	Effect of new testing possibilities is difficult to quantify; a 2% effect is assumed to be exploited by 2025	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	0.0%	<0.5%	The manufacturers' optimisation strategies are expected to be similar throughout Europe	0.0%	<0.5%	0.0%	<0.5%	0.0%	<0.5%	0.0%	<0.5%	Effect is expected to be similar for all vehicles sizes
SUM road load determination			**0.2%**	**<0.5%**	**5.9%**	**~6.0%**	**9.9%**	**~10.0%**	**9.8%**	**~10.0%**	**13.0%**	**~13.0%**		**3.4%**	**~3.5%**		**7.7%**	**~7.5%**		**0.0%**	**<0.5%**		**10.2%**	**~10.0%**		**10.4%**	**~10.5%**	**9.9%**	**~10.0%**	**9.8%**	**~10.0%**	**6.9%**	**~7.0%**	
Chassis dynamometer testing																																		
Vehicle weight	1. For testing, inertia classes are used instead of the actual weight of the vehicle; manufacturers can use deliberate lightweighting to push some vehicles into the next lower inertia class. 2. For testing, no optional vehicle equipment and load is taken into account; in reality vehicle weight is higher than during testing.	1. [ICCT, 2011] shows that in 2011 about 30% of vehicles had a mass that was immediately below an inertia step; 10% would usually be expected for a normal distribution, i.e. for about one fifth of vehicles deliberate optimization had to be expected for 2011; the effect per inertia class step (55-120kg) is estimated to be 2%; assuming that the vehicle weight was in the 'middle' of an inertia class before optimization, the resulting effect is 1%; for 2002 no optimization is assumed and for 2014/2020 it is assumed that 30/40% of vehicles will be optimized. 2. For NEDC testing, only vehicle kerb weight + 100kg is taken into account; for WLTP additionally 15% of max. payload and the average weight of optional equipment is taken into account, the resulting added weight is estimated to be 55kg+70kg=125kg [ICCT, 2014], the CO_2 effect is about 3.5% [ICCT, 2014]; the WLTP weight is assumed to be representative of real-world weight; payload is assumed to not have changed over time; average mass of optional equipment is estimated to have increased over time, due to optimization of manufacturers and change in customer choices (e.g. optional spare wheel, optional navigation system), being 30kg (0.8%, 2002), 50kg (1.4%, 2010), 70kg (2.0%, 2014), 90kg (2.6%, 2020).	2.3%	~2.5%	3.1%	~3.0%	3.8%	~4.0%	1.5%	~1.5%	4.5%	~4.5%	Some more potential assumed until 2020	0.0%	<0.5%	WLTP will not use inertia steps anymore and will take into account payload and optional equipment of vehicles; ideally WLTP will eliminate this flexibility	0.0%	<0.5%	No further change assumed	0.0%	<0.5%	No further change assumed	3.8%	~4.0%	The manufacturers' optimisation strategies and customer behaviour are expected to be similar throughout Europe	3.8%	~4.0%	3.8%	~4.0%	3.8%	~4.0%	5.7%	~5.5%	The inertia class optimization observed is slightly higher for smaller vehicles segments [ICCT, 2011]; however, absolute mass of optional equipment is likely higher for larger vehicle segments (expected to be similar in %-terms); for vans all vehicles with a mass higher than 2.2tons are represented by the same inertia class, this affects about 50% of all vans [ICCT, 2013], i.e. effect is likely higher for vans

Parameter	Description	General estimate	2002	2002	2010	2010	2014	2014	Δ2002-2014	Δ2002-2014	2020 without WLTP	2020 with WLTP	2020 with WLTP	2025 with WLTP only	2025 with WLTP only	2025 with CO2-RDE~	2025 with CO2-RDE~	UK specific estimate	PC-D	PC-S	PC-M	PC-M	PC-L	PC-L	LCV	LCV	
			Estimated contribution to real-world CO2 emissions gap of the EU new vehicles' fleet																								
Running in period	For testing, the manufacturer can select a vehicle that has already been driven for many kilometers, thereby having lower friction losses than a brand new vehicle. In reality, customers buying a new vehicle will have higher friction losses in the beginning. Only those friction losses not covered in the road load determination section are included here (e.g. engine internal friction losses).	In NEDC, the test vehicle has to be run-in for at least 3,000km. [TNO, 2012] assumes that the mileage of vehicles tested has increased by 2,400km for 50% of vehicles and provides a maximum effect of 0.5%; on average the mileage of vehicles covered by websites like Spritmonitor and HonestJohn will likely be higher than 5,000km, i.e. the effect should be smaller for private cars and might be larger for company cars which usually have a lower starting mileage; more recent analysis from [TNO] suggests that the effect is 0.5-1% for going from 500km to 3,000km; for this study, an overall effect of less than 0.5% is assumed.	