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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 2020 on CO2 emissions from and fuel consumption of new heavy-duty vehicles

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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 second report under this Regulation, providing a data analysis for the reporting period 2020 running from 1 July 2020 to 30 June 2021 with a reporting deadline of 30 September 2021.

The CO2 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 CO2 emissions and fuel consumption of heavy-duty vehicles[2].

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 based on the CO_2 emissions for selected representative heavy-duty vehicle groups for different mission profile, payload 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 also covers the available data on the uptake of new and advanced CO_2 reducing technologies, as well as of alternative powertrains.

It is based on data as available on 07/11/2022.

Further performance values can be found in the Central Register for data on heavy-duty vehicles[3].

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 2020.

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[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] 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).

[3] As provided for by Article 6 of Regulation (EU) 2018/956. The Central Register is published by the EEA under https://discomap.eea.europa.eu/app/CO2HDV/.

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 2020. These cover lorries in vehicle groups 1, 2, 3, 4, 5, 9, 10, 11, 12 and 16[4]. Lorries in groups 11, 12 and 16 are covered for the first time[5].

All these lorries are defined as heavy lorries in Regulation (EU) 2017/2400. This report, when relevant, distinguish between lorries below or equal to (groups 1, 2 and 3) and above (4, 5, 9, 10, 11, 12 and 16) 16 tonnes of technical maximum permissible laden weight.

Buses and coaches are not included.

4. ANALYSIS FOR THE 2020 REPORTING PERIOD

4.1 CO₂ 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, i.e. zero emission vehicles, hybrid electric vehicles, and dual-fuel vehicles, are separately discussed in section 4.2.

4.1.1 Performance of the fleet of the Union

The reported CO_2 emissions strongly depend on the vehicle groups and sub-groups[6]. **Table 1** provides data on the composition and CO_2 emissions of the vehicle groups and sub-groups. In particular, it shows the number of vehicles as well as the average specific CO_2 emissions of different groups and sub-groups. All vocational vehicles registered during the 2020 reporting period belong to vehicle groups 4, 5 and 9. The very large majority of matched lorries below 16 tonnes of technical maximum permissible laden weight belong to groups 2 and 3. As regards lorries above 16 tonnes, the vehicles in sub-group 5-Long Haul (5-LH) represent 68% of all new lorries above 16 tonnes. These are the most common vehicles used for long-haul freight transportation in the EU.

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[7] as defined in Annex I of Regulation (EU) 2019/1242. For vehicle groups 1, 2, 3, 11, 12 and 16, 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 Annex A.1.

Table 1 also provides the average payload in tonnes for all vehicle groups as well as the average specific CO2 emissions in g/tkm, calculated dividing the average specific CO_2 emissions in g/km by the average payload in tonnes. The average specific CO2 emissions in

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[4] As set out is Article 4 of Regulation (EU) 2017/2400

[5] The number of vehicles registered in the groups 11, 12 and 16 might not be representative of a typical reporting period. Since they were not certified before the beginning of the reporting period, some vehicles might have been registered without being reported by a manufacturer.

[6] 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.

[7] 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".

g/tkm of a vehicle group corresponds to the reference CO2 emissions of a vehicle group as defined in Article 2(1), sub-paragraph point 38, subpoint (b)[8] of Directive 1999/62/EC, as amended by Directive 2006/38/EC, by Directive 2011/76/EU, and by Directive (EU) 2022/362[9], and can be used for the purposes outlined in this Directive.

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

Table 1: Number of vehicles, average specific CO2 emissions in g/km, average payload in tonnes and average specific CO2 emissions in g/tkm per vehicle group and sub-group (note: RD stands for vehicles used mostly for Regional Delivery, LH for Long Haul, and UD for Urban Delivery)

