BRIEFING

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CO_2 emissions from new passenger cars in Europe: Car manufacturers' performance in 2021

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This briefing paper provides an overview of CO_2 emission levels of new passenger cars in the European Union (EU) in 2021 based on a preliminary dataset recently released by the European Environment Agency (EEA).[1] The dataset showed that new cars sold in the European Economic Area in 2021 had average CO_2 emissions of 115 g/km determined following the Worldwide Harmonized Light Vehicles Test Procedure (WLTP), which is approximately 16 g/km lower than average emissions in 2020. Including flexible compliance mechanisms, average emissions declined to 113 g/km. All manufacturers seem to have met their 2021 CO_2 targets.

As an update to the previous year's briefing, this paper details manufacturer performance in terms of CO_2 emissions reduction, fuel type and technology trends, and market share.[2] The paper focuses on differences between countries, as well as between the major car makers. It also discusses flexible compliance mechanisms.

The preliminary EEA dataset used in this briefing has yet to be validated. The final dataset will be published at the end of 2022, so the specific values used in this report may change. The preliminary data for 2021 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 European Environment Agency, "Monitoring of CO2 Emissions from Passenger Cars – Regulation (EU) 2019/631," Data, European Environment Agency, June 9, 2022, https://www.eea.europa.eu/data-and-maps/data/co2-cars-emission-20.

2 Uwe Tietge et al., "CO_2 Emissions from New Passenger Cars in Europe: Car Manufacturers' Performance in 2020" (Washington, D.C.: International Council on Clean Transportation, August 31, 2021), https://theicct.org/publication/co2-emissions-from-new-passenger-cars-in-europe-car-manufacturers-performance-in-2020/.

3 Historically there had been little difference between preliminary and final data. In 2019, the difference between preliminary and final average CO_2 emissions was less than 1 g/km for NEDC and approximately 1 g/km for WLTP values. Final 2020 data has not been published at the time of writing.

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 2021. 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 (EU) 2019/631.[5] The EEA collects data from countries in the European Economic Area, which are required to submit detailed information on each new car registered in each calendar year.

Two issues related to the quality and scope of the monitoring data may impact the results of the analysis. First, a small number of records, equivalent to 0.03% of 2021 passenger car registrations, were identified 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. Second, because vehicles registered in all countries in the European Economic Area—not only EU member states—count toward the 2021 CO_2 emission targets, the data include records for Iceland and Norway, but no longer covers the United Kingdom. Including the United Kingdom would have increased market-wide CO_2 emissions in 2021 to 116 g/km, or by approximately 1 g/km.

Last year, 2021, was the first year that manufacturer CO_2 performance was determined using the WLTP instead of the New European Driving Cycle (NEDC). The 2020 fleet-wide target of 95 g/km over the NEDC was converted to manufacturer-specific WLTP targets based on manufacturers' average vehicle mass in 2020 and 2021, and manufacturers' average WLTP to NEDC CO_2 emissions ratio in 2020. A fleet-wide CO_2 target for 2021 has not been defined, but an equivalent value can be estimated from the fleet average WLTP to NEDC CO_2 emissions ratio in 2020. On this basis, the fleet average WLTP CO_2 target in 2021 would be in the range of 115 g/km. Flexible compliance mechanisms like super-credits and eco-innovation credits (see Section 4) were also translated to the WLTP in 2021. Lastly, the phase-in provision—allowing manufacturer emission targets to only apply to 95% of vehicles registered in 2020—was removed in 2021.

The EEA data show that the sales-weighted average WLTP CO_2 emissions from new passenger cars in 2021 were 115 g/km, 16 g/km (12%) lower than in 2020. Including flexible compliance mechanisms (see Section 4), emissions declined by another 2 g/km (1.7%).

Figure 1 plots the historical average CO_2 values relative to emission targets. Up to and including 2020, NEDC CO_2 values are reported; after 2020, WLTP values are presented. Before standards were introduced, CO_2 emissions, on average, declined by 1.9 g/km 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 3.6 g/km annual reduction, average CO_2 emissions declined by 4.9 g/km per year. After 2015 targets were met, and in the absence of targets before 2020, average CO_2 emissions increased by 0.7 g/km per year. The 2020 target was set at 95 g/km over the NEDC. It included a phase-in provision and flexible compliance mechanisms (see Section 4), but still led to a steep decline of 14 g/km from 2019 to 2020. In 2021, the 2020 target of 95 g/km over the NEDC was converted to WLTP targets and the phase-in provision was removed. The 2021 target led to a similarly steep decline in average CO_2 emissions as the 2020 target. The currently adopted passenger car CO_2 regulation sets a −15% reduction

5 European Union, "Regulation (EU) 2019/631 of the European Parliament and of the Council of 17 April 2019 Setting CO_2 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

target for 2025 and a −37.5% reduction target for 2030 compared to 2021 levels. A recent regulatory proposal by the European Commission includes strengthening the 2030 target to −55% and introducing a new −100% target for 2035.

