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BRIEFING

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CO_2 emissions from new passenger cars in the European Union: Car manufacturers' performance in 2018

This briefing paper provides an overview of CO_2 emission levels of new passenger cars in the European Union (EU) in 2018 based on a preliminary dataset recently released by the European Environment Agency (EEA).[1] The dataset showed that new cars sold in the EU in 2018 had average CO_2 emissions of 121 g CO_2/km, 2 g/km higher than in 2017, as measured over the New European Driving Cycle (NEDC).

As a follow-up to the previous year's briefing,[2] this paper details manufacturer performance in terms of CO_2 emissions reduction, fuel and technology trends, and market share. The paper focuses on differences between Member States, as well as between the major car makers. It also discusses flexible compliance mechanisms and presents data on the Worldwide Harmonized Light Vehicles Test Procedure (WLTP).

The preliminary EEA dataset used in this briefing has yet to be validated. The final dataset will be published at the end of 2019, so the specific values used in this report may change. The preliminary data for 2018 should, however, provide relatively reliable results.[3] The ICCT will review the final European emissions data in the next edition of the European Vehicle Market Statistics Pocketbook.[4]

1 EEA, "Monitoring of CO_2 Emissions from Passenger Cars – Regulation (EC) No 443/2009," Data, European Environment Agency, 2019, https://www.eea.europa.eu/data-and-maps/data/co2-cars-emission-16.

2 Uwe Tietge, *CO_2 Emissions from New Passenger Cars in the EU: Car Manufacturers' Performance in 2017* (ICCT: Washington, DC, July 2018), https://theicct.org/publications/co2-emissions-new-passenger-cars-eu-car-manufacturers-performance-2017.

3 Historically there had been little difference between preliminary and final data. In 2017, there was virtually no difference in fleet-average CO_2 emission values between the preliminary and final data.

4 European vehicle market statistics pocketbook, International Council on Clean Transportation, http://eupocketbook.org

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1. BACKGROUND

The EEA recently released a preliminary dataset on the CO_2 emissions performance of new passenger cars in the EU in 2018. This dataset is used by the European Commission to monitor and evaluate whether manufacturers are in compliance with mandatory CO_2 emission targets for passenger cars as defined in Regulation EC 443/2009. The EEA collects data from EU Member States, which are required to submit detailed information on each new car registered in each calendar year.

Compared to previous years, the EEA monitoring data underwent several structural changes. First, both NEDC and WLTP CO_2 emissions values are reported due to the transition to the WLTP. In the preliminary 2018 data, NEDC CO_2 emission values were reported for 97.4% of passenger cars registered in 2018; WLTP CO_2 emission values were reported for 29.0% of vehicles; and both NEDC and WLTP values were reported for 26.4% of vehicles. This section and sections 2–4 focus on NEDC values relative to the 2020 CO_2 emission target, which is solely based on NEDC CO_2 emission values. Section 5 investigates WLTP-based CO_2 emission values, which will be used in post-2020 CO_2 targets. Second, a small number of records, equivalent to 0.9% of passenger car registrations, were marked as duplicates in the dataset. Duplicates refer to vehicles that appeared multiple times in the monitoring data, which will be consolidated in the final dataset. Duplicates were removed before aggregating the data for this briefing. Lastly, because vehicles registered in all countries in the European Economic Area—not only EU member states—will count toward future CO_2 emission targets, the monitoring data for the first time includes vehicles registered in Iceland. Iceland accounted for 0.1% of passenger car registrations in 2018. Norway is expected to be added in the monitoring data for 2019.

The EEA data show that the sales-weighted average CO_2 emissions on the NEDC from new passenger cars in the EU in 2018 were 121 g/km, 2 g/km higher than in 2017, continuing the trend of increasing CO_2 emission values after 2016. Figure 1 plots the historical average CO_2 values relative to targets. Before CO_2 standards were introduced, CO_2 emissions, on average, declined by 1.2% per year from 2000 to 2007. When the first CO_2 standards were agreed upon in 2008, manufacturers significantly outperformed the annual reduction rates required to meet the 2015 target of 130 g/km: instead of the required 2.5% annual reduction, average CO_2 emissions declined by 3.5% per year. After 2015 targets were met, and in the absence of targets before 2020, average CO_2 emissions increased by 0.3% per year. As of 2018, fleet-average CO_2 emissions will have to decline by 7.6% per year to comply with the 2021 target. Manufacturers will likely also rely to a larger degree on flexible compliance mechanisms such as super-credits and eco-innovations (see Section 4) to comply with 2020/21 targets.