Vehicle group	Vehicle sub-group[10]	Number of vehicles	Average specific CO2 emissions (g/km)	Average payload (t)	Average specific CO2 emissions (g/tkm)
1	-	2 170	592.1	1.44	410,1
2	-	8 876	625.5	2.33	267.9
3	-	8 219	696.3	3.36	207.2
4	4-UD	94	814.7	2.65	307.4
	4-RD	10 816	629.2	3.18	197.9
	4-LH	3 223	758.8	7.42	102.3
	vocational	583	1390.9	-	
5	5-RD	1 318	853.7	10.26	83.2
	5-LH	130 194	773.4	13.84	55.9
	vocational	1	954.5	-	
9	9-RD	13 080	701.5	6.28	111.7
	9-LH	17 287	857.4	13.40	64.0
	vocational	1 703	1554.5	-	
10	10-RD	48	907.4	10.26	88.5
	10-LH	5 573	810.5	13.84	58.6
11	-	2 166	846.3	5.39	157.0
12	-	1 167	1024.5	9.81	104.4
16	-	3 201	1082.5	9.81	110.3
EU total	**-**	209 719	773.7		

8 That definition refers to the average value of all CO_2 emissions of vehicles in a vehicle group, which is equivalent to the average specific CO_2 emissions in g/tkm of a vehicle group.

9 Directive 1999/62/EC of the European Parliament and of the Council of 17 June 1999 on the charging of vehicles for the use of road infrastructures (OJ L 187, 20.7.1999, p. 42)

10 As defined in Regulation (EU)2019/1242

4.1.2 Performance of the fleet of the Member States

Table 2 provides information on the average specific CO_2 emissions in g/km for each Member State. Vocational vehicles are not taken into account. For conciseness reasons, only emission values for vehicle group 2, sub-group 5-Long-Haul (5-LH), and group 16 are shown. These 3 (sub) groups have been selected as the representative groups for lorries below 16 tonnes (groups 1, 2, and 3) and lorries above 16 tonnes (currently subject to the CO_2 standards: groups 4, 5, 9, and 10; not subject to current CO_2 standards: groups 11, 12 and 16) respectively[11]. Section A.3 of the Annex provides a description on how the average specific CO_2 emissions, reported in **Table 2** are calculated.

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[11] For the lorries below 16 tonnes, 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 these lorries. Sub-group 5-LH and group 16 are a representative group, as they account for the highest share of newly registered lorries above 16 tonnes in the groups which are and are not subject to the current CO_2 standards, respectively. In some countries, no group 16 vehicle has been registered in the reporting period, and hence their average emissions are not available.

Table 2: Average specific CO_2 emissions in g/km of vehicle (sub)groups 2, 5-LH and 16, as well as the number of lorries registered in each Member State in certain groups

	Groups 1, 2, 3 N. of vehicles	Group 2 Avg. spec. CO_2 emissions (g/km)	Groups 4, 5, 9, 10 N. of vehicles	Sub-group 5-LH Avg. spec. CO_2 emissions (g/km)	Groups 11, 12, 16 N. of vehicles	Group 16 Avg. spec. CO_2 emissions (g/km)
Austria	396	614.6	3 896	780.7	312	1 080.3
Belgium	834	622.0	4 432	784.2	506	1 050.3
Bulgaria	29	635.5	1 689	759.4	6	1 102.4
Croatia	63	614.7	500	774.8	14	1 084.1
Cyprus	5	573.3	17	789.8	4	N/A
Czechia	748	644.5	5 610	767.3	214	1 080.2
Denmark	225	619.4	2 428	763.1	280	1 083.9
Estonia	3	711.9	542	750.1	41	1 074.1
Finland	169	614.5	1 081	795.5	694	1 113.9
France	3 407	599.2	30 182	781.3	1 369	1 080.5
Germany	7 157	624.4	40 601	778.7	1 048	1 048.6
Greece	85	615.0	135	792.3	7	1 108.2
Hungary	44	629.7	1 828	765.3	2	1 009.7
Ireland	147	629.2	1 401	761.6	91	1 044.8
Italy	1 780	687.4	16 785	780.3	80	1 093.4
Latvia	27	635.1	996	760.7	31	987.6
Lithuania	18	629.9	6 389	771.4	41	N/A
Luxemburg	4	580.2	601	792.5	2	N/A
Malta	3	640.7	4	790.6	0	N/A
Netherlands	833	609.5	8 128	768.0	211	1 050.4
Poland	992	628.7	23 277	763.2	203	1 094.9
Portugal	207	662.0	3 455	767.4	88	1 127.4
Romania	73	613.6	3 821	771.2	40	1 094.5
Slovakia	163	626.1	1 943	764.0	27	1 044.0
Slovenia	35	659.3	1 254	764.3	21	1 108.3
Spain	1 331	622.8	17 057	769.2	118	1 077.0
Sweden	477	588.0	3 463	784.4	1 078	1 098.2
Unknown[12]	10	599.1	118	742.8	6	974.2
EU total	19 265	625.5	181 633	773.4	6 534	1 082.5

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[12] Unknown vehicles are those registered in more than one Member State, and then they could not be attributed to one precise Member State.

