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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

BRIEFING

JULY 2017

CO_2 emissions from new passenger cars in the EU: Car manufacturers' performance in 2016

The purpose of this briefing paper is to provide a summary of CO_2 emission levels of new passenger cars in the European Union (EU) in 2016. The briefing is based on a preliminary dataset recently released by the European Environment Agency (EEA) on monitoring CO_2 emissions from new passenger cars in the EU. New cars sold in the EU in 2016 had average CO_2 emissions of 118 g CO_2/km, which was 1.2% lower than in 2015.

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 the super-credit provision on the average CO_2 emission values of manufacturer groups.

1. BACKGROUND

The EEA recently released a preliminary dataset on the CO_2 emissions performance of new passenger cars in the EU in 2016.[2] This dataset is at the core of the monitoring scheme of CO_2 emissions from passenger cars, and is used by the European Commission to evaluate whether car manufacturers comply with their mandatory CO_2 targets as defined in the

1 Sonsoles Díaz, Uwe Tietge, and Peter Mock, *CO_2 emissions from new passenger cars in the EU: Car manufacturers' performance in 2015* (ICCT: Washington DC, 2015). http://www.theicct.org/co2-from-new-cars-eu-2015.

2 European Environment Agency, "Monitoring of CO_2 emissions from passenger cars – Regulation 443/2009" (2017). https://www.eea.europa.eu/data-and-maps/data/co2-cars-emission-12.

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Regulation EC 443/2009. The EEA collects the data from the Member States, which are required to submit detailed information on each new car registered on a yearly basis.

The EEA data show that the sales-weighted average CO_2 emissions from new passenger cars in the EU in 2016 were 118 g CO_2/km, 1.2% lower than in 2015. As illustrated in Figure 1, average CO_2 emissions from new cars decreased by more than 27% from 2005 to 2016. From 2008, when CO_2 targets were first agreed upon, CO_2 emissions fell at an average rate of 3.2% per year, and vehicle manufacturers reached the average 2015 target of 130 g/km in time. If average CO_2 emissions from new cars continue to decrease at a similar pace, car manufacturers would meet the 2020/21 target of 95 g CO_2/km, which includes a one-year phase-in. The reduction rate is much higher than in a business-as-usual scenario without mandatory standards: Before mandatory standards were agreed upon in 2008, the annual rate of improvement was only about 1.2%.

The reduction of CO_2 emissions implies a reduction in fuel consumption, as they are effectively proportional. Since 2005, fuel consumption has decreased from 6.9 l/100km to 5.1 l/100km (gasoline equivalent) in 2016.[3]

