BRIEFING

SEPTEMBER 2021

Fit for 55: A review and evaluation of the European Commission proposal for amending the CO_2 targets for new cars and vans

Prepared by Jan Dornoff, Peter Mock, Chelsea Baldino, Georg Bieker, Sonsoles Díaz, Josh Miller, Arijit Sen, Uwe Tietge, and Sandra Wappelhorst

BACKGROUND

On July 14, the European Commission (EC) put forward "Fit for 55," a package of regulatory proposals intended to secure a European Union (EU) economy-wide greenhouse gas (GHG) reduction of at least 55% by 2030, compared to 1990 levels.[1] These emission reduction efforts for 2030 are a follow-up of the European Green Deal,[2] a sustainable growth strategy put forth in December 2019, and a response to the European Climate Law that foresees a legally binding target of climate neutrality by 2050.[3]

One of the regulatory proposals adopted by the EC is to amend the mandatory carbon dioxide (CO_2) emission targets for new passenger cars and light commercial vehicles (vans). This briefing summarizes and evaluates the key elements of this proposal before it enters the political negotiation process between the European Parliament and the Council.[4]

1 Regulation (EU) 2021/119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law'), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R1119

2 European Commission, "The European Green Deal: Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions," (December 11, 2019), https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF.

3 European Commission, "European Climate Law," (March 4, 2020), https://ec.europa.eu/clima/policies/eu-climate-action/law_en

4 European Commission, "Proposal for a regulation of the European Parliament and of the Council amending Regulation (EU) 2019/631 as regards strengthening the CO_2 emission performance standards for new passenger cars and new light commercial vehicles in line with the Union's increased climate ambition," COM(2021) 556 final, 2021/0197 (COD), (July 14, 2021), https://ec.europa.eu/info/sites/default/files/amendment-regulation-co2-emission-standards-cars-vans-with-annexes_en.pdf

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SUMMARY OF KEY ELEMENTS OF THE PROPOSAL

The EC proposal strengthens the current **2030 CO_2 targets**, from -37.5% to **-55% for new passenger cars** and from -31% to **-50% for new vans**, both relative to a 2021 baseline. In addition, the proposal introduces a new **2035 CO_2 target** set at **-100% for new cars and vans**, again relative to a 2021 baseline. The **2025 CO_2 target** remains unchanged at **-15%** for both new cars and vans. The EC does not propose any interim targets nor a transition to annual instead of stepwise target values. Target values remain dependent on the average mass of a manufacturer's new vehicle fleet, i.e. for heavier vehicles, higher absolute CO_2 emission levels are granted. The penalty for non-compliance with the CO_2 targets remains unchanged, at a level of €95 per vehicle and per gram/km of CO_2.

The benchmark target for zero- and low-emission vehicles (**ZLEVs**) for the years **2025 to 2029** remains in place, at a level of **15%** of the respective fleets of new passenger cars and vans. A manufacturer selling more ZLEVs can benefit from a relaxation of its CO_2 target of up to 5%. Meanwhile, the previously enacted ZLEV benchmarks of 35% (cars) and 30% (vans) for 2030 are no longer part of the regulatory proposal as ZLEV credits are **phased out from 2030 onwards**. Plug-in hybrid electric vehicles (PHEVs) with official CO_2 emission levels of less than 50 g/km continue to benefit from an extra discount factor for the purpose of the ZLEV credit calculations, artificially reducing the often already unrealistically low CO_2 level of those vehicles by another 30%. New registrations of ZLEVs in EU Member States with a fleetwide share of zero- and low-emission vehicles of below 60% of the Union average in 2017 and with less than 1,000 new ZLEVs registered in the same year continue to count 1.85 times as much as those registrations in all other EU Member States, but only as long as less than 5% ZLEVs are registered in the member state concerned.

Credits for **eco-innovation** technologies remain in place, capped at a level of 7 gCO_2/km, with the EC being empowered to adjust the cap from 2025 onwards. Small manufacturers, with less than 10,000 new car and 22,000 new van registrations per year can still benefit from **derogations** but only until 2028. Also, an exemption for manufacturers with less than 1,000 registrations per year remains in place.

All provisions regarding **real-world driving emission and energy consumption** levels remain unchanged. This means the EC will continue to collect data from on-board fuel consumption and energy consumption monitors (OBFCMs). The data will be published for the first time at the end of 2022, aggregated by manufacturer, fuel type, vehicle category, and powertrain type. By June 2023, the EC will assess how fuel and energy consumption data may be used to ensure that type-approval vehicle CO_2 emissions and fuel or energy consumption values are representative of real-world emissions over time for each manufacturer and, in 2027, will assess the feasibility of adjusting a manufacturer's average specific emissions of CO_2 as of 2030.

The vehicle CO_2 regulation remains targeted at tailpipe emissions, leaving the reduction of upstream well-to-tank emissions, including those of non-CO_2 greenhouse gases such as methane, to be dealt with by other regulations. Consequently, the regulatory proposal does not provide for any credits for **low-carbon fuels** and leaves the promotion of renewable fuels for the Renewable Energy Directive and other regulations.

By December 2025, and every two years thereafter, the EC will report on the progress towards zero emission road mobility and assess the need for additional measures. In **2028**, the EC will **review** the effectiveness and impact of the regulation and will eventually propose an amendment.

As part of the 'Fit for 55' package, the new vehicle CO_2 targets' regulation is accompanied by other regulations for establishing a separate emissions trading

system (**ETS**) for the transport and buildings sectors, strengthening the **recharging and refueling infrastructure**, as well as adapting the **energy tax** levels across the EU. A regulatory proposal to amend the CO_2 standards for new **heavy-duty vehicles** will follow in 2022.

EVALUATION OF KEY ELEMENTS OF THE PROPOSAL

LEVEL AND TIMING OF EMISSIONS TARGETS

The proposed regulation would be the fourth set of mandatory vehicle CO_2 performance standards in the EU. The **first regulations** for passenger cars (EC) 443/2009 and light commercial vehicles (EU) 510/2011, adopted in 2009 and 2011, respectively, after a voluntary commitment by the auto industry to reduce average vehicle CO_2 emissions failed to produce adequate results, established EU fleet-wide targets of **130 g/km for new passenger cars in 2015 and 175 g/km for vans in 2017**. Vehicle manufacturers met both targets several years in advance, based on the type-approval emissions as measured under the New European Driving Cycle (NEDC). Real-world driving emission levels decreased but to a lesser extent.[5]

These regulations were amended in 2014. Regulation (EU) 333/2014 required average official CO_2 emissions of new cars to fall to **95 g/km by 2021**. For 2020, a phase-in provision allowed manufacturers to comply with the 95 g/km target by not including 5% of highest CO_2 emission vehicles of their respective fleet. For new vans, Regulation (EU) 253/2014 set the target value to **147 g/km by 2020**. Both 2020 target values for cars and vans were met by all manufacturers without any or at least without any substantial penalty payments.[6]

In April 2019, the EU adopted regulation (EU) 2019/631, combining CO_2 emission performance standards for new passenger cars and light commercial vehicles into one regulatory text. This regulation introduced new mandatory CO_2 targets for 2025 and 2030. With the transition from the NEDC to the World Harmonized Light Vehicles Test Procedure (WLTP), the 2025 and 2030 targets were no longer defined as absolute emission targets in g/km, but instead as percentage reduction targets relative to a 2021 baseline emission level. **For 2025, the required CO_2 reduction is 15% for both new cars and vans. For 2030, the reduction target is 37.5% for cars and 31% for vans**.

With the recent EC proposal, the **2030** target values would be strengthened to **-55% for cars** and **-50% for vans**. In addition, the proposed regulation for **2035** sets a **-100%** target for manufacturers, requiring all new vehicles from 2035 onwards to have zero tailpipe CO_2 emissions. The 2025 target remains unchanged at -15%. Similarly, there are no additional interim targets, nor a transition to annual CO_2 targets.

Figure 1 and Figure 2 illustrate the historic and expected future development of new passenger cars and van average CO_2 emission levels in the EU, including both absolute and annual percentage reductions and also estimated absolute values in NEDC and WLTP terms.

5 Uwe Tietge, Sonsoles Díaz, Peter Mock, Anup Bandivadekar, Jan Dornoff, Norbert Ligterink, *From Laboratory to Road: A 2018 update of official and 'real-world' fuel consumption and CO_2 values for passenger cars in Europe*, (Washington, DC: ICCT: 2019), https://theicct.org/publications/laboratory-road-2018-update

6 Uwe Tietge, Peter Mock, Sonsoles Díaz, Jan Dornoff, *CO_2 emissions from new passenger cars in Europe: car manufacturers' performance in 2020*, (Washington DC: ICCT, 2021), https://theicct.org/publications/eu-co2-pvs-performance-2020-aug21

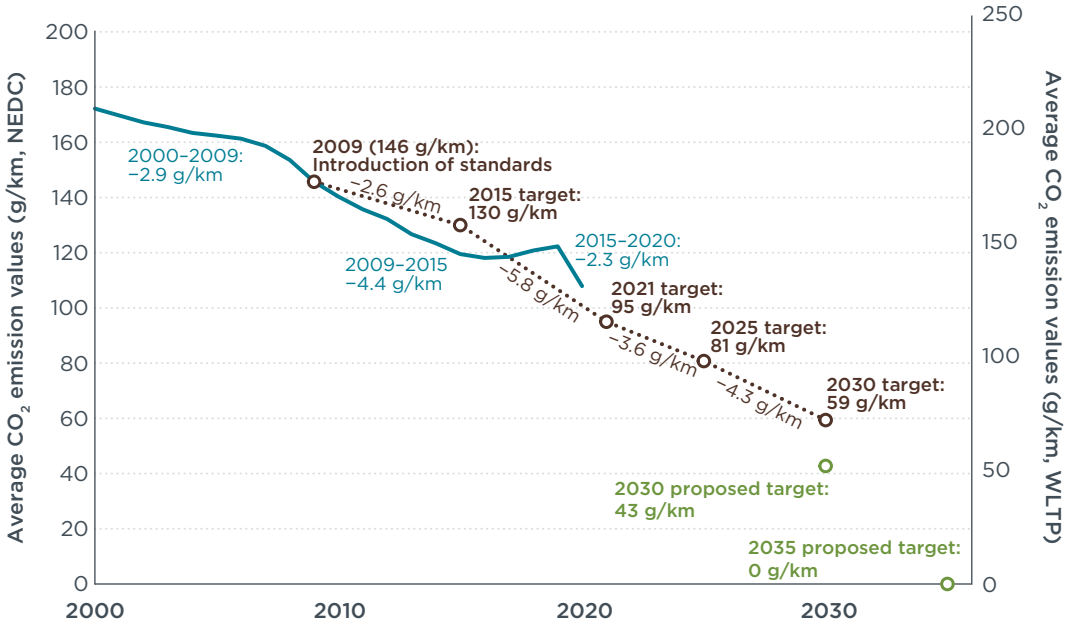


Figure 1. Historical average official CO_2 emission values (in blue), standards (in brown), and proposed targets (in green) for European passenger cars. Rates in g/km refer to annual rates. All CO_2 values labeled in the figure refer to NEDC. WLTP CO_2 values on secondary axis are estimated based on an average WLTP-NEDC correlation factor of 1.21.