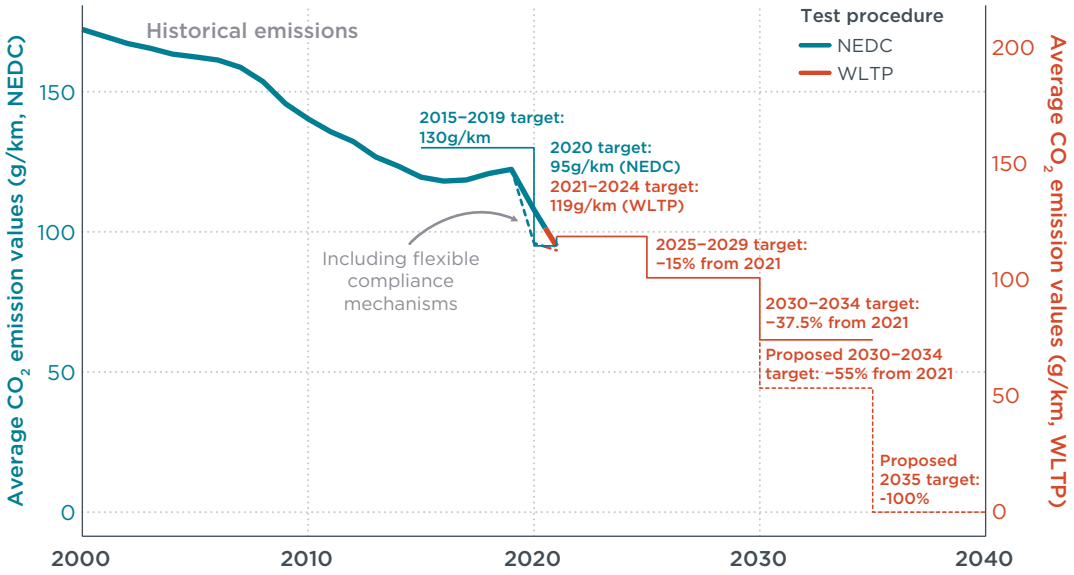

Figure 1. Historical average NEDC and WLTP CO_2 emission values and targets of new passenger cars.

2. CO_2 EMISSIONS BY VEHICLE MANUFACTURER

Car manufacturers can pool together several brands to meet CO_2 standards. For this analysis, unless otherwise noted, we track manufacturer pools.[6] Vehicle manufacturers with less than 300,000 registered passenger cars per calendar year can apply for a niche derogation in order to receive non-standard, manufacturer-specific reduction targets for 2021 onward. This niche derogation could apply to Volvo in 2021; Volvo is therefore omitted from the analysis.

Table 1 presents data for ten manufacturer pools representing approximately 96% of all EU new passenger car registrations in 2021. In addition to displaying each manufacturer's market share, average CO_2 emissions, and CO_2 target, Table 1 accounts for the impact of flexible compliance mechanisms, namely:

- mass-based manufacturer targets;
- super-credits for vehicles with NEDC CO_2 emissions below 50 g/km, which are counted 1.67 times in the calculation of average emissions; and
- eco-innovation credits, which reward innovative technologies that produce real-world CO_2 savings beyond what is measured over a standardized test cycle during vehicle type approval.

These mechanisms are described in more detail in Section 4.

All manufacturer pools appear to have met their 2021 CO_2 targets. Only two pools, Mazda-Subaru-Suzuki-Toyota and Renault-Nissan-Mitsubishi, required flexible compliance mechanisms to do so. Eight out of ten pools had already exhausted their

6 In 2021, manufacturer pools (and their major brands) were: BMW (BMW, Mini); Ford (Ford); Hyundai (Hyundai); Kia (Kia); Mazda-Subaru-Suzuki-Toyota (Lexus, Mazda, Subaru, Suzuki, Toyota); Mercedes-Benz (Mercedes-Benz, Smart); Renault-Nissan-Mitsubishi (Dacia, Mitsubishi, Nissan, Renault); Stellantis (Alfa Romeo, Citroën, DS Automobiles, Fiat, Jeep, Lancia, Opel, Peugeot, SEAT, Vauxhall); Tesla (Honda, Land Rover, Tesla); and VW-SAIC (Audi, Cupra, MG, Porsche, SEAT, Škoda, VW).

super-credits in 2020, which are capped at 7.5 g/km for the period 2020–2022. Eco-innovation technologies lowered CO_2 emission levels by 0.2 to 2.0 g/km.

Table 1. Manufacturer pool market shares, average vehicle mass and CO_2 emissions, impact of flexible compliance mechanisms, and CO_2 emission targets for 2021.