0.0%	<0.5%	0.1%	<0.5%	0.3%	<0.5%	0.3%	<0.5%	0.3%	<0.5%	Upper realistic bound already reached according to [TNO, 2012]	0.3%	<0.5%	WLTP will define vehicle run-in period to be 2,000-8,000km (3,000-15,000km upon request by manufacturer); i.e. more specific but with no significant change compared to average real-world situation	0.3%	<0.5%	No further change assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	0.3%	<0.5%	The manufacturers' optimisation strategies are expected to be similar throughout Europe	0.3%	<0.5%	0.3%	<0.5%	0.2%	<0.5%	0.1%	<0.5%	The CO2 effects scales %-wise, a similar effect for all car segments is therefore expected; for vans, a lower effect is expected because often default road load values are used instead of carrying out individual road load determination
Laboratory instruments	When the NEDC was developed, laboratory equipment was not as accurate as nowaways. With the precise instruments that are available today, this allows for a systematic exploitation of measurement tolerances.	[TNO, 2012] assumes a max. effect of 4.7% when adding up all known flexibilities in terms of laboratory instruments; for this study it is assumed that without WLTP by 2020 manufacturers would make 100% use of these flexibilities.	0.9%	−1.0%	1.9%	−2.0%	3.8%	−4.0%	2.8%	−3.0%	4.7%	−4.5%	For 2020 assume maximum flexibility given in [TNO, 2012]	2.4%	−2.5%	Tolerances for laboratory instruments provided for WLTP are lower than for NEDC, but some flexibility still remains (50% assumed)	2.4%	−2.5%	No further change assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	3.8%	−4.0%	The manufacturers' optimisation strategies are expected to be similar throughout Europe	4.1%	−4.0%	3.8%	−4.0%	3.4%	−3.5%	1.9%	−2.0%	The CO2 effects scales %-wise, a similar effect for all car segments is therefore expected; for vans, a lower effect is expected because often default road load values are used instead of carrying out individual road load determination
Fuel specifications	The fuel used for testing might not be entirely representative of real-world fuel (for example, in terms of summer/winter fuel, increasing share of biofuels, water content, etc.). It is also in principle possible for manufacturers to blend up special fuels with high energy density for testing.	[TNO, 2012] assumes no significant effect, but more recent fuel sampling from [TNO] suggests some effect; for the effect of biofuels, [JRC] found a 3.9% difference between E10 and E0 fuel and 1.1% between B10 and B0; no quantification of the effect at this point. It is expected that more data on the impact of fuel specifications will be released in the near future. For this study, as a placeholder, an effect of 0.5% is estimated for 2014.	0.0%	<0.5%	0.0%	<0.5%	0.5%	−0.5%	0.5%	−0.5%	0.5%	−0.5%	No further change assumed	0.5%	−0.5%	No further change assumed	0.5%	−0.5%	No further change assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	0.5%	−0.5%	The manufacturers' optimisation strategies are expected to be similar throughout Europe	0.5%	−0.5%	0.5%	−0.5%	0.5%	−0.5%	0.5%	−0.5%	No difference between vehicle segments expected
Soak temperature	For NEDC testing, a maximum temperature of 30°C is allowed. In reality, the average ambient temperature is closer to 14°C.	For 2002 it is assumed that vehicles were tested at 20°C, the resulting CO2 effect is about 3% when compared to 14°C [ICCT, 2014b; Fig. 10]; for 2014 it is assumed that vehicles were tested at 26°C, the resulting CO2 effect is about 6%; at the same time, the cold start effect is overestimated in NEDC, in reality the additional emissions due to low start are smaller as trips tend to be longer than the NEDC; based on [ICCT, 2014b] it is estimated that this effect reduces the discrepancy by about 50 percent.	1.5%	−1.5%	2.0%	−2.0%	3.0%	−3.0%	1.5%	−1.5%	3.0%	−3.0%	In light of the NEDC framework conditions, a further increase of testing temperature would be possible; however for engine efficiency too high temperatures are also not ideal; therefore no further change assumed	0.5%	−0.5%	For WLTP, the test temperature will be lowered to 23°C, i.e. no significant effect; if EU introduces a test temperature of 14°C, this will be much closer to real-world situation (but still, temperature will be higher than EU average, and effect of starting at colder temperatures is likely to be higher than starting at higher temperatures); also, the WLTP is expected to accurately reflect cold start behavior; as a result WLTP should largely eliminate this flexibility	0.5%	−0.5%	No further change assumed	0.5%	−0.5%	No further change assumed	3.0%	−3.0%	The manufacturers' optimisation strategies are expected to be similar throughout Europe; average temperature in the UK similar to the EU average	3.3%	−3.5%	3.0%	−3.0%	2.7%	−2.5%	1.5%	−1.5%	The CO2 effects scales %-wise, a similar effect for all car segments is therefore expected; for vans, a lower effect is expected because often default road load values are used instead of carrying out individual road load determination