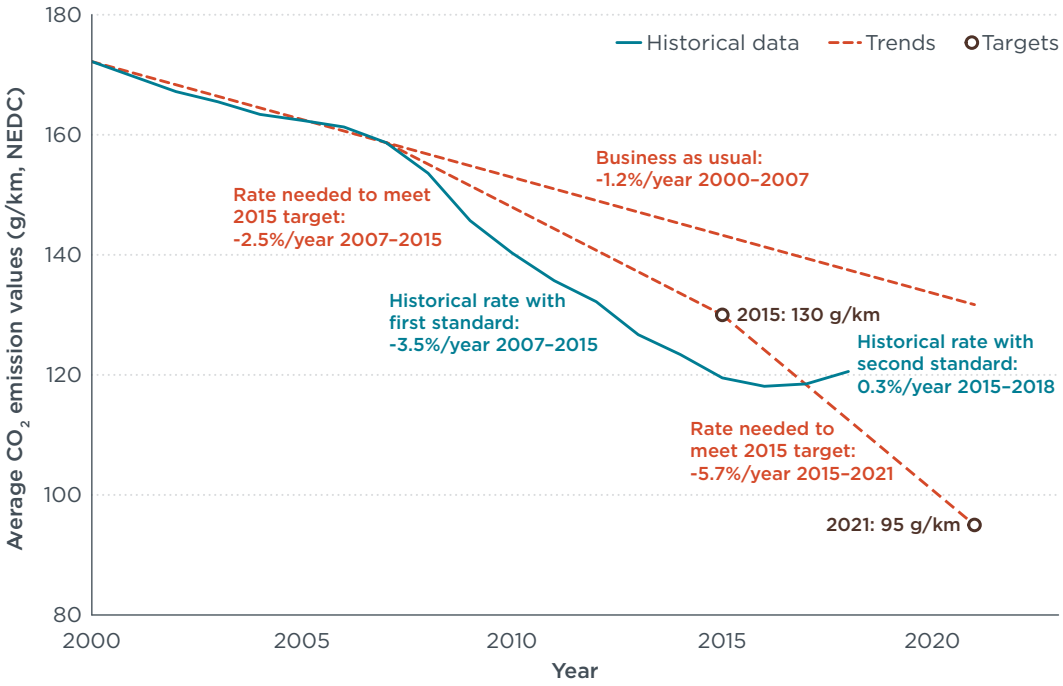

Figure 1. Historical average CO_2 emission values, targets, and annual reduction rates of new passenger cars in the European Union.

2. CO_2 EMISSIONS BY VEHICLE MANUFACTURER

Car manufacturers can pool together the average emissions of several brands to meet CO_2 standards. For this analysis, unless otherwise noted, we track manufacturer pools and individual manufacturers with more than 250,000 registered passenger cars in 2018.[5] Vehicle manufacturers with less than 300,000 registered passenger cars per calendar year can apply for a so-called niche derogation, which results in non-standard, manufacturer-specific reduction targets for 2020 onward.

Figure 2 and Table 1 present data for ten major manufacturer pools and two large manufacturers representing approximately 94% of all EU new passenger car sales in 2018. Figure 2 plots each manufacturer's average emissions relative to its 2015 and 2020/21 targets. The targets are adjusted for vehicle mass using so-called limit value curves, which are displayed in the figure. Table 1 presents the same data, but includes information on each manufacturer's market share in 2018 and emission reductions since 2017.

5 Manufacturer pools (and their major brands) are: BMW (BMW, Mini); Daimler (Mercedes-Benz, Smart); FCA-Tesla (Alfa Romeo, Fiat, Jeep, Lancia, Tesla); Ford (Ford); Hyundai (Hyundai); Kia (Kia); PSA-Opel (Citroën, DS Automobiles, Opel, Peugeot, Vauxhall); Renault (Dacia, Renault); Toyota-Mazda (Lexus, Mazda, Toyota); and Volkswagen Group (Audi, Porsche, SEAT, Škoda, VW). Two manufacturers outside of pools (Nissan, Volvo) registered more than 250,000 passenger cars in 2018. The four following pools (and their major brands) registered less than 250,000 passenger cars in 2018: Honda (Honda); Mitsubishi (Mitsubishi); Suzuki (Suzuki); and Tata Motors-Jaguar Land Rover (Jaguar, Land Rover).

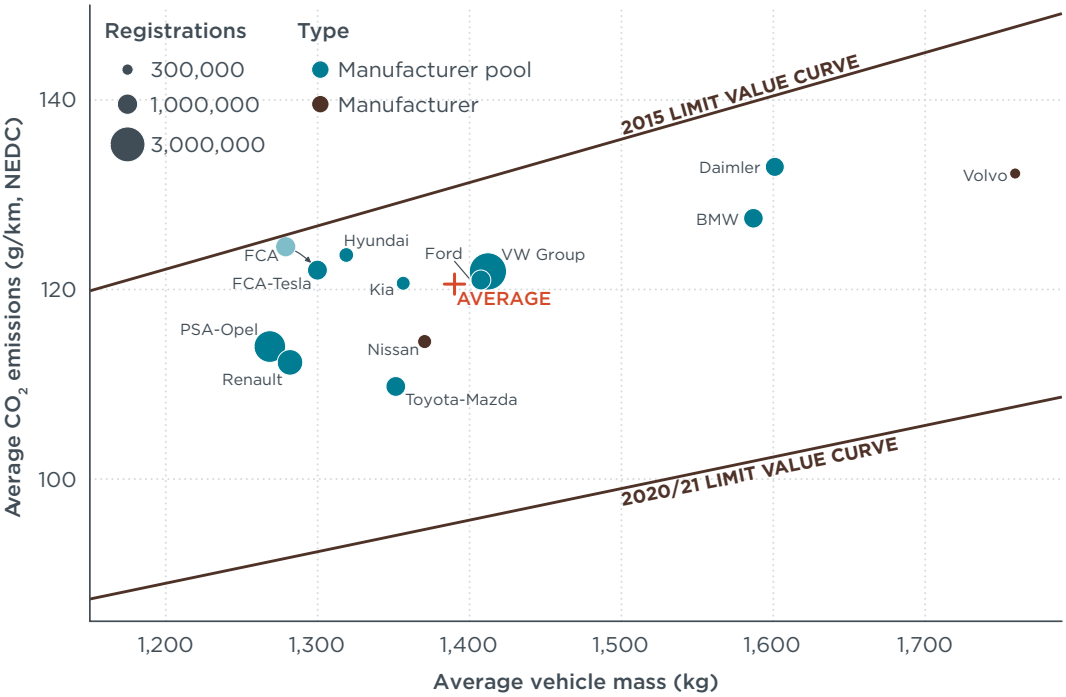

Figure 2. Performance of top-selling EU passenger car manufacturers in 2018 compared to 2015 and 2020/2021 emission target compliance curves.

