RANKING EU PROGRESS ON IMPROVING MOTORWAY SAFETY

PIN Flash Report 28

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European Transport Safety Council

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The PIN programme relies on panellists in the participating countries to provide data for their countries and to carry out quality assurance of the figures provided. This forms the basis for the PIN Flash report and other PIN publications. In addition, all PIN panellists are involved in the review process of the reports to ensure the accuracy and reliability of the findings.

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ABOUT THE EUROPEAN TRANSPORT SAFETY COUNCIL (ETSC)

ETSC is a Brussels-based independent non-profit organisation dedicated to reducing the numbers of deaths and injuries in transport in Europe. Founded in 1993, ETSC provides an impartial source of expert advice on transport safety matters to the European Commission, the European Parliament, and Member States. It maintains its independence through funding from a variety of sources including membership subscriptions, the European Commission, and public and private sector support.

ABOUT THE ROAD SAFETY PERFORMANCE INDEX PROJECT

ETSC's Road Safety Performance Index (PIN) programme was set up in 2006 as a response to the first road safety target set by the European Union to halve road deaths between 2001 and 2010. In 2010, the European Union renewed its commitment to reduce road deaths by 50% by 2020, compared to 2010 levels.

By comparing Member State performance, the PIN serves to identify and promote best practice and inspire the kind of political leadership needed to deliver a road transport system that is as safe as possible.

The PIN covers all relevant areas of road safety including road user behaviour, infrastructure and vehicles, as well as road safety policymaking. Each year ETSC publishes PIN 'Flash' reports on specific areas of road safety. A list of topics covered by the PIN programme can be found at www.etsc.eu/pin.

Ranking EU progress on improving motorway safety is the 28th PIN Flash report edition. The report covers 31 countries: the 27 Member States of the European Union (except Bulgaria) together with Israel, Norway, the Republic of Serbia and Switzerland.

CONTENTS

EXECUTIVE SUMMARY

Nearly 27,500 people have died on motorways in the EU in the last ten years.

Motorways are the safest roads by design and regulation (see Note below). Nevertheless in 2013, around 1,900 people were killed on the motorway network in the EU, representing 7% of all road deaths. Nearly 27,500 people have died on motorways in the EU in the last ten years 2004 to 2013.

Nevertheless progress has been made. Across the EU the number of people killed on motorways was cut by 49% between 2004 and 2013 (compared to 44% on the rest of the road network). Over the same period, the length of the motorway network increased by about a quarter.

Motorway users in Denmark, Great Britain, Sweden and the Netherlands experience a lower level of risk than users in the rest of Europe.

Lithuania, **Slovakia** and **Spain** top the ranking for annual reduction of deaths on motorways between 2004 and 2013 (Fig. 1). Motorway users in **Denmark**, **Great Britain**, **Sweden** and **The Netherlands** experience a lower level of risk than users in the rest of Europe (Fig. 2).

Progress in better than average countries is a result of a comprehensive mix of measures, including improved infrastructure safety and road user behaviour (such as better compliance with speed limits or increased seat belt use). Other factors, such as improved vehicle safety and changes in mobility patterns, play a role too but these are hard to quantify.

The European Commission is currently reviewing **Directive 2008/96 on Road Infrastructure Safety Management** (see Section 2.2) which sets road safety requirements for the EU's Trans-European Road Network (TERN). An upcoming evaluation carried out on behalf of the European Commission concludes that, although the direct benefits and costs are difficult to assess, the possible collision reduction effect of the implementation of the Directive is in the range of 10% to 20%. The main success has been the introduction of cost-effective Road Safety Audits. This has also been seen as an important step in the direction of a more systematic discipline as well as establishing a "common language" concerning infrastructure safety.

Much more benefit could be achieved by extending the principles of the Road Infrastructure Safety Management Directive to other parts of the road network.

ETSC supports the European Commission's recognition that much more benefit could be achieved by extending the principles of Directive 2008/96 to other parts of the road network, in particular rural roads, where many more road users are killed. Almost half of EU countries already apply the rules on some other parts of their national road networks.

Some countries are upgrading some of their rural roads in various ways to high speed rural roads as cost-effective alternatives to motorways. Noteworthy experience mainly in Sweden shows that one form of high speed rural road can be as safe as motorways in appropriate circumstances (see Part 3).

Key recommendations to EU institutions

Within the context of the review of the Infrastructure Safety Management Directive 2008/96:

- Extend application of the instruments of the directive to cover all motorways, rural and urban roads.
- Set up guidelines for providing and maintaining road markings, safety barriers and obstacle-free roadsides.
- Extend application of the instruments of the directive to cover tunnels and maintain all the safety requirements currently covered by the Tunnel Safety Directive 2004/54.

Within the context of the revision of Regulation 2009/661 concerning Type-Approval Requirements for the General Safety of Motor Vehicles[1]:

- Extend the mandatory fitment of advanced seat belt reminders as standard equipment to all seats.
- Adopt legislation for the mandatory fitting all new vehicles with an overridable assisting Intelligent Speed Assistance (ISA) system.
- Introduce uniform standards for alcohol interlocks in Europe which ensure that vehicle interfaces make it possible to fit an alcohol interlock. As a first step towards wider use of alcohol interlocks, legislate to require their use by professional drivers.
- Extend the mandatory fitment of Lane Departure Warning Systems to all new cars and vans.

Key recommendations to Member States

- Implement the Infrastructure Safety Management Directive 2008/96 on all kinds of road.
- Apply best practice in the enforcement of speed limits, including experience in using safety cameras and time over distance cameras, seat belt use and limits on drink and drug driving.
- To tackle fatigue amongst professional drivers, increase levels of enforcement of tachograph rules.
- Eliminate all removable obstacles from the roadside; install side barriers where the obstacles can not be removed.
- Install barriers friendly to powered two-wheelers in areas susceptible to motorcycle collisions.
- Implement engineering measures to prevent pedestrians accessing motorways.

NOTE

Countries are compared according to their progress in reducing deaths on motorways over the last decade (Fig. 1). This report also uses as an indicator of the safety on motorways the risk of death per unit vehicle-distance driven, namely the number of deaths on motorways divided by the distance driven by vehicles on the same roads over the same period (Fig. 2).

Motorways are roads with dual carriageways, at least two lanes each way; entrance and exit at signposted grade separated interchanges; central barrier or central reservation; no crossing movements at the same level; no stopping permitted unless in an emergency. Use of motorways on foot and by some types of vehicle is restricted in various ways in different countries.

Although motorways are high speed roads, they are safer than other types of roads by design and regulation. Many more road users die on rural and urban roads than on motorways. These other roads are more difficult to compare internationally because of different definitions of road types and lack of detailed data on vehicle-km travelled.

When available, the numbers of deaths were retrieved from the European Commission's CARE database and completed or updated by the PIN panellists (see inside cover). The numbers of people killed on motorways are available only from 2008 to 2013 in Serbia and until 2012 in Greece. No reply was received from Bulgaria. Altogether 20 out of the 31 countries covered under the Road Safety PIN provided data on vehicle-km travelled on motorways; the IRTAD database was used to supplement this information.

This analysis builds on previous country rankings on people killed on motorways in ETSC's 2nd Road Safety PIN Report (2008). For reductions in deaths on rural and urban roads see the 5th Road Safety PIN report (2011). These publications can be downloaded from http://etsc.eu/projects/pin/.

[1] Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefor.

PART I
COUNTRY COMPARISON

1.1 Across the EU between 2004 and 2013 the numbers of people killed on motorways decreased by 8% per year on average, compared to 6.5% on the rest of the road network

Lithuania achieved the best average year-on-year reduction in the number of people killed on motorways as estimated over the period 2004-2013 (-20%), followed by **Slovakia** (-14%) and **Spain** (-13%) (Fig. 1).

Denmark, **Serbia**, **Austria**, **Great Britain**, the **Czech Republic**, **The Netherlands** and **Italy** achieved better reductions than the EU average. Because the length of motorway in **Poland** almost quadrupled over this period from about 400 to 1500km the decrease of 0.7% per year shown in Fig. 1 represents an improvement in safety comparable to those countries shown in light green.[2]

For the EU as a whole, the number of deaths on motorways has been decreasing on average by 8% each year over the period 2004 to 2013, compared to 6.5% on the rest of the road network.

In 2010, the European Union renewed its commitment to improving road safety by setting a target of reducing road deaths by 50% by 2020. Since 2010 around 870 fewer people have been killed on motorways across the EU than would have been if the annual number had remained as it was in 2010. Compared to 2010, the number of people killed on motorways in 2013 was lower by about 16%, representing a year-to-year average reduction of about 6%. This result is close to an annual reduction of 6.7% which is needed over the 2010-2020 period to reach the target through constant progress in annual percentage terms.

