The evolution of car power, weight and top speed during the last twenty years in Belgium: a consideration for future policies

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Abstract

Traffic is one of the main causes of the most serious environmental problems worldwide. Accidents, photochemical air pollution, climate change, air quality and noise levels are some of these factors. The challenge of today is how to reduce these negatives effects in the coming years. As "sustainable development" and "sustainable consumption" are getting more important or even becoming preconditions for a better environment, the tendencies within road traffic can be labeled as "unsustainable," i.e. the number of vehicles is still rising and consumption of oil and contribution to CO_2 emissions remain high. Kroon (1998) suggests that only a forced decline in the average fuel consumption per km of at least 50% between 1998 and 2010 will have an effect on reducing CO_2 and other emissions. In the opinion of Kroon (1998) this was denoted as a feasible target if technical vehicle improvements were geared more towards fuel efficiency instead of upgrading power, performance and weight and if, at the same time, driver behavior could be guided towards fuel efficiency and away from speeding and strong acceleration. Within the last decade, it is still noted that the trend for more powerful engines and higher performance still exists and that the policy of car manufactures to counter the problem is scantily made. These powerful vehicles will also influence road safety and feelings of security and safety of other road users. Accidents and fatalities will increase when speed levels increase, but also the weight and size of vehicles can effect the security of drivers and other road users.
For several years, the Institute of Sustainable Mobility conducts studies on the evolution of weight, engine power and speeds of the sold vehicles in Belgium. The first results of 2007

indicate that there is still an increase in power, weight and speed. In this paper the results and the problem of bigger cars will be described on different levels.

KEY WORDS: top speed, power, weight, road safety.

1 Research method and data

In 2009 De Mol et al. (2009) conducted a study on the evolution of weight, engine power and speed of the sold vehicles in Belgium. Data provided by the Belgian Vehicle Registration Service (DIV) was used and contained information of the sold new vehicles in 2007 on car brand, model, cylinder capacity (cc), Power to weight (kW), weight, top speed, CO_2 emission (g/km) and fuel consumption. From this data, 500 847 (98,5 %) of the 508 499 new sold vehicles were retained. Within this segment different types of car models were found. Only the 30 most sold car models -283 095 (56,52 % of the 500 847 cars) - were retained. Not only to exclude rare or exclusive models but also to investigate only the car models which could have an important impact on the market. These 30 car models are analysed in detail.
A comparison with the data of 1983, 1993, 1999, 2004 and 2007 give the evolution of period of 24 years.

Within these models different **types** of vehicles can be found (different power, weight, design, options, etc.). To get a detailed insight –within a model as Volkswagen Golf, there are a lot of different versions (power: 13, weight: more than 30, top speed: 33, CO_2 emission: 44, average consumption: 34)- three categories of car model types are analysed: the standard version (SV), top version (TV) and best-sold type of model (BSM) as seen in table 1. The standard version is the lowest type within the model with the most basic engine and options. The top version is the highest type with the most powerful engine and full options. The best-sold model is the type within the model, which is bought the most. In table 1 the average power, top speed, weight CO_2 emissions and consumption of these versions is also given. This average is based on all the sold types (N) in one model c.q. version.

The power, weight, top speed, CO_2 emissions and the average consumption of the different versions are analysed. The power to weight, weight and top speed were analysed for each type of model. In a first analysis the tendencies over time are given and in the second analysis the different models are compared within the same type of model. These results are related to road safety, fuel consumption, emissions and consumer behaviour.

Table 1: Power, top speed, weight, emissions and consumption of the 30 most sold cars in Belgium in 2007

