THE EUROPEAN UNION'S ROLE IN PROMOTING THE SAFETY OF CYCLING

Proposals for a safety component in a future EU Cycling Strategy

ETSC
European Transport Safety Council

Contributing Experts

ETSC gratefully acknowledges the invaluable contributions of the following experts in the preparation of this report:

Brian Deegan - Transport for London

Werner De Dobbeleer - Flemish Foundation for Traffic Knowledge

Stijn D'Hondt - Flemish Foundation for Traffic Knowledge

Duncan Dollimore – Cycling UK

Roland Huhn - German Cyclists' Federation, ADFC

Eddy Klynen - Flemish Foundation for Traffic Knowledge

Ciaran Simms - Trinity College, Dublin

Maurizio Tira - University of Brescia

Divera Twisk - SWOV

Ceri Woolsgrove - European Cyclist Federation

For more information

European Transport Safety Council
20 Avenue des Celtes
B-1040 Brussels
Tel: +32 2 230 4106
information@etsc.eu
www.etsc.eu

ETSC is grateful to the Flemish Foundation for Traffic Knowledge (VSV) for financial support for this publication.

THE EUROPEAN UNION'S ROLE IN PROMOTING THE SAFETY OF CYCLING

Proposals for a safety component in a future EU Cycling Strategy

Author
Ellen Townsend

July 2016

European Transport Safety Council

CONTENTS

PRIORITY RECOMMENDATIONS FOR INCLUSION IN AN EU CYCLING STRATEGY

OVERARCHING

- Encourage national governments to include targets (including to reduce deaths/serious injuries and increase modal share of cycling), measures and resources to improve safety of cyclists and promote cycling safety in their national cycling strategies.
- Promote cycling within the context of health, but with the emphasis on safe use of the roads.

INFRASTRUCTURE

- Apply the instruments of the Infrastructure Safety Directive to urban and rural roads.
- Draft guidelines for promoting best practice in cycle-friendly traffic calming measures for different road types, based upon physical measures such as road narrowing, chicanes, road humps and techniques of space-sharing.
- Draft guidelines for best practice on applying road safety audits which cover cyclists.
- Draft guidelines for best practice on separation of traffic with bicycles.
- Dedicate funds for cycling infrastructure under the Connecting Europe Facility (CEF) to support increasing the safety of cyclists. Apply conditionality for compliance with road safety infrastructure legislation for use of all EU funds used for building and maintaining roads, including the Regional Funds.
- Encourage Member States to adopt maximum 30km/h in residential areas and areas where there are high levels of cyclists, or where they could be potential to increase cycling by investing in cycling infrastructure.

VEHICLE SAFETY

- Update existing tests and extend scope of Regulation 78/2009 to include cyclist protection.
- Introduce energy absorbing front underrun protection for all new heavy goods vehicles to attenuate the severity of cyclist/HGV collisions.
- Ensure that side protection closes off the open space between the wheels of all new heavy goods vehicles and increase current strength requirement to accommodate side collisions with bicycles.
- Remove exemptions that exist so as to oblige use of side guards to protect cyclists in collisions with trucks.
- Develop new direct vision requirements for trucks that would improve the driver's current field of view by lowering the eye height and enlarging the size of the window apertures.
- Improve the vision of the passenger side both through the windscreen and through the side door window and to the rear.
- Adopt legislation for the mandatory fitting of all new passenger cars and light trucks and vans under 3.5 tonnes with Autonomous Emergency Braking (AEB) systems which operate at all speeds, as well as those that can detect cyclists.
- Adopt legislation for the mandatory fitting of all new vehicles with an overridable assisting Intelligent Speed Assistance (ISA) system.
- Revise standards for testing bicycle helmets to increase the safety standard currently in use to offer high levels of protection.

ENFORCEMENT AND DRIVER TRAINING

- Support member states in preparing national enforcement plans with annual targets for compliance in the areas of speeding, drink driving and distraction, especially in urban areas where there are high numbers of pedestrians and cyclists.
- Encourage a Zero Tolerance approach to use of drugs and alcohol to cover all road users.[1]
- Strengthen the Cross Border Enforcement Directive within the context of the revision in 2016 by ensuring greater convergence in enforcement of road safety related road traffic rules and developing common minimum standards for enforcement.
- Within the upcoming revision of Directive 2003/59 concerning initial and periodic training of professional drivers improve HGV and bus driver awareness of what it is like to be a cyclist interacting with large vehicles.[2] Consider extending this training to van drivers.

[1] A tolerance level for alcohol could be set at either 0.1 or 0.2g/l. In ETSC (2012), Raising the Bar – Review of Cycling Safety Policies in the European Union. http://goo.gl/3hwdui

[2] 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. http://goo.gl/wSihAx

INTRODUCTION

1.1 CONTEXT

This paper builds on recent calls for the European Commission to come forward with a cycling strategy for the European Union. Over the last two years, amongst others:

- the Luxembourg EU presidency agreed a 'Declaration on Cycling' calling for the European Commission to develop an EU level strategic document on cycling (October 2015);[3]
- the European Parliament's response to the European Commission's mid-term review of EU transport policy called on the Commission to adopt an EU road map for cycling (September 2015);[4]
- the Committee of the Regions issued an opinion on 'An EU Road Map for Cycling' (Adoption expected in October 2016);[5]
- the Paris Declaration of the Transport, Health and Environment pan-European Programme (PEP) called for 'a pan-European Master Plan for Cycling Promotion' (2014).[6]

ETSC also supports the need for co-ordinated European action on cycling and would welcome a pan-European strategy. This paper is designed to serve as inspiration for the safety component of such a strategy.

1.2 CYCLING AND SAFETY

Cyclists represent 8% of all road deaths in the European Union but big disparities exist between countries (see Figure 1).[7] Cyclists (like pedestrians) are generally unprotected and are vulnerable in traffic. As active travel is being encouraged for health, environmental, congestion and other reasons, the safety of walking and cycling in particular must be addressed urgently.[8] This chapter focuses its recommendations mainly on cycling for commuting or recreation but not for professional sports cycling.

