



Analysis of emissions from new cars in 2020

Annex to T&E's 2021 car CO₂ report

November 2021

1. Context and summary

The car CO₂ standards, i.e. Regulation (EU) 2019/631, are the main instrument to reduce emissions from new passenger cars in Europe. The 2020/21 CO₂ emissions target of 95 g/km entered into force in 2020 (covering 95% of registrations in 2020 and all registrations in 2021), replacing the previous target of 130 g/km in 2015–2019 (as measured on the New European Driving Cycle, or NEDC). As a result, passenger cars registered in 2020 emitted 12% less per km than they did in 2019. This historic drop put an end to the steady annual increase in emissions started in 2017, demonstrating the effectiveness of the regulation.

Yet, new cars emitted 108 g/km on average in 2020, or 13% more than the official emissions target of 95 g/km. This is due to a number of regulatory flexibilities meant to make it easier for carmakers to reach their target. This technical annex, whose publication accompanies T&E's 2021 car CO₂ report [1], delves into this unprecedented decrease in emissions and documents how carmakers have exploited regulatory flexibilities to be compliant.

Unless otherwise specified, this annex uses provisional monitoring data for 2020 [2], collected by Member States on each new registration and published by the European Environment Agency in June 2021, covering a total of 11,603,752 registrations¹. Final data for 2020 will be published in 2022 and will serve as the basis to determine official compliance status and penalties. Only small adjustments are expected compared to provisional data, so conclusions drawn here should hold. The database contains data for the EU27, the United Kingdom, Iceland, and Norway. Since the car CO₂ standards only regulate CO₂ emissions, *emissions* always refer to CO₂ emissions. Additionally, unless stated otherwise, *emissions* refer to NEDC emissions.

2. Car CO₂ emissions in 2020

As can be seen on Figure 1, emissions from new cars fell by 12% as measured on the NEDC, from 122 g/km in 2019 to 108 g/km in 2020. This 12% decline is also observed when measuring emissions using the Worldwide Harmonised Light Vehicles Test Procedure (WLTP), as emissions from this test dropped from 147 g/km in 2019 to 130 g/km in 2020. In previous years, emissions had been increasing from their previous low of 118 g/km in 2016, growing by 1.2% annually in 2017–2019. The previous

¹ Out of the 11,603,752 records included in the database, 46,303 were omitted as they were identified as either individual approvals (AA-IVA), national small series (AA-NSS), or duplicates (i.e. records appearing multiple times in the monitoring data), and 5 had a running mass exceeding 2,815 kg and thus had to be removed according to the regulation guidelines [3].

emissions target of 130 g/km introduced in 2015 had indeed been met without much effort years earlier, in 2013, and carmakers had therefore room for emissions increases, until the next target entered into force in 2020.

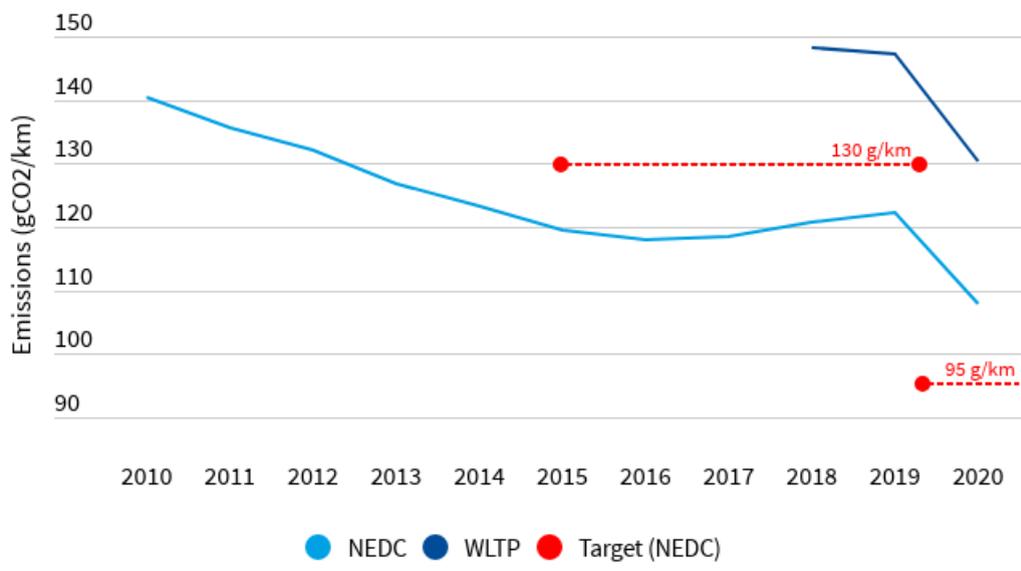
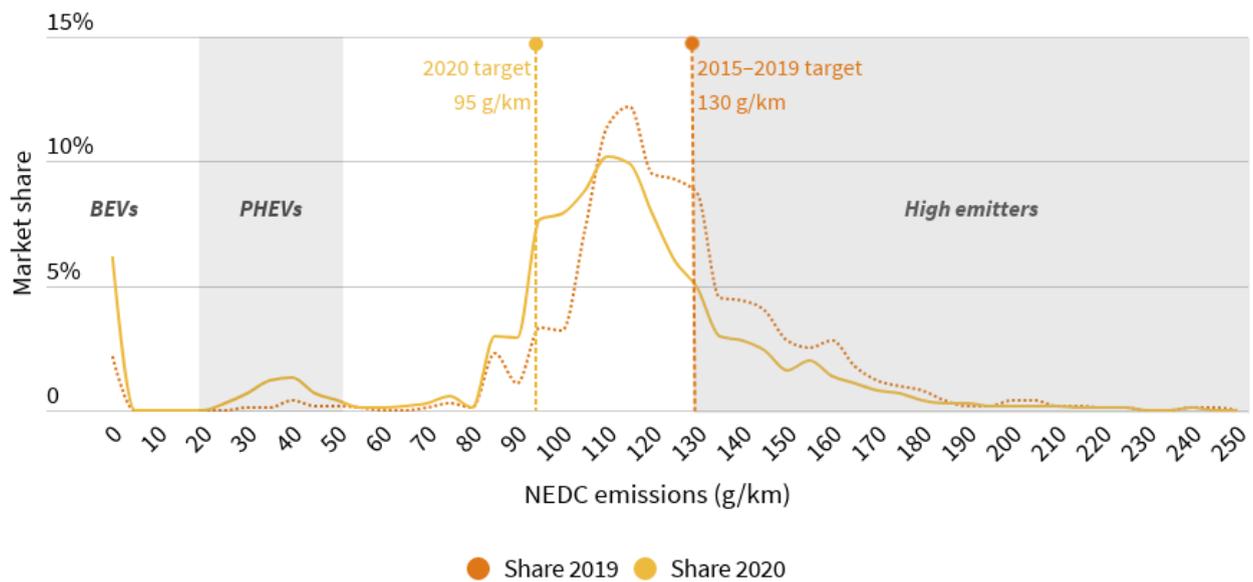


Figure 1. Annual NEDC and WLTP emissions in the European Economic Area

The share of cars emitting less than 95 g/km grew significantly in the past decade, from 1% in 2010 to 26% in 2020. Yet, while it increased gradually at first, reaching 13% in 2015, it steadily declined from 2016 (14%) to 2019 (10%) as manufacturers focused on profitability before the entry into force of a more ambitious emissions target. The 2020 target also resulted in a jump in the market share of battery-electric vehicles (BEVs) and plug-in hybrids (PHEVs). Zero-emission cars made up 6% of all registrations in 2020, up 4 percentage points from 2019, while cars emitting between 20 and 50 g/km (i.e. PHEVs) made up 5% of all registrations, up from 1% in 2019 (see Figure 2).



Emissions are rounded up to the nearest 5 g/km. Only registrations within the scope of the car CO2 standards are included.

Figure 2. Distribution of NEDC emissions in 2019 and 2020

2.1. Analysis per country

The largest emissions drop was in Norway, where emissions fell by 36% from 60 g/km in 2019 to 38 g/km. Norway's emissions are also the lowest in Europe, followed by Iceland (80 g/km), the Netherlands (82 g/km), and Sweden (93 g/km). In all other countries emissions exceeded the on-paper target of 95 g/km. Regarding major markets, emissions declined by 13% in Germany (reaching 114 g/km), France (98 g/km) and the United Kingdom (112 g/km); by 9% in Italy (109 g/km); and by 7% in Spain (112 g/km) (Figure 3). Every country experienced a decrease in emissions except for Bulgaria, where emissions increased by 2% to 133 g/km in 2020 and are the highest in Europe, followed by Poland and Cyprus (each 125 g/km in 2020).

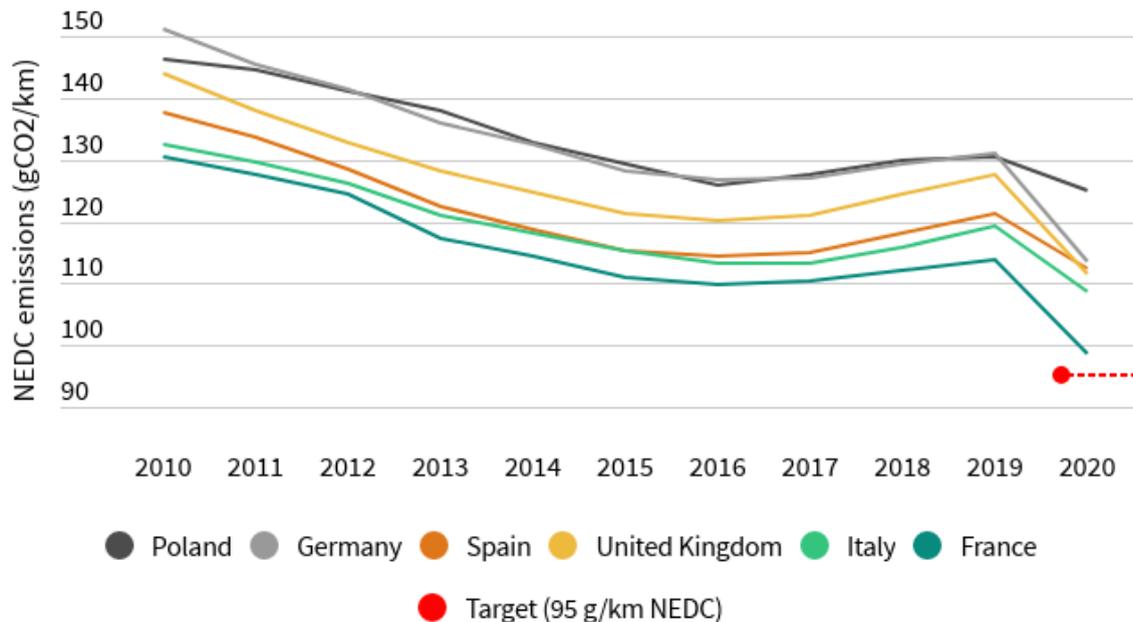


Figure 3. Annual NEDC emissions in major European markets

2.2. Analysis per powertrain

The average car with only an internal combustion engine and no electric motor (pure ICE) emitted 121 g/km in 2020: 5% less than in 2019 but as much as in 2015 (Figure 4). Indeed, carmakers had no incentives to rein in their emissions in the absence of stronger targets, so ICE emissions annually had increased by 2.2% on average since 2017. For full hybrid vehicles (HEV), emissions are going up for the third consecutive year, increasing by 2% between 2019 and 2020. As a result, the gap between pure ICEs and HEVs is beginning to close. Although HEVs still emitted 10% less than pure ICEs in 2020, this number was -16% in 2019. Plug-in hybrid vehicles emitted 41 g/km on average on paper in 2020, down 10% from their 2019 emissions. As previously shown by T&E, real-world PHEV emissions exceed official values even in optimal conditions [4]. Real-world PHEV emissions are on average two to four times higher than official values [5]. It is thus unclear whether this drop corresponds to an actual reduction of the real-world emissions of new PHEVs.

