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Impact of WLTP introduction on CO_2 emissions from M1 and N1 vehicles

Evidence from type-approval and 2018 EEA data

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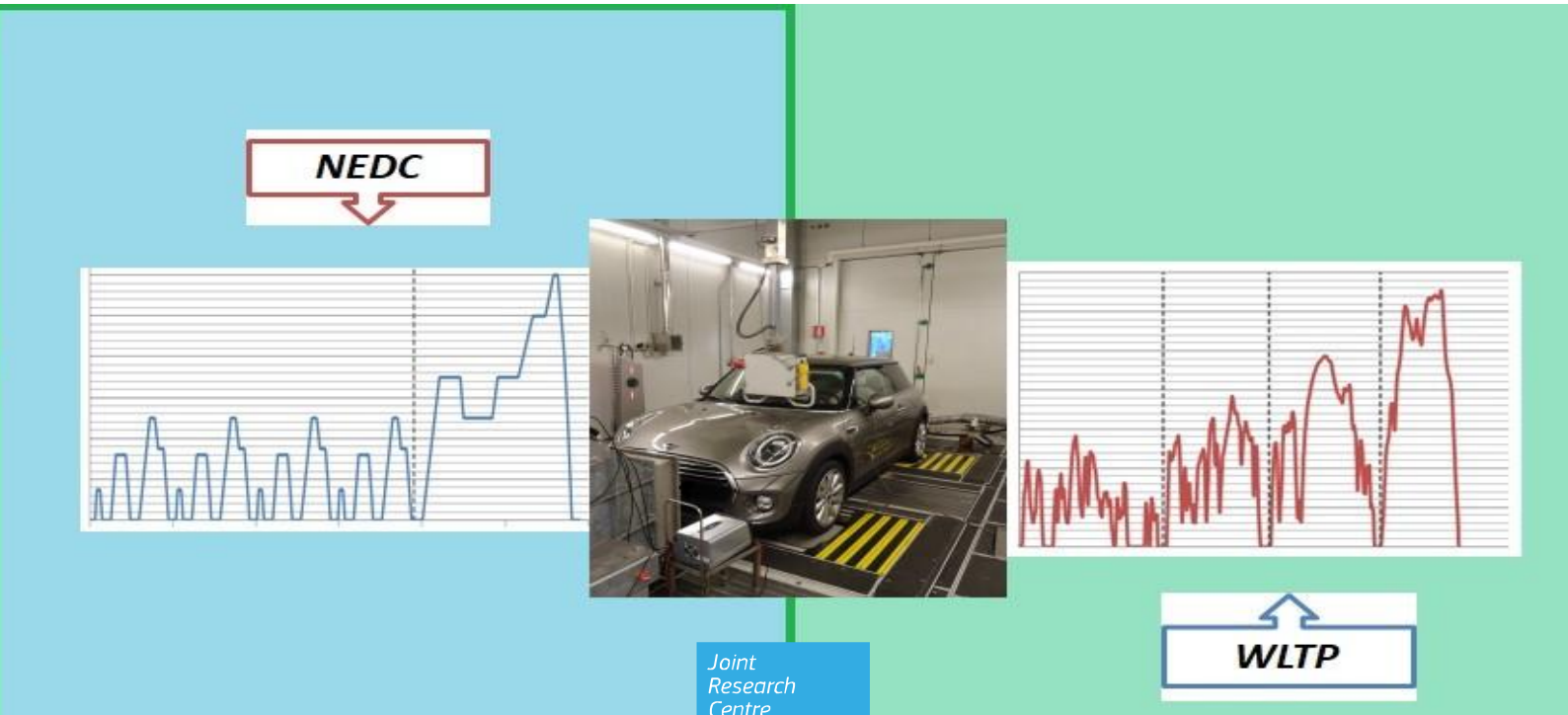

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Abstract

The analysis of official type-approval documents covering the period September 2017 - August 2018 and which were uploaded in the ETAES platform has given a first insight of the impact of the introduction of the WLTP procedure on declared and measured CO_2 emissions.

The first topic analysed was the ratio between declared WLTP and NEDC emissions. On average, this ratio is higher for diesel ICE vehicles compared to gasoline ICE vehicles. The mean ratio for diesel VH was 1.26 for M1 category and 1.28 for N1 and for VL 1.18 for M1 and 1.22 for N1 category. The 2018 EEA data showed an average ratio of 1.25 for M1 and 1.27 for N1 category. For gasoline ICE vehicles the mean ratio for VH is 1.16 for M1 1.19 for N1 category and for VL 1.13 for M1 and 1.14 for N1 category. The 2018 EEA data show an average ratio of 1.19 for M1 1.16 for N1 category. The highest average ratio for diesel and gasoline VH was calculated for OEM_3 group and for VL for OEM_15 (diesel) and OEM_3 (gasoline) groups. The 2018 EEA registrations data show the highest average ratio coming from OEM_3 (diesel) and OEM_11 (gasoline) groups.

For NOVC-HEVs and OVC-HEVs the data sets analysis were much smaller and any conclusions drawn should be treated with caution. The mean WLTP/NEDC ratio for NOVC-HEVs was 1.22 (VH) and 1.18 (VL), which is higher than that of gasoline ICE vehicles. For all OVC-HEVs analysed (weighted-combined CO_2 emissions) the ratio for VH is 1.13, but with a range from 0.34 to 1.44 and for VL the average was 1.03 (range: 0.31-1.32). In the 2018 EEA data NOVC-HEVs and OVC-HEVs could not be distinguished.

Analysis of Emission type-approval documents (ETA) revealed that for the majority of IP families analysed (70% for VH and 73% for VL) the declared WLTP values were less than 5% higher than the WLTP measured values. In 26% of cases for VH and 23% for VL the over-declaration was between 5% and 10%. In only 4% of cases for VH and 4% for VL OEM's over-declaration was above 10% (but always below 20%).

In total, 18% (266) of IP families are type-approved with only vehicle high (VH), which leads to higher CO_2 emissions compared to the interpolation approach. Some OEMs are only type-approving VH (OEM_13, OEM_16, OEM_17, OEM_18, OEM_19, OEM_21, OEM_22, OEM_23, OEM_24, OEM_25, OEM_27, OEM_28), but except OEM_13, the other OEM groups have very low registrations. OEM groups with high registrations (more than half million) and high % of IP families with only VH are: OEM_7 (24%), OEM_5 (22%), OEM_2 (20%), OEM_9 (7%), and OEM_3 (6%). OEM_12 and OEM_10 are another OEMs with high % of IP families with only VH (91% and 73%, respectively) and registrations higher than 200,000.

Various inconsistencies and issues have been identified in the data collected. Such inconsistencies should be addressed to ensure correct implementation of the legislation and a level playing field.

1 Introduction

Starting from 1st January 2020, Regulation (EU) 2019/631 for the reduction of CO_2 emissions from cars and vans has replaced and repealed the former Regulations (EC) 443/2009 (cars) and 510/2011 (vans). The Regulation sets targets for the fleet-wide vehicle emissions as well as manufacturer-specific binding targets. From 2020, the EU fleet-wide average emission target for new vans is 147 g CO_2/km. From 2021, phased in from 2020, the EU fleet-wide average emission target for new cars is 95 g CO_2/km. From 2025, stricter targets will apply. The fleet-wide average CO_2 emissions of new cars will have to be reduced by 15% relative to the 2021 fleet baseline, both for cars and vans. From 2030 on, further reductions are needed, with a target of 37.5% reduction for cars and 31% for vans, all relative to the 2021 fleet baseline.

Since September 2017, emissions of passenger cars are being certified according to the WLTP (Worldwide harmonized Light Vehicles Test Procedure), as defined in Regulation (EU) 2017/1151 [3]. The WLTP replaces the old type-approval procedure, which was based on the New European Driving Cycle (NEDC) and UNECE Regulation 83 [4].

WLTP is expected to bring more realistic values of fuel consumption and CO_2 emissions. Several studies analysed the effect of WLTP introduction even before the official testing procedure was in place [5], [6], [7]. Most of them concluded that WLTP values will be considerably higher than the NEDC values. Previous JRC studies or papers had estimated that this increase could be as high as 25% [8], [9].

In the past, TNO performed an investigation on the difference between NEDC type-approved values and NEDC values measured in the laboratory and a significant deviation between them was found [10]. How much declared and measured CO_2 emissions differ under WLTP is still unclear at this stage of implementation. The main reasons behind this uncertainty are the lack of consistent and complete datasets, the learning effects experienced by both manufacturers (OEMs) and technical services/type-approval authorities, and other regulations that have been introduced in parallel for addressing pollutant emissions. A clearer view of the WLTP impact on certified CO_2 emissions will be drawn once datasets for years 2018 and 2019 become available.

This report aims to provide a first analysis of the ratio between WLTP and NEDC CO_2 emissions for different vehicle types and technologies (gasoline, diesel, ICE, NOVC-HEVs, and OVC-HEVs). Also, it investigates the difference between WLTP declared values and WLTP values measured during the physical tests in the laboratory.

The vehicle categories analysed in this report are:

- → Category M1 vehicles (passenger cars): "motor vehicles with not more than eight seating positions in addition to the driver's seating position and without space for standing passengers, regardless of whether the number of seating positions is restricted to the driver's seating position"; and
- → Category N1 vehicles (vans, light commercial vehicles): "motor vehicles with a maximum mass not exceeding 3,5 tonnes".

2 Methodology

The report presents the results of an analysis based on two distinct data sets one of which was gathered from the ETAES platform and the other was provided from EEA.

The first one are 513 Type Approval (TA) reports (plus 142 Revisions and Corrections) uploaded to the ETAES electronic platform (www.etaes.eu) [11] in the period between 01/09/2017 and 31/08/2018. In total 1500 Interpolation (IP) families have been type-approved by 13 different TAAs from 11 MSs and 16 different TSs.

Secondly, the report considers the final CO_2 emission data from vehicles registered in the European Union in 2018, using the data set compiled by the EEA (2018 EEA, [12]).

2.1 ETAES Data

The data used have been collected from the ETAES platform [11] where TA documents from different MSs are uploaded by the TAAs and/or TSs. The submission of documents to this platform is performed voluntarily and therefore not all MSs appear in the analysis. Also, the number of TAs is limited to the first year of the introduction of the WLTP testing (the period between 01/09/2017 and 31/08/2018).

In the following sections two types of TA documents from ETAES have been analysed:

- Whole vehicle type-approval (WVTA) documents and
- Emission type-approval (ETA) documents.

As far as the WVTA documents are concerned, in general, the data collected include:

→ Technical characteristics of the vehicle (fuel, transmission, power, engine size, tires, etc.);
→ Results of the exhaust emission tests;
→ Interpolation family number;
→ WLTP and NEDC results of the CO_2 emissions (declared values) and fuel/electric energy consumption;
→ Results of CO_2MPAS simulation and deviation from declared NEDC CO_2 emissions (when available)

In total, 1500 Interpolation (IP) families that comply with Euro 6D-Temp standards were analysed. For these IP families, the ratio between the WLTP and NEDC declared CO_2 emissions were analysed for vehicles with different fuels, including both ICE and hybrid vehicles. Furthermore, the results were grouped by OEM groups (as shown in Table 1). From the 1500 IP families analysed, 1391 are M1 vehicle category and 109 are N1 vehicle category.

In addition to data available in WVTA documents, the ETA documents contain results of physical WLTP tests (measured-corrected results and number of tests performed). Therefore, the ETAs are a valuable source of information for what regards the difference between declared and measured WLTP CO_2 emissions. In total 166 IP families are analysed and results are presented. For the rest of the report, the results are being presented as OEM_1, OEM_2, etc.

Table 1. OEM groups

OEM Group	OEM	OEM Group	OEM
BMW Group	BMW	SUZUKI Group	Suzuki
	Mini	TOYOTA Group	Toyota
	Rolls-Royce		Lexus
HYUNDAI Group	Hyundai	MAZDA Group	Mazda
	Kia	MITSUBISHI Group	Mitsubishi
PSA Group	Peugeot	TATA Group	Jaguar
	Citroen		Land Rover
	DS	HONDA Group	Honda
	Opel	FUJI Group	Subaru
	Vauxhall	LOTUS Group	Lotus
	Tripod	SSANG YONG Group	Ssang Yong
VW Group	Audi	LAMBORGHINI Group	Lamborghini
	Seat	INFINITI Group	Infiniti
	Skoda	ASTON MARTIN Group	Aston Martin
	Volkswagen	FERRARI Group	Ferrari
FORD Group	Ford	AUTOVAZ Group	Lada
	CNG-Technik	MCLAREN Group	McLaren
DAIMLER Group	Daimler	GENERAL MOTORS (GM) Group	Chevrolet
	Mercedes		MG
RENAULT Group	Renault	MASERATI Group	Maserati
	Dacia	ALPINE Group	Alpine
	Nissan	DONGFENG SOKON (DFSK) Group	DFSK
GEELY Group	Volvo		Sokon
FCA Group	Fiat	JAC Group	Jac
	Jeep		
	Alfa Romeo		
	FCA		

Source: JRC, 2020.

2.2 2018 monitoring data (EEA)

The final CO2 emission monitoring data from vehicles (M1 and N1) registered in European Union in 2018, as reported by the Member States to the EEA, have also been analysed (2018 EEA, [12]) and the results have been combined with the outcome of the analysis using the type-approval (ETAES) data. In total 16,922,523 vehicles were registered in 2018 in the European Union of which 15,169,829 (~90%) were of M1 category and 1,752,694 (~10%) of N1 category. Approximately 30% of the M1 registered vehicles were WLTP type-approved and almost all of them had both NEDC and WLTP CO2 emissions reported (4,552,214 vehicles). The situation for N1 category is significantly different since only 2.6% of the registered vehicles were WLTP type-approved and almost all of them had both NEDC and WLTP CO2 emissions reported (44,934 vehicles).

Counter to the obligation of Members States to report the CO2 emissions of each registered vehicle to the EEA, the ETAES platform collects TAs voluntarily and therefore do not cover the entire fleet of OEMs neither they come from all Member States. In addition, because of the voluntary nature of the ETAES platform, the insertion of TAs often occurs on a different date compared to the one of the actual type-approval (delay of several months usually) and this results that the period of two data sets is not fully synchronised and therefore also fully comparable.

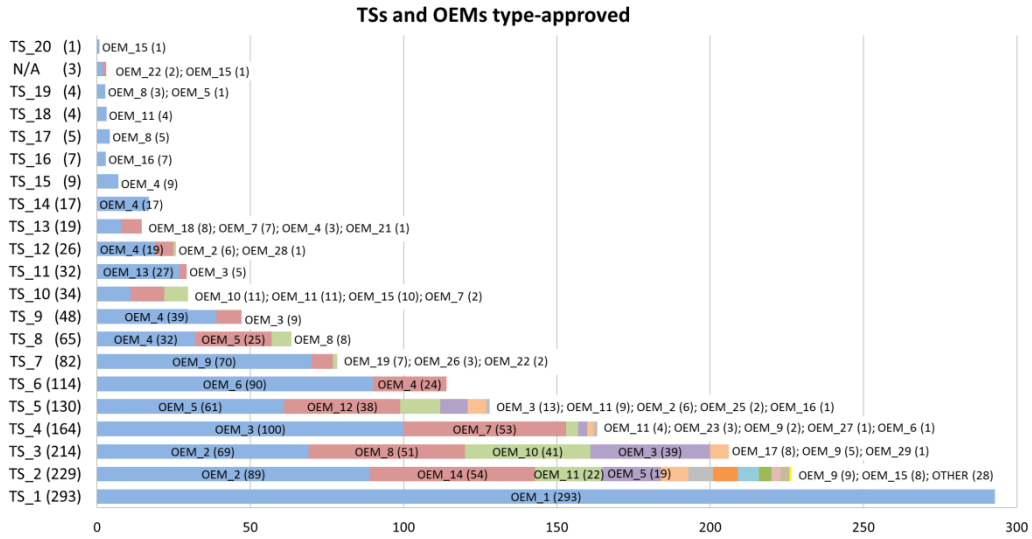
3 Results

3.1 General analysis

3.1.1 Analysis by TAAs/TSs, OEMs, MSs and vehicle characteristics

In total 1500 IP families have been analysed. Most type-approvals analysed were performed by TUV SUD (19%), followed by VCA (15%), RDW (14%), UTAC (11%) and TUV RH (9%). Figure 1 shows how many IP families (M1 and N1 together) have been tested and reported by 16 different TSs (also for which OEMs). Annex I shows full denomination of all TAAs and TSs.

Figure 1. Number of IP families of each OEM type-approved per TS.

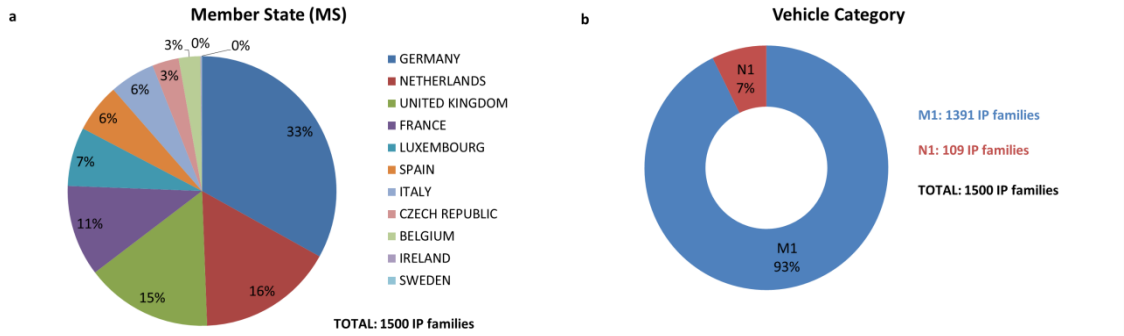


Source: JRC, 2020.

As shown in Figure 2a (where M1 and N1 are grouped together) one-third of the TA reports analysed came from Germany (496 TAs), 16% from the Netherlands, 15% from the United Kingdom, 11% from France, 7% from Luxembourg, 6% from Spain and Italy, 3% from the Czech Republic and Belgium. The remaining TAs came from Ireland (3) and Sweden (3).