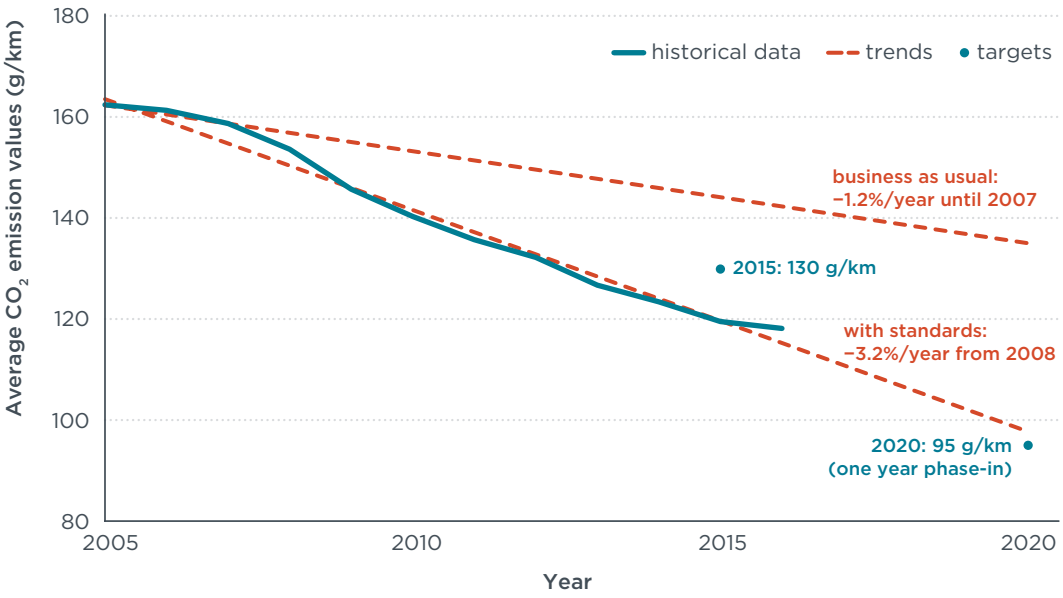

Figure 1. Historical development, trends, and targets for CO_2 emission levels of new passenger cars in the EU. Effects of phase-in, super-credits, and eco-innovations are not considered here.

2. CO_2 EMISSIONS BY VEHICLE MANUFACTURER

Car manufacturers can pool together the average emissions of several brands to meet CO_2 standards (only the average CO_2 emissions of a pool as a whole are regulated). For the purpose of this analysis, we follow a definition of manufacturer groups that is

3 The factor of 23.3 g CO_2/km per liter gasoline/100 km was used to convert from CO_2 emissions to fuel consumption.

intended to mirror the actual vehicle market as closely as possible and may be different from manufacturer pools in the context of the EU regulations.[4]

Figure 2 illustrates the distance of each manufacturer group to its 2015 and 2020/21 emission targets. The 2015 and 2020/21 targets for each manufacturer group are set according to the average mass of their new fleet, based on the limit value curves displayed in the figure. The exact 2020/21 target line equation has not been officially set yet, as it will be adjusted based on the average mass of new passenger cars in the three calendar years leading up to the target year. For the current analysis, the 2020/21 target equation was defined using the 2016 average vehicle mass. For each manufacturer group, the 2020/21 target implies a decrease of approximately 27% in average CO_2 emissions compared to the 2015 target.

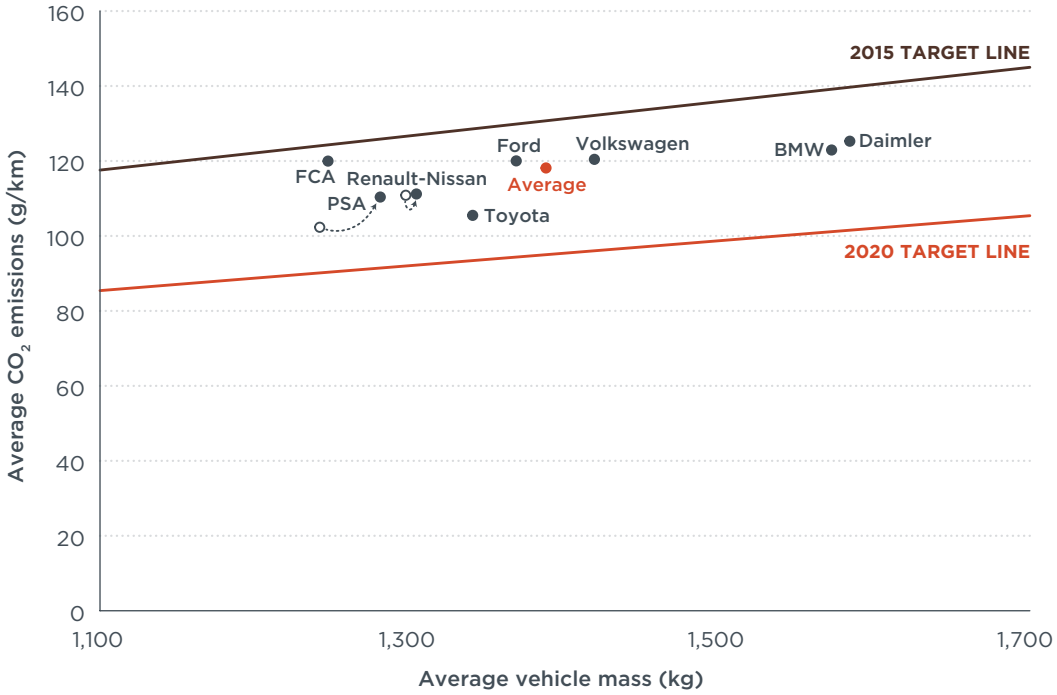

Figure 2. Performance of the top-selling EU passenger car manufacturer groups for 2016, along with the 2015 and 2020 (effectively 2021) target lines. For PSA and Renault-Nissan the changes in their respective fleet averages resulting from the recently announced mergers with Opel/Mitsubishi are indicated with arrows.