MODEL	#	POWER			TOPSSPEED			WEIGHT			CO_2-EMISSIONS			AVERAGE CONSUMPTION (in cl)		
		STD	**BEST**	**TOP**	**STD**	**BEST**	**TOP**	**STD**	**BEST**	**TOP**	**STD**	**BEST**	**TOP**	**STD**	**BEST**	**TOP**
RENAULT MEGANE	19270	63	78	169	167	178	236	1245	1465	1730	120	138	209	450	520	880
PEUGEOT 207	16728	50	50	128	166	166	220	1238	1286	1518	120	120	173	450	450	720
VOLKSWAGEN GOLF	15997	55	77	184	164	176	250	1253	1351	1445	119	132	255	450	500	1070
OPEL ASTRA	14249	66	66	177	172	172	244	1235	1405	1638	130	130	228	480	510	950
CITROEN C4	13574	65	80	130	180	182	227	1281	1630	1750	120	155	211	450	590	890
OPEL CORSA	13043	44	55	141	150	163	225	1005	1260	1345	115	124	190	430	460	790
BMW 3	12804	90	110	225	204	206	250	1420	1530	1865	123	150	245	470	560	1020
VOLKSWAGEN POLO	12697	40	51	110	152	164	216	1113	1189	1249	102	119	186	400	450	780
FORD FOCUS	12171	59	85	166	164	190	241	1252	1490	1633	114	124	224	430	470	930
RENAULT CLIO	11591	43	50	145	157	162	215	1015	1265	1360	115	123	209	430	460	890
CITROEN C3	11058	44	50	80	153	165	190	1110	1148	1305	113	115	172	430	440	720
PEUGEOT 307	10975	55	66	130	150	174	221	1258	1331	1678	126	134	200	480	510	840
AUDI A4	9476	75	85	253	186	197	250	1400	1550	1845	144	154	322	500	580	1340
FORD FIESTA	8069	44	50	110	151	164	208	1120	1163	1190	116	119	179	440	450	740
VOLKSWAGEN PASSAT	7942	75	77	184	185	185	246	1443	1577	1627	136	153	233	500	580	980
OPEL ZAFIRA	7781	69	74	177	165	174	231	1528	1638	1690	138	162	230	600	600	960
TOYOTA COROLLA	7757	66	66	130	170	180	205	1115	1205	1700	125	128	195	470	480	830
AUDI A6	7019	100	100	320	199	201	250	1620	1710	2070	160	163	319	600	620	1340
CITROEN BERLINGO	6834	51	55	80	142	150	170	1297	1340	1369	140	143	181	530	540	750
TOYOTA YARIS	6648	51	66	98	155	175	194	980	1055	1250	119	141	170	450	450	650
CITROEN XSARA	6352	66	66	100	175	175	192	1368	1390	1426	135	135	205	510	510	860
AUDI A3	6316	75	77	195	183	187	250	1305	1435	1665	119	135	250	450	510	1050
MERCEDES C	5928	90	120	200	197	226	250	1490	1630	1785	149	177	243	570	610	1020
OPEL MERIVA	5801	55	55	92	157	157	190	1355	1418	1485	135	135	190	500	500	790
BMW 5	5698	110	120	270	213	217	250	1560	1610	1880	136	158	276	510	590	1150
PEUGEOT PARTNER	5648	55	55	80	150	150	170	1288	1340	1369	140	143	177	530	540	750
VOLKSWAGEN TOURAN	5507	66	77	125	171	179	214	1527	1598	1768	156	156	193	590	590	810
PEUGEOT 206	5489	44	50	80	158	168	196	1010	1050	1310	112	112	179	430	430	750
FIAT PUNTO	5358	44	55	96	155	165	200	960	1205	1320	116	123	154	440	470	610
PEUGEOT 407	5315	80	100	155	189	192	243	1500	1530	1877	140	140	242	530	530	1020
Average		**63**	**72**	**151**	**169**	**178**	**221**	**1276**	**1393**	**1571**	**128**	**138**	**215**	**483**	**517**	**877**

STD= Standard version
BEST= Best sold version
TOP= Top version

2 “Big is beautiful?”

2.1 Weight and Size

Large, heavy cars consume more fuel than small, lighter ones. Heavier vehicles require a higher power output for the same performance, especially when accelerating and under urban driving conditions (Kroon, 1998). A higher power output requires more fuel consumption that will influence the amount of $C0_2$ emissions. Van den Brink and Van Wee (2001) already asked the question why fuel consumption is not decreasing since 1990. The main reason for higher fuel consumption is the vehicle weight and the engine capacity. The difference between real-world specific fuel consumption and the specific fuel consumption measured in the Eurotest –mentioned by Van den Brink and Van Wee (2001)- is due to the lack of good numbers about the real-world consumption and this is not taken in account.

Within a context of “sustainable mobility” a policy of building and promoting smaller and fuel efficient cars should be the guideline but even the Dutch consumer organization noted that cars are getting higher, longer, broader; for example: between 1976 and 1990 a Volkswagen Polo weight increased with 43 %, the length, with 11%, the breadth with 5,8% and height with 8,9%. Between 1976 and 2004 the Volkswagen Golf increased with 52% in weight, 13,2% in length, 9,3% in breadth and 5,6% in height. MuConsult (2004) ascertained that between 1996 and 2003 a constant tendency to “bigger” cars, as best sold cars was noted. The main findings are summarized in table 2.

Table 2: Average annual observed and technical developments for the period 1996-2003

periode 1996 – 2003

	Totaal		Benzine		Diesel	
Kenmerk	Waar-genomen	Tech. Ontw.*	Waar-genomen	Tech. Ontw.*	Waar-genomen	Tech. Ontw.*
Lengte	0,1%	–	-0,2%	–	0,3%	–
Breedte	0,3%	–	0,2%	–	0,3%	–
Oppervlak (m^2)	0,4%	–	0,2%	–	0,6%	–
Verbruik	-1,0%	-1,3%	-0,9%	-0,9%	-0,9%	-1,5%
Gewicht	1,7%	1,2%	1,4%	1,2%	1,9%	1,2%
Vermogen	2,5%	1,9%	2,0%	1,9%	4,4%	3,3%
Cilinderinhoud	0,6%	0,1%	0,3%	0,1%	0,6%	0,1%
Hoogte	0,9%	0,9%	1,0%	0,9%	0,8%	0,6%
Maximumsnelheid	0,5%	0,3%	0,4%	0,2%	0,8%	0,6%
CO_2	-1,0%	-1,3%	-0,9%	-1,1%	-1,0%	-1,6%
Geluid	-0,1%	-0,1%	0,0%	0,0%	-0,2%	-0,2%

*: Ontwikkeling gecorrigeerd voor verschuivingen in grootteklasse

Source: MuConsult, 2004.