Battery state of charge	For NEDC testing, it is possible for the manufacturer to start the test with a fully charged battery and to end the test with a battery that is only partially charged, i.e. some energy of the battery is used during testing without being taken into account for the determination of the CO2 emission value.	[TNO, 2012] assumes that this flexibility was not used in 2002, but was regularly used in 2010, having reached its maximum potential of 1% effect; other experts argue that even going only from a state of charge of 100% to 90% has a 7g/km effect, i.e. about 4%; for this study, only a 2% effect is assumed, taking into account that a 10% discharge probably would require deactivating the alternator completely during NEDC testing.	0.0%	<0.5%	1.0%	−1.0%	2.0%	−2.0%	2.0%	−2.0%	2.0%	−2.0%	No further change assumed	0.0%	<0.5%	For WLTP, the allowed state of change of the battery before/after testing will be defined more precisely and a post-SOC correction will be applied, if necessary	0.0%	<0.5%	No further change assumed	0.0%	<0.5%	No further change assumed	2.0%	−2.0%	The manufacturers' optimisation strategies are expected to be similar throughout Europe	2.2%	−2.0%	2.0%	−2.0%	1.8%	−2.0%	1.4%	−1.5%	CO2 effects scales in %
Driving technique	Professional drivers (or robots) can systematically "smoothen" the speed profile during the test drive and can thereby achieve lower CO2 emission values.	[TNO, 2012] assumes a maximum effect of 1.2%; other vehicle testing experts' feedback suggests that a higher effect seems likely; for this study, taking into account a safety margin to ensure that the driver can still follow the required speed trace, a value of about 1% is assumed for 2014, with increasing exploitation over time	0.0%	<0.5%	0.5%	−0.5%	0.8%	−1.0%	0.8%	−1.0%	1.2%	−1.0%	Some more potential assumed until 2020; mostly because vehicle testing experts' feedback suggests that not yet all manufacturers are fully exploiting this flexibility today	0.2%	<0.5%	For WLTP, the allowed flexibility to follow the speed trace will be lower than in NEDC, also it will be more difficult to follow the WLTP as it is a more dynamic speed profile	0.5%	−0.5%	The WLTP speed profile is more dynamic, i.e. the brake energy to be gained by "smoothening" the profile is larger (about 12% of braking energy in WLTP vs. 3% in NEDC); it is assumed that in the future robots can be used to take advantage of this effect; however, there is different opinions among experts on whether this effect would then be subject to post-processing of the test results; for this analysis, a placeholder effect of 0.5% is assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	0.8%	−1.0%	The manufacturers' optimisation strategies are expected to be similar throughout Europe	0.9%	−1.0%	0.8%	−1.0%	0.7%	−0.5%	0.6%	−0.5%	CO2 effects scales in %
Particulate filter	For testing, manufacturers can use a vehicle that has an unloaded diesel particulate filter, thereby avoiding the back pressure of a particulate filter under normal driving conditions.	[TNO] estimates the effect of a loaded diesel particulate filter to be around 1-5 g/km CO2, depending on soot loading and driving style; more recent data from [TNO] suggests a value of 0.5-3.0 g/km, depending greatly on air-fuel ratio and filter load; for this study a 1% effect is assumed for diesel vehicles, accounting for about 50% of the fleet	0.0%	<0.5%	0.5%	−0.5%	0.5%	−0.5%	0.5%	−0.5%	0.5%	−0.5%	Upper realistic bound most likely already reached	0.5%	−0.5%	WLTP is not expected to bring any change regarding this flexibility	0.5%	−0.5%	No further change assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	0.5%	−0.5%	The manufacturers' optimisation strategies are expected to be similar throughout Europe and the diesel vehicle share in the UK is very similar to the EU average	0.4%	−0.5%	0.5%	−0.5%	0.6%	−0.5%	0.6%	−0.5%	Effect applies only to diesel vehicles, larger vehicle segments and vans more likely to be affected because of a higher market share of diesel vehicles