Table 1 presents average CO_2 emission values for the eight major manufacturer groups (representing 86% of the 2016 EU new car registrations), both with and without considering the effect of super-credits. Super-credits are favorable weightings for cars emitting less than 50 g CO_2/km. The impact of super-credits is discussed in detail in Section 4. It should be noted that to illustrate the effect of super-credits, the 2021 multiplier 1.67 has been applied in the table. The 2020/21 target for each manufacturer was calculated using the respective average mass in 2016.

4 Manufacturers are defined here as: PSA (Citroën, Peugeot, DS Automobiles, with and without Opel); Toyota (Daihatsu, Lexus, Toyota); Renault-Nissan (Dacia, Infiniti, Lada, Nissan, Renault, with and without Mitsubishi); Ford (Ford, Lincoln); FCA (Alfa Romeo, Chrysler, Dodge, Fiat, Jeep, Lancia, Maserati); Volkswagen (Audi, Bentley, Bugatti, Lamborghini, Porsche, SEAT, Škoda, Volkswagen); Daimler (Mercedes-Benz, Smart); and BMW (BMW, Mini). Mitsubishi Motors joined the Renault-Nissan alliance in October 2016. Opel was acquired by PSA in March 2017.

Table 1. Manufacturer group market shares, average vehicle mass, CO_2 emissions with and without super-credits for 2016, and CO_2 emission targets for 2020 (effectively 2021).

	EU market share	Average mass (kg)	CO_2 (g/km)		
			2016 w/o super-credits	2016 w/ super-credits for 2021	2020/21 target
Toyota	4%	1,340	105	105	93
PSA	17%	1,281	110	110	91
Renault-Nissan	15%	1,304	111	110	92
Average		**1,388**	**118**	**118**	**95**
FCA	6%	1,247	120	120	90
Ford	7%	1,369	120	120	94
Volkswagen	24%	1,419	120	120	96
BMW	7%	1,572	123	121	101
Daimler	6%	1,584	125	125	102

Overall, the CO_2 reduction progress from 2015 to 2016 was slow for most manufacturers. The market share of PSA increased from 11% in 2015 to 17% in 2016, thanks to the recent acquisition of Opel. At the same time, average fleet CO_2 emissions of PSA including Opel increased by 5 g/km to a level of 110 g/km. The 2020/21 target for PSA remained stable at 91 g/km despite efficiency improvements by the two major PSA brands Peugeot and Citroën, indicating that the Opel brand is still further away from its 2020/21 CO_2 target level than the rest of the new PSA group (see Figure 1). Toyota remains the manufacturer group closest to its 2020/21 target, with a current emissions level of 105 g/km CO_2 and a target of 93 g/km. An effect of super-credits at the manufacturer group level is only notable for Renault-Nissan and BMW, respectively benefiting from a 1 g/km and 2 g/km reduction of average CO_2 values as a result of the super-credits provision.

3. FUEL/TECHNOLOGY TRENDS BY MEMBER STATE AND MANUFACTURER

Passenger cars powered by alternative fuels made up a small share of the new EU car fleet in 2016. The share of electric vehicles, namely hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and battery electric vehicles (BEVs), increased from 2.5% in 2015 to 3.2%. Conventional diesel and petrol cars accounted for 95% of new cars. With a market share of 49%, diesel cars continued to account for most new registrations, but lost three percentage points compared to 2015.[5]

Table 2 presents the market share of various fuels and technologies in 2016 by country.[6] Alternative fuel types such as hydrogen, compressed natural gas (CNG), ethanol-gasoline mix, and liquefied petroleum gas (LPG) have been grouped as "Other."

5 For details on the recent developments in diesel market shares in Europe see "Cities driving diesel out of the European car market," Uwe Tietge and Sonsoles Díaz, 16 May 2017, http://theicct.org/blogs/staff/cities-driving-diesel-out-european-car-market.

6 Because the EEA data do not include details on plug-in hybrid electric vehicles, EEA data have been supplemented with commercial data obtained from IHS-Polk.