4.1.3 Performance of the fleet of the manufacturers

Table 3 presents average specific CO_2 emissions in g/km, for all manufacturers, in line with the data presented in **Table 2**. Vocational vehicles are not taken into account.

Table 3: Average specific CO_2 emissions in g/km of vehicle (sub)groups 2, 5-LH and 16

	Lorries below 16 tonnes	*Lorries above 16 tonnes*	
	Group 2 Average specific CO_2 emissions (g/km)	Sub-group 5-LH Average specific CO_2 emissions (g/km)	Group 16 Average specific CO_2 emissions (g/km)
DAF Trucks N.V.	669.3	778.4	1 031.1
Daimler Truck AG	628.7	780.5	1 126.1
Ford Otomotiv Sanayi A.S.	-	812.4	-
ISUZU MOTORS LIMITED	751.2	-	-
Iveco S.p.A.	706.1	-	-
Iveco-Magirus A.G.	-	797.2	1 112.7
MAN Truck & Bus AG	602.2	771.1	1 040.4
RENAULT TRUCKS	576.2	794.7	1 086.5
SCANIA CV AB	-	736.5	1 094.0
VOLVO TRUCK CORPORATION	592.6	771.8	1 088.1
EU total	625.5	773.4	1 082.5

Table 4 and **Table 5** present the number of vehicles registered, for all manufacturers, in different groups and subgroups, respectively. Vocational vehicles are not included.

Table 4: Number of vehicles per vehicle group for each manufacturer, for groups 1,2, 3, 11, 12 and 16[13]

	Vehicle Group						Sub-Total
	1	2	3	11	12	16	
DAF Trucks N.V.	94	881	705	46	49	91	1 866
Daimler Truck AG	548	2 832	2 752	163	186	233	6 714
Ford Otomotiv Sanayi A.S.	0	0	0	0	0	0	0
ISUZU MOTORS LIMITED	0	9	13	0	0	0	22
Iveco S.p.A.	427	1 097	1 366	0	0	0	2 890
Iveco-Magirus A.G.	0	0	0	135	26	108	269
MAN Truck & Bus AG	832	2 101	1 184	274	128	633	5 152
Mitsubishi Fuso Truck & Bus Corporation	246	0	0	0	0	0	246
RENAULT TRUCKS	0	1 482	1543	160	37	221	3 443
SCANIA CV AB	0	0	0	545	232	1 048	1 825
VOLVO TRUCK CORPORATION	23	474	656	843	509	867	3 372
Total	2170	8 876	8 219	2 166	1 167	3 201	25 799

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[13] See footnote 5

Table 5: Number of vehicles per vehicle sub-group for each manufacturer, for groups 4, 5, 9 and 10

	Vehicle sub-group									Sub-Total
	4-UD	4-RD	4-LH	5-RD	5-LH	9-RD	9-LH	10-RD	10-LH	
DAF Trucks N.V.	34	854	310	83	26 170	173	1 703	8	820	30 155
Daimler Truck AG	0	1 782	876	385	22 505	3 074	3 859	13	549	33 043
Ford Otomotiv Sanayi A.S.	0	152	24	2	1 152	59	19	0	0	1 408
ISUZU MOTORS LIMITED	0	0	0	0	0	0	0	0	0	0
Iveco S.p.A.	11	951	0	0	0	0	0	0	0	962
Iveco-Magirus A.G.	0	311	119	100	11 251	1 599	1 284	0	121	14 785
MAN Truck & Bus AG	0	1 937	539	244	17 824	2 577	2 908	12	504	26 545
Mitsubishi Fuso Truck & Bus Corporation	0	0	0	0	0	0	0	0	0	0
RENAULT TRUCKS	0	2 120	503	84	10 461	1 904	771	1	230	16 074
SCANIA CV AB	49	1 510	546	343	20 283	2 241	3 663	6	1 817	30 458
VOLVO TRUCK CORPORATION	0	1 199	306	77	20 548	1 453	3 080	8	1 532	28 203
Total	94	10 816	3 223	1 318	130 194	13 080	17 287	48	5573	181 633

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, subgroup 5-LH and group 16.

