Inputs to the GSR2
LISA Car: towards a limit to power, mass and speed for safer roads

1. Introduction

Within the framework of GSR2, three types of measures (three "layers" referring to the nomenclature proposed by TRL) are promoted/enhanced: driver assistance, active safety and passive safety measures. They are necessary but not sufficient to reach political targets in terms of road safety. Scientific literature shows a clear relationship between fundamental characteristics of the cars (their mass, power, top speed and "aggressiveness") on the one hand and the number and seriousness of the crashes in which they are involved on the other hand. Therefore, it would really make sense to integrate a fourth layer in the assessment conducted by TRL. This layer should be put first: before providing assistance to the driver, avoiding collisions with active safety measures and limiting the damages by the means of passive safety measures, it is necessary to build and sell cars that are safer "by themselves".

25 years ago, the ECMT called for actions in the regulatory sphere to address the problem of the ever-increasing power and speed of cars.

Today, the Belgian federation Inter-Environnement Wallonie (IEW) and the association Parents of road victim children (OVK-PEVR), with the support of the European Federation of Road Victims (FEVR), ask the Commission to respond to the still-unanswered political call of ECMT by fixing clear limits to the mass, the power, the top speed of cars and to the aggressiveness of their front face. That is the aim of the LISA Car project (Light and Safe Cars), which will furthermore reduce both road transport CO_2 emissions and energy consumption.

2. 25 years ago : an unanswered political call

In 1991, The Council of the European Conference of Ministers of Transport (ECMT) adopted a resolution on the power and speed of vehicles:

> "*The Council of Ministers of Transport, meeting in Paris on 21st November 1991,*
>
> *Agrees:*
>
> - *That the continuous increase in the power of vehicles (cars and heavy goods vehicles) is undesirable and unacceptable for safety, environmental and energy conservation reasons;*
> - *That a range of actions is needed to halt and reverse the observed trends*."[1]

In its "Cover note", ECMT indicated that:

> "*In all ECMT countries except Germany, speed limits of at most 130 km/h are in use.* ***There is no need for speed reserves substantially in excess of this****. Yet the top speed of a modern saloon car is frequently almost 200 km/h and for some models is up to 250 km/h. The resources used to design cars, including all their components and parts, for such speeds could be more appropriately used to provide cleaner, safer and more fuel efficient cars*."
>
> "*By limiting power and potential speed, safety, environmental and fuel economy benefits can be obtained. The Resolution gives a clear political indication from Governments that* ***ever-increasing power and speed are unacceptable****. The Hearing with manufacturers made it clear that* ***manufacturers are not able to resist competitive demands and market pressures in this area and, therefore, support from Government is needed****. To halt the growth in vehicle power and potential speed it is believed that actions are needed in the regulatory sphere, in the economic sphere and in relation to the advertising of, and information about vehicles. The Resolution makes recommendations to Governments in all of these areas*."[2]

20 years later, in 2011, The French Parliament (Assemblée Nationale) adopted an "information report" on the analysis of the causes of road accidents and on road safety policies. The tenth (out of 39) proposal was entitled: "Mettre chacun devant ses responsabilités en matière de vitesse".

> *(translation) "****There is a collective hypocrisy concerning speed****. Everybody agrees that speed is a major cause of road accidents, but vehicles that are sold enable driving at largely faster speed than allowed. An end must be put to this situation: either speed is effectively a major cause of road accidents, and a root approach is needed (limiting top speed of vehicles), or this is not the case, and then the drivers that do not respect the speed limits cannot be punished.*
>
> *Whatever the case, it is difficult to understand that respecting speed limits is the sole responsibility of the drivers while they have access to vehicles that allow them to drive largely faster. On the other hand, public authorities dedicate huge amounts of money*

[1] ECMT (1991), Resolution N° 91/5 on the power and speed of vehicles
[2] ECMT (1991b), Cover note on the power and speed of vehicles [CEMT/CM(91)28/Final]