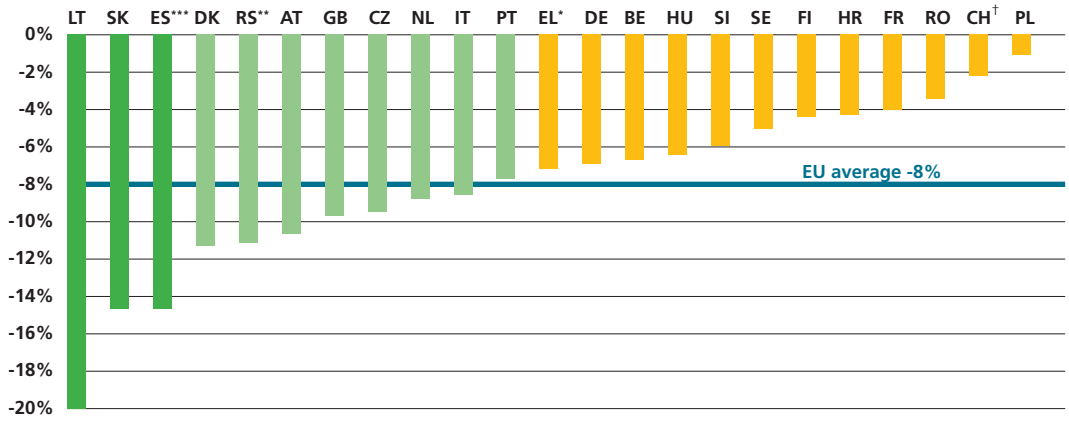


Fig. 1: Average yearly percentage change estimated over the period 2004-2013 in deaths on motorways. *2004-2012, **2008-2013, *** Motorways and autovias. Except for RS**, the average of the numbers for 2003, 2004 and 2005 were used as the number of deaths in the baseline year of 2004. CY, IE, IL, LU, NO are excluded from Fig. 1 as the numbers of deaths are small and are therefore subject to substantial annual fluctuation.

† In Switzerland in 2012, 28 of the 63 people killed on motorways died in a single bus collision. In any country having relatively few deaths per year, a single collision in which many are killed has a big effect on the annual total, but this case is exceptional among such countries in the years considered. Without this collision, the estimated annual percentage change for Switzerland would have been -4%.

[2] Among the countries that provided data this it the biggest increase of the motorway network.

Lithuania: explaining the progress

Although the estimate of 20% for the annual reduction in road deaths on motorways in **Lithuania** (Fig. 1) is exaggerated somewhat by the process of estimation, the reduction to an average of 11 deaths on motorways annually in 2011-2013, compared to 48 annually in 2004-2006 is a remarkable achievement. The progress in reducing the number of people killed on motorways is the result of a comprehensive approach implementing international proven best practice, including infrastructure safety management, enforcement and education.[3] The number of high risk sites on Lithuanian motorways was reduced from 10 in 2005 to 1 in 2014. Despite this, the number of deaths per vehicle-km travelled on motorways is still highest in Lithuania among countries that could provide vehicle-km data (Fig. 2).

"The EU Infrastructure Safety Management Directive was the main instrument in creating a safer road environment and improving infrastructure management procedures. Following road safety audits and inspections, acceleration and deceleration lanes were widened, crossroads were reconstructed to roundabouts, dangerous roadside objects were removed and engineering measures were implemented to prevent pedestrian access to motorways. Yet, there is still a lot to be done to reduce road mortality, in particular to make full use of Intelligent Transport Systems and to improve the protection of vulnerable road users".
Vidmantas Pumputis, Ministry of Transport and Communications, Lithuania.

Spain: safety cameras and penalty point system aid progress

In **Spain** overall road deaths were 64% fewer in 2013 compared with 2004 and road deaths on motorways 69% fewer (cut from 921 in 2004 to 290 in 2013). Those impressive results followed a set of comprehensive measures, including the introduction of a penalty point system, the deployment of an extensive network of safety cameras and stricter sanctions for traffic offences.

Austria: focus on high risk sites

In **Austria**, the number of people killed on motorways decreased by 73% from 116 in 2004 to 31 in 2013.

"The Infrastructure Safety Management Directive has been implemented to the full on the Trans-European Network of Austrian motorways and helped put in place a culture of providing and maintaining inherently safe motorways. In 2010, ASFiNAG, the Austrian motorway agency, set up an integrated Road Safety Programme with the help of the Austrian Road Safety Board, aiming at making Austrian motorways the safest in Europe[4]. In order to reach our target of halving the number of deaths per billion vehicle-km by 2020, the Plan prioritises reducing the number of high risk sites, increasing compliance with speed limits, raising awareness about the danger of not wearing seat belts, driving fatigued or distracted and making better use of Intelligent Transport Systems." Klaus Machata, Austrian Road Safety Board (KFV).

Ireland: unfamiliarity with risks

The number of people killed on the motorways in **Ireland** remained below 10 between 2004 and 2013, while at the same time the length of the network was multiplied by four.

"The motorway network in Ireland has expanded significantly in recent years with most of the main urban centres now linked by motorway. Of concern is the number of drivers involved in fatal collisions as a result of driving the wrong way on a motorway, some of which are linked to intoxicated driving, and the number of pedestrian deaths occurring on the motorway network. With many drivers unfamiliar with or untrained in safe motorway use we have put considerable resources into driver education awareness campaigns." Michael Rowland, Irish Road Safety Authority.

[3] Read more about road safety developments in Lithuania (pages 21-22): 2010 Road Safety Target Outcome: 100,000 fewer deaths since 2011. 5th Road Safety PIN Report.
[4] ASFiNAG (2010) Road Safety Programme 2020.

Germany: deaths higher on motorways sections without speed limits

Deaths on **German** motorways were cut from 694 in 2004 to 387 in 2012. But in 2013 the number of people killed on German motorways increased by 11% compared to 2012, while overall road deaths went down by 7%. The German Road Safety Council (DVR) says that in 2013 the number of deaths per kilometre of motorway was 30% lower on stretches of German motorways that have speed limit compared to those without limits. In 2008, the latest year available, around 66% of the total motorway network in Germany had no speed limits.[5]

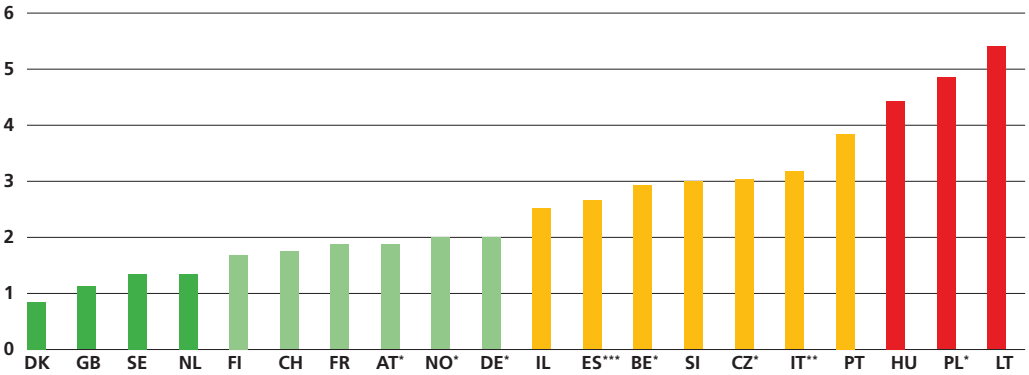
"Speeding is a major cause of concern on our motorways. High differential speeds and failure to keep a safe distance can result in very severe rear-end collisions. Measures to reduce speeding are therefore urgently needed to achieve our national target of 40% reduction in deaths between 2010 and 2020 and our long-term Vision Zero. DVR recommends the German authorities to increase enforcement of speed limits, both by safety camera and by on-the-spot police checks."
Jacqueline Lacroix, DVR, German Road Safety Council.

ETSC recommends that there should be a speed limit on all Germany motorways. Germany should also follow the example of many EU countries who monitor traffic speed and regularly update the length of the motorway network to assess the effectiveness of their actions.

1.2 Users of the least safe national motorway networks are at four times greater risk than users of the safest

Road users in **Denmark**, **Great Britain**, **Sweden** and **The Netherlands** experience the safest travel on motorways in Europe (Fig. 2). Around one person is killed on average for every billion vehicle-km travelled on their motorways. These four countries were already among the top five in 2006. Switzerland would be in this leading position but for one very exceptional collision in 2012.

Fig. 2 Number of deaths in collisions on motorways per billion vehicle-km over the period 2011-2013.
*2010-2012. **Number of deaths in collisions on motorways per billion vehicle-km over the period 2011-2013 on toll motorways only (representing 77% of the overall motorway network). ***Motorways and autovias.



The number of people killed on Danish motorways was 56% fewer in 2004 than in 2013, 12 compared with 27.

"In 2012 only 8 people were killed, a record low number, following the introduction of higher fines for speeding. Improved vehicle safety also must have had an impact, as people bought new vehicles offering higher levels of active and passive safety"
Jesper Sølund, Danish Road Safety Council.

[5] Bast (2008) Tempolimits auf Autobahnen.

Belgium is lagging behind its neighbouring countries in terms of road safety on motorways. A 2014 study by the Belgian Road Safety Institute examined data on 520 fatal collisions that occurred between 2009 and 2013 and in which 582 people died. Some of the findings are disturbing.

"We found for instance that in 1 out of 10 fatal collisions the central reservation was not protected by a crash barrier to prevent the vehicle colliding with ongoing traffic. In 11% of the fatal collisions there was no hard shoulder and in 39% there was no barrier at the side of the road to prevent a crash with a roadside obstacle. The study also revealed that, in 30% of the fatal collisions for which the information is available, 45% of the drivers killed and 72% of the rear passengers killed were not wearing a seat belt. Based on those findings we recommend that police enforcement of seat belt use, drink driving and speeding is increased, as well as the number of safety cameras and time-over-distance cameras. We also recommend infrastructure improvements, in particular to install middle and side barriers."

Freya Slootmans, co-author, Belgian Road Safety Institute.

Big disparities in terms of motorway safety still exist in Europe.

In **Finland**, **Switzerland**, **France**, **Austria**, **Norway** and **Germany** the death rates are below two deaths per billion vehicle-km. In **Israel**, **Spain**, **Belgium**, **Slovenia**, the **Czech Republic**, **Italy** and **Portugal** death rates are below four deaths per billion vehicle-km. On **Polish** and **Hungarian** motorways more than four people, and on **Lithuanian** motorways more than five people, are killed per billion vehicle-km. Big disparities in terms of motorway safety still exist in Europe. The difference in risk between the best and the worst performing groups of countries is a factor of four. But it was a factor of six in 2006.