Table 6: Average specific CO_2 emissions in g/km and g/tkm of vehicle groups 2, 5, and 16 for each mission profile

	Lorries below 16 tonnes		Lorries above 16 tonnes			
	Vehicle group 2		Vehicle sub-group 5 LH		Vehicle group 16	
Mission profile / payload	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	508.0	849.8	663.2	255.1	-	-
RDR	546.7	182.9	824.5	63.9	-	-
LHL	668.3	514.8	636.3	244.7	-	-
LHR	771.8	78.8	831.8	43.1	-	-
UDL	644.0	1 077.3	1 046.7	402.6	-	-
UDR	743.8	248.8	1 437.9	111.5	-	-
REL	-	-	838.7	239.6	-	-
RER	-	-	1 064.2	60.8	-	-
LEL	-	-	801.3	228.9	-	-
LER	-	-	1 079.2	40.7	-	-
MUL	-	-	-	-	-	-
MUR	-	-	-	-	-	-
COL	-	-	-	-	908.8	349.5
COR	-	-	-	-	1 156.9	89.7

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 2** and **Table 3**, it presents values for vehicle (sub)groups 2, 5-LH and 16, excluding vocational vehicles. None of the vehicles registered during the reporting period of 2020 used Petrol (PI), Ethanol (PI), or LPG (PI)[14]. A more detailed analysis of the different fuels used by newly registered vehicles is given in section 4.2.2.

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

Table 7: Number of vehicles, average specific CO2 emissions in g/km and average fuel consumption of vehicle (sub)groups 2,5-LH and 16 by fuel type

| | *Lorries below 16 tonnes* | | | *Lorries above 16 tonnes* | | | | | |
| | Vehicle group 2 | | | Vehicle sub-group 5-LH | | | Vehicle group 16 | | |
Fuel type (engine)	Number of vehicles	Av. spec. CO_2 emissions (g/km)	Average fuel consumption	Number of vehicles	Av. spec. CO_2 emissions (g/km)	Average fuel consumption	Number of vehicles	Av. spec. CO_2 emissions (g/km)	Average fuel consumption
Diesel (CI)	8 798	625.5	24 l/100km	124 406	774.1	30 l/100km	3 161	1 082.8	41 l/100km
Ethanol (CI)	-	-	-	5	720.4	49 l/100km	-	-	-
LNG (PI)	-	-	-	5 003	757.8	274 g/km	-	-	-
CNG (PI)	78	620.0	230 g/km	770	765.2	284 g/km	40	1 054.8	392 g/km
NG (PI)	-	-	-	9	749.8	295 g/km	-	-	-

For 9 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.

4.2.1 Advanced CO_2 technologies

During the reporting period of 2020, manufacturers could, but were not obliged to, indicate additional "advanced CO_2 technologies"[15]. This information had no influence on VECTO simulation results.

Out of all new vehicles of the manufacturer which has reported on such technologies, 66% were equipped with an active front grille, classified as an advanced aerodynamic measure. Furthermore, around 94% 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

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[15] Field 74 of Table 2 in Annex I of Regulation (EU) 2018/956.

systems (ADAS) technology[16]. **Table 8** presents the total number of vehicles equipped with an ADAS technology.

