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Monitoring CO_2 emissions from new passenger cars and vans in 2017

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Abbreviations

ACEA	European Automobile Manufacturers' Association
AFV	Alternative fuel vehicle
BDR	Business Data Repository
BEV	Battery electric vehicle
CDR	Central Data Repository
E85	Petrol containing 85 % ethanol
EEA	European Environment Agency
ETC/ACM	European Topic Centre on Air Pollution and Climate Change Mitigation
FCEV	Fuel cell electric vehicle
GHG	Greenhouse gas
HDV	Heavy-duty vehicle
HEV	Hybrid electric vehicle
IVA	Individual vehicle approval
LPG	Liquefied petroleum gas
NEDC	New European Driving Cycle
NG	Natural gas
NO_x	Nitrogen oxides
NSS	National small series
PHEV	Plug-in hybrid electric vehicle
PM	Particulate matter
SUV	Sport utility vehicle
VIN	Vehicle identification number
WLTP	World Harmonised Light Vehicle Test Procedure

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Data sources

Unless otherwise specified, the graphs and tables in this report are based on two data sets for which the EEA is responsible:

- Monitoring of CO_2 emissions from passenger cars — Regulation (EC) No 443/2009: https://www.eea.europa.eu/data-and-maps/data/co2-cars-emission-15
- Monitoring of CO_2 emissions from vans — Regulation (EU) 510/2011 https://www.eea.europa.eu/data-and-maps/data/vans-11

Disclaimer

This report documents the latest official data submitted by Member States and vehicle manufacturers. The final CO_2 performance for each manufacturer and pool is confirmed by a European Commission Decision.

It is important to mention as well that, for both passenger cars and vans, the reported CO_2 emissions are based upon measurements performed in the laboratory using a standard European vehicle test cycle. Such measurements may not reflect real-world driving performance.

Country groupings

Throughout this report, the following abbreviations are used to refer to specific country groupings:

- EU-13: Bulgaria, Croatia, Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia;
- EU-15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and the United Kingdom;
- EU-27: EU-28, excluding Croatia;
- EU-28: EU-15 and EU-13.

Executive summary

This report provides a summary of CO_2 emission levels of new passenger cars and vans in the European Union in 2017. It is based on data reported by Member States to the European Environment Agency (EEA) and verified by manufacturers ([1]). The report provides an overview of the performance of car and van manufacturers towards their 2017 CO_2 emission targets.

Regulation (EC) No 443/2009 (EU, 2009) for passenger cars set the average CO_2 emissions for new passenger cars at 130 gCO_2/km by 2015, while Regulation (EU) No 510/2011 (EU, 2011) for light commercial vehicles set the average CO_2 emissions for new light commercial vehicles at 175 gCO_2/km by 2017. Stricter targets will apply under these regulations from 2020 (vans) and 2021 (cars).

Since 2013 for cars and 2014 for vans, a binding specific emission target has been calculated for each manufacturer based on a limit value curve according to the average mass of the new vehicles registered by that manufacturer. For each manufacturer, average specific emissions, defined as the average value for each manufacturer's fleet of newly registered vehicles in the EU that year, are compared with specific emission targets.

Average CO_2 emissions from new cars increased for the first time since 2010 in 2017

For the first time in 2017, average CO_2 emissions ([2]) from new cars sold in the EU were higher than in the previous year: 118.5 gCO_2/km in 2017 versus 118.1 gCO_2/km in 2016. Whereas in the first 5 years of monitoring, average CO_2 emissions decreased by almost 21 gCO_2/km, in the last 2 years emissions have decreased by 1 gCO_2/km.

Since 2013, the average emissions of new light commercial vehicles have been below the 2017 target of 175 gCO_2/km. The average van registered in the EU in 2017 emitted 156.1 gCO_2/km, which is 7.5 gCO_2/km less than in 2016. This reduction brings the EU average emissions 11 % below the 2017 target of 175 gCO_2/km and only 6 % above the 2020 target.

Average CO_2 emissions from new cars have decreased by more than 15 % since 2010, while the emissions of new vans have decreased by more than 13 % since 2012. For new vans, average CO_2 emissions could continue decreasing at a similar pace to meet their EU 2021 targets (Figure ES. 1).

The difference between provisional average specific emission data, reported by Member States in February 2018 and final average specific emission data, which considered error notifications reported by manufacturers by the end of May 2018, was insignificant (< 0.1 gCO_2/km for cars and 0.1 gCO_2/km for vans).

The majority of new registrations in 2017 were for petrol cars, for the first year since 2009

As in previous years, conventional diesel and petrol cars accounted for the large majority of the fleet (97.1 % of new registrations). However, for the first year, petrol cars constituted the majority of new registrations (almost 53 %). The proportion of plug-in hybrid and battery electric cars increased from 1 % in 2016 to 1.5 % in 2017. For the first time, hydrogen cars appeared in the data set (fewer than 200 units). Other alternative fuel vehicles, such as liquefied petroleum gas (LPG) and compressed natural gas (NG-biomethane) cars, accounted for the remaining registrations (1.3 %).

([1]) Relevant registration data are reported to the EEA and the European Commission by EU Member States. The provisional data and the provisional calculations are then given to manufacturers, which have 3 months to notify the Commission of any errors. The Commission then considers any notifications from the manufacturers and either confirms or amends the provisional calculations in response. These amended/confirmed data are referred to as final average specific emissions.

([2]) Average CO_2 emissions are calculated as simple averages without taking into account any adjustments.

Diesel cars emitted on average 117.9 gCO_2/km (Table ES.1), which is 3.7 gCO_2/km less than the average petrol car, whereas in 2000 the emission difference between diesel and petrol cars was much larger (17.1 gCO_2/km). The average fuel efficiency of petrol cars has been constant in the last 2 years, whereas the fuel efficiency of diesel cars has worsened, compared with 2016 (116.8 gCO_2/km).

As in previous years, the average diesel car was heavier than the average petrol one, but this difference was the smallest observed in the last 9 years.

On average, the most efficient cars were bought in Portugal (105 gCO_2/km), Denmark (107 gCO_2/km), the Netherlands (108 gCO_2/km) and Greece (109 gCO_2/km). For new vans, average emission levels were lowest among those sold in Portugal (132 gCO_2/km), Cyprus (133 gCO_2/km) and Bulgaria (135 gCO_2/km).

Small-sized cars have been replaced by medium-sized cars

The petrol car market is dominated by the small-sized cars segment (0.8-1.4 l), whereas the diesel market is dominated by the medium-sized cars segment (1.4-2.0 l). Over the years, for both petrol and diesel, a shift towards the medium-sized segment has been observed. In the last 3 years, the share of the medium-sized petrol segment increased from 21 % to 23 %. The shift to the medium-sized diesel segment started earlier, from 75 % in 2010 to 84 % in 2017. If similar petrol and diesel segments are compared, conventional petrol cars emit 10-40 % more than conventional diesel cars. For diesel cars only the large-sized segment managed to achieve a small reduction (0.5 gCO_2/km) in 2017 compared with 2016. Small- and medium-sized diesel cars increased their emissions by about 1 and 1.5 gCO_2/km, respectively, over the same period. For conventional petrol cars, large-sized cars saw a significant reduction in CO_2 emissions of around 6 gCO_2/km, medium-sized cars remained rather stable and small-sized cars saw a slight increase of about 0.4 g/km in 2017, compared with 2016.

In almost all size categories, a slight increase in the mass of cars has been observed since 2010. Cars have also become more powerful (an increase in the engine power), despite the fact that a stable (for diesel cars) or decreasing (for petrol cars) engine capacity trend was observed over the same period.

Three car manufacturers exceeded their specific emission targets

The majority of car manufacturers met their specific CO_2 emission targets in 2017 (Annex 3). Certain manufacturers would have exceeded their specific emission target, but they met the target as part of pools or because of derogations. Three manufacturers, Automobili Lamborghini SPA, Mazda Motor Corporation and Société des Automobiles Alpine, exceeded their specific emission targets and therefore are required to pay excess emission premiums.

All van manufacturers met their CO_2 specific emission targets in 2017, taking into account pools and derogations.

The trends in total CO_2 emissions from passenger cars were mostly driven by transport demand

The demand for passenger cars has been the main contributing factor to the trend in CO_2 emissions since 2000: when demand decreases, the emissions follow. Improvements in passenger car energy efficiency contributed to the reduction in CO_2 emissions from 2009 to 2016. Compared with 2000, the reduction in total CO_2 emissions from passenger cars as a result of improvements in efficiency is around 6.7 %. The biggest changes were observed between 2009 and 2013. In the last few years (2014-2016), the impact of this factor has been less significant. The carbon intensity of fossil fuels pushes the emissions up because diesel's carbon content per unit of energy is higher than that of petrol (as the former emits more CO_2 per unit of energy). The increase in transport biofuels was also relevant in the first period: since 2005, the use of biofuels started to increase significantly, thereby contributing to decreasing emissions of CO_2 from passenger cars. Modal shift had a minor effect on the entire period.

Figure ES.1 Average CO_2 emissions: historical development and targets for new passenger cars and vans in the EU-28

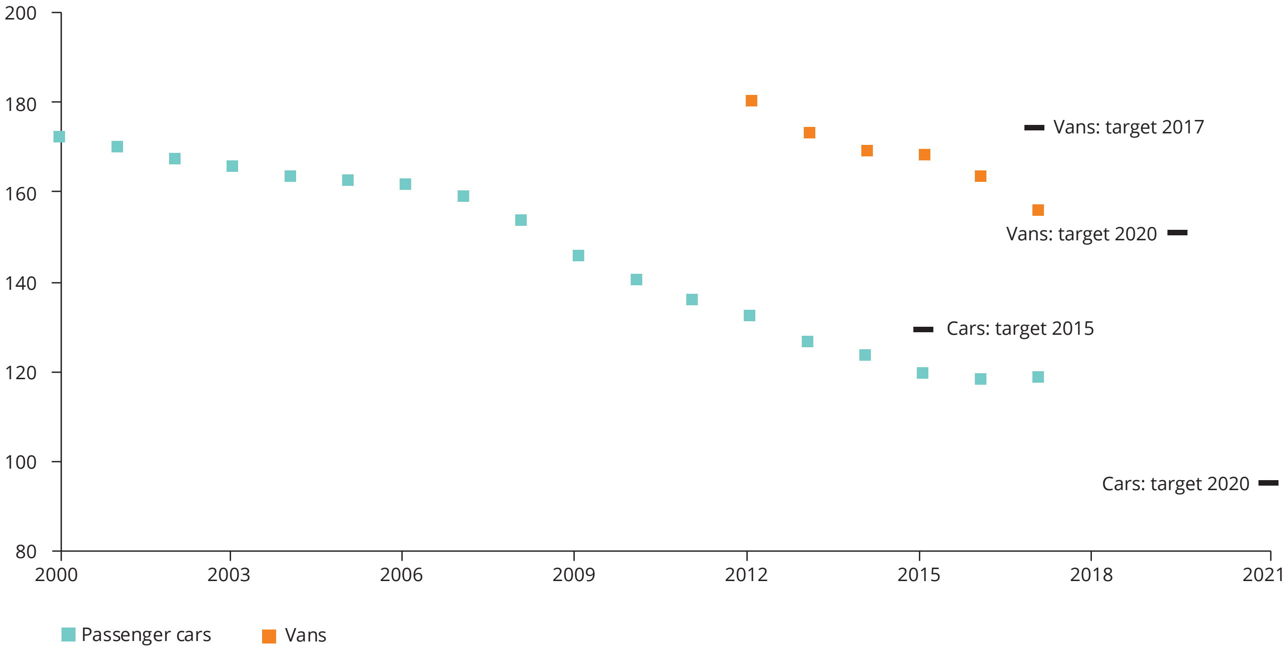


Table ES.1 Market share and average CO_2 emissions (gCO2/km) from new passenger cars, by fuel type

Fuel	Registrations (%)	Average CO_2 emissions (gCO_2/km)
Diesel	44.50	117.9
Petrol	52.60	121.6
E85	0.01	123.3
BEV	0.64	0.0
Hydrogen	0.001	0.0
LPG	1.05	121.0
NG	0.32	103.2
Petrol/Electric	0.77	45.9
Diesel/Electric	0.04	64.0

1 Introduction

Reducing greenhouse gas (GHG) emissions from the transport sector is a key priority for the EU. Transport has not seen the same reduction in emissions as other sectors. In 2016, CO_2 emissions from transport (including international aviation) were 27 % above 1990 levels despite a decline between 2008 and 2013. Road transport accounted for more than 82 % of all CO_2 emissions in the sector in 2016. Cars, which are responsible for 50 % of the emissions from the transport sector, were 16 % above 1990 levels in 2005.

To reduce CO_2 emissions in the road transport sector, the European Parliament and the Council adopted two regulations: Regulation (EC) No 443/2009, which introduced mandatory CO_2 emission performance standards for new passenger cars, and Regulation (EU) No 510/2011, which introduced mandatory CO_2 emission performance standards for new vans.

- For new passenger cars, the regulation set the average specific CO_2 emissions at 130 gCO_2/km by 2015, defined as the average value for the fleet of newly registered passenger cars in the EU. A target of 95 gCO_2/km has been set for 2021 (to be phased in from 2020).
- For new light commercial vehicles, Regulation (EU) No 510/2011 set the average CO_2 emissions at 175 gCO_2/km by 2017, defined as the average value for the fleet of newly registered vans in the EU. A medium-term target of 147 gCO_2/km has been set for 2020.

In accordance with these regulations, data on CO_2 emissions from a newly registered passenger car or van, together with other characteristics of the vehicle, are collected each year by Member States and submitted to the European Commission and the EEA. Manufacturers can also verify the data and notify the Commission of any errors. The Commission assesses the manufacturers' corrections, and, where justified, takes these into account when calculating their average CO_2 emissions and specific emission targets. This report presents the data collected over the period 2010-2018 ([3]). For both cars and vans, the main statistics for Member States, as well as the manufacturers' progress towards their targets, are reported.

For both passenger cars and vans, the reported CO_2 emissions are based on measurements performed in the laboratory using a standard European vehicle test cycle (NEDC), although for some new vehicle types Member States have reported CO_2 emissions based on the new test procedure (WLTP).

([3]) Data for the period 2000-2009 are shown when available.

2 Recent developments in policy for road transport

Cars and vans

As part of the clean mobility package presented on 8 November 2017, the Commission adopted a proposal for post-2020 CO_2 emission performance standards for new cars and new vans. On 17 December 2018, the European Parliament and the Council reached a provisional agreement on the new Regulation on light duty vehicles.

The Regulation sets targets for the average emissions of new cars and vans in 2030. These targets require average 2030 emission levels from new cars to be 37.5 % lower than target in 2021. Similarly, average CO_2 emissions from new vans must fall by 31 % by 2030 compared with 2021. An intermediary 15 % reduction for both cars and vans must be reached by 2025.

The new Regulation will also include a new mechanism to encourage manufacturers to sell zero- and low-emission vehicles (ZLEVs). This concerns vehicles with emissions between 0 and 50 gCO_2/km. Manufacturers achieving a share of zero- and low-emission passenger car registrations that is higher than the benchmark levels set out in the Regulation will be rewarded with a less strict CO_2 target (up to a maximum of 5 %). For cars, the zero- and low emission vehicle benchmarks are 15 % in 2025 and 35 % in 2030. For vans, the benchmarks are 15 % for 2025 and 30 % for 2030. The lower the emissions of a ZLEV, the more that vehicle will count towards the benchmarks. There is no penalty for manufacturers that fail to meet the benchmarks. A multiplier, designed to incentivise ZLEV sales, applies for newly registered ZLEVs in EU Member States where the fleet share of such vehicles is less than 60 % of the 2017 EU average, and in which there were fewer than 1 000 new ZLEV registrations in 2017. Until 2030, each newly registered ZLEV in these countries will be counted 1.85 times more than the default value for the purpose of the incentive mechanism. This multiplier will no longer applied from the year after the ZLEV share in such Member States exceeds 5 %.

The new legislation continues to include eco-innovation credits for innovative technologies that deliver CO_2 emission reductions outside the official test procedure, with a 7 g/km cap, which the Commission may revise. Until 2028, it will be possible for 'niche' car manufacturers registering fewer than 300 000 cars per year to obtain a derogation from the default targets.

To ensure that the targets are effective, the legislation introduces an obligation to monitor and report data, which allows the real-world representativeness of the emissions determined through the test procedure for type approval to be assessed. This will be based on real-world data from standardised on-board fuel and/or energy consumption monitoring devices, which will be required in new vehicles as of 1 January 2021.

Moreover, in-service conformity checks will be introduced to ensure that vehicles on the road perform in the same way as those approved during type-approval. If there are deviations, a correction mechanism will allow these to be taken into account during the compliance assessment.

Heavy-duty vehicles (HDVs)

As part of its third mobility package presented on 17 May 2018, the Commission proposed a regulation to set the first-ever CO_2 emission performance standards for new HDVs. On 19 February 2019, the European Parliament and the Council reached a provisional agreement on the new Regulation on heavy duty vehicles. The average CO_2 emissions from new lorries in 2025 would have to be 15 % lower than in 2019 and, in 2030, at least 30 % lower than in 2019 (subject to review in 2022). The proposal also includes an incentive mechanism for the uptake of ZLEVs.

Testing procedures for CO_2 emissions of new vehicles

Over the past year, amendments have been made to the regulations already in place. Since September 2017, the World Harmonised Light Vehicle Test Procedure (WLTP) has been the emission testing procedure for all new vehicle types. This replaced the New European Driving Cycle (NEDC) test procedure. The new procedure has been mandatory for all new passenger cars since September 2018.

Compared with the NEDC, the WLTP introduces more realistic testing conditions that better represent real-world driving (EEA, 2016b): a greater range of driving situations, more dynamic and representative accelerations and decelerations, more realistic driving behaviour, more realistic test-vehicle mass and stricter test conditions.

The average CO_2 emissions until 2020 will be calculated using the NEDC values. For vehicles that are now type-approved in accordance with the WLTP, a procedure has been developed and put in place to correlate the WLTP CO_2 values with the corresponding NEDC values, which makes use of the CO2MPAS tool (JRC, 2018). From 2021 onwards, CO_2 emission targets will be expressed in WLTP values and compliance will be checked using WLTP values only.

3 New passenger cars

3.1 Registrations

In 2017, for the fourth year in a row, new passenger car registrations increased, reaching 15.1 million, the second highest number since 2007 (Annex A.1). This trend seems to have continued in 2018. According to European Automobile Manufacturers' Association (ACEA) statistics (ACEA, 2018), during the first half of 2018, new passenger car registrations in the EU increased by 4.7 %, compared with the same period in 2017.

The number of registrations increased by 7 % in the EU-13, and by only 2 % in the EU-15. As in previous years, the EU new passenger car market is centred on a few countries, as 76 % of all registrations occur in Germany, the United Kingdom, France, Italy and Spain. Germany is the largest new-car market in Europe, with 22 % registrations in 2017, followed by the United Kingdom (17 %) and France (15 %). Italy and Spain registered 13 % and 9 %, respectively, of the EU fleet in 2017. In these two countries, the number of new car registrations has fallen since 2007, but car sales have been sharply rising again in the last few years: in 2017, registrations in Spain and in Italy were about 83 % and 51 % above the lowest levels observed in 2012 and 2013, respectively. In the past year, the number of registrations increased in 24 out of the 28 Member States, with the biggest increases observed in Bulgaria and Lithuania (+28 %). The largest decrease was seen in Ireland (-12 %).

In 2017, for the first year since 2009, more petrol cars were sold than diesel ones. Diesel cars represent almost 45 % of the newly registered car fleet, almost 11 percentage points less than in 2011, the year in which the percentage of diesel cars was highest (Table 3.1). Compared with 2011, in all Member States except Greece (+35 percentage points), Cyprus (+28 percentage points), Romania (+10 percentage points) and Malta (+9 percentage points), the diesel share decreased or remained stable. In France, Germany and Spain, where the diesel market share used to be significantly higher than in other Member States, the market share dropped by more than 9 percentage points in the last year. However, diesel shares vary by Member State. For example, in Ireland and Portugal, the percentage of diesel cars is higher than 60 %. In contrast, in the Netherlands, Estonia and Finland, this is below 30 % (17 %, 25 % and 29 %, respectively).

3.2 Average CO_2 emissions

The final data presented here confirm the provisional data published by the EEA earlier in 2018. The average CO_2 emissions from the new passenger car fleet in the EU in 2017 were 118.5 gCO_2/km (Figure 3.1), which is 0.4 gCO_2/km higher than in 2016. This is the first year since the legislation came into force, in 2009, in which no improvement has been recorded in new cars' average CO_2 emissions. Since 2009, however, average CO_2 emissions have decreased by 27.2 gCO_2/km, i.e. by an average of 3.4 gCO_2/km per year.

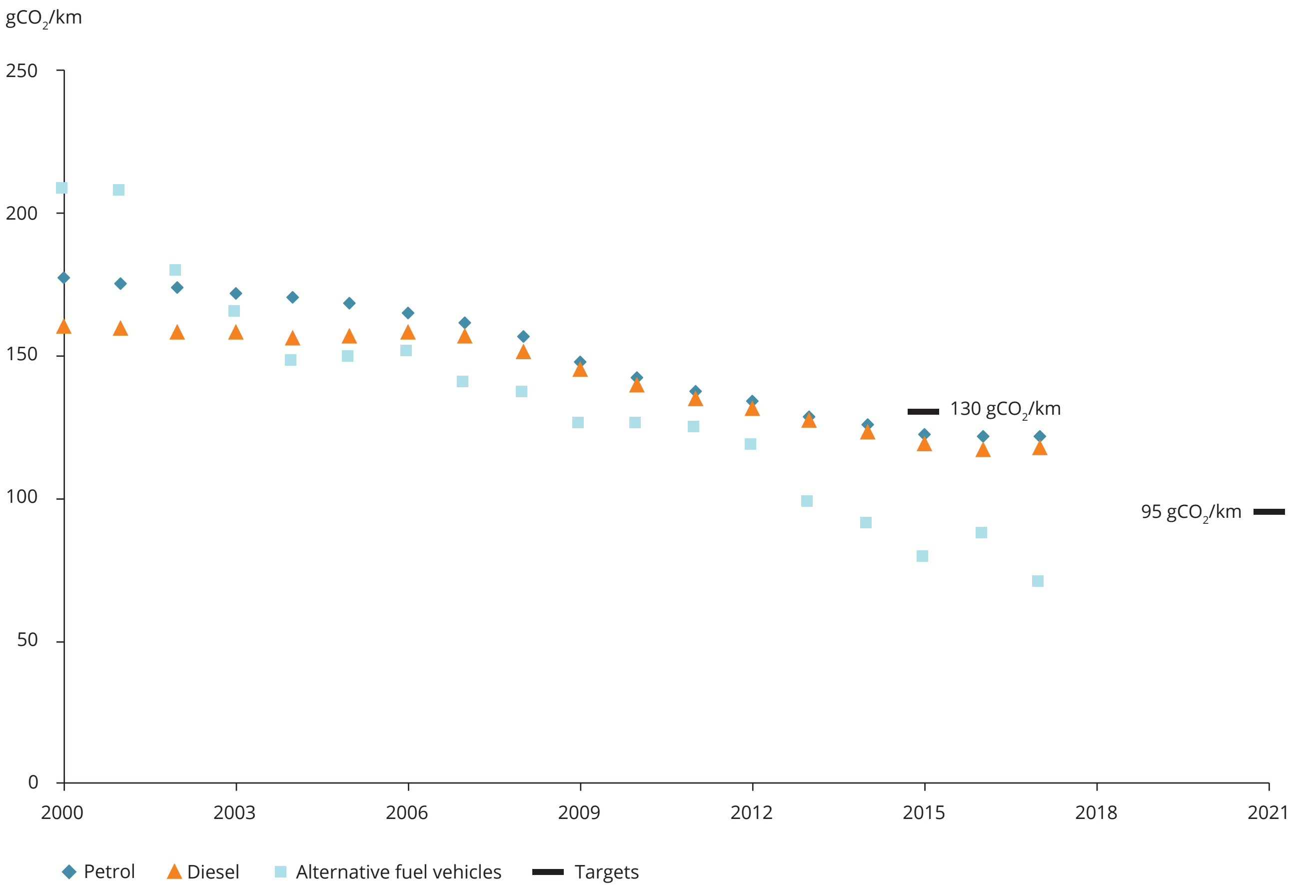
The past year was the first that, for both conventional engine technologies, the average CO_2 emissions did

Table 3.1 Share of fuel type in new passenger cars (EU-28)

Fuel	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Petrol	68.9	64.0	59.2	55.5	51.9	50.7	49.4	47.3	47.4	51.1	45.3	43.4	43.0	45.1	44.3	45.4	47.3	52.6
Diesel	31.0	35.9	40.7	44.4	47.9	49.1	50.3	51.9	51.3	45.1	51.3	55.2	54.9	52.5	53.0	51.8	49.5	44.5
AFV	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.7	1.3	3.8	3.5	1.4	2.2	2.4	2.7	2.8	3.2	2.9

Notes: The geographical scope of the data changes over time from EU-15 through EU-25 and EU-27 to EU-28. See Annex 1 for details.
AFVs, alternative fuel vehicles.

Figure 3.1 Average CO_2 emissions (gCO_2/km) from new passenger cars, by fuel type (EU-28)



Notes: In the calculation of the average CO_2 emissions of AFVs, battery electric, liquefied petroleum gas, natural gas, E85, biodiesel and plug-in hybrid vehicles are all included.

The geographical scope of the data changes over time from EU-15 through EU-25 and EU-27 to EU-28. See Annex 1 for details.

not decrease. The average fuel efficiency of petrol cars has been constant in the last 2 years, whereas the fuel efficiency of diesel cars has worsened, compared with 2016 (117.9 gCO_2/km in 2017 and 116.8 gCO_2/km in 2016). The efficiency gap between new diesel and petrol passenger cars is 3.7 gCO_2/km (Figure 3.2). The average emissions of alternative fuel vehicles (AFV) dropped in the last year due to the increase in the number of electric vehicles.

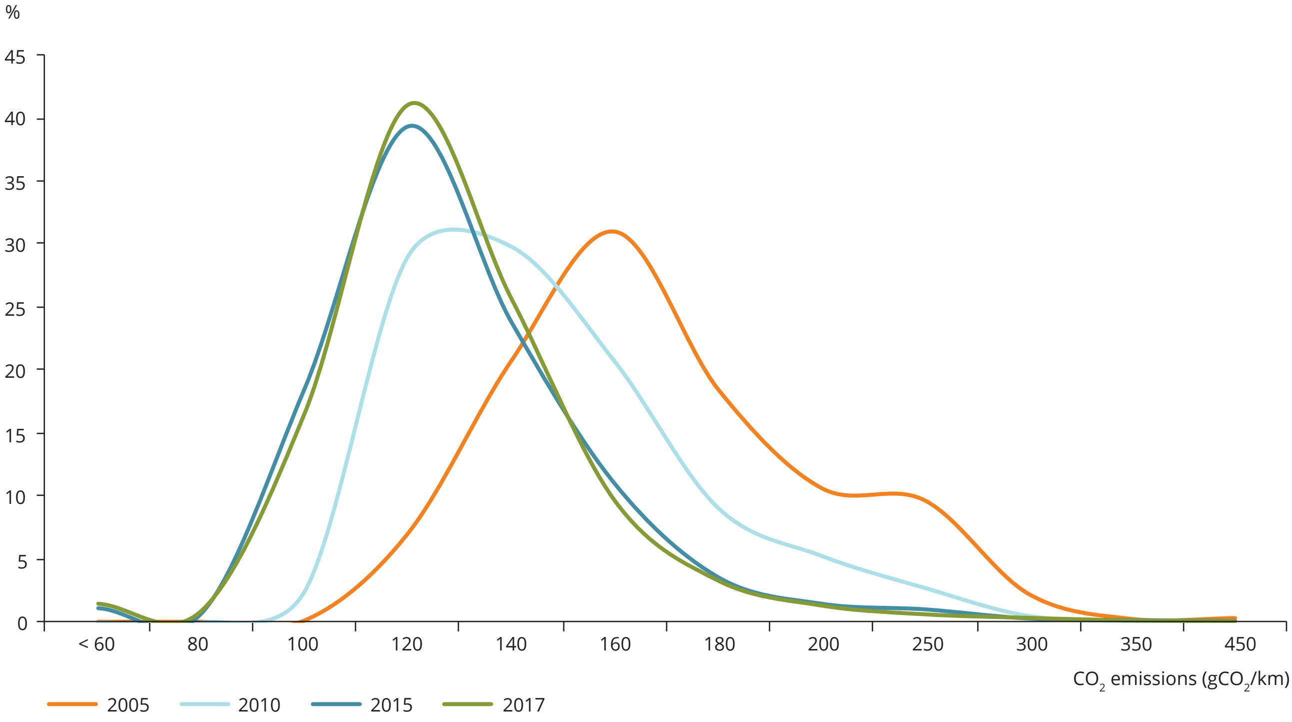
The distribution of emissions across the fleet in four selected years (2005, 2010, 2015 and 2017) is shown in Figure 3.2. The emission distribution of newly registered cars did not change significantly in the last 3 years. During this period, the largest group of cars emitted between 100 and 120 gCO_2/km (39.3 % in 2015 and 41.0 % in 2017), whereas in 2010 the largest group emitted between 120 and 140 gCO_2/km. In 2017, 18.7 % of newly registered cars emitted less than 100 gCO_2/km, fewer than in 2015, when 20 % of newly registered cars emitted less than 100 gCO_2/km.

In all EU Member States except Estonia, the 2017 average specific CO_2 emissions from newly registered cars were below the EU's 130 gCO_2/km target (Figure 3.3). However, for the first time, only 12 Member States saw their CO_2 emissions from newly registered passenger cars fall in 2017 compared with 2016.

Figure 3.4 shows the absolute and percentage variations by Member State between 2016 and 2017.

On average, the highest emitting cars were sold in Estonia and Latvia (132.8 and 128.8 gCO_2/km, respectively), followed by Poland (127.6 gCO_2/km). As in 2016, Portugal (104.7 gCO_2/km) registered the

Figure 3.2 **Frequency distributions of emissions of cars registered in the EU-28 in 2005 (data based on Decision 1753/2000 (EU, 2000)), 2010, 2015 and 2017 (data based on Regulation (EC) No 443/2009)**



lowest emitting new passenger car fleet. Denmark, the Netherlands and Greece followed, with average emissions between 107 and 109 gCO_2/km.

Amongst the four best-performing Member States, which have been in the same position for the last 4 years, only Portugal has not increased its average emissions in the last year.

In Denmark, the low average emissions are mainly related to the registration of relatively small cars: the average mass of the new fleet is below 1 280 kg and the engine capacity is around 1.4 l. Compared with 2016, the number of conventional cars for each technology stayed relatively stable and the average emissions for each conventional technology increased by 1 gCO_2/km. Compared with 2015, the number of battery electric vehicles (BEVs) decreased from 1.2 % to 0.3 % of the new market and the diesel increased by 7 percentage points. As a consequence, emissions increased by around 1 gCO_2/km in 2017 compared with 2016 and 2015.