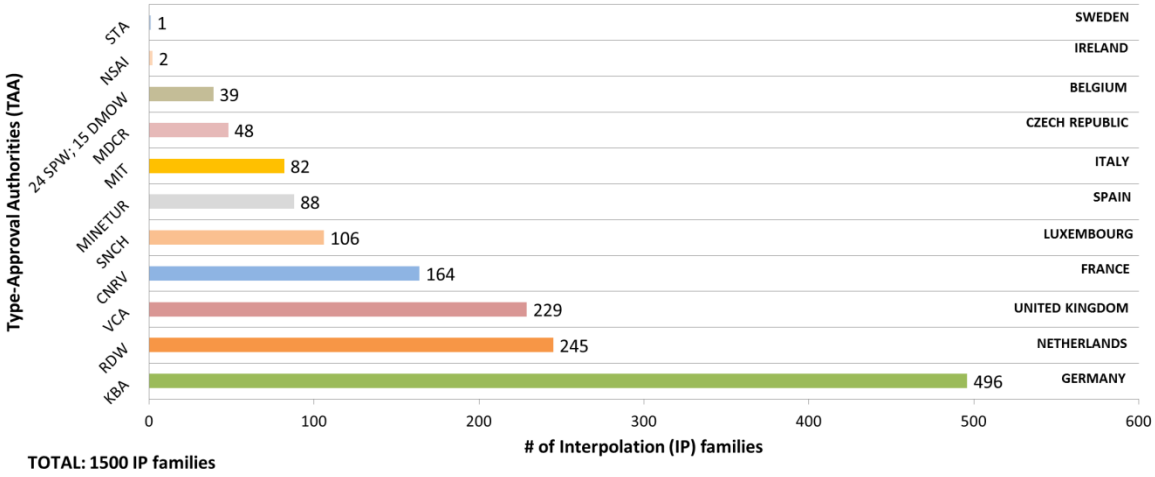
From the 1500 IP families, 1391 concern Category M1 vehicles and 109 Category N1 (Figure 2b). Figure 3 shows the number of TAs issued per TAA in each MS. All MSs have one TAA that issues TAs, except Belgium, which has two: SPW and DMOW.

Figure 2. (a) % of Interpolation (IP) families per Member State (MS) and (b) % of vehicle category for the total number of IP families analysed.



Source: JRC, 2020.

Figure 3. Number of IP families type approved per MS and TAAs.



Source: JRC, 2020.

3.1.2 Interpolation families

The interpolation family is composed of vehicles with identical powertrain and drivetrain configuration (engine type and capacity, transmission, number of powered axles, etc.). For a given family, the VH and VL are identified in each TA document. Since each IP family must have VH, the number of IP families is always identical to the number of VH. VL is optional, and having only VH inside of IP family can be one of the measures taken by the OEMs to increase the WLTP CO_2 emission. Therefore, in separate column is calculated the percentage of IP families that have only VH (for each OEM). Results are shown in Table 2a (M1 category) and 2b (N1 category).

Table 2 a. Number of interpolation (IP) families, VH and VL (ETAES), number of vehicles in final 2018 CO2 monitoring data set (EEA) for M1 vehicle category.

		ETAES					Final 2018 monitoring data		
OEM Group	IP	VH		VL		Only VH (WLTP)	TOTAL 2018	WLTP	WLTP and NEDC
		WLTP	NEDC	WLTP	NEDC				
OEM_1	291	291	291	289	280	1%	987,154	491,515	491,454
OEM_2	170	170	166	138	138	19%	1,013,182	255,045	254,983
OEM_3	141	141	92	133	89	6%	2,523,296	817,376	817,318
OEM_4	136	136	3	135	3	1%	3,506,714	728,616	728,213
OEM_5	65	65	11	57	7	12%	992,073	376,309	376,203
OEM_6	91	91	91	89	89	2%	939,992	378,745	377,805
OEM_7	56	56	49	40	34	29%	2,148,931	531,357	531,313
OEM_8	67	67	67	67	67	0%	297,869	174,924	166,338
OEM_9	76	76	5	70	4	8%	990,083	219,555	219,507
OEM_10	52	52	52	14	14	73%	239,533	44,685	44,619
OEM_11	44	44	6	40	4	9%	736,109	305,727	305,637
OEM_12	45	45	45	4	4	91%	224,333	69,653	69,648
OEM_13	26	26	25	0	0	100%	130,501	67,841	67,833
OEM_14	52	52	51	48	48	8%	227,701	55,343	55,341
OEM_15	20	20	19	15	15	25%	131,318	32,538	32,537
OEM_16	8	8	8	0	0	100%	32,417	6,945	6,945
OEM_17	8	8	8	0	0	100%	759	43	43
OEM_18	8	8	8	0	0	100%	14,451	1,156	1,098
OEM_19	7	7	7	0	0	100%	1,509	169	162
OEM_20	4	4	4	4	4	0%			
OEM_21	4	4	4	0	0	100%	2,162	654	652
OEM_22	4	4	4	0	0	100%	3,053	454	381
OEM_23	2	2	2	0	0	100%	4,911	116	115
OEM_24	3	3	3	0	0	100%	1,008	127	127
OEM_25	5	5	5	0	0	100%	11,994	1,634	1,634
OEM_26	3	3	0	3	0	0%	7,208	1,837	1,837
OEM_27	1	1	1	0	0	100%	1,537	457	457
OEM_28	1	1	1	0	0	100%	31	26	14
OEM_29	1	1	0	0	0	100%			
TOTAL	**1391**	**1391**	**1028**	**1146**	**800**	**18%**	**15,169,829**	**4,562,847**	**4,552,214**

Source: JRC, 2020.

When analysing the situation for M1 vehicle category from ETAES data the following observations can be made:

→ In total ~18% (245) of IP families are type-approved with only VH. Some OEMs are only type-approving VH (OEM_13, OEM_16, OEM_17, OEM_18, OEM_19, OEM_21, OEM_22, OEM_23, OEM_24, OEM_25, OEM_27, OEM_28), but except OEM_13, the other OEM groups have very low registrations. OEM groups with high registrations (more than half million) and high % of IP families with only VH are: OEM_7 (29%), OEM_5 (12%), OEM_2 (19%), OEM_9 (8%), and OEM_3 (6%). OEM_12 and OEM_10 are another OEMs with high % of IP families with only VH (91% and 73%, respectively) and registrations higher than 200,000.

While WLTP CO_2 emissions in ETAES documents are always provided for VH (and VL if available), NEDC CO_2 emissions are often missing in TA documents. The table also shows how many VH (and VL) have NEDC CO_2 emissions.

→ For 26% of VH and 30% of VL NEDC CO_2 emissions are missing. The situation is worst for OEM_4 (98%), OEM_9 (93%), OEM_11 (86%), OEM_5 (83%) and OEM_3 (35%) where numbers in brackets refer to percentage of IP families with NEDC CO_2 emissions missing.

In order to check the representativeness of ETAES sample analysed and whether the number of type-aproval families can be linked to the number of vehicles registered in 2018, the EEA 2018 data are also presented in the Table 2a (total 2018 M1 registrations, 2018 registrations of WLTP vehicles, and 2018 vehicles registered for which both NEDC and WLTP CO_2 emissions have been provided).

→ In the EEA data 30% of vehicles sold in 2018 were WLTP type-approved. Almost all of these vehicles had both NEDC and WLTP CO_2 emissions reported.
→ In 2018, OEM_3, OEM_4, and OEM_1 groups registered the most of WLTP M1 vehicles, while the most IP families in TA documents analysed are from OEM_1, OEM_2 and OEM_3 groups.

The same analysis has been performed also for the N1 vehicle category and according to Table 2b it can be seen that:

→ In total, ~19% (21) of IP families are type-approved with only VH. OEM_5 has type-approved 37% of IP families with only VH, whereas the rest of the OEM groups have significantly lower percentages of only VH type-approvals (OEM_4 with 14%, OEM_3 with 8% and OEM_7 with 7%).
→ For 70% of VH and 67% of VL NEDC CO_2 emissions are missing in ETAES TA documents. The situation is worst for OEM_4 (100%), OEM_9 (100%), OEM_11 (100%), OEM_5 (97%) and OEM_3 (39%). Numbers in brackets refer to the percentage of IP families with NEDC CO_2 emissions missing.
→ In the EEA data only ~2.5% of vehicles sold in 2018 were WLTP type-approved. Almost all of these vehicles had both NEDC and WLTP CO_2 emissions reported.
→ In 2018, OEM_5 group registered the most WLTP N1 vehicles and most of the IP families in TA documents analysed are from the same group.

Table 2 b. Number of interpolation (IP) families, VH and VL (ETAES), number of vehicles in final 2018 CO2 monitoring data set for N1 vehicle category.

		ETAES					Final 2018 monitoring data		
OEM Group	**IP**	**VH**		**VL**		**Only VH (WLTP)**	**TOTAL 2018**	**WLTP**	**WLTP and NEDC**
		WLTP	**NEDC**	**WLTP**	**NEDC**				
OEM_5	41	41	1	26	1	37%	313,140	23,504	23,496
OEM_3	25	25	14	23	14	8%	426,335	2,947	2,936
OEM_7	14	14	13	13	10	7%	327,525	5,634	5,601
OEM_9	10	10	0	10	0	0%	149,422	3,285	3,248
OEM_4	7	7	0	6	0	14%	214,003	1,997	1,977
OEM_11	6	6	0	6	0	0%	42,374	698	640
OEM_1	2	2	2	2	2	0%	417	115	114
OEM_14	2	2	2	2	2	0%	1,841	510	498
OEM_13	1	1	0	0	0	100%	18,042	9	8
OEM_23	1	1	1	0	0	100%	350	30	30
OTHER							259,245	6,477	6,386
TOTAL	**109**	**109**	**33**	**88**	**29**	**19%**	**1,752,694**	**45,206**	**44,934**

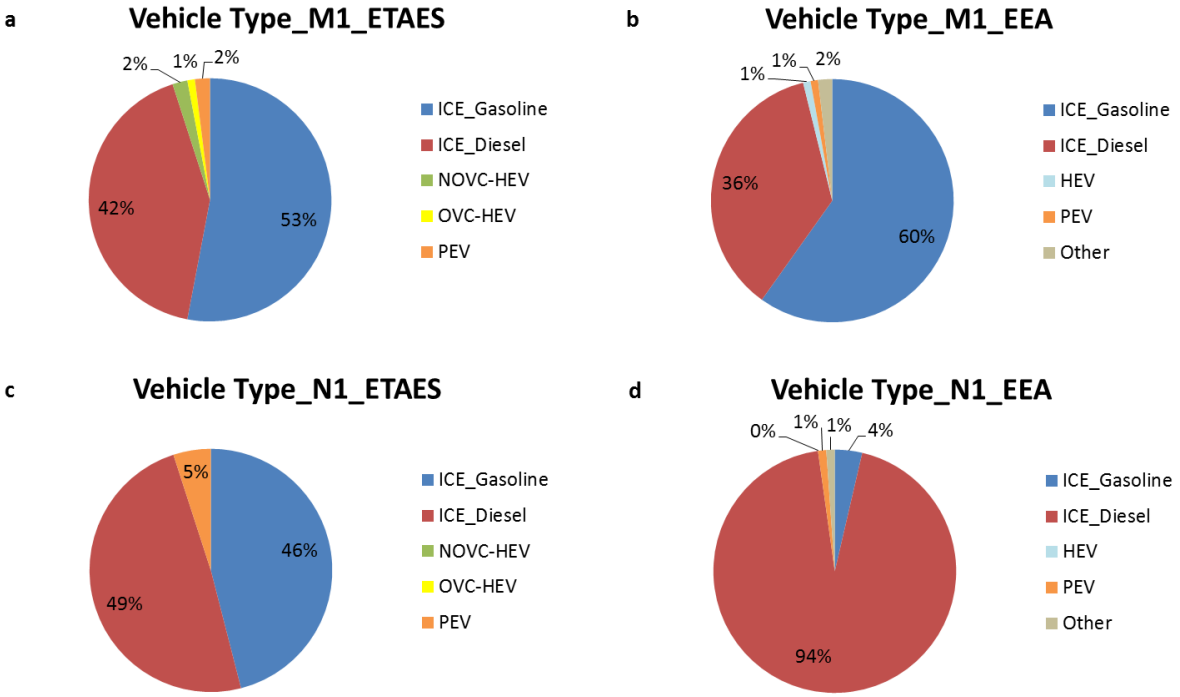
Source: JRC, 2020.

3.1.3 Fuel type and transmission

When analysed by fuel type, for the M1 vehicle category, the highest number of IP families in the ETAES dataset concern gasoline vehicles, (53%), followed by diesel vehicles (42%), hybrid vehicles (3%), and pure electric vehicles (2%), as shown in Figure 4a. In Figure 4b, the 2018 EEA dataset of WLTP type-approved vehicles shows a higher percentage of gasoline vehicles (60%), and a lower percentage of diesel vehicles (36%). The percentage of hybrids is 1% and pure electric vehicles 1%.

Figures 4c and 4d analyse the fuel type for vehicles of N1 vehicle category. Gasoline and diesel vehicles share a similar percentage with 49% of the IP families analysed from the ETAES platform being diesel and 46% being gasoline. The rest 5% represents pure electric vehicles. On the other hand, the data from the EEA dataset show that the vast majority (94%) of the registered N1 vehicle category are diesel, only 4% are gasoline and hybrids represent only 1% of the total number of registrations.

Figure 4. Fuel type for M1 from ETAES (a) and EEA (b) and N1 from ETAES (c) and EEA (d)(EEA: WLTP only).



Source: JRC, 2020.

In Table of Annex II, the fuel type data are grouped by OEM for the ETAES M1 and N1 vehicle categories. The highest number of gasoline type-approvals is coming from OEM_2 (13%), followed by OEM_1 (12%), OEM_4 (11%), and OEM_3 (9%). The highest number of diesel type-approvals is coming from OEM_1 (29%), followed by OEM_3 (13%), OEM_5 (10%), and OEM_2 (9%).

As far as the transmission of the M1 and N1 vehicle categories from the ETAES is concerned 48% of them have automatic transmission (AT), 46% manual transmission (MAN) and 4% are CVT vehicles (Table 3). For ~1% of the analysed vehicles, the transmission type could not be identified.

3.1.4 Engine size and power

Annex IIIa and IIIb show the size of engine of the vehicles analysed grouped by OEM for the ETAES dataset for the M1 and N1 vehicle categories respectively. 24% of M1 and ~38% of N1 vehicles analysed have engine sizes smaller than 1400cc, 28% of M1 and 49% of N1 between 1400 and 1800cc whereas 35% and 9% for M1 and N1 respectively have engine sizes between 1800 and 2200cc. Bigger engine sizes (>2200cc) belong to only 13% of the M1 vehicles analysed in this report and for the N1 vehicles, this percentage is 5%. These percentages refer to the total of all fuel type vehicles, i.e. gasoline, diesel and CNG.

Table 3. Gearbox type of analysed vehicles for the ETAES M1 and N1 in () vehicle categories.

OEM Group	TOTAL	AT	MT	CVT	n/a
OEM_1	291(2)	216(2)	75		
OEM_2	170	73	93		4
OEM_3	141(25)	49(4)	89(19)	3(2)	
OEM_4	136(7)	67(1)	69(6)		
OEM_5	65(41)	12(10)	52(31)		1
OEM_6	91	80	11		
OEM_7	56(14)	12(1)	41(13)	3	
OEM_8	67	56	11		
OEM_9	76(10)	27	49(10)		
OEM_10	52	12	31	9	
OEM_11	44(6)	9(1)	15(3)	20(1)	(1)
OEM_12	45	20	25		
OEM_13	26(1)	1(1)	14	11	
OEM_14	52(2)	38(2)	14		
OEM_15	20	2	10	8	
OEM_16	8			8	
OEM_17	8	1	7		
OEM_18	8				8
OEM_19	7	7			
OEM_20	4	3	1		
OEM_21	4	4			
OEM_22	4	2	2		
OEM_23	2(1)		2(1)		
OEM_24	3	3			
OEM_25	5	2	3		
OEM_26	3	3			
OEM_27	1	1			
OEM_28	1			1	
OEM_29	1	1			
TOTAL	**1391(109)**	**701(22)**	**614(83)**	**63(3)**	**13(1)**

Source: JRC, 2020.

Annex IV-a shows the rated engine power of the vehicles analysed grouped by different OEMs. 42% of the vehicles have a rated power lower than 100kW, most of them (~21%) being between 76 and 100kW for gasoline, diesel and CNG fuel type. The rest ~40% of the analysed vehicles have a rated power of more than 101kW and more, in particular, 25% is between 101 and 125kW, 8% between 126 and 150kW. High rated power vehicles, i.e. more than 151kW are 26% of the total number of vehicles analysed in this report. Annex IV-b

presents the same analysis for the ETAES N1 vehicle category. In this case, the majority (84%) of the vehicles analysed has a rated engine power less than 100kW and 53% of these lay between 51 and 75kW. The rest 16% has a rated engine power of more than 101kW.

In the case of NOVC, OVC and PEV vehicles, half of the vehicles have an electric motor of maximum net power of less than 100kW and 25% of them have an electric motor of more than 101kW. For the rest 25% of these vehicles, the maximum net power was not found reported in the corresponding TA documents. The table with the maximum net power of the electric motor for M1 and N1 vehicle categories for the ETAES dataset can be found in Annex V.

3.2 NEDC and WLTP CO_2 emissions

3.2.1 ICE vehicles

3.2.1.1 NEDC and WLTP CO_2 emissions

Type-approval data have been collected from 1500 IP families. To compare the WLTP type-approved CO_2 emissions with the NEDC ones for the same IP family, both CO_2 emissions are needed. As shown in section 3.1.2., for 29% of VH and 33% of VL NEDC CO_2 emissions are missing. Therefore, the analysis is based on 1031 (both M1 and N1 for VH) and 804 (both M1 and N1 for VL) IP families for which both WLTP and NEDC CO_2 emission values are provided.

Table 4a presents the main findings grouped by OEM group for what concerns the average WLTP/NEDC TA CO_2 ratio for VH and VL for all ICE vehicles of M1 vehicle category. Also, the 2018 EEA registrations data are analysed, grouped by OEMs, and shown in the same table. The corresponding results for N1 vehicle category are shown in Table 4b.

For the M1 vehicles, according to Table 4a:

- The mean WLTP/NEDC TA CO_2 ratio (all OEMs) for VH is 1.20, and for VL it is 1.15. The WLTP/NEDC ratio for individual IP families ranges from 0.94 to 1.52 for VH and VL between 0.96 and 1.39.
- The 2018 EEA data show an average WLTP/NEDC ratio equal to 1.21.
- The highest average ratio for VH was calculated for OEM_3 group (1.30 with the maximum going to 1.46), and for VL again for OEM_3 group (1.22 with the maximum going to 1.39). The OEM_1, OEM_3, OEM_4 and OEM_11 2018 EEA registrations data show the highest registration weighted ratio of 1.27, 1.23, 1.23 and 1.25 respectively.
- Higher than the average WLTP/NEDC TA CO_2 ratio for VH was calculated also for OEM_1 (1.26 with maximum going to 1.38), OEM_4 (1.26 with maximum going to 1.33), OEM_8 (1.26 with maximum going to 1.37), OEM_11 (1.22 with maximum going to 1.42), OEM_14 (1.22 with maximum going to 1.33), and OEM_15 (1.22 with maximum going to 1.43) groups. Beside the OEM_3 group, higher than the average WLTP/NEDC TA CO_2 ratio for VL is found for OEM_12 (1.20 with maximum going to 1.28), OEM_11 (1.19 with maximum going to 1.24), OEM_15 (1.19 with maximum going to 1.30), OEM_1 (1.17 with maximum going to 1.27), OEM_4 (1.17 with maximum going to 1.21), and OEM_8 (1.17 with maximum going to 1.27) groups. Beside the OEM_3 and OEM_11 group, higher than the average WLTP/NEDC TA CO_2 ratio for 2018 EEA registrations is calculated for OEM_1 (1.27), OEM_4 (1.23) and OEM_28 (1.27). These results are better presented in Figure in Annex VI-a.