2.2 Evolution in time of Speed and Power

Excessive speed is direct or indirect responsible for the cause of accidents and the level of impact. Finch et al. (1994) noted that reducing speed with 1 km/h could lead to a 3% less accidents risk. Accident frequencies and fatality rates increase more than proportionally when speed levels increase (Elvik, 2004), especially when certain speed limit is exceeded. Passive safety features (such as crush zones) are most effective at lower speeds that triggered their design. Inappropriate speed is responsible for one-third of the accidents resulting in vehicle occupant fatalities (ETSC, 1995). Speed reduction is not only to the benefit of road safety but can also leads to a reduction of fuel consumption and CO_2 emissions (Kroon, 1998; Auto Bild, 2006).

Cylinder capacity, maximum power, acceleration capacity, top speed, and, above all, the specific power rating (kW/kg) are most significant indicators for fuel consumption and CO_2 emissions. The largest engines and the highest power and performance ratings tend to be found in the heaviest vehicles. High-powered (petrol) cars consume more fuel - all other things being equal - than those with smaller powered engines (Sorell, 1992). It can also be noted that with a speed above about 60 - 70 km/hour, fuel consumption, CO_2 emissions and NO_x emissions increase. Depending on the mode of transport the increase of emissions begins to rise faster when the speed is above about 80 km/hour in the case of freight vehicles and about 100 km/hour in the case of private cars.

On average, a modern 1,100 kg car requires a power output of less than 30 kW to travel at 120 km/hour. *Technologically, engine and performance downsizing is not a problem. The motor industry is quite capable of designing vehicles, which meet modern safety and comfort requirements while being extremely economical in terms of fuel consumption (3 litres/100 km)* (Kroon, 1998). Although new vehicles become steadily more efficient, these efficiency gains however have been offset by increases in average vehicle weight (OECD, 2001).

2.2.1. Evolution in Weight of cars (1983-2007)

The effect of more weight has an import effect on fuel consumption. *Large, heavy cars consume more fuel than small, lighter ones. Heavier vehicles require a higher power output for the same performance, especially when accelerating and under urban driving conditions* (Kroon, 1998). It is obvious that bigger cars don't match with the improvement of fuel efficiency: *Although in the 1990s, the pure technology effect itself was much reduced compared to the earlier period, the shift of consumer choice to bigger cars also obstructed the improvement of fuel efficiency in this period* (Kwon, 2006).

In Belgium the average weight of a car has increased with more than 41 % or 403 kg since 1993. Compared with the figures of 1999, car weight increased with 29 % or 311 kg. However, these figures are only related to the average mass of all cars (25). Van Brink and Van Wee (2001) analysed the weight of new cars (The Netherlands) and concluded that the weight of the average new passenger car between 1980 and 1997 increased by 190 kg (20 %). The weight of the top version (Belgium) increased with 65 kg or 4 % between 2004 and 2007, the weight of the standard version with 34 kg or 2,8 %. The tendency of increasing weight for a longer period -1993-2007- is confirmed in the recent period of 3 years (2004-2007).

2.2.2. Evolution Power to Weight

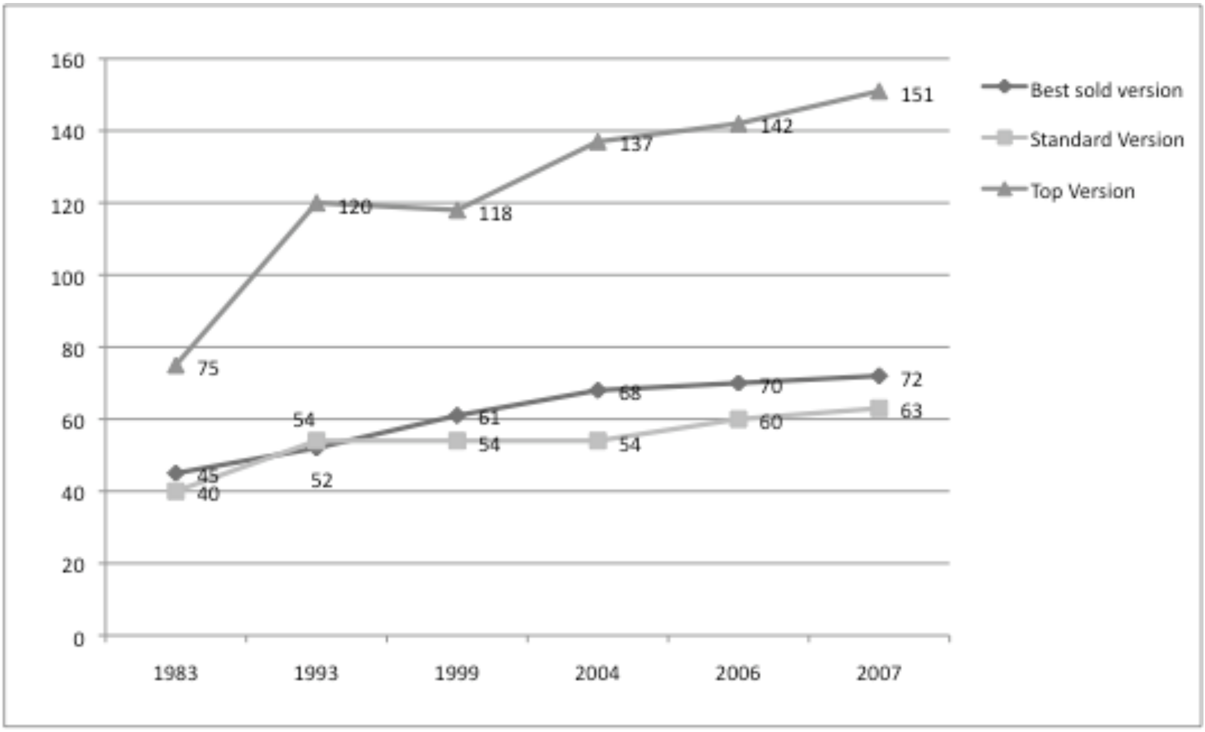
Increasing the weight and the power of motor vehicles increases the emissions and has an important impact on road safety. Reducing the power to weight-ratios of motor vehicles is one of most effective ways to reduce vehicle fuel consumption. Putting limits on maximum power to weight ratios could also produce significant safety benefits (OECD 2004).
In relation to passenger cars, analysis of collisions in France has shown that male drivers under age 30 were driving vehicles with higher power to weight ratios, and that they were involved in more severe collisions than young male drivers of lower performance