The average emissions of the Netherlands have increased compared with last year (+2.4 gCO_2/km). Battery electric cars have increased by more than 100 % in 1 year, while the number of plug-in vehicles has drastically reduced (from more than 17 400 in 2016 to around 1 000 in 2017). In 2017, plug-in hybrid electric vehicles (PHEVs) were taxed in the same way as internal combustion engine vehicles and new sales of PHEVs dropped dramatically. The average emissions of petrol have been constant over the last 2 years (at around 111 gCO_2/km), while the emissions of an average diesel car have increased by around 2 gCO_2/km. Without the contribution of BEVs, average CO_2 emissions in the Netherlands would be 110.7 gCO_2/km (around 2.3 gCO_2/km higher).

The new-car fleet in Greece has the lowest mass (on average 1 242 kg) after Malta and one of the lowest engine capacities and engine powers in Europe. The demand for diesel cars, which are often heavier than petrol cars, was tempered by a ban on diesel cars in Athens and Thessaloniki. This ban was lifted in 2012, having been in place since 1991 to protect citizens and buildings from the heavy air pollution. Correspondingly, the share of new cars sold that were diesel increased from 10 % in 2011 to 55 % in 2016. This trend was reversed in 2017, when petrol cars became the more frequently sold, reaching 55 % of the new market.

Logically, the Member States with the most car registrations — France, Germany, Italy, Spain and the United Kingdom — are the major contributors to the trend in CO_2 emissions from newly registered passenger cars in the EU-28. Compared with 2016, average emissions increased in all countries except Italy: from 0.2 gCO_2/km in Germany to 1 gCO_2/km in the United Kingdom.

France has a relatively high proportion of battery electric cars (1.2 %) with zero emissions, which reduced average emissions by 1.3 gCO_2/km. An additional 0.3 gCO_2/km are saved because of PHEVs.

On the other end of the scale, Germany has one of the highest average CO_2 emissions: its fleet is significantly heavier, bigger and more powerful than the EU average (1 454 versus 1 388 kg, 1 696 versus 1 577 cm^3 and 111 versus 96 kW).

3.3 Vehicle technologies

The vast majority of Europe's new cars remain conventionally powered (by petrol or diesel). However, the registration of AFVs has increased substantially over the last decade (Figure 3.5). This category comprised only a few vehicles in 2000, but in 2009 it accounted for over half a million new vehicle registrations, before dropping to slightly below half a million in 2010. AFV registrations have increased considerably in the last 6 years, by 150 %, after a significant drop between 2010 and 2011 (when registrations fell by 62 %).

On the basis of the monitoring data, it is also possible to report CO_2 emissions for different fuel types (Table 3.2). It is noteworthy that the mix of vehicles in this category has changed over the years, which helps to explain the high variability in the trend of emissions and other characteristics of the AFV fleet (Figure 3.1). In the early 2000s, AFVs were dominated by dual-fuel vehicles, i.e. vehicles mostly able to operate on petrol and ethanol blends. This gradually changed because of the registration of LPG vehicles and NG vehicles. 2017 was the first year in which the number of BEVs and PHEVs together exceeded the number of LPG and NG vehicles.

In recent years, the increase in BEVs and PHEVs has contributed to the declining emission levels (Figure 3.1).

Figure 3.3 Average CO_2 emissions by EU Member State in 2017, compared with the EU average (118.5 gCO_2/km)

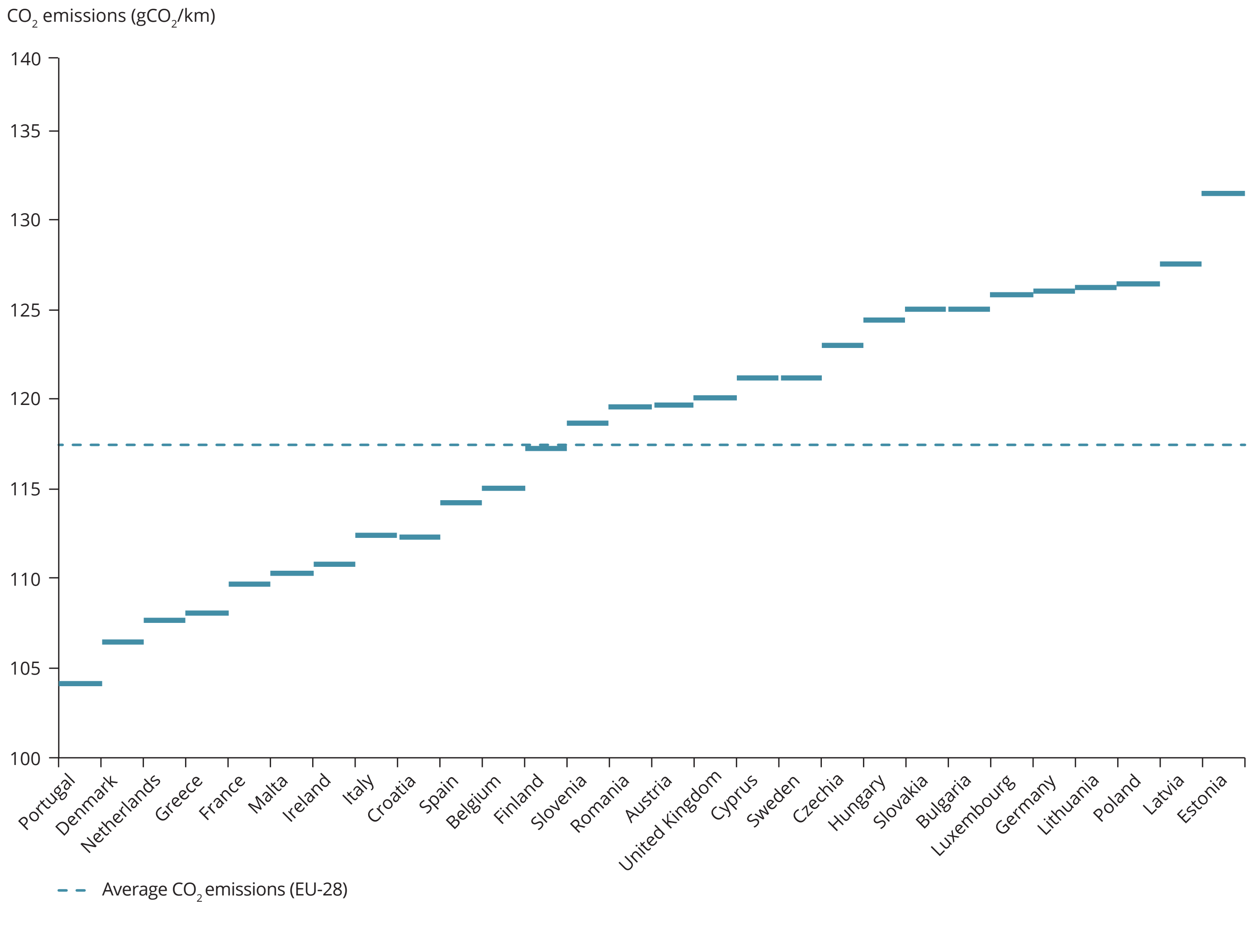


Figure 3.4 Absolute and relative reduction (%) in specific emissions between 2016 and 2017, by Member State

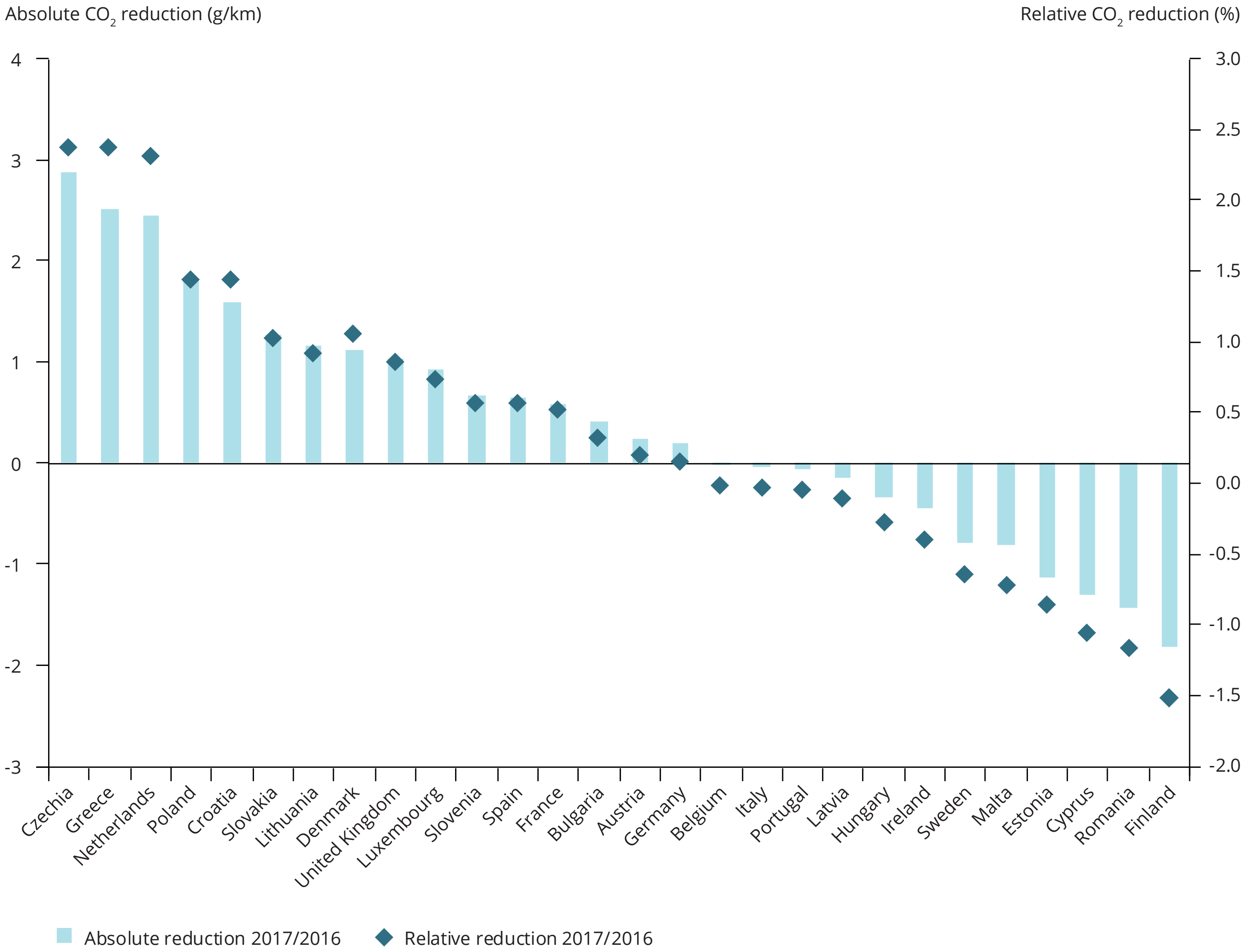
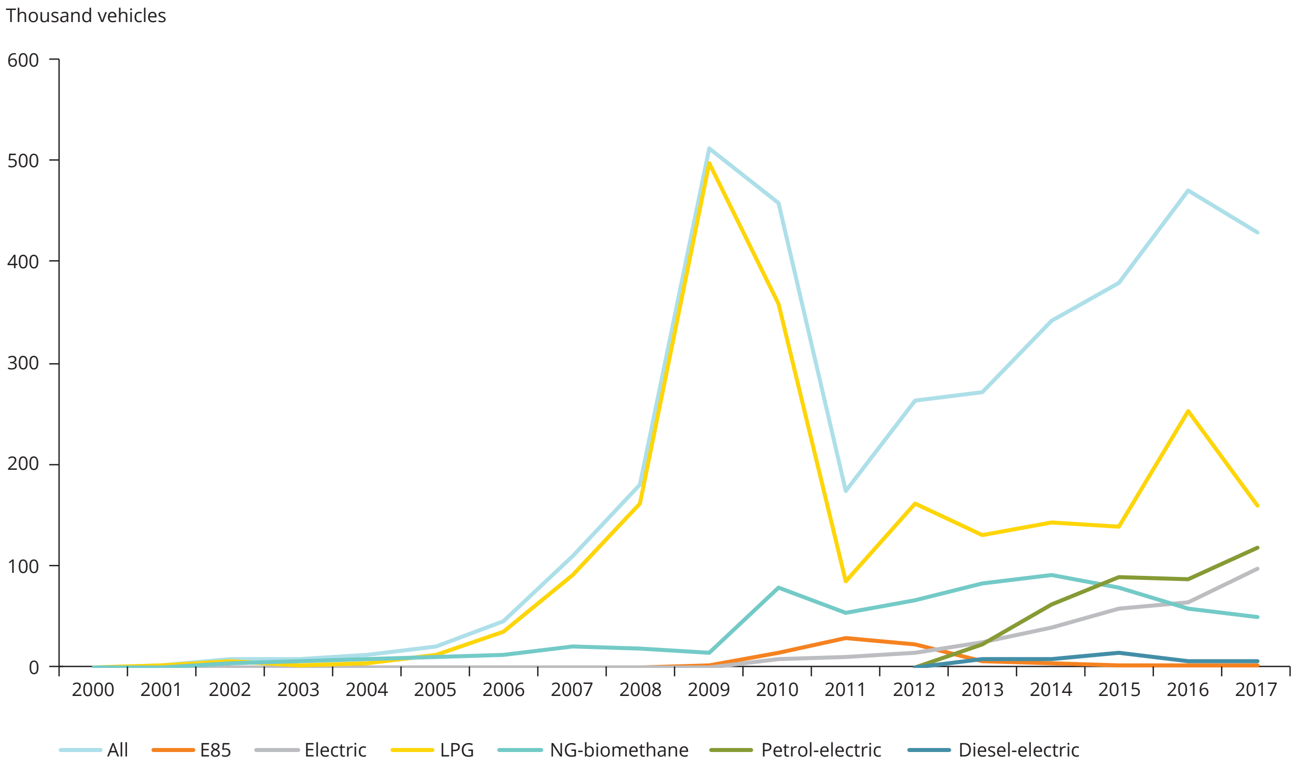


Table 3.2 AFV data: number of registrations, CO_2 emissions (gCO_2/km), mass (kg)

Fuel	Registrations	Average CO_2 emissions (g CO_2/km)	Average mass (kg)
E85	1 772	123.3	1 316
BEV	97 081	0.0	1 628
Hydrogen	175	0.0	1 924
LPG	158 238	121.0	1 217
NG	48 901	103.2	1 323
Petrol/Electric	116 956	45.9	1 852
Diesel/Electric	5 843	64.0	2 131

Notes: Only exhaust emissions are considered. For BEVs and fuel cell electric vehicles, the emission is null; for E85, only the petrol CO_2 emissions are reported; for LPG and NG-biomethane, the corresponding LPG and compressed NG CO_2 emissions are reported.

Figure 3.5 Trends in total registrations of AFVs, 2000-2017



BEVs are propelled by electric motors, using electrical energy stored in batteries or another energy storage device. The tail-pipe emissions of this kind of vehicle are considered to be 0 gCO_2/km. It is important to mention that only tail-pipe emissions ([4]) are included in the data set. PHEVs are powered by an electric motor and an internal combustion engine designed to work either together or separately. The on-board battery can be charged from the grid, and the combustion engine supports the electric motor when higher operating power is required or when the battery's charge is low.

In 2017 there were almost 33 000 more registrations of BEVs than in 2016, representing 0.6 % of the fleet. The average emissions from PHEVs were generally below 70 gCO_2/km. New registrations of PHEVs have increased greatly in recent years: in 2017 approximately 123 000 PHEVs were registered in Europe. Together with BEVs, they represent 1.5 % of the fleet (Figure 3.6).

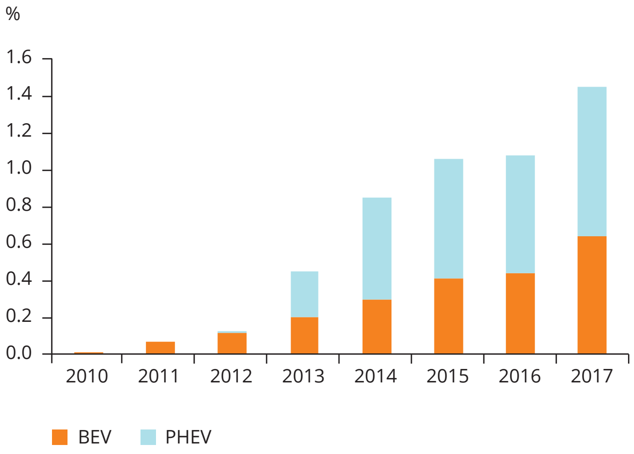
For the first year, hydrogen vehicles appeared on the market. Their number is very limited (fewer than 200 vehicles). In these vehicles, the electrical energy is provided by a fuel cell 'stack' that uses hydrogen from an on-board tank combined with oxygen from the air.

Hybrid electric vehicles (HEVs) have been available in Europe since 2000. They combine an internal combustion engine and an electric motor that assists the conventional engine during, for example, acceleration. The battery of an HEV cannot be charged from the grid, but it is typically charged during regenerative braking or while the vehicle is coasting. However, registration numbers for these types of vehicle are not available in the officially reported statistics. Such vehicles are reported by Member States as petrol or diesel vehicles.

([4]) Tail-pipe emissions are the exhaust emissions of the vehicles. There are no end-of-pipe emissions for BEVs. However, BEVs produce indirect emissions when they are plugged into the electricity grid. The indirect emissions are not taken into account in this report or in the regulation.

Registrations of BEVs in the EU-28 have increased in the last 7 years, from around 700 in 2010 to around 97 000 in 2017. France (more than 26 100 vehicles), Germany (around 24 300 vehicles) and the United Kingdom (almost 13 600 vehicles) have seen the highest increase in absolute numbers has been over recent years. Significant numbers of PHEVs have been registered in the United Kingdom (almost 36 300 vehicles) and Germany (more than 28 800 vehicles).

Figure 3.6 Percentages of BEV and PHEV registrations in the EU-28

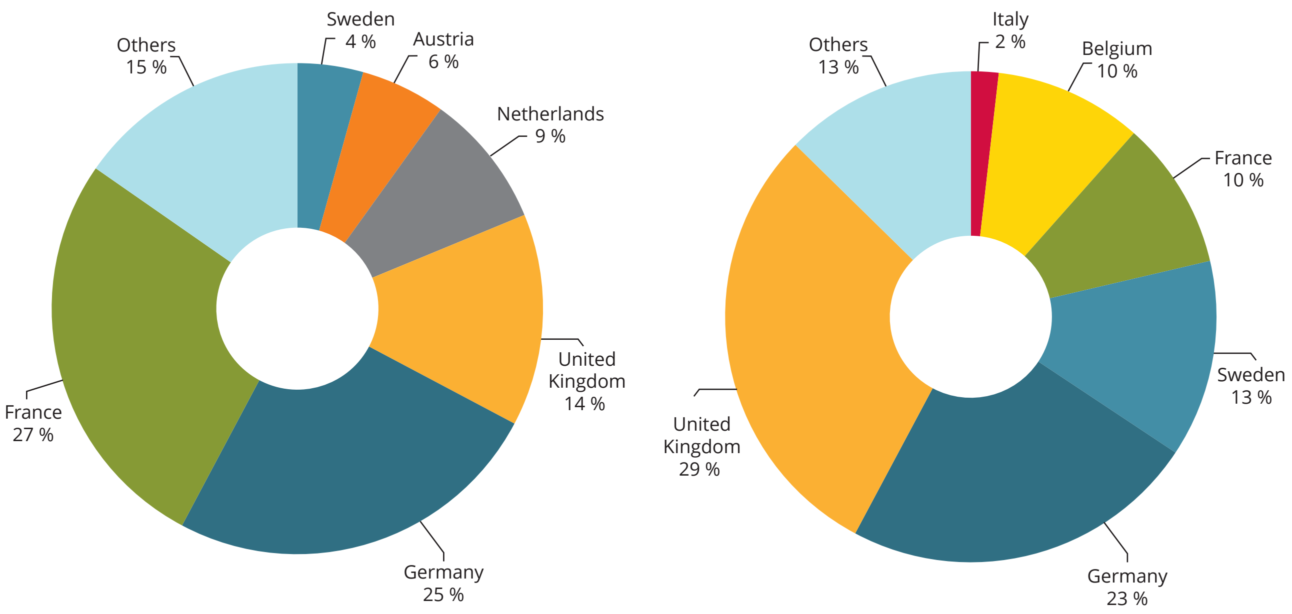


Among the other types of AFV, NG and LPG emissions have been constant over the years (103.2 g and 121.0 gCO_2/km, respectively). The improvement in these technologies is marginal compared with the previous year and the conventional technologies: in 2014, NG and LPG vehicles emitted, respectively, 97.8 and 120.3 gCO_2/km. Emissions from LPG cars are, on average, higher than those from diesel vehicles, even though their mass is significantly lower (1 217 kg for LPG cars and 1 539 kg for diesel cars). Italy has the largest number of LPG and NG vehicles, making up 8.2 % of its vehicles. In the other countries the proportion of LPG and NG vehicles is below 3.3 %.

3.4 Overview of main technical parameters

Vehicle mass is a critical parameter in vehicle design, as it is closely linked to fuel consumption. Increasing the mass of a vehicle means that more energy is needed to accelerate the vehicle and increase its rolling resistance ([5]), resulting in increased fuel consumption (and, thus, in increased CO_2 emissions). For example, for an additional 50-200 kg, over various cycles and operating conditions, the increase in fuel consumption ranges from 5 to 9 % (Fontaras, et al., 2017).

Figure 3.7 BEVs (left) and PHEVs (right) by Member State (% of EU-28 total)



([5]) The force resisting a car's motion when it rolls on the road.

Figure 3.8 Evolution of vehicle mass for petrol and diesel passenger cars

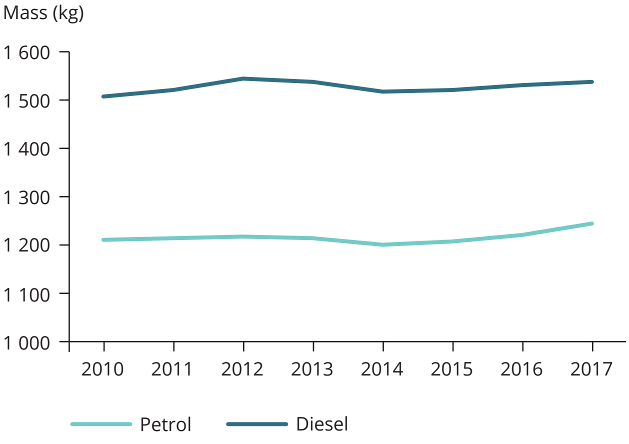
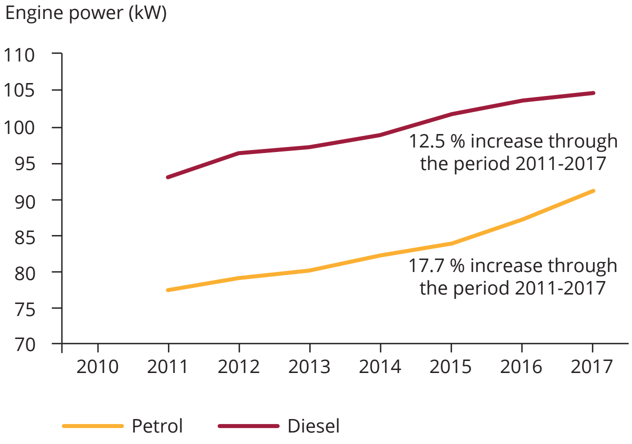


Figure 3.9 Trends in engine power for petrol and diesel passenger cars



Note: Data for 2010 were not available in the monitoring database.

The mass of new cars sold in Europe over the last 13 years has grown by 3.1 % on average, from 1 347 kg to 1 388 kg. This peaked in 2012 (1 402 kg), after which the average mass started to slowly decrease for a few years, and then rose again in 2015. The average mass of petrol cars (6) grew by around 3 % in 2017 compared with 2010 levels, while that of conventional diesel cars — despite some fluctuations — increased by about 2 % during the same period (Figure 3.8). Diesel cars are, on average, about 300 kg heavier than their petrol counterparts.

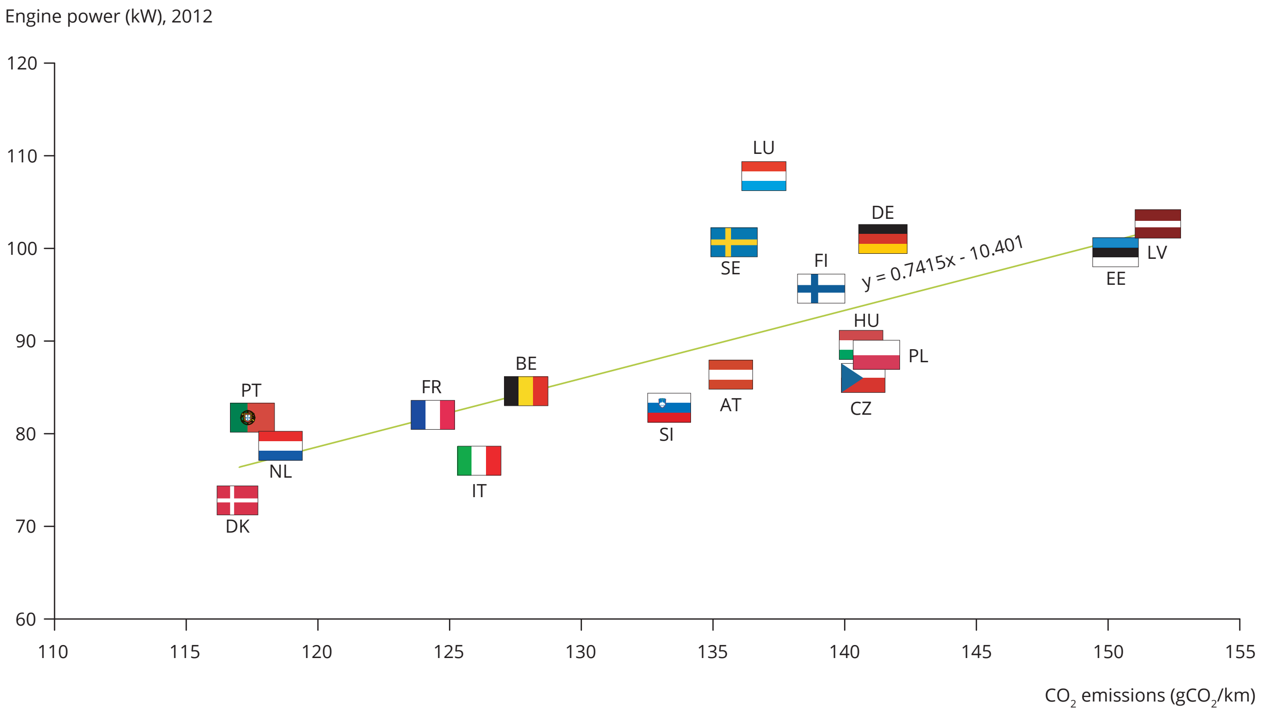
Several and conflicting factors have shaped the average mass variation over the years. In the past, this was mainly related to the need for an increase in car dimensions to meet consumers' demands for larger interior volumes, as well as to accommodate more safety features, emission control components and comfort/entertainment equipment on board. The increased market share of diesel cars, which tend to be heavier than petrol ones, affected the overall mass increase. A surge in demand for sport utility vehicles (SUVs) over recent years has also led to an increase in the mass of the average passenger car, as these cars tend to be heavier than others. On the other hand, the optimising of the car design and the use of advanced lightweight materials, such as high strength steels, aluminium, magnesium alloys and carbon fibre composites, have contributed to a weight reduction.

Looking at the trends in engine power, a substantial increase from 2011 to 2017 is observed (Figure 3.9). On average, petrol and diesel cars are about 18 % and 12.5 %, respectively, more powerful in 2017 than they were in 2011; and diesel cars are generally more powerful than petrol ones.

The correlation between engine power and CO_2 emissions is well known. To verify whether this correlation has changed over the years, average values for selected EU Member States are shown in Figure 3.10 for 2 years: 2012 and 2017. In 2012, the countries with the lowest emissions and engine power were Denmark, Portugal and the Netherlands, while those with the highest emissions and engine power were Latvia, Estonia and Germany. In 2017 the situation had not changed dramatically in terms of the leading countries. Portugal, Denmark and the Netherlands still had lower emissions, while those with the most powerful cars were Poland, Luxembourg and Germany. Even though the countries' performance ranks had not changed much between the 2 years, the relationship between these two parameters (CO_2 emissions and engine power) had. The relationships (as linear regressions) are compared in Figure 3.11 to facilitate the comparison between the two years. This graph clearly shows the progress in car efficiency over the last 5 years. As an example, in 2012 the average 100 kW car emitted 150 gCO_2/km, whereas in 2017 it emitted only 121 gCO_2/km.

(6) In this chapter, in the category petrol vehicles, HEVs are not included.

