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IMPACT ASSESSMENT

Accompanying the document

Proposal for a Directive of the European Parliament and of the Council amending Directive 2008/96/EC on road infrastructure safety management

{COM(2018) 274 final} - {SEC(2018) 226 final} - {SWD(2018) 176 final}

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Glossary

Term or acronym	*Meaning or definition*
Active safety	Vehicle safety systems that help avoid automobile accidents and minimise the effects of a crash. These include braking systems, like brake assist, traction control systems and electronic stability control systems
Advanced driver assistant systems (ADAS)	Vehicle systems that help the driver in the driving process
The Abbreviated Injury Scale (AIS)	The scale used in the medical world to express the severity of injuries. See also MAIS 3+
Black spot management	The identification and elimination of road sections with a historically high number of fatalities and serious injuries
CCAM	Cooperative, connected and automated mobility
Forgiving roads	This approach aims not only to prevent accidents, but also to lay out the road in an intelligent way such that unintentional driving errors do not result in serious injuries or fatalities.
MAIS 3+	Includes all road traffic victims with a MAIS score of at least three (i.e. a MAIS score of three, four, five or six).
Passive safety	Refers to features that help reduce the effects of an accident, such as seat belts, airbags and strong body structures
Portal area	Tunnel entrances and exits where open road sections connect to road tunnels
RISM	Road infrastructure safety management
Road assessment programme	A systematic network wide assessment of the built-in safety of the road
Road safety audit	An independent detailed systematic and technical safety check relating to the design characteristics of a road infrastructure project and covering all stages from planning to early operation
Road safety impact assessment	A strategic comparative analysis of the impact of a new road or a substantial modification to the existing network on the safety performance of the road network
Road safety inspection	A periodical verification of the characteristics and defects that require maintenance work for reasons of safety
Safe System	A holistic view of the road transport system and the interactions among roads, vehicles and road users
Self-explaining road	A road where the driver is encouraged to naturally adopt a behaviour consistent with the design and the function of the road
Serious injury	Traditionally for the purposes of the CARE database, "serious injury" has been defined as an injury that requires 24 hours or more of hospital care. As this definition has led to imprecisions in reporting, Member States have agreed to start collecting injury data based on a new definition in line with the "Maximum Abbreviated Injury Score" (see MAIS3+)
Star-rating of roads	Star ratings are based on road inspection data and provide a simple and objective measure of the level of safety which is ‘built-in’ to the road for vehicle occupants, motorcyclists, bicyclists and pedestrians. The
Vision zero	Vision Zero is a road safety approach that aims to achieve no fatalities or serious injuries involving road traffic
Vulnerable road users	Vulnerable road users include users of powered two-wheelers (motorcycles) and non-motorised road users (cyclists and pedestrians).

1. INTRODUCTION

The EU regulatory framework for road infrastructure safety management is composed of two Directives: Directive 2008/96/EC on road infrastructure safety management[1] (the RISM Directive) and Directive 2004/54/EC on minimum safety requirements for tunnels in the trans-European road network[2] (the Tunnel Directive).

The current legislation covers roads and tunnels within the Trans-European Transport Network (TEN-T), a network of major European roads (primarily motorways and national/main roads) that is defined in the TEN-T Guidelines[3]. The TEN-T road network makes up about 4% of the EU road network (excluding urban roads).

The RISM Directive and the Tunnel Directive have, according to evaluations carried out in 2015[4,5], delivered on their objective to improve the design, maintenance and safety management of roads and tunnels across Europe, and have contributed substantially to the reduction of road fatalities in Europe over the last decade. However, the evaluations also highlighted some factors that prevented the legislation, in particular the RISM Directive, from exploiting its full potential and some areas in which the legislation may need to be updated in view of new technological developments.

This report builds on the outcome of the ex-post evaluations of the two Directives as well as on an impact assessment support study[6]. It verifies the existence of a problem which could be solved by a revision of these Directives and assesses the options for their revision. Reflections on whether and how the two Directives should be amended should be seen as part of the preparation of an EU road safety policy framework for the period 2020-2030 (to be proposed as part of the Third Mobility Package in May 2018).

Progress in the reduction of road fatalities and serious injuries on EU roads has stalled in recent years, and a revised framework better adapted to this challenge and to the changes in mobility resulting from societal trends (e.g. more cyclists and pedestrians, an aging society) and technological developments is necessary. The complex situation calls for a dynamic policy adjustment that addresses the major challenges in a consistent and effective way across the entire spectrum of road safety policies. The framework will follow the Safe System approach. This approach is based on the principles that human beings can and will continue to make mistakes and that it is a shared responsibility for actors at all levels to ensure that road crashes do not lead to serious or fatal injuries. In a Safe System approach, the safety of all parts of the system must be improved – roads and roadsides, speeds, vehicles and road use so that if one part of the system fails, other parts will still protect the people involved.

It is estimated that road infrastructure and road surroundings are a contributing factor in more than 30% of crashes.[7] On the other hand, well-designed and properly maintained roads can reduce the probability of road traffic accidents, while "forgiving" roads (roads laid out in an intelligent way that ensures that driving errors do not immediately have serious consequences) can reduce the severity of accidents that do happen. This is why infrastructure safety will play an important part in the policy framework for the next decade.

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[1] Directive 2008/96/EC of the European Parliament and of the Council of 19 November 2008 on road infrastructure safety management, OJ L 319, 29.11.2008, p. 59–67

[2] Directive 2004/54/EC of the European Parliament and of the Council of 29 April 2004 on minimum safety requirements for tunnels in the Trans-European Road Network, OJ L 167, 30.4.2004, p. 39‑91

[3] Regulation (EU) No 1315/2013 of the European Parliament and of the Council of 11 December 2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU, OJ L 348, 20.12.2013, p. 1–128

[4] http://ec.europa.eu/transport/facts-fundings/evaluations/doc/2014-12-ex-post-evaluation-study-road-infra-safety-mgmnt.pdf

[5] http://ec.europa.eu/transport/facts-fundings/evaluations/doc/tunnel_final_report.pdf

[6] COWI/SWOV (2017), "Impact assessment support study for the revision of Directive 2008/96/EC on road infrastructure safety management and Directive 2004/54/EC on minimum safety requirements for road tunnels in the trans-European network"

[7] Danish Road Traffic Accident Investigation Board (2014), "Why do road traffic accidents happen?"; Elvik, Hove et al (2012), "The Handbook of Road Safety Measures"

Infrastructure safety management procedures have to be ready for new technological developments. The review of the two directives, as well as the overall framework, needs to take into account developments in connected and automated driving, which are advancing at high speed. Therefore, the present exercise is closely linked to initiatives that are part of the Commission's Strategy on Cooperative Intelligent Transport Systems (C-ITS)[8], in particular the upcoming proposal for a strategy for Connected and Automated Mobility Systems.

The initiative is also closely linked to the proposal for the revision of the General Safety Regulation[9] and the Pedestrian Safety Regulation[10], aiming to raise the bar in the rules on vehicle safety through additional safety features, including accident avoidance technologies and features to protect vulnerable road users. The two initiatives do not only share a common baseline, but they also interlink where vehicle technology relies on infrastructure (e.g. visible road markings to support lane keeping assistance technologies). They are part of a broad set of measures addressing road safety from the Safe System perspective.

According to the Safe System approach[11], death and serious injury in road collisions are not an inevitable price to be paid for mobility. While collisions will continue to occur, death and serious injury are largely preventable. The Safe System seeks to better accommodate human errors, which are often simple errors of perception or judgment by otherwise compliant users, whilst also dealing with misbehaviour. It is a shared responsibility of actors at all levels and from all relevant sectors to ensure that road crashes do not lead to serious or fatal injuries. Better vehicle construction, improved road infrastructure, lower speeds for example all have the capacity to reduce the impact of accidents, and addressing one factor alone will not be enough. The aim is to create several layers of protection so that when one element fails, others will compensate for it. For example, if a drowsy driver veers from his lane, vehicle technology can alert him or gently correct the vehicle's trajectory. Rumble strips provide another warning. Should the vehicle nevertheless leave the road, a "forgiving roadside" without dangerous obstacles or with an energy absorbing roadside barrier can prevent serious consequences. Finally, crash absorbing vehicle design, along with seatbelts and airbags, protect vehicle occupants. The Safe System approach is being adopted increasingly in EU Member States, regions and cities. It is recommended globally by the World Health Organisation[12].

1.1. Policy and legal context

1.1.1. EU policy context

Road safety in the EU has greatly improved over the past decades, thanks to action at EU, national, regional and local level. Between 2001 and 2010, the number of road deaths in the EU decreased by 43%, and between 2010 and 2016 by another 19%. In 2016, 25,620 people lost their lives on EU roads, 510 fewer than in 2015 and almost 5,900 fewer than in 2010 (see Figure 1). This is a substantial reduction, but it appears unlikely at this stage that we will meet the first part of the EU's strategic objective, which is to halve the number of road deaths by 2020 compared to 2010. In order to move close to zero deaths and serious injuries by 2050 (as

[8] Communication from the Commission "A European strategy on Cooperative Intelligent Transport Systems, a milestone towards cooperative, connected and automated mobility" (COM/2016/0766 final)
[9] 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, OJ L 200, 31.7.2009
[10] Regulation (EC) No 78/2009 of the European Parliament and of the Council of 14 January 2009 on the type-approval of motor vehicles with regard to the protection of pedestrians and other vulnerable road users; OJ L 35, 4.2.2009
[11] OECD/International Transport Forum (2016): "Zero Road Deaths and Serious Injuries: Leading a paradigm shift to a Safe System", OECD Publishing, Paris; and http://www.visionzeroinitiative.com/
[12] http://www.who.int/roadsafety/decade_of_action/plan/plan_en.pdf

set out in the "Vision Zero" approach)[13], a major paradigm shift will clearly be needed which is beyond the scope of this impact assessment report.

Although some Member States are still making considerable progress every year, EU-wide road fatality rates have stagnated in recent years, with some Member States even reporting slight increases. The causes are diverse, including structural factors (urbanisation; a growing number of cyclists and pedestrians; an ageing population; fewer resources for enforcement, road maintenance and vehicles following the economic crisis) and behavioural factors (distraction by electronic devices; speeding; alcohol). The lack of detailed data makes a precise analysis difficult. It is however clear that much of the low hanging fruit for policy making at national and EU level have been picked and that it is unlikely that the EU objective of a 50% reduction in road fatalities between 2010 and 2020 will be reached. A paradigm shift is needed towards a framework based on results that addresses the major challenges in an effective and flexible way across the entire spectrum of road safety policies. Such a framework will be proposed for the period 2020-2030 as part of the third Mobility Package and will follow the Safe System approach.

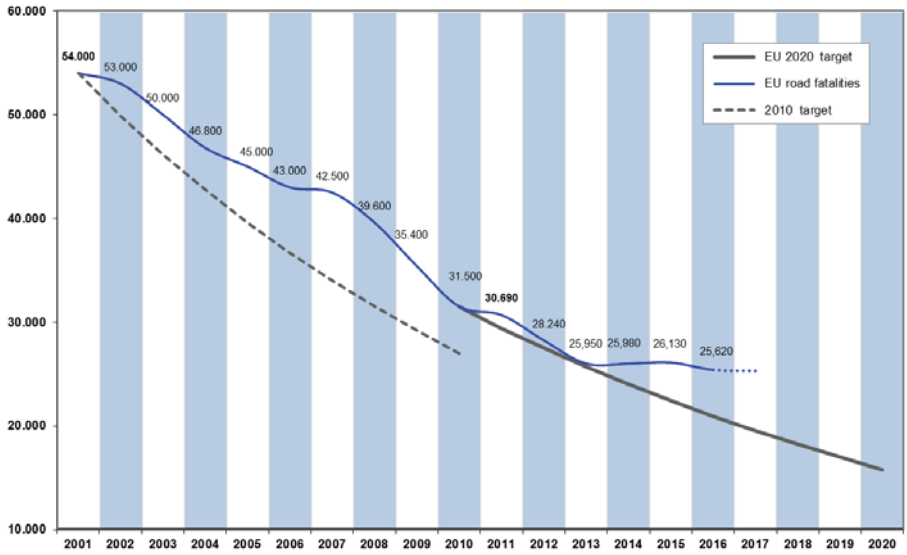
This situation is common to many developed countries, where the positive trend in reducing road fatalities of the past years did not continue in 2015 and 2016 (see next section on international context).

Road safety actors in the EU have reacted to the slowdown with renewed commitment to the cause, as expressed by EU transport ministers in the Valletta Declaration on road safety[14] of March 2017. In the Declaration, ministers confirmed that road safety "*requires concrete and joint action by the institutions of the European Union, the Member States, regional and local authorities, industry and civil society*". They undertook to "*continue and reinforce measures necessary to halve the number of road deaths in the EU by 2020 from the 2010 baseline*" and to set a target of halving the number of serious injuries in the EU by 2030 from the 2020 baseline. They committed, among other things, to improving "*the safety of road users by developing safer infrastructure, bearing in mind the possibility of extending the application of infrastructure safety management principles beyond the Trans-European Transport Network (TEN-T) roads".*

Working towards the EU's strategic objectives to halve the number of road deaths by 2020 compared to 2010 and to move close to zero deaths by 2050 ("Vision Zero" approach) requires a wide range of measures. Experts agree[15] that contributions towards these targets will have to come from all areas of road safety policy. Measures addressing speed, drink-driving and vehicle safety, and – to a slightly lesser extent – measures addressing road infrastructure, protective equipment (seatbelts, child restraints) and post-crash care, are generally regarded as having the highest potential impact. Vehicle and infrastructure safety are being addressed in the present proposals. Further complementary actions will be assessed in the future, subject to separate impact assessments.

[13] Communication from the Commission "Towards a European road safety area: policy orientations on road safety 2011-2020" (COM(2010) 389 final)
[14] http://data.consilium.europa.eu/doc/document/ST-9994-2017-INIT/en/pdf
[15] The SafetyCube (Safety CaUsation, Benefits and Efficiency) review project, financed under Horizon2020, synthesises relevant research: https://www.safetycube-project.eu/

Figure 1: Evolution of EU road fatalities and targets for 2001-2020



Source: CARE database[16]

1.1.2. International context

At global level, the EU is the region with the safest roads. Its fatality rate of 50 deaths per million inhabitants in 2016 compares to 93 deaths per million for the entire European region and 174 deaths per million globally. The total number of road traffic deaths in the world is around 1.25 million per year.

In many developed countries, the positive trend in reducing road fatalities of the past years did not continue in 2015 and 2016, with fatality figures even increasing in some countries (e.g. United States, Australia).[17] This illustrates that the trend of stagnating road safety figures in the EU is not an isolated phenomenon, but the expression of a trend that has led to increased fatality rates in other developed parts of the world.

1.1.3. EU legal context

Infrastructure safety management has been a strong focus of EU road safety policy since the adoption of the White Paper on Transport policy[18] in 2001 and the European Road Safety Action Programme 2003-2010[19].

The RISM Directive was adopted with the purpose to ensure that road safety considerations are part of all phases of the planning, design and operation of road infrastructure, to work towards a consistently high level of safety of roads across Member States and to use the limited funds for more efficient construction and maintenance of roads. The RISM Directive defines guidelines and best practices without imposing specific technical standards or measures on Member States. The main management instruments are road safety impact assessments (strategic analysis at the planning stage), road safety audits (from design to early

[16] Community Road Accident Database, the European centralised database on road accidents which result in death or injury across the EU

[17] In the United States, the year 2015 ended a five-decade trend of declining fatalities (albeit at a much higher level of fatalities than in the EU with 109 deaths per million inhabitants) with a 7.2% increase in deaths over 2014. Provisional data for the first 9 months of 2016 indicates an additional 8% increase in fatalities over the same period in 2015. In Australia, where road deaths have decreased by 34% since 2000 (to 49 deaths per million inhabitants), the trend has also been reversed since 2014. Road deaths increased by 4.8% in 2015, with provisional data from 2016 indicating a further increase of 7.2%. Canada, which reduced its fatality rate by 36% since 2000, has seen stagnating figures in 2015 (at 52 deaths per million inhabitants). Source: OECD "Road Safety Annual Report 2017"

[18] White Paper "European transport policy for 2010: time to decide" (COM(2001) 370 final)

[19] Communication from the Commission "European road safety action programme – Halving the number of road accident victims in the European Union by 2010: a shared responsibility" (COM(2003) 311 final)

operation), road network safety management (regular safety ranking and follow-up at accident prone locations) and safety inspections (periodic checks).

As regards tunnel safety, major accidents in the tunnels of Mont Blanc and Tauern in 1999 and St. Gotthard in 2001 prompted work at Member State, EU and international levels. The EU became involved following a request by its Heads of State. The Tunnel Directive aims to prevent the occurrence of fires and accidents in tunnels and to provide improved protection of road tunnel users in the event of an accident. It defines organisational and technical requirements that need to be fulfilled in order to provide a minimum level of safety in road tunnels longer than 500 metres that are part of the trans-European road network. The Directive requires Member State authorities to take safety measures in existing TEN-T tunnels, to clearly allocate responsibilities amongst entities involved, to improve tunnel safety management procedures (e.g. periodic inspections), and to design and manage new tunnels to at least a common minimum standard.

Since the adoption of the two directives, the EU legislative framework for road safety has evolved, notably as regards the education and training of road users (Directive 2006/123/EC on driving licences[20], introducing a European format for licences, Directive 2003/59/EC on the initial qualification and periodic training of bus and lorry drivers[21] - currently being revised), enforcement (Directive 2015/413/EC on cross-border exchange of information for enforcement[22]) and vehicle safety, in the form of the "Roadworthiness Package"[23] (Directive 2014/45/EC, Directive 2014/46/EC and Directive 2014/47/EC, helping to eliminate unsafe vehicles from the roads) and type-approval requirements for new vehicles in the form of the Vehicle General Safety Regulation (EC) 661/2009[24].

As regards the Vehicle General Safety Regulation, new safety features (seatbelt reminders for drivers, ISOFIX child seat anchorages) became mandatory in November 2014 for every new car, van, truck and bus sold in the EU. As of November 2015, all new trucks and buses have to be equipped with advanced emergency braking systems and lane departure warning systems. The General Safety Regulation is currently being reviewed with a view to making additional safety features mandatory.

The Construction Products Regulation (EU) No 305/2011[25] led to the elaboration of harmonised product standards for a number of construction products relevant for road infrastructure safety (e.g. road marking materials, vertical road traffic signs, road restraint systems etc.) and obliged the manufacturers of these products to CE mark their products and issue a Declaration of Performance regarding their performance[26]. This helps road infrastructure managers to procure construction products that fulfil their own performance requirements. The Regulation, however, does not impose performance requirements (i.e.

[20] Directive 2006/123/EC of the European Parliament and of the Council of 12 December 2006 on services in the internal market, OJ L 376, 27.12.2006, p. 36–68

[21] Directive 2003/59/EC of the European Parliament and of the Council of 15 July 2003 on the initial qualification and periodic training of drivers of certain road vehicles for the carriage of goods or passengers, amending Council Regulation (EEC) No 3820/85 and Council Directive 91/439/EEC and repealing Council Directive 76/914/EEC, OJ L 226, 10.9.2003, p. 4–17

[22] Directive (EU) 2015/413 of the European Parliament and of the Council of 11 March 2015 facilitating cross-border exchange of information on road-safety-related traffic offences, OJ L 68, 13.3.2015, p. 9–25

[23] European Commission press release: "Road safety: Tougher vehicle testing rules to save lives" of 13 July 2012, http://europa.eu/rapid/press-release_IP-12-780_en.htm?locale=en

[24] 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, OJ L 200, 31.7.2009, p. 1–24

[25] Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

[26] Several harmonised European standards are now available and must be used by the manufacturers in order to place their products in the EU market by affixing the CE Marking and issuing a Declaration of Performance for the following products (e.g. EN 1317-5: Road restraint systems - Product requirements and evaluation of conformity for vehicle restraint systems; EN 1423: Road marking materials - Drop on materials; EN 1463-1: Road marking materials – Retro-reflecting road studs - Performance requirements, etc.). In absence of a harmonised standard, the European Assessment Documents recently elaborated by the European Organisation for Technical Assessment (EOTA) under the Regulation (EU) No 305/2011 allow the CE marking and the Declaration of Performance for: EAD 230011-00-0106 on road paints, and EAD 120001-01-0106 on microprismatic reflective sheets used in traffic signs.

thresholds of performance for road barriers) on manufacturers so it is up to road infrastructure managers to decide what performance requirements they aim to fulfil with the products and procure them from manufacturers accordingly.

1.2. Assessment and monitoring

The Commission has assessed the implementation and effectiveness of both the RISM Directive and the Tunnel Directive. The findings from the ex-post evaluations have been described in two separate Evaluation Reports[27,28] and can be summarised as follows:

- The RISM Directive has triggered a different way of thinking about and dealing with road safety management. Firstly, it has encouraged a generalised use of the road infrastructure safety management procedures which are now established in all Member States and which are based on a minimum set of compulsory EU rules in the management of TEN-T roads. Secondly, the Directive provides a "common language" for carrying out road infrastructure safety measures. At national level, the Directive has prompted a normative and operational process that would not have taken place in such a widespread manner without EU intervention. On the other hand, the Directive does not seem to have provided an incentive to extend the exchange of good practices across Member States and has not led to increased mobility of road safety professionals across Member States. Furthermore, the scope of the Directive is limited to TEN-T roads which are mostly motorways and account for only about 8% of the total road fatalities in the EU. However, the majority of Member States apply one or more of the road safety management procedures of the Directive to parts of their road networks beyond the TEN-T on a voluntary basis.
- The Tunnel Directive has had a positive influence on road tunnel safety management, even though the task of making all TEN-T road tunnels in the scope of the Directive compliant with the Directive's requirements was far from complete at the time of the ex-post evaluation and thus the minimum safety standard prescribed by the Directive not yet in place throughout the EU. The Directive set a deadline of 2014 for tunnel refurbishments, with a possibility of an extension until 2019 for Member States with a higher than average density of tunnels. The evaluation noted that in the Member States with the 2014 tunnel refurbishment deadline, 82% of the tunnels in scope (as measured by total tube length) were compliant with the provisions of the Directive while in the Member States with a deadline extension to 2019[29] only 17% of the tunnels were compliant. Considering the EU as a whole, the overall compliance rate was 30% when assessed on total tube length and 26% when measured on the basis of the number of tunnels. The evaluators concluded that some of the Member States with a large number of tunnels will face significant challenges in meeting their 2019 deadline. However, the Directive has had a positive effect regarding the awareness of the problem of tunnel safety, has prompted investment that successfully complements other road safety measures, has improved the capacity of tunnel managers and emergency services to manage dangerous events and to prevent and mitigate the effects of accidents and fires, and it has triggered research into new technological solutions.

Since the publication of the ex-post evaluation Denmark, Germany, Luxembourg and the United Kingdom have completed the refurbishment of their existing tunnels and are now fully compliant with the Directive. As for the Member States with the 2014 deadline, three of them (Belgium, Bulgaria and France) still have tunnels that are not fully compliant with the Directive. As for the Member States with the 2019 deadline, only Luxembourg has

[27] http://ec.europa.eu/transport/facts-fundings/evaluations/doc/2014-12-ex-post-evaluation-study-road-infra-safety-mgmnt.pdf
[28] http://ec.europa.eu/transport/facts-fundings/evaluations/doc/tunnel_final_report.pdf
[29] Austria, Greece, Italy, Luxembourg, Slovenia, Spain and Croatia

successfully completed the refurbishments and Italy has by far the most infrastructure related upgrades to perform as about two thirds of all the tunnels to be upgraded in the EU are located in Italy. Except for the compliance issue, the evaluation of the Tunnel Directive did not identify any major issue and concluded that the existing legislation was fit for purpose.

Neither of the two evaluations provided any evidence that the integration of the RISM Directive with the Tunnel Directive would further improve the safety of the road tunnels on the TEN-T, but both evaluations noted that further investigation would be necessary to determine whether there was any positive impact to be achieved by merging the Directives.

2. PROBLEM DEFINITION

Figure 2 presents the intervention logic of the initiative, identifying the general problem, the main problems and problem drivers and the general and specific objectives.

2.1. General problem: High number of fatalities and injuries on EU roads with road infrastructure being an important crash cause and severity factor

The general problem that the initiative intends to tackle is the high number of fatalities and injuries on EU roads, for which road infrastructure remains an important crash cause and severity factor.

In 2016, 25,620 people were killed on EU roads and about 246,000 were seriously injured[30]. While most Member States have improved their road safety records since 2010, there is still a significant gap in performance across the EU. In 2016, countries with the lowest fatality rate per million inhabitants were Sweden (27 per million inhabitants), the UK (28 per million inhabitants), the Netherlands (33 per million inhabitants), Spain (37 per million inhabitants), Denmark (37 per million inhabitants), Germany (39 per million inhabitants) and Ireland (40 per million inhabitants). Those with the weakest road safety records and around three times higher fatality rates were Bulgaria (99 per million inhabitants), Romania (97 per million inhabitants), Latvia (80 per million inhabitants) and Poland (79 per million inhabitants). Despite the wide gap between the fatality rates of the best performing and the worst performing Member States, a general trend can be observed over the past 10 years whereby the performance of all Member States is converging towards the performance of the best performing Member States (see Figure 3).

[30] For the purposes of the CARE database, "serious injury" has been defined as an injury that requires 24 hours or more of hospital care. CARE data is based on police reports. As this definition has led to imprecisions in reporting, Member States have agreed to start collecting injury data based on a new definition in line with the "Maximum Abbreviated Injury Score" (MAIS3+). Based on data from a majority of Member States, the number of serious injuries per year in the EU is now estimated to be around 135,000. However, as the data set is still incomplete and historical data is missing, calculations in this document are based on CARE data.

Figure 2: Intervention logic

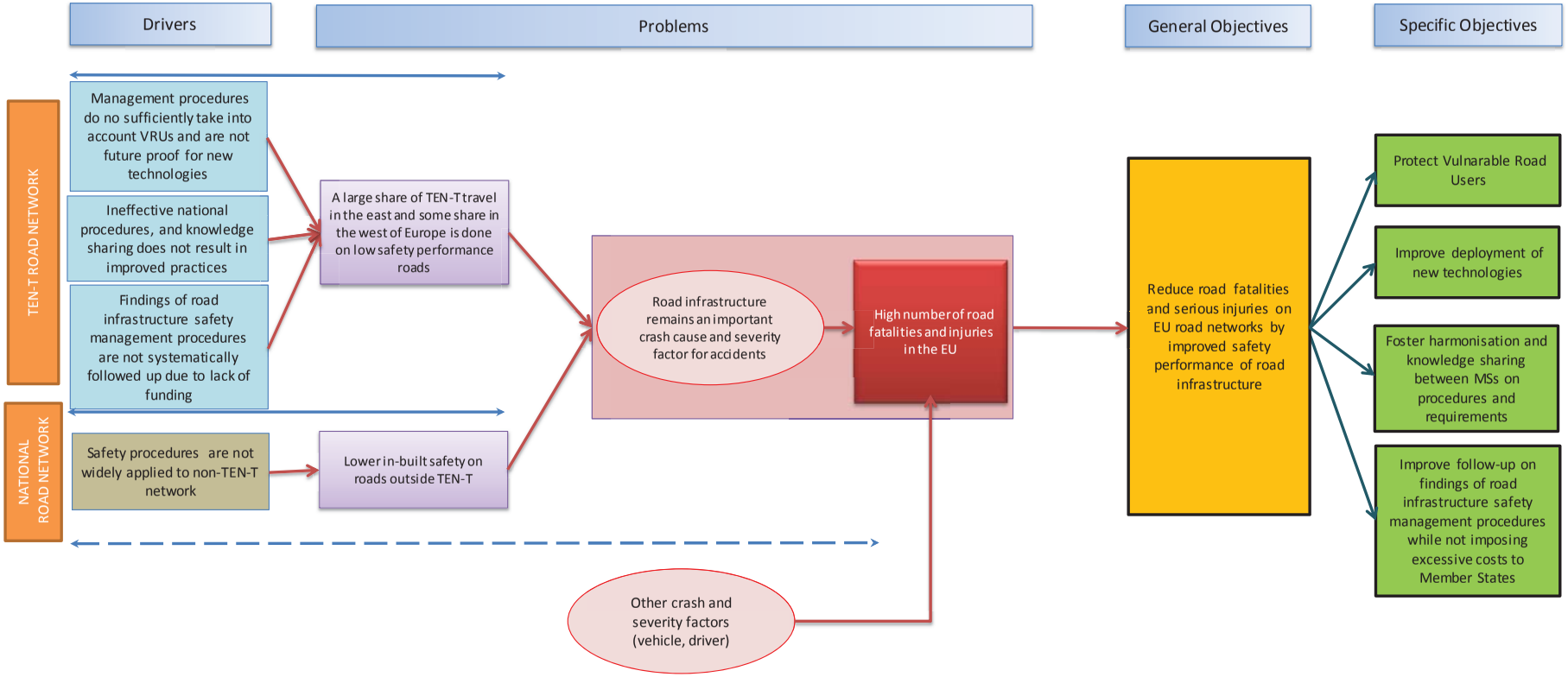
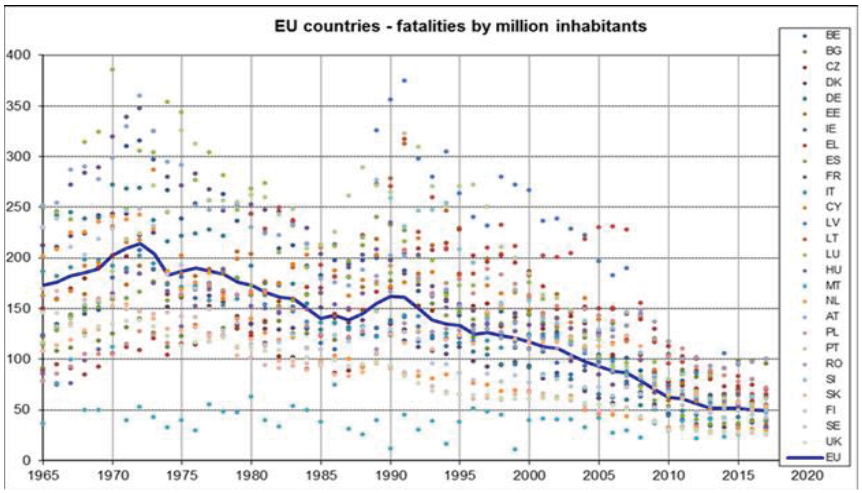


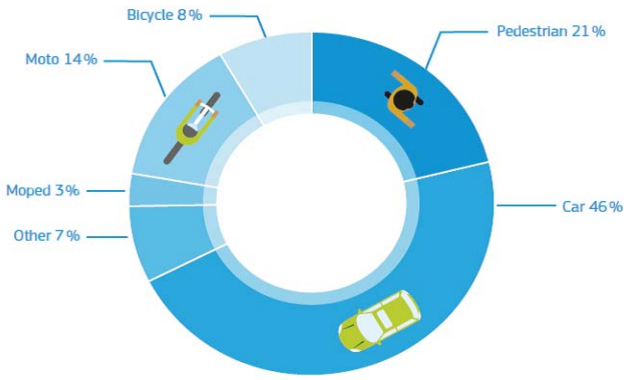
Figure 3: Evolution of road fatalities per million inhabitants in the EU



Source: CARE database

Car occupants accounted for the largest share of victims in 2016 (46%), while 21% of all people killed on roads were pedestrians. Cyclists accounted for 8% and motorcyclists, who are less protected during a crash, accounted for 14% of road fatalities. In general, fatalities among vulnerable road users have over the years decreased much more slowly than fatalities among all road users. Pedestrians and two wheeler deaths combined are 46% of the total – the same as the total for all deaths of car occupants – and are particularly exposed in urban areas. For the period 2000-2010, fatalities for all road users decreased by 45%, whereas it decreased by 38% for vulnerable road users. For the period 2010-2015, fatalities for all road users decreased by 16%, whereas fatalities of vulnerable road users decreased by 13%. The number of vulnerable users is likely to increase, in particular in urban areas, as a result of the promotion of more sustainable modes of transport, and therefore the exposure to risk.

Figure 4: Road fatalities by transport mode in 2016



Source: CARE database

On average only about 8% of road fatalities occurred on motorways. 37% of fatalities happened in urban areas while most fatalities (55%) happened outside urban areas on non-motorways. *Motorways are the safest type of road by definition and by design.* Segregated unidirectional traffic flows, the absence of horizontal crossings and the absence of pedestrians mean that despite the higher travel speeds it is much safer to travel on a motorway than to travel on any other type of road.

From an economic point of view, the yearly cost of road fatalities and serious injuries is estimated to be about EUR 121 billion[31]. These costs comprise individual costs and suffering

[31] COWI/SWOV (2017), "Impact assessment support study for the revision of Directive 2008/96/EC on road infrastructure safety management and Directive 2004/54/EC on minimum safety requirements for road tunnels in the trans-European network"

and costs to the society in the form of output loss, material expenses and combined police and medical expenses.

Measuring accident costs

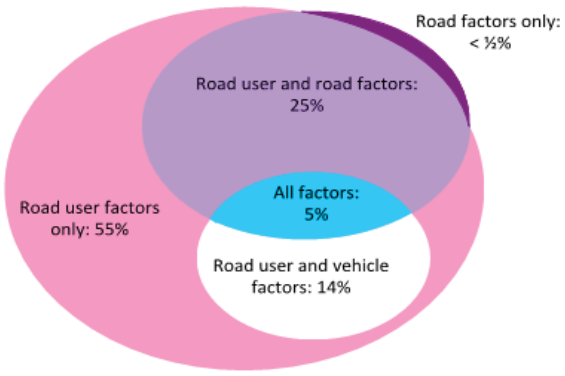
According to the Handbook on external costs of transport (2014), the basis for the measurement of accident costs - the main element being the cost of fatality - is the estimates of the value of statistical life (VSL). VSLs mostly come from valuation studies where participants are asked to assess their own willingness to pay for accident risk reduction. A VSL is therefore by no means the intrinsic value of life, but rather the price that individuals implicitly attribute to their lives when they make economic decisions: it can be derived, for example, from the price that consumers are willing to pay for a feature reducing the risk of fatal accident by a certain percentage. As they are based on economic decisions, estimates of the VSL differ across age groups, income levels, types of risks under assessment, etc., and evolve over time. In particular, VSL estimates vary across EU countries, reflecting differences in population income and risk characteristics. With this in mind, it is important to ensure consistency in the methods and assumptions used for calculating country-level and EU-level VSLs. The Handbook on external costs of transport (2014) has based its calculations on the UNITE study (2002), updated to represent the average income level in the EU in 2010 prices, which amounts to an EU-wide VSL of €1.8 million. Following HEATCO (2006) recommendations, the value of a severe injury is assumed to be 13% of the fatality value, while a light injury is valued at 1% of the fatality value. These estimates are a tool to support decision making, despite their limitations and their inability to capture all the effects of the loss of human life.

The role played by users, vehicles and infrastructure in the high number of road fatalities and injuries is analysed in terms of:

- their contribution to the occurrence of a crash (= "crash factor") and
- their contribution to the severity of a crash, when it does happen (= "severity factor").

The traditional understanding of road crash causation was based on the perception that driver or road user error was the predominant cause of road accidents but the emergence of the Safe System approach has put this perception in a different context. While road user factors are still the leading crash factor, there is converging scientific evidence[32] indicating that road infrastructure and road surroundings are an important crash factor in about 30% of accidents leading to fatalities. Road conditions can be the single most lethal factor in serious crashes, ahead of speeding, alcohol and non-use of seatbelts[33]. Addressing the human factor alone cannot address a significant proportion of accidents as there are indications that even if all road users complied with all road rules, 40% of fatalities would still happen[34].[35].