Declaration of CO2 value	The NEDC test procedure allows manufacturers to declare a CO2 value that is up to 4% lower than the actually measured CO2 figure.	For 2010, [TNO, 2012] assumes that about half of this flexibility is used; for 2014 it is assumed that the flexibility is applied for nearly all vehicles. The full amount of 4% cannot be achieved as other criteria like the FC/CO2 conversion factor and the UDC/EUDC relation must also be taken into account.	0.0%	<0.5%	1.8%	−2.0%	3.2%	−3.0%	3.2%	−3.0%	3.5%	−3.5%	Some more potential assumed until 2020	0.0%	<0.5%	In WLTP, it is not permitted anymore to deduct 4% from the CO2 test result; ideally WLTP will eliminate this flexibility	0.0%	<0.5%	No further change assumed	0.0%	<0.5%	No further change assumed	3.2%	−3.0%	The manufacturers' optimisation strategies are expected to be similar throughout Europe	3.2%	−3.0%	3.2%	−3.0%	3.2%	−3.0%	5.4%	−5.5%	The effect is the same for all vehicle categories; for vans, the NEDC allows for a 6% correction (2004/3/EC, 11.1)
Driving modes	More and more vehicles offer a choice between different driving modes (for example "eco-drive", "sport-drive"), where the engine calibration and other vehicle characteristics are dynamically adapted depending on which mode is selected. The mode which is used during testing may not necessarily be the same as used during everyday driving on the road.	It is expected that the effect is most pronounced for automatic transmission vehicles, as for these it is relatively easily possible to adapt gear ratios depending on the mode selected; according to [TNO] a diesel vehicle with automatic transmission tested in WLTP showed a 12% difference between the "eco-drive" and "normal" mode; but also for manual transmission vehicles it is possible to e.g. reduce the ventilation and to change the gas pedal sensitivity; it is assumed that in 2014 25% of all automatic transmission vehicles were subject to an impact of 10% difference and 25% of all manual transmission vehicles to an impact of 3%, for 2030 the effect is expected to increase to 15%/5%, with 50% of vehicles being subject to it	0.0%	<0.5%	0.2%	<0.5%	1.1%	−1.0%	1.1%	−1.0%	3.5%	−3.5%	Significantly more potential assumed until 2020	2.0%	−2.0%	In WLTP, the vehicle needs to be tested in mode that is pre-set when starting the vehicle; nevertheless, experts expect that many consumers will still select a different setting for everyday driving, therefore some flexibility remaining; furthermore, for the future it is also possible to introduce more and more self-learning systems that adapt to the driving style of the customer, thereby implicitly changing the original type-approval settings	5.0%	−5.0%	It is assumed that without proper in-use on-road testing, more possibilities will be exploited for the vehicle to recognize a testing situation and to switch to a different driving mode, to a more limited extent also for manual transmission vehicles. For this study, a value of 5% is assumed, realizing that more research and vehicle testing in this respect is needed to better quantify the likely effect in the future	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	1.1%	−1.0%	The manufacturers' optimisation strategies are expected to be similar throughout Europe; the market share of automatic transmission vehicles in the UK is similar to the EU average	1.3%	−1.5%	1.1%	−1.0%	1.3%	−1.5%	1.1%	−1.0%	The effect is expected to be larger for the larger vehicle segments, due to a higher market share of automatic transmission vehicles; for vans the effect is expected to be similar
SUM Chassis dynamometer testing			**4.7%**	**−4.5%**	**11.5%**	**−11.5%**	**18.7%**	**−18.5%**	**14.7%**	**−14.5%**	**23.0%**	**−23.0%**		**6.2%**	**−6.0%**		**9.3%**	**−9.5%**		**0.5%**	**−0.5%**		**18.7%**	**−18.5%**		**19.4%**	**−19.5%**	**19.4%**	**−19.5%**	
SUM use of flexibilities in the test procedure			**4.9%**	**−5.0%**	**16.7%**	**−16.5%**	**26.8%**	**−27.0%**	**23.0%**	**−23.0%**	**33.0%**	**−33.0%**		**9.3%**	**−9.5%**		**16.3%**			**0.5%**	**−0.5%**		**27.0%**	**−27.0%**		**27.8%**	**−28.0%**	**26.8%**	**−27.0%**	**26.5%**	**−26.5%**	**24.9%**	**−25.0%**	
Technology deployment																																