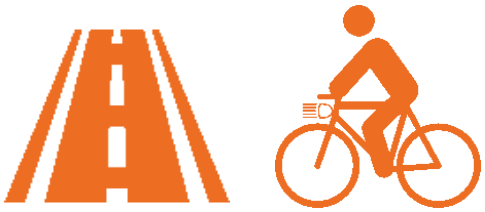
An EU cycling strategy should contribute to reaching the EU road safety target to reduce deaths by 50% by 2020.[9]

The EU approach to cycling safety should follow the "Safe System Approach" which aims to design the road transport system to accommodate human error and incorporate a full range of strategies for better management of collision forces, addressing infrastructure design, road user behaviours, enforcement and the design of vehicles. This approach is endorsed by the European Commission [10,11] .

This paper will look at initiatives within these different areas of action of relevance to cyclist safety. It cannot be fully comprehensive but aims to raise the main priorities for action at EU level.

1.3 PROGRESS IN REDUCING DEATHS AND SERIOUS INJURIES AMONG CYCLISTS

Around 25,000 cyclists were killed between 2004 and 2013 on European roads.[12] In the last ten years all EU countries have seen a reduction in the number of cyclist deaths. However, since 2010 the reduction in the number of cyclist deaths has stagnated with less than a 1% year-



25,000 cyclists were killed between 2004 and 2013 on European roads.

[3] Luxembourg Presidency (2015) Luxembourg EU Presidency Declaration on Cycling calling for the European Commission to develop an EU level strategic document on cycling. http://goo.gl/Hi1BVE
[4] European Parliament (2015) Report on the Transport White Paper Mid Term Review. http://goo.gl/CriQ9
[5] Committee of the Regions 'An EU Roadmap for Cycling' Draft Opinion. http://goo.gl/tcbGRN
[6] Paris Declaration of the Transport, Health and Environment pan-European Progamme (2014) http://goo.gl/tcbGRN
[7] PIN Report "Making Walking and Cycling on Europe's Roads Safer' (2015). http://goo.gl/FVDAZW
[8] Geus, B.d. & Hendriksen, I. (2015). Cycling for Transport, physical activity and health: what about pedelecs? . In: Gerike, R. & Parkin, J. (red.), Cycling futures: From research into practice Ashgate Hendriksen, I. & Van Gijlswijk, R. (2010). Fietsen is groen, gezond en voordelig: Onderbouwing van 10 argumenten om te fietsen [Cycle use is green, healty and cheap: Evidence in support of 10 reasons to use bicycles] TNO Kwaliteit van Leven: Preventie en Zorg, Leiden. http://goo.gl/bCK3Vg
[9] And if an EU target to reduce serious injury were to be set this too. ETSC (2016) Briefing on Setting an EU Serious Injury Target http://goo.gl/apT1ro
[10] European Commission (2013) First Milestone Towards a Serious Injury Strategy http://goo.gl/qEnNw5
[11] SWOV (2006) Advancing Sustainable Safety. National Road Safety Outlook for 2005-2020. SWOV, Leidenscham, 2006. http://goo.gl/L5gMGC
[12] ETSC (2015) Making Walking and Cycling Safer on Europe's Roads http://goo.gl/FVDAZW

to-year reduction in the EU. This slowdown may well be partly related to growing use of bicycles as a form of active travel among EU citizens or possibly related to an active ageing society.[13]

An increasing number of EU countries are adopting national strategies to promote cycling, so it is possible that in recent years more people are choosing cycling as a means of transport.[14] However, national cycling strategies should not only encourage cycling, but also promote high safety standards for bicycle users.

More than 2,000 cyclist deaths were recorded in traffic collisions in the EU in 2014, many more were seriously injured. More than half of the people seriously injured on the roads are pedestrians or other vulnerable road users involved in a collision in an urban area.[15]

ETSC is calling for the setting of an EU-wide serious road injury reduction target and the adoption of measures which would address priority groups including cyclists.[16]

A high level of underreporting in the number of non-fatal collisions involving cyclists exists and needs to be addressed so as to have a fuller understanding of the scope of the problem and which measures can be adopted to tackle it. This is noticed when police reporting is compared to hospital records.

More than 2,000 cyclist deaths were recorded in traffic collisions in the EU in 2014, many more were seriously injured.

Moreover, the rate of reporting is much higher for bicycle collisions with motor vehicles involved than for bicycle only collisions.[17] Along with underreporting comes near misses, in London for example, a recent project looked at the number of near misses that regular cyclists encountered.[18]

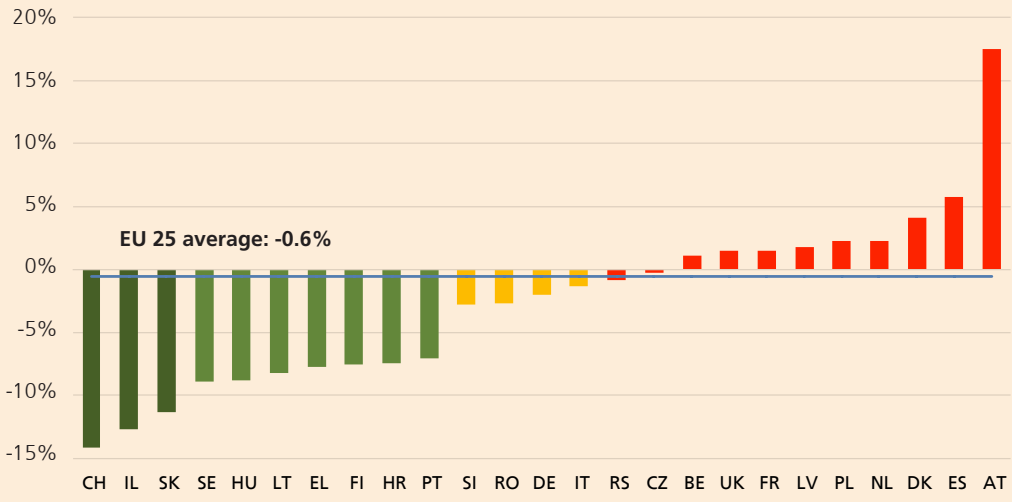
1.4 CYCLIST MORTALITY AND HEALTH

Cycling carries a much greater risk in some EU countries, compared to others. Road deaths per million inhabitants differs by a factor of more than four between the groups of countries with the highest and lowest mortality.[19]

FIG. 1

AVERAGE ANNUAL PERCENTAGE CHANGE IN CYCLIST DEATHS OVER THE PERIOD 2010 - 2013.