vehicles(Fontaine, 1994).

Power to weight ratios are important but within built up areas this alone will not solve all the speed related problems. Maximum vehicle speeds should be restricted to levels more consistent with highway and motorway speed limits (OECD, 2006).

In Belgium the Power to Weight ratio[1] is steadily increasing: for the best sold cars the P/W went from 40 in 1983 to 63 in 2007; this is a growth with 58 % (see Figure 1: Power to weight). The power to weight of the top version doubled in 24 years from 75 to 151 (201 %).

Figure 1: Power to weight (1983-2007)



Note: The P/W is multiplied with 100.

The CEMT (2003) reported that: *The average weight of cars has also grown steadily throughout the period, though at a slightly lower rate than for power. The power to weight ratio has therefore shown a continuous gradual increase* (see Figure 2). Reducing the power-to-weight ratio of motor vehicles would be one of the most effective ways available to reduce vehicle fuel consumption, whatever the technology of the engine. It would have immediate benefits on both local pollutants and global emissions as new, more fuel-efficient cars would replace older vehicles with higher fuel consumption.
Also, lower power-to-weight ratio vehicles would contribute to lower emissions over the lifetime of the vehicle – by comparison with the higher power-to-weight vehicles that would otherwise have been purchased (OECD, 2004).

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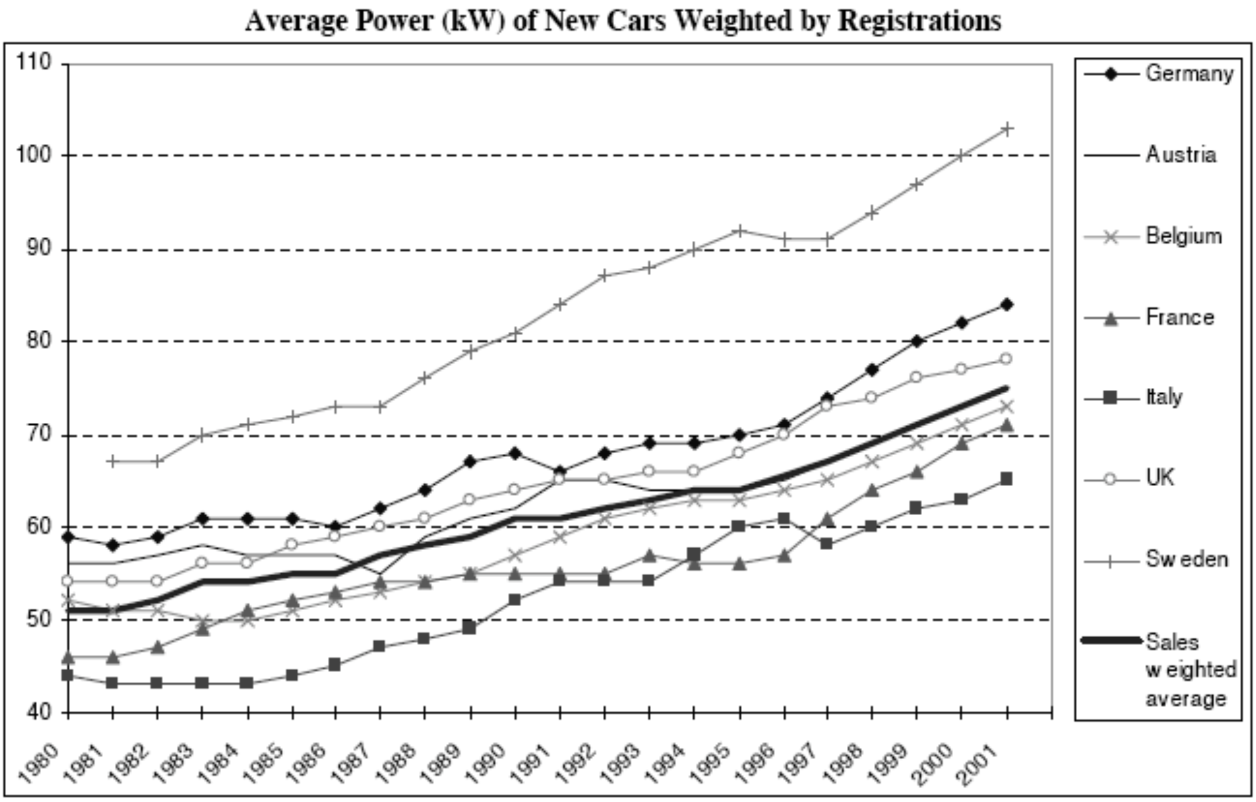
[1] Power to weight is expressed in 10^2