Figure 5: Shares of crashes caused by road user, vehicle and road factors



Source: Danish Road Traffic Accident Investigation Board (2014)

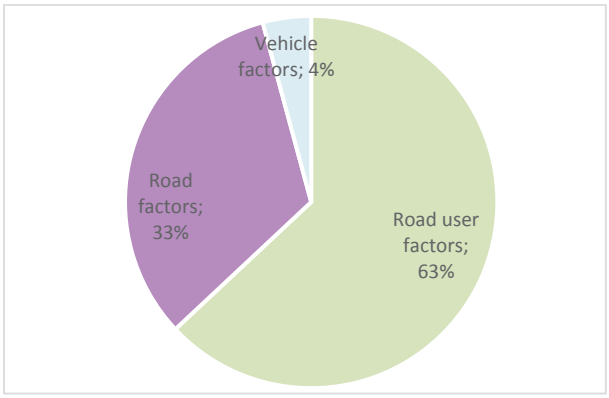
[32] See for example Danish Road Traffic Accident Investigation Board (2014)
[33] Road infrastructure Safety Management Research Report, ITF (2015)
[34] Elvik and Vaa (2004)
[35] PIARC Road Safety Manual

Similar figures can be found in the literature for other European countries, which suggests that a figure around 30% can be regarded as a mean estimate.[36] For example, a study for Romania shows that the main risk factors are similar to those in other countries.[37] Figures from the US and from Australia show similar tendencies.[38] Only data from UK accident records suggests a lower influence: in one recent study, the road environment was found to be a factor in 18.8% of accidents in the UK.[39]

In addition, road infrastructure plays an important role in the severity of about a third of road accidents.[40] If a complicated road layout or difficult driving conditions (slippery road surface, bad visibility of road markings) place high demands on human performance, errors are more likely to have more severe consequences than in more straightforward circumstances.

Therefore, better enforcement of traffic rules, while crucial, cannot in itself successfully prevent all road traffic accidents. Conversely, positive infrastructure measures can often more effectively influence human behaviour than other measures, such as driver training or police enforcement. Although the overall effects of road infrastructure as a crash cause and as a severity factor taken together have not been studied, for analytical purposes it is reasonable to assume from the above that infrastructure plays a role both in causing accidents and in determining their outcome at a magnitude of around 30%.

Figure 6: Shares of severity factors in road accidents



Source: Based on figures from the Danish Road Directorate (2016)

Lack of consistent data about the location of road traffic accidents in the EU, a lack of common classification of road types and lack of information about the input and output of road infrastructure safety management procedures create difficulties for the impact assessment, making it necessary to extrapolate limited available data in some places. The need for a more harmonised road classification across Europe has already been identified by EuroGeographics, the association representing European National Mapping, Cadastre and Land Registry Authorities[41] that has developed EuroRegionalMap (ERM), a pan-European map and dataset containing topographic information in GIS format.

A similar classification of roads together with harmonised requirements as regards the identification of road traffic accidents might be helpful to determine the optimal scope of EU-wide road infrastructure safety management measures and to monitor their impact.

[36] Elvik, Hove et al (2012)
[37] Petre Liviu Munteanu et al (2014)
[38] Lum and Regan (2015), found in Roshandel, Saman, Zheng, Zuduo, Washington, Simon
[39] Jenkins (2015)
[40] Danish Road directorate (2016)
[41] http://www.eurogeographics.org

2.2. Main problems

2.2.1. Main problem 1: A large share of TEN-T travel in the East and some share in the West of Europe is on roads with low safety performance

There are considerable regional differences at the level of infrastructure safety of TEN-T roads but current EU legislation does not provide for a common methodology to measure the crash risk of road infrastructure. Some relevant and comparable data is, however, available from the European Road Assessment Programme (EuroRAP), an international non-profit organisation of automobile clubs, road authorities and researchers. EuroRAP has carried out road assessment programmes across many EU Member States with a view to providing evidence based safety ratings of the assessed roads to benchmark crash and infrastructure risk, inform investment priorities and track performance over time. These programmes result in infrastructure safety ratings of between 1 and 5 stars (the higher the number of stars, the higher the safety of the road). Star ratings are awarded for roads overall and differentiated for pedestrians, cyclists, motorcyclists and vehicle occupants. The roads assessed belong predominantly to TEN-T. In Western Europe, EuroRAP found that only an estimated 15% of the network length was below the 3-star benchmark (the minimum safety rating target advocated globally by the International Road Assessment Programme[42], whereas in Eastern Europe the corresponding figure was 58%.[43]

Table 1: Safety levels of national roads in selected European Member States using iRAP/EuroRAP methodology[44]

Country	Average	Fatalities per mio. vkm	<1 star	2 star	3 star	4 star	5 star
UK	3.8	1.4	2%	6%	20%	51%	21%
Netherlands*	>3	1.7	0%	0%	100%	0%	0%
Spain	4.1	1.8	2%	4%	11%	44%	39%
France	3.1	2.7	8%	27%	17%	48%	0%
Slovenia	2.8	4.6	3%	26%	65%	4%	2%
Czech Republic	3.0	5.4	8%	25%	32%	27%	8%
Slovakia	2.3	5.6	26%	26%	38%	8%	2%
Greece	2.2	7.2	35%	16%	45%	4%	0%
Hungary	2.3	8.4	22%	31%	40%	6%	1%
Croatia	2.7	8.5	21%	23%	28%	20%	8%
Poland	2.1	9.9	34%	34%	18%	11%	3%
Bulgaria	1.9	9,6	47%	23%	28%	2%	
Romania	2.1	16.7	30%	23%	46%	0%	0%

*Source: EuroRAP Country reports from the SENSOR project. CARE data and Eurostat; Note: not all roads in the specific countries have been analysed; * All NL TEN-T and national roads are above 3 stars. There are no details indicating distribution between 3, 4 and 5 star rating.*

The Netherlands, Sweden and the United Kingdom have already set policy targets on the basis of EuroRAP star rating targets. The variations between the crash risks on roads detected in the EuroRAP surveys are mirrored in the *perceived* quality of road infrastructure across the EU. In a survey among business executives organised by the World Economic Forum[45], the

[42] http://irap.org/en/irap-news/3-star-or-better
[43] Data provided by EuroRAP on 23/8/2017 with analysis based on 2015 data representing a 35% sample of the comprehensive TEN-T network assessed using the iRAP (International Road Assessment Programme) methodology.
[44] The data outlined in the table are based on assessment of a selection of roads in the respective countries. They are carried out on national roads. The calculation of fatalities per mio. vehicle km. is using the total number of fatalities in the country and traffic on all roads.
[45] World Economic Forum: Global Competitiveness Report https://www.weforum.org/reports/the-global-competitiveness-report-2016-2017-1/

Netherlands, France, Austria and Portugal score ratings of 6 or above on a scale from 1 to 7, whereas Bulgaria, Romania, Malta and Latvia score below 4.

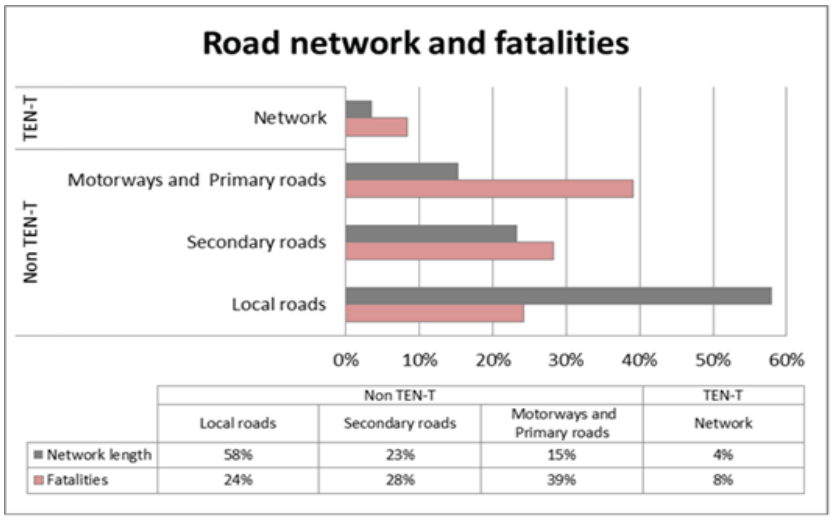
Such perceived differences were also confirmed in the Open Public Consultation carried out as part of this impact assessment, with a large majority of respondents (61 out of 73) having experienced "significant differences" or "some differences" between countries.

2.2.2. Main problem 2: Lower in-built safety on roads outside TEN-T

Among non-TEN-T roads, only a small percentage is of motorway standard. Many main or national roads carry high traffic volumes, but do not possess the road infrastructure safety characteristics of a motorway. The resulting road safety risks are, for example, the presence of bi-directional traffic, bends with limited visibility, slow moving vehicles and the absence of appropriate crash barriers.

Data on fatal accidents compiled by Member States and collected in the European Commission's CARE database permits the classification of accidents by road type (motorways, urban roads, other roads). While the reports do not specify whether an accident took place on a road that is part of the TEN-T network or not, eight Member States (Austria, the Czech Republic, Luxembourg, France, the Netherlands, Portugal, Slovenia and the UK) report the exact location of accidents using GPS coordinates, which means that accidents can be located on TEN-T or non-TEN-T roads, provided that the data quality is sufficient. On that basis, it is possible to estimate the number of fatalities that occur on TEN-T roads versus non-TEN-T roads.[46,47]

Figure 7: Distribution of fatalities by road type on the EU inter-urban road network (TEN-T vs non-TEN-T roads), based on a sample of eight Member States



	Non TEN-T			TEN-T
	Local roads	Secondary roads	Motorways and Primary roads	Network
Network length	58%	23%	15%	4%
Fatalities	24%	28%	39%	8%

Source: DG MOVE calculations based on GPS accident data reported by Member States

It is estimated that the TEN-T network comprises 4% of the overall road network (excluding urban roads), on which a disproportionate 8% of fatalities occur. It is important to bear in mind that this is mostly due to high traffic volumes, given that TEN-T roads are mostly motorways, the safest type of road. Motorways and primary roads that are not part of the

[46] Although the sample of Member States for which these figures are established is relatively small, it contains a mixture of large and small countries as well as countries from different regions within the EU. In addition, the distribution of road types within the network (percentage of motorways/primary/secondary roads) is generally very similar across countries of the same region and consequently the distribution in the sample is similar to the overall EU distribution of road types. Therefore, the data permits conclusions that are valid across the EU.

[47] The classification of roads is based on the definitions of EuroRegionalMap (ERM). ERM differentiates between motorways (roads especially sign-posted as a motorway and reserved for specific categories of road motor vehicles), primary roads (defined as roads lacking the characteristics of motorways but having a significant meaning as connection between major cities and regions), secondary roads (defined as regional roads connecting smaller cities within a region where density of the road network is higher than of the primary roads), and local roads (roads not otherwise classified as a motorways, primary roads or secondary roads).

TEN-T network comprise 15% of the overall network. On these roads alone, it is estimated that 39% of fatalities occur. Local roads, which make up 58% of the road length in the overall network, on the other hand, only register 24% of fatalities. This is due to generally lower traffic flows.

2.3. Problem drivers

The main problems identified in the previous section are a result of a number of problem drivers.

2.3.1. Problem driver 1: Ineffective national procedures, and knowledge sharing does not result in improved practices

All Member States have transposed the provisions of the RISM Directive into their national legislation. Therefore, procedures for road safety impact assessments, road safety audits, road safety inspections and procedures for the safety ranking and management of the road network in operation are in place in all Member States. However, the ex-post evaluation study concluded that: *"Whilst on the whole, the national laws regulating the procedures stipulated in the Directive have been issued in all EU Member States and specific guidelines have been developed, the level of implementation of the Directive and the level of compliance differ in their details from country to country and the potential road safety effects may vary. In this respect, a range of stakeholders believe that some Member States still appear to have difficulties in implementing the procedures effectively, although the Directive is formally transposed into their national legislation."*

National procedures can be overly complex, limiting their utility for road authorities as evidenced by the findings concerning road auditors' work in Romania[48]. In this case, infrastructure safety management has been included in the legislation, but in a way that places substantial restrictions on the users of the legislation[49]. For example, the existing training module for road safety auditors is very demanding and leads to few auditors being trained. Recommendations from road safety inspections must be followed by the authorities. Although procedures are outlined, the authorities might not want to use them because they will lead to mandatory implementation of recommendations, for which there may not be sufficient funding.[50]

Conversely, the ex-post evaluation[51] also noted that some national rules and guidelines do not give much guidance for the practical application of the procedures. While overly complex procedures are the likely cause of less effective roads infrastructure safety measures, they also indicate that there is a lack of common practices, and that knowledge sharing between Member States does not result in improved practices.

One of the problems with the current legislative framework is therefore related to the process steps in achieving road infrastructure safety improvements (see Figure 8). There is a lack of clarity of the steps, or of the link between the steps. For example, if the road safety management procedures are complex or if there is a lack of experience among the authorities, it is likely that ineffective road safety measures are identified, and so non-optimal investments are made.

The stakeholder consultation that was part of the ex-post evaluation of the RISM Directive showed that while RISM procedures are considered as clearly defined and effective in many Member States, their clarity and effectiveness could be further improved in a number of

[48] Jaspers (2016)
[49] COWI (2017)
[50] Jaspers, 2016
[51] TML (2014a)

Member States. This is backed up by experience of the European Investment Bank[52]. The targeted stakeholder survey confirmed that there appeared to be issues in some countries: 5 out of 27 respondents considered RISM national procedures to be ineffective while four other respondents indicated that the procedures in national legislation are too complex for practical use.

Figure 8: Process steps in achieving road infrastructure safety improvements

2.3.2. Problem driver 2: Management procedures do not sufficiently take into account vulnerable road users and are not future-proof for new technologies

Vulnerable Road Users

The RISM Directive does not explicitly address the protection of vulnerable road users (pedestrians, cyclists, motorcyclists), although they account for about 46% of all road fatalities in the EU. The share of cyclist fatalities is particularly high in the Netherlands (24%) and Denmark (17%), while motorcyclist fatalities are particularly frequent in Greece (29%), Italy (21%) and France (20%).

Table 2: Share of vulnerable road user fatalities on all roads (including urban)

Country	Pedestrians	Cyclists	Motorcyclists	Total VRU
AT	15%	10%	13%	38%
BE	14%	10%	14%	38%
BG	23%	5%	5%	33%
CZ	25%	11%	10%	46%
DE	17%	11%	17%	45%
DK	17%	17%	8%	42%
EE	25%	12%	2%	39%
EL	17%	2%	29%	48%
ES	22%	4%	18%	44%
FI	13%	8%	9%	30%
FR	14%	4%	20%	38%
HR	19%	6%	13%	38%
HU	25%	12%	10%	47%
IE	18%	5%	12%	35%
IT	16%	7%	21%	44%
LT	34%	9%	5%	48%

[52] EIB (2016)

Country	Pedestrians	Cyclists	Motorcyclists	Total VRU
LV	39%	7%	6%	52%
NL	11%	24%	6%	41%
PL	34%	9%	8%	51%
PT	23%	5%	12%	40%
RO	39%	9%	3%	51%
SE	16%	5%	15%	36%
SI	15%	9%	14%	38%
SK	18%	10%	7%	35%
UK	23%	6%	19%	47%
Average	**22%**	**8%**	**15%**	**45%**

Source: CARE database, 2015

Vulnerable road users on the TEN-T are mostly motorcyclists. In 2015 they represented 10% of all fatalities on EU motorways. In addition, in some Member States pedestrians, cyclists and moped riders also use non-motorway TEN-T roads to a limited extent. They may also be affected at intersections and when crossing motorways. According to cycle traffic measurements by members of the European Cyclists' Federation, there are for example several thousand cyclists crossing a certain motorway in Belgium every day and around 1,500 cyclists per day using a stretch of non-motorway TEN-T road in the Netherlands.

The Conference of European Directors of Roads (CEDR)[53] acknowledged that for many years national road administrations had primarily focused on the safety of car occupants. CEDR agrees that ensuring the safety of vulnerable road users will be one of the main challenges of the next 5-10 years.

New Technologies

As regards new technologies, there has been rapid progress since the time of the adoption of the Directive (for example advanced driver assistance systems in vehicles, cooperative Intelligent Transport Systems (C-ITS)), and more developments are unfolding (automated driving). Some vehicle technology improvements, such as lane departure warning systems, lane keeping assistance and intelligent speed adaptation can only work to their full potential if specific elements of the road infrastructure (e.g. road markings and road signs) are available and of appropriate quality. The deployment of connected and automated driving may be hindered unless these issues are directly addressed in road infrastructure safety management procedures.

Automated cars are likely to sustain the shift towards a new mobility scenario where more sustainable transport solutions can replace the traditional car ownership/car usage paradigm. Many major car manufacturers and several technology firms have announced plans to start the commercial production of highly automated vehicles, and many observers expect that a wide range of such models will be on the market by 2030. Some of these may be self-driving[54]. According to the UNECE[55], fully automated vehicles that can handle all the driving situations they encounter, "are expected to enter the market around 2020 and/or are currently under research".

Some road safety gains are expected to be realised through the uptake of some advanced vehicle safety technologies which are taken into consideration in the baseline scenario.

[53] CEDR (2016) Main road safety challenges for European Road Directors the next 5-10 years – towards vision zero
[54] OECD and ITF (2015)
[55] UNECE (2017)

At the same time the expected deployment of automated vehicles is likely to involve additional requirements for road infrastructure: readability by automated vehicles, placing emphasis on an appropriate vertical signage, road markings and road delineation. Furthermore, the lack of appropriate information about RISM procedures means that there is no information on the safety performance of roads, which will be needed during the transition period towards automated traffic.

2.3.3. Problem driver 3: Findings of road infrastructure safety management procedures are not systematically followed up due to lack of funding

The current EU legislation does not provide any requirements or incentives to follow up the recommendations arising from road infrastructure safety management procedures. Lack of transparency and publicly available information about the recommendations and the actual follow-up measures make it difficult to monitor implementation and the actual effectiveness of countermeasures.

The availability and level of funds allocated to road infrastructure safety is a key root cause for this problem driver. However, there is a lack of data on the current level of investment. Investments in road infrastructure safety are often included in the general budget for road construction and maintenance; the share specifically used for safety measures is not consistently recorded by Member States.

Overall, public spending on road infrastructure maintenance has decreased in the EU by about 30% (or 40% in relation to GDP) between 2006 and 2013[56] and stood at around 0.5% of GDP in 2013[57]. At times of budget cuts, deferring maintenance and investment in the road sector is a relatively quick way to reduce public spending and this has been pursued by a number of EU countries. For example, significant reduction of maintenance activities were reported in Italy, Ireland, Slovenia and Spain in recent years and a likely downward trend also in Slovakia, Finland, Czech Republic, the UK, Portugal and Hungary[58]. Case studies[59] on Italy, Spain and the UK revealed significant falls in maintenance expenditure that were reportedly due to budgetary pressures and the need to reduce government spending overall.

Road safety audits deal with road designs for new road sections or for the reconstruction of road sections while road safety inspections deal with existing roads. In both cases, the resulting recommendations can be accepted or not by the road authority. As the specific reports or a summary of the number of recommendation that are followed up are not published by Member States, there is a lack of transparency about the extent to which recommendations are followed up. If all recommendations are rejected, the safety effects of the road safety audit or road safety inspection will not be realised.[60]

While road safety audits only concern new or renewed infrastructure, the biggest road safety challenges concern existing road infrastructure. It is the objective of road safety inspections to identify safety issues with existing roads but follow-up is just as crucial as with road safety audits.

An authority may well have legitimate reasons to reject recommendations, such as budgetary constraints, practical considerations or a disagreement with the auditor/inspector. However, at

[56] Data extracted on 22 Jan 2017 from OECD.Stat, https://stats.oecd.org/Index.aspx?DataSetCode=ITF_INV-MTN_DATA#
[57] http://www.cedelft.eu/publicatie/road_taxation_and_spending_in_the_eu/1899
[58] European Parliament. (2014). *EU Road Surfaces: Economic and Safety Impact of the Lack of Regular Road Maintenance.* http://www.europarl.europa.eu/thinktank/en/document.html?reference=IPOL_STU(2014)529059
[59] The Italian operator of national roads, ANAS, reported a reduction in the expenditure on road maintenance both in routine and structural budgets, respectively of 16% and 43% in the 2008 to 2012 period. In the UK, funding reduced by 30% between 2011 and 2015 for the Highways Agency. In Spain, national government allocation for maintenance and operational expenditures reduced from €1,257m in 2009 to €926m in 2012.
[60] SWOV (2012)

present, the authority's decision may seem arbitrary, as there are no official guidelines for what constitutes a valid ground for dismissal.

There are large variations in how national procedures are used and to what extent they are being followed up between Member States. According to the results of the targeted stakeholder consultations in some Member States only few inspections are carried out[61] and there are indications that recommendations are not followed, while only the cheapest solutions are implemented during black spot treatments[62]. Member States are not required to report regularly on the road infrastructure safety management activities carried out in accordance with the RISM Directive, and the data collected as part of the targeted stakeholder consultation does not allow easy comparison due to the fact that procedures are typically carried out in multiannual cycles. The number of road safety inspections carried out in 2016 varied between 0 and 517 depending on Member State and it is unknown what percentage of the road network covered by the Directive has been subject to the procedures. Bulgaria also referred to a lack of financing.

2.3.4. Problem driver 4: Safety management procedures are not widely applied on non-TEN-T network

Whereas the current EU road infrastructure safety management legislation only applies to the TEN-T roads and tunnels, consisting mainly of motorways, the safest type of road, 54% of road fatalities happen on other inter-urban roads and 38% occur in urban areas. These high numbers are partly due to lower safety standards compared to the TEN-T network. In addition, the non-TEN-T network accounts for the largest road length of the network, and thus also the largest number of crashes, fatalities and injuries.

Many Member States[63] have decided on a voluntary basis to extend the application of some of the road infrastructure safety management procedures to selected non-TEN-T roads. There is variation in the extent to which individual Member States have made the extensions, but typically the additional roads that are covered are other motorways and/or other main roads.

Therefore, there is a lack of consistency in the way RISM procedures are applied outside the TEN-T. In addition, the potential of safety management procedures in decreasing the number of fatalities and injuries is also limited in particular in countries that need to make most progress in improving road safety.

2.4. The Tunnel Safety Directive

The Tunnel Directive was included in the European Commission's Regulatory Fitness and Performance Programme (REFIT) to explore the possibility of administrative simplification, in particular by merging it with the RISM Directive. The ex-post evaluation studies of both the RISM and the Tunnel Directive did not identify any safety improvements to be realised through the integration of the two Directives, but recommended further study. The impact assessment and stakeholder consultation have not found any evidence of an excessive administrative burden. In particular, the assessment did not identify any road safety gains to be achieved by merging the Directives. As the current RISM Directive is a very simple peiece of legislation with no reporting obligation for Member States, it does not lend itself to further simplification. Artificially merging the two Directives without actually reducing the administrative burden was not considered beneficial and desirable.

[61] However, the questionnaire referred to a single year (2016). Data for a longer periods would be necessary to draw more reliable conclusions.
[62] Jaspers (2016)
[63] Belgium (in the region of Wallonia), Cyprus, the Czech Republic, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Lithuania, Luxembourg, Malta, the Netherlands, Portugal, Romania, Sweden and the United Kingdom.

The results of the on-line public consultation confirmed that the current legislative framework for road tunnel safety is appropriate and that the level of safety in road tunnels is high compared to road infrastructure in general.

The ex-post evaluation of the Tunnel Directive[64] also highlighted that, in view of the very specific infrastructure requirements of the Tunnel Directive, that were specifically designed for the long tunnels of the TEN-T network, extending the application of specific tunnel infrastructure requirements to tunnels beyond the current scope would require significant financial resources which could potentially be better spent on other road safety improvements on other parts of the road network identified as a result of a more systematic assessment of costs and benefits of infrastructure measures.

Respondents to the open public consultation also indicated a preference for keeping the current scope of the Tunnel Directive.

The Ecoroads project[65] focused on the interface between road tunnels and open road sections (the so-called portal areas) and has identified joint safety inspections by tunnel and road safety experts as a best practice measure to improve the safety of portal areas and tunnels. On this basis, this initiative will aim to improve the interface between the two Directives with a view to reducing risks in the portal areas of road tunnels.

The draft problem definition, the draft retained policy measures and the design of the draft policy options were discussed in the Tunnel Safety Committee during the meeting of the Committee on 8 November 2017. The members of the Committee generally agreed with the proposed approach of maintaining a separate Tunnel Directive, with only one Member State (Cyprus) indicating a preference for further analysis of a possible merging of the two directives. The Committee supported the suggested focus on portal areas which are generally considered the most dangerous sections of road tunnels.

Therefore, the conclusion as regards REFIT considerations in view of the evaluations as well as extensive stakeholder consultations was to keep the two Directives separate, propose the revision of the RISM Directive and address the specific issue of tunnel portal areas (where open road and tunnels meet) in the framework of the revision of the RISM Directive.

The issue of future compliance pointed out in the evaluation of the Tunnel Directive (concerning some Member States with a high number of tunnels to be upgraded by the 2019 deadline, and in particular Italy which has almost half of all the tunnels falling under the scope of the Directive), does not require a revision of the Directive. The current Directive already provides Member States with flexibility to derogate from certain infrastructure requirements provided that they can demonstrate that, through the application of alternative operational measures, they can guarantee the same or a better level of safety to tunnel users. Authorisation for the use of such alternative measures are foreseen in the Tunnel Directive to allow the implementation of possible future measures that are the result of technological developments, but they can also be particularly relevant in cases where no alternative route to the tunnel exists and where the partial or full closure of the tunnel that would be necessary to implement the infrastructure measures defined in the Directive would create significant adverse impacts on roads safety. There is sufficient international experience with the successful use of operational measures as demonstrated by the presentations at an international conference organised on the subject in Rome on 16 February 2017[66] where

[64] http://ec.europa.eu/transport/facts-fundings/evaluations/doc/tunnel_final_report.pdf
[65] www.ecoroadsproject.eu
[66] http://www.fastigi.com/2017/02/17/conferenza-misure-gestionali/

speakers from several European countries presented successful examples of the identification, assessment and implementation of alternative measures.[67]

2.5. Most affected stakeholders

Existing EU legislation puts responsibilities on national road authorities and infrastructure managers who need to carry out the road infrastructure safety management procedures prescribed by the RISM Directive and ensure that long TEN-T road tunnels meet the minimum safety requirements as stipulated by the Tunnel Safety Directive.

However, any shortcomings in the safety of road infrastructure directly affect all road users. Road fatalities and serious injuries create suffering for those involved in the accidents and their families. In addition, they create costs that are ultimately borne by society as a whole, including the costs of emergency services, health care costs and production losses.

2.6. How will the problem evolve?

The Directives will continue to exercise a limited impact on the safety performance of the TEN-T roads while the roads outside TEN-T will continue to pose significant challenges.

Despite the completion of the core TEN-T network by 2030 and of the comprehensive TEN-T network by 2050, that would lead to some improvements in the road infrastructure especially in the Eastern European countries, **a large share of TEN-T travel will continue to take place on roads with low safety performance**. As explained, motorways are the safest type of road by definition and by design. However, the density of motorways in EU13 countries (7.8 km per thousand km^2 of territory) is substantially lower relative to EU15 countries (20.1 km per thousand km^2 of territory); reaching similar densities may take several decades and goes beyond the scope of TEN-T core and comprehensive network completion. Therefore, the share of the network length below the 3-star benchmark (the minimum safety rating target advocated globally by the International Road Assessment Programme) is not expected to improve significantly under current trends and adopted policies.

In addition, **lower in-built safety on roads outside TEN-T will continue to pose significant challenges**. No further extension of the application of RISM procedures is foreseen by Member States on voluntary basis. Growing traffic volumes on the roads concerned will result in higher exposure of road users to the risks represented by inadequate road infrastructure.

In the baseline scenario[68], measures addressing infrastructure safety and driver behaviour would compensate for the increase in traffic over time while the uptake of the mandatory and voluntary vehicle technology safety measures would result in some limited decrease in the number of fatalities and serious injuries. The number of fatalities is projected to go down by 9% between 2016 and 2030 and 14% during 2016-2050, while the reduction in the serious injuries is expected to be lower at 6% by 2030 and 10% by 2050.

The evolution of fatalities and serious injuries by EU region is projected to continue recent trends observed in the historical data, with the Eastern and Southern EU countries showing the highest decrease in the number of casualties. A description of the Baseline scenario assumptions and results is provided in Annex 4 *"Analytical methods"* and further in the Impact Assessment Support Study.

[67] Alternative measures can be either preventive measures or damage limiting measures. Illustrative examples of preventive measures may include traffic restrictions or reduced speed limits with measures that ensure that these speed limits are observed or improved lighting in tunnels. Illustrative examples of damage limiting measures may include additional capabilities for emergency response or increased fire protection measures.

[68] The common baseline scenario used for this impact assessment and the impact assessment accompanying the revision of the General Safety Regulation draws on an update of the EU Reference scenario 2016 and has been jointly developed with the PRIMES-TREMOVE model by the ICCS-E3MLab and the TRL model.

The projected developments under current trends and adopted policies would not allow achieving the EU's strategic objective, which is to halve the number of road deaths by 2020 compared to 2010 and to move close to zero deaths and serious injuries by 2050 ("Vision Zero" approach).

Considering the high uncertainty surrounding the evolution of fatalities and injuries, sensitivity analysis has been performed on the baseline scenario reflecting on the impacts of infrastructure safety performance and vehicle technologies. An alternative optimistic and a pessimistic baseline scenario have been considered. In cumulative terms, between 2016 and 2030 the number of fatalities is projected to go down by 18% in the optimistic baseline scenario and 6% in the pessimistic scenario. Serious injuries would decrease by 15% in the optimistic baseline and 4% in the pessimistic baseline. A description of the sensitivity analysis is provided in Annex 4 *"Analytical methods"* and the Impact Assessment Support Study.

Vehicle automation is likely to sustain the shift towards a new mobility approach (see section 2.3.1). As described above, the uptake of certain existing vehicle safety technologies is projected to have a significant influence on the baseline. As to the deployment of fully automated vehicles however, there is a high degree of uncertainty, for example about the technologies to be used, timescale and prices. Only once fully automated vehicles are deployed at a large scale will they be able to deliver a potentially significant contribution to road safety. For the foreseeable future, it is more likely that mixed traffic of vehicles with a high level of automation and of traditional vehicles will lead to increased road safety risks.

Generally, road infrastructure and vehicle safety measures can be regarded as complementary (e.g. for measures like alcohol interlock installation facilitation, autonomous emergency braking for pedestrians and cyclists, distraction recognition, better follow-up of road safety management procedures etc.) although there are also some measures which are mutually reinforcing (e.g. visible road markings to support lane keeping assistance technologies). The baseline scenario assumes the application of the existing General Safety Regulation in line with the current legislation, as required by the Better Regulation principles. No further policy action is considered at the EU level in the baseline. Including additional vehicle safety measures in the baseline would result in lower numbers of fatalities and serious injuries. Consequently, the impact of road infrastructure safety policy options in terms of lives saved and serious injuries avoided may be slightly reduced when compared to such an alternative baseline. This is due to the overlapping effects between the impacts of the policies, in the same way as there is nearly always more than one factor in accident causation. The individual influence of each factor is virtually impossible to determine. In other words the combined effect of road infrastructure and vehicles safety measures deployed together, is going to be somewhat lower than the sum of their individual effects.

3. WHY SHOULD THE EU ACT?

3.1. Legal basis

The Union has shared competence in the field of transport safety as set out in Article 4 of the TFEU. The RISM Directive and the Tunnel Directive are based on Article 91 (c) of the Treaty on the Functioning of the European Union (former Article 71(1)(c) of the Treaty establishing the European Community), according to which the Council "shall, acting in accordance with the ordinary legislative procedure and after consulting the Economic and Social Committee and the Committee of the Regions, lay down (…) (c) measures to improve transport safety" in the framework of a Common Transport Policy. As competence is shared, subsidiarity considerations apply.

3.2. Subsidiarity: Necessity of EU action

The necessity test assesses if the objectives of the proposed action can be sufficiently achieved by Member States. The legitimate rights of Member States to take actions which reflect their local, regional or national specificities must not unduly jeopardise the achievement of road safety targets.

Negative externalities of road accidents, including road fatalities and congestion, are trans-boundary problems that cannot be solved by national or local action alone. The EU has worked on reducing negative externalities of the transport sector for more than a quarter of a century as one of the objectives of the Common Transport Policy. Co-ordinated EU action is necessary to achieve the EU's strategic objective and the goals set in the Transport White Paper 2011, which include halving the number of road fatalities by 2020 on a 2010 baseline and moving close to zero fatalities by 2050.

The scope of the existing EU legislation is the trans-European road network. To achieve and maintain a high minimum level of road safety across the TEN-T network requires the use of harmonised road safety management procedures, which are designed in such a way that the highest levels of safety can be guaranteed in combination with an appropriate and proportionate regulatory framework.

Arguments for an EU intervention that were put forward when the two Directives were proposed included the following:

- Experience had shown that there was not a sufficiently high common level of safety on roads across EU Member States. The sharing of best practice on its own had not delivered sufficient improvement although there is consensus among stakeholders that this has a clear role to play in improving road safety.
- The necessary level of safe mobility on the crucial TEN-T network would not be achieved without intervention at EU level as voluntary action is not supported by all Member States.

These considerations remain valid, and the ex-post evaluations as well as the consultations carried out in the framework of the impact assessment have confirmed that the chosen approach has delivered results and is widely accepted among Member States and stakeholders. Updating the RISM framework to new developments as well as increasing its efficiency and effectiveness is therefore a logical response to the above considerations.

In addition, the deployment of some new safety technologies and the safe roll-out of connected and automated mobility across the EU is likely to require a more harmonised approach at EU level. For example, some new in-vehicle safety solutions will rely on the deployment or upgrade of adequate infrastructure. Road infrastructure must be readable for such applications and therefore infrastructure performance - in particular as regards the visibility and state of repair of traffic signs and road markings - has a role to play in supporting higher levels of safe and reliable automated driving. This is confirmed in a recent report of the TM 2.0 Task Force on Road Automation (composed of representatives of public authorities, service providers, suppliers, manufacturers and researchers), which concludes:

"It is expected that, at least for mixed fleets of vehicles, spatial or temporal restrictions may be enforced on the circulation of automated vehicles. All traffic signs and road delineation relevant to such restrictions should be harmonised among countries, to allow interoperability of automated functions, as they may be based on the recognition of such markings and signs. (...) Good lane markings condition can support the accurate positioning of automated vehicles.

Stricter criteria and maintenance processes as regards the condition of lane markings should be studied."[69]

Compatibility between infrastructure and vehicle technical solutions will need to be assured across the EU in order to fully benefit from those technologies. This shows again how important a holistic approach remains. Thus, as part of the planned Third Mobility Package, the Commission will propose both a revision of the General Safety Regulation and the Pedestrian Safety Regulation with a view to increasing the safety of vehicles and a revision of the RISM Directive with a view to improving the safety of road infrastructure and supporting deployment of some new vehicle safety technologies.

The issue of subsidiarity is important when considering the possible extension of the scope of the legislation to other roads beyond the TEN-T. TEN-T roads represent only about 4% of the inter-urban EU road network. However, many roads that are not part of the TEN-T network are important for the overall functioning of road transport within the EU and carry significant volumes of national and international traffic. For example, many national roads connect urban and industrial centres to the TEN-T network. And road safety standards on these roads can be considerably lower than on TEN-T roads themselves. Calculations presented in section 2.2.2 indicate that due to the high traffic volumes, the primary road network of the EU represents a high percentage of fatalities compared to the share of these roads in the total road network. Therefore co-ordinated EU action on the primary road network (including the non-TEN-T part) will help achieve both the medium-term EU target of halving fatalities by 2020 and the long-term target of moving towards zero fatalities in road transport by 2050.

3.3. Subsidiarity: EU added value

The EU added value test assesses whether there are clear benefits from EU level action and whether the objectives can be met more efficiently at EU level.

The main benefits of EU action lie in the convergence towards higher standards of infrastructure safety across the EU which the initiative aims to achieve. Travel throughout the EU should become safer, whereby less well performing countries will be able to benefit from the experience of more advanced countries. This should in turn improve the functioning of the internal market, through a smoother and more coherent travel experience for passenger and freight transport, and support the EU's objective of economic, social and territorial cohesion.

In addition, the EU-wide setting of standards, e.g. for road markings and road signs, should improve visibility and subsequently driving conditions. It should also facilitate and accelerate the deployment of new technological safety elements that rely on features of the road infrastructure, such as lane keeping assistance and intelligent speed adaptation.

As for vulnerable road users, action at EU level could ensure that road assessment programmes assess separately the safety of vulnerable road users with a view to improving their safety on the road network concerned.

4. OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1. General objectives

The revision of EU road infrastructure safety management legislation aims to address the high number of road fatalities and serious injuries on EU roads by improving the safety performance of road infrastructure, including but possibly not limited to the roads that belong to the TEN-T.

[69] http://2r1c5r3mxgzc49mg1ey897em.wpengine.netdna-cdn.com/wp-content/uploads/sites/8/2018/01/TM2.0_TF_RoadAutomation_report3_FINAL.pdf

The general objective of the proposed revision is defined as the reduction of road fatalities and serious injuries on EU road networks. It is in line with the goals of the 2011 White Paper and with the Council conclusions based on the Valletta Declaration. This initiative has strong links to the other planned elements of the Third Mobility Package that are relevant for road safety, namely the new framework for effective road safety policy, the legislative proposal for the revision of the General Vehicle Safety Regulation which aims to improve the safety of vehicles through the mandatory fitting of important safety features to new vehicles, and the envisaged strategy for Connected and Automated Mobility Systems.

The new framework for effective road safety policy is intended to establish the Safe System approach to road safety at EU level[70]. Concretely, this implies setting up a system of closer cooperation between authorities and stakeholders and a system of monitoring of results through Key Performance Indicators. The objective of improving the safety performance of road infrastructure is key to the Safe System approach. Roads that are well designed, built and maintained and which are "forgiving" towards the inevitable errors human drivers make, improve road safety on two levels: they reduce the likelihood of accidents happening and they also reduce the severity of accidents that still happen.

Digitalisation and automation will be central topics in the new road safety framework, with connectivity and automation being dealt with concretely in the strategy for Connected and Automated Mobility Systems. In order to become future-proof, infrastructure safety management procedures have to be ready for these new technological developments, which is why reflections in the present context have been influenced strongly by the thinking behind the specific initiative.

Lastly, this initiative does not only share a common baseline with the planned proposal for a revision of the General Vehicle Safety Regulation, but the two initiatives also interlink where vehicle technology relies on infrastructure (e.g. visible road markings to support lane keeping assistance technologies).

4.2. Specific objectives

To achieve this general objective, four specific objectives have been defined:

SO-1: To foster harmonisation and better use of knowledge sharing between Member States on road infrastructure safety management procedures;

This specific objective takes into account the existence of proven best practice procedures and approach which have been already applied for some time in the best performing Member States and aims to facilitate the transfer of this knowledge to those Member States which still need to catch up and improve the safety of their road infrastructure. SO-1 aims to tackle Problem Driver 1 (Ineffective national procedures and lack of knowledge sharing).

SO-2: To protect vulnerable road users;

This specific objective aims to counter the recent trend whereby vulnerable road users are increasingly involved in road accidents. This trend is going to persist over the years to come because due to environmental and congestion considerations it is projected that more people will walk, cycle and ride motorcycles.

SO-3: To improve the deployment of new technologies on EU road networks;

This specific objective aims to future-proof the legislation and aims to facilitate in particular the roll-out of connected and automated mobility systems.

[70] This is based on the principle that human beings can and will continue to make mistakes and that it is a shared responsibility for actors at all levels to ensure that road crashes do not lead to serious or fatal injuries.

SO-2 and SO-3 together aim to tackle Problem Driver 2 (Management procedures do not sufficiently take into account vulnerable road users and are not future proof for new technologies).

SO-4: To improve the follow-up on findings of road infrastructure safety management procedures while not imposing excessive costs to Member States.

This specific objective aims to increase transparency and data availability with a view to maximising the positive impact of RISM procedures that are being carried out through better implementation of the most relevant findings. At times of budget cuts, deferring maintenance and investment in the road sector is a relatively quick way to reduce public spending and this has been pursued by a number of EU countries. Therefore, SO-4 aims at improving the follow-up on findings of road infrastructure safety management procedures while not imposing excessive costs to Member States. SO-4 aims to tackle Problem Driver 3 (Findings of road infrastructure safety management procedures are not systematically followed up due to lack of funding).

All four specific objectives aim to address also Problem Driver 4 (Safety procedures not widely applied to non-TEN-T roads). Problem Driver 4 will be addressed by separate options covering the non-TEN-T network

5. WHAT ARE THE AVAILABLE POLICY OPTIONS?

Based on the ex-post evaluations of the two EU directives, on the impact assessment support study and on contacts with stakeholders (through targeted consultations, the open public consultation, and meetings), the Commission has identified a number of policy measures to address the main problem drivers as listed above and which are in line with the specific objectives of the initiative. These policy measures have been combined into policy packages (options). In the development of the policy options, the principles of proportionality, efficiency and effectiveness have been the guiding principles.

EU funded road safety projects such as the European SafetyCube project[71], and relevant international scientific research such as Elvik et al. (2012) and OECD/ITF (2015) were used in order to identify initial policy measures, which were then subjected to a preliminary assessment leading to the choice of retained measures described below.

5.1. Description of the retained policy measures

After a preliminary assessment of different policy measures, 14 policy measures where retained. The retained policy measures are presented below organised according to the main problem driver that they aim to address.

Problem Driver 1 – Ineffective national procedures and lack of knowledge sharing

No.	Policy measure and policy measure description
1	**Promote knowledge sharing by publishing national best practices in central EU repository** All relevant documents would be published on EC's road safety website. These documents may include documentation of national road safety programmes, including guidelines, findings related to applying specific procedures, equipment etc.[72] An important element in this knowledge sharing concerns best practices as regards the implementation of new technological developments (e.g. C-ITS) with a view to maximising their potential contribution to road safety.
2	**Create a European Forum of Road Safety Auditors**

[71] https://www.roadsafety-dss.eu/#/
[72] An example of such a report is the Danish *Road Safety Audit Handbook* (www.vejdirektoratet.dk)

	This measure is based on the already existing European Forum for Tunnel Safety Officers. The Commission could facilitate and support a forum, where experts working with audits and inspections can meet and exchange experiences and ideas. This can lead to the establishment of guidelines that can substantiate the high-level requirements in the legislation (e.g. common methodology for CBA to identify the most relevant safety measures to implement). This will complement the exchange of best practices already undertaken by organisations such as the Conference of European Directors of Roads (CEDR) and the World Road Association (PIARC). Participation in this forum will not be limited to the members of the organisations and it will have a wider outreach.
3	**Create interface between the Road and Tunnel Directives** This measure includes the definition of tunnel portal areas and periodic joint inspections of portal areas and road tunnels. Current legislation leaves uncertainties with respect to the portal areas of tunnels, i.e. whether they are inspected as part of the tunnel inspections or as part of the RISM Directive inspections. Joint inspection of tunnels will ensure a stronger focus on unsafe elements in road tunnels, because a road safety specialist will participate in the inspections and will have road safety as their primary focus during the inspections.[73] This measure will include a reference in the RISM Directive to establish joint inspections to be carried out periodically in the portal areas of all tunnels over 500 meters on the TEN-T road network. This measure addresses Driver 1 by increasing the knowledge sharing between road and tunnel safety experts and also supports addressing Driver 3 by improving the detection of road safety defects.

Problem Driver 2 – Gaps in the legislation regarding vulnerable road users and new technologies

No.	Policy measure and policy measure description
4	**Include clear reference to assessing the safety of vulnerable road users in all road infrastructure safety management procedures** For road sections that carry significant traffic of motorcycles, cyclists or pedestrians, the safety of each user group should be assessed separately.
5	**Include clear reference to supporting deployment of C-ITS and automation[74] on the TEN-T in all road infrastructure safety management procedures** General requirement to be followed up with specific requirements once relevant standards are available. New technologies in vehicles enable them to 'read' the infrastructure and communicate with the infrastructure and other vehicles. This development is happening fast. This measure will require Member States to focus on possibilities to adapt their infrastructure to future technologies. This concerns all procedures: RSA (Road Safety Audits) would ensure that new infrastructure is built such that it accommodates the recent technology developments within C-ITS; RSIA (Road Safety Impact Assessment) procedures would include specific reference to analysis of impacts of the required equipment; RSI (Road Safety Inspections) would generally focus on edge and centrelines markings as well as address possible ways of upgrading existing infrastructure to support the most recent developments. Due to the fast pace of technological developments as regards connected and automated mobility, the measure will not include specific references to technologies nor will it restrict the requirement to certain issues. The formulation is general such that Member States in their procedures must include reference to the most recent information. In addition to addressing Driver 2, this measure supports addressing Driver 1 as well.
6	**Establish general performance requirements for road markings and road signs on TEN-T** Road markings are an important part of delineation. They help drivers position themselves on the road laterally and (also in periods of poor light) show the alignment of the road ahead. The type, shape and colour of markings play a role in conveying specific messages to the road user (e.g. overtaking/ barrier

[73] The ECOROADS project has demonstrated that the exchange of experience and views between road safety and tunnel safety experts is beneficial and relevant safety factors can be identified during joint inspections.
[74] The terms C-ITS and automation are technology neutral. They comprise all relevant communication technologies and infrastructure.

	lines, yellow lines in work zones etc.). A common minimum standard of how TEN-T roads must be marked will be outlined in the RISM Directive. There are European standards (IS EN 1436, http://www.nen.nl) governing the quality of road markings, essentially applying only to new road markings. These European standards, however, do not represent general performance requirements and an evaluation of the standards could lead to a commonly agreed performance level that could be applicable to the TEN-T. The Construction Products Regulation (EU) No 305/2011 foresees the elaboration of harmonised product standards for a number of construction products relevant for road infrastructure safety (e.g. road marking materials and vertical road traffic signs) and obliged the manufacturers of these products to CE mark their products and issue a Declaration of Performance regarding their performance. The Regulation, however, does not impose performance requirements (i.e. thresholds of performance for road barriers) on manufacturers[75]. Article 3(3) of Regulation (EU) 305/2011 allows the Commission if appropriate to determine by means of delegated acts the threshold levels (the minimum or maximum performance levels of an essential characteristic) of a construction product. Such minimum thresholds would, however, apply to all the products manufactured so this would not be the appropriate tool to define general performance levels for road markings (or other construction products) on the TEN-T. Moreover, as road markings may wear and lose their primary function[76], regular monitoring of road marking performance and preventive maintenance will be outlined in the Directive to ensure that markings always comply with the standards. At the present time there is no EU legislation imposing specifications for harmonised road signs and road markings on Member States. This issue is addressed by the Vienna Convention on Road Signs and Signals of 1968[77]. While today there is no agreement on common requirements concerning signs, the deployment of automated vehicles could lead to a need for a much more harmonised approach, to be aligned with the approach of the United Nations Economic Commission for Europe (UNECE). This particular requirement is aiming at supporting the deployment of new technologies. Clear and consistent road signs and road markings of good quality will be beneficial to automated systems. This potential further need can be addressed through a delegated act that would have to be subject to a separate impact assessment.
7	**Establish general performance requirements for road furniture on TEN-T (e.g. motorcycle friendly guardrails)** This measure is about defining minimum standards for the design of roadside elements such as: motorcycle friendly guardrails and frangible road side posts (giving in when hit by a car). A minimum standard is defined for each of such types of furniture using the above-mentioned CEN standards. For some Member States this will require reinstallation of road equipment. A deadline for this reinstallation will be set. Minimum standard requirements for roadside elements along the TEN-T network will serve to improve the safety performance of these elements over time and ensure that these meet the safety specifications, not only when new but also during the lifecycle of the road. Individual Member States have developed national road design standards and guidelines. In the majority of cases these standards and guidelines are unique to the Member States themselves although certain aspects related to guardrails and other furniture are subject to the European Committee for Standardisation (CEN) standards (and include standards such as EN 12767: 2013; EN 1317) and maybe

[75] Article 3(3) of Regulation (EU) 305/2011 allows the Commission if appropriate to determine by means of delegated acts the threshold levels (the minimum or maximum performance levels of an essential characteristic) of a construction product. Such minimum thresholds would, however, apply to all the products manufactured so this would not be the appropriate tool to define general performance levels for road markings (or other construction products) on the TEN-T.

[76] This has been named as a safety problem by a number of organisations (http://www.irfnet.eu/index.php/publications/position-papers/18-publications/position-papers/173-road-marking-requirements-in-europe) (EuroRAP; and EuroNcap 2013)

[77] The Vienna Convention is a multilateral treaty designed to increase road safety and aid international road traffic by standardising the signing system for road traffic (road signs, traffic lights and road markings) in use internationally. The Convention was adopted under the auspices of the United Nations Economic Commission for Europe (UNECE). The convention has 69 state parties and most but not all EU Member States are contracting parties. The implementation of the Convention is currently under review by the UNECE. The current multilateral approach has advantages as it is not limited to EU Member States. The Convention, however, does not prevent the EU to agree on further harmonisation and also a more active role of the EU in UNECE meetings could have a positive impact. Given the huge number of road signs across the EU any proposal for further harmonisation would have to be preceded by an appropriate cost-benefit analysis which was beyond the scope of the present impact assessment.

	other standards (such as the international ASTM A741-11:2016). Many of the road elements are renewed at regular intervals. So the requirement is aimed at setting common standards when renewals are made. This measure is in particular addressing the low safety level of vulnerable road users such as motorcyclists.

Problem Driver 3 – Findings of RISM procedures are not systematically followed up

No.	Policy measure and policy measure description
8	**Make information about procedures publicly available** To increase transparency and increase pressure for eliminating deficiencies. Information can be published at different level of detail. Many Member States are already publishing annual reports about the general safety levels on national roads[78]. Detailed reports of individual inspections or audits are generally not published though, according to the responses received form national authorities in the stakeholder consultation. This measure would require Member States to publish information as regards the number of different RISM procedures carried out and about the number of recommendations resulting from these procedures (without publishing the actual recommendations and the number of recommendations actually implemented). This measure is expected to alleviate the lack of data as regards the actual safety management of roads. In addition to addressing problem driver 3, this measure supports mitigating Driver 1, by promoting exchange of experiences and knowledge as well as increasing the awareness of road users.
9	**Obligation to compile a risk-based prioritised action plan** Follow-up actions and their timings are to be determined using a risk-based approach. The current provisions of the Directive do not make the implementation of recommendations following a RSA or RSI compulsory. This is appropriate since it is not the task of the auditor or inspector to take over the design role, but rather to highlight potential safety defects and to give the road authority/designer the opportunity to devise improvements. In certain instances, a road authority may have sufficient arguments not to adopt recommendations. Under this policy option, it may continue to do so provided that this is motivated and documented. This measure intends to ensure that a larger proportion of RSA and RSI recommendations are implemented in new road design and in upgrading or improvement projects. In addition, this measure also addresses Driver 1 through publications, increased knowledge sharing and stronger focus on solving the detected safety defects.
10	**Carry out network-wide safety inspections/road assessment programmes** This measure requires Member States to set up a road assessment programme and carry out network-wide safety inspections and star rate the roads. Network-wide safety inspections (which are also known as road assessment programmes or RAP) do not only focus on already known dangerous road sections ("black spots" or "high risk sites"), but provide a framework to improve the general safety performance of the road network. The purpose of road assessment programmes is to rank elements of a road network based on road safety and identify infrastructure or traffic related factors increasing accident or injury risk[79]. A road assessment programme will systematically map the risk levels of the roads, identify safety defects and provide the basis for safety rating of roads. The assessment programs will lead to the preparation of risk-based safer roads investment plans identifying cost–effective countermeasures for detected deficiencies. This will in turn lead to an increased follow-up of findings and will help address the impact of Driver 3. Road assessment programmes are a proactive tool to implement the Safe System approach across the entire road network concerned as opposed to concentrating reactively on isolated accident black spots or

[78] 13 out of 22 responses to the stakeholder questionnaire referred to publication of results on safety levels annually. Some mainly consist in an overview of safety levels, some contain maps showing where accidents and/or safety issues are identified. In Switzerland the specific reports (RSI and RSA, RSIA) can be obtained upon demand. No other country has indicated a similar possibility.
[79] OECD/ITF 2015

	localised road safety inspections. There are a number of different methodologies to assess the safety performance of roads. These fall into the reactive and proactive categories, with the former being based on approaches using crash data as a primary source of analysis to develop outputs such as risk maps, black spot (high crash) locations and crash types. The proactive tools aim to assess the state of a road more from the Safe Systems perspective, which is based on extensive historical research, making use of evidence that certain conditions lead to higher risk for crashes. These proactive tools make use of visual inspections to assess a number of road design related variables and to use these to develop an overall safety rating of the road. Safety rating of roads adds transparency for road users, but also helps designers and operators of the system to improve it. Member States will have to describe the methodology they intend to use. This can be an existing international methodology such as the iRAP/EuroRAP programme[80], existing national programmes or methodologies that will be developed specifically for this purpose. Consistent star rating of roads across the EU would, however, require a common methodology to be agreed at EU level. This is not excluded under this option as a possible second step. As part of the measure, the RISM Directive will clarify that carrying out a road assessment programme may replace some of the RSIs that should have been performed.
11	**Implement corrective actions to meet minimum safety levels across the TEN-T** This measure requires Member States to achieve a minimum safety level on TEN-T roads. This includes the obligation to carry out road assessment programmes (measure 10). To ensure a common reference for the minimum rating, the measure requires a common rating approach. It is proposed that this approach should be based on EuroRAP star ratings.[81] The EuroRAP star rating has five levels. For this measure the minimum standard is set at three stars as a commonly used reference point. An example of the target could be to aim to ensure that at least 80% of the network concerned will reach a minimum of 3 stars or above by an agreed date. This measure ensures that Member States follow up on the findings in the procedures and invest in higher road safety levels of the infrastructure.

Problem Driver 4 – RISM procedures not widely applied to non-TEN-T network

No.	Policy measure and policy measure description
12	**Conditionality of EU funds** This measure turns what is a recommendation in the current Directive into an obligation. The conditionality of EU funds would require that the provisions of the RISM Directive have to be applied to any part of the national road transport infrastructure if it is built using EU funding in whole or in part.
13	**Apply the provisions of the current RISM Directive to main national roads** Member States must apply the RISM procedures also for their main national roads. This implies that all new or refurbished national roads will be subject to RSA, national roads will be included in the network safety management procedures for identification of high risk locations, and national roads will be included in the inspection programme.
14	**Application of policy measures 8-10 to main roads outside TEN-T** The extension of these policy measures to main/national roads that are not part of TEN-T address problem driver 4. *As part of this measure, some, but not all of the additional policy measures to be applied to TEN-T roads would also be applied to main/national roads.*[82]

[80] http://www.eurorap.org/protocols/

[81] Another common assessment methodology can obviously be proposed as well. However, currently no other such generally accepted procedures are established.

[82] The notable exception is the establishment of minimum safety standards for TEN-T road (policy measure number 11) which would only be applicable to TEN-T roads even under this scenario.

5.2. Options discarded at an early stage

The policy measures that were included in the preliminary analysis but were later discarded are presented below providing also the reasons for discarding them.

No.	Discarded policy measure	Reason for discarding
1	Prescribe specific approaches and standards for how to undertake RISM procedures	Revisions that include the requirement to carry out RISM procedures using specific standards and approaches would not respect the proportionality and subsidiarity principles. It would not be possible to accommodate the geographical, organisational and administrative specificities of the different Member States, and no specific approach could guarantee high effectiveness and efficiency across all Member States. This measure would have addressed problem driver 1.
2	Require mutual recognition of road safety auditor certificates	Most Member States accept the certificates issued in other Member States, some, however, require national training to be undertaken to understand and learn about local legislation, procedures and conditions. The impact assessment has not found evidence that the requirement from some Member States for national training hinders the effective implementation of RISM procedures. This measure would have addressed problem driver 1.
3	Extending the scope of the RISM Directive to include all roads	There are about 5 million kilometres of roads in the EU, about half of them in urban areas. Beyond the main national roads managed by national road authorities, the responsibility for regional and local rural roads and urban roads is scattered across many thousands of authorities (regional authorities, local councils etc.). Because of reasons of subsidiarity, proportionality and efficiency it is considered that EU road infrastructure safety management legislation should not be extended beyond the high traffic national road networks managed by national road authorities. This measure would have addressed problem driver 4.

5.3. Description of the policy options

The retained policy measures were combined into six policy options (in addition to the baseline scenario), addressing policy objectives and tackling problem drivers, but with different levels of ambition. The precise measures and level of ambition of each policy option are described below.

All policy options are compared to the baseline scenario (Policy option 0). Policy options limiting the policy intervention to the TEN-T (Policy options 1-3) and those that extend the scope beyond the TEN-T (Policy options A-C) are assessed separately. Due to the complementary nature of road infrastructure safety management measures, Options 1 to 3 are alternatives, but build on one another in an incremental way. Similarly, the policy options extending the policy interventions beyond the TEN-T are alternatives, but build on one another: Option A can be implemented on its own. Option B includes Option A. Option C builds on and includes Option B.

All legislative measures in all policy options are limited to the revision of provisions of the RISM Directive. None of the policy options involve the revision of the Tunnel Directive (see section 2.4 above).

5.3.1. Policy option 0: Baseline scenario

Policy option 0 reflects developments under current trends and adopted policies (i.e. the baseline scenario) as described in section 2.5. This option assumes that Member States continue to apply current EU road infrastructure safety management legislation as they do today. No further action at EU level is assumed in policy option 0.

5.3.2. Policy option 1: Light intervention within current scope – on TEN-T

Policy option 1 covers minimum change at minimum cost, taking into account forthcoming technological changes and proposing limited legislative changes which are relatively easy and quick to implement. It builds on the baseline scenario firstly by adding non-legislative, "soft" measures such as the promotion of knowledge sharing and exchange of best practices with a view to supporting the effectiveness of the management procedures already included in the RISM Directive. Secondly this policy option also introduces legislative measures to improve the transparency of road infrastructure safety management procedures; introduces a clear requirement to focus on assessing the safety of vulnerable road users in RISM procedures; and includes a requirement that RISM procedures review how the road infrastructure can support new technologies such as the deployment of C-ITS and automation. Finally, an improved interface between the RISM and Tunnel Directives is created through the revision of the RISM Directive with a particular focus on portal areas (the areas where open road and tunnel connect) and on joint inspections of tunnels and portal areas involving both road and tunnel personnel.

The scope of the legislation in this policy option remains limited to the TEN-T.

In the Open Public Consultation, there was broad support for the measures proposed in this option, but respondents in general only expected a limited effect on road safety.

5.3.3. Policy option 2: Moderate intervention within current scope – on TEN-T

This policy option goes further to include elements of the Safe System approach such as network-wide safety inspections but also general performance requirements for certain road infrastructure components to facilitate the smooth roll-out of cooperative, connected and automated mobility. It also aims to address the lack of consistent and comparable data as regards the safety level of the road network. This policy option also includes the introduction of an additional RISM procedure, the road assessment programme, in the EU legislation. The guiding principle behind Policy option 2 is that EU legislation would require Member States to conduct and properly follow-up proactive RISM procedures to identify a wide range of potential road infrastructure risks, but Member States would retain flexibility to set the desired level of road infrastructure safety. The choice of appropriate technical solutions would also remain with Member States with EU legislation only setting general performance requirements where required by the smooth roll-out of CCAM.

Policy option 2 builds on Policy option 1 and focuses on ensuring that the safety deficiencies identified by RISM procedures are actually addressed by appropriate actions. It therefore includes further legislative measures such as the compulsory follow-up of RISM procedures using a plan based on risk-based prioritisation of actions, introduces a requirement for network-wide safety inspections (also known as road assessment programmes) which provide an objective and comparable measurement of the actual built-in safety level of roads and aims to establish general performance requirements for road markings and potentially road signs on TEN-T roads. Policy option 2 represents a more proactive approach to road infrastructure safety in line with the proposed framework for road safety 2020-2030 focusing on the implementation of the necessary road safety countermeasures to address identified road infrastructure deficiencies. This option also foresees the possibility of the harmonisation of road signs which might be necessary due to technological developments.

The scope of the legislation remains limited to the TEN-T.

In the Open Public Consultation, 47% of respondents fully agreed that the safety of road infrastructure should be measured across the EU using comparable methodologies while 41% rather agreed with this proposition. The Open Public Consultation also showed wide support

for performance requirements concerning the visibility of road markings (47% fully agree, 41% rather agree) and concerning the visibility of road signs (45% fully agree, 43% rather agree).

NGOs and private entities strongly support road assessment programmes. While many Member States' authorities are reluctant to a mandatory approach, they also in general agree with the positive effect of network-wide road assessment programmes. In the 8 November 2017 meeting of the RISM Committee, disagreements were mostly limited to the question of which particular methodology to use[83].

5.3.4. Policy option 3: Ambitious intervention within current scope – on TEN-T

This is an ambitious policy option setting a minimum safety level to be achieved on TEN-T roads and defining additional general performance requirements for road furniture. This represents a results-oriented approach which can be used to achieve a uniform level of minimum safety across the whole TEN-T network. The minimum level of safety to be achieved would be set at EU level. Member States would retain flexibility on the choice of road infrastructure safety countermeasures.

Policy option 3 builds on Policy option 2 and includes a further legislative measure to ensure that roads fulfil certain minimum safety rating requirements. It also aims to establish general performance requirements for certain road furniture (motorcycle-friendly guardrails on road sections with significant relevant traffic).

The scope of the legislation remains limited to the TEN-T.

In the Open Public Consultation, 45% of respondents fully agreed that minimum road infrastructure safety requirements should be established for roads that are part of the TEN-T network while 25% rather agreed. However, there were also 24% of respondents who strongly disagreed with the latter proposition. Individual responses included the following: *"Due to the travelling between countries within Europe, the drivers shouldn't face different 'environment' (…). Thus, comparable methodologies are needed."* and: *"Setting any requirements on Member States of the EU, it puts financial strain on countries where there is insufficient funding for the road network."*[84] While NGOs typically support compulsory minimum road infrastructure safety requirements for the TEN-T, many national road authorities disagree with the idea and doubt the feasibility of implementation.

Table 3: Linking policy measures to policy options within the current scope - Measures only apply to the TEN-T road network

No.	Measures	PO 0	PO 1	PO 2	PO 3	Problem driver addressed	Specific objective addressed
1	*Promote knowledge sharing by publishing national best practices in central EU repository**		x	x	x	Driver 1	SO1
2	*Create a European Forum of Road Safety Auditors**		x	x	x	Driver 1	S01
3	Create interface between the RISM and Tunnel Directives		x	x	x	Driver 1 and 2	SO1
4	Include clear reference to assessing safety of vulnerable road users in all road infrastructure safety mgmt. procedures		x	x	x	Driver 3	SO2

[83] Many Member States are using the EuroRAP methodology for road assessment programmes but some Member States have developed their own methodologies which they would prefer to continue to use.
[84] Overview report on the Open Public Consultation, COWI 2017, pp. 41-43.

No.	Measures	PO 0	PO 1	PO 2	PO 3	Problem driver addressed	Specific objective addressed
5	Include clear reference to supporting deployment of C-ITS and automation on the TEN-T in all road infrastructure safety management procedures		x	x	x	Driver 3	SO3
6	Establish general performance requirements for road markings on TEN-T			x	x	Driver 2 and 3	SO3
7	Establish general performance requirements for road furniture on TEN-T (e.g. motorcycle friendly guard rails)				x	Driver 2	SO2
8	Make information about procedures publicly available		x	x	x	Driver 1 and 2	SO4
9	Obligation to compile a risk-based prioritised action plan			x	x	Driver 2	SO4
10	Carry out network-wide safety inspections/road assessment programmes			x	x	Driver 2 and 3	SO4
11	Implement corrective actions to meet minimum safety standards				x	Driver 2 and 3	SO4

** These measures are soft (=non-legislative) measures*

Contrary to Policy options 1-3, Policy options A, B and C all involve some extension of the procedures of the RISM Directive beyond the TEN-T. Of the policy options that involve an extension of scope, only Option A and Option B can be applied on their own. Options C can only be applied in combination with Option 2 or 3. This is because Option C includes policy measures which are not applied under the current Directive[85].

The extensions are restricted to main or national roads which are typically represented by the primary road networks of the Member States. As an EU-wide harmonised common definition of this road category does not exist, a prerequisite for their implementation is the identification of roads that can be categorised as main/national roads.

The possible extension of the field of application beyond the TEN-T network proved to be the most controversial point in the Open Public Consultation. 37% of respondents stated that the scope of the legislation should remain limited to TEN-T. The remainder of respondents were roughly equally divided between the options of extending the application to "all roads", to "all main or national roads" and to "road infrastructure of European importance". Looking at the results by type of respondent, private enterprises and NGOs mainly consider that all roads or all main/national roads should be in the scope of EU legislation, whereas regional and local authorities prefer to see the scope limited to TEN-T.[86]

Motorway operators were supportive of an extension, arguing that legislation only on TEN-T roads would lead to over-legislation on the safest roads, whereas the most dangerous roads were not addressed. The ETSC even favoured an extension to all main rural and main urban roads. This was required in view of the new objective to focus on reducing serious injuries as well as deaths (because a larger proportion of injuries occur in urban areas) and because citizens should be entitled to equal levels of safety on all roads.

[85] The guiding principle in the design of options being that only those policy measures can be extended to main roads beyond the TEN-T which are applied on TEN-T roads.
[86] Overview report on the Open Public Consultation, COWI (2017), pp. 36-37.

5.3.5. Policy option A: Conditionality of EU Funds on main/national roads

This policy option has a very specific focus as it aims to ensure that RISM procedures are fully applied when national road infrastructure is upgraded, using EU funds. Policy option A would transform a recommendation in the current Directive into a legal obligation for Member States. Option A includes one single legislative measure stipulating that any road project on the national road network financed fully or partly with EU funds would have to be subject to the procedures prescribed in the RISM Directive. This policy option would only have an impact on Member States that have not yet extended the application of the RISM procedures to cover their national road networks on a voluntary basis. It is assumed that those Member States that have extended the application of the RISM procedures to their national road network already fulfil the recommendation to apply the procedures to EU-funded road transport projects on their national road transport infrastructure.

Policy option A can be applied on its own without being combined with any of the options 1-3. It conditionally extends the scope of the current RISM Directive beyond the TEN-T.

5.3.6. Policy option B: Extension of current RISM provisions to main/national roads

Policy option B aims to ensure that the already established RISM procedures are applied on a wider road network specifically including the busy roads of Member States' primary road network. This policy option represents a moderately ambitious mandatory extension of the scope of the procedures of the current RISM Directive. The application of new additional RISM procedures is not foreseen. This policy option would only have an impact on Member States that have not yet extended the application of these procedures on a voluntary basis.

Policy option B consists in making the procedures of the current RISM Directive, namely Road Safety Impact Assessments, Road Safety Audits, Road Safety Inspections and Network Safety Management, mandatory for the national/main roads outside the TEN-T network. This policy option includes Policy option A which would only cover projects that are funded by the EU. Option B applies RISM procedures on all roads of the primary network irrespective of whether they were constructed using EU funds or not.

Option B can be applied on its own without being combined with any of the options 1-3. While theoretically this policy option could also be applied in combination with Policy options 2 or 3, in practice such combinations would involve the application of different RISM procedures on different interconnecting parts of the road network. This may result in unnecessary complexity and potential confusion for the road authorities.

5.3.7. Policy option C: Extension of Option 2 measures to main/national roads

Policy Option C aims to apply the philosophy of proactive network-wide road safety management also to Member states' primary road networks. This policy option represents a more ambitious extension of the application of the revised RISM procedures to a larger network of roads beyond the TEN-T.

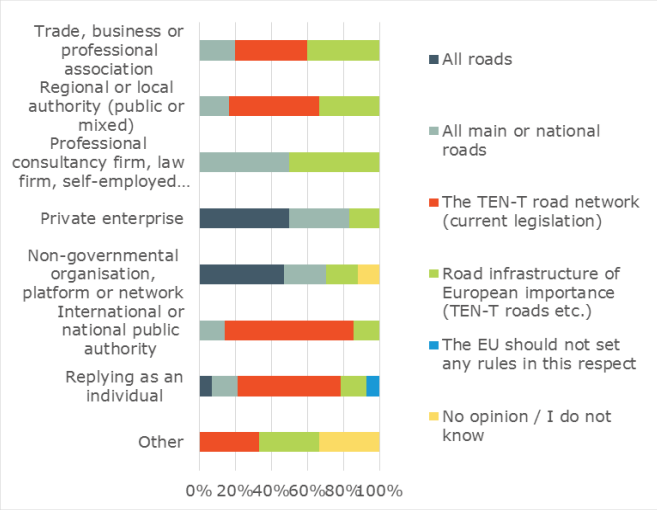
Policy option C builds on Policy option B and extends the measures outlined under Option 2 (moderate intervention) above to main/national roads. This includes in particular making information about procedures publicly available, the obligation to compile a risk based prioritised action plan and the obligation to carry out network-wide safety inspections. It does, however, not foresee a uniform minimum level of safety to be set at EU level and achieved by Member States for the primary road network.

This policy option can be used in combination with either Policy option 2 or 3. If used in combination with Policy option 2, the same requirements would apply to all roads in the scope of the RISM Directive. If used in combination with Policy option 3, the measures providing for minimum safety rating requirements for roads would not apply to non-TEN-T roads.

The results of the public consultation indicate differing views as regards the ideal geographical scope of EU road infrastructure safety management legislation where preferences are very much determined by the type of respondent. While private enterprises and NGOs advocate an extension to all main or national roads or even to all roads in the EU, Member State authorities and road administrations in particular tend to favour the current scope and do not favour a mandatory extension of RISM procedures beyond the TEN-T.

Bearing these mixed reactions in mind, it is clear that road infrastructure safety management procedures at EU level should also be proportionate, they should provide Member States with the necessary flexibility to implement specific procedures that are best suited for local circumstances and they should not add unnecessary administrative burden on national authorities.

Figure 9: Responses by type of organisation to OPC question "In your opinion, what should be the scope of EU legislation in the area of road infrastructure safety management?"



The table below shows an overview of the policy options that aim to address the problems of unsafe road infrastructure outside the TEN-T. The baseline option for these policy options is the preferred option selected for TEN-T with the baseline for non-TEN-T. Policy measures 12 and 13 are additional policy measures which specifically apply to non-TEN roads whereas policy measures 8-10 are the same policy measures that are applied to TEN-T roads in Policy option B.

Table 4: Linking policy measures to policy options going beyond the current scope - Measures apply to main/national roads outside the TEN-T

No.	Measures	PO 0	PO A	PO B	PO C	Problem driver addressed	Specific objective addressed
12	Conditionality of EU Funds (CEF and Cohesion Funds)		x	x	x	Driver 1 and 4	SO 1,2,3
13	Apply the provision of current RISM Directive to national roads			x	x	Driver 1 and 4	SO 1,2,3
8	Make information about procedures publicly available				x	Driver 1, 2 and 4	SO4
9	Obligation to compile a risk-based prioritised action plan				x	Driver 2 and 4	SO4

No.	Measures	PO 0	PO A	PO B	PO C	Problem driver addressed	Specific objective addressed
10	Carry out road assessment programmes				x	Driver 2, 3 and 4	SO4

6. WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?

The main impacts of the initiative are expected to be social and economic, whereby most benefits will materialise in the form of a reduced number of fatalities and serious injuries resulting from improved road safety management measures. Costs will be incurred through the application of road infrastructure safety management procedures (road safety inspections, road assessment programmes etc.) and the costs associated with the resulting implementation of findings by means of upgrading the road infrastructure concerned.

Because of the significant difference in the geographical scope of the road networks concerned, the social impacts of options which assume a continued focus on TEN-T only (Options 1-3) and the options which involve an extension beyond the TEN-T (Options A, B and C) are analysed separately.

The general assumption across all countries and types of measures is that the impacts on reductions in fatalities and injuries (the benefits) will gradually be obtained over a 10 year period although many of the most cost-effective low cost interventions can be implemented in a shorter period. The same assumption is applied to the investments related to the measures. This is because the identification of safety defects does not imply that immediate action is taken to correct these defects. Often, due to operational and financial limitations, some time passes before a project can be started. Road authorities have to plan their interventions in advance and Member States have a budget for road safety – typically as part of an overall budget for road renewals and maintenance. It means that it is reasonable to assume that not all identified and confirmed defects are dealt with immediately, they will be prioritised and will be addressed gradually over time, and the effects equally will flow over time.