Automatic transmission	For NEDC testing, manufacturers can optimize the gear shift patterns for automatic transmissions; for manual transmissions the gear shifts are fixed by the test procedure and have to be followed; under certain conditions manufacturers can skip the 1st gear during type-approval testing, meaning that the entire NEDC is then driven one gear higher than it would otherwise be the case.	Based on [AVL, 2014] and [ICCT, 2014a; Fig. 4] it is estimated that automatic transmission vehicles show a real-world discrepancy that is about 5 percentage points higher than for manual transmission vehicles; the market share of automatic transmission vehicles increased from 12% in 2002 to 21% in 2013	0.6%	−0.5%	0.8%	−1.0%	1.1%	−1.0%	0.5%	−0.5%	1.5%	−1.5%	Increase to 30% automatic transmission market share assumed	2.9%	−3.0%	For WLTP there is no change to gear shift guidance for automatic transmissions; for manual transmissions, gear shift points will be calculated using a tool, it is expected that this will drive manufacturers to optimize to some extent (2% assumed here) also for manual transmissions; also, in WLTP gears will shift upwards more quickly, but on the other hand it will more difficult to skip the 1st gear	2.9%	−3.0%	No further change assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	1.3%	−1.5%	The market share of automatic transmission vehicles is slightly higher in the UK than for the EU average, i.e. a slightly higher effect is assumed	0.5%	−0.5%	1.1%	−1.0%	1.6%	−1.5%	0.1%	<0.5%	A higher market share of automatic transmission vehicles is expected for larger vehicle segments; for vans, the market share of automatic transmission vehicles is below 5%
Direct injection and downsizing	The NEDC to a large extent covers driving in an area that requires only partial load from the vehicle's engine. Downsized engines show a better efficiency for these partial load areas and have become more popular in recent years. Under real-world driving, the benefit of downsized engines is smaller than in NEDC.	Based on [AVL, 2014] and [AEA] it is assumed that the 'gap' increasing effect for direct-injection downsized petrol vehicles is about 3 percentage points; for diesel vehicles the effect is expected to be lower (estimated 1 percentage point); the market share of direct-injection downsized petrol vehicles increased to about 35% in 2014; for diesel vehicles it is assumed that 50% of the new vehicles have a downsized engine.	0.0%	<0.5%	0.9%	−1.0%	1.6%	−1.5%	1.6%	−1.5%	2.9%	−3.0%	Increase to 80% direct-injection downsized petrol is assumed	0.0%	<0.5%	It is expected that WLTP accurately reflects the real-world benefits of direct-injection and downsizing	0.0%	<0.5%	No further change assumed	0.0%	<0.5%	No further change assumed	1.6%	−1.5%	The market share of direct-injection and downsizing is about the same in the UK as for the EU market average	0.8%	−1.0%	1.6%	−1.5%	2.3%	−2.5%	0.0%	<0.5%	Direct-injection and downsizing is more common for larger vehicles; for vans it is expected that no significant downsizing has occurred so far (market dominated by diesel vehicles)
Stop start	During about 25% of NEDC testing, the vehicle is at standstill, i.e. stop start technology has a relatively large effect for NEDC test results while during real-world driving the effect is lower.	Simulations from [AVL, 2014] and other sources show that the CO2 reduction effect of stop start in NEDC is about 5%, but only about 2.5% in WLTP; it is assumed that WLTP provides a reasonable estimate for stop phases in real-world driving; the market share of stop start for new cars in the EU increased from 1% in 2002 to 35% in 2013 [km77/ICCT].	0.0%	<0.5%	0.4%	−0.5%	0.9%	−1.0%	0.9%	−1.0%	2.5%	−2.5%	Increase to 100% stop start market share assumed	0.5%	−0.5%	It is expected that WLTP better reflects the real-world benefits of stop start technology, while still a significant effect remains (about 10% of WLTP is still idling); also, due to the 23°C start temperature stop start will have an effect sooner after start of the engine in WLTP than in real-world driving	0.5%	−0.5%	No further change assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected	0.9%	−1.0%	The market share of stop start technology is about the same in the UK as for the EU market average	0.4%	−0.5%	0.9%	−1.0%	1.3%	−1.5%	0.0%	<0.5%	The market share of stop start is higher for larger vehicles, also it is to be expected that on average the effect of stop start is lower for larger vehicles that tend to be driven less in an urban environment; for vans stop start technology is not common yet

Estimated contribution to real-world CO2 emissions gap of the EU new vehicles' fleet

Parameter	Description	General estimate	2002	2002	2010	2010	2014	2014	Δ2002-2014	Δ2002-2014
