T&E

BRIEFING

PHEV emissions definition: a science-based approach

Correcting utility factors drives technology and performance improvement rather than removing PHEVs from the market

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Summary

Correcting the plug-in hybrid electric vehicle (PHEV) utility factor (UF) does not threaten the European PHEV producers, it ensures that PHEV design and performance are improved. Market evidence shows that CO2 emissions can be reduced through better technology and longer electric range to offset the increase in official CO2 emissions from the utility factor correction.

Key data points

5 times

For 2023 models, real-world PHEV emissions were almost five times higher than official values.

90% offset

Volkswagen has offset 90% of emission increase due to the first UF correction by increasing the range.

< 50 g/km

Thanks to improvements in range and efficiency, emissions can be limited to below 50 gCO_2/km in 2030.

The evidence from recent PHEV model launches suggests that **utility factor corrections incentivise the improvement of PHEVs**:

- **On average, some carmakers have increased the electric range of their vehicles from 63 km to 117 km** to offset the impact of the first correction.
- **The average battery size in upgraded 2026 models has risen from 14 kWh to 24 kWh** (compared to past variants).
- **These upgrades have offset three-quarters of the increase** in official CO2 emissions due to the corrected utility factor. This kept many models below 50 gCO_2/km.
- **The increased battery size required for this upgrade only increased vehicle price by 2%.**

T&E's analysis shows that, by 2030, electric ranges of around 140–220 km will keep PHEVs at or below 50 gCO2/km. This increase in range is consistent with the expected progress in battery and vehicle technology. If PHEVs are fitted with better technology, the range increase needed is limited to about 180 km. The final November 2027 UF correction not only harmonises regulation with real-world performance, thus correcting a critical regulatory misstep, but it also encourages the development of higher-performance PHEVs.

Key recommendations

European co-legislators should not interfere with the planned and approved upcoming correction of the utility factor in the current Automotive package discussions.

The utility factor is a technological methodology that is designed to ensure the official PHEV emissions match real-world emissions. It should not be for politicians to interfere with the application of this technical methodology. Instead, co-legislators should merely reaffirm their political support for a **robust, science-based system that guarantees that official emission accounting reflects real-world performance.**

The EU should keep the planned correction of the PHEV utility factors.

01

Utility factors updates: a correction based on real-world evidence

Utility factors — the main parameters that influence PHEV CO_2 emission — are being corrected based on empirical evidence in order to better reflect real-world conditions. Political demands to cancel this correction are obstructing a science-based approach.

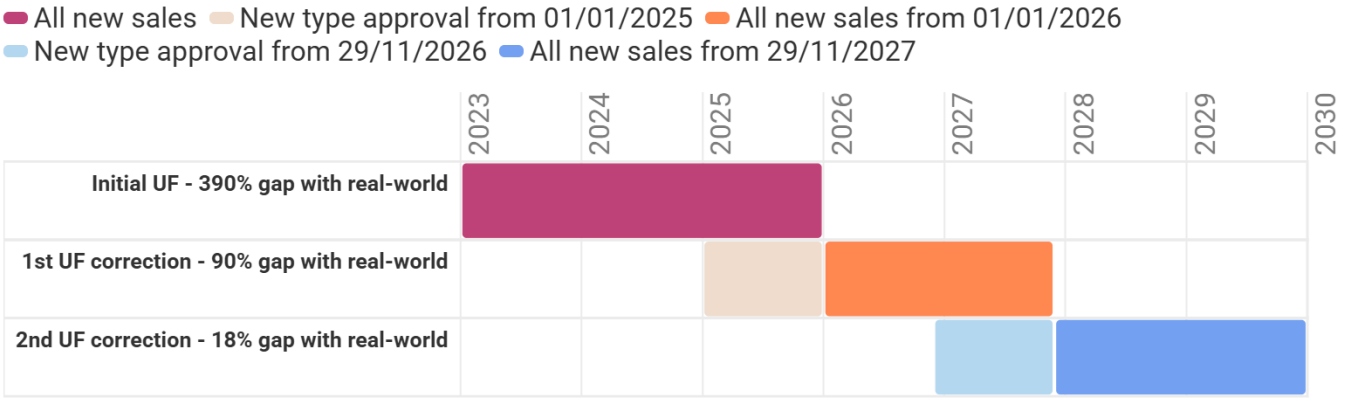
What are utility factors:

The utility factor (UF) is a key parameter used to calculate the official CO_2 emissions of PHEVs under the Worldwide Harmonised Light Vehicles Test Procedure (WLTP). It estimates the average share of total driving that is powered by electricity, based on the electric range (in km) that is measured in laboratory conditions. The higher the range, the more the PHEV is assumed to be running in electric mode.

Following research which showed that the WLTP included overly optimistic assumptions, resulting in significant discrepancies between real-world and official emissions, the European Commission planned a correction of the UF in a two-step approach. The first correction took effect in 2025 for newly type approved PHEVs and in 2026 for existing models. A second correction is scheduled for 29.11.2026 (new type approval) and 29.11.2027 (all new vehicles).

These correction steps can be illustrated in terms of underlying share of driving on electric mode. For instance, with the initial UF (pre-2025), a PHEV with a 100 km electric driving range was assumed to be driven 90% of its mileage on electricity. With the first correction, the PHEV model is assumed to drive two-thirds on electricity. With the second correction, a more realistic 44% of the distance is assumed to be driven on electricity.

Utility factor correction timeline



Source: Euro 6e / Euro 7 regulations ; T&E analysis of official real-world emission data

Our analysis of official real-world data confirms the significant gap between real-world and official emissions and shows that the 2027/28 correction is essential in order to reduce the real-world gap to a level comparable with that of other ICE powertrains.

Our analysis of real-world emissions data reported by the European Environment Agency showed that, on average, real-world emissions were almost five times higher than official emissions for models registered in 2023. For these models, our analysis shows that this is reduced to a factor of about 2 in 2026 after the first correction step.

Under the upcoming planned UF correction in November 2027, the official real-world emission would 'only' be 18% higher than official CO2 emissions (see Annex). This gap is comparable to that observed for conventional petrol and diesel cars. This confirms that the planned correction in 2027/28 is essential to adequately reflect emissions and prevent underreporting.

China is also correcting the PHEV utility factor

China officially adopted a revised UF curve for plug-in hybrid electric vehicles (PHEVs) in May 2026. This change will be implemented on January 1, 2028. Like Europe and the United States, PHEVs in China were initially assigned higher-than-actual UF values due to limited real-world data. This led to an assumption that PHEVs drive more on electricity than many users actually do. Based on recent real-world data, the updated UF curve reduces this assumed electric driving share to better reflect actual vehicle use. For example, a PHEV with 100 km of electric range was previously assumed to operate on electricity 80% of the time; under the revised curve, this assumption is reduced to approximately 65% as reported by ICCT. One key characteristic of the new Chinese UF is that it does not approach 100% for large ranges, being limited to a maximum of 88%. China also cancelled tax incentives for

PHEVs and Extended Range Electric Vehicles (EREVs). These incentives had been in place since 2012 and were due to end on 1 January 2027.