Figure 3.10 Engine power versus CO_2 emissions in 2012 and 2017



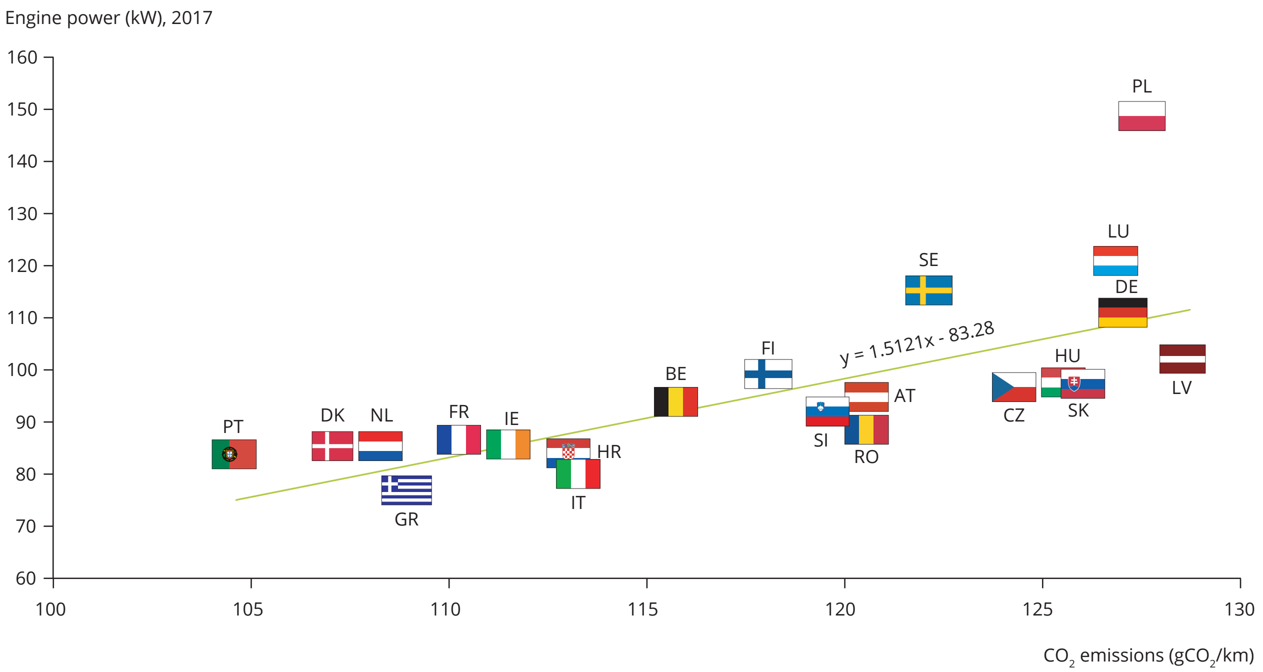


Figure 3.11 Relationship between engine power and CO_2 emissions for 2012 and 2017

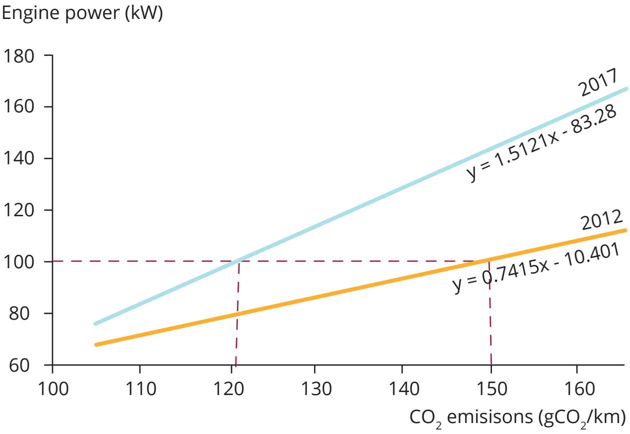
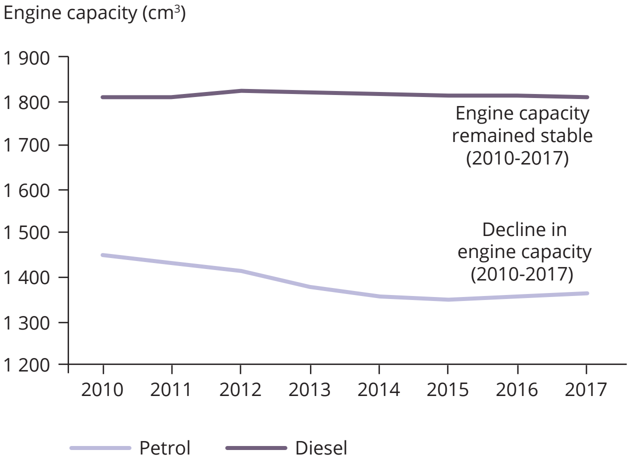


Figure 3.12 Evolution of engine capacity of conventional petrol and diesel passenger cars



As discussed previously, the automotive industry has been able to reduce CO_2 emissions and meet its 2015 target, so far delivering even more powerful passenger cars to the market. One factor that helped this decoupling of emissions from engine performance was the engine downsizing that has taken place in recent years. Engine downsizing can be defined as the use of a smaller engine able to deliver the power of a larger engine thanks to devices that increase the engine's efficiency (i.e. supercharging or turbocharging).

Diesel and petrol cars exhibit different trends as regards engine capacity. In general, the average engine capacity of diesel cars remained stable during the 8-year period (2010-2017) at slightly above 1 800 cm^3, whereas petrol cars followed a downward trend with a total reduction of 90 cm^3 over the same period. As shown in Figure 3.12, the engine displacement of diesel cars is much larger than that of petrol ones.

Whereas downsizing was the main reason for the reduction in engine displacement of petrol cars, the average engine capacity of diesel cars has remained almost stable. This is not because downsizing is not used for this technology, but because the diesel market has moved towards bigger and heavier cars, offsetting the downsizing.

3.5 Average vehicle parameters per segment

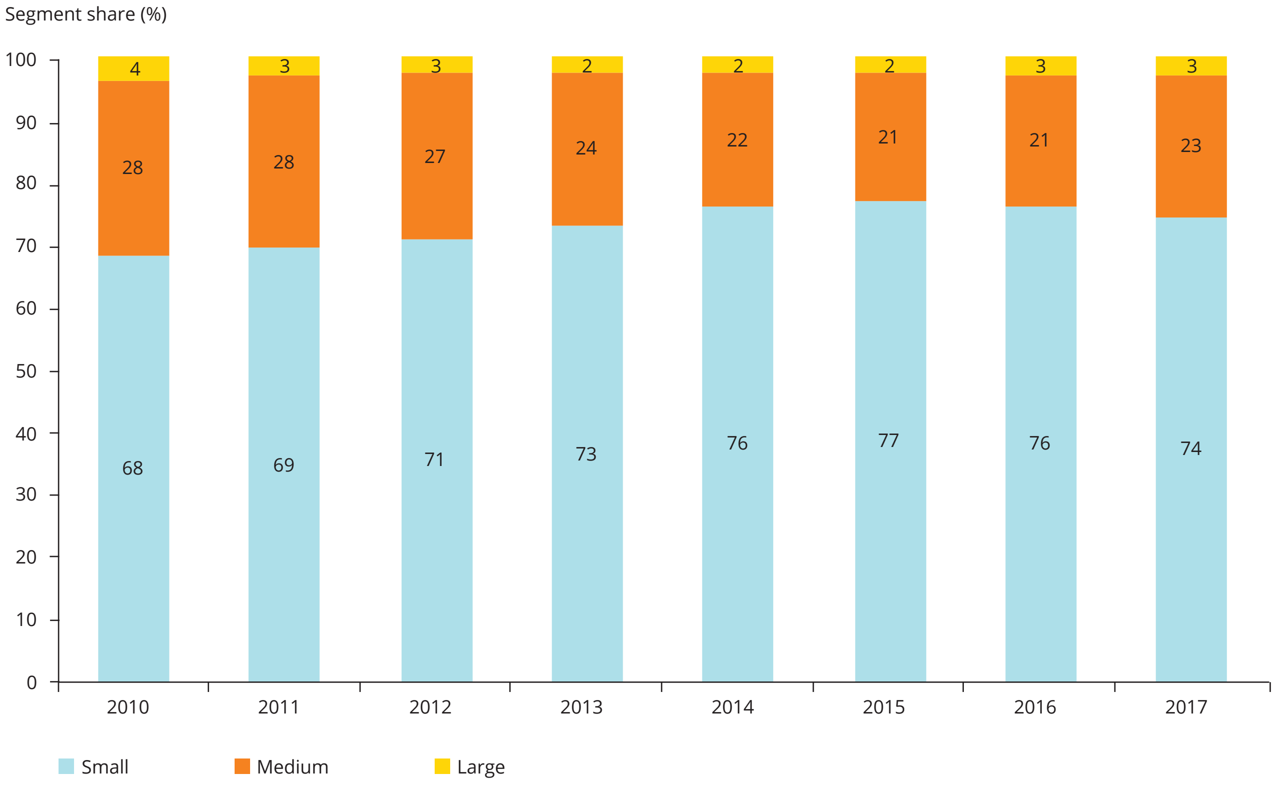
Passenger cars can be classified by fuel and by segment based on their engine capacity, as follows:

- Mini: < 0.8 l (800 cm^3)
- Small: 0.8-1.4 l (800-1 400 cm^3)
- Medium: 1.4-2.0 l (1 400-2 000 cm^3)
- Large: > 2.0 l (2 000 cm^3)

The data presented in rest of this chapter will adhere to these classifications. It should be noted that mini cars recorded a very small market share that was negligible towards the end of the time series for both petrol and diesel cars.

The market share of conventional petrol cars is shown in Figure 3.13. Small cars constitute most of the sales, followed by medium-sized cars. Large cars constitute only a minor share, in the order of 3 %. Over the past 8 years, small cars have significantly strengthened their share: whereas in 2010 they represented 68 % of the market, in 2015 they increased their share by 9 percentage points, constituting 77 % of all petrol cars. In the last 2 years, however, the percentage of small cars has decreased in favour of medium and large cars.

Figure 3.13 Market share per segment for petrol passenger cars



As for diesel cars (Figure 3.14), the highest share of the market belongs to medium cars. Small and large cars hold minor shares. The trend observed in recent years is that the share of mid-range cars has grown mainly at the expense of small cars.

As expected, larger cars generally had higher CO_2 emissions (Figure 3.15 and Figure 3.16). However, a decreasing trend in CO_2 emissions is observed for all segments. The CO_2 emission reductions are highest for large cars and rather marginal for small ones.

For diesel cars only the large segment managed to achieve a small reduction (0.5 gCO_2/km) in 2017 compared with 2016. Small and medium diesel car emissions increased by about 1 and 1.5 gCO_2/km, respectively, during the same period. However, for conventional petrol cars, large saw a significant reduction in CO_2 emissions of around 6 gCO_2/km, medium cars remained rather stable, and CO_2 emissions of small petrol cars increase slightly by about 0.4 g/km in 2017 compared with 2016.

The peculiar behaviour of mini-petrol cars, which for several years had higher CO_2 emissions than small-petrol cars, is attributed to the fact that mini cars recorded a very small market share, which was negligible towards the end of the time series.

Almost all size categories have seen an increase in the mass of the car since 2010, except large-diesel cars, for which the mass had reduced by about 40 kg in 2017 compared with 2010 (Figure 3.17 and Figure 3.18). However, it should be noted that the changes in mass were generally quite mild, with the most intense occurring in the small segment, in which the mass of petrol cars increased by 5 % and the mass of diesel cars increased by 7.5 % in the period 2010-2017.

Figure 3.14 Market share per segment for diesel passenger cars

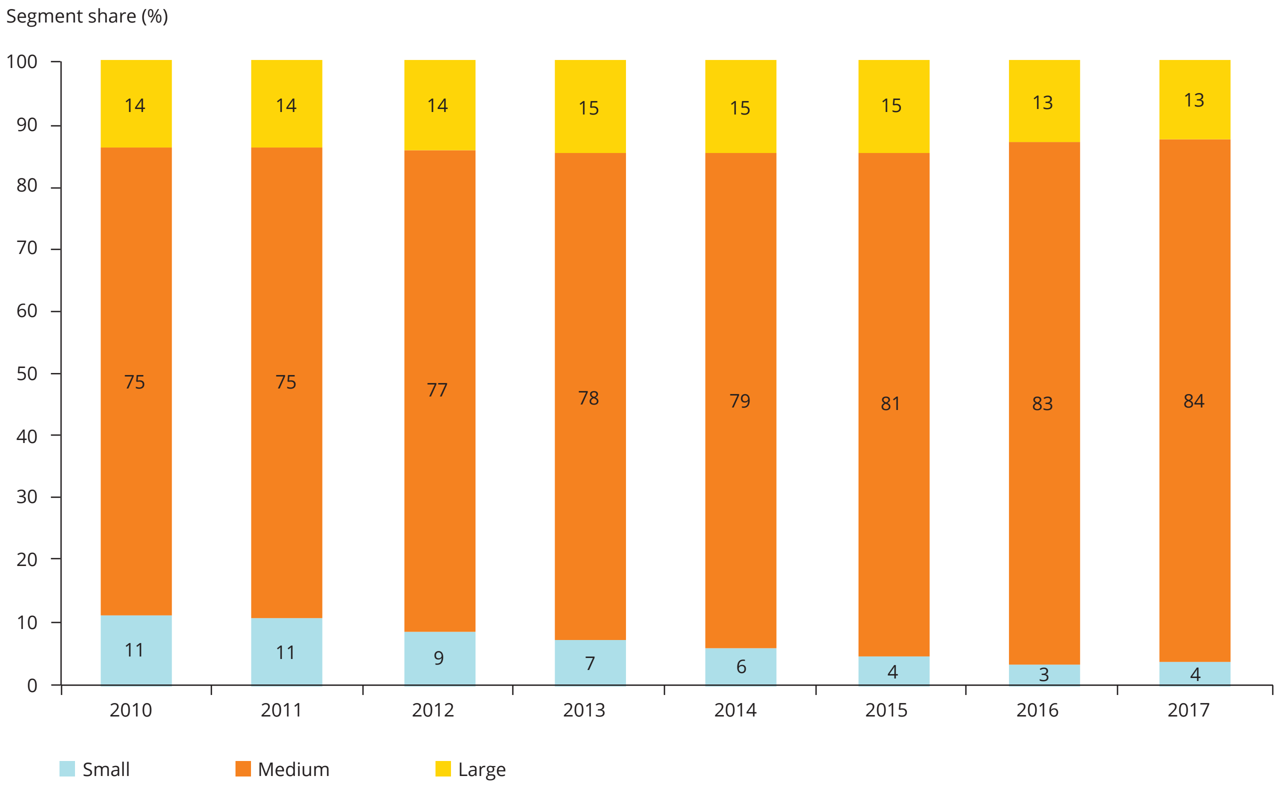


Figure 3.15 Trends in CO_2 emissions of petrol passenger cars per segment

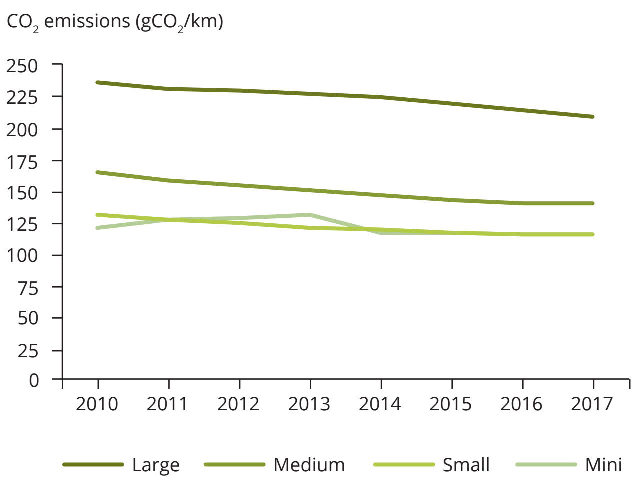


Figure 3.16 Trends in CO_2 emissions of diesel passenger cars per segment

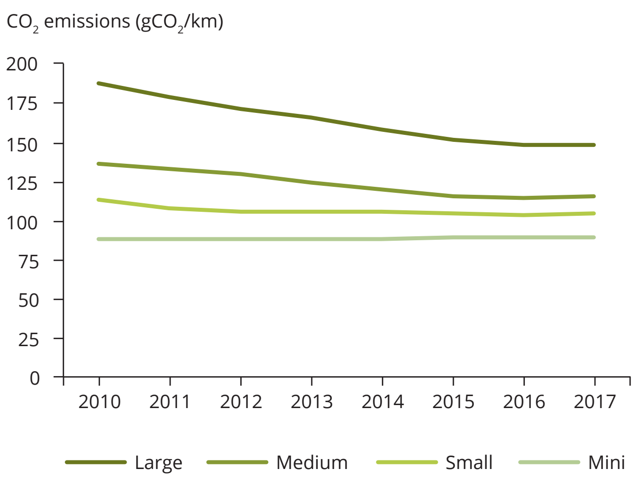


Figure 3.17 Trends in mass of petrol passenger cars per segment

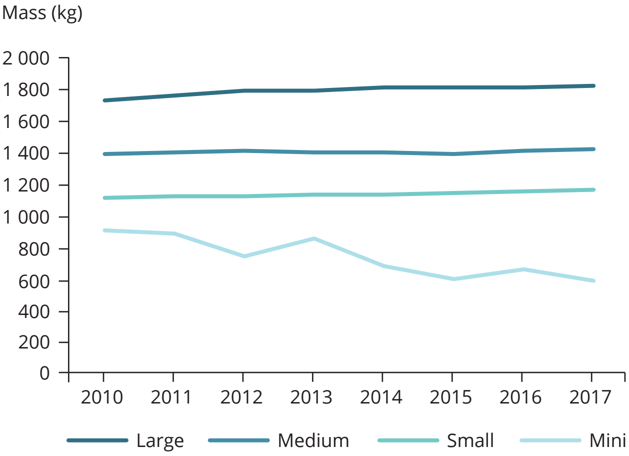


Figure 3.18 Trends in mass of diesel passenger cars per segment

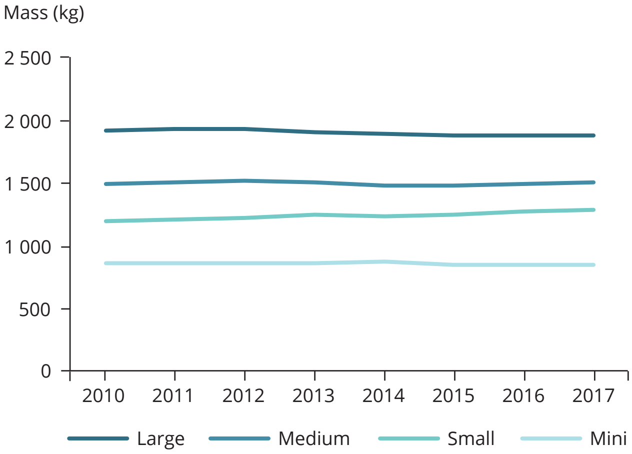


Figure 3.19 Trends in engine power of petrol passenger cars per segment

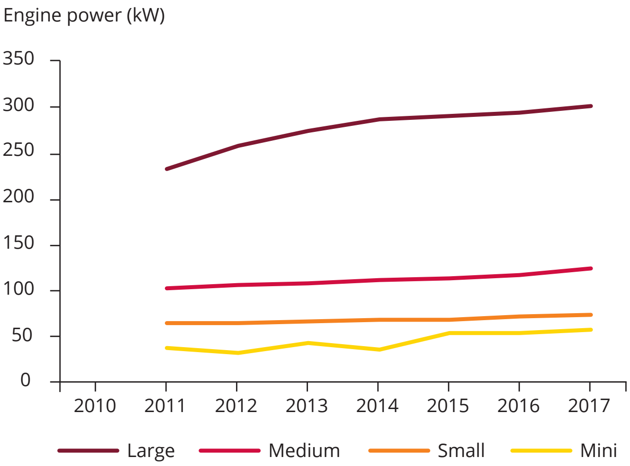


Figure 3.20 Trends in engine power of diesel passenger cars per segment

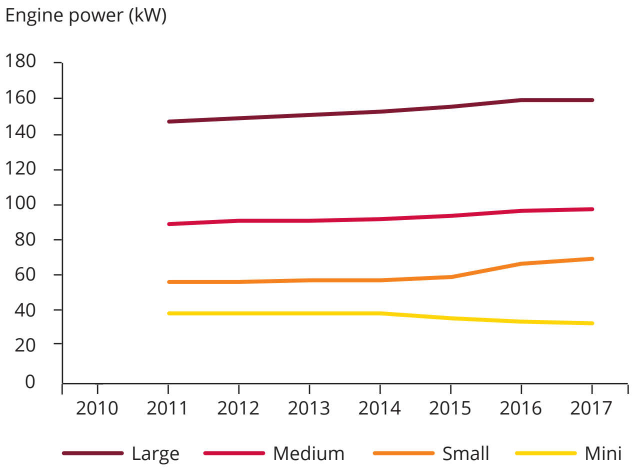


Figure 3.21 Trends in engine capacity of petrol passenger cars per segment

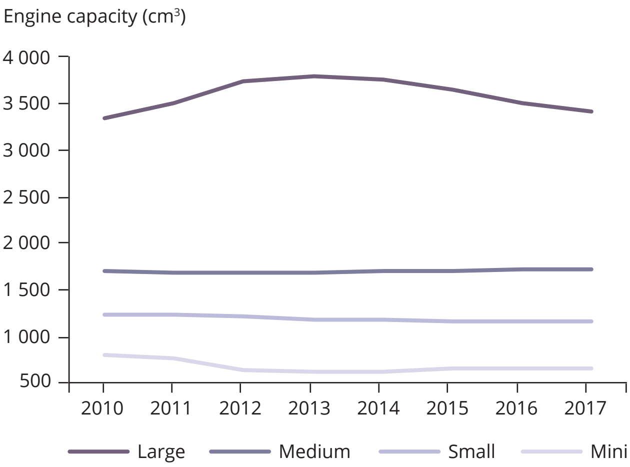
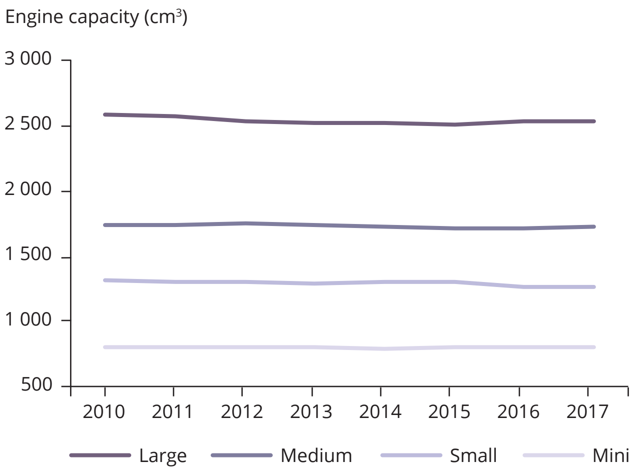


Figure 3.22 Trends in engine capacity of diesel passenger cars per segment



Cars have become more powerful over the past 7 years, and this applies to all size classes and to both petrol and diesel engines (Figure 3.19 and Figure 3.20). The large petrol vehicles sold were much more powerful than the large diesel ones.

Regarding the other size categories (medium and small), petrol powertrains are slightly more powerful than the corresponding diesel ones. This is because in similar engine sizes, a petrol engine will have greater power than a diesel engine because it can run at higher rotational speeds and power is directly proportional to the speed. However, at lower speeds a diesel engine can produce higher torque than a petrol engine.

Finally, the strongest relative increase in power was seen in small cars: for diesel cars there was an overall increase of 22 % and for petrol cars the total increase reached about 17 % from 2010 to 2017.

Regarding engine capacity, a small decreasing engine displacement trend was observed over the period for almost all segments (Figure 3.21 and Figure 3.22). The only exception was for large petrol cars for which the engince capacity increased by about 56 cm^3.

Medium-sized cars' capacity remained almost stable for both petrol and diesel powertrains over the period 2010-2017. In addition, their values ranged around the same level, just above 1 700 cm^3.

In the small cars category there was a significant downwards trend for both petrol and diesel powertrains. More specifically, petrol cars recorded an overall absolute reduction of about 72 cm^3 (6 % in relative terms) and diesel cars fell about 55 cm^3 (4 % in relative terms). It is also worth noting that the petrol powertrains of this category are generally smaller than the diesel ones, with an average of 1 167 cm^3 in 2017, while the diesel powertrains were about 1 266 cm^3.

3.6 Distance to the 2017 target per manufacturer

The distance of manufacturers to their specific emissions target, including the applicable derogation targets, is calculated by considering the average specific emissions of their entire new-car fleet, taking into account the modalities listed in Annex 1 (only eco-innovations for cars in 2017).

Based on their average CO_2 emissions in 2017, 34 manufacturers out of 89 achieved individually their specific emission targets for the year 2017. Taking the pools into account, 55 manufacturers out of 89 achieved their targets. Nine manufacturers respected their derogation targets (derogations or niche derogations).

Twenty-two manufacturers fall within the scope of the *de minimis* threshold, according to which manufacturers with fewer than 1 000 registrations are exempt from achieving a specific emissions target. These 22 manufacturers registered fewer than 3 600 vehicles in 2017, i.e. fewer than 0.02 % of all registrations. The data are available in Annex 3.

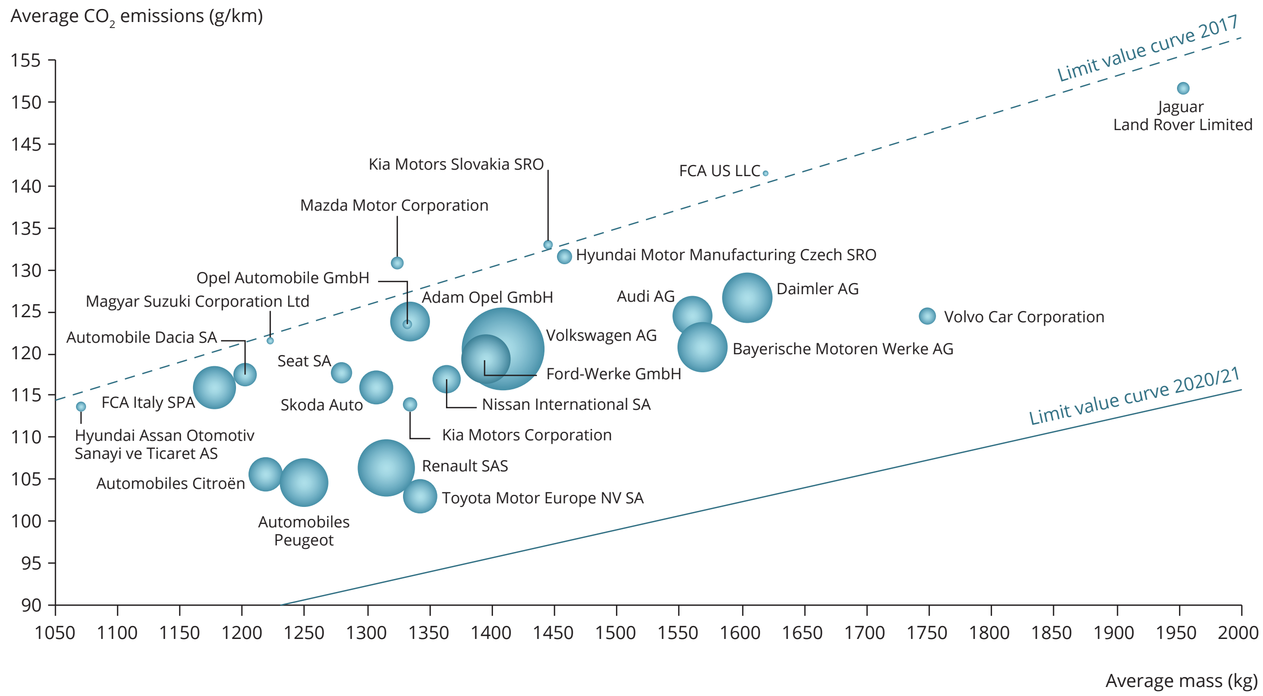
Figure 3.23 presents 2017 data (number of registrations, average mass and average emissions) for all large manufacturers ([7]) individually, i.e. those that registered more than 100 000 cars in that year. In total, these manufacturers sold 14.3 million new cars in the EU-28 in 2017, 95 % of all new registrations.

In 2017, for the first year, Toyota Motor Europe had the lowest CO_2 emissions of all larger manufacturers, as it managed to reduce average CO_2 emissions by more than 2 g/km from the previous year. It continued to produce some of the lowest-emitting cars, as half of its fleet had emissions below 95 gCO_2/km (51 %). The Toyota Motor Europe fleet comprised 92 % petrol cars, with one of the lowest average emissions (101.8 gCO_2/km) of the large manufacturers. This was mainly related to the high proportion of hybrid cars emitting less than a conventional car.

Automobiles Peugeot, Automobiles Citroën and Renault followed, with average emissions below 110 gCO_2/km. They still are among the best performers in 2017, but all of them increased their emissions compared with 2016. In the last year, the emissions of Automobiles Peugeot and Automobiles Citroën increased by 2.8 and 2.3 gCO_2/km, respectively. Even though both manufactures have some of the lightest fleets (diesel cars of around 1 350 kg and petrol cars of around 1 150 kg), their average emissions increased for both diesel and petrol cars: 1.5-2.5 gCO_2/km for diesel cars and 2-3 gCO_2/km for petrol ones. The proportion of cars emitting less than 95 gCO_2/km decreased to 21 % in 2017 (from 27 % and 24 % in 2016, respectively, for Automobiles Peugeot and Automobiles Citroën). Compared with previous years,

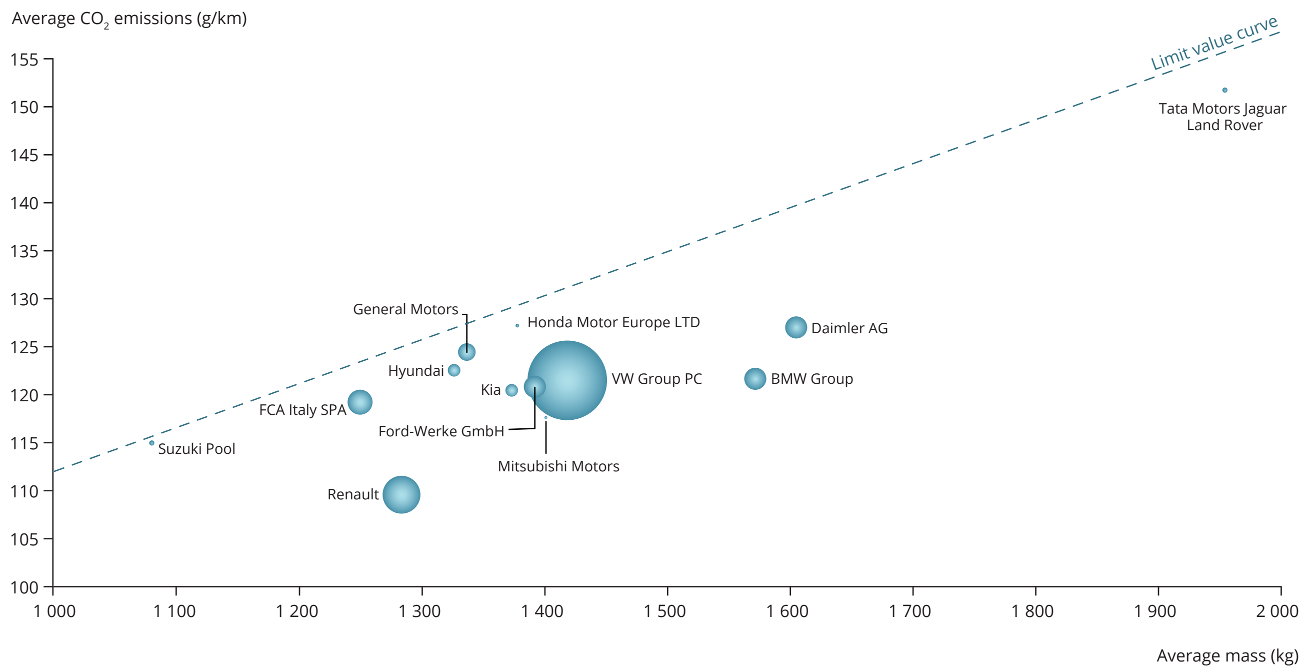
([7]) In this report, large manufacturers are those responsible for more than 100 000 registrations per year, whereas according to Regulation (EC) No 443/2009 large manufacturers are those responsible for more than 300 000 registrations per year.

Figure 3.23 Distance to 2017 target by individual manufacturers registering more than 100 000 vehicles per year



Note: The size of a bubble is proportional to the number of vehicles registered in the EU-28.