Table 4 a. Summary results of WLTP/NEDC CO_2 ratio for all ICE vehicles from ETAES (VH and VL) and 2018 EEA for M1 vehicle category.

OEM Group	ALL VH					ALL VL					ALL EEA (registrations weighed)				
	IP No	MEAN	STDEV	MIN	MAX	IP No	MEAN	STDEV	MIN	MAX	Reg No	MEAN	STDEV	MIN	MAX
OEM_1	281	1.26	0.07	1.00	1.38	270	1.17	0.05	0.98	1.27	460,916	1.27	0.35	0.01	19.65
OEM_2	162	1.15	0.06	1.00	1.29	134	1.12	0.06	0.99	1.25	243,049	1.14	0.06	0.89	1.49
OEM_3	92	1.30	0.09	1.11	1.46	89	1.22	0.07	1.08	1.39	810,202	1.23	0.09	0.10	4.00
OEM_4	3	1.26	0.06	1.20	1.33	3	1.17	0.06	1.10	1.21	708,317	1.23	0.05	0.00	1.59
OEM_5	11	1.16	0.20	0.97	1.52	7	1.10	0.16	0.96	1.32	364,288	1.19	0.06	0.63	1.86
OEM_6	88	1.18	0.05	1.03	1.28	86	1.11	0.05	0.97	1.29	368,881	1.16	0.06	0.49	1.86
OEM_7	49	1.17	0.07	1.01	1.33	34	1.12	0.07	0.98	1.33	455,115	1.19	0.06	0.01	2.44
OEM_8	62	1.26	0.06	1.15	1.37	62	1.17	0.05	1.05	1.27	158,305	1.21	0.08	0.34	3.36
OEM_9	5	1.09	0.06	1.03	1.15	4	1.06	0.07	0.99	1.14	173,057	1.17	0.05	0.01	1.49
OEM_10	44	1.18	0.05	1.07	1.30	10	1.14	0.05	1.08	1.26	44,594	1.15	0.05	1.00	1.73
OEM_11	6	1.22	0.18	0.97	1.42	4	1.19	0.05	1.14	1.24	305,635	1.25	0.16	0.97	3.54
OEM_12	45	1.12	0.09	0.97	1.30	4	1.20	0.06	1.16	1.28	69,648	1.14	0.07	0.99	1.93
OEM_13	25	1.11	0.03	1.04	1.17	0	n/a	n/a	0.00	0.00	58,406	1.16	0.06	1.00	1.35
OEM_14	51	1.22	0.05	1.03	1.33	48	1.15	0.04	1.07	1.22	52,295	1.20	0.06	0.49	2.24
OEM_15	19	1.22	0.10	1.05	1.43	15	1.19	0.07	1.06	1.30	32,529	1.20	0.08	1.00	1.45
OEM_16	8	1.17	0.01	1.15	1.18	0	n/a	n/a	0.00	0.00	6,932	1.16	0.03	0.97	1.18
OEM_17	8	0.99	0.04	0.94	1.03	0	n/a	n/a	0.00	0.00	43	0.96	0.03	0.94	1.03
OEM_18	8	1.05	0.03	1.01	1.08	0	n/a	n/a	0.00	0.00	1,094	1.06	0.05	0.68	1.18
OEM_19	7	1.01	0.03	0.98	1.07	0	n/a	n/a	0.00	0.00	162	1.10	0.07	0.99	1.36
OEM_20	4	1.13	0.05	1.06	1.19	4	1.10	0.05	1.03	1.16		1.11	0.02	0.97	1.14
OEM_21	4	1.10	0.05	1.06	1.14	0	n/a	n/a	0.00	0.00	652	1.09	0.12	1.00	3.37
OEM_22	4	1.09	0.04	1.05	1.13	0	n/a	n/a	0.00	0.00	381	1.04	0.02	0.90	1.16
OEM_23	2	1.04	0.00	1.04	1.04	0	n/a	n/a	0.00	0.00	115	1.08	0.06	0.85	1.55
OEM_24	3	1.09	0.04	1.04	1.11	0	n/a	n/a	0.00	0.00	127	1.11	0.02	1.07	1.29
OEM_25	5	1.14	0.04	1.09	1.18	0	n/a	n/a	0.00	0.00	1,631	1.10	0.05	1.00	1.19
OEM_26	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	1,837	1.08	0.00	1.08	1.08
OEM_27	1	1.08	n/a	1.08	1.08	0	n/a	n/a	0.00	0.00	457	1.05	0.06	1.00	1.16
OEM_28	1	1.11	n/a	1.11	1.11	0	n/a	n/a	0.00	0.00	13	1.27	0.35	0.01	19.65
OEM_29	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00					
TOTAL	**998**	**1.20**	**0.09**	**0.94**	**1.52**	**774**	**1.15**	**0.07**	**0.96**	**1.39**	**4,318,681**	**1.21**	**0.14**	**0.00**	**19.65**

* IP No: number of IP families; Reg No: number of vehicles registered

Source: JRC, 2020.

For the N1 vehicles, according to Table 4b:

- The mean WLTP/NEDC TA CO_2 ratio (all OEMs) for VH is 1.23, and for VL it is 1.18. The WLTP/NEDC ratio for individual IP families for VH ranges from 0.97 to 1.41 and for VL between 1.06 and 1.33.
- The 2018 EEA data show an average WLTP/NEDC ratio equal to 1.24.

- ❖ The highest average ratio for VH was calculated for OEM_3 group (1.31 with the maximum going to 1.41), and for VL again for OEM_3 group (1.23 with the maximum going to 1.33). The OEM_3 and OEM_5 2018 EEA registrations data show the highest registrations weighted ratio of 1.28 both.
- ❖ Higher than the average WLTP/NEDC TA CO_2 ratio for VH was calculated also for OEM_14 (1.24 with the maximum going to 1.26). These results are better presented in Figure in Annex VI-b.

Table 4 b. Summary results of WLTP/NEDC CO2 ratio for all ICE vehicles from ETAES (VH and VL) and 2018 EEA for N1 vehicle category.

OEM Group	ALL VH					ALL VL					ALL EEA (registrations weighed)				
	IP No	MEAN	STDEV	MIN	MAX	IP No	MEAN	STDEV	MIN	MAX	Reg No	MEAN	STDEV	MIN	MAX
OEM_1	2	1.23	0.00	1.23	1.24	2	1.17	0.00	1.17	1.17	114	1.23	0.03	1.14	1.30
OEM_3	14	1.31	0.07	1.24	1.41	14	1.23	0.07	1.14	1.33	2,563	1.28	0.10	1.00	1.62
OEM_4	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	1,788	1.15	0.09	0.90	1.47
OEM_5	1	1.21	n/a	1.21	1.21	1	1.17	n/a	1.17	1.17	23,496	1.28	0.06	0.74	1.45
OEM_7	13	1.16	0.08	0.97	1.25	10	1.13	0.06	1.06	1.20	3,873	1.18	0.07	0.82	1.50
OEM_9	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	2,835	1.11	0.02	1.00	1.29
OEM_11	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	640	1.23	0.05	1.00	1.35
OEM_13											8	1.00	0.13	0.81	1.17
OEM_14	2	1.24	0.02	1.23	1.26	2	1.16	0.03	1.14	1.18	498	1.23	0.02	1.00	1.26
OEM_23	1	1.04	n/a	1.04	1.04	0	n/a	n/a	0.00	0.00	30	1.03	0.00	1.03	1.03
OTHER											1,759	1.18	0.09	0.63	1.42
TOTAL	**33**	**1.23**	**0.10**	**0.97**	**1.41**	**29**	**1.18**	**0.07**	**1.06**	**1.33**	**37,604**	**1.24**	**0.09**	**0.63**	**1.62**

Source: JRC, 2020.

Gasoline vehicles

For the M1 vehicles, as shown in Table 5a, the average WLTP/NEDC CO_2 ratio for gasoline vehicles is 1.16 for VH (554 IP families) and 1.13 for VL (357 IP families). The 2018 EEA data show a higher average ratio of 1.19 for gasoline vehicles.

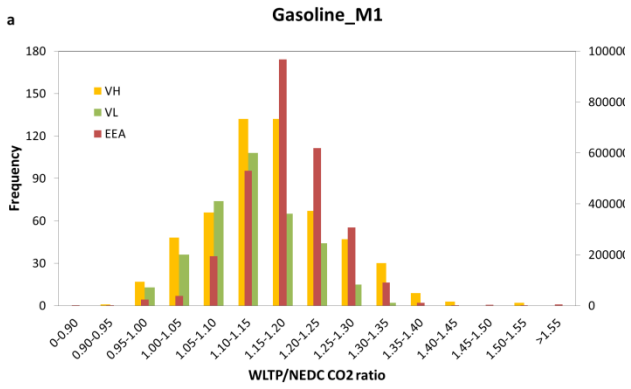
The distribution of the WLTP/NEDC ratio for gasoline vehicles is presented in Figure 5a. It is evident from 2018 EEA data that more gasoline vehicles are registered with configurations that have a WLTP/NEDC TA CO_2 emissions ratio closer to that of VH compared to VL. More gasoline vehicles are sold with WLTP/NEDC TA CO_2 ratio higher than 1.15 (~80%) than with a ratio below 1.15 (~20%).

From the data grouped by OEMs, it is evident that:

- ❖ The WLTP/NEDC ratio for individual IP families for gasoline VH is between 0.94 and 1.52 and for VL it is between 0.96 and 1.32.
- ❖ The highest average ratio for gasoline VH was found for OEM_3 group (1.26 with maximum 1.43), and this was also the case for gasoline VL (1.19 with maximum 1.30). A higher than average WLTP/NEDC TA CO_2 ratio for gasoline VH was also found for OEM_1 (1.23 with maximum 1.36), OEM_8 (1.21 with maximum 1.28), OEM_15 (1.21 with maximum 1.43), OEM_14 (1.20 with maximum 1.29), OEM_4 (1.20), OEM_10 (1.18 with maximum 1.30), and OEM_16 (1.17 with maximum 1.18) groups. Higher than average WLTP/NEDC TA CO_2 ratios for gasoline VL were also found for OEM_15 (1.18 with maximum 1.30), OEM_1 (1.16 with maximum 1.26), OEM_12 (1.16 with maximum going to 1.17), OEM_10 (1.14 with maximum 1.26), and OEM_14 (1.14 with maximum 1.20) groups.
- ❖ The 2018 EEA registrations data show the highest average ratio of 1.26 for OEM_1. Higher than average WLTP/NEDC TA CO_2 ratios were also found for OEM_11 (1.25), OEM_3 (1.20) and OEM_4 (1.20). These results are better presented in Annex VI-a.

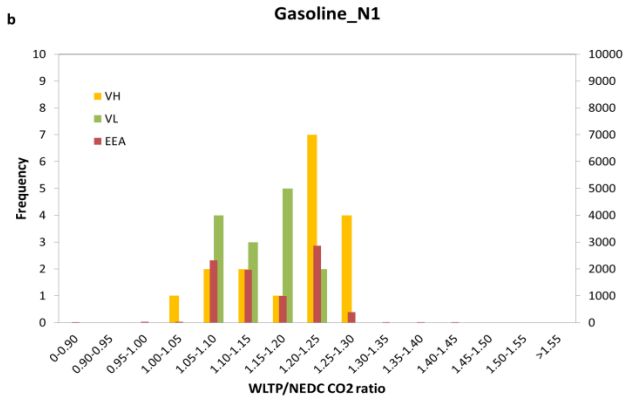
Figure 5. Distribution of WLTP/NEDC TA CO2 ratio for gasoline vehicles (VH, VL, 2018 EEA) for the M1 vehicle category (a) and the N1 vehicle category (b).

a



	VH	VL	EEA
WLTP / NEDC CO_2 ratio	***Cumulative %***	***Cumulative %***	***Cumulative %***
0-0.90	0%	0%	0%
0.90-0.95	0%	0%	0%
0.95-1.00	3%	4%	1%
1.00-1.05	12%	14%	1%
1.05-1.10	24%	34%	7%
1.10-1.15	48%	65%	19%
1.15-1.20	71%	83%	35%
1.20-1.25	84%	95%	22%
1.25-1.30	92%	99%	11%
1.30-1.35	97%	100%	3%
1.35-1.40	99%	100%	0%
1.40-1.45	100%	100%	0%
1.45-1.50	100%	100%	0%
1.50-1.55	100%	100%	0%
>1.55	100%	100%	0%

b



	VH	VL	EEA
WLTP / NEDC CO_2 ratio	***Cumulative %***	***Cumulative %***	***Cumulative %***
0-0.90	0%	0%	0%
0.90-0.95	0%	0%	0%
0.95-1.00	0%	0%	0%
1.00-1.05	6%	0%	0%
1.05-1.10	18%	29%	27%
1.10-1.15	29%	50%	23%
1.15-1.20	35%	86%	11%
1.20-1.25	76%	100%	33%
1.25-1.30	100%	100%	5%
1.30-1.35	100%	100%	0%
1.35-1.40	100%	100%	0%
1.40-1.45	100%	100%	0%
1.45-1.50	100%	100%	0%
1.50-1.55	100%	100%	0%
>1.55	100%	100%	0%

Source: JRC, 2020.

Table 5 a. Summary results for gasoline ICE vehicles from ETAES (VH and VL) and 2018 EEA for M1 vehicle category.

OEM Group	GASOLINE VH					GASOLINE VL					GASOLINE EEA (registrations weighted)				
	IP No	MEAN	STDEV	MIN	MAX	IP No	MEAN	STDEV	MIN	MAX	Reg No	MEAN	STDEV	MIN	MAX
OEM_1	96	1.23	0.08	1.00	1.36	87	1.16	0.07	0.98	1.26	185,833	1.26	0.37	0.12	19.65
OEM_2	103	1.12	0.05	1.00	1.21	83	1.09	0.05	0.99	1.17	205,551	1.12	0.05	1.00	1.49
OEM_3	39	1.26	0.08	1.12	1.43	38	1.19	0.06	1.08	1.30	530,020	1.20	0.07	0.11	3.65
OEM_4	1	1.20	n/a	1.20	1.20	1	1.10	n/a	1.10	1.10	394,723	1.20	0.05	0.01	1.56
OEM_5	10	1.14	0.21	0.97	1.52	6	1.09	0.17	0.96	1.32	253,844	1.17	0.05	0.76	1.86
OEM_6	47	1.14	0.04	1.03	1.24	46	1.08	0.05	0.97	1.29	187,882	1.15	0.05	0.49	1.65
OEM_7	35	1.15	0.07	1.01	1.28	26	1.11	0.07	0.98	1.25	330,686	1.16	0.04	0.01	2.44
OEM_8	25	1.21	0.04	1.15	1.28	25	1.13	0.03	1.08	1.18	47,686	1.15	0.05	0.34	3.36
OEM_9	3	1.05	0.04	1.03	1.09	2	1.00	0.02	0.99	1.02	136,039	1.17	0.05	0.92	1.35
OEM_10	44	1.18	0.05	1.07	1.30	10	1.14	0.05	1.08	1.26	44,594	1.15	0.05	1.00	1.73
OEM_11	2	1.01	0.06	0.97	1.05	0	n/a	n/a	0.00	0.00	301,107	1.25	0.17	0.97	3.54
OEM_12	35	1.09	0.07	0.97	1.19	2	1.16	0.01	1.16	1.17	59,901	1.12	0.07	0.99	1.45
OEM_13	25	1.11	0.03	1.04	1.17	0	n/a	n/a	0.00	0.00	58,393	1.16	0.06	1.00	1.35
OEM_14	17	1.20	0.06	1.03	1.29	14	1.14	0.03	1.09	1.20	11,136	1.19	0.07	0.49	1.66
OEM_15	17	1.21	0.10	1.05	1.43	13	1.18	0.07	1.06	1.30	27,860	1.18	0.08	1.00	1.45
OEM_16	8	1.17	0.01	1.15	1.18	0	n/a	n/a	0.00	0.00	6,932	1.16	0.03	0.97	1.18
OEM_17	8	0.99	0.04	0.94	1.03	0	n/a	n/a	0.00	0.00	42	0.96	0.03	0.94	1.03
OEM_18	8	1.05	0.03	1.01	1.08	0	n/a	n/a	0.00	0.00	954	1.06	0.05	0.81	1.18
OEM_19	7	1.01	0.03	0.98	1.07	0	n/a	n/a	0.00	0.00	162	1.10	0.07	0.99	1.36
OEM_20	4	1.13	0.05	1.06	1.19	4	1.10	0.05	1.03	1.16					
OEM_21	4	1.10	0.05	1.06	1.14	0	n/a	n/a	0.00	0.00	651	1.11	0.02	0.97	1.14
OEM_22	4	1.09	0.04	1.05	1.13	0	n/a	n/a	0.00	0.00	381	1.09	0.12	1.00	3.37
OEM_23	2	1.04	0.00	1.04	1.04	0	n/a	n/a	0.00	0.00	115	1.04	0.02	0.90	1.16
OEM_24	3	1.09	0.04	1.04	1.11	0	n/a	n/a	0.00	0.00	127	1.08	0.06	0.85	1.55
OEM_25	5	1.14	0.04	1.09	1.18	0	n/a	n/a	0.00	0.00	1,631	1.11	0.02	1.07	1.29
OEM_26	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	876	1.06	0.03	1.00	1.12
OEM_27	1	1.08	n/a	1.08	1.08	0	n/a	n/a	0.00	0.00	457	1.08	0.00	1.08	1.08
OEM_28	1	1.11	n/a	1.11	1.11	0	n/a	n/a	0.00	0.00	13	1.05	0.06	1.00	1.16
OEM_29															
TOTAL	**554**	**1.16**	**0.09**	**0.94**	**1.52**	**357**	**1.13**	**0.07**	**0.96**	**1.32**	**2,787,596**	**1.19**	**0.13**	**0.01**	**19.65**

Source: JRC, 2020.

For the N1 vehicles, as shown in Table 5b, the average WLTP/NEDC CO_2 ratio for gasoline vehicles is 1.19 for VH (17 IP families) and 1.14 for VL (14 IP families). The 2018 EEA data show the average ratio of 1.16 for gasoline vehicles.

The distribution of the WLTP/NEDC ratio for gasoline vehicles is presented in Figure 5b. It is evident from 2018 EEA data that more gasoline vehicles are registered with configurations that have a WLTP/NEDC TA CO_2 emissions ratio closer to that of VH compared to VL. More gasoline vehicles are sold with WLTP/NEDC TA CO_2 ratio higher than 1.15 (77%) than with a ratio below 1.15 (23%).

From the data grouped by OEMs, it is evident that:

→ The WLTP/NEDC ratio for individual IP families for gasoline VH is between 1.04 and 1.26 and for VL it is between 1.06 and 1.23.