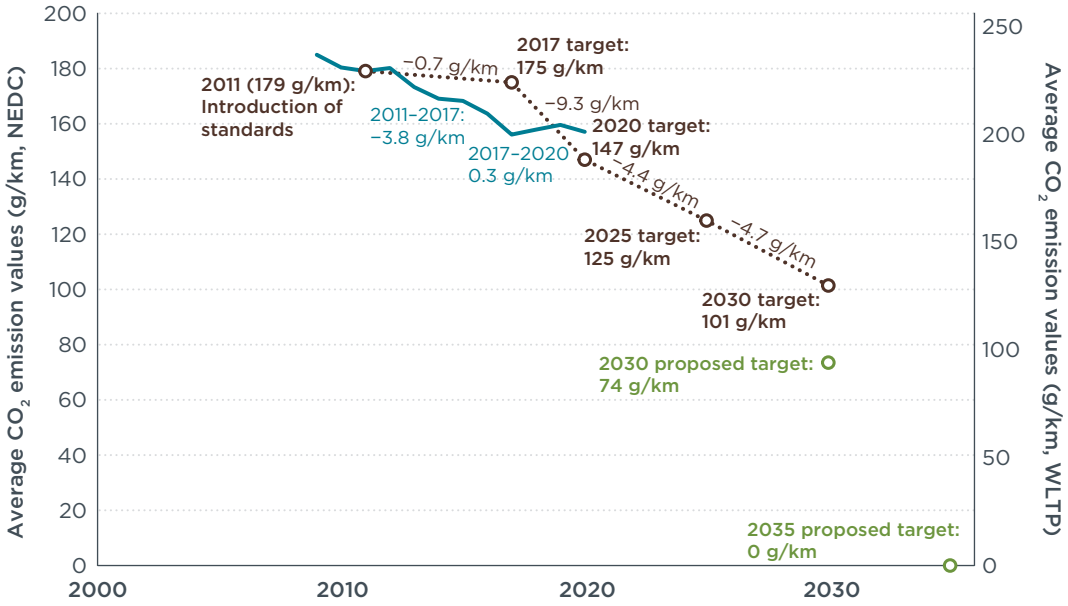


Figure 2. Historical average official CO_2 emission values (in blue), standards (in brown), and proposed targets (in green) for European vans. Rates in g/km refer to annual rates. All CO_2 values labelled in the figure refer to NEDC. WLTP CO_2 values on secondary axis are estimated based on an average WLTP-NEDC correlation factor of 1.28.

Prior to the publication of the EC proposal, some had recommended strengthening the 2025 CO_2 target to at least -25%,[7] transitioning to annual CO_2 targets or

7 Transport & Environment, "Cars CO_2 review: Europe's chance to win the emobility race," (January 2021), https://www.transportenvironment.org/publications/car-co2-review-europe's-chance-win-e-mobility-race

introducing a 2027 interim target,[8] strengthening the 2030 target to at least –75%,[9] and phasing out combustion engines by 2035 at the latest.[10] Meanwhile, some industry stakeholders had warned against strengthening the 2030 CO_2 target,[11] and the government of France expressed a preference for delaying a phase-out of combustion engine vehicles to 2040.[12]

IMPACT ON OVERALL EMISSION LEVELS

In order to determine the impact of the EC proposal and possible alterations on tailpipe CO_2 emissions in the EU, we modeled eight regulatory scenarios for passenger cars and vans. These scenarios include currently adopted CO_2 standards, the Commission's July 2021 proposal, a scenario that reflects a delay from the Commission's proposal, and five scenarios that progressively tighten elements of the Commission's proposed standards. These scenarios, listed below, are numbered in ascending order based on their overall stringency and expected CO_2 benefits. In cases where two reduction targets are stated, the more stringent reduction applies to passenger cars and the less stringent applies to vans.

The scenarios evaluated for passenger cars and vans are:

(1) Adopted policies: 15% reduction by 2025, 31% and 37.5% reduction by 2030

(2) Decrease the proposed 2035 reduction target to 80% and delay the 100% target to 2040

(3) Commission proposal as of July 2021: 15% reduction by 2025, 50% and 55% reduction by 2030, and a 100% reduction by 2035 (5-year targets)

(4) Increase the 2030 target in the Commission proposal to 60%

(5) Increase the 2030 target in the Commission proposal to 70%

(6) Increase the 2025 target in the Commission proposal to 30%

(7) Switch to annual reduction targets after 2025

(8) Higher ambition: 35% and 40% reduction targets by 2025, 100% reduction by 2030, with annual targets

Figure 3 shows the corresponding CO_2 targets for each scenario. In this paper, we modeled only two scenarios with annual targets (7 and 8). In practice, any of scenarios could be combined with annual targets to increase their cumulative CO_2 emissions benefits and ensure that manufacturers steadily increase production of zero-emission vehicles.[13]

8 Peter Mock, (2021). "Europe's lost decade: About the importance of interim targets (blog post)," ICCT staff blog, May 9, 2021, https://theicct.org/blog/staff/interim-targets-europe-may2021; Joshua Miller and Arijit Sen, (2021). "Details matter: The outsized climate benefits of setting annual targets for new cars in Europe (blog post)," ICCT staff blog, 8 July 2021, https://theicct.org/blog/staff/details-matter-annual-targets-europe-jul2021

9 Agora Verkehrswende, "Notes on the revision of the EU CO_2 emission performance standards for cars and light commercial vehicles," (February 5, 2021), https://www.agora-verkehrswende.de/en/publications/notes-on-the-revision-of-the-eu-co2-emission-performance-standards-for-cars-and-light-commercial-vehicles/

10 See the March 10, 2021 letter "Transition to zero-emission light-duty vehicles," signed by the governments of nine EU member states (https://klimaat.be/doc/2021-non-paper-transition-zero-emission-light-duty-vehicles.pdf) (the letter does not include a specific phase-out date) and Claire Buysse, Joshua Miller, Sonsoles Díaz, Arijit Sen, and Caleb Braun, *The role of the European Union's vehicle CO_2 standards in achieving the European Green Deal*, (Washington, DC: ICCT, 2021), https://theicct.org/publications/eu-vehicle-standards-green-deal-mar21

11 See, for example, "CLEPA position paper on climate neutral transport and CO_2 emission standards," (February 25, 2021), https://clepa.eu/mediaroom/clepa-position-paper-on-climate-neutral-transport-and-co2-emission-standards/

12 Ania Nussbaum and Tara Patel, "France pushes back against EU banning combustion engine cars by 2035," *Bloomberg*, (July 12, 2021), https://www.bloomberg.com/news/articles/2021-07-12/france-pushes-back-against-eu-banning-combustion-cars-by-2035

13 Joshua Miller and Arijit Sen, " Details matter: The outsized climate benefits of setting annual targets for new cars in Europe (blog post)," ICCT staff blog, July 8, 2021, https://theicct.org/blog/staff/details-matter-annual-targets-europe-jul2021

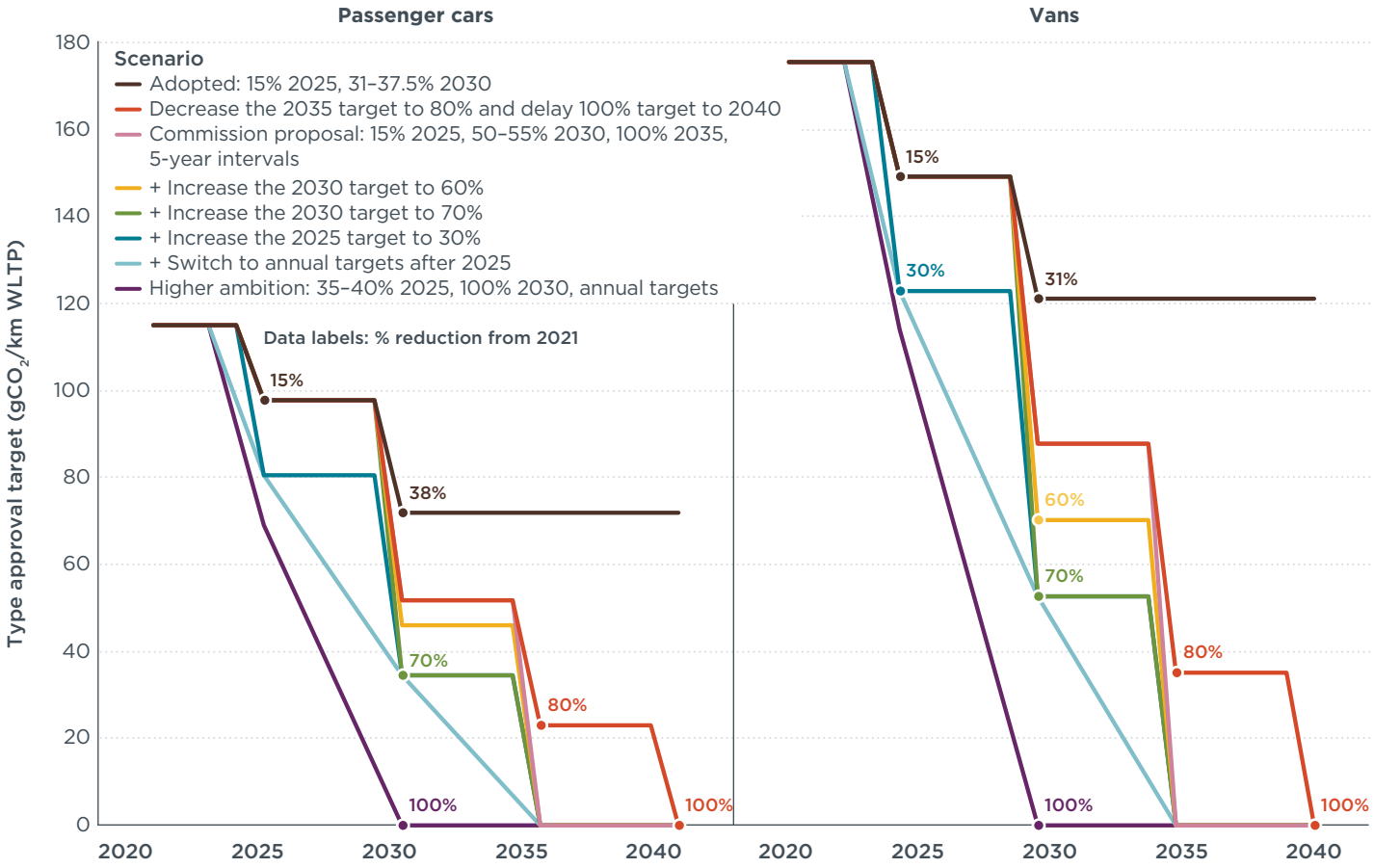


Figure 3. CO_2 targets evaluated for passenger cars and vans, by scenario.

Figure 4 shows the projected impacts of these scenarios on road transport tailpipe CO_2 emissions from 2021 to 2050, excluding emissions from L-category vehicles (motorcycles). Our scenario estimates for passenger cars and vans are shown together with scenarios for heavy-duty vehicles from an ICCT briefing paper published in March 2021.[14]

In the baseline scenario, which assumes **no progress beyond currently adopted policies, road transport CO_2 emissions would still be 6% above 1990 levels in 2030**. In contrast, **if the EU were to adopt higher ambition CO_2 standards** for cars, vans, trucks, and buses, **road transport CO_2 emissions would be reduced to 13% below 1990 levels in 2030 and 94% in 2050 (33% and 95% below 2005)**, avoiding 6.3 Gt CO_2 cumulatively to 2050 (Table 1).