Table 2. Market share of fuels/technologies for new passenger cars in 2016, by country.

	Diesel	Petrol	Hybrid-electric	Plug-in hybrid electric	Battery-electric	Other	EU Market share
EU Total	49%	46%	1.9%	0.7%	0.6%	1.1%	—
Germany	46%	52%	1.0%	0.4%	0.4%	0.2%	22.9%
UK	48%	49%	1.9%	1.0%	0.5%	0.0%	18.4%
France	52%	44%	2.4%	0.3%	1.1%	0.1%	13.5%
Italy	57%	33%	2.0%	0.1%	0.1%	7.8%	12.6%
Others (EU)	40%	58%	1.6%	0.1%	0.1%	0.9%	8.0%
Spain	57%	40%	2.7%	0.1%	0.2%	0.0%	7.8%
Belgium	52%	44%	1.7%	1.3%	0.4%	0.4%	3.7%
Netherlands	19%	72%	2.9%	4.8%	1.1%	0.4%	2.6%
Sweden	53%	39%	3.6%	2.7%	0.9%	1.2%	2.5%
Austria	57%	40%	1.0%	0.4%	1.2%	0.2%	2.3%
Denmark	36%	61%	2.6%	0.2%	0.6%	0.1%	1.5%
Portugal	65%	32%	1.5%	0.5%	0.4%	0.5%	1.4%
Ireland	70%	28%	1.8%	0.2%	0.3%	0.3%	1.0%
Finland	33%	62%	3.4%	1.6%	0.2%	0.2%	0.8%
Greece	54%	43%	1.9%	0.1%	0.1%	0.3%	0.5%
Luxembourg	65%	33%	1.1%	0.3%	0.4%	0.0%	0.3%
Iceland	44%	45%	3.8%	3.2%	1.3%	1.9%	—
Norway	31%	29%	11.3%	13.4%	15.7%	0.0%	—
Switzerland	39%	56%	2.4%	0.8%	1.1%	0.3%	—
Turkey	61%	38%	0.1%	0.0%	0.0%	0.0%	—

Norway remains at the forefront of the European electric vehicle market, with 15.7% of new car registrations in 2016 being BEVs and another 13.4% being PHEVs. In addition, 11.3% of vehicles are HEVs. For PHEVs, the Netherlands, Iceland, and Sweden[7] show relatively high market shares (4.8%, 3.2%, and 2.7%). However, the PHEV market share in the Netherlands dropped from 8.8% in 2015 to 4.8% in 2016. In Finland, on the other hand, the market share of PHEV increased from 0.4% to 1.6% within the last year.

Table 3 presents the market share of fuels/technologies in 2016 for major car manufacturer groups and brands, sorted by descending market shares of manufacturer groups.

The Toyota group clearly stands out with the highest share of HEVs (40.8% of sales), followed by the Kia brand as a distant second with 1.9%. As in 2015, Renault-Nissan and BMW led the BEV market. BEVs accounted for 1.6% and 1.1% of their 2016 sales, respectively. As for the PHEV market, BMW and Daimler are leading the market with shares of 2.0% and 1.4%, respectively. However, at the brand level we observe much higher market shares, with PHEVs accounting for more than 14.8% of Mitsubishi's total

7 For details on electric vehicle sales in Sweden see "Lessons learned from Sweden's electric vehicle rollercoaster," Uwe Tietge, 14 February 2017, http://www.theicct.org/blogs/staff/lessons-learned-sweden-EV-rollercoaster.

sales. Porsche and Volvo also sold a considerable share of PHEVs (4.8% and 4.5% respectively). The Italian automaker Fiat led the market for natural gas vehicles, which made up 6.3% of total sales.

Table 3. Market share of fuel/technologies for new passenger cars in 2015 for selected brands and manufacturers.