Figure 3.24 Distance to 2017 target by pools



Note: The size of a bubble is proportional to the number of vehicles registered in the EU-28.

for both manufacturers the number of diesel cars decreased from around 60 % to less than 51 % of their fleets. The number of electric cars for these two manufacturers did not increase in the last 2 years.

After years of significant improvements, Renault's emissions increased by 1.1 gCO_2/km in the last year. This slight increase is related to the increase in the average emissions of petrol (around 1.3 gCO_2/km), the decrease in the number of diesel cars (around 51 % in 2017 and 58 % in 2016) and the increase in their average emissions (around 1 gCO_2/km). Its average emissions increased even though 2.5 % of its new fleet was BEVs; these vehicles contributed to reducing the average CO_2 emissions by 2.6 gCO_2/km.

More significant emission reductions were achieved by Kia Motors (-5.7 gCO_2/km) and FCA US LLC (Chrysler) (-5.1 gCO_2/km). For both manufacturers, the number of diesel cars decreased by 5 and 9 percentage points, respectively, in favour of petrol and AFVs (6 % and 1 % of their fleet, respectively, for Kia and Chrysler). The CO_2 emissions of all car technologies decreased in the last year by more than 2.5 gCO_2/km. Despite its improvements, FCA US LLC, together with Jaguar Land Rover, is the larger manufacturer with the highest average CO_2 emissions.

For the first time, the majority of larger manufacturers increased their average specific emissions in 2017 compared with the previous year. The largest increase was observed for Skoda (4.1 gCO_2/km) and Mazda (4 gCO_2/km). For both manufacturers, the fleet composition changed in favour of petrol cars, which represented 57 % and 74 % for Skoda and Mazda, respectively (in 2016, 53 % and 62 %, respectively). The average emissions of conventional cars, for both petrol and diesel, have increased between 1.5 and 7 gCO_2/km in the last 2 years.

Figure 3.23 also shows the distance to target adjusted for car mass using what are known as limit value curves, as explained in Annex 1. Some manufacturers that may have missed their specific emission targets met their obligations as members of a pool (see above for further details). This was the case for Kia Motors Slovakia (Kia pool) and FCA US LLC (FCA Italy SPA), which would not have otherwise met their specific emissions targets, as their average specific emissions would have been 0.552 and 1.159 gCO_2/km, respectively, above their targets. In addition to a pooling arrangement, the Suzuki pool and the Tata and Jaguar Land Rover pool benefited from niche derogations (see Annex 1).

The distance to target varies between 1.3 gCO_2/km above target for Mazda and 26.4 gCO_2/km below target for Jaguar Land Rover. All relevant data are included in Annex 3.

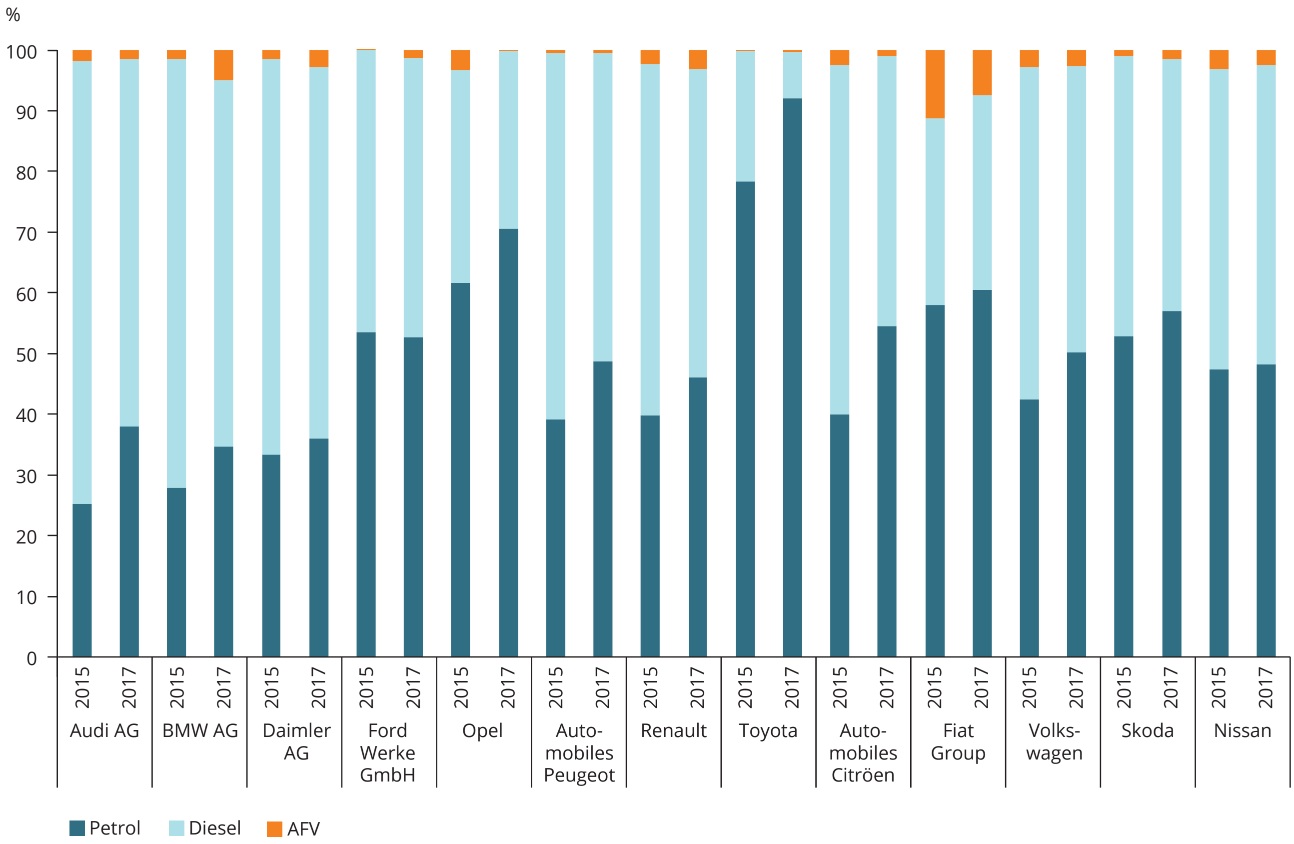
As explained in Annex 1, the limit value curve implies that heavier cars are allowed higher emissions than lighter cars. As a result, the specific CO_2 emission targets range from 115 gCO_2/km for Hyundai Assan to 146 gCO_2/km for Volvo Corporation.

The distance to target for pools of manufacturers is presented in Figure 3.24 and Table 3.3. In 2017, all of the pools respected their specific emission targets. However, the distribution of emissions among manufacturers is different in the pools. For example, Daimler AG and Mercedes AMG belong to the same pool, but the average specific emissions of the former are 126 gCO_2/km, while the average specific emissions of the latter are 241 gCO_2/km.

Table 3.3 Distance to target for the pools in 2017

Pool	Manufacturer	Average emissions (gCO_2/km)	Target (gCO_2/km)	Distance to target (gCO_2/km)
	Bayerische Motoren Werke AG	121	138	-17
	BMW M GmbH	161	141	19
	Rolls-Royce Motor Cars Ltd	329	182	147
BMW Group		**122**	**138**	**-17**
	Daimler AG	127	140	-13
	Mercedes-Amg GmbH	241	143	99
Daimler AG		**127**	**140**	**-13**
	Alfa Romeo SPA	121	133	-13
	FCA US LLC	142	140	1.2
	FCA Italy SPA	116	120	-4.1
FCA Italy SPA		**119**	**123**	**-4.3**
	Cng-Technik GmbH	163	138	25
	Ford India Private Limited	114	115	-0.9
	Ford Motor Company	205	150	55
	Ford-Werke GmbH	119	130	-11
Ford-Werke GmbH		**121**	**130**	**-9.2**
	General Motors Holdings LLC	261	152	109
	GM Korea Company	140	136	3.3
General Motors		**124**	**127**	**-3.1**
	Honda Automobile China Co Ltd	125	118	7.4
	Honda Motor Co Ltd	120	124	-4.2
	Honda Turkiye AS	138	128	10
	Honda of the UK Manufacturing Ltd	136	136	0.3
Honda Motor Europe Ltd		**127**	**129**	**-2.1**
	Hyundai Motor Company	115	134	-18
	Hyundai Motor Manufacturing Czech SRO	132	133	-1.4
	Hyundai Motor Europe GmbH	111	135	-24
	Hyundai Motor India Ltd	135	115	20
	Kia Motors Corporation	114	127	-13
	Kia Motors Slovakia SRO	133	132	0.6
Kia		**120**	**129**	**-8.6**
	Mitsubishi Motors Corporation MMC	126	139	-13
	Mitsubishi Motors Europe BV MME	135	127	7.6
	Mitsubishi Motors Thailand Co Ltd MMTH	97	109	-12
Mitsubishi Motors		**118**	**130**	**-13**
	Avtovaz JSC	172	122	50
	Automobile Dacia SA	117	121	-3.8
	Renault SAS	106	126	-20
Renault		**110**	**125**	**-15**
	Magyar Suzuki Corporation Ltd	122	123	-1.6
	Maruti Suzuki India Ltd	100	123	-23
	Suzuki Motor Corporation	115	123	-8.6
	Suzuki Motor Thailand Co Ltd	97	123	-26
Suzuki Pool		**115**	**123**	**-8.2**
	Jaguar Land Rover Limited	152	178	-26
Tata Motors Ltd. Jaguar Cars Ltd. Land Rover		**152**	**178**	**-26**
	Audi AG	125	138	-13
	Audi Hungaria Motor KFT	145	130	15
	Bugatti Automobiles SAS	518	161	357
	Dr Ing HCF Porsche AG	176	153	23
	Quattro GmbH	218	149	69
	Seat SA	118	125	-7.1
	Skoda Auto AS	116	126	-10
	Volkswagen AG	120	131	-10
VW Group PC		**121**	**131**	**-10**

Figure 3.25 Fuel type distribution for the largest manufacturers (more than 500 000 vehicle registrations per year)



Notes: Data for the time series 2001-2009 were gathered using the monitoring regulated by Decision 1753/2000/EC, which was repealed by Regulation (EC) No 443/2009. These data do not include all Member States in all years. Manufacturers' names and groups may have changed. Moreover, because of changes in methodology and monitoring improvements, breaks in trends may occur.

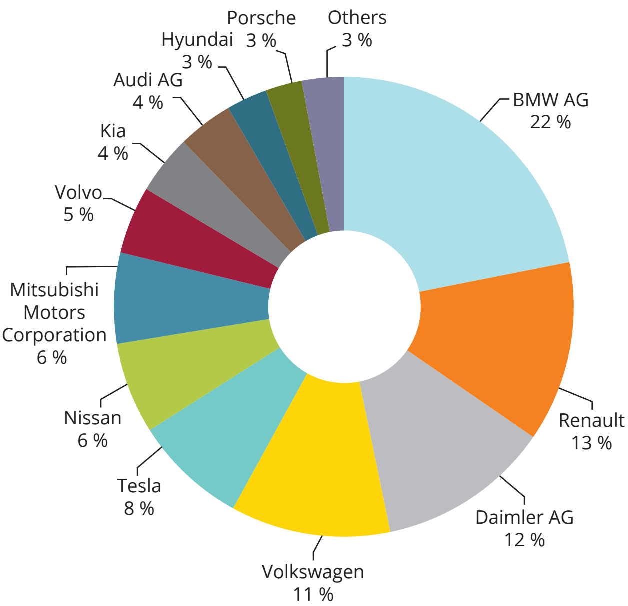
As a general observation, dieselisation ([8]) (the introduction of more diesel cars) of the total fleet decreased in 2017. For only five out of the 12 larger manufacturers, the proportion of diesel cars in 2017 was higher than 50 %: Audi AG (60.6 %), Daimler AG (61.2 %), BMW AG (60.2 %), Renault SAS (50.8 %) and Automobile Peugeot (50.6 %) (Figure 3.25).

Despite the increasing trend, the proportion of AFVs remains low in absolute terms, and hence has not contributed significantly to the observed emission reductions. However, in 2017, the contribution of AFVs became important for some manufacturers, accounting for more than 7 % of registrations for Dacia and Fiat Group (Figure 3.25 and Figure 3.26). The majority of electric cars (BEVs) registered in the EU are produced by Renault (more than 28 000), Tesla (almost 17 800) and Nissan (almost 14 300).

The distribution of registrations over different emission classes (Figure 3.27) has not changed over the past few years. It shows that for some manufacturers (Volvo, Nissan, Renault and BMW AG) the market for cars emitting less than 50 gCO_2/km is slowly increasing. However, each of those manufacturers has a proportion of electric cars lower than 4.2 %. For Toyota and Renault, the proportions of cars emitting less than 95 g/km are relatively high, at 51 % and 27 %, respectively. Cars with emissions below 130 gCO_2/km account for the largest proportion of registrations for all larger manufacturers. For only a few manufacturers in this group (Mazda, Chrysler and Jaguar Land Rover), the majority of their cars sold emitted more than 130 gCO_2/km.

([8]) Older diesel vehicles, which have not been type-approved under the Real Driving Emissions (RDE) procedure, generally emit more air pollutants per kilometre than their conventional petrol equivalents. This is particularly true for emissions of black carbon, which has impacts on health and the climate, but also for particulate matter (PM) and nitrogen oxide (NO_x). See the EMEP/EEA air pollutant emission inventory guidebook 2016 (http://www.eea.europa.eu/publications/emep-eea-guidebook-2016).

Figure 3.26 Registrations of electric vehicles (BEVs and PHEVs) by manufacturers



3.7 Effect of eco-innovation technologies on specific CO_2 emissions

Regulation (EC) No 443/2009 gives an incentive to car manufacturers that implement certain innovative technologies in their fleets. As explained in Annex 1, eligible innovative technologies are those that help to cut emissions, but for which it is not possible to demonstrate effectiveness during the test procedure used for car type-approval. Examples of eco-innovation technologies are LED lights, solar roofs and efficient alternators. Technologies that are mandatory as part of the European Commission's strategy to reduce CO_2 emissions from light-duty cars are not eligible as eco-innovations. For this restriction, air conditioning systems, tyre pressure monitoring systems or gear shift indicators cannot qualify as eco-innovations.

Eco-innovation applications should be submitted to the Commission, which will assess the application and, within 9 months of receiving a complete application, will approve the innovative technology

Figure 3.27 Percentage of registrations in different specific emission classes (%)

as an eco-innovation. The assessment period may be extended by 5 months depending on the complexity of the technology and the size and contents of the application. Once approved, each eco-innovation receives an identification code, used to track eco-innovations and CO_2 savings. CO_2 savings from eco-innovations are certified during the car type-approval process and recorded on the certificate of conformity.

Until now, the Commission has approved more than 20 applications concerning technologies that contribute to, for example, improving the efficiency of 12 V alternators, improving the efficiency of exterior lighting systems, or deploying coasting technology.

Manufacturers can reduce their average specific emissions through savings from eco-innovations by up to 7 gCO_2/km per year.

In 2017 only a few manufacturers equipped vehicles with eco-innovations. However, the number of cars has increased over the last few years. Table 3.4 summarises the average emissions calculated when including or excluding eco-innovations. For 2017 the effect of eco-innovations on the average emissions of manufacturers is lower than 0.4 gCO_2/km. However, it appears that Member States did not systematically report eco-innovations savings and no manufacturers corrected this during notification. Therefore, the reported data on eco-innovations may underestimate the actual number of installed eco-innovation technologies and the CO_2 savings achieved from these.

3.8 Distance to the 2021 targets

Regulation (EC) 443/2009 set a 95 gCO_2/km target for 2021 while Regulation No 333/2014 defined the modalities for reaching this target.

When calculating the CO_2 performance of each car-maker's fleet in 2020, only 95 % of the registered cars will be considered, whereas in 2021 100 % of new cars will be included.

In addition, from 2020 super-credits will be reintroduced. The super-credit weight factor will be two cars in 2020, 1.67 cars in 2021 and 1.33 cars in 2022. In the period 2020-2022, the use of super-credits is subject to a cap of 7.5 gCO_2/km for each manufacturer. When calculating the 2021 average emissions, we assumed that the car manufacturer did not reach their cap.

Taking into account those modalities, it is possible to estimate the emission reductions that manufacturers would have to achieve from 2017 onwards to reach their targets in 2021, as well as the effect of super-credits on their specific emissions. The average emissions by manufacturers are calculated using 2017 emissions values including eco-innovations and super-credits effect. The targets for manufacturers are calculated using 2017 mass values and the 2021 limit value curve (Annex 1).

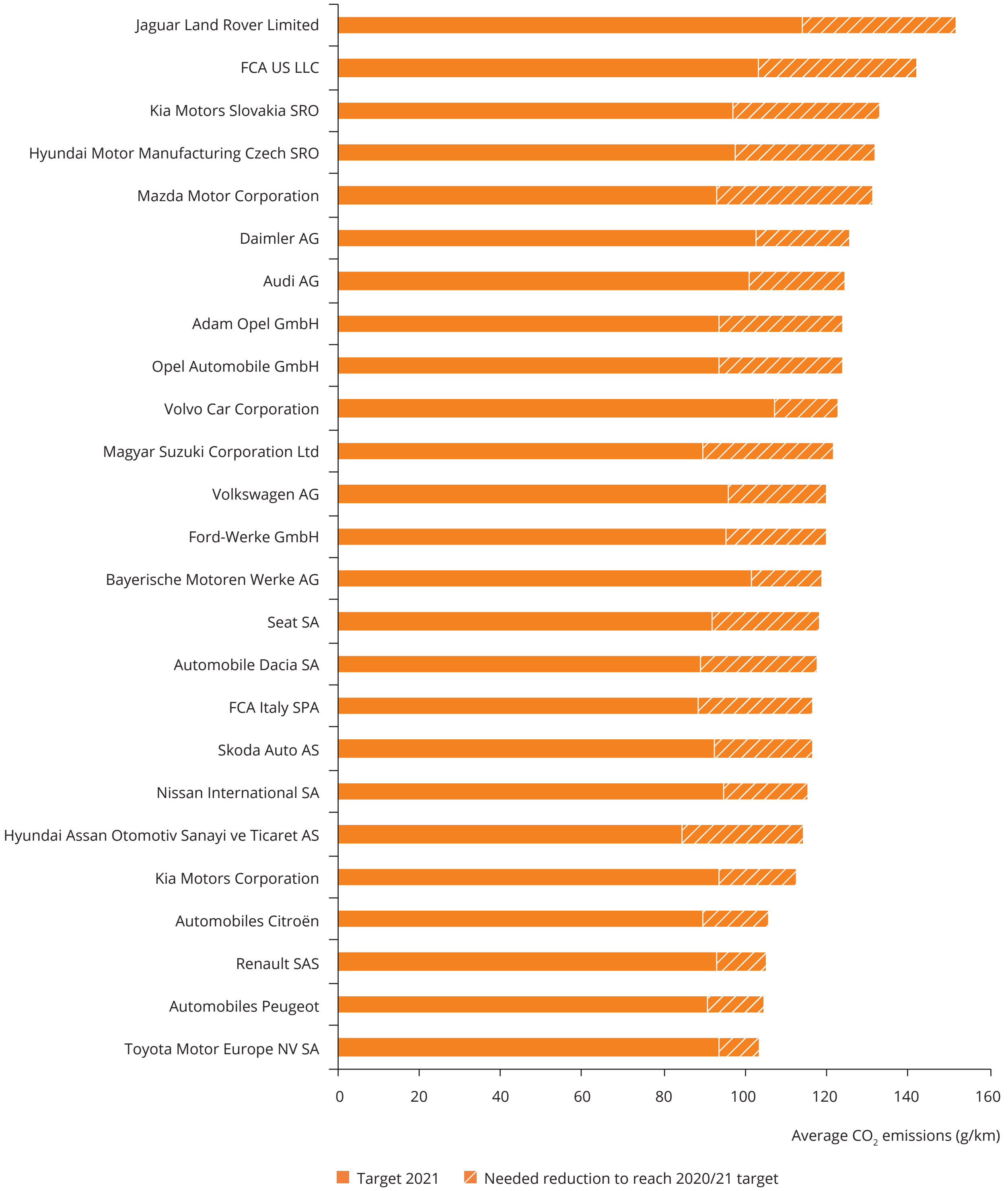
Table 3.4 Performance of the manufacturers that registered eco-innovation in 2017 including and excluding eco-innovation adjustments

Manufacturer	Average CO_2 specific emissions Including eco-innovation (gCO_2/km)	Average CO_2 specific emissions excluding eco-innovation (gCO_2/km)	Difference with or without eco-innovation (gCO_2/km)
Bayerische Motoren Werke AG	120 794	120 967	0.173
BMW M GmbH	160 703	160 908	0.205
Daimler AG ([a])	126 672	126 759	0.087
Honda Motor Co Ltd	119 922	119 984	0.062
Honda Turkiye AS	138 168	138 342	0.174
Honda of the UK Manufacturing Ltd	135 935	135 938	0.003
Mazda Motor Corporation	130 745	130 771	0.026
Opel Automobile GmbH	123 572	123 578	0.006
Porsche AG	175 925	176 045	0.120
Skoda Auto AS	115 948	115 971	0.023

Note: ([a]) Following verification by the European Commission pursuant to Article 12 of Regulation (EU) No 725/2011, the CO_2 savings from eco-innovation code e8 reported for Daimler AG's vehicles have been withdrawn from the calculation of the average specific emissions of that manufacturer.

In the last 2 years, the improvements achieved by manufactures have been considerably smaller than those in previous years. As a result, only a few manufacturers are on track to reach their 2021 targets. For instance, Automobiles Peugeot, Renault SAS and Toyota are the closest to reaching their 2021 targets, but they will still need to reduce their average emissions by more than 9-14 gCO_2/km in the next 3 years (Figure 3.28).

Figure 3.28 Progress needed to meet the 2021 targets



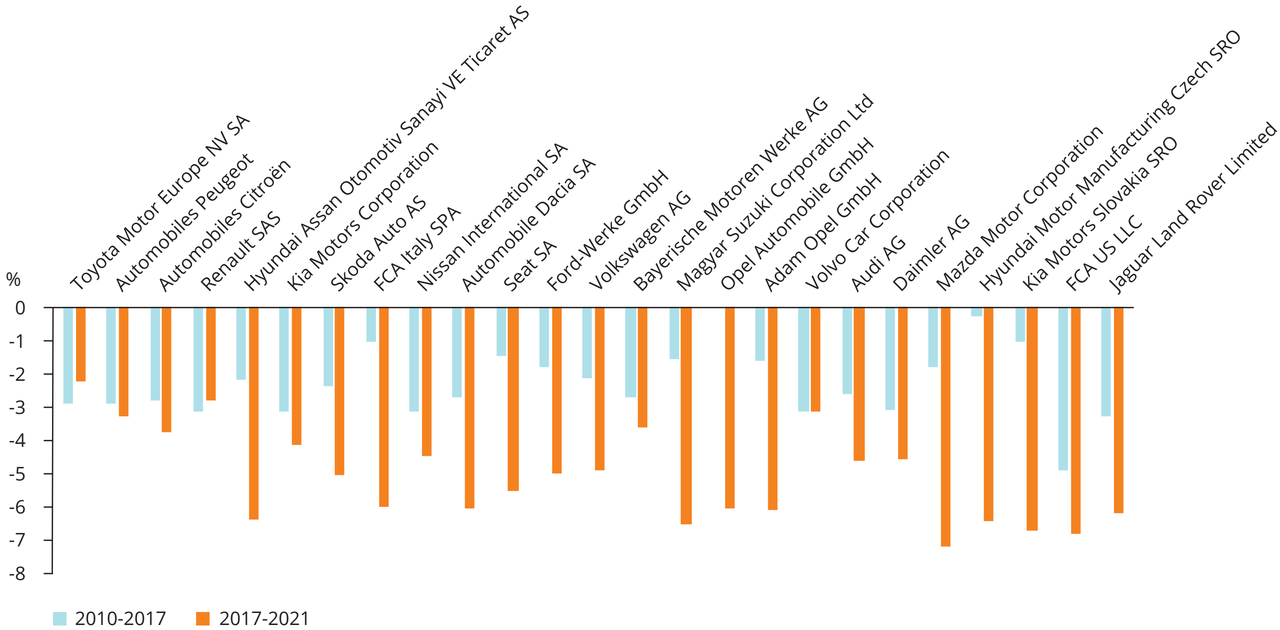
Other manufacturers still have to make considerable progress to achieve their 2021 targets. Some will need to reduce their average emissions by more than 30 gCO_2/km in the coming 3 years.

Figure 3.29 presents the progress of the manufacturers in terms of annual percentage changes for two periods: the past annual reductions rate (2010-2017) and the expected reductions needed to achieve the 2021 target set by the regulation (2017-2021).

There is only one manufacturer for which the progress rates required in the period 2017-2021 are comparable with those observed in the last 7 years (Toyota). For all other manufacturers, the rate of progress required from now until 2021 is generally higher than the rate that has been achieved since Regulation (EC) No 443/2009 came into force.

Table 3.5 summarises the average emissions calculated including and excluding the super-credits for the largest manufacturers registering low-emitting cars. The biggest effect of the super-credits on average fleet emissions is 2.4 gCO_2/km. It is important to mention that for the period 2020-2023 each manufacturer can benefit from a maximum of 7.5 gCO_2/km. This means, for example, than BWM AG has a residual 5.5 gCO_2/km that can be used in the following 2 years, if no super-credits were used in 2020. Because of the super-credit cap, it will be impossible for manufacturers to reach the 2021 target using only super-credits. In fact, even for the manufacturer closest to reaching its target (Toyota), only 7.5 of the missing 9 gCO_2/km can be reached with super-credits. Improvements to conventional cars or a shift towards better technologies need to be achieved to reach 2021 targets.

Figure 3.29 Comparison of past and future progress towards meeting the 2021 targets



Note: For Automobile Opel it was not possible to calculate the reduction rate for 2010-2017 because it appeared as a new manufacturer only in 2017.

Table 3.5 Performance of the manufacturers including and excluding super-credit adjustments

Manufacturer	Average CO_2 specific emissions excluding super credit (gCO_2/km)	Average CO_2 specific emissions including super credit (gCO_2/km)	Difference with or without super credit (gCO_2/km)
Bayerische Motoren Werke AG	120 794	118 362	-2.432
Kia Motors Corporation	113 941	111 979	-1.962
Nissan International SA	116 915	114 958	-1.957
Volvo Car Corporation	124 437	122 561	-1.876
Renault SAS	106 28	104 591	-1.689
Volkswagen AG	120 391	119 427	-0.964
Daimler AG	126 672	125 786	-0.886
Audi AG	124 527	124 035	-0.492
Toyota Motor Europe NV SA	103 069	102 904	-0.165
Opel Automobile GmbH	123 572	123 432	-0.140
Automobiles Citröen	105 584	105 446	-0.138
Automobiles Peugeot	104 533	104 418	-0.115
Adam Opel GmbH	123 837	123 82	-0.017
Ford-Werke GmbH	119 36	119 357	-0.003
Kia Motors Slovakia SRO	132 944	132 943	-0.001

4 Light commercial vehicles (vans)

4.1 Registrations

Since the beginning of vans monitoring, and for the sixth year in a row, the number of new van registrations has increased (Annex 2). This trend seems have continued in 2018. According to ACEA statistics (ACEA, 2018), from January to June 2018, 5.1 % more new vans were registered across the EU, compared with the same period 1 year ago.

For 17 Member States, the number of registrations in 2017 increased from 2016. The biggest increases in new vehicle registrations were observed in Sweden (48 %), Czechia (27 %) and Slovenia (20 %), while the biggest decreases were observed in Croatia (28 %), Hungary (15 %) and Poland (13 %).

The EU-15 still accounts for the vast majority of registrations of new light commercial vehicles in the EU, with more than 92 % of the total. Compared with 2016, the number of vehicles registered in the EU-13 has decreased by 3.2 %, while the number of newly registered vehicles in the EU-15 has increased by 1.7 %.

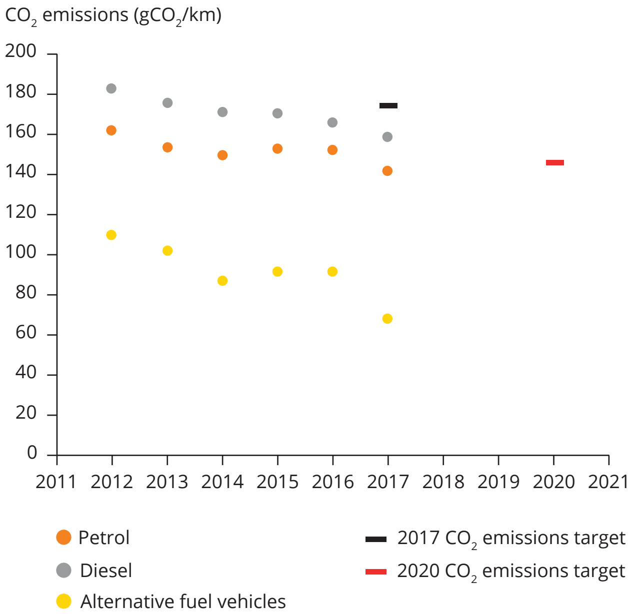
As in previous years, in 2017 diesel vehicles represented the large majority of the fleet (Table 4.1). There were about 13 400 newly registered BEVs, compared with 9 900 registered in 2016. Of the other types of AFVs, LPG and NG are the most frequently sold (around 5 650 and 7 600 vehicles registered, respectively).

Table 4.1 Percentage of fuel type in light commercial vehicles (EU)

Fuel	2012	2013	2014	2015	2016	2017
Diesel	96.5	96.5	96.8	96.7	96.2	95.9
Petrol	1.8	2	2	1.8	1.9	2.4
AFVs	1.7	1.5	1.2	1.5	1.8	1.7

Note: The geographical scope of the data changes over time from EU-27 to EU-28. See Annex 2 for details.

Figure 4.1 Evolution of CO_2 emissions from light commercial vehicles by fuel type in the EU-28



4.2 Average CO_2 emissions

The final data presented here confirm the provisional data published by the EEA earlier in 2018. The average CO_2 emissions from the new light commercial vehicle fleet in the EU-28 in 2017 were 156.1 gCO_2/km, a reduction of 7.5 gCO_2/km from the previous year (163.7 gCO_2/km in 2016). Since the legislation came into force, in 2012, average CO_2 emissions have decreased by 24.1 gCO_2/km, i.e. by an average of 4.8 gCO_2/km per year.

In terms of technologies, the average CO_2 emissions of diesel vehicles decreased by 7.2 gCO_2/km, while the average emissions of petrol decreased by more than 10 gCO_2/km, compared with 2016 (Figure 4.1). In 2017 the average diesel vehicle emitted 158.0 gCO_2/km, about 17 gCO_2/km more than the average petrol vehicle. It should be noted that the proportion of petrol vehicles is particularly small, at around 2 %.