Figure 2: Average Power (kW) of New Cars Weighted by Registrations



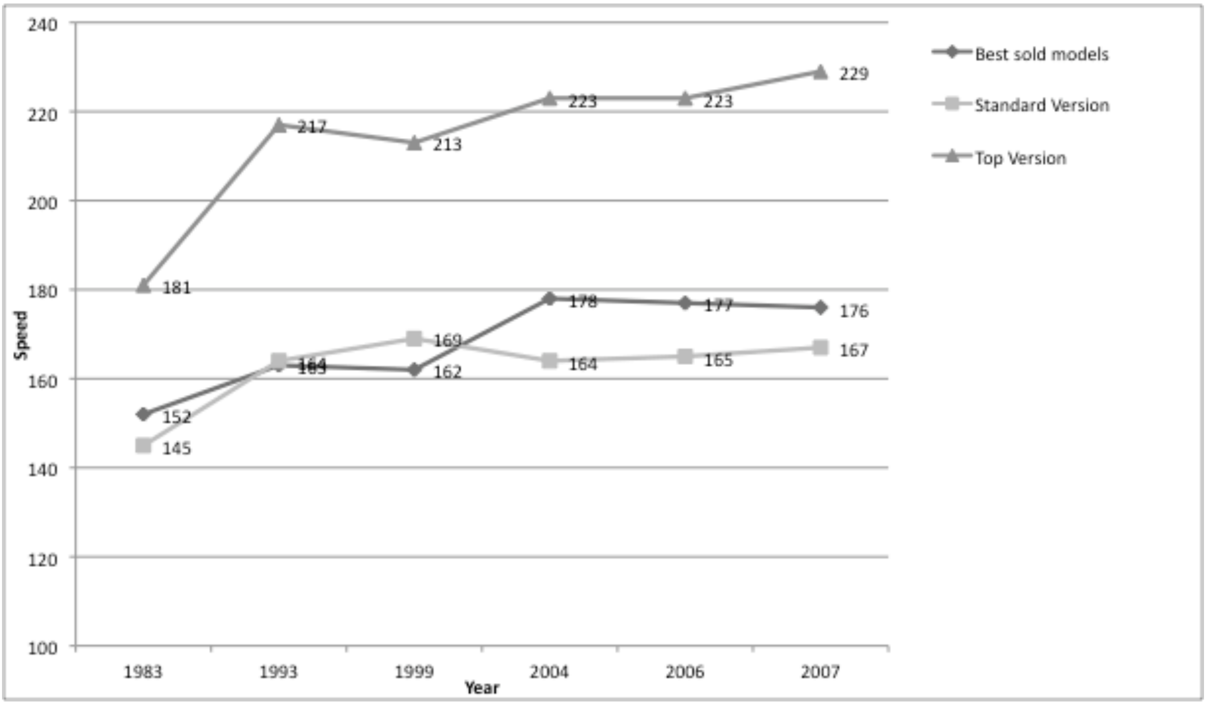
Source: ACEA/OICA/ECMT, 2003, drawn from AAA database for all manufacturers to 1997, figures extrapolated linearly to 2000, figures for ACEA cars only in 2001.

2.2.3. Evolution of top speed

The top speed of cars is an indicator of road safety and fuel consumption. Although a top speed doesn't mean that this top speed has to be used, the top speeds don't meet the maximum speed of 130 km/h in nearly every European country. Only on stretches of German highways (20 to 30 % of the German highways) there is no speed limit.
OECD en ECMT published figures of the over speeding on motorways. OECD and ECMT concluded, "*The extent of excessive speed, at least for the motorway network, is undoubtedly linked to increasing vehicle performance. In 2004, 99% of the new vehicles sold could reach 150 km/h or more, which for most countries is above the maximum authorised speed on motorways*" (OECD 2006).