A model suite has been used for assessing the impacts. The PRIMES-TREMOVE transport model and a specific model developed by TRL in the programming language Python have been used to develop the Baseline scenario. In addition, an excel-based tool was developed by COWI to assess the impacts of the policy options. The tool covers each EU Member State individually and distinguishes between the TEN-T and non-TEN-T network, drawing on the CARE database[87] and the TENtec information system[88]. The main sources used for the estimation of impacts on the number of fatalities and serious injuries in the COWI tool are: the Safety Cube project[89] and the Handbook of Road Safety Measures[90]. Further explanations on the methodology used are provided in Annex 4 on Analytical methods.

6.1. Impacts of policy options targeting TEN-T (Policy options 1 to 3)

6.1.1. Social impacts

The main effect of the policy options is the reduction in the number of fatalities and serious injuries from road crashes. This effect is achieved either through a reduction in the number of road crashes or through a reduction in the impact on the persons involved in the crashes. These further have impacts on public or private health costs, production loss etc. They are included in the monetisation of fatalities and of serious injuries.

[87] Source: https://ec.europa.eu/transport/road_safety/specialist/statistics_en
[88] Source : https://ec.europa.eu/transport/themes/infrastructure-ten-t-connecting-europe/tentec-information-system_en
[89] See e.g. Filtness A. & Papadimitriou E. (Eds) (2016), Identification of Infrastructure Related Risk Factors, Deliverable 5.1 of the H2020 project SafetyCube.
[90] Elvik, R., T. Vaa, A. Hove and M. Sorensen eds. (2012) The Handbook of Road Safety Measures: Forth Edition in Norwegian Second ed. In English, 2009.

The assumptions used in the quantification of each policy option and the detailed results by Member State are provided in the Annex 4 *"Analytical methods"* and further in the Impact Assessment Support Study.

Policy option 1 (PO1), reflecting light intervention – best practice sharing, publication of information about procedures, would result in a reduction by 1% in the number of fatalities on TEN-T roads (0.1% reduction for the whole road network) and 0.9% of serious injuries (0.1% decrease for the whole road network) in 2030 relative to the baseline (representing an absolute reduction of 14 fatalities and 116 serious injuries). The estimated reduction in fatalities and serious injuries is due to the increased focus of RISM procedures on the safety of vulnerable road users, in particular motorcyclists.[91] At Member State level, the impacts on fatalities and serious injuries range between 1.5% reduction in Greece in 2030 relative to the baseline and 0.6% in Luxembourg, the Netherlands and Slovenia. Overall, PO1 delivers an estimated reduction of 0.8 billion euros in the social costs of road traffic accidents by 2050 (expressed as present value), based on the application of social unit costs of fatalities and serious injuries to the above-calculated reduction.

Policy option 2 (PO2), covering moderate intervention – mandatory follow-up and network-wide inspections, is projected to lead to a more significant reduction in the order of 8.8% for fatalities on TEN-T roads (0.6% decrease for the whole road network) and 6.5% of serious injuries (0.4% decrease for the whole road network) in 2030 relative to the baseline (representing an absolute reduction of 129 fatalities and 815 serious injuries). The impacts of PO2 are mainly due to better follow-up of the findings of existing RISM procedures and to the positive effects of running road assessment programmes in addition to the existing procedures. General performance requirements for road markings contribute to these positive results. Policy option 2 has a relatively low effect in some countries (e.g. 3.2% reduction for Sweden, 1.6% reduction for the Netherlands, 2.6% decrease for the UK). This is because these countries already apply road assessment programmes and have high safety levels on their TEN-T roads. When the impacts of PO2 are monetised, the savings amount to approximately 5.4 billion euros by 2050 (expressed as present value). Total savings are highest in countries with large road networks such as Germany and Italy, but Greece would also experience significant social cost savings.

Policy option 3, covering ambitious intervention – minimum star rating, shows a significant reduction in the number of fatalities and serious injuries: 13.8% decrease in fatalities on TEN-T roads (0.9% decrease for the whole road network) and 8.6% of serious injuries (0.5% decrease for the whole road network) in 2030 relative to the baseline (204 fatalities and 1076 serious injuries). The distribution of the impacts is to a large extent similar to that in PO2, where countries with large road networks or a relatively high number of fatalities and injuries in the baseline would experience a higher total impact. The relative impact is highest in countries with a relatively low safety rating of roads in the baseline (e.g. Greece, Hungary and Romania). The higher reduction in the number of fatalities and serious injuries compared to PO2 is mainly due to the compulsory improvements to road infrastructure which would be carried out to meet minimum safety requirements on the road network concerned. This is complemented by general performance requirements for road furniture (guardrails). The estimated social cost saving resulting from the reduction in the number of fatalities and serious injuries is 6.9 billion euros by 2050 (expressed as present value).

While all three policy options deliver a reduction in social costs by 2050 (expressed as present value), the impacts of PO2 (5.4 billion euros) and PO3 (6.9 billion euros) are an order of magnitude larger than the impact of PO1 (0.8 billion euros).

[91] Due to the level of quantification of the impact of many elements of this option, the overall impact is possibly slightly underestimated.

6.1.2. Economic impacts

(a) Regulatory costs

The main economic impact of the policy options relates to the regulatory costs associated with the policy measures. These regulatory costs include in particular:

- Compliance costs related to the costs of using the road infrastructure safety management procedures (carrying out road safety inspections, road safety audits, road assessment programmes etc.) and to implementation costs related to making the necessary improvements to the road infrastructure (maintenance type and investment type costs)
- Administrative costs borne by businesses, citizens, civil society organisations and public authorities as a result of administrative activities performed to comply with information obligations included in legal rules. In this case the costs are imposed on national public administration to fulfil the reporting obligations of the Directive.
- Enforcement costs representing the resources that authorities need to monitor and enforce the legislation. As the RISM Directive put the responsibilities for compliance directly on national road authorities, no enforcement costs are expected.

While the unit cost of RISM procedures can be quite stable (notwithstanding the differences in labour costs between Member States), the implementation part of compliance costs will always depend on the actual condition of the infrastructure and the specific infrastructure countermeasures required to address the safety shortcoming detected by the procedures carried out. Therefore, significant differences in total compliance costs are expected between Member States.

Using the cost assumptions and the data on the length of TEN-T roads, the compliance costs for Policy options 1 to 3 at EU level (where the scope of the legislation is limited to TEN-T) over the period 2020-2050 are presented in Table 5. The costs represent the present values of one-off and recurring costs where recurring costs also include the cost of reporting. Recurrent costs are estimated at 10,000 euro annually per Member State for Policy option 1, 2 and 3. The detailed assumptions for estimating these costs are presented in the Impact Assessment Support Study while the costs by Member State are presented in the Annex 4 *"Analytical methods"*.

Table 5: Compliance costs in million euro (TEN-T roads), over the period 2020-2050

EU level	Policy option 1	Policy option 2	Policy option 3
Compliance costs	103	2,004	5,563

As the scope of the measures increase, so does the cost of compliance. The major part of the compliance costs associated with PO2 and PO3 are the costs of the infrastructure upgrades resulting from the improved follow-up of RISM procedures and in case of PO3 specifically the infrastructure costs required for all the TEN-T roads to meet the agreed minimum safety requirements.

Given the persisting budgetary pressures to reduce government spending overall in many Member States, it is important to assess whether EU and national resources will be able to cover the financing needs to be addressed. It is therefore important to estimate the compliance costs associated with the various policy options as a share of GDP for each Member State.

Differences between costs by Member State are due to the length of the roads concerned and their current level of safety. For example, as a share of GDP costs are higher especially in Eastern and Southern Europe where the safety level is currently lower (i.e. Bulgaria, Cyprus,

Estonia, Greece, Croatia, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia). Table 6 shows the compliance costs in million euro by EU country in 2030 relative to the baseline. Overall, compliance costs in PO3 are almost 3 times higher than those of PO2. However, all policy options for all Member States result in compliance costs below 0.1% of GDP in 2030[92] relative to the baseline.

Table 6: Compliance costs in million euro (TEN-T roads) by EU country in 2030

Member State	Policy option 1	Policy option 2	Policy option 3
AT	0.2	0.3	10
BE	0.2	7.8	12.1
BG	0.1	9.6	35.1
CY	0	2	3.7
CZ	0.1	5	8.9
DE	1.5	1.6	72.1
DK	0.3	6.2	3
EE	0.1	5.2	9.6
EL	0.3	18.7	42.3
ES	1.3	1.3	27.7
FI	0.5	8.5	9
FR	1.9	62	69.7
HR	0.1	2.1	7.7
HU	0.1	3.7	9.3
IE	0.2	0.3	11.9
IT	1.3	27.7	97.9
LT	0.1	2	14.1
LU	0	0.1	0.5
LV	0.1	4.5	12.1
MT	0	0.4	0.9
NL	0.3	0.3	0.3
PL	0.3	17	55.7
PT	0.2	11.5	18.3
RO	0.2	13.3	37.7
SE	0.7	0.7	0.7
SI	0.1	0.8	1.5
SK	0.1	2.9	8
UK	0.8	1	24.4
EU28	**11.1**	**216.5**	**604.2**

(b) Other economic impacts

Proper follow-up of road infrastructure safety management procedures in general and road assessment programmes in particular will result in many relatively small scale interventions aimed to upgrade the safety of the existing road network. Such activities are typically carried out by SMEs, who are therefore likely to benefit from the initiative. Due to the relatively

[92] The share is derived using the projected GDP for 2030 in the baseline scenario.

localised nature of these activities, no impacts are expected on the competitiveness of EU companies.

6.1.3. Environmental impacts

The measures might have small positive environmental impacts. Fewer road crashes could marginally improve the overall flow of traffic on TEN-T roads. This might reduce congestion and thus energy consumption and air emissions from road traffic. Measures that reduce speed in order to improve the safety of certain road or tunnel sections might also reduce energy consumption and air emissions. However, these impacts are expected to be very limited and they are thus not quantified.

6.2. Impacts of policy options targeting an extended road network (Policy options A to C)

6.2.1. Social impacts

Similarly to the Policy options 1 to 3 that limit the application of policy measures to TEN-T, the major effect of the policy options which involve an extension of the scope of the RISM Directive is the reduction in the number of road fatalities and serious injuries. The assumptions used in the quantification of each policy option and the detailed results by Member State are provided in the Annex 4 *"Analytical methods"* and further in the Impact Assessment Support Study.

Policy option A, covering the conditionality of EU funds, would result in very limited reduction in the number of fatalities and serious injuries in 2030 relative to the baseline at EU level.[93] Policy option A provides social benefits in Member States where national road infrastructure outside the TEN-T is being upgraded using EU funding and where the RISM procedures are not currently applied beyond the TEN-T. The size of the overall impact is small (less than 0.5 billion euros by 2050, expressed as present value). This is due to the limited length of the road infrastructure covered.

Policy option B, including the extension of current RISM provisions to main/national roads, is projected to deliver about 1.8% reduction in the number of fatalities on non-TEN-T motorway and main roads (0.4% decrease for the whole network) and 0.8% cut in the serious injuries (0.2% decrease for the whole network) in 2030 relative to the baseline (83 fatalities and 418 serious injuries). By 2050, Policy option B provides significant social benefits in countries where RISM procedures have not been extended to non-TEN-T roads so far. It is assumed that Policy option B will not have any impact on those Member States that already apply RISM procedures on non-TEN-T national roads. Overall, the estimated social cost saving resulting from the reduction in the number of fatalities and serious injuries is 3.3 billion euros by 2050 (expressed as present value).

Policy option C, covering the extension to main/national roads including network-wide inspections, shows the highest impacts: about 9.4% reduction in the number of fatalities on non-TEN-T motorway and main roads (1.9% decrease for the whole network) and 5.6% cut in the serious injuries (1.2% decrease for the whole network) in 2030 relative to the baseline (433 fatalities and 2,860 serious injuries). The estimated social cost saving resulting from the reduction in the number of fatalities and serious injuries is approximately 20 billion euros by 2050 (expressed as present value).

[93] The length of the roads concerned by the measure has been estimated on the basis of the data presented in the table below assuming that in the baseline period from 2020 to 2050, the same length of roads will be constructed or reconstructed as the length planned for ESIF 2014-2020. This assumption is in the upper range of what may be expected to happen as the absolute level of EU funding dedicated to the construction of new roads is unlikely to increase in the future in the light of other transport priorities (e.g. decarbonisation of transport).

In summary, all policy options are effective in reducing road transport casualties, but to a different extent. While the size of the impact of Policy option A is very limited, Policy option B delivers a significant impact. Policy option C delivers by far the biggest reduction in fatalities and serious injuries among the options concerned and thus the highest impact on social cost savings.

6.2.2. Economic impacts

(a) Regulatory costs

For the policy options involving a change in the scope of the legislation (to include roads beyond the TEN-T), the compliance costs at EU level for 2020-2050 are presented in Table 7, while the results at Member State level are provided in Annex 4. The costs represent the present values of one-off and recurring costs where recurring costs include the cost of reporting. Recurrent costs are estimated at 30,000 euro annually per Member State for Policy options B and C.

Table 7: Compliance costs in million euros for Policy options A to C, 2020-2050

EU level	Policy option A	Policy option B	Policy option C
Compliance costs	203.3	257	7,440

The compliance costs for all policy options include the compliance costs associated with the necessary upgrade of the road infrastructure concerned. The much higher compliance costs for Policy option C relative to Policy options A and B are largely the result of the implementation of the findings of road assessment programmes.

The distribution of the costs by Member State is influenced by the length of road (some Member States have very large primary road networks) and by the current state and safety level of the existing road infrastructure in the scope. Table 8 shows the compliance costs in million euro by EU country in 2030 relative to the baseline. All policy options for all Member States result in compliance costs below 0.1% of GDP in 2030[94] relative to the baseline.

Table 8: Compliance costs in million euro (TEN-T roads) by EU country in 2030

Member State	POA	POB	POC
AT	0	0	0
BE	0	0	26.4
BG	0	0	3.9
CY	0	0	2.4
CZ	0	0	13.2
DE	0	0	0
DK	0	3.4	18.5
EE	1.2	3.3	13.4
EL	8.8	4	16.1
ES	3.8	0	172.4
FI	0	4.2	54.6
FR	0	0	224
HR	0.5	3	20.8
HU	0	0	2.7

[94] The share is derived using the projected GDP for 2030 in the baseline scenario.

Member State	POA	POB	POC
IE	0	0	17.6
IT	0	0	103.9
LT	0	0	0
LU	0	0	0.8
LV	0	0	0.2
MT	0	0	0
NL	0	0	0
PL	30.9	8.2	41
PT	0	0	35.1
RO	0	0	30.4
SE	0	0	0
SI	0.1	0.4	2.1
SK	4.2	1.4	7
UK	0	0	0
EU28	**49.5**	**27.9**	**806.5**

(b) Other economic impacts

Proper follow-up of road infrastructure safety management procedures in general and road assessment programmes in particular will result in many relatively small scale interventions aimed to upgrade the safety of the existing road network. Such activities are typically carried out by SMEs, who are therefore likely to benefit from the initiative. Due to the relatively localised nature of these activities, no impacts are expected on the competitiveness of EU companies.

6.2.3. Environmental impacts

The measures might have small positive environmental impacts. Fewer road crashes could marginally improve the overall flow of traffic on national roads outside the TEN-T. This might reduce congestion and thus energy consumption and air emissions from road traffic. Measures that reduce speed in order to improve the safety of certain road or tunnel sections might also reduce energy consumption and air emissions. However, these impacts are expected to be very limited and they are thus not quantified.

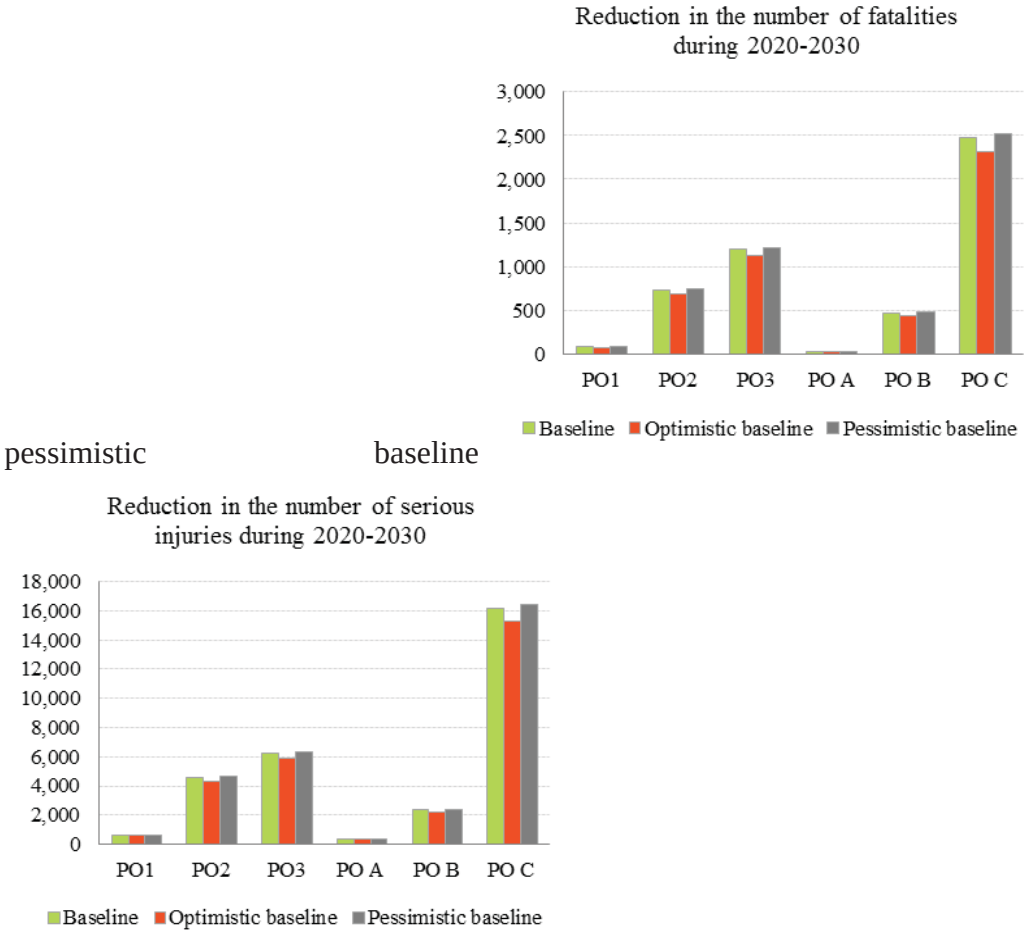
6.3. Results of the sensitivity analysis

As explained in section 2.6, sensitivity analysis has been performed on the baseline scenario, reflecting on the impacts of infrastructure safety performance and vehicle technologies. An alternative optimistic and a pessimistic baseline scenario have been developed. The policy options have been then tested against the optimistic and the pessimistic baseline scenario to assess the robustness of their results.

Overall, the number of lives saved and the number of serious injuries avoided is slightly lower when assessing the policy options relative to the optimistic baseline compared to the situation where the policy options are assessed relative to the main baseline scenario. The opposite is true when assessing the policy options relative to the pessimistic baseline (see Figure 10).

The sensitivity analysis shows that the ranking of the policy options is the same when considering both the optimistic and the pessimistic baseline. Among policy options targeting TEN-T, Policy option 2 would result in 691 to 751 lives saved (compared to the central estimate of 738) and 4,342 to 4,674 serious injuries avoided (compared to the central estimate of 4,595) during 2020-2030 relative to the optimistic and pessimistic baseline, respectively, while Policy option 3 would lead to 1,123-1,216 lives saved (1,195 for the central estimate) and 5,917 to 6,347 serious injuries avoided (6,244 for the central estimate). Among the policy options targeting an extended road network, policy option B would result in 444 to 482 lives saved (474 for the central estimate) and policy option C in 2,313 to 2,520 lives saved (2,472 for the central estimate) over 2020-2030 horizon relative to the optimistic and pessimistic baseline, respectively. In addition, policy option B would lead to 2,234 to 2,394 serious injuries avoided (2,358 for the central estimate) and policy option C to 15,271 to 16,436 serious injuries avoided (16,167 for the central estimate) over 2020-2030.

Figure 10: Impacts of the policy options on the number of lives saved and on the number of serious injuries avoided during 2020-2030 relative to the optimistic and pessimistic baseline



7. HOW DO THE OPTIONS COMPARE?

7.1. Effectiveness

The effectiveness of the intervention is measured by the total reduction in the number of fatalities and severe injuries achieved by each of the alternative policy options for the entire evaluation period. Table 9 below shows the estimated reductions in the number of fatalities and seriously injured in 2030 (by which all the measures are fully implemented) relative to the Baseline for the policy options concerning the TEN-T (Policy option 1 to Policy option 3)

and for the policy options extending the scope to national roads beyond the TEN-T (Policy options A to C). The reduction in the number of fatalities and seriously injured is also provided relative to the whole road network. In addition, Table 10 provides the cumulative reductions in the number of fatalities and serious injuries over 2020-2030 relative to the Baseline.

Table 9: Reduction in the number of road fatalities and serious injuries by policy option in 2030 compared to the Baseline

Policy option	Reduction in number of fatalities in 2030	% reduction in fatality in 2030 (targeted roads)	% reduction in fatalities in 2030 (all roads)
PO1	14	1.0%	0.1%
PO2	129	8.8%	0.6%
PO3	203	13.8%	0.9%
PO A	1	0.0%	0.0%
PO B	83	1.8%	0.4%
PO C	433	9.4%	1.9%
Policy option	**Reduction in number of serious injuries in 2030**	**% reduction in serious injuries in 2030 (targeted roads)**	**% reduction in serious injuries in 2030 (all roads)**
PO1	116	0.9%	0.0%
PO2	815	6.5%	0.3%
PO3	1,076	8.6%	0.5%
PO A	6	0.0%	0.0%
PO B	418	0.8%	0.2%
PO C	2,860	5.6%	1.2%

From the policy options that concern only TEN-T roads, Policy option 3 is the most effective. It achieves almost 10 times more reduction in the number of fatalities and serious injuries than Policy option 1 and about 50% more than Policy option 2. As regards the options involving an extension of the scope, Policy option C is by far the most effective and achieves 6-7 times higher reduction in the number of road casualties than the next best policy option (Option B). Option A is by far the least effective delivering only a very limited reduction in the number of fatalities. The ranking of the policy options does not change when looking at the cumulative impacts over the 2020-2030 horizon.

Table 10: Reduction in the number of road fatalities and serious injuries by policy option during 2020-2030 (cumulative) compared to the Baseline

Policy option	Reduction in number of fatalities during 2020-2030	% reduction in fatality during 2020-2030 (targeted roads)	% reduction in fatalities during 2020-2030 (all roads)
PO1	82	0.5%	0.0%
PO2	738	4.8%	0.3%
PO3	1,195	7.9%	0.5%
PO A	36	0.1%	0.0%
PO B	474	1.0%	0.2%
PO C	2472	5.2%	1.0%
Policy option	**Reduction in number of severe injuries during 2020-2030**	**% reduction in severe injuries during 2020-2030 (targeted roads)**	**% reduction in severe injuries during 2020-2030 (all roads)**
PO1	645	0.5%	0.1%
PO2	4,595	3.6%	0.2%
PO3	6,244	4.9%	0.3%
PO A	382	0.1%	0.0%
PO B	2,358	0.5%	0.1%
PO C	16,167	3.1%	0.7%

7.2. Efficiency

The efficiency is assessed by comparison of the benefits (the reduced social costs of fatalities and serious injuries) and the compliance costs (costs of undertaking procedures and the costs of investments into the road network). Table 11 below shows the aggregated results for the EU as a whole.

Table 11: Costs, benefits and benefit-cost ratios for policy options within the current scope

	Policy option 1 (million euro)	Policy option 2 (million euro)	Policy option 3 (million euro)
Social benefits			
Fatalities costs savings	339	2,788	3,916
Injuries costs savings	443	2,620	3,080
Total social benefits	**782**	**5,408**	**6,996**
Costs			
Compliance costs[95] (Investments and use of procedures)	103	2,004	5,563
Other derived costs	No specific impacts	No specific impacts	No specific impacts
Net benefits (present value)	**679**	**3,404**	**1,433**
Benefit-cost ratio	**7.6**	**2.7**	**1.3**

All three options show net benefits (expressed as present values). Policy option 2 exhibits the highest net benefits while Policy option 1 shows the highest benefit-cost ratio. Policy option 1 is by far the most efficient option. It is, however, the one with the lowest net benefits.

Option 3 is the option that directly mandates Member States to implement improvements in road infrastructure in order to obtain a minimum safety level on TEN-T. Policy option 3 will require some countries to invest in their road networks, especially in Southern and Eastern Europe where the safety level is currently lower.

For the three policy options that include an extension of the scope, efficiency calculations are summarised in Table 12.

Table 12: Costs, benefits and benefit-cost ratios for policy options representing extensions to non-TEN-T roads

	Policy option A (million euro)	Policy option B (million euro)	Policy option C (million euro)
Social benefits			
Fatalities costs savings	203	2.008	10,470
Injuries costs savings	288	1.274	9,398
Total social benefits	**491**	**3,282**	**19,868**
Costs			
Compliance costs[96] (Investments and use of procedures)	203	257	7,440
Other derived costs	No specific impacts	No specific impacts	No specific impacts
Net benefits (present value)	**289**	**3,025**	**12,428**
Benefit-cost ratio	**2.4**	**12.8**	**2.7**

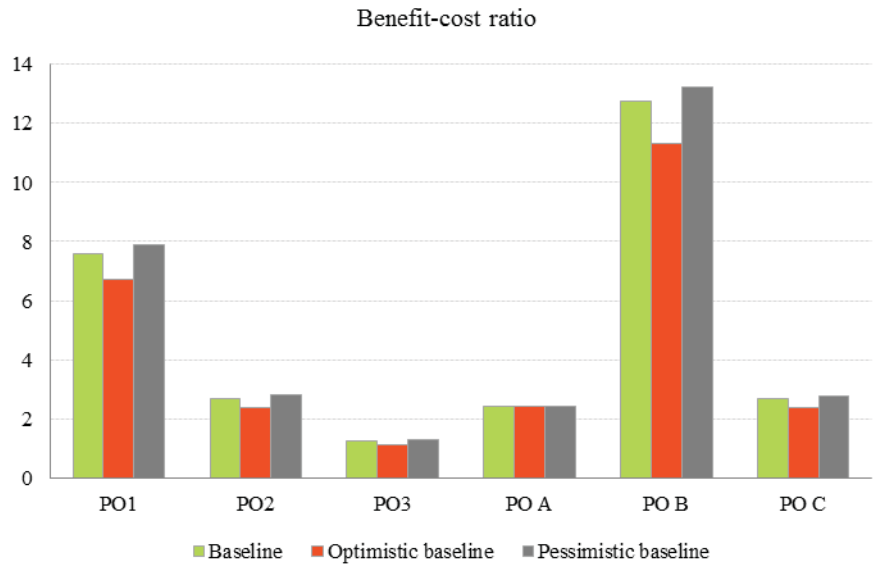
All options show net benefits, expressed as present value. The largest impact will be achieved in Member States where the application of RISM procedures is currently limited to TEN-T

[95] Recurrent costs are included in the estimated present value of compliance costs. They are estimated at 10,000 euro annually per Member State for Policy options 1, 2 and 3.
[96] Recurrent costs are included in the estimated present value of compliance costs. They are estimated at 30,000 euro annually per Member State for Policy options B and C.

and where the application of RISM procedures will enable the identification of safety deficiencies on roads where no RISM procedures are carried out at present.

The choice of the baseline scenario does not change the ranking of the options in terms of benefit-cost ratio (see Figure 11).

Figure 11: Benefit-cost ratio for the policy options relative to the baseline, optimistic and pessimistic baseline



7.3. Coherence

Coherence describes how each policy option is related to national and EU road safety policies as well as to EU transport policies in a broader perspective.

In terms of coherence with national policies, options that maintain the scope and current form of the RISM procedures are most coherent with national safety policies. Policy option 3, which includes the requirement to achieve a three star rating, means that most Member States would have to adapt their national policies as at the present time only a few Member States have made explicit commitments to achieving a minimum star rating on their networks. Policy options A, B and C, which extend the scope to national non-TEN-T roads, could interfere with national policies at least in some Member States.

The coherence assessment is summarised in the table below with a qualitative scoring of the options. Policy options 1, 2 and A score higher than the other options. All of the options are coherent with EU policies. Option A is very coherent as it only requires the application of RISM procedures that are built using EU funding. Options B and C, which expand the scope of coverage to the main national road network, give Member States flexibility as it will be up to them to designate national roads, which increases coherence with national policies.

Table 13: Assessment of the coherence of the alternative policy options

	National safety policies	EU safety policies	EU transport policies	Overall coherence
Option 1	+	+	+	+++
Option 2	+	+	+	+++
Option 3	0	+	+	++
Option A	+	+	+	+++
Option B	0	+	+	++

Option C	0	+	+	++

7.4. Proportionality

The assessed policy options represent various degrees of proportionality in achieving the policy objectives. While all policy options are made up of proven measures to tackle effectively the problem of road fatalities and serious injuries, the most ambitious policy option (Policy option 3) is the least proportionate. The extension of the scope of the RISM legislation to the primary road networks of Member States (Policy option B and Policy option C) are proportionate, as these policy options target 15% of the road network by length which is responsible for approximately 39% of road fatalities in the EU. Member States would also be involved in the exact definition of the road network concerned.

8. PREFERRED OPTION

The table below provides an overview of the results of the assessment of the effectiveness, efficiency and coherence of all policy options.

Table 14: Comparison of options

	Effectiveness		Efficiency	Coherence
	Cumulative reduction in the number of fatalities over 2020-2050 (compared to Baseline)	Cumulative reduction in the number of serious injuries over 2020-2050 (compared to Baseline)	Cost-benefit ratio	Qualitative scoring
Option 1	374	3,247	7.6	+++
Option 2	3,377	21,778	2.7	+++
Option 3	5,370	29,100	1.3	++
Option A	20	209	2.4	+++
Option B	2,179	11,166	12.8	++
Option C	11,273	75,724	2.7	++

In selecting the preferred options, there are trade-offs to be made. The overall political objective of the initiative has to be clearly born in mind: to reduce the number of deaths and serious injuries in line with current and future EU aspirational targets as a step towards the Vision Zero by 2050 announced in the 2011 White Paper for Transport.

In terms of efficiency, Policy option 1 ranks higher than any other option. It has both limited costs and limited effects. It is the option with the lowest effectiveness as it does not make a significant contribution to the political objective of reducing road deaths and serious injuries.

The most effective option targeting the TEN-T network is Policy option 3, but it is less efficient than Policy option 2. Option 3 implies that the TEN-T network (both core and comprehensive) has to comply with a minimum safety level (e.g. 3 star rating) by a certain point in time. It is clearly the option that brings the biggest benefits in terms of road safety on TEN-T, and to Member States with low safety standards in particular. However, compliance costs in Policy option 3 are almost three times higher than those of Policy option 2. It is also less coherent than Option 2 in the sense that it will require Member States to adapt their national policies to achieve a minimum star rating (while only few MSs have taken such commitments so far).

On the contrary, Policy option 2 preserves the flexibility of Member States to focus their road infrastructure safety efforts where they consider them most effective and efficient. It obliges Member States to screen infrastructure through inspections at network level (Road Assessment Programmes) identifying the parts of network below the 3-star benchmark but leaves them the flexibility to decide on the priorities, the level of investments and the

timetable. The rationale of Option 3 i.e. to ensure a minimum level of safety across the TEN-T network remains valid and coherent with the overall policy objective but it could potentially be achieved through more flexible and softer means. Such instruments include the monitoring of the safety level across TEN-T (a potential Key Performance Indicator in the forthcoming road safety policy framework for the next decade), the inclusion of a performance target in the next revision of TEN-T guidelines, and, most importantly, the possibility to support road safety upgrades through Community funds. Such possibility is currently being explored for the next Multi-annual Financial Framework.

As regards vulnerable road users, Option 3 would prescribe the mandatory implementation of a specific technical solution (motorcycle-friendly guardrails), which may raise questions of acceptability and may not in all cases be the best measure to improve overall safety. Option 2 on the other hand obliges Member States to systematically assess the safety requirements of all types of vulnerable road users in the framework of network-wide inspections, but leaves them the flexibility to implement solutions which best fit the specific local circumstances. This appears to be the most comprehensive and suitable way to take the needs of vulnerable road users into account in this initiative.

Policy option 2 is more proportionate than Policy option 3, as the costs are almost three times lower and as it is more flexible. As a conclusion, Policy option 2 (moderate intervention - mandatory follow-up, network wide inspections) is the preferred option for the current scope.

With respect to extending the scope to target a larger network, Policy option A is coherent with EU policies but only delivers very small benefits by limiting the intervention to a small share of the national road network. Policy option B extends the provisions of the current legislation to the main roads but due to the inherent limitations of the current legislation (such as the lack of obligation on the follow-up of findings), it is much less effective than Policy option C. Option C is applying the same, more ambitious procedures as Option 2 (without the general performance requirements for road markings and signs though). It is the most effective of all options and has the advantage of aligning procedures on TEN-T and on national roads. Option C is less efficient than B but addresses in a coherent manner the substantial road safety problem on the main roads which count for 39 % of the fatalities (in contrast to less than 10% for the TEN-T network). Option C (extension to main/national roads including network-wide inspections) is therefore the proposed option in terms of the extension of scope. The Commission shares the concern of stakeholders related to ensuring that an extension of the scope of the Directive takes the needs of vulnerable road users into account. This is the reason why the Commission proposes to set up of a Forum of Exchange for auditors, in order to facilitate the spreading of best practice in this regard.

Analysis has shown that benefits and costs of the selected options are unequally distributed across the EU, with low benefits and low costs in well performing countries and higher benefits and costs in less well performing countries. If accompanied by appropriate funding assistance, this need not be a weakness of the proposed approach, but could become a strength, helping to spread an advanced road safety culture across the EU in road infrastructure investment and to close the gap between the good and poorer performers. By helping the poorer performers catch up, the initiative will support the EU's objective of economic, social and territorial cohesion.

Therefore, based on the analysis above, it is recommended to proceed with the preparation of the implementation of Policy option 2 combined with Policy option C.

The analysis shows that the combination of Policy option 2 and Policy option C could save over 3,200 lives and avoid more than 20,700 serious injuries during 2020-2030 relative to the baseline (14,650 lives saved and 97,502 serious injuries avoided for 2020-2050). Vehicle safety measures would have higher impact, reducing the number of fatalities by 4,380 to

7,300 and of serious injuries by 19,850 to 38,900 during 2020-2030.[97] For 2030 alone road infrastructure measures would result in 562 lives saved and 3,675 serious injuries avoided, while vehicle safety measures would result in 1,030 to 1,769 fewer fatalities and 4,721 to 9,824 serious injuries avoided. Thus, additional measures going beyond road infrastructure and vehicle safety will be needed to achieve the EU's strategic objectives.

The sensitivity analysis does not change the choice of the preferred options as they remain the preferred option under both the optimistic and the pessimistic scenario (see section 6.3).

The application of Policy option 2 and Policy option C in combination is coherent as they involve the application of the same RISM procedures on the TEN-T and on the primary road networks of Member States representing a consistent approach to road infrastructure safety management on the roads that carry the biggest traffic flows across the EU.

9. HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

An important element of the Safe System approach, which will be implemented at EU level in the EU framework for effective road safety policy 2020-2030, is the performance monitoring of different aspects of road safety work. As part of the framework, the Commission will propose a set of Key Performance Indicators, one of which should relate to the safety quality of the road network (TEN-T and national roads). The Commission is working with experts to define and operationalise these indicators.

The indicators will be used as a basis for best practice exchange between Member States, with the High Level Group on road safety (bringing together high level representatives of Member States' transport administrations) taking on a strong coordinating role.

More specifically, the Commission services will monitor the implementation and effectiveness of this initiative through a set of core indicators that will measure the progress towards achieving the operational objectives, based on the monitoring obligation that is part of the preferred Option. Some of the indicators are of a qualitative nature and show if the desired deliverables are being achieved and implemented, while others are based on data to be collected that will need to be analysed further. More detailed data concerning traffic volumes and traffic flows, improved availability of exact location data of road traffic accidents resulting in fatalities or serious injuries, more information about the road infrastructure safety management procedures carried out and information about the effectiveness of the deployed infrastructure measures will allow a more targeted application of policies that effectively contribute to the improvement of road infrastructure safety.