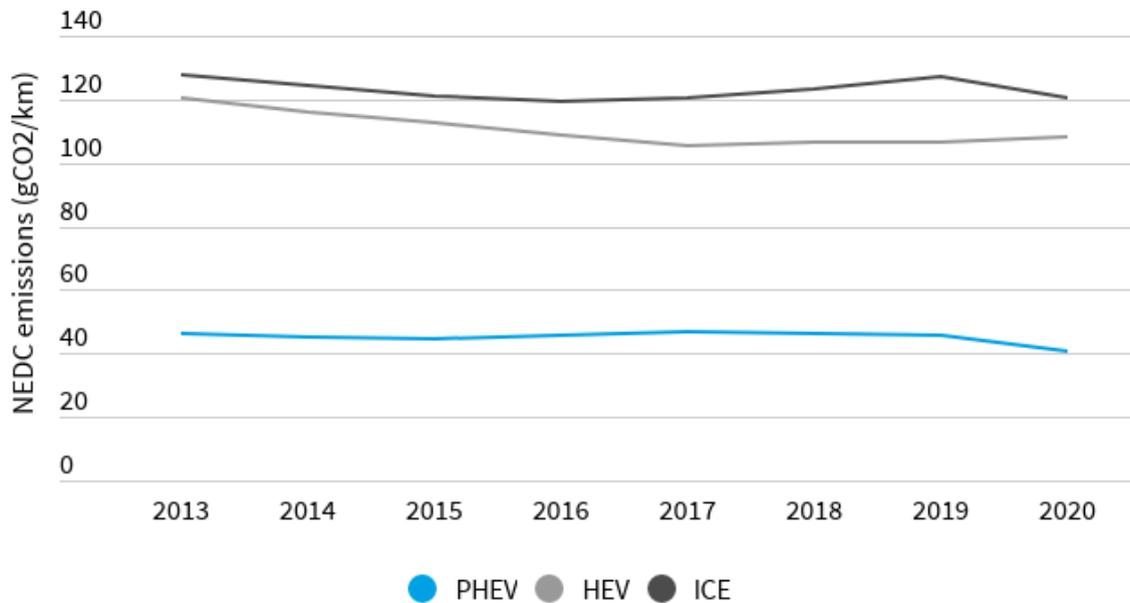


Figure 4. Annual NEDC emissions by powertrain

Average emissions by powertrain depend on carmakers (Figure 5). On average, a pure ICE car from PSA, Toyota-Mazda, the Renault-Nissan-Mitsubishi alliance, or Ford-Volvo emitted less than the European average (121 g/km). Meanwhile, the most-polluting pure ICEs are produced by non-regulated OEMs (*Others*: 208 g/km), OEMs enjoying a derogation from the car CO₂ standards (JLR: 175 g/km, Subaru: 161 g/km), and OEMs with heavier fleets (Daimler: 140 g/km, BMW Group: 132 g/km; see subsection 3.2.2 for more information on their mass and how it impacts their emissions targets).

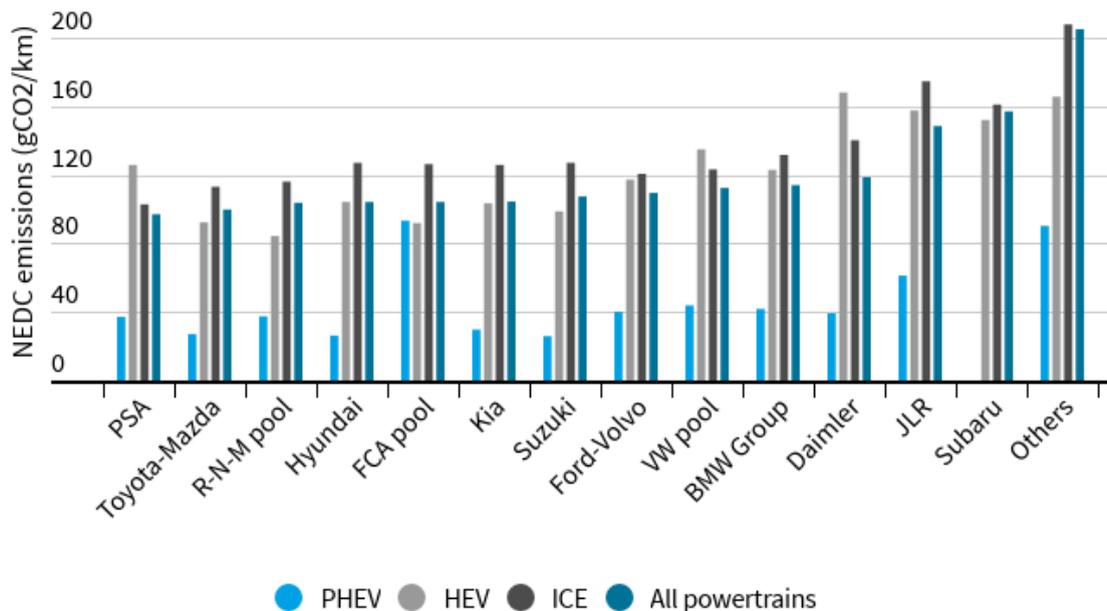


Figure 5. Annual NEDC emissions by powertrain and carmaker

Regarding full hybrids, which emit 108 g/km on average, emissions are particularly high for Daimler (168 g/km), non-regulated carmakers (166 g/km), OEMs with a derogation (JLR: 157 g/km, Subaru: 152 g/km), and Volkswagen's pool (135 g/km). Finally, on plug-in hybrids, the FCA pool and Jaguar Land

Rover are the only regulated carmakers where the average PHEV emits more than 50 g/km and thus does not qualify for super-credits (FCA pool: 93 g/km, JLR: 61 g/km). This is because their only PHEVs in 2020 were offered by traditionally high-emitting brands (Jeep for FCA pool, and Land Rover for JLR).

On market shares, 6% of new cars registered in 2020 were battery-electric, 5% were plug-in hybrids, 11% were full hybrids, and the remaining 78% were conventional pure ICE cars (Figure 6). Hyundai sold the highest share of battery-electric cars (14%) followed by FCA-Tesla-Honda (*FCA pool*, 13%). Together, they are the only two manufacturers where 1 in 10 new cars is zero-emission. Daimler registered the highest share of PHEVs in 2020 (14%) and is the only carmaker where 1 in 5 cars is an electric vehicle. BMW Group and Ford-Volvo also sold more than 10% of plug-in hybrids (12% and 11% respectively). Suzuki, Toyota-Mazda, and Subaru had the lowest shares of pure ICEs (32%, 44%, and 56% respectively) in their fleets, but the highest shares of full hybrids (67%, 54%, and 44% respectively). This is because all three carmakers bet on hybridisation to cut emissions. Notably, Suzuki and Subaru are the only regulated OEMs who did not register a single zero-emission car in 2020. As will be detailed in section 3.4, both manufacturers also missed their targets by the highest amount. This suggests that direct electrification is a more effective compliance strategy, though Suzuki and Subaru are both small-scale OEMs, so a more general conclusion cannot be drawn. Non-regulated manufacturers (*Others*) were the group with the highest share of ICE cars (98%), followed by PSA (94%).

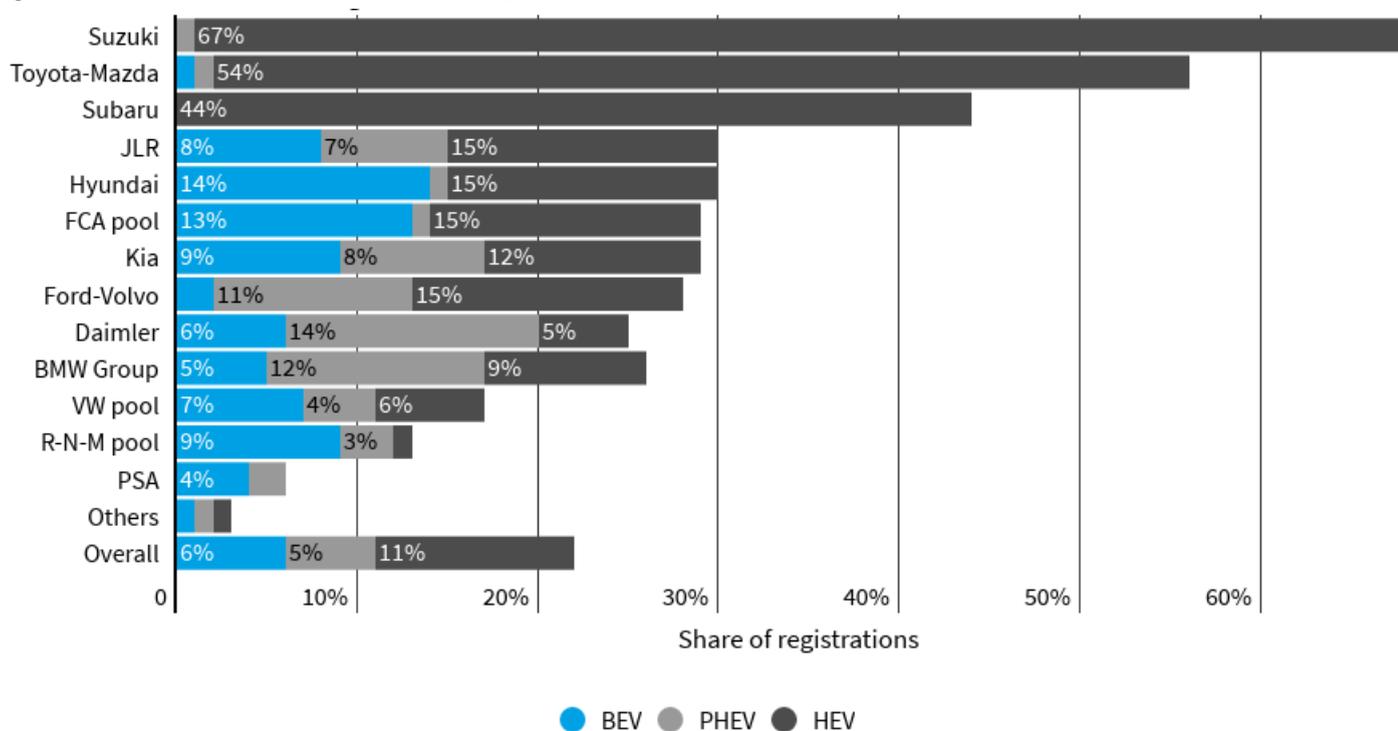


Figure 6. Powertrain shares by carmaker

2.3. Analysis by segment

The Euro Car Segment combines two elements: body type (segments J for SUVs, M for minivans, and S for sports cars) and size (segments A, B, C, D, E, for hatchbacks). This section disaggregates both components. First, emissions by vehicle category are examined, which is split into cars (hatchbacks), SUVs, and other body types (mainly minivans and sports cars), regardless of vehicle size. Second, emissions by vehicle size are considered, regardless of vehicle category.

2.3.1. Vehicle category: car, SUV, others

Emissions fell across all vehicle categories in 2020: -13% for hatchbacks, -12% for sport utility vehicles (SUVs), and -4% for other passenger cars (mostly minivans and sports cars). Previously, the emissions of cars and SUVs had been steadily converging: SUVs emitted 30% more than hatchbacks in 2010 and only 15% more in 2018. This trend has since reversed, and SUVs emitted 18% more than cars in 2020 (116 g/km for SUVs vs 98 g/km for cars). This trend reversal is due to hatchbacks' faster full electrification, which translates into larger emissions cuts. The share of zero-emission vehicles is twice higher for hatchbacks than for SUVs (8% of cars are battery-electric, while only 4% of SUVs are BEVs). Meanwhile, SUV market share has been increasing every year in the last decade, and SUVs made up 42% of all passenger car registrations in 2020 (see Figure 7).