(radars, R&D on ISA, …) to try to reduce the effective speed of vehicles that are designed to drive at high speeds, in a context where speed is also a factor of increased GHG emissions. The hypocrisy of the situation is patent and would need to be discussed at a European level, this kind of problem being impossible to solve at the level of one country."[3]

3. Power, mass and speed are linked

In 2008, ETSC stated that « *It is clear that* ***vehicle size, weight and engine power all have an impact on road safety and should be considered together****. Cutting weight alone for example, with other vehicle characteristics remaining unchanged, increases a vehicle's acceleration and top speed performance and consequently does not improve safety. Reduced speed capability is not inherent in downsizing. One then should consider vehicle downsizing in terms of a philosophy of designing vehicles that integrates many parameters, including engine power, vehicle weight, size, and other design characteristics including the protection of occupants and pedestrians*. »[4]

Why do car manufacturers steadily increase cars power? Let alone the commercial reasons (notably related to human psychology), high power is needed if one wants heavy vehicles to move at high speeds with great acceleration capabilities.

In France, in 2005, the citizen car project[5] was conducted by a large panel of experts. They identified a clear relationship between the formula that insurance companies use to calculate the third party liability premiums on the one hand and the maximum kinetic energy (one half of mass multiplied by the square of top speed) on the other hand. On the **figure 1** below, "groupe SRA" means the segmentation groups of vehicles used by SRA (Sécurité et Réparation Automobile): **the segmentation groups used for the third party liability insurances are intimately correlated to the maximum kinetic energy of the vehicles**.

[3] Assemblée nationale, 2011, Rapport d'information fait en application de l'article 145 du Règlement au nom de la Mission d'information relative à l'analyse des causes des accidents de la circulation et à la prévention routière, Tome I : rapport et annexes, p. 179

[4] ETCS, 2008, Downsizing and speed: Towards a new philosophy of designing cars?, Speed Fact Sheet n°03/08, p. 2

[5] http://violenceroutiere.org/vc/

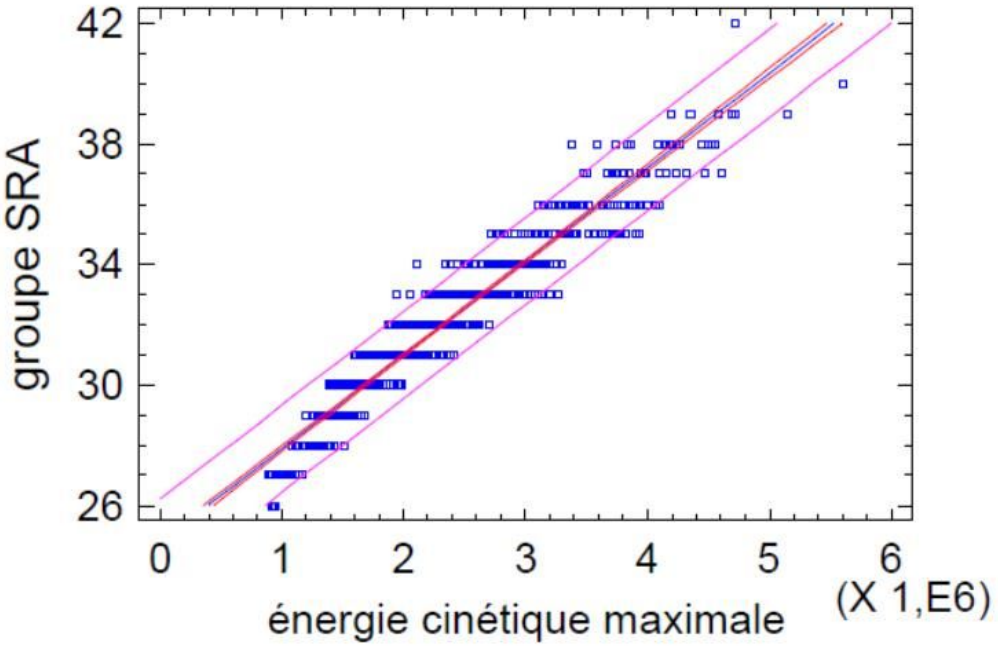

Figure 1: Relationship between the maximum kinetic energy and the segmentation groups used by SRA