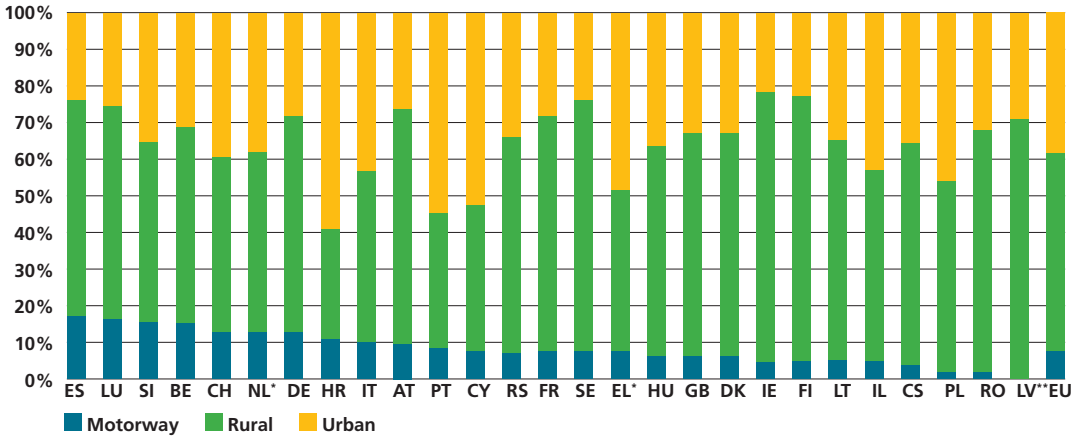
The indicator of risk on motorways could not be calculated for **Ireland**, **Greece**, **Croatia**, **Cyprus**, **Luxembourg**, **Romania** or **Slovakia** due to the lack of data on the number of vehicle-km.

There are no motorways in **Malta**, **Latvia** and **Estonia**. Due to settlement structures in these countries, the main road sections with high traffic volumes are not long enough to attract financial resources for building motorways. In Latvia, funds dedicated to road infrastructure are invested to improve the deteriorating rural roads network.

1.3 7% of all road deaths occur on motorways

On average in the EU 7% of all road deaths occur on motorways (Fig. 3). The share of people killed on the motorways in comparison with other types of roads is highest in **Spain** which is followed by **Luxembourg**, **Slovenia**, **Belgium**, **Switzerland**, **The Netherlands** and **Germany**. For some of those countries, this can be partly explained by their having higher proportions of their traffic on motorways (usually in transit countries and countries with a longer motorway network).

Percentage share of the total number of road deaths by road type (motorways, rural roads, urban roads) in the latest 3 years (2011-2013). *2010-2012. **There are no motorways in LV. EE, MT, SK, NO are excluded due to insufficient data.

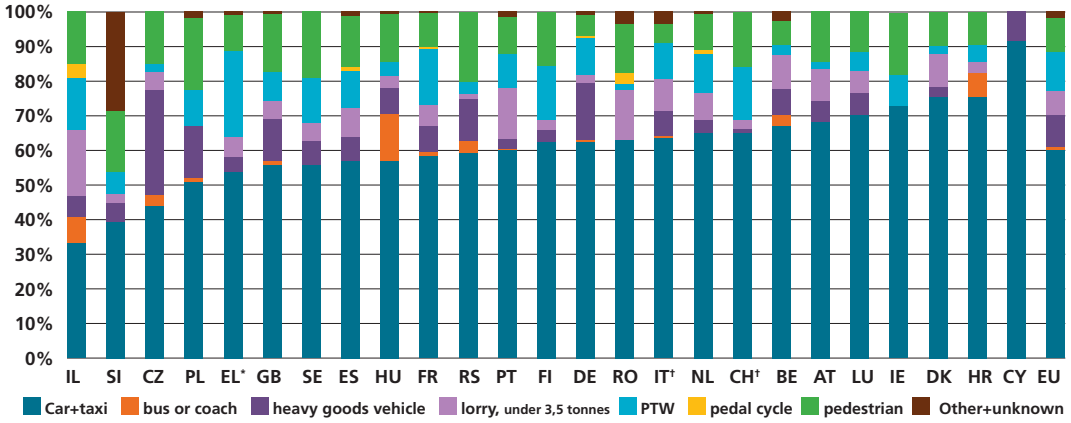


1.4 10% of people killed on motorways are pedestrians

In the 22 EU countries that could provide data, the great majority of people killed on motorways are car occupants (61%). Powered two wheeler (PTW) users represent around 11%, pedestrians 10% and occupants of heavy goods vehicles around 9% of all deaths on motoways (Fig. 4).

Even though pedestrians are prohibited from using motorways they account for 10% of deaths (in comparison they represent 11% of deaths on rural roads and 35% on urban roads). In 2012 alone, 217 pedestrians lost their lives on motorways in the EU, 847 since 2010. The share of those killed on motorways who are pedestrians is as high as 20% in **Poland**, 17% in **Great Britain**, 15% in **Spain** and 10% in **France**. Pedestrians killed on motorways might be vehicle users who have left their vehicles for some reason, workers in work zones or individuals who entered the motorway on foot illegally. Pedal cyclists are also prohibited, and there are very few of them among those killed.

Percentages of people killed on motorways by road user group in 2011-2013.
*2010-2012.
† Average of the years 2010-2012 for IT and 2010-2011-2013 for CH to remove effects of exceptional bus collisions.



Another 11% of people killed on motorways are motorcyclists and moped users (in comparison they represent 19% of people killed on rural roads and 22% on urban roads). In 2012 alone, 200 powered two wheelers' (PTW) users were killed, 880 in the last four years. The share of killed people who are PTW users is as high as 26% in **Greece**, 17% in **France**, 11% in **Germany** and 10% in **Italy**.

PART II
TOWARDS VISION ZERO ON MOTORWAYS

Progress in better-than-average countries is a result of a comprehensive mix of measures, including improved infrastructure safety and improved road user behaviour such as better compliance with speed limits or increased seat belt use. Other factors such as improved vehicle safety and changes in mobility patterns play a role too, but these are harder to quantify.

"White Roads" is an EU funded project that aimed at identifying road sections of at least 15 km along the Trans-European Road Network (TERN) where no fatal collision occurred in the period 2005-2009. The initiative was aimed at distinguishing the infrastructure features that can potentially reduce accident frequency in comparison with other stretches that have similar traffic conditions. The analysis has shown that over 40% of TERN roads can be considered as "white roads".[6]

2.1 Improved behaviour

Speed management

The best progress in reducing mean speed on motorways has been achieved in France and was prompted by the deployment of safety cameras coupled with stricter sanctions like penalty point systems including speed offences and higher fines (Fig. 5).[7]

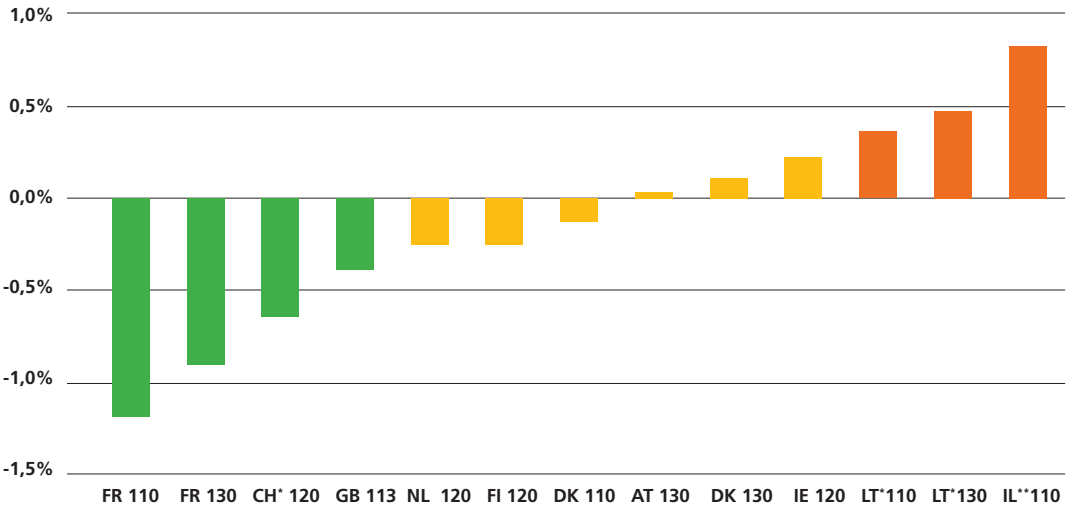
In Switzerland the reduction of mean speed on motorways is the result of a combination of factors, such as an increase in traffic density, improved speed enforcement and stricter regulation leading to driver licence withdrawal. Switzerland has also been complying with EU Regulation 2135/98 on digital tachograph use[8] since 2006.

Both, France and Switzerland achieved substantial reductions in the number of deaths on motorways in the first half of the previous decade9 but the progress has slowed down in recent years.

In Lithuania and Ireland the mean speed on motorways has increased slightly (Fig. 5) but it still remains well below the legal speed limit (Fig. 6).

[6] White Roads project, www.whiteroads.eu
[7] ETSC (April 2014) Ranking EU progress on car occupant safety, PIN Flash Report 27.
[8] Council Regulation (EC) No 2135/98 of 24 September 1998 amending Regulation (EEC) No 3821/85 on recording equipment in road transport and Directive 88/599/EEC concerning the application of Regulations (EEC) No 3820/84 and (EEC) No 3821/85.
[9] ETSC (2008), Countdown to 2010. Only two more years to act! 2nd Road Safety PIN Report (page 32).