→ The highest average ratio for gasoline VH was found for OEM_3 group (1.25 with maximum 1.26), and this was also the case for gasoline VL (1.19 with maximum 1.23). A higher than average WLTP/NEDC

TA CO_2 ratio for gasoline VH was also found for OEM_5 (1.21 with maximum 1.21) but with only 1 vehicle. The same occurred also in the case of VL for OEM_5 group (1.17 with maximum 1.17).

→ The 2018 EEA registrations data show the highest average ratio of 1.23 for OEM_1 and OEM_11 groups. Higher than average WLTP/NEDC TA CO_2 ratios were also found for OEM_3 (1.21) and OEM_5 (1.22). These results are better presented in Annex VI-b.

Table 5 b. Summary results for gasoline ICE vehicles from ETAES (VH and VL) and 2018 EEA for N1 vehicle category.

OEM Group	GASOLINE VH					GASOLINE VL					GASOLINE EEA (registrations weighted)				
	IP No	MEAN	STDEV	MIN	MAX	IP No	MEAN	STDEV	MIN	MAX	Reg No	MEAN	STDEV	MIN	MAX
OEM_1	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	3	1.23	0.06	1.18	1.29
OEM_3	6	1.25	0.01	1.24	1.26	6	1.19	0.04	1.14	1.23	253	1.21	0.04	1.00	1.34
OEM_4	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	546	1.14	0.05	1.04	1.35
OEM_5	1	1.21	n/a	1.21	1.21	1	1.17	n/a	1.17	1.17	2,737	1.22	0.02	1.07	1.45
OEM_7	9	1.16	0.06	1.07	1.22	7	1.10	0.05	1.06	1.16	1,415	1.10	0.03	0.82	1.29
OEM_9	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	2,834	1.11	0.02	1.00	1.29
OEM_11	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	423	1.23	0.05	1.13	1.29
OEM_13											1	1.15		1.15	1.15
OEM_14	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	5	1.16	0.04	1.12	1.23
OEM_23	1	1.04	n/a	1.04	1.04	0	n/a	n/a	0.00	0.00	30	1.03	0.00	1.03	1.03
OTHER											349	1.15	0.08	0.70	1.37
TOTAL	17	1.19	0.07	1.04	1.26	14	1.14	0.06	1.06	1.23	8,596	1.16	0.06	0.70	1.45

Source: JRC, 2020.

Diesel vehicles

For M1 category diesel vehicles, results from 444 IP families (VH) and 417 IP families (VL) were analysed and as shown in Table 6a, the mean ratio for VH is 1.26 and for VL 1.18. The 2018 EEA data show an average ratio equal to 1.25. The distribution of the ratio is shown in Figure 6a. It is clear from 2018 EEA data that diesel vehicles registered have configurations closer to that of VH in terms of WLTP/NEDC TA CO_2 ratio. In addition, more diesel vehicles are registered with a WLTP/NEDC TA CO_2 ratio higher than 1.20 (85%) than with a ratio below 1.20 (15%).

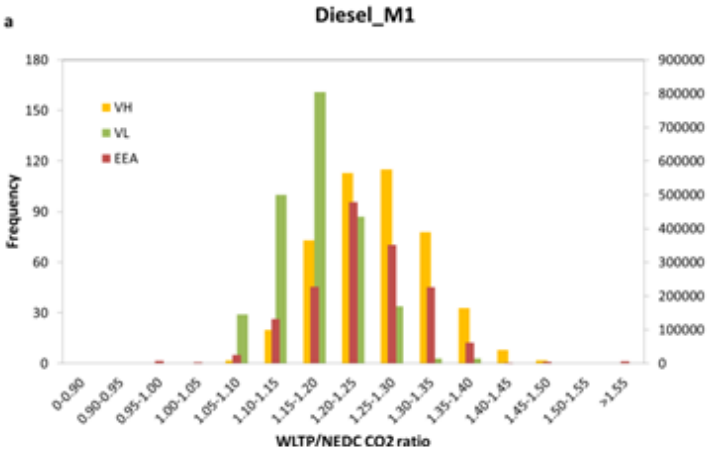
Data grouped by OEM are shown in Table 6a. These results confirm:

→ That the WLTP/NEDC ratio is higher for diesel vehicles compared to gasoline vehicles. For diesel VH, the ratio is between 1.09 and 1.46 and for VL between 1.05 and 1.39. The highest average ratio for diesel VH was found for OEM_3 group (1.34 with a maximum of 1.46). Higher than average WLTP/NEDC TA CO_2 ratios for diesel VH were also found for OEM_11 (1.33 with maximum 1.42), OEM_15 (1.31 with maximum 1.34), OEM_4 (1.29 with maximum 1.33), OEM_8 (1.29 with maximum 1.37), OEM_1 (1.27 with maximum 1.38) and OEM_5 (1.32 with maximum 1.32) groups.

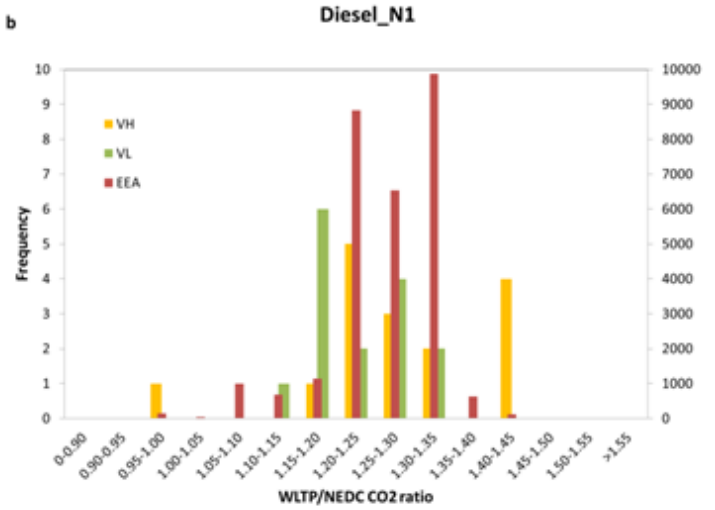
→ The highest average ratio for diesel VL was found for OEM_15 group (1.25 with a maximum of 1.26). Higher than average WLTP/NEDC TA CO_2 ratios for diesel VL were also found for OEM_3 (1.24 with a maximum of 1.39), OEM_12 (1.23 with maximum 1.28), OEM_4 (1.21 with maximum 1.21), OEM_8 (1.20 with a maximum of 1.27), and OEM_11 (1.23 with maximum 1.28) groups.

→ The 2018 EEA registrations data show also the highest average ratio of 1.28 coming from OEM_3 and OEM_4 groups. Higher than average WLTP/NEDC TA CO_2 ratios were also found for OEM_15 (1.27). These results are better presented in Annex VI-a.

Figure 6. Distribution of WLTP/NEDC TA CO2 ratio for diesel vehicles (VH, VL, 2018 EEA) for M1 vehicle category (a) and for N1 vehicle category (b).



WLTP / NEDC CO_2 ratio	VH Cumulative %	VL Cumulative %	EEA Cumulative %
0-0.90	0%	0%	0%
0.90-0.95	0%	0%	0%
0.95-1.00	0%	0%	1%
1.00-1.05	0%	0%	0%
1.05-1.10	1%	7%	2%
1.10-1.15	5%	30%	9%
1.15-1.20	21%	69%	15%
1.20-1.25	47%	89%	31%
1.25-1.30	73%	98%	23%
1.30-1.35	90%	99%	15%
1.35-1.40	97%	100%	4%
1.40-1.45	100%	100%	0%
1.45-1.50	100%	100%	0%
1.50-1.55	100%	100%	0%
>1.55	100%	100%	0%



WLTP / NEDC CO_2 ratio	VH Cumulative %	VL Cumulative %	EEA Cumulative %
0-0.90	0%	0%	0%
0.90-0.95	0%	0%	0%
0.95-1.00	6%	0%	1%
1.00-1.05	6%	0%	0%
1.05-1.10	6%	0%	3%
1.10-1.15	6%	7%	2%
1.15-1.20	13%	47%	4%
1.20-1.25	44%	60%	30%
1.25-1.30	63%	87%	23%
1.30-1.35	75%	100%	34%
1.35-1.40	75%	100%	2%
1.40-1.45	100%	100%	0%
1.45-1.50	100%	100%	0%
1.50-1.55	100%	100%	0%
>1.55	100%	100%	0%

Source: JRC, 2020.

Table 6 a. Summary results for diesel ICE vehicles from ETAES (VH and VL) and 2018 EEA for M1 vehicle category.

OEM Group	DIESEL VH					DIESEL VL					DIESEL EEA (registrations weighted)				
	IP No	MEAN	STDEV	MIN	MAX	IP No	MEAN	STDEV	MIN	MAX	Reg No	MEAN	STDEV	MIN	MAX
OEM_1	185	1.27	0.05	1.12	1.38	183	1.18	0.04	1.07	1.27	275,083	1.28	0.34	0.01	6.43
OEM_2	59	1.20	0.05	1.09	1.29	51	1.16	0.05	1.05	1.25	37,498	1.20	0.05	0.89	1.46
OEM_3	53	1.34	0.08	1.11	1.46	51	1.24	0.07	1.09	1.39	280,182	1.28	0.09	0.10	4.00
OEM_4	2	1.29	0.05	1.26	1.33	2	1.21	0.00	1.21	1.21	313,594	1.25	0.05	0.00	1.59
OEM_5	1	1.32	n/a	1.32	1.32	1	1.14	n/a	1.14	1.14	110,444	1.23	0.05	0.63	1.58
OEM_6	41	1.21	0.04	1.14	1.28	40	1.14	0.04	1.05	1.21	180,999	1.17	0.05	0.73	1.86
OEM_7	14	1.20	0.06	1.15	1.33	8	1.15	0.07	1.10	1.33	124,429	1.25	0.06	0.01	1.57
OEM_8	37	1.29	0.05	1.17	1.37	37	1.20	0.05	1.05	1.27	110,619	1.24	0.08	0.36	2.69
OEM_9	2	1.15	0.00	1.15	1.15	2	1.12	0.02	1.10	1.14	37,018	1.18	0.04	0.01	1.49
OEM_11	4	1.33	0.08	1.24	1.42	4	1.19	0.05	1.14	1.24	4,528	1.24	0.05	0.98	1.36
OEM_12	10	1.25	0.04	1.18	1.30	2	1.23	0.07	1.18	1.28	9,747	1.22	0.05	1.00	1.93
OEM_13											13	1.06	0.05	1.00	1.12
OEM_14	34	1.23	0.05	1.10	1.33	34	1.16	0.04	1.07	1.22	41,159	1.21	0.05	0.76	2.24
OEM_15	2	1.31	0.04	1.29	1.34	2	1.25	0.01	1.24	1.26	4,669	1.27	0.02	1.00	1.41
OEM_17											1	0.96		0.96	0.96
OEM_18											140	1.06	0.06	0.68	1.14
OEM_21											1	1.14		1.14	1.14
OEM_26	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	961	1.14	0.03	1.07	1.19
TOTAL	**444**	**1.26**	**0.07**	**1.09**	**1.46**	**417**	**1.18**	**0.06**	**1.05**	**1.39**	**1,531,085**	**1.25**	**0.16**	**0.00**	**6.43**

Source: JRC, 2020.

For N1 category diesel vehicles, results from 16 IP families (VH) and 15 IP families (VL) were analysed and as shown in Table 6b, the mean ratio for VH is 1.28 and for VL 1.22. The 2018 EEA data show an average ratio equal to 1.27. The distribution of the ratio is shown in Figure 6b. It is clear from 2018 EEA data that diesel vehicles registered have configurations closer to that of VH in terms of WLTP/NEDC TA CO_2 ratio. In addition, more diesel vehicles are registered with a WLTP/NEDC TA CO_2 ratio higher than 1.25 (30%) than with a ratio below 1.25 (70%).

Data grouped by OEM are shown in Table 6b:

→ For diesel VH, the ratio is between 0.97 and 1.41 and for VL between 1.14 and 1.33. The highest (and only) average ratio for diesel VH was found for OEM_3 group (1.35 with maximum 1.41).

→ The highest (and only) average ratio for diesel VL was found for OEM_3 group (1.26 with maximum 1.33).

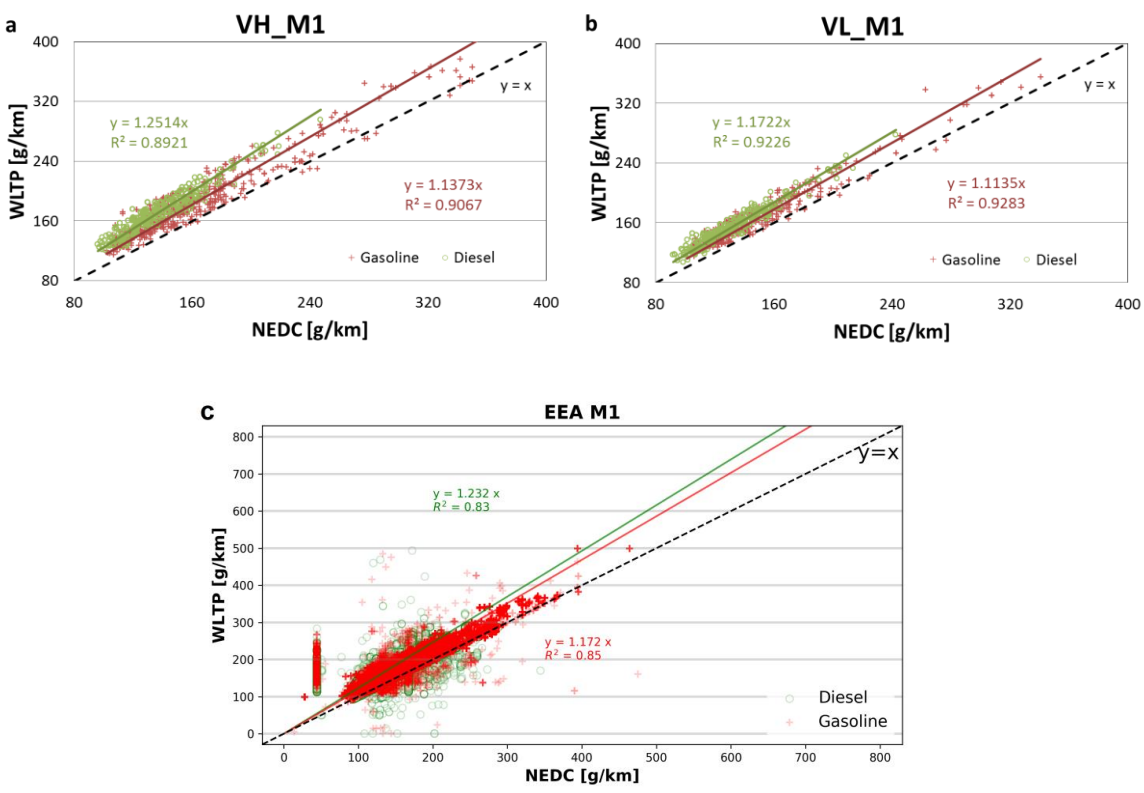
→ The 2018 EEA registrations data show also the highest average ratio of 1.29 coming from OEM_3 and OEM_5 groups. These results are better presented in Annex VI-b.

Table 6 b. Summary results for diesel ICE vehicles from ETAES (VH and VL) and 2018 EEA for N1 vehicle category.

OEM Group	DIESEL VH					DIESEL VL					DIESEL EEA (registrations weighted)				
	IP No	MEAN	STDEV	MIN	MAX	IP No	MEAN	STDEV	MIN	MAX	Reg No	MEAN	STDEV	MIN	MAX
OEM_1	2	1.23	0.00	1.23	1.24	2	1.17	0.00	1.17	1.17	111	1.23	0.03	1.14	1.30
OEM_3	8	1.35	0.06	1.29	1.41	8	1.26	0.07	1.16	1.33	2,310	1.29	0.10	1.00	1.62
OEM_4	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	1,242	1.16	0.10	0.90	1.47
OEM_5	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	20,759	1.29	0.06	0.74	1.39
OEM_7	4	1.16	0.13	0.97	1.25	3	1.19	0.03	1.15	1.20	2,458	1.23	0.04	1.00	1.50
OEM_9	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	1	1.00		1.00	1.00
OEM_11	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	217	1.23	0.05	1.00	1.35
OEM_13											7	0.97	0.13	0.81	1.17
OEM_14	2	1.24	0.02	1.23	1.26	2	1.16	0.03	1.14	1.18	493	1.23	0.02	1.00	1.26
OEM_23	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00					
OTHER											1,410	1.19	0.09	0.63	1.42
TOTAL	16	1.28	0.11	0.97	1.41	15	1.22	0.07	1.14	1.33	29,008	1.27	0.07	0.63	1.62

Source: JRC, 2020.

Figure 7. WLTP vs NEDC CO2 emissions for gasoline and diesel vehicles for (a) VH, (b) VL, and (c) 2018 EEA for M1 category vehicles.

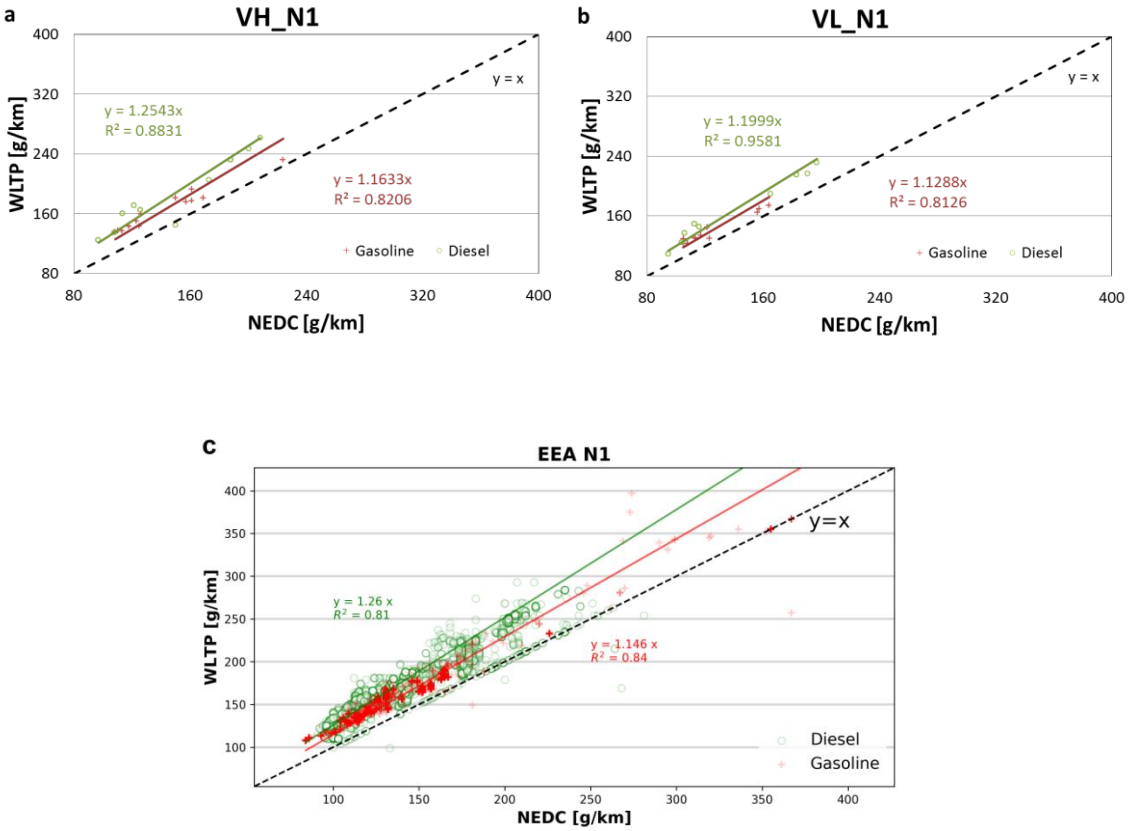


Source: JRC, 2020.

