The Impact of New Passenger Vehicle Changes and the Shift to Diesel on the European Union's New Automobile CO_2 Emissions Intensity (11-4126)

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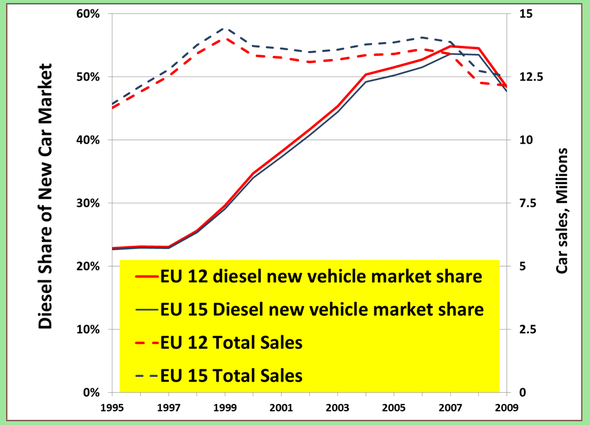
Introduction

Diesel technology has been a mainstay of reducing CO_2 emissions from new light duty passenger vehicles in the European Union (EU). Did this save energy and emissions?

To find out, we gathered data on sales and properties (CO_2 emissions, mass, power, engine capacity or volume) from the EU's monitoring data base. For a smaller set of countries (Be, De, Es, Fr, It, NL, UK, Se), data for the fleets of gasoline and diesel cars (numbers, yearly use, fuel intensity and fuel consumption) were taken from authoritative national data sources to gauge the outcome of this shift to diesel cars.

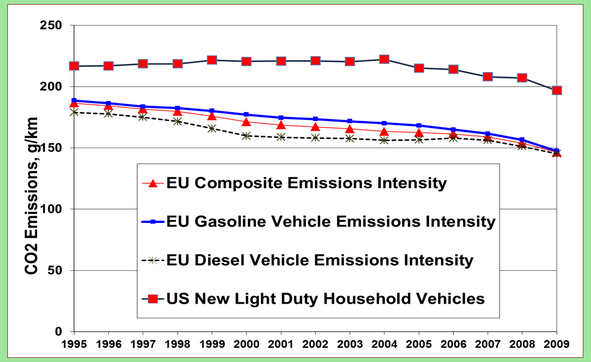
TRENDS:

Massive Shift to Diesel New Cars

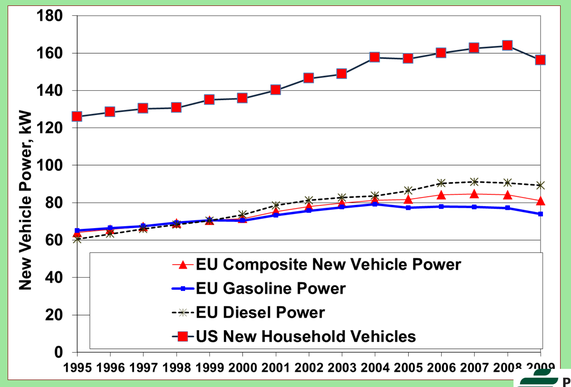


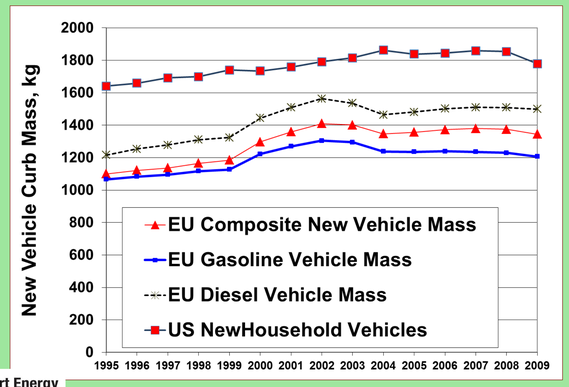
CO_2 g/km of new cars: gasoline dropped more than diesel

This key indicator dropped from the mid 1990s, even though the voluntary agreement on reducing emissions did not take effect until model year 1998. Notice that US new vehicle emissions rose slightly until 2003.



Power and Mass Increase, Marking Similar Trends to U.S.