Fig. 5 Average yearly percentage change in mean speed of cars and vans on motorways (from 2004 until the latest available year).
* All traffic.
** All traffic in daytime.



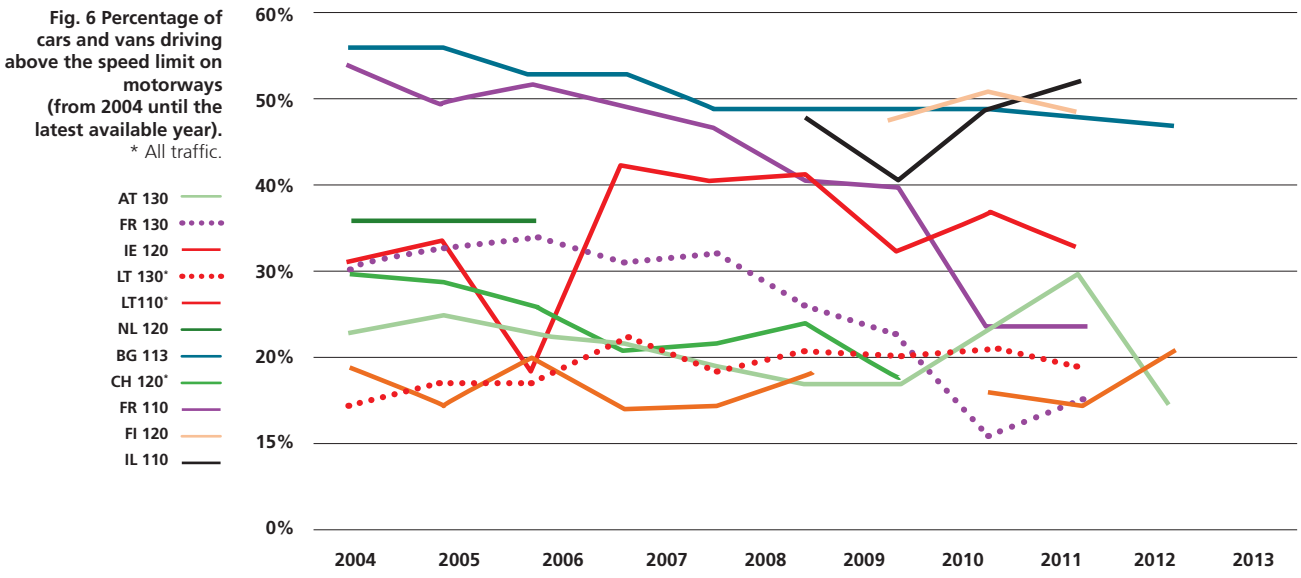
Tackling speed, which is one of the main contributory factors to collisions on the roads, has been an important point on the Lithuanian road safety agenda. The measures were undertaken by installing the first safety cameras in 2005, and increasing the penalties for speed violations. Currently, there are 9 automatic speed cameras installed on Lithuanian motorways. Fines for excessive speeding – 30km/h above the limit – have also been increased, with novice drivers face licence suspension. Nevertheless, speeding remains an area of high concern because as many as 19% of drivers still exceed the speed limits on motorways limited to 130km/h and 33% on stretches limited to 110km/h (Fig. 6). The years 2004-2008 were also marked by an economic boom in Lithuania, during which people bought new cars that are safer but are also capable of higher speeds.

Among the countries monitoring speed, the proportion of drivers exceeding the speed limit on motorways has been between 15% and 50% since 2008 (Fig. 6). As many as 48% of drivers in free-flowing traffic exceed the limit on motorways in Finland and Great Britain, 38% in Spain and 35% in The Netherlands.

Best progress has been achieved in France where the number of drivers exceeding the speed limit of 110km/h decreased from 59% in 2003, before the deployment of speed cameras, to 24% in 2012. 18% of drivers exceeded the limit of 120km/h on Swiss motorways in 2010 compared to 38% in 2003.

In Great Britain there has been steady progress since 2006. Whilst nearly half of drivers in free-flowing traffic exceed the limit of 113km/h (70miles/h) relatively few exceed 130km/h (80miles/h) (Fig. 6).

Fig. 6 Percentage of cars and vans driving above the speed limit on motorways (from 2004 until the latest available year).
* All traffic.



Several countries in Europe, including The Netherlands, Italy, the Czech Republic, Great Britain, Austria and Belgium[10] use automatic time over distance cameras on motorways and in tunnels. Scotland has recently deployed these cameras along 220km of its main north-south route through the Highlands. Use of time over distance cameras (also called "section controls") is a relatively new way of enforcing speed limits which allows measuring the average speed of a vehicle over a distance, often of about 3km. This helps to make drivers adhere to speeds along entire sections and results in more fluid traffic.[11]

Drivers are usually aware of the increased risk of being involved in a fatal collision after drinking but greatly underestimate the increased risk of being involved in a fatal collision when speeding. Driving with 0.5 g/l BAC increases the risk of a fatal crash by a factor of 5, the same as driving about 50% faster. The increased risk of driving 180km/h on a 120km/h motorway is therefore similar to the risk of driving with a 0.5g/l BAC.[12]

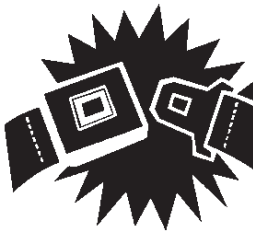
Recommendations to EU institutions

- Propose a maximum speed limit of 120 km/h or less for all motorways.
- Within the context of the revision of the General Safety Regulation[13] require all new commercial vehicles to be fitted with the assisting form of Intelligent Speed Assistance (ISA)[14], in line with the recommendations of the evaluation study conducted on behalf of the European Commission[15]. The system should be overridable up to 100 km/h for buses and 90 km/h for lorries, in line with existing EU legislation on speed limiters.
- Within the context of the revision of the General Safety Regulation fit all new passenger cars with an overridable assisting Intelligent Speed Assistance (ISA) system.
- Uphold the inclusion of the collection and maintenance of speed limit data to enable the rollout of Intelligent Speed Assistance within the newly proposed Intelligent Transport Systems Directive's specifications on "real-time traffic information". Prepare guidelines to support Member States in undertaking this ongoing map collection work.

Recommendations to Member States

- Support the introduction of Intelligent Speed Assistance and set up digital maps with information on speed limits.
- Apply best practice in the enforcement of speed limits, including experience in using safety cameras and time over distance cameras.
- Incorporate speeding offences in penalty point systems, and make sure that the levels of penalty escalate as the level of speeding above a speed limit increases.
- Promote the introduction of owner or keeper liability as opposed to driver liability to facilitate enforcement of speed limits and other traffic laws.
- Improve enforcement of speed limits upon drivers of powered two wheelers by improving number plate visibility and the accuracy of speed detection.
- Monitor speed patterns (including mean speeds and proportions of vehicles exceeding the speed limit) and publish regular overviews of changes by different kinds of road user.

[10] TML (2015) A Concise Impact Assesment of Average Speed Control.
[11] ETSC (2008) Countdown to 2010. Only two more years to act! 2nd Road Safety PIN Report.
[12] ETSC (2012) Drink Driving: Towards Zero Tolerance.
[13] Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefor.
[14] ETSC, Intelligent Speed Assistence – Frequently Asked Questions.
[15] European Commission (2013) Evaluation Study on Speed Limitation Devices.



Seat belt use on motorways

The seat belt remains the single most effective safety feature in vehicles. Moreover, other important safety features such as airbags work as designed only if occupants are restrained by their seat belts. Even though seat belt wearing rates have improved in Europe, the proportion of killed vehicle occupants who were not wearing their seat belt is disproportionately high, which is also the case on motorways.

Table 1 : Percentage of people killed on motorways not wearing a seatbelt and car occupants seat belt weating rates on motorways in some countries.
*toll motorways only.

	Percentage of people killed on motorways not wearing a seat belt	Car occupants seat belt wearing rates on motorways	
		Front seat passenger	Rear seat passenger
France[16*]	23%	98%	87%
Hungary	31%	89%	75%
Portugal		96%	81%
Austria[17]	40% to 50%	95%	84%
Finland[18]	50%	n/a	n/a
Belgium[19]	61%	n/a	n/a

Up to 60% of those killed on motorway collisions were not wearing a seat belt

Recommendations to EU Institutions

- Within the context of the revision of the General Safety Regulation[20] extend the mandatory fitment of advanced seat belt reminders as standard equipment to all seats.

Recommendations to Member States

- Conduct intensive seat belt use actions lasting from 1 to 4 weeks, which should take place at least twice a year.

Drink and drug driving on motorways

Data on drink and drug driving on motorways are limited across the EU. It is estimated that drink and drug driving is a factor in 21% of fatal collisions on French toll motorways.[21] Drink driving is estimated to be a factor in 22% and drug driving in around 7% of fatal collisions on Finnish motorways while on the rest of the network in Finland the corresponding numbers are 26% and 5%.[22] Around 25% of fatal collisions on motorways in Denmark are related to drink driving - the same proportion as for the rest of the road network.

Recommendations to EU Institutions

- Within the context of the revision of the General Safety Regulation introduce uniform standards for alcohol interlocks in Europe which ensure that vehicle interfaces make it possible to fit an alcohol interlock. As a first step towards wider use of alcohol interlocks, legislate to require their use by professional drivers.