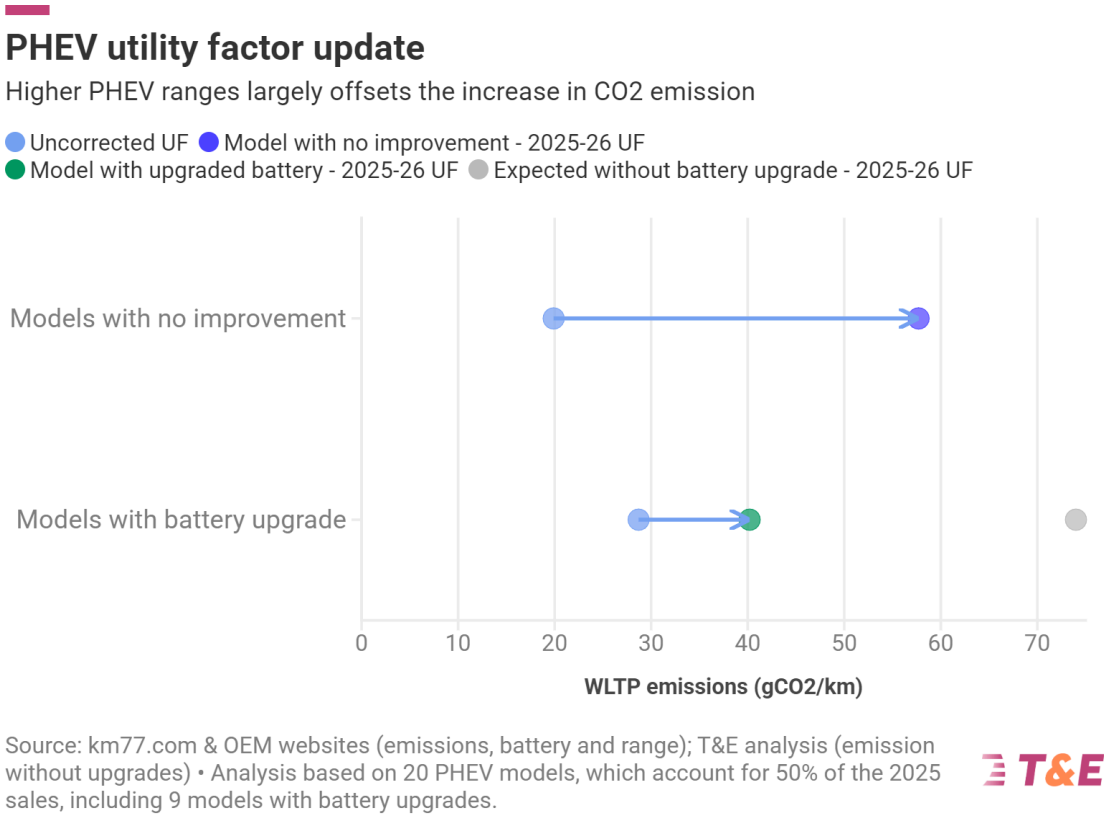
02

Key findings from the first utility factor correction step

The first correction step has led to a better accounting of official CO_2 emissions of PHEVs, which increases the official CO_2 emission of the PHEV if the design and range are not changed. However, some carmakers have improved their PHEV models in order to offset the effect of the UF correction.

T&E finds that carmakers upgrading their PHEV technologies are keeping official PHEV emissions below 50 gCO_2/km.

- **Without technical improvements**: Carmakers that continue selling existing models without making technical improvements see official PHEV average emissions triple from 20 gCO_2/km to 58 gCO_2/km when the 2026 utility factor is applied.
- **Battery upgrades**: Carmakers who upgrade their battery technologies to extend the electric driving range of their new models only see a 40% increase in emissions, from 29 gCO_2/km to 40 gCO_2/km.