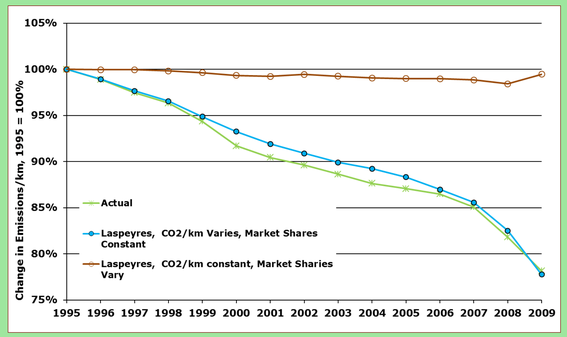




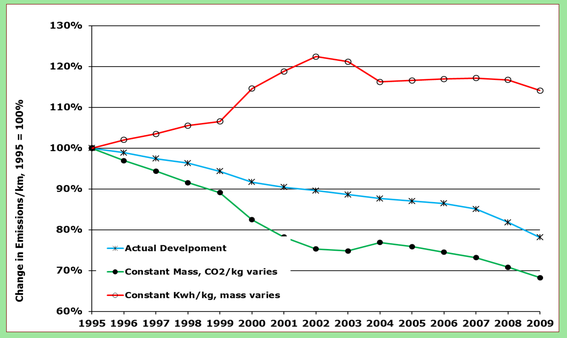
Increased Diesel Market Shares Have Little Impact...

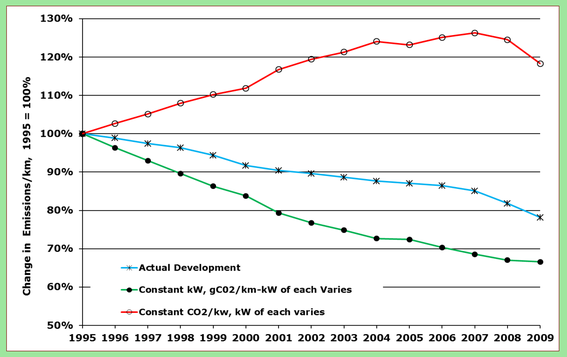
A Laspeyres decomposition illustrates the impact of changing one factor at a time. Changing *only* the relative market shares of gasoline and diesel cars would have had minimal impact. Reductions in CO_2 per km have had a far more drastic effect *(below)*.

Other decompositions show what happens if the emissions/unit of power-km are held constant and power varies with actual sales over time, or if the emissions/ unit of power-km evolve as actual but the power is held constant at base year values (*right*). If mass and power had held constant, there would have been an even more marked improvement in emissions per km.



...But Power and Weight Increases Offset Efficiency Improvements





On-Road Data Are Similar...

On-road fuel economy data from eight countries confirm what the new-vehicle market suggest. In 1995 diesel fleets emitted 10% less CO_2/km than gasoline fleets. By 2008 that number and fallen to 6%, and only in Belgium was the difference as large as 12%. Thus, the diesel "advantage" in CO_2 emissions shrunk over time.

..But Diesels Driven More

Diesel cars are driving 60-120% more than gasoline cars. Much of this difference can be attributed to the younger age of diesel cars and their prominence as first cars in households, as well as to a small extent their use as taxis or other business vehicles. Some of the higher usage must be attributed to a small rebound effect (i.e., 20-40% lower fuel costs/km than for gasoline). Finally, there are selection effects by which those who have longer driving distances select diesel cars. These differences expanded through 2009, but may be reversing as diesel prices rise and diesel cars reach into more and more buyer segments.

Conclusions

The obvious conclusion from this analysis is well known – automobile power and mass tend to absorb a considerable share of the potential of new technology to save fuel, whether driven by a standard, a voluntary agreement, or higher fuel prices. But EU vehicles became increasingly more fuel economic after 1995, while those in the US only saw improvements after 2003 as fuel prices rose. This suggests that both standards and prices are important determinants of fuel economy.

The less obvious conclusion is that most of the improvement in new vehicles in the EU arose because both technologies became more efficient, and only a small part (>5%) because of the shift to diesels. This is not the fault of diesel technology, but of the way the market for diesel was set up – a low price of diesel and declining incremental costs for switching from gasoline to diesel.

The much higher driving distances of diesel cars also begs for caution in comparing two vehicle technologies. This may mean that the present approach comparing hybrid, plug-in, and conventional fueled vehicles on an "equivalence" basis may lead to surprises in the ultimate impact of the development, purchase, and use of these vehicles on fuel demand and CO_2 emissions.

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