14 Buysse, Miller, Díaz, Sen, Braun, *The role of the European Union's vehicle CO_2 standards in achieving the European Green Deal*

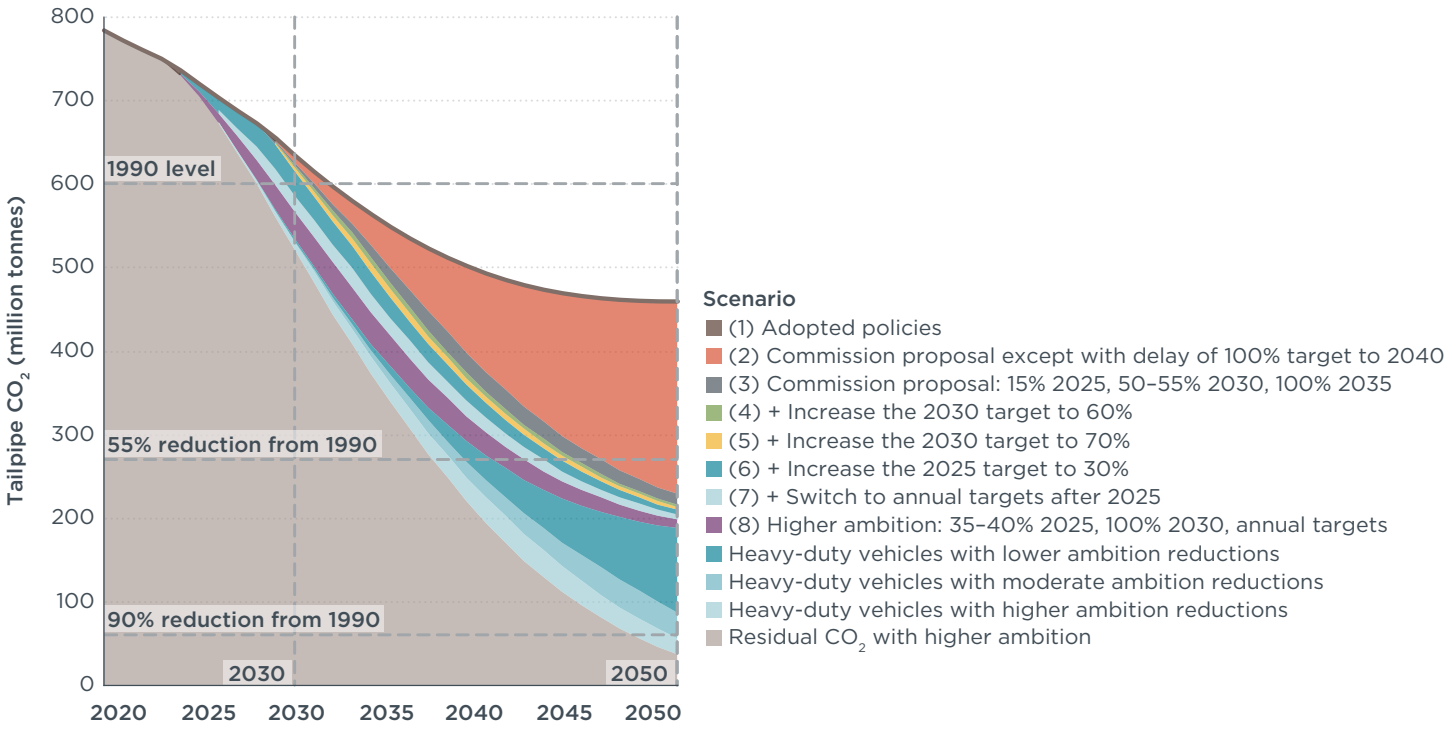


Figure 4. Combined road transport tailpipe CO_2 emissions between 2020 and 2050, by scenario.

Table 1. Potential CO_2 benefits of "higher ambition" CO_2 standards for cars, vans, trucks, and buses in the EU-27.

Category	Scenario	Cumulative CO_2 reduction by 2050 compared to Adopted policies	Share of CO_2 reduction by 2050 compared to Adopted policies	Change in CO_2 emissions 1990–2030 (target -55%)	Change in CO_2 emissions 1990–2050 (target -90%)
	(1) Adopted policies	0	0%	6%	-23%
Cars and vans proposal	(2) Commission proposal except with delay of 100% target to 2040	2468	39%	4%	-62%
	(3) Commission proposal: 15% 2025, 50% and 55% 2030, 100% 2035	356	6%	4%	-64%
	Subtotal CO_2 reduction potential	*2824*	*45%*		
Strengthen cars and vans proposal	(4) + Increase the 2030 target to 60%	111	2%	3%	-64%
	(5) + Increase the 2030 target to 70%	147	2%	3%	-65%
	(6) + Increase the 2025 target to 30%	478	8%	-2%	-66%
	(7) + Switch to annual targets after 2025	375	6%	-5%	-67%
	(8) Higher ambition: 35% and 40% 2025, 100% 2030, annual targets	649	10%	-11%	-69%
	Subtotal CO_2 reduction potential	*1760*	*28%*		
Strengthen heavy-duty vehicle standards	Heavy-duty vehicle lower ambition reductions	785	12%	-11%	-86%
	Heavy-duty vehicle moderate ambition reductions	413	7%	-12%	-91%
	Heavy-duty vehicle higher ambition reductions	516	8%	-13%	-94%
	Subtotal CO_2 reduction potential	*1714*	*27%*		
	Total CO_2 reduction potential (million tonnes)	***6298***			

The Commission's proposal for cars and vans is an important first step to realizing these reductions: it could avoid 2.8 Gt CO_2 cumulatively to 2050, which is approximately 45% of the potential CO_2 benefits of higher ambition CO_2 standards. The remaining mitigation potential with the higher ambition standards is achieved by further strengthening the proposed standards for cars and vans to 1.76 Gt CO_2 and strengthening the CO_2 standards for trucks to 1.71 Gt CO_2 and extending them to buses.

Of the 5 scenarios we evaluated, **the strategies with the greatest additional CO_2 benefits are to aim for higher ambition overall** (scenario 8, 649 Mt CO_2), **increase the 2025 target to 30%** (scenario 6, 478 Mt CO_2), and **switch to annual targets after 2025** (scenario 7, 375 Mt CO_2). These findings underscore the importance of encouraging early CO_2 reductions, as opposed to requiring manufacturers to do relatively little for almost a decade. Increasing the 2025 target and switching to annual targets would have the largest CO_2 reduction impact in 2030.

With respect to the target to reduce transport CO_2 emissions by 90% from 1990 to 2050, our findings indicate that road transport will not achieve a 90% CO_2 emissions reduction by 2050 without substantially strengthening the proposed standards for cars and vans and revising the heavy-duty CO_2 standards to achieve close to 100% zero-emission heavy-duty vehicle sales no later than 2040. Yet, with higher ambition CO_2 standards for light-duty and heavy-duty vehicles, road transport could achieve a 55% reduction from 1990 levels by 2038—8 years after the 2030 economy-wide GHG reduction target—and a 94% reduction by 2050. Considering aviation and shipping are more difficult to decarbonize than light-duty vehicles, regulators should aim for as close to zero emissions for light-duty vehicle operations by 2050 in order to meet the overall 90% reduction target for transport.[15]

TECHNOLOGY POTENTIAL AND COSTS, BENEFITS FOR CONSUMERS AND SOCIETY

For the impact assessment underlying the regulatory proposal, the EC made use of a set of vehicle technology cost curves to estimate additional manufacturing costs as well as savings from a consumer and societal perspective triggered by the proposed measures. The impact assessment refers to the DIONE Cost Curve Model, developed for the previous rulemaking that was adopted in 2019.[16] It states that "in particular, recent battery development trends were reflected, in line with the assumptions made in the EU Reference Scenario 2020,"[17] and "variants of the cost curves were developed to include technology costs to meet more stringent air pollutant standards". ICCT's own vehicle technology cost curves for passenger cars, updated in 2021,[18] allow for a comparison with the EC's assumptions and calculations despite slight differences regarding the baseline year as well as cost and benefit definitions.

For a medium-size PHEV passenger car with 50 km electric range, the EC in its EU Reference Scenario 2020 assumes capital cost in 2030 being around €3,400 higher than for a conventional gasoline car of model year 2015 (Figure 5). For the same type of PHEV, ICCT estimates similar additional direct manufacturing cost of around €4,000 compared to a conventional gasoline car of model year 2018. In the case of a battery electric vehicle (BEV) with 350 km electric range, the additional costs compared to a conventional vehicle assumed by EC are about twice as high as those of ICCT around

15 See Figure 6 in *The role of the European Union's vehicle CO_2 standards in achieving the European Green Deal*

16 Jette Krause, Donati, Alberto, and Christian Thiel, "Light-Duty Vehicle CO_2 Emission Reduction Cost Curves and Cost Assessment - the DIONE Model", EUR 28821 EN, Publications Office of the European Union, (2017) http://publications.jrc.ec.europa.eu/repository/handle/JRC108725

17 EU Reference Scenario 2020, https://ec.europa.eu/energy/data-analysis/energy-modelling/eu-reference-scenario-2020_en

18 Peter Mock and Sonsoles Díaz, (2021), *Pathways to decarbonization: The European passenger car market, 2021–2035*, (Washington, DC: ICCT, 2021), https://theicct.org/publications/decarbonize-EU-PVs-may2021

€4,000 vs. €1,800. This is partially explained by the EC's assumptions regarding the development of battery pack costs, which range from €174 per kWh in 2020, to €134/kWh in 2025, and €102/kWh in 2030.[19] In comparison, the ICCT calculations are based on an expected decrease in battery pack costs from €141/kWh in 2021, to €105/kWh in 2025, and €73/kWh in 2030.[20] For a fuel cell electric vehicle (FCEV) with 450 km of range, the difference in cost assumptions is most striking, with the additional manufacturing costs in 2030 assumed by the EC being about five times higher than those of ICCT.

Figure 5. Estimated additional manufacturing cost for selected medium size electric vehicles in 2030 and 2035 compared to a 2015 (EC) and 2018 (ICCT) conventional combustion engine vehicle. The estimates for 2040 uses EC data for 2035.

When comparing the ICCT estimates for 2035 with the EC estimates for 2040 (in the EU Reference Scenario 2020, the EC does not provide data for the year 2035), the observations are similar; **The manufacturing cost estimates for PHEVs are almost identical, for BEVs the EC cost estimates are about twice as high as the ICCT cost estimates, and for FCEVs they are about four times as high.** Overall, the estimated costs of BEVs and FCEVs are significantly lower in 2035 compared to 2030.

For 2030, the EC impact assessment considers three CO_2 reduction scenarios of -40%, -50%, and -60%, and the ICCT assessment considers three reduction scenarios of -50%, -70%, and -100%. For the -50% scenario, the ICCT assessment assumes new vehicle shares of 27%s PHEV and 27% BEVs. For the same scenario, the EC assumes a lower share of PHEVs (16%) and a higher share of BEVs (35%) (Figure 6).