The Table below presents possible progress indicators for the policy measures included in the preferred policy options.

Core progress indicators for monitoring purposes

Operational objectives	Core progress indicators	Source of data
Foster harmonisation and knowledge sharing between Member States	Number of Member States actively participating in exchange of best practices	Attendance records in relevant events
Improve follow-up on findings of RISM procedures	Number of RISM procedures carried out	Member States' reports
Improve follow-up on findings of RISM procedures	Number of road infrastructure safety interventions carried out in response to RISM findings	Member States' reports

[97] Add reference to IA on GSR

Improve follow-up on findings of RISM procedures	% of road network assessed by network-wide safety inspections	Member States' reports
Improve follow-up on findings of RISM procedures **Protect vulnerable road users**	Distribution of the assessed road network across the safety categories defined in network-wide safety inspections (1 star, 2 star, 3 star etc.) by category of road users	Member States' reports
Improve deployment of new technologies	% of road network type covered by cooperative-ITS services and applications	Voluntary reporting of Member States in the framework of ITS Directive[98]

It is foreseen that once the new legislative framework has become applicable in its entirety, the Commission services will carry out an evaluation to verify whether the objectives of the initiative have been reached. This is intended to determine whether the new measures in place have resulted in an improvement of the situation. This evaluation shall be carried out based on the above core progress indicators in line with Commission requirements on evaluation.

[98] 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

EUROPEAN
COMMISSION

Brussels, 17.5.2018
SWD(2018) 175 final

PART 2/2

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Proposal for a Directive of the European Parliament and of the Council amending Directive 2008/96/EC on road infrastructure safety management

{COM(2018) 274 final} - {SEC(2018) 226 final} - {SWD(2018) 176 final}

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Annex 1: Procedural information

1.1. LEAD DG, DECIDE PLANNING/CWP REFERENCES

Agenda Planning Reference AP N°	Short title	Foreseen adoption
2016/MOVE/007	Road infrastructure and tunnel safety	Spring 2018 (Commission proposal)

1.2. ORGANISATION AND TIMING

The Inter Service Steering Group (ISSG) for the Impact Assessment was set up in January 2016 and includes the following DGs and Services: SG, SJ, CONNECT and GROW as well as INEA (Innovations and Networks Executive Agency). Representatives of EIB were also invited to participate in the work of the Steering Group.

Six meetings of the Steering Group were organised between 8 January 2016 and 7 November 2017. Further consultations with the ISSG were carried out by e-mail.

The ISSG approved the Inception Impact Assessment. The ISSG also discussed the main milestones in the process, in particular the consultation strategy and main stakeholder consultation activities, the task specifications to launch the contract for the external IA support study, key deliverables from the support study, and the draft impact assessment report before the submission to the Regulatory Scrutiny Board.

1.3. CONSULTATION OF THE RSB

The impact assessment was submitted to the Commission's Regulatory Scrutiny Board on 15 December 2017. Following the meeting on 17 January 2018, the Board issued a positive opinion with reservations on 19 January 2018. The Board made recommendations. Those were addressed in the revised IA report as follows:

Main considerations	**Modification of the IA report**
(1) The report does not sufficiently delimit the expected contribution of this initiative within the comprehensive approach to road safety of the Safe System. It does not well explain the relationship and complementarity with the parallel general safety of vehicles and pedestrian safety initiative.	Explanations on the Safe System approach, the contribution of individual initiatives, the relationship with the parallel general safety of vehicles and pedestrian safety initiative and their respective contributions to the general objective were added in section 1, section 1.1.1, section 2.6 and section 8.
(2) The report does not sufficiently demonstrate that the preferred policy option is proportionate. It does not clearly identify the constraints by EU and national financial resources and how lacking resources hinder the full	The lack of funding has been added to problem driver 3 (section 2.3.3) and the fourth specific objective has been extended to take into account the financial constraints (section

enforcement of the Directive.	4.2). Compliance costs by Member State for 2030 have been included in sections 6.1.2 and 6.2.2.
(3) The problems analysis does not take up some of the conclusions of the evaluations, in particular for the tunnel safety Directive. The report fails to explain how enforcement problems of the existing Directives will be addressed.	
Further considerations and adjustment requirements	
(1) The report should clarify the (limited) contribution of this initiative to the overall road safety objectives. It should clarify the relation, prioritisation and complementarity with the parallel initiative on general vehicle and pedestrian safety. It should better explain how the scope of this initiative fits into the overall road safety policy. For this purpose, the report should include a description of the Safe System approach that is common to both initiatives. It should present all initiatives on road safety and their respective contributions to the common objectives. The impact analysis should describe the interaction with the vehicle and pedestrian safety initiative. It should show how the two initiatives complement each other and together contribute to multiple safety layers. The report should also clarify how the methodologies of the studies for the two proposals have been developed to avoid double counting within and between proposals. It should elaborate on how its cost-effectiveness is justified compared to alternative measures (such as the vehicle safety features or more targeted enforcement measures of the existing Directive). For this purpose, the report should include a "chapeau" on the safety system that is common to both initiatives in order to strengthen the mutual reinforcement of the respective contributions to the common objectives. The impact analysis should describe the relation with the road vehicle safety initiative, i.e. show how the two initiatives complement (or overlap) each other (clarify how both initiatives together contribute to multiple safety layers).	A description of the Safe System approach and the relation with vehicle and pedestrian safety initiative was added in section 1. The relation with other road safety initiatives was further described in section 1.1.1. Explanations on the complementarity between road infrastructure and vehicle safety measures were added in section 2.6. However, in the same section, it is acklowledged that there are overlapping effects between the impacts of the policies, in the same way as there is nearly always more than one factor in accident causation. In other words the combined effect of road infrastructure and vehicles safety measures deployed together, is going to be somewhat lower than the sum of their individual effects. A discussion of the relative contribution of the road safety infastructure measures and the vehicle and pedestrian safety initiative has been added in section 8.
(2) The report should demonstrate that the preferred policy option is proportionate. As the choice of the preferred option is the result of a trade-off between road safety and enforcement costs, the financial constraints should be integrated into the policy objectives. The report needs to assess the compatibility of the policy options with the	The lack of funding has been added to problem driver 3 (section 2.3.3) and the fourth specific objective has been extended to take into account the financial constraints (section

national budgets; this necessitates repatriating information from the annexes to the main report about the financial impacts on the various Member States. The report should demonstrate how likely EU and national resources can ensure the financing of the policy options. The impact analysis (and the annex) should provide more information about the underlying methodology for the estimates (e.g. explain the varying impacts of options 2 and 3 on individual Member States, provide a sensitivity analysis of the impacts). Finally the impact analysis should reflect the overall contribution of the initiative with the 2020 objectives on road fatalities. The analysis should also inform whether the distribution of costs and benefits across Member States of the final option allows addressing the critical bottlenecks to achieve the EU target.	4.2). The impacts on compliance costs by Member State for 2030 have been included in sections 6.1.2 and 6.2.2. A section on sensitivity analysis has been added (section 6.3) and additional considerations related to sensitivity analysis have been added in section 7.2.
(3) The report should more closely link the problems analysis to the outcomes of the evaluations of the two Directives. In particular, it should explain how the identified loopholes of the tunnel safety Directive will be addressed. The report should explain more in details how stakeholders concerns or proposals have been addressed.	More details on how stakeholder concerns and proposals have been addressed have been added to the report, in particular in sections 2.3.3, 3.2 and 4.2, and in the stakeholder consultation annex.
(4) The analysis should include a discussion of the REFIT dimension of the initiative. It should as a minimum explain expected simplification of the legislative framework. It should also give indications on future updates of the legislation. Equally important is to explain the efforts to simplify the stock of possible outdated regulatory dispositions in view of potential cost reduction.	Further elements on the REFIT dimension of the initiative have been added to section 2.4.

1.4. EVIDENCE, SOURCES AND QUALITY

The starting point to the drafting of the Impact Assessment report was the ex-post evaluations of the RISM Directive and the Tunnel Directive. The findings of the ex-post evaluations have been described in two separate Evaluation Reports[1,2].

Information provided by the stakeholders through the stakeholder consultation activities were an important source of information (see Annex 2). It was completed by information provided ad hoc by different stakeholders to the Commission.

The Commission sought external expertise through a contract for a support study with a consortium led by Ecorys and consisting of experts from COWI and SWOV, which was launched in September 2016. The findings of the impact assessment report build on the final report from this contract.

[1] http://ec.europa.eu/transport/facts-fundings/evaluations/doc/2014-12-ex-post-evaluation-study-road-infra-safety-mgmnt.pdf
[2] http://ec.europa.eu/transport/facts-fundings/evaluations/doc/tunnel_final_report.pdf

In addition, an external expert (Professor George Yannis from the Technical University of Athens) was contracted to provide complementary analysis, scientific review and additional validation.

A non-exhaustive list of external studies used as input for the drafting of the Impact Assessment report is provided below:

- Elvik, R., T. Vaa, A. Hove and M. Sorensen eds. (2012) The Handbook of Road Safety Measures
- ICF (2015). Study on the implementation and effects of Directive 2004/54/EC on minimum safety requirements for road tunnels in the trans-European road network. ICF Consulting Services in association with TRT Trasporti e Territorio, London.
- OECD/ITF (2015). Road Infrastructure Safety Management. Research Report. International Transport Forum. International Traffic Safety Data and Analyses Group.
- Ricardo-AEA, et al. (2014). Update of Handbook of External costs. Final report
- TML (2014a). Study on the effectiveness and on the improvement of the EU legislative framework on road infrastructure safety management: ex post evaluation – final report". Transport & Mobility, Leuven.
- TML (2014b). Final Report. Study on the effectiveness and on the improvement of the EU legislative framework on road infrastructure safety management (Directive 2008/96/EC): preliminary analysis of some crucial areas for road safety and for safety of road infrastructure – Final report, Transport & Mobility, Leuven. December 2014

Overall, the sources used for the drafting of the Impact Assessment report are numerous, largely exhaustive and representative of the different stakeholder groups.

Annex 2: Stakeholder consultation

2.1. INTRODUCTION

In the context of the preparation of the Impact Assessment for the revision of Directives 2008/96/EC on road infrastructure management (the RISM Directive) and Directive 2004/54/EC on minimum safety requirements for road tunnels in the trans-European network (the Tunnel Safety Directive), the European Commission (DG MOVE) has carried out a number of stakeholder consultation activities. Some of these were part of the Impact Assessment support study (by an external contractor, COWI), which was launched in September 2016 to assist the Commission in assessing options for the revision of the two directives.

This annex provides an overview of the stakeholder groups that were consulted as well as a summary and analysis of the responses received. The consultation covered all aspects of the Impact Assessment (problem definition, EU dimension, options and potential impacts). In particular, the consultation was crucial in getting a better view on the scope of the issues identified in the ex-post evaluations of the two directives and in identifying the policy measures that could be most suitable to address them.

The following consultation activities have been carried out:

- Stakeholder seminar organised by the European Commission in March 2017 in Valletta, Malta
- Meetings with key stakeholders
- A targeted stakeholder survey (by COWI)
- Individual interviews with selected stakeholders (by COWI)
- An Open Public Consultation, conducted between 14 June and 10 September 2017
- Meetings of the Committee on Tunnel Safety and of the Committee on Infrastructure Safety Management

2.2. CONSULTATION METHODS

2.2.1. Stakeholder seminar in Valletta, Malta

The Maltese Presidency, in collaboration with the European Commission, organised a high-level stakeholder meeting and Ministerial Conference in Malta on 28 and 29 March 2017, bringing together road safety experts, stakeholders, and policy-makers. The stakeholder meeting was held in a participatory form, encouraging open discussions around the key pressure points of the road safety system. The conclusions, which were presented to Transport Ministers on the following day, included a set of recommendations specifically relating to infrastructure safety[3].

[3] https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/rapporteurs_summary_reports_28_march_03.pdf

2.2.2. Meetings with key stakeholders

Throughout the period of preparing the Impact Assessment, Commission services have met with a wide variety of stakeholders, including Abertis (manager of toll roads in a number of European countries), ACEM (Association des Constructeurs Européens de Motocycles), ASECAP (Association Européenne des Concessionnaires d'Autoroutes et d'Ouvrages à Péage), the Task Force on Road Infrastructure Safety of the CCE (Conseil de Coopération Economique, an advisory board under the patronage of the Spanish, French, Italian and Portuguese governments), CEDR (Conference of European Directors of Roads), ECF (the European Cyclists' Federation), ETSC (European Transport Safety Council), Michelin and 3M (manufacturer of road markings and road signs). In addition, Commission services have been in contact with national authorities through established forums, in particular the High Level Group on road safety (expert group) as well as the Road Infrastructure Safety Management Committee and the Road Tunnel Safety Committee.

2.2.3. Targeted stakeholder survey and interviews

As part of the Impact Assessment support study, COWI circulated a survey to road authorities, road user organisations, traffic safety experts and NGOs, aiming at a wide and geographically balanced coverage of stakeholder types. Out of 120 potential respondents, 27 replies were received, some of which partial.

In addition, COWI conducted a number of interviews with selected stakeholders, to gather in-depth information and to fill data and knowledge gaps.

The stakeholders involved in the survey and interviews included the following:

- Member State authorities: Austrian Ministry for Transport, Innovation and Technology, Ministry of Transport, Communication and Works of the Republic of Cyprus, Danish Road Directorate, Highways England, Finnish Transport Agency and Finnish Transport Safety Agency, Agency of Roads and Traffic and Department of Mobility and Public Works of Flanders (Belgium), Ministry in charge of Transports (MTES, France), Federal Ministry of Transport and Digital Infrastructure (Germany), Budapest Capital Government Office Department for Transport (Hungary), Italian Ministry for Infrastructure and Transport, Ministère du Développement durable et des Infrastructures (Luxembourg), Ministry of the Interior (Bulgaria), Ministerio de Formento (Spain), Swedish Transport Agency, Swedish Tunnel Agency and Swedish supercising Authority according to RISM, Ministry of Infrastructure and the Environment (the Netherlands), Ministry of Transport and Construction of the Slovak Republic, Federal Roads Office (Switzerland)

- Road operators: ASFINAG (Austrian publicly owned corporation which plans, finances, builds, maintains and collects tolls for Austrian motorways), EGNATIA ODOS S.A. (company responsible for the design, construction, operation and maintenance of the homonym motorway across northern Greece), Association of Portuguese Concession Companies of Toll Motorways or Bridges, Compania Nationala de Administrare a Infrastructurii Rutiere (Romania), Spanish toll concessions, CEDR, ASECAP, ECOROADS

- Road user organisations: OAMTC (Austrian Club of Motorists and Cyclists), Danish Road User Organisation (FDM)

- Traffic safety experts: Public Enterprise Road and Transport Research Institute (Lithuania), Institute of Transport Economics (Norway)

- NGOs: European Union Road Federation, iRAP/EuroRAP

- EU: European Investment Bank

In view of the low response rate to the targeted survey especially of representatives of vulnerable road users, the Commission held meetings with the ETSC, ACEM and ECF specifically to discuss the needs of vulnerable road users in the context of this initiative.

2.2.4. Open Public Consultation

An Open Public Consultation (OPC) ran from 14 June to 10 September 2017 on the European Commission's "Your Voice in Europe" platform. The consultation resulted in 74 replies from 19 EU countries, 46 of which from organisations and 28 from individuals.

Figure 1: Number of OPC respondents per country

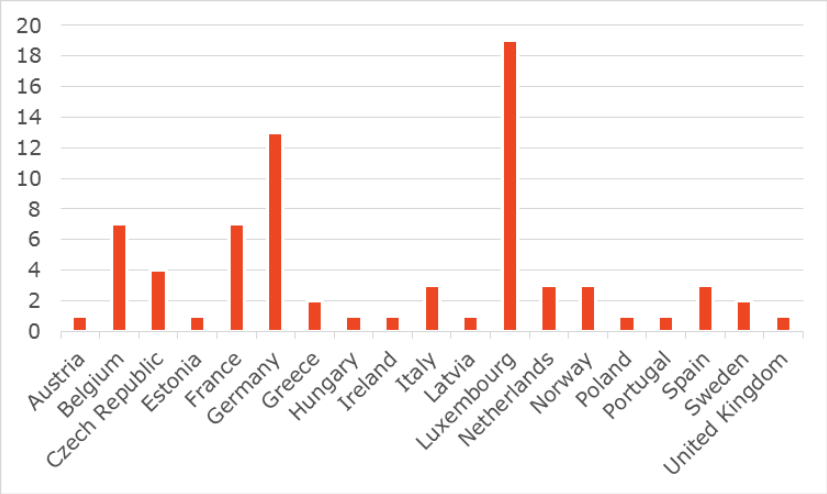
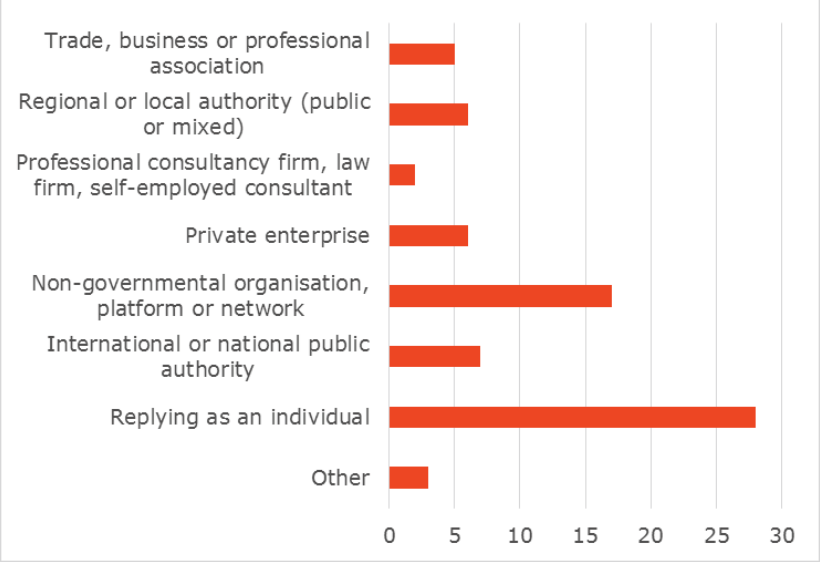


Figure 2: Number of OPC respondents by type



Individuals from Luxembourg were strongly overrepresented (19 out of 74 respondents), which had to be borne in mind in analysing the results.

2.2.5. *Meetings of the Committees on Tunnel Safety and on Infrastructure Safety Management*

The two Committees associated to the Tunnel and RISM Directives, composed of representatives of national administrations of EU Member States and chaired by DG MOVE, with EEA countries and sectoral stakeholders as observers, met on 8 November 2017. A COWI representative presented preliminary results of the Impact Assessment support study, including the problem definition, possible measures and possible policy options. Members were invited to comment on all three aspects.

2.3. RESULTS OF CONSULTATION ACTIVITIES

2.3.1. *Assessment of the current regime*

Comparative safety of roads

A large majority of respondents to the OPC rated the safety of EU motorways in general high or very high (86%). The safety of national/main roads was seen as medium high by a majority (53%), with 32% rating it high. Opinions on the safety of regional/local/urban roads were most divided, ranging between medium (35%), high (27%) and low (26%). Ratings were more varied when respondents were asked about the safety of the three types of roads in the country they know best.

Figure 3: Perceived safety of motorways "in the country that you know best"

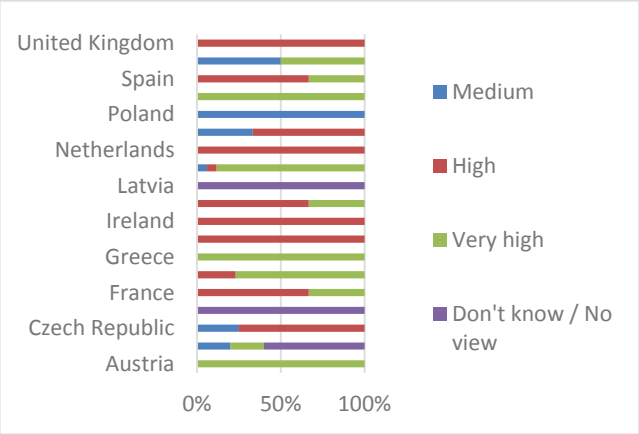


Figure 4: Perceived safety of national/main roads "in the country that you know best"

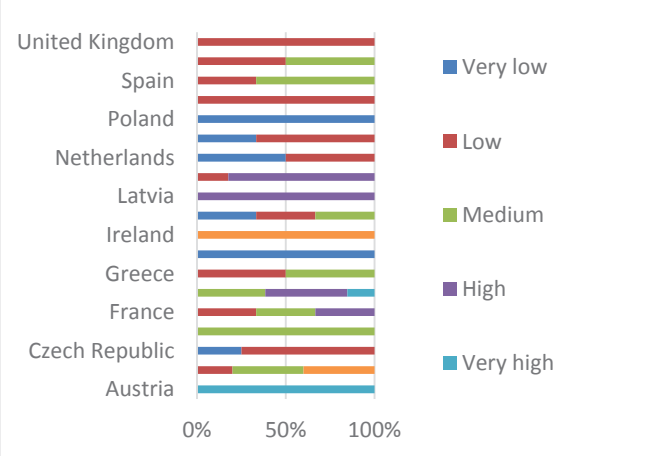
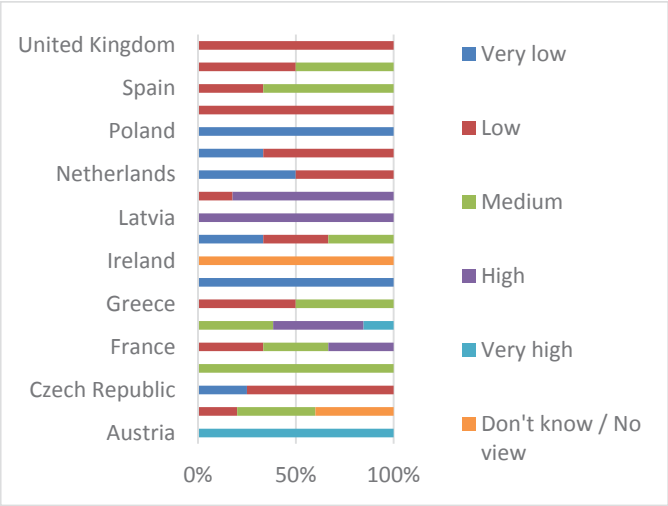
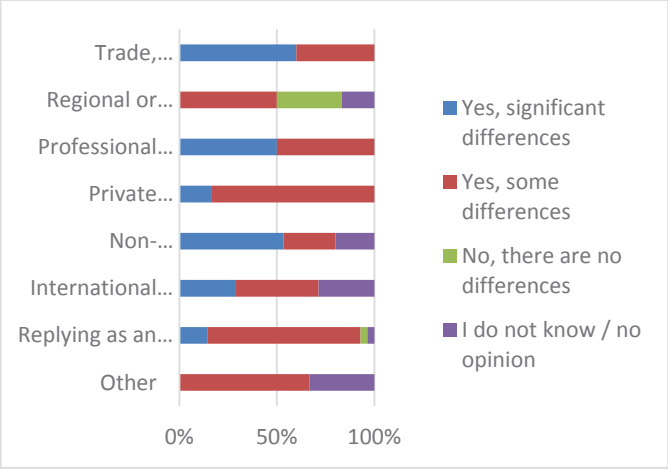


Figure 5: Perceived safety of regional/local/urban roads "in the country that you know best"



58% of OPC respondents have experienced some difference in the road infrastructure safety on the TEN-T network between countries, and 85% have experienced some or significant differences. Respondents who replied on behalf of organisations saw bigger differences than individuals.

Figure 6: OPC replies to the question "Have you experienced any variation in road infrastructure safety on the TEN-T network between countries?"



These general results are complemented by comments on specific aspects. For example, Egnatia ODOS (motorway operator) from Greece listed some specific differences in the level of road or tunnel infrastructure safety across countries:

- Level of pavement maintenance

- Road markings visibility

- Mobile communication coverage inside tunnels

- Linear chainage reference system to identify easily your location on the network

- Level of accessibility (for elderly, children, people with special needs) of emergency exits and cross passages inside tunnels

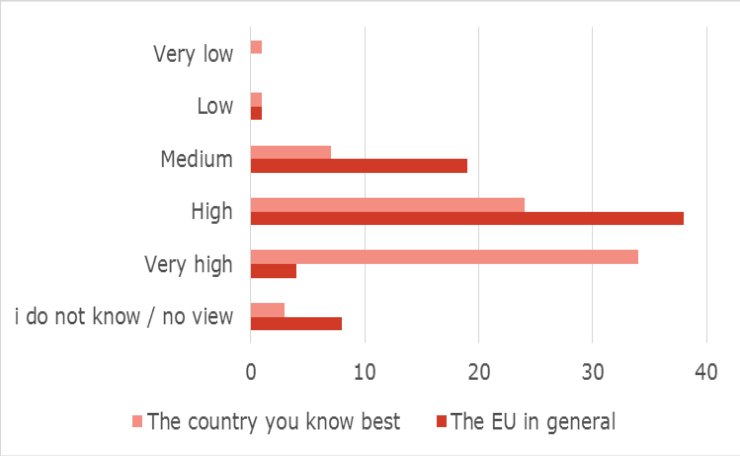
The public authority for transport infrastructure in Ireland highlighted differences across countries depending on whether TEN-T roads are dual carriageways or single

carriageways with poorer safety performance. It also referred to the safety differences between the core and comprehensive road network. Finally, it pointed out that there are variations between Eastern and Western Europe also with respect to the age of the road infrastructure.

Tunnel safety

The OPC respondents tended to rate the safety level of road tunnels very high in the country they know best (although this result is biased by the large number of individual respondents from Luxembourg). In comparison, the safety level of tunnels in the EU in general is getting a medium to high rating. Overall, the respondents rate the safety level in road tunnels as high.

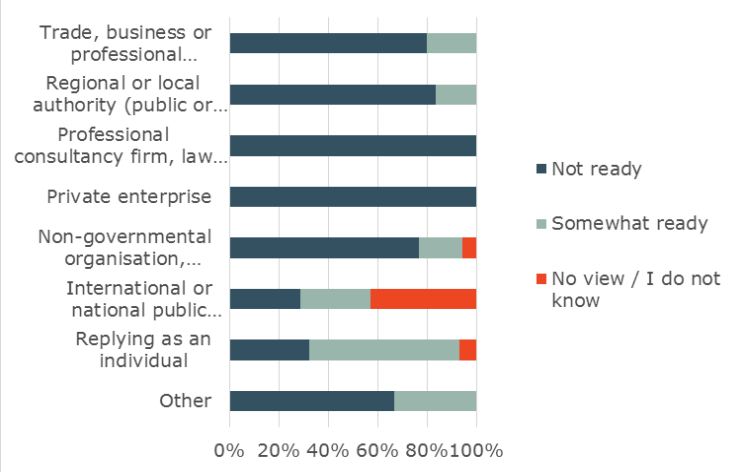
Figure 7: The safety level in road tunnels with respect to infrastructure in the EU in general vs "in the country that you know best"



Readiness for deployment of automated and connected driving

58% of OPC respondents do not think that the existing road infrastructure is ready for the deployment of automated and connected driving.

Figure 8: OPC replies to the question "In your opinion how ready is the existing road infrastructure for the deployment of automated and connected driving?"



The Swedish and Norwegian motorcyclist organisations both commented that there is not yet enough knowledge about how connected driving will influence road users. The Latvian Ministry for Transport highlighted the variation in the level of readiness for

automated driving across Member States. It attributed this difference to the current state of the infrastructure and the availability of funding. In Latvia for example, 40% of all roads were in poor conditions due to lack of funding for maintenance; therefore, it was necessary to prioritise the basic needs of road users while automated driving had low priority. This view is supported by the European Motorcyclist Federation (FEMA) and the Italian Assoprevenzione NGO, pointing out that many highways are ready, but most other roads are not, and highlighting the lack of universal road signs in particular.

The European Union Road Federation (ERF) commented in the targeted stakeholder consultation that more needed to be done to link the RISM Directive to ITS. Particularly, it mentioned the need for maintenance of road markings and signs as a necessity for in-vehicle systems to work properly. It underlined that the Directive should more explicitly promote a better understanding of the interaction between the vehicle systems and the road infrastructure, including road equipment.

ASECAP considered that road infrastructure has a key role to play in C-ITS, since it is the infrastructure manager who provides significant safety instructions to the vehicles (closed lanes/tunnels/bridges, work zones etc), manages the traffic flows and decides which measures to take based on improved information available.

A private company working with ITS submitted that an automated and connected car must have the ability to detect and avoid moving and static objects. Physical infrastructure performance needs for e.g. vehicle sensors must be recognised. Clear visibility of road infrastructure, including lane markings, road signs, speed limit signs, traffic signs indicating change of speed limits / entrance to towns must be ensured. Deployment of digital infrastructure enabling V2X communication was still missing in the EU, although V2X communication based on ITS-G5 (802.11p) had been tested for more than ten years and was ready for roll-out. Road-side units (RSUs) could be deployed in much of the existing roadway infrastructure, including traffic lights and traffic signs. To make automated and connected driving a reality on European roads, a harmonised, EU-wide approach to accelerate and coordinate infrastructure upgrades was needed.

On the other hand, France pointed out that, as far as automated driving was concerned, the logic had to be that the development of automated driving takes into account the existing infrastructure and adapts to it, not the other way round:

- The rhythm of infrastructure renewal was much slower than that of vehicle renewal;
- The European road networks were mature and very large (...), which means that to adapt the entire network would imply prohibitive costs;
- Putting into question the rules of road conception, developed and honed over decades for the human driver, could harm the road safety for those drivers;
- It was technically impossible for a road infrastructure manager to guarantee, for example, a minimum level of contrast of horizontal signalling at every moment. The wear of the horizontal signalling depended on the number of tyre passages and of the meteorological conditions, and the moment at which it would fall under a certain threshold was thus unpredictable. Even with unlimited financial means, it was impossible to guarantee that an automated vehicle would never come across horizontal signalling erased following an unplanned event (accident, severe weather).

This was in fact the logic that vehicle manufacturers apply in their experiments. On-board sensors, algorithms of reconstituting lines and embedded intelligence were continuously improving to adapt to driving conditions on existing infrastructure.

Having thoroughly studied the arguments of both sides of this discussion, the Commission concludes that a certain degree of harmonisation of the physical infrastructure will be needed in order to allow a smooth roll-out of higher levels of automation and to ensure that automated vehicles behave safely in mixed traffic. This is confirmed in a recent report of the TM 2.0 Task Force on Road Automation (composed of representatives of public authorities, service providers, suppliers, manufacturers and researchers), which concludes:

"It is expected that, at least for mixed fleets of vehicles, spatial or temporal restrictions may be enforced on the circulation of automated vehicles. All traffic signs and road delineation relevant to such restrictions should be harmonised among countries, to allow interoperability of automated functions, as they may be based on the recognition of such markings and signs. (…) Good lane markings condition can support the accurate positioning of automated vehicles. Stricter criteria and maintenance processes as regards the condition of lane markings should be studied."[4]

Performance of the directives

A large majority of respondents to the targeted stakeholder consultation (27 replies, mostly from Member State authorities) considered that the current EU legislative framework both for infrastructure safety management and for tunnel safety addresses the problem of road safety to a large extent (11 replies) or to a fairly good extent (6 replies).

In the targeted stakeholder survey, respondents referred in particular to the following as problems of the current framework: lack of harmonisation, lack of information sharing and a limited scope.

The lack of harmonisation was mentioned by road operators in Portugal and Greece and the European Union Road Federation – all pointing to the fact that the RISM Directive does not include specific guidelines and therefore management procedures vary across Member States. The Greek Motorway operator also mentioned the lack of harmonised reporting forms.

Regarding sharing of information, the Flanders Agency of Roads and Traffic called for sharing of information about accepted alternative risk-reduction measures for tunnels. The Cypriot Ministry for Transport, Communication and Works emphasised the challenge for Member States with very few tunnels to establish comprehensive national procedures and that information sharing would be useful.

The limited scope of the RISM Directive was mentioned as a specific issue by one respondent suggesting that the RISM should be extended beyond the TEN-T road network (Public Enterprise Road and Transport Research Institute from Lithuania).

National implementation

As regards implementation of the RISM provisions by Member States, 5 out of 27 respondents to the targeted stakeholder survey considered RISM national procedures to be ineffective while four other respondents indicated that the procedures in national legislation were too complex for practical use (two of these are from Spain, one from Austria and one from Portugal). The remaining 18 respondents did not see any particular implementation issues.

[4] http://2r1c5r3mxgzc49mg1ey897em.wpengine.netdna-cdn.com/wp-content/uploads/sites/8/2018/01/TM2.0_TF_RoadAutomation_report3_FINAL.pdf

According to the results of the targeted stakeholder consultations, in some Member States only few inspections are carried out. However, the questionnaire referred to a single year (2016). Data for a longer period would be necessary to draw more reliable conclusions. Bulgaria also referred to a lack of financing, in particular as regards tunnels that were built before the two directives were transposed into Bulgarian legislation.

Table 1: Overview of the use of RISM procedures and number of auditors and inspectors - responses based on the targeted stakeholder survey

MS	How many times have the procedures been applied in the country you represent on TEN-T roads in 2016?				How many certified road safety auditors and inspectors are there in the country you represent?
	RSI	**RSIA**	**RSA**	**NSM**	
LT	All state roads network - once in 7 years.	All new road projects and near road structure projects.	All projects	"Black spots" - once per year. Network safety ranking - once per 3 years.	No certifications. Auditors are chosen by the road owner according to the eligible experience in road safety. Inspectors are the road safety experts of Public Enterprise Road and Transport Research Institute (under the Ministry of Transport).
AT	9	0	15	1	24
DK	0	N/A	N/A	1	150 road auditors. There is no certification for inspectors/and it is not required according to the RISM directive.
CH	2016: 4	2014: 1	2016: 8 RSA on maintenance/updating projects	2016 (each year)	Safety auditors: Approx. 150 Inspectors: Approx. 80
DE	Road safety inspections have been carried out on the whole national road network.	RSIA is an integrated part of the road planning process. All measures which are part of the Federal Transport Master 2030 plan have been assessed.	Between 2007 and 2011 over 3,300 audits have been carried out. The audits have not only been carried out on TEN-T roads but on all kind of roads.	The NSM is a permanent task carried out by local authorities. Results are published on a national level at the website of the Federal Highway Research Institute (www.bast.de)	With a view to the high number of audits, no estimate can be given on the number
HU	n/a	n/a	n/a	n/a	150
IT	"2015" 514[5]	0	3	0	0[6]
LU	2x RSI (20% of network)	0	0	2x NSM (25% of network)	3
NL	About 40	About 15	About 60	1	RSA: 13 RSI: 4
RO	-	-	-	-	12
SK	n/a	1	4	n/a	1 auditors and 17

[5] An inquiry has been sent to the respondent about what the number covers. It is interpreted as the number of road sections that are inspected.
[6] In Italy no certified - according to D.Lgs. 35/2011 - road safety auditors and inspectors are present because the decree on new training courses is in the process of being defined. However, pursuant to Article 12, paragraph 4 of D.Lgs. n. 35/2011, there is a transitional list of experts with experience requirements.

MS	How many times have the procedures been applied in the country you represent on TEN-T roads in 2016?				How many certified road safety auditors and inspectors are there in the country you represent?
					inspectors
UK	This is ongoing activity - a number cannot be estimated.	Estimate in 2016 of 100	Estimate in 2016 of 750	This is ongoing activity - a number cannot be estimated. we have no way of guessing.	Road Safety Auditors with a Certificate of Competency in the UK is 425. [7]
CY	10	0	4	1 - national level	10 RSA. No requirement for certified inspectors
BE (Fl)	About 2	About 3	About 25	1	15 (June 2017)
SE		Don't have compiled statistics Approx. 5-10	Don't have compiled statistics Yearly approx. 5-10	Yearly mapping and planning of actions/activities	20
FI	Several	Several	Several	Once	35 persons
FR	All the national road network is inspected on a 3-year basis cycle. The 3rd cycle began in 2015 and will end in 2017.	Fully applied (about 10 cases in 2016)	About 90	Almost all local manager units of national roads has carried out the network safety ranking dating less than 3 years. At least 50 safety diagnosis and 30 action plans have been launched since 2006	Around 160 inspectors and 160 auditors.

