

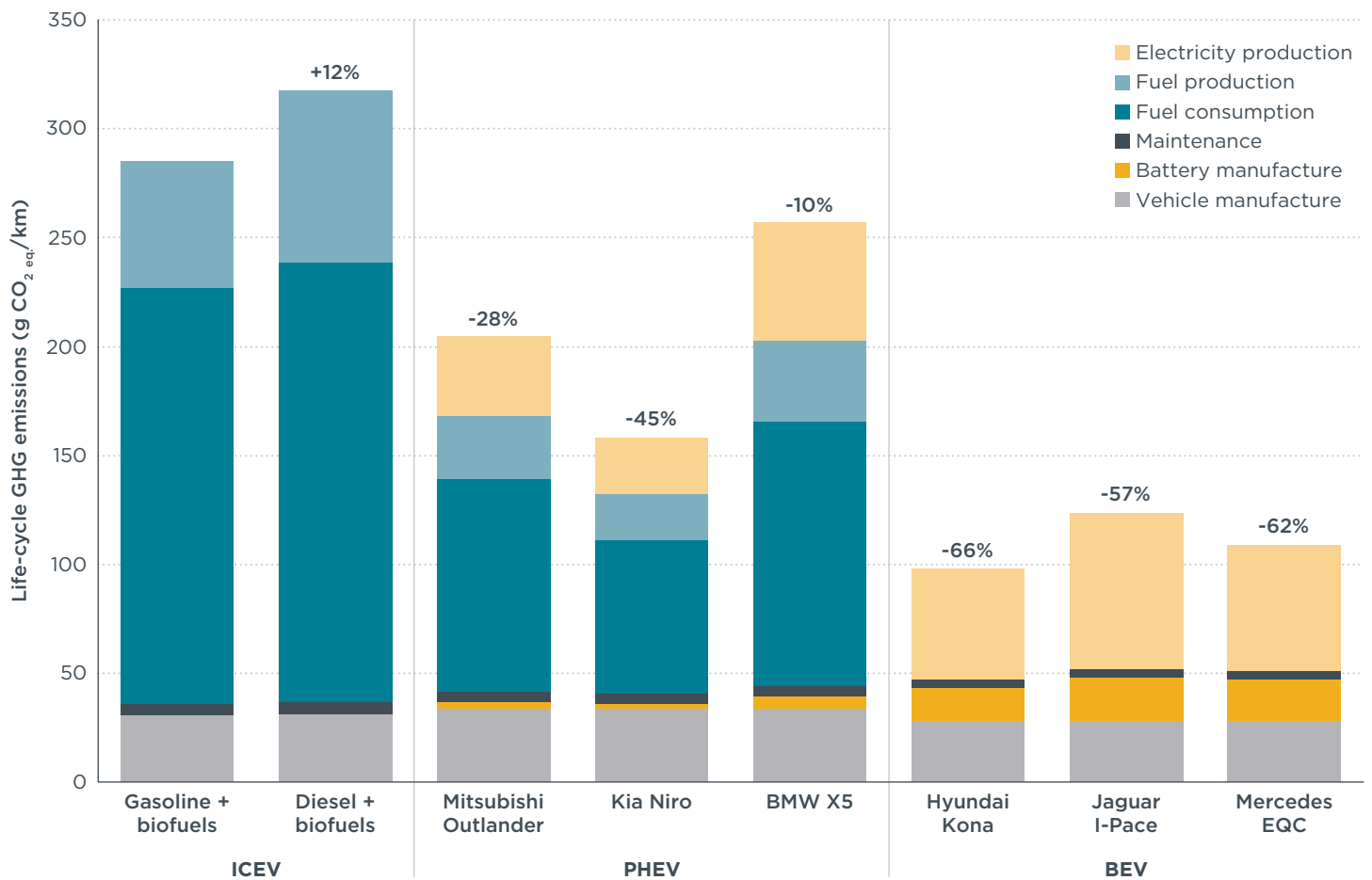
## Life-cycle greenhouse gas emission benefits and fiscal incentives of plug-in hybrid and battery electric vehicles in Germany

The Federal Government of Germany aims to achieve climate neutrality by 2045. This entails a full decarbonization of the passenger car fleet. In parallel to the European Union's CO<sub>2</sub> standards, the German government's measures include supporting the automotive industry in achieving this goal via fiscal incentives for plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs). Currently, the government incentivizes the purchase of a PHEV by up to €4,500, in the case of BEVs up to €6,000. In addition, PHEVs and BEVs receive fiscal incentives in form of lower vehicle ownership and company car tax rates.

A new study by ICCT and Fraunhofer ISI puts these fiscal incentives for PHEVs and BEVs in perspective to their greenhouse gas (GHG) emissions reduction potential, in terms of real-world driving and over the entire life-cycle of the vehicles. For the study, nine PHEV models and nine BEV models were selected across the lower medium, medium, and sport utility vehicle (SUV) segments. The study compares the GHG emission benefits and fiscal incentives of the selected PHEV and BEV models to the respective segment average gasoline vehicles. Further, the study estimates the climate impact of future PHEVs and BEVs, registered in 2030.

### LIFE-CYCLE GREENHOUSE GAS EMISSIONS

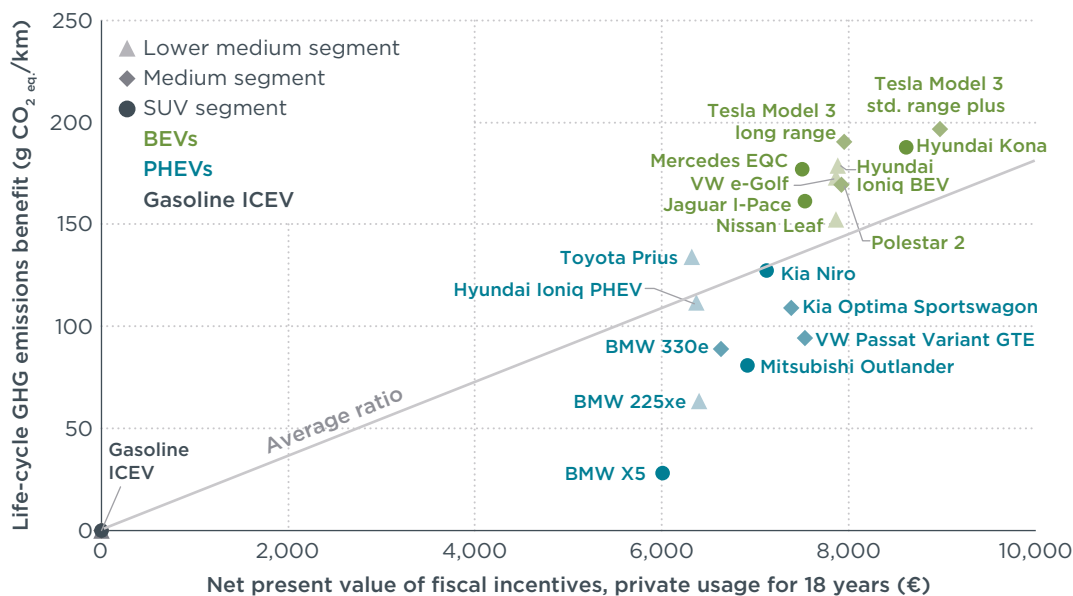
- » **BEVs have, on average, 63% lower life-cycle GHG emissions than respective segment average new gasoline vehicles.** With values ranging between 57% and 67%, differences in the GHG emissions benefit of the BEV models are determined by the electric energy consumption and battery production emissions (Figure 1).
- » **For PHEVs, the life-cycle GHG emissions are, on average, 34% lower than respective segment average new gasoline vehicles.** Depending on the PHEV model, this value varies between 10% and 52%. Even though the realized electric drive share is similar for many PHEV models, they show a wide range of fuel and electric energy consumption.
- » **For vehicles registered in 2030, PHEVs correspond to 40%–63% lower emissions than for today's segment average gasoline cars, while BEVs show a reduction of 74%–80%.** Although assuming higher ranges and higher electric drive shares for future PHEV models, PHEVs will still not be able to meet the reduction of GHG emissions required for a climate neutral passenger car fleet.



**Figure 1.** Life-cycle GHG emissions of selected sport utility vehicle (SUV) segment PHEV and BEV models compared to average SUV segment gasoline and diesel internal combustion engine vehicles (ICEVs) driven in Germany in 2021 to 2038.

## COMPARISON OF FISCAL INCENTIVES AND GHG EMISSIONS BENEFIT

- » **PHEVs show a lower ratio of the life-cycle GHG emissions benefit per costs of fiscal incentives than BEVs.** The ratio of the life-cycle GHG emissions benefit over the respective segment average gasoline vehicles, per the net present value of purchase subsidy and vehicle ownership tax benefit of the analyzed PHEVs, spreads over a large range and is generally much lower than for BEVs (Figure 2). Including the company car taxation for the first two years of the vehicle lifetime results in the same trends.
- » **Only PHEV models with a very low fuel consumption in real-world usage show a similar ratio of the GHG emissions benefit to fiscal incentives as for BEVs.** Although the large majority of the analyzed PHEV models show a significantly lower ratio of the life-cycle GHG emissions benefit per fiscal incentives than observed for BEVs, the PHEV models with an average fuel consumption of about 2 L/100 km in real-world usage correspond to a similar ratio as BEVs.
- » **A reduction of the total fiscal incentives for PHEVs by €2,500 would result in a similar average ratio of the GHG emissions benefit to fiscal incentives as for BEVs.** While the average ratio of GHG emissions benefit per fiscal incentives in private usage is 22 g CO<sub>2</sub>eq./km per €1,000 for BEVs, the average ratio is 14 g CO<sub>2</sub>eq./km per €1,000 for PHEVs. To achieve the same average ratio as for BEVs, the fiscal incentives for PHEVs would generally need to be reduced by €2,500.



**Figure 2.** Life-cycle GHG emissions benefit when compared to a segment average gasoline ICEV versus net present value of the fiscal incentives for the PHEV and BEV models in private usage in 2021 to 2038.

## POLICY RECOMMENDATIONS

- » **Reduce fiscal incentives for PHEVs.** A general reduction of the national purchase subsidy for PHEVs by about €2,500 would, on average, result in a similar ratio of the life-cycle GHG emissions benefit to the cost of fiscal incentives as for BEVs. An increase of the company car taxation rates for PHEVs could further help to adjust this ratio for company cars. Considering that, in contrast to BEVs, PHEVs are not able to meet the long-term requirements of a climate neutral passenger car fleet, the long-term climate benefit of supporting the up-scaling of their production is much lower than for BEVs. Therefore, a further reduction of the fiscal incentives for PHEVs, such as fully abolishing the purchase subsidy, could also be considered.
- » **Limit incentives to PHEVs with a low fuel consumption.** Alternatively, the life-cycle GHG emissions benefit of PHEVs can be improved by limiting incentives to vehicles with an average fuel consumption of about 2 liters per 100 km in real-world operation:
  - » On a **vehicle model level**, this means fiscal incentives should focus on PHEV models with a **high electric range** in combination with a **low fuel consumption in both charge-sustaining and charge-depleting mode**. Due to the large differences in the fuel consumption of individual PHEV models for a given electric drive share, the electric range alone is not a sufficient proxy.
  - » On an **individual user level**, fiscal incentives could be tied to **demonstrating a low average fuel consumption in real-world usage**. All PHEV models registered in the European Union from January 2021 onwards are equipped with on-board fuel consumption meters (OBCFM) that detect both the average fuel consumption and the share of driving in charge-depleting mode with the combustion engine off. These data can be made available to users or collected during regular technical inspections.

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## PUBLICATION DETAILS

**Title:** More bang for the buck: A comparison of the life-cycle greenhouse gas emission benefits and incentives of plug-in hybrid and battery electric vehicles in Germany

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