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REPORT FROM THE COMMISSION

under Regulation (EU) 2018/956 analysing the data transmitted by Member States and manufacturers for the reporting period 2019 on CO2 emissions from and fuel consumption of new heavy-duty vehicles

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under Regulation (EU) 2018/956 analysing the data transmitted by Member States and manufacturers for the reporting period 2019 on CO2 emissions from and fuel consumption of new heavy-duty vehicles

1. LEGAL BASE

In accordance with Article 10 of Regulation (EU) 2018/956 of the European Parliament and of the Council of 28 June 2018 on the monitoring and reporting of CO_2 emissions from and fuel

consumption of new heavy-duty vehicles[1], the Commission shall publish each year a report with its analysis of the data transmitted by Member States and manufacturers for the preceding reporting period. This is the first report under this Regulation, providing a data analysis for the reporting period 2019 exceptionally running from 1 January 2019 to 30 June 2020[2] with a reporting deadline of 30 September 2020.

The CO_2 emissions from and fuel consumption of new heavy-duty vehicles are determined via the Vehicle Energy Consumption Calculation Tool (VECTO), a simulation tool for heavy-duty vehicles developed by the European Commission. The principles underpinning the simulation of new heavy-duty vehicles using VECTO are provided by Regulation (EU) 2017/2400 on the determination of the CO_2 emissions and fuel consumption of heavy-duty vehicles[3].

2. CONTENT OF THE REPORT

In accordance with the requirements of Article 10 of Regulation (EU) 2018/956, this analysis covers

1) the performance of the heavy-duty vehicle fleet of the Union
2) the performance of the heavy-duty vehicle fleet of each Member State
3) the performance of the heavy-duty vehicle fleet of each manufacturer

All three items above are estimated on the basis of the CO_2 emissions for selected representative heavy-duty vehicle groups for different mission profile load combinations and different fuels. Additionally, selected values on the average fuel consumption of the heavy-duty vehicle fleet of the Union are included.

The analysis covers the available data on the uptake of new and advanced CO_2 reducing technologies, as well as of alternative powertrains.

Further performance values can be found in the Central Register for data on heavy-duty vehicles[4].

Results of on-road verification tests could not be added to the report as they are not available to the Commission for the reporting period 2019.

3. DATA BASIS

This report is based on data including all vehicles reported by manufacturers, matched by registrations in the Member States during the reporting period of 2019 as they were available to the Commission by 30 June 2021[5]

[1] Regulation (EU) 2018/956 of the European Parliament and of the Council of 28 June 2018 on the monitoring and reporting of CO_2 emissions from and fuel consumption of new heavy-duty vehicles (OJ L 173, 9.7.2018, p. 1).
[2] The usual reporting periods are from 1 July of a given year to 30 June of the following year.
[3] Commission Regulation (EU) 2017/2400 of 12 December 2017 implementing Regulation (EC) No 595/2009 of the European Parliament and of the Council as regards the determination of the CO_2 emissions and fuel consumption of heavy-duty vehicles and amending Directive 2007/46/EC of the European Parliament and of the Council and Commission Regulation (EU) No 582/2011 (OJ L 349, 29.12.2017, p. 1).
[4] As provided for by Article 6 of Regulation (EU) 2018/956. The Central Register will be published by the EEA under https://discomap.eea.europa.eu/app/CO2HDV/.
[5] It is possible that certain corrections for individual vehicles will be reported to the Commission after this date and will therefore not be included in this report.

Regulation (EU) 2017/2400 sets out a grouping of vehicles based on key technical parameters[6]. The starting date of the CO_2 emissions determination differed between the different vehicle groups[7] (*see Table 1*).

Vehicle groups	Starting date of mandatory CO_2 emissions determination	Covered by this report
Heavy lorries 4, 5, 9, and 10	1 January 2019	Yes
Medium lorries 1, 2, and 3	1 January 2020	Yes
11, 12, and 16	1 July 2020	No

Table 1: Starting date of mandatory CO_2 emissions determination for different vehicle groups

For vehicles in the groups 4, 5, 9, and 10 (henceforth called together *heavy lorries*), the CO_2 emissions determination is mandatory for vehicles registered as from 1 January 2019. The CO_2 emissions of heavy lorries are regulated under the CO_2 emissions Standard Regulation (EU) 2019/1242[8]. It should also be noted that heavy lorries emit about 70% of all CO_2 emissions of heavy-duty vehicles.

In addition, the CO_2 emissions determination is mandatory for vehicles in the groups 1, 2, and 3 (henceforth called together *medium lorries*) only when registered since 1 January 2020. Therefore, for this reporting period, the total number of medium lorries is not directly comparable with that of heavy lorries.

The CO_2 emissions determination is mandatory for vehicles in the groups 11, 12, and 16 only when registered since 1 July 2020. These vehicle groups are therefore not covered by the first reporting period and excluded from this report.

4. ANALYSIS FOR THE FIRST REPORTING PERIOD

4.1 CO_2 emissions and fuel consumption

This section provides an analysis of the CO_2 emissions by Member States, manufacturers, vehicle groups and different mission profiles. Additionally, selected values on fuel consumption, as well as different fuel types used by the newly registered vehicles are presented. Vehicles with alternative powertrains are separately discussed in section 4.2.3, and hence excluded from all data analysed in section 4.1.