Manufacturer pool	Market share	Average mass (kg)	CO_2 values (g/km, WLTP)					
			2021 average	Super-credits	Eco-innovations	Adj. 2021 average	Target	Distance to target
Tesla	2%	1,909	67	0	-0.2	67	136	-69
BMW	7%	1,714	117	0	-1.6	116	126	-10
Mercedes-Benz	5%	1,814	116	0	-0.7	115	125	-10
Stellantis	22%	1,327	116	-2.3	-1.7	112	118	-6
ALL POOLS	**96%**	**1,474**	**115**	**-0.7**	**-1.3**	**113**	**119**	**-6**
Kia	4%	1,425	107	0	-0.6	106	112	-5
Hyundai	4%	1,445	108	0	-0.6	108	113	-5
Ford	4%	1,558	121	0	-2	119	123	-5
VW-SAIC	25%	1,534	119	0	-1.3	118	121	-3
Mazda-Subaru-Suzuki-Toyota	10%	1,373	118	-1.9	-0.7	116	117	-1
Renault-Nissan-Mitsubishi	13%	1,333	111	0	-1.4	109	111	-1

Note: Rows are sorted by the distance to 2021 target levels.

3. FUEL TYPE AND TECHNOLOGY TRENDS BY MEMBER STATE AND MANUFACTURER

Uptake of all forms of electrified powertrain vehicles increased from 2020 to 2021. Battery electric vehicle (BEV) and plug-in hybrid electric vehicle (PHEV) shares grew by roughly two thirds (from 6.1% to 10.1% and from 5.3% to 9.2%, respectively); hybrid electric vehicle (HEV) shares grew by roughly one third (from 4.7% to 6.6%); and mild hybrid electric vehicle (MHEV) shares using 48-volt systems almost doubled (from 7.7% to 13.8%). Plagued by the aftermath of Dieselgate, diesel market shares, including mild-hybrid electric vehicles, continued to fall, decreasing from 30% in 2020 to 23% in 2021. Other powertrains, predominantly compressed natural gas and liquified petroleum gas vehicles, accounted for 2.7% of the market.

Table 2 presents the market share of various fuels and technologies in 2021 by country.[7] Norway continues to dominate the European electric vehicle (EV) market, with more than 64.5% of new car registrations in 2021 being BEVs and another 21.7% being PHEVs. Iceland, another non-EU country, also recorded high EV market shares of 26.9% for BEVs and 31% for PHEVs. Within the EU, Sweden saw the highest uptake of electric vehicles (19% BEVs and 25.7% PHEVs) and the Netherlands saw the highest uptake of BEVs (19.8%). Germany, the largest vehicle market in the EU, nearly doubled PHEV shares (6.9% in 2020 to 12.4% in 2021) and BEV shares (6.7% in 2020 to 13.6% in 2021). Shares of HEVs were particularly high in Finland (14.8%) and exceeded 10% in seven countries. Mild hybrid-electric vehicles using 48-volt systems entered the European market in 2018 and were commonplace in most countries by 2021.

At their peak in 2010 to 2015, diesel vehicles accounted for more than half of annual passenger car registrations in Europe, but in 2021 exceeded 30% in only three markets (Ireland, Luxembourg, and Austria). Italy was the only major market with a significant share of compressed natural gas and liquified petroleum gas vehicles in 2021.

7 Because the EEA data do not include details on electric powertrains, EEA data have been supplemented with proprietary data content supplied by Dataforce.

Table 2. Market share of fuels and technologies for new passenger cars in 2021 by country.

Market	Diesel	Petrol	Mild hybrid electric	Hybrid electric	Plug-in hybrid electric	Battery electric	Other	Market share
Germany	25%	45%	13.7%	2.7%	12.4%	13.6%	0.6%	26.5%
France	23%	47%	9.0%	8.5%	8.5%	9.8%	3.0%	16.8%
Italy	26%	48%	21.9%	7.0%	4.8%	4.6%	9.4%	14.8%
Spain	26%	55%	14.9%	10.0%	4.9%	2.7%	1.6%	8.9%
Poland	17%	63%	11.9%	12.9%	2.0%	1.6%	3.0%	4.5%
Belgium	25%	51%	13.4%	5.0%	12.2%	5.8%	0.8%	3.9%
Netherlands	2%	59%	13.6%	8.6%	9.6%	19.8%	0.7%	3.3%
Sweden	16%	30%	15.5%	7.7%	25.7%	19.0%	0.9%	3.1%
Austria	31%	46%	13.7%	3.4%	6.0%	13.6%	0.0%	2.5%
Czechia	25%	65%	5.4%	3.8%	1.8%	1.3%	1.5%	2.1%
Denmark	14%	47%	8.1%	4.7%	21.7%	13.3%	0.0%	1.9%
Norway	4%	4%	1.1%	5.4%	21.7%	64.5%	0.0%	1.8%
Portugal	25%	49%	8.6%	4.7%	10.8%	8.7%	2.3%	1.5%
Hungary	22%	63%	31.7%	8.5%	2.7%	3.5%	0.6%	1.2%
Romania	20%	52%	15.2%	7.7%	2.4%	5.2%	13.2%	1.2%
Ireland	36%	34%	7.0%	14.1%	7.6%	8.2%	0.3%	1.1%
Greece	18%	63%	14.9%	8.6%	4.4%	2.2%	3.4%	1.0%
Finland	11%	43%	13.8%	14.8%	20.5%	10.3%	0.9%	1.0%
Slovakia	24%	65%	13.1%	6.9%	1.6%	1.5%	1.6%	0.8%
Luxembourg	31%	45%	13.8%	2.6%	10.0%	10.5%	0.0%	0.4%
Slovenia	26%	64%	11.0%	4.1%	1.2%	3.8%	1.2%	0.4%
Croatia	29%	57%	10.6%	3.9%	1.8%	3.2%	4.5%	0.4%
Lithuania	15%	65%	25.0%	13.4%	1.3%	3.7%	1.0%	0.3%
Estonia	23%	58%	14.8%	13.3%	1.0%	2.1%	2.1%	0.2%
Iceland	15%	18%	6.7%	9.0%	31.0%	26.9%	0.1%	0.2%
Latvia	27%	53%	6.3%	14.3%	1.0%	2.9%	2.0%	0.1%
Cyprus	14%	57%	N/A	1.5%	0.9%	0.8%	0.0%	0.1%
Total	**23%**	**48%**	**13.7%**	**6.6%**	**9.2%**	**10.1%**	**2.7%**	