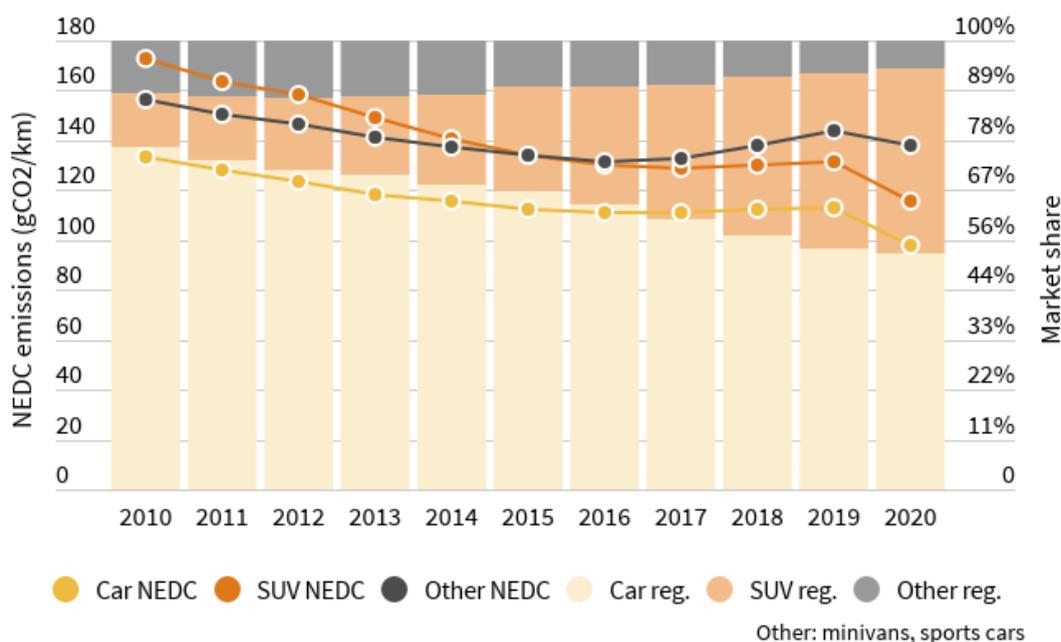
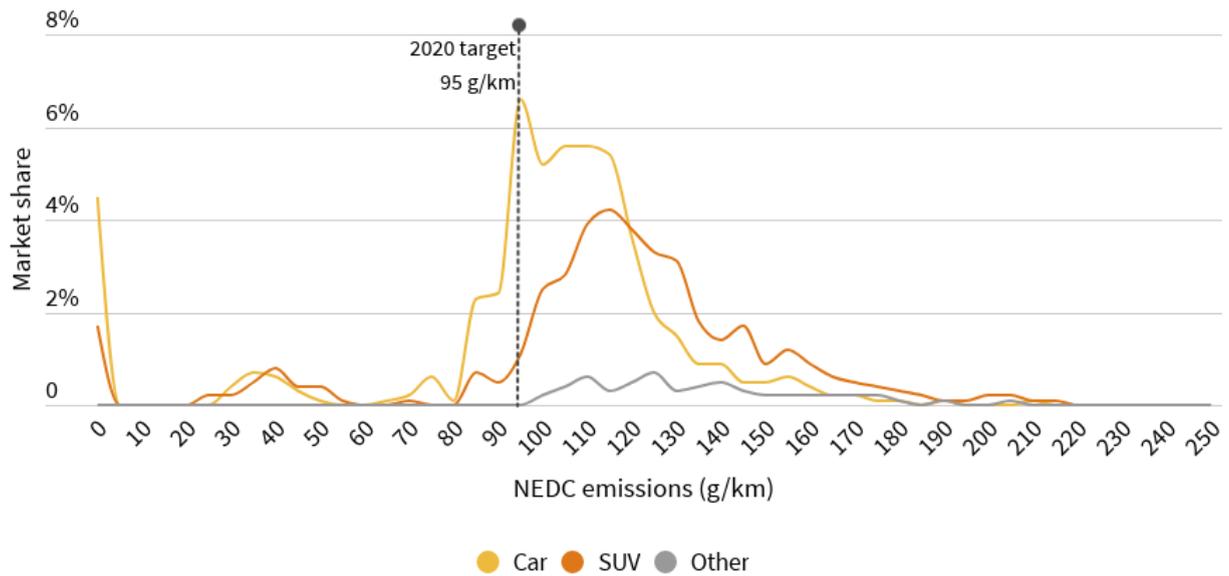


Figure 7. Annual NEDC emissions and market share by segment

Emissions cuts in 2020 were more moderate when excluding zero-emission vehicles from the analysis: -8% for hatchbacks, -9% for SUVs, and -3% for other registrations. In this case (i.e. when considering only pure ICEs, HEVs, and PHEVs), SUVs still emit 13% more than cars (121 g/km for SUVs vs 107 g/km for cars), but the gap is closing as average SUV emissions declined faster than cars' in the last year (-9% for SUVs, -8% for hatchbacks). Yet, SUVs make up the bulk of passenger cars emitting over 115 g/km: 57% of all such vehicles are SUVs while only 32% are conventional cars (see Figure 8).



Emissions are rounded up to the nearest 5 g/km. Only registrations within the scope of the car CO2 standards are included.

Figure 8. Distribution of NEDC emissions by vehicle category

2.3.2. Vehicle size: A, B, C, D, E

When looking at vehicle size, emissions decreased by 18% for mini cars (A), 12% for small cars (B), 11% for medium (C), and 13% for large (D) and executive (E) (see Figure 9). As expected, the decline is less pronounced when excluding ZEVs: -8% for A, B, and C, -11% for D, and -7% for E. Moving up a size increases emissions by 9 g/km on average, regardless of whether ZEVs are excluded from the analysis.

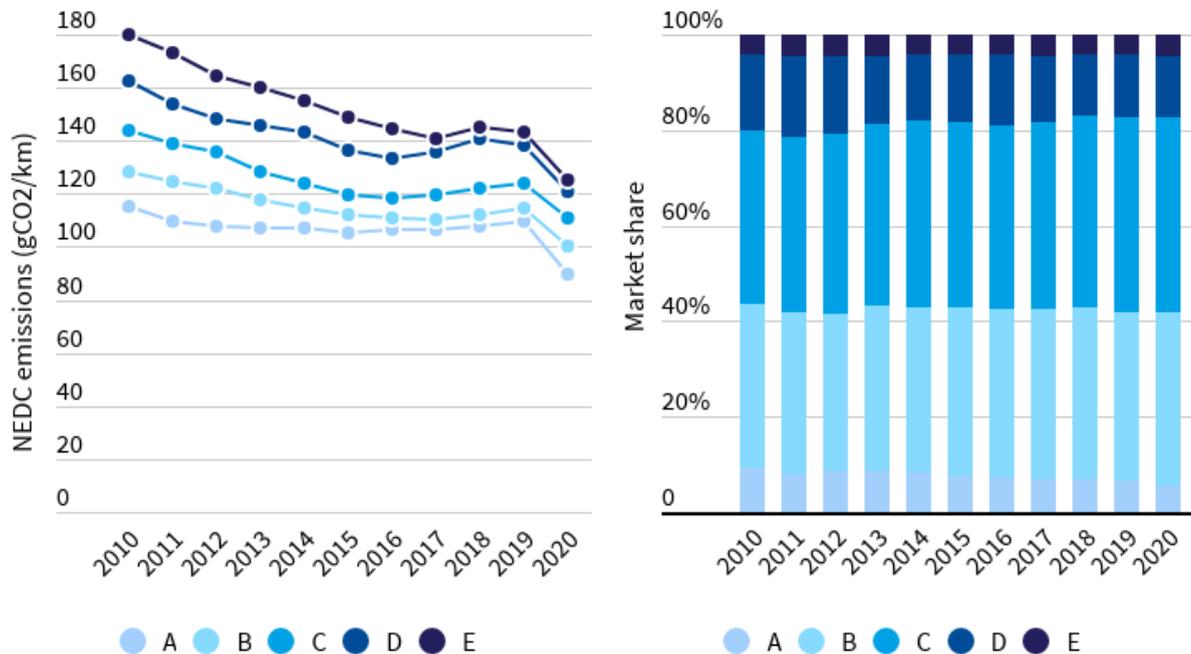


Figure 9. Annual NEDC emissions and market share by vehicle size

2.4. High-emitting vehicles

In this subsection, the emissions of high-emitting vehicles are considered, first by looking into cars emitting more than 130 g/km, then by zooming on pick-up trucks.

2.4.1. Cars emitting more than 130 g/km

High-emitters are defined here as vehicles emitting more than 130 g/km. This threshold was selected as it corresponds to the previous target in force in 2015–2019. In 2020, high-emitters made up a fifth of new cars, down from a third in 2019. Note that their market share in 2019 was the highest since 2013, and was the result of 3 years of steady increase. High-emitters emitted 155 g/km on average in 2020: 2% more than in 2019, and as much as they did in 2011 (Figure 10).

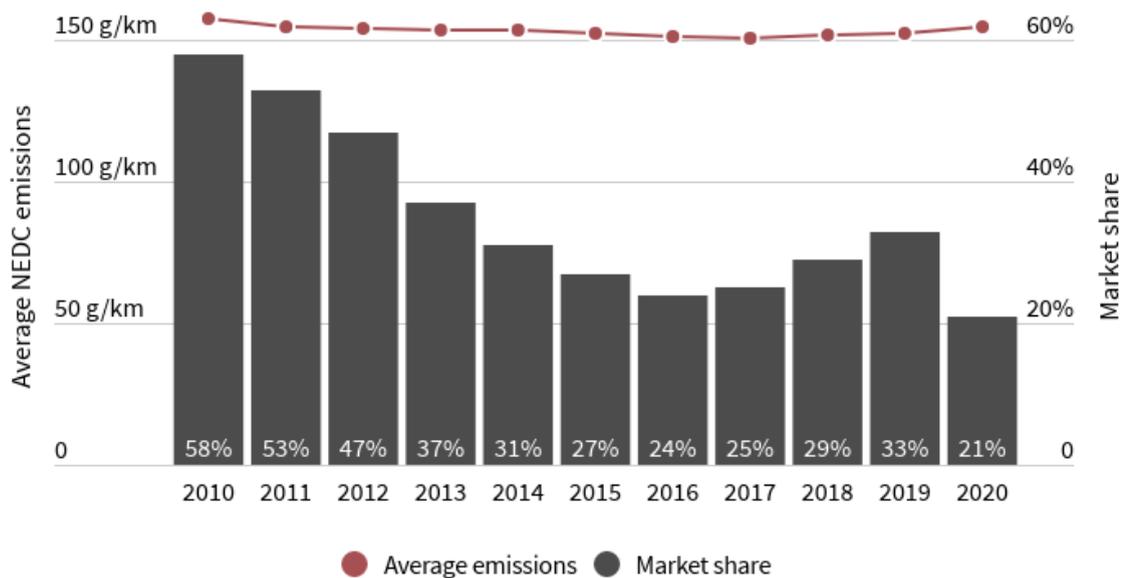


Figure 10. Annual NEDC emissions and market share of high-emitters

High-emitters make up the bulk of some carmakers' fleets (Figure 11). All Subaru cars and 4 out of 5 Jaguar Land Rover cars emit more than 130 g/km. This is unsurprising, as both manufacturers face less ambitious CO₂ targets (121 g/km and 131 g/km respectively) as they have been granted derogations (see section 3.1). Of the regulated OEMs without a derogation, Daimler is the one with the highest share of high-emitters (44%).

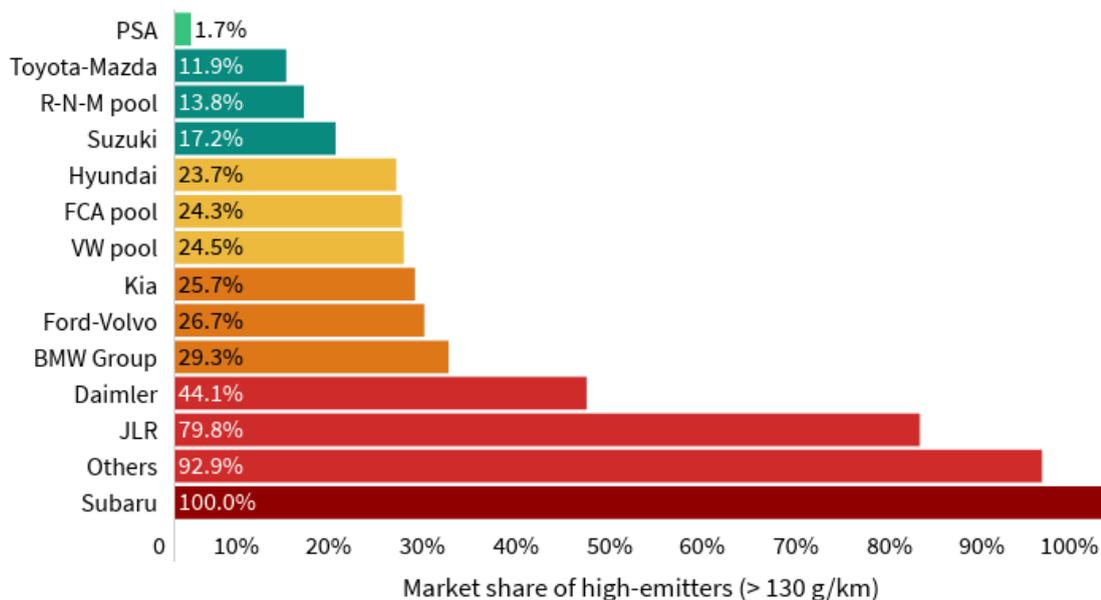


Figure 11. Share of high-emitters in 2020 by carmaker

Figure 12 shows the top ten most popular high-emitters in 2020. Six models qualifying as high-emitters registered more than 50,000 units in 2020: they are the VW Tiguan, Mercedes-Benz GLC-Class, Volvo XC40, Audi Q3, Skoda Kodiaq, and Nissan Qashqai. The highest emitter in the top 10 registered models is the Kia Sportage, which emits 157 g/km on average. Overall, 59% of high-emitters in 2020 are SUVs, compared to only 20% in 2010.

