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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

BRIEFING

JULY 2018

CO_2 emissions from new passenger cars in the EU: Car manufacturers' performance in 2017

This briefing paper provides an overview of CO_2 emission levels of new passenger cars in the European Union (EU) in 2017 based on a preliminary dataset recently released by the European Environment Agency (EEA). New cars sold in the EU in 2017 had average CO_2 emissions of 119 g CO_2/km, 1 g/km higher than in 2016, as measured over the New European Driving Cycle (NEDC).

As a follow-up to the previous year's briefing,[1] this paper details manufacturers' 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 manufacturer groups. It also discusses the impact of flexible compliance mechanisms on average CO_2 emission values of manufacturer groups.

The preliminary EEA dataset used in this briefing has yet to be validated. The final dataset will be published at the end of 2018, so the specific values used in this report may change. The preliminary data for 2017 should, however, provide relatively reliable results.[2] The ICCT will review the final European emissions data in the forthcoming European Vehicle Market Statistics Pocketbook 2017/2018.[3]

1 Murat Şenzeybek, Uwe Tietge, and Peter Mock, *CO_2 Emissions from New Passenger Cars in the EU: Car Manufacturers' Performance in 2016* (The International Council on Clean Transportation, July 3, 2017). http://theicct.org/CO2-emissions-new-PV-EU-OEM-performance-2016

2 Historically the difference between preliminary and final data has been low. In 2016, there was virtually no difference in fleet-average CO_2 emission values between the preliminary and final data.

3 International Council on Clean Transportation, *European vehicle market statistics pocketbook 2018/2019*. http://eupocketbook.org

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BACKGROUND

The EEA recently released a preliminary dataset on the CO_2 emissions performance of new passenger cars in the EU in 2017.[4] 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 the Regulation EC 443/2009 and Regulation EC 333/2014. The EEA collects data from EU Member States, which are required to submit detailed information on each new car registered in each calendar year.

The EEA data show that the sales-weighted average CO_2 emissions from new passenger cars in the EU in 2017 were 119 g/km, 1 g/km higher than in 2016—the first recorded increase in annual fleet-average CO_2 emissions. Figure 1 plots the historical average CO_2 values relative to targets. Before CO_2 standards were introduced, average CO_2 emissions declined by 1.2% per year. When CO_2 standards were agreed upon in 2008, manufacturers significantly outperformed annual reduction rates required to meet the 2015 target of 130 g/km. Until 2016, manufacturers were also largely on track to meet the 2020/21 target of 95 g/km, which includes a one-year phase-in. However, the stagnation in CO_2 reductions in 2017 is at odds with meeting the 2021 target. Reduction rates will have to increase in 2018–2021: As of 2017, fleet-average CO_2 emissions will have to decline by 5.5% per year to comply with the 2021 target. Manufacturers will likely also increasingly rely on flexible compliance mechanisms such as super-credits and eco-innovations (see Section 4) to comply with 2020/21 targets.