Notes: Countries are sorted by descending market share. "Diesel" and "Petrol" columns include mild hybrid-electric vehicles. The "Other" column primarily covers compressed natural gas and liquified petroleum gas fuels.

Table 3 presents the market share of various fuels and technologies in 2021 for car manufacturer pools and select brands. Among pools, the Tesla pool, which included the brands Jaguar-Land Rover and Honda, had the highest EV share with almost two-thirds of registrations being BEVs or PHEVs, followed by Mercedes-Benz, BMW, and Kia, each with more than 20%. Mazda-Subaru-Suzuki-Toyota stands out with almost half of registrations being HEVs. Among brands, Volvo, MG, Cupra, Mitsubishi, and DS Automobiles topped the ranking of PHEV shares, while Tesla, Smart, MG, Porsche, and Mini topped the BEV ranking. Two German premium manufacturer pools, Mercedes-Benz and BMW, stood out with the highest diesel shares (41% and 35%, including MHEVs, respectively). Outside those pools, diesel accounted for more than half of the passenger car registrations of two brands, Alfa Romeo and Land Rover. The manufacturer pool Renault-Nissan-Mitsubishi and its Dacia brand had the highest share of compressed natural gas and liquified petroleum gas vehicles by a wide margin.

Table 3. Market share of fuels/technologies for new passenger cars in 2021 for manufacturer pools.

Manufacturer pool	Diesel	Petrol	Mild hybrid electric	Hybrid electric	Plug-in hybrid electric	Battery electric	Other	Market share
VW-SAIC	27%	52%	9.5%	0.0%	8.8%	10.8%	1.6%	25.2%
VW	28%	52%	2.9%	0.0%	5.4%	13.3%	1.1%	11.1%
Škoda	27%	57%	3.3%	0.0%	5.3%	8.6%	2.1%	5.2%
Audi	37%	38%	37.3%	0.0%	14.9%	9.3%	0.5%	4.7%
SEAT	15%	71%	5.6%	0.0%	6.6%	3.0%	4.9%	2.8%
Cupra	5%	52%	0.0%	0.0%	37.2%	5.1%	0.0%	0.6%
Porsche	0%	56%	0.0%	0.0%	23.0%	21.1%	0.0%	0.6%
MG	0%	2%	0.0%	0.0%	38.9%	59.0%	0.0%	0.2%
Stellantis	30%	57%	10.7%	0.0%	5.4%	6.9%	0.9%	21.8%
Peugeot	36%	48%	0.0%	0.0%	7.2%	9.2%	0.0%	6.7%
Fiat	23%	65%	42.5%	0.0%	0.0%	8.8%	3.1%	4.6%
Citroën	34%	59%	0.0%	0.0%	3.4%	2.8%	0.0%	4.2%
Opel/Vauxhall	23%	66%	0.0%	0.0%	2.7%	8.6%	0.0%	4.0%
Jeep	34%	39%	0.0%	0.0%	26.8%	0.0%	0.0%	1.2%
Lancia	0%	87%	85.4%	0.0%	0.0%	0.0%	13.4%	0.4%
DS Automobiles	36%	27%	0.0%	0.0%	29.9%	7.2%	0.0%	0.4%
Alfa Romeo	65%	35%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Renault-Nissan-Mitsubishi	15%	50%	6.0%	5.2%	4.4%	11.4%	14.1%	12.8%
Renault	15%	48%	8.1%	10.3%	5.5%	14.0%	6.7%	6.4%
Dacia	19%	39%	0.0%	0.0%	0.0%	7.1%	35.0%	3.9%
Nissan	7%	77%	13.2%	0.0%	0.0%	15.2%	0.9%	1.8%
Mitsubishi	0%	68%	0.0%	0.0%	31.2%	0.0%	0.4%	0.7%
Mazda-Subaru-Suzuki-Toyota	3%	45%	24.0%	48.7%	2.5%	1.2%	0.2%	9.5%
Toyota	3%	22%	0.0%	70.9%	3.6%	0.1%	0.1%	6.0%
Suzuki	0%	95%	88.5%	3.4%	1.1%	0.0%	0.0%	1.7%
Mazda	5%	88%	53.9%	0.0%	0.0%	7.4%	0.0%	1.3%
Lexus	0%	5%	0.0%	89.4%	0.0%	5.3%	0.0%	0.3%
BMW	35%	37%	21.2%	0.0%	18.6%	9.0%	0.0%	6.8%
BMW	42%	31%	26.1%	0.0%	20.5%	6.9%	0.0%	5.5%
Mini	8%	64%	0.0%	0.0%	10.3%	18.0%	0.0%	1.3%
Mercedes-Benz	41%	23%	7.8%	0.1%	24.3%	11.9%	0.0%	5.7%
Mercedes-Benz	43%	25%	8.3%	0.1%	25.9%	6.1%	0.0%	5.3%
Smart	0%	0%	0.0%	0.0%	0.0%	99.8%	0.0%	0.4%
Hyundai	9%	56%	20.5%	14.5%	5.7%	13.7%	0.6%	4.4%
Hyundai	9%	56%	20.5%	14.5%	5.7%	13.7%	0.6%	4.4%
Ford	26%	53%	28.6%	3.7%	10.4%	4.7%	1.2%	4.4%
Ford	26%	53%	28.6%	3.7%	10.4%	4.7%	1.2%	4.4%
Kia	12%	55%	17.0%	5.5%	11.8%	11.9%	3.6%	4.1%
Kia	12%	55%	17.0%	5.5%	11.8%	11.9%	3.6%	4.1%
Tesla	15%	11%	16.0%	10.4%	6.4%	57.2%	0.0%	2.4%
Tesla	0%	0%	0.0%	0.0%	0.0%	100.0%	0.0%	1.3%
Land Rover	53%	19%	58.9%	0.2%	27.3%	0.0%	0.0%	0.5%
Honda	1%	30%	0.2%	61.7%	0.0%	6.5%	0.0%	0.4%
Other brands								
Volvo	25%	28%	36.7%	0.0%	40.4%	5.9%	0.0%	2.4%
Total	**23%**	**48%**	**13.7%**	**6.6%**	**9.2%**	**10.1%**	**2.7%**	

