Reaching 95 g/km - challanges for the automotive industry and benefits for the customer regarding CO2 emissions

Motivation

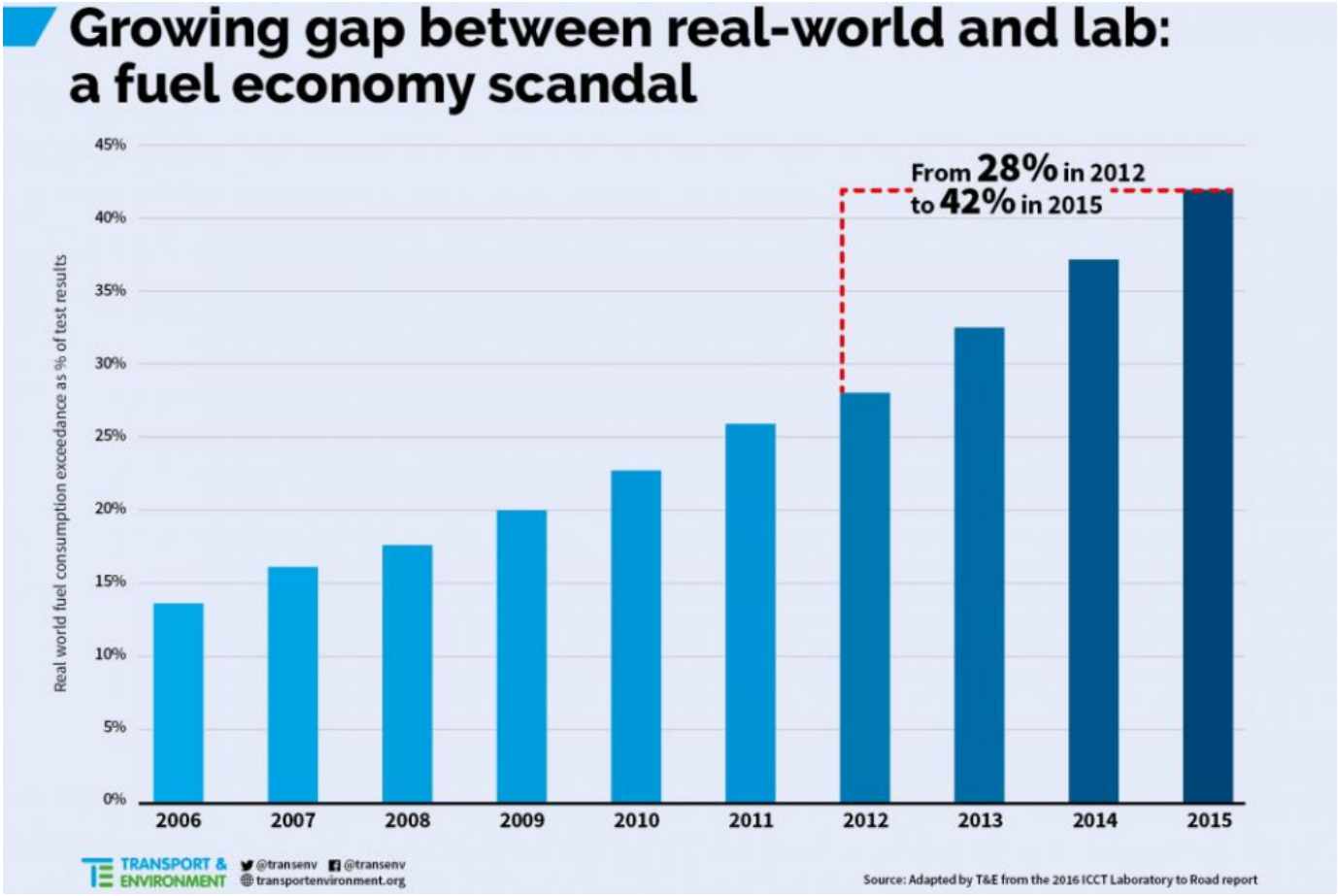
Any data concerning the registration figures or a passenger cars CO2 emissions are a sheltered good for the passenger car manufactures (OEMs). Luckily the EU requires Member States to record information for each new passenger car registered in its territory (under EU Regulation No 443/2009). This data is publicly availbale.