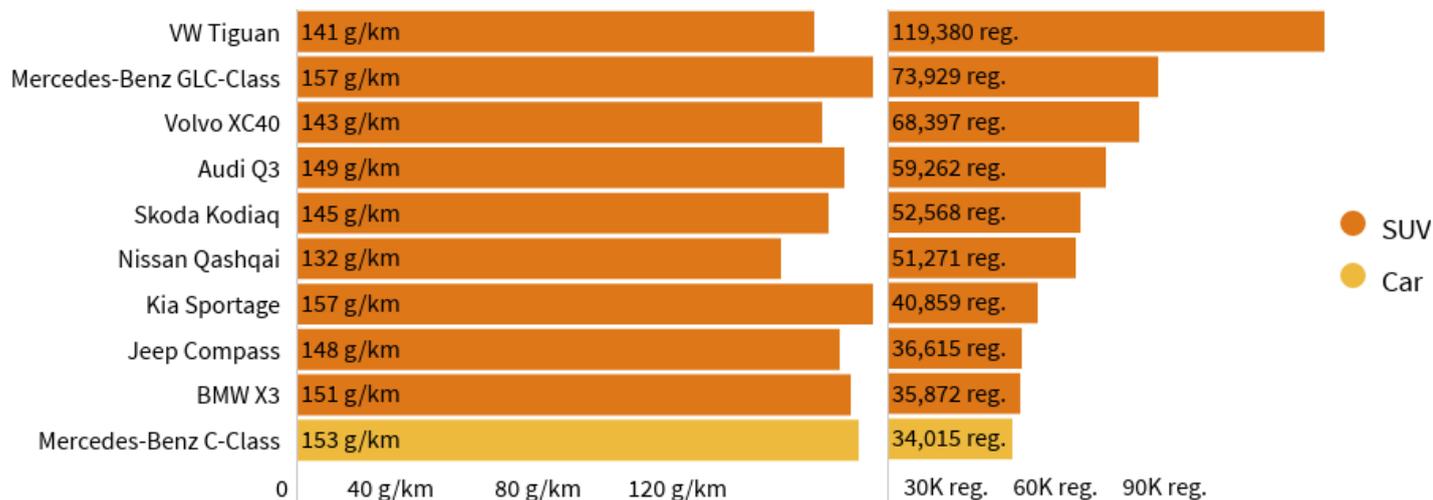


Figure 12. Top ten models emitting more than 130 g/km

2.4.2. Pick-up trucks

Pick-up trucks are only partially registered as passenger cars, and mostly registered as vans. Therefore, the data analysed here come from both the cars and vans databases [6]. All registrations are included, including individual registrations and small series². Additionally, pickups have been excluded from cars and vans registration numbers.

² Note that the average emissions for passenger cars when all registrations are included are 121 g/km in 2020, so 13 g/km higher than the average emissions of registrations falling within the scope of the car CO₂ standards.

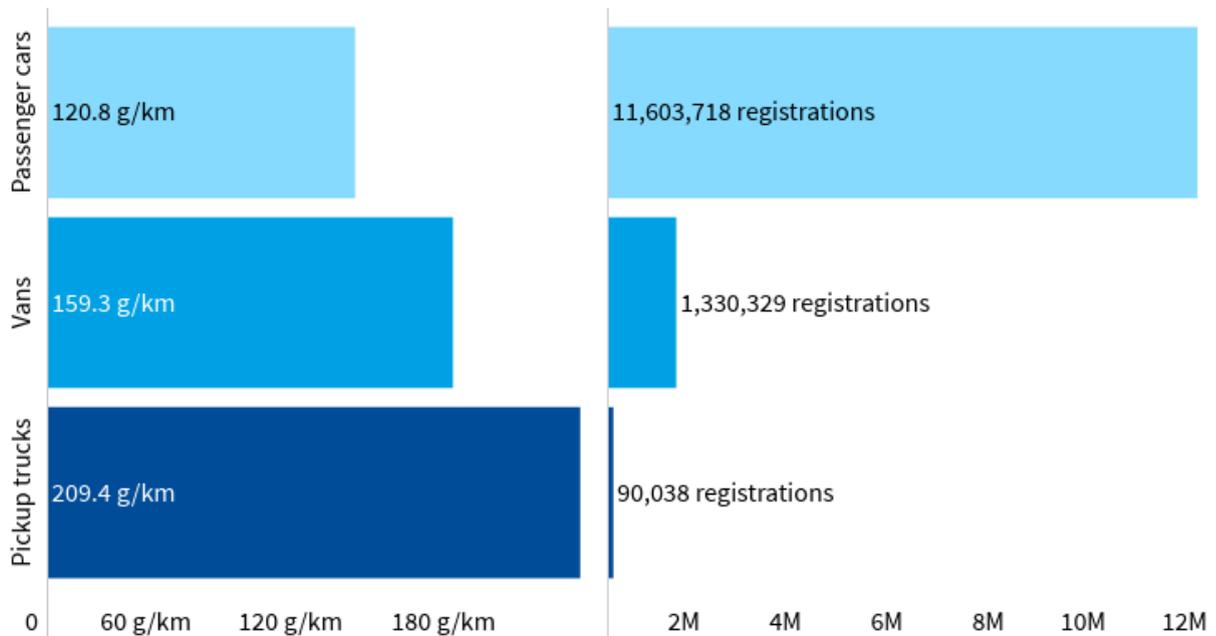


Figure 13. NEDC emissions and registrations in 2020 for passenger cars, vans, and pick-up trucks

As is clear from figure 13, pickup trucks make up only a small portion of the light-duty vehicle market (0.7% in 2019 and 2020). However, they emitted 73% more than cars and 31% more than vans on average in 2020³. The most polluting pick-up in the top ten was the Dodge Ram, which emits 323 g/km; while the most popular in 2020 was by far the Ford Ranger, making up 40% of new pickup truck registrations, followed by the Toyota Hilux, with almost 20,000 units registered (see Figure 14). Note that the production of the third most popular model, the VW Amarok, was discontinued in Europe in spring 2020, due in part to the van CO₂ standards [7]. Both the Mercedes-Benz X-Class [8] and Fiat Fullback were also axed in 2019, with incoming emissions regulation being cited as a reason for stopping production of the Fiat Fullback [9].

³ In 2019, pick-up trucks emitted 60% more than cars and 27% more than vans. The emissions gap between pick-up trucks and other light-duty vehicles grew from 2019 to 2020 as passenger car emissions dropped by 5.2% (when including all registrations) and van emissions by 0.6% as a result of the car and van CO₂ standards, while pick-up truck emissions increased by 2.8%.

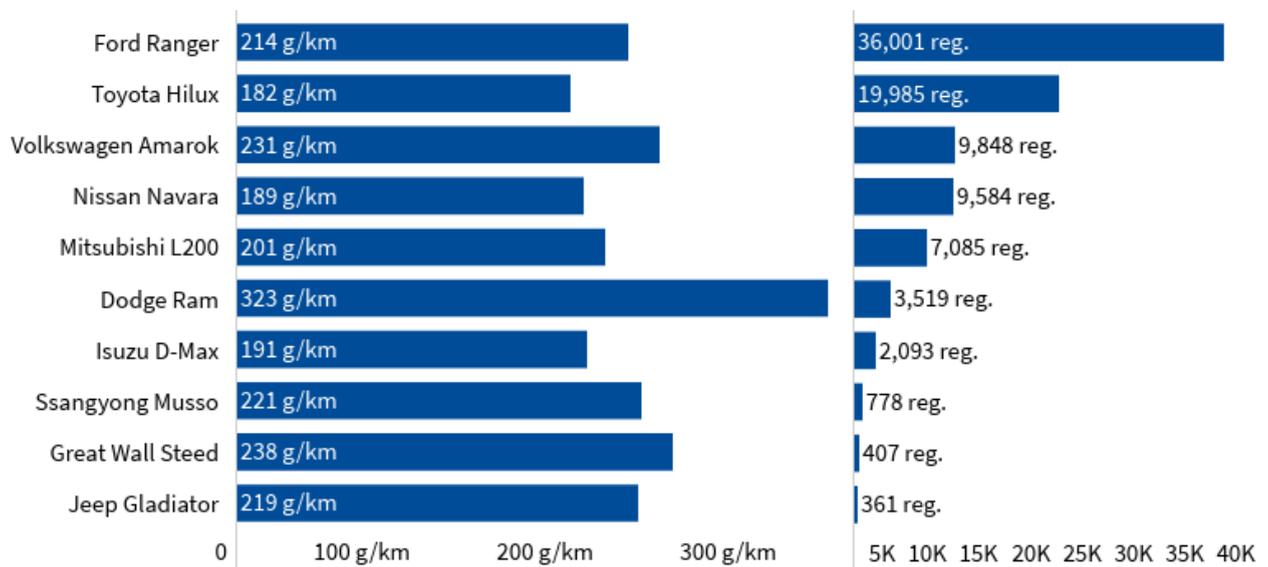


Figure 14. Top ten pickup trucks in Europe in 2020

2.5. WLTP-NEDC uplift

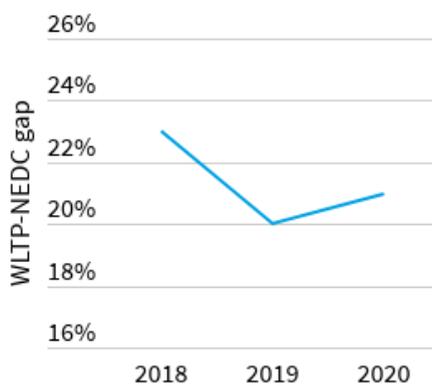


Figure 15. Annual WLTP-NEDC gap

From 2021 onwards, emissions will be reported based on the Worldwide Harmonized Light Vehicles Test Procedure (WLTP), rather than the New European Driving Cycle. Estimating the uplift between the NEDC and WLTP test cycles is key as it is used to translate future CO₂ emissions reduction targets for 2025 and 2030 from NEDC into WLTP. The WLTP cycle aims at testing vehicles under more realistic conditions so as to better approximate real-world emissions. As a result, emissions tested on the WLTP cycle are higher than on the NEDC cycle. In 2020, WLTP emissions were 20.9% higher than NEDC, slightly up from 20.4% in 2019 (see Figure 15).

The WLTP-NEDC gap varies widely across carmakers. For PSA, the average uplift is 29%, or double that of Daimler or Hyundai (Figure 16). Section 5.1 of the car CO₂ report details how carmakers could benefit from inflating the gap between NEDC and WLTP measurements [1].

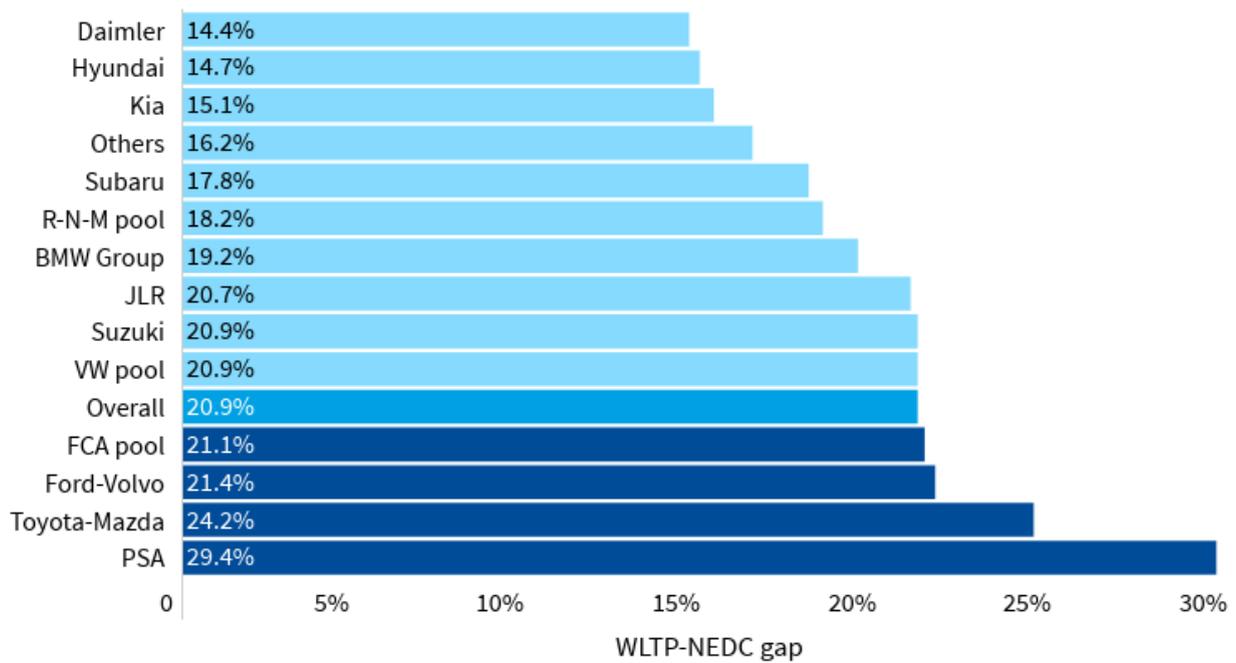


Figure 16. WLTP-NEDC gap by carmaker in 2020

3. Car CO₂ emission compliance

Passenger cars within the scope of the car CO₂ standards emitted 108 g/km on average in 2020, with wide variation between carmakers: indeed, the average Subaru car emitted 157 g/km, or 62% more than the average PSA car (97 g/km). Notably, no carmaker met their CO₂ emissions target without flexibilities. Once the phase-in contribution, super-credits, emissions savings from eco-innovations, and the target's mass adjustment are all taken into account, only four manufacturers appear to have missed their target. Namely, in order from farthest to closest to compliance: Subaru (34 g/km over its target), Suzuki (15 g/km), Jaguar Land Rover (4 g/km), and Volkswagen (1 g/km).