4.1.1 Performance of the fleet of the Union

The reported CO_2 emissions strongly depend on the vehicle groups and sub-groups[9]. Table 2 provides data on the composition and CO_2 emissions of the vehicle groups. In particular, it shows the number of vehicles as well as the average specific CO_2 emissions of different sub-groups. All vocational vehicles registered during the first reporting period belong to vehicle groups 4 and 9. The very large majority of medium lorries belong to groups 2 and 3. As regards

[6] As provided for by Article 4 of Regulation (EU) 2017/2400.
[7] As provided for by Article 24 of Regulation (EU) 2017/2400.
[8] Regulation (EU) 2019/1242 of the European Parliament and of the Council of 20 June 2019 setting CO2 emission performance standards for new heavy-duty vehicles and amending Regulations (EC) No 595/2009 and (EU) 2018/956 of the European Parliament and of the Council and Council Directive 96/53/EC (OJ L 198, 25.7.2019, p. 202-240).
[9] The vehicle sub-groups reflect the vehicles' typical usage pattern and specific technical characteristics. They are defined by Annex I of Regulation (EU) 2019/1242.

heavy lorries, the vehicles in sub-group 5-Long Haul (5-LH) represent 63% of all new heavy lorries. These are the most common vehicles used for long-haul freight transportation in the EU.

Vehicle group	Vehicle sub-group	Number of vehicles	Average specific CO_2 emissions (g/km)[10]	Average payload (t)
1	-	953	566.84	1.46
2	-	4647	619.85	2.34
3	-	4676	704.80	3.37
4	4-UD	681	814.32	2.65
	4-RD	13 099	627.00	3.18
	4-LH	9506	794.25	7.42
	vocational	894	1396.77	-
5	5-RD	1345	862.69	10.26
	5-LH	159 004	786.26	13.84
9	9-RD	10 302	697.11	6.28
	9-LH	27 787	876.21	13.40
	vocational	1957	1589.25	-
10	10-RD	171	858.04	10.26
	10-LH	27 047	808.53	13.84
EU total	-	262 069	790.31	-

Table 2: Number of vehicles, average specific CO_2 emissions in g/km, and average payload in t per vehicle sub-group (note: RD stands for vehicles used mostly for Regional Delivery, LH for Long Haul, and UD for Urban Delivery)

Therein, average specific CO_2 emissions of a heavy-duty vehicle from a given sub-group are calculated as a weighted mean over different mission profiles[11] as defined in Annex I of Regulation (EU) 2019/1242. For vehicle groups 1, 2, and 3, the mission profile weights used for all calculations in this report are not yet defined in legislation. The definitions used for this report can be found in Table A-1 in the Annex.

Table 2 also provides the average payload in t for all vehicle groups. The average specific CO_2 emissions in g/tkm can be obtained through a division of the specific CO_2 emissions in g/km by the average payload in tone can obtain[12].

Section A.2 of the Annex provides a description on how the average payload has been calculated for all vehicle groups.

4.1.2 Performance of the fleet of the Member States

Table 3 provides information on the average specific CO_2 emissions in g/km for each Member States. Vocational vehicles are not taken into account. For conciseness reasons, only emission values for vehicle group 2 and sub-group 5-Long-Haul (5-LH), as well as all heavy lorries (i.e., groups 4, 5, 9, and 10) are shown herein[13]. Groups 2 and 5-LH have been selected as the two

[10] In Regulation (EU) 2019/1242, the term of average specific CO_2 emissions is used for values in g/tkm. This report uses the same notion for values in g/km.

[11] Regulation (EU) 2019/1242 defines a mission profile as a "combination of a target speed cycle, a payload value, a body or trailer configuration and other parameters, if applicable, reflecting the specific use of a vehicle".

[12] This is valid for all CO_2 emissions values averaged over mission profiles presented in this report. Hence, for conciseness reasons no values in g/tkm are provided.

[13] The current legislation does not yet define the mileage and payload weighting factors to calculate combined emissions from medium lorries. Thus, this report provides only combined emissions from heavy lorries.

representative groups for medium lorries (groups 1, 2, and 3) and heavy lorries (groups 4, 5, 9, and 10) respectively[14].