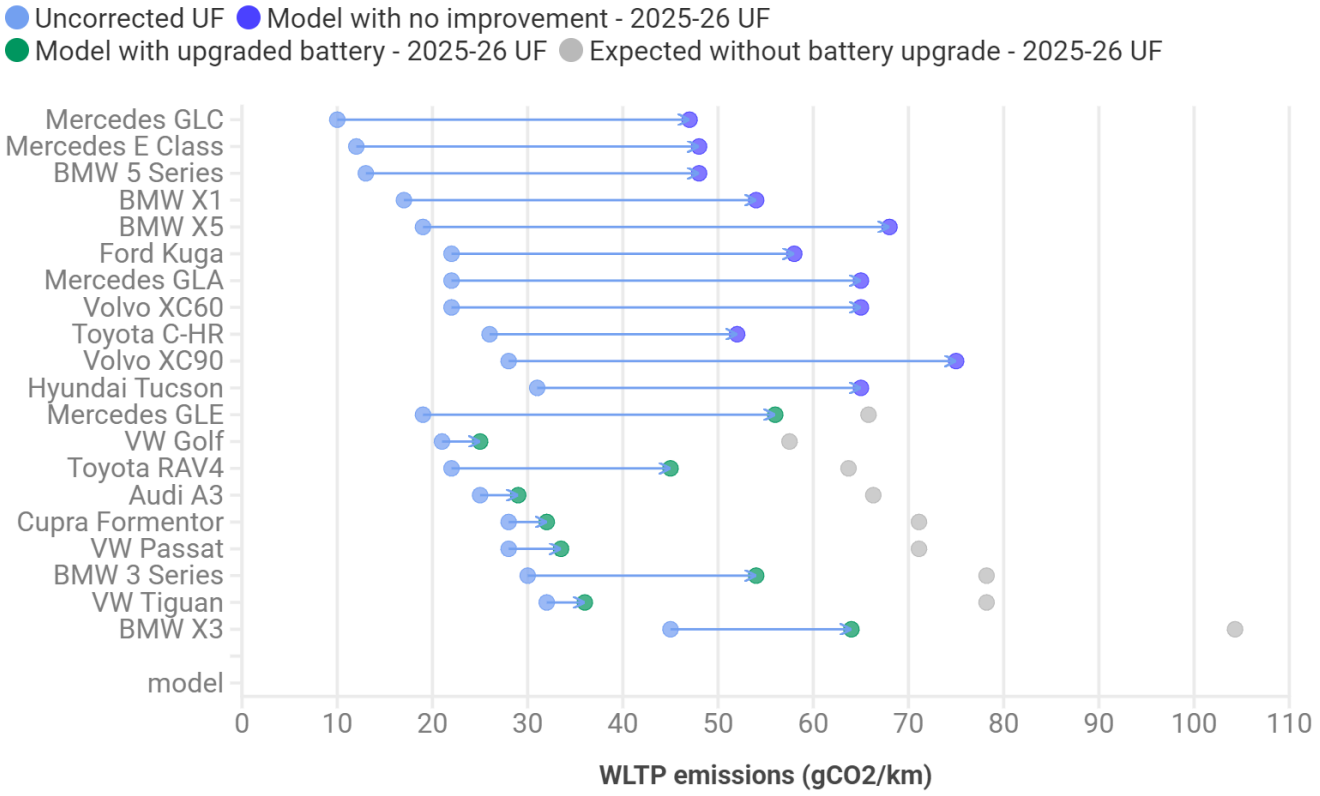
Source: km77.com & OEM websites (emissions, battery and range); T&E analysis (emission without upgrades) • Analysis based on 20 PHEV models, which account for 50% of the 2025 sales, including 9 models with battery upgrades.

T&E analysed 20 models among the top 30 of 2025 sales, representing 51% of the 2025 market. Of those, 9 models were upgraded in 2025 as a consequence of the introduction of the first correction to the utility factors. Carmakers prioritised upgrading models with the highest emissions.

- **The range increase has offset 3/4 of the increase in emissions from the utility factor.** Without an upgrade, these models would have emitted 74 gCO_2/km after the 2026 UF is applied.
- **The batteries have been upgraded, increasing in size by an average of 68%**, from 14 kWh to 24 kWh. Assuming an average cost of €107/kWh for an NMC battery, this battery upgrade would cost around €1,000, which is an average 2% increase on the model's price.
- **The model upgrade has enabled the range to increase by 85%**, from 63 km to 117 km. The range has increased more than the battery size (85% vs. 68%), which suggests that, in addition to the battery upgrade, carmakers have achieved further technical improvements.
- **The model upgrades have offset 90% of the emission increase across five models from the Volkswagen Group.** The Volkswagen Tiguan is among the models with the most significant improvements; its battery size has increased to extend the electric driving range by 116%, from 55 km to 119 km, thereby limiting emissions to 36 gCO_2/km (from 32 g/km before the UF correction and range increase). Similarly, the range of the Cupra Formentor has increased by 114%, limiting emissions to 32 gCO_2/km.

VW Group model upgrades offset 90% of the PHEV CO2 emission increase

These upgrades reduce the impact of the correction of the utility factor (UF) correction



Source: km77.com & OEM websites (emissions, battery and range); T&E analysis (emission without upgrades) • Analysis based on 20 PHEV models, which account for 50% of 2025 sales.