Overall, fleet-average CO_2 emissions increased by 2 g/km from 2017 to 2018. Toyota-Mazda had the lowest CO_2 emissions out of all major manufacturer pools in 2018 and was the closest to its 2020/21 limit value. Nissan was the only manufacturer to record a decrease in average CO_2 emissions. By paying Tesla to join its pool in 2019, Fiat-Chrysler Automobiles (FCA) would have seen a 2 g/km decrease in average CO_2 emissions in 2018 (see Figure 2). FCA and Tesla are grouped together throughout the rest of this briefing to reflect current manufacturer pools, even though, in 2018, both manufacturers had not yet officially formed a manufacturer pool. Volvo recorded the largest increase in CO_2 emissions at 8 g/km. With 16 g/km (15%) remaining, Toyota-Mazda was the closest to its 2020/21 target in 2018. Hyundai was in the worst position to meet its 2020/21 target, with a 31 g/km (25%) reduction needed to comply, but could still form a pool with its affiliate Kia to make progress toward 2020/21 targets. Fleet-average CO_2 emissions will have to decline by 26 g/km (21%) to be compliant with 2020/21 targets.

Table 1. Manufacturer market shares, average vehicle mass and CO_2 emissions, and CO_2 emission targets for 2020 (effectively 2021). Rows are sorted by average CO_2 emissions in 2018. Impact of flexible compliance mechanisms (see section 4) not considered here.

Manufacturer pool/ manufacturer	EU market share	Average mass (kg)	CO_2 values (g/km, NEDC)			
			2018 average	Change 2017–2018	2020/21 target	Distance to target
Toyota-Mazda	6%	1,351	110	0	94	16 (15%)
Renault	11%	1,281	112	2	92	20 (18%)
PSA-Opel	17%	1,269	114	7	91	23 (20%)
Nissan	3%	1,370	115	-2	95	20 (18%)
Ford	7%	1,411	121	0	96	25 (21%)
Kia	3%	1,356	121	1	94	27 (22%)
AVERAGE	**100%**	**1,392**	**121**	**2**	**95**	**26 (21%)**
FCA-Tesla	6%	1,300	122	5	92	30 (24%)
VW Group	23%	1,413	122	1	96	26 (21%)
Hyundai	4%	1,318	124	2	93	31 (25%)
BMW	6%	1,589	128	6	102	26 (20%)
Volvo	2%	1,760	132	8	108	24 (18%)
Daimler	6%	1,602	133	6	102	31 (23%)

3. FUEL/TECHNOLOGY TRENDS BY MEMBER STATE AND MANUFACTURER

Fuel type and power train technology trends from 2017 continued into 2018. Plagued by the aftermath of Dieselgate, diesel market shares continued to fall, from 44% in 2017 to 36% in 2018. Electrified powertrains generally gained ground during the same time period: hybrid-electric vehicles (HEVs) grew from 2.7% to 3.3% of total new car sales, and plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles both grew from 0.9% to 1.0%. Overall gains in electrified powertrains were not enough to offset the decrease in diesel sales, leaving room for petrol vehicles to grow by 7 percentage points from 2017 to 2018. Other powertrains, predominantly compressed natural gas and liquified petroleum gas vehicles, accounted for 1.6% of the market.

The extent to which the decline in diesel market shares explains the stagnation in fleet-average CO_2 emission reductions has been the matter of debate in Europe. Figure 3 explores this topic by plotting the 2015–2018 change in market shares and average CO_2 emission values by vehicle segment and fuel type.[6] The figure shows that only small to medium-sized vehicles recorded notable losses in market shares. Small diesel, small petrol, and medium-sized diesel vehicles—all with comparatively low CO_2 emission values—lost more than 15 percentage points from 2015 to 2018. These relatively small vehicles were replaced by sales of medium-sized petrol vehicles and petrol sport utility vehicles (SUVs). The increase in the latter group was particularly problematic for fleet-average CO_2 reductions, because SUVs have comparatively high CO_2 emission values. In short, it does not merely seem to be the shift away from diesel that explains the increase in fleet-average CO_2 emission, but the simultaneous shift to larger vehicle segments, specifically SUVs. Because EU CO_2 targets are calculated relative to vehicle mass, the

6 The plot only shows vehicles with conventional and mild hybrid-electric diesel and petrol powertrains. Vehicle segments were defined as: Small (mini and small segments); Medium (lower medium and medium segments); Other (upper medium, sport, and multipurpose vehicle segments); SUV (sport utility vehicles).

observed increase in fleet-average emissions does not necessarily affect the ability of manufacturers to comply with the regulatory targets.