Recommendations to Member States

- Intensify enforcement of drink driving laws by setting targets for minimum level of alcohol checks of the motorist population, e.g. 1 in 5 motorists should be checked in a typical year.
- Introduce obligatory testing for alcohol in all collisions dealt with by the police.
- Collect rates of drink driving and/or rates of traffic deaths from accidents involving drivers over the limit.

[16] ASFA (2013) Analyse accidents mortels sur autoroutes concédées. Communiqué de Presse.
[17] SFiNAG (2010) Road Safety Programme 2020.
[18] VALT (2015) Database of road and off-road accidents investigated by Finnish accident investigation team.
[19] IBSR (2014) Les tués sur les autoroutes. The information on whether the person was belted or not is available for only 30% of fatal collisions.
[20] Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefor.
[21] ASFA (2013) Analyse des accidents mortels sur autoroutes concédées. Communiqué de Presse.
[22] VALT (2015) Database of road and off-road accidents investigated by Finnish accitents investigation team.

A person who drives after being awake for 17 hours has a risk of crashing equivalent to being at 0.5g/l blood alcohol level.

Fatigue

Collisions caused by tired drivers are most likely to occur on long journeys on monotonous roads, thus motorways are high risk roads for fatigued drivers. Fatigue manifests itself in slower reaction times, diminished steering performance, reduced ability to keep a safe distance from the car in front, increased tendency to withdraw mentally from the driving task and fall asleep. A person who drives after being awake for 17 hours has a risk of collision equivalent to being at 0.5g/l blood alcohol level.[23]

EU average data regarding fatigue-related collisions are not available as contributory factors are not routinely recorded in many countries. Furthermore, even when a checklist of contributory factors is included on police accident reporting forms, it does not necessarily include fatigue as one of the choices, thus fatigue remains a 'grey zone' in road safety.[24]

It is estimated that on Austrian motorways 16% of fatal collisions involve fatigue, compared to 7% for the whole network.[25] As many as 29% of fatal collisions on French toll motorways are fatigue related.[26]

A 2009 UK study indicated that the number of both fatigue and non fatigue collisions was significantly lower on motorway sections containing rest areas.[27] Sufficient breaks of at least 15 minutes should be taken after every two hours of driving[28] and a short nap can be an effective solution to tackle fatigue when the driver feels tired.

Recommendations to EU Institutions

- Within the context of the revision of the General Safety Regulation[29] extend the introduction of Lane Keeping Device Systems to all vehicles.
- To tackle fatigue amongst professional drivers, implement the recommendations of ETSC's PRAISE Report on EU Social Rules[30], prioritising tackling tachograph corruption and supporting harmonised approaches of tachograph enforcement and minimum and maximum penalties for breaches of working time legislation.
- Make safe and secure rest facilities a long term commitment and an ongoing work programme priority, featuring a set of annual objectives as well as providing funding[31].

Recommendations to Member States

- To tackle fatigue amongst professional drivers, increase levels of enforcement of tachograph rules[32].
- Provide safe and secure rest facilities at appropriate locations.
- Encourage infrastructure managers to introduce run-off preventive technologies while using rumble strips to alert drivers who drift from the carriageway - which may occur if tired.
- Carry out public information and education campaigns raising drivers' awareness about the dangers of driving while subject to fatigue.
- Work with the Police to develop a course on identifying and investigating fatigue collisions.

[23] ETSC (2010) PRAISE: Preventing Road Accidents and Injuries for the Safety of Employees.
[24] University of Helsinki (2009) Convicted of fatigued driving: Who, why and how?
[25] ASFiNAG (2010) Road Safety Programme 2020.
[26] ASFA (2013) Analyse des accidents mortels sur autoroutes concédées. Communiqué de Presse.
[27] ASFA (2009) Sleepiness at the Wheel.
[28] RoSPA Driver Fatigue and Road Accidents.
[29] Regulation (EC) No 661/2009 of the European Parliament and of the Council of 13 July 2009 concerning type-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units intended therefor.
[30] ETSC (2011) Tackling Fatigue: EU Social Rules and Heavy Goods Vehicle Drivers, PRAISE Report.
[31] Ibid
[32] Ibid

2.2 Improved infrastructure safety

Impact of the Infrastructure Safety Management Directive 2008/96

In 2008, the EU adopted the **Infrastructure Safety Management Directive**[33] which requires Member States to apply the following four instruments on the Trans-European Road Network (TERN):

- **Road safety impact assessments**: these demonstrate the road safety implications of different planning alternatives for a road project, whether construction of new infrastructure or rehabilitation of existing infrastructure, by analogy with environmental impact assessment.
- **Road safety audits**: independent technical checks aimed at identifying unsafe features of a road project and making proposals for remedying them.
- **Network safety management**: targeting remedial measures at parts of the network with high concentrations of collisions (high-risk road sections) and/or a high potential to avoid collisions in the future.
- **Safety inspections**: carried out as part of regular road maintenance, these enable the detection and hence reduction of collision risk in a preventive way through low cost measures.

The Directive aims to promote the objective that safety must be integrated in all phases of planning, design and operation of road infrastructure. It must be regarded in its own right and separately from economic and environmental analysis. Member States were also encouraged but not mandated to apply the provisions of the directive to national road transport infrastructure, not included in the trans-European road network. In this regard the European Commission has funded the PILOT4SAFETY project which aims to apply the Directive's approaches related to training and certification of Road Safety Experts for the application of Road Safety Audit and Road Safety Inspection procedures to selected secondary roads, in the EU Regions represented in the project. The idea is to share good practices and define common agreed training curricula and tools for qualification of road safety personnel.[34]

The European Commission is currently reviewing the Infrastructure Safety Management Directive. A forthcoming evaluation carried out by TML and TRT concludes that, although the direct benefits and costs are difficult to assess, the possible collision reduction effect of the implementation of the Directive is in the range of 10% to 20%.[35] The main success has been the introduction of cost-effective Road Safety Audits. This has also been seen as an important step in the direction of a more systematic discipline on infrastructure safety as well as establishing a "common language".

Thirteen EU countries have extended implementation of the EU Infrastructure Safety Management Directive to other parts of their national road network.

ETSC supports the European Commission's recognition that much more benefit could be achieved by extending the application of the principles of this Directive to other parts of the road network. In the EC Road Safety Policy Orientations 2011-2020, the EC recommended to EU Member States to extend these requirements to the secondary road network. This has become even more of a priority given the new objective to reduce serious injuries and the European Commission's serious injury document[36] proposed the application of the instruments included in the Directive 2008/96 to the secondary road network and, for the first time, also extending them to the urban environment. According to the uncoming TML study, extending the Directive to all rural roads on a voluntary basis would lead to a 4% reduction in deaths. If this were to be mandatory this reduction would be 8% on all roads taken together.

Thirteen countries - Austria, Cyprus, France, Finland, Germany, Hungary, Ireland, Italy (from 2016), Latvia, Lithuania, The Netherlands, Romania, Slovenia and the UK

[33] Directive 2008/96/EC of the European Parliament and of the Council of 19 November 2008 on Road Infrastructure Safety Management.
[34] ETSC (2010) PRAISE: Preventing Road Accidents and Injuries for the Safety of Employees.
[35] The upcoming TML study will be published here: TML, Road Infrastructure Safety Management.
[36] European Commission (2013) Commission Staff Working Document: On the Implementation of Objective 6 of the European Commission's Policy Orientations on Road Safety 2011-2020 – First Milestone Towards an Injury Strategy.

implement the directive also on other roads, mainly motorways and some main rural roads ("national roads"). The **Czech Republic**, **Denmark**, **Greece**, **Luxembourg**, **Norway**, **Portugal**, **Spain** and **Sweden** implement the directive only on the TERN. In **Slovakia**, the last two instruments of the directive are also implemented on express roads. In **Estonia**, the implementation on national roads is only recommended.

At European level countries are encouraged to co-operate through the Conference of European Directors of Roads (CEDR) to facilitate the exchange of experience and information on all road related issues, especially infrastructure management.[37]

An ongoing CEDR project the SAVeRS (Selection of Appropriate Vehicle Restraint Systems) aims at reducing the severity of run-off-road collisions. Besides constructing so called "forgiving roadsides", an operator of the road network must also know what appropriate vehicle restraint systems (e.g. roadside barriers) should be selected for certain traffic conditions and identify where to install these systems. The project will deliver practical guidance which will assist operators in selecting the most appropriate vehicle restraint systems in different road and traffic configurations.[38]

Tunnel safety

Linkages should be made between the Infrastructure Safety Management Directive 2008/96 and the Tunnel Safety Directive 2004/54. The principles of Directive 2008/96 should be extended to tunnels. Within the context of the EU REFIT[39] programme to cut red tape, the tunnel directive is being evaluated with a view to revising or repealing it. ETSC strongly supports the retention of this important piece of EU road safety legislation. The upcoming TML study also considers the idea of extending the Infrastructure Safety Management Directive to the tunnels which are currently covered by the tunnel Directive, and concludes that this would lead to administrative simplifications but that the safety benefits would be more limited than those offered by the Tunnel Safety Directive.

Recommendations to EU Institutions

Within the context of the review of the Infrastructure Safety Management Directive 2008/96:

- Extend the application of the instruments of the directive to cover all motorways, rural and urban roads.
- Extend the rules to tunnels covered by the Tunnel Directive 2004/54 and uphold the effects of the Tunnel Directive.
- Set up guidelines for the provision and maintenance of road markings and safety barriers.
- Support common EU curricula for auditors and inspectors.