Hybrid	During about 25% of NEDC testing, the vehicle is at standstill and about 15% of the time, the vehicle is decelerating, i.e. hybrid technology has a relatively large effect for NEDC test results while during real-world driving the effect may be lower, depending on driving situation and style.	Based on [ICCT, 2014] hybrid vehicles show a discrepancy that is about 10-15 percentage points higher than for conventional vehicles; however, it has to be taken into account that hybrid vehicles always are automatic transmission vehicles (see above) and also include the effect of a stop start system (see above); furthermore, the absolute CO2 emissions of hybrid vehicles are lower, i.e. the percentage effect of the discrepancy is higher; as a result it is assumed that the net gap effect of hybrid vehicles in NEDC is about 5 percentage points; the market share in 2014 in the EU was about 2% [ICCT], i.e. the total effect in 2014 is estimated to be less than 0.5%.	0.0%	<0.5%	0.1%	<0.5%	0.1%	<0.5%	0.1%	<0.5%
Plug-in hybrid	For NEDC, for an electrified vehicle the CO2 emissions during electric and combustion engine driving are added up in such a way that for a plug-in hybrid vehicle with 25km electric range the CO2 emission level is reduced by 50% and if the vehicle has 50km electric driving range by another 33%, etc. As a result, plug-in hybrid vehicles have very low CO2 emissions in NEDC. If not driven in urban conditions and/or only for short distances with electric recharging, the real-world CO2 emissions are likely to be much higher.	Two effects need to be separated: (1) Most of today's plug-in hybrid vehicles have an electric NEDC range of about 25-50km. Based on the NEDC calculation formula, this leads to a situation in where it is assumed that the vehicle is driven in electric mode during about two thirds of the overall distance (according to [Fraunhofer, 2015] it is about 50% for Toyota Prius PHEV, 67% for Mitsubishi Outlander and Volvo V60 PHEV, and about 77% for Chevrolet Volt/Opel Ampera PHEV). In reality, electric driving shares of individual customers will vary widely. Based on [Fraunhofer, 2015] the real-world electric driving share is about 50% or less for Prius, Outlander and Volvo; only for Volt/Ampera it is found higher (mostly US-customers in this study); assuming, based on this data, that on average in NEDC plug-in hybrids are assumed to drive 75% of km electric, but in real-world - on average - are driven only 50% of km electric, and furthermore assuming a CO2 emission of the combustion engine of 150 g/km, this results in a 'gap' of 50% for plug-in hybrids when comparing NEDC to real-world CO2 data. This is only the effect of assuming a different electric driving share in NEDC than observed in real-world, while assuming that the driver regularly re-charges electricity. (2) According to [TNO], plug-in hybrid vehicles in the Netherlands often are re-charged not on electricity but on petrol (due to benefits for company car drivers). As a result, the average 'gap' for plug-in hybrids in the Netherlands is not 50% but around 200%. Data from private drivers and also car magazines in Germany, analyzed by [ICCT] confirm that the average 'gap' from plug-in hybrids is closer to 100-150%. For the current status, an effect of 100% is therefore assumed. The market share of plug-in hybrid vehicles in 2014 was about 0.2%.	0.0%	<0.5%	0.1%	<0.5%	0.2%	<0.5%	0.2%	<0.5%
SUM technology deployment			0.6%	~0.5%	2.2%	~2.0%	3.7%	~3.5%	3.1%	~3.0%
External factors										
Air conditioning	During vehicle testing, the air conditioning system is turned off. In reality, air conditioning systems are turned on part of the time.	The effect of A/C is estimated to be 8.5% at 25°C, 13% at 30°C; the annual average for 8°C (set point 18°C) is estimated to be 2.7% (diesel) / 3.6% (petrol) [Weilenmann, et al., 2010]; based on experts this estimate might be too high because the efficiency of A/C systems has improved in the meantime and the A/C is not necessarily turned on all the time, on the other hand absolute CO2 emissions have gone down over time; [ICCT] Spritmonitor data analysis suggests an average effect of about 3%; for this study an average effect of 3% is assumed; market share of vehicles with A/C in Germany: 25% in 1995, 96% in 2008 [Hoffmann and Plehn, 2010], assumed 100% for 2014.	1.5%	~1.5%	2.9%	~3.0%	3.0%	~3.0%	1.5%	~1.5%
Auxiliary electrical devices	During vehicle testing, only a limited use of electricity for auxiliary devices is taken into account. In reality, car drivers tend to make use of more electrical devices.	[EC, 2013] estimates that the total electric power requirement in NEDC is 350W, compared to 750W for real-world driving; based on data from [Schmidt and Johannsen, 2010] this 400W difference is equivalent to a difference of about 0.5 l/100km of fuel consumption, i.e. about 7% of CO2 impact; on the basis of this data the overall effect is assumed to be 5% for 2014 and having doubled since 2002 (devices such as electric seat, steering wheel heating, navigation system are expected to be new for 2010/14); also the percentage impact increases with decreasing CO2 emission level.	2.5%	~2.5%	3.0%	~3.0%	5.0%	~5.0%	2.5%	~2.5%