19 See p. 149/150 in EU Reference Scenario 2020, https://ec.europa.eu/energy/data-analysis/energy-modelling/eu-reference-scenario-2020_en as well as Table 2.4 in Nikolas Hill, Ian Skinner, Georgios Zazias, Pelopidas Siskos, Apostolos Petropoulos, Kostas Fragkiadakis and Leonidas Paroussos, "Assessing the impacts of selected options for regulating CO_2 emissions from new passenger cars and vans after 2020", Ricardo Energy & Environment, (2018), https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/ldv_post_2020_co2_en.pdf

20 See Table 17 in Mock and Díaz, *Pathways to decarbonization: The European passenger car market, 2021–2035*

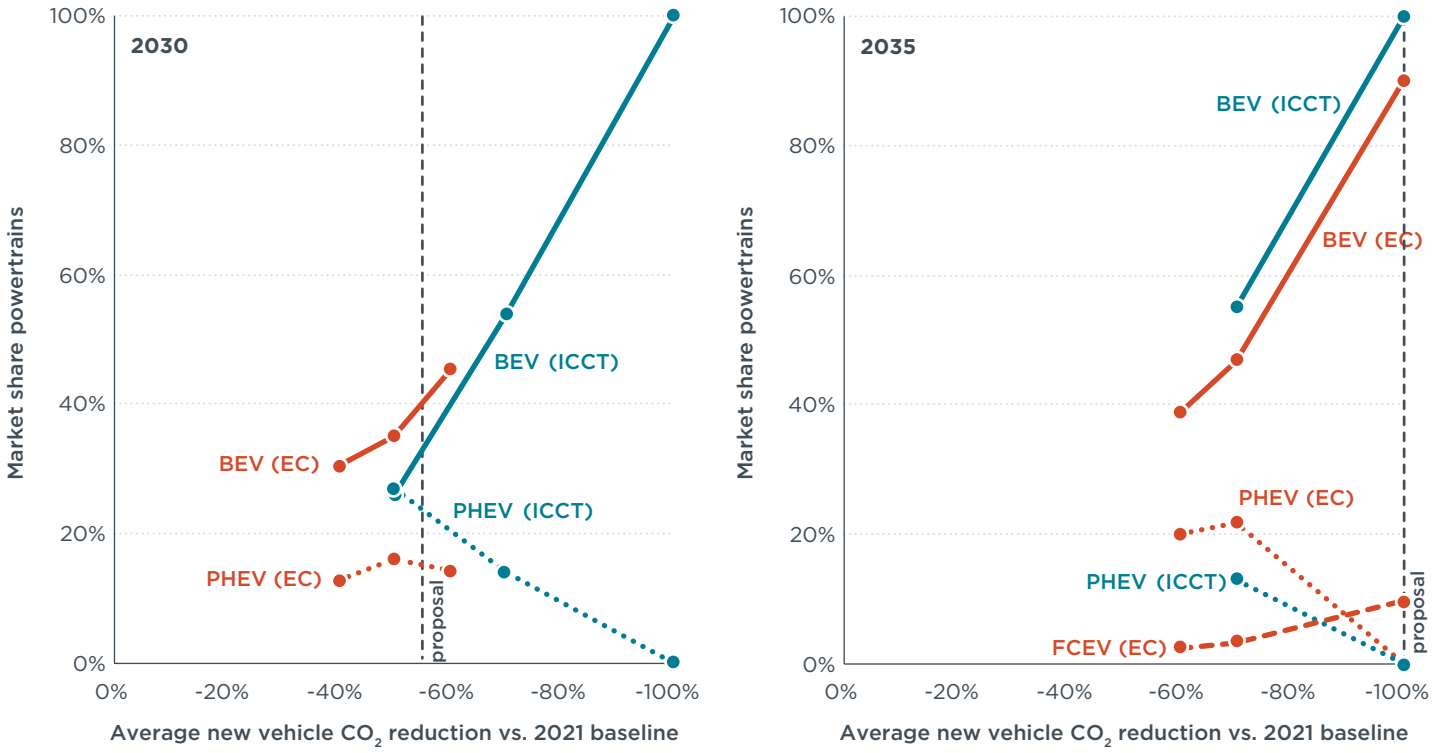


Figure 6. Powertrain market shares assumed by EC vs. ICCT for new passenger cars in 2030 and 2035. The x-axis refers to the average CO_2 reduction for a new vehicle in comparison to a 2021 baseline.

For 2035, the EC assesses a -60% reduction scenario as well as -70% and -100% scenarios, while the ICCT analysis considers -70% and -100% scenarios. For the latter two scenarios, the assumed BEV shares are rather similar (EC: 47%–90%, ICCT: 55%–100%). The PHEV share assumed for the -70% scenario is higher for EC (22%) than for ICCT (13%). In addition, the EC assumes a 10% share of FCEVs in 2035, whereas the ICCT assessment does not foresee any FCEVs in the main scenario for 2035.

For the -50% CO_2 reduction in 2030 scenario, the EC estimates an average additional manufacturing cost of about €300 compared to the adopted policies scenario. This estimate is nearly identical to the ICCT estimate, despite the higher BEV cost estimates by the EC. **For a higher CO_2 reduction scenario (-60%) and thereby an increasing BEV market share, the EC cost estimate increasingly exceeds the corresponding ICCT cost estimate** (Figure 7). **For 2035, the EC cost estimates are about four times the ICCT estimates**, which is a result of the higher assumed BEV costs as well as an assumed penetration of FCEVs in combination with high FCEV cost assumptions.

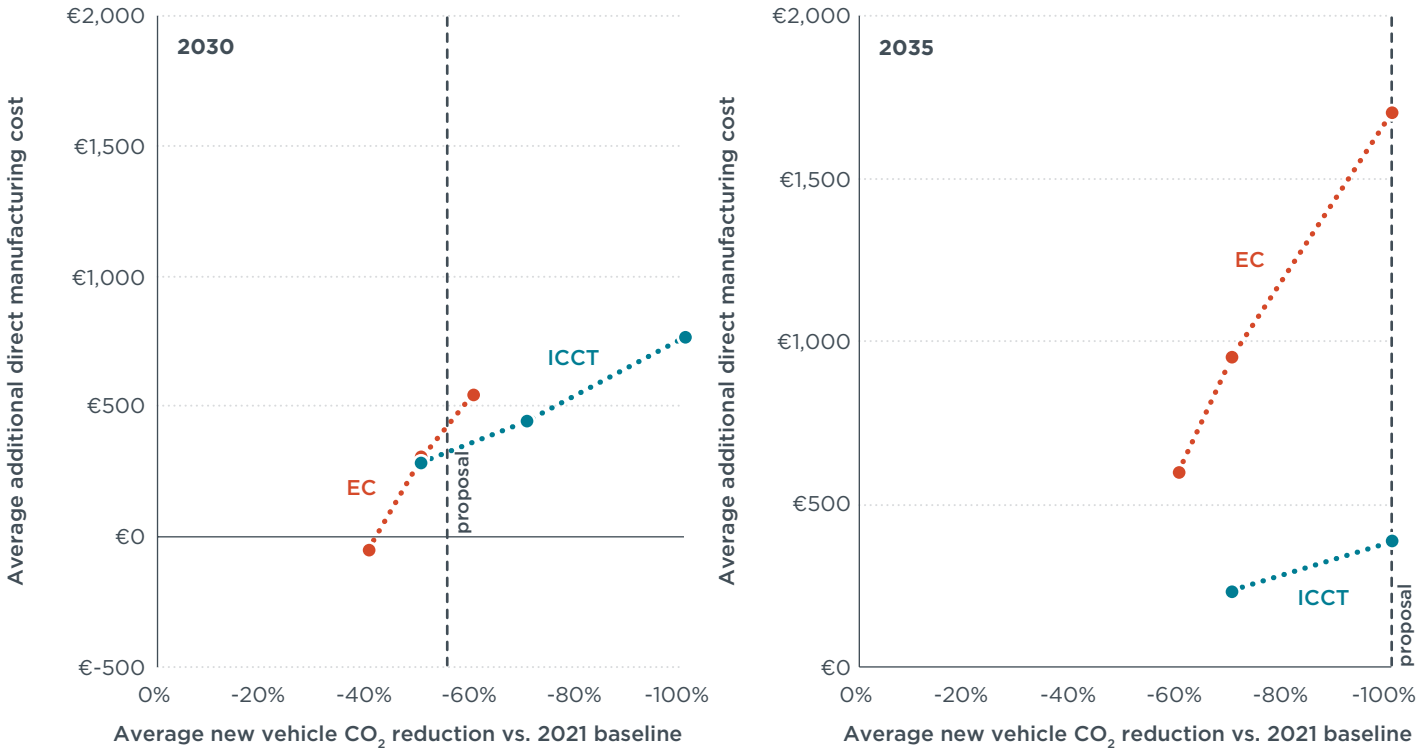


Figure 7. Average additional direct manufacturing costs estimated by EC vs. ICCT for new passenger cars in 2030 and 2035, all versus a baseline scenario of -37.5% CO_2 reduction by 2030. The x-axis refers to the average CO_2 reduction for a new vehicle in comparison to a 2021 baseline.

For the -50% CO_2 scenario in 2030, with the expected average additional manufacturing costs estimated by the EC vs. ICCT being roughly in line **for 2030, the estimated net economic savings from a first user over the first five years after vehicle purchase are also well in line** (Figure 8). **For 2035, the ICCT estimated benefits are more than 40% higher than those estimated by the EC**. For all scenarios and years, all estimates indicate significant savings for consumers and suggest moving forward the -100% CO_2 target from 2035 to 2030 could quadruple the net savings to first users compared to the EC proposal.

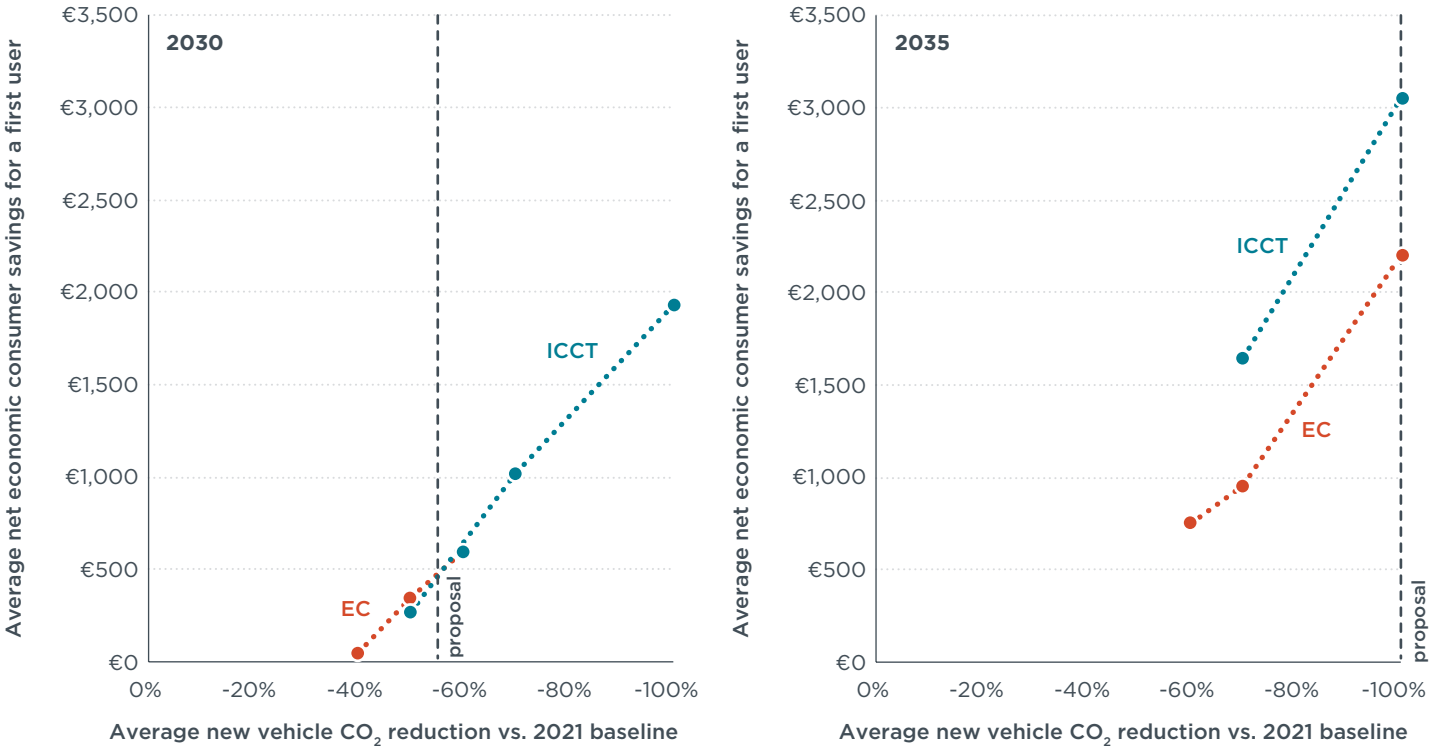


Figure 8. Average net economic consumer savings, for the first five years of ownership after vehicle purchase. The x-axis refers to the average CO_2 reduction for a new vehicle in comparison to a 2021 baseline.