CY, EE, IE, LU and NO are excluded due to fluctuation in small numbers of deaths but their numbers are included in the EU average. BG and MT are excluded due to insufficient data.



[13] PIN Report "Making Walking and Cycling on Europe's Roads Safer' (2015). http://goo.gl/FVDAZW
For instance in the Netherlands, from 2004 onwards, the Dutch cycle more frequently and over longer distances (+ 9%). KIM (2016) 'Fietsen en lopen: de smeerolie van onze mobiliteit' http://goo.gl/gtrb6l
[14] European Cyclists' Federation, Cycling in All Policies. http://goo.gl/tcbGRN
[15] European Commission (2013) Commission Staff Working Document: On the Implementation of Objective 6 of the European Commission's Policy Orientations on Road Safety 2011-2020 – First Milestone Towards an Injury Strategy. http://goo.gl/8Kr1Z6
[16] ETSC (2016) A Proposal for a Strategy to Reduce the Number of People Seriously Injured on Europe's Roads http://etsc.eu/wp-content/uploads/201602serious_injuries_position_final.pdf
[17] In ETSC (2015) Making Walking and Cycling Safer on Europe's Roads. http://goo.gl/FVDAZW
[18] Aldred, R. (2015) Near Miss BikeSurvey of existing cyclists near miss experiences http://goo.gl/5044Eo
[19] ETSC (2015) Making Walking and Cycling Safer on Europe's Roads. http://goo.gl/FVDAZW

Recent analysis from Belgium has evaluated the risk of cycling in comparison to other modes for distance and shows that for all age categories taken together the risk of a serious injury per kilometre travelled is 23 times higher for cyclists than for car drivers.[20] However, this risk drops to around four times when calculated according to time in traffic. This is because, as compared to other road users, cyclists need more time to cover a certain distance.[21]

The level of cycling deaths could be better evaluated as a function of time or distance taken by bicycle. Risk values provide a better picture of the areas where policies to increase cycle safety should be targeted. However, only The Netherlands, Sweden and Great Britain have reported such data for the last three years, so comparison between all other EU countries on the basis of the risk of cycling by distance travelled was not possible in ETSC's analysis to date.

Although an increase in cycling might, at least at first, lead to an increase in the number of cyclists killed or seriously injured,[22] the advantages of cycling (a healthy life through regular exercise, benefit to the environment and higher quality of life) outweigh their disadvantages (in terms of disability adjusted life years of DALYs).

The World Health Organisation (WHO) has published a methodology and user guide for appraising the health economic effects of walking and cycling.[23] Based on this methodology the WHO estimates that anyone cycling 100 minutes or more a week reduces their chance of dying in any year by 10%.[24] Recent research from London also took into account serious injury, however the advantages of cycling outweigh the risks not only for risk of death, but also for morbidity (diseases and injuries)[25,26]. Note though that the net outcome is highest for the oldest age groups, it steadily declines in younger age groups, reaching about zero for the youngest groups in the study. Thus, for younger age groups cycle promotion should also ensure safe cycling conditions.

The WHO estimates that anyone cycling 100 minutes or more a week reduces their chance of dying in any year by 10%

Moreover, cyclists and pedestrians do not endanger other road users as much as car drivers do because of their lower speed and mass. So shifting a substantial proportion of short-distance car trips to walking, cycling and public transport can, if accompanied by measures to reduce the risks of walking and cycling, increase overall road safety.

1.5 CHARACTERISTICS OF COLLISIONS OF CYCLISTS

Collisions with passenger cars make up slightly more than half of the total number of cyclist deaths in the EU (52%). Collisions with goods vehicles (including turning) accounted for 7% of all cyclist deaths in 2013.[27] Collisions with buses accounted for 54 cyclists killed in 2013, representing 7% of all deaths in collisions involving a bus/coach.[28] Single bicycle or bicycle with bicycle collisions account on average for 15% of all cyclist deaths in the EU.[29] Due to high levels of underreporting the true figures may be higher.

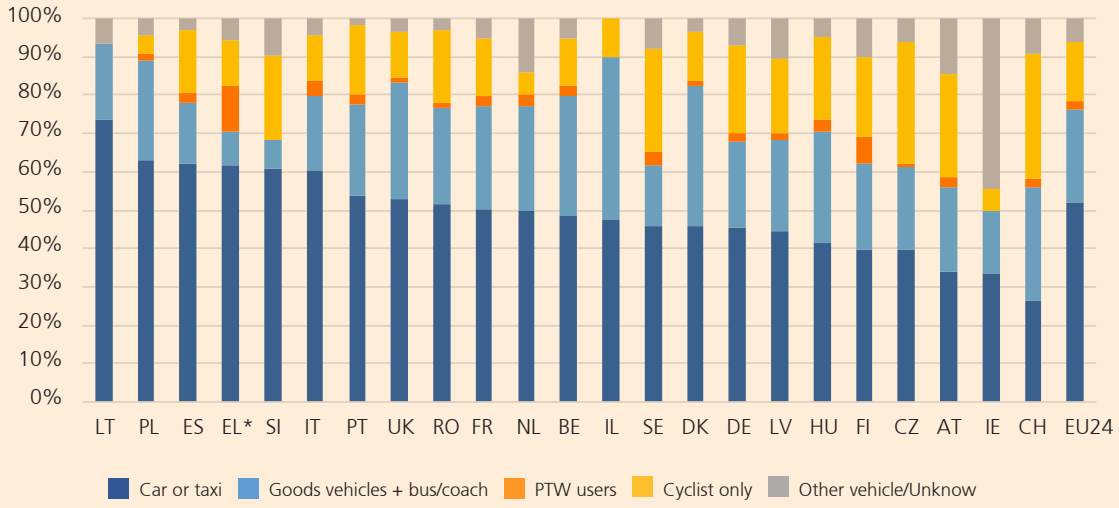
For the EU as a whole, just over half of cyclist deaths occur in urban areas.[30] The highest proportion of cycling deaths in most EU countries are in urban areas. However, in other countries, such as the Netherlands, the location of most non-motorised vehicle bicycle crashes is unknown and not recorded.