	Diesel	Petrol	Hybrid-electric	Plug-in hybrid electric	Battery-electric	Other	EU Market share
EU Total	**49%**	**46%**	**1.9%**	**0.7%**	**0.6%**	**1.1%**	**—**
Volkswagen	**53%**	**46%**	**0.0%**	**0.8%**	**0.1%**	**1.0%**	**23.9%**
VW	52%	46%	0.0%	1.0%	0.2%	1.3%	11.3%
Audi	69%	30%	0.0%	0.9%	0.0%	0.3%	5.5%
Škoda	45%	54%	0.0%	0.0%	0.0%	1.0%	4.3%
SEAT	36%	63%	0.0%	0.0%	0.0%	1.0%	2.3%
Porsche	40%	55%	0.2%	4.8%	0.0%	0.0%	0.5%
PSA	**44%**	**55%**	**0.1%**	**0.0%**	**0.2%**	**1.2%**	**16.4%**
Peugeot	53%	47%	0.1%	0.0%	0.2%	0.2%	5.7%
Opel	33%	63%	0.0%	0.0%	0.0%	3.8%	4.9%
Citroën	50%	50%	0.0%	0.0%	0.4%	0.0%	3.6%
Vauxhall	28%	72%	0.0%	0.0%	0.0%	0.0%	1.7%
DS	51%	48%	0.7%	0.0%	0.0%	0.0%	0.4%
Renault-Nissan	**50%**	**46%**	**0.0%**	**0.7%**	**1.6%**	**0.8%**	**14.6%**
Renault	55%	44%	0.0%	0.0%	1.8%	0.0%	7.3%
Nissan	50%	46%	0.0%	0.0%	2.8%	0.7%	3.7%
Dacia	44%	53%	0.0%	0.0%	0.0%	3.0%	2.8%
Mitsubishi	30%	54%	0.0%	14.8%	0.1%	0.2%	0.7%
Ford	**46%**	**52%**	**0.1%**	**0.0%**	**0.0%**	**1.5%**	**7.0%**
Ford	46%	52%	0.1%	0.0%	0.0%	1.5%	7.0%
FCA	**41%**	**53%**	**0.0%**	**0.0%**	**0.0%**	**6.3%**	**6.8%**
Fiat	36%	58%	0.0%	0.0%	0.0%	6.2%	5.1%
BMW	**67%**	**30%**	**0.0%**	**2.0%**	**1.1%**	**0.0%**	**6.7%**
BMW	74%	22%	0.0%	2.5%	1.3%	0.0%	5.4%
Mini	38%	62%	0.0%	0.0%	0.0%	0.0%	1.4%
Daimler	**63%**	**35%**	**0.4%**	**1.4%**	**0.2%**	**0.1%**	**6.3%**
Mercedes-Benz	71%	27%	0.4%	1.6%	0.2%	0.1%	5.6%
Smart	0%	100%	0.0%	0.0%	0.3%	0.0%	0.7%
Toyota	**14%**	**45%**	**40.8%**	**0.1%**	**0.0%**	**0.0%**	**4.2%**
Toyota	15%	47%	36.9%	0.2%	0.0%	0.0%	3.9%
Lexus	0%	7%	93.2%	0.0%	0.0%	0.0%	0.3%
Other brands							
Hyundai	42%	56%	0.5%	0.0%	0.1%	1.5%	3.4%
Kia	48%	48%	1.9%	0.2%	0.7%	1.5%	2.9%
Volvo	83%	12%	0.0%	4.5%	0.0%	0.3%	1.9%
Honda	38%	62%	0.0%	0.0%	0.0%	0.0%	1.0%

4. SUPER-CREDITS

Super-credits were introduced to incentivize car manufacturers to produce low-carbon vehicles, such as PHEVs and BEVs. According to the super-credit provision, vehicles with low CO_2 emissions, below 50 g CO_2/km, are assigned an increased weight when calculating manufacturers' average emissions.

During the first stage of super-credits, from 2013 to 2015, the following weighting factors applied: Each low-emitting car counted as 3.5 cars in 2013, 2.5 in 2014, 1.5 in 2015, and 1 starting in 2016. The second stage is planned for 2020 to 2023, although the weighting factors will be lower than in the first period. For this second phase, the following multipliers will be used: Each low-emitting car will count as 2 cars in 2020, 1.67 in 2021, 1.33 in 2022, and 1 starting in 2023. There will be a cap on super-credits' contribution to CO_2 reductions of 7.5 g CO_2/km per manufacturer over the entire period.