Further analysis focused on the correlation between WLTP CO_2 emissions and NEDC CO_2 emissions for gasoline and diesel vehicles (Figure 7 for M1 category vehicles and Figure 8 for N1 category vehicles). Slightly higher impact of WLTP introduction (for both gasoline and diesel vehicles) in ETAES data (both VH and VL) is observed for vehicles with higher NEDC CO_2 emissions compared to those with lower CO_2 emissions. Again, the higher

ratio for diesel compared to gasoline vehicles is visible over the whole CO_2 emission range (both VH and VL). The 2018 EEA data show a much higher WLTP/NEDC CO_2 emissions ratio for vehicles with higher CO_2 emissions (especially vehicles with CO_2 emissions higher than 200 g/km).

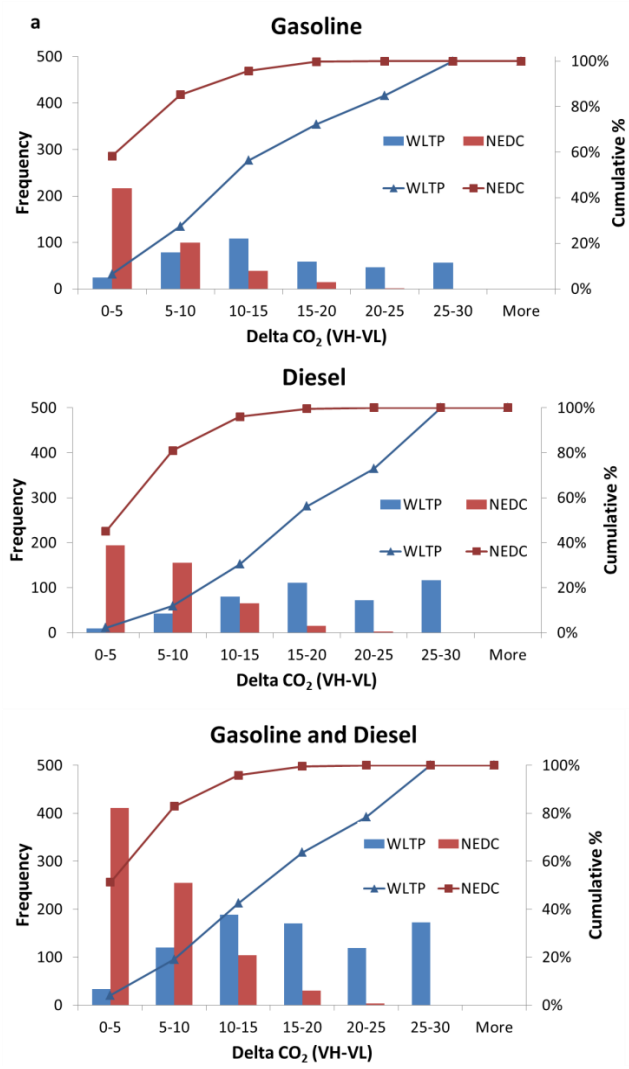
Figure 8. WLTP vs NEDC CO2 emissions for gasoline and diesel vehicles for (a) VH, (b) VL, and (c) 2018 EEA for N1 category vehicles.



Source: JRC, 2020.

Figure 9 shows the sizes (in gCO_2/km) of the WLTP and NEDC interpolation families i.e. the difference in gCO_2/km between VH and VL. As expected, WLTP IP families have larger sizes with the difference between VH and VL going up to 30 g/km. The difference between VH and VL for NEDC IP families goes up to 25 g/km. It is also visible that for more than 50% of NEDC IP families the difference between VH and VL is less than 5 g/km, while only a small percentage of WLTP IP families (<10%) have that size.

Figure 9. Histogram of the size of families for NEDC and WLTP gasoline and diesel and all ICE vehicles

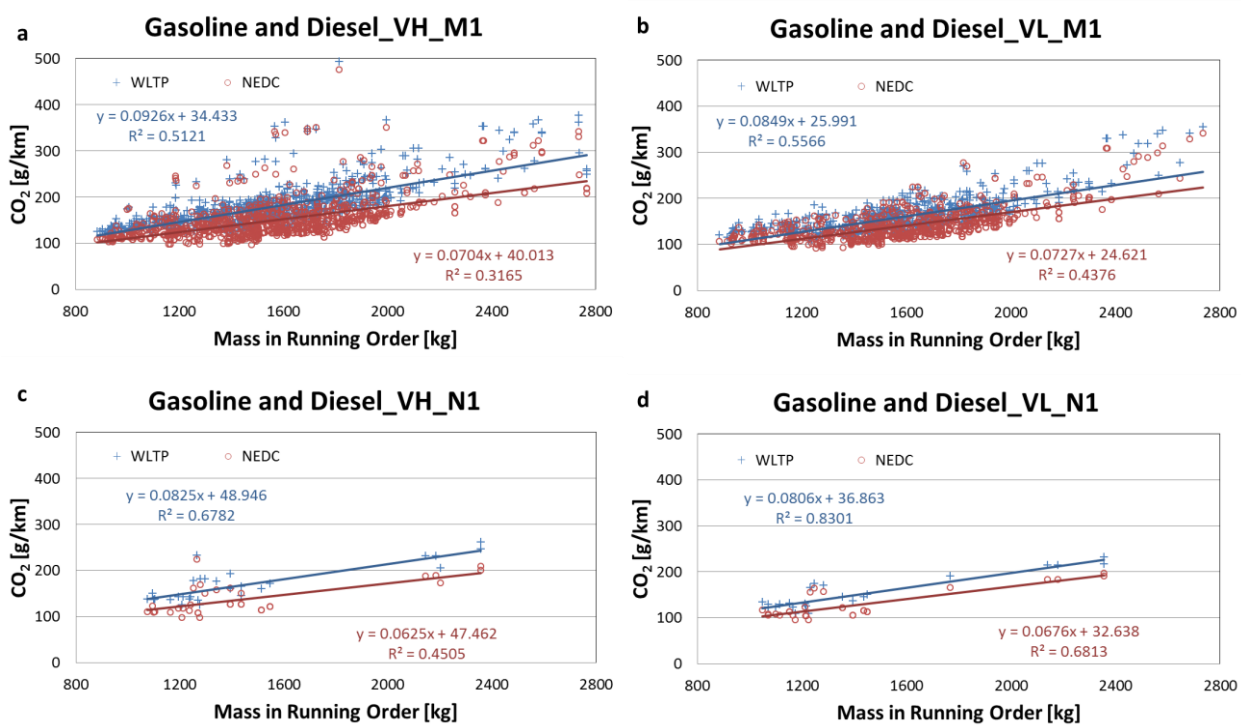


Source: JRC, 2020.

3.2.1.2 $WLTP_{TA}$ and $NEDC_{TA}$ CO_2 emissions as a function of vehicle mass and power

In Figure 10, the WLTP and NEDC CO_2 emissions are plotted against the mass in running order (MRO) of each VH and VL vehicle for M1 and N1 vehicle category. As expected, the higher the MRO of the vehicle, the higher also the emissions for both VL and VH and both WLTP and NEDC. The ratio between WLTP and NEDC CO_2 emissions increases as a function of the MRO, because the slope of the WLTP line is higher compared to the slope of the NEDC line. This is the case for both VH and VL, but more evidently for VH. That is in line with Figure 7 and could be expected since vehicles with a lower MRO also have lower type-approval CO_2 emissions.

Figure 10. WLTP and NEDC CO2 emissions vs MRO for all ICE vehicles (a) VH and (b) VL for M1 vehicle category and all ICE vehicles (c) VH and (d) VL for N1 vehicle category.

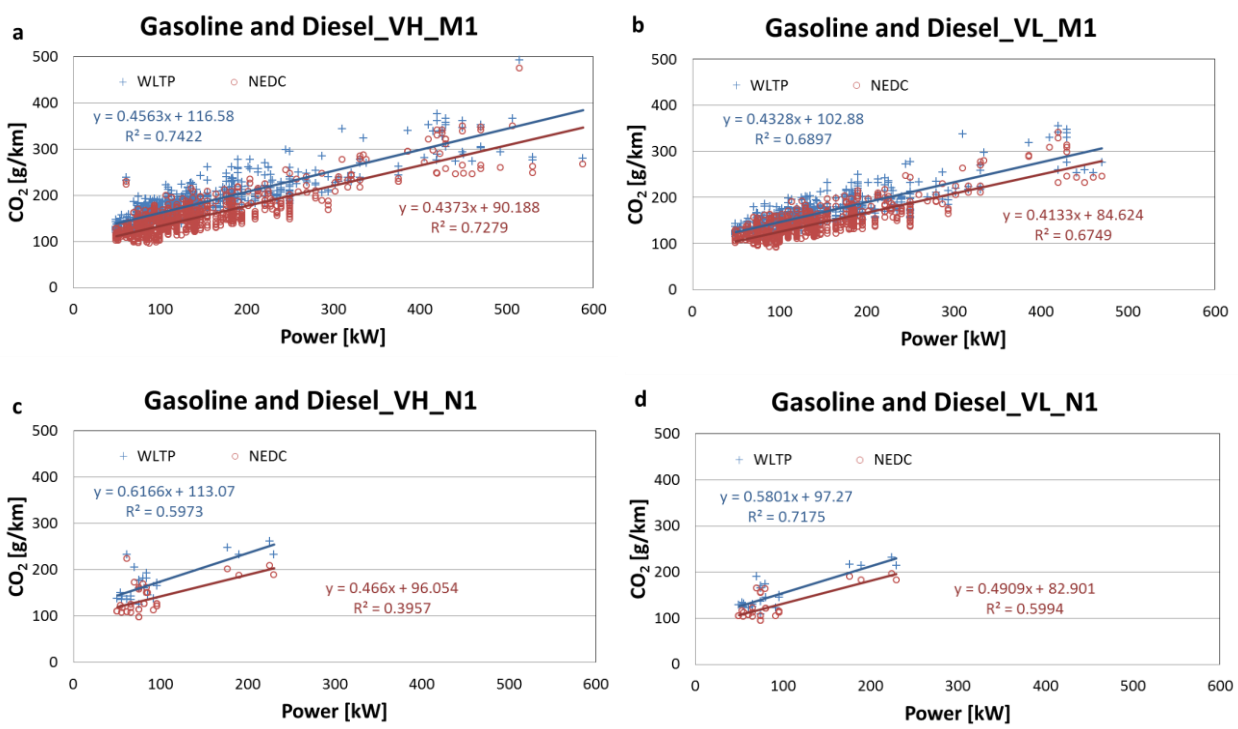


Source: JRC, 2020.

In Figure 11, the WLTP and NEDC CO_2 emissions of all ICE vehicles are plotted against the vehicle power for VH and VL vehicles for M1 and N1 vehicle category. As expected, the higher the power, the higher also the CO_2 emissions. The situation is slightly different compared to that for the MRO. Here, the two lines are parallel which means that an increase in power equally impacts both the WLTP and NEDC CO_2 emissions (for both VH and VL).

For the entire range of the vehicles' power analysed WLTP results in approximately 30g/km higher CO_2 emissions than NEDC for VH, whereas for VL this difference in CO_2 emissions is on average 22g/km.

Figure 11. WLTP and NEDC CO2 emissions vs power for all ICE vehicles (a) VH and (b) VL for M1 vehicle category and all ICE vehicles (c) VH and (d) VL for N1 vehicle category.



Source: JRC, 2020.

3.2.2 Hybrid vehicles

3.2.2.1 $WLTP_{TA}$ and $NEDC_{TA}$ CS CO_2 emissions (OVC and NOVC-HEV)

The number of type-approved hybrid vehicles until September 2018 is much lower than that of ICE vehicles. As already seen in Figure 4, hybrid vehicles represented only 3% of the total number of the vehicles analysed and all of them were from the M1 category. This corresponds to 33 IP families type-approved as NOVC-HEV (27 gasoline and 6 diesel) and 16 IP families type-approved as OVC-HEV (all gasoline). Out of these 33 NOVC-HEV IP families, only 13 had recorded CO_2 emissions in WVTA documentation and could be processed for further analysis. On the other side, 15 (out of total 16) OVC-HEV IP families had available both NEDC and WLTP CO_2 emissions.

This section will focus on the analysis of charge-sustaining (CS) CO_2 emissions of both NOVC and OVC-HEVs (Table 7 for VH and Table 8 for VL). The mean WLTP/NEDC CO_2 ratio for all NOVC-HEV analysed for VH is 1.22 (min 1.07, max 1.31) and for VL 1.18 (min 1.03, max 1.26). The NOVC-HEV vehicles analysed are all gasoline vehicles and as we saw in the previous section, the average ratio for all gasoline VH vehicles is 1.16 and VL 1.13, approximately 6% and 5% lower, respectively, compared to this average value of NOVC-HEVs. These average results suggest a higher impact of WLTP introduction on CS CO_2 results of NOVC-HEVs compared to gasoline ICE vehicles, but one needs to be careful when analyzing these data since they are coming from a very limited number of vehicles.

The mean CS WLTP/NEDC CO_2 ratio for all OVC-HEVs analysed for VH is 1.26 (min 1.08, max 1.44) and for VL 1.21 (min 1.10, max 1.40). The mean ratio is mainly impacted by that of OEM_8 vehicles that have a significantly higher number (average VH 1.37 and VL 1.31) compared to OEM_1 and OEM_2 (average VH 1.20 and VL 1.14).

The OVC-HEV vehicles analysed are all gasoline vehicles and, as already stated, the average ratio for all gasoline VH vehicles is 1.16 and VL 1.13, approximately 10% and 8% lower, respectively, compared to this average value of OVC-HEVs. As in the case of NOVC-HEVs, these average results suggest a higher WLTP/NEDC ratio for CS CO_2 results of OVC-HEVs compared to the CS CO_2 results of NOVC-HEVs and gasoline pure ICE vehicles. There is no clear explanation for this. Again, one needs to be careful when analyzing these data since they are coming from a very limited number of vehicles tested.

Table 7. Summary results for NOVC and OVC-HEVs for VH.

OEM Group	NOVC VH					OVC-CS VH					OVC-Weighted Combined VH				
	IP No	MEAN	STDEV	MIN	MAX	IP No	MEAN	STDEV	MIN	MAX	IP No	MEAN	STDEV	MIN	MAX
OEM_1						8	1.20	0.07	1.08	1.30	8	1.00	0.40	0.34	1.31
OEM_2	2	1.23	0.00	1.23	1.23	2	1.20	0.03	1.18	1.22	2	1.05	0.05	1.01	1.08
OEM_4	0	n/a	n/a	0.00	0.00										
OEM_5	0	n/a	n/a	0.00	0.00										
OEM_6	3	1.13	0.08	1.07	1.21										
OEM_8						5	1.37	0.06	1.32	1.44	5	1.37	0.06	1.30	1.44
OEM_10	8	1.25	0.04	1.17	1.31										
OEM_11	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00
OEM_15	0	n/a	n/a	0.00	0.00										
ALL	**13**	**1.22**	**0.07**	**1.07**	**1.31**	**15**	**1.26**	**0.10**	**1.08**	**1.44**	**15**	**1.13**	**0.34**	**0.34**	**1.44**

* The number of IP families does not correspond to the total number of type-approved families by each OEM and shown in Table 3. It corresponds to the number of IP families having both WLTP and NEDC CO2 values, to be able to calculate the WLTP/NEDC CO2 ratio.

Source: JRC, 2020.

Table 8. Summary results for NOVC and OVC-HEVs for VL.

OEM Group	NOVC VL					OVC-CS VL					OVC-Weighted Combined VL				
	IP No	MEAN	STDEV	MIN	MAX	IP No	MEAN	STDEV	MIN	MAX	IP No	MEAN	STDEV	MIN	MAX
OEM_1						8	1.14	0.04	1.10	1.21	8	0.89	0.37	0.31	1.20
OEM_2	2	1.26	0.00	1.26	1.26	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00
OEM_4	0	n/a	n/a	0.00	0.00										
OEM_5	0	n/a	n/a	0.00	0.00										
OEM_6	3	1.08	0.06	1.03	1.15										
OEM_8						5	1.31	0.10	1.21	1.40	5	1.25	0.09	1.15	1.32
OEM_10	4	1.22	0.03	1.19	1.26										
OEM_11	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00
OEM_15	0	n/a	n/a	0.00	0.00										
ALL	**9**	**1.18**	**0.09**	**1.03**	**1.26**	**13**	**1.21**	**0.11**	**1.10**	**1.40**	**13**	**1.03**	**0.34**	**0.31**	**1.32**

* The number of IP families does not correspond to the total number of type-approved families by each OEM and shown in Table 3. It corresponds to the number of IP families having both WLTP and NEDC CO2 values, in order to be able to calculate the WLTP/NEDC CO2 ratio.