02

Vehicle improvements can keep PHEV emissions under 50 g/km in 2030

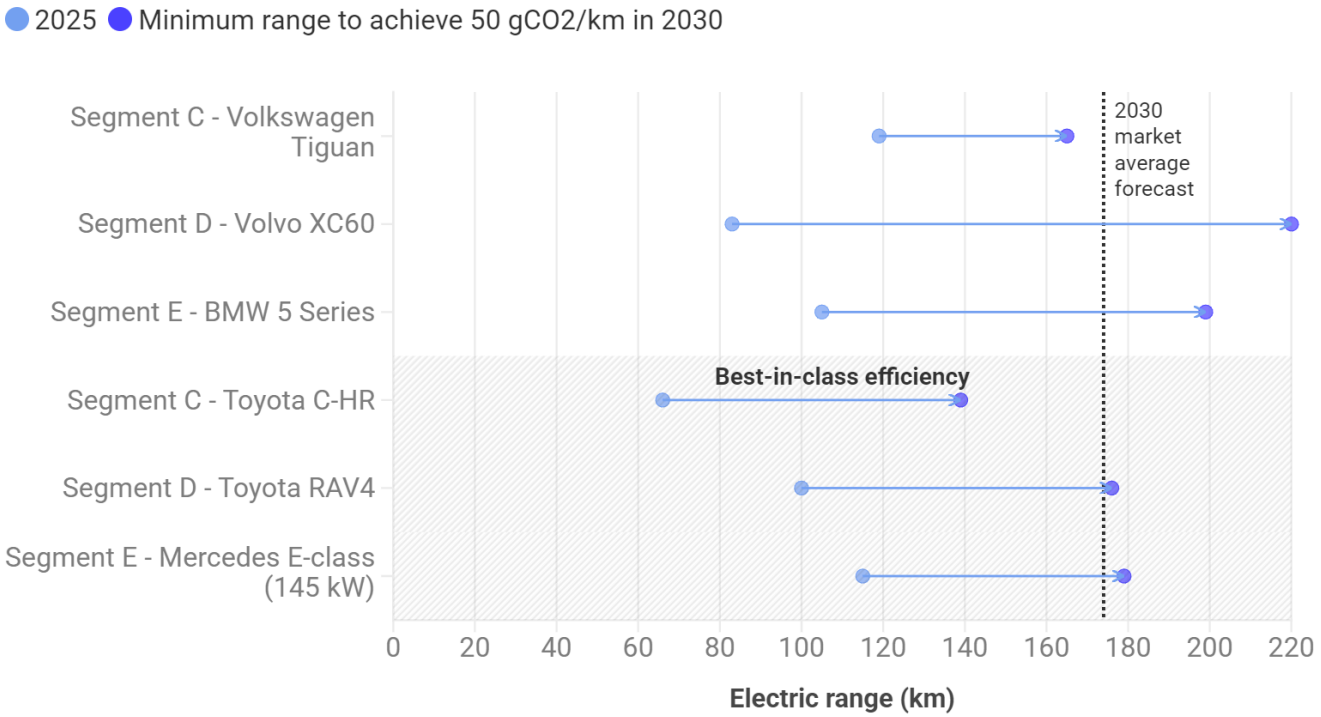
Carmakers can use higher ranges, innovation and technical improvements to limit PHEV emissions to 50 gCO_2/km by 2030. The second step of the utility factor correction incentivises progress rather than deterring PHEV sales.

T&E analysis of 6 representative PHEV models shows that the range needed in 2030 to reach 50 gCO2/km (140-220 km depending on the models) is in line with the ranges expected in

2030 thanks to technology and design progress. Additionally, improved ICE vehicle efficiency can help significantly reduce the range required to stay below 50 g/km and keep it below 180 km. This is illustrated in the graph below (methodology and additional information available in the Annex).

Battery improvements can ensure PHEVs do not exceed 50 g/km

The rise in electric range will limit the impact of the next correction of the utility factor (UF)



Source: T&E forecast; km77.com and carmakers websites (2025) • 2030 emissions based on the next UF correction. Range forecasted so that each model achieve 50 gCO2/km in 2030.