2.3.2. Justification to act

Among respondents to the OPC, there was near unanimity that improvements are needed to the maintenance and repair of existing roads (97% think that they need some or significant improvements), to upgrading safety features of existing roads (92% think that they need some or significant improvements) and to improving the protection of vulnerable road users (89% think that some or significant improvements are needed). 81% also thought that the design and construction of new roads need some or significant improvement. Opinions were more divided as to whether improvements are needed to the quality of road equipment, the visibility of road markings and the visibility of road signs, with however still a clear majority of respondents considering improvements necessary.

There was wide agreement among respondents to the OPC that there should be common EU performance requirements for road equipment (88% fully or rather agree), for the visibility of road markings (88% fully or rather agree) and for the visibility of road signs (88% fully or rather agree).

However, there was also wide agreement (80% fully or rather agree) in reply to the following question: "Do you agree that rather than aiming for common EU minimum

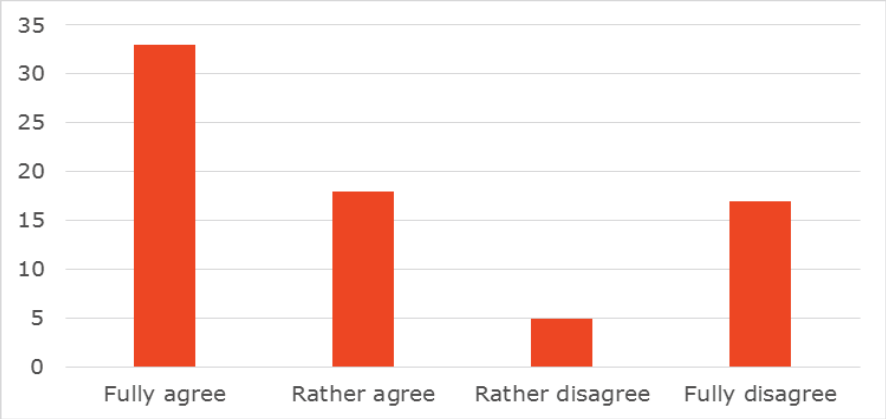
[7] The UK does not specify specific qualifications for inspectors in the UK. Highway authorities in the UK generally use private sector companies. The company that employs the inspectors must ensure that suitable, competent people are used and that the selection takes account of the range of skills required for different types of inspection.

performance requirements, the exchange of best practices regarding road infrastructure safety management should be promoted at EU level?" This shows a flaw in the formulation of the question (presupposing the exchange of best practice as an alternative to performance requirements). The interpretation of this result can therefore not be unequivocal. However, the most likely explanation is that respondents consider the exchange of best practice useful *in addition* to performance requirements.

The OPC also showed wide agreement that the safety of road infrastructure should be measured across the EU using comparable methodologies (47% fully agree, 88% fully or rather agree).

47% of respondents (i.e. 33 respondents) fully agreed that minimum road safety requirements should be established for roads that are part of the TEN-T network. 25% rather agreed to this proposition. However, 23% also fully disagreed and 7% rather disagreed.

Figure 9: OPC replies to the question "Do you agree that minimum road infrastructure safety requirements should be established for roads that are part of the trans-European transport network guaranteeing road users a certain minimum level of safety on these roads?"



There were few comments in the OPC addressing the question of minimum safety requirements. A few individuals and associations emphasised a need for more harmonised road safety standards across EU Member States. For example, The European Federation of Road Traffic Victims (FEVR) called for more common approaches and that best practices be promoted throughout the EU.

The Latvian Ministry of Transport commented that although common procedures and legislation could be relevant, this may put a financial strain on countries where funding is a problem.

A private French company suggested that whatever approaches were applied, they should promote innovations. There was a potential for innovations leading to higher road infrastructure safety levels.

ASECAP expressed the view that there was no need to amend the two directives. It asked to maintain a certain degree of flexibility. Changes should not lead to an increasing complexity of procedures and costs that might threaten to compromise the existing high safety standards.

Vulnerable road users

As regards vulnerable road users, the targeted stakeholder survey showed that Germany, the Netherlands, Austria, Denmark, Luxembourg, the UK, Belgium and Sweden have already installed motorcycle friendly guardrails.

Sveriges Motorcyclister (a Swedish association of motorcyclists) stated in the OPC that the choice of measures in Sweden was based entirely on persons travelling in cars. The choice of barriers was the most obvious example. While a cable barrier saved lives of persons in cars, they caused severe injuries and fatal accidents among riders every year. Motorcycle Protection Systems were not used in Sweden. Hooks and protruding parts were allowed on obstacles on the roads on highways in Sweden. A roadside barrier was seen as safe for all road users, and forgiving roadsides were rarely used. The association asked that the safety of all road users be considered in designing and constructing roads, that all existing regulations should be reviewed to include them in all EU countries and to include safety of all road users when deciding on the choice of method to repair and maintain the roads.

FEMA, the European Association of Motorcyclists, saw large differences on TEN-T roads between countries in terms of maintenance, safe/unsafe design (obstacle-free roadsides, unsafe exits, etc.) and in the safety of road-side infrastructure. It recommended (1) applying barriers that are safer for motorcycles or applying MPS on existing barriers on dangerous spots (bends, exits, etc.), (2) applying obstacle-free roadsides (both to avoid collisions and to improve the view) and (3) banning cable barriers. In addition, it called for uniformity and standards for signs, markings and traffic calmers.

The CCE, an advisory board under the patronage of the Spanish, French, Italian and Portuguese governments, considered that systems for the protection of motorcyclists in dangerous curves should be installed systematically. However, as there was no harmonised norm for these products, it would not be possible to define a proper performance level.

This comment highlights the difficulty in prescribing individual measures for certain types of vulnerable road users. On balance, the Commission considers that it is preferable not to prescribe such specific measures, but rather to mandate a general requirement to take the needs of all groups of vulnerable road users into account in road safety management procedures and to find the most appropriate solution adapted to the local circumstances.

The European Cyclists' Federation (ECF) submitted that even if the scope of the Directive stayed limited to the TEN-T network, an average 10% of people killed on motorways in Europe were pedestrians, up to 20% in some countries. This number did not even include cyclists, people killed on TEN-T roads other than motorways, and many lower-class roads that were affected by TEN-T road design, for example in the interchanges area. It recommended

1. Provision of safe, comfortable and direct active mobility routes – functional connections of settlements and workplaces along the (re)constructed road;
2. Sufficient density of safe and comfortable crossings across (re)constructed roads;
3. Upgrade of other roads affected by the (re)construction project to safe standards;
4. Safe active mobility option or an attractive alternative for tunnels;
5. Minimum quality requirements for cycling infrastructure;

6. Cycling infrastructure included in training and certification of road safety auditors.

As regards this last point made by the ECF, it is true that there is currently no systematic information about the content of training and certification of road safety auditors as regards the needs of vulnerable road users. Neither is there an association of auditors that could facilitate the exchange of good practice in this regard. This is the reason why the Commission's preferred option includes the setting up of a Forum of Exchange for auditors.

Road markings and signs

In terms of the visibility of road markings and signs, FIA Region I stated that simple measures like appropriate basic standards for road marking and signs could be implemented at low cost. FIA Region I also highlighted that, in view of the upcoming revision of the General Safety Regulation, three out of the eighteen technologies identified for possible inclusion depend on the existence of a well maintained infrastructure: Automatic Emergency Breaking (AEB) depends on pavements, Intelligent Speed assistance (ISA) depends on traffic signs and Lane Keeping Assistance (LKA) depends on road markings.

The European Automobile Manufacturers' Association took the view that vehicle safety features as provided for in the General Safety Regulation will be very effective to reduce fatalities and injuries. But to achieve the highest level of effectivity the contribution of the infrastructure was needed. For example Lane Keeping Assistance needed appropriate road edges in order to detect them as precisely as possible, and to reduce accidents with vehicles in cities, the layout of the inner city roads should be modified in the relevant areas e.g. to avoid crossings of bicycle-lanes with vehicle lanes.

In addition ACEA referred to discussions about the implementation of an Intelligent Speed Adaptation. For this, it was key to transmit the applicable speed limit to the car in any situation and on every road, which was currently not possible due to too heterogeneous signs, hidden signs and temporary limitations. Therefore the infrastructure should be updated first at this point and then the Intelligent Speed Adaptation could be set on this basis.

This comment reinforces the argument advanced by the ERF, ASECAP and a private ITS company (see "Readiness for deployment of automated and connected driving" above), confirmed by the final report of the TM 2.0 Task Force on Automation. As stated above, the Commission shares this view.

The CCE stressed the importance of being able to evaluate the performance of road markings along their full lifecycle. It suggested that the Directive could require each Member State to set its own performance level for road markings (with a view to subsequently developing a standard) and oblige the operators to maintain a certain performance level of the road marking.

Overall approach

Stakeholders represented at the stakeholder conference in Malta in March 2017 recommended that the Commission should review the RISM directive to focus on measured outputs and less on inputs, in addition to reviewing programme goals (for TEN-T) and financial instruments.

2.3.3. Impact of policy options

2.3.3.1. Options within current scope

In the targeted stakeholder survey, respondents were asked to comment on the impact that they expected a number of policy options to have. The policy options have however evolved during the impact assessment process and are no longer identical to the ones formulated in the survey. Therefore, the following analysis is qualitative rather than based on respondents' ratings of the options.

Most respondents (20 out of 27 respondents were public authorities) considered that all proposed options would have relatively limited impact.

As regards what is now **Policy Option 1** (light intervention in current scope (TEN-T) – including in particular best practice sharing, publication of information about procedures), most of the respondents expected no significant effect on safety, with some however pointing out that the exchange of best practices could have a positive effect.

A number of respondents answered that the focus on vulnerable road users in their countries would have no impact, as they generally are not allowed on the TEN-T roads. Motorcyclists were, however present, but they were generally protected in risk zones (guard rails in curves etc.).

As regards what is now **Policy Option 2** (moderate intervention in current scope – including in particular mandatory follow-up of procedures, network-wide inspections), 47% of OPC respondents fully agreed that the safety of road infrastructure should be measured across the EU using comparable methodologies. 41% rather agreed with this proposition. The OPC also showed wide support for general performance requirements concerning the visibility of road markings (47% fully agree, 41% rather agree) and concerning the visibility of road signs (45% fully agree, 43% rather agree). The European Transport Safety Council (ETSC) asked to include requirements for automated and semi-automated vehicles such as clear road markings and adapted intersections in the revision of the Directive. It also recommended that systematic and periodic inspections should be undertaken for the detection of high risk sites, and it asked that, to enable better monitoring and evaluation, annual reporting to the Commission should be introduced and made public.

France commented that the allocation of safety performance ratings did not appear to be relevant. Apart from the difficulty to define indicators for this rating, the question arose as to the use of this information and their real impact on safety which remained to be proven. It considered that, instead, greater transparency could be envisaged concerning the road safety statistics and actions towards the public, notably in the framework of making accessible data concerning the national road network.

The CCE on the other hand considered a rating system a good way to raise awareness regarding the operator's maintenance of the roads. According to the CCE, it could be a real lever to encourage them to improve the safety level of the infrastructures under their supervision, and it would be a good tool to aid decision-making in prioritising investments. The CCE added that a rating system could also – in future – promote the development of autonomous vehicles, determining the areas where they can work well. The CCE advocated using the EuroRAP programme.

As regards **Policy Option 3** (ambitious intervention in current scope – in particular introducing a minimum star rating for TEN-T roads), 45% of OPC respondents fully agreed that minimum road infrastructure safety requirements should be established for

roads that are part of the TEN-T network. 25% rather agreed. However, there were also 24% of respondents who strongly disagreed with the latter proposition. The ETSC recommended introducing a Network Safety Management assessment of the road network and setting a target of upgrading roads to 3-star or better on all roads and 4-star or better on roads with high traffic volume. The ERF raised doubts about making certain requirements mandatory: Setting compulsory minimum requirements in the RISM Directive would never be acceptable to Member States/road authorities as a matter of principle. At the same time, they understood the value of establishing some minimum requirements that could support road automation. But this should be done on a voluntary basis amongst NRA's and with a solid technical basis. Where the RISM Directive could help was to point out the need for setting general performance requirements but allow these requirements to be defined by industry/authorities/other relevant bodies.

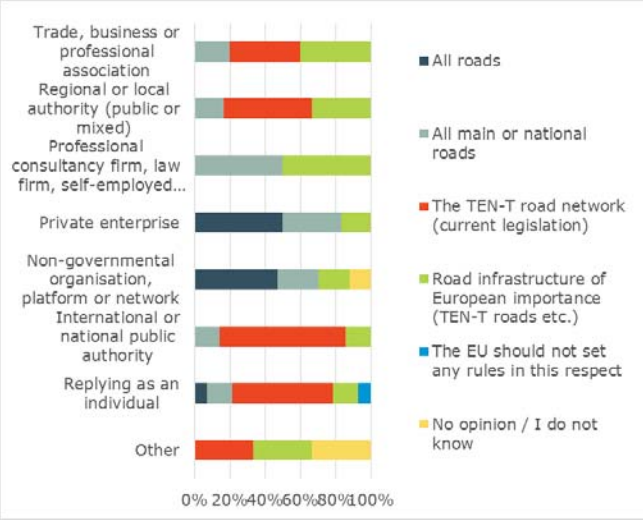
Member State authorities supported this view. The Dutch Ministry for Transport, the Ministry for Transport in Luxembourg and the Italian Ministry for Transport stated that it would be impossible to implement minimum standards on existing roads.

The German Ministry of Transport also pointed out that a further update of minimum standards for tunnels was unnecessary.

2.3.3.2. Possible extension of scope beyond TEN-T

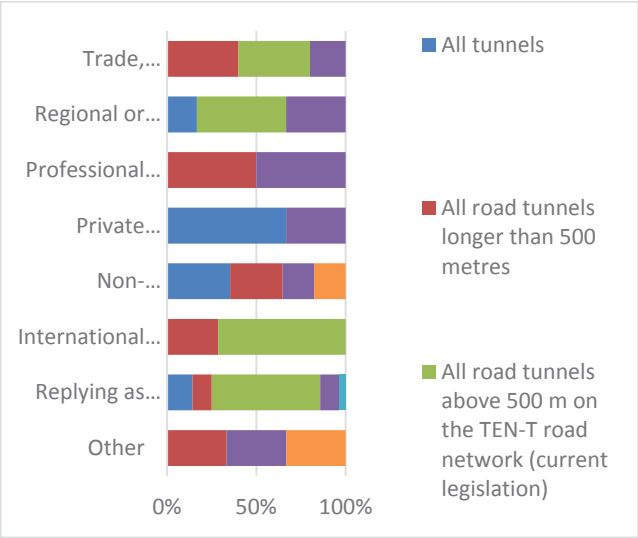
Opinions expressed in the OPC about a possible extension in the scope of the legislation beyond the TEN-T network diverged. 37% replied that the TEN-T network should be the scope of EU legislation, 20% that it should cover road infrastructure "of European importance", 19% all main or national roads and 18% all roads. Private enterprises and NGOs were most likely to consider that all roads or all main and national roads should be the scope of legislation, whereas public authorities tended to consider that the TEN-T network should be the scope.

Figure 10: OPC replies to the question "In your opinion, what should be the scope of EU legislation in the area of road infrastructure safety management?"



OPC replies to the question of the geographical scope of tunnel safety legislation are very similar to the above, with 37% of respondents in favour of the current scope of the legislation (tunnels longer than 500m on the TEN-T network). Again private enterprises and NGOs tend to favour an extension, whereas public authorities favour the current scope.

Figure 11: OPC replies to the question "In your opinion, what should be the scope of EU legislation in the area of road tunnel safety?"



A number of respondents to the targeted stakeholder survey mentioned "the reluctance of Member States to accept the extension to non-TEN-T roads" on subsidiarity grounds. A number of countries have already extended the application of the legislation, but as one respondent put it "they prefer this to be their own choice". However, respondents also recognised the large potential in reducing fatalities, given that most fatal accidents happen outside the TEN-T network.

France commented that apart from the subsidiarity question, it was preferable not to extend the scope of the directives (beyond TEN-T), in order to maintain the possibility to adapt the approaches and provisions to the specificities of the networks and their managers.

On the other hands, one of the conclusions of the stakeholders represented at the stakeholder conference in Malta in March 2017 was:

"*The majority of road deaths, and travel, are concentrated on 10% of Europe's roads. This economically important, largely rural network, comprises the TEN-T, national roads and busy regional roads. Europe's safety goal requires targeting this network.*"

The CCE took the view that including non-TEN-T main roads in the scope of the Directive would simplify regulations for Member States, as more roads of the national network will need to meet the same safety requirements. The main drawback of extending the scope would likely be economic, as main roads are usually older than those on the TEN-T network.

The European Cyclists' Federation (ECF) submitted that the potential extension of the scope of the RISM Directive should be accompanied by changes in training and certification of road safety auditors (for example to take into account different requirements for cycling infrastructure in lower speed environments) and by EU level guidance on cycling infrastructure. Introducing obligatory provisions for cyclists and pedestrians, as well as minimum quality requirements for cycling infrastructure, should be a prerequisite for the scope extension.

The Commission shares the concern related to ensuring that an extension of the scope of the Directive takes the needs of vulnerable road users into account. This is the reason why the Commission's preferred option includes the setting up of a Forum of Exchange

for auditors, in order to facilitate the spreading of best practice in this regard. Additional comments from NGOs and road associations in the OPC focused on the need for having similar road safety standards across all EU. AISCAT, the Italian Association of Tunnel and Motorway Concessionaire Companies, cautioned that legislation only on TEN-T roads would lead to an over-legislation on the safest roads, whereas the most dangerous roads were not addressed. A similar opinion was expressed by the Spanish Road Association emphasising that it was not acceptable that some roads were subject to legislation and had very high standards, whereas others were not addressed at all by safety procedures. The Polish NGO *Zielone Mazowsze* believed that safety audits on selected roads should be undertaken by the EU using EU funds to ensure a common minimum safety standard.

The ETSC argued that the scope of the legislation should be extended to cover all motorways, all EU (co-)financed roads and all main rural and main urban roads. This was required in view of the new objective to focus on reducing serious injuries as well as deaths (because a larger proportion of injuries occur in urban areas) and because citizens should be entitled to equal levels of safety on all roads.

2.3.3.3.Merging of the directives

Reactions to the proposition of merging the two directives in the targeted stakeholder survey were clearly negative. 15 out of 27 respondents said that the directives should not be merged, 4 answered yes, 1 answered Don't know and 6 did not answer at all.

Among the respondents who were against merging the two directives, the main concern was that it could in fact increase the administrative burden. This point was made by national road authorities or transport ministries such as the Dutch Rijkswaterstraat, the UK Department for Transport, the German Federal Ministry of Transport, the Danish Road Directorate and the Budapest Capital Government Office, Department for Transport. Moreover, these respondents did not see any positive effect, because the two directives had a different scope, were using different systems and that the safety procedures used were not related to each other.

On the other hand, the respondents who answered Yes (such as the Lithuanian Public Enterprise Road and Transport Research Institute and the Cyprus Ministry for Transport) did believe that the merging could bring a higher safety level in tunnels if RISM procedures were applied.

The Italian Ministry for Infrastructure and Transport stated that the RISM Directive acted on a different and higher level than the Tunnel Directive. RISM recommendations should be applied to complete roads (including tunnels), implementing the actual minimum safety tunnel requirements and eventually introducing specific requirements for roads.

2.4. USE OF CONSULTATION RESULTS

The findings from the consultation activities have been used to analyse the problems, define the right policy alternatives and fine-tune the proposed measures. Input from stakeholders with a high level of technical expertise also served to validate the information from existing reports and studies.

Where relevant, references have been made in the Impact Assessment Report to the outcome of the stakeholder consultations.

Annex 3: Who is affected and how?

3.1 PRACTICAL IMPLICATIONS OF THE INITIATIVE

The stakeholders affected by the initiative and their key interests are described in the table below.

Stakeholder	Description	Key interests/ Key impacts
Road users	People travelling on the road by all means of transport including motorised transport but also cyclists and pedestrians	• To have safe road infrastructure which helps road users to avoid accidents ("self-explaining roads") and protects them when accidents do happen ("forgiving roads") • Road users will benefit from the reduction in the number of fatalities (14,650) and serious injuries (97,502) over the 30 year reference period
Road transport operators	Companies involved in the transport of passengers or goods by road	• To have safe and efficient road infrastructure which enables smooth and reliable road transport operations to be carried out • Road transport operators will benefit from less disruption and congestion on the network as a result of fewer and less serious accidents (impact not quantified)
Road authorities	These are the national or regional authorities in Member States that are reponsible for the road network.	• Implementation and enforcement of the requirements under the Directive • Road authorities will bear the regulatory costs associated with the Directive. The costs include the cost of RISM procedures (road safety inspections etc.) and the costs of making the necessary improvements to road infrastructure
Manufacturers of road vehicles	Manufacturers of passenger cars, trucks, buses, motorcycles etc.	• To have safe road infrastructure that enables and supports the reliable operation of vehicle safety technologies ("roads that cars can read") • More reliable operation of active vehicle safety technologies as a result of improved quality of road markings
	Companies involved in the construction and maintenance	• These companies will benefit from the increased spending on road

Stakeholder	Description	Key interests/ Key impacts
	of the road network	safety upgrades and road maintenance as a result of the follow-up to the findings of RISM procedures. SMEs are expected to benefit in particular from increased road maintenance spending
Manufacturers of road equipment and materials	Companies involved in the manufacturing of materials used in the construction, maintenance and operation of roads (e.g. asphalt, paint for road markings, road signs, road furniture such as crash barriers etc.)	• To have legislation that maximises the market opportunities for the materials and equipment produced
EU citizens	Road safety affects not only road trauma victims but also their families and everyone else due to the social costs of road fatalities and injuries	• To have safe road infrastructure that helps minimise the number of road accidents and their severity • Society at large will benefit from the reduction of the social costs of road fatalities and serious injuries

3.2 SUMMARY OF COSTS AND BENEFITS

I. Overview of Benefits (total for all provisions) – Preferred Option		
Description	Amount (in million euro)	Comments
Direct benefits		
Reduced fatalities and injuries on EU roads (in Policy option 2 and Policy option C combined)	25,277	Present value for the period 2020-2050. Includes value of reduced fatalities and serious injuries. Benefit estimates include reductions in authority costs for hospital care, emergency services etc., and for those involved in accidents, and their relatives.
Indirect benefits		
-	-	-

II. Overview of costs – Preferred option			
	Citizens/Consumers	Businesses	Administrations

		One-off	Recurrent	One-off	Recurrent	One-off and Recurrent (net present value in million euro for 2020-2050)[8]
Policy option 2	Direct costs					2,004
	Indirect costs					-
Policy option C	Direct costs					7,440
	Indirect costs					2,004

Note: The one-off costs for the preferred option comprise costs related to undertaking assessment programmes, for investing in new road safety installations in the infrastructure and for maintaining these new installations. The costs are distributed throughout the evaluation period 2020-2050 and include both installation costs and recurring maintenance costs. The costs are not calculated separately, as the sources used report total costs. The costs are therefore reported as the present value of all costs covering the entire period.

[8] The net present value of estimated compliance costs over the 2020-2050 period. Recurrent costs are included in the estimated present value of compliance costs. They are estimated at 10,000 euro annually per Member State for Policy option 2 and 30,000 euro annually per Member State for Policy option C.

Annex 4: Analytical methods

4.1. DESCRIPTION OF ANALYTICAL MODELS USED

A model suite has been used for the analytical work: PRIMES-TREMOVE transport model, a specific model developed by TRL in the programming language Python[9] with inputs and outputs produced in Microsoft Excel spreadsheets and an Excel-based tool developed by COWI. While PRIMES-TREMOVE is a transport model covering the entire transport system, used for the development of the EU Reference scenario 2016, TRL and COWI models specifically focus on evaluating the impacts of vehicle technologies and infrastructure measures on road safety, respectively. A brief description of each model is provided below, followed by an explanation of each model's role in the context of this impact assessment.

4.1.1. PRIMES-TREMOVE transport model

The PRIMES-TREMOVE transport model projects the evolution of demand for passengers and freight transport by transport mode and transport mean. It is essentially a dynamic system of multi-agent choices under several constraints, which are not necessarily binding simultaneously. The model consists of two main modules, the transport demand allocation module and the technology choice and equipment operation module. The two modules interact with each other and are solved simultaneously.

The projections include details for a large number of transport means, technologies and fuels, including conventional and alternative types, and their penetration in various transport market segments for each EU Member State. They also include details about greenhouse gas and air pollution emissions (e.g. NOx, PM, SOx, CO), as well as impacts on external costs of congestion, noise and accidents.

In the transport field, PRIMES-TREMOVE is suitable for modelling *soft measures* (e.g. eco-driving, deployment of Intelligent Transport Systems, labelling), *economic measures* (e.g. subsidies and taxes on fuels, vehicles, emissions; ETS for transport when linked with PRIMES; pricing of congestion and other externalities such as air pollution, accidents and noise; measures supporting R&D), *regulatory measures* (e.g. CO_2 emission performance standards for new passenger cars and new light commercial vehicles; EURO standards on road transport vehicles; technology standards for non-road transport technologies), *infrastructure policies for alternative fuels* (e.g. deployment of refuelling/recharging infrastructure for electricity, hydrogen, LNG, CNG). Used as a module which contributes to a broader PRIMES scenario, it can show how policies and trends in the field of transport contribute to economy wide trends in energy use and emissions. Using data disaggregated per Member State, it can show differentiated trends across Member States.

PRIMES-TREMOVE has been used for the 2011 White Paper on Transport, Low Carbon Economy and Energy 2050 Roadmaps, the 2030 policy framework for climate and energy and more recently for the Effort Sharing Regulation, the review of the Energy Efficiency Directive, the recast of the Renewables Energy Directive, the European

[9] https://www.python.org/

strategy on low-emission mobility, the revision of the Eurovignette Directive and the recast of the Regulations on CO2 standards for light duty vehicles.

The PRIMES-TREMOVE is a private model that has been developed and is maintained by E3MLab/ICCS of National Technical University of Athens[10], based on, but extending features of the open source TREMOVE model developed by the TREMOVE[11] modelling community. Part of the model (e.g. the utility nested tree) was built following the TREMOVE model[12]. Other parts, like the component on fuel consumption and emissions, follow the COPERT model.

As module of the PRIMES energy system model, PRIMES-TREMOVE[13] has been successfully peer reviewed[14], most recently in 2011[15].

4.1.2. TRL model

A simulation model was developed by TRL to estimate the benefits (monetary values of casualties prevented by safety measures) and costs (cost to vehicle manufacturers of fitment of safety measures to new vehicles) associated with policy measures assessed in the context of the revision of the General Safety Regulation and Pedestrian Safety Regulation. The model was implemented in the programming language Python[16] with inputs and outputs produced in Microsoft Excel spreadsheets. The model is represented at EU28 level. Figure 12 presents a simplified visualisation of the structure and calculation steps of the model.

The vehicle fleet calculation model determines how the vehicle safety measures disperse into the fleet. The model determines the effect of mandating a measure for all new types, and two years later for all new registered vehicles, on the overall proportion of the fleet equipped. Benefits conferred by a safety measure, that is, casualties prevented, will only be realised by equipped vehicles. However, the legacy fleet will also be affected by active safety measures; for example, if a rear-end shunt is avoided by autonomous emergency braking for driving and still-standing vehicles ahead (AEB-VEH), the vehicle in front, will benefit from the measure even if it is a legacy vehicle. This is taken into account in the benefit calculations.

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10 Source: http://www.e3mlab.ntua.gr/e3mlab/

11 Source: http://www.tmleuven.be/methode/tremove/home.htm

12 Several model enhancements were made compared to the standard TREMOVE model, as for example: for the number of vintages (allowing representation of the choice of second-hand cars); for the technology categories which include vehicle types using electricity from the grid and fuel cells. The model also incorporates additional fuel types, such as biofuels (when they differ from standard fossil fuel technologies), LPG and LNG. In addition, representation of infrastructure for refuelling and recharging are among the model refinements, influencing fuel choices. A major model enhancement concerns the inclusion of heterogeneity in the distance of stylised trips; the model considers that the trip distances follow a distribution function with different distances and frequencies. The inclusion of heterogeneity was found to be of significant influence in the choice of vehicle-fuels especially for vehicles-fuels with range limitations.

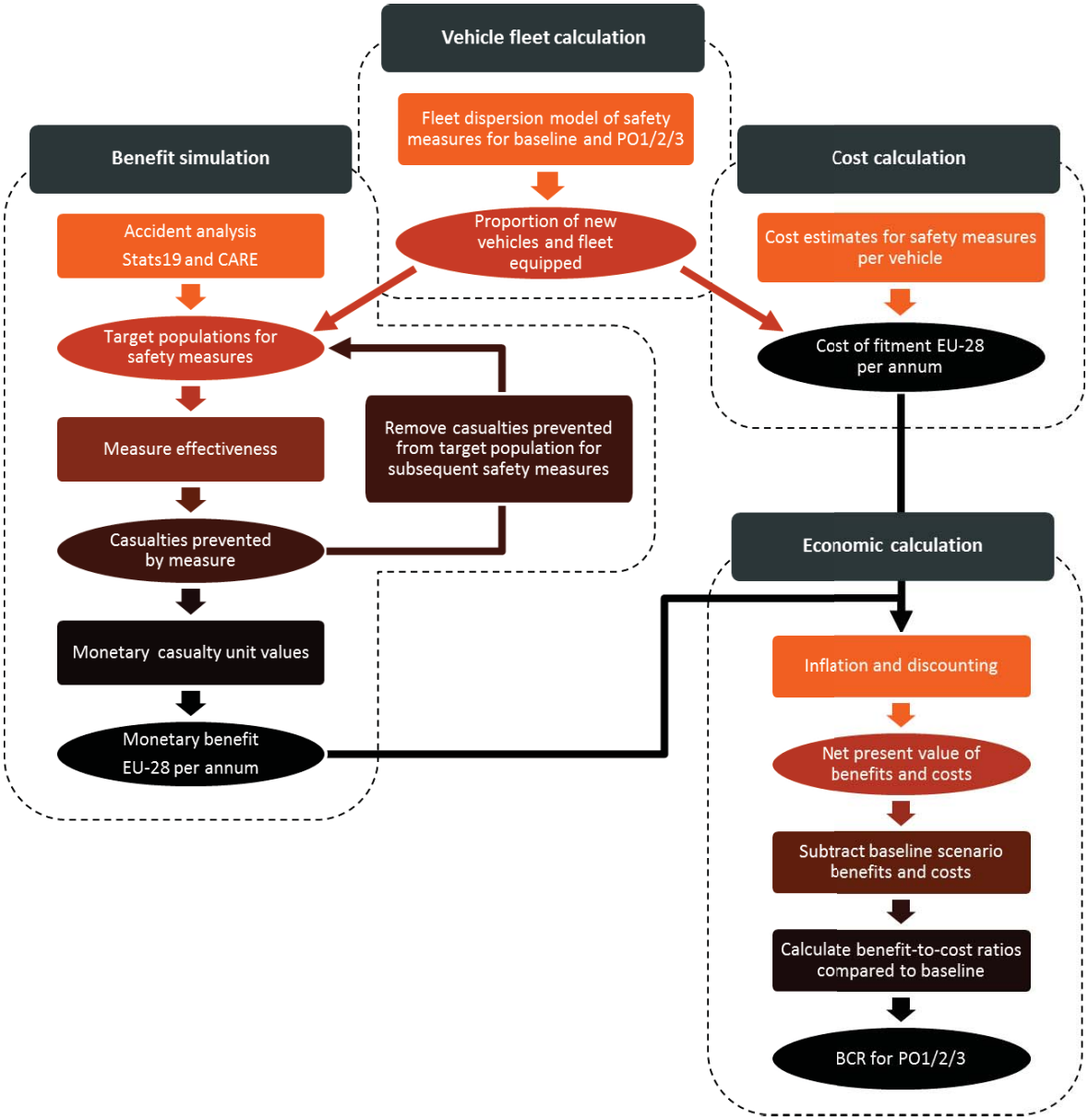
13 The model can be run either as a stand-alone tool (e.g. for the 2011 White Paper on Transport and for the 2016 Strategy on low-emission mobility) or fully integrated in the rest of the PRIMES energy systems model (e.g. for the Low Carbon Economy and Energy 2050 Roadmaps, for the 2030 policy framework for climate and energy, for the Effort Sharing Regulation, for the review of the Energy Efficiency Directive and for the recast of the Renewables Energy Directive). When coupled with PRIMES, interaction with the energy sector is taken into account in an iterative way.

14 Source: http://ec.europa.eu/clima/policies/strategies/analysis/models/docs/primes_model_2013-2014_en.pdf.

15 https://ec.europa.eu/energy/sites/ener/files/documents/sec_2011_1569_2.pdf

16 https://www.python.org/

Figure 12: Flowchart of the TRL simulation model to calculate benefit-to-cost ratios



To simulate the casualties prevented by each measure, an accident data analysis was performed based on UK national road accident data (Stats19) to determine the casualty target population for each proposed measure, i.e. the number of fatal, serious and slight injuries that could potentially be affected by a safety measure based on relevant characteristics of the collision (e.g., collision geometry or contributory factors). The target populations were scaled to EU28 level using weighting factors, based on severity and vehicle categories involved, derived from analysis of the pan-European CARE database. The target populations found are multiplied with effectiveness values for each safety measure, i.e. a percentage value indicating what proportion of the relevant accidents will be avoided or mitigated by the measure. Mitigated casualties (fatal turned to serious casualty, or serious to slight casualty) are added to the target population of the next lower injury severity level for other measures. The casualties prevented are

multiplied with monetary values for casualty prevention to calculate the monetary benefit.

Evaluation period

To model the costs and benefits of the safety measures, it was necessary to set an evaluation window which allowed technology sufficient time to propagate through the vehicle fleet and into the collision population. This was set by considering the earliest time at which a measure could affect all new vehicles (year 2023, 2 years after introduction for new approved types); then an allowance was added for the age of the traffic population (mileage contribution to total miles driven is not constant over the vehicle age). Previous evidence, established for the car fleet in London, has demonstrated that about 88% of the traffic is 0 to 11 years old and 97% of the traffic is 0 to 14 years old. Vehicles which are 15 years old account for only about 1% of the traffic and about 2% of collisions involving cars. Therefore, 14 years was added to new vehicle implementation date to allow the full cycle of fleet benefits to be captured. This period also matches the length of time allocated for the majority of voluntary uptake measures to reach close-to-full adoption levels. As such, the evaluation period was set to extend from 2021 to 2037.

The model also addresses the interaction of different safety measures on overlapping casualty groups. To give an example, there are collisions where a driver was exceeding the speed limit, left the lane and suffered a frontal impact. These collisions will be in the target populations for multiple measures, but they can only be prevented once by either one of these systems. This is addressed in the model by removing casualties prevented by one measure from the subsequent target population of the other measures. The impact of highly effective existing safety measures, which have been mandatory for a few years, but are still dispersing into the vehicle fleet is also modelled to reduce the remaining target populations for the proposed measures.

Fleet dispersion of vehicle technology safety measures

There are two aspects to the fleet fitment estimates which are vital to the process of establishing the cost-effectiveness for the measures related to vehicle technologies.

- The voluntary uptake which defines a ‘do nothing’ scenario. In this case, the propagation of technology is led by the willingness of manufacturers to fit the necessary components to vehicles and the willingness of consumers to pay for them.
- The mandatory uptake brought about by a policy intervention. In this case, all new vehicles or all vehicle types will be required to meet the regulatory requirements by an implementation date. The effects of this will be superimposed at that moment in time.

To model the uptake of technology alongside each of the measures, it was necessary to define the uptake by new vehicles and also the penetration into the fleet due to fleet expansion and ‘churn’ (the rolling addition of new vehicles and scrappage of old). This textbox provides an illustration on the way in which the model accounts for technology propagation on a voluntary or mandatory basis.

Estimates of technology adoption were based on evidence provided by a Tier 1 supplier for Electronic Stability Control (ESC) uptake within the car fleet. These data of new vehicle adoption and penetration into the fleet generated two s-shaped curves, as shown in Figure 13 for the new vehicles and Figure 14 for the total car fleet.