Driving patterns	Every customer has an individual driving profile in terms of driving style, mix of road types, speed distribution, congestion level, road inclination, share of stops, and even climate conditions. Ideally, the test cycle used should be representative for the average (EU) driving profile.	NEDC testing only includes driving speeds up to 120km/h, while in reality driving speeds of up to 130-140km/h are expected to be quite common; acceleration and decceleration patterns are considered being less demanding in NEDC than for real-world driving; also, road inclination is not taken into account for type-approval testing. On the other hand, modern vehicle engines often perform better under high load conditions. Also, small road inclinations can help to reduce CO2 levels (driving at more efficient engine loads uphill and gliding off downhill), while higher road inclination will worsen CO2 emission levels (due to shifting back, and braking). In summary, it is expected that the effects nearly level out, and an effect of roughly 1% is estimated for the NEDC; no change over time is expected.	1.0%	~1.0%	1.0%	~1.0%	1.0%	~1.0%	0.0%	<0.5%
SUM external factors			4.9%	~5.0%	6.7%	~6.5%	8.8%	~9.0%	4.0%	~4.0%
Road load determination			0.2%	<0.5%	5.9%	~6.0%	9.9%	~10.0%	9.8%	~10.0%
Chassis dynamometer testing			4.7%	~4.5%	11.5%	~11.5%	18.7%	~18.5%	14.7%	~14.5%
Technology deployment			0.6%	~0.5%	2.2%	~2.0%	3.7%	~3.5%	3.1%	~3.0%
External factors			4.9%	~5.0%	6.7%	~6.5%	8.8%	~9.0%	4.0%	~4.0%
SUM all			10.1%	~10.0%	24.0%	~24.0%	35.7%	~35.5%	28.4%	~28.5%
Change based on 2014 level										
Observed average gap		All data sources	9.0%		23.0%		38.0%		29.0%	
		Spritmonitor	9.0%		20.0%		35.0%		26.0%	

Parameter	2020 without WLTP			2020 with WLTP			2025 with WLTP only			2025 with CO2-RDE^{pro}		
Hybrid	1.5%	~1.5%	Increase to 30% hybrid market share assumed	1.5%	~1.5%	The WLTP includes less stop phases but more acceleration and deceleration phases than NEDC; overall, the effect for hybrid vehicles is assumed to remain about the same	1.5%	~1.5%	No further change assumed	0.8%	~1.0%	The on-road CO2 emissions of hybrid vehicles depends very much on the respective driving pattern; if randomly selected vehicles are tested, then a much lower discrepancy is expected, but the vehicle tests carried out may not be representative for some vehicle drivers
Plug-in hybrid	8.0%	~8.0%	Increase to 8% plug-in hybrid market share assumed (market share was given as input by CCC); no change in the electric drive share of average drivers assumed, also no change in re-charging behaviour assumed	4.0%	~4.0%	The utility parameter concept applied in WLTP and the more demanding drive profile of WLTP (which will reduce the electric range) is expected to bring plug-in hybrid vehicle results closer to the average real-world driving situation; is it assumed that the 'gap' due to different electric drive shares in WLTP and real-world is going to be 25% (half of NEDC estimate); no change in -recharging behaviour assumed, i.e. overall effect is expected to be 50%	6.8%	~7.0%	Increase to 18% plug-in hybrid market share assumed (market share was given as input by CCC); at the same time it is assumed that there will be additional measures for improving the availability of charging spots and consumer education, thereby reducing the overall effect to about 35%	3.4%	~3.5%	The on-road CO2 emissions of hybrid vehicles depend very much on the respective driving pattern; if randomly selected vehicles are tested, then a much lower discrepancy is expected (about 50% discrepancy compared to 2025 WLTP situation assumed), but the vehicle tests carried out may still not be representative for some vehicle drivers
SUM technology deployment	15.5%	~15.5%		8.6%	~8.5%		11.3%	~11.5%		4.1%	~4.0%	
External factors												
Air conditioning	3.0%	~3.0%	100% market share of A/C already reached; a 10% improved in efficiency of A/C is assumed; at the same time absolute CO2 emission level of vehicle decreasing, i.e. percentage impact remains about constant	3.0%	~3.0%	Air conditoning systems will still be turned off for WLTP; average power and velocity in WLTP higher than NEDC, while at the same time absolute CO2 emission level of vehicle decreasing; overall, no change of percentage value assumed	3.0%	~3.0%	No further change assumed; unless efficiency of air conditioning systems is taken into account for future vehicle testing	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected