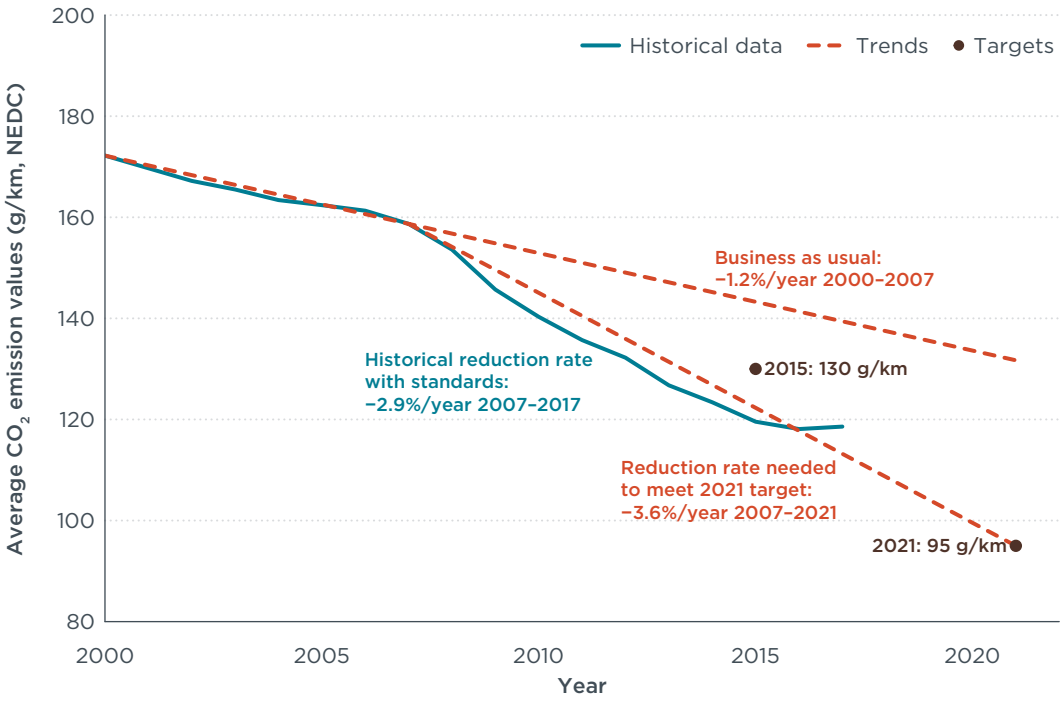

Figure 1. Historical average CO_2 emission values, targets, and annual reduction rates of new passenger cars in the EU.

4 European Environment Agency, "Monitoring of CO_2 Emissions from Passenger Cars – Regulation (EC) No 443/2009, Data," (April 24, 2018). https://www.eea.europa.eu/data-and-maps/data/CO2-cars-emission-14

CO_2 EMISSIONS BY VEHICLE MANUFACTURER

As only the average CO_2 emissions of a pool as a whole are regulated, car manufacturers can pool together the average emissions of several brands to meet CO_2 standards. For this analysis, we follow a definition of manufacturer groups that is intended to mirror the actual vehicle market as closely as possible and may be different from manufacturer pools in the context of EU regulations.[5]

Figure 2 and Table 1 present data for nine major manufacturer groups representing approximately 92% of all EU new passenger car sales in 2017. Figure 2 plots each manufacturer group'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 2017 and emission reductions since 2016.

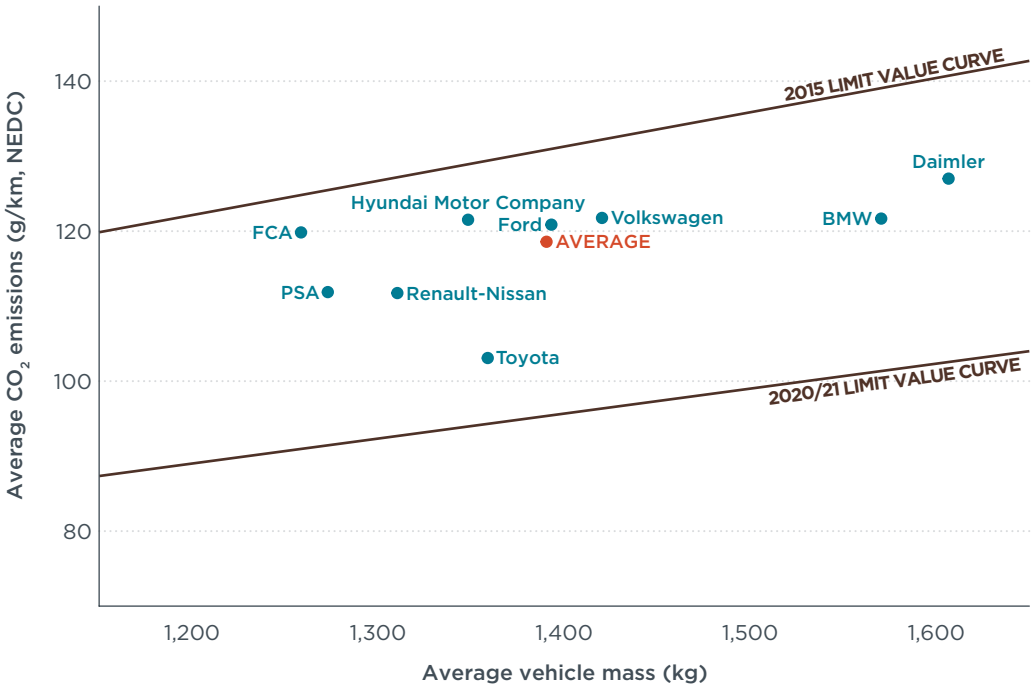

Figure 2. Performance of top-selling EU passenger car manufacturer groups in 2017, with 2015 and 2020 (effectively 2021) target lines.