[20] For cyclists aged 65-74, the risk however increases up to 93 times the risk of an average age car driver. The analysis is based on hospital data, and hence also takes under registration of bicycle (and other) collisions into account. Belgian Road Safety Institute, (2014) Analysis of the risk of serious or fatal injuries in traffic according to age and mode of transport http://goo.gl/qEnNw5
[21] The fatal risk per minute for cyclists is not that much higher than for motorists and is "only" four times greater. Belgian Road Safety Institute, (2014) Analysis of the risk of serious or fatal injuries in traffic according to age and mode of transport http://goo.gl/qEnNw5
[22] SWOV (2010), H. Stipdonk, M. Reurings, The safety effect of exchanging car mobility for bicycle mobility. https://goo.gl/XCH42S
[23] WHO (2015) HEAT Health Economic Assessment Tools for Walking and Cycling http://goo.gl/BceunG
[24] WHO (2015) HEAT Health Economic Assessment Tools for Walking and Cycling http://goo.gl/BceunG
[25] However, in the youngest age groups, medium term harms and benefits are both much smaller, and there is the potential for negative net effects. In Woodcock, J. et al (2014) Health Effects of the London bicycle sharing system: health impact modelling study. http://goo.gl/QZJbzY
[26] Woodcock, J. et al (2014) Health Effects of the London bicycle sharing system: health impact modelling study. http://goo.gl/QZJbzY
[27] Total number of deaths following collisions with HGVs occurring while the vehicle is performing a nearside turn ranges between 5-18% depending on MS and where data is available. ETSC (2013) PIN Annual Report http://goo.gl/GLv04f
[28] Traffic Safety Basic Facts DaCoTA on collisions involving HGVs - stats on cyclists killed in collisions involving a truck and buses/coaches up to 2013 (2015) http://goo.gl/6nXXss
[29] ETSC (2015) Making Walking and Cycling Safer on Europe's Roads. http://goo.gl/FVDAZW
is not possible to breakdown the 15% figure into single bicycle collision only and/or bicycle to bicycle in the ETSC data. This is further complicated by underreporting of bicycle only collisions.
[30] ETSC (2015) Making Walking and Cycling Safer on Europe's Roads. http://goo.gl/FVDAZW

FIG. 2

PERCENTAGE SHARE OF CYCLIST DEATHS OCCURRING IN COLLISIONS WITH DIFFERENT TYPES OF VEHICLES (2011 - 2013).

*2011-2012. CY, EE and LU are excluded due to fluctuation in small numbers of deaths but their numbers are included in the EU24 percentages. BG, HR, MT, SK and NO are excluded due to insufficient data.[31]



1.6 SAFETY PERCEPTION AS A BARRIER TO CYCLING

Fear of traffic is an oft-cited reason for not walking or cycling. UK research has shown that 43% feel that the bicycle is a suitable alternative to the car for short trips of less than two miles,[32] while 54% of Edinburgh residents thought that they should ride a bike more often, and 80% want safer conditions for cyclists.[33]

A survey in Transport for London's Attitudes to Cycling Report in the UK showed that 59% of potential cyclists cite safety concerns as the key barrier to them cycling.[34] Fear of safety risks is a major barrier to the uptake of cycling and introducing safety measures and the fact that cyclist numbers are increasing can help to overcome this fear.[35] Addressing both perceived and objective safety improvements will require slightly different but necessarily coordinated approaches.

1.7 CYCLING PROMOTION AS PART OF A CYCLING STRATEGY

The European Commission should, in a future EU cycling strategy, stress the importance of providing safe and attractive infrastructure to encourage more cycling. Information about cycle routes can also help in this regard. By providing shorter (direct) or quicker and safer routes for cyclists or by ensuring that the quickest routes are also the safest. Comfort should also be taken into account.[36]

Some researchers and observers argue that a motorist is less likely to collide with a person walking and bicycling when there are more people walking or bicycling - the so-called "safety in numbers" effect.[37]

The reason for this is not fully understood though possible explanations include: drivers being used to cyclists; cyclists being drivers themselves; or better infrastructure being built in response to an increase in cycling numbers.

Wegman suggests "awareness in numbers" to be more fitting.[38] This "safety in numbers" effect has been widely cited and would suggest that the relative risk ratios for cycling are not static but may change in relation to the composition of the different types of road users present in the traffic.[39]

However, this may not be so simple and there are different interpretations of the "safety in numbers" effect. The OECD cautions that: care must be taken to not conflate observed correlation with causality when discussing "safety in numbers" as there are numerous different explanations for the observed phenomenon.[40]

Wegman, cited in the OECD Report, explains that "If numbers of cyclists are correlated with risks and these numbers are assumed to be the only explanation, we are in error. Large numbers of cyclists in countries such as the

[31] ETSC (2015) Making Walking and Cycling Safer on Europe's Roads. http://goo.gl/FVDAZW
[32] National Centre for Social Research (2011), British Social Attitudes Survey 28 http://goo.gl/xO1qI5
[33] SUSTRANS, Bike Life Edinburgh 2015 http://goo.gl/cKoNJq
[34] Transport for London (2014) Attitudes to Cycling Report http://goo.gl/pjNdJd
[35] Thornton 2011 Department for Transport in July 2011, "Climate Change and Transport Choices" https://goo.gl/6iVERh
[36] CROW (2016) PPT from POLIS Workshop http://goo.gl/AQrx3L
[37] Jacobsen (2003), Safety in numbers: more walkers and bicyclists, safer walking and bicycling. Injury Prevention. http://goo.gl/FEPfrl
Jacobsen looked at three published analysis of collision rates at specific intersections and five additional data sets to compare the amount of walking or bicycling and the injuries incurring in collisions with motor vehicles.
[38] Wegman, F. et al (2012) How to make Cycling Good for Road Safety? http://goo.gl/rnmW1L
[39] OECD, (2013) Cycling Health and Safety. http://goo.gl/qPHEf4
[40] OECD, (2013) Cycling Health and Safety. http://goo.gl/qPHEf4

Netherlands, Denmark and Germany are associated with high densities of bicycle facilities. If not both numbers of cyclists and bicycle facilities are taken into account, the wrong conclusions may be arrived at." Wegman then questions Jacobsen's conclusions: "this may be wrong if we simply add numbers of cyclists to the system without adding safety quality, that is to say, risk reducing measures."

The OECD report says that due to the lack of strong evidence on the behavioural or infrastructure-related determinants of "safety in numbers", it would seem that great care should be taken in using the observed phenomenon as a basis for a bicycle safety policy.[41] And stresses that policies seeking to increase the number of cyclists should be accompanied by robust risk reduction actions within a cycling strategy.