In 2017, the average new light commercial vehicle in the EU-15 emitted 4.2 gCO_2/km less than the average newly registered vehicle in the EU-13. This was the

Table 4.2 Average CO_2 emissions (gCO_2/km) from light commercial vehicles by region

Region	2012	2013	2014	2015	2016	2017
EU	180.2	173.3	169.1	168.3	163.7	156.1
EU-15	180.0	172.9	168.8	167.9	163.3	155.8
EU-13	182.5	178.5	172.2	172.8	168.0	160.0

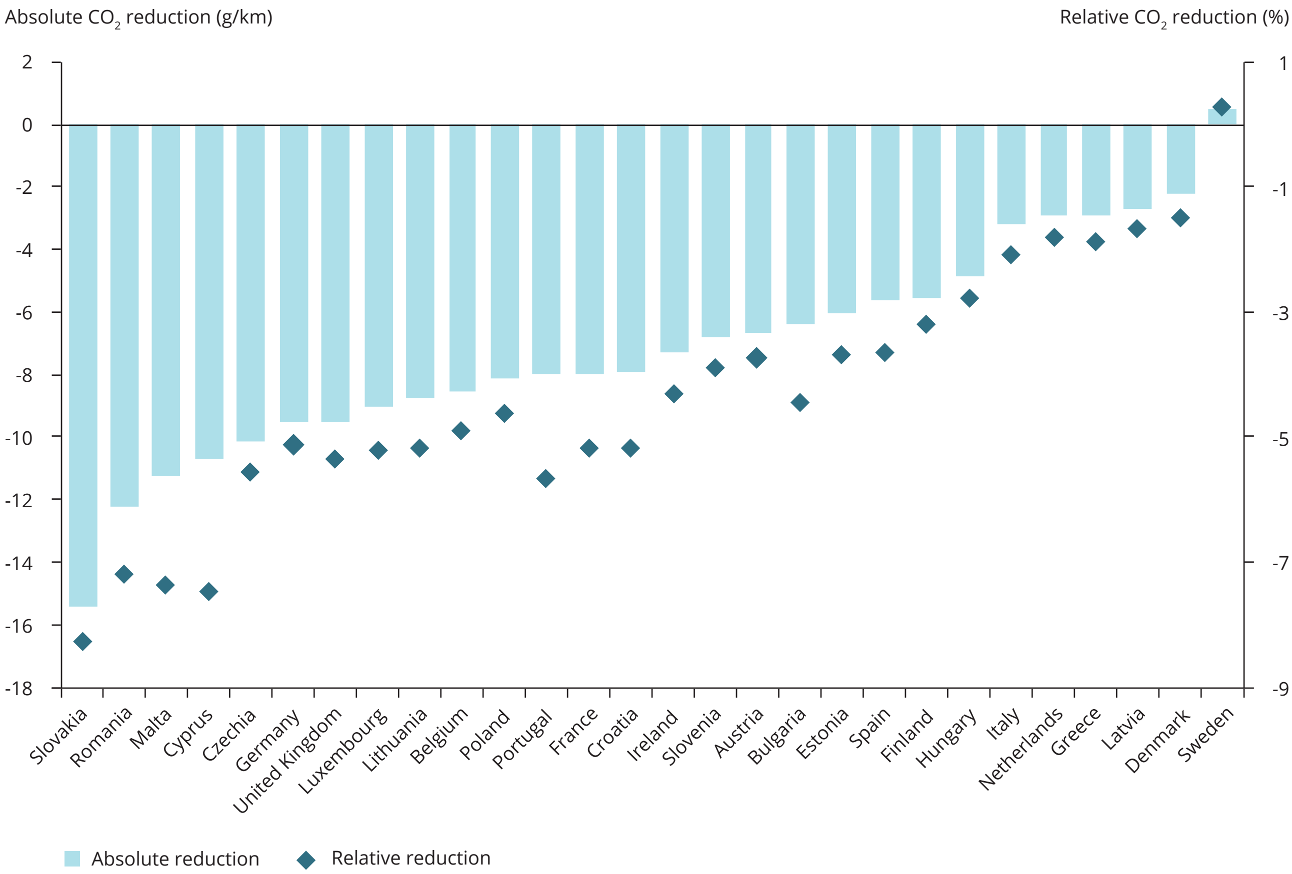
Note: Croatia provided data for 2014, whereas for 2012 and 2013 data for Croatia were not included in the calculations.

second year in which the emissions of the average new light commercial vehicle in the EU-15 and those of the average one in the EU-13 decreased by a similar amount (Table 4.2).

With the exception of Sweden, in which average CO_2 emissions increased by 0.5 gCO_2/km from 2016, in all countries CO_2 emissions from light commercial vehicles fell in 2017 (Figure 4.2). The reductions varied from 2.2 gCO_2/km in Denmark to 15.4 gCO_2/km in Slovakia. Five Member States (Slovakia, Romania, Malta, Cyprus and Czechia) had emission reductions higher than 10 gCO_2/km. For Slovakia, Romania and Malta, the improved efficiency of diesel vehicles is the main reason for their high emission reductions. No major changes were observed in fleet composition or average mass in these countries.

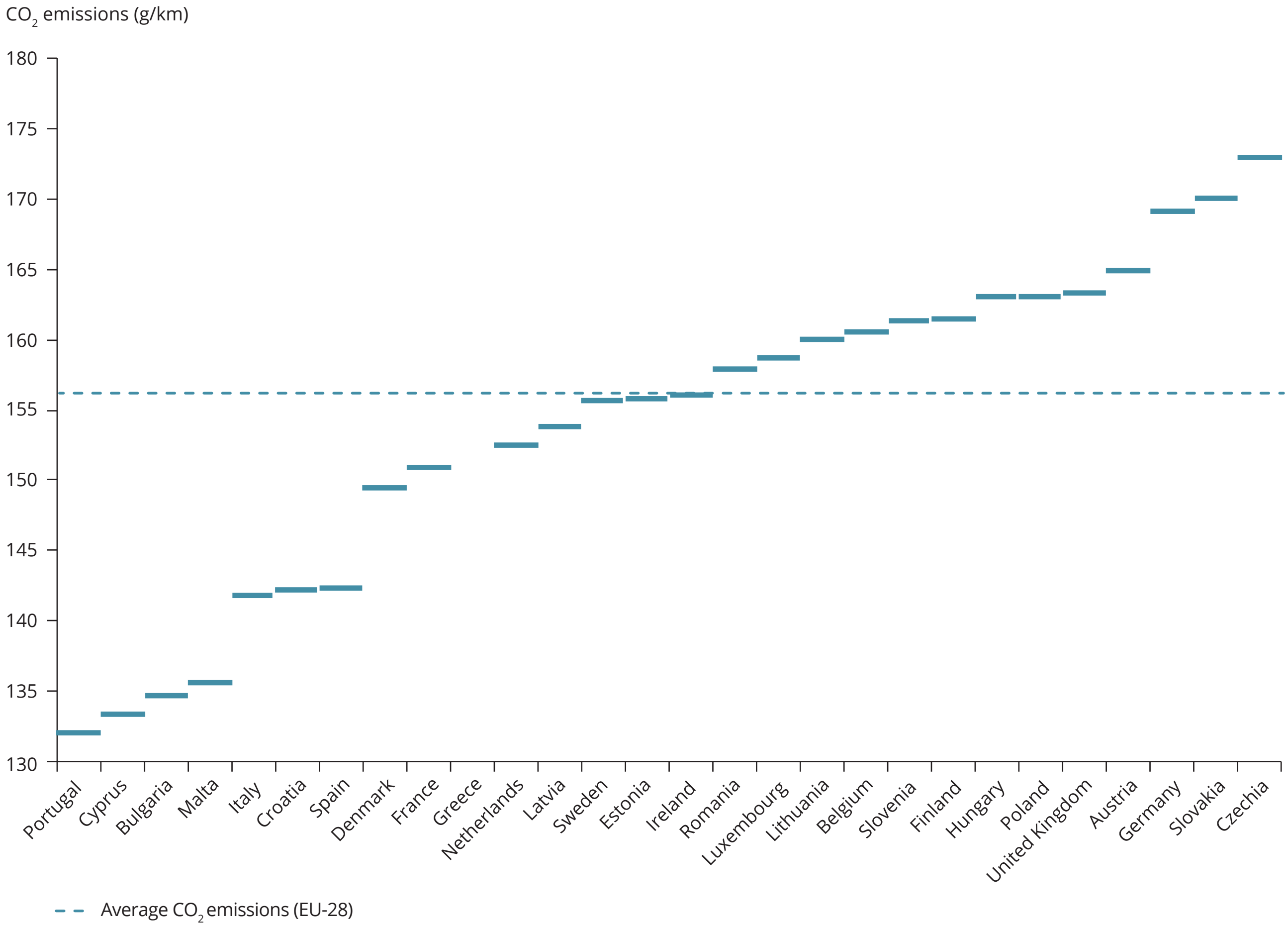
All Member States had average specific CO_2 emissions from newly registered vans already below the 175 gCO_2/km EU target set for 2017 [9] (Figure 4.3). Seventeen of these had emission values below 160 gCO_2/km. Seven of these had emission values below 147 gCO_2/km.

Figure 4.2 Absolute reduction and relative reduction in specific emissions between 2016 and 2017, by Member State



(9) Regulation (EU) No 510/2011 sets an average emission target of 175 gCO_2/km by 2017 for new light commercial vehicles registered in the EU as a whole.

Figure 4.3 Average CO_2 emissions by EU Member State in 2017



Because of their market size, the Member States with higher numbers of vehicle registrations — France, Germany, Italy, Spain and the United Kingdom — are the major contributors to the total reductions in EU-28 CO_2 emissions from light commercial vehicles. Of these five, France, Italy and Spain have the lowest average CO_2 emissions. In Italy, this was for a combination of reasons. Italy, similar to Malta, Portugal and Cyprus, had one of the lowest average engine capacity values (1 713 cm^3, the fourth lowest among EU Member States). In addition, Italy had registered the most AFVs among the EU-28 (4.7 % of all new registrations in Italy). The latter are mainly NG vehicles (51 % of all AFV registrations in Italy) with an average emissions value of 133.9 gCO_2/km, and LPG vehicles (42 % of all AFV registrations) with an average value of 129.6 gCO_2/km. In France and Spain, it seems that the light diesel fleet (153.3 gCO_2/km with an average mass of 1 775 kg for France, and 143.5 gCO_2/km with an average mass of 1 700 kg for Spain) was the main reason for the low CO_2 emissions. In addition, France had a relatively high percentage of battery electric vans (1.5 % of vehicles registered in France), with zero emissions.

4.3 Technical parameters: vehicles technologies, mass, engine capacity and power

The vast majority of registered vans are powered by diesel. In the majority of Member States (except Bulgaria, Estonia and Poland), the proportion of diesel vehicles is above 90 %. For some countries, the proportion is above 99%: Croatia, Ireland, Malta and Portugal.

In the last year, the contribution of petrol vehicles has increased from 1.9 % to 2.4 %, while the contribution of AFVs has stayed constant (1.7 %). The number of newly registered BEVs has increased by 35%, and become the highest contributor to AFVs. Germany registered 36.3 % of BEVs, followed by France (34.5 %) and the United Kingdom (8.5 %).

Regarding the other technical parameters, data show that the mass of vans sold in Europe over the last 5 years grew by 3.2 %, from 1 764 kg to 1 821 kg. The peak was observed in 2012: the mass was 1 834 kg. In 2013 it dropped to 1 764 kg, after which it started to slowly increase until 2017. The mass of a vehicle is one of the most important parameters affecting fuel consumption, as it affects the energy needed to move the vehicle.

There is a clear correlation between the average emissions and the average mass/engine capacity by Member State: higher average mass corresponds to higher average emissions (Figure 4.4 and Figure 4.5). For some Member States (Bulgaria, Portugal, Malta and Cyprus), the low average emissions are mainly related to the registration of relatively small vehicles: the average mass of the new fleet in these countries was below 1 650 kg. Portugal had registered vans with the second lowest average engine capacity in Europe and the second lowest average engine powers. Malta had the lowest average engine capacity value, followed by Portugal and Cyprus. Only three Member States had average CO_2 emissions around 170 gCO_2/km: Czechia, Slovakia and Germany. Their fleets also had high average mass (> 1 920 kg), engine size (> 1 980 cm^3) and power (> 97 kW).

4.4 Average CO_2 emissions per manufacturer in 2017

Table 4.3 presents data (number of registrations, average mass and average emissions) for large van manufacturers that registered more than 10 000 vehicles in 2017. In total these account for 97.3 % of the van fleet. The same table also presents the average emissions of those manufacturers in 2012-2017.

In 2017 the most popular brand was Ford-Werke GmbH, with 15 % of the vans registered in the EU-28. Renault SAS and Volkswagen AG followed, with 14 % and 12 %, respectively.

Eleven manufacturers, representing almost 83 % of the European new van fleet, had average emissions lower than 175 gCO_2/km. The top five of these manufacturers also had the lowest average mass in the group. The

Figure 4.4 Correlation between mass (kg) and CO_2 emissions (gCO_2/km) by Member State

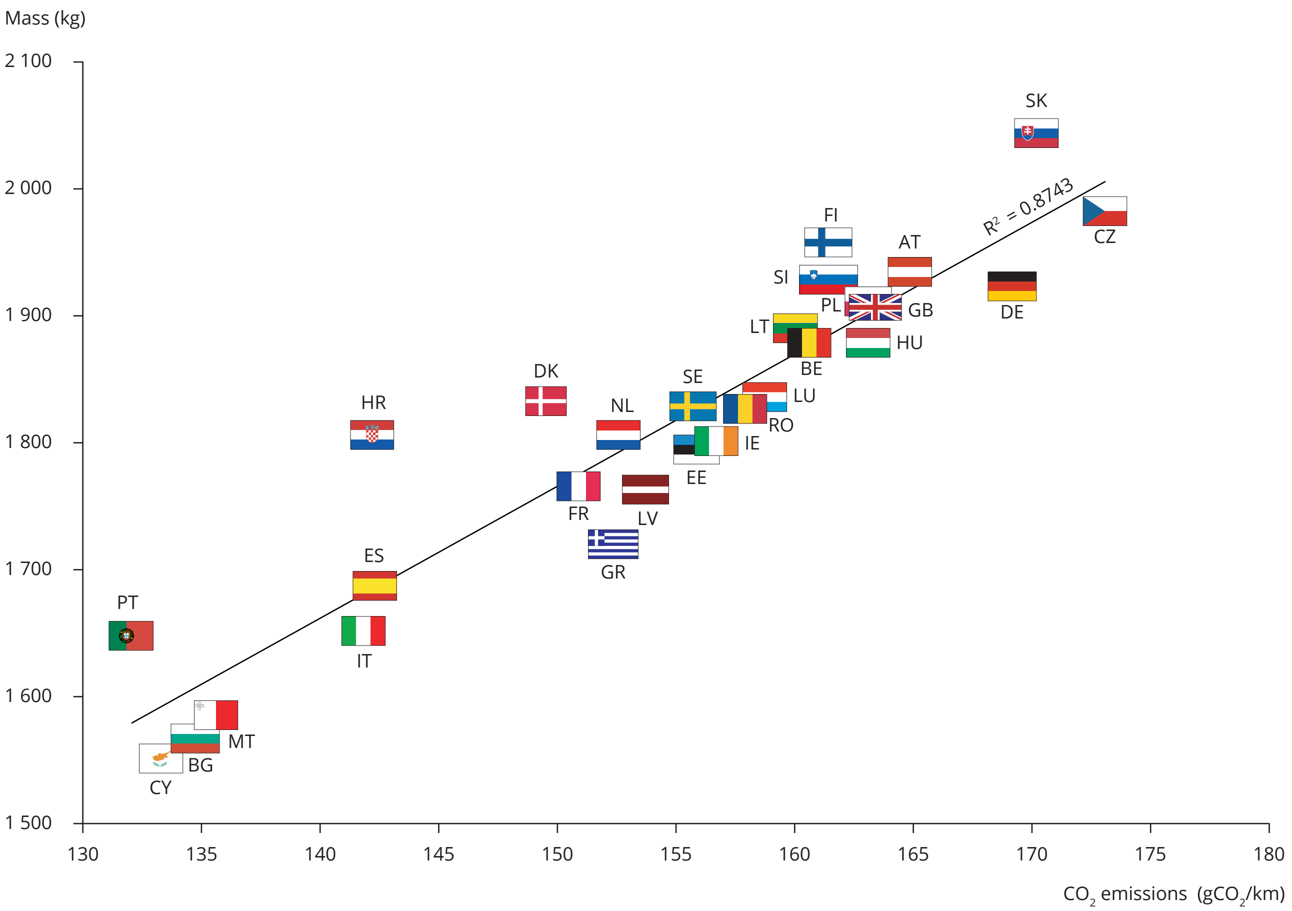
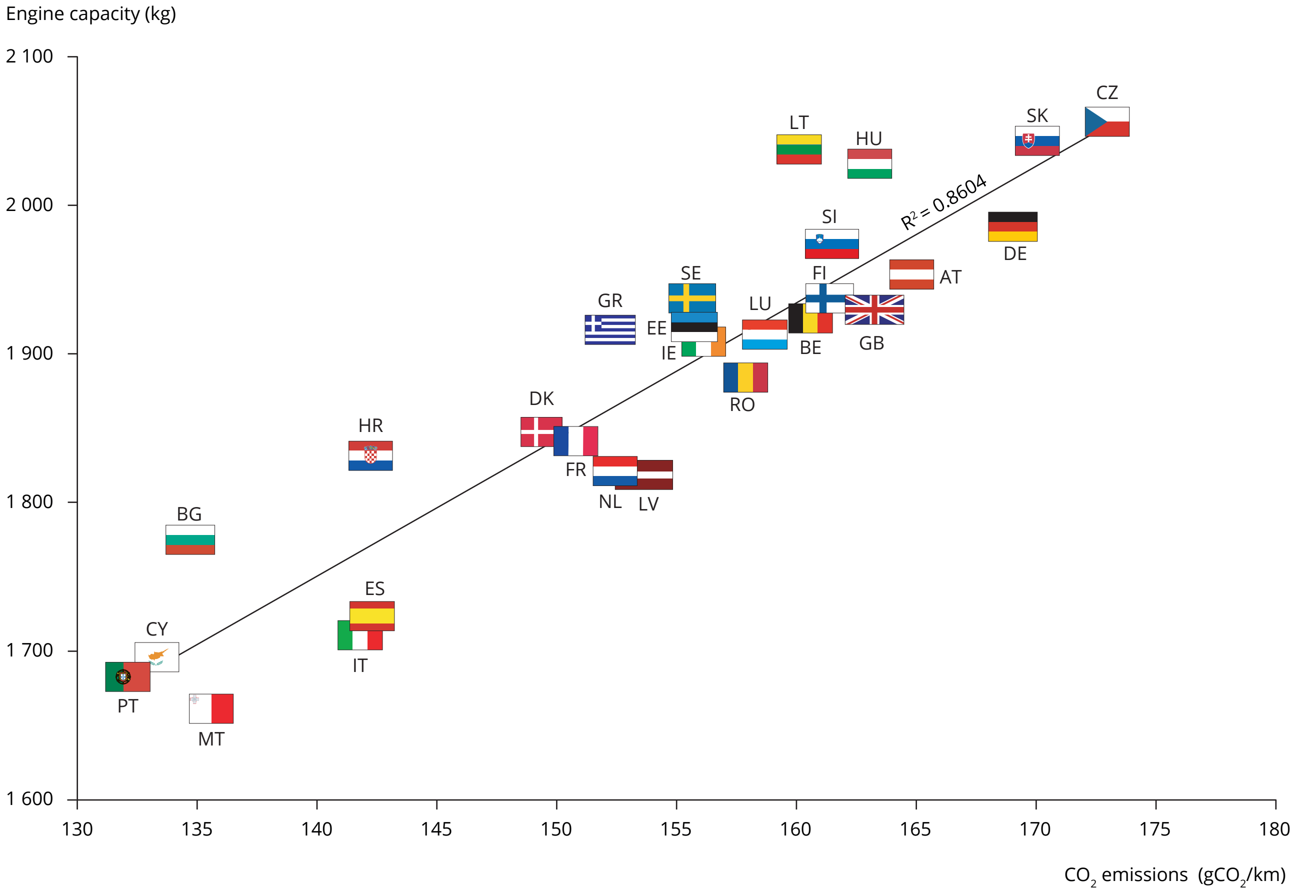


Figure 4.5 Correlation between engine capacity (cm³) and CO_2 emissions (gCO_2/km) by Member State



average emissions for the large manufacturers are in the range of 118-214 gCO_2/km and the average mass values are in the range of 1 278-2 402 kg.

For the fifth year in a row, and by far, Automobile Dacia SA achieved the lowest average CO_2 emissions (118 gCO_2/km), and, as in the previous year, it had the lowest average mass (1 278 kg). In the last 2 years, the emissions level of its fleet has decreased by 15 gCO_2/km.

The next two best-performing manufacturers had similar emission levels, around 132 gCO_2/km. Both of these, Automobile Citroën and Automobile Peugeot, decreased their emissions by more than 14.5 gCO_2/km in the last year, keeping mass at a similar level. The decrease in emissions corresponds to the decrease in the emissions of diesel vehicles. In addition, for both manufacturers, the contribution of BEVs increased in the last year: the number of these vehicles almost doubled.

Over the last 2 years, the Fiat Group has improved its performance: while emissions in the period 2012-2015 were consistently around 158 gCO_2/km, the average emissions in the last 2 years decreased by 4-5 gCO_2/km each year, even though the proportion of AFVs decreased from 6 % in 2016 to 3 % in 2017.

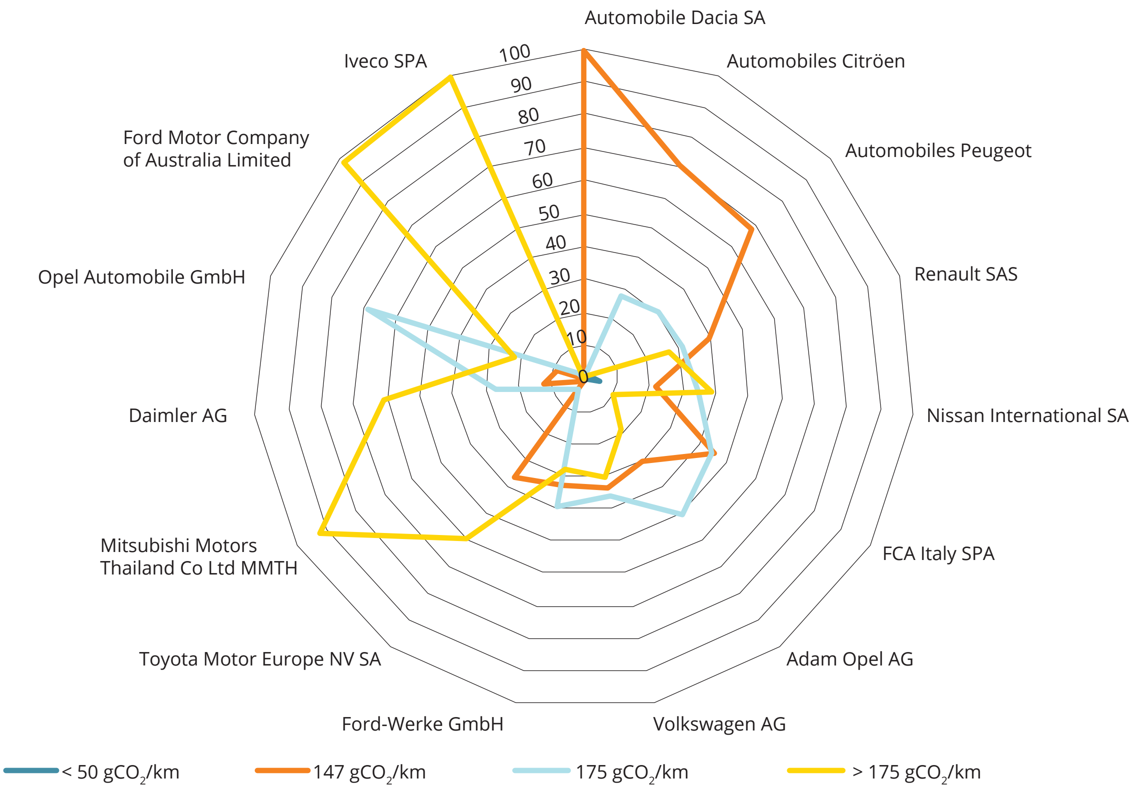
All of the larger manufacturers, except Mitsubishi Motors Thailand and Ford Motor Company of Australia Limited, reduced their average emission levels in 2017 compared with 2016. The largest reductions in average emissions were achieved by Automobile Peugeot (14.7 gCO_2/km), Automobile Citroën and (14.6 gCO_2/km) and Iveco (12.9 gCO_2/km). Since the van emissions legislation came into force, Nissan, Toyota and Ford Werke GmbH have recorded average decreases in emissions of 35.9, 33.5 and 31.6 gCO_2/km, respectively.

The distribution of registrations by emission class (Figure 4.6) shows that fleet composition is very different among manufacturers. For the large majority of manufacturers, low-emitting vehicles (< 50 gCO_2/km) represent a very small percentage: only Renault and Nissan have more of these vehicles, with proportions around 2 % and 5 %,

Table 4.3 **Main specific emission statistics for the vans manufacturers registering more than >10 000 vehicles a year (ordered by average emissions in 2017)**

Manufacturer	Registrations 2017	Average mass (kg) 2017	Average CO_2 (gCO_2/km)					
			2017	2016	2015	2014	2013	2012
Automobile Dacia SA	26 776	1 278	118	124	133	132	132	145
Automobiles Citröen	158 547	1 622	131	146	150	148	153	158
Automobiles Peugeot	170 032	1 647	133	148	151	147	154	159
FCA Italy SPA	143 898	1 704	149	153	158	158	157	157
Renault SAS	223 583	1 733	151	152	148	149	152	171
Ford-Werke GmbH	242 012	1 909	157	169	171	175	189	188
Adam Opel AG	65 552	1 767	160	161	161	173	178	178
Volkswagen AG	192 478	1 861	160	166	181	180	180	185
Nissan International SA	55 160	1 887	163	164	176	184	192	199
Toyota Motor Europe NV SA	38 266	1 935	168	179	188	193	191	202
Opel Automobile GmbH	17 374	1 865	169					
Mitsubishi Motors Thailand Co Ltd MMTH	20 576	1 896	186	179	195	207	207	210
Daimler AG	148 016	2 111	188	188	189	200	205	219
Iveco SPA	23 641	2 402	203	216	219	228	224	230
Ford Motor Company of Australia Limited	38 381	2 268	214	213	236	228	227	228

Figure 4.6 **Distribution of registrations by specific emission classes (%)**



respectively. For three manufacturers (Automobile Dacia SA, Automobiles Citroën and Automobile Peugeot), the proportion of vehicles emitting less than 147 gCO_2/km is higher than 50 %. Compared with 2016, the percentage of vehicles included in between 147 and 175 gCO_2/km has increased for almost all manufactures. There are only six manufacturers for which most of their vehicles emit more than 175 gCO_2/km.

4.5 Distance to the 2017 targets per manufacturer

The distance of the manufacturers to their specific emission targets is calculated by taking into account the modalities listed in Annex 1 (i.e. phase-in, super-credits and eco-innovations).

Based on their average CO_2 emissions in 2017, 35 manufacturers out of 65 achieved individually their specific emission targets for the year 2017. Taking the pools into account, 38 manufacturers out of 65 achieved their targets. Two manufacturers achieved their derogation targets.

Twenty-five manufacturers fall within the scope of the de minimis threshold, according to which manufacturers with fewer than 1 000 registrations are exempt from achieving a specific emission target. These 25 manufacturers constitute fewer than 3 400 vehicles registered in 2017. The data are available in Annex 3.

Figure 4.7 illustrates the distance to target for the 15 manufacturers with more than 10 000 new registered vehicles in 2017.

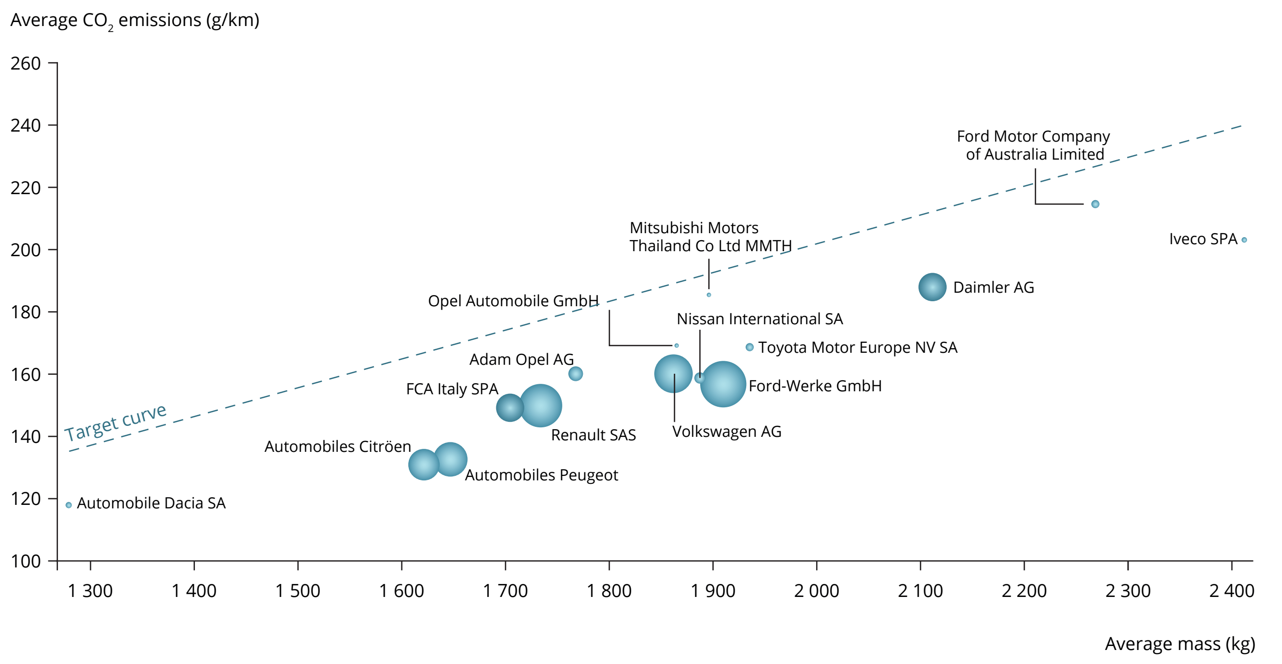
The distance to target for the eight pools of manufacturers is presented in Table 4.4. In 2017, all pools of manufacturers achieved their specific emissions target. A derogation target has been granted for Mitsubishi Motors.

4.6 Distance to the 2020 targets

The distance of the largest manufacturers (i.e. manufacturers registering more than 10 000 vehicles per year) to their 2020 targets is calculated based on the 2017 CO_2 emission data.

Progress towards the target for 2017 is calculated on the basis of the modalities summarised in Annex 1. Manufacturers have 3 more years to further reduce CO_2 emissions and ensure compliance with their targets in 2020.