Overall, fleet-average CO_2 emissions increased by 1 g/km from 2016 to 2017. Toyota had the lowest CO_2 emissions out of all manufacturer groups in 2017 and managed to reduce average CO_2 emissions by 2 g/km from the previous year. Only the Hyundai Motor Company achieved a greater reduction of 3 g/km. Out of the European manufacturer groups, only BMW achieved emission reductions in 2016–2017—average emission values of all other European manufacturer groups either remained stable or increased by up to 2 g/km from 2016 to 2017. With 9 g/km (9%) remaining, Toyota was the closest to its 2020/21 target in 2017. Fiat Chrysler Automobiles (FCA) was in the worst position to meet its 2020/21 target, with a 29 g/km (24%) reduction left to go. Fleet-average CO_2 emissions will have to decline by 24 g/km (20%) to be compliant with 2020/21 targets.

5 Manufacturer groups were defined as: BMW (BMW, Mini); Daimler (Mercedes-Benz, Smart); FCA (Alfa Romeo, Chrysler, Dodge, Fiat, Jeep, Lancia, Maserati); Ford (Ford, Lincoln); Hyundai Motor Company (Hyundai, Genesis, Kia); PSA (Citroën, DS Automobiles, Opel, Peugeot, Vauxhall); Renault-Nissan (Dacia, Infiniti, Lada, Mitsubishi, Nissan, Renault); Toyota (Daihatsu, Lexus, Toyota); and Volkswagen (Audi, Bentley, Bugatti, Lamborghini, Porsche, SEAT, Škoda, Volkswagen).

Table 1. Manufacturer group 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 2017. Impact of flexible compliance mechanisms (see section 4) not considered here.

Manufacturer group	EU market share	Average mass (kg)	CO_2 values (g/km, NEDC)			
			2017 average	Change 2016–2017	2020/21 target	Distance to target
Toyota	5%	1,359	103	-2	94	9
PSA	16%	1,273	112	2	91	21
Renault-Nissan	15%	1,310	112	1	93	19
Average	—	1,390	119	1	95	24
FCA	6%	1,259	120	0	91	29
Ford	7%	1,393	121	1	95	26
BMW	7%	1,570	122	-1	101	21
Hyundai Motor Company	6%	1,348	122	-3	94	28
Volkswagen	23%	1,420	122	2	96	26
Daimler	6%	1,607	127	2	103	24

FUEL/TECHNOLOGY TRENDS BY MEMBER STATE AND MANUFACTURER

Fuel type and power train technology trends from 2016 continued into 2017. Plagued by the aftermath of Dieselgate, diesel market shares continued to fall, from 49% in 2016 to 44% in 2017. All types of electrified powertrains gained ground during the same time: hybrid-electric vehicles (HEVs) grew from 1.9% to 2.7%, plug-in hybrid electric vehicles (PHEVs) from 0.7% to 0.9%, and battery electric vehicles (BEVs) from 0.6% to 0.9%. Those gains were not enough to offset the drop in diesel sales, leaving room for petrol vehicles to grow by 4 percentage points from 2016 to 2017. Last year thus marks the first year since 2009 that more petrol than diesel new passenger cars were sold in the EU. Other powertrains, predominantly compressed natural gas and liquified petroleum gas vehicles, accounted for 1.3% of the market.