From a society perspective, estimated savings are also high for all scenarios and years. However, **savings estimated by ICCT tend to be about twice as high as those by EC, for 2030 as well as 2035** (Figure 9). In its impact assessment, the EC emphasizes that "in all scenarios, lower income groups are projected to see higher savings relative to their annual income" and "the faster these vehicles become available on the second-hand market, the faster the benefits for the lower income groups will materialise". Similar as for the consumer savings, the estimates suggest that pulling forward the -100% CO_2 target to 2030 could quadruple the savings also from a societal perspective.

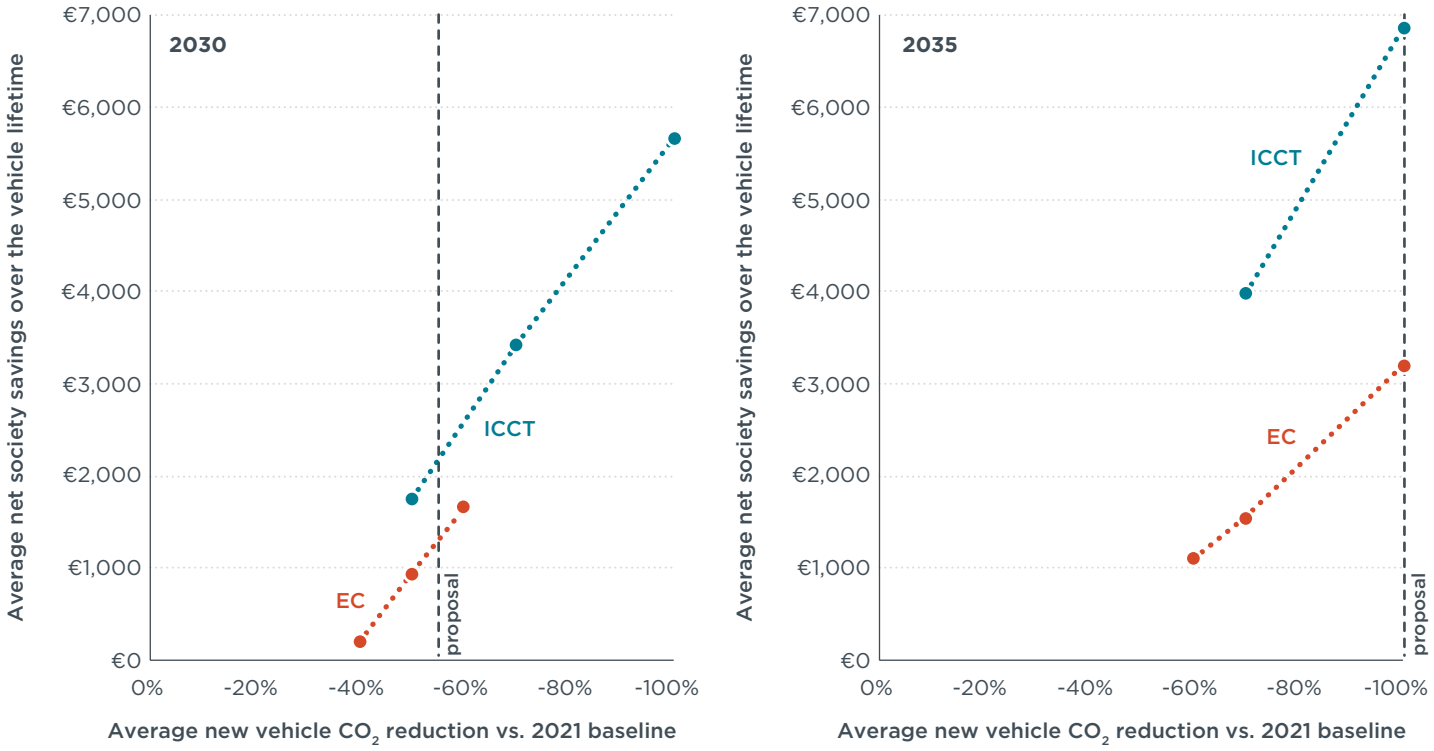


Figure 9. Average net savings from a society perspective, over the vehicle lifetime. The x-axis refers to the average CO_2 reduction for a new vehicle in comparison to a 2021 baseline.

Generally, technology cost estimates of assessments of previous years often are too conservative in retrospect. This was particularly impressively demonstrated by an ex-post study carried out for the European Commission in 2015, which confirmed that the additional manufacturing costs associated with meeting the 2015 CO_2 target of 130 g/km turned out to be only a third of the originally estimated costs.[21]

For the year 2030 estimates specifically, if assuming that the EC cost estimate for the baseline scenario (-37.5% by 2030) has not changed, with the information provided in the impact assessment it is then possible to compare the most recent cost estimates by EC with those from 2017 as well as ICCT's own estimates. As can be seen in Table 2, **the estimated average additional manufacturing cost of about €1,900** (relative to the baseline year 2021) **for the -50% scenario is lower than for the previous EC impact assessment from 2017 (about €2,750) but still significantly higher than the most recent ICCT estimate (about €1,220)**. For the -70% scenario, the EC did previously not provide an estimate. The current estimate of about €2,000 is approximately €600 higher than ICCT's own estimate.

21 Nikolas Hill, Elisabeth Windisch, Felix Kirsch, Gareth Horton, Craig Dun, Stefan Hausberger, Claus Matzer, Ian Skinner, Alberto V. Donati, Jette Krause, Christian Thiel, and Peter Wells "Improving understanding of technology and costs for CO_2 reductions from cars and LCVs in the period to 2030 and development of cost curves (Report for DG Climate Action Ref. CLIMA.C.2/ FRA/2012/0006)," 2016, https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/ldv_co2_technologies_and_costs_to_2030_en.pdf

Table 2. Estimated additional manufacturing cost for various CO_2 reduction scenarios, differentiated by year and source of estimate.

-37.5% by 2030 versus 2021 baseline	
2017 European Commission estimate (EC, 2017)	€1,610
2018 ICCT estimate (ICCT, 2018)	€870
2021 ICCT estimate (ICCT, 2021)	€940
-50% by 2030 versus 2021 baseline	
2017 European Commission estimate	€2,750
2018 ICCT estimate	€1,160
2021 ICCT estimate	€1,220
2021 European Commission estimate	€1,910
-70% by 2030 versus 2021 baseline	
2018 ICCT estimate	€1,640
2021 ICCT estimate	€1,400
2021 European Commission estimate	€2,052

INCENTIVES FOR ZERO- AND LOW-EMISSION VEHICLES

The currently applicable CO_2 standards for passenger cars and vans include incentives for ZLEVs with type-approval CO_2 emissions of less than 50 g/km. For the calendar years 2020 to 2022, each ZLEV is counted more than once when calculating the manufacturers' average fleet CO_2 emissions, with the applied multiplication factor diminishing from 2.0 in 2020 to 1.67 in 2021 and 1.33 in 2022. The total available CO_2 credit is capped at 7.5 g/km per manufacturer or pool for the entire 2020–2022 time period, with most of the credits having already been used in 2020.

From 2025 onwards, a different mechanism for incentivizing low emission vehicles applies. With this mechanism, manufacturers can raise their annual CO_2 target by up to 5% when their share of $ZLEV_{specific}$ vehicles exceeds a threshold of 15% for the years 2025–2029 and 35% (30% for vans) from 2030 onwards. The calculation parameter $ZLEV_{specific}$ describes how much each ZLEV counts towards determining the share of registered low emission vehicles—a vehicle with CO_2 emissions of 0 g/km is counted as one $ZLEV_{specific}$ while a vehicle with 50 g CO_2/km counts as 0.3 $ZLEV_{specific}$. Between these two boundary values, linear interpolation is applied to determine the $ZLEV_{specific}$.

In its proposal for strengthening the cars and vans CO_2 emission performance standards, the European Commission **ceases the ZLEV incentives from 2030 onwards**. This is a logical step, as ZLEVs are expected to account for the majority of new vehicle registrations by 2030 and 100% of new vehicles by 2035. However, **ZLEV incentive provisions for 2025–2029 are proposed to remain unchanged**. This is despite the recently strong uptake of ZLEVs, which accounted for 10.3% of new registrations in 2020, equivalent to a fleet average $ZLEV_{specific}$ share of 8.7 %. This recent trend indicates that **all manufacturers can reach the required 20% $ZLEV_{specific}$ share by 2025 with little extra effort** (Figure 10). This would then allow them to fully exploit the 5% CO_2 target relaxation and, as a consequence, the ZLEV corrected industry-wide fleet CO_2 target in 2025 would only be about 10.8% lower than in 2021, instead of the originally intended 15% CO_2 reduction.

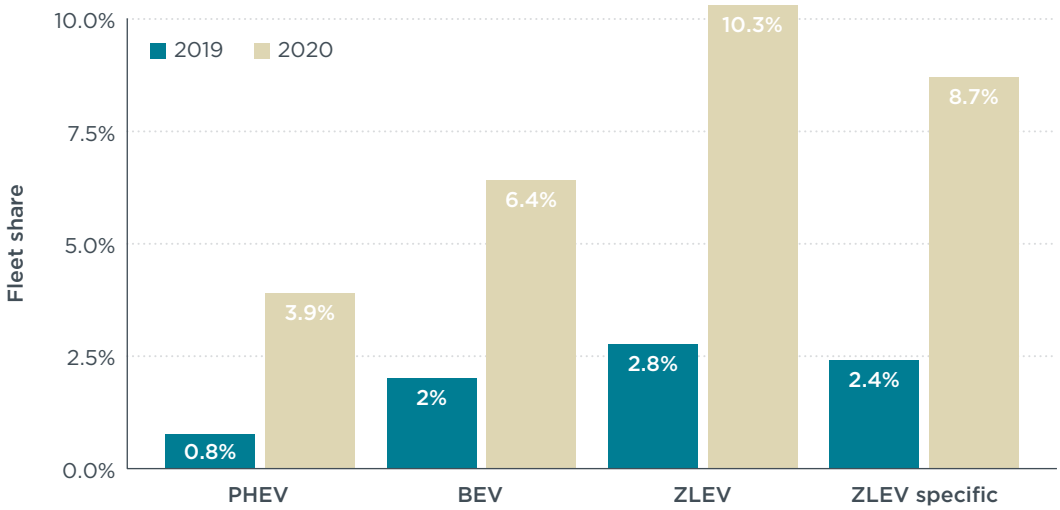


Figure 10. Market share of zero- and low-emission vehicles (ZLEV) in 2019 and 2020. The CO_2 adjusted ZLEV share increased from 2.4% in 2019 to 8.7% in 2020. Data source: European Environmental Agency, "Monitoring of CO_2 emissions from passenger cars – Regulation (EU) 2019/631," (2021), https://www.eea.europa.eu/data-and-maps/data/co2-cars-emission-20

TYPE-APPROVAL VERSUS REAL-WORLD EMISSION LEVELS

To ensure that CO_2 emission levels of vehicles decrease in line with their official type-approval values, the current CO_2 standards for cars and vans foresee the introduction of in-service conformity (ISC) verification. However, while the current CO_2 standards regulation was put into force in January 2020, **the corresponding regulatory acts defining the ISC procedure are not yet complete**.