Within the segment of the standard versions, the top speed in Belgium increased (1983-2007) with 22 km/h or 15 %. Within the segment of the best-sold cars the top speed increased with 16 % compared to 1983, and 7 % compared to 1999. The top speeds of the top versions have increased with 27 % the last twenty-four years. The average top speed (top versions) is 229 km/h. This means that this average speed meets the informal agreement that vehicle manufacturers would limit vehicles to maximum 230 or 250 km/h; the consequence is that manufacturers will cancel this agreement.

Figure 3: Top Speed (1983-2007)



2.2.4 Conclusion

Although policy makers aim at a reduction of road-accidents, high fuel consumption and emissions, the power to weight and speed increased dramatically. There is a lack of cars' efficiency if 35 % of the top speed of the best sold models, legally can't be used (maximum average speed of best sold cars of 2007 is 176 km/h and the maximum speed in most countries of Europe is 130 km/h). The comparison of the different version shows that speed and power to weight is still increasing. A more in-depth analysis of the segment of the sold cars (2007) in Belgium is performed in part 3.

3 Power, weight and speed in 2007

3.1 Standard version

Within the standard versions there is a significant difference of 70 kW in the amount of power between the highest (BMW: 110 kW) and lowest (Volkswagen Polo: 40 kW). Different brands offer vehicles with very high powers within the segment of standard versions: BMW: 110 kW, Audi A6 (100 kW), Mercedes C class (90 kW) en BMW 3 (90 KW). The average power of the 30 most sold models within the standard version is 63 kW.
The highest top speed within the analysed set of standard models is 213 km/h (BMW 5), while the lowest is 142 km/h (Citroën Berlingo); this is a difference of 63 %. The average top speed of the standard version is 178 km/h or 37 % above the maximum speed (130 km/h) in Europe.
The big difference in weight between the lightest (Fiat Punto 960 kg) and the heaviest (Audi A6 1620 kg) cannot only be explained by new vehicle safety requirements. Within the standard version the average weight is 1276 kg.

3.2 Best sold versions and top versions

The highest power within the best sold versions is 120 kW and the lowest is 50 kW; in the top speed of the best sold version, the highest is 226 km/h (Mercedes C) and the lowest is 150 Km/h (Peugeot Partner and Citroen Berlingo). 4 of the 30 models (best sold version) have a top speed above 200 km/h. The average top speed for the 30 best-sold cars is 178 km/h and an average power is 72 kW.

In the top version the highest power is the Audi A6 with 320 kW; the lowest is 80 kW (Citroen C3 and Citroen Berlingo; Peugeot Partner and 206); the average is 169 kW. If the average power of the standard versions is compared with the most sold models, one could conclude that consumers buy vehicles with a high power. The average power of the most sold cars is 72 kW. The reason why consumers choose these high-powered models is not clear: do they prefer these vehicles because of more power or are they "seduced" to choose these models because they prefer more (quality) options? It is well known that car-manufactures do not offer certain options (air-conditioning, cloth or leather seats or a CD player or satellite radio, satellite navigation, metallic paint, parking sensors …) within their segments of standard models, while in higher models some of these options are standard included or are a special offer.

Whether the consumer bought this car, only because of 'getting more power' is not known. Most standard versions don't include extra features: if the consumer wants to have certain options he has to pay more, while in higher models some of the options are standard or within an attractive package; this package can make the vehicle more favourable.

The highest top speed in the top version is 250 km/h (7 models); the lowest top speed is 170 km/h. The average power is 151 kW and the average top speed is 221 km/h. A lot of car constructors limit voluntary the maximum speed of their cars at 230 or 250 km/h.