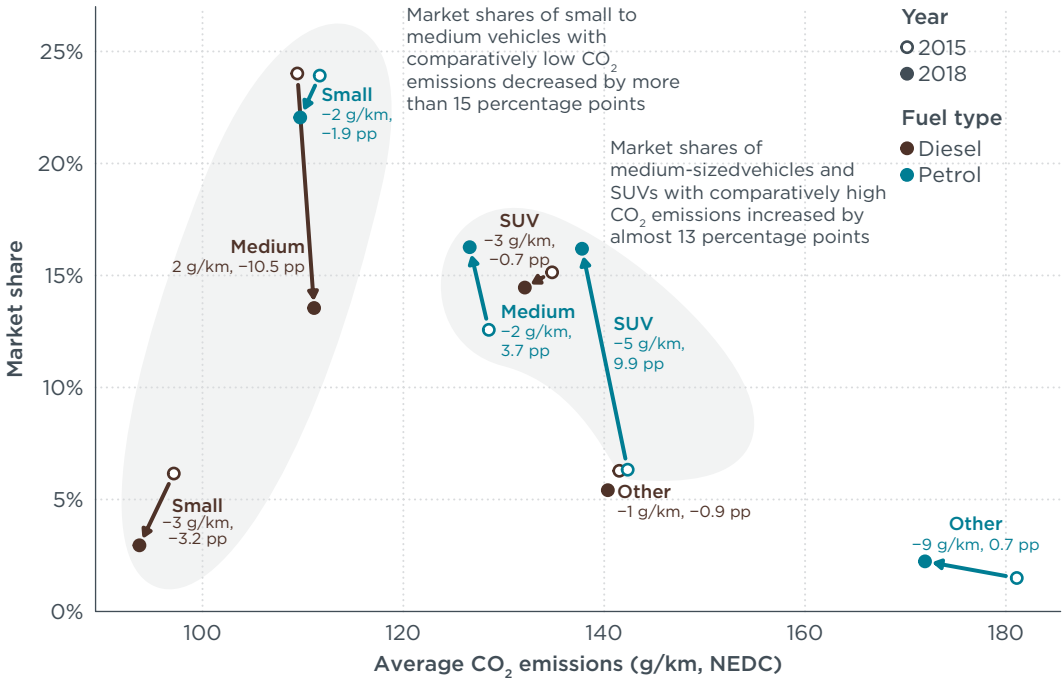

Figure 3. Change in market shares and average CO_2 emission values from 2015 to 2018, by segment and fuel type.

Table 2 presents the market share of various fuels and technologies in 2018 by country.[7] Norway continues to dominate the European electric vehicle market, with 31.2% of new car registrations in 2018 being BEVs and another 17.8 % being PHEVs. Iceland, another non-EU country, also recorded high electric vehicle market shares of 10.9% for PHEVs and 3.8% for BEVs. Within the EU, Sweden saw the highest uptake of electric vehicles: 8.2% of vehicles were either PHEVs or BEVs, with HEVs adding another 5.8% percent. The Netherlands had the highest uptake of BEVs (5.4%) in the EU, while Finland had the highest share of HEVs (8.8%). Germany, the largest vehicle market in the EU, saw a moderate increase in PHEV and BEV shares from 2017 to 2018, from 0.8% each in 2017, to 0.9% and 1% respectively in 2018. Mild hybrid-electric vehicles using 48-volt systems were rare in 2018, comprising less than 1.0% of passenger car registrations in Germany. Italy was the major EU market with the highest diesel share despite a 6 percentage point decrease in diesel shares from 2017 to 2018. Italy also was the only market with a significant share of compressed natural gas and liquified petroleum gas vehicles.

7 Because the EEA data do not include details on electric powertrains, EEA data have been supplemented with proprietary data content supplied by IHS Markit; Copyright © IHS Markit, 2019. All rights reserved. Statistics for Iceland were complemented using data from the Icelandic Transport Authority.

Table 2. Market share of fuels/technologies for new passenger cars in 2018, by country. Sorted by descending EU market share. "Other" column primarily covers compressed natural gas and liquified petroleum gas fuels.

Market	Diesel	Petrol	Mild hybrid-electric	Hybrid-electric	Plug-in hybrid electric	Battery-electric	Other	EU market share
Germany	32%	63%	0.8%	1.5%	0.9%	1.0%	0.4%	22.8%
UK	32%	62%	0.4%	3.5%	1.8%	0.6%	0.0%	15.7%
France	39%	55%	0.1%	3.7%	0.7%	1.4%	0.1%	14.4%
Italy	51%	36%	0.1%	3.7%	0.3%	0.3%	8.3%	12.7%
Others (EU)	31%	64%	0.3%	3.1%	0.2%	0.3%	1.6%	8.8%
Spain	36%	56%	0.1%	5.5%	0.4%	0.5%	2.1%	8.8%
Belgium	36%	59%	0.1%	2.5%	1.7%	0.7%	0.7%	3.6%
Netherlands	13%	76%	0.2%	4.6%	0.8%	5.4%	0.4%	2.9%
Sweden	38%	47%	0.3%	5.8%	6.2%	2.0%	1.2%	2.3%
Austria	41%	54%	0.3%	1.4%	0.7%	2.0%	0.2%	2.3%
Portugal	54%	39%	0.2%	2.9%	1.6%	1.8%	0.8%	1.5%
Denmark	33%	61%	0.2%	4.0%	1.4%	0.7%	0.0%	1.5%
Ireland	54%	38%	0.1%	5.5%	0.6%	1.0%	0.0%	0.8%
Finland	24%	61%	0.3%	8.8%	4.0%	0.6%	1.0%	0.8%
Greece	36%	60%	0.0%	3.4%	0.2%	0.1%	1.0%	0.7%
Luxembourg	47%	49%	0.4%	1.4%	1.2%	0.8%	0.0%	0.4%
Iceland	38%	41%		5.1%	10.9%	3.8%	0.9%	—
Norway	18%	23%	0.2%	10.5%	17.8%	31.2%	0.1%	—
Switzerland	30%	63%	0.6%	2.5%	1.4%	1.7%	0.3%	—
Turkey	59%	37%	0.1%	0.8%	0.0%	0.0%	3.4%	—
EU Total	**36%**	**57%**	**0.4%**	**3.3%**	**1.0%**	**1.0%**	**1.6%**	**100%**