Figure 4.7 Distance to 2017 target by individual manufacturers (only manufacturers registering > 10 000 vehicles per year in the EU-28)



Note: The size of a bubble is proportional to the number of vehicles registered in Europe.

Table 4.4 Distance to target for the pools in 2017

Pool	Manufacturer	Average emissions (gCO_2/km)	Target (gCO_2/km)	Distance to target (gCO_2/km)
	Daimler AG	188	213	-25
	Mitsubishi Fuso Truck & Bus Corporation	243	265	-22
	Mitsubishi Fuso Truck Europe SA	237	274	-38
	MFTBC	239	265	-26
Daimler AG		**188**	**213**	**-25**
	FCA US LLC	221	201	19
	FCA Italy SPA	149	175	-26
FCA Italy SPA		**149**	**175**	**-26**
	Ford Motor Company of Australia Limited	214	227	-13
	Ford Motor Company	159	199	-40
	Ford-Werke GmbH	157	194	-37
Ford-Werke GmbH		**165**	**198**	**-34**
	General Motors Holdings LLC	163	178	-15
	Adam Opel GmbH	160	181	-21
General Motors		**160**	**181**	**-21**
	Hyundai Motor Company	209	224	-14
	Hyundai Assan Otomotiv Sanayi VE	112	122	-10
	Hyundai Motor Manufacturing Czech SRO	112	147	-35
Hyundai		**207**	**222**	**-15**
	Kia Motors Corporation	124	156	-31
	Kia Motors Slovakia SRO	124	150	-26
Kia		**124**	**155**	**-30**
	Mitsubishi Motors Corporation MMC	184	195	-11
	Mitsubishi Motors Thailand Co Ltd MMTH	186	195	-9
Mitsubishi Motors		**186**	**195**	**-9**
	Avtovaz JSC	216	136	80
	Automobile Dacia SA	118	135	-17
	Renault SAS	150	178	-28
Renault		**146**	**173**	**-27**
	Audi AG	134	179	-46
	Man Truck & Bus AG	198	220	-22
	Dr Ing Hcf Porsche AG	187	206	-19
	Seat SA	109	129	-19
	Skoda Auto AS	111	133	-23
	Volkswagen AG	160	189	-29
VW Group PC		**159**	**188**	**-29**

All manufacturers appear well on track to reach the 2020 targets (Figure 4.8). Some of them have already achieved the 2020 target: Automobile Peugeot, Automobile Citroën, Ford-Werke GmbH and Iveco. Manufacturers such as Nissan International, Volkswagen AG and Toyota Motor Europe are already very close to their 2020 targets; they still need to reduce their average emissions by less than 5 gCO_2/km in the next 3 years. Other manufacturers will have to make further progress to achieve their 2020 targets.

Figure 4.9 presents the manufacturers' progress in terms of annual percentage changes for two periods: the observer rate (2012-2017) and the expected reductions for respecting the 2020 target set by the regulation (2017-2020). For the manufacturers for which additional reductions have to be in place, the rate of progress required from now until 2020 is generally much lower than, or comparable with, the rate that has been achieved in the 5 years since Regulation (EU) No 510/2011 came into force.

Figure 4.8 **Van manufacturers' progress towards meeting the 2020 targets**

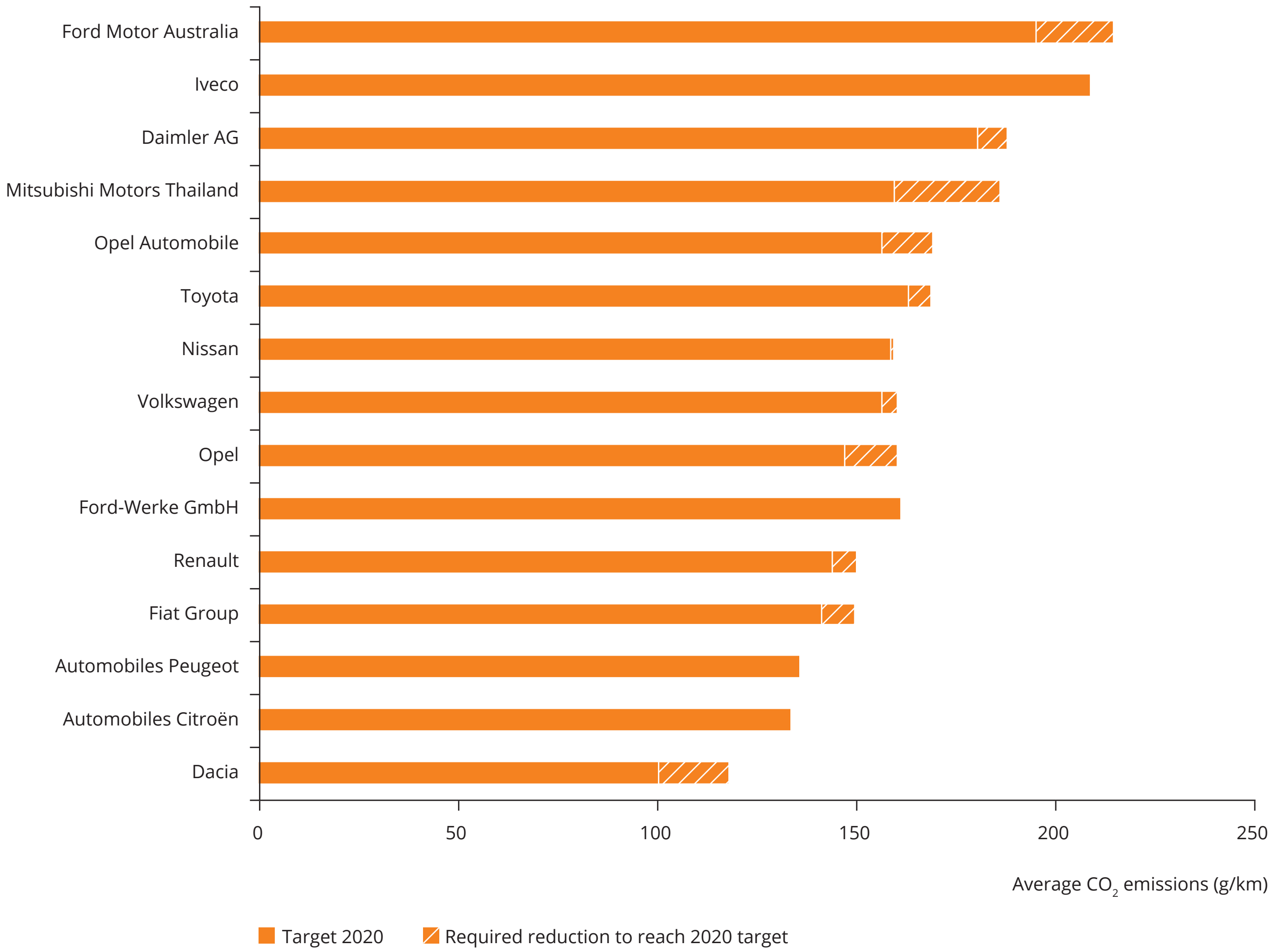
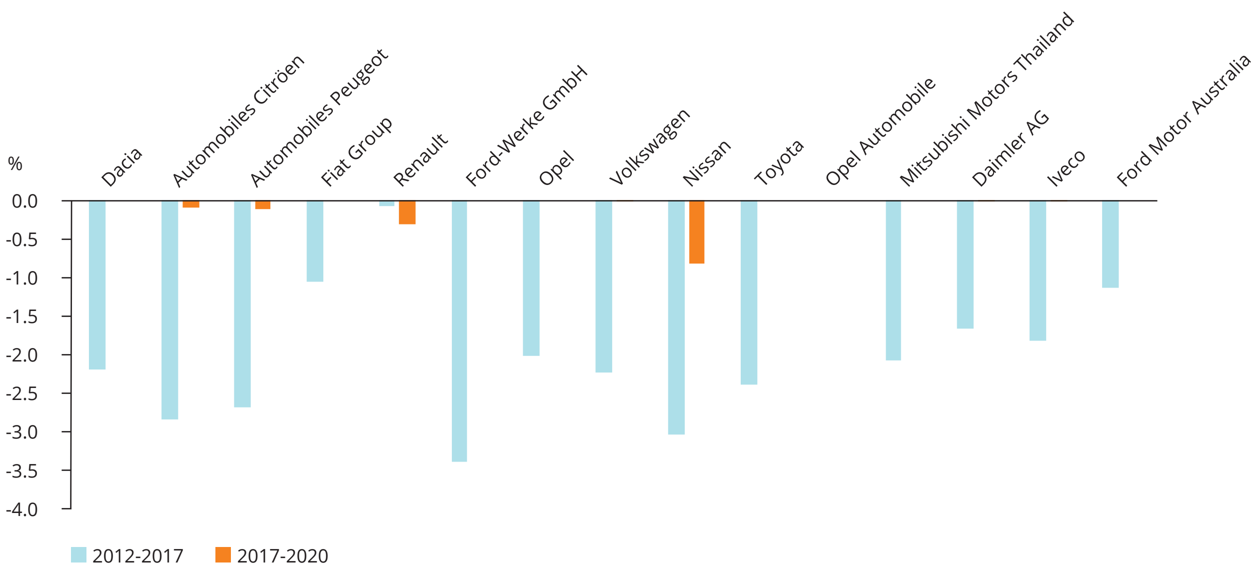


Figure 4.9 **Comparison of past and future progress towards meeting the 2020 targets**

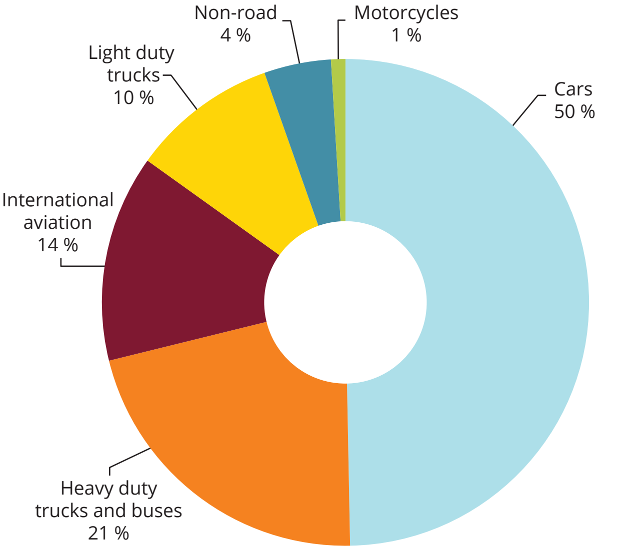


5 Exploring the reasons for changes in total CO_2 emissions from passenger cars

5.1 Trends in CO_2 emissions from transport in the EU

From 1990 to 2016, CO_2 emissions decreased in all main sectors of the EU economy except transport. Compared with 1990, transport emissions (including international aviation) increased by 27 % during the period. Road transport CO_2 emissions increased for the third year in a row, confirming the upwards trend in emissions that started in 2014. In 2016, the transport sector contributed more than 29 % of all CO_2 emissions. Most emissions originate from road transport (82 %), whereas emissions from domestic aviation and navigation each contribute only 1.5-2 % to the total emissions from transport. The remaining 14 % come from international aviation (Figure 5.1). In 2016, passenger cars were responsible of 61 % of road transport emissions, followed by heavy-duty vehicles (HDVs) with 26 % (Figure 5.2). Vans emitted only 12 %.

Figure 5.1 Contributions of different modes of transport to EU transport CO_2 emissions in 2016



Source: EEA, 2018b.

5.2 Main emission drivers

To better understand the trend in CO_2 emissions from passenger cars and to identify the factors that most affect it, a decomposition analysis has been carried out.

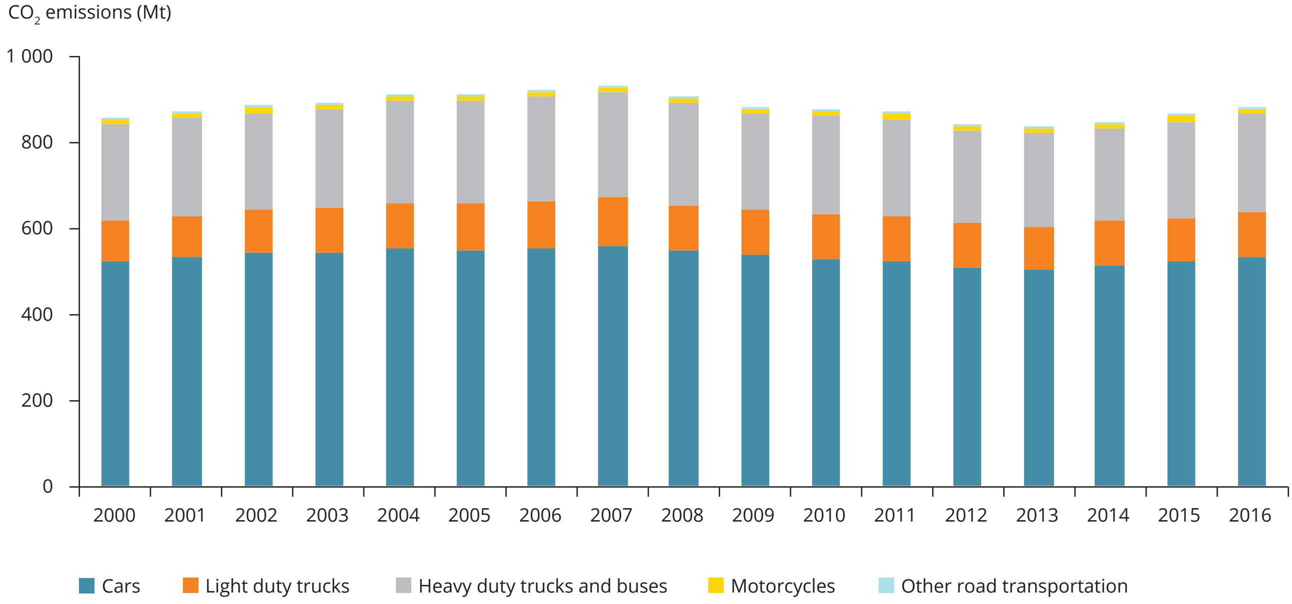
A decomposition analysis is often used to illustrate the contributions that different factors have made to CO_2 emissions over time.

An equation linking the observed emissions to the selected factors is first specified. These factors are typically chosen as those likely to have had a significant impact on emissions over the period considered, and for which data are available.

Following the same logic applied in the previous EEA study (EEA, 2015), the selected explanatory factors (Figure 5.3) used for the CO_2 decomposition analysis were:

- Passenger transport demand (passenger-kilometre or tonne-kilometre): this is expressed as the product of the distance a vehicle travels and the number of occupants (passengers) travelling that distance (EC, 2017).
- Proportion of passenger car transport in total passenger transport: this represents the changes in modal split over the years considered, i.e. the proportion of passenger cars in total passenger transport (EC, 2017).
- Improvements in energy efficiency: this is the total fuel consumption from passenger cars per passenger-kilometre (EEA, 2016a).
- Development of transport biofuels: this is the fossil fuel consumption (i.e. all fuels but biofuels) from passenger cars as the proportion of total fuel consumption (EEA, 2016a). For this decomposition, biofuels are assumed to be emission neutral.
- Carbon intensity of fossil fuels: this is defined as the amount of CO_2 emitted per unit of fossil fuel consumed by passenger cars.

Figure 5.2 CO_2 emissions from the road transport sector in the EU-28, 2000-2016



Source: EEA, 2018b.

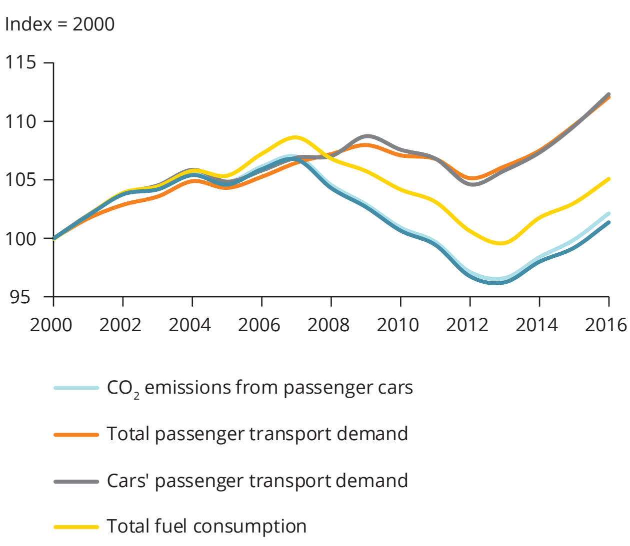
To determine the corresponding contributions of these drivers, CO_2 emissions are decomposed into a sum of the individual changes attributed to each driver. The effect of a certain driver is quantified by calculating the effect of a change in this driver on the total CO_2 emissions, independently of the other drivers. The sum of all effects of the drivers should be equivalent to the overall change in CO_2 emissions.

The formula used for the analysis is based on the logarithmic mean Divisia index method and it has been applied to emissions from road passenger transport. It is based on Ang (2004) and Ang (2005) and described there in detail:

[ln]CO_2 = [ln]PKMa + [ln]PKMc/PKMa + ln]FUEL/PKMc + ln]FF/FUEL + [ln]CO_2/FF

Where:
CO_2 is the carbon dioxide emissions from cars
PKMa is the passenger-kilometres by competing modes (inland modes)
PKMc/PKMa is the passenger-kilometres by cars divided by the passenger-kilometres by competing modes
FUEL/PKMc is the total fuel consumption from cars per passenger-kilometre
FF/FUEL is the fossil fuel consumption from cars (i.e. all fuels but biofuels) in the total fuel consumption
CO_2/FF is the CO_2 emissions per fossil fuel.

Figure 5.3 Drivers of CO_2 emissions from passenger cars in the EU, 2000-2016



Sources: EC, 2017; EEA, 2016a; EEA, 2018b.

The results of the decomposition analysis for passenger car CO_2 emissions are shown in Figure 5.4 and Figure 5.5.

It is clear that passenger car demand has been the main factor contributing to the trend in CO_2 emissions since 2010: when transport demand decreases, the emissions follow. As soon as the transport demand starts to increase, the emissions increase.

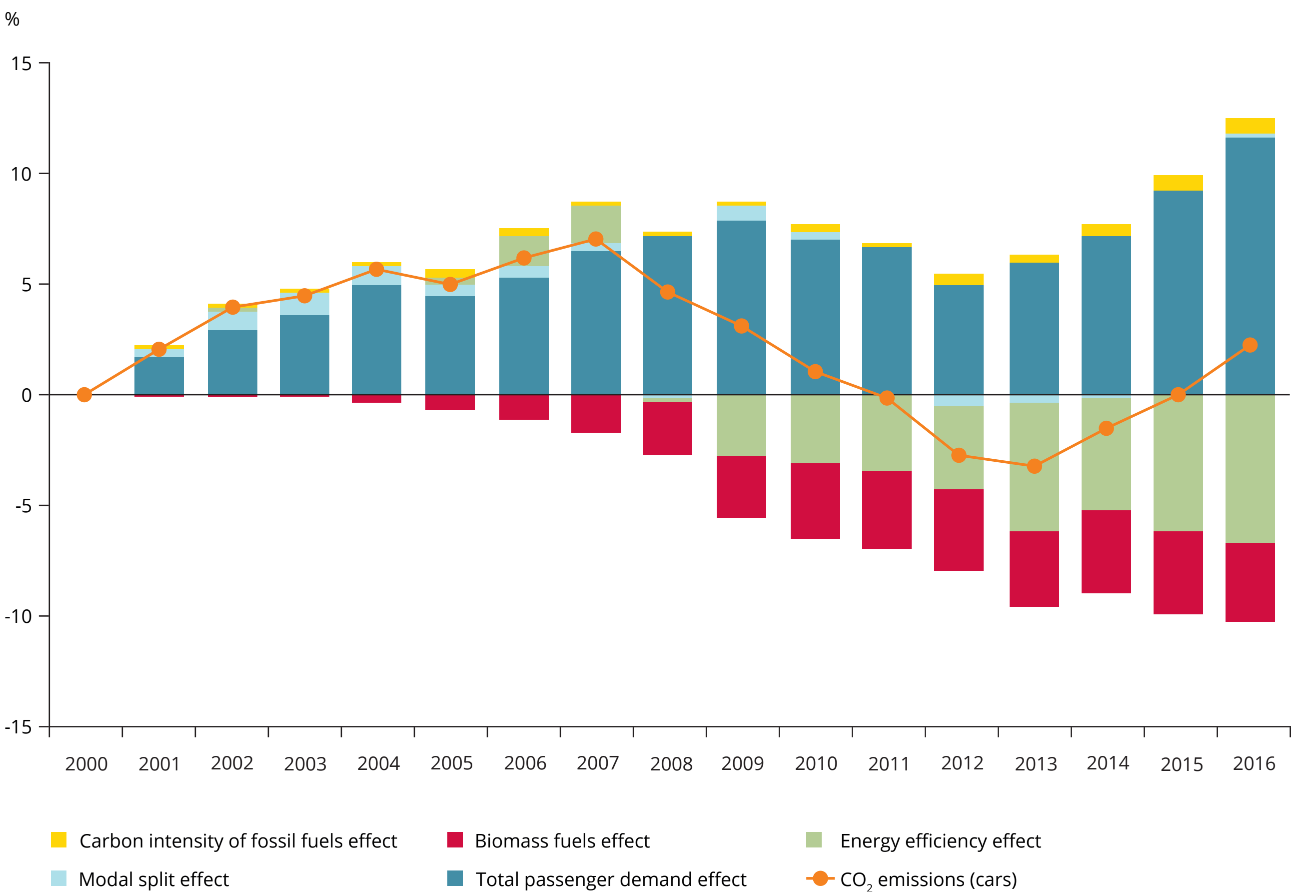
The improvements in passenger car energy efficiency have been a factor in the reduction in CO_2 emissions since 2009, the year in which Regulation (EC) 443/2009 came into force. Although the car manufacturers signed a voluntary agreement to reduce CO_2 emissions before this regulation was introduced, little reduction in emissions arising from improvements in vehicle efficiency was observed during that time. Compared with 2000, the reduction of total CO_2 emissions from passenger cars due to efficiency improvements is around 6.7 %. The biggest changes were observed between 2009 and 2013. In the last few years (2014-2016), the contribution has been more or less stable.

The carbon intensity of fossil fuels pushes the emissions up because diesel's carbon content per unit of energy is higher than that of petrol (as the former emits more CO_2 per unit of energy). In addition, the number of diesel vehicles increased over the period.

On the other hand, the increased number of diesel vehicles (19 % in 2000, 44 % in 2016) lowered CO_2 emissions, as diesel cars need less energy than petrol ones to drive the same distance.

The increase in transport biofuels was also relevant in the first period: since 2005, the use of biofuels started to increase significantly, thereby contributing to decreasing emissions of CO_2 from passenger cars. In the last few years, there has been no change in the

Figure 5.4 **Decomposition analysis in the EU — percentage contribution**



Sources: EC, 2017; EEA, 2016a; EEA, 2018b.

use of transport biofuels, which decreased the impact that this factor had on passenger car emissions.

Modal shift had a minor effect on the entire period.

5.3 Technologies affecting CO_2 emissions

This section examines the main trends and the major technologies that have emerged in the passenger car sector in the recent past and influenced CO_2 emissions either positively or negatively:

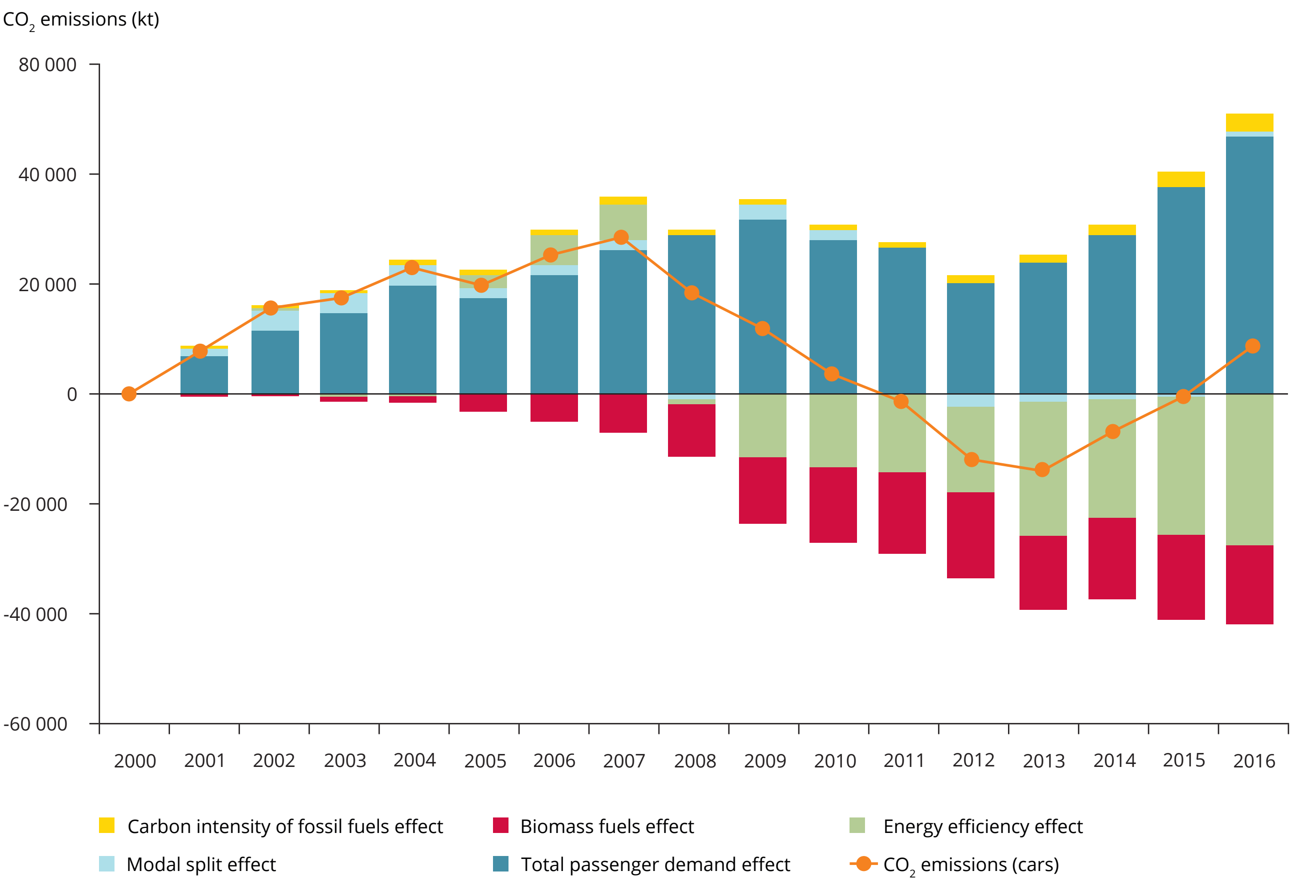
- downsizing;
- electrification of the fleet;
- lightweight design;
- SUVs market;
- dieselisation.

One of the most important strategies followed to comply with stringent emissions regulations enforced in the EU automotive market was the replacement of bigger engines with compact ones or, in other words, engine downsizing. These compact engines can both provide the power needed and reduce fuel consumption, despite being smaller (Patil, et al., 2017).

The increased performance in a downsized engine is achieved by adding a forced aspiration device (turbocharger or supercharger) accompanied by other engine technologies such as direct injection technology or variable valve timing (VVT). The major advantages of a direct injection engine are increased fuel efficiency and high-power output. VVT is the process of altering the timing of a valve lift event, and is often used to improve performance, fuel economy and emissions.

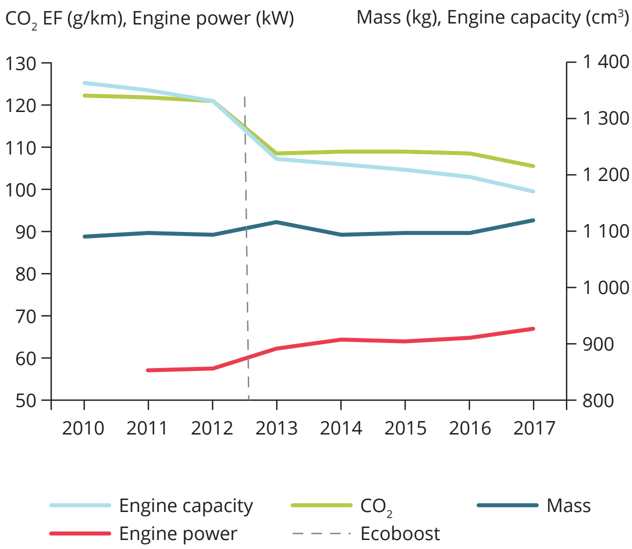
To examine how the engine downsizing design technique has influenced passenger cars over the years, the example of a popular model, Ford Fiesta, is presented in Figure 5.6.

Figure 5.5 Decomposition analysis in the EU — absolute contribution



Sources: EC, 2017; EEA, 2016a; EEA, 2018b.

Figure 5.6 Evolution of average parameters of Ford Fiesta



Until 2012, all parameters were stable. In 2013, the first Fiesta Ecoboost engines were introduced. Ecoboost is Ford's commercial name for vehicles to which engine downsizing has been applied. It is obvious that, in 2013, both CO_2 emissions and engine capacity were greatly reduced, whereas the engine power was increased. After 2014, there was a smoother increase in power and reduction in engine capacity and CO_2 emissions.

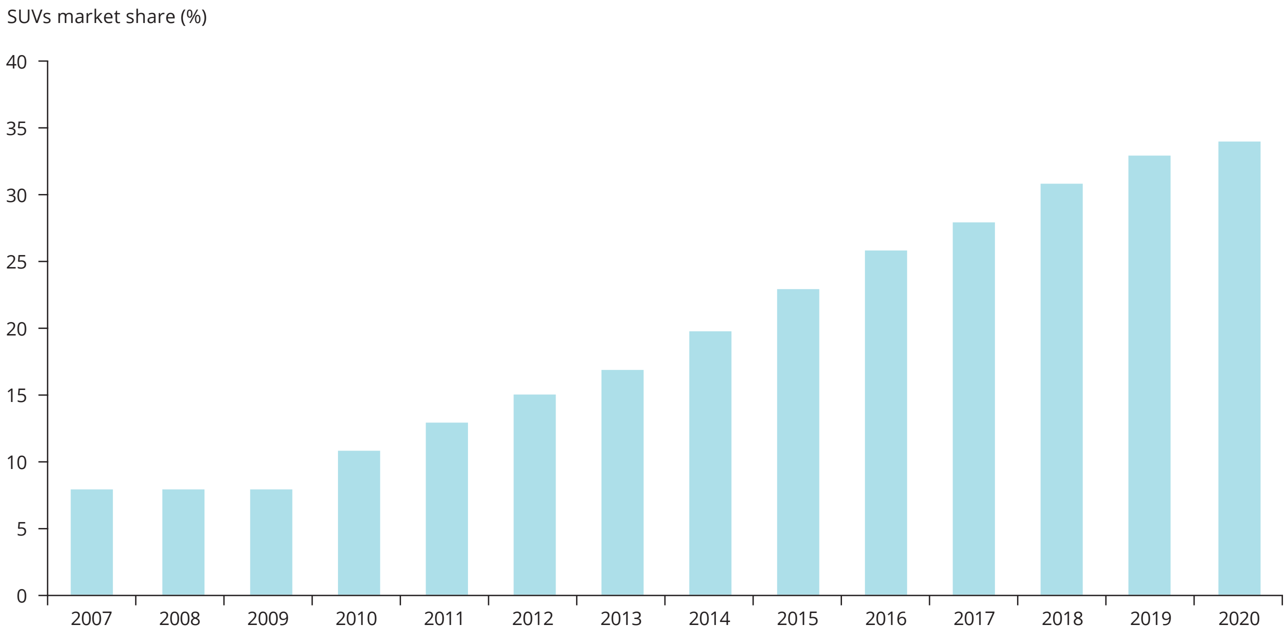
Lightweight design has been at the forefront of the automotive industry's attempt to reduce fuel consumption and, consequently, CO_2 emissions.