There is also a clear relationship between the power and the maximum kinetic energy, as illustrated on **figure 2** established by IEW on the basis of 79 cars (from Fiat 500 to Range Rover 5.0 V8).

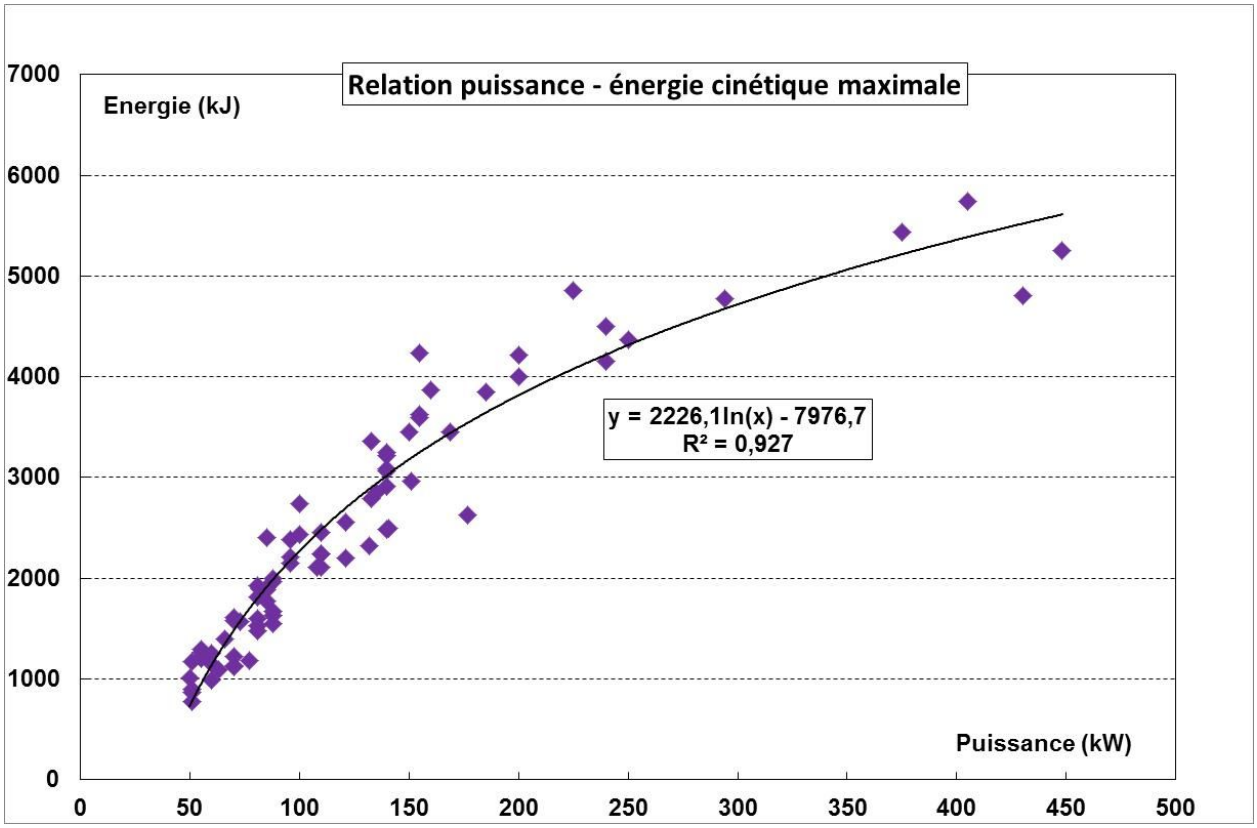

Figure 2: relationship between the mechanical power and the maximum kinetic energy