Furthermore, the CO_2 standards regulation mandates the European Commission to develop a mechanism for ensuring that the reduction of type-approval CO_2 emission values is representative of real-world driving emissions, based on data recorded by on-board fuel and energy consumption monitoring (OBFCM) devices. OBFCM is mandatory for all new passenger cars as of January 2021 and will be mandatory as of January 2022 for all new vans. Still**, the EC is only required to make use of the OBFCM data for assessing the feasibility of a CO_2 target compliance adjustment mechanism by 2027, which will then apply from 2030 onwards**.

Past experience, when the gap between official and real-world CO_2 figures grew from about 8% in 2001 to about 40 % in 2016,[22] suggests **that manufacturers could again exploit loopholes in the test procedure, thereby watering down the intent of the 2025 and 2030 CO_2 reduction targets**. Particularly in the case of plug-in hybrid electric vehicles, statistical evidence suggests that average real-world CO_2 emission levels are about 3–4 times higher than suggested by official type-approval values.[23] Still, the EC proposal for strengthening the CO_2 targets does not foresee any changes to the current provisions.

POTENTIAL FUELS CREDITING MECHANISM IN THE RENEWABLE ENERGY DIRECTIVE

The purchase of alternative fuels is not allowed to count towards compliance with the CO_2 standards for passenger cars and vans. While some stakeholders support

22 Tietge, Díaz, Mock, Bandivadekar, Dornoff, and Norbert Ligterink, *From Laboratory to Road: A 2018 update of official and 'real-world' fuel consumption and CO_2 values for passenger cars in Europe*

23 Patrick Plötz, Cornelius Moll, Yaoming Li, Georg Bieker, and Peter Mock, *Real-world usage of plug-in hybrid electric vehicles: Fuel consumption, electric driving, and CO_2 emissions*, (Washington, DC:ICCT, 2020), https://theicct.org/publications/phev-real-world-usage-sept2020

this idea, these fuels are costly and in limited supply. Synthetic fuels such as eFuels and other renewable fuels of non-biological origin (RFNBOs), which are made from CO_2 and electricity, are inefficient and expensive compared to alternative powertrain technologies such as battery electric vehicles. The potential supply of low-carbon biofuels made from wastes and residues listed in Annex 9A in the Renewable Energy Directive II (RED II) is low. In addition, these limited liquid fuels will be in demand in other hard-to-decarbonize sectors like aviation and marine, which have their own proposed regulations to reduce GHG emissions in the Fit for 55 package.

The production of eFuels will cost around €3 per liter more than gasoline by 2030, which is about twice the current price of diesel. For 2030 and 2035, a previous ICCT study found that **a compliance scenario relying strongly on eFuels is expected to require about twice as much investment per vehicle compared to a scenario relying primarily on electric vehicles**.[24] With technology improvements and declining cost for renewable electricity generation, eFuel production cost in Europe is expected to fall. However, eFuels will not be an economical strategy for complying with the vehicle CO_2 standards because it is unlikely that eFuels will cost less than the non-compliance penalty of €280–€600 per tonne of CO_2.

The impact assessment for the proposal to amend the CO_2 standards comes to similar conclusions. The EC found that **it would cost much more for a manufacturer to purchase low-carbon fuel credits than to build additional BEVs to meet the target**. They found this to be the case in both a high- and low-cost scenario, and when either advanced waste and residue biofuel or eFuels were used. Assessing total cost of ownership for first and second users, the EC estimated the cost of vehicles using either Annex 9A waste and residue biofuels or eFuels and other RFNBOs is much higher than the manufacturer cost to produce an additional BEV.

The impact assessment cites BEV energy efficiency as a reason for their advantage compared to low carbon fuels. To produce eFuels, around half the energy in the input electricity is lost as heat during the fuel conversion process. Because there are also high energy losses in internal combustion engine vehicles, **only about 16% of the original electric energy used to produce eFuels ends up being used for propelling a vehicle**. This compares to a total efficiency of about 72% when instead using the electricity directly in a BEV.[25]

Low carbon alternative fuels are an important part of decarbonizing transport in Europe, but they will be in high demand from other sectors and are well-supported by other legislative pieces in the Fit for 55 package. The ReFuelEU regulation requires that 5% of jet fuel in 2030 be advanced alternative fuels, which includes an eFuels subtarget of 0.7%. Likewise, the RED II revision proposal increases the overall ambition of the transport target and includes a 2.2% advanced fuel submandate as well as a 2.6% submandate for RFNBOs. The marine sector will also demand low carbon fuels to help meet its 2030 6% GHG intensity target under FuelEU Maritime.

EXCESS PREMIUM

As part of the first CO_2 emissions standards for passenger cars in the EU in April 2009, an excess premium of €95 was introduced for each vehicle and for each gram of CO_2 exceeding the manufacturer's target in a calendar year.[26] The same value of €95 was then carried over unchanged to the 2020 CO_2 standards (EU) 2019/631, adopted ten years later in April 2019. Under the recent EC's proposal for strengthening the CO_2

24 Peter Mock and Sonsoles Díaz, *Pathways to decarbonization: The European passenger car market 2021-2035,"* (Washington, DC: ICCT, 2021), https://theicct.org/publications/decarbonize-EU-PVs-may2021

25 Stephanie Searle, "E-fuels won't save the internal combustion engine (blog post)," ICCT staff blog, 23 June 2020, https://theicct.org/blog/staff/e-fuels-will-not-save-ice

26 Between 2012 and 2018, manufacturers were granted a discounted fee for the first 3 grams of CO_2 exceedance.

emission targets, CO_2 emitting vehicles can be registered until calendar year 2034, meaning **the excess premium will remain unchanged for 25 years**.

LIMIT VALUE CURVE

Since the first CO_2 regulations for passenger cars and vans were adopted in 2009 and 2011, respectively, the manufacturers annual CO_2 targets are adjusted for vehicle mass. If the average mass of vehicles registered by one manufacturer exceeds a presumed average fleet mass its target is increased, while it is lowered if the vehicles are lighter. Even though this mechanism incentivizes manufacturers to produce heavier vehicles and undermines the CO_2 reduction targets,[27] it is unchanged in the recent EC proposal.

The adjustment factor, referred to by the impact assessment as limit value curve slope, is fixed at 0.0333 by the current regulation until 2024, which means that for every additional kilogram in vehicle mass deviating from the presumed average mass, a vehicle can on average emit 3.33 g more CO_2. However, an analysis of preliminary European Environmental Agency (EEA) CO_2 monitoring data reveals that in 2020, the slope of the CO_2-emission/vehicle mass dependency has already dropped to 0.009 (blue dots in Figure 11), which is less than a third of the value foreseen by the regulation (blue line in Figure 11). Consequently, **manufacturers producing heavier vehicles are granted a CO_2 allowance almost four times higher than needed to compensate for the additional mass, while manufacturers producing lightweight vehicles are penalized** as they must reduce CO_2 emissions more than is gained by the mass reduction alone. The original intent of the mass adjustment, generating a level playing field for all manufacturers, is therefore not realized.

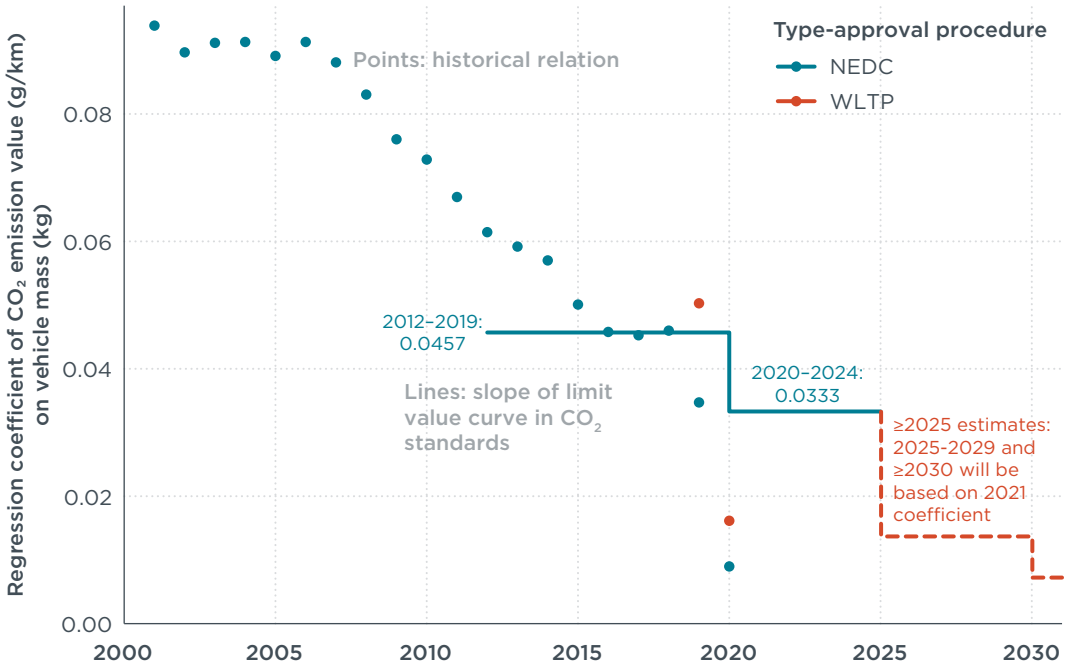


Figure 11. Historical development of the annual NEDC and WLTP fleet CO_2/vehicle-mass regression coefficients, compared to the effective and projected regulatory slope of the limit value curve. The estimated limit value curve slope is derived from the 2020 WLTP CO_2/mass regression coefficient, while the final value will be based on the 2021 data.

27 Peter Mock, Uwe Tietge, and Jan Dornoff, *Adjusting for vehicle mass and size in European post-2020 CO_2 targets for passenger cars*, (Washington, DC: ICCT, 2018), https://www.theicct.org/publications/eu-ldv-co2-utility-parameter-20180808

The fleet CO_2/vehicle mass regression coefficient is expected to remain below the regulatory limit value curve slope, because the slope of the limit value curve applicable between 2025–2029 and from 2030 onwards will be calculated based on the WLTP CO_2-emission/vehicle test mass regression coefficient in 2021. To assume that the CO_2/vehicle mass dependency of vehicles registered from 2025 onwards can be deducted from the situation in 2021 is questionable, considering the non-linear development of the regression coefficient since 2016 (blue dots in Figure 11).