The extent to which the decline in diesel market shares explains the stagnation in fleet-average CO_2 emission reductions in 2016–2017 is the matter of debate in Europe. Figure 3 explores this topic by plotting the 2015–2017 change in market shares and average CO_2 emission values by vehicle segment and fuel type. 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 9 percentage points from 2015 to 2017. These relatively small vehicles were replaced by medium-sized petrol vehicles and sport utility vehicles (SUVs). The increase in the latter group was particularly problematic for fleet-average CO_2 reductions, because SUVs had comparatively high CO_2 emission values. In short, it does not merely seem to be the shift away from diesel that explains the slowdown in fleet-average CO_2 emission reductions, but the simultaneous shift to larger vehicle segments.

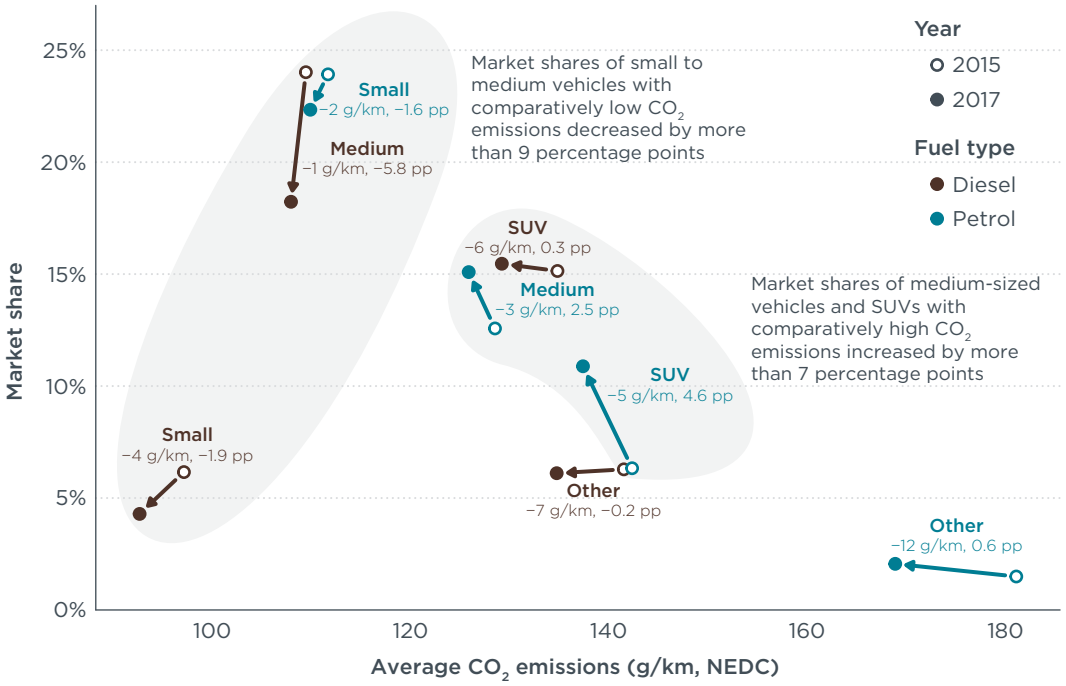

Figure 3. Change in market shares and average CO_2 emission values from 2015 to 2017, by segment and fuel type.[6]

Table 2 presents the market share of various fuels and technologies in 2017 by country, sorted by EU market share.[7] Norway continues to dominate the European electric vehicle market, with 17.8% of new car registrations in 2017 being BEVs and another 20.8% being PHEVs. Iceland, another non-EU country, also recorded high electric vehicle market shares, of 6.8% for PHEVs and 2% for BEVs. Within the EU, Sweden saw the highest uptake of electric vehicles: 5% of vehicles were either PHEVs or BEVs, with HEVs adding another 5% percent. Germany, the largest vehicle market in the EU, saw a doubling in PHEV and BEV shares from 2016 to 2017, with both technologies rising from 0.4% in 2016, to 0.8% in 2017. Italy was the only major EU market that did not see a decline in its diesel market share in 2017 and was the only market with a significant share of compressed natural gas and liquified petroleum gas vehicles.

6 The plot only comprises vehicles with conventional diesel and petrol engines. 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).

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.

Table 2. Market share of fuels/technologies for new passenger cars in 2017, by country. Sorted by descending EU market share. "Other" column primarily covers compressed natural gas and liquified petroleum gas fuels.