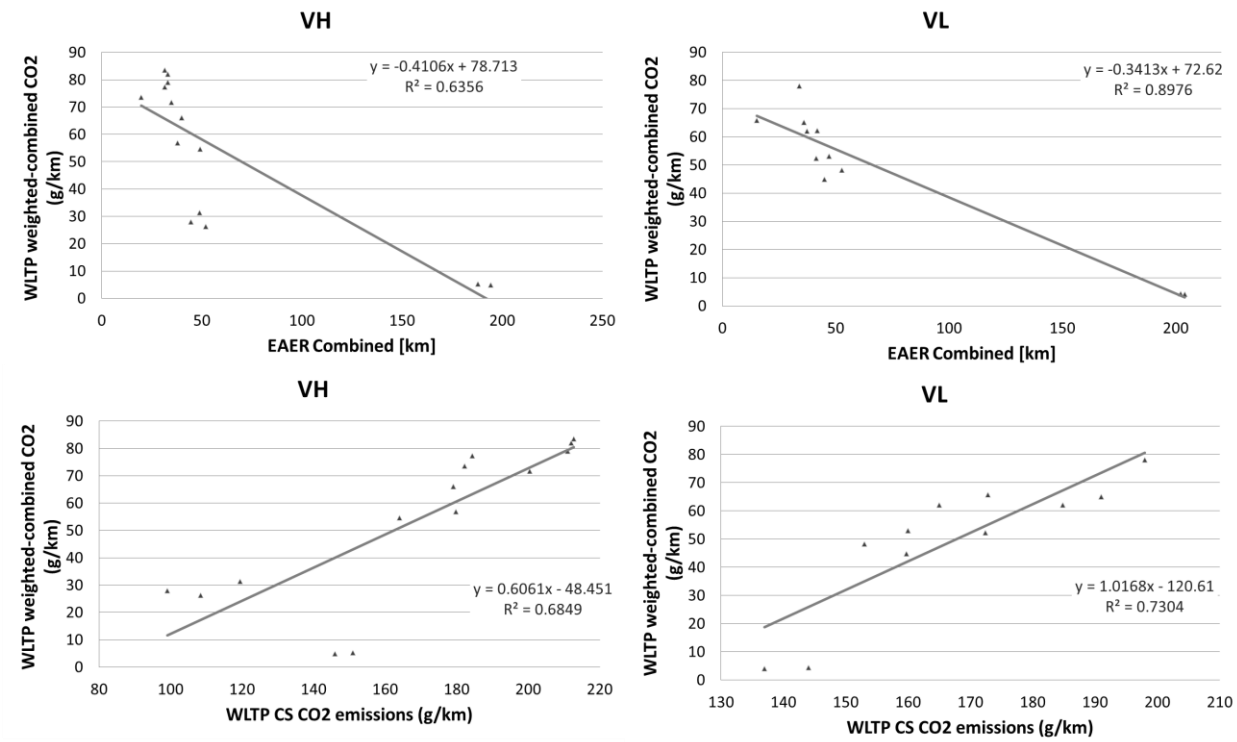
Source: JRC, 2020.

3.2.2.2 $WLTP_{TA}$ and $NEDC_{TA}$ weighted-combined CO_2 emissions (OVC-HEV)

In the case of OVC-HEV, CS and CD CO2 emissions are measured during the physical WLTP type-approval test and weighted-combined CO2 emissions are calculated and reported as the final type-approval CO2 emissions for one OVC-HEV in TA documentation (ETA and WVTA) and Certificate of Conformity (CoC) for individual vehicles registered in the EEA monitoring dataset. These weighted-combined CO2 emissions will depend on the electric range (equivalent all-electric range EAER) of the vehicle (the longer the range, the lower CD emissions and lower the weighted-combined emissions are), and performance of the vehicle in CS mode (the higher CS emissions the higher weighted-combined emissions are). These two relationships are shown in Figure 12 for all OVC-HEVs analysed from type-approval documentation (16 IP families for VH and 13 IP families for VL). Again, one needs to be careful when analyzing these data since they are coming from a very limited number of vehicles tested.

As presented in Figure 12 OVC-HEVs with electric range (EAER) higher than ~50-70km will result in weighted-combined CO2 emissions lower than 50 g/km. When OVC-HEVs electric range (EAER) is about 200 km, the weighted-combined CO2 emissions are approaching a value of 0 g/km. Also, OVC-HEVs vehicles with CS CO2 emissions lower than 160-170 g/km will result in weighted-combined CO2 emissions lower than 50 g/km.

Figure 12. OVC-HEVs weighted-combined CO2 emissions for VH and VL as a function of EAER and WLTP CS CO2 emissions.



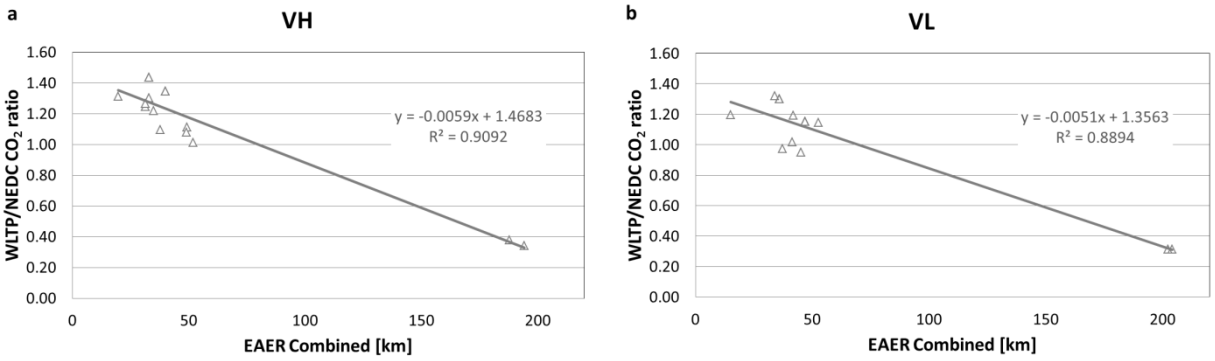
Source: JRC, 2020.

The mean weighted-combined WLTP/NEDC CO2 ratio for all OVC-HEVs analysed for VH is 1.13 (min 0.34, max 1.44) and for VL 1.03 (min 0.31, max 1.32) as shown in Tables 7 and 8. The mean ratio is mainly impacted by that of OEM_8 vehicles that have a significantly higher ratio (1.37 for VH and 1.25 for VL) compared to OEM_1 (1.00 for VH and 0.89 for VL) and OEM_2 (1.05 for VH, no VL).

Correlation between WLTP/NEDC CO2 ratio and electric range (EAER) is shown in Figure 13. The figure confirms that for OVC-HEVs with electric range (EAER) higher than ~ 50km, WLTP procedure brings even lower

weighted-combined CO2 emissions compared to the old NEDC procedure (benefits for OEMs under the WLTP). Again, one needs to be careful when analyzing these data since they are coming from a very limited number of vehicles tested.

Figure 13. WLTP/NEDC CO2 ratio for weighted-combined CO2 emissions for (a) VH and (b) VL as a function of EAER.



Source: JRC, 2020.

In the 2018 EEA registrations data is impossible to distinguish between NOVC-HEVs and OVC-HEVs. Therefore the CO2 emissions (both NEDC and WLTP) found in the 2018 EEA database correspond to both: a) CS (in the case of NOVC-HEVs) CO2 emissions and b) weighted-combined (in the case of OVC-HEVs) CO2 emissions. OEM_1 group sold the most hybrid vehicles, followed by OEM_13 and OEM_8 groups (Table 9). In the table are shown only results for vehicles for which both CO2 emissions (NEDC and WLTP) are provided (42552 out of total 43183 hybrid vehicles registered in 2018). The mean WLTP/NEDC CO2 ratio for all 2018 EEA hybrid vehicles collected is 1.20.

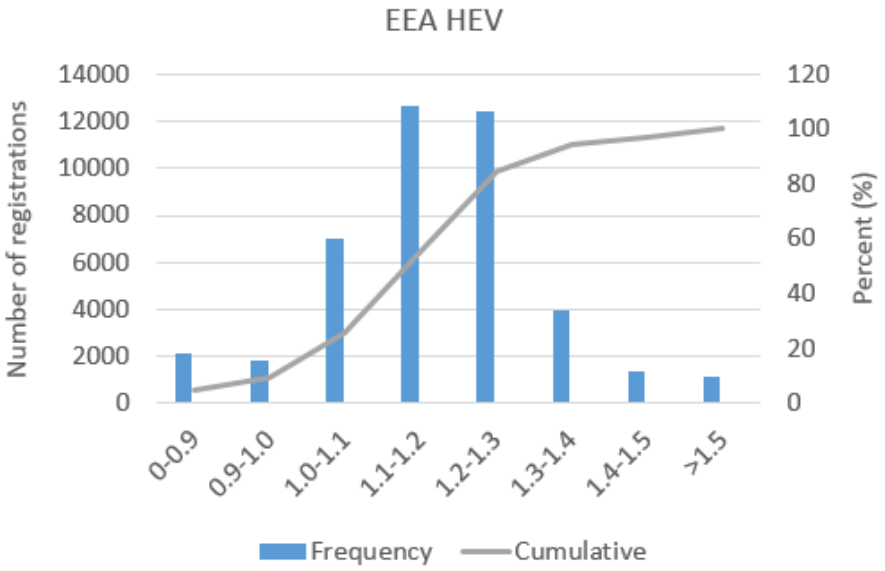
If we assume that WLTP/NEDC CO2 ratio lower than 1 is possible only in the case of OVC-HEVs (as seen from ETAES dataset) we can conclude that ~10% of vehicles sold were most likely OVC-HEVs, while the rest (~90%) represent the mixture of NOVC-HEVs and OVC-HEVs (Figure 14). The most hybrid vehicles were in the range of WLTP/NEDC CO2 ratio between 1.1 and 1.3.

Table 9. Summary results for EEA HEVs.

OEM Group	EEA HEVs				
	Reg. No	MEAN	STDEV	MIN	MAX
OEM_1	22,213	1.12	0.49	0.09	20.00
OEM_13	9,406	1.15	0.05	1.15	4.78
OEM_8	7,961	1.51	0.61	0.63	3.88
OEM_14	1,858	1.07	0.29	0.99	3.92
OEM_2	966	1.07	0.02	0.95	1.26
OEM_6	117	1.94	1.20	1.00	3.87
OEM_10	19	1.17	0.00	1.17	1.17
PORSCHE	5	2.86	1.89	0.93	4.82
OEM_4	4	1.14	0.28	1.00	1.56
OEM_5	2	1.09	0.12	1.00	1.17
OEM_9	1	3.24	NA	3.24	3.24
ALL	42,552	1.20	0.48	0.09	20.00

Source: JRC, 2020.

Figure 14. Histogram of WLTP/NEDC CO2 ratio for 2018 EEA hybrid vehicles



Source: JRC, 2020.

3.3 $WLTP_{declared}$ and $WLTP_{measured}$ CO_2 emissions

As already stated in the section "Methodology", Emission TA documents (ETA) have also been analysed. Additional information that is not recorded in WVTA documentation but can be collected from ETA, are the results of WLTP physical tests (MCO2,c,5 [g/km]) together with the number of tests performed. In total 221 ETA documents (plus 21 Corrections) were analysed covering 166 IP families.

It should be noted that ETA documents are uploaded to the ETAES platform only by 2 TAAs/TSs (RDW and KBA) and therefore can't be taken as the general behaviour of all OEMs. In particular, 6 ETA documents (i.e. 6 IP families) were inserted in the platform from KBA while the rest was from RDW. The ETA documents analysed concern only 8 OEMs, and 85% of them belong to OEM_2, OEM_8, and OEM_10 groups.

Figure 15a presents a histogram of the difference between WLTPdeclared and WLTPmeasured values in g/km for all IP families analysed.

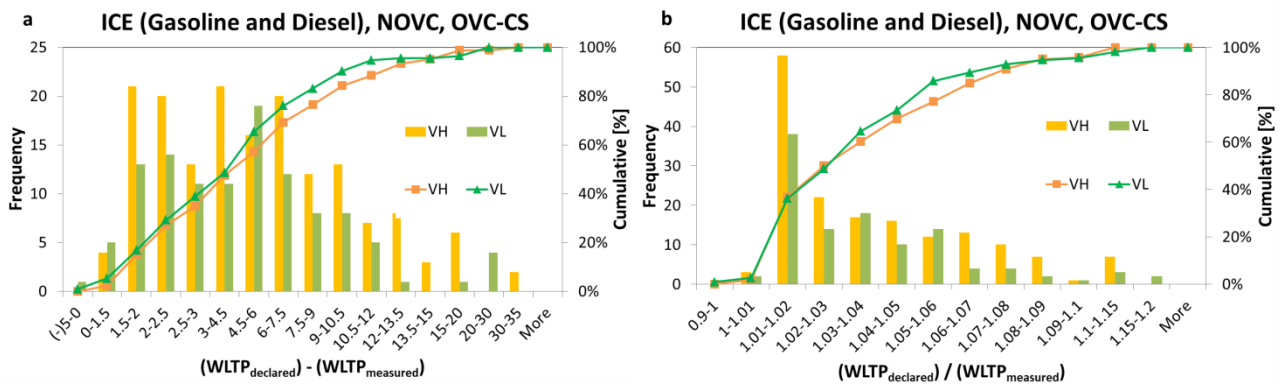
→ For 50% of type-approved VH and 50% of VL, the difference between WLTPdeclared and WLTPmeasured was lower than 4.5 g/km. Approximately 35% of VH and 42% of VL had this delta between 4.5 and 10.5 g/km. For ~15% of VH and 10% of VL the difference was higher than 10.5 g/km.

For VL, there has been only 1 case (out of 113) identified where WLTPdeclared was lower than WLTPmeasured by approximately 1 g/km but a second physical test was not performed (or at least not mentioned in ETA) as the regulation foresees. This was an OEM_8 vehicle.

Figure 15b presents the histogram of the ratio between WLTPdeclared and WLTPmeasured.

→ The majority of IP families (70% for VH and 73% for VL) have a ratio between 1.00 and 1.05 (OEMs declare values that are from 1 to 5% higher compared to the test results). In 26% of cases for VH and 23% for VL the ratio is between 1.05 and 1.10. Only 4% of cases for VH and 4% for VL demonstrate a ratio higher than 1.10 and lower than 1.20.

Figure 15. Histogram of (a) delta (WLTPdeclared – WLTPmeasured) in g/km and (b) ratio WLTPdeclared/WLTPmeasured for all vehicles.



Source: JRC, 2020.

Table 10 (for VH) and Table 11 (for VL) analysed differences between declared and measured WLTP results (ratio and absolute values) grouped by different OEMs.

→ The average difference between WLTPdeclared and WLTPmeasured for all OEMs is 6.23 g/km for VH and 5.55 g/km for VL. On average, the biggest difference is found for OEM_6 (11.75 g/km), whereas the lowest mean difference is for OEM_2 (2.40 g/km). One IP family from OEM_2 group had a difference equal to 32.83 g/km (in percentage that corresponds to 13.4% higher declared value compared to the measured).

The mean WLTPdeclared/WLTPmeasured ratio, for all VH and VL is 1.04. The lowest mean ratio (1.02) was found for OEM_2, OEM_17, OEM_4 and OEM_25 and the highest one for OEM_6 (1.07). One IP family from OEM_8 group (corresponding to VL) had a ratio equal to 1.16 that corresponds to 16% higher declared value compared to the measured.

When analyzing the number of tests performed for VH, as depicted in Table 10, for all OEMs there has been performed only one test apart from OEM_8 for which a second physical test (2.4% corresponds to 1 IP family) was needed. For what regards the number of tests performed for VL (Table 11), only OEM_3 group performed 3-second tests. However, none of the IP families had to undergo three tests.

Table 10. Differences between WLTPdeclared and WLTPmeasured results for VH.

OEM Group	WLTPdeclared - WLTPmeasured (g/km)					WLTPdeclared/WLTPmeasured					Test No	
	IP No	MEAN	STDEV	MIN	MAX	IP No	MEAN	STDEV	MIN	MAX	% of IP fam. with 1 test	% of IP fam. with 2 tests
OEM_2	58	3.56	5.54	1.32	32.83	58	1.02	0.02	1.01	1.14	100%	0%
OEM_3	11	6.58	3.97	2.59	16.23	11	1.04	0.02	1.02	1.10	100%	0%
OEM_4	1	7.03	n/a	7.03	7.03	1	1.03	n/a	1.03	1.03	100%	0%
OEM_6	5	11.75	2.48	8.85	14.38	5	1.07	0.01	1.05	1.08	100%	0%
OEM_8	41	7.60	4.27	1.58	17.34	41	1.04	0.02	0.94	1.11	97.6%	2.4%
OEM_10	41	8.42	3.25	1.92	15.65	41	1.06	0.02	1.01	1.11	100%	0%
OEM_17	7	3.45	3.45	3.45	3.45	7	1.02	1.02	1.02	1.02	100%	0%
OEM_25	2	3.90	1.92	2.54	5.25	2	1.02	0.01	1.02	1.03	100%	0%
ALL	**166**	**6.23**	**4.92**	**1.32**	**32.83**	**116**	**1.04**	**0.03**	**1.01**	**1.14**	**99.4%**	**0.6%**

Source: JRC, 2020.

Table 11. Differences between WLTPdeclared and WLTPmeasured results for VL.

OEM Group	WLTPdeclared - WLTPmeasured (g/km)					WLTPdeclared/WLTPmeasured					Test No	
	IP No	MEAN	STDEV	MIN	MAX	IP No	MEAN	STDEV	MIN	MAX	% of IP fam. with 1 test	% of IP fam. with 2 tests
OEM_2	41	2.40	1.04	1.45	6.44	41	1.02	0.01	1.01	1.04	100%	0%
OEM_3	11	5.16	3.45	1.17	12.18	11	1.04	0.02	1.01	1.08	75%	25%
OEM_4	1	4.06	n/a	4.06	4.06	1	1.02	n/a	1.02	1.02	100%	0%
OEM_6	5	9.24	3.86	5.70	15.07	5	1.06	0.02	1.04	1.09	80%	20%
OEM_8	41	8.05	5.23	-0.98	22.36	41	1.05	0.04	0.99	1.16	100%	0%
OEM_10	14	6.53	2.96	2.20	11.71	14	1.05	0.02	1.02	1.11	100%	0%
OEM_17	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	n/a	n/a
OEM_25	0	n/a	n/a	0.00	0.00	0	n/a	n/a	0.00	0.00	n/a	n/a
ALL	**113**	**5.55**	**4.41**	**-0.98**	**22.36**	**113**	**1.04**	**0.03**	**0.99**	**1.16**	**96.5%**	**3.5%**

Source: JRC, 2020.

3.4 Errors and Inconsistences in TA documents

During the analysis and evaluation of the collected data, a number of inconsistencies were identified:

1. It was noted that in some cases former directives for type-approval of motor vehicles, such as 98/14/EC and 2001/116/EC have been used and not new directive 2007/46/EC. This way the type-approved vehicles cannot be found under the new and ultimate directive 2007/46/EC but one has to search based on the old directives mentioned before.
2. NEDC values were lacking in many new TA documents.
3. Most TAAs did not provide the CO2MPAS report and CO2MPAS simulation results in WVTA documents. Only the French TAAs have included CO2MPAS reports as attachments in their TA documents.
4. In some cases, different TAAs (of different countries) use the same CO2MPAS report for different IP families. In these cases the WMI code is different but the last 4 numbers of the IP family are identical.

This matter should have been resolved with the CO2MPAS version released in February 2019 and the addition of the "parent and child family".

5. There have been cases of bi-fuel vehicles type-approved as 2 different IP families (one IP family for each fuel), a situation that is not allowed by the regulation. This occurred for Italian TA documents.
6. Not all OEMs have acted fast as far as type-approving with WLTP is concerned. There is an evident delay and lack of TA documents from several OEMs, especially if one considers their size and number of vehicles released in the market.
7. Emission type-approvals are submitted to ETAES by only 2 TAAs and a couple of OEMs (therefore also the analysis of WLTP measured vs WLTP declared CO2 emissions is very much limited).