Notes: Brand shares may not add up to manufacturer pool totals because not all brands are included. Manufacturer pools are sorted by descending market share. "Diesel" and "Petrol" columns include mild hybrid electric vehicles. The "Other" column primarily covers compressed natural gas and liquified petroleum gas fuels.

4. FLEXIBLE COMPLIANCE MECHANISMS

Several 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 principal mechanisms to account for varying consumer preferences. Other compliance 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 sales of low-emission vehicles that emit less than 50 g CO_2/km over the NEDC. 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 cars in 2014, and 1.5 cars in 2015. In the 2020/21 standard, each low-emission car counts as 2 cars in 2020, 1.67 cars in 2021, and 1.33 cars in 2022. The combined impact of super-credits for the years 2020–2022 for compliance with the CO_2 targets is capped at 7.5 g/km per manufacturer pool. From 2025 onwards, super-credits are removed in favor of EV share-based incentives. In its recent regulatory proposal, the European Commission proposed to remove these incentives by 2030.

Figure 2 plots historical average CO_2 emissions excluding electric vehicles (BEVs and PHEVs), including electric vehicles, and including the effect of super-credits. The figure indicates that the share and impact of low-emission vehicles has been growing over the years, reaching 18 g/km in 2021. With eight out of ten manufacturer pools having met their super-credit cap in 2020, super-credits reduced fleet-average CO_2 emissions by almost 7 g/km (NEDC) in 2020 but by less than 1 g/km (WLTP) in 2021.