Recommendations to the EU

- Promote cycling within the context of health, but with the emphasis on safe use of the roads.

Recommendations to member states

- Keep records of the numbers of deaths and serious injuries of cyclists involved in incidents not involving motor vehicles.
- Record cycling distance or time travelled exposure data in order to understand cycling risk and assess cycling road safety interventions
- Tackle high levels of underreporting in cyclist deaths and injuries.
- Develop and use collision maps with cyclists with special focus on turning-accidents between vehicles and cyclists
- Include alcohol as collision cause of cyclists, including Blood Alcohol Content (BAC) levels.

59% of potential cyclists in London cite safety concerns as the key barrier.

[41] OECD, (2013) Cycling Health and Safety. http://goo.gl/qPHEf4

INFRASTRUCTURE SAFETY AND LAND USE PLANNING

2.1 INFRASTRUCTURE AND SAFETY FOR CYCLISTS

Increasing cyclist safety requires a combination of measures.[42] In line with the "Safe System Approach" infrastructure which separates motor vehicles and bicycles can be designed to prevent collisions. Cyclists need space to cycle safely: they should not be expected to stay close to the nearside kerb at all times where they are more exposed to parked car doors and unstable road surfaces.[43]

Infrastructure can also play a key role in reducing speeds which can in turn can reduce both cyclist deaths and severe injuries when collisions do occur. The aim should be to minimise potential conflict between motor vehicles and vulnerable road users by engineering out potentially unsafe features on roads, including those relating to traffic management schemes and maintenance projects [44]. Infrastructure can also spur more cycling and stimulate public demand for more and better solutions[45]. Part of the current problem in many EU Member States is that most infrastructure has not been built with cyclists in mind.[46] There are different approaches across Europe, some are included here for inspiration, however each country must develop their own interpretation of best practice.

Infrastructure can also play a key role in reducing speeds.

Audits of existing infrastructure and planned construction, traffic managements schemes and maintenance work are useful first steps. Planning a cycle network should be undertaken with the same accuracy used for the road network: planning has to be the first activity to implement to ensure a safe and continuous layout[47]. The London Cycling Design Standards suggests that cycling facilities should be appropriate to the street context. For example, minimising the speed and volume of traffic on local streets could encourage people to cycle, whereas on a major road, efforts to minimise the differentials between motorised traffic and unprotected cyclists could prove more difficult. In this context full segregation would be the only method possible.[48]

In accordance with the Dutch Sustainable Safety principles, the first step in deciding how to maximise the level of cyclist safety on the road network should be the categorisation of the roads according to the traffic function they must fulfil such as being a through, access or distributor road.[49] The work of the Roads Task Force in London suggests that streets have a "place function" that should be acknowledged in design considerations. "Place Function" recognises that some streets are more important places to the community, such as places of historical interest or town squares where people congregate.

It would do the city a disservice to only consider traffic movement when designing streets with a high place function. Improving the quality and character of a street can also improve safety for cyclists and all other road users.[50]

The German "Guidelines for cycling infrastructure" were developed specifically for the design and construction of infrastructure dedicated to cycling and are based on three main principles:

- Ensure and create visibility between cyclists and other road users
- Allow sufficient width of cycling paths
- Create continuous cycle paths and lanes without any interruption, even in narrow sections.[51]

[42] ETSC (1999) Safety of Pedestrians and Cyclists in Urban Areas. http://goo.gl/1S8hKo
[43] ETSC (1999) Safety of Pedestrians and Cyclists in Urban Areas. http://goo.gl/1S8hKo
[44] ETSC (1999) Safety of Pedestrians and Cyclists in Urban Areas. http://goo.gl/1S8hKo
[45] OECD (2013) Cycling, Health and Safety. http://goo.gl/qPHEf4
[46] OECD (2013) Cycling, Health and Safety. http://goo.gl/qPHEf4
[47] Tira M and Zazzi M (2007) Pianificare le reti ciclabili territoriali, Gangemi, Roma
[48] Transport for London (2014) London Cycling Design Standards, https://goo.gl/FxNSuF
[49] SWOV (2006) Advancing Sustainable Safety. National Road Safety Outlook for 2005-2020. SWOV, Leidenscham, 2006. http://goo.gl/L5gMGC
[50] Transport for London (2014) Roads Task Force https://goo.gl/72Rq7G
[51] Cycling Expertise (2010) State of the Art Design for Cycling Facilities (Empfehlungen für Radverkehrsanlagen) CyE Infrastructure factsheet CyE i-1 http://goo.gl/ejd50L

2.2 EU INFRASTRUCTURE SAFETY DIRECTIVE – A MODEL THAT SHOULD BE EXTENDED TO COVER ROADS USED BY CYCLISTS

Directive 2008/96/EC on road infrastructure safety management mandates the use of four already existing procedures for all roads which are part of the Trans-European Road Network (mainly motorways):

- Road safety impact assessments: demonstrate the road safety implications of different planning alternatives for a road project, whether construction of new infrastructure or rehabilitation of existing infrastructure, as in the case of environmental impact assessment;
- Road safety audits: an independent technical check aiming at identifying unsafe features of a road project, including proposals for remedy;
- Network safety management targeting remedial measures to parts of the network with high concentrations of accidents (high-risk road sections) and/or a high potential to avoid accidents in the future;
- Safety inspections: as part of regular road maintenance, enable the detection and hence reduction of accident risk in a preventive way through low cost measures.[52]

ETSC recommends that these instruments be extended beyond the safest part of the network, namely the TEN-T. EU citizens travel beyond the high speed TEN-T and should be entitled to equal levels of safety on all roads that they travel on, in whichever country. If the requirements of Directive 2008/96/EC were extended beyond the TEN-T network the use of the four instruments could enable road designers and planners to identify the need to design road infrastructure that is safe for cyclists.

Building on its 'Policy Orientations on Road Safety 2011-2020' the European Commission's document on Serious Injury proposes application of the instruments included in the Infrastructure Safety Directive to the secondary road network (where over half of all cyclist deaths occur in 5 EU MSs[53]) and, for the first time, extending them also to the urban environment (where over half of all cyclist deaths occur).

