FACT SHEET EUROPE

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REAL-WORLD USAGE OF PLUG-IN HYBRID VEHICLES IN EUROPE: A 2022 UPDATE

Plug-in hybrid electric vehicles (PHEVs) combine an electric and a combustion engine drive train. Their potential to reduce fuel consumption, global greenhouse gas (GHG) emissions, and local air pollution thus depends on how much they are effectively driven on electricity. In light of their growing relevance in sales and vehicle stock in Europe, an understanding of the fuel consumption of PHEVs in real-world usage is crucial for the effectiveness of climate policies, such as the European Union's CO_2 emission standards, as well as national incentive or taxation policies.

A new study by ICCT and Fraunhofer ISI presents a large-scale analysis of the average real-world fuel consumption and electric driving share of about 9,000 private and company car PHEVs across the European Union, Norway, Switzerland, and the United Kingdom with an emphasis on Worldwide Harmonized Light-Duty Vehicles Test Procedure (WLTP) type-approved vehicle models. The study is an update of an earlier ICCT and Fraunhofer ISI study that investigated the real-world usage of PHEVs in Europe, China, and the United States.

KEY FINDINGS

» **The real-world fuel consumption and CO_2 emissions of PHEVs in Europe is on average three to five times higher than the official WLTP type-approval values.** The average real-world fuel consumption of PHEVs in Europe is 4.0–4.4 L/100 km for private vehicles and 7.6–8.4 L/100 km for company cars compared to an average of 1.6–1.7 L/100 km in WLTP type approval (Figure 1). These values correspond to tailpipe emissions of 90–105 g CO_2/km for private vehicles and 175–195 g CO_2/km for company cars compared to only 37–39 g CO_2/km in WLTP type approval.

» **The deviation between real-world and type-approval fuel consumption is growing.** For PHEVs in general, the real-world fuel consumption has been growing by 0.1–0.2 L/100 km on average with every new vehicle build year since 2012 (Figure 1). The deviation from type-approval values is higher for WLTP certified cars than for the former New European Driving Cycle (NEDC) certified vehicles, as newer WLTP certified cars show slightly higher average real-world fuel consumption.

» **The deviation between real-world and type-approval fuel consumption is similar across European countries**. The deviation between real-world and type-approval fuel consumption values varies greatly between vehicle models and users. When considering the average within a country sample, however, only minor differences between countries are observed. For private cars, the country average deviation between real-world and WLTP type-approval values ranges between 2.5 and 3.5, while it ranges between 4 and 5 for company cars.

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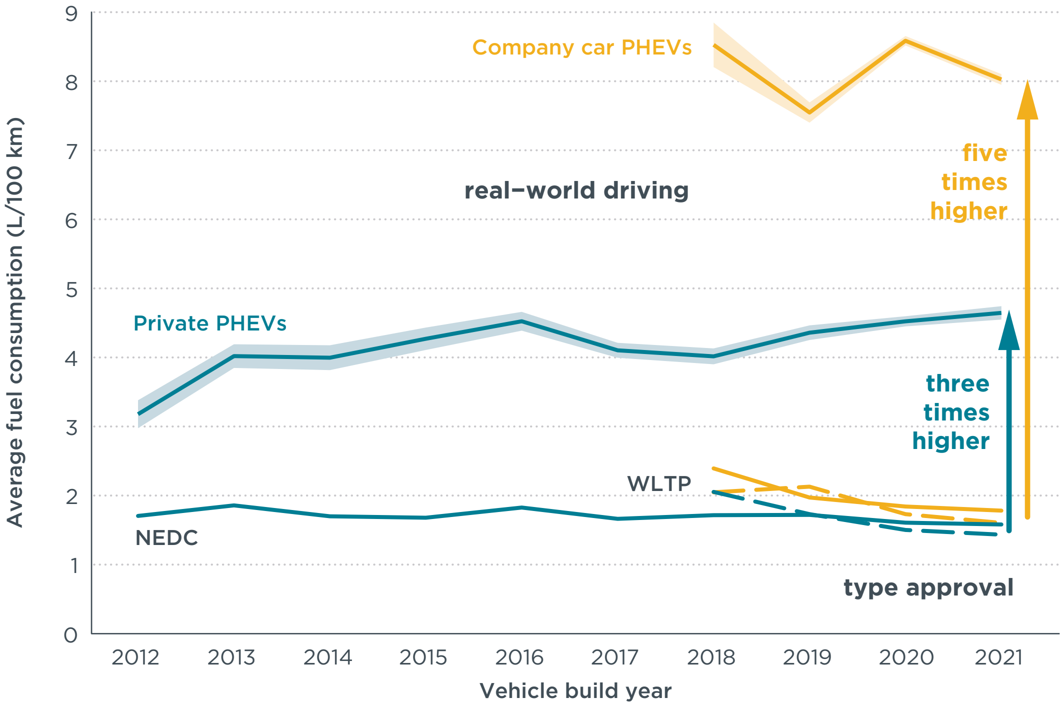

Figure 1. Development of the average real-world and type-approval fuel consumption of private and company car PHEVs in Europe over vehicle build year. Shaded areas represent 95% confidence interval from sample size uncertainty.

- **The average real-world electric driving share is about 45%–49% for private cars and about 11%–15% for company cars**. The electric driving share corresponds to the share of distance driven on the electric motor with the combustion engine off. In contrast, the official WLTP type-approval procedure assumes the share of driving in the mostly, but not fully, electric charge-depleting mode to be around 70%–85% (Figure 2).
- **Four main factors contribute to the high deviation between the real-world usage and type-approval fuel consumption values of PHEVs.** First, the real-world all-electric range is shorter than under type-approval conditions. Second, long-distance driving exceeds the electric driving range and leads to large distances traveled mainly powered by the combustion engine. Third, many vehicles are not fully charged before every driving day. And, fourth, when the combustion engine is running, it uses more fuel during real-world usage than in type-approval conditions. The first three factors could be addressed by adjusting the WLTP assumptions on the share of driving in charge-depleting mode (Figure 2).