This gives a curious data scientist a unique possibility to examine the registration entries and come up with conclusions.

The main questions arising in this context are:

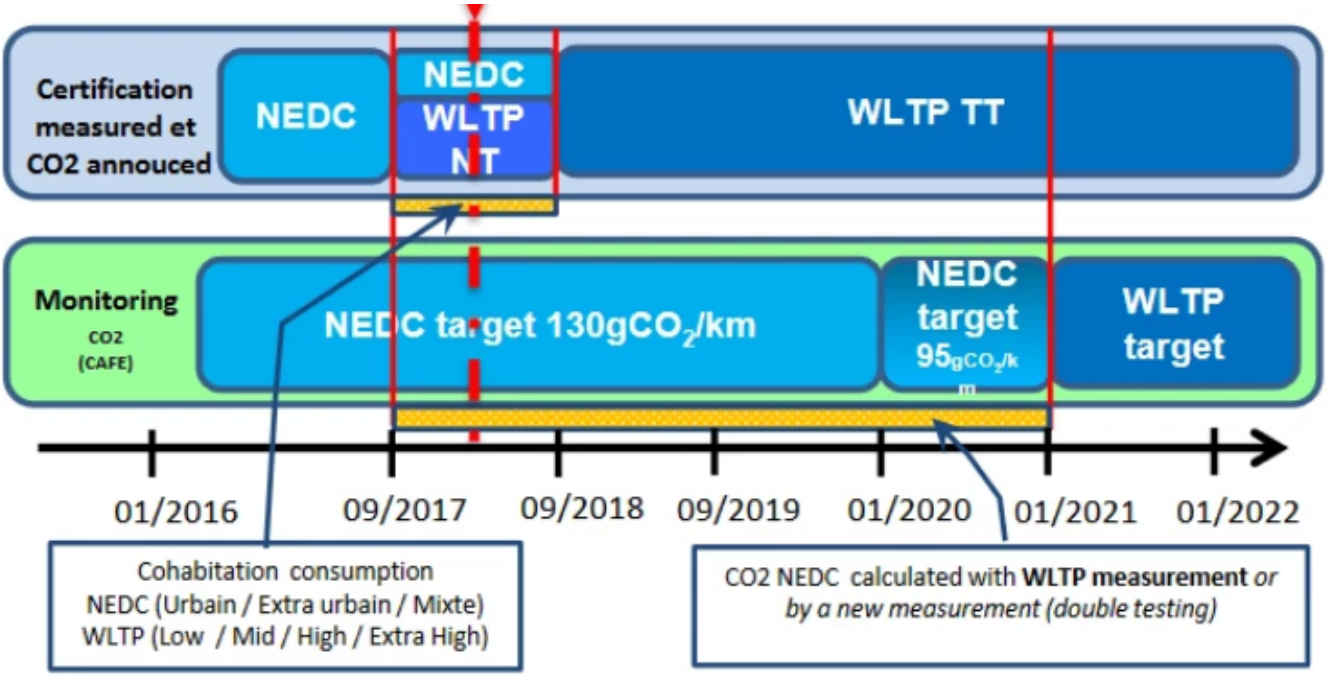
- Which vehicle characteristics show a significant influence on the vehicles CO_2 emission?
- How can OEMs (car manufacturers) reduce their fleet emissions?
- When is the best time to buy an electrified vehicle in europe?

All these questions must be answered against the background of the new legislation (WLTP, Euro 6d-temp und RDE), which will demand a lot from vehicle manufacturers in the future.



Since real-world measurements of CO2 emissions and manufacturer specifications are diverging more and more, a new test cycle (**W**orld Harmonisedd **L**ight Vehicle **T**est **P**rocedure) was implemented.