The number of vehicles that qualify for the super-credits showed a modest 2% increase from 2015 to 2016. The effect of super-credits on average CO_2 emissions of car manufacturers was rather limited. Table 4 presents the effect of super-credits on average CO_2 emissions of both manufacturer groups and a selection of their brands in 2015 and 2016.

Table 4. Effect of super-credits on CO_2 emissions by manufacturer group and brand. Super-credits multiplier was 1.5 in 2015 and 1.67 in 2016 (super-credits multiplier for 2021 used).

	2015 Avg. CO_2 emissions (g/km)			2016 Avg. CO_2 emissions (g/km)			Reduction since 2015	
	w/o super-credits	w/ super-credits	Difference	w/o super-credits	w/ super-credits	Difference	w/o super-credits	w/ super-credits
Toyota	**108.3**	**108.3**	**0.0**	**105.5**	**105.5**	**0.0**	**3%**	**3%**
Toyota	107.9	107.8	0.0	104.6	104.6	0.0	3%	3%
Lexus	115.5	115.5	0.0	118.5	118.5	0.0	-3%	-3%
PSA	**113.1**	**113.0**	**0.0**	**110.4**	**110.3**	**0.1**	**2%**	**2%**
Peugeot	103.7	103.7	0.1	101.7	101.6	0.1	2%	2%
Citroën	105.9	105.8	0.1	103.2	102.9	0.3	3%	3%
DS	103.6	103.6	0.0	103.8	103.8	0.0	0%	0%
Opel	126.1	126.1	0.0	122.6	122.6	0.0	3%	3%
Vauxhall	128.5	128.5	0.0	123.6	123.6	0.0	4%	4%
Renault-Nissan	**112.0**	**110.7**	**1.3**	**111.2**	**109.7**	**1.5**	**1%**	**1%**
Renault	106.2	105.3	0.9	105.2	104.0	1.2	1%	1%
Nissan	114.6	113.3	1.3	116.2	114.1	2.1	-1%	-1%
Dacia	122.7	122.7	0.0	117.8	117.8	0.0	4%	4%
Mitsubishi	110.0	103.0	7.0	118.1	111.1	7.0	-7%	-8%
FCA	**121.7**	**121.7**	**0.0**	**120.0**	**120.0**	**0.0**	**1%**	**1%**
Fiat	117.8	117.8	0.0	116.4	116.4	0.0	1%	1%
Ford	**118.0**	**118.0**	**0.0**	**120.0**	**120.0**	**0.0**	**-2%**	**-2%**
Ford	118.0	118.0	0.0	120.0	120.0	0.0	-2%	-2%
Volkswagen	**121.3**	**120.9**	**0.4**	**120.4**	**120.0**	**0.4**	**1%**	**1%**
Škoda	115.5	115.5	0.0	111.9	111.9	0.0	3%	3%
SEAT	116.6	116.6	0.0	115.8	115.8	0.0	1%	1%
VW	118.8	118.2	0.6	118.7	118.0	0.7	0%	0%
Audi	127.8	127.2	0.6	126.2	125.9	0.3	1%	1%
Porsche	183.8	183.8	0.0	185.1	185.1	0.0	-1%	-1%
BMW	**126.2**	**125.6**	**0.7**	**122.9**	**121.4**	**1.5**	**3%**	**3%**
Mini	117.7	117.7	0.0	117.2	117.2	0.0	0%	0%
BMW	128.4	127.6	0.8	124.4	122.5	1.9	3%	4%
Daimler	**124.7**	**124.3**	**0.5**	**125.3**	**124.7**	**0.6**	**0%**	**0%**
Smart	94.1	93.2	0.9	95.9	95.8	0.2	-2%	-3%
Mercedes-Benz	128.7	128.3	0.4	129.0	128.3	0.7	0%	0%
Other brands								
Volvo	121.9	120.7	1.2	121.2	119.2	2.0	1%	1%
Hyundai	127.3	127.3	0.0	124.5	124.4	0.1	2%	2%
Kia	128.0	127.2	0.8	124.8	124.1	0.7	3%	2%
Honda	131.3	131.3	0.0	126.9	126.9	0.0	3%	3%

At the group level, the provision translated into a maximum reduction of 1.5 g CO_2/km for Renault-Nissan and BMW due to the groups' comparatively high share of BEVs and/or PHEVs. At the brand level, the effect of super-credits was most notable for Mitsubishi, with a reduction of 7 g CO_2/km in the average emissions of the brand.