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

| ADAS technology | Vehicle group | | | | | | | | | | Total |
	1	2	3	4	5	9	10	11	12	16	
Eco-roll without engine stop-start	287	2 047	1 818	4 500	102 002	15 050	3 385	765	504	974	131 330
Predictive cruise control	0	0	0	2 569	83 993	9 294	2 258	381	375	522	99 392
Share of vehicles equipped with at least 1 ADAS (%)	13	23	22	31	78	47	60	37	51	32	60

No vehicles registered during the reporting period of 2020 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 uses ethanol, LNG, or CNG. **Table 9** gives an overview of the different fuel and engines within the vehicle groups.

| Fuel type (engine) | Vehicle group | | | | | | | | | | Total |
	1	2	3	4	5	9	10	11	12	16	
Diesel (CI)	2 166	8 798	8 117	14 268	125 685	30 615	5 602	2 164	1 166	3 161	201 742
Ethanol (CI)	0	0	0	8	5	14	1	0	0	0	28
LNG (PI)	0	0	0	27	5 013	401	9	0	0	0	5 450
CNG (PI)	4	78	99	405	800	999	9	2	1	40	2 437
NG (PI)	0	0	0	0	9	2	0	0	0	0	11
Share of vehicles using AF (%)	0	1	1	3	4	4	0	0	0	1	4

Table 9: Number of vehicles per vehicle group by fuel type (AF: Alternative Fuels)

For 11 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.

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

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: lorries below 16 tonnes (i.e. groups 1, 2, and 3), as well as lorries above 16 tonnes (i.e. groups 4, 5, 9, 10, 11, 12 and 16) and exclude the alternative powertrains presented in the next section.

Table 10: Number of vehicles per Member State by fuel. Gas powered include LNG and CNG

	Lorries below 16 tonnes			Lorries above 16 tonnes			Total number of vehicles (excl. ZEV)	*Share of vehicles using AF (%)*
	Diesel (CI)			Ethanol (CI)				
Member State	Diesel (CI)	Ethanol (CI)	Gas powered	Diesel (CI)	Ethanol (CI)	Gas powered		
Austria	393	0	3	4 181	0	62	4 639	1
Belgium	827	0	7	4 931	0	186	5 951	3
Bulgaria	29	0	0	1 531	0	167	1 727	10
Croatia	63	0	0	515	0	1	579	0
Cyprus	5	0	0	22	0	0	27	0
Czechia	746	0	2	5 764	0	98	6 610	2
Denmark	225	0	0	2 771	0	64	3 060	2
Estonia	3	0	0	576	0	8	587	1
Finland	165	0	4	1 716	0	64	1 949	3
France	3 345	0	62	30 432	6	1 426	35 271	4
Germany	7 151	0	6	40 134	0	2 080	4 9371	4
Greece	85	0	0	159	0	0	244	0
Hungary	44	0	0	1 832	0	3	1 879	0
Ireland	147	0	0	1 497	0	14	1 658	1
Italy	1 747	0	33	15 926	0	1 181	18 887	6
Latvia	27	0	0	948	0	79	1 054	7
Lithuania	18	0	0	6 360	0	70	6 448	1
Luxemburg	4	0	0	596	0	8	608	1
Malta	3	0	0	8	0	0	11	0
Netherlands	831	0	1	8 463	0	249	9 544	3
Poland	981	0	11	22 600	0	1 000	24 592	4
Portugal	198	0	9	3 526	0	46	3 779	1
Romania	70	0	3	3 770	0	107	3 950	3
Slovakia	163	0	0	1 931	0	43	2 137	2
Slovenia	35	0	0	1 250	0	26	1 311	2
Spain	1 296	0	35	16 688	0	545	18 564	3
Sweden	470	0	5	4 409	22	188	5 094	4
Unknown[17]	10	0	0	125	0	2	137	1
Total EU	19 081	0	181	182 661	28	7717	209 668	4

[17] Unknown vehicles are those registered in more than one Member State, and then they could not be attributed to one precise Member State.

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

Regulation (EU) 2019/1242 defines a zero-emission heavy-duty vehicle (ZEV) 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.

No hybrid electric[18] nor dual-fuel vehicles[19] have been registered in the reporting period 2020 in the vehicle groups covered by the report. Some have been registered in group 0 (between 3.5 and 7.5 tonnes). **Table 11** shows that the number of zero-emission vehicles registered during the reporting period was very limited.