Market	Diesel	Petrol	Hybrid-electric	Plug-in hybrid electric	Battery-electric	Other	EU market share
Germany	39%	58%	1.4%	0.8%	0.8%	0.2%	22.7%
UK	42%	53%	2.7%	1.3%	0.6%	0.0%	16.8%
France	47%	48%	3.0%	0.5%	1.2%	0.1%	13.9%
Italy	57%	32%	3.0%	0.1%	0.1%	8.1%	13.0%
Others (EU)	36%	60%	2.5%	0.1%	0.2%	1.6%	8.7%
Spain	48%	46%	4.5%	0.3%	0.3%	0.6%	8.1%
Belgium	46%	48%	2.3%	2.1%	0.6%	0.5%	3.6%
Netherlands	18%	75%	4.2%	0.3%	1.9%	0.4%	2.8%
Sweden	50%	39%	4.9%	4.1%	1.2%	1.3%	2.5%
Austria	50%	47%	1.6%	0.5%	1.5%	0.1%	2.3%
Denmark	35%	61%	3.2%	0.3%	0.3%	0.1%	1.5%
Portugal	61%	34%	2.1%	1.1%	0.8%	0.8%	1.5%
Ireland	65%	31%	3.4%	0.2%	0.5%	0.2%	0.9%
Finland	30%	60%	7.1%	2.1%	0.4%	0.4%	0.8%
Greece	44%	52%	2.7%	0.2%	0.1%	0.4%	0.6%
Luxembourg	54%	42%	1.5%	1.2%	0.8%	0.0%	0.3%
Iceland	42%	43%	4.9%	6.8%	2.0%	1.5%	—
Norway	23%	26%	12.7%	17.8%	20.8%	0.1%	—
Switzerland	36%	59%	2.3%	1.1%	1.6%	0.2%	—
Turkey	61%	38%	0.6%	0.0%	0.0%	0.0%	—
EU Total	44%	50%	2.7%	0.9%	0.9%	1.3%	—

Table 3 presents the market share of fuel type and technologies in 2017 for major car manufacturer groups and select brands, sorted by descending EU market shares of manufacturer groups. Among manufacturer groups, BMW stands out with an electric vehicle (PHEVs and BEVs) share of almost 5%, followed by Daimler and Renault-Nissan with more than 2%. Among brands, Mitsubishi, Porsche, BMW, Volvo, and Mercedes-Benz topped the ranking of PHEV shares, while Smart, Nissan, Renault, BMW, and Kia topped the BEV ranking. Similar to its home country Italy, FCA was the only manufacturer group to see an increase in diesel shares from 2016 to 2017, and was the only manufacturer group 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 2017 for major manufacturer groups and select brands. Manufacturer groups sorted by descending EU market share. "Other" column primarily covers compressed natural gas and liquified petroleum gas fuels.