For example, the Opel Astra 2015 is up to 200 kg lighter than its predecessor as a result of its lightweight architecture; 77 kg was saved from the increased use of high- and ultra-high-strength steel and from new manufacturing processes on the body structure. Figure 5.7 shows how the overall weight reduction of the vehicle was achieved (Romain, 2018).

Similarly, the Audi Q7 2015 is up to 325 kg lighter than its predecessor. The body, which is made of a mix of lightweight materials, saves up to 71 kg. The doors, which are made of aluminium, contribute an additional saving of 24 kg. Audi carried out an interesting life cycle analysis for both the new lightweight model and the predecessor model. Based essentially on the low weight, the new Audi Q7 has been able to reduce its life cycle GHG emissions (from production to recycling after 200 000 km) by 16 %, compared with the previous model.

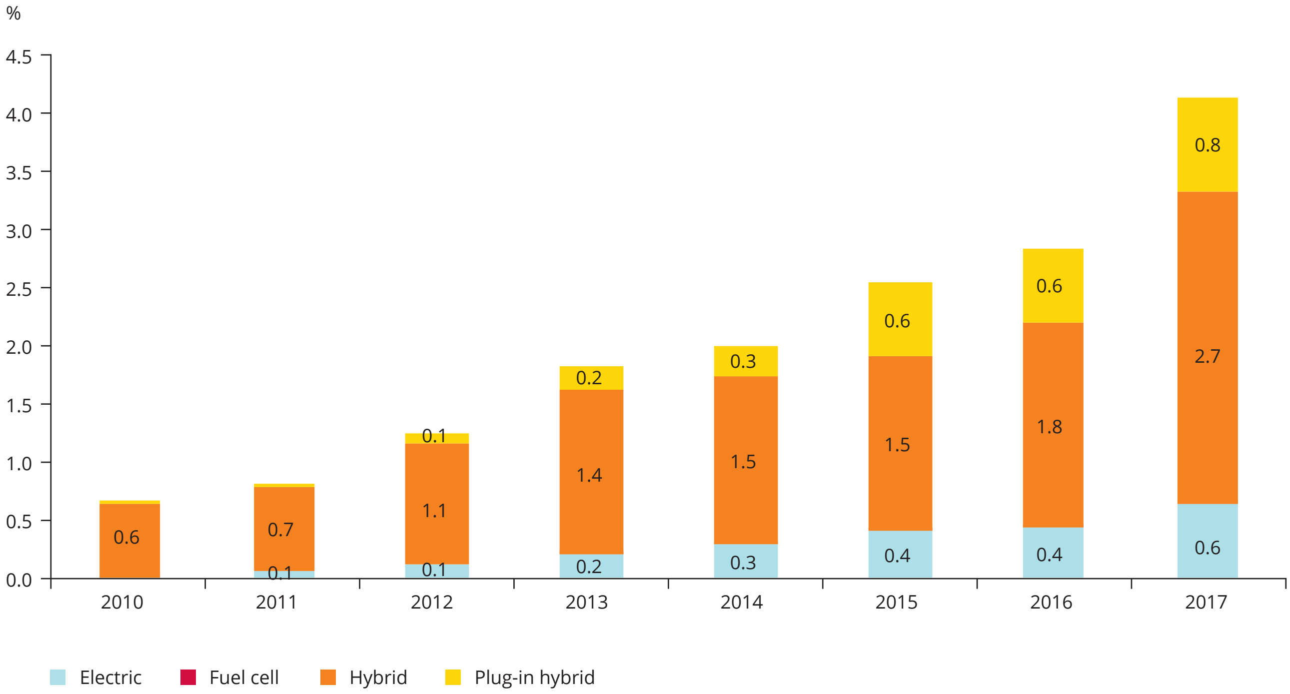
In Europe, SUVs accounted for 26 % of all passenger car sales in 2016 (Figure 5.7), whereas in 2007 they represented only 8 % of the new passenger car market, according to JATO (Munoz, 2018). In addition, according to the LMC Automotive forecast, this strong upwards trend is expected to continue, reaching as many as 34 % of all passenger car sales in 2020 (LMC, 2018). However, an issue arises from these booming SUV

Figure 5.7 SUVs market share for 2007-2016 and forecast until 2020



Sources: LMC, 2018; Munoz, 2018.

Figure 5.8 Market share of electric vehicles



sales. In comparison with other car types, SUVs have characteristics such as large frontal areas and high drag coefficients that have a negative impact on vehicle performance and fuel consumption and can weaken efforts to reduce CO_2 emissions.

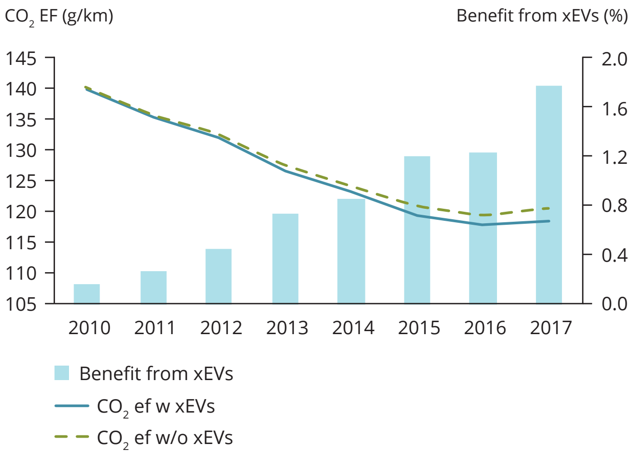
Stop/start has been one of the fastest-growing technologies in Europe. It is estimated that the market share of new vehicles with stop/start technology exceeded 70 % in 2016 (ICCT, 2018). The concept of the stop/start system is simple. It automatically turns off the engine when the vehicle is stopped to reduce fuel consumption and eliminate idle emissions. It then restarts the engine automatically when the driver releases the brake pedal. This technology reduces fuel consumption during city driving by 4-10 %, or more, depending on the extent to which the technology is used and the specific driving conditions.

Electric vehicles (EVs) are currently a 'hot topic' in the effort to reduce emissions of CO_2 and other pollutants such as NO_x (nitrogen oxides) and PM (particulate matter), particularly in urban area. Manufacturers have ambitious plans to roll out more and more electric models in the near future, but for now the market share of EVs remains very small. The term EV includes the following categories:

- HEV (hybrid electric vehicle);
- PHEV (plug-in hybrid electric vehicle);
- BEV (battery electric vehicle);
- FCEV (fuel cell electric vehicles.

In 2010, all EVs did not account for more than 1 %. However, more EVs were introduced over the following years, ending up accounting for over 4 % of the market share in 2017. In that year, HEVs reached 2.7 % of the total market. PHEVs and BEVs have also increased over the years, but reached only 0.8 % and 0.6 % of the total

Figure 5.9 **CO_2 emissions with and without electric vehicles**



market, respectively. Finally, only a few FCEVs have been sold, showing that this technology is still at an early stage.

Figure 5.9 shows the average CO_2 emissions including and excluding electric vehicles. The gap between the two lines increases over the years, resulting in an absolute difference of 2.2 gCO_2/km (or 1.8 %) in 2017.

There are differences in the market shares of EVs among Member States: countries with robust incentives for EVs also had an increased share of EVs, while in countries with no significant incentives the sales of EVs remained low (EEA, 2018a). This suggests that, until these technologies become more mature and competitive with conventional internal combustion powertrains, the introduction of EVs into the fleet is more dependent on external factors such as political decisions.

6 References

ACEA, 2018, 'From NEDC to WLTP: what will change?' (http://wltpfacts.eu/from-nedc-to-wltp-change) accessed 28 September 2018.

Ang, B. W., 2004, 'Decomposition analysis for policymaking in energy: which is the preferred method?', *Energy Policy* 32, pp. 1131-1139.

Ang, B. W., 2005, 'The LMDI approach to decomposition analysis: a practical guide', *Energy Policy*, 33, pp. 867-871.

EC, 2017, *Statistical pocketbook 2017 — Mobility and transport.*

EEA, 2015, *Evaluating 15 years of transport and environmental policy integration — TERM 2015: Transport indicators tracking progress towards environmental targets in Europe*, EEA Report 7/2015, European Environment Agency.

EEA, 2016a, *Annual European Union greenhouse gas inventory 1990-2014 and inventory report 2016*, EEA Report 15/2016, European Environment Agency.

EEA, 2016b, *Explaining road transport emissions — A non-technical guide*, EEA Report, European Environment Agency.

EEA, 2018a, 'Appropriate taxes and incentives do affect purchases of new cars' (https://www.eea.europa.eu/themes/transport/vehicles-taxation/appropriate-taxes-and-incentives-do) accessed 1 October 2018.

EEA, 2018b, 'EEA greenhouse gas — data viewer' (https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer) accessed 2 October 2018.

EU, 2000, Decision No 1753/2000/EC of the European Parliament and of the Council of 22 June 2000 establishing a scheme to monitor the average specific emissions of CO_2 from new passenger cars.

EU, 2009, Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles, OJ L 140, 5.6.2009, pp. 1-15.

EU, 2011, Regulation (EU) No 510/2011 of the European Parliament and of the Council of 11 May 2011 setting emission performance standards for new light commercial vehicles as part of the Union's integrated approach to reduce CO_2 emissions from light-duty vehicles, OJ L 145, 31.5.2011, pp. 1-18.

EU, 2014a, Regulation (EU) No 253/2014 of the European Parliament and of the Council of 26 February 2014 amending Regulation (EU) No 510/2011 to define the modalities for reaching the 2020 target to reduce CO_2 emissions from new light commercial vehicles Text with EEA relevance.

EU, 2014b, Regulation (EU) No 333/2014 of the European Parliament and of the Council of 11 March 2014 amending Regulation (EC) No 443/2009 to define the modalities for reaching the 2020 target to reduce CO_2 emissions from new passenger cars.

Fontaras, G., Zacharof, N. and Cuiffo, B., 2017, 'Fuel consumption and CO_2 emissions from passenger cars in Europe — Laboratory versus real-world emissions', *Progress in Energy and Combustion* Science 60, pp. 97-131.

ICCT, 2018, *European vehicle market statistics, pocketbook 2017/18*, International Council on Clean Transportation, Berlin, Germany.

JRC, 2018, 'CO2MPAS: Vehicle simulator predicting NEDC CO2 emissions from WLTP — CO2MPAS 2.0.0+9.g5b3144d documentation' (https://co2mpas.io) accessed 26 September 2018.

LMC, 2018, 'Automotive sales, production, powertrain forecasting' (https://lmc-auto.com) accessed 1 October 2018.

Munoz, F., 2018, 'The global domination of SUVs continues in 2017' (https://www.jato.com/global-domination-suvs-continues-2017/) accessed 1 October 2018.

Patil, C., Varade, S. and Wadkar, S., 2017, 'A review of engine downsizing and its effects', *International Journal of Current Engineering and Technology* Special Issue 7, pp. 319-324.

Romain, 2018, 'The new Opel Astra lightweight design: 200 kg lighter than its predecessor' (http://www.car-engineer.com/the-new-opel-astra-lightweight-design-200-kg-lighter-than-its-predecessor) accessed 26 October 2018.

Annex 1 Monitoring system for passenger cars and vans

Since 2010 the EEA has collected data about passenger cars registered in all EU Member States. Since 2013 the EEA has also collected data about vans. For both cars and vans, the same time scale applies for data monitoring:

- Member States record information for each new passenger car and van registered in its territory and transmit this information to the Commission by 28 February of each year. Data are submitted to the Central Data Repository (CDR ([10])), managed by the EEA.
- For vans only, manufacturers submit the vehicle identification number for each new van sold in the EU-28 to the Commission by 28 February of each year. Data are submitted to the Business Data Repository (BDR ([11])), managed by the EEA.
- The EEA performs several quality checks to evaluate the accuracy and quality of the data sets. On the basis of the checks and the feedback from Member States, the EEA finalises and publishes the provisional database. At the same time, notification letters are sent to manufacturers informing them of their provisional CO_2 performances.
- Manufacturers can, within 3 months of being notified of the provisional calculation, notify the Commission of any errors in the data.
- The EEA and the European Commission assess the manufacturers' corrections, and, where justified, take them into account for the calculation of the manufacturers' final average CO_2 emissions and specific emission targets. The final data and targets are to be published by 31 October each year.

In the remainder of this annex, the process is described in further detail.

Data quality

The EEA performs several quality checks to evaluate the accuracy and quality of Member States' data. These checks cover the following:

- The completeness rate. This has two main components. The first concerns numerical data such as vehicle mass and emission values for each vehicle. The second measures the extent to which more granular data — such as model type — are available for each vehicle that has been registered.
- Data plausibility and outliers ([12]).
- Assignment to a specific manufacturer using a harmonised denomination. Identical vehicles are often sold under different brand or model names in different countries. For the purposes of monitoring, one naming system is used to ensure correct manufacturer attribution.
- Data variability (for the same vehicle, an estimate of the variability of the mass, emissions and engine capacity was developed).
- Fuel type classification.
- Handling of unknown individual vehicle approvals (IVAs) and national small series (NSS) vehicles ([13]).
- For vans, a comparison between the vehicle identification number (VIN) ([14]) provided by Member

([10]) The CDR is like a bookshelf, with data reports on the environment as submitted by Member States (more information is available at http://cdr.eionet.europa.eu).
([11]) The BDR is an electronic online reporting system specifically developed for handling confidential company-based information (more information is available at http://bdr.eionet.europa.eu).
([12]) An outlier observation is well outside the expected range of values in a study or experiment, and is often discarded from the data set.
([13]) IVAs are made on vehicles imported from third countries or on own-build vehicles that have to be individually approved. NSS vehicles are vehicles that are approved nationally in very small numbers, typically because they are made by smaller manufacturers.
([14]) The VIN is a unique code, including a serial number, used by the automotive industry to identify individual motor vehicles as defined in ISO 3833.

States and that provided by manufacturers. Whenever VINs are matching but data are missing in a Member State's submission, the manufacturer's data ([15]) will be used to complete the data set for the main parameters (emission- and mass-related entries).

After these quality checks, the provisional database is finalised. Based on the provisional database, the EEA calculates the provisional performance of car and van manufacturers in meeting their CO_2 emission targets. The performance is calculated as the difference between the average CO_2 specific emissions and the specific emission target for each manufacturer. The Commission notifies each manufacturer (and pool) of the provisional calculations and the provisional data are published on the EEA website.

Manufacturers can notify the Commission of errors in the provisional CO_2 emission data set. The notification must be submitted within 3 months from the notification of the provisional calculations.

As it does for Members States' data, the EEA performs several quality checks to evaluate the accuracy and the quality of the data that have been corrected in the notification of errors. The verification process is very similar to the one performed for Member States' data presented in the previous paragraphs. After this additional quality check, the database is finalised.

Based on the final data, the EEA calculates the performance of car and van manufacturers in meeting their CO_2 emission targets. The performance is calculated as the difference between the average CO_2 specific emissions and the specific emission target for each manufacturer. The Commission notifies each manufacturer (and pool) of the final calculations and the provisional data are published on the EEA website.

Calculation of average CO_2 specific emissions

Average specific CO_2 emissions are calculated as a weighted average of the manufacturer's fleet registered in a particular year. The average specific emissions for each manufacturer are subsequently adjusted to take into account the following modalities (summarised in Table A1.1):

- phase-in;
- super-credits;
- eco-innovations.

Phase-in

A phase-in schedule applies for calculating average specific emissions for cars only: the 2021 specific emission targets will be phased in from 2020 taking into account 95 % of the best-performing cars in that year. From 2021, 100 % of new cars from each manufacturer will be taken into account.

Super-credits

The regulation provides for the allocation of super-credits for new passenger cars and new vans with CO_2 emissions lower than 50 gCO_2/km. These vehicles are temporarily given a greater weight when calculating the average specific emissions, as they are considered to have the following equivalences:

- For passenger cars: the super-credit weight factor will become 2 cars in 2020, 1.67 cars in 2021 and 1.33 cars in 2022. In the period 2020-2022, the use of super-credits will be subject to a cap of 7.5 gCO_2/km for each manufacturer.

- For vans: 1.5 vans in 2017. For the duration of the super-credit scheme, the maximum number of vans per manufacturer to be taken into account for the application of the super-credit multipliers will not exceed 25 000. For the period 2018-2019, no super-credits will be taken into account. In the period 2020-2022, the use of super-credits will be subject to a cap of 7.5 gCO_2/km for each manufacturer.

Eco-innovations

Certain innovative technologies cannot demonstrate their CO_2-reducing effects under the current type-approval test procedure, but they produce real-world CO_2 savings. To support technical development, a manufacturer or supplier can apply to the Commission for the approval of such innovative technologies. The approval conditions are set out

([15]) In addition to VINs, manufacturers may submit detailed monitoring data for the vehicles registered.

in Commission Regulation (EU) No 725/2011. If a manufacturer fits its car fleet with an approved eco-innovation, the average emissions of that manufacturer may be reduced by a maximum of 7 gCO_2/km. In 2017, 25 eco-innovations were approved: 16 were granted to component suppliers and 9 were granted to car manufacturers.

Calculation of specific emission targets

Under the regulation, each manufacturer has an individual annual target, calculated on the basis of the overall target and the average 'mass in running order' ([16]) of registered cars/vans. The following formulae apply to passenger cars (1) and vans (2) until 2020:

Passenger cars: Specific emissions of CO_2 = $130 + a \times (M - M_0)$ (1)

Vans: Specific emissions of CO_2 = $175 + a \times (M - M_0)$ (2)

where:

M is the average mass of the manufacturer's fleet in kilograms;

$\boldsymbol{M_0}$ is the reference mass (initially 1 392.4 kg for passenger cars and 1 706.0 kg for vans);

a is 0.0457 for passenger cars and 0.093 for vans.

This means that, for example, if the average mass of a manufacturer's newly registered passenger car fleet in a given year is 1 392.4 kg, the target for that manufacturer is 130.0 gCO_2/km.

If the average mass of the newly registered passenger car fleet is 1 492.4 kg, the target for that manufacturer is 134.57 gCO_2/km. If the average mass of the newly registered passenger car fleet is 1 292.4 kg, the target will be 125.43 gCO_2/km.

The manufacturer complies with its specific emission target if its average specific emissions (taking into account all the relevant modalities as described above) are lower than the target.

Regulation (EU) No 333/2014 (EU, 2014b) amended Regulation (EC) No 443/2009 with a view to defining the modalities for reaching the 2020 target to reduce CO_2 emissions from new passenger cars. The 95 gCO_2/km target, set in the previous regulation, was confirmed and the following formula will apply to passenger cars from 2020:

Specific emissions of CO_2 = $95 + a \times (M - M_0)$ (3)

where:

M is the average mass of the manufacturer's fleet in kilograms;

$\boldsymbol{M_0}$ is the reference mass (see above);

a is 0.0333.

For vans, Regulation (EU) No 253/2014 (EU, 2014a) amended Regulation (EU) No 510/2011 with a view to defining the modalities for reaching the 2020 target to reduce CO_2 emissions from new vans. The target of 147 gCO_2/km, set in the previous regulation, was confirmed and the following formula will apply from 2020:

Specific emissions of CO_2 = $147 + a \times (M - M_0)$ (4)

where:

M is the average mass of the manufacturer's fleet in kilograms;

$\boldsymbol{M_0}$ is the reference mass (see above);

a is 0.096.

Manufacturers may form a pool with other manufacturers to have a common target. In this case, the binding target will be the pool target (calculated on the basis of the whole fleet of the pool registered that year). In 2017, 13 pools for passenger cars (Table A1.2) and nine pools for vans (Table A1.3) were declared.

For passenger cars, manufacturers selling fewer than 10 000 vehicles per year can apply for a small-volume derogation. In this case, a specific emission target can be granted consistent with the manufacturer's

([16]) According to Regulation (EC) No 443/2009, mass in running order means the mass of the car with bodywork, coolant, oils, fuel, spare wheel, tools and driver as stated in the certificate of conformity and defined in Section 2.6 of Annex I to Directive 2007/46/EC.

economic and technological potential to reduce specific CO_2 emissions. In 2017, 18 manufacturers benefited from a small-volume derogation target (Table A1.4).

For vans, five manufacturers benefited from a derogation target (Table A1.5)

Niche derogations are provided for manufacturers responsible for between 10 000 and 300 000 new vehicle registrations. In this case, a special target is established, corresponding to a 25 % reduction from the average specific emissions of that manufacturer in 2007 for the period 2012-2019 and a 45 % reduction from the 2007 level as of 2020. In 2017, four niche derogations were granted for passenger cars (Table A1.6).

A manufacturer who, together with all of its connected undertakings, is responsible for fewer than 1 000 new registered cars may be exempt from meeting a specific emission target pursuant to Regulation (EC) No 443/2009 and Regulation (EU) No 510/2011, as amended by Regulation (EU) No 333/2014 and Regulation (EU) No 253/2014. In 2015, 33 manufacturers, responsible for a total of around 5 500 registrations, benefited from an exemption (21 for passenger cars and 25 for vans).

Table A1.1 Summary of the modalities applying to the calculation of manufacturer performance for the period 2017-2024

Modality	Vehicles	2017	2018-2019	2020	2021	2022	2023-2024
Phase-in (%)	Passenger cars	100	100	95	100	100	100
	Vans	100	100	100	100	100	100
Super-credit for vehicle emitting less than 50 gCO_2/km	Passenger cars	1	1	2	1.67	1.33	1
	Vans	1.5	1	1	1	1	1

Table A1.2 Manufacturers' pools in 2017 (passenger cars)

Pool	Manufacturer
BMW Group	Bayerische Motoren Werke AG
	BMW M GmbH
	Rolls-Royce Motor Cars Ltd
Daimler AG	Daimler AG
	Mercedes-AMG GmbH
FCA Italy SPA	Alfa Romeo SPA
	FCA US LLC
	FCA Italy SPA
Ford-Werke GmbH	CNG-Technik GmbH
	Ford India Private Limited
	Ford Motor Company of Australia Limited
	Ford Motor Company
	Ford-Werke GmbH
General Motors	Chevrolet Italia SPA
	General Motors Holdings LLC
	GM Korea Company
	Adam Opel AG
Honda Motor Europe Ltd	Honda Automobile China Co Ltd
	Honda Motor Co Ltd
	Honda Turkiye AS
	Honda Automobile Thailand Co Ltd
	Honda of the UK Manufacturing Ltd
Hyundai	Hyundai Motor Company
	Hyundai Assan Otomotiv Sanayi VE Ticaret AS
	Hyundai Motor Manufacturing Czech SRO
	Hyundai Motor Europe GmbH
	Hyundai Motor India Ltd
Kia	Kia Motors Corporation
	Kia Motors Slovakia SRO
Mitsubishi Motors	Mitsubishi Motors Corporation MMC
	Mitsubishi Motors Europe BV MME
	Mitsubishi Motors Thailand Co Ltd MMTH
Renault	Avtovaz JSC
	Automobile Dacia SA
	Renault SAS
Suzuki	Magyar Suzuki Corporation Ltd
	Maruti Suzuki India Ltd
	Suzuki Motor Corporation
	Suzuki Motor Thailand Co Ltd
Tata Motors Ltd, Jaguar Cars Ltd, Land Rover	Jaguar Land Rover Limited
	Tata Motors Limited
VW Group Pc	Audi AG
	Audi Hungaria Motor KFT
	Bugatti Automobiles SAS
	Man Truck & Bus AG
	Dr Ing HCF Porsche AG
	Quattro GmbH
	Seat SA
	Skoda Auto AS
	Volkswagen AG

Table A1. 3 Manufacturers' pools in 2017 (vans)

Pool	Manufacturer
Daimler	Daimler AG
	Mitsubishi Fuso Truck & Bus Corporation
	Mitsubishi Fuso Truck Europe SA
	MFTBC
FCA Italy SPA	FCA US LLC
	FCA Italy SPA
Ford-Werke GmbH	CNG-Technik GmbH
	Ford India Private Limited
	Ford Motor Company of Australia Limited
	Ford Motor Company
	Ford-Werke GmbH
General Motors	Chevrolet Italia SPA
	General Motors Company
	GM Korea Company
	Adam Opel AG
Hyundai	Hyundai Motor Company
	Hyundai Assan Otomotiv Sanayi VE Ticaret AS
	Hyundai Motor Manufacturing Czech SRO
Kia	Kia Motors Corporation
	Kia Motors Slovakia SRO
Mitsubishi Motors	Mitsubishi Motors Corporation MMC
	Mitsubishi Motors Europe BV MME
	Mitsubishi Motors Thailand Co Ltd MMTH
Renault	Avtovaz JSC
	Automobile Dacia SA
	Lada France SAS
	Renault SAS
Volkswagen Group LCV	Audi AG
	Audi Hungaria Motor KFT
	Bentley Motors Ltd
	Bugatti Automobiles SAS
	Automobili Lamborghini SPA
	Dr Ing HCF Porsche AG
	Quattro GmbH
	Seat SA
	Skoda Auto AS
	Volkswagen AG

Table A1. 4 Manufacturers with low volume derogations granted for 2017 (passenger cars)

Manufacturer	Specific emissions targets in gCO_2/km
Alpina Burkard Bovensiepen GmbH e Co KG	220
Artega	215
Aston Martin Lagonda Ltd	299
Automobili Lamborghini SPA	316
Bentley Motors Ltd	287
Donkervoort Automobielen BV	178
DR Motor Company SRL	125
Ferrari SPA	290
Lotus Cars Limited	225
Maserati SPA	242
McLaren Automotive Limited	270
MG Motor UK Limited	146
Noble Automotive Ltd	338
Pagani Automobili SPA	340
Perusahaan Otomobil Nasional SDN BHD	158
Radical Motorsport Ltd	198
Secma SAS	131
Zoyte	156

Note: This table includes all manufacturers that benefited from a small-volume derogation target even if they did not sell any vehicles in 2017.

Table A1. 5 Manufacturers with derogations granted for 2017 (vans)

Manufacturer	Specific emission target (gCO_2/km)
Gonow Auto Co Ltd	175
Great wall Motor Company Limited	198
Mitsubishi Motors Pool	195
Piaggio & C. SPA	155
Ssangyong Motor Company	210

Note: This table includes all manufacturers that benefited from a small volume derogation target even if they did not sell any vehicles in 2017.

Table A1.6 Niche derogations granted for 2017 (passenger cars)

Manufacturer/Pool	Specific emissions targets in gCO_2/km
Subaru Corporation	164 616
Tata Motors Ltd, Jaguar Cars Land Rover	178 025
Mazda Motor Corporation	129 426
Suzuki Pool	123 114
Ssangyong Motor Company	167 573

Excess emission premiums

If a manufacturer's or a pool's average specific CO_2 emissions exceed the specific emission target, both Regulation (EC) No 443/2009 and Regulation (EU) No 510/2011 require the payment of an excess emission premium. This premium is calculated by multiplying the following three elements:

- the distance to the emission target in a given year (in gCO_2/km), i.e. the excess emissions;
- the number of vehicles registered by the manufacturer during that year;
- the premium level, included in Table A1.1

The premium amounts to EUR 5 for the first gram of CO_2/km of exceedance, EUR 15 for the second, EUR 25 for the third and EUR 95 for each subsequent gram. A higher distance to the target therefore implies a higher excess premium per gram of CO_2/km emitted.

For example, if a manufacturer registers 100 000 vehicles in the EU, the formula to be used for calculating the excess emission premium varies depending on the distance to the target as follows:

- If the distance to the target is 0.5 gCO_2/km, the first formula in Table A1.1 applies and the excess emission premium = 0.5 × 5 × 100 000 = EUR 250 000.
- If the distance to the target is 1.5 gCO_2/km, the second formula in Table A1.1 applies and the excess emission premium = (1 × 5 + (1.5 - 1) × 15) × 100 000 = EUR 1 250 000.
- If the distance to the target is 2.5 gCO_2/km, the third formula in Table A1.1 applies and the excess emission premium = (1 × 5 + 1 × 15 + (2.5 - 2) × 25) × 100 000 = EUR 3 250 000.
- If the distance to the target is 3.5 gCO_2/km, the fourth formula in Table A1.1 applies and the excess emission premium = (1 × 5 + 1 × 15 + 1 × 25 + (3.5 - 3) × 95) × 100 000 = EUR 9 250 000.

From 2019, the cost will be EUR 95 from the first gram of exceedance onwards.

Table A1.7 Coefficients to be used in the formula for calculating excess emission premium

Excess emissions (gCO_2/km)	Fine (EUR)				Number of vehicles	Formula for calculating excess emission premium (EUR)
	5	15	25	95		
0-1	(EE)	-	-	-	NV	((EE) * 5)*NV
1-2	1	(EE-1)	-	-	NV	(1*5 + (EE-1)*15)*NV
2-3	1	1	(EE-2)	-	NV	(1*5 + 1*15 + (EE-2)*25)*NV
> 3	1	1	1	(EE-3)	NV	(1*5 + 1*15 + 1*25 + (EE-3)*95)*NV

Note: EE, distance from target or excess emission; NV, number of vehicles registered.