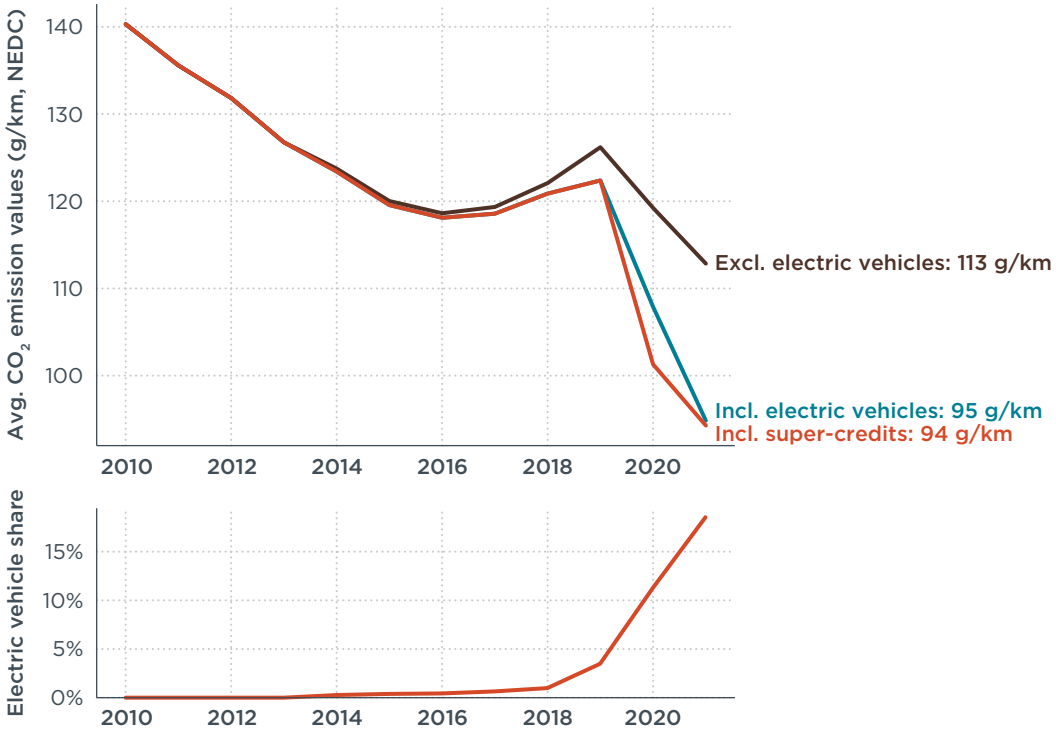

Figure 2. Top panel: Historical average CO_2 emissions (g/km, NEDC) excluding and including low-emission vehicles. Bottom panel: Share of low-emission vehicles.

Figure 3 plots the market share and average NEDC CO_2 emissions of different fuel and powertrain technologies in 2019, 2020, and 2021. The figure indicates that all technologies saw declining CO_2 emissions from 2019 to 2021. Although MHEVs saw

some of the largest efficiency gains over time, comparing annual average emissions from MHEVs with conventional internal combustion engine vehicles (ICEVs) reveals that MHEVs generally offered no additional emission reductions compared to their ICEV counterparts. This could at least in part be due to mild hybrid technologies predominantly being installed in heavier vehicle models. Petrol MHEVs, PHEVs, and BEVs saw the largest increase in market shares at the expense of diesel and petrol ICEVs. Taken together, efficiency improvements in all technologies and the shift toward hybrid technologies and BEVs led to the decline in average CO_2 emissions from 2019 to 2021.

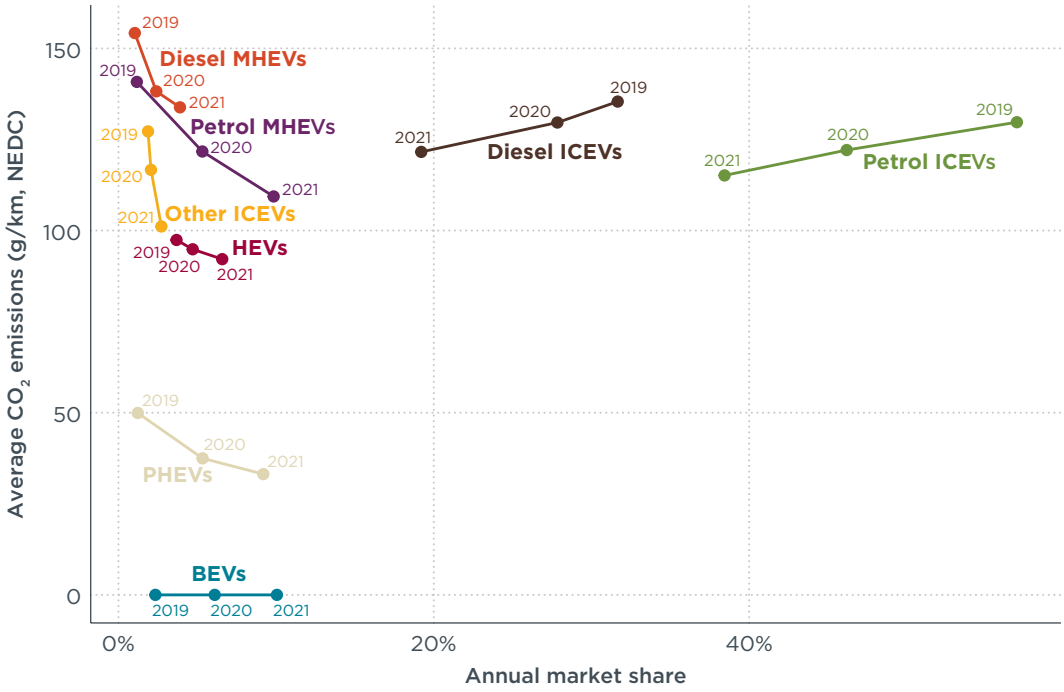

Figure 3. Annual average CO_2 emissions and market share per fuel/powertrain technology in 2019 to 2021. "Other ICEVs" primarily covers compressed natural gas and liquified petroleum gas fuels.