	Medium lorries		*Heavy lorries*		
Member State	*Groups 1, 2, 3* Number of vehicles	*Group 2* Average specific CO_2 emissions (g/km)	*Groups 4, 5, 9, 10* Number of vehicles	*Group 5-LH* Average specific CO_2 emissions (g/km)	*Groups 4, 5, 9, 10* Combined average specific CO_2 emissions (g/km)
Austria	219	619.41	4836	804.26	799.01
Belgium	458	636.11	7159	795.12	780.23
Bulgaria	18	600.96	2611	772.63	773.13
Croatia	36	653.07	877	777.48	778.79
Cyprus	2	569.51	10	752.88	802.88
Czechia	384	641.92	6567	777.68	783.79
Denmark	104	611.25	3059	775.19	798.63
Estonia	5	683.71	764	765.57	780.54
Finland	79	593.44	1480	776.98	805.17
France	2093	594.77	42 500	795.17	789.68
Germany	3469	616.74	43 703	791.84	794.94
Greece	24	746.75	122	807.34	740.52
Hungary	24	627.44	4418	779.23	782.54
Ireland	101	598.33	1083	774.59	775.04
Italy	477	666.24	16 641	787.17	789.91
Latvia	4	595.23	933	780.60	781.84
Lithuania	4	563.61	7666	784.17	784.48
Luxemburg	42	594.97	1069	801.07	797.38
Malta	12	681.17	10	790.63	801.98
Netherlands	400	621.66	12 539	776.98	779.00
Poland	458	643.44	25 462	777.11	779.19
Portugal	87	636.34	4026	770.12	768.37
Romania	35	628.95	5313	783.45	783.60
Slovakia	80	647.41	1432	772.17	768.83
Slovenia	8	609.04	1278	775.38	771.94
Spain	666	594.45	18 878	782.72	778.83
Sweden	151	607.41	4451	787.31	827.08
United Kingdom	833	736.10	29 508	793.91	789.57
Unknown[15]	3	-	547	781.71	787.17
EU total	10276	619.85	248 942	786.26	787.50

Table 3: Average specific CO_2 emissions in g/km of vehicle groups 2 and 5-LH, as well as all heavy lorries in each Member State

Section A.3 of the Annex provides a description on how the average specific CO_2 emissions, as well as the combined average specific CO_2 emissions from Table 3 are calculated.

[14] For the medium lorries, groups 2 and 3 contain a comparable number of vehicles. Regarding the average specific CO_2 emissions and average payload, group 2 is "in between" groups 1 and 3 (*see Table 2*), and hence best represents the medium lorries. Sub-group 5-LH is chosen as a representative group as it accounts for more than 60% of all newly registered heavy lorries.

[15] 3 medium lorries, as well as 547 heavy lorries are classified as *Unknown*. These are vehicles registered in more than one Member State, hence could not be attributed to one precise Member State.

4.1.3 Performance of the fleet of the manufacturers

Table 4 presents average specific CO_2 emissions in g/km for all manufacturers. Vocational vehicles are not taken into account.

	Medium lorries		*Heavy lorries*		
Manufacturer	*Groups 1, 2, 3* Number of vehicles	*Group 2* Average specific CO_2 emissions (g/km)	*Groups 4, 5, 9, 10* Number of vehicles	*Group 5-LH* Average specific CO_2 emissions (g/km)	*Groups 4, 5, 9, 10* Combined average specific CO_2 emissions (g/km)
DAF NV	1968	709.58	48 247	784.34	783.95
DAIMLER TRUCK AG	2253	626.13	40 462	793.61	801.21
FORD OTOMOTIV SANAYI AS	-	-	789	830.36	824.81
IVECO SPA	407	693.41	1281	-	695.13
IVECO MAGIRUS-AG	-	-	11 432	802.80	803.60
MAN TRUCK AND BUS SE	2884	601.14	34 728	803.19	788.93
RENAULT TRUCK SA	1960	564.44	22 196	807.96	801.09
SCANIA CV AB	-	-	49 207	743.16	755.71
VOLVO TRUCK CORPORATION	804	597.01	40 600	798.19	805.58

Table 4: Average specific CO_2 emissions in g/km of vehicle groups 2 and 5-LH, as well as all heavy lorries for each manufacturer

It should be noted that the combined average specific CO_2 emissions strongly depend on the distribution of vehicles between the different sub-groups[16]. The sub-groups reflect the different technical parameters and driving patterns of the vehicles, and hence show significant differences in terms of their average specific CO_2 emissions (*see Table 2*).

Therefore, for a holistic analysis of the variations between manufacturers regarding the combined average specific CO_2 emissions, the composition of their fleets needs to be taken into account (see Table 5 with the number of vehicles per sub-group for each manufacturer). As an example, Iveco SPA has by far most of its vehicles in the 4-RD sub-group, which has a relatively low mileage*payload weighting factor (which reflects the lifetime transport utility of the vehicle sub-group). As a result, the combined average specific CO_2 emissions of this manufacturer are significantly lower than those of the other manufacturers.

	Vehicle sub-group								
Manufacturer	4-UD	4-RD	4-LH	5-RD	5-LH	9-RD	9-LH	10-RD	10-LH
DAF NV	620	2332	1676	94	33 640	377	3320	5	6183
DAIMLER TRUCK AG	0	1765	2304	302	26 226	1812	5693	5	2355

[16] This applies to the combined average specific CO_2 emissions shown in both Table 3 and Table 4.

	Vehicle sub-group								
Manufacturer	4-UD	4-RD	4-LH	5-RD	5-LH	9-RD	9-LH	10-RD	10-LH
FORD OTOMOTIV SANAYI AS	0	117	147	0	495	18	12	0	0
IVECO SPA	5	1187	89	0	0	0	0	0	0
IVECO MAGIRUS-AG	0	317	156	135	7978	1511	1107	0	228
MAN TRUCK AND BUS SE	0	2415	1337	279	20 896	2457	4296	98	2950
RENAULT TRUCK SA	3	2032	1159	163	14 339	1320	1766	0	1414
SCANIA CV AB	53	1514	1642	285	29 218	1528	6571	51	8345
VOLVO TRUCK CORPO-RATION	0	1420	996	87	26 212	1279	5022	12	5572

Table 5: Number of vehicles per vehicle sub-group for each manufacturer

Section A.4 of the Annex provides a description on how the average specific CO_2 emissions, as well as the combined average specific CO_2 emissions from Table 4 are calculated.