For the present report 655 TAs (including revisions and corrections) were analysed. These correspond to the period from 01.09.2017 to 31.08.2018. From 01.09.2018 to 31.12.2018 there exist roughly 878 TAs (including revisions and corrections) and from 01.01.2019 to 31.03.2019 the number of the TAs (including revisions and corrections) is 590. The total number of TAs from 01.09.2017 to 31.03.2019 is 2125 (including revisions and corrections) and only ~30% of these 2125 TAs has been analysed and presented in this report.

4 Conclusions

This report analyses the impact of the introduction of the Worldwide Light-duty vehicle Test Protocol (WLTP) on Carbon Dioxide (CO_2) emissions of M1 and N1 vehicles by analyzing data from the official whole vehicle type-approval (WVTA) documents retrieved from ETAES (type-approval electronic platform) and the final 2018 European Environmental Agency (2018 EEA) CO_2 monitoring data.

In total, 513 WVTA documents (plus 142 Revisions and Corrections) were analysed. These documents were filed from 01/09/2017 to 31/07/2018, and originated from 13 different Type Approval Authorities (TAAs) in 11 Member States (MSs) and involving 16 different Technical Services (TSs). The number of Interpolation (IP) families considered in this report is equal to 1500 (M1 and N1 vehicle categories). In this dataset, most of the vehicles concerned (93%, 1391 IP families) are passenger cars (Category M1) and 7% (109 IP families) are light-commercial vehicles (Category N1). For the M1 category, 95% of the vehicles are Internal Combustion Engine (ICE) vehicles (53% gasoline and 42% diesel), 3% are hybrids (Non-Off Vehicle Charging NOVC and Off Vehicle Charging OVC), and 2% are Pure Electric Vehicles (PEVs) whereas for the N1 category 96% is Internal Combustion Engine (ICE) vehicles (60% gasoline and 36% diesel), 1% are hybrids (Non-Off Vehicle Charging NOVC and Off Vehicle Charging OVC), 1% are Pure Electric Vehicles (PEVs) and 2% other.

According to the final 2018 EEA data, in total 16,922,523 vehicles were registered in that year in the European Union of which 15,169,829 (~90%) were of M1 category and 1,752,694 (~10%) of N1 category. Approximately 30% of the M1 registered vehicles were WLTP type-approved and almost all of them had both NEDC and WLTP CO_2 emissions reported (4,552,214 vehicles). The situation for N1 category is significantly different since only 2.6% of the registered vehicles were WLTP type-approved and almost all of them had both NEDC and WLTP CO_2 emissions reported (44,934 vehicles).

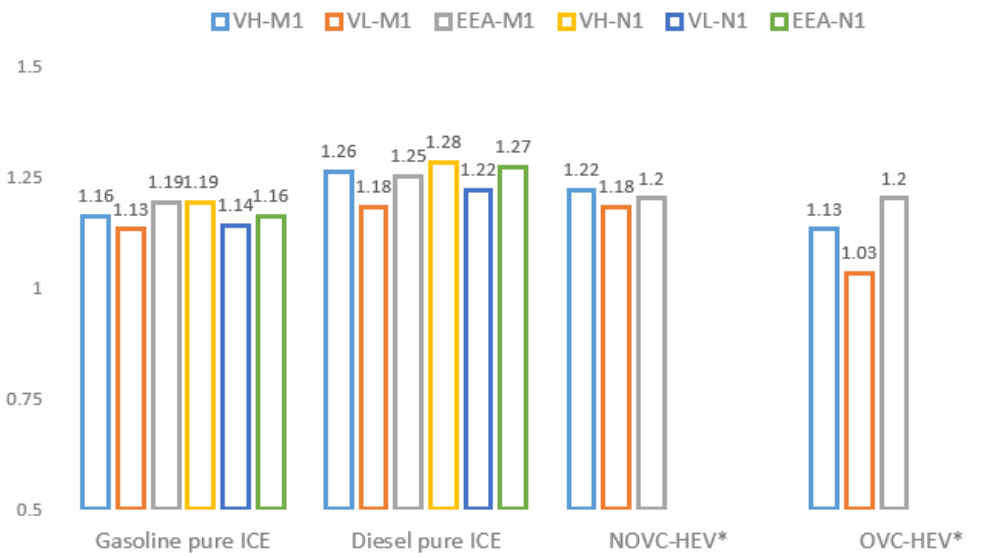
In total, from the ETAES dataset, 18% of IP families are type-approved only as vehicle high (VH) for the M1 vehicle category whereas the rest 82% report both VH and VL in their TA documents. For the N1 vehicle category, 19% of IP families are type-approved only as vehicle high (VH) and the rest 81% report both VH and VL in their TA documents. Approving only VH is the case for OEM_13, OEM_16, OEM_17, OEM_18, OEM_19, OEM_21, OEM_22, OEM_23, OEM_24, OEM_25, OEM_27 and OEM_28 for M1 vehicles and OEM_23 and OEM_13 for N1 vehicles. Apart from OEM_13, those manufacturers have a very low number of registrations. Amongst the larger manufacturer groups, i.e. those with more than 200,000 registrations, the following have the highest share of IP families with only VH: OEM_12 (91%), OEM_10 (73%), OEM_7 (24%), OEM_5 (22%) and OEM_2 (20%). OEM_9 (7%) and OEM_3 (6%) have a significantly lower share of VH-only registrations.

A critical issue identified in many WVTA documents is the lack of NEDC CO_2 emission data. In total, 29% of VH and 33% of VL are missing NEDC CO_2 emissions. The situation is worst for OEM_4 (98%), OEM_9 (94%), OEM_11 (88%), OEM_5 (87%), and OEM_3 (36%) groups (numbers in brackets refer to the percentage of IP families without NEDC CO_2 emissions). Due to the missing NEDC CO_2 emissions, the analysis on the impact of WLTP was based on only 1061 (out of 1500) IP families for VH and 828 (out of 1234) IP families for VL.

For what regards the 2018 EEA data the impact of WLTP is analysed from 4,552,214 M1 registered vehicles and 44,934 N1 registered vehicles.

As shown in Figure 16, the increase of CO_2 emissions under WLTP compared to NEDC is highest for diesel ICE vehicles. However, it should be noted that the period under scrutiny coincides with the period of the introduction of compulsory real-world testing for in-service-conformity of pollutant emissions (RDE testing). It is expected that as vehicle manufacturers optimise exhaust aftertreatment systems for real-world emission conditions, fuel consumption and CO_2 emissions will also improve.

Figure 16. Comparison of WLTP/NEDC ratio (CO2 emissions) for different datasets (ETAES and 2018 EEA), different vehicle fuel types (diesel, gasoline and hybrid vehicles) and vehicle categories (M1 and N1).



* in EEA datasets NOVC-HEV and OVC-HEV are analysed together (the same number showed on plot); in ETAES there were no hybrids from N1 category and in EEA only 5 vehicles (no results showed on plot)

Source: JRC, 2020.

The WLTP/NEDC CO_2 emission ratio for M1 diesel VH is 1.26, on average, and for M1 VL it is 1.18. The 2018 EEA dataset shows an average ratio of 1.25. The majority of diesel vehicles had a WLTP/NEDC TA CO_2 ratio higher than 1.20 (74%). The highest average ratio between all OEMs for diesel VH was calculated for OEM_3 group and it was 1.34, and for diesel VL for OEM_15 group (1.25). In the 2018 EEA data, the highest average ratio was also found for OEM_3 and OEM_1 groups (1.28).

The situation for N1 vehicles is slightly different. The WLTP/NEDC CO_2 emission ratio for N1 diesel VH is 1.28, for VL it is 1.22 and for the 2018 EEA dataset was calculated 1.27. The highest average ratio between all OEMs for diesel VH, VL and EEA was calculated for OEM_3 group and it was 1.35, 1.26 and 1.29 respectively.

For gasoline ICE vehicles the average WLTP/NEDC ratio for VH is 1.16 and for VL 1.13. For the 2018 EEA data, the average WLTP/NEDC ratio is 1.19. For most gasoline vehicles (73%) the WLTP/NEDC TA CO_2 ratio is higher than 1.15. The highest average ratio for gasoline vehicles was found for the OEM_3 group (VH 1.26 and VL 1.19). The 2018 monitoring data show the highest average ratio for OEM_1 (1.26) and OEM_11 (1.25), while for OEM_3 the average ratio is equal to 1.20.

The N1 gasoline vehicles had an average WLTP/NEDC ratio for VH of 1.19, for VL 1.14 and EEA 1.16. The highest average ratio was found for the OEM_3 group for both VH and VL and it was 1.25 and 1.19 respectively whereas for the EEA dataset OEM_1 group exhibited the highest average ratio which was 1.23.

On average the NOVC-HEVs had a WLTP/NEDC ratio of 1.22 for VH and 1.18 for VL (slightly higher compared to that of gasoline ICE vehicles). For OVC-HEVs (weighted-combined CO_2 emissions) the average ratio for VH is 1.13 (ranging from 0.34 to 1.44) and for VL it is 1.03 (ranging from 0.31 to 1.32). The 2018 monitoring dataset does not allow to distinguish between NOVC-HEVs and OVC-HEVs. The average ratio calculated for all hybrid vehicles is 1.20.

Analysis of a limited set of Emission type-approval (ETA) documents provided some indication as regards the degree of over declaration by manufacturers of the VH and VL WLTP values (the difference between the declared value and measured one). For the majority of IP families (70% for VH and 73% for VL), the OEM over declaration was not more than 5%. In 26% of the cases for VH and 23% for VL the OEM's over-declaration was

between 5% and 10%. In 4% of the cases for VH and VL the OEM over declaration was even above 10% (with a maximum of 14%). This analysis is based on data from only 2 TAAs/TSs (RDW and KBA) and only 8 OEMs (85% of them belong to OEM_2, OEM_8, and OEM_10 groups). Other OEMs and TAAs/TSs do not insert ETAs in ETEAS platform.

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List of abbreviations and definitions

Abbreviation	Full Term
MS	Member State
TA	Type Approval
IP fam.	Interpolation Family
OEM	Original Equipment Manufacturer
TAA	Type-Approval Authority
TS	Technical Service
ICE	Internal Combustion Engine
NOVC-HEV	Non-Off Vehicle Charging Hybrid Electric Vehicle also Hybrid Electric Vehicle (HEV)
OVC-HEV	Off Vehicle Charging Hybrid Electric Vehicle also PHEV: Plug-In Hybrid Electric Vehicle
CD	Charge-Depleting
CS	Charge-Sustaining
PEV	Pure Electric Vehicle also Battery Electric Vehicle (BEV)
NEDC	New European Driving Cycle
WLTP	World-wide harmonized Light-duty Test Procedure
EAER Combined-HEV	Equivalent All Electric Range Combined for OVC -HEV
MRO	Mass in Running Order
VH	Vehicle High
VL	Vehicle Low
WVTA	Whole Vehicle Type Approval
ETA	Emission Type Approval

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TYPE APPROVAL AUTHORITIES (TAAs)	
FULL NAME	ABBREVIATION
Kraftfahrt-Bundesamt	KBA
RDW Vehicle Technology and Information Centre	RDW
Vehicle Certification Agency	VCA
Centre National de Réception des Véhicules	CNRV
Société Nationale de Certification et d'Homologation	SNCH
Ministero de Economia, Industria y Competitividad	MINETUR
Ministero delle Infrastrutture e dei Trasporti	MIT
Ministry of Transport of the Czech Republic	MDCR
Vlaamse overheid - Dep. Mobiliteit en Openbare Werken	DMOW
Service Publique de Wallonie	SPW
National Standards Authority of Ireland	NSAI
Swedish Transport Agency	STA
TECHNICAL SERVICES (TSs)	
FULL NAME	ABBREVIATION
Technischer Überwachungsverein Sud	TUV SUD
UTAC CERAM	UTAC
Technischer Überwachungsverein Rheinland	TUV RH
SGS Technischer Überwachungsverein Saar	SGS TUV
INTA	INTA
Technischer Überwachungsverein Sud Czech	TUV SUD CZ
VINCOTTE	VIN
Technischer Überwachungsverein Hessen	TUV HES
Technischer Überwachungsverein Nord Mobilitaet	TUV NM
IDIADA	IDIADA
Allied Technology Experts Enterprise of Luxembourg	ATE EL
Technischer Überwachungsverein Nord Mobilitaet	TUV NORD
LUXCONTROL	LC
Anstalt für Verbrennungskraftmaschinen List	AVL
VLAAMSE OVERHEID	VO
TRANSPORT STYRELSEN	TSTYR
Ministero de Economia, Industria y Competitividad	MINETUR
Ministero delle Infrastrutture e dei Trasporti	MIT
RDW Vehicle Technology and Information Centre	RDW
Vehicle Certification Agency	VCA

Annex II. Fuel type of the ETAES analysed vehicles grouped by OEMs for M1 vehicle category and N1 vehicle category in ().

OEM Group	TOTAL	GASOLINE			DIESEL			PEV	Other
		ICE	NOVC	OVC	ICE	NOVC	OVC		
OEM_1	291 (2)	96		8	185 (2)			2	
OEM_2	170	103	2	2	59			4	
OEM_3	141 (25)	62 (11)			73 (12)			5 (2)	1
OEM_4	136 (7)	76 (6)			53	6		1 (1)	
OEM_5	65 (41)	27 (13)	1		37 (28)				
OEM_6	91	47	3		41				
OEM_7	56 (14)	35 (9)			14 (4)			7 (1)	
OEM_8	67	25		5	37				
OEM_9	76 (10)	39 (6)			37 (4)				
OEM_10	52	44	8						
OEM_11	44 (6)	25 (4)	12	1	6 (2)				
OEM_12	45	35			10				
OEM_13	26 (1)	25						1 (1)	
OEM_14	52 (2)	17			34 (2)			1	
OEM_15	20	17	1		2				
OEM_16	8	8							
OEM_17	8	8							
OEM_18	8	8							
OEM_19	7	7							
OEM_20	4	4							
OEM_21	4	4							
OEM_22	4	4							
OEM_23	2 (1)	2 (1)							
OEM_24	3	3							
OEM_25	5	5							
OEM_26	3	1			2				
OEM_27	1	1							
OEM_28	1	1							
OEM_29	1							1	

Annex III-a. ICE engine sizes of the ETAES analysed vehicles grouped by OEMs for M1 vehicle category.

ICE Engine Size (cc) *										
	Gasoline					Diesel				CNG
OEM Group	<999	1000-1399	1400-1799	1800-2199	>2200	1000-1399	1400-1799	1800-2199	>2200	1000-1399
OEM_1			34	47	21		14	127	44	
OEM_2	31	32	26	10	8		38	21		
OEM_3	4	41	17				53	20		1
OEM_4	53		21	2			30	19	10	
OEM_5	14	7	1	1	5		15	22		
OEM_6		5	7	22	16		2	21	18	
OEM_7	14	11	10				12	2		
OEM_8			1	29				37		
OEM_9	5	28	2	3	1	1	14	20	2	
OEM_10	9	39	3							
OEM_11	2	7	12	8	9		2	2	2	
OEM_12			13	19	3		4	6		
OEM_13	11	4	10							
OEM_14				12	5			24	10	
OEM_15	2	3	11	1	1		2			
OEM_16			5	2	1					
OEM_17			2		6					
OEM_18			8							
OEM_19					7					
OEM_20			2	2						
OEM_21					4					
OEM_22					4					
OEM_23			2							
OEM_24					3					
OEM_25	2	1	2							
OEM_26					1				2	
OEM_27			1							
OEM_28			7							
TOTAL	**150**	**178**	**191**	**158**	**95**	**1**	**186**	**321**	**88**	**1**

* NOVC Gasoline, OVC Gasoline and NOVC Diesel engine size is included. Only OEM Groups with data are included in the table.

Annex III-b. ICE engine sizes of the ETAES analysed vehicles grouped by OEMs for N1 vehicle category.

ICE Engine Size (cc) *							
	Gasoline					Diesel	
OEM Group	<999	1000-1399	1400-1799	1000-1399	1400-1799	1800-2199	>2200
OEM_1							2
OEM_2							
OEM_3		11			10	2	
OEM_4	6						
OEM_5	6	1	6		22	6	
OEM_6							
OEM_7	4		5		4		
OEM_8							
OEM_9	1	5		4			
OEM_10							
OEM_11	1		3				2
OEM_12							
OEM_13							
OEM_14						1	1
OEM_15							
OEM_16							
OEM_17							
OEM_18							
OEM_19							
OEM_20							
OEM_21							
OEM_22							
OEM_23			1				
OEM_24							
OEM_25							
OEM_26							
OEM_27							
OEM_28							
TOTAL	**18**	**17**	**15**	**4**	**36**	**9**	**5**

* NOVC Gasoline, OVC Gasoline and NOVC Diesel engine size is included. Only OEM Groups with data are included in the table.

Annex IV-a. ICE rated power of the ETAES analysed vehicles grouped by OEMs for M1 vehicle category.

ICE Rated Power (kW) *												
OEM Group	Gasoline						Diesel					CNG
	<50	51-75	76-100	101-125	126-150	>151	51-75	76-100	101-125	126-150	>151	76-100
OEM_1	2	7	20	20	19	36	2		60		54	
OEM_2	9	33	29	12	15	9	1		2			
OEM_3	2	10	31	8	7	4	18		9		2	1
OEM_4	3	13	39	19	2		8	22	12	7	10	
OEM_5		14	5	4		5	8		9			
OEM_6		1	5	6	10	28			12		20	
OEM_7		15	8	8	3	4	4		1			
OEM_8				1		26			10		7	
OEM_9		14	8	11	3	3	4		9		3	
OEM_10		31	10	11								
OEM_11		8	13	6	3	8	1		1			
OEM_12		3	7	16	9				4			
OEM_13		15	4	6								
OEM_14					2	15			11		14	
OEM_15		3	8		5	2						
OEM_16			5	2	1							
OEM_17						8						
OEM_18			8									
OEM_19						7						
OEM_20			1	1		2						
OEM_21						4						
OEM_22						4						
OEM_23		2										
OEM_24						3						
OEM_25		1	3	1								
OEM_26						1					2	
OEM_27						1						
OEM_28				1								
TOTAL	**16**	**170**	**204**	**133**	**79**	**170**	**46**	**22**	**140**	**7**	**112**	**1**

* NOVC Gasoline, OVC Gasoline and NOVC Diesel rated power is included. Only OEM Groups with data are included in the table.

Annex IV-b. ICE rated power of the ETAES analysed vehicles grouped by OEMs for N1 vehicle category.