Manufacturer group/brand	Diesel	Petrol	Hybrid-electric	Plug-in hybrid electric	Battery-electric	Other	EU market share
Volkswagen	**46%**	**52%**	**0.0%**	**0.9%**	**0.2%**	**1.0%**	**23.6%**
VW	47%	51%	0.0%	1.0%	0.5%	1.2%	10.9%
Audi	60%	39%	0.0%	1.1%	0.0%	0.3%	5.3%
Škoda	41%	57%	0.0%	0.0%	0.0%	1.3%	4.5%
SEAT	29%	70%	0.0%	0.0%	0.0%	1.0%	2.6%
Porsche	31%	61%	0.0%	8.4%	0.2%	0.0%	0.5%
PSA	**40%**	**59%**	**0.0%**	**0.0%**	**0.1%**	**1.5%**	**16.1%**
Peugeot	49%	50%	0.0%	0.0%	0.2%	0.4%	6.0%
Opel	30%	66%	0.0%	0.0%	0.1%	3.8%	4.8%
Citroën	43%	56%	0.0%	0.0%	0.3%	0.9%	3.7%
Vauxhall	21%	79%	0.0%	0.0%	0.0%	0.0%	1.3%
DS	45%	55%	0.5%	0.0%	0.0%	0.0%	0.3%
Renault-Nissan	**45%**	**50%**	**0.0%**	**0.6%**	**1.8%**	**2.1%**	**14.9%**
Renault	49%	48%	0.0%	0.0%	2.4%	0.7%	7.5%
Nissan	47%	49%	0.0%	0.0%	2.6%	0.5%	3.6%
Dacia	39%	53%	0.0%	0.0%	0.0%	8.3%	3.0%
Mitsubishi	23%	63%	0.0%	13.4%	0.2%	0.3%	0.7%
FCA	**42%**	**52%**	**0.0%**	**0.0%**	**0.0%**	**6.0%**	**6.8%**
Fiat	36%	58%	0.0%	0.0%	0.0%	6.1%	5.1%
Ford	**44%**	**54%**	**0.1%**	**0.0%**	**0.0%**	**1.2%**	**6.8%**
Ford	44%	54%	0.1%	0.0%	0.0%	1.2%	6.8%
BMW	**60%**	**35%**	**0.0%**	**3.4%**	**1.5%**	**0.0%**	**6.6%**
BMW	68%	27%	0.0%	3.9%	1.9%	0.0%	5.2%
Mini	29%	69%	0.0%	1.8%	0.0%	0.0%	1.4%
Daimler	**61%**	**36%**	**0.2%**	**1.9%**	**0.8%**	**0.1%**	**6.4%**
Mercedes-Benz	68%	30%	0.2%	2.1%	0.1%	0.1%	5.8%
Smart	0%	94%	0.0%	0.0%	6.5%	0.0%	0.6%
Hyundai Motor Company	**35%**	**57%**	**4.6%**	**0.5%**	**0.9%**	**1.4%**	**6.4%**
Hyundai	32%	63%	2.9%	0.1%	0.8%	1.7%	3.4%
Kia	39%	51%	6.6%	0.9%	1.0%	1.1%	3.0%
Toyota	**8%**	**41%**	**51.6%**	**0.3%**	**0.0%**	**0.0%**	**4.6%**
Toyota	8%	43%	48.8%	0.3%	0.0%	0.0%	4.3%
Lexus	0%	6%	93.7%	0.0%	0.0%	0.0%	0.3%
Other brands							
Volvo	79%	17%	0.0%	3.8%	0.0%	0.2%	1.9%
Honda	26%	74%	0.1%	0.0%	0.0%	0.0%	0.9%
EU Total	**44%**	**50%**	**2.7%**	**0.9%**	**0.9%**	**1.3%**	**—**

FLEXIBLE COMPLIANCE MECHANISMS

A number of flexible compliance mechanisms were built into 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, niche derogations for small manufacturers, and phase-in provisions for CO_2 targets.

In the 2015 and 2020/21 CO_2 standards, so-called super-credits incentivize the market uptake of low-emission vehicles. Super-credit multipliers increase the weighting of low-emission vehicles—vehicles that emit less than 50 g CO_2/km—in the calculation of manufacturers' CO_2 emission averages. In the first CO_2 standard, each low-emission vehicle counted as 3.5 cars in 2013, 2.5 in 2014, and 1.5 in 2015. In the second standard, each low-emission car will count as 2 cars in 2020, 1.67 in 2021, and 1.33 in 2022. The proposal for post-2020 CO_2 standards for European light-duty vehicles suggests removing super-credits in favor of EV sales targets.

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.

Table 2 presents the impact of super-credits and eco-innovations on major manufacturer groups' and select brands' average CO_2 values.[8] Super-credit provisions reduced CO_2 emissions by several grams per kilometer for manufacturer groups and brands with notable electric vehicle shares (see Table 4). Three manufacturer groups—BMW, Hyundai Motor Company, and Renault-Nissan—stand to gain the most from the super-credit provision at current low-emission vehicle shares. Only German premium carmakers BMW and Daimler, as well as the Porsche brand, achieved significant CO_2 savings through eco-innovations. While eco-innovations have barely been marketed to date, pressure on manufacturers to meet the next round of CO_2 targets is expected to increase their use by 2021.[9]

8 Several member states seem to have neglected to report CO_2 savings from eco-innovations in the preliminary 2017 monitoring data for passenger cars. Figures presented here therefore likely underestimate the impact eco-innovations, but they would have a negligible impact on average CO_2 emission values regardless of the missing data.