5. INTERNATIONAL CONTEXT

In the international context, the EU has historically been a front-runner with respect to vehicle emission targets. In recent years, however, most large economies have set converging CO_2 emission targets for new vehicles (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.

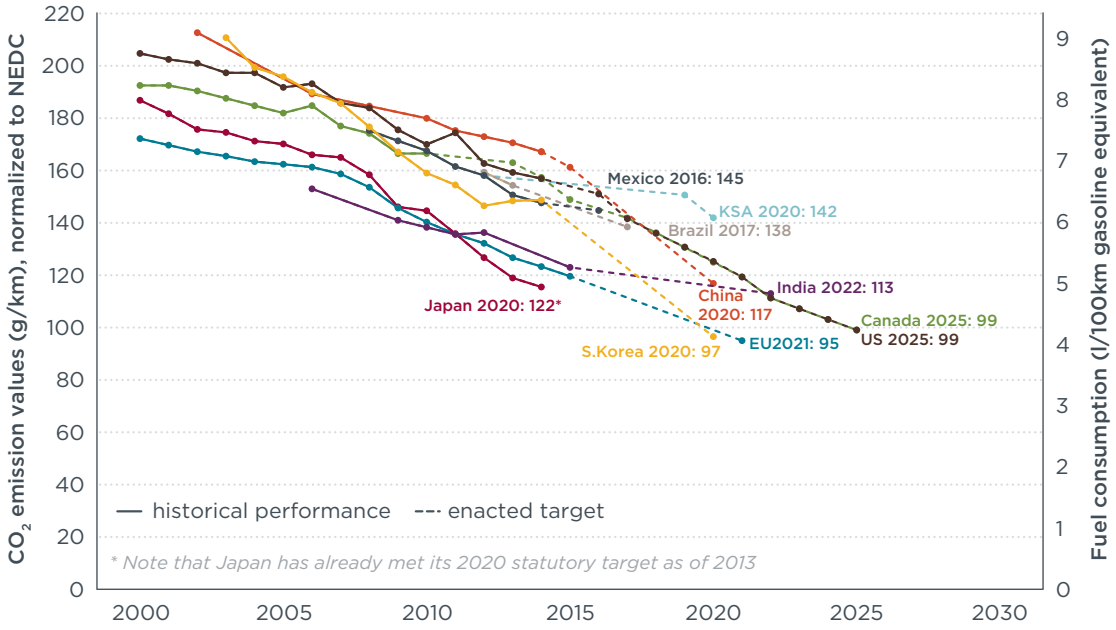

Figure 3. Comparison of global CO_2 regulations for new passenger cars.[8]

6. OUTLOOK

It should be noted that the EEA dataset has yet to be validated. The final dataset will be published at the end of 2017, so the specific numbers in this report may change.[9] The preliminary data for 2016 should, however, provide relatively reliable results. Real-world emissions are significantly higher than the official values used here. The gap between official and real-world CO_2 emission values of European cars has been widening over time and reached approximately 42% in 2015, indicating that the values

8 China's target reflects gasoline vehicles only. 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). Gasoline in Brazil contains 22% ethanol (E22); all data in the chart have been converted to the gasoline (E00) equivalent. Supporting data can be found at www.theicct.org/info-tools/global-passenger-vehicle-standards.

9 Historically the difference between preliminary and final data has been low. In 2015, there was a less than 0.01% difference in the preliminary and final data for average CO_2 emissions.

presented in this briefing significantly underestimate on-road emissions and fuel consumption.[10] The ICCT will follow up on European emissions data in the forthcoming European Vehicle Market Statistics Pocketbook 2017/2018.[11]

10 Uwe Tietge, et al., *From laboratory to road – A 2016 update of official and "real-world" fuel consumption and CO_2 values for passenger cars in Europe*, (ICCT: Washington DC, 2016). http://www.theicct.org/laboratory-road-2016-update.

11 International Council on Clean Transportation, *European vehicle market statistics pocketbook 2017/2018*. http://eupocketbook.org.