In addition to incentivizing heavier vehicles and creating a competitive disadvantage for manufacturers of smaller and lightweight vehicles, **the mass adjustment also inflates the CO_2 fleet target** because the average fleet mass assumed by the regulation was below the actual fleet average mass in most years between 2012 and 2020 (Figure 12). In 2020, the average fleet mass was 1,464 kg while the reference mass is only about 1,380 kg. In combination with the limit value curve slope of 0.0333, this results in an actual fleet CO_2 target of about 97.8 g/km or 2.9% higher than the 95 g/km limit originally intended by the European Parliament and the Council. This issue is expected to worsen over the coming years due to the rapidly increasing average fleet mass in combination with the adaption of the reference mass applicable from 2022 to 2024, which will be calculated as the average vehicle mass of in the years 2017 to 2019. Based on the EEA monitoring data, the reference mass for these years will be approximately 1,399 kg, which was already exceeded in 2020 by 65 kg.

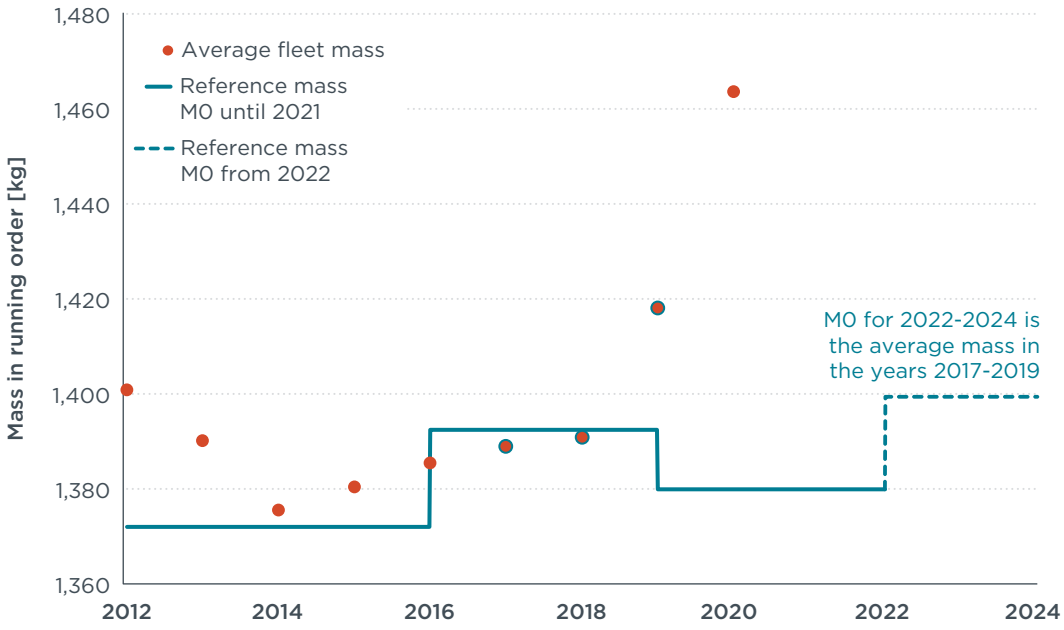


Figure 12. Average fleet mass in running order between 2012 and 2020 compared to the reference mass M0 from 2012 until 2024.

COMPLEMENTING DEVELOPMENTS AND PROPOSALS

Along with the CO_2 targets for new cars and vans, the EC's regulatory proposal package includes complementing proposals, such as establishing a separate emissions trading system (ETS) for the transport and buildings sectors, strengthening the recharging and refueling infrastructure, as well as adapting the energy tax levels across the EU. The proposal is further influenced by developments such as announcements from governments and manufacturers regarding intentions to phase-out of combustion engine vehicles.

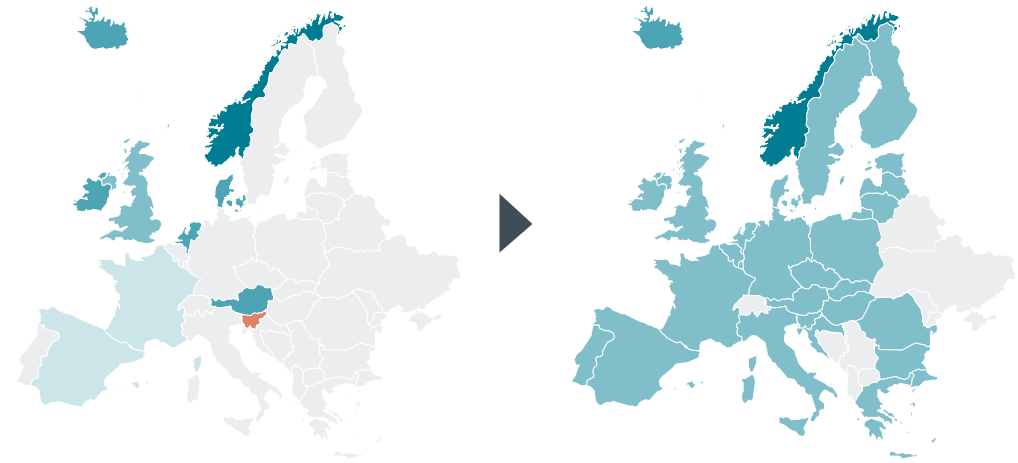
COMBUSTION ENGINE VEHICLE PHASE-OUT ANNOUNCEMENTS

The proposal for revising the current CO_2 emission performance standards for new passenger cars and vans sets a de facto phase-out target for registrations of new ICE vehicles. As of September 2021, ten countries across Europe have announced non-binding phase-out targets for new combustion engine passenger cars and partially also vans, as part of official policy documents such as a national climate or transport strategy/plan or in a law (Figure 13, left hand side). **Nine countries are aiming for the sale or registration of new BEVs and FCEVs only**. Slovenia is the only country to also allow the registration of new vehicles with emissions up to 50 g CO_2/km which would also include PHEVs based on today's technology landscape.

If the EC's regulatory proposal is adopted as drafted, all 27-EU Member States would be required to only allow the registration of BEVs and FCEVs (Figure 13, right hand side). The binding regulation may then also apply to Iceland, Liechtenstein, and Norway. Iceland and Norway already announced earlier non-binding targets to end sales/registrations of new ICE vehicles, by 2025 and 2030 respectively. The United Kingdom, no longer part of the EU, has set a target to only allow the registration of new zero-emission cars and vans starting in 2035 and has started consultation on its own CO_2 regulation.

European governments with official non-binding targets to 100% phase out sales or registrations of new internal combustion engine passenger cars by a certain date (Status: September 2021)

Proposal by the European Commission (EC) for amending the binding regulation on CO_2 emission performance standards for new passenger cars and vans* to only allow the registration of new zero-emission vehicles from 2035 (Proposal date: 14 July 2021, not adopted yet)



Targets to only allow the sale or registration of new zero-emission cars (BEVs and FCEVs)

2025 2030 2035 2040

Targets to only allow the sale or registration of new cars with emissions up to 50 g CO_2/km (BEVs, FCEVs, PHEVs)

2030

* Note that CO_2 standards for new passenger cars and vans not only apply to the 27 Member States of the European Union (EU) but may also apply to Iceland, Liechtenstein, and Norway. BEV – battery electric vehicles, FCEV – fuel cell electric vehicle, PHEV – plug-in hybrid electric vehicle.

Figure 13. Non-binding targets to phase out the sale or registration of new combustion engine cars at the national level (left, status: September 2021) and at the EU level if EC regulatory proposal gets adopted.

Vehicle manufacturers have also come forward with announcements for the phase out of selling combustion engine vehicles (in the EU). In addition to some manufacturers already selling 100% of their vehicles as BEVs, Jaguar (by 2025), Alfa Romeo (by 2027), Opel (by 2028), Fiat, Ford, and Volvo (by 2030), Audi (by 2033), and Volkswagen (by 2035) have announced intentions to go 100% electric (Figure 14).

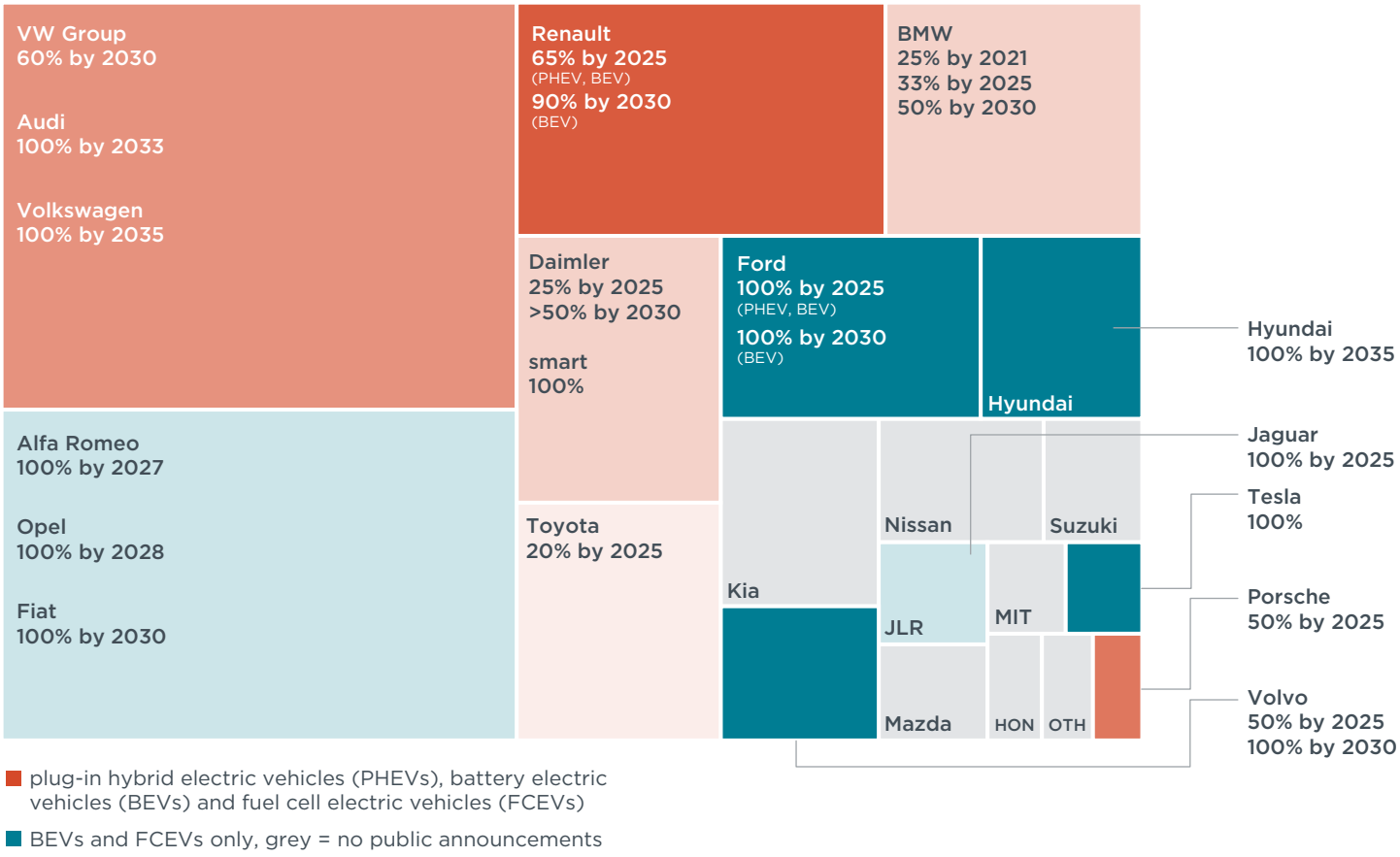


Figure 14. Overview of public vehicle manufacturer announcements for the market share of new electric passenger car sales in Europe. The size of the boxes is proportional to the total number of all new passenger car registrations in 2020.