4. A more powerful car is more dangerous for third parties, according to insurers

As revealed by the citizen car project, insurance companies are particularly concerned by the influence of the cars characteristics on damages to third parties. The mechanical power of the cars is an important segmentation criterion for the calculation of the amount of the third-party liability insurance. Just a few examples in Belgium:

- Touring says that the segmentation criteria include "*the power, the make and the "sporting character" or not*". Touring underlines those criteria were chosen "*on basis of our professional experience and our statistical models. These show that the number and/or the seriousness of the accidents have a direct link with these criteria*." [6]
- FIDEA underlines that "*the mechanical power of the vehicle determines, on the one hand, its maximal speed and, on the other hand, at which speed you can accelerate. Statistics notably show that faster and more powerful cars are more often involved in an accident than others and that these accidents are generally more serious. […] You'll face a lower risk of accident with serious consequences for third parties if you drive a small urban car than if you drive a 4WD*." [7]
- AXA states that "*the statistics establish that the more powerful a car, the higher the frequency and the seriousness of the accidents*." [8]
- Assuralia puts an emphasis on the power of the vehicle: "*the amount you will pay for you civic liability will greatly depend upon the power of your vehicle. Fast cars generate higher risks than small urban cars*." [9]
- Partner clearly makes the link between the vehicle and the behaviour: « *the characteristics of the vehicle (make, type, power, sporty character, body, …) make it possible to predict the behaviour of the driver and the potential dangerousness of the vehicle; both influencing the seriousness of the crashes*." [10]

5. Powerful, fast, heavy cars induce speeding, according to scientists

Speeding increases the risk of being involved in an accident:

> "*35% of those car drivers who had been penalised for speeding in the last 3 years reported also having been accident-involved, compared to 22% of those who had not been penalised, indicating that the kinds of drivers who have been recently caught for speeding are 59% more likely to have also been recently crash-involved. Speed kills and speeders crash*."[11]

[6] https://www.touring-assurances.be/auto/formules-assurance-auto/responsabilite-civile/, visited on Octobre, 21, 2016
[7] FIDEA, 2015, Critères de segmentation, assurance véhicule à moteur et protection juridique, p. 1
[8] AXA, 2016, Critères de segmentation RC voiture – camionnette.
[9] http://www.assuralia.be/index.php?id=194&L=1&tx_ttnews%5Btt_news%5D=1095, visited on October, 10, 2016
[10] Partner, 2015, Critères de segmentation – L'assurance responsabilité civile véhicules automoteurs
[11] Stephen Stradling, Michelle Meadows and Susan Beatty, Characteristics of speeding, violating and thrill-seeking drivers, In J.A.Rothengatter, R.D.Hugenin (Eds) Traffic and Transport Psychology. Oxford: Pergamon, 2002, p. 5

In case of an accident due to speeding, who is responsible? The car driver or the car manufacturer? According to scientific literature, the latter could be at least co-responsible.

If imprudent drivers tend to buy fast cars, powerful cars also induce speeding as demonstrated by Horswill et al.:

> *"We have demonstrated a robust relationship between vehicle performance and drivers' risk-taking behaviour using a number of different approaches. The relationship was found to hold even when other potentially confounding vehicle characteristics were controlled for. Results indicate that the causal mechanism behind the relationship is bi-directional , such that while drivers who take more risks choose faster cars, vehicle performance also influences drivers' risk-taking intentions."*[12]

SWOV underlines that modern cars features can induce unintentional speeding:

> *"The nowadays quiet and comfortable cars and particular road features can also unintentionally lead to higher speeds than desired*."[13]

Cars influence drivers' behaviour not only on highways:

> *"the drivers of higher performance vehicles chose to drive faster, even on a residential road with a low speed limit*."[14]