Recommendations to Member States

- Implement the Infrastructure Safety Management Directive on all roads.
- Prioritise road markings and road signs in maintenance budgets to achieve optimal performance of Advanced Driver Assistance Systems such as Lane Departure Warning and Traffic Sign Recognition.
- Eliminate all removable obstacles from the roadside; install side barriers where the obstacles cannot be removed.
- Install barriers friendly to powered two-wheelers in areas susceptible to motorcycle collisions.
- Implement engineering measures to prevent pedestrian access to motorways, for example install higher and stronger safety fences alongside motorways and take care of their maintenance.
- Raise awareness about the danger of leaving a vehicle on a motorway and precautions to take when doing so.

[37] Conference of European Directors of Roads, www.cedr.fr
[38] SAVeRS – Selection of Appropriate Vehicle Restraint Systems.
[39] REFIT – making EU law lighter, simpler and less costly.

2.3 TEN-T guidelines and the EU budget

Between 1.5 and 2 billion EUR of the EU budget are spent every year on building roads in the EU.

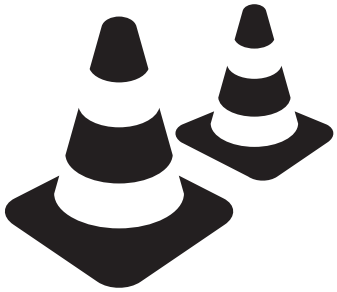
Between 1.5 and 2 billion EUR of the EU budget are spent every year on building roads in the EU. EU member states and the European Commission should ensure that this huge amount of money is spent in such a way as to make EU roads safer. The TEN-T guidelines and accompanying Connecting Europe Facility fund put into place in 2014, include a specific reference to the two main infrastructure directives: Directive 2008/96 and Directive 2004/54.

The TEN-T guidelines also include the prioritisation of "road safety" when promoting projects of common interest. The guidelines foresee the provision of secure parking areas as a priority, rest areas being important for managing fatigue. The reference made in the guidelines to intelligent transport systems safety applications, under the Intelligent Transport Systems Directive[40] and action plan[41], is also welcomed by ETSC. The accompanying Connecting Europe Facility fund requires projects to comply with the TEN-T guidelines to be eligible.

Recommendations to EU institutions

- The 'conditionality' to comply with EU infrastructure safety legislation (which exists now in the TEN-T guidelines and road safety policy priorities) should be extended to all EU funds including the European regional development funds.

2.4 Work zone safety



An international review of collision studies, carried out in 1998 as part of the European project ARROWS, revealed that 'work zone areas have typically higher road traffic collision rates in comparison with equivalent non-works sections'[42]. A recently published report by ETSC gathered the latest data and policy recommendations on tackling work zone safety[43]. In Austria, around 4 deaths and 120 collisions occur at roadwork zones on motorways every year (representing 4% of collisions on motorways)[44]. Around 9% of fatal collisions on Belgian motorways happen at workzones.[45] One exception is a study carried out on behalf of the UK Highways Agency[46]. The study showed 'no significant difference in the rate of injury collisions when road works were present on the motorway in 2012.'

From a road safety viewpoint, the risks involved with work zones can include risk of collisions between general road users (vehicles, pedestrians) and barriers, equipment, vehicles or personnel associated with the roadworks as well as collisions involving only road users due to the disturbance to the normal traffic flow induced by the roadworks (e.g. side swipe collisions due to sudden lane changes, rear-end collisions due to sudden braking). Identification of the exact causes of collisions is often difficult as a combination of factors may interact to culminate in a collision. As such it is difficult to ascertain when the presence of a work zone on or near a road or its characteristics has directly resulted in a road traffic collisions.

From the worker safety viewpoint, the risks involved with work zones can include risk of collisions in or outside the work zone, or when the worker enters or leaves the work zone. The collisions can happen with passing vehicles or works vehicles. The worker can be a pedestrian or driving a vehicle.

Recommendations to EU Institutions

- Work towards harmonisation of standards and guidance nationally and across the EU concerning road work zones.
- Collate various approaches and disseminate good practice.
- Support the revision of police reporting procedures at the national level to facilitate the identification of collisions occurring in or near work zones.

Recommendations to Member States

- Adopt best practice as set out in ETSC's PRAISE report on Work Zone Safety to improve safety of workers and road users[47].

[40] Directive 2010/40/EU of the European Parliament and of the Council of 7 July 2010 on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport.
[41] Commission Communication 2008/886, Action plan for the deployment of Intelligent Transport Systems in Europe.
[42] ARROWS (1998) Advanced Research on Road Work Zones Safety Standards in Europe.
[43] ETSC (2011) PRAISE Road Safety at Work Zones.
[44] ASFiNAG (2010) Road Safety Programme 2020
[45] IBSR (2014) Les tués sur les autoroutes.
[46] TRL (2004) Safety performance of traffic management at major motoway road works.
[47] ETSC (2011) PRAISE Road Safety at Work Zones.

PART III
HIGH SPEED RURAL ROADS: POSSIBLE ALTERNATIVES TO MOTORWAYS

High speed rural roads are designed for fast moving traffic, so high infrastructure safety standards should be ensured

High speed rural roads

Some countries have identified among their rural roads other than motorways a category of roads built or adapted to a high standard for fast moving long distance traffic. These roads are referred to here as high speed rural roads. The definitions of high speed rural roads differ among the countries and so do the speed limits on these roads, which range between 80 and 130 km/h.

Table 2 provides information about definitions, lengths of high speed rural road networks and recent annual numbers of deaths on these roads in EU countries that have identified them. It also shows estimated annual average percentage changes in the number of deaths, with corresponding estimates for motorways in the same countries for comparison. It should be noted that, because the definitions of these roads in different countries differ so greatly, the percentage changes for these roads are not comparable between countries. The percentage changes indicate that progress in reducing deaths on these roads is broadly similar to that on motorways in about half the countries defining high speed rural roads. Two of the large differences arise from the rapid growth in the length and use of high speed rural roads in Hungary and Poland.

In the future, countries might upgrade some rural roads to high speed rural roads instead of building motorways in those locations. By their nature these roads are designed for fast moving traffic, so high infrastructure safety standards should be ensured.

Recommendations to EU institutions and Member States

- Give priority to high speed rural roads, if any, in extending application of the Infrastructure Safety Management Directive to cover all road networks.
- Investigate the safey potential of 2+1 roads when upgrading rural roads to high speed rural roads.

Table 2 : High speed rural roads

Definitions of high speed rural roads (HSRR)	Lengthof HSRR 2013 (km)	Average number of deaths per year on HSRR (2011-2013)	Average yearly percentage change 2004-2013	
			in deaths on HSRR	in deaths on motorways
In the Czech Republic high speed rural roads have similar design parameters to motorways except that some geometric standards may be relaxed. The speed limit on high speed rural roads is 130 km/h, the same as on motorways and these roads are limited to motor vehicles with operational speed of at least 80 km/h. The length of high speed rural roads increased by almost one third between 2007 and 2013.	458	10*	-13.7*	-9.2
High speed rural roads in Estonia are dual carriageways and they are considered as the first class roads. Their design standards are lower than motorways and the speed limit is 90 km/h. In summer season, which lasts from March till October, the speed limit might be raised to 110 km/h if the road section meets safety and side visibility criteria.	121	1	**	*
In Finland, all single carriageways with a speed limit of 80 km/h or above are regarded as high speed rural roads connecting the very dispersed pattern of settlements in the country. The length of these roads has changed by only a few per cent since 2003.	7112	78	-4.7	-4.1
In France high speed rural roads are dual carriageways with central barrier, limited to 110km/h and reserved for motor vehicles only ("voies express").	n/a	159	-3.8	-3.7
High speed rural roads in Hungary account for less than 1% of the total state road network. Around half of these roads are dual carriageways with the speed limit of 110 km/h and they are reserved for motor vehicles only. In the last ten years the length of high speed rural roads in Hungary has more than trebled while the number of vehicle-km driven on them has quadrupled, thus the annual increase in deaths by 9.3% over the same period signifies a substantial improvement in safety.	204	12	9.3***	-6.0
In Israel high speed rural roads are dual carriageways with the speed limit of 90 km/h or above. The length of these roads has increased by almost a quarter since 2003 and is almost 7 times that of the motorways. Reduction of deaths on the high speed roads can be partly attributed to continuous engineering developments including safer roadsides, better crash barriers, crash cushions and improvements at junctions.	1133	68	-5.9	-2.4
High speed rural roads in Norway have a speed limit of 90km/h and they are reserved for motor vehicles only.	453**	9	-7.7	-8.0
In Poland high speed rural roads have one or two carriageways, and grade separated junctions with all roads and motorways that cut across them, with at-grade public road junctions allowed in exceptional circumstances. The maximum speed is 120 km/h and these roads are designed solely for use by motor vehicles. The length of these roads has increased eightfold since 2003, so the annual average increase in deaths of 5% over the same period signifies a substantial improvement in safety.	818***	34	5***	-0.1
In Portugal high speed rural roads can be a single or dual carriageways, the speed limit is 100 km/h or above and the use of these roads is limited to motor vehicles.	n/a	66	-8.6	-7.4
In Slovakia high speed rural roads are of two kinds: roads for motor vehicles only like motorways with a speed limit of 130km/h but with narrower hard shoulders, and 2-lane single-carriageway roads with a speed limit of 90km/h and similar hard shoulders. The latter are open to cyclists and may terminate at at-grade junctions.	n/a	4	**	-14.4
Spanish high speed rural roads are single carriageways where the speed limit for passenger cars is 100 km/h. The total length of these roads is less than 0.06% of the total road network outside urban areas.	100*	5	-13.2*	-13.2
In Sweden high speed rural roads are 2+1 roads as discussed in detail in the section below Table 2.	2720	35**	n/a	-4.6
In Switzerland the majority of high speed rural roads are single carriageways with one lane in each direction, the speed limit is 100 km/h. These roads are called semi-motorways and they are reserved for motor vehicles only. The length of these roads has remained almost the same since 2005.	282	10	-8.1	-1.9
In Great Britain, the national speed limit for rural dual carriageways is 113km/h, compared with 97 km/h on rural single carriageways, except in each case where a lower local limit is imposed. Some of these dual carriageways have only grade-separated junctions, but others still have some at-grade junctions, and all are open to cyclists and pedestrians as well as all motor vehicles. The government has announced plans for some important sections to be freed from at-grade junctions and designated as expressways, creating a distinct category of road. In the meantime, all 113km/h dual carriageways are treated here as high speed rural roads. Their length has not changed greatly since 2003.	5000*	139	-8.7	-9.4
	*roughly *in 2011 ***in 2012	*deaths within 24 h **2009-2013	*2008-2013 **too few data to allow estimation ***greatly increased length	*no motorways