Manufacturer CO_2 targets are adjusted by vehicle mass to account for varying consumer preferences. Figure 4 plots the annual average CO_2 emissions over average vehicle mass, both including and excluding low-emission vehicles. Excluding low-emission vehicles, the figure indicates that 2016–2020 efficiency improvements were offset by a 41 kg increase in average vehicle mass, which was largely driven by the increasing share of sport utility vehicles and crossover utility vehicles.[8] In 2021, however, vehicle mass declined when excluding low-emission vehicles and average CO_2 emissions declined including and excluding low-emission vehicles. Because 2020 manufacturer targets were calculated against a baseline mass of 1,379.88 kg, and the average mass of vehicles belonging to manufacturer pools increased to approximately 1,453 kg in 2020, manufacturer targets were, on average, approximately 97 g/km instead of the intended 95 g/km over the NEDC. Because the baseline mass of 1,379.88 kg is still used in the calculation of 2021 targets, manufacturers targets were, on average, inflated to approximately 119 g/km as determined by the WLTP, instead of the approximately 115 g/km that would result from converting the 95 g/km 2020 NEDC target to WLTP in 2021.

8 Sonsoles Díaz et al., "European Vehicle Market Statistics 2021/2022" (Washington, D.C.: ICCT, December 17, 2021), https://theicct.org/publications/european-vehicle-market-statistics-2021-dec21.

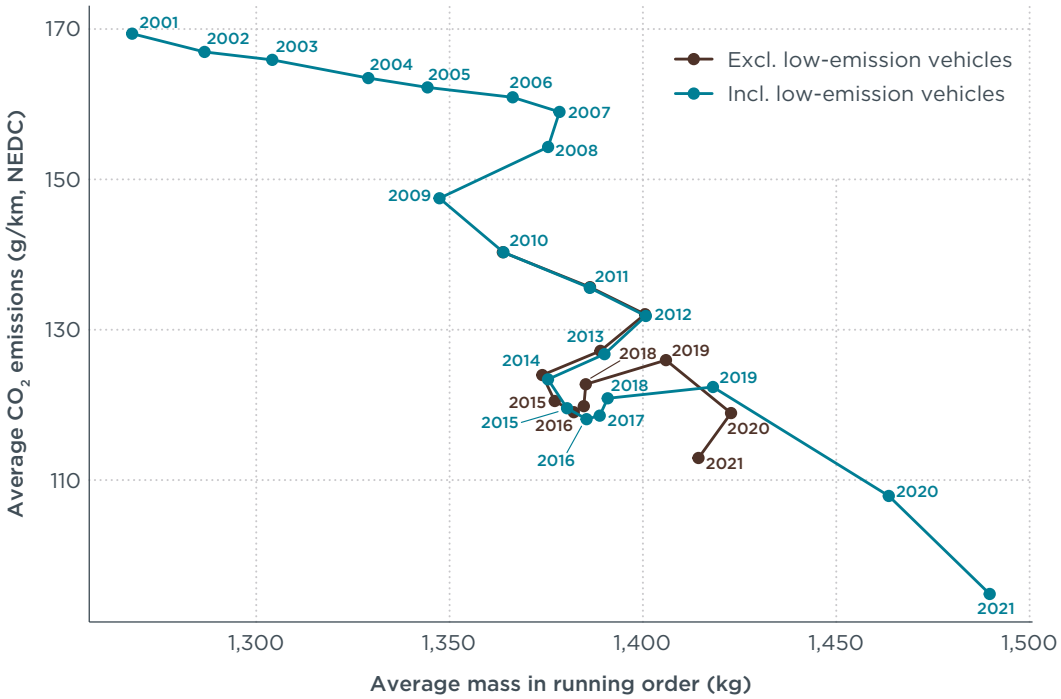

Figure 4. Annual average CO_2 emissions (g/km, NEDC) over average mass in running order (kg), including and excluding low-emission vehicles.

Eco-innovation credits incentivize the development and adoption of innovative fuel-efficiency technologies by rewarding innovative technologies that produce real-world CO_2 savings beyond what is measured over a standardized test cycle during vehicle type approval. Up to and including 2020, the NEDC was the applicable reference cycle; since 2021, the Worldwide Harmonized Light Vehicles Test Cycle (WLTC) has been used. Because CO_2 savings from eco-innovations count toward manufacturers' CO_2 targets, automakers have an incentive to develop and deploy cost-effective eco-innovation technologies.[9] In the years 2021, 2022, and 2023, eco-innovation credits are multiplied by 1.9, 1.7, and 1.5, respectively, in the calculation of manufacturers' CO_2 savings from eco-innovation technologies. The reasoning behind the introduction of the multiplier is unclear. For the purpose of complying with CO_2 emission targets, the total impact of eco-innovation technologies each year is limited to 7 g/km per manufacturer pool.

The share of new passenger cars with eco-innovation technologies installed has increased over time but remained stable from 2020 to 2021 at 43%. Figure 5 plots the average CO_2 emission reduction through eco-innovation technologies per manufacturer pool in 2021, including and excluding the 1.9 multiplier. Market-wide average CO_2 reductions from eco-innovation technologies were 1.3 g/km over the WLTP in 2021, up from 0.7 g/km over the NEDC in 2020. Two manufacturer pools, Ford and Stellantis, had eco-innovation technologies installed in more than half of all passenger cars registered in 2021 and lead the pools in CO_2 savings.