4.1.4 CO_2 emissions at different mission profiles/payload combinations

In VECTO, all vehicles are simulated over different mission profiles and with two different payloads (low or representative). Each vehicle group is simulated over a defined number of corresponding mission profiles.

Table 6 presents average specific emissions in g/km and g/tkm from vehicle groups 2, and 5, as well as from all vocational vehicles in group 9.

	Medium lorries Vehicle group 2		*Heavy lorries* Vehicle group 5		*Vocational vehicles* Vehicle group 9v	
Mission profile / payload[17]	Average CO_2 emissions (g/km)	Average CO_2 emissions (g/tkm)	Average CO_2 emissions (g/km)	Average CO_2 emissions (g/tkm)	Average CO_2 emissions (g/km)	Average CO_2 emissions (g/tkm)
RDL	506.95	845.48	674.46	259.41	-	-
RDR	546.14	182.15	839.13	65.05	-	-
LHL	671.07	516.21	647.22	248.93	-	-
LHR	775.28	79.02	846.45	43.86	-	-
UDL	633.01	1055.76	1056.16	406.21	-	-
UDR	733.52	244.65	1449.55	112.37	-	-
REL	-	-	852.18	243.48	-	-

[17] Mission profiles are: regional delivery payload low (RDL), regional delivery payload representative (RDR), long haul payload low (LHL), long haul payload representative (LHR), urban delivery payload low (UDL), urban delivery payload representative (UDR), regional delivery *EMS* payload low (REL), regional delivery *EMS* payload representative (RER), long haul *EMS* payload low (LEL), municipal utility payload low (MUL), municipal utility payload representative (MUR), construction payload low (COL), and construction payload representative (COR). Herein, MUL, MUR, COL, and COR are designed specifically for vocational vehicles, which include, e.g., vehicles used for garbage collection or construction works.

	Medium lorries Vehicle group 2		*Heavy lorries* Vehicle group 5		*Vocational vehicles* Vehicle group 9v	
Mission profile / payload[17]	Average CO_2 emissions (g/km)	Average CO_2 emissions (g/tkm)	Average CO_2 emissions (g/km)	Average CO_2 emissions (g/tkm)	Average CO_2 emissions (g/km)	Average CO_2 emissions (g/tkm)
RER	-	-	1080.30	61.73	-	-
LEL	-	-	813.22	232.35	-	-
MUL	-	-	-	-	2239.60	1866.34
MUR	-	-	-	-	2414.47	402.41
COL	-	-	-	-	784.72	560.52
COR	-	-	-	-	918.22	129.33

Table 6: Average specific CO_2 emissions in g/km and g/tkm of vehicle groups 2, 5, and 9 for each mission profile

4.1.5 CO_2 emissions and fuel consumption by fuel type

Table 7 provides the average specific CO_2 emissions by fuel type. Similarly to Table 3 and Table 4, it presents values for vehicle groups 2 and 5-LH, excluding vocational vehicles. None of the vehicles registered during the reporting period of 2019 used Petrol (PI), Ethanol (PI), or LPG (PI)[18]. A more detailed analysis of the different fuels used by newly registered vehicles is given in section 4.2.2.

	Medium lorries Vehicle group 2			*Heavy lorries* Vehicle sub-group 5-LH		
Fuel type (engine)	Number of vehicles	Average specific CO_2 emissions (g/km)	Average fuel consumption	Number of vehicles	Average specific CO_2 emissions (g/km)	Average fuel consumption
Diesel (CI)	4632	620	23.69 l/100km	155 180	787.10	30.08 l/100km
Ethanol (CI)	-	-	-	15	696.22	46.90 l/100km
LNG (PI)	-	-	-	2015	754.62	272.42 g/km
CNG (PI)	15	611	227.15 g/km	1350	752.63	279.79 g/km
NG (PI)	-	-	-	444	743.66	292.78 g/km

Table 7: Number of vehicles, average specific CO2 emissions in g/km and average fuel consumption of vehicle groups 2 and 5-LH by fuel type

For 444 natural gas vehicles from sub-group 5-LH simulated with early VECTO versions, no specification on the type of natural gas, whether liquefied natural gas (LNG), or compressed natural gas (CNG) is used, is available. These vehicles are classified here as NG.

4.2 Advanced CO_2 technologies and alternative powertrains

This section focuses on the use of advanced and alternative technologies within the vehicles registered during the first reporting period. In particular, it lists the total number of vehicles and the share of the fleet equipped with a given technology. It compares the fleets of different manufacturers and Member States.

[18] PI stands for a Positive Ignition engine and CI for Compressed Ignition engine.

4.2.1 Advanced CO_2 technologies

During the reporting period of 2019, manufacturers could, but were not obliged to, indicate additional "advanced CO_2 technologies"[19]. This information had no influence on VECTO simulation results. Only one manufacturer consistently indicated whether a vehicle registered presents advanced CO_2 technologies. As a result, this analysis concerns only the fleet of this single manufacturer.