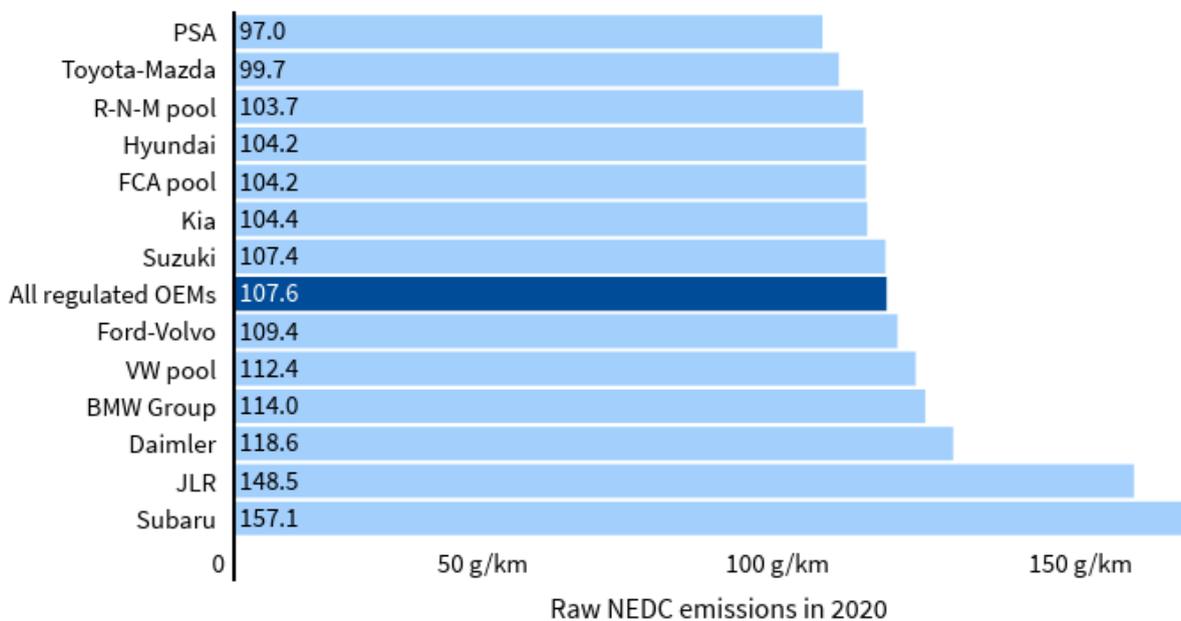


Figure 17. Average emissions of regulated carmakers in 2020

Adjusted targets and specific emissions⁴ are calculated according to the guidance issued by the European Commission [10]. Methodology for calculating the contribution of each flexibility is presented along with the results in the following subsections.

3.1. Who is regulated? Pooling, exemptions, and derogations

In order to meet their obligations, car manufacturers can choose to form pools [11]. In 2020, FCA pooled with Honda and Tesla (*FCA pool*); Ford with Volvo (*Ford-Volvo*); Renault with Nissan and Mitsubishi (*R-N-M pool*); Toyota with Mazda (*Toyota-Mazda*); and Volkswagen Group with MG-Saic as well as e.Go, LEVC, and Aiyways (*VW pool*). BMW Group, Daimler, Hyundai, Kia, PSA-Opel did not join any pooling agreement.

Note that certain low-volume manufacturers specialising in high-end, highly-emitting cars are not included in their parent group fleets. For example, Alpina is not listed as a pool member of BMW Group, nor is Maserati listed as a member of the FCA pool. Indeed, carmakers selling fewer than 1,000 cars per year are exempted from meeting a specific emissions target, while small-volume manufacturers (who register fewer than 10,000 cars a year) propose their own derogation targets.

In 2020, three niche manufacturers (responsible for 10,000–300,000 annual registrations) were granted derogations: Jaguar Land Rover, Subaru, and Suzuki. Instead of facing the 95 g/km target, they must reduce their emissions by 45% relative to their average CO₂ emissions in 2007. This corresponds to a target of 130.552 g/km for JLR, 120.718 g/km for Subaru, and 90.283 g/km for Suzuki [12]. The reason why Suzuki applied for a derogation, thus apparently choosing to face a stricter target (90 g/km with the derogation compared to 95 g/km without) is associated with how targets are adjusted for mass and explained in the following subsection.

3.2. What's their target? Mass adjustment

3.2.1. Average mass in 2020 and related target adjustment

For carmakers without a derogation, the 95 g/km target is adjusted according to the average mass of vehicles in their fleet. ICE vehicles emit more when they get heavier [13], so this mechanism was implemented to create a level-playing field where targets were relaxed for manufacturers selling heavier-than-average cars. In practice, a carmaker's average mass is not compared to the average mass of vehicles that year, but to the reference mass M_0 . In 2020 M_0 is 1379.88 kg, which corresponds to the average mass of cars registered in 2014–2016. As cars have been getting heavier, the average car in 2020 weighed 82 kg more than the reference mass. This translated into an average target weakening of 2.7 g/km for all new cars registered in 2020, as shown on Figure 18. Jaguar Land Rover had the heaviest fleet, as its cars weighed 2,096 kg on average. However, since JLR has a derogation, its target is not adjusted for fleet mass. Daimler had the heaviest cars among the manufacturers without a derogation. Since Daimler's cars were on average 354 kg heavier than the reference mass M_0 , the 95 g/km target was relaxed by almost 12 g/km. Meanwhile, three manufacturers faced stricter targets as a result of the mass adjustment: PSA, the Renault-Nissan-Mitsubishi alliance (*R-N-M pool*), and FCA-Tesla-Honda (*FCA pool*). Suzuki produced the lightest fleet, which was on average 267 kg lighter than the reference mass in 2020.

⁴ Specific emissions are carmakers' emissions once all flexibilities (phase-in, supercredits, savings from eco-innovations) have been taken into account.

Had Suzuki not been granted a derogation, it would have received an adjustment of -9 g/km and thus face a target of 86 g/km, stricter than its 90 g/km target with the derogation.

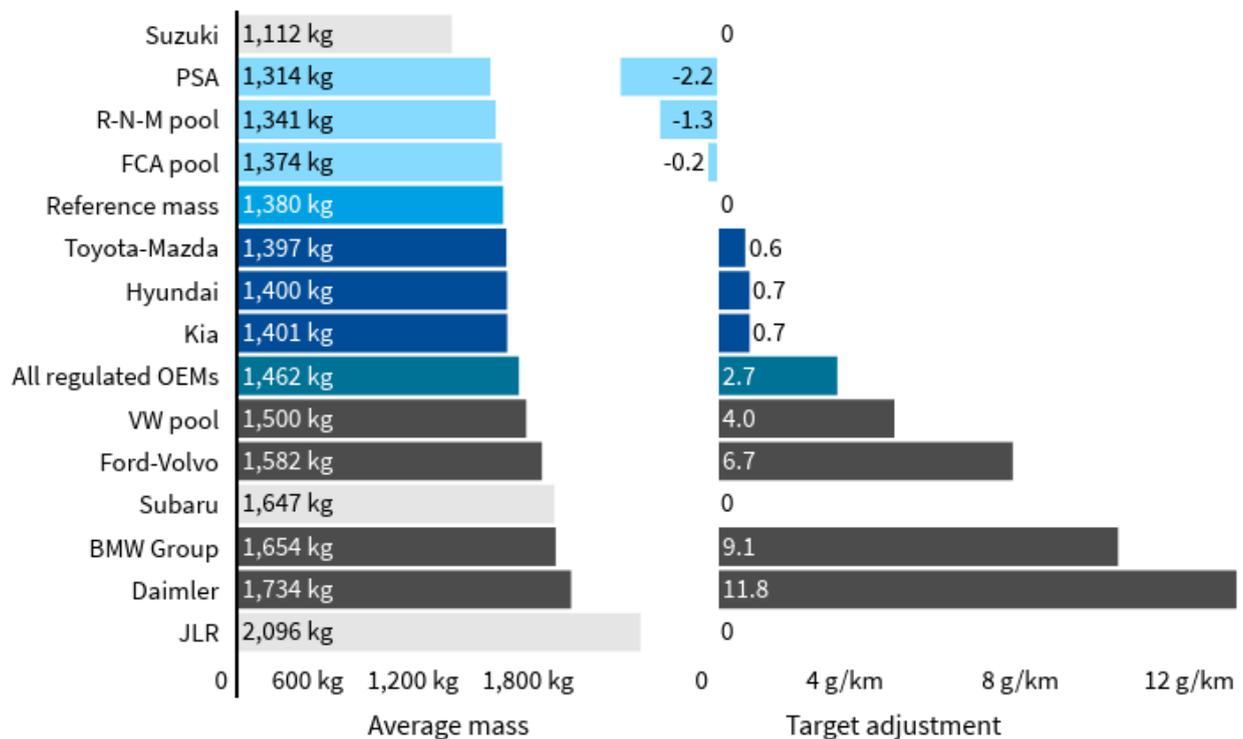
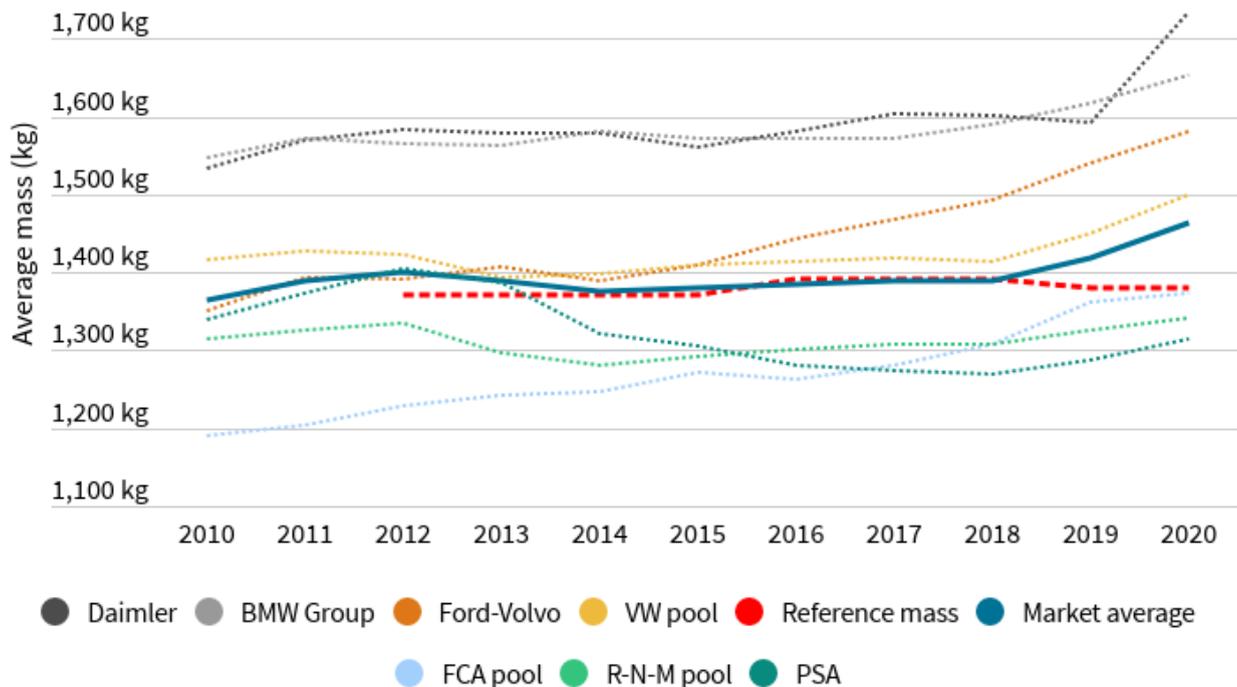


Figure 18. Average mass and resulting target adjustment by carmaker

3.2.2. Mass trends

This subsection looks at how average mass has evolved by carmaker, by vehicle category, by powertrain, and finally by country.