Table 3 presents the market share of fuel type and technologies in 2018 for major car manufacturer pools and select brands, sorted by descending EU market shares of manufacturer pools. Among manufacturer pools, BMW had the highest electric vehicle (PHEVs and BEVs) share with more than 6%, followed by Kia and Daimler, each with more than 2.5%. FCA reached the second-highest BEV share after creating a joint pool with Tesla. Toyota-Mazda stands out with a 46.1% share of HEVs. Among brands, Mitsubishi, Porsche, Volvo, BMW, and Mini topped the ranking of PHEV shares, while Tesla, Smart, Nissan, Renault, and Hyundai topped the BEV ranking. German premium car brands Audi and Mercedes-Benz were the only brands with a significant uptake of mild hybrid-electric powertrain technology. Two German premium manufacturer pools, Daimler and BMW, stood out with the highest diesel shares (55% and 49%, respectively), while Volvo had the highest diesel share among major brands (64%). FCA-Tesla was the only manufacturer pool with a significant share of compressed natural gas and liquified petroleum gas vehicles.

Table 3. Market share of fuel/technologies for new passenger cars in 2018 for major manufacturer pools and select brands.

Manufacturer pool/brand	Diesel	Petrol	Mild hybrid-electric	Hybrid-electric	Plug-in hybrid electric	Battery-electric	Other	EU market share
VW Group	**37%**	**59%**	**1.0%**	**0.0%**	**0.9%**	**0.5%**	**1.5%**	**23.7%**
VW	39%	58%	0.0%	0.0%	1.0%	0.9%	1.7%	11.2%
Audi	48%	46%	5.0%	0.0%	0.7%	0.2%	0.7%	4.6%
Škoda	36%	62%	0.0%	0.0%	0.0%	0.0%	1.3%	4.5%
Porsche	6%	81%	0.0%	0.0%	12.9%	0.3%	0.2%	0.4%
PSA-Opel	**34%**	**64%**	**0.0%**	**0.0%**	**0.0%**	**0.2%**	**1.8%**	**16.3%**
Peugeot	44%	56%	0.0%	0.0%	0.0%	0.2%	0.4%	6.3%
Opel/Vauxhall	23%	72%	0.0%	0.0%	0.0%	0.1%	4.0%	5.8%
Citroën	34%	65%	0.0%	0.0%	0.0%	0.3%	1.1%	3.9%
DS	50%	50%	0.0%	0.2%	0.0%	0.0%	0.0%	0.3%
Renault	**39%**	**56%**	**0.1%**	**0.0%**	**0.0%**	**2.2%**	**3.2%**	**10.5%**
Renault	41%	55%	0.2%	0.0%	0.0%	3.2%	0.8%	7.2%
Dacia	34%	57%	0.0%	0.0%	0.0%	0.0%	8.5%	3.3%
FCA-Tesla	**37%**	**54%**	**0.0%**	**0.0%**	**0.0%**	**1.9%**	**6.9%**	**6.7%**
Fiat	30%	63%	0.0%	0.0%	0.0%	0.0%	7.2%	4.6%
Tesla	0%	0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.1%
Ford	**35%**	**64%**	**0.0%**	**0.7%**	**0.0%**	**0.0%**	**0.2%**	**6.6%**
Ford	35%	64%	0.0%	0.7%	0.0%	0.0%	0.2%	6.6%
BMW	**49%**	**45%**	**0.0%**	**0.0%**	**5.2%**	**1.1%**	**0.0%**	**6.5%**
BMW	57%	36%	0.0%	0.0%	5.4%	1.4%	0.0%	5.1%
Mini	19%	77%	0.0%	0.0%	4.4%	0.0%	0.0%	1.4%
Toyota-Mazda	**8%**	**46%**	**0.0%**	**46.1%**	**0.3%**	**0.0%**	**0.0%**	**6.3%**
Toyota	5%	37%	0.0%	58.0%	0.4%	0.0%	0.0%	4.5%
Mazda	19%	81%	0.0%	0.0%	0.0%	0.0%	0.0%	1.5%
Lexus	0%	6%	0.0%	93.8%	0.0%	0.0%	0.0%	0.3%
Daimler	**55%**	**41%**	**1.9%**	**0.1%**	**1.3%**	**1.4%**	**0.1%**	**6.3%**
Mercedes-Benz	61%	35%	2.1%	0.1%	1.4%	0.0%	0.1%	5.6%
Smart	0%	87%	0.0%	0.0%	0.0%	13.1%	0.0%	0.6%
Hyundai	**19%**	**74%**	**0.0%**	**3.6%**	**0.6%**	**1.6%**	**1.8%**	**3.4%**
Hyundai	19%	74%	0.0%	3.6%	0.6%	1.6%	1.8%	3.4%
Kia	**28%**	**61%**	**0.0%**	**7.3%**	**2.4%**	**1.1%**	**0.5%**	**3.2%**
Kia	28%	61%	0.0%	7.3%	2.4%	1.1%	0.5%	3.2%
Other brands								
Nissan	40%	54%	0.0%	0.0%	0.0%	5.9%	0.3%	3.1%
Volvo	64%	30%	0.0%	0.0%	6.1%	0.0%	0.2%	2.0%
Mitsubishi	14%	72%	0.0%	0.0%	13.9%	0.0%	0.3%	0.9%
EU Total	**36%**	**57%**	**0.4%**	**3.3%**	**1.0%**	**1.0%**	**1.6%**	**100%**