9 European Commission, "Impact Assessment Accompanying the Document Proposal for a Regulation of the European Parliament and of the Council Setting Emission Performance Standards for New Passenger Cars and for New Light Commercial Vehicles as Part of the Union's Integrated Approach to Reduce CO_2 Emissions from Lightduty Vehicles and Amending Regulation (EC) No 715/2007 — Part 1/2" (Brussels: European Commission, November 8, 2017). https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/swd_2017_650_p1_en.pdf

Table 4. Effect of flexible compliance mechanisms on CO_2 emissions by manufacturer group and brand. Super-credit multiplier for 2021 (1.67) was used in calculations. All values in g CO_2/km over the NEDC.

Manufacturer group/brand	Avg. CO_2 w/o flexibility mechanisms	Impact of flexibility mechansisms			Avg. CO_2 with flexbility mechanisms
		Super-credits	Eco-innovations	Total	
Toyota	**103**	**0**	**0**	**0**	**103**
Toyota	102	0	0	0	102
Lexus	119	0	0	0	119
Renault-Nissan	**112**	**-2**	**0**	**-2**	**110**
Renault	106	-2	0	-2	105
Nissan	117	-2	0	-2	115
Dacia	117	0	0	0	117
Mitsubishi	118	-6	0	-6	111
PSA	**112**	**0**	**0**	**0**	**112**
Peugeot	105	0	0	0	104
DS	105	0	0	0	105
Citroën	106	0	0	0	105
Opel	123	0	0	0	123
Vauxhall	126	0	0	0	126
FCA	**120**	**0**	**0**	**0**	**120**
Fiat	116	0	0	0	116
Ford	**121**	**0**	**0**	**0**	**121**
Ford	121	0	0	0	121
Hyundai Motor Company	**122**	**-1**	**0**	**-1**	**120**
Kia	120	-1	0	-1	119
Hyundai	122	-1	0	-1	122
BMW	**122**	**-2**	**-0.2**	**-3**	**119**
Mini	116	-1	-0.1	-1	116
BMW	123	-3	-0.2	-3	120
Volkswagen	**122**	**-1**	**0**	**-1**	**121**
Škoda	116	0	0	0	116
SEAT	118	0	0	0	118
VW	120	-1	0	-1	120
Audi	126	0	0	0	125
Porsche	176	0	-0.1	0	176
Daimler	**127**	**-1**	**-0.4**	**-1**	**126**
Smart	90	-4	0	-4	87
Mercedes-Benz	131	0	-0.4	-1	130
Other brands					
Volvo	124	-2	0	-2	123
Honda	127	0	0	0	127
EU Total	**119**	**-1**	**0**	**-1**	**118**

INTERNATIONAL CONTEXT

In an international context, the EU has historically been a leader in implementing vehicle CO_2 emission standards. In recent years, however, most large economies have set converging CO_2 emission targets for new vehicles (see Figure 3). Compared to the EU's 2020/21 target of 95 g CO_2/km, the United States (99 g CO_2/km for 2025 passenger cars), South Korea (97 g CO_2/km by 2020), and Canada (99 g CO_2/km by 2025) have set similar targets. The European Commission's proposal for post-2020 CO_2 standards would position the EU as the only market with 2030 targets. However, the proposed reduction targets for 2025 are less ambitious than originally envisioned by the European Parliament. Moreover, the proposed post-2020 targets fail to align new vehicle emissions with long-term climate goals even though it would be economical for manufacturers to comply with more ambitious targets.[10]