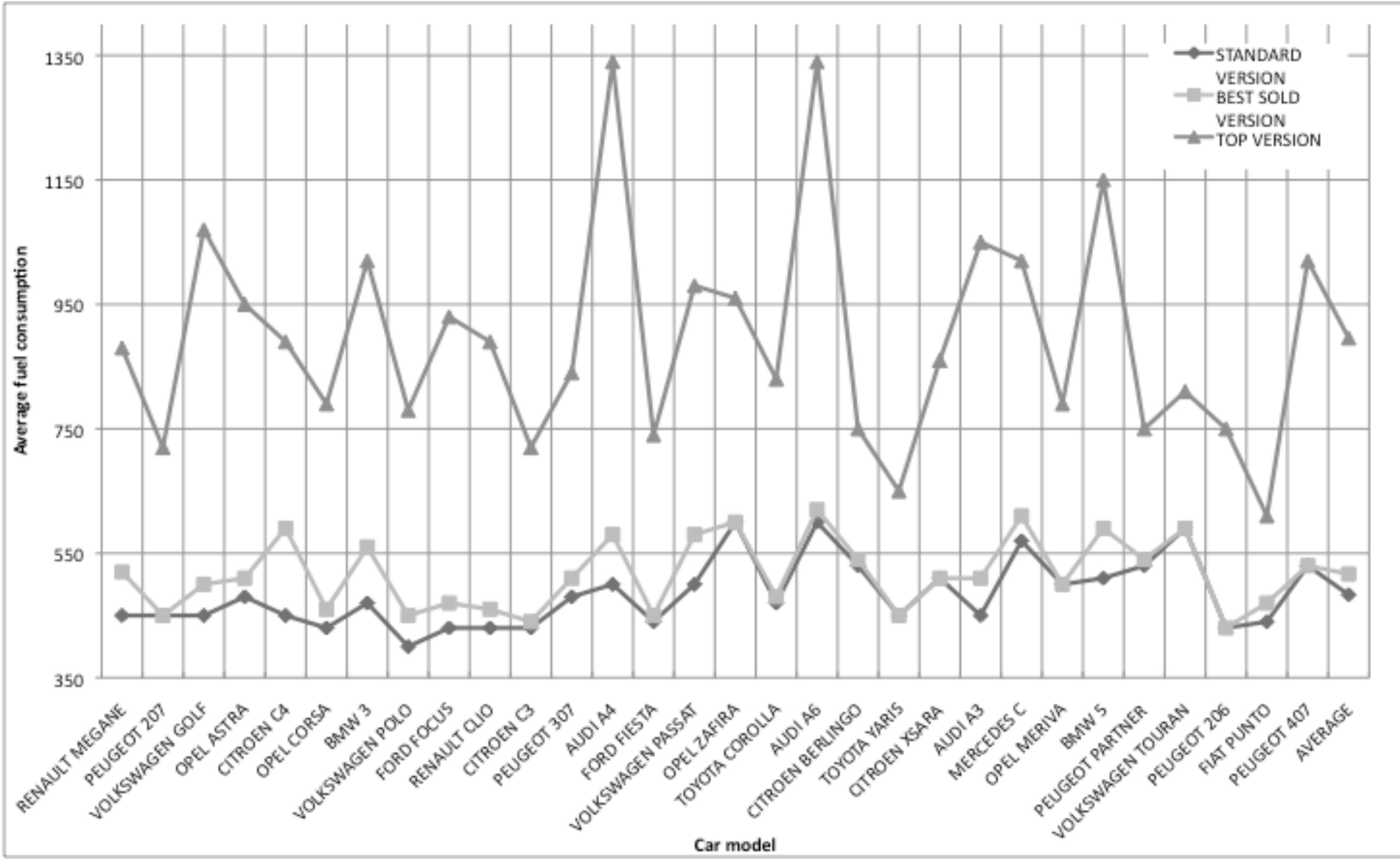
The lightest vehicle in the best sold version is the Peugeot 206 (1050 Kg) and it is 660 kg lighter than the heaviest vehicle (Audi A6 1710 kg). In the top version the difference between the lightest (Ford Fiesta 1190 kg) and the heaviest vehicle (Audi A6 2070 kg) is 880 kg. This difference is nearly the weight of the lowest vehicle (Fiat Punto 960 kg). The Fiat Punto has 4 stars (Euro NCAP) for safety of the driver/passengers but one can imagine what the result would be if a frontal accident with an Audi A6 (5 stars Euro NCAP) would occur.

4 Some impacts of being "obese"

4.1 The effect of weight, size and engine power on fuel consumption

The analysis was performed with the figures of the car-constructors as noted in the homologation documents of the vehicles. Other aspects like driving behaviour, the number of passengers, car accessories like air-conditioning, GPS, and traffic situations (high density, traffic jams,…) will influence the effective fuel consumption and emissions.

Figure 4: Fuel consumption (2007)



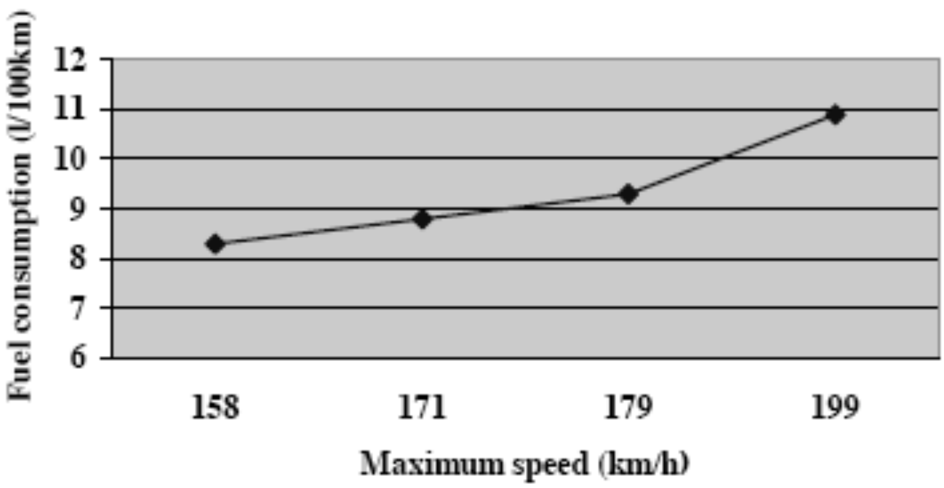
The average fuel consumption of the 30 vehicles in 2007 within the segment of standard version is 4,83 liters/100 km. For the best sold vehicle the average fuel consumption is 5,17 liters/100 km and for the top version 8,77 liters/100 km. It must be noted that the real fuel consumption would be higher. Therefore the question arises if it would be more realistic to relate the average fuel consumption to the weight of cars and more realistic driving statistics.