This requires vehicle manufacturers to achieve an average fleet CO2 emissions of a **maximum of 95 g/km** from 2020:

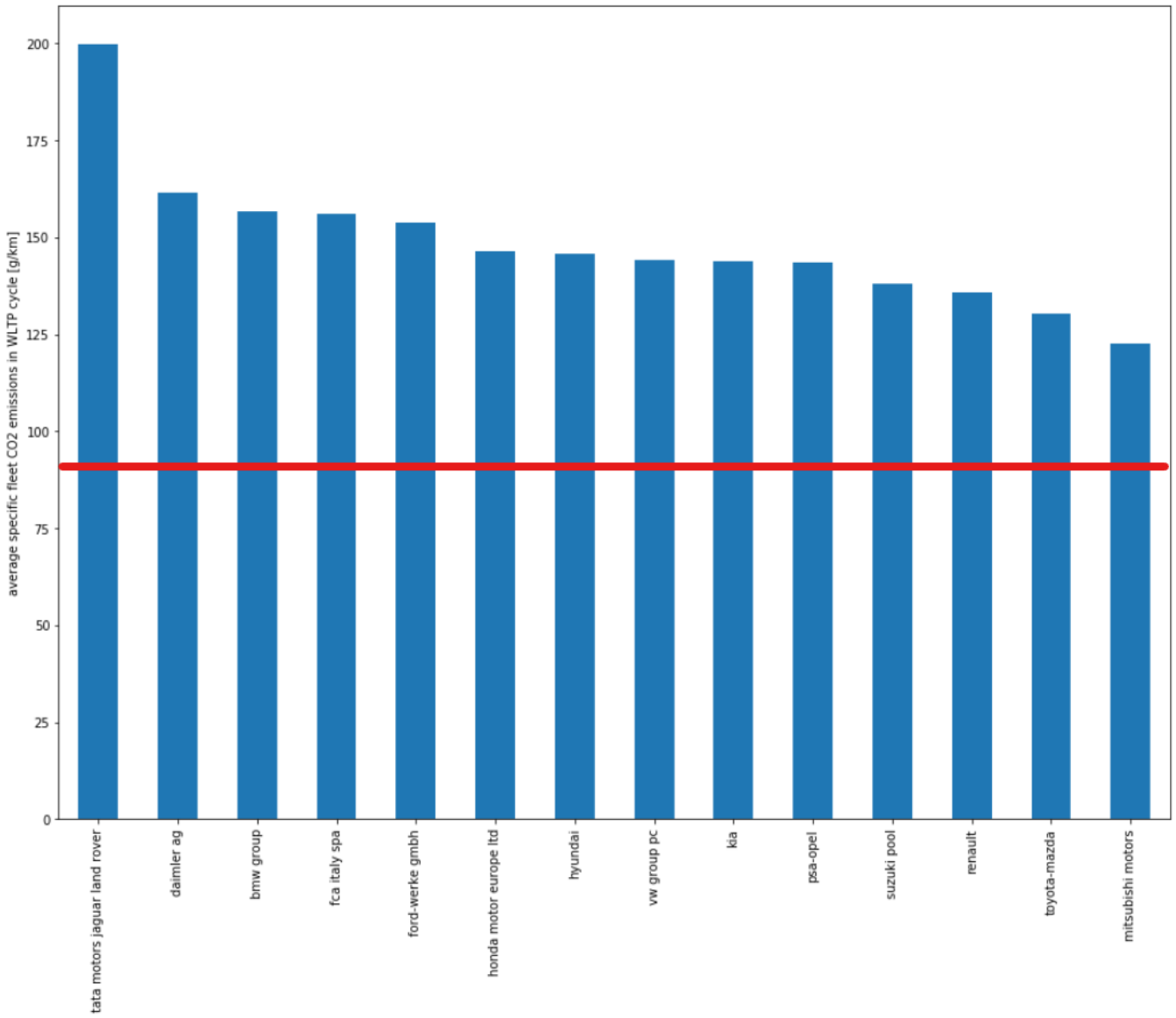


Lets see how this was working out in 2018 by taking a look into the most recent validated data base.