Out of all new vehicles of its fleet, 67% were equipped with an active front grille, classified as an advanced aerodynamic measure. Furthermore, around 80% of its new vehicles were equipped with a pulse and glide technology, leading to more energy-efficient driving.

No conclusions about advanced CO_2 technologies within the whole fleet of the Union can be made.

Besides this optional information on "advanced CO_2 technologies", the manufacturers had to indicate, whether the registered vehicle is equipped with an advanced driver-assistance systems (ADAS) technology[20]. These parameters were taken into account during VECTO simulations, and hence it can be assumed that the data reported are accurate for all manufacturers. Table 8 presents the total number of vehicles equipped with an ADAS technology.

	Vehicle group							Total
ADAS technology	1	2	3	4	5	9	10	
Eco-roll without engine stop-start	17	184	154	2121	58 180	7251	6461	74 368
Predictive cruise control	0	0	0	488	41 039	2668	3472	47 667
Total number of vehicles in group	953	4647	4676	24 180	160 349	40 046	27 218	262 069
Share of vehicles equipped with ADAS (%)	1.8	3.9	3.3	10.8	61.9	24.8	36.5	6.6

Table 8: Number of vehicles per vehicle group equipped with an ADAS technology

No vehicles registered during the reporting period of 2019 were equipped with the ADAS technologies "engine stop-start during vehicle stop" or "eco-roll with engine stop-start".

4.2.2 Alternative fuels

The fuel and engine type of a registered vehicle were mandatory specifications during the reporting period as they have an impact on the emissions determination via VECTO. Even though almost 98% of vehicles registered use Diesel, a small amount of newly registered vehicles use ethanol, LNG, or CNG. Table 9 gives an overview of the different fuel and engines within the vehicle groups.

		Vehicle group							Total
	Fuel type (engine)	1	2	3	4	5	9	10	
Conventional fuels	Diesel (CI)	953	4632	4662	23 694	156 445	39 039	27 176	256 601

[19] Field 74 of Table 2 in Annex I of Regulation (EU) 2018/956.
[20] Fields 97-100 of Table 2 in Annex I of Regulation (EU) 2018/956.

Alternative fuels	Ethanol (CI)	0	0	0	0	16	15	0	31
	LNG (PI)	0	0	0	28	2024	110	14	2176
	CNG (PI)	0	15	14	389	1420	768	25	2631
	NG (PI)	0	0	0	69	444	114	3	630
Total number of vehicles in group		953	4647	4676	24 180	160 349	40 046	27 218	262 069
Share of vehicles using alternative fuels (%)		0.0	0.3	0.3	2.0	2.4	2.5	0.2	2.1

Table 9: Number of vehicles per vehicle group by fuel type

For 630 natural gas vehicles simulated with early VECTO versions, no specification on the type of natural gas (LNG or CNG) is available. In Table 9 these vehicles are classified as NG.

Table 10 shows data per Member State in terms of the number of vehicles using alternative fuels. The data are summed up within the two most important categories: medium lorries (i.e. groups 1, 2, and 3), as well as heavy lorries (i.e. groups 4, 5, 9, and 10).

	Medium lorries Vehicle group 1, 2, and 3		*Heavy lorries* Vehicle groups 4, 5, 9, and 10					**Total number of vehicles**	*Share of vehicles using alternative fuels (%)*
Member State	Diesel (CI)	CNG (PI)	Diesel (CI)	Ethanol (CI)	LNG (PI)	CNG (PI)	NG (PI)		
Austria	219	0	4822	0	7	22	8	5078	0.73
Belgium	458	0	7091	0	93	75	22	7739	2.46
Bulgaria	18	0	2417	0	1	171	29	2636	7.63
Croatia	36	0	873	0	1	1	4	915	0.66
Cyprus	2	0	10	0	0	0	0	12	0.0
Czechia	384	0	6522	0	6	44	15	6971	0.93
Denmark	104	0	3163	0	0	13	10	3290	0.70
Estonia	5	0	725	0	1	28	11	770	5.19
Finland	79	0	1448	1	5	45	5	1583	3.54
France	2087	6	41 452	14	323	805	144	44 831	2.88
Germany	3469	0	43 421	0	431	295	34	47 650	1.59
Greece	24	0	122	0	0	0	0	146	0.0
Hungary	24	0	4416	0	1	1	0	4442	0.05
Ireland	101	0	1081	0	0	10	0	1192	0.84
Italy	457	20	15 736	0	459	355	230	17 257	6.17
Latvia	4	0	921	0	10	2	0	937	1.28
Lithuania	4	0	7630	0	30	6	0	7670	0.47
Luxemburg	42	0	1077	0	1	2	0	1122	0.27
Malta	12	0	14	0	0	0	0	26	0.0
Netherlands	400	0	12 610	0	80	50	30	13 170	1.21
Poland	458	0	25 163	0	212	103	36	25 972	1.35
Portugal	87	0	3997	0	19	24	6	4133	1.19
Romania	35	0	5145	0	84	86	3	5353	3.23
Slovakia	80	0	1415	0	17	3	0	1515	1.32
Slovenia	8	0	1273	0	2	3	0	1286	0.39
Spain	663	3	18 355	0	366	177	37	19 601	2.97
Sweden	151	0	4396	16	24	99	3	4689	3.02
United Kingdom	833	0	30 516	0	1	182	1	31 533	0.58