Table 11: Number of vehicles with alternative powertrains by manufacturers (ZEV: Zero Emission Vehicles)

Manufacturer	ZEV	*Share of ZEV*
DAF NV	1	0,00%
DAIMLER TRUCK AG	0	0,00%
FORD OTOMOTIV SANAYI AS	0	0,00%
ISUZU MOTORS LIMITED	0	0,00%
IVECO SPA	0	0,00%
IVECO MAGIRUS AG	0	0,00%
MAN TRUCK AND BUS SE	14	0,04%
MITSUBISHI FUSO TRUCK & BUS CORPORATION	0	0,00%
RENAULT TRUCK SA	11	0,06%
SCANIA CV AB	1	0,00%
VOLVO TRUCK CORPORATION	24	0,08%
Total number of vehicles	51	0,02%

The majority of these 51 vehicles belong to the sub-group 9-LH and 9-RD (24 and 15 ZEV, respectively), while the others belong to (sub)groups 3, 4-LH and 5-LH.

5. CONCLUSION

This second report aims foremost to present the status quo of the EU's heavy-duty vehicle fleet.

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

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[18] A hybrid electric vehicle is a vehicle combining an internal combustion engine with an electric motor
[19] 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

as the share of alternative technologies in heavy-duty vehicles registered during the second reporting period. This section summarizes the key observations from the reported data.

5.1 CO₂ 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 or sub-groups (for lorries in groups 4, 5, 9 and 10).

Within the representative group for lorries below 16 tonnes, i.e. group 2, significant differences among the fleets of different Member States and manufacturers can be observed. However, these are also driven by the limited number of vehicles registered in some countries or produced by some manufacturers. Excluding those countries and manufacturers, the relative difference between the best- and the worst-performing Member State's fleet is of more than 15% (see **Table 2**). For the manufacturers, the relative difference accounts to around 20% (see **Table 3**).

As for the lorries above 16 tonnes, the performances of the 5-Long Haul and group 16 fleets of different Member States and manufacturers are more aligned.

The higher variation of average specific CO_2 emissions of lorries below 16 tonnes as compared to those above 16 tonnes can be explained by the fact that lorries below 16 tonnes are simulated with slightly different payloads depending on their technically permissible maximum laden mass, while the payload used at the simulations of lorries above 16 tonnes does not depend on the technical characteristics of the individual vehicle.

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

5.2 Fuels and powertrains

At present, diesel vehicles still account for more than 96% of all newly registered heavy-duty vehicles covered in this report. Only a limited number of vehicles use alternative fuels or alternative powertrains, mostly LNG and CNG.

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 Croatia, Cyprus, Greece, Hungary and Malta, it reaches 10% in Bulgaria (see **Table 10**). This is due to a relatively high share of natural gas vehicles, reflecting a quite well-developed gas refilling infrastructure in this country.

Currently, the number of zero-emission heavy-duty vehicles across the EU is small, with only 51 vehicles matched during the 2020 reporting period (see **Table 11**). There could be however some ZEV which are not reported and therefore not included.

A.1 Mission profile weights

The values provided in **Table 12** are used in VECTO for the determination of specific CO_2 emissions of individual vehicles indicated in the Certificate of Conformity (CoC).

Table 12:Mission profile weights for vehicle groups 1, 2, 3, 11, 12 and 16

Vehicle group	RDL	RDR	UDL	UDR	COL	COR
1	0.1	0.3	0.18	0.42	0	0
2	0.125	0.375	0.15	0.35	0	0
3	0.125	0.375	0.15	0.35	0	0
11	0.15	0.35	0	0	0.15	0.35
12	0.21	0.49	0	0	0.09	0.21
16	0	0	0	0	0.3	0.7

A.2 Average payload

For groups 4, 5, 9,10, 11, 12 and 16 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[20]. The average payload Pl_g for groups 1, 2, and 3 is calculated as follows:

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

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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 12**).

A.3 Average CO₂ emissions per Member State

The average specific CO_2 emissions $avgCO2_{g,MS}$ in g/km of a vehicle (sub-) group[21] per Member State are calculated as follows:

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[20] European Commission. (2017). *VECTO tool development: Completion of methodology to simulate Heavy Duty Vehicles' fuel consumption and CO₂ emissions. Upgrades to the existing version of VECTO and completion of certification methodology to be incorporated into a Commission legislative proposal* (pp. 71-73).

[21] 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.

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

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 g and Member State MS, as defined by point 2.1. in Annex I of Regulation (EU) 2019/1242 (see **Table 12**). $V_{g,MS}$ is the total number of vehicles from group g registered in Member State MS.