This precedent also indicates the way in which regulatory requirements can shape the adoption of a measure. With ESC, all new vehicle types had to make this safety feature available by November 2011 with all new vehicles having to be sold with ESC before 2014. This has the effect of boosting voluntary fitment from a plateau at around 80% in 2008 and 2009 up to 100% by 2014.

Even with full fitment in new vehicles, it still takes time for those vehicles to replace existing vehicles on the road. This explains the lag in the vehicle fleet curve, where an effective 100% fitment will be reached sometime before 2025.

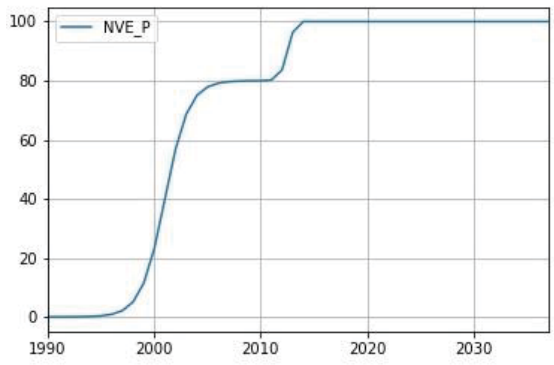


Figure 13: Percentage of newly registered cars equipped with ESC

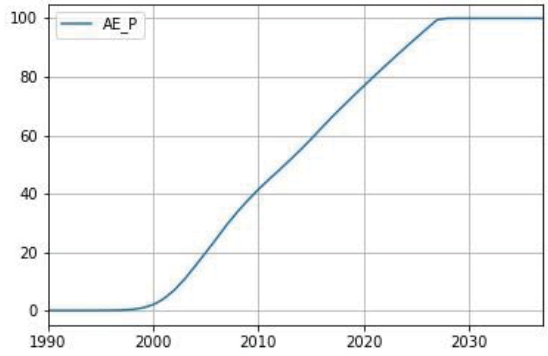


Figure 14: Percentage of all cars within the vehicle fleet equipped with ESC

By including the average vehicle age in the model calculations an effort was made to account for the fact that some of the vehicles being scrapped in the churn process would also have the technology fitted. Otherwise, an overly optimistic estimate of technology penetration would be generated.

Voluntary fleet fitment estimates were based on evidence identified previously (Seidl *et al.*, 2017), comments provided by stakeholders and, in the absence of other information, opinions of an expert panel within TRL based on observations of similar technologies and expectations of pressures on the industry (for instance, whether a measure is likely to be incentivised by Euro NCAP).

The launch date for a technology was used to define the x-axis (time) start point for the s-shaped curves of fitment. This relates to the first time a system was released with the characteristics likely to be required in order to meet the regulatory requirements. As a general rule, the launch date was intended to be independent of vehicle category; assuming general transfer of technologies was possible, with some exceptions.

The voluntary take up of technology and the implementation within the fleet was selected to be one of three possible options:

- None = No voluntary uptake, regulatory action required to drive adoption
- Medium = 40% voluntary propagation within the fleet without additional stimuli
- High = 80% voluntary propagation leaving the 20% of vehicles which wouldn't be equipped without regulatory action

These values represent point estimates for the resulting final take up in the fleet. The s-shaped curve for percentage of newly registered cars equipped is modelled to form a plateau at this value.

The cost of a policy option is calculated by multiplying per-vehicle cost estimates for each measure with the number of new vehicles of each vehicle category across EU28 that are equipped with the measure in the given year of the analysis according to the output of the fleet calculation model. In the economic calculation model, the monetary values of costs and benefits are subjected to inflation and discounting to determine their present value. The present values of benefits and costs, calculated for individual years and summed over the study period, are compared in order to arrive at cost-effectiveness estimates.

A more detailed description of the TRL model is provided in the support study accompanying the revision of the General Safety Regulation and Pedestrian Safety Regulation.

4.1.3. COWI model

An Excel-based tool was developed by COWI to assess the impacts of measures related to infrastructure on road safety. The tool covers each EU Member State individually and distingueshes between the TEN-T and non-TEN-T network, drawing on the CARE database[17] and the TENtec information system[18].

The approach to quantify impacts on fatalities and injuries includes a number of calculation steps:

- Estimation of the effect of each measure expressed as a percentage reduction of the baseline number of fatalities and serious injuries;
- Estimation of the share of fatalities and serious injuries that the measure apply to;
- Calculation of the expected reduction in the number of fatalities and serious injuries by Member State for the proportion of the fatalities and injuries that are covered by the measure;
- Application of social unit costs of fatalities and serious injuries to the above-calculated reduction to derive the estimated benefits.

The sources for the estimation of the impacts on the number of fatalities and serious injuries are based on two main studies: the Safety Cube project and the Handbook of Road Safety Measures. These studies include almost all evidence available on the impacts of infrastructure on road safety.

SafetyCube review project[19]

The SafetyCube project is a Horizon2020 research project, which aims at "*...developing an innovative road safety Decision Support System (DSS) that will enable policy-makers and stakeholders to select and implement the most appropriate strategies, measures and cost-effective approaches to reduce casualties of all road user types and all severities".*

The project involves a review of some 50 infrastructure related road **safety risk factors** and 48 associated **improvement measure**s. In total, some 800 papers/studies were coded. Many of the studies reviewed as part of the SafetyCube project are specific **Case studies**, where certain risk factors are analysed in certain geographical locations, including examples of measures applied to address these factors.

The Handbook of Road Safety Measures[20]

Contains summaries regarding the effects of 128 road safety measures. It covers various areas of road safety including: traffic control; vehicle inspection; driver training; publicity campaigns; police enforcement; and, general policy instruments. It also covers topics such as post-accident care, and speed cameras.

The main sections and topics of the handbook are:

- Literature Survey and Meta-Analysis
- Factors Contributing to Road Accidents
- Basic Concepts of Road Safety Research
- Assessing the Quality of Evaluation Studies
- Road Design and Road Equipment

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17 Source: https://ec.europa.eu/transport/road_safety/specialist/statistics_en

18 Source : https://ec.europa.eu/transport/themes/infrastructure-ten-t-connecting-europe/tentec-information-system_en

19 See e.g. Filtness A. & Papadimitriou E. (Eds) (2016), Identification of Infrastructure Related Risk Factors, Deliverable 5.1 of the H2020 project SafetyCube.

20 Elvik, R., T. Vaa, A. Hove and M. Sorensen eds. (2012) The Handbook of Road Safety Measures: Forth Edition in Norwegian Second ed. In English, 2009.

- Road Maintenance
- Traffic Control
- Vehicle design and protective devices
- Vehicle and Garage Inspection
- Driver Training and Regulation of Professional Drivers
- Public Education and Information
- Police Enforcement and Sanctions
- Post-Accident Care
- General-Purpose Policy Instruments

The handbook builds upon a large number of case studies, research papers and reports and studies undertaken in many different projects. It is recognised among road safety experts as a central reference point.

The compliance costs[21] are closely related to the share of fatalities and injuries that are influenced by each measure. For the calculation of the compliance costs (costs of applying the road infrastructure safety management procedures and subsequent investments in changes to the infrastructure), the calculation steps include:

- Estimation of the relevant unit costs per kilometre of road of each measure;
- Estimation of the share of roads (typically in km) where the measure would be applied;
- Calculation of the total compliance costs of the measure.

In the compliance costs estimation, it is assumed that the same share (length) of roads is subject to each measure as the one used for the estimation of the reduced number of fatalities and injuries. There are, however, deviations from this general assumption. For example, the assumption is changed when considering motorcycle friendly guard rails. Such rails are installed where the risk of a crash is high (in turns where there are road side objects etc.). This will typically not be along the entire stretch of road. Therefore, we assume a smaller number of kilometres where the rails are installed, but retain the full impact of the measure on all VRU fatalities and injuries.

Another important assumption is that investments are made firstly where the impacts are highest. This is also the approach outlined in the 14 *case studies* of the EuroRAP SENSOR project[22] looking at Southern and Eastern European countries. The textbox below outlines how the case study has been used to estimate investment costs needed to correct the safety defects in Member States where there is no specific information about costs of making upgrades.

SENSOR case studies and the use to estimate costs

The outcome of the SENSOR study is an application of the iRAP EuroRAP method to assess roads using automated detection vehicles. The results are shown in section 4 of the impact assessment support study for the investigated EU Member States[23].

Part of the work also included a bottom up approach to calculate investments costs in order to remedy the

[21] In the quantification of economic impacts, 'compliance costs' are costs both to undertake the different procedures and the costs of investing in the safety changes recommended as part of the procedures.

[22] These case studies are documented in a set of national reports and in a joint summary report: EuroRAP (2016)

[23] COWI/SWOV (2017), "Impact assessment support study for the revision of Directive 2008/96/EC on road infrastructure safety management and Directive 2004/54/EC on minimum safety requirements for road tunnels in the trans-European network"

detected safety issues. For the broad categories of issues (e.g. obstacles placed close to the road, missing centre and edge lines, barriers, road surface, additional lanes etc.), measures to correct the defects were proposed and cost-benefit analysis was carried out. For measures with an overall positive evaluation, these were added up in so-called *Safer Roads Investment Plans (SRIP)*.

The costs per km of road is the factor that has been used to calculate the total costs. The costs are adjusted by using *Price level index* and the *Purchase Power Parity (PPP)* to undertake value transfer to other countries.

When calculating costs, it has been assumed that the costs in the SRIP correspond to lifting all roads in the observed countries to 3 star roads.[24] This means that 1 star roads must be "lifted by two stars", whereas 2 star roads must be "lifted only one star". This implies that on average, there are twice as many defects to be adjusted on 1 star roads compared to 2 star roads.[25] For each country, we therefore assume that one km of 1 star roads is twice as costly to adjust compared to one km of 2 star road. The distribution between 1 and 2 star roads in the observed SENSOR countries is used to calculate the weighted average of lifting a road by one star. Or in mathematical terms:

$$Cost\ per\ star\ lifted\ per\ km = 2 * \frac{\#km_{1\ star}}{\#km_{1\ star} + \#km_{2\ star}} SRIP\ costs\ per\ km + \frac{\#km_{2\ star}}{\#km_{1\ star} + \#km_{2\ star}} SRIP\ costs\ per\ km$$

The resulting weighted average costs per km to lift a road by one star is then applied to other countries where specific costs are not provided (after adjusting to the price level in this country).

The resulting average unit costs per km using the approach outlined in the text box are shown in Table 2. The resulting compliance costs per km of road that is improved by one star are shown for each country in annex G of the impact assessment support study.

Table 2: Estimated costs per km of carriageway[26] to address the identified safety defects using the EuroRAP methodology

Country	Country code	Price adjusted million euro/carriageway km
Bulgaria	BG	0.3369
Croatia	HR	0.1102
Greece	EL	0.1556
Hungary	HU	0.0852
Romania	RO	0.2201
Slovakia	SK	0.1052
Slovenia	SI	0.0624
Average		0.1537

Source: SENSOR case study. Note: Prices are adjusted according to price level indexes.

The assessment of administrative costs is based on the EU Standard Cost Model, covering the costs of reporting obligations.

[24] IRAP and EuroRAP use 3 star roads as the reference point for safe roads. Hence, on average the identified defects in the SENSOR study is aiming at lifting roads to 3 stars.

[25] In reality there may be more individual things to change in lifting a 1 star road to 2 star than a road lifted from 2 star to 3 stars. On the other hand, the possibly fewer things to improve on 2-star roads will be on average more expensive. Due to variations between the specific roads, the assumption is that the total costs per km "per star" that is lifted is the same.

[26] Carriageways corresponds to main roads and motorways, but not to smaller roads, nor to general urban roads. The costs are estimated in the SENSOR study. They are not the result of actual investments made.

To calculate the present values of the benefits (and the costs), the following set of assumptions has been applied.

Table 3: Cost benefit analysis - assumptions

Parameter	Unit	Assumption	Comment
Time horizon	years	2020-2050	A sensitivity analysis is carried out, where only a ten year period is analysed (2020-2030)
First year of effect from measures	year	2020	It is assumed that the measures will have an effect on the number of fatalities and injuries from 2020 onwards
Implementation period	years	10	It is assumed that all measures are implemented gradually over ten years and the effects follow the implementation.
Social discount rate (SDR)	%	4%	The Better Regulation Guidelines suggest the use of 4% as the social discount rate for impact assessments. It is mentioned that when considering road infrastructure with long life times, a lower or a declining rate could be used.
Inflation	% per year	Harmonized Index of Consumer Prices (HICP)	All costs and benefits have been expressed in 2016 prices based on the HICP from Eurostat.
Price Level Index	Index	Calculated for all countries	The price level index, drawing on Eurostat and European Central Bank, is used to account for the different price levels in each country.

4.1.4. PRIMES-TREMOVE, TRL and COWI models role in the impact assessment

The *PRIMES-TREMOVE transport model* is a building block of the modelling framework used for developing the EU Reference scenario 2016, and has a successful record of use in the Commission's transport, climate and energy policy analytical work – it is the same model as used for the 2011 White Paper on Transport and the 2016 European strategy on low-emission mobility.

The *TRL model* is a simulation tool assessing the impact of vehicle technologies on road safety in the context of the revision of the General Safety Regulation and Pedestrian Safety Regulation.

In this impact assessment, building on an update of the EU Reference scenario 2016 (including few policy measures that have been adopted after its cut-off date i.e. end of 2014), the PRIMES-TREMOVE model together with the TRL model have been used to define the common Baseline scenario used for the purpose of the present impact assessment report and for the impact assessment accompanying the revision of the General Safety Regulation and Pedestrian Safety Regulation. In the first step, the TRL model has been calibrated on the projected evolution of the vehicle stock from the update of the EU Reference scenario 2016. In the second step, the impact of mandatory and

voluntary vehicle technology measures on the number of fatalities, serious and slight injuries has been assessed at EU28 and Member State levels with the TRL and PRIMES-TREMOVE models drawing on input from TRL.

The COWI tool has been calibrated on the Baseline scenario developed with the PRIMES-TREMOVE and TRL model and has been subsequently used for assessing the impacts of infastructure measures on road safety and performing cost-benefit analysis in the context of this impact assessment. The TRL model has been used for assessing the impacts of vehicle tehchnologies on road safety and performing cost-benefit analysis in the context of the impact assessment accompaying the revision of the General Safety Regulation and Pedestrian Safety Regulation.

4.2. BASELINE SCENARIO

4.2.1. Scenario design, consultation process and quality assurance

The Baseline scenario used in this impact assessment builds on the EU Reference scenario 2016 but additionally includes few policy measures adopted after its cut-off date (end of 2014) and some updates in the technology costs assumptions.

Building an the EU Reference scenario is a regular exercise by the Commission. It is coordinated by DGs ENER, CLIMA and MOVE in association with the JRC, and the involvement of other services via a specific inter-service group.

For the EU Reference scenario 2016, Member States were consulted throughout the development process through a specific Reference scenario expert group which met three times during its development. Member States provided information about adopted national policies via a specific questionnaire, key assumptions have been discussed and in each modelling step, draft Member State specific results were sent for consultation. Comments of Member States were addressed to the extent possible, keeping in mind the need for overall comparability and consistency of the results.

Quality of modelling results was assured by using state of the art modelling tools, detailed checks of assumptions and results by the coordinating Commission services as well as by the country specific comments by Member States.

The EU Reference scenario 2016 projects EU and Member States energy, transport and GHG emission-related developments up to 2050, given current global and EU market trends and adopted EU and Member States' energy, transport, climate and related relevant policies. "Adopted policies" refer to those that have been cast in legislation in the EU or in MS (with a cut-off date end of 2014[27]). Therefore, the binding 2020 targets are assumed to be reached in the projection. This concerns greenhouse gas emission reduction targets as well as renewables targets, including renewables energy in transport. The EU Reference scenario 2016 provides projections, not forecasts. Unlike forecasts, projections do not make predictions about what the future will be. They rather indicate what would happen if the assumptions which underpin the projection actually occur. Still, the scenario allows for a consistent approach in the assessment of energy and climate trends across the EU and its Member States.

[27] In addition, amendments to two Directives only adopted in the beginning of 2015 were also considered. This concerns notably the ILUC amendment to the Renewables Directive and the Market Stability Reserve Decision amending the ETS Directive.

The report "EU Reference Scenario 2016: Energy, transport and GHG emissions - Trends to 2050"[28] describes the inputs and results in detail. In addition, its main messages are summarised in the impact assessments accompanying the Effort Sharing Regulation[29] and the revision of the Energy Efficiency Directive[30], and the analytical work accompanying the European strategy on low-emission mobility[31].

PRIMES-TREMOVE is one of the core models of the modelling framework used for developing the EU Reference scenario 2016 and has also been used for developing the Baseline scenario of this impact assessment in connection with the TRL model. The model was calibrated on transport and energy data up to year 2013 from Eurostat and other sources.

4.2.2. Main assumptions of the Baseline scenario

The projections are based on a set of assumptions, including on population growth, macroeconomic and oil price developments, technology improvements, and policies.

Macroeconomic assumptions

The Baseline scenario uses the same macroeconomic assumptions as the EU Reference scenario 2016. The population projections draw on the European Population Projections (EUROPOP 2013) by Eurostat. The key drivers for demographic change are: higher life expectancy, convergence in the fertility rates across Member States in the long term, and inward migration. The EU28 population is expected to grow by 0.2% per year during 2010-2030 (0.1% for 2010-2050), to 516 million in 2030 (522 million by 2050). Elderly people, aged 65 or more, would account for 24% of the total population by 2030 (28% by 2050) as opposed to 18% today.

GDP projections mirror the joint work of DG ECFIN and the Economic Policy Committee, presented in the 2015 Ageing Report[32]. The average EU GDP growth rate is projected to remain relatively low at 1.2% per year for 2010-2020, down from 1.9% per year during 1995-2010. In the medium to long term, higher expected growth rates (1.4% per year for 2020-2030 and 1.5% per year for 2030-2050) are taking account of the catching up potential of countries with relatively low GDP per capita, assuming convergence to a total factor productivity growth rate of 1% in the long run.

Fossil fuel price assumptions

Oil prices used in the Baseline scenario are the same with those of the EU Reference scenario 2016. Following a gradual adjustment process with reduced investments in upstream productive capacities by non-OPEC[33] countries, the quota discipline is assumed to gradually improve among OPEC members and thus the oil price is projected to reach 87 $/barrel in 2020 (in year 2013-prices). Beyond 2020, as a result of persistent demand growth in non-OECD countries driven by economic growth and the increasing number of passenger cars, oil price would rise to 113 $/barrel by 2030 and 130 $/barrel by 2050.

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[28] ICCS-E3MLab et al. (2016), EU Reference Scenario 2016: Energy, transport and GHG emissions - Trends to 2050
[29] SWD(2016) 247
[30] SWD(2016) 405
[31] SWD(2016) 244
[32] European Commission/DG ECFIN (2014), The 2015 Ageing Report: Underlying Assumptions and Projection Methodologies, European Economy 8/2014.
[33] OPEC stands for Organization of Petroleum Exporting Countries.

Techno-economic assumptions

For all transport means, except for light duty vehicles (i.e. passenger cars and light commercial vehicles), the Baseline scenario uses the same technology costs assumptions as the EU Reference scenario 2016.

For light duty vehicles, the data for technology costs and emissions savings has been updated based on a recent study commissioned by DG CLIMA[34]. Battery costs for electric vehicles are assumed to go down to 205 euro/kWh by 2030 and 160 euro/kWh by 2050; further reductions in the cost of both spark ignition gasoline and compression ignition diesel are assumed to take place. Technology cost assumptions are based on extensive literature review, modelling and simulation, consultation with relevant stakeholders, and further assessment by the Joint Research Centre (JRC) of the European Commission.

Specific policy assumptions

The key policies included in the Baseline scenario, similarly to the EU Reference scenario 2016, are[35]:

- CO2 standards for cars and vans regulations (Regulation (EC) No 443/2009, amended by Regulation (EU) No 333/2014 and Regulation (EU) No 510/2011, amended by Regulation (EU) No 253/2014); CO2 standards for cars are assumed to be 95gCO2/km as of 2021 and for vans 147gCO2/km as of 2020, based on the NEDC test cycle, in line with current legislation. No policy action to strengthen the stringency of the target is assumed after 2020/2021.
- The Renewable Energy Directive (Directive 2009/28/EC) and Fuel Quality Directive (Directive 2009/30/EC) including ILUC amendment (Directive 2015/1513/EU): achievement of the legally binding RES target for 2020 (10% RES in transport target) for each Member State, taking into account the use of flexibility mechanisms when relevant as well as of the cap on the amount of food or feed based biofuels (7%). Member States' specific renewable energy policies for the heating and cooling sector are also reflected where relevant.
- Directive on the deployment of alternative fuels infrastructure (Directive 2014/94/EU).
- Directive on the charging of heavy goods vehicles for the use of certain infrastructures (Directive 2011/76/EU amending Directive 1999/62/EC).
- Relevant national policies, for instance on the promotion of renewable energy, on fuel and vehicle taxation, are taken into account.

In addition, a few policy measures adopted after the cut-off date of the EU Reference scenario 2016 at both EU and Member State level, have been included in the Baseline scenario:

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[34] Source: https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/technology_results_web.xlsx

[35] For a comprehensive discussion see the Reference scenario report: "EU Reference Scenario 2016: Energy, transport and GHG emissions - Trends to 2050"

- Directive on weights & dimensions (Directive 2015/719/EU);
- Directive as regards the opening of the market for domestic passenger transport services by rail and the governance of the railway infrastructure (Directive 2016/2370/EU);
- Directive on technical requirements for inland waterway vessels (Directive 2016/1629/EU), part of the Naiades II package;
- Regulation establishing a framework on market access to port services and financial transparency of ports[36];
- The replacement of the New European Driving Cycle (NEDC) test cycle by the new Worldwide harmonized Light-vehicles Test Procedure (WLTP) has been implemented in the Baseline scenario, drawing on work by JRC. Estimates by JRC show a WLTP to NEDC CO_2 emissions ratio of approximately 1.21 when comparing the sales-weighted fleet-wide average CO_2 emissions. WLTP to NEDC conversion factors are considered by individual vehicle segments, representing different vehicle and technology categories[37].
- Changes in road charges in Germany, Austria, Belgium and Latvia.

Safety measures assumptions

Reflecting the plateauing in the number of fatalities and injuries in the recent years, in the Baseline scenario it has been assumed that post-2016 vehicle technologies would be the main source of reduction in fatalities, serious and slight injuries while measures addressing infrastructure safety (such as the existing RISM and Tunnel Directives), and driver behaviour (such as legislation improving enforcement across borders, namely Directive 2015/413/EU facilitating cross-border exchange of information on road safety related traffic offences) would compensate for the increase in traffic over time. The following vehicle technologies safety measures are covered by the Baseline scenario:

- The impact of highly effective existing vehicle technologies safety measures, which have been mandatory for a few years, but are still dispersing into the vehicle fleet (standard electronic stability control systems for all vehicle categories, and advanced emergency braking systems and lane departure warning systems for all new heavy goods vehicles and buses), are modelled to reduce the remaining target populations for the proposed measures.[38]
- Voluntary uptake of vehicle technology safety measures. The list of these measures is provided in Table 4.

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[36] Awaiting signature of act (Source : http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2013/0157(COD)&l=en)

[37] Simulation at individual vehicle level is combined with fleet composition data, retrieved from the official European CO_2 emissions monitoring database, and publicly available data regarding individual vehicle characteristics, in order to calculate vehicle CO_2 emissions and fuel consumption over different conditions. Vehicle CO_2 emissions are initially simulated over the present test protocol (NEDC) for the 2015 passenger car fleet; the accuracy of the method is validated against officially monitored CO_2 values and experimental data.

[38] Standard electronic stability control systems are mandatory for all new vehicles and vehicle categories since 1 November 2014 and from 1 November 2015, all new trucks and buses must also be equipped with advanced emergency braking systems as well as lane departure warning systems.

Table 4: List of vehicle technology safety measures considered for voluntary uptake

Measure	Description	Applicable vehicle categories			
AEB-VEH	Autonomous emergency braking for vehicles (moving and stationary targets)	M1		N1	
AEB-PCD	Autonomous emergency braking for pedestrians and cyclists	M1		N1	
ALC	Alcohol interlock installation document	M1	M2&M3	N1	N2&N3
DDR-DAD	Drowsiness and attention detection	M1	M2&M3	N1	N2&N3
DDR-ADR	Advanced distraction recognition	M1	M2&M3	N1	N2&N3
EDR	Event data recorder	M1		N1	
ESS	Emergency stop signal	M1	M2&M3	N1	N2&N3
FFW-137	Full-width frontal occupant protection (current R137 configuration with Hybrid III ATDs)	M1		N1	
FFW-THO	Full-width frontal occupant protection (introduction of THOR-M ATDs and lower appropriate injury criteria thresholds to encourage adaptive restraints)	M1		N1	
HED-MGI	Adult head-to-windscreen impact (mandatory HIC limit in headform-to-glass impact tests; no mandatory A-pillar impact)	M1		N1	
ISA-VOL	Intelligent speed assistance (voluntary type system; can be overridden by driver and switched off for the rest of journey)	M1	M2&M3	N1	N2&N3
LKA-ELK	Lane keeping assist (emergency lane keeping system that intervenes only in case of an imminent threat such as leaving the road, or leaving the lane with oncoming traffic)	M1		N1	
PSI	Pole side impact occupant protection	M1		N1	
REV	Reversing camera system	M1	M2&M3	N1	N2&N3
TPM	Tyre pressure monitoring system		M2&M3	N1	N2&N3
VIS-DET	Front and side vulnerable road user detection and warning (no auto braking)		M2&M3		N2&N3
VIS-DIV	Minimum direct vision requirement (best-in-class approach)		M2&M3		N2&N3

The year that full voluntary implementation is achieved represents the time necessary for the measure to reach maturity in terms of full voluntary adoption into new vehicle registrations. All but three measures were assumed to have a long voluntary implementation phase, with 14 years between launch of the technology and full voluntary implementation. Car fitment Event Data Recorders (EDR) and Full-width frontal protection for UN Regulation No. 137 with the Hybrid III dummy (FFW-137) were given a shorter voluntary uptake period of 6 years. This was justified based on the percentage of vehicles in the fleet already expected to meet the regulatory requirements for the system, which matches the predicted final voluntary uptake levels. A medium and a long length adoption period were used for vans and heavier vehicle uptake of EDRs, respectively. The full voluntary implementation years for the various measures are provided in Table 5.

The voluntary uptake up of technology and the implementation within the fleet was selected to be one of three possible options:

1. None = No voluntary uptake, regulatory action required to drive adoption
2. Medium = 40% voluntary propagation within the fleet without additional stimuli
3. High = 80% voluntary propagation leaving the 20% of vehicles which wouldn't be equipped without regulatory action

These values represent point estimates for the resulting final uptake in the fleet.

Table 5: Maximum voluntary uptake of vehicle technologies for new registrations

	M1	M2&M3	N1	N2&N3
AEB-VEH	High	High	High	High
AEB-PCD (pedestrian)	High	n/a	Medium	n/a
AEB-PCD (cyclist)	High	n/a	Medium	n/a
ALC	None	None	None	None
DDR-DAD	Medium	Medium	Medium	Medium
DDR-ADR	None	None	None	None
EDR	Medium	n/a	Medium	n/a
ESC	High	High	High	High
ESS	High	High	High	High
FFW-137	High	n/a	Medium	n/a
FFW-THO	High	n/a	Medium	n/a
HED-MGI	None	n/a	None	n/a
ISA-VOL	None	None	None	None
LDW	n/a	High	n/a	High
LKA-ELK	Medium	n/a	Medium	n/a
PSI	High	n/a	None	n/a
REV	Medium	None	Medium	None
TPM	n/a	None	None	None
VIS-DET	n/a	None	n/a	None
VIS-DIV	n/a	Medium	n/a	Medium

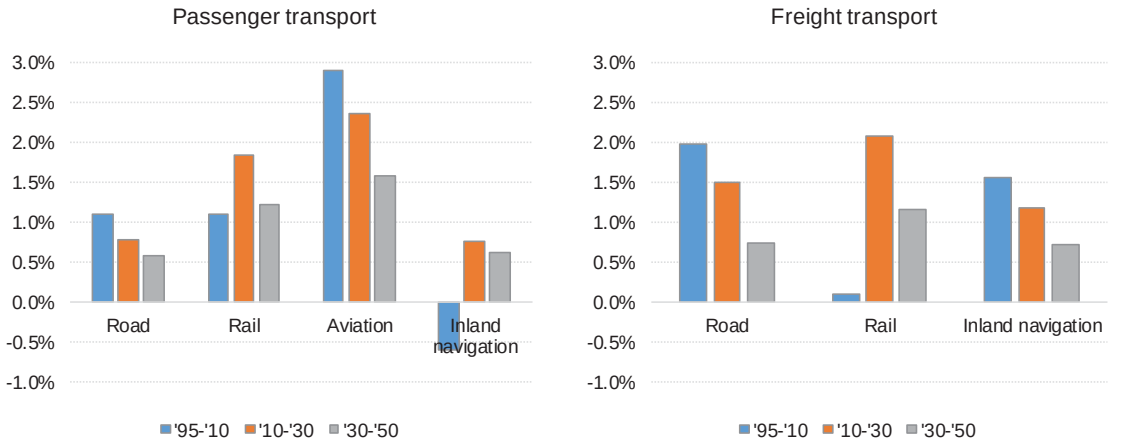
4.2.3. Summary of main results of the Baseline scenario

EU transport activity is expected to continue growing under current trends and adopted policies beyond 2015, albeit at a slower pace than in the past. Freight transport activity for inland modes is projected to increase by 36% between 2010 and 2030 (1.5% per year) and 60% for 2010-2050 (1.2% per year). Passenger traffic growth would be slightly lower than for freight at 23% by 2030 (1% per year) and 42% by 2050 (0.9% per

year for 2010-2050). The annual growth rates by mode, for passenger and freight transport, are provided in Figure 15[39].

Road transport would maintain its dominant role within the EU. The share of road transport in inland freight is expected to slightly decrease at 70% by 2030 and 69% by 2050. The activity of heavy goods vehicles expressed in tonnes kilometres is projected to grow by 35% between 2010 and 2030 (56% for 2010-2050) in the Baseline scenario, while light goods vehicles activity would go up by 27% during 2010-2030 (50% for 2010-2050). For passenger transport, road modal share is projected to decrease by 4 percentage points by 2030 and by additional 3 percentage points by 2050. Passenger cars and vans would still contribute 70% of passenger traffic by 2030 and about two thirds by 2050, despite growing at lower pace (17% for 2010-2030 and 31% during 2010-2050) relative to other modes, due to slowdown in car ownership increase which is close to saturation levels in many EU15 Member States and shifts towards rail.

Figure 15: EU passenger and freight transport projections (average growth rate per year)



Source: Baseline scenario, PRIMES-TREMOVE transport model (ICCS-E3MLab)
Note: For aviation, domestic and international intra-EU activity is reported, to maintain the comparability with reported statistics.

High congestion levels are expected to seriously affect road transport in several Member States by 2030 in the absence of effective countervailing measures such as road pricing. While urban congestion will mainly depend on car ownership levels, urban sprawl and the availability of public transport alternatives, congestion on the inter-urban network would be the result of growing freight transport activity along specific corridors, in particular where these corridors cross urban areas with heavy local traffic. The largest part of congestion will be concentrated near densely populated zones with high economic activity such as Belgium and the Netherlands – to a certain extent as a result of port and transhipment operations – and in large parts of Germany, the United Kingdom and northern Italy.

The PRIMES-TREMOVE model considers the stock of transport means inherited from previous periods, calculates scrapping due to technical lifetime, evaluates the economics of possible premature scrapping and determines the best choice of new transport means,

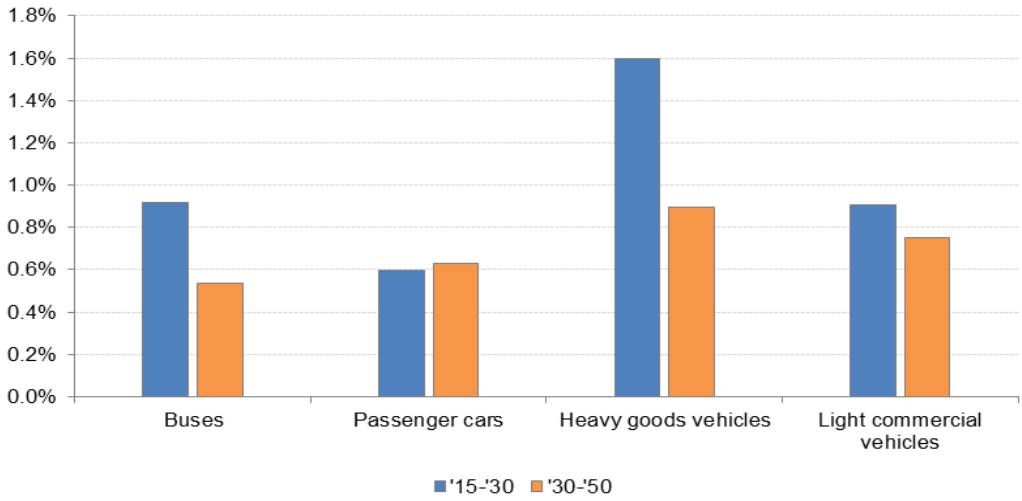
[39] Projections for international maritime and international extra-EU aviation are presented separately and not included in the total passenger and freight transport activity to preserve comparability with statistics for the historical period.

which are needed to meet demand. The choices are based on cost minimisation, which include anticipation factors.[40]

The road transport vehicle fleet is projected to continue growing over time, driven by developments in transport activity. The heavy goods vehicle fleet is projected to grow by 27% between 2015 and 2030 (1.6% per year) and 52% for 2015-2050 (0.9% per year). Growth in the light commercial vehicle stock is projected to be somewhat lower at 15% between 2015 and 2030 (0.9% per year) and 33% during 2015-2050 (0.8% per year).

The passenger cars fleet would grow at a lower pace compared to heavy goods and light commercial vehicles: 9% by 2030 (0.6% per year) and 24% by 2050 (0.6% per year), driven by slowdown in car ownership increase which as explained above is close to saturation levels in many EU15 Member States. The buses and coaches fleet is also projected to go up, at rates similar to those of light commericial vehicles: 15% increase between 2015 and 2030 (0.9% per year) and 28% during 2015-2050 (0.5% per year).

Figure 16: Road transport vehicle stock projections by type of vehicle (average growth rate per year) at EU level



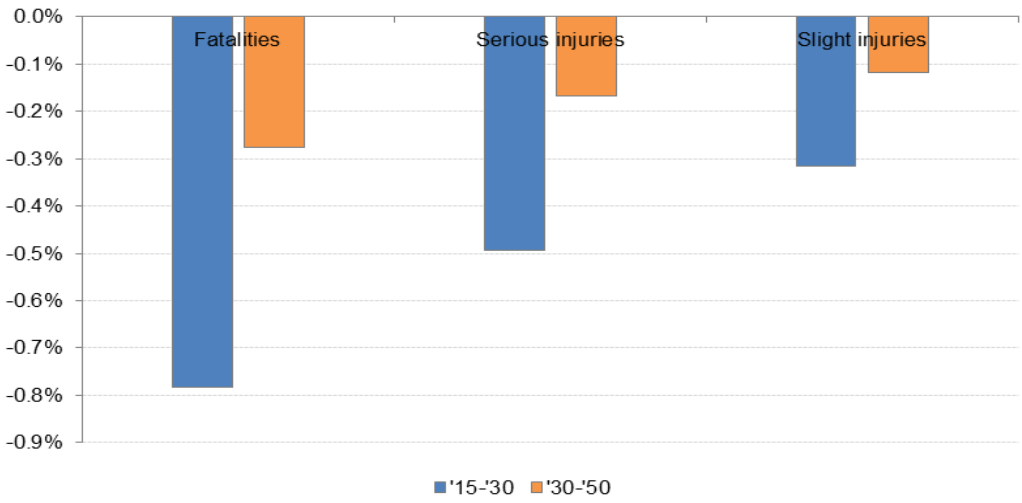
Source: Baseline scenario, PRIMES-TREMOVE transport model (ICCS-E3MLab)

Under current trends and adopted policies, measures addressing infrastructure safety and driver behaviour would compensate for the increase in traffic over time while the uptake of the mandatory and voluntary vehicle technology safety measures described above would result in further decreases in the number of fatalities, serious and slight injuries over time. The number of fatalities is projected to go down by 11% between 2015 and 2030 (9% for 2016-2030) and 16% during 2015-2050 (14% for 2016-2050), while the reduction in the serious injuries is expected to be lower at 7% by 2030 (6% for 2016-2030) and 10% by 2050 (10% for 2016-2050). Slight injuries are also projected to drop

[40] There are several factors influencing the choice of a new transport means, covering payable and non-payable elements. True payable costs include all cost elements over the lifetime of the candidate transport means: purchasing cost; annual fixed costs for maintenance, insurance and ownership/circulation taxation; variable costs for fuel consumption depending on trip type and operation conditions; other variable costs including congestion charges, parking fees, etc. Other factors, like perceived cost factors, which do not necessarily imply true payments by the user but may imply indirect costs are influencing decisions about choice of new vehicles. They reflect technical risk of yet immature technologies, acceptance factors representing market penetration, density of refuelling/recharging infrastructure applicable to technologies using alternative fuels and those that have range limitations.

by 2050, however, at much lower pace than fatalities and serious injuries (5% for 2015-2030 and 7% for 2015-2050).