	Medium lorries Vehicle group 1, 2, and 3		*Heavy lorries* Vehicle groups 4, 5, 9, and 10					**Total number of vehicles**	*Share of vehicles using alternative fuels (%)*
Member State	Diesel (CI)	CNG (PI)	Diesel (CI)	Ethanol (CI)	LNG (PI)	CNG (PI)	NG (PI)		
Unknown[21]	3	0	543	0	2	0	2	550	0.73
EU total	10 247	29	246 354	31	2176	2602	630	262 069	2.09

Table 10: Number of vehicles per Member State by fuel type

Differences between Member States might result from differently developed re-filling infrastructures for alternative fuels, e.g. CNG/LNG. Nonetheless, the number of registered vehicles using alternative fuels is low throughout the whole EU.

4.2.3 Alternative powertrains

Vehicles with alternative powertrains, i.e. zero emission vehicles, hybrid electric vehicles, and dual-fuel vehicles, are exempt from VECTO simulations according to Article 9(1) of Regulation (EU) 2017/2400.

Regulation (EU) 2019/1242 defines a zero-emission heavy-duty vehicle as a vehicle without an internal combustion engine, or with an internal combustion engine that emits less than 1 g CO_2/kWh, or less than 1 g CO_2/km.

A hybrid electric vehicle is a vehicle combining an internal combustion engine with an electric motor[22]. A dual-fuel vehicle is a vehicle with an internal combustion engine that is designed to operate on two different fuels at the same time[23].

Based on the data provided during the reporting period of 2019, it is only possible to provide data on the total number of vehicles with alternative powertrains per manufacturer and Member State. Additional information on these vehicles, as e.g., their vehicle groups and sub-groups, are not available yet. Table 11 shows that the number of vehicles with alternative powertrains registered during the reporting period was very limited.

	Alternative powertrain				
Manufacturer	Zero emission vehicle	Hybrid electric vehicle	Dual-fuel vehicle	**Total number of vehicles by manufacturer**	*Share of vehicles with an alternative powertrain (%)*
DAF NV	1	0	0	51 765	0.00
DAIMLER TRUCK AG	0	0	0	43 942	0.00
FORD OTOMOTIV SANAYI AS	0	0	0	789	0.00
IVECO SPA	0	0	0	1688	0.00
IVECO MAGIRUS-AG	0	0	0	11 432	0.00

[21] 3 medium lorries, as well as 547 heavy lorries are classified as *Unknown*. These are vehicles registered in more than one Member State, hence could not be attributed to one precise Member State.

[22] For the entire definition, see Article 3(15) of Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles (OJ L 263, 9.10.2007, p. 1-160).

[23] For the entire definition, see Article 2(48) of Commission Regulation (EU) No 582/2011 (OJ L 47, 18.2.2014, p.1-57) as amended by Commission Regulation (EU) No 133/2014 of 31 January 2014..

	Alternative powertrain				
Manufacturer	Zero emission vehicle	Hybrid electric vehicle	Dual-fuel vehicle	**Total number of vehicles by manufacturer**	*Share of vehicles with an alternative powertrain (%)*
MAN TRUCK AND BUS SE	1	0	0	37 613	0.00
RENAULT TRUCK SA	0	0	0	24 156	0.00
SCANIA CV AB	0	20	0	49 227	0.04
VOLVO TRUCK CORPO-RATION	1	0	1006	42 486	2.37
Total number of vehicles	3	20	1006	263 098	0.39

Table 11: Number of vehicles with alternative powertrains by manufacturers

5. EXTENT OF THE USE OF STANDARD VALUES IN THE REPORTED DATA

For CO_2 emissions determination in accordance with Regulation (EU) 2017/2400, standard values, instead of certified values determined on the basis of testing, are set in that Regulation and can be used for certain components upon the choice of the manufacturer. The use of standard values reduces testing costs. These standard values are set in a way that encourages manufacturers to apply for component certification and testing. This means that standard values have to reflect the performance of the less efficient components available on the market. Therefore, their application results typically in a certain overestimation of the fuel consumption and CO_2 emissions of the vehicles simulated.

This section provides an overview on the extent of the use of standard values in the reported data. A more exhaustive analysis of the quantitative influence of the use of standard versus certified values on the reported CO_2 emissions is beyond the scope of this report. An evaluation will be carried out by the Commission in the context of the assessment of reference CO_2 emissions[24].

Table 12 shows the percentage of vehicles from groups 1, 2, and 3 using at least one standard value during simulation[25]. Additionally, it provides the total number of vehicles in the respective groups.

Vehicle group	Share of vehicles within group using a standard value for at least one component (%)	Fleet composition: total number of vehicles
1	82.7	1890
2	61	4660
3	48.3	3557

[24] As provided for by Article 10 of Regulation (EU) 2019/1242.