First, this paragraph focuses on how average mass has changed by carmaker (Figure 19). Average mass increased for all regulated OEMs in 2020, going up by 3% on average. Among manufacturers without a derogation, Daimler had the heaviest cars. It also experienced the highest weight gain in the past year: +9%. Three factors played a part. First, Daimler’s share of SUVs jumped from 21% in 2019 to 33% in 2020. Second, its share of plug-in hybrids went from 2% to 14%, 9 percentage points higher than the overall PHEV share across the EEA. As will be seen later, PHEVs are the heaviest powertrain in 2020 (see Figure 21). Third, Daimler’s share of small cars (segment A) fell from 11% to 4%, its lowest to date. This is because Smart discontinued ICE production in 2020 but failed to ramp up battery-electric car sales to match previous sales levels. In 2019, Smart registered 96,000 ICE cars and 17,000 battery-electric cars. In 2020, it registered only 83 ICE cars, a drop in volumes of 99.9%, and 27,000 battery-electric cars, an increase of 60%.



All carmakers include regulated and non-regulated carmakers. Carmakers with a derogation have been excluded as their targets are not adjusted for mass. Non-European carmakers are not shown to avoid cluttering.

Figure 19. Annual average mass by carmaker

Second, this paragraph examines how mass has evolved by vehicle category in the past decade (Figure 20). Hatchback mass was relatively stable overall until 2018, with annual fluctuations cancelling each other out. Indeed the average hatchback weighed 1,288 kg both in 2010 and in 2018. However, this stagnation was followed by rapid weight gain in 2019 (up 2%, reaching 1,308 kg) and 2020 (up 3%, reaching 1,350 kg). This sudden increase also occurred for SUVs (+1% in 2019, +3% in 2020), thus reversing the downward trend which had been observed until 2018. From 2010 to 2018, SUVs lost 183 kg on average, or about 11% of their 2010 mass. This sustained decline was caused by the increased popularity of smaller models, namely compact and subcompact SUVs. SUVs then regained 66 kg (i.e. 4% of their 2018 mass) in 2018–2020. The other reason behind this rapid weight gain is the increased market penetration of electric vehicles which are heavier than ICEs on average (see next paragraph). For cars, battery-electric vehicles and plug-in hybrids each represented 0% of registrations in 2010–2014 and 1% each in 2015–2018. However, the share of cars which are battery-electric jumped to 3% in 2019 and to 8% in 2020, while the share of cars which are plug-in hybrids went from 1% in 2019 to 4% in 2020. Similarly, BEVs and PHEVs each represented 1% of SUVs in 2019, but their respective shares of the SUV market increased to 4% and 7% in 2020.

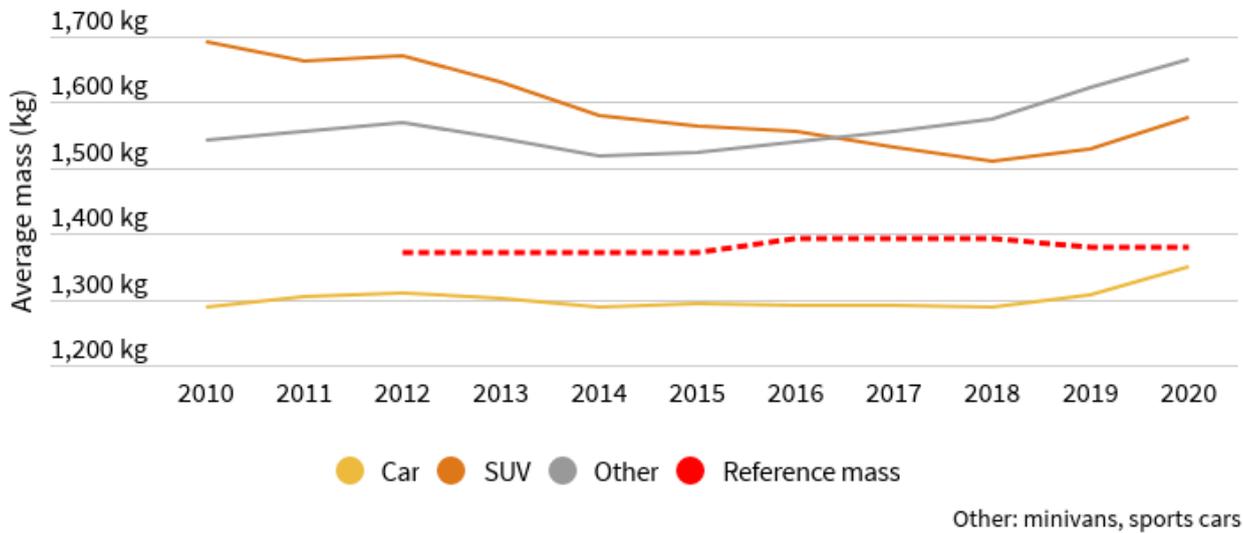


Figure 20. Annual average mass by vehicle category

Then, this paragraph analyses how mass evolved by powertrain (Figure 21). Plug-in hybrids are now the heaviest vehicles, weighing 1,932 kg on average in 2020 and having surpassed fuel cell cars in weight in 2019. EVs put on the most weight in the past decade: +49% for battery-electric vehicles and +23% for PHEVs. This evolution is due to both increased battery sizes (especially for BEVs) and increased SUV share (especially for PHEVs). By comparison, the average mass of full hybrids increased by 11% from 2010 to 2020, and that of pure ICE cars by 3%.

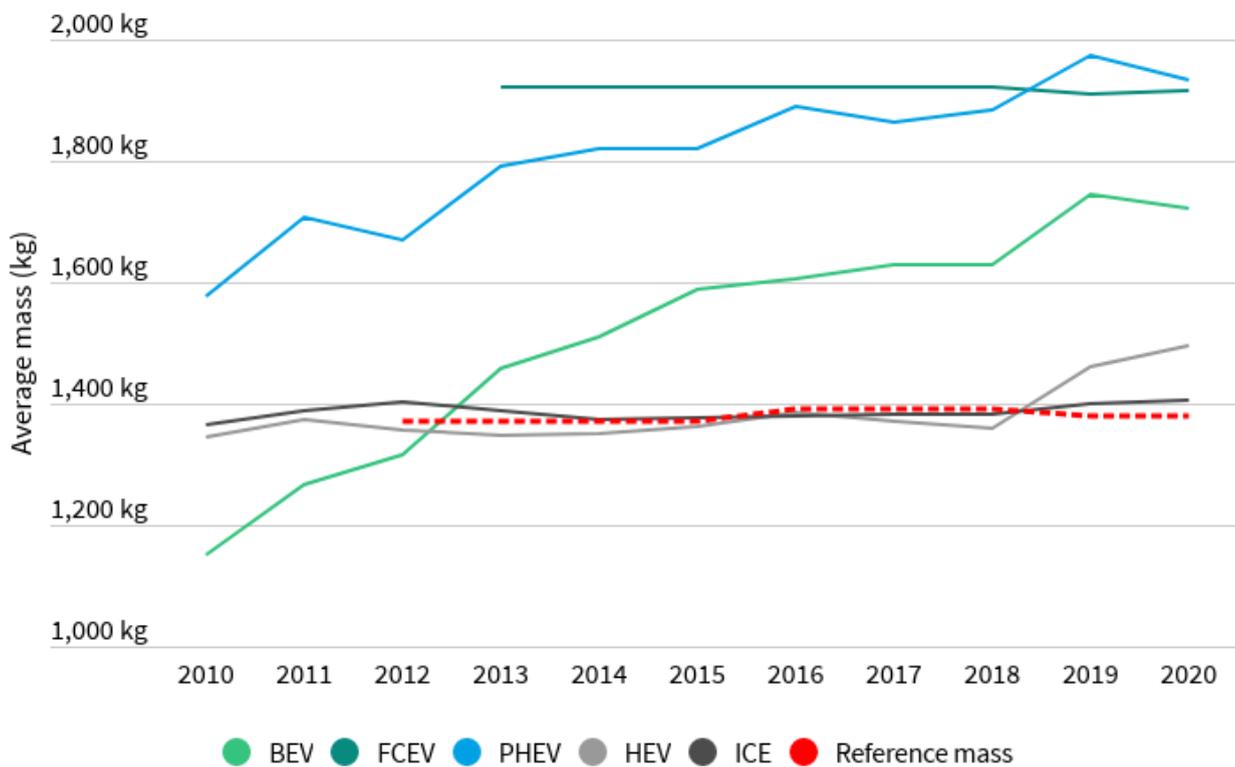


Figure 21. Annual average mass by powertrain

Finally, this paragraph looks at average fleet mass by country (Figure 22). Passenger cars are heaviest in Norway (1,807 kg in 2020), Iceland (1,767 kg), and Sweden (1,655 kg), that is to say in the countries with the highest EV shares (75%, 46%, and 33% respectively). For the largest passenger car markets in 2020, German cars weighed 1,534 kg on average, French cars 1,360 kg, British cars 1,509 kg, Italian cars 1,351 kg, Spanish cars 1,425 kg, Belgian cars 1,478 kg, and Polish cars 1,518 kg. Only 7 countries (out of 30 concerned by the car CO₂ standards) had average car masses under the reference mass: Malta, Greece, Hungary, Italy, France, Lithuania, and Romania (listed from lightest to heaviest).

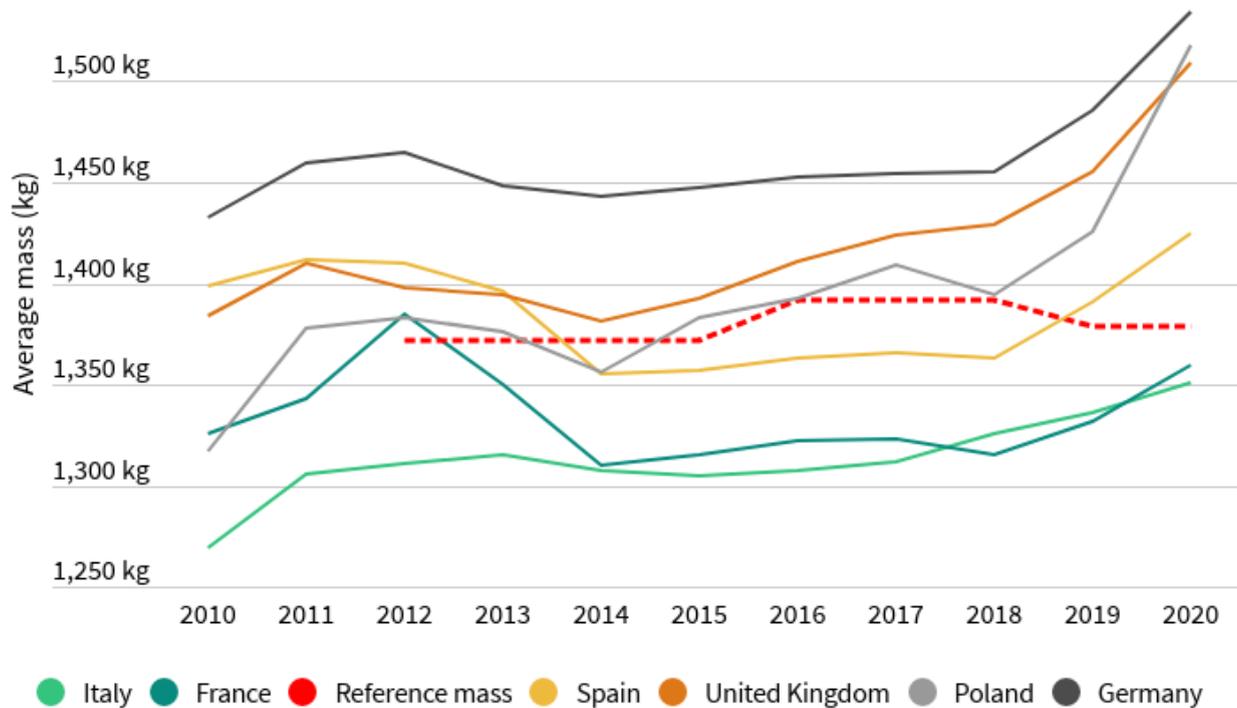


Figure 22. Annual average mass by country

3.3 Meeting the target

This section analyses the contribution of all the flexibilities which affect a carmaker’s specific emissions. These are the 95% phase-in, super-credits, and credits for eco-innovations.