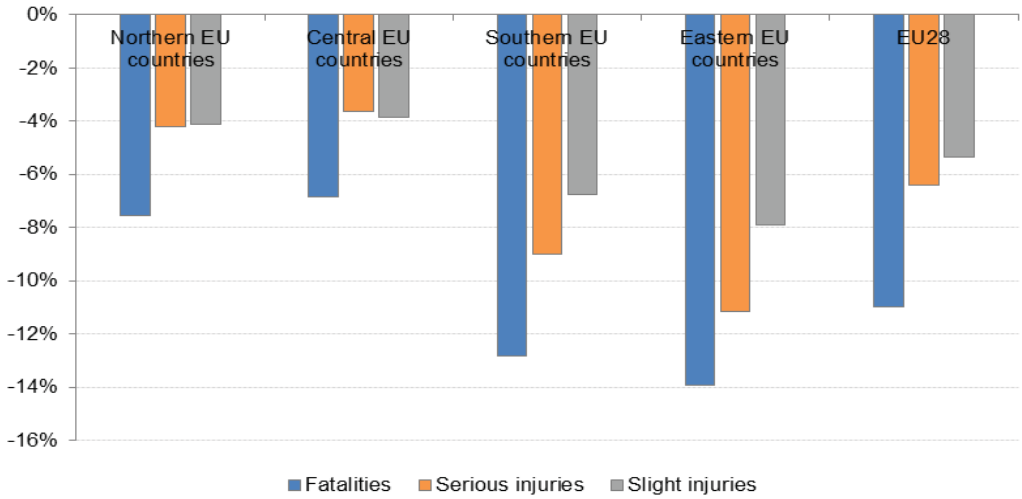
Figure 17: Evolution of fatalities, serious and slight injuries over the 2015-2050 time horizon (average growth rate per year)



Source: Baseline scenario, TRL model and PRIMES-TREMOVE transport model (ICCS-E3MLab)

In the Baseline scenario, the evolution of fatalities, serious and slight injuries by EU region continues recent trends observed in the historical data, with the Eastern and Southern EU countries showing the highest decrease in the number of casualties.

Figure 18: Evolution of fatalities, serious and slight injuries by EU region between 2015 and 2030 (cumulative growth rates)



Source: Baseline scenario, PRIMES-TREMOVE transport model (ICCS-E3MLab) and TRL model

4.2.4. Baseline scenario – sensitivity analysis

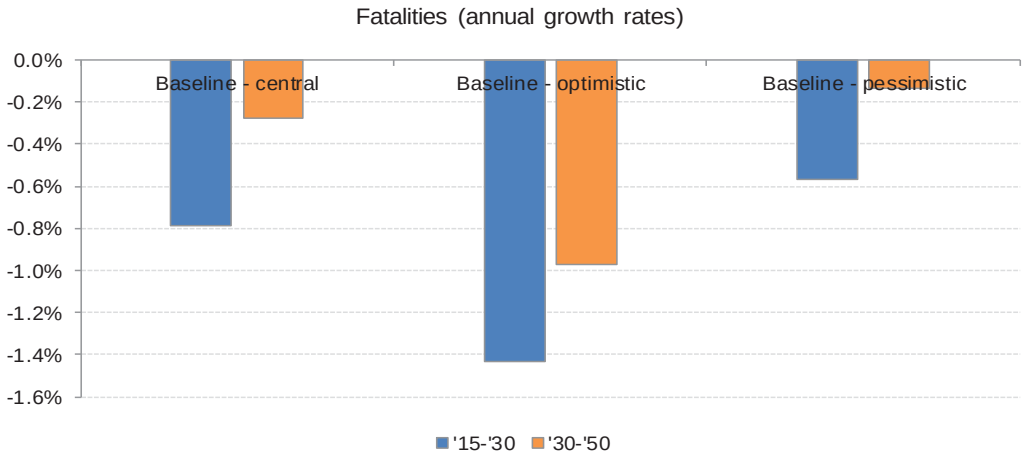
Considering the high uncertainty surrounding the evolution of fatalities and injuries, sensitivity analysis has been performed on the Baseline scenario. An alternative optimistic and a pessimistic baseline scenario have been considered:

- In the optimistic baseline scenario, it is assumed that the slight reduction of fatalities and serious injuries observed during 2014-2016 (0.7% per year) would come from infrastructure, driver behaviour and other factors (mandatory vehicles technologies) and the trend would be continued in time. In addition, the voluntary uptake of vehicle technologies measures is assumed to be the same as in the main Baseline scenario.

- In the pessimistic baseline scenario, it is assumed that post-2016 vehicle technologies would be the main source of reductions in fatalities, serious and slight injuries, while measures addressing infrastructure safety and driver behaviour and other factors would compensate for the increase in traffic over time. However, the voluntary uptake of vehicle technologies in new vehicles is reduced by a factor.

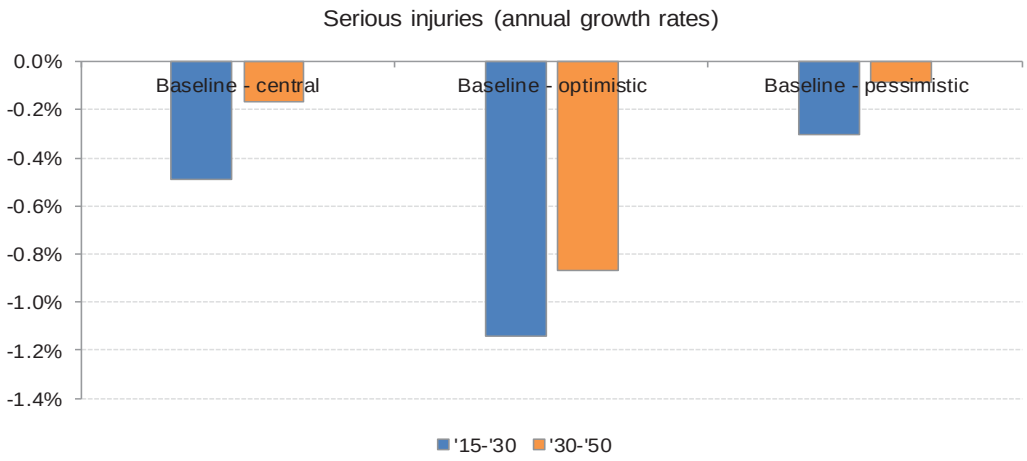
The projected evolution of fatalities, serious and slight injuries over the 2015-2050 horizon in the optimistic and pessimistic baseline scenarios is presented in Figure 19 to Figure 20. It is compared with the central baseline scenario described in the previous section. In cumulative terms, between 2016 and 2030 the number of fatalities is projected to go down by 18% in the optimistic baseline scenario and 6% in the pessimistic scenario relative to 9% in the central baseline scenario. Similarly, serious injuries would decrease by 15% in the optimistic baseline and 4% in the pessimistic baseline compared to 6% in the central baseline scenario while slight injuries would go down by 15% in the optimistic baseline and 4% in the pessimistic baseline relative to 7% in the central baseline scenario.

Figure 19: Evolution of fatalities over the 2015-2050 time horizon (average growth rate per year) in the optimistic and pessimistic baseline scenarios



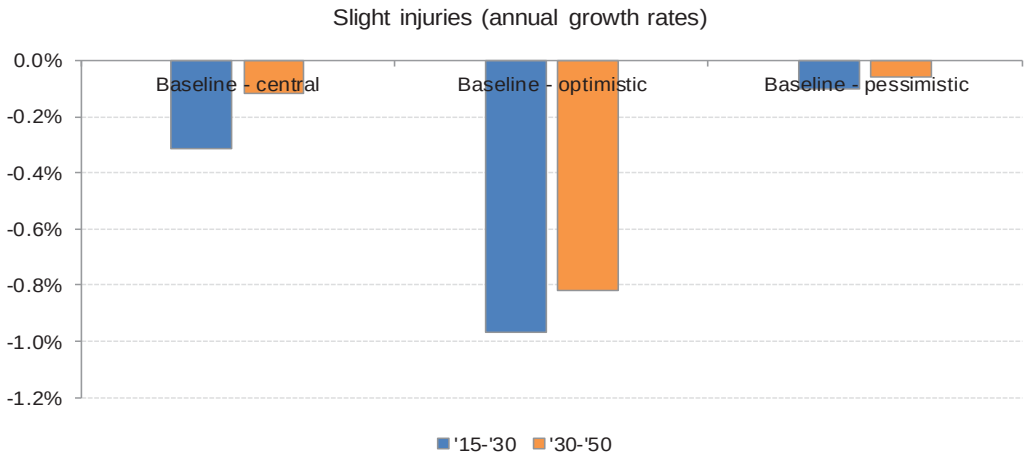
Source: Baseline scenario, TRL model and PRIMES-TREMOVE transport model (ICCS-E3MLab)

Figure 20: Evolution of serious injuries over the 2015-2050 time horizon (average growth rate per year) in the optimistic and pessimistic baseline scenarios



Source: Baseline scenario, TRL model and PRIMES-TREMOVE transport model (ICCS-E3MLab)

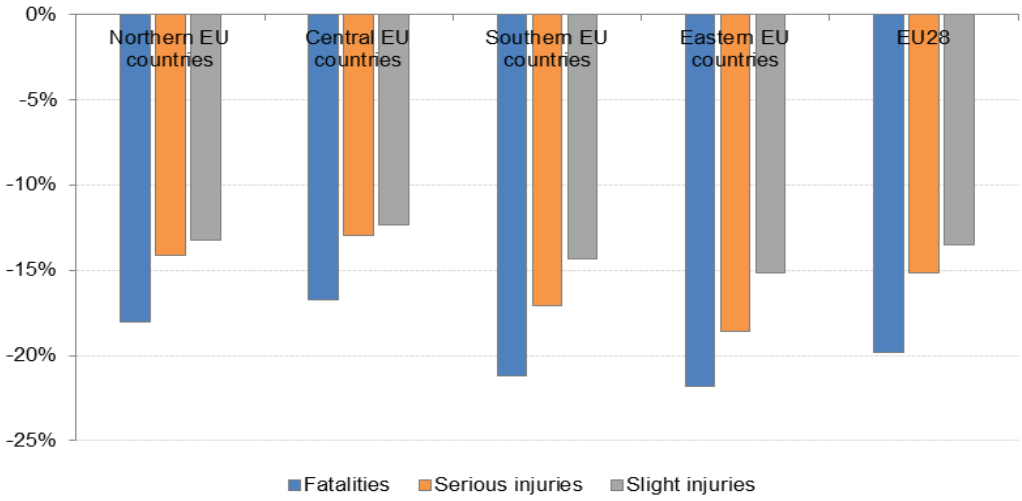
Figure 21: Evolution of slight injuries over the 2015-2050 time horizon (average growth rate per year) in the optimistic and pessimistic baseline scenarios



Source: Baseline scenario, TRL model and PRIMES-TREMOVE transport model (ICCS-E3MLab)

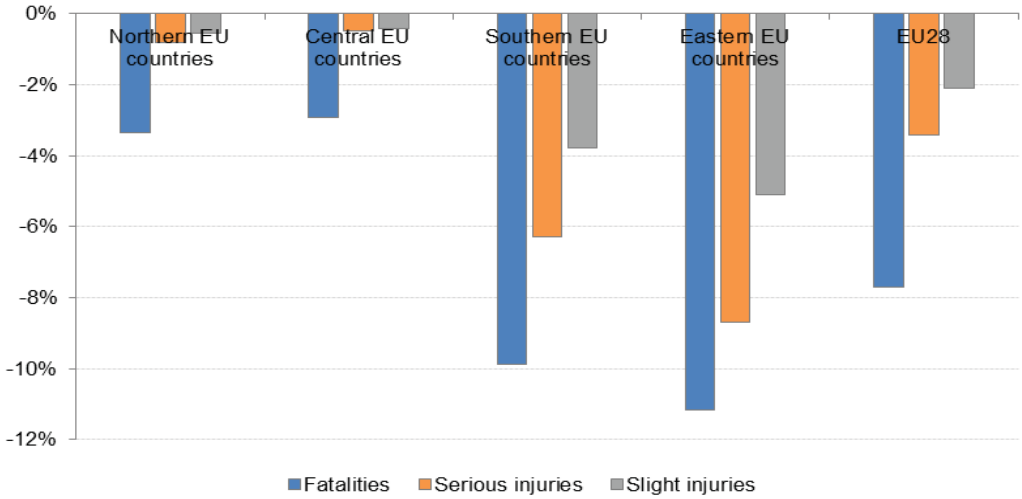
Similarly to the central baseline scenario, the evolution of fatalities, serious and slight injuries by EU region in the optimistic and pessimistic baseline scenarios continues recent trends observed in the historical data, with the Eastern and Southern EU countries showing higher decreases in the number of casualties relative to the Northern and Central EU countries.

Figure 22: Evolution of fatalities, serious and slight injuries by EU reagion between 2015 and 2030 (cumulative growth rates) in the optimistic baseline scenario



Source: Baseline scenario, PRIMES-TREMOVE transport model (ICCS-E3MLab) and TRL model

Figure 23: Evolution of fatalities, serious and slight injuries by EU reagion between 2015 and 2030 (cumulative growth rates) in the pessimistic baseline scenario



Source: Baseline scenario, PRIMES-TREMOVE transport model (ICCS-E3MLab) and TRL model

4.3. DETAILED RESULTS OF POLICY OPTIONS BY MEMBER STATE

This section presents the detailed social and economic impacts by Member State for each policy option (policy options 1 to 3 and A to C).

4.3.1. Social impacts

In terms of social impacts, as explained in section 6 of the Impact Assessment report, the main effect of the policy options is the reduction in the number of fatalities and serious injuries from road crashes. This effect is achieved either through a reduction in the number of road crashes or through a reduction in the impact on the persons involved in

the crashes. These further have impacts on public or private health costs, production loss etc. They are included in the monetisation of fatalities and of severe injuries.

For each policy option (policy options 1 to 3 and A to C) a table is included that presents the expected social impacts of individual policy measures used in the quantification of effects. As explained in section 4.1.3, the sources for the estimation of the impacts on the number of fatalities and serious injuries are based on two main studies: the Safety Cube project and the Handbook of Road Safety Measures. These studies include almost all evidence available on the impacts of infrastructure on road safety.

Policy option 1 (PO1)

The expected social impacts of the individual policy measures included in PO1 are presented in the table below.

Table 6: Effect of each measure of PO1 (light intervention – best practice sharing, publication of information about procedures) on the number of injuries and fatalities

No.	Measures	Effect (% reduction in fatalities and serious injuries)
1.	Promote knowledge sharing by publishing national best practices in central EU repository	Positive, but not quantified
2.	Create a European Forum of Road Safety Auditors	Positive, but not quantified
8.	Make information about procedures publicly available	Positive, but not quantified
4.	Include clear reference to assessing safety of vulnerable road users in all RISM procedures	R:5-10 % CE: 7.5%
5.	Include clear reference to supporting deployment of C-ITS and automation on the TEN-T in all road infrastructure safety management procedures	Positive, but not quantified
3.	Create interface between the RISM and Tunnel Directives	Positive, but not quantified

Source: COWI/SWOV (2017); Note: R=range and CE = central estimate

The social impacts of PO1 (light intervention – best practice sharing, publication of information about procedures) are presented in the table below. The results are presented both as the percentage reduction compared to the baseline and the change in absolute numbers in 2030 relative to the baseline. The estimated reduction in fatalities and serious injuries is due to the increased focus of RISM procedures on the safety of vulnerable road users, in particular motorcyclists.

Table 7: Estimated reduction in the number of fatalities and serious injuries in PO1 in 2030 compared to the Baseline

Member State	Fatalities		Serious injuries	
	% change	Absolute change	% change	Absolute change
AT	0.7%	0	0.7%	3

Member State	Fatalities		Serious injuries	
	% change	Absolute change	% change	Absolute change
BE	0.7%	0	0.7%	1
BG	0.8%	0	0.8%	1
CY	1.1%	0	1.1%	0
CZ	0.9%	1	0.9%	3
DE	0.8%	1	0.8%	23
DK	0.7%	0	0.7%	1
EE	1.1%	0	1.1%	1
EL	1.5%	1	1.5%	1
ES	0.9%	1	0.9%	7
FI	0.9%	1	0.9%	1
FR	0.9%	1	0.9%	11
HR	1.2%	0	1.2%	2
HU	1.0%	0	1.0%	3
IE	0.9%	0	0.9%	1
IT	1.0%	1	1.0%	19
LT	1.3%	0	1.3%	1
LU	0.6%	0	0.6%	0
LV	1.4%	0	1.4%	1
MT	1.4%	0	1.4%	1
NL	0.6%	0	0.6%	1
PL	1.2%	1	1.2%	5
PT	0.7%	0	0.7%	1
RO	1.3%	1	1.3%	4
SE	1.0%	1	1.0%	9
SI	0.6%	0	0.6%	1
SK	0.7%	0	0.7%	1
UK	1.2%	1	1.1%	13
Total (TEN-T roads)	1.0%	14	0.9%	116
Total (whole network)	0.1%	14	0.1%	116

Source: COWI/SWOV (2017)

Policy option 2 (PO2)

The table below summarises the impacts of the individual measures in PO2 on fatalities and serious injuries.

Table 8: Effect of each measure of PO2 on the number of fatalities and serious injuries on the roads where they are implemented (moderate intervention – mandatory follow-up, network-wide inspections)

Measures	Effect (% reduction in fatalities and serious injuries) on roads where implemented
Obligation to compile a risk-based prioritised action plan	R: 10-20% CE: 15%
Carry out road assessment programmes	
Establish general performance requirements for road markings on TEN-T	Edge lines/Centre lines R: 1-3%/0-1% CE: 2%/1%

Source: COWI/SWOV (2017); Note: R=range and CE = central estimate

The overall impacts on the number of fatalities and injuries in PO2 compared to the Baseline are shown in the table below. The impacts of PO2 are mainly due to better follow-up of the findings of existing RISM procedures and to the positive effects of running road assessment programmes in addition to the existing procedures. General performance requirements for road markings contribute to these positive results.

PO2 has a relatively low effect in some countries (e.g. Sweden, the Netherlands and the UK). This is because these countries already apply road assessment programmes and have high safety levels on their TEN-T roads.

Table 9: Estimated reduction in the number of fatalities and serious injuries on the road network concerned in PO2 in 2030 compared to the Baseline

Member State	Fatalities		Serious injuries	
	% change	Absolute change	% change	Absolute change
AT	1.4%	0	1.4%	7
BE	12.3%	3	12.3%	19
BG	14.4%	5	14.4%	17
CY	16.8%	1	16.8%	8
CZ	13.5%	9	13.5%	38
DE	0.9%	1	0.9%	28
DK	9.1%	2	9.1%	15
EE	18.4%	4	18.4%	23
EL	18.1%	11	18.1%	15
ES	1.4%	2	1.4%	10
FI	7.1%	6	7.1%	11
FR	12.5%	18	12.5%	146
HR	11.2%	2	11.2%	23

Member State	Fatalities		Serious injuries	
	% change	Absolute change	% change	Absolute change
HU	13.6%	4	13.6%	41
IE	2.9%	1	2.9%	2
IT	8.8%	11	8.8%	172
LT	7.4%	2	7.4%	5
LU	4.3%	0	4.3%	0
LV	15.1%	4	15.1%	11
MT	15.1%	0	15.1%	6
NL	1.6%	0	1.6%	4
PL	14.6%	16	14.6%	59
PT	16.2%	7	16.2%	29
RO	14.8%	10	14.8%	49
SE	3.2%	3	3.2%	27
SI	8.3%	1	8.3%	8
SK	13.5%	3	13.5%	11
UK	2.6%	2	2.6%	29
Total (TEN-T roads)	**8.8%**	**129**	**6.5%**	**815**
Total (whole network)	0.6%	129	0.4%	815

Source: COWI/SWOV (2017)

Policy option 3 (PO3)

The overall assumptions supporting the quantification of PO3 (ambitious intervention – minimum star rating) are largely based on experience from the EuroRAP/iRAP road assessment programmes and their estimation of the impact of better safety ratings. This measure of setting a minimum safety level is defined in the assessments as similar to requiring all roads to have a minimum 3 star rating according to the iRAP definition. According to EuroRAP, when a road is upgraded from 1 star to 2, this will lead to a reduction in fatalities of 30%. An improvement from 2 to 3 stars will reduce fatalities by 40%.

The table below summarises the impacts of the individual measures in PO3 on fatalities and serious injuries.

Table 10: Effect of each measure of PO3 on the number of injuries and fatalities (ambitious intervention – minimum star rating)[41]

No	Measures	Effect (% reduction in fatalities and injuries)
	Implement corrective actions to meet minimum safety levels (3 stars) on 1 star roads	R: 25-39% CE: 30%
	Implement corrective actions to meet minimum safety levels (3 stars) on 2 star roads [42]	R: 33-48% CE: 40%
	Establish general performance requirements for road furniture on TEN-T (e.g. motorcycle friendly guardrails)	New guardrails along the roadside/ Guardrails in central lane R: 41-52%/23-36% CE: 45%/30

Source: COWI/SWOV (2017); Note: R=range and CE = central estimate

The quantification of impacts of PO3 shows a significant reduction in the number of fatalities and injuries as shown in the table below. The distribution of impacts is to a large extent similar to that in PO2, where countries with large road networks or a relatively high number of fatalities and injuries would experience a higher total impact. The relative impact is highest in countries with a relatively low safety rating of roads in the baseline (e.g. Greece, Hungary and Romania). The higher reduction in the number of fatalities and serious injuries compared to PO2 is mainly due to the compulsory improvements to road infrastructure which will be carried out to meet minimum safety requirements on the road network concerned. This is complemented by general performance requirements for road furniture (guardrails).

Table 11: Estimated reduction in the number of fatalities and serious injuries on the road network concerned in PO3 in 2030 compared to the Baseline

Member State	Fatalities		Severe injuries	
	% change	Absolute change	% change	Absolute change
AT	4.9%	1	4.9%	23
BE	4.1%	1	4.1%	6
BG	42.3%	15	42.3%	51
CY	13.8%	1	13.6%	6
CZ	16.3%	11	16.2%	45
DE	2.0%	3	2.0%	60
DK	2.3%	1	2.4%	4
EE	33.3%	6	33.3%	42
EL	32.6%	21	32.6%	27

[41] Star ratings are not currently available for all Member States. Available data include observations for 14 Member States. Findings from these Member States have been used for other countries in the same regions. See footnote 54 for more details.

Member State	Fatalities		Severe injuries	
	% change	Absolute change	% change	Absolute change
ES	3.5%	5	3.5%	27
FI	8.2%	7	8.2%	13
FR	4.1%	6	4.1%	47
HR	36.9%	8	36.9%	77
HU	21.3%	7	21.4%	65
IE	15.3%	5	15.3%	11
IT	6.2%	8	6.2%	121
LT	32.3%	10	32.3%	23
LU	0.6%	0	0.6%	0
LV	37.8%	9	37.8%	29
MT	38.1%	1	38.1%	15
NL	0.6%	0	0.6%	1
PL	38.1%	41	38.1%	154
PT	8.2%	4	8.2%	15
RO	35.4%	24	35.5%	118
SE	1.0%	1	1.0%	9
SI	2.2%	0	2.2%	2
SK	23.1%	5	22.7%	19
UK	5.8%	5	5.7%	65
Total (TEN-T roads)	**13.8%**	**204**	**8.6%**	**1,076**
Total (whole network)	0.88%	204	0.46%	1,076

Source: COWI/SWOV (2017)

The reductions in fatalities and injuries under PO3 are significant. It is estimated that the annual reduction in fatalities on the TEN-T road network in 2030 would be 13.8% compared to the baseline. There are variations between countries due to the differences in the current star rating level of their roads.

Policy option A (PO A)

The table below indicates the estimated social impact of the proposed measure and identifies the extent of the road network that it concerns.

Table 12: Effect of the measure on the number of severe injuries and fatalities in PO A (Conditionality of EU funds)

Measures	Effect (% reduction in injuries)	Applies to
Apply the provisions of the current RISM Directive to parts of the national road infrastructure that is built using EU funding	R: 3-10% CE: 5%	All fatalities and injuries on non-TEN-T road built with EU funding in those Member States that are not already conducting RISM procedures on non-TEN-T roads

Source: COWI/SWOV (2017); Note: R=range and CE = central estimate

The estimated social impacts of PO A are presented below. Improvements are assumed to be limited to those Member States that receive funding from the EU and that have not yet extended the application of RISM procedures to their national road networks on a voluntary basis.

Table 13: Estimated reduction in the number of fatalities and serious injuries on the road network concerned in PO A in 2030 compared to the Baseline

Member State	Fatalities		Serious injuries	
	% change	Absolute change	% change	Absolute change
AT	0,00%	0	0,00%	0
BE	0,00%	0	0,00%	0
BG	0,00%	0	0,00%	0
CY	0,00%	0	0,00%	0
CZ	0,00%	0	0,00%	0
DE	0,00%	0	0,00%	0
DK	0,00%	0	0,00%	0
EE	0,03%	0	0,18%	0
EL	2,13%	0	1,75%	1
ES	0,01%	0	0,03%	0
FI	0,00%	0	0,00%	0
FR	0,00%	0	0,00%	0
HR	0,01%	0	0,10%	0
HU	0,00%	0	0,00%	0
IE	0,00%	0	0,00%	0
IT	0,00%	0	0,00%	0
LT	0,00%	0	0,00%	0
LU	0,00%	0	0,00%	0
LV	0,00%	0	0,00%	0
MT	0,00%	0	0,00%	0
NL	0,00%	0	0,00%	0

Member State	Fatalities		Serious injuries	
	% change	Absolute change	% change	Absolute change
PL	0,24%	0	0,49%	4
PT	0,00%	0	0,00%	0
RO	0,00%	0	0,00%	0
SE	0,00%	0	0,00%	0
SI	0,01%	0	0,02%	0
SK	0,19%	0	0,53%	1
UK	0,00%	0	0,00%	0
Total (non-TEN-T motorways and main roads) including cross-border projects	**0,02%**	**1**	**0,02%**	**6**

Source: COWI/SWOV (2017)

Policy option B (PO B)

The table below summarises the impacts of the measures in PO B on fatalities and serious injuries.

Table 14: Effect of the measure of PO B on the number of severe injuries and fatalities (Extension of current RISM provisions to main/national roads)

Measures	Effect (% reduction in fatalities and serious injuries)	Applies to
Apply the provisions of the current RISM Directive to national roads	R: 3-10% CE: 5%	All fatalities and injuries on national roads in those Member States that are not already conducting RISM procedures on non-TEN-T roads

Source: COWI/SWOV (2017); Note: R=range and CE = central estimate

The overall social impacts estimated for PO B in 2030 relative to the Baseline are presented below. PO B provides significant social benefits in countries where RISM procedures have not been extended to non-TEN-T roads so far. It is assumed that PO B will not have an impact on those Member States that already apply RISM procedures on non-TEN-T national roads.

Table 15: Estimated reduction in the number of fatalities and serious injuries on the road network concerned in PO B in 2030 compared to the Baseline

Member State	Fatalities		Serious injuries	
	% change	Absolute change	% change	Absolute change
AT	0.0%	0	0.0%	0
BE	0.0%	0	0.0%	0

Member State	Fatalities		Serious injuries	
	% change	Absolute change	% change	Absolute change
BG	0.0%	0	0.0%	0
CY	0.0%	0	0.0%	0
CZ	0.0%	0	0.0%	0
DE	0.0%	0	0.0%	0
DK	7.5%	3	7.5%	23
EE	7.5%	3	7.5%	18
EL	7.5%	3	7.5%	4
ES	7.5%	38	7.5%	208
FI	7.5%	9	7.5%	18
FR	0.0%	0	0.0%	0
HR	7.5%	7	7.5%	71
HU	0.0%	0	0.0%	0
IE	7.5%	3	7.5%	8
IT	0.0%	0	0.0%	0
LT	0.0%	0	0.0%	0
LU	0.0%	0	0.0%	0
LV	0.0%	0	0.0%	0
MT	0.0%	0	0.0%	0
NL	0.0%	0	0.0%	0
PL	7.5%	12	7.5%	47
PT	0.0%	0	0.0%	0
RO	0.0%	0	0.0%	0
SE	0.0%	0	0.0%	0
SI	7.5%	1	7.5%	11
SK	7.5%	3	7.5%	10
UK	0.0%	0	0.0%	0
Total (non-TEN-T motorways and main roads)	**1.8%**	**83**	**0.8%**	**418**
Total (whole network)	0.4%	83	0.2%	418

Source: COWI/SWOV (2017)

Policy option C (PO C)

The table below shows the effects of individual measures used to quantify the impacts of PO C. The option contains measures that are also used in PO2 for TEN-T roads. The impacts of PO C are therefore quantified using the same assumptions as those used for the measures in PO2, however extending the scope beyond TEN-T roads.

Table 16: Effect of each measure of PO C on the number of severe injuries and fatalities

No	Measures	Effect (% reduction in fatalities and serious injuries)
8.	Make information about procedures publicly available	-
9.	Compulsory follow-up of findings using a plan based on risk-based prioritisation of actions	R: 10-20% CE: 15%
10.	Carry out road assessment programmes	

Source: COWI/SWOV (2017); Note: R=range and CE = central estimate

The estimated social impacts of PO C are presented in the Table below.

Table 17: Estimated reduction in the number of fatalities and serious injuries on the road network concerned in PO C in 2030 compared to the Baseline

Member State	Fatalities		Severe injuries	
	% change	Absolute change	% change	Absolute change
AT	0.0%	0	0.0%	0
BE	11.3%	10	11.3%	69
BG	11.3%	2	11.3%	5
CY	15.0%	1	15.0%	10
CZ	11.3%	20	11.3%	83
DE	0.0%	0	0.0%	0
DK	17.9%	8	17.9%	55
EE	21.4%	8	21.4%	51
EL	21.4%	9	21.4%	12
ES	21.4%	108	21.4%	594
FI	21.4%	26	21.4%	51
FR	11.3%	80	11.3%	630
HR	21.4%	21	21.4%	202
HU	11.3%	3	11.3%	28
IE	21.4%	10	21.4%	23
IT	7.5%	43	7.5%	684
LT	0.0%	0	0.0%	0
LU	3.7%	1	3.8%	5
LV	11.3%	0	11.3%	0
MT	0.0%	0	0.0%	0
NL	0.0%	0	0.0%	0
PL	21.4%	35	21.4%	133
PT	15.0%	21	15.0%	82

Member State	Fatalities		Severe injuries	
	% change	Absolute change	% change	Absolute change
RO	11.3%	18	11.3%	86
SE	0.0%	0	0.0%	0
SI	17.9%	4	17.9%	27
SK	21.4%	7	21.4%	29
UK	0.0%	0	0.0%	0
Total (non-TEN-T motorways and main roads)	**9.4%**	**433**	**5.6%**	**2,860**
Total (whole network)	1.9%	433	1.2%	2,860

Source: COWI/SWOV (2017)

4.3.2. Economic impacts – regulatory costs

The economic impacts relate to the regulatory costs associated with the policy measures. These regulatory costs include in particular: (i) compliance costs related to the costs of using the road infrastructure safety management procedures and to implementation costs related to making the necessary improvements to the road infrastructure; (ii) administrative costs borne by businesses, citizens, civil society organisations and public authorities as a result of administrative activities performed to comply with information obligations included in legal rules; (iii) enforcement costs representing the resources that authorities need to monitor and enforce the legislation. As the RISM Directive put the responsibilities for compliance directly on national road authorities, no enforcement costs are expected.

While the unit cost of RISM procedures can be quite stable (notwithstanding the differences in labour costs between Member States), the implementation part of compliance costs will always depend on the actual condition of the infrastructure and the specific infrastructure countermeasures required to address the safety shortcoming detected by the procedures carried out. Therefore significant differences in total compliance costs are expected between Member States.

Policy option 1 to 3 (PO1 to PO3)

Using the cost assumptions and the data on the length of TEN-T roads, the compliance costs for PO1 to PO3 (where the scope of the legislation is limited to TEN-T roads) are presented in the table below. The specific assumptions on how these elements have been estimated are presented in the Impact Assessment Support Study.

As the scope of the measures increase, so does the cost of compliance. The major part of the compliance costs associated with PO2 and PO3 are the costs of the infrastructure upgrades resulting from the improved follow-up of RISM procedures and in case of PO3 specifically the infrastructure costs required for all the TEN-T roads to meet the agreed minimum safety requirements. Differences between costs by Member State are due to the length of the roads concerned and their current level of safety.

Table 18: Compliance costs in million euro in PO1 to PO3 (TEN-T roads) over the period 2020-2050

Member State	PO1	PO2	PO3
AT	2	2	92
BE	2	72	111
BG	1	89	323
CY	0	19	34
CZ	1	46	82
DE	14	14	664
DK	2	57	28
EE	1	48	89
EL	3	173	390
ES	12	12	255
FI	4	79	83
FR	18	575	642
HR	1	19	71
HU	1	34	85
IE	2	3	110
IT	12	257	902
LT	1	18	130
LU	0	1	5
LV	1	42	111
MT	0	3	9
NL	2	2	2
PL	3	158	513
PT	2	107	168
RO	2	123	347
SE	7	7	7
SI	1	7	14
SK	1	27	74
UK	8	9	224
Total	**103**	**2,004**	**5,563**

Source: COWI/SWOV (2017)

Policy option A to C (PO A to PO C)

For the policy options involving a change in the scope of the legislation (to include roads beyond the TEN-T), the compliance costs by Member States are presented in the table below.

The compliance costs for the policy options include the compliance costs associated with the necessary upgrade of the road infrastructure concerned. The very significant estimated compliance costs for PO C are largely the result of the implementation of the findings of road assessment programmes. The distribution of the costs by Member State is influenced by the length of road (some Member States have very large primary road networks) and by the current state and safety level of the existing road infrastructure in the scope.

Table 19: Compliance costs in million euro in PO A to PO C over the period 2020-2050

Member state	PO A	PO B	PO C
AT	0.0	0.0	0
BE	0.0	0.0	243
BG	0.0	0.0	36
CY	0.0	0.0	22
CZ	0.0	0.0	122
DE	0.0	0.0	0
DK	0.0	31.0	171
EE	4.4	30.8	123
EL	32.6	37.1	148
ES	14.0	0.0	1,591
FI	0.0	38.7	504
FR	0.0	0.0	2,066
HR	1.8	27.4	192
HU	0.0	0.0	25
IE	0.0	0.0	162
IT	0.0	0.0	958
LT	0.0	0.0	0
LU	0.0	0.0	8
LV	0.0	0.0	2
MT	0.0	0.0	0
NL	0.0	0.0	0
PL[43]	114.6	75.5	378
PT	0.0	0.0	324
RO	0.0	0.0	280
SE	0.0	0.0	0
SI	0.5	3.4	19
SK	15.6	12.9	64
UK	0.0	0.0	0
Total	**203.3**	**257**	**7,440**

Source: COWI/SWOV (2017)

[43] Poland has a very large national road network compared to other countries; Hence, road safety upgrades will require more investment than in other countries. Poland has also by far received the most funding from the structural funds historically. The assumption in the calculations is that the same will be the case in the future. This implies that the length of road to which RISM procedures will apply is high, which results in high costs of making the required adjustments.