2.3 USING EU INFRASTRUCTURE FUNDING TO LEVERAGE CYCLING SAFETY

All EU funding streams used for infrastructure, such as the regional development fund, should apply conditionality criteria to ensure that new projects guarantee minimum safety criteria for cycling. This is the principle already established for motorway and highway projects funded through the TEN-T programme whereby the rules of the infrastructure safety directive are applied (see above).

The application of minimum safety criteria could then support cycling infrastructure within an urban context. This should lever additional funds to support road safety within the Sustainable Urban Mobility Plan (SUMP) projects at city level. The TEN-T urban infrastructure nodes should reinforce this new commitment by encouraging safe and sustainable integrated transport options especially for the last kilometre.

EuroVelo, the European cycle route network, is a network of 15 long distance cycle routes connecting and uniting the whole European continent. They can be used for short commutes or for longer tourist journeys.[54] This entire network should be recognised as part of the TEN-T network and the Connecting Europe Facility (CEF) instrument should be accessible for supporting its development and expansion. The revision of the TEN-T Guidance in 2014 included the following wording:

"When implementing projects of common interest on the TEN-T, due consideration should be given to the particular circumstances of the individual project. Where possible, synergies with other policies should be exploited, for instance with tourism aspects by including on civil engineering structures such as bridges or tunnels bicycle infrastructure for long-distance cycling paths like the EuroVelo routes."[55]

Guidance is needed for the regional and national level on how and where to start the process of developing a national level cycling network and the European Commission could help to facilitate this process. The revised TEN-T guidance is welcome but much more is needed to realise a full European wide cycling network. The EU should carry out a full "needs" assessment for what an EU wide cycling network would look like in the future including a vision in relation to infrastructure requirements. A Europe-wide network can also unlock local commuting trips and inspire citizens to consider cycling as a more sustainable and efficient method of travel.

[52] Directive 2008/96/EC of 19 November 2008 on road infrastructure safety management http://goo.gl/lFx1kT
[53] European Commission (2013) Staff Working Document On the implementation of objective 6 of the European Commission's policy orientations on road safety 2011-2020 – First milestone towards an injury strategy http://goo.gl/8Kr1Z6
[54] http://www.eurovelo.org/
[55] ETSC (2012), Raising the Bar – Review of Cycling Safety Policies in the European Union http://goo.gl/wUmdg3

2.4 TRAFFIC CALMING

Traffic calming involves efforts to reduce motorised vehicle speeds in residential and urban core zones so as to facilitate sharing road space with cyclists and pedestrians[56]. At low speeds drivers have more time to react to the unexpected and avoid collisions. At speeds of below 30 km/h pedestrians and cyclists can mix with motor vehicles in relative safety. This relative safety can be reduced if large volumes of traffic are present and particularly if there is a high HGV percentage to the traffic composition. Transport for London in the UK undertook a full safety assessment of its cycling deaths and found that some deaths occurred at slow speeds and were more the result of poor visibility[57]. Thus there is a need for caution and keeping vehicles at safe speeds is paramount.

At speeds of below 30 km/h pedestrians and cyclists can mix with motor vehicles in relative safety.

Traffic calming reduces the speed of motor vehicles by various physical modifications: vertical and horizontal deflections, changes in surface colour and texture, a reduction in overall carriageway area, and signs and other symbols to convey to drivers that they need to have greater awareness of vulnerable road users.[58] Different traffic calming measures are more suited to different functions of roads depending on the road hierarchy. Gateways may indicate entries into traffic calmed areas although provisions for cyclists should be made so that no bottlenecks for cyclists occur. Research has found that infrastructure measures in the Netherlands have resulted in reducing cycling and pedestrian deaths with 30 km/h zones listed as -15%, cycle paths at - 24%, 60 km/h zones – 32% and roundabouts at -30%. [59,60] Thus the development of EU Guidelines on traffic calming for use in EU Member States would also benefit road users in urban areas, especially cyclists.

2.5 LAND USE PLANNING – EU URBAN MOBILITY PACKAGE

The European Commission adopted an Urban Mobility Package which included guidelines for cities to set up Sustainable Urban Mobility Plans (SUMPs). Road safety was highlighted as a horizontal issue and specific guidance on integrating road safety are being prepared. Plans should adopt a clear hierarchy of transport users, with pedestrians, cyclists and public transport users at the top of the hierarchy. As a general principle, these users should have their safety, convenience and comfort needs considered first. Walking should be at the top of the hierarchy, followed by cycling and use of public transport, freight should also be considered in terms of traffic management and infrastructure needs.[61]

It is most important that the hierarchy is applied where a large share of travel is (or could be) made by walking, cycling and public transport. As part of this planning, cycling should also be integrated into the public transport system enabling for combinations including measures such as taking the bike onto the public transport and more bicycle parking at train and metro stations. Some cities also include bike sharing schemes as part of their public transport. In Spain, some municipalities (Barcelona, Seville, Zaragoza, Bilbao, San Sebastian and Madrid) have added electric bikes to public transport.[62]

In line with the "Safe System Approach" the transport system should accommodate cyclists and account for their needs.[63] This can also act as a measure to invite more cyclists out into the roads and to help these new users consider cycling as a habitual mode of transport.

Recommendations to member states

- Prioritise the safety of cyclists and pedestrians when developing sustainable urban mobility plans.
- Interlink cycling with public transport systems enabling for them to be used interchangeably (parking, taking the bike on the train).
- Develop attractive cycling pathway networks in urban areas.
- Create sufficient parking areas for bicycles.