Notes: Brand shares do not add up to manufacturer pool totals because not all brands are included. Manufacturer pools sorted by descending EU market share. "Other" column primarily covers compressed natural gas and liquified petroleum gas fuels.

4. FLEXIBLE COMPLIANCE MECHANISMS

A number of flexible compliance mechanisms were included in the EU CO_2 standards to reduce compliance costs, foster innovation, and accommodate changes in the vehicle market. Mass-based CO_2 targets are one of the principle mechanisms to account for varying consumer preferences (see Section 2). Other flexible mechanisms include incentives for electric vehicles and innovative technologies, manufacturer pooling, derogations for small manufacturers, and phase-in provisions for CO_2 targets.

In the 2015 and 2020/21 CO_2 standards, super-credits were included to incentivize the sales of low-emission vehicles that emit less than 50 g CO_2/km. Super-credit multipliers increase the weighting of low-emission vehicles in the calculation of manufacturers' CO_2 emission averages. In the 2015 CO_2 standard, each low-emission vehicle counted as 3.5 cars in 2013, 2.5 in 2014, and 1.5. In the 2020/21 standard, each low-emission car will count as 2 cars in 2020, 1.67 in 2021, and 1.33 in 2022. The impact of super-credits for complying with CO_2 targets is capped at 7.5 g/km per manufacturer or manufacturer pool. For 2025–2030 targets, super-credits were removed in favor of electric vehicle (EV) sales targets. In 2018, the impact of applying a super-credit multiplier of 2.0 would have ranged from 0 g/km to 7 g/km, depending on the manufacturer. Manufacturers with high EV shares, like the BMW pool, Kia, and Nissan, would have seen a reduction of 4 g/km or more. If EV market shares increase in future years, the impact of super-credits for compliance purposes could be higher than these current calculations suggest, again depending on the respective EV shares of each manufacturer or pool.

The development and adoption of innovative fuel-efficiency technologies is incentivized by so-called eco-innovations. Eco-innovation credits reward innovative technologies that produce real-world CO_2 savings beyond what is measured over a standardized test cycle during vehicle type approval. Because CO_2 savings from eco-innovations count toward manufacturers' CO_2 targets, automakers have an incentive to develop and deploy cost-effective eco-innovations.[8] For the purpose of complying with CO_2 emission targets, the total impact of eco-innovation technologies is limited to 7 g/km per manufacturer pool. In 2018, only two manufacturers, BMW and Daimler, implemented eco-innovation technologies to a measurable degree. Overall, eco-innovation technologies reduced EU-wide CO_2 values by less than 0.1 g/km in 2018 and were installed in approximately 532,000 vehicles, approximately 142,000 more than in 2017. The average CO_2 emission reduction in vehicles that had eco-innovations installed was 1.46 in 2018. For individual vehicles, the maximum recorded CO_2 emission reduction from eco-innovation technologies was 4 g/km in 2018.

The phase-in provision included in the EU standards results in only 95% of passenger cars registered during 2020 counting towards manufacturers' 2020 CO_2 emission targets. In other words, the provision allows manufacturers to base average CO_2 emission values on the best-performing 95% of vehicles. The phase-in ends in 2021, when all vehicles count toward manufacturers' CO_2 emission targets. If applied in 2018, the phase-in provision—removing each manufacturer's highest-emitting 5% of vehicles—would have reduced each manufacturers' average CO_2 emissions by 2–5 g/km.

8 Uwe Tietge, Peter Mock, and Jan Dornoff, *Overview and Evaluation of Eco-Innovations in European Passenger Car CO_2 Standards* (ICCT: Washington, DC, July 11, 2018), https://www.theicct.org/publications/eco-innovations-european-passenger-car-co2-standards.

5. TRANSITION TO THE WLTP

The WLTP was phased in for new passenger cars in the EU starting in September 2017 and became mandatory for most new passenger cars in September 2018. Due to its more dynamic speed profile, more realistic vehicle test mass and road load, lower ambient temperature, and other factors, the WLTP is expected to produce more realistic CO_2 emission values than the NEDC-based procedure. Contrary to the NEDC procedure, a CO_2 emission value will be determined for each individual vehicle, taking into account details like the mass of fitted optional equipment and the aerodynamics of the installed wheels.