9 Uwe Tietge, Peter Mock, and Jan Dornoff, "Overview and Evaluation of Eco-Innovations in European Passenger Car CO2 Standards" (Washington, D.C.: ICCT, July 11, 2018), https://theicct.org/publication/overview-and-evaluation-of-eco-innovations-in-european-passenger-car-co2-standards/.

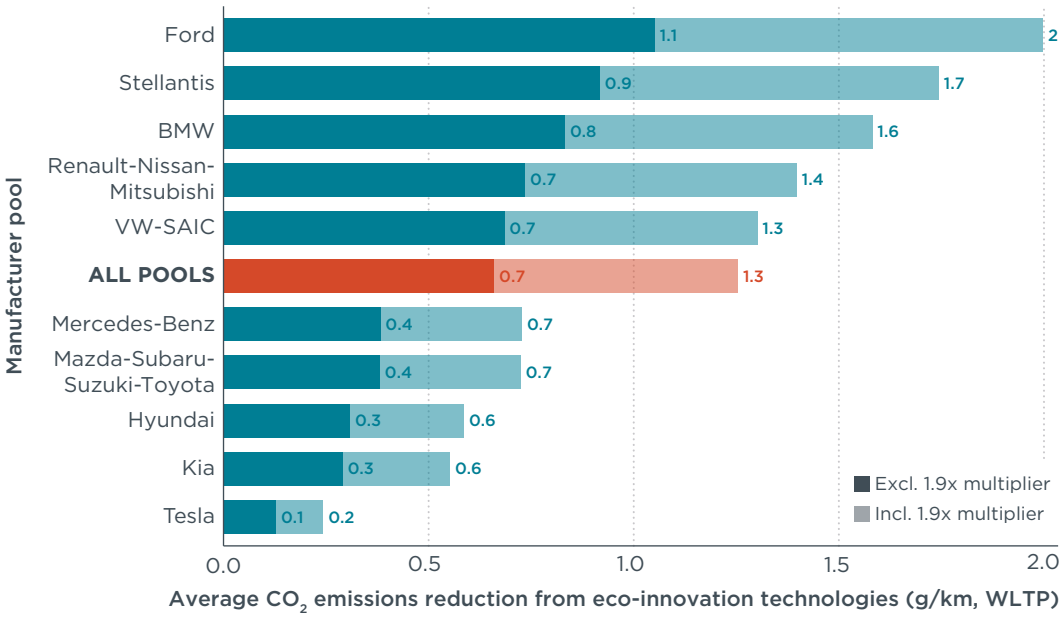

Figure 5. Average CO_2 emission reduction (g/km, WLTP) in 2021 per manufacturer pool from eco-innovation technologies.

5. OUTLOOK

All manufacturer pools appear to have met their 2021 CO_2 targets. The CO_2 standards thus led to a substantial decrease in average type-approval CO_2 emissions from 2020 to 2021, largely because of an equally significant increase in electric vehicle shares.

In 2020, all manufacturer pools relied on one or more of the flexible compliance mechanisms afforded by EU regulations—the phase-in provision, super-credits for low-emission vehicles, and eco-innovation technology credits—to meet their targets. In 2021, reliance on compliance mechanisms dwindled after the phase-in provision had lapsed and most pools had exhausted the super-credits cap for 2020–2022 in 2020. Instead, manufacturers relied on battery electric and plug-in hybrid electric vehicles and, to a lesser extent, efficiency improvements and hybridization of conventional powertrains, to meet their targets.

A recent regulatory proposal by the European Commission includes strengthening the 2030 CO_2 reduction target from –37.5% to –55% compared to 2021 levels and introduces a new –100% target for 2035. In order to meet these targets, manufacturers will have to continue to electrify their fleets in the coming years. However, with the 2025 target remaining at –15% for the moment, and in the absence of annual or additional interim targets, there remains a risk that automakers will postpone the introduction of innovative vehicle technologies to the late 2020s, similar to the pattern observed in 2016–2019. Still, setting a phase-out date for new combustion engine vehicles for 2035 at the latest will be an important step towards reaching the EU's climate protection targets and sends a strong signal to the rest of the world that the EU is leading by example.

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 at least at the same rate. Real-world emissions are significantly higher than the official values presented in this briefing. The gap between real-world and NEDC CO_2 emission values of European cars widened over time and reached approximately 39% in 2018, with the WLTP narrowing the gap between real-world and official figures to

approximately 14%.[10] In 2020, on-board fuel consumption meters were 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 enact policies to prevent a widening of the gap between type-approval and real-world emission values in the future.[11] For meaningful monitoring of real-world emission levels, detailed fuel and energy consumption data must become publicly available.

10 Jan Dornoff, Uwe Tietge, and Peter Mock, "On the Way to 'Real-World' CO2 Values: The European Passenger Car Market in Its First Year after Introducing the WLTP" (Washington, D.C.: ICCT, May 19, 2020), https://theicct.org/publication/on-the-way-to-real-world-co2-values-the-european-passenger-car-market-in-its-first-year-after-introducing-the-wltp/.

11 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.