---

[56] OECD (2013) Cycling, Health and Safety. http://goo.gl/qPHEf4
[57] Transport for London pedal cyclists fatality report (2014) http://goo.gl/PQ2UuL
[58] ETSC (1999) Safety of Pedestrians and Cyclists in Urban Areas. http://goo.gl/1S8hKo
[59] In the Netherlands special provisions of seperate cycle paths are made to make roundabouts safer for cyclists. ETSC (2012), Raising the Bar – Review of [58] Cycling Safety Policies in the European Union. http://goo.gl/3hwdui
[60] Twisk, D. et al (2015) Challenges in Reducing Bicycle Casualties with High Volume Cycle Use: Lessons from the Netherlands https://goo.gl/iVfdVP
[61] An example of where this is applied is Flanders which has an approach called STOP which stands for: "S" stands for "stappen" (pedestrians) "T" stands for "trappen" (cyclists) "O" stands for "openbaar vervoer" (public transport) "P" (of "privé") stands for individual motorised traffic. http://goo.gl/BKfTBb
[62] For example, the Madrid City Council has implemented the public service BiciMAD. http://www.esmadrid.com/en/bicimad-en The service has 1,500 electric bicycles that can be picked up at over 120 points dotted around the city.
[63] OECD, (2013) Cycling Health and Safety. http://goo.gl/qPHEf4

2.6 TRAFFIC REDUCTION – EU TRANSPORT WHITE PAPER

Promoting walking and cycling is one of the priorities of the EU transport white paper within urban areas and the European Commission states that they "could readily substitute the large share of trips which cover less than 5km".[64] Heavy traffic flows are a major deterrent to cycling. Conflict between vulnerable road users and motor vehicles can be reduced by the introduction of car-free areas.[65] A concept reducing the role of the motor vehicle in urban areas is also known as 'woonerf' and introduced in the Netherlands as early as the 1970s[66]. Traffic and speeds may also be reduced by road closures. The closure of minor streets can offer lightly trafficked routes for cyclists. An area-wide approach should be adopted to avoid displaced traffic leading to more collisions elsewhere. Even at low speeds, mixing with heavy traffic, especially lorries, is hazardous.

Recommendations to the EU

- Apply the instruments of the Infrastructure Safety Directive to urban and rural roads.
- Draft guidelines for promoting best practice in cycle friendly traffic calming measures for different road types, based upon physical measures such as road narrowing, chicanes, road humps and techniques of space-sharing.
- Draft guidelines for best practice on applying road safety audits which cover cyclists.
- Draft guidelines for best practice on separation of traffic with bicycles.
- Dedicate funds for cycling infrastructure under the Connecting Europe Facility (CEF) to support increasing the safety of cyclists. Apply conditionality for compliance with road safety infrastructure legislation for use of all EU funds used for building and maintaining roads, including the Regional Funds.
- Encourage member states to adopt maximum 30km/h in residential areas and areas where there are high levels of cyclists, or where they could be potential to increase cycling by investing in cycling infrastructure.
- Encourage member states to adopt maximum 50km/h in urban areas.
- Within the EC Sustainable Urban Mobility Plan Guidelines encourage the integration of road safety and of cycling promotion into land use and transport planning.

In the area of infrastructure safety, the EU can also influence Member States by encouraging examples of best practice. Some examples are outlined below.

2.7 SEPARATION

According to the Safe System Approach, bicycles should never mix with motor vehicle traffic, where motor vehicle speed exceeds 30 km/h. Above 30 km/h separate infrastructure for bicycles should be built. Volume, together with speed, should be taken into account when developing separate infrastructure. As this is rarely the case in most EU countries, Member States need to prioritise separation of bicycles from motor vehicles on the roads with the highest speeds and those with the highest volumes.[67] There is a great deal of literature and real world examples on the construction and use of cycling infrastructure that could act as a guide to the most appropriate design.[68] For example the German Guidelines for Cycling Facilities (ERA 2010), published in 2010 use a function based on traffic speed and traffic volume when recommending whether bicycle-specific infrastructure must be built for the protection of cyclists.[69]

Separation is also relevant when discussing mixed use of the footway for pedestrians and cyclists. Cycling on footpaths is common in Europe. Indeed, in some countries such as Germany children are obliged to do so until the age of 8. Whereas in others such as Belgium and the Netherlands, young children are allowed to cycle there. However this can be of concern to many pedestrians, particularly the elderly and people who are visually impaired or less able bodied[70]. In specific instances where no on-carriageway solution can be found, and where visibility is good, it may be appropriate to convert the footway to shared use. Widening of the footway, clear signs and markings will help to make shared use more acceptable.[71]

Recommendations to member states

- Create conditions so that cyclists can mix freely with motorised traffic where the travel speed, volume and mass of motorised traffic does not pose a significant risk to the unprotected road users.
- Arrange for cycle traffic and motorised traffic to be physically separated where the speed of the latter is too big or where the traffic flow is too high to allow them to mix safely.
- Disaggregate the street alignment of cycle routes from public transport and high volume corridors at a network planning level.
- Allow young children (until the age of 10) accompanied by their parents to cycle on the pavement in a manner considerate to pedestrians, especially in areas of heavy traffic and where segregated, purpose-built cycling facilities are not provided.

[64] EU Transport White Paper 2011. http://goo.gl/Ki6jM3
[65] ETSC (1999) Safety of Pedestrians and Cyclists in Urban Areas. http://goo.gl/1S8hKo
[66] 'Woonerf' (reducing the role of the motor vehicle in urban areas) in OECD (1979) Traffic safety in Residential Areas
[67] OECD (2013) Cycling, Health and Safety. http://goo.gl/qPHEf4
[68] CROW design manual http://goo.gl/zjTzRf ; TFL best practise guide http://goo.gl/gE4cv2
[69] Cycling Expertise (2010) State of the Art Design for Cycling Facilities CyE Infrastructure factsheet CyE i-1 http://goo.gl/ejd50L
[70] ETSC (1999) Safety of Pedestrians and Cyclists in Urban Areas. http://goo.gl/1S8hKo
[71] ibid

2.8 MAINTENANCE

The effectiveness of safety-improving infrastructure treatments relies on ensuring that the measures operate as intended and at all times of the year. In order to do so, bicycle infrastructure must be maintained to a standard such that the condition of the infrastructure does not contribute to crashes. Priority should be given to road maintenance and especially to the quality of surfaces on cycle paths and the parts of carriageways most used by crossing cyclists. A good-quality riding surface is essential for the safety of cyclists. Relatively minor defects in pavement or track surfaces can be a real safety hazard for cyclists whereas for motorists they may be merely an inconvenience. Provision should be made for pedestrians and cyclists at road works, with appropriate signing and routing.[72]

2.9 CYCLING SAFETY ON RURAL ROADS

Some EU Member States have a high number of cyclist deaths on rural roads. At these higher speeds there should be separate infrastructure. Member States should focus on building cyclist infrastructure along roads which have been identified to have high risk sites and which are currently popular amongst cyclists, or could become so. Especially now with increasing numbers of eBikes which allow for longer distances to be travelled more easily. For example, in North-Rhein Westphalia, so called "cycle highways" have been developed which allow cyclists to use their own infrastructure without being in contact with other types of vehicles and pedestrians.[73]

Recommendation to member states

- Develop separate cycle lanes and cycle paths to encourage cycling especially on high risk sites and consider trip generation and the potential for trips to be made by bicycle when prioritising delivery of the cycling network.