ENERGY TAXATION DIRECTIVE

The taxation of fuels and electricity in the EU varies largely between Member States. In order to reduce the resulting imbalances within the internal market, the Energy Tax Directive (ETD) mandates minimum rates for energy products and electricity. In its current version, however, the rates are too low to effectively achieve this purpose. More importantly, however, the rates are also considered too low to sufficiently support the GHG emission reduction goals of the European Green Deal. In addition, the currently volume-based tax rates privilege the use of fuels with a higher energy content per liter, such as diesel, over fuels with a lower energy content, such as gasoline. As a higher energy density generally correlates with a higher carbon content per liter, the current ETD rates effectively incentivize the use of high carbon fuels and disincentivizes the use of biofuels with a low energy content per liter, such as bioethanol.

To improve the ETD, **the Commission proposes (1) to increase the minimum tax rates on fossil fuels and (2) to restructure the current volume-based minimum tax rates to an energy content-based system. Member States would maintain the flexibility to set higher national tax rates, but shall replicate the ranking of energy products as in the minimum tax rates.** The proposal generally foresees a minimum tax rate of €10.75 per GJ of fuel, which, adjusted to inflation, corresponds to €11.53 in 2023 and €13.25 in 2033. These rates correspond to €0.37–0.42 per liter of fossil gasoline and €0.41–0.48 per liter of diesel. While for gasoline, diesel, and non-sustainable biofuels this rate applies from 2023, the rate for liquified petroleum gas (LPG), natural gas, non-sustainable biofuels and biogas, and non-renewable hydrogen is set to €7.68 per GJ from 2023 and increases to €13.25 per GJ only from 2033. Similarly, for sustainable food and feed crop-based biofuels and biogas, a reduced rate of €5.76 per GJ would

apply from 2023, increasing to €13.25 per GJ from 2033. For sustainable biofuels and biogas not produced from food or feed crops, the rate of €5.76 per GJ increases to €6.63 per GJ after 2033. Finally, the rate for advanced sustainable biofuels and biogas, as well as renewable electricity-based fuels and electricity would be €0.16 per GJ from 2023 and €0.18 per GJ from 2033. For the use of fuels for certain purposes, such as heating, agriculture, and construction, lower rates apply.

The proposed restructuring of the system results in similar minimum taxation rates of the use of gasoline and diesel, while incentivizing the use of low carbon fuels, such as sustainable biofuels and renewable hydrogen. The proposed minimum tax rates would directly affect Member States with comparatively low national energy tax rates on fuels, such as Spain, Austria, and Poland. Member States with comparatively high energy tax rates, such as Germany, Italy, and France, would have to adjust their national energy taxation rates according to the ranking the energy products in the minimum rates.

EMISSION TRADING SYSTEM FOR ROAD TRANSPORT AND BUILDINGS

Complementary to the existing ETS for stationary applications in the industry and power sector, which further covers aviation and is proposed to be expanded to maritime transport, the Commission proposes to introduce an additional, separate ETS for the road transport and buildings sectors. Beginning in 2026, the EU Member States would issue a limited quantity of GHG emission allowances for the new ETS and reduce this quantity in a linear trajectory of about 5% of the 2024 value to eventually reach the 2030 target of a 43% reduction compared to 2005. The proposed ETS covers CO_2 emissions from fuel combustion. Non-CO_2 GHG emissions, of which methane emissions are most important, as well as emissions from the fuel production are not covered.

Differing from the existing system, the emission allowances in the proposed ETS for road transport and buildings would not be auctioned by the emitters directly, but further upstream, by tax warehouses and fuel suppliers. Also, there would be no free allowances. In effect, the limited and decreasing supply of CO_2 emission allowances would translate to an increasing price of fuels at the gas station, thereby reducing consumption. If the price of the allowances increases too fast, i.e., if there are three consecutive months in which it is, on average, two or even three times higher than in the preceding six months, the limitation of allowances will be lifted by additional allowances from the Market Stability Reserve.

The Commission proposes to allocate a certain share of allowances and thus auction revenues to the EU-wide Innovation Fund and to distribute the remaining allowances among the Member States according to their shares of the emissions in road transport and buildings sectors in 2016–2018. According to the proposal, the Member States would then be required to spend the auction revenues (1) on climate and energy-related projects, e.g., for charging infrastructure or to shift to public transport, and (2) to address social impacts on vulnerable households, vulnerable micro-enterprises, and vulnerable transport users. For this purpose, the Commission further proposes to allocate 25% of the auction revenues of the new ETS to an EU-wide Social Climate Fund.

The proposed new ETS also aims to safeguard the EU's 2030 emissions reduction target in the road transport and building sectors. Complementary to regulatory measures like the CO_2 standards for passenger cars, it directly addresses businesses and consumers, providing financial incentives for sustainable mobility behavior and to invest in energy-efficient, low carbon technologies. At the same time, it increases the pressure on the Commission and Member States to provide access to such mobility in a timely manner in order to avoid energy and mobility poverty. Meeting the proposed rate of reducing CO_2 allowances in 2026 to 2030 may thereby especially

require lowering the proposed 2025 and 2030 levels of the CO_2 emission standards for passenger cars and vans (compare expected effect on CO_2 emissions in Figure 4). Also, it requires reduced fuel consumption by strengthening the CO_2 standards for heavy-duty vehicles.

ALTERNATIVE FUELS INFRASTRUCTURE REGULATION (AFIR)

If adopted, the AFIR would repeal the current Directive 2014/19/EU on the Deployment of Alternative Fuels Infrastructure (AFID) which came into force in 2014.[28] From a legislative perspective, **the main difference between the current version and the proposal is that it would be a regulation and no longer a directive**. In contrast to directives, EU regulations supersede national laws and thereby are binding and directly applicable in all EU Member States as soon as they enter into force.

The proposal includes targets for electric vehicle public charging stations as well as hydrogen refueling infrastructure. It outlines that the deployment of publicly accessible charging stations shall be directly linked to the uptake of electric cars and vans, with **at least 1 kW of additional charging infrastructure installed for each BEV and 0.66 kW for each PHEV**. The targets shall be met cumulatively by the end of each year, separately for each Member State, based on the date the proposal comes into force.

In terms of coverage, the proposal formulates minimum deployment goals along the Trans-European Transport Network (TEN-T). The AFIR proposes that each charging pool i.e., one or more charging stations at a specific location which may include dedicated adjacent parking lots shall offer (1) a power output of at least 300 kW and include at least one charging station with an individual power output of at least 150 kW by the end of 2025 along the TEN-T core network and by the end of 2030 along the TEN-T comprehensive network; and (2) a power output of at least 600 kW and include at least one charging station with an individual power output of at least 150 kW by the end of 2030 along the TEN-T core and by end of 2035 along the TEN-T comprehensive network.

In addition to electrical charging infrastructure, the proposal also sets targets for hydrogen refueling infrastructure and proposes that EU Member States shall ensure a **maximum distance between publicly accessible hydrogen refueling stations of 150 km along the TEN-T core and the TEN-T comprehensive network by the end of 2030**. In case of liquid hydrogen, the maximum distance shall be 450 km. In terms of capacity of publicly accessible hydrogen refueling stations, the minimum value shall be 2 tons per day and equipped with at least a 700 bars dispenser. In addition, the proposal states that EU Member States shall ensure at least one station in each urban node and consider the deployment of such stations in multimodal hubs.

The AFIR proposes that each Member State shall provide the EC a draft national policy framework including the development of the market as well as charging and hydrogen refueling infrastructure by 1 January 2024. By 1 January 2025, the final national policy framework shall be provided to the EC by each EU Member State. In addition, EU Member States shall submit to the EC a progress report on the implementation of the national policy framework starting 1 January 2027 and then every second year thereafter. To guarantee the implementation of the targets, each EU Member State shall report to the EC the number of publicly accessible charging points, the aggregated charging power output, and the number of registered BEVs and PHEVs on an annual basis.

28 European Commission (2014), "Directive 2014/94/EU of the European Parliament and of the Council as of 22 October 2014 on the deployment of alternative fuels infrastructure", https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0094

Compared to the current AFID from 2014, the proposed AFIR sets more detailed targets for the EU Member States in terms of coverage and power output/capacity of the alternative fuel vehicle charging infrastructure. Most importantly, **changing the directive into a regulation ensures a faster implementation** of the necessary charging infrastructure in line with a growing number of low- and zero-emission vehicles across Europe.

SUMMARY AND RECOMMENDATIONS

The Commission's proposal for strengthening the CO_2 emission standards for new cars and vans is an important first step to realizing the reduction in road transport CO_2 emissions necessary to be in line with the European Climate Law. It could avoid 2.8 Gt cumulative CO_2 emissions by 2050 and could be leveraged by further strengthening the proposed standards for cars and vans (1.76 Gt CO_2) as well as strengthening the CO_2 standards for trucks and extending them to buses (1.71 Gt CO_2).

Although the EC's and ICCT's technology cost estimates are similar for PHEVs, the EC's estimates for BEVs are about twice as high and, in the case of FCEVs, at least four times as high than ICCT's figures. This suggests that additional CO_2 reductions are achievable at lower costs. **Our findings indicate that the benefits for consumers and society could be increased by a factor of four by introducing higher ambition standards compared to the EC's proposal.** This provides a strong justification for the most impactful strategies listed below, since these would improve alignment with climate goals and objectives of the regulations.

Specifically, our analysis finds that the most impactful strategies to increase the emission reductions for new cars and vans, versus the current EC proposal, are:

- To increase the 2030 CO_2 reduction target to at least 70%
- To increase the 2025 CO_2 reduction target to at least 30%
- To switch to annual CO_2 targets after 2025

In addition, we also recommend implementation of the following strategies:

- To phase out ZLEV credits earlier than 2030 or to raise the ZLEV benchmark target for 2025 to 20% and to limit any credits to BEVs and FCEVs
- To introduce a real-world driving correction mechanism for manufacturers' CO_2 target performance by 2025 and to adjust type approval CO_2 values, particularly for PHEVs based on real-world OBFCM data
- To adapt the excess premium for the inflation rate or, preferably, for the price development of CO_2 emission allowances of the EU ETS
- To update the vehicle mass adjustment factor as well as the reference mass used in the regulation on an annual basis

The EC's regulatory proposal constitutes an important signal for EU member states and vehicle manufacturers as well as markets abroad. Within the EU, eleven Member State governments already announced intentions to phase out the sale of new combustion engine vehicles before the EC came forward with a suggested EU-wide phase-out target for 2035. Among the major vehicle manufacturers, nearly all have already publicly announced plans to transition largely to electric vehicles within the next approximately ten years. The EC proposal, if further strengthened and implemented, will serve as a powerful instrument to shape industrial strategy and to secure Europe's automotive sector a leading role in the global transition to zero-emission mobility.