The increase in power and top speed is reducing the effectiveness of other measures:

> "*Cars are designed, built, marketed, and sold with a substantial emphasis on speed and power, and travel speed is glorified in television, film, printed media, and through motor sport (Johnston, 2004, 2005; Tranter & Lowes, 2005; Warn, Tranter, & Kingham, 2004). The increase in top speeds and acceleration has made it much easier to drive at inappropriately fast speeds, thus counteracting other vehicle safety improvements*. »[15]

The WHO underlines the difficulty to limit effective speeds on roads when cars can reach twice the posted limits:

> "*The problem of speeding has increased over the years since the maximum speed that new cars are capable of is, in many cases, double the existing speed limit in rural areas. Many modern cars now are easily capable of speeding, which was typically not the case when speed limits were first introduced. It is therefore more of a challenge to convince drivers to drive within posted speed limits*."[16]

Even the seating position can influence the driving behaviour, as underlined by SWOV:

> "*When a car driver is seated at a considerable height above the road surface, he underestimates his speed more often*."[17]

[12] Mark S. Horswill & Martin E. Coster, 2002, The effect of vehicle characteristics on drivers' risk-taking behaviour, Ergonomics, 45:2, 85-104, p. 102
[13] SWOV, 2006, Speed choice: the influence of human, vehicle and road, Fact sheet, p. 1
[14] Horswill et al., 2002, p. 89
[15] Murray M. et al., 2010, Towards a holistic framework for road safety, UNSW, p. 13
[16] WHO, 2008, Speed management, A road safety manual for decision-makers and practitioners, p. 8
[17] SWOV, 2006, Speed choice: the influence of human, vehicle and road, Fact sheet, p. 3

Other authors confirm these findings, notably Rakotonirainy et al. reporting the results of a study where people drove a sedan and a 4WD on the same trip in real conditions:

> "*These preliminary findings show a relationship between vehicle type and driver behaviour. The average speed of the 4WDs was slightly higher over all the trip for the majority of the drivers. […] Around the 90 degree, turn with the stop sign, most drivers again drove the 4WD faster. They decelerated later in the 4WD than in the sedan, in spite of the greater initial speed, which is of safety concern as the braking distance required to stop in a 4WD is substantially longer than for a sedan due to vehicle's weight. […] From a stopping position, all drivers accelerated faster in the 4WD than in the sedan. As for their deceleration behaviour, this has both safety implications linked to speed, and implications for fuel consumption and tyre wear*."[18]

The driver of heavy cars can also have other dangerous behaviours than speeding, notably the use of cell phones, as studied by Walker:

> "*Drivers of four wheel drive vehicles were four times more likely than drivers of other cars to be seen using hand held mobile phones*"[19]

Risky driving also implies a wide range of behaviours: race away from traffic lights, dangerous overtakes, …

> "*Drivers from higher social class, higher income households, living out-of-town and driving larger engined cars for high annual mileages as part of their work tended to score higher on most of these indices of risky driving. And all measures of risky driving used in this study showed an association with elevated crash involvement*."[20]

Hultkrantz argues that the mass remains a major concern*:*

> *"The literature shows that vehicle mass is a crucial factor behind how the injuries are distributed among the involved vehicles in a two-vehicle crash. A larger vehicle mass will protect the occupants in the vehicle while on the same time inflict a higher injury risk on the occupants in the collision partner."*[21]

The problem already existed 20 years ago, according to Kroone:

> "*In the case of fast cars, design features (such as character, performance, perfect active safety features, airbags and sophisticated crash testing) in conjunction with psychological factors, such as overestimation of one's own abilities and risk compensation, lead to a high*

[18] Rakotonirainy et al., 2006, Comparing driving behavior between 4WD and sedan vehicles: Preliminary results. In Proceedings Australasian Road Safety Research, Policing and Education Conference, Gold Coast – Australia, pp. 8-9