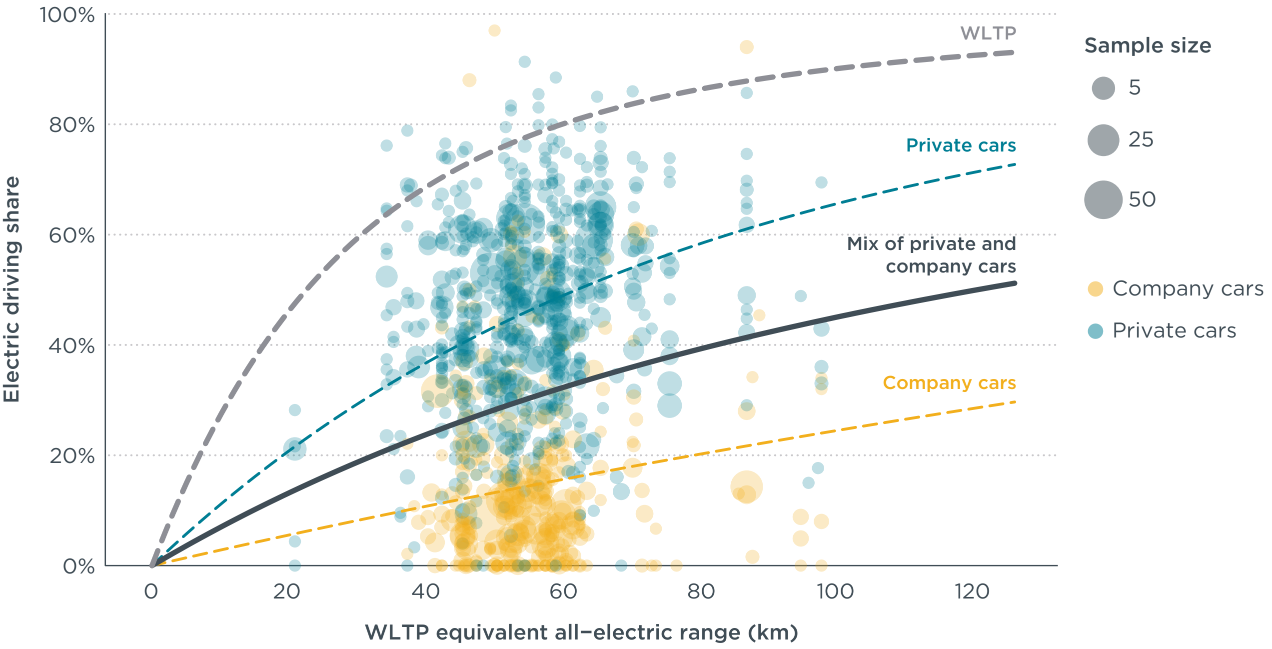

Figure 2. Real-world electric driving share compared to WLTP assumption on charge-depleting mode driving share.

POLICY RECOMMENDATIONS

- » **PHEV usage assumptions in WLTP type approval should be adjusted to empirical evidence.** Rescaling the existing formula for the assumed charge-depleting mode driving share in the WLTP (the utility factor, or UF) allows a more accurate reflection of real-world usage conditions. The existing evidence from almost 9,000 vehicles across many European countries allows for an immediate adjustment. The usage assumptions could be further refined based on fleet-wide data obtained from on-board fuel consumption monitoring (OBFCM) devices, but such data will not become available for several years. The ICCT and Fraunhofer ISI study offers a solution that could be implemented already today: replace the parameter d_n = 800 km in the UF regulation with a more realistic value of d_n = 4260 km.
- » **PHEVs should be excluded from zero- and low-emission vehicle (ZLEV) credits in the CO_2 emission standards.** Given PHEVs' much higher CO_2 emissions in average real-world operation compared to type-approval values, they should not be considered in the credits for zero- and low-emission vehicles targets of the European Union's CO_2 emission standards. Alternatively, only those vehicles that meet the low emission targets during real-world operation could be included.
- » **Fiscal incentives for PHEVs should be abolished or limited to vehicles with demonstratively low fuel consumption or high electric driving share.** On an individual user level, fiscal incentives such as purchase subsidies and reduced taxation rates for PHEVs should only be issued if a user can demonstrate a fuel consumption of about 2 L/100 km or an electric driving share of about 80% for average PHEV models. An electric driving share of 50% would, depending on the vehicle model, still result in an about two to three times higher fuel consumption than considered in WLTP values. On a vehicle model level, incentives for PHEVs should thus be limited to vehicles that allow users to realize low fuel consumption and high electric driving shares. Real-world data on fuel consumption and electric driving share may be obtained through OBFCM devices.

» **Increase the required WLTP equivalent all-electric range to about 90 km.** To enable users to realize high electric driving shares and low fuel consumption over longer daily driving distances, even in cold weather and at high velocities, fiscal incentives could further be limited to vehicle models with a high electric range. In addition, as the study finds that higher fuel consumption correlates with higher maximum system power, which is typically dominated by the combustion engine, the power of the combustion engine should be limited. This could be achieved by deciding on a minimum regulatory ratio for electric motor power to combustion engine power, typically well above 40%–50%. In parallel, this would allow purely electric driving in real-world usage conditions, including during cold weather and with higher power load.

PUBLICATION DETAILS

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