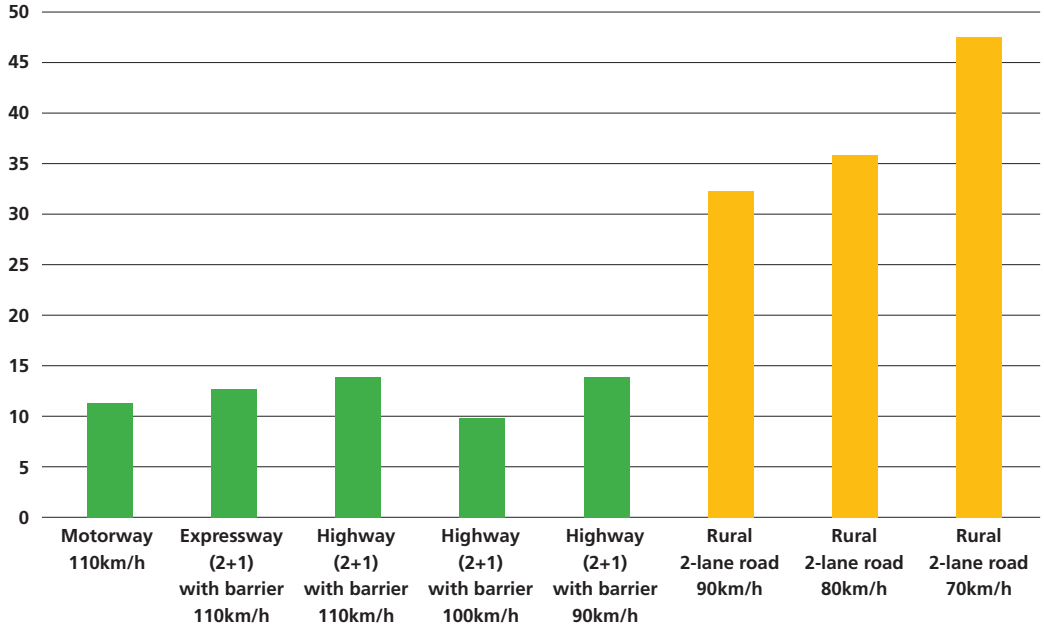
2+1 roads: near-motorway safety standards

A 2+1 road consists of two lanes in one direction of travel and one lane in the opposite direction. For traffic in each direction, the two-lane section, which provides a safe overtaking zone, alternates with a one-lane section at intervals of about 2km. Vehicles travelling in opposite directions are separated by a safety barrier system, which prevents overtaking manoeuvres on the one-lane section[48]. 2+1 design provides a smart and cost effective solution for upgrading major roads of appropriate width where traffic is too light to qualify for building a dual carriageway or motorway.

2+1 roads have been implemented in Sweden, and to a lesser extent in Germany, Finland and Denmark. In Sweden, about 5000 km of roads have separated traffic flow (covering around 45% of traffic flow on national roads, mainly rural), 2700 km of which are on 2+1 roads. To rebuild a rural road to a 2+1 road costs about one fifth of the costs of building a motorway.

Regarding the Swedish 2+1 roads, Carlsson's evaluation study from 2009 showed impressive reductions in deaths of almost 80% following the upgrade to 2+1 roads[49]. Carlsson's study also showed that, in contrast to what motorcyclists feared, there was no increase in collisions involving motorcyclists. On the contrary, the risk of death per vehicle-km travelled for motorcyclists decreased, in part because median barriers prevented motorcyclists from colliding with opposing traffic.

Fig. 7 People killed or serious injured (KSI) other than at junctions per billion vehicle-km in Sweden for some road types over the period 2009-2012.



"We have now more than 15 years of experience with 2+1 roads, and the results are very positive. The number of people killed per vehicle-km travelled on 2+1 roads is about the same as for motorways with speed limit 110 km/h, if we exclude junctions (Fig. 7). We upgraded 2720 km of rural roads into 2+1 roads and the reconstruction of a rural road (13 m) into a 2+1 road has shown that benefits are 2.6 higher than costs. With capacity only 15% less than a motorway, the level of service is almost as good as for motorways". Anna Vadeby, VTI.

[48] Breen, J.et al. (2008) An independent review of road safety in Sweden.
[49] VTI (2009) Evaluation of 2+1 roads with cable barrier.

ANNEXES

Country	ISO Code
Belgium	BE
Bulgaria	BG
Czech Republic	CZ
Denmark	DK
Germany	DE
Estonia	EE
Ireland	IE
Greece	EL
Spain	ES
France	FR
Croatia	HR
Italy	IT
Cyprus	CY
Latvia	LV
Lithuania	LT
Luxembourg	LU
Hungary	HU
Malta	MT
The Netherlands	NL
Austria	AT
Poland	PL
Portugal	PT
Romania	RO
Slovenia	SI
Slovakia	SK
Finland	FI
Sweden	SE
The UK	UK
Serbia	RS
Israel	IL
Norway	NO
Switzerland	CH

Table 1 (Fig. 1). Average yearly percentage change estimated over the period 2004-2013 in deaths on motorways

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Annual average % change between 2004 and 2013
LT	36	41	59	44	50	24	21	8	9	11	13	**-19.9%**
SK	16	20	19	15	19	13	9	13	8	5	5	**-14.4%**
ES***	1064	921	851	767	611	487	460	413	336	298	290	**-13.2%**
DK	31	27	31	16	24	31	24	26	12	8	12	**-10.9%**
RS**	n/a	n/a	n/a	n/a	n/a	82	71	58	57	44	49	**-10.9%**
AT	104	116	89	74	74	71	61	58	46	50	31	**-10.4%**
GB	217	164	204	187	183	158	132	118	106	88	100	**-9.4%**
CZ	48	58	45	37	48	30	25	28	21	22	25	**-9.2%**
NL	176	148	128	119	100	111	103	81	67	90	58	**-8.5%**
IT	711	648	577	590	526	452	350	376	338	330	321	**-8.3%**
PT(1)	127	116	98	84	128	96	89	111	84	58	44	**-7.4%**
EL*	58	116	111	147	140	120	108	87	81	57	n/a	**-6.9%**
DE	811	694	662	645	602	495	475	430	453	387	428	**-6.6%**
BE	136	124	158	168	152	139	151	105	119	87	89	**-6.4%**
HU	58	60	47	55	61	54	38	44	49	31	30	**-6.0%**
SI	34	37	20	33	37	13	30	19	20	20	16	**-5.6%**
SE	34	42	24	28	25	18	21	24	20	18	21	**-4.6%**
FI	7	17	10	17	14	9	12	4	11	13	8	**-4.1%**
HR	65	39	41	57	76	70	47	38	28	45	42	**-3.9%**
FR	439	312	323	292	273	233	225	238	268	223	261	**-3.8%**
RO	12	16	20	46	41	21	25	18	16	17	24	**-3.0%**
CH	58	51	25	31	47	27	34	23	22	63†	23	**-1.9%**
PL	37	42	33	55	54	35	43	28	37	44	40	**-0.7%**
CY	11	9	15	10	12	8	7	8	7	3	2	
IE	8	6	2	11	10	2	4	8	9	5	8	
IL	13	20	10	10	7	15	10	13	14	9	7	
LU	6	7	4	6	11	6	3	7	4	7	6	
NO	18	5	9	5	3	4	11	6	3	2	7	
BG	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
EU(2)	4,246	3,780	3,571	3,503	3,271	2,696	2,463	2,290	2,149	1,917	1,900(±)	**-8.2%**

Except for RS, the average of the numbers for 2003, 2004 and 2005 were used as the number of deaths in the baseline year of 2004.

* Average yearly percentage change estimated over the period 2004-2012 **2008-2013.

*** Deaths on motorways and autovias taken together.

(1) Increase in 2010 in Portugal is partly due to change in reporting methods. Prior to 2010 the number of people killed on motorways are people killed on the spot multiplied by a coefficient of 1.14. Since 2010 Portugal is able to collect deaths according to the EU common definition of any person killed immediately or dying within 30 days as a result of an injury accident.

(2) EU28 except BG. There are no motorways in EE, LV and MT.

(±) The number is rounded up to account for the lack of 2013 data for Greece at the time of publication.

CY, IE, IL, LU, NO are excluded from Fig. 1 as the numbers of deaths are small and are therefore subject to substantial annual fluctuation.

Source: Data were retrieved from the EU's CARE road safety database when available and completed or updated by national statistics provided by the PIN Panellists.