3.3.1. 95% phase-in

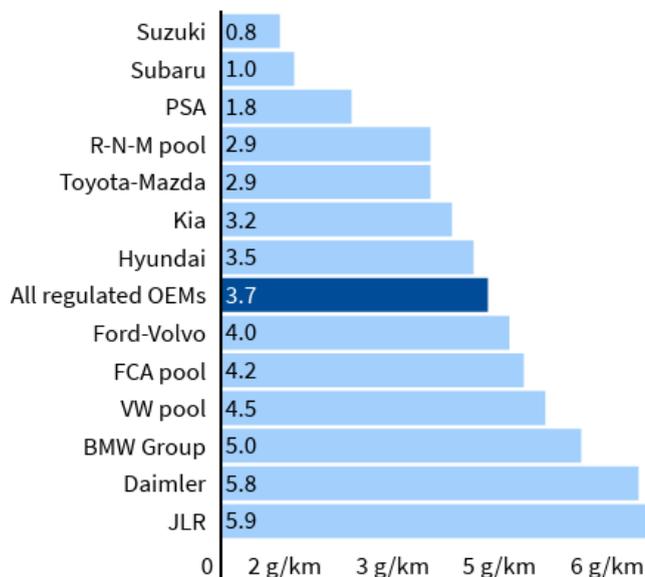


Figure 23. Phase-in contribution by OEM

2020 is a phase-in year, meaning that only 95% of a manufacturer's new registrations are considered for the purposes of determining its average emissions. The 95% cars with the lowest emissions should be included, once emissions savings from eco-innovations have been taken into account (see points a and b in the European Commission's guidance [10]). Overall, this phase-in provision reduced on-paper emissions from regulated OEMs by 3.7 g/km. For Jaguar Land Rover and Daimler, more than 5 g/km were shaved off of their emissions by excluding their 5%-most-polluting vehicles from their fleet average in 2020.

3.3.2. Super-credits

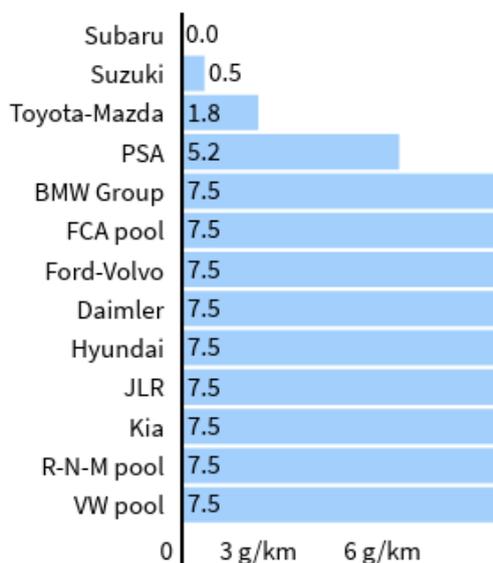


Figure 24. Super-credits by OEM

To incentivise the uptake of cars emitting under 50 g/km—known as zero- and low-emission vehicles or ZLEVs—every ZLEV registered in 2020 was counted twice in the average fleet emissions. To preserve the integrity of the regulation, the maximum amount of emissions reductions due to super-credits is capped at 7.5 g/km for 2020–2022. Most manufacturers have exhausted their super-credits in 2020. Only Subaru, Suzuki, Toyota-Mazda, and Stellantis (the merger of PSA and FCA) have any super-credits left for 2021 and 2022. (Note that a ZLEV registered in 2021 counts as 1.67 cars, not 2 as in 2020). The WLTP value of the remaining super-credits for each pool is explored in the report [1].

3.3.3. Eco-innovations

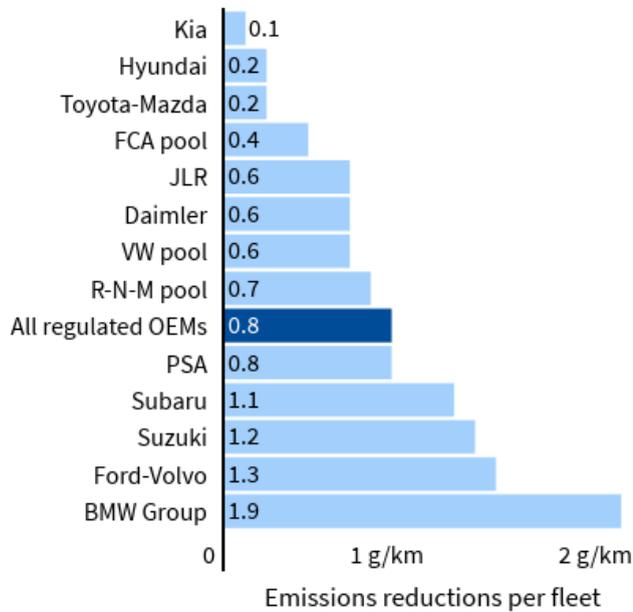


Figure 25. Average emissions reductions from eco-innovations by OEM at the fleet level

Eco-innovation technologies such as LED lights or efficient alternators can result in emissions savings which are not fully captured by the NEDC test. Car manufacturers can claim emissions reductions from fitting such innovative technologies onto their cars.

In 2020, eco-innovations shaved off 0.8 g/km on average of the emissions of regulated carmakers (Figure 25). For BMW Group, emissions savings reached 1.9 g/km as it fitted almost 75% of its fleet with at least one innovative technology (see Figure 30). At the opposite end of the spectrum, Kia earned a mere 0.1 g/km in eco-innovations credits. In fact, Kia had the lowest share (7%) of cars fitted with eco-innovations (when excluding non-regulated carmakers).

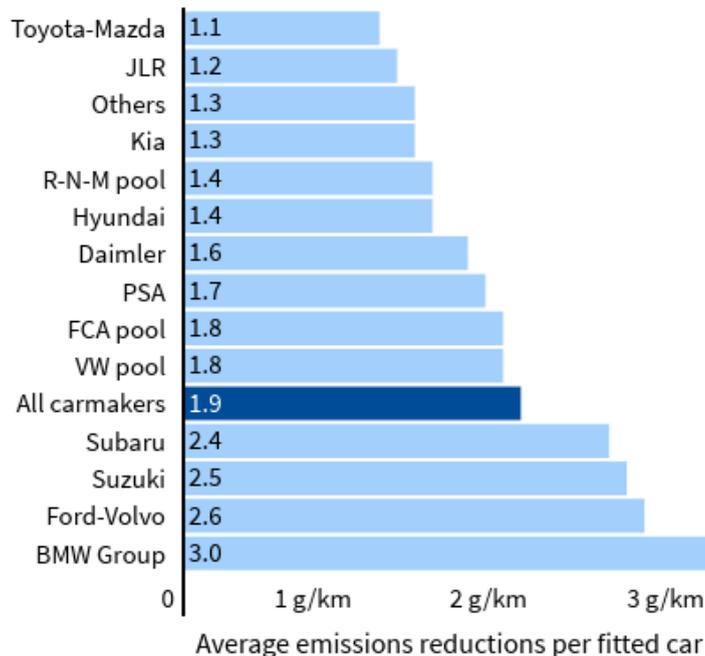


Figure 26. Average emissions reductions from eco-innovations by OEM for fitted cars only

When looking at the average emissions savings per car fitted with eco-innovations, BMW Group leads as well: on average its cars fitted with eco-innovations earn 3 g/km in emissions savings (Figure 26). This is because BMW Group fits both more eco-innovations per car, and invests in (and combines) technologies other than lights and alternators. In addition, BMW Group is the only car manufacturer fitting a total of 4 innovative technologies onto some of its cars. Toyota-Mazda and Jaguar Land Rover earn the least

credits per fitted car (1.1 g/km and 1.2 g/km respectively), as respectively 82% and 100% of their fitted cars only have LED lights. Yet, LED lights are the eco-innovation which save the least emissions (see Table 2 and Figure 29).

Number of innovative technologies	Average emissions reductions	Share of cars fitted with this number of technologies in 2020
1	1.4 g/km	28.4%
2	2.6 g/km	16.2%
3	4.3 g/km	1.1%
4	5.8 g/km	0.1%

Table 1. Average emissions reduction and market share by number of innovative technologies

In 2020, 28% of new registrations had a single innovative technology, 16% had two, 1% had three, and 0.1% had four (Table 1). The figures given for the whole market should be put into perspective by looking at previous years (Figure 27). In 2015, innovative technologies were virtually nonexistent, as only 0.3% of new registrations had one or more eco-innovation(s). Market adoption grew to 2.3% in 2016 and 2.6% in 2017, before doubling to 5.6% in 2018, and trebling two years in a row to 15.4% in 2019 and 45.8% in 2020. This sudden and massive increase shows that manufacturers ramped up eco-innovations in recent years in order to maximise emissions savings and curb their CO₂ emissions on paper in 2020.

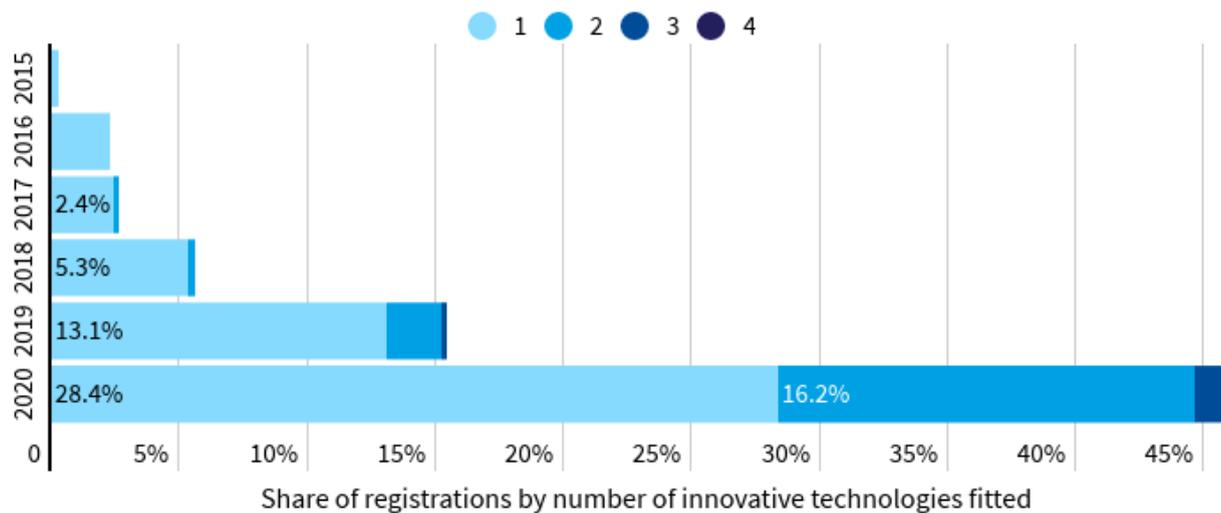
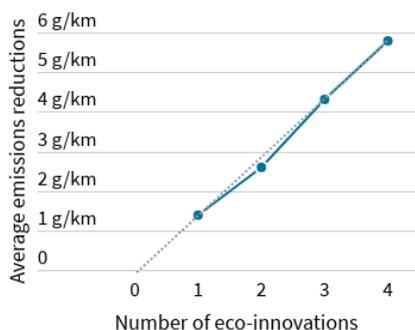


Figure 27. Annual share of registrations by number of eco-innovations fitted



As expected, emissions savings correlate positively with the number of eco-innovations fitted (Figure 28). Yet, as seen above, most carmakers only fit a single technology onto their cars. The exceptions are BMW Group, Ford-Volvo, Suzuki, and Subaru, which all fit more cars with two eco-innovations than with a single one. This explains why these four carmakers have the highest savings per fitted car (Figure 26) and at the fleet level (Figure 25).