In the **medium segment**, the Volkswagen Tiguan would need a range of 165 km to limit emissions to 50 gCO_2/km. Therefore, the Tiguan's range growth is in line with technological trends (in the Annex, we present T&E's forecast of electric range, showing that the average new model should achieve a range of 174 km in our central scenario).

In the **large segment**, a best-selling European model such as the Volvo XC60 would need to achieve a range of 220 km, given its high fuel consumption in combustion mode. This type of range is possible for premium models, and Volvo has already demonstrated this with its XC70 model in China, which has a range of over 200 km.

Regarding the **executive segment**, we found that a best-selling BMW 5 Series would need a range of 200 km. Premium carmakers can easily fit large batteries in their vehicles as they can afford to use high-end battery chemistry with a high energy density. This allows them to achieve a long range with a limited battery weight and volume.

When we consider the best-in-class models with the **best efficiency in combustion mode**, we find that a C-segment model such as the Toyota C-HR would require an electric range of only 139 km, while a larger model such as the Toyota RAV4 would need only 176 km. An efficient Mercedes E-Class variant would only require a range of 179 km. Reduced fuel consumption in combustion mode could be achieved through improvements in engine efficiency, aerodynamics, and the use of lightweight materials, as well as optimisation of the hybrid system's energy recovery.

In our central scenario, the range would increase from 103 km for the 2025 models to 174 km for the 2030 models, which would increase the battery price by €1,240, assuming an NMC battery price of €81/kWh in 2030. This would represent only a **2% price increase** compared to the new 2025 models.

Annex

Analysis of real-world emissions data

Using a non-weighted average, real-world emissions were 4.9 times higher than official emissions for models registered in 2023. For these models, our analysis shows that this ratio would be reduced to 1.9 in 2026 after the first correction step.

Looking at models registered between 2021 and 2023, and applying a weighted average based on sales, the official real-world emissions would be 18% higher than official CO2 emissions when the planned UF correction in 2027 is applied.

2030 emission forecast

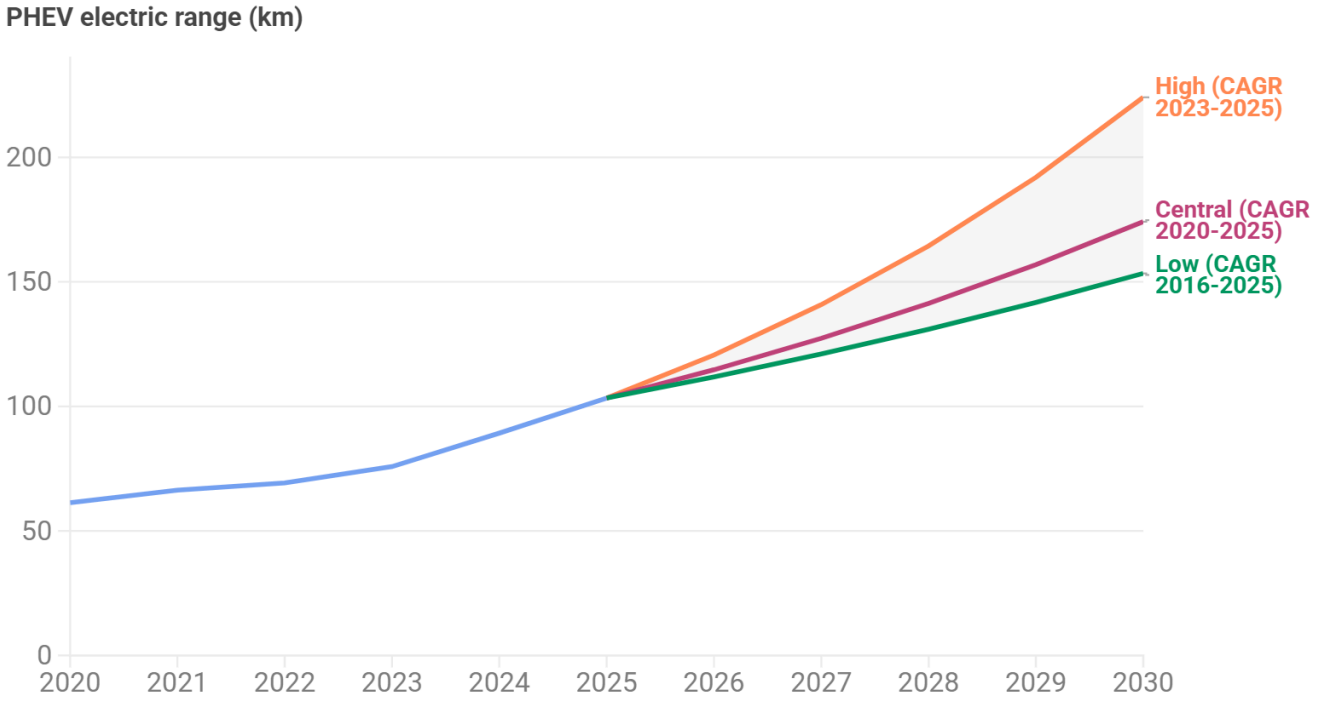
In order to project emissions to 2030, we have used the corrected utility factor of 2028 to recalculate the emissions of PHEV models. To provide a conservative estimate of the range required to achieve 50 gCO_2/km, we assumed that no improvements in efficiency would reduce emissions in combustion mode (charge sustaining, CS mode). Therefore, the electric range was optimised to achieve the 50 gCO_2/km target. Using data from the European Environment Agency's 2021 and 2023 registration datasets, we carried out a linear regression to derive a relationship between electric range and CS emissions. On average, we observe that CS emissions increase by 0.4 gCO_2/km for every 10 km increase in electric range. This is due to the increased battery mass required to increase the electric range. This correlation is used to derive the change in CS emissions in 2030 when the range varies.