[25] Results are based on data containing simulation results of vehicles registered between 1 October 2019 and 30 June 2020, hence a different period than used for the rest of this report. Thus, the fleet composition presented in Tables 12 and 13 slightly differs from the fleet composition presented in all other tables of this analysis. Although the data source used in Tables 12 and 13 is different, it remains representative also for the first reporting period, and hence does not impact the general conclusions drawn in regards with the use of standard value in reported data. In Tables 12 and 13 vocational vehicles are not taken into account.

Table 12: Fleet composition and share of vehicles using standard values in groups 1, 2, and 3 (medium lorries)

Vehicles belonging to the heavy lorries' groups are further separated into sub-groups that reflect the vehicles' typical usage pattern and specific technical characteristics[26]. Table 13 shows the percentage of vehicles from the different sub-groups using at least one standard value during simulation. It also presents the composition of the heavy lorries' fleet.

Vehicle sub-group	Share of vehicles within sub-group using a standard value for at least one component (%)	Fleet composition: total number of vehicles
4-UD	0.2	413
4-RD	43.5	10 324
4-LH	10.7	2419
5-RD	35.5	1151
5-LH	1.3	76 504
9-RD	30.8	9822
9-LH	10.6	11 445
10-RD	12	150
10-LH	1.4	11 751

Table 13: Fleet composition and share of vehicles using standard values in groups 4, 5, 9, and 10 (heavy lorries)

The reported data also covers vocational vehicles, i.e. vehicles used for special purposes such as garbage collection or construction works. Vocational vehicles are, however, excluded from the data in Table 12 and 13.

Overall, within sub-group 5-LH, which has the largest share of the fleet, 98.7% of all vehicles are simulated using certified values. In total, 93.6% of the heavy lorries are simulated using certified values.

However, a significant use of at least one standard value can be observed in some of the vehicle sub-groups of the heavy lorries (i.e. 43.5% in 4-RD, 35.5% in 5-RD or 30.8% in 9-RD). Furthermore, more than 57% of all medium lorries were simulated using at least one standard value.

This observation confirms the expectations that standard values would be mainly used for vehicle types that are registered in lower numbers.

6. CONCLUSION

This first report aims foremost to present the status quo of the EU's heavy-duty vehicle fleet. More in-depth analyses of the monitoring data are planned for the upcoming reports, as it will only then be possible to examine developments and trends over time.

The report compares the performance of the fleets of different Member States, manufacturers, and vehicle groups. It provides selected values on CO_2 emissions, fuel consumption, as well as the share of alternative technologies in heavy-duty vehicles registered during the first reporting period. This section summarizes the key observations from the reported data.

[26] As provided for by Annex I of Regulation (EU) 2019/1242. Therein, RD stands for vehicles used mostly for regional delivery, LH for long haul, and UD for urban delivery.

6.1 CO_2 emissions

A fair comparison of the performance of different Member States and manufacturers in terms of the average specific CO_2 emissions of their fleets is only possible within a given group (for medium lorries) or sub-groups (for heavy lorries).

Within the representative group for medium lorries, i.e. group 2, significant differences among the fleets of different Member States and manufacturers can be observed. The relative difference between the best- and the worst-performing Member State's fleet is of more than 30% (*see Table 3*). For the manufacturers, the relative difference accounts to 25% (*see Table 4*).

As for the heavy lorries, the performances of the 5-Long Haul fleets of different Member States and manufacturers are more aligned. The relative difference in the performance of fleets is of around 7% amongst Member States (*see Table 3*), and around 12% amongst manufacturers (*see Table 4*).

The higher variation of average specific CO_2 emissions of medium lorries as compared to heavy lorries can be explained by two elements. Firstly, medium lorries are simulated with slightly different payloads depending on their technically permissible maximum laden mass, while the payload used at the simulations of heavy lorries does not depend on the technical characteristics of the individual vehicle. Secondly, there are more than one order of magnitude more heavy than medium lorries. As a result, coincidental fluctuations of CO_2 emissions, in particular in smaller Member States, are more likely to occur for medium lorries.

Furthermore, the data on the uptake of advanced technologies indicates that almost half of the newly registered vehicles are equipped with an advanced driver-assistance systems. The data on additional advanced CO_2 technologies is limited, but suggests that a high share of vehicles is also equipped with advanced aerodynamic measures or a pulse and glide technology.

6.2 Fuels and powertrains

At present, diesel vehicles still account for more than 97% of all EU's newly registered heavy-duty vehicles. Only a limited number of vehicles use alternative fuels or alternative powertrains.

The share of vehicles using alternative fuels, i.e. ethanol, CNG, or LNG, significantly varies between the Member States. While it is very low (below 0.5%) in Cyprus, Greece, Hungary, Lithuania, Luxemburg, Malta, and Slovenia, it reaches more than 7% and 6% in Bulgaria and Italy, respectively (*see Table 10*). This is mainly due to a relatively high share of natural gas (LNG, CNG, NG) vehicles, reflecting a quite well-developed gas refilling infrastructure in these countries.

Currently, the number of zero-emission heavy-duty vehicles across the EU is negligibly small, with only three vehicles registered during the first reporting period (*see Table 11*). However, due to the entry in force of Regulation 2019/1242 setting CO_2 emission performance standards for new heavy-duty vehicles, the uptake of zero-emission heavy-duty vehicles is expected to increase in the coming years.