Auxiliary electrical devices	6.0%	~6.0%	Some more increase expected because of additional electrical devices and because of decreasing absolute CO2 emission level	3.0%	~3.0%	It is expected that for the WLTP, the use of electrical devices will be taken into account more realistically, but that about 50% of the discrepancy is expected to remain	3.0%	~3.0%	No further change assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected
Driving patterns	1.0%	~1.0%	No change expected	1.0%	~1.0%	The WLTP driving profile is more dynamic, with higher acceleration/deceleration phases; it is also longer than the NEDC; the WLTP was derived from real-world driving data; WLTP still does not take into account uphill/downhill driving; overall no significant change expected	1.0%	~1.0%	No further change assumed	0.0%	<0.5%	If a randomly selected customer's vehicle is tested on-road, then no longer a deviation between test and real-world figure for this parameter is expected
SUM external factors	9.7%	~9.5%		6.9%	~7.0%		6.9%	~7.0%		0.0%	<0.5%	
Road load determination	13.0%	~13.0%		3.4%	~3.5%		7.7%	~7.5%		0.0%	<0.5%	
Chassis dynamometer testing	23.0%	~23.0%		6.2%	~6.0%		9.3%	~9.5%		0.5%	~0.5%	
Technology deployment	15.5%	~15.5%		8.6%	~8.5%		11.3%	~11.5%		4.1%	~4.0%	
External factors	9.7%	~9.5%		6.9%	~7.0%		6.9%	~7.0%		0.0%	<0.5%	
SUM all	48.9%	~49.0%		22.8%	~23.0%		30.8%	~31.0%		4.6%	~4.5%	
Change based on 2014 level	137%			64%			86%			13%		

Parameter	UK specific estimate			PC-S	PC-S	PC-M	PC-M	PC-L	PC-L	LCV	LCV	
Hybrid	0.1%	<0.5%	The market share of hybrid vehicles is about the same in the UK as for the EU market average	0.1%	<0.5%	0.1%	<0.5%	0.2%	<0.5%	0.0%	<0.5%	The market share of hybrid vehicles is higher for larger vehicles, also it is to be expected that on average the effect of the hybrid technology is lower for larger vehicles that tend to be driven less in an urban environment; for vans hybrid technology is not very common yet
Plug-in hybrid	0.2%	<0.5%	The market share of plug-in hybrid vehicles is currently lower in the UK than for the EU market average; however, for the future it is expected that the market share in the UK in the UK will grow quicker than for some other Member States	0.1%	<0.5%	0.2%	<0.5%	0.3%	<0.5%	0.0%	<0.5%	The market share of plug-in hybrid vehicles is higher for larger vehicles, also it is to be expected that on average the effect of the plug-in hybrid technology is lower for larger vehicles that tend to be driven less in an urban environment; for vans plug-in hybrid technology is not very common yet
SUM technology deployment	3.9%	~4.0%		1.9%	~2.0%	3.7%	~3.5%	5.6%	~5.5%	0.1%	<0.5%	
External factors												
Air conditioning	3.0%	~3.0%	The ambient temperature and market share is similar for the UK than for Germany and the EU average	3.6%	~3.5%	3.0%	~3.0%	2.4%	~2.5%	2.1%	~2.0%	The additional absolute CO2 emission for A/C is nearly constant, i.e. the percentage impact decreases with increasing vehicle size
Auxiliary electrical devices	5.0%	~5.0%	The market penetration of electrical devices and the usage patterns are expected to be the same for the UK than for the EU average	6.0%	~6.0%	5.0%	~5.0%	4.0%	~4.0%	3.5%	~3.5%	The additional absolute CO2 emission for the electrical devices is nearly constant, i.e. the percentage impact decreases with increasing vehicle size
Driving patterns	1.0%	~1.0%	The distribution of speed patterns and road profiles in the UK is similar than for the EU average	1.0%	~1.0%	1.0%	~1.0%	1.0%	~1.0%	1.0%	~1.0%	For larger vehicles it is expected that higher driving speeds are reached more regularly, but also individual trips tend to be longer; for smaller vehicles the opposite; in summary, no significant difference between segments is expected
SUM external factors	8.8%	~9.0%		10.3%	~10.5%	8.8%	~9.0%	7.2%	~7.0%	6.5%	~6.5%	
Road load determination	10.2%	~10.0%		10.4%	~10.5%	9.9%	~10.0%	9.8%	~10.0%	6.9%	~7.0%	
Chassis dynamometer testing	18.7%	~18.5%		19.4%	~19.5%	18.7%	~18.5%	18.4%	~18.5%	19.4%	~19.5%	
Technology deployment	3.9%	~4.0%		1.9%	~2.0%	3.7%	~3.5%	5.6%	~5.5%	0.1%	<0.5%	
External factors	8.8%	~9.0%		10.3%	~10.5%	8.8%	~9.0%	7.2%	~7.0%	6.5%	~6.5%	
SUM all	36.0%	~36.0%		36.4%	~36.5%	35.7%	~35.5%	35.6%	~35.5%	29.9%	~30.0%	
Change based on 2014 level												

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