2.11 INTERSECTIONS

About one-quarter of all fatal crashes occurred within intersections for European countries reporting data, though there is great variability amongst countries[74]. In London for example 84% of cycling collisions take place within 20m of intersections[75]. Intersection design and treatment is perhaps the most important infrastructure-related safety intervention[76]. Visibility, predictability and speed reduction should be incorporated as key design principles in cycling infrastructure policies[77]. Thus, Member States should prioritise treating intersections and especially those which have already been seen to have had collisions resulting in death or serious injury. There is also a case to be made for looking beyond high risk sites. As some cases intersections may need to be treated as they act as area barriers to cycling even if safety records are sound. Large intersections can be so intimidating to cyclists that they avoid cycling routes that cross them – or take alternative transport.

Recommendation to member states

Develop a cycle highway network as a priority, taking into account intersections

[72] ETSC (1999) Safety of Pedestrians and Cyclists in Urban Areas. http://goo.gl/1S8hKo
[73] https://goo.gl/HNjRKy
[74] OECD (2013) Cycling, Health and Safety. http://goo.gl/qPHEf4
[75] Transport for London (2014) Cycle Safety Action Plan http://goo.gl/pzFOPV
[76] OECD (2013) Cycling, Health and Safety. http://goo.gl/qPHEf4
[77] ibid.

VEHICLE SAFETY

Collisions with motorised vehicles account for a large proportion of cyclist deaths[78]. Different factors influence impact severity between motor vehicles and cyclists including the level of protection provided by the vehicle. For large vehicles the risk of overrun is high and countermeasures for this are needed. For all vehicles, the shape and stiffness of the vehicle front substantially influence injury risk and measures to encourage forgiving vehicle fronts are needed. The EU has exclusive competence on vehicle safety measures and vehicle type approval under Article 114 of the EU treaty. The European Commission is set to revise[79] the Pedestrian Protection Regulation[80] and the General Safety Regulation[81] which set technical requirements applied to all new motor vehicles sold in the EU market.

3.1 REVISION OF REGULATION 2009/78 ON THE PROTECTION OF PEDESTRIANS AND OTHER VULNERABLE ROAD USERS

EU pedestrian protection legislation prescribes requirements for the construction and functioning of vehicles and frontal protection systems in order to reduce the number and severity of injuries to pedestrians and other vulnerable road users who are hit by the fronts of vehicles. An update of motor vehicle testing procedures, including technical features setting requirements for more forgiving car fronts, should explicitly include the needs of cyclists and incorporate improvements in the crush depth available in the event of a collision with an unprotected road user and therefore reduce the number and severity of injuries.[82]

Recommendations to the EU

- Update existing tests and extend scope of Regulation 78/2009 to include cyclist protection.
- Evaluate the location on the vehicle of injuries resulting from vehicle to pedestrian and cyclist collisions and amend coverage of the regulation accordingly to support the development of airbags for the windshield and windshield frame as a viable safety measure to improve the protection of cyclists and other vulnerable users struck by cars.
- Introduce Autonomous Emergency Braking systems which operate at all speeds, as well as those that can detect cyclists.

3.2 CYCLIST SAFETY UNDER THE GENERAL SAFETY REGULATION 2009/661[83]

The General Safety Regulation 2009/661 will reconsider current technical requirements applied to all new motor vehicles sold in the EU market. The revision offers an opportunity to maximise vehicle safety potential by improved heavy goods vehicle cabin design and in-vehicle technologies that will bring safety benefits for both car occupants and for those outside the vehicles such as cyclists. ETSC is calling for a range of safety technologies, including overridable Intelligent Speed Assistance (ISA) and Autonomous Emergency Braking (AEB), to be fitted as standard on new vehicles.[84]

Of relevance under both the GSR and Pedestrian Protection regulations is the development of a new protocol for consumer testing of cyclist AEB systems for passenger cars.[85] The protocol will determine test ranges for bicycle speeds, the collision point on the vehicle, size and posture of the bicyclist. This will be based on studying databases from six EU countries and looking at severe car-to-cyclist deaths and seriously injured and will finish by the end of 2016, in line with the timeline for this technology to be included in the Euro NCAP testing.[86]

Each year European public authorities spend the equivalent of 16% of EU Gross Domestic Product in total on procurement and this is regulated at EU level. Criteria for procuring safe vehicles should be integrated into this legislative framework.[87,88]

---

[78] This picture differs for the seriously injured where more data is needed.
[79] European Commission Work Programme 2016-2017
[80] 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, amending Directive 2007/46/EC and repealing Directives 2003/102/EC and 2005/66/EC. http://goo.gl/2aCVLk
[81] 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 therefore. http://goo.gl/2aCVLk
[82] ETSC (2016) Position on Revision of the Pedestrian Protection Regulation. http://goo.gl/8xbtG3
[83] ETSC (2015), Position Paper: Revision of the General Safety Regulation. http://goo.gl/zdX0w0
[84] ETSC (2015), Position Paper: Revision of the General Safety Regulation. http://goo.gl/zdX0w0
[85] TNO (2016) Overview of Main Accident Scenarios in Car-to-Cyclist Accidents for use in AEB-System Test Protocol. https://goo.gl/yGFrSB
[86] EuroNCAP (2015) EuroNCAP 2020 Roadmap http://goo.gl/BfNX3o
[87] European Commission (2008) Public Procurement for a Better Environment. http://goo.gl/qmWI5T
[88] ETSC (2015) Reducing Road Risk at Work Through Public Procurement. http://goo.gl/5k91dR

Recommendations to the EU

- Introduce energy-absorbing front underrun protection for all new heavy goods vehicles to attenuate the severity of cyclist/HGV collisions.
- Ensure that side protection closes off the open space between the wheels of all new heavy goods vehicles and increase the current strength requirement to accommodate side collisions with bicycles.
- Remove exemptions that exist so as to oblige use of side guards to protect cyclists in collisions with trucks.
- Develop new direct vision requirements for trucks that would improve the driver's current field of view by lowering the eye height and enlarging the size of the window apertures.[