The manufacturer-specific ratio between WLTP and NEDC CO_2 emission values in 2020 will be used to determine the WLTP 2021–2030 CO_2 emission targets. This provides manufacturers an incentive to record the highest-possible WLTP-NEDC CO_2 ratio.[9] In July 2018, the European Commission estimated that manufacturers were artificially inflating the measured WLTP values by approximately 5%, with an additional inflation when declaring those measured WLTP values, by another approximately 4.5%.[10] As a result, the European Commission adapted the underlying regulatory procedures described above. It is unclear how the CO_2 data of those vehicles included in the preliminary 2018 monitoring data were affected by these developments. Future research will scrutinize the WLTP-NEDC CO_2 ratio, its evolution over time, and the factors which affect it.

Even though these values may be inflated, the 2018 monitoring data provides the first glimpse at the ratio between WLTP and NEDC CO_2 emission values: WLTP and NEDC CO_2 emission values were reported for 26.4% of vehicles in the data. Figure 4 presents the distribution of this ratio. The mean and median ratio was 1.21, and the vast majority of passenger cars (99.7%) had a ratio between 0.9 and 1.6. Average ratios range from 1.15 to 1.24 per manufacturer pool (Figure 5).

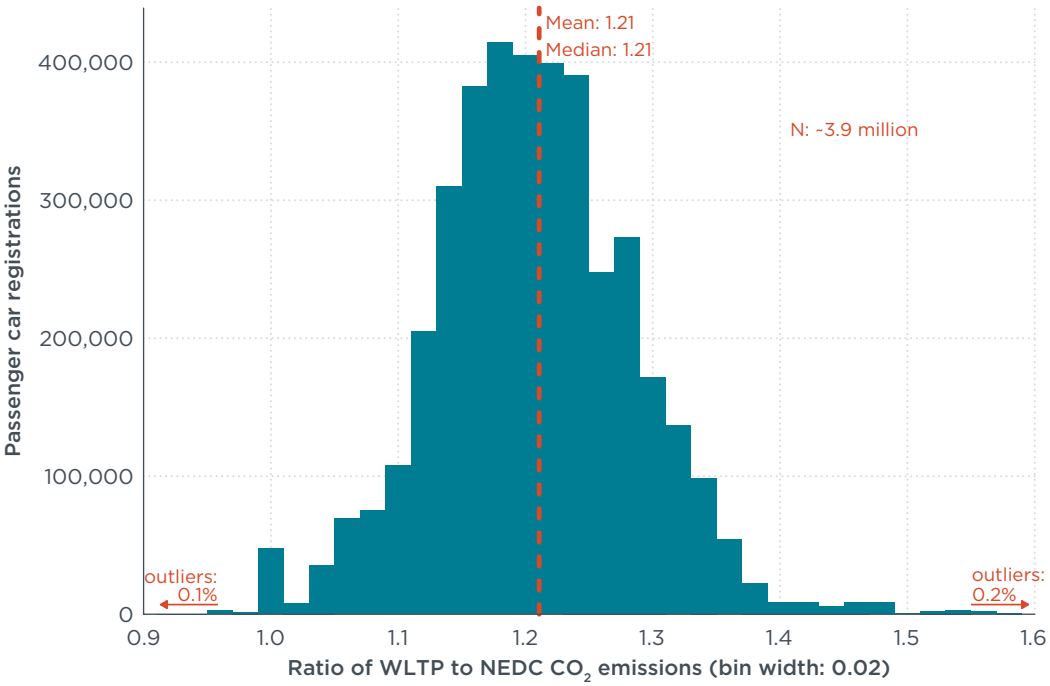

Figure 4. Distribution of the ratio between WLTP and NEDC CO_2 emission values of new passenger cars registered in 2018, for which both NEDC and WLTP values were provided. Zero-emission vehicles were filtered out.

9 Jan Dornoff et al., *The European Commission Regulatory Proposal for Post-2020 CO_2 Targets for Cars and Vans* (ICCT: Washington, DC, January 9, 2018), https://www.theicct.org/publications/ec-proposal-post-2020-co2-targets-briefing-20180109.

10 European Commission, "Non-paper. CO_2 Regulations for cars/vans. Risk of inflated starting point for calculating the 2025 and 2030 targets" (July 18, 2018), https://www.transportenvironment.org/sites/te/files/2018_07_18_Commission_non-paper_WLTP_manipulation.pdf