ANNEX

A.1 Mission profile weights (medium lorries)

The values provided in Table A-1 are not yet defined in legislation but used in VECTO for the determination of specific CO_2 emissions of individual vehicles indicated in the Certificate of Conformity (CoC).

Vehicle group	RDL	RDR	UDL	UDR
1	0.1	0.3	0.18	0.42
2	0.125	0.375	0.15	0.35
3	0.125	0.375	0.15	0.35

Table A-1: Mission profile weights for vehicle groups 1, 2, and 3 (medium lorries)

A.2 Average payload

For groups 4, 5, 9, and 10, the average payload is fixed within each sub-group.

For groups 1, 2, and 3, the payload values are not fixed but vary according to the technically permissible maximum laden mass (TPMLM) of the individual vehicle. Hence, to calculate the average payload within a group, one has to take into account vehicle-specific payloads[27]. The average payload Pl_g for groups 1, 2, and 3 is calculated as follows:

$$Pl_g = \frac{\sum_{v_g} \sum_{mp} W_{g,mp} \times Pl_{v_g,mp}}{V_g}.$$

Therein, $\sum_{v_g}$ is the sum over all vehicles from group g, $\sum_{mp}$ the sum over all mission profiles, $Pl_{v_g,mp}$ the payload value attributed to vehicle v_g for mission profile mp, and V_g the total number of vehicles from vehicle group g.

$W_{g,mp}$ are the same mission profile weights that are used for the calculation of the specific CO_2 emissions of groups 1, 2, 3 (*see Table A-1*).

A.3 Average CO_2 emissions per Member State

The average specific CO_2 emissions $avgCO2_{g,MS}$ in g/km of a vehicle (sub-)group[28] per Member State are calculated as follows:

$$avgCO2_{g,MS} = \frac{\sum_{v_{g,MS}} CO2_{v_{g,MS}}}{V_{g,MS}}.$$

Therein, $\sum_{v_{g,MS}}$ is the sum over all vehicles from a given (sub-)group g and Member State MS and $CO2_{v_{g,MS}}$ are the average specific CO_2 emissions of a new heavy-duty vehicle v from group

[27] European Commission. (2017). *VECTO tool development: Completion of methodology to simulate Heavy Duty Vehicles' fuel consumption and CO_2 emissions. Upgrades to the existing version of VECTO and completion of certification methodology to be incorporated into a Commission legislative proposal* (pp. 71-73).

[28] Vehicle groups as defined in point 1 of Annex I of Regulation (EU) 2017/2400 are: 1, 2, 3, 4, 5, 9, 10. Vehicle sub-groups as defined in point 1 of Annex I of Regulation 2019/1242 are: 4-UD, 4-RD, 4-LH, 5-RD, 5-LH, 9-RD, 9-LH, 10-RD, 10-LH. The first digit of a vehicle sub-group indicates the vehicle group to which it belongs.

g and Member State MS, as defined by point 2.1. in Annex I of Regulation (EU) 2019/1242[29]. $V_{g,MS}$ is the total number of vehicles from group g registered in Member State MS.

The combined average specific CO_2 emissions $avgCO2_{4,5,9,10,MS}$ from groups 4, 5, 9, and 10 are calculated analogously to the formula given in 2.7. in Annex I of Regulation (EU) 2019/1242:

$$avg\mathrm{CO2}_{4,5,9,10,MS} = \sum_{sg} avg\mathrm{CO2}_{sg,MS} \times MPW_{sg} \times share_{sg,MS}.$$

Therein, $\sum_{sg}$ is the sum over all sub-groups within groups 4, 5, 9, and 10, $avg\mathrm{CO2}_{sg,MS}$ are the average specific emissions of all new heavy-duty vehiclesin the Member State *MS* and in the vehicle sub-group sg, as defined above and presented in Table 3. MPW_{sg} is the mileage and payload weighting factor as determined in point 2.6. in Annex I of Regulation (EU) 2019/1242, $share_{sg,MS}$ is the share of new heavy-duty vehicles from a given Member State MS in a given sub-group sg.

A.4 Average CO_2 emissions per manufacturer

All values are calculated using the same methodology as in section A.3. Vocational vehicles are not taken into account.

The average specific emissions $avg\mathrm{CO2}_{g,M}$ in g/km of a vehicle (sub-)group per manufacturer are calculated as follows:

$$avg\mathrm{CO2}_{g,M} = \frac{\sum_{v_{g,M}} \mathrm{CO2}_{v_{g,M}}}{V_{g,M}}.$$

Herein the specific CO_2 emissions are averaged over all vehicles from a given (sub-)group g and a given manufacturer M(instead of a given Member State MS, as above).

Similarly, the combined average specific CO_2 emissions $avgCO2_{4,5,9,10,M}$ from groups 4, 5, 9, and 10 are given by:

$$avg\mathrm{CO2}_{4,5,9,10,M} = \sum_{sg} avg\mathrm{CO2}_{sg,M} \times MPW_{sg} \times share_{sg,M}.$$

Herein, $share_{sg,M}$ is the share of new heavy-duty vehicles from a given manufacturer M in a given sub-group sg.

[29] The average specific CO_2 emissions $CO2_v$ for vehicles from groups 1, 2, 3 are calculated using mission profile weights defined in Table A-1.