[19] L. Walker et al., 2006, Unsafe driving behaviour and four wheel drive vehicles: observational study, BMJ, published online 23 June 2006

[20] Stephen Stradling, Michelle Meadows and Susan Beatty, Characteristics of speeding, violating and thrill-seeking drivers, In J.A.Rothengatter, R.D.Hugenin (Eds) Traffic and Transport Psychology. Oxford: Pergamon, 2002, p. 1

[21] Hultkrantz L. et al., 2011, Accident cost, speed and vehicle mass externalities, and insurance, Discussion paper 2011-26, p. 20

level of active unsafety. Since the new car fleet average top speed is now up to 190 km/hour, this phenomenon is true for all cars except real minis."[22]

Nevertheless, the problem is not addressed by public authorities:

"*The extraordinary psychological effect of the speed and power which the car and motor-cycle give to their driver does not receive enough attention in traffic studies and transport policy.*"[23]

6. Downsizing : next step on the safety way

Road safety is stagnating in EU. The European Commission's current policy is to fit cars with more and more technology, hoping this will lead to new progress. Surely, driving assistance, active and passive safety systems will help decreasing the number of crashes, fatalities and (serious) injuries. But the progress will remain limited if the "mass-power-speed taboo" remains:

"*Limiting cars' top speed and engine power, in the light of existing speed limits, seems to be a sensible way of improving road safety. […] downsizing engine power as a means to lower the top speed of vehicles (as opposed to just fitting cars with speed limiters) might also have repercussions on how drivers behave on local urban and rural roads*."[24]

Downsizing is recommended by scientists all around the world:

"To the extent that cars are still used, a strong case can be made on road safety and environmental grounds for slower, smaller and lighter cars, in contrast with cars that are designed and marketed with an emphasis on speed and power.[25]

"*Within a context of "sustainable mobility" a policy of building and promoting smaller and fuel efficient cars should be the guideline.*[26].

"Hence, in the longer term, vehicles could be designed, possibly through the use of regulation, to 'cap' top speed capability. This would ensure that top speed is more closely related to the highest permitted speed limit and would help re-orientate vehicle design and re-appropriate the improvements in fuel efficiency which have so far been devoted to travelling further, faster, in heavier cars."[27]

[22] M. Kroon, 1998, Downsizing power and speed, the safe road to fuel economy, road safety and sustainability
[23] R. Diekstra et al., 2006, Cars and behaviour: psychological barriers to car restraint and sustainable urban transport, p. 11
[24] ETCS, 2008, Downsizing and speed: Towards a new philosophy of designing cars?, Speed Fact Sheet n°03/08, p. 3
[25] Murray M. et al., 2010, Towards a holistic framework for road safety, UNSW, p. 54
[26] De Mol J., et al., 2008, The evolution of car power, weight and top speed during the last twenty years in Belgium: a consideration for future policies, p. 5
[27] Anable J. et al., 2006, Getting the genius back in the bottle : Limiting speed to reduce carbon emissions and accelerate the shift to low carbon vehicles, p. 5

"*Downsizing vehicles should be regarded as a design philosophy geared towards the production of vehicles that fit customer needs while ensuring better safety of all road users (car occupants and pedestrians alike)*."[28]

7. To conclude

Dr Claude Got, expert in accidentology, has worked for decades to enhance road safety. He considers that "*It's not arguable having limited the top speed of motorized two wheelers and heavy vehicles for safety reasons and not having adopted the same approach for light duty vehicles which cause the greatest number of fatalities […] This is a huge failure of our civilization, a sign of barbary and of indifference to a suffering that one refuses he could face himself but accepts it can affect other people*."[29]

[28] ETCS, 2008, Downsizing and speed: Towards a new philosophy of designing cars?, Speed Fact Sheet n°03/08, p. 3
[29] C ; Got, 2011, Dommages liés aux véhicules, http://www.securite-routiere.org/