How are the OEMs doing so far

The list below shows average characteristics for the major passenger car grops in europe sorted by the number of registrations in the year 2018:

	average specific fleet CO2 emissions in WLTP cycle [g/km]	average engine power specific CO2 emissions (WLTP) [g/km/kW]	number of recorded vehicle registrations
mitsubishi motors	122.488560	1.659059	25174
honda motor europe ltd	146.286312	1.394457	32021
suzuki pool	138.151129	1.769621	37564
tata motors jaguar land rover	199.710065	1.306529	52360
kia	143.698190	1.807348	102505
hyundai	145.702105	1.836103	133302
fca italy spa	155.945275	2.342156	171273
daimler ag	161.661135	1.397090	302719
ford-werke gmbh	153.882023	1.762048	327080
toyota-mazda	130.201762	1.757771	362224
renault	135.651362	2.000545	369007
bmw group	156.822969	1.284032	443415
vw group pc	144.018787	1.592527	623662
psa-opel	143.497599	1.796200	765088



The most vehicles registered in 2018 were built by the Volkswagen Group and Groupe PSA. Not a single OEM has managed to stay below 95 g/km.

What can OEMs do?

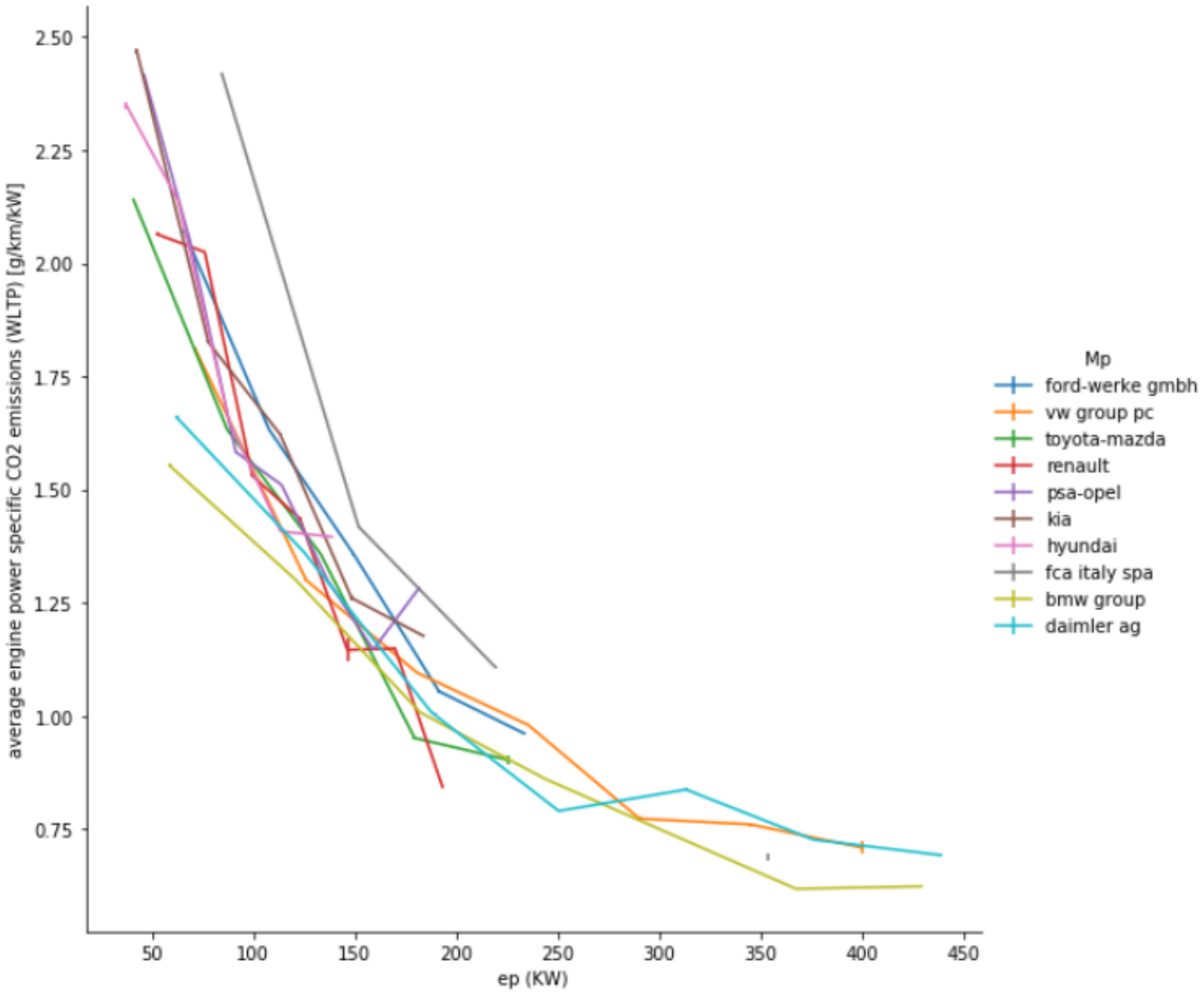
This raises the question of how this can be resolved. So lets have a look at the different power train (PT) concepts and its CO2 emissions:

	average specific fleet CO2 emissions in WLTP cycle [g/km]	average engine power specific CO2 emissions (WLTP) [g/km/kW]	average nominal engine power [kW]	vehicle mass [kg]	number of recorded vehicle registrations
electric	0.000000	0.000000	84.842003	1563.043798	79849
hydrogen	0.000000	0.000000	60.793103	1924.172414	29
petrol/electric	61.733652	0.521861	142.443681	1900.970299	40571
diesel/electric	76.891892	0.557386	133.459459	2011.351351	37
natural gas	131.915749	2.171364	61.551746	1217.085648	6445
lpg	143.589975	2.359243	62.751719	1164.652012	92509
petrol	147.232399	1.867693	85.867194	1269.689023	2489628

diesel	158.074297	1.485399	111.390794	1607.966610	1378580

We can see the CO2 emissions for different PT concepts sorted by average CO2 emissions in WLTP cycle.

Wait a second….Hasn't diesel always been certified as emitting less CO2 compared to petrol? If you look at the average nominal power of the diesel power trains, you can see that diesel cars are usually heavier compared to petrol cars and hence need a more powerful PT. To compensate for this it might be expedient to look at the engine power specific CO2 emissions. This value is smaller compared to petrol engines. The engine power specific CO2 emissions might not be relevant for the EUs legal requirements, but from an engineering perspective this value represents the technical maturity of a internal combustion concept.



Looking at this characteristic vs. the average nominal engine power shows almost equal representations for all OEMs. There are three phenomena we should highlight in greater detail:

- the german car makers are creating more powerfull engines (up to almost 450 kW)
- Daimler and BMW show relatively low CO2 emissions in their low power engines (50 to 100 kW)
- FCA shows the highest engine power specific CO2 emissions (at 100 kW almost 40% higher than other OEMs)

The latter aspect has led to very interesting synergies (Fiat Chrysler pools fleet with Tesla to avoid EU emissions fines).

The most important take away from the upper table is however the zero CO2 emissions from fully electric and hydrogen concepts.

From an engineering perspective it might be highly debatable whether there are no CO2 emissions connected to electric or hydrogen vehicles (well-to-wheel). From the EU legal perspective however we are dealing with zero-emission vehicles.

What immediately catches the eye is that the concepts with the highest CO2 emissions are the ones most frequently bought.

This, together with the high current emissions, means that OEMs are now forced to bring large quantities of electrified vehicles onto the market in order to reduce fleet emissions accordingly.

What does this mean for us as customers?

If you are considering buying an electrified vehicle in Europe, you may want to wait until the end of 2020. At this time, many manufacturers will be forced to bring more electric vehicles onto the market via probably unprecedented low-cost offers.

Let's wait and see and be surprised.