Table 2 (Fig. 2) Number of deaths in collisions on motorways per billion vehicle-km over the period 2011-2013

	Average number of deaths on motorways	Average number of vehicle-km travelled on motorways (in billions)	Deaths per billion vehicle-km
DK	11	13.775	0.8
GB	98	100.600	1.0
SE	20	16.300	1.2
NL	72	57.224	1.2
FI	11	6.792	1.6
CH	36	21.944	1.6
FR	251	143.267	1.7
AT*	51	29.166	1.8
NO*	4	1,987	1.9
DE*	423	220.667	1.9
IL	10	4.123	2.4
ES***	308	119.739	2.6
BE	104	36.263	2.9
SI	19	6.328	2.9
CZ	24	7.934	3.0
IT**	240	77.968	3.1
PT	62	16.159	3.8
HU	37	8.377	4.4
PL	36	7.545	4.8
LT	11	2.058	5.3
IE	7	n/a	n/a
EL	75	n/a	n/a
HR	38	n/a	n/a
CY	4	n/a	n/a
LU	6	n/a	n/a
RO	19	n/a	n/a
SK	6	n/a	n/a
RS	50	n/a	n/a

* 2010-2012
** Toll motorways only (representing 77% of the overall motorway network in Italy).
*** Deaths on motorways and autovias taken together.

Source: Estimations of vh-km travelled by cars supplied by PIN Panellists, IRTAD database was used to supplement this information.

Countries use various methodologies to estimate vh-km. The reader should bear in mind that comparison is hampered because of the differences in methods of collecting data on vh-km travelled.

Table 3 (Fig. 3) Percentages of the total number of road deaths by road type in 2011-2013

	Percentages of road deaths on motorways	Percentages of road deaths on rural roads	Percentages of road deaths on urban roads
ES	16%	59%	24%
LU	15%	59%	26%
SI	14%	50%	36%
BE	14%	55%	31%
CH	12%	48%	40%
NL*	12%	48%	38%
DE	12%	60%	29%
HR	10%	31%	59%
IT	9%	48%	43%
AT	8%	65%	27%
PT	8%	37%	55%
CY	7%	40%	53%
RS	7%	59%	34%
FR	7%	65%	28%
SE	7%	68%	25%
EL*	7%	45%	49%
HU	6%	57%	37%
GB	5%	61%	34%
DK	6%	61%	33%
IE	4%	74%	22%
FI	4%	73%	23%
LT	4%	61%	36%
IL	4%	53%	44%
CZ	3%	61%	36%
PL	1%	52%	47%
RO	1%	67%	32%
LV**	0%	70%	30%
EE	n/a	n/a	n/a
MT	n/a	n/a	n/a
SK	n/a	n/a	n/a
EU[1]	**7%**	**54%**	**39%**

[1] EE, MT, SK excluded from Fig. 3 due to insufficient data.
* EL, NL (2010-2012)
**There are no motorways in Latvia.

Source: Data were retrieved from the EU's CARE road safety database when available and completed or updated by national statistics provided by the PIN Panellists.

Table 4 (Fig. 4) Percentages of people killed on motorways by road user group in 2011-2013

	Car + taxi	Bus or coach	Heavy goods vehicle	Lorry, under 3.5 tonnes	PTW	Pedal cycle	Pedestrian	Other + unknown
IL	34%	6%	6%	19%	16%	3%	16%	0%
SI	39%	0%	5%	4%	5%	0%	18%	29%
CZ	44%	3%	31%	4%	1%	0%	16%	0%
PL	51%	1%	16%	0%	10%	0%	20%	2%
EL*	54%	0%	4%	5%	26%	0%	11%	0%
GB	55%	1%	13%	5%	9%	0%	17%	0%
SE	56%	0%	7%	5%	14%	0%	19%	0%
ES	57%	0%	7%	7%	11%	1%	15%	1%
HU	57%	13%	6%	5%	3%	0%	14%	1%
FR	58%	1%	7%	7%	17%	0%	10%	1%
RS	59%	3%	12%	2%	3%	0%	20%	0%
PT	61%	0%	3%	15%	10%	0%	10%	2%
FI	63%	0%	3%	3%	16%	0%	16%	0%
DE	63%	0%	17%	2%	11%	0%	7%	1%
RO	63%	0%	0%	14%	2%	4%	14%	4%
IT†	63%	1%	7%	9%	10%	0%	6%	3%
NL	65%	0%	4%	7%	11%	1%	10%	1%
CH†	65%	0%	1%	3%	15%	0%	16%	0%
BE	67%	2%	8%	9%	3%	0%	6%	3%
AT	69%	0%	6%	9%	2%	0%	15%	0%
LU	71%	0%	6%	6%	6%	0%	12%	0%
IE	73%	0%	0%	0%	9%	0%	18%	0%
DK	75%	0%	3%	9%	3%	0%	9%	0%
HR	76%	7%	0%	3%	5%	0%	10%	0%
CY	92%	0%	8%	0%	0%	0%	0%	0%
EU[(1)]	**61%**	**1%**	**9%**	**6%**	**11%**	**0%**	**10%**	**2%**

(1) EU except BG, LT, SK which were excluded due to insufficient data. There are no motorways in EE, LV and MT.
EL* (2010-2011)
† average years 2010-2012 for IT and 2010-2011-2013 for CH to remove effects of exceptional bus collision.

Source: Data were retrieved from the EU's CARE road safety database when available and completed or updated by national statistics provided by the PIN Panellists.

Table 5 (Fig.5) Mean speed of cars and vans on motorways

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AT 130	118	119	120	120	118	117	116	116	120	121	116
BE 120		120	120	121					118		
CZ 130		107	116	105							
DK 110	119	116	115	116	117	117	117	116	116	117	115
DK 130	120	120	120	121	122	122	123	121	121	120	
IE 120	106	108	109	110	108	107	108	n/a	109	109	111
ES 120**								M:117 A:114		M:118 A:108	
FR 110	112	111	109	109	109	108	107				
FR 130	124	121	119	119	120	118	118				
CY 100* on the left lane				98						99	
CY 100* on the fast lane				112						110	
LT 100*	92	100	100	97	99	98	101	101	97	93	
LT 110*	100	99	99	104	105	105	105	103	104	100	
LT 130*	105	106	108	104	113	111	112	111	112	110	109
LU 110*				105							
LU 130*				115							
HU 130				120	112	116					
NL 120	116	115	114	114	114	114	114	113	114		
PT 120		121								118	
SI 100*						111	110				
SI 130*						115	116				
FI 80		87	87	87	88	86	85	85	85	84	
FI 100	99	100	101	100	100	99	98	98	98	97	
FI 120	111	110	111	110	111	110	110	108	109	108	
SE 110	111	110								106	
GB 113	114	114	114	113	113	111	113	111	111	111	110
RS 120										119	
IL 110							119	114	119	118	
NO 100*	100	100	100	100	100	100	99	99	99		
CH 120*	114	111	111	110	107	109	109	108			

DE	n/a
EL 130	n/a
HR 130	n/a
IT 130	n/a
PL 140	n/a
RO 130	n/a
SK 130	n/a

CY 100*, LT 100*, LT 110*, LT 130*, LU 110*, LU 130*, SI 100*, SI 130*, NO 100*, CH 120*: All traffic. Separate data for cars and vans only are n/a.
ES 120** M = Motorways. A = Autovias.

Source: Data supplied by PIN Panellists.

Table 6 (Fig.6) Percentage of cars and vans driving above the speed limit on motorways

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
AT 130	24%	23%	25%	23%	22%	19%	17%	18%	23%	30%	15%
BE 120									41%		
CZ 130		11%	25%	35%							
DK 110					68%	70%					
DK 130					31%	32%					
IE 120	23%	19%	15%	20%	14%	15%	18%		16%	15%	21%
ES 120**								M: 49% A: 38%		M: 38% A: 26%	
FR 110	59%	54%	50%	52%	50%	47%	42%	40%	24%	24%	
FR 130	42%	31%	33%	32%	31%	32%	28%	23%	11%	15%	
CY 100* on the left lane				3%							
CY 100* on the fast lane				75%							
LT 100*	29%	48%	47%	40%	50%	54%	60%	55%	50%	37%	
LT 110*	32%	31%	34%	19%	42%	41%	41%	33%	37%	33%	
LT 130*	9%	15%	17%	17%	22%	19%	21%	20%	21%	19%	
LU 110*				5%							
LU 130*				5%							
HU 130				56%	48%	32%					
NL 100	45%	47%	45%	41%				43%	47%		
NL 120	42%	36%	36%	36%				33%	35%		
PT 120		54%								45%	
SI 100*						89%	9%				
SI 130*						17%	26%				
FI 80								71%	73%	68%	
FI 100 summer								52%	51%	50%	
FI 100 winter								35%	38%	35%	
FI 120 summer								37%	38%	37%	
FI 120 winter								59%	63%	60%	
SE 110	65%	64%								54%	
GB 113	57%	56%	56%	53%	53%	49%		49%	49%	48%	47%
RS 120										45%	
IL 110							77%	65%	75%	75%	
NO 90*		45%	34%	35%							
NO 100*		55%	49%	51%							
CH 120*	38%	30%	29%	26%	21%	22%	24%	18%			

BG 130	n/a
DE	n/a
EL 130	n/a
HR 130	n/a
IT 130	n/a
PL 140	n/a
RO 130	n/a
RO 110	n/a
SK 130	n/a

CY 100*, LT 100*, LT 110*, LT 130*, LU 110*, LU 130*, SI 100*, SI 130*, NO 100*, CH 120* All traffic. Separate data for cars and vans only are n/a.
ES 120** M = Motorways, A = Autovias.

Source: Data supplied by PIN Panellists.

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