Kroon (1998) calculated that the fuel consumption of a private car – considered a vehicle of 1.000 kg under the same circumstances – will increase with 7% each time a vehicle get 100 kg heavier. If the weight of each vehicle should decrease with 300 kg, the fuel consumption of a same car fleet would be reduced with 21%.

According to Van den Brink and Van Wee (2001) the average new passenger car in 1997 would have been approximately 17% more fuel-efficient in the new Eurotest if it had had the same weight and the same engine size as the average new car

It is possible to reduce the weight of most European, Japanese or North American cars by at least 200-300 kg, using conventional and known technologies –without excessive cost, or lost of comfort or safety. If vehicles are lighter, it is also possible to reduce the power of the engines and reduce their fuel consumption rate by several litres of fuel per 100 km: *Car manufacturers frequently offer a range of engines, with varying power, acceleration and top speed characteristics for the same model. Increases in engine power usually lead to increased fuel consumption.* The relationship between maximum power and speed of the vehicle and its fuel consumption is demonstrated in Graph 5 for the Peugeot 206 (OECD, 2004).

Figure 5: Urban fuel consumption of the same model (Peugeot 206) as a function of the vehicle's maximum speed (models with 60, 75, 88 and 135 horsepower)



Kwon (2005) concluded that over the period 1979 – 2000, the fuel consumption rate of new petrol cars improved annually by 0.9% but if there was no change in the average engine capacity of vehicles, it could be improved annually by 1,1 %. As weight has his effect on fuel consumption, the design of (possible) more (fuel) efficient engines has resulted in increased engine power. Increasing of engine power could be associated with faster speeds and higher accident risks (Noland, 2005). It must be noted that the change in fuel consumption of vehicles can change due to the use of new technology or to a shift in consumer demand to different types.

4.2 The effect on Road Safety

In terms of safety, driving with a bigger vehicle will give a more secure feeling for the driver. As the design in most common cars has resolved in an improved level of safety (also in smaller vehicles), it is a basic assumption that larger and heavier vehicles will provide greater protection to the occupant in both single-vehicle crashes and multi-vehicle crashes than occupants of smaller (Evans, 2001; Noland, 2005; Elvik, 2004). For car-drivers, being in a vehicle that is higher, longer, broader and heavier may create an illusion of safety, but the fact is that these vehicle design attributes do not determine safety – neither for the driver of the vehicle nor for other road users.

Kim et al. (2006) also concluded that the probability of survival is most likely influenced by the physical characteristics of the vehicles involved in an accident and possibly by the characteristics and behaviour of driver and occupants. They also found that the probability of having an accident is most likely influenced by the driving behaviour and probably influenced by the vehicle's characteristics. Seating in a small vehicle reduces the probability of survival, while hitting a small vehicle increases the probability of survival.

The last years SUV's are getting more popular: These vehicles are marketed to consumers as a safe and solid alternative to the station wagon. The most recent analysis by the United States' National Highway Traffic Safety Administration (NHTSA, 2004) found that, in 2003, drivers and passengers in sport utility vehicles (SUVs) were 11% more likely to die in a car accident than people in cars. These SUV's are noted to have a higher rollover risk than standard vehicles.

Heavier vehicles can also influence the impact of accidents when vulnerable road users are involved. Roudsari et al. (2004) noted that the change in vehicle design and increase in the number of light truck vehicles (heavier vehicles, like SUV, pickups, etc.) have led to changes in pedestrian injury profile: through the analyse of 552 recorded cases where pedestrians are involved in car accidents, pedestrians had a higher risk of severe injuries when struck by heavier vehicles (29%) compared with passenger vehicles (18%). The risk of death when pedestrians were stroke by heavier vehicles was around 3 times higher than that for (normal) passenger vehicles.
Besides the weight, the use of more powerful cars and possibility to use higher speeds are a factor in many accidents. It has been estimated that in 25 to 30% of fatal accidents excessive speeds are involved (TRB, 1998).

The weight effect of safety measures is very low. They are only a few kilograms heavier and do not consume more fuel than their counterparts with safety scores: active and passive measures would seem to have improved automobile safety but is not heavier than usual steel (Zachariadis, 2008; Ahmad, 2005).

5 Conclusions and discussion

Within the last twenty years in Belgium, the power has increased as well within the segment of the standard cars, the most sold cars as within the top versions. Compared with 1983, the power to weight has increased with 58 %. The power to weight for the top version even doubled in 24 years from 75 to 151.

A better regulation and policy strategies are needed. The CEMT guidelines to create power ratio's can be considered as a proper base to tackle the problem.

The average weight of cars has increased between 1993-2007 within the segment of most sold cars with 41%. Car manufactures still have a long way to go before lighter vehicles will be constructed.

Although policy makers aim to reduce road-accidents, high fuel consumption and emissions, the power to weight and speed increased dramatically. There is a lack on efficiency of cars if 35% of the top speed of the best sold models, legally can't be used (maximum average speed of best sold cars of 2007 is 176 km/h and the maximum speed in most countries of Europe is 130 km/h).

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