Annex 2 Country statistics

Table A2.1 Registration of new passenger cars by Member State (in thousands)

Member State	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Austria	295	280	300	311	308	309	298	294	319	328	356	335	319	303	308	329	353
Belgium	497	468	459	485	480	526	525	536	475	551	577	490	490	485	503	541	548
Bulgaria	-	-	-	-	-	-	86	91	21	14	14	14	15	16	17	20	26
Croatia	-	-	-	-	-	-	-	-	-	-	-	-	28	35	36	45	48
Cyprus	-	-	-	20	18	20	25	24	16	15	15	11	7	8	9	12	13
Czechia	-	-	-	115	105	107	126	134	159	165	169	170	162	179	227	214	221
Denmark	97	113	102	124	147	154	160	148	111	151	170	171	184	188	204	221	220
Estonia	-	-	-	17	20	25	31	24	10	10	17	19	20	21	21	23	26
Finland	106	113	145	141	146	143	123	137	89	109	122	107	100	103	106	115	114
France	2 228	2 120	1 988	1 996	2 059	1 986	2 050	2 037	2 259	2 250	2 174	1 932	1 827	1 838	2 011	2 167	2 256
Germany	3 342	3 122	3 237	3 267	3 319	3 445	3 126	3 067	3 786	2 873	2 933	3 062	2 930	3 012	3 177	3 316	3 377
Greece	245	242	203	264	274	279	294	279	221	140	97	57	58	71	76	79	88
Hungary	-	-	-	230	199	193	167	163	66	43	47	52	55	68	77	95	107
Ireland	117	152	146	154	171	177	186	151	56	89	90	73	74	96	123	146	129
Italy	2 430	2 278	2 244	2 264	2 237	2 325	2 494	2 163	2 160	1 954	1 745	1 402	1 304	1 351	1 573	1 823	1 965
Latvia	-	-	-	11	16	25	31	19	5	6	10	10	10	12	14	15	15
Lithuania	-	-	-	9	11	15	21	22	7	7	12	12	12	14	17	20	25
Luxembourg	22	44	44	48	49	51	51	52	47	50	50	49	46	49	46	49	52
Malta	-	-	-	4	7	6	6	5	6	4	6	6	6	6	7	7	8
Netherlands	526	507	487	479	452	478	494	493	396	480	554	500	416	384	438	378	412
Poland	-	-	-	297	230	223	264	305	221	219	275	274	288	304	354	417	430
Portugal	-	232	194	202	208	199	204	215	159	223	154	96	105	142	179	207	222
Romania	-	-	-	-	-	-	313	286	115	94	82	66	57	70	81	95	107
Slovakia	-	-	-	-	45	65	65	57	70	65	69	70	66	74	78	89	97
Slovenia	-	-	-	37	64	62	69	72	60	60	55	50	51	54	53	53	60
Spain	400	969	1 319	1 606	1 640	1 622	1 606	1 165	964	976	810	704	732	895	1 076	1 185	1 286
Sweden	223	249	257	260	269	278	300	248	209	277	289	263	252	297	338	364	369
United Kingdom	2 232	2 611	2 558	2 512	2 386	2 295	2 390	2 112	1 968	2 026	1 937	2 036	2 254	2 467	2 623	2 687	2 533
Iceland																	21
Norway																	158

Table A2.2 Average mass (kg) of new passenger cars by Member State (in kg)

Member State	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Austria	1 314	1 335	1 426	1 432	1 435	1 449	1 445	1 431	1 385	1 409	1 442	1 453	1 448	1 446	1 459	1 467	1 431
Belgium	1 288	1 319	1 361	1 375	1 396	1 407	1 423	1 425	1 406	1 406	1 416	1 439	1 421	1 415	1 418	1 413	1 419
Bulgaria	-	-	-	-	-	-	-	-	-	1 454	1 462	1 485	1 475	1 424	1 408	1 402	1 410
Croatia	-	-	-	-	-	-	-	-	-	-	-	-	1 309	1 307	1 326	1 336	1 333
Cyprus	-	-	-	1 205	1 277	1 316	1 354	1 372	1 367	1 388	1 377	1 370	1 367	1 391	1 395	1 408	1 417
Czechia	-	-	-	1 704	1 242	1 247	1 261	1 275	1 335	1 380	1 368	1 368	1 370	1 364	1 374	1 352	1 385
Denmark	-	1 306	1 325	1 327	1 324	1 328	1 370	1 320	1 313	1 335	1 312	1 248	1 227	1 216	1 227	1 261	1 274
Estonia	-	-	-	1 349	1 408	1 433	1 465	1 456	1 471	1 473	1 502	1 514	1 508	1 474	1 456	1 463	1 464
Finland	1 752	1 759	1 336	1 355	1 381	1 401	1 437	1 442	1 447	1 426	1 452	1 455	1 445	1 440	1 421	1 422	1 434
France	1 254	1 280	1 305	1 327	1 341	1 349	1 375	1 387	1 326	1 326	1 343	1 385	1 350	1 310	1 315	1 322	1 323
Germany	1 332	1 352	1 381	1 408	1 412	1 424	1 433	1 425	1 347	1 433	1 460	1 466	1 448	1 443	1 447	1 453	1 454
Greece	1 172	1 223	1 262	1 277	1 287	1 304	1 314	1 311	1 423	1 252	1 231	1 242	1 243	1 240	1 250	1 250	1 242
Hungary	-	-	-	1 182	1 203	1 237	1 264	1 288	1 330	1 370	1 396	1 390	1 401	1 398	1 394	1 369	1 370
Ireland	1 248	1 276	1 265	1 314	1 341	1 372	1 441	1 440	1 440	1 380	1 378	1 420	1 397	1 410	1 393	1 385	1 378
Italy	1 604	1 632	1 649	1 259	1 277	1 294	1 287	1 285	1 255	1 269	1 306	1 311	1 314	1 307	1 305	1 307	1 312
Latvia	-	-	-	1 452	1 445	1 468	1 502	1 498	1 535	1 522	1 543	1 563	1 552	1 519	1 491	1 438	1 474
Lithuania	-	-	-	1 433	1 448	1 483	1 481	1 467	1 486	1 481	1 498	1 497	1 486	1 435	1 423	1 412	1 406
Luxembourg	1 834	1 851	1 442	1 471	1 487	1 504	1 498	1 490	1 462	1 473	1 519	1 528	1 505	1 488	1 495	1 497	1 503
Malta	-	-	-	-	-	-	-	1 317	1 182	1 200	1 216	1 465	1 212	1 199	1 206	1 216	1 213
Netherlands	1 260	1 264	1 301	1 314	1 337	1 332	1 350	1 324	1 295	1 254	1 249	1 266	1 288	1 285	1 323	1 300	1 284
Poland	-	-	-	1 181	1 242	1 271	1 304	1 260	1 261	1 317	1 378	1 383	1 376	1 356	1 383	1 393	1 409
Portugal	-	1 229	1 254	1 295	1 329	1 352	1 365	1 352	1 344	1 333	1 354	1 361	1 350	1 345	1 343	1 339	1 344
Romania	-	-	-	-	-	-	1 268	1 286	1 291	1 281	1 325	1 381	1 365	1 347	1 333	1 341	1 351
Slovakia	-	-	-	-	1 174	-	-	-	-	1 386	1 418	1 421	1 410	1 410	1 420	1 426	1 434
Slovenia	-	-	-	1 246	1 305	1 316	1 340	1 350	1 346	1 332	1 355	1 358	1 344	1 333	1 335	1 361	1 379
Spain	1 266	1 725	1 317	1 335	1 374	1 395	1 416	1 400	1 394	1 399	1 413	1 410	1 396	1 355	1 357	1 363	1 366
Sweden	1 448	1 454	1 472	1 467	1 470	1 488	1 503	1 488	1 490	1 497	1 510	1 522	1 520	1 513	1 526	1 515	1 540
United Kingdom	1 347	1 356	1 392	1 387	1 374	1 390	1 394	1 380	1 358	1 384	1 410	1 398	1 394	1 381	1 393	1 411	1 424
Iceland																	1 462
Norway																	1 620

Table A2.3 Average CO_2 emissions (gCO_2/km) from new passenger cars by Member State

Member State	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Austria	165.6	164.4	163.8	161.9	162.1	163.7	162.9	158.1	150.2	144.0	138.7	135.7	131.6	128.5	123.7	120.4	120.7
Belgium	163.7	161.1	158.1	156.5	155.2	153.9	152.8	147.8	142.1	133.4	127.2	128.0	124.0	121.3	117.9	115.9	115.9
Bulgaria	-	-	-	-	-	-	171.6	171.5	172.1	158.9	151.4	149.2	141.7	135.9	130.3	125.8	126.2
Croatia	-	-	-	-	-	-	-	-	-	-	-	-	127.1	115.8	112.8	111.5	113.1
Cyprus	-	-	-	173.4	173.0	170.1	170.3	165.6	160.7	155.8	149.9	144.3	139.2	129.8	125.7	123.5	122.2
Czechia	-	-	-	154.0	155.3	154.2	154.2	154.4	155.5	148.9	144.5	140.8	134.6	131.6	126.3	121.2	124.1
Denmark	172.9	170.0	169.0	165.9	163.7	162.5	159.8	146.4	139.1	126.6	125.0	117.0	112.7	110.2	106.2	106.0	107.1
Estonia	-	-	-	179.0	183.7	182.7	181.6	177.4	170.3	162.0	156.9	150.3	147.0	140.9	137.2	133.9	132.8
Finland	178.1	177.2	178.3	179.8	179.5	179.2	177.3	162.9	157.0	149.0	144.0	139.1	131.8	127.4	123.0	120.0	118.2
France	159.8	156.8	155.0	153.1	152.3	149.9	149.4	140.1	133.5	130.5	127.7	124.4	117.4	114.2	111.0	109.8	110.4
Germany	179.5	177.4	175.9	174.9	173.4	172.5	169.5	164.8	154.0	151.1	145.6	141.6	136.1	132.5	128.3	126.9	127.2
Greece	166.5	167.8	168.9	168.8	167.4	166.5	165.3	160.8	157.4	143.7	132.7	121.1	111.9	108.2	106.4	106.3	108.8
Hungary	-	-	-	158.5	156.3	154.6	155.0	153.4	153.4	147.4	141.6	140.8	134.4	133.0	129.6	125.9	125.6
Ireland	166.6	164.3	166.7	167.6	166.8	166.3	161.6	156.8	144.4	133.2	128.3	125.1	120.7	117.1	114.1	112.0	111.6
Italy	158.3	156.6	152.9	150.0	149.5	149.2	146.5	144.7	136.3	132.7	129.6	126.2	121.1	118.1	115.2	113.3	113.3
Latvia	-	-	-	192.4	187.2	183.1	183.5	180.6	176.9	162.0	154.4	152.0	147.1	140.4	137.1	128.9	128.8
Lithuania	-	-	-	187.5	186.3	163.4	176.5	170.1	166.0	150.9	144.4	144.2	139.8	135.8	130.0	126.2	127.4
Luxembourg	177.0	173.8	173.5	169.7	168.6	168.2	165.8	159.5	152.5	146.0	142.2	137.0	133.4	129.9	127.5	126.1	127.0
Malta	-	-	-	148.8	150.5	145.9	147.8	146.9	135.7	131.2	124.7	121.5	118.7	115.3	113.3	111.8	111.0
Netherlands	174.0	172.4	173.5	171.0	169.9	166.7	164.8	156.7	146.9	135.8	126.1	118.6	109.1	107.3	101.2	105.9	108.3
Poland	-	-	-	154.1	155.2	155.9	153.7	153.1	151.6	146.2	144.5	141.3	138.1	132.9	129.3	125.8	127.6
Portugal	-	154.0	149.9	147.1	144.9	145.0	144.2	138.2	133.8	127.2	122.8	117.6	112.2	108.8	105.7	104.7	104.7
Romania	-	-	-	-	-	-	154.8	156.0	157.0	148.5	140.7	139.0	132.1	128.2	125.0	122.0	120.6
Slovakia	-	-	-	-	157.4	152.0	152.7	150.4	146.6	149.0	144.9	141.0	135.1	131.7	127.6	124.8	126.1
Slovenia	-	-	-	152.7	157.2	155.3	156.3	155.9	152.0	144.4	139.7	133.4	125.6	121.3	119.2	119.0	119.6
Spain	156.8	156.4	157.0	155.3	155.3	155.6	153.2	148.2	142.2	137.9	133.8	128.7	122.4	118.6	115.3	114.4	115.0
Sweden	200.2	198.2	198.5	197.2	193.8	188.6	181.4	173.9	164.5	151.3	141.8	135.9	133.2	131.0	126.3	123.1	122.3
United Kingdom	177.9	174.8	172.7	171.4	169.7	167.7	164.7	158.2	149.7	144.2	138.0	132.9	128.3	124.6	121.3	120.1	121.1
Iceland																	120.9
Norway																	82.6

Table A2.4 New vans registrations by Member State

Member State	2012	2013	2014	2015	2016	2017
Austria	26	27	30	31	34	38
Belgium	53	51	52	59	65	73
Bulgaria	8	7	8	9	9	9
Croatia	-	-	4	6	7	5
Cyprus	1	1	1	1	2	2
Czechia	10	10	12	13	11	14
Denmark	11	17	25	29	34	34
Estonia	2	3	3	4	4	4
Finland	10	10	10	10	12	14
France	227	300	348	309	283	303
Germany	195	199	212	224	245	243
Greece	2	3	5	5	6	6
Hungary	8	10	15	15	19	16
Ireland	6	10	16	22	26	23
Italy	106	92	107	117	167	159
Latvia	2	2	2	2	2	2
Lithuania	1	2	2	2	3	3
Luxembourg	3	3	3	3	4	4
Malta	0	0	0	1	1	1
Netherlands	47	49	46	49	63	63
Poland	30	34	61	47	47	41
Portugal	13	17	24	27	29	31
Romania	8	6	8	9	10	12
Slovakia	5	5	5	7	7	7
Slovenia	5	6	5	6	7	9
Spain	65	70	90	76	113	121
Sweden	21	20	26	28	30	44
United Kingdom	232	262	307	351	350	328
Iceland	-	-	-	-	-	2
Norway	-	-	-	-	-	32

Table A2.5 New vans mass and CO_2 average emissions by Member State

Member State	Mass (kg)						Emissions (gCO_2/km)					
	2012	2013	2014	2015	2016	2017	2012	2013	2014	2015	2016	2017
Austria	1 856	1 860	1 900	1 905	1 928	1 934	186.6	185.8	183.6	178.3	171.6	164.9
Belgium	1 842	1 861	1 883	1 875	1 861	1 876	185.8	182.8	179.4	175.8	169.2	160.6
Bulgaria	1 578	1 592	1 545	1 526	1 553	1 567	160.8	156.3	149.2	144.0	141.1	134.7
Croatia	-	-	1 668	1 646	1 708	1 805	0.0	0.0	158.8	154.3	150.1	142.2
Cyprus	1 605	1 734	1 674	1 661	1 665	1 550	151.5	170.6	158.1	143.2	144.1	133.4
Czechia	1 827	1 835	1 942	1 890	1 959	1 982	196.0	189.1	191.2	183.0	183.2	173.0
Denmark	1 854	1 793	1 736	1 731	1 777	1 830	178.1	166.8	155.0	151.1	151.7	149.5
Estonia	1 821	1 831	1 831	1 724	1 741	1 792	184.4	182.0	178.1	165.1	161.9	155.9
Finland	1 922	1 910	1 936	1 952	1 917	1 959	193.5	182.0	179.7	174.7	167.0	161.5
France	1 804	1 601	1 625	1 674	1 761	1 763	170.2	152.8	151.6	154.7	158.9	150.9
Germany	2 034	1 911	1 913	1 908	1 946	1 922	195.5	192.9	190.1	186.3	178.7	169.2
Greece	1 634	1 624	1 598	1 602	1 690	1 719	170.3	161.3	157.0	156.0	155.2	152.3
Hungary	1 828	1 845	1 843	1 884	1 850	1 876	184.0	181.9	177.7	177.0	168.0	163.1
Ireland	1 762	1 785	1 778	1 820	1 799	1 798	175.6	177.2	168.7	169.3	163.5	156.2
Italy	1 713	1 707	1 674	1 626	1 631	1 652	168.2	163.5	157.0	153.2	145.0	141.8
Latvia	1 770	1 750	1 728	1 747	1 728	1 763	176.9	171.6	167.4	165.3	156.6	153.9
Lithuania	1 891	1 856	1 830	1 814	1 896	1 889	190.8	180.3	176.3	169.2	168.8	160.1
Luxembourg	1 902	1 857	1 845	1 817	1 830	1 834	188.3	179.2	178.8	172.8	167.8	158.8
Malta	1 507	1 518	1 520	1 602	1 598	1 584	147.5	150.5	145.4	153.6	146.9	135.6
Netherlands	1 777	1 774	1 778	1 785	1 763	1 803	177.5	173.4	167.4	163.3	155.5	152.5
Poland	1 778	1 796	1 779	1 834	1 872	1 911	179.6	176.4	168.5	177.2	171.3	163.1
Portugal	1 579	1 583	1 581	1 570	1 615	1 647	154.2	150.9	144.8	141.7	140.1	132.1
Romania	1 806	1 766	1 781	1 791	1 832	1 827	183.1	171.8	171.9	170.3	170.1	158.0
Slovakia	1 986	1 995	2 026	2 006	2 045	2 045	200.8	196.3	193.2	186.8	185.6	170.1
Slovenia	1 860	1 849	1 877	1 853	1 873	1 927	191.2	188.0	185.1	174.9	168.2	161.4
Spain	1 764	1 734	1 672	1 659	1 680	1 687	167.4	162.9	156.1	154.6	148.0	142.4
Sweden	1 724	1 760	1 811	1 775	1 763	1 827	165.8	167.1	170.4	163.0	155.2	155.7
United Kingdom	1 815	1 827	1 838	1 848	1 879	1 901	186.3	185.2	181.0	177.9	172.9	163.4
Iceland						1 792						156.1
Norway						1 784						153.6

Annex 3 Manufacturers' CO_2 emission performance

Table A3.1 CO_2 emission performance of car manufacturers in 2017

Manufacturer	Pools and derogations	Number of registrations	Average specific emissions of CO_2 (gCO_2/km)	Specific emissions target (gCO_2/km)	Distance to target (gCO_2/km)
Adidor Voitures SAS	DMD	42	159.000		
Alfa Romeo SPA	P3	82 132	120.506	133.388	-12.882
Alpina Burkard Bovensiepen GmbH E CO KG	DMD	486	179.021		
Societe Des Automobiles Alpine		7	137.000	119.425	17.575
Aston Martin Lagonda Ltd	D	2 174	289.245	299.000	-9.755
Audi AG	P13	776 701	124.527	137.686	-13.159
Audi Hungaria Motor KFT	P13	7 743	145.060	129.957	15.103
Automobiles Citröen		626 876	105.584	122.062	-16.478
Automobiles Peugeot		949 417	104.533	123.476	-18.943
Avtovaz JSC	P10	3 767	171.997	121.641	50.356
Bee Bee Automotive	DMD	4	0.000		
Bentley Motors Ltd	D	3 439	267.428	287.000	-19.572
Bluecar SAS	DMD	340	0.000		
Bayerische Motoren Werke AG	P1	965 330	120.794	138.061	-17.267
BMW M GmbH	P1	17 246	160.703	141.478	19.225
Bugatti Automobiles SAS	P13	13	517.769	160.949	356.820
BYD Auto Industry Company Limited	DMD	1	0.000		
Caterham Cars Limited	DMD	119	141.975		
Chevrolet Italia SPA	P5	2	119.000	107.040	11.960
FCA US LLC	P3	104 206	141.530	140.371	1.159
CNG-Technik GmbH	P4	517	162.714	137.815	24.899
Automobile Dacia SA	P10	456 291	117.496	121.287	-3.791
Daimler AG	P2	959 295	126.672	139.684	-13.012
Donkervoort Automobielen BV	DMD	6	178.000		
Dr Motor Company SRL	DMD	410	151.634		
Ferrari SPA	D	2 578	282.772	290.000	-7.228
FCA Italy SPA	P3	789 688	116.079	120.190	-4.111
Ford India Private Limited	P4	35 037	113.770	114.631	-0.861
Ford Motor Company	P4	19 185	205.214	149.988	55.226
Ford-Werke GmbH	P4	969 899	119.360	130.121	-10.761
General Motors Holdings LLC	P5	2 478	260.976	151.809	109.167
GM Korea Company	P5	6	139.500	136.166	3.334
Great Wall Motor Company Limited	DMD	2	214.500		
Honda Automobile China Co Ltd	P6	1	125.000	117.643	7.357
Honda Motor Co Ltd	P6	72 149	119.922	124.126	-4.204
Honda Turkiye AS	P6	766	138.168	128.157	10.011
Honda of The UK Manufacturing Ltd	P6	58 701	135.935	135.678	0.257

Table A3.1 CO_2 emission performance of car manufacturers in 2017 (cont.)

Manufacturer	Pools and derogations	Number of registrations	Average specific emissions of CO_2 (gCO_2/km)	Specific emissions target (gCO_2/km)	Distance to target (gCO_2/km)
Hyundai Motor Company	P7	89 118	115.397	133.556	-18.159
Hyundai Assan Otomotiv Sanayi VE Ticaret AS	P7	172 602	113.695	115.302	-1.607
Hyundai Motor Manufacturing Czech SRO	P7	235 459	131.628	132.985	-1.357
Hyundai Motor Europe GmbH	P7	256	111.055	134.884	-23.829
Hyundai Motor India Ltd	P7	3	134.667	114.703	19.964
Jaguar Land Rover Limited	P12/ND	229 124	151.667	178.025	-26.358
Kia Motors Corporation	P8	299 233	113.941	127.350	-13.409
Kia Motors Slovakia SRO	P8	156 263	132.944	132.392	0.552
Koenigsegg Automotive AB	DMD	3	381.000		
KTM-Sportmotorcycle AG	DMD	27	191.667		
Lada Automobile GmbH	DMD	917	216.000		
Automobili Lamborghini SPA	D	897	320.896	316.000	4.896
Lotus Cars Limited	D	704	204.964	225.000	-20.036
Magyar Suzuki Corporation Ltd	P11/ND	111 790	121.564	123.114	-1.550
Mahindra & Mahindra Ltd	DMD	410	187.344		
Man Truck & Bus AG	P13	3	194.000	169.299	24.701
Maruti Suzuki India Ltd	P11/ND	19 780	100.060	123.114	-23.054
Maserati SPA	D	8 715	199.485	242.000	-42.515
Mazda Motor Corporation	ND	215 697	130.745	129.426	1.319
Mclaren Automotive Limited	D	790	252.158	270.000	-17.842
Mercedes-AMG GmbH	P2	2 111	241.227	142.677	98.550
MG Motor UK Limited	D	4 385	128.122	146.000	-17.878
Mitsubishi Motors Corporation MMC	P9	75 724	125.682	138.791	-13.109
Mitsubishi Motors Europe BV MME	P9	9	135.000	127.377	7.623
Mitsubishi Motors Thailand Co Ltd MMTH	P9	29 213	96.637	108.541	-11.904
Morgan Technologies Ltd	DMD	415	194.535		
Nissan International SA		562 522	116.915	128.675	-11.760
Noble Automotive Ltd	D	2	335.500	338.00	-2.500
Adam Opel GmbH	P5	748 316	123.837	127.333	-3.496
Opel Automobile GmbH		168 684	123.572	127.263	-3.691
Pagani Automobili SPA	DMD	2	343.000		
Perodua UK Limited	DMD	1	137.000		
PGO Automobiles	DMD	3	202.333		
DR Ing HCF Porsche AG	P13	67 186	175.925	152.765	23.160
PSA Automobiles SA		503	130.205	137.935	-7.730
Quattro GmbH	P13	7 188	218.391	149.262	69.129
Radical Motorsport Ltd	DMD	7	343.000		
Renault SAS	P10	1 171 619	106.280	126.441	-20.161
Renault Trucks	DMD	25	169.800		
Rolls-Royce Motor Cars Ltd	P1	600	329.247	181.831	147.416
Seat SA	P13	386 597	117.749	124.835	-7.086
Secma SAS	DMD	50	133.560		
Skoda Auto AS	P13	660 580	115.948	126.105	-10.157
Ssangyong Motor Company	ND	16 426	157.207	167.573	-10.366
Subaru Corporation	ND	28 951	160.390	164.616	-4.226
Suzuki Motor Corporation	P11/ND	78 324	114.500	123.114	-8.614

Table A3.1 CO_2 emission performance of car manufacturers in 2017 (cont.)

Manufacturer	Pools and derogations	Number of registrations	Average specific emissions of CO_2 (gCO_2/km)	Specific emissions target (gCO_2/km)	Distance to target (gCO_2/km)
Suzuki Motor Thailand Co Ltd	P11/ND	23 258	96.756	123.114	-26.358
Tecno Meccanica Imola SPA	DMD	4	0.000		
Tesla Motors Ltd		17 780	0.000	172.304	-172.304
Toyota Motor Europe Nv Sa		692 814	103.069	127.740	-24.671
Volkswagen AG	P13	1 634 804	120.391	130.638	-10.247
Volvo Car Corporation		277 748	124.437	146.260	-21.823

Notes: The number of registrations represents the number of vehicles having both a mass and an emission value.

The Commission implementing decision confirming the 2017 CO_2 emissions assigns some manufacturers an uncertainty adjustment for 2017 data, which modifies the distance to their targets. The uncertainty is not reported here. A detailed description of the uncertainty calculation is presented with the Commission implementing decision.

'D' indicates that a derogation for small-volume manufacturers has been granted in accordance with the Commission implementing decision.

'DMD' means that a de minimis derogation applies, i.e. a manufacturer which, together with all its connected undertakings, was responsible for fewer than 1 000 new registered vehicles in 2015. According to Regulation (EU) No 333/2014, it does not have to meet a specific emission target. However, the targets are reported in the above table for information purposes only.

'ND' indicates that a derogation for niche manufacturers has been granted in accordance with the Commission implementing decision.

'P' indicates that the manufacturer is member of a pool in accordance with Article 7 of Regulation (EC) No 443/2009.

Table A3.2 CO_2 emission performance of light commercial vehicle manufacturers in 2017

Manufacturer name	Pools and derogations	Number of registrations	Average specific emissions of CO_2 (gCO_2/km)	Specific emissions target (gCO_2/km)	Distance to target (gCO_2/km)
Alfa Romeo SPA		8	137.375	161.283	-23.908
Alke SRL	DMD	1	0.000		
Audi AG	P8	1 275	133.705	179.293	-45.588
Automobiles Citröen		158 465	130.881	167.142	-36.261
Automobiles Peugeot		169 852	132.590	169.521	-36.931
Avtovaz JSC	P7	272	215.967	135.884	80.083
Bluecar SAS	DMD	21	0.000		
Bayerische Motoren Werke AG	DMD	94	150.979		
BMW M GmbH	DMD	411	146.014		
FCA US LLC	P2	157	220.541	201.360	19.181
Automobile Dacia SA	P7	26 775	117.858	135.230	-17.372
Daimler AG	P1	147 953	187.601	212.680	-25.079
DFSK Motor Co Ltd	DMD	353	179.759		
Esagono Energia SRL	DMD	19	0.000		
FCA Italy SPA	P2	143 889	149.154	174.813	-25.659
Ford Motor Company of Australia Limited	P3	38 381	214.276	227.258	-12.982
Ford Motor Company	P3	9	159.111	199.459	-40.348
Ford-Werke GmbH	P3	242 012	156.630	193.916	-37.286
Subaru Corporation	DMD	52	161.192		
Mitsubishi Fuso Truck & Bus Corporation	P1	446	242.807	264.642	-21.835
Mitsubishi Fuso Truck Europe SA	P1	31	236.806	274.345	-37.539
Llc Automobile Plant Gaz	DMD	37	285.000		
General Motors Holdings Llc	P4	344	163.282	178.428	-15.146
Gonow Auto Co Ltd	DMD	51	184.647		
Goupil Industrie SA	DMD	349	0.000		
Great Wall Motor Company Limited	DMD	57	202.439		
Honda Motor Co Ltd	DMD	14	112.571		
Honda of the UK Manufacturing Ltd	DMD	21	141.429		
Hyundai Motor Company	P9	2 775	209.458	223.768	-14.310
Hyundai Assan Otomotiv Sanayi VE	P9	1	112.000	122.176	-10.176
Hyundai Motor Manufacturing Czech SRO	P9	83	111.590	147.043	-35.453
Isuzu Motors Limited		9 887	195.044	204.716	-9.672
Iveco SPA		23 369	203.007	239.767	-36.760
Jaguar Land Rover Limited	DMD	387	157.755		
Kia Motors Corporation	P5	1 295	124.415	155.643	-31.228
Kia Motors Slovakia SRO	P5	312	124.160	150.401	-26.241
Lada Automobile GmbH	DMD	3	216.000		
Magyar Suzuki Corporation Ltd	DMD	2	115.000		
Mahindra & Mahindra Ltd	DMD	310	210.958		
Man Truck & Bus AG	P8	1 485	197.790	220.221	-22.431
Mazda Motor Corporation	DMD	105	136.875		
MFTBC	P1	36	239.250	265.401	-26.151
Mitsubishi Motors Corporation MMC	P6/D	330	184.176	195.000	-10.824
Mitsubishi Motors Europe BV MME	P6/D	205	217.210	195.000	22.210
Mitsubishi Motors Thailand Co Ltd MMTH	P6/D	20 576	185.501	195.000	-9.499
Nissan International SA		55 137	158.636	191.852	-33.216

Table A3.2 CO_2 emission performance of light commercial vehicle manufacturers in 2017 (cont.)

Manufacturer name	Pools and derogations	Number of registrations	Average specific emissions of CO_2 (gCO_2/km)	Specific emissions target (gCO_2/km)	Distance to target (gCO_2/km)
Adam Opel GmbH	P4	65 538	159.798	180.693	-20.895
Opel Automobile GmbH		17 373	168.923	189.777	-20.854
Piaggio & C SPA	D	2 980	151.640	155.000	-3.360
DR Ing HCF Porsche AG	P8	53	186.774	206.254	-19.480
Renault SAS	P7	223 583	149.683	177.514	-27.831
Renault Trucks		9 126	208.652	229.287	-20.635
Romanital SRL	DMD	48	166.354		
Saic Maxus Automotive Co Ltd	DMD	159	231.595		
Seat SA	P8	354	109.263	128.576	-19.313
SFL Technologies GmbH	DMD	5	0.000		
Skoda Auto AS	P8	4 209	110.631	133.165	-22.534
Ssangyong Motor Company	D	1 000	192.914	210.000	-17.086
Streetscooter GmbH		3 808	0.000	159.554	-159.554
Suzuki Motor Corporation	DMD	14	162.714		
Tesla Motors Ltd	DMD	1	0.000		
Toyota Motor Europe NV SA		38 266	168.452	196.264	-27.812
Univers VE Helem	DMD	5	0.000		
Volkswagen AG	P8	192 470	159.987	189.446	-29.459
Volvo Car Corporation	DMD	852	121.619		

Notes: The number of registrations represents the number of vehicles having both a mass and an emission value. The parameters used in calculating manufacturer performance for 2017 are set out in Annex 1.

The Commission implementing decision confirming the 2017 CO_2 emissions assigns some manufacturers an uncertainty adjustment for 2017 data, which modifies the distance to their targets. The uncertainty is not reported here. A detailed description of the uncertainty calculation is presented with the Commission implementing decision.

'D' indicates that a derogation for small-volume manufacturers has been granted in accordance with the Commission implementing decision.

'DMD' means that a de minimis derogation applies, i.e. a manufacturer which, together with all its connected undertakings, was responsible for fewer than 1 000 new registered vehicles in 2015. According to Regulation (EU) No 253/2014, it does not have to meet a specific emission target. However, the targets are reported in the above table for information purposes only.

'ND' indicates that a derogation for niche manufacturers has been granted in accordance with the Comamission implementing decision.

'P' indicates that the manufacturer is member of a pool in accordance with Article 7 of Regulation (EC) No 510/2011.

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