ICE Rated Power (kW) *										
	Gasoline					Diesel				
OEM Group	<50	51-75	76-100	101-125	126-150	51-75	76-100	101-125	126-150	>151
OEM_1										2
OEM_2										
OEM_3	2	7	2			5	5	1	1	
OEM_4	3	3								
OEM_5		6	3	2	2	15	8	3	2	
OEM_6										
OEM_7		6	3			3	1			
OEM_8										
OEM_9		5	1			4				
OEM_10										
OEM_11		1	3						2	
OEM_12										
OEM_13										
OEM_14										2
OEM_15										
OEM_16										
OEM_17										
OEM_18										
OEM_19										
OEM_20										
OEM_21										
OEM_22										
OEM_23		1								
OEM_24										
OEM_25										
OEM_26										
OEM_27										
OEM_28										
TOTAL	**5**	**29**	**12**	**2**	**2**	**27**	**14**	**4**	**5**	**4**

* NOVC Gasoline, OVC Gasoline and NOVC Diesel rated power is included. Only OEM Groups with data are included in the table

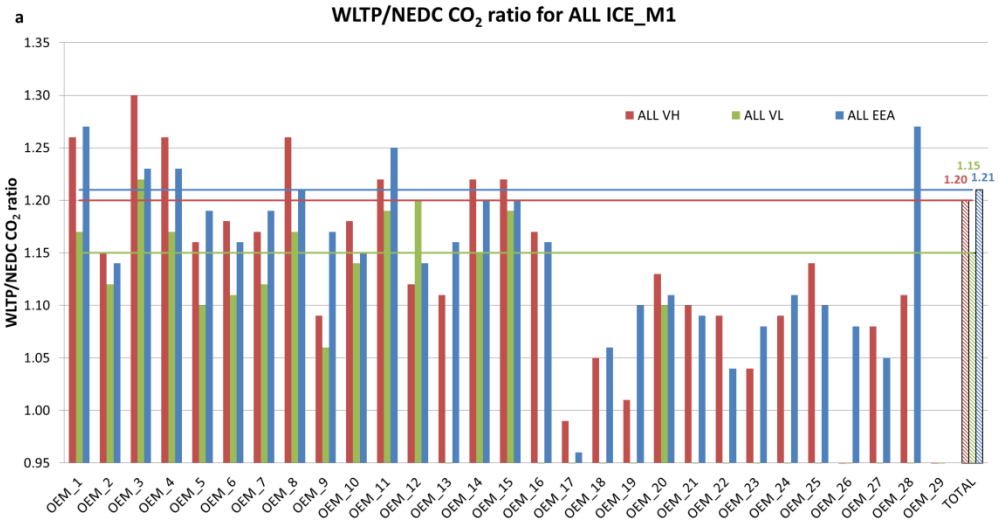
Annex V. Electric motor Maximum Net power of the ETAES analysed M1 vehicle category vehicles and in () for N1 vehicle category.

Max. Net Power of Electric motor (kW) *																		
OEM Group	**NOVC_Gasoline**				**OVC_Gasoline**					**NOVC_Diesel**		**PEV**						
	<50	**51-75**	**>151**	**n/a**	**51-75**	**76-100**	**101-125**	**126-150**	**n/a**	**<50**	**n/a**	**<50**	**51-75**	**76-100**	**101-125**	**126-150**	**>151**	**n/a**
OEM_1					2	3	1	2								2		
OEM_2				2					2					2		2		
OEM_3												3(2)				2		
OEM_4										4	2							1(1)
OEM_5		1																
OEM_6	2			1														
OEM_7													3	2(1)	2			
OEM_8							2		3									
OEM_10	4			4														
OEM_11	1	2	5	4		1												
OEM_13												1(1)						
OEM_14																	1	
OEM_15		1																
OEM_29														1				
ALL	**7**	**4**	**5**	**11**	**2**	**4**	**3**	**2**	**5**	**4**	**2**	**4(3)**	**3**	**5(1)**	**2**	**6**	**1**	**1(1)**

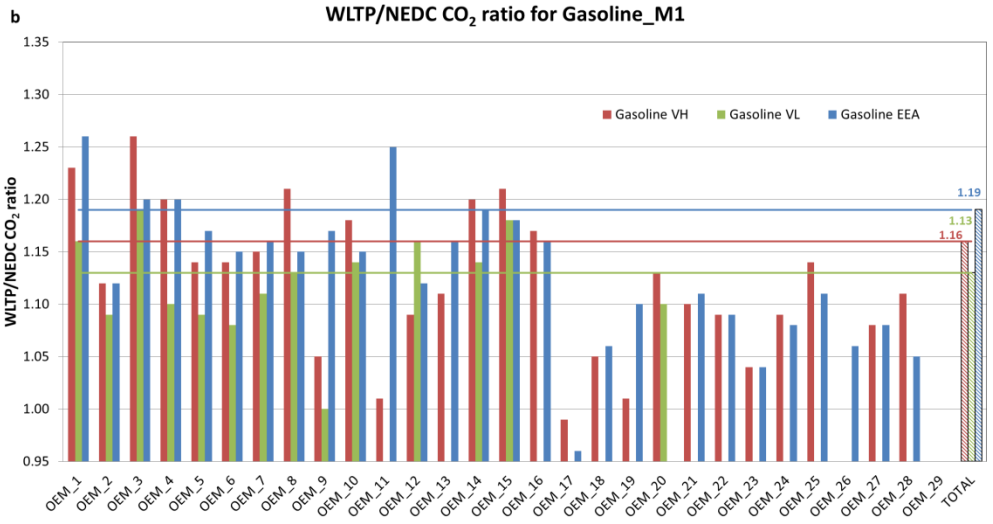
* NOVC, OVC and PEV Max. Net power of electric motor is included. Only OEM Groups with data are included in the table.

Annex VI-a. WLTP/NEDC CO_2 ratio for each OEM for all ICE, gasoline and diesel vehicles (VH, VL and 2018 EEA) for N1 vehicle category.

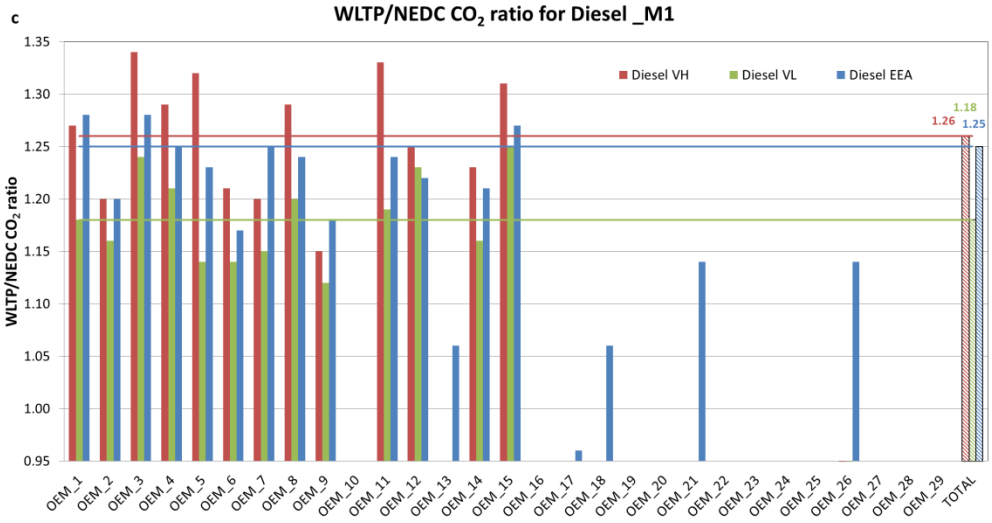
a



b

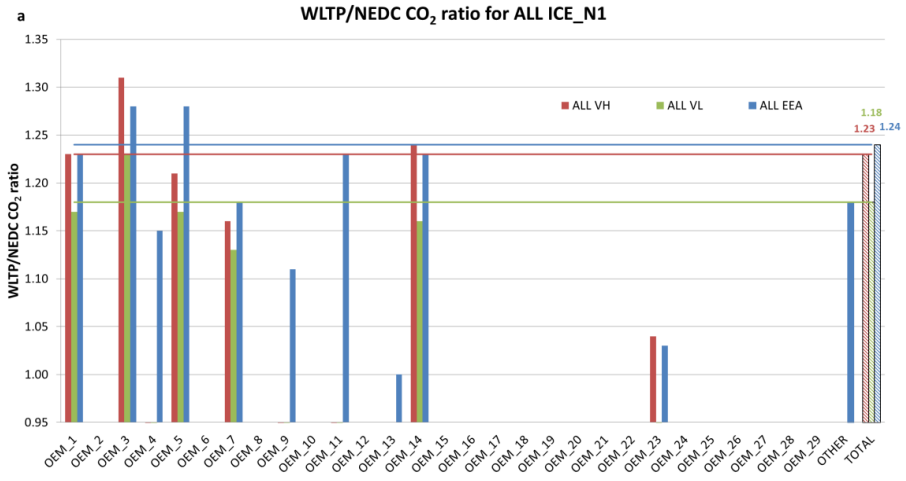


c

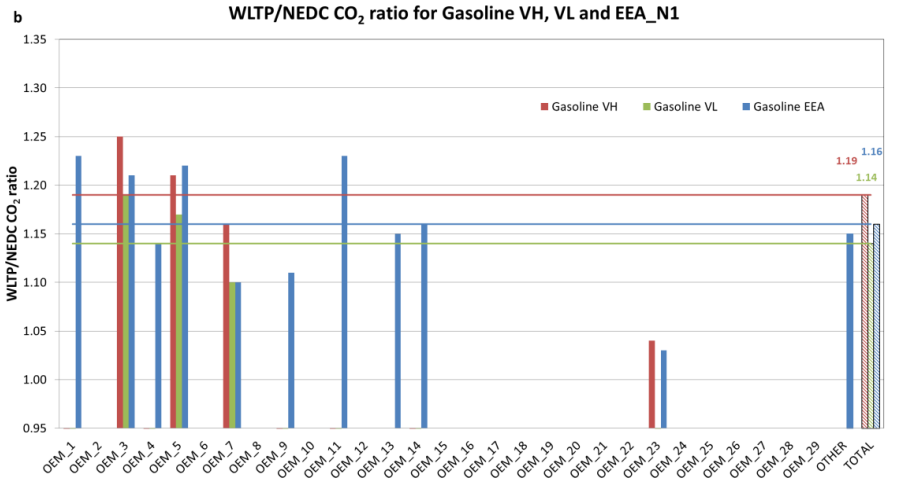


Annex VI-b. WLTP/NEDC CO_2 ratio for each OEM for all ICE, gasoline and diesel vehicles (VH, VL and 2018 EEA) for N1 vehicle category.

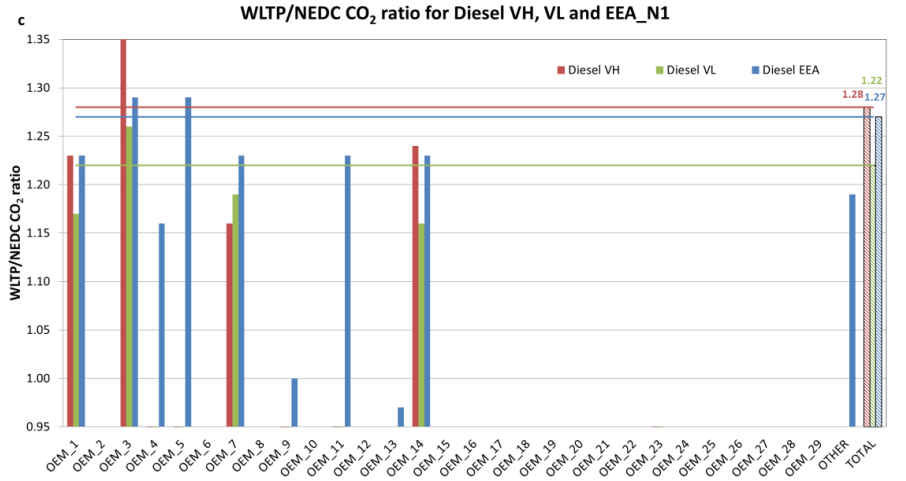
a



b



c



Annex VII. List of information (data) recorded from the TA documents

WHOLE VEHICLE TYPE APPROVAL DOCUMENT	
GENERAL	
Type Approval (TA) number	e??2007/46*????*??
Kind of document	TA /Extension
Revisions & Corrections	Revision / Correction
Status of vehicle	Complete / Completed / Incomplete
Make	
Type	
Commercial name	
Vehicle category	M1 / M1G / M1S / N1 / N1G / N1S
Approval date	
Type Approval Authority (TAA) name	
TAA country	
Technical service	
Type	
Variant	
Version	
JRC Identifier	Vehicle HIGH: _01 Vehicle LOW: _00
Other Type-Variant-Version (TVVs) of the same Interpolation (IP) Family	
GENERAL CONSTRUCTION CHARACTERISTICS OF THE VEHICLE	
Number of axles and wheels	
Powered axles (number, position, interconnection)	FWD / RWD / 4WD
Length	
Width	
Height	
MASSES AND DIMENSIONS	
Mass in Running Order (MRO) [kg]	Total
Distribution of MRO among the axles [kg]	Front and Rear
Mass of the optional equipment [kg]	
Technically permissible maximum laden mass (TPMLM) [kg]	Total
Distribution of TPMLM among the axles [kg]	Front and Rear
Technically permissible maximum mass on each axle [kg]	Front and Rear
Roof load	
PROPULSION ENERGY CONVERTER	
Working principle	Positive ignition / Compression ignition / Dual-fuel
Number of cylinders	
Engine capacity [cm3]	

Normal engine idling speed [min -1]	
Rated engine power [kW at min –1]	
Light-duty vehicles fuel	Diesel / Petrol / LPG / NG or Biomethane / Ethanol (E 85) / Biodiesel / Hydrogen / H2NG
Vehicle fuel type	Mono fuel / Bi fuel / Flex fuel
Working principle	Direct injection / Pre-chamber / Swirl chamber
Pressure charger	Yes / No
Catalytic converter	Yes / No
Exhaust gas recirculation (EGR)	Yes / No
Particulate trap (PT)	Yes / No
Maximum net power [kW]	For electric engines
Operating voltage [V]	For electric engines
Battery Capacity [Ah]	For electric engines
Category of hybrid electric vehicle	OVC / NOVC / FC / PEV
TRANSMISSION	
Type of gearbox	Manual / Automatic / CVT
Number of gears	
Final gear ratio	
Internal gearbox ratios	
Total gear ratios	
Max. gear ratio for CVT	
Min. gear ratio for CVT	
Max. total ratio for CVT	
Max. total ratio for CVT	
Maximum vehicle design speed [km/h]	
SUSPENSION	
Upper and lower limits of rolling radii of Axle 1 [mm]	
Upper and lower limits of rolling radii of Axle 2 [mm]	
Tyre/Wheel information	
BODYWORK	
Type of bodywork	AC / AF / AB / etc.
Number of seating positions	
INTERPOLATION FAMILY	
Interpolation (IP) family name	IP-??-???-201?-????
RESULTS OF THE EXHAUST EMISSION TESTS	
Type 1 test Vehicle emissions in the test cycle after a cold start	
CO [mg/km]	
THC [mg/km]	For Gasoline and Diesel vehicles
NMHC [mg/km]	For Gasoline vehicles
NOx [mg/km]	For Gasoline vehicles
THC+NOx [mg/km]	For Gasoline and Diesel vehicles
Mass of particulate matter (PM) [mg/km]	For Diesel vehicles
Number of particles (PN) [#/km]	For Gasoline and Diesel vehicles
	For Gasoline and Diesel vehicles

Family correction factor (FCF)	
Type 4 test Evaporative emissions [g/test]	
Type 5 test Durability of anti-pollution control devices	
Deterioration factor (DF)	Multiplicative (Gasoline) / Additive (Diesel)
CO [mg/km]	For Gasoline and Diesel vehicles
THC [mg/km]	For Gasoline vehicles
NMHC [mg/km]	For Gasoline vehicles
NOx [mg/km]	For Gasoline and Diesel vehicles
THC+NOx [mg/km]	For Diesel vehicles
Mass of particulate matter (PM) [mg/km]	For Gasoline and Diesel vehicles
Number of particles (PN) [#/km]	For Gasoline and Diesel vehicles
Type 6 test Average emissions at low ambient temperatures	
CO [g/km]	
THC [g/km]	
CO2MPAS REPORT	
NEDC Inertia [kg]	
NEDC f0 [N]	
NEDC f1 [N/km/h]	
NEDC f2 [N/(km/h)2]	
NEDC Declared CO2 [g/km]	
NEDC CO2MPAS CO2 [g/km]	
NEDC CO2MPAS Deviation [%]	
Ki Factor	For Diesel vehicles
RESULTS OF THE CO2 EMISSION, FUEL/ELECTRIC ENERGY CONSUMPTION AND ELECTRICE RANGE TESTS	
NEDC TA Electric Energy Consumption [Wh/km]	For PEV
NEDC TA Pure Electric Range Combined [km]	For OVC and PEV
NEDC TA CO2 mass emission Urban Conditions [g/km]	
NEDC TA CO2 mass emission Extra Urban Conditions [g/km]	
NEDC TA CO2 mass emission Combined [g/km]	
NEDC TA CO2 mass emission (Condition A, combined) [g/km]	For OVC
NEDC TA CO2 mass emission (Condition B, combined) [g/km]	For OVC
NEDC TA CO2 mass emission (weighted, combined) [g/km]	For OVC
NEDC TA Electric energy consumption (Condition A, combined) [Wh/km]	For OVC
NEDC TA Electric energy consumption (Condition B, combined) [Wh/km]	For OVC
NEDC TA Electric energy consumption (weighted and combined) [Wh/km]	For OVC
WLTP Vehicle Test Mass [kg]	
WLTP f0 [N]	
WLTP f1 [N/km/h]	
WLTP f2 [N/(km/h)2]	
WLTP Rolling Resistance Coefficient (RR)	
WLTP delta CdA	
WLTP Electric Consumption Combined [Wh/km]	For PEV
WLTP Pure Electric Range Combined [km]	For PEV
WLTP Pure Electric Range City [km]	

WLTP CO2 mass emission LOW phase [g/km]	
WLTP CO2 mass emission MID phase [g/km]	
WLTP CO2 mass emission HIGH phase [g/km]	
WLTP CO2 mass emission EXTRA-HIGH phase [g/km]	
WLTP CO2 mass emission (ombined) [g/km]	
Fuel consumption (combined) [l/100km]	
WLTP CS CO2 mass emission LOW phase [g/km]	For OVC
WLTP CS CO2 mass emission MID phase [g/km]	For OVC
WLTP CS CO2 mass emission HIGH phase [g/km]	For OVC
WLTP CS CO2 mass emission EXTRA-HIGH phase [g/km]	For OVC
WLTP CS CO2 mass emission (combined) [g/km]	For OVC
WLTP CS Fuel consumption (combined) [l/100 km]	For OVC
WLTP CD CO2 mass emission (combined) [g/km]	For OVC
WLTP CO2 mass emission (weighted, combined) [g/km]	For OVC
WLTP ECAC,weighted [Wh/km]	For OVC
WLTP EAER combined [km]	For OVC
EAERcity [km]	For OVC
Deviation Factor	
Verification Factor	
EMISSION TYPE APPROVAL DOCUMENT	
Type Approval (TA) number	e?*715/2007*2017/1347ag*????*??
Random Sample	Yes/no
#WLTP Tests*	
Measured WLTP MCO2,c,5 [g/km]*	

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