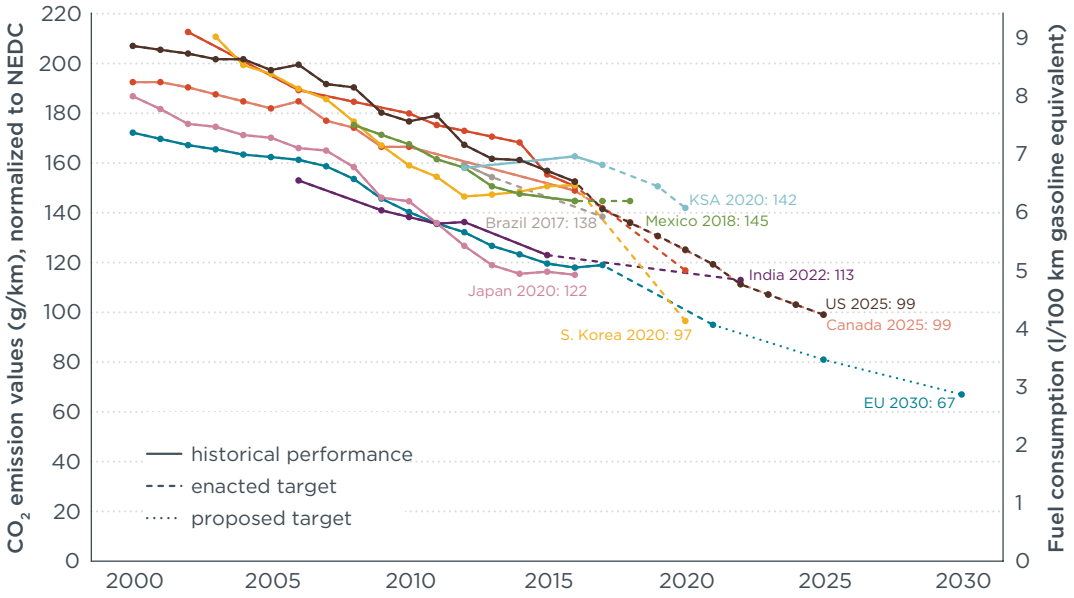

Figure 4. Comparison of global CO_2 regulations for new passenger cars.[11]

OUTLOOK

Real-world emissions are significantly higher than the official values presented in this briefing. The gap between official and real-world CO_2 emission values of European cars has been widening over time and reached approximately 42% in 2016.[12] In response to the growing real-world gap, the EU has been phasing in a new type-approval procedure, the Worldwide Harmonized Light Vehicles Test Procedure (WLTP), since September 2017. Because of its more dynamic driving cycle and more realistic testing conditions, the WLTP is expected to furnish higher, more realistic CO_2 values. Most new passenger cars will be type-approved under the WLTP from September 2018 on. As more WLTP

10 Jan Dornoff et al., "The European Commission Regulatory Proposal for Post-2020 CO_2 Targets for Cars and Vans" (The International Council on Clean Transportation, January 9, 2018). https://www.theicct.org/publications/ec-proposal-post-2020-co2-targets-briefing-20180109

11 U.S. CO_2 emission values are derived from fuel economy standards set by NHTSA, reflecting tailpipe GHG emission (i.e., they exclude low-GWP refrigerant credits incorporated in the U.S. EPA GHG regulation). Additional information can be found in: Zifei Yang and Anup Bandivadekar, "2017 Global Update: Light-Duty Vehicle Greenhouse Gas and Fuel Economy Standards" (International Council on Clean Transportation, June 23, 2017), https://www.theicct.org/node/1474.

12 Uwe Tietge et al., "From Laboratory to Road: A 2017 Update of Official and 'Real-World' Fuel Consumption and CO_2 Values for Passenger Cars in Europe" (The International Council on Clean Transportation, November 5, 2017). http://theicct.org/publications/laboratory-road-2017-update

measurements become available over the next years, the data will show to what extent the WLTP closes the gap between laboratory and real-world measurements.

The development of fleet-average CO_2 values in the 2018–2021 timeframe will also demand close scrutiny. The 2016–2017 slump in fleet-average CO_2 reduction rates occurred after manufacturers had already met 2015 CO_2 targets and with the next round of targets three years away. Several manufacturer groups, including BMW, Daimler, FCA, and Volvo, announced plans to substantially electrify their fleets in time for the 2020/21 targets. To what extent manufacturers will market fuel efficiency technologies before 2020—and to what extent average CO_2 values will decline in the absence of regulatory pressure—remains to be seen.