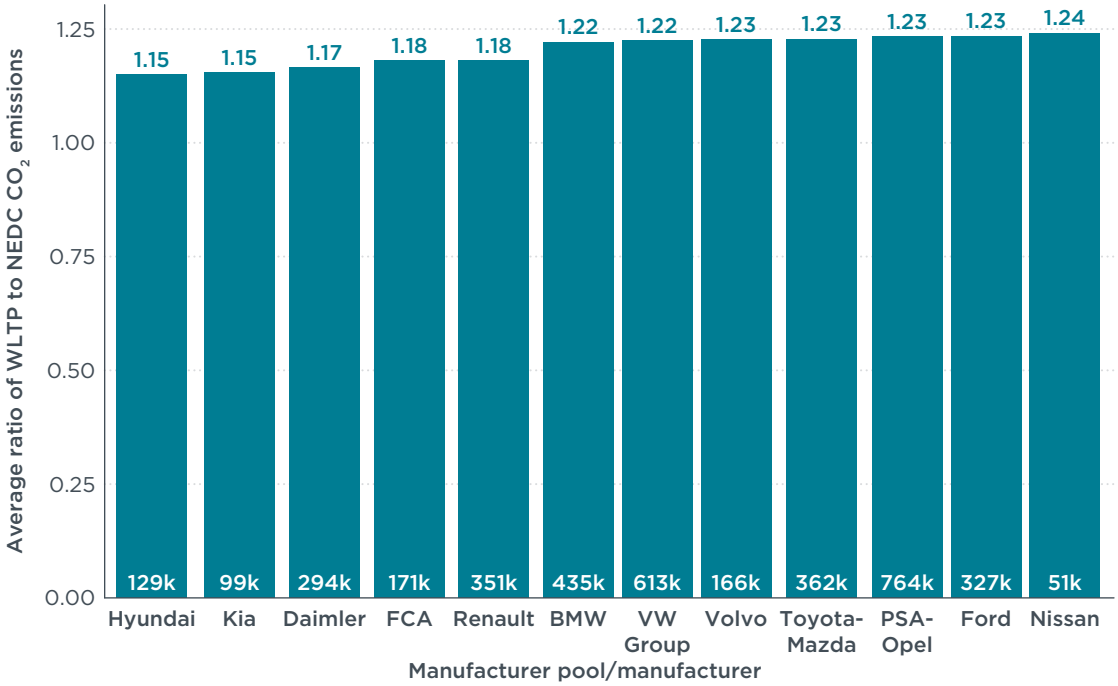

Figure 5. Average ratio between WLTP and NEDC CO_2 emission values of new passenger cars registered in 2018 for which both NEDC and WLTP values were provided, per manufacturer pool or manufacturer. The number of vehicles (in thousands) is presented at the bottom of each column.

6. OUTLOOK

After having met the 2015 CO_2 emission target, manufacturers' efforts to further decrease emission levels seem to have come to a halt, with fleet-average CO_2 emission levels increasing for the second year in a row in 2018. Unprecedented CO_2 emission reduction rates will be needed for all manufacturers by 2020 and 2021 to meet their respective targets and to avoid substantial fines.

However, unlike in U.S. regulations where manufacturers have to comply with annual targets, there are no targets for the years 2016–2019 in the EU CO2 standards, allowing for a delay of technology introduction during these years. As a result, the 2018 data presented in this Briefing should not be extrapolated to future years. There are a number of factors that will affect manufacturers' compliance with the 2020/21 CO_2 targets:

- There remains CO_2 emission reduction potential for conventional combustion engine vehicles, including lightweighting and improvements in aerodynamic and rolling resistance.
- There may be substantial growth in the hybrid electric vehicle market. At present, Toyota remains the only manufacturer in Europe with a significant share of HEVs. But a number of manufacturers—including Audi, BMW and Daimler—have announced plans to ramp up the market shares of 48-volt mild hybrid-electric vehicles.
- All major manufacturers have announced plans to substantially electrify their fleets in time for the 2020/21 targets, with numerous new electric vehicle models scheduled to enter the market from 2020 onwards. An increased uptake of electric vehicles will have a direct effect on manufacturers' compliance, plus an indirect effect, via super-credit multipliers.

- The application of eco-innovation credits could greatly increase. The number of approved eco-innovation technologies reached 26 in 2019, but only a fraction of them have been installed in significant numbers.
- In future years, the range of countries counting toward CO_2 emission targets will change, with Iceland, Norway and Liechtenstein to be taken into account, while the UK could be removed as a result of Brexit.
- Manufacturers can form or modify manufacturer pools for compliance with the 2020/2 CO_2 targets, as illustrated by the recent formation of the FCA-Tesla pool.

It remains to be seen how much each manufacturer will make use of the various options for complying with the 2020/21 CO_2 targets. Unprecedented reduction rates will have to be achieved in the coming years, but a broad range of technical options and flexible compliance mechanisms are available to manufacturers.

While the focus of the EU CO_2 emission standards is on official type-approval emissions, it is important to ensure that real-world emissions decrease over time. Real-world emissions are significantly higher than the official values presented in this briefing. The gap between real-world and official CO_2 emission values of European cars widened over time and reached approximately 39% in 2017.[11] The ratio between WLTP and NEDC CO_2 emission values, observed from preliminary data for about 26% of the 2018 new car fleet, indicates that the WLTP will roughly halve the gap. In 2020, on-board fuel consumption meters will be phased-in to monitor the real-world fuel consumption of all new European passenger cars and light commercial vehicles. The European Commission is tasked with using these data to prevent a widening of the gap between type-approval and real-world emission values in the future.[12]

11 Tietge et al., *From Laboratory to Road: A 2018 Update of Official and 'Real-World' Fuel Consumption and CO_2 Values for Passenger Cars in Europe*, (ICCT: Washington, DC, 2019), https://theicct.org/publications/laboratory-road-2018-update.

12 European Union, "Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 Setting CO2 Emission Performance Standards for New Passenger Cars and for New Light Commercial Vehicles, and Repealing Regulations (EC) No 443/2009 and (EU) No 510/2011 (Text with EEA Relevance.)," Pub. L. No. 32019R0631, 111 OJ L 13 (2019), http://data.europa.eu/eli/reg/2019/631/oj/eng.