The average electric range of new models should exceed 150 km by 2030.

Based on the observed growth rate between 2020 and 2025, the electric range of new models launched in 2030 is expected to reach 174 km in our central forecast. However, using a longer reference period (2016–2025), which includes years of slow growth, would result in an electric range of 153 km. This could be the consequence if the next utility factor correction were cancelled, meaning that carmakers would not need to innovate in order to achieve a longer range. Conversely, the recent trend between 2023 and 2025 shows that carmakers have upgraded their models as a result of the UF correction. If this trend continues and carmakers seek technical innovations, the electric range of new models could well exceed 200 km.

PHEV electric range to exceed 150 km by 2030

If recent trends continue, the electric range of new models could reach more than 200 km



Source: T&E analysis of new PHEV models/variants; Autovista • Forecast based on the compound annual growth rate (CAGR) for different reference periods

Vehicles characteristics and forecast results

Scenarios	Year	Range (km)	CS emissions (gCO2/km)	Average emissions (2028 UF)	Average emissions (2026 UF)	Average emissions (2024 UF)
Average new models	2025	103	166	90	55	15
Average new models	2030 - Central forecast	174	169	63	31	7
Average new models	2030 - Low forecast	153	168	70	36	8
Average new models	2030 - High forecast	224	171	50	22	4
Segment C - Volkswagen Tiguan	2025	119	125	63	36	9
	To achieve 50 gCO2/km in 2030	165	126	50	25	6
Segment C - Toyota C-HR	2025	66	109	73	52	19
	To achieve 50 gCO2/km in 2030	139	111	50	27	7
Segment D - Volvo XC60	2025	83	162	99	65	21
	To achieve 50 gCO2/km in 2030	220	167	50	23	4
Segment D - Toyota RAV4	2025	100	132	73	45	13

	To achieve 50 gCO2/km in 2030	176	134	50	24	5
Segment E - BMW 5 Series	2025	105	147	80	48	13
	To achieve 50 gCO2/km in 2030	199	150	50	23	5
Segment E - Mercedes E-class (145 kW)	2025	115	134	69	40	11
	To achieve 50 gCO2/km in 2030	179	136	50	24	5

Further information
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