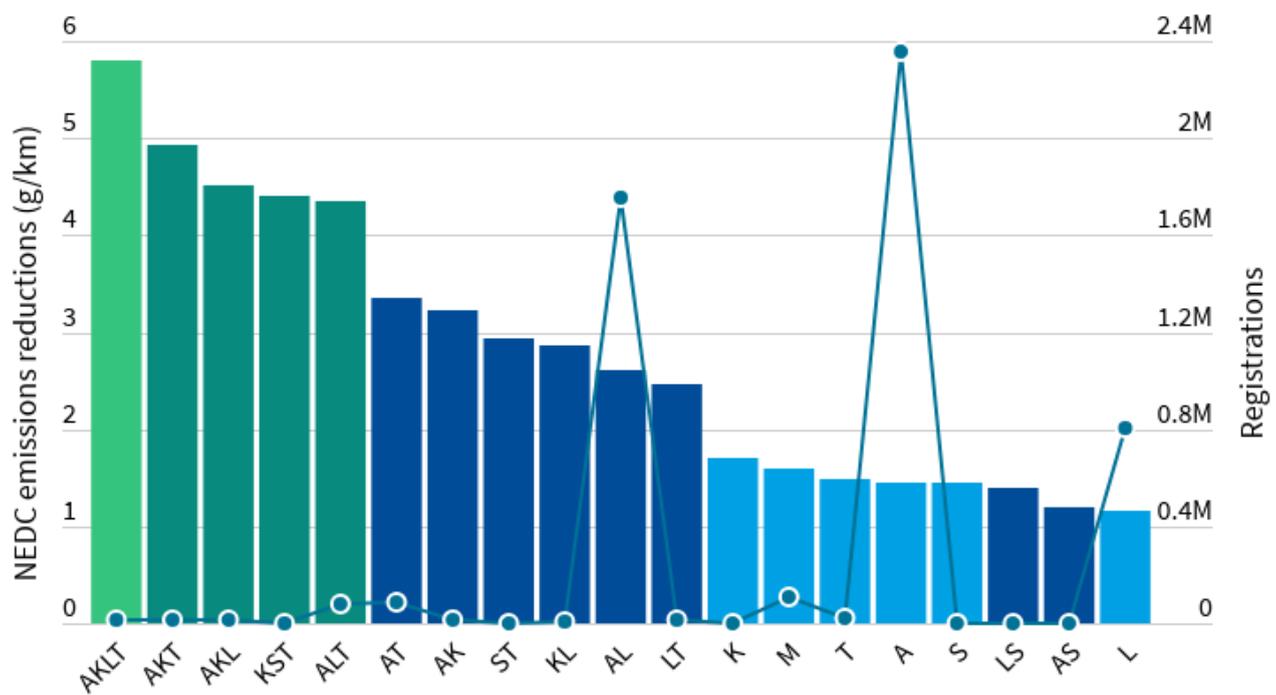
Figure 28. Emissions savings by number of eco-innovations

As presented in Table 2, there are five types of innovative technologies certified on the NEDC test cycle: LED lights (L), efficient alternators (A), kinetic (e.g. coasting function, K), solar (e.g. battery-charging solar roof, S), and thermal (e.g. enthalpy storage tank, T). In practice, most fitted eco-innovations are alternators and lights.

Technology type	Average emissions reductions when the technology is fitted alone	Share of cars fitted with this technology in 2020
Alternator	1.5 g/km	37.5%
Lights	1.2 g/km	23.3%
Thermal	1.5 g/km	2.0%
Kinetic	1.7 g/km	0.5%
Solar	1.4 g/km	0.001%
Missing information	1.6 g/km	0.9%

Table 2. Average emissions reduction and market share by type of innovative technology

When looking at all existing combinations of innovative technologies (Figure 29), fitting only an efficient alternator is the most common eco-innovation, though it reduces emissions by less than 1.5 g/km. Fitting only LED lights is both the third most popular option, and the one which saves the least emissions (less than 1.2 g/km on average in 2020). Fitting both LED lights and an alternator is the second option preferred by carmakers. This saves 2.6 g/km on average on paper, which is less than half the savings from the most effective combination: fitting an alternator, a coasting function, LED lights, and a thermal tank. This combination, only present on some BMW Group cars, reduces emissions by 5.8 g/km on paper.



A: Alternator K: Kinetic, L: Lights, S: Solar, T: Thermal, M: Missing information on technology type.

Figure 29. Average emissions reductions from eco-innovation combinations in 2020

The rest of this section focuses on the three main combinations: alternators, lights, and alternators and lights (Figure 30). *Other* refers to all other observed combinations, and shares of cars fitted with a certain combination are given for the whole fleet, including cars without any eco-innovations. Jaguar Land Rover has the highest share of cars fitted with only lights (48%), followed by Toyota-Mazda (21%) and Volkswagen’s pool (10%). Daimler has the largest share of cars fitted with only an efficient alternator (45%), ahead of FCA-Tesla-Honda (42%) and Renault-Nissan-Mitsubishi (35%). The manufacturer which combines the most alternators and lights together is Ford-Volvo, which fits this combination on 43% of its cars, followed by Suzuki (37%) and BMW Group (34%).

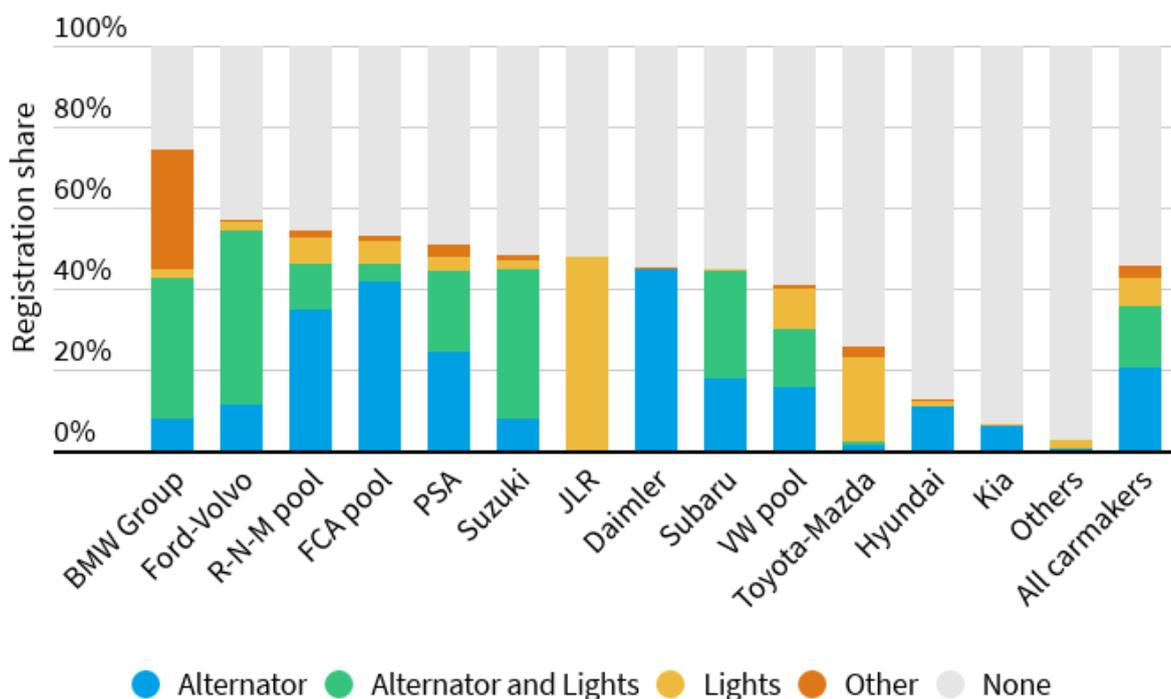


Figure 30. Share of registrations with any of the top 3 eco-innovations by OEM

Eco-innovations other than the top 3 most popular combinations are mostly fitted by BMW Group, as they are found on 30% of the group’s cars. They are predominantly combinations of alternator and thermal technologies (36% of BMW Group’s “Other” eco-innovations) and combinations of alternator, lights and thermal technologies (34%). Apart from BMW Group, only PSA and Toyota-Mazda appear to fit more than one in fifty cars with eco-innovation other than the top 3 (3% and 2% of their respective fleets). However, under closer inspection, these are mainly combinations which cannot be identified: eco-innovations where information is missing make up 99.9% of PSA’s “Other” eco-innovations, and 86% of Toyota-Mazda’s.

3.4. Who is compliant?

Once all flexibilities used in calculating official emissions for each carmaker are considered—namely the 95% phase-in, supercredits, and credits for innovative technologies—, regulated carmakers emitted on average 95.6 g/km in 2020. While this is above the on-paper target of 95 g/km, it is 2.1 g/km under the mass-adjusted target of 97.7 g/km. As shown on Figure 28, four manufacturers—specifically Volkswagen pool and the three niche manufacturers with a derogation—appear to have missed their target based on provisional data. As a consequence, they could face fines equal to 95€ per g/km per new car registered in 2020 (if their non-compliance is confirmed when final data is published). For Volkswagen, which emitted

0.8 g/km than its target, this translates to 76€ per new car, or approximately 223 million euros in total. Jaguar Land Rover, whose emissions exceeded its target by 3.9 g/km, could face a fine of 372€ per new car, or 58 million euros. Suzuki could face a fine of 1,380€ per new car, or 232 million euros in total, the highest fine of the four non-compliant OEMs. Finally, Subaru could face a fine of 3,261€ per new car, or 52 million euros, the lowest penalty of the four, in spite of having missed its target by the largest amount.

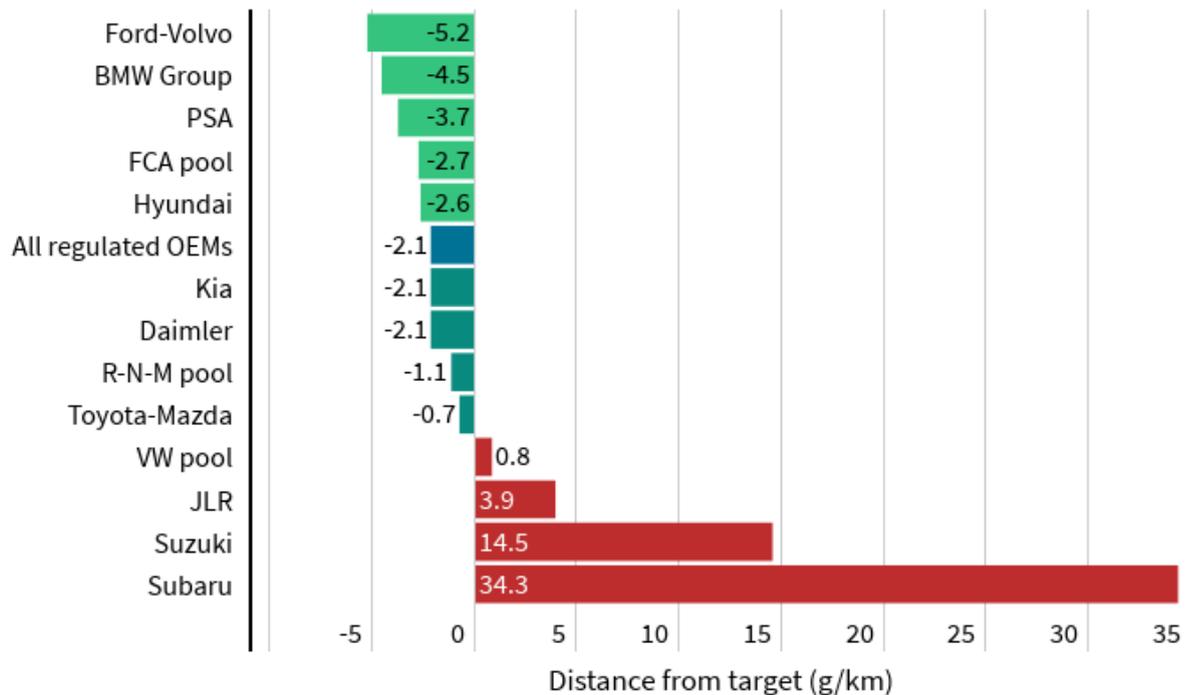


Figure 28. Difference between specific emissions and mass-adjusted target by OEM

4. Conclusions

The 2020 car CO₂ standards had a measurable impact on the European market, as carmakers finally ramped up electric vehicle sales to meet their targets. As a result, battery-electric cars made up 6% of all registrations within the scope of the regulation, while plug-in hybrids made up 5%.

However, emissions reductions on paper were not fully reflected in the real world, as manufacturers also made use of regulatory flexibilities to be compliant. On average, adjusting each OEM's target for average fleet mass relaxed the official target by 2.7 g/km, from 95 g/km to 97.7 g/km. As cars are expected to keep getting heavier, the mass adjustment will continue to severely weaken the regulation, as is detailed in the report [1]. Compliance was also eased by excluding the 5%-most-polluting vehicles in each carmaker's fleet, thus artificially reducing emissions by 3.7 g/km on average. Yet this phase-in provision was only in place in 2020, so its weakening effect was fortunately temporary. Then, almost all major manufacturers benefitted from super-credits worth 7.5 g/km. Toyota-Mazda and Stellantis (i.e. the merger of PSA and FCA) are the only non-niche carmakers with any super-credits left in 2021, and the super-credit mechanism will be phased out after 2022. Lastly, eco-innovations are expected to grow in popularity as an easy way to reduce on-paper emissions, as technologies become cheaper. On average, eco-innovation credits shaved 0.8 g/km off the emissions of all regulated carmakers. BMW Group benefited the most from eco-innovation credits in 2020, thus reducing its on-paper emissions by 1.9 g/km.

Finally, this annex also showed how SUVs are slowing down emissions reductions from new passenger cars, as they emit more than regular cars and make up an increasing share of the market. The majority (59%) of high-emitters (i.e. vehicles emitting more than 130 g/km) are SUVs. High market penetration of SUVs also increases the average fleet mass, which further hinders emissions savings by relaxing the emissions target.

Further information

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