EUROPEAN UNION CO_2 STANDARDS FOR NEW PASSENGER CARS AND VANS

JULY 2021

Life-cycle greenhouse gas emissions

As part of the European Green Deal's target of a climate neutral European Union by 2050, the transport sector is called on to reduce greenhouse gas (GHG) emissions by 90% compared to 1990, and ICCT's projections show that a large part of this reduction needs to come from passenger cars. It is therefore important for policymakers to understand which powertrain and fuel technologies are most capable of shrinking the carbon footprint of cars—and not only the emissions from the tailpipes, but also from fuel and electricity production and vehicle manufacturing.

A life-cycle assessment (LCA) of the GHG emissions of passenger cars in Europe was carried out. It considers the most relevant powertrain types—internal combustion engine vehicles (ICEVs), including hybrid electric vehicles (HEVs); plug-in hybrid electric vehicles (PHEVs); battery electric vehicles (BEVs); and fuel cell electric vehicles (FCEVs)—and a variety of fuel types and power sources including fossil gasoline, diesel, and natural gas (each of these with the current and future biofuels or biomethane blend rate), e-fuels, hydrogen, and electricity. The assessment is part of a global LCA study that also covers India, China, and the United States. For each of the four regions, the same trends are observed.

- Average gasoline and diesel cars correspond to very similar, and relatively high, life-cycle GHG emissions levels (Figure 1). **HEVs** are found to reduce life-cycle GHG emissions **by only about 20%** compared to conventional gasoline cars. The GHG emissions of **compressed natural gas (CNG) cars can even exceed** those of gasoline and diesel cars.
- The European **biofuel blend does not significantly improve** the life-cycle GHG emissions of average gasoline, diesel, and CNG cars, even considering a phase out of palm oil and increased shares of waste- and residues-based feedstocks by 2030. The very high production cost of **e-fuels** means they are **not likely to contribute substantially to decarbonization** of the fuel mix within the lifetimes of 2021 or 2030 cars.
- In real-world usage, the fuel consumption of PHEVs is several times higher than in the official test values. Therefore, the life-cycle GHG emissions of lower medium segment **PHEVs** registered today in Europe are estimated to be only **25%–27% lower** than for average new gasoline cars.
- The life-cycle emissions of lower medium segment **BEVs** registered in Europe today are already **66%–69% lower** than for comparable new gasoline cars. For lower

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medium segment cars projected to be registered in 2030, as the electricity mix continues to decarbonize, the life-cycle emissions gap between BEVs and gasoline vehicles **increases to 74%–77%**. BEVs entirely powered by renewable energy correspond to **81% lower** life-cycle GHG emissions than gasoline cars.

» Life-cycle emissions of **FCEVs** are **only about 26% less** than for average new gasoline vehicles registered today in the lower medium segment, if they are powered by hydrogen produced through reforming methane from natural gas ("grey hydrogen"). Utilizing hydrogen produced from renewable electricity ("green hydrogen"), instead, would result in **76% lower** life-cycle GHG emissions for FCEVs. Renewable energy powered FCEVs show slightly higher life-cycle emissions than BEVs powered by the same renewable electricity, though; this is because the electricity-based FCEV pathway is approximately **three times as energy intensive** as the BEV pathway, and as such, emissions from the construction of additional renewable electricity installations were taken into account.

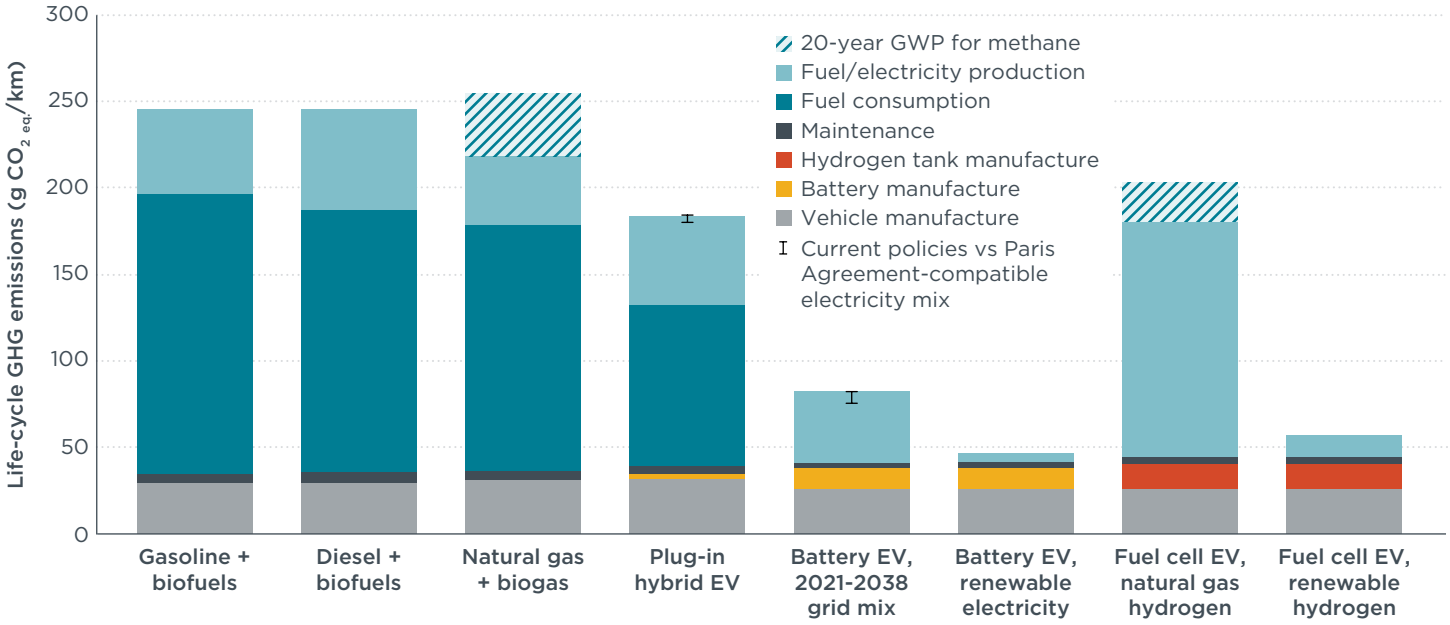

Figure 1. Life-cycle greenhouse gas (GHG) emissions of average new lower medium segment gasoline, diesel, and compressed natural gas (CNG) cars, plug-in hybrid electric vehicles (PHEVs), battery electric vehicles (BEVs) and fuel cell electric vehicles (FCEVs) registered in Europe in 2021. The error bars indicate the difference between the development of the electricity mix according to stated policies (the higher values) and what is required to align with the Paris Agreement. GWP = global warming potential.

Flowing from the analysis, ICCT recommends considering the following policy action:

» The **registration of new combustion engine vehicles** should be **phased out in the 2030–2035 time frame**. Given average vehicle lifetimes of 18 years, only those technologies that can achieve a deep decarbonization of the European car fleet by 2050 should be produced and registered by about 2030–2035. BEVs powered by renewable electricity and FCEVs fueled by green hydrogen are the only two technology pathways that qualify. Hybridization can be utilized to reduce the fuel consumption of new internal combustion engine vehicles registered over the next decade, but neither HEVs nor PHEVs provide the magnitude of reduction in GHG emissions needed in the long term.

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A global comparison of the life-cycle greenhouse gas emissions of combustion engine and electric passenger cars [https://theicct.org/publications/global-LCA-passenger-cars-Jul2021]

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