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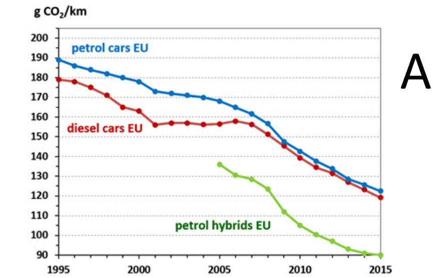
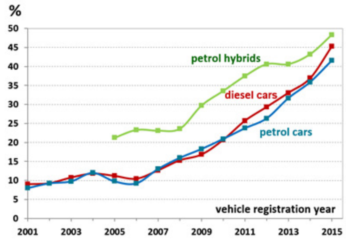
Power and mass growth of popular cars and resulting efficiency losses

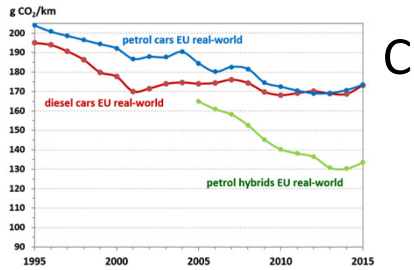
INTRODUCTION



Average type-approval CO_2 -emissions of new cars in the EU*



Divergence between type-approval and real-world CO_2 -emissions for passenger cars in the EU*



Average real-world CO_2 -emission values of new cars in Europe*

The “official” view (A): Between 1995 and 2015, type approval CO_2 emissions of newly registered petrol cars in the EU decreased by around 30 %. Real-world emissions, however, have been more and more deviating from these values. One main reason are the increasing divergences between type-approval and real-world CO_2 emissions of newly registered cars (B). Corrected for those divergences, it turned out that real-world CO_2 emissions of newly registered diesel cars did not decrease since the year 2001 in the EU, while real-world CO_2 emissions of newly registered petrol cars did not decrease since the year 2012 (C). *Source: Helmers et al. (2019)

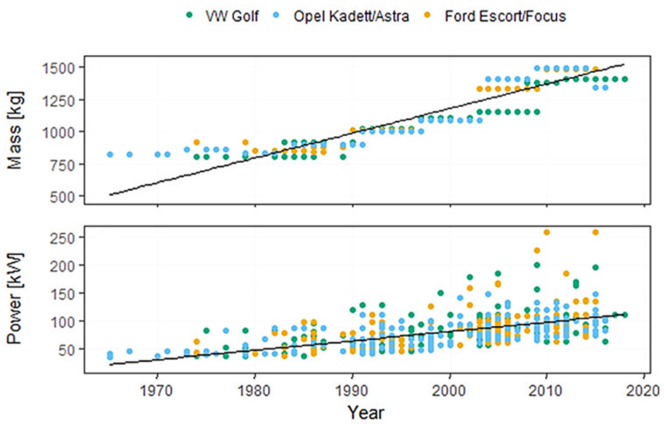
HYPOTHESIS and STATE of KNOWLEDGE

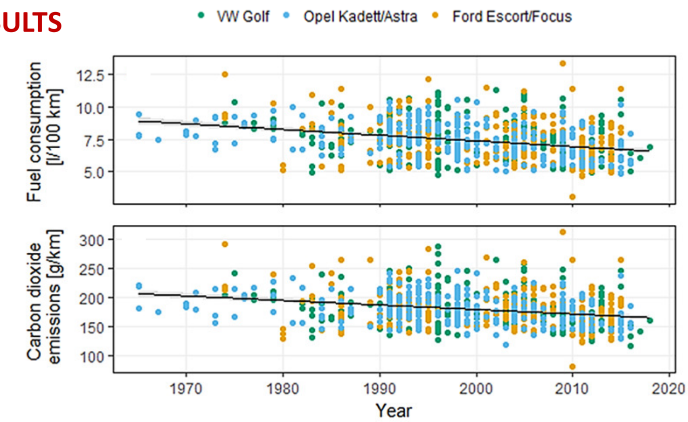
- The main reason for the lack of (sufficient) CO_2 emission reduction in new cars registration in Europe is the continuous growth of mass and power (hypothesis).
- Although this trend may absorb part of the increasing powertrain efficiency, it has received little attention in the European climate policy and as well in science. While the context between mass and energy consumption is established, this is not the case for the connection between power and energy consumption of a vehicle.
- The main reason for this lack of knowledge is that type approval energy consumption data go back to dynamometer measurements in which only a minimum of engine power is used.
- Consequently, the trade-offs between mass, power, and fuel consumption of light-duty vehicles in the EU cannot be analyzed based on type-approval data as Knittel (2012) performed it in USA for the years from1980 to 2006.

METHODOLOGY

- This project traces efficiency trade-offs and CO_2 saving potentials for three popular compact car models (VW Golf, Opel Kadett/Astra, Ford Escort/Focus) based on real-world fuel consumption data provided by Spritmonitor.de
- The investigation is based on a multiple regression analysis of 1,645 individual model variants from the years 1962 - 2018
- In a sensitivity analysis, the above data set was complemented by analyzing 700 variants of 14 models (4 small cars, 6 compact cars, and 4 midsize sedans) of 8 manufacturers sold in Germany between 1989 and 2017.

RESULTS





RESULTS & CONCLUSIONS

- While mass and power of model variants increased by 66% and 150% between 1980 and 2018, fuel consumption decreased 11% for gasoline cars and increased 0.4% for diesel cars in the same period.
- However, due to this analysis fuel consumption could have decreased by 23% and 24%, respectively if mass and power of vehicles had remained at 1980 levels. The resulting efficiency trade-offs amount to 51% or 24 g CO_2/km for gasoline cars and 102% or 40 g CO_2/km for diesel cars among these popular cars.
- These findings were verified in a sensitivity test based on 700 vehicle variants resulting in even larger trade-offs.
- Concluding, a substantial share of CO_2 savings due to engineering progress was not arriving to the streets in the last decades, which probably goes back to a legislation setting weak targets and granting carmakers higher CO_2 emissions for heavier vehicles.

Literature sources

Helmers, Leitao, Tietge, Butler (2019) CO_2-equivalent emissions from European passenger vehicles in the years 1995–2015 based on real-world use: Assessing the climate benefit of the European “diesel boom”. Atmos. Environ. 198: 122–132.

Knittel (2012) Automobiles on steroids. Product attribute trade-offs and technological progress in the automobile sector. American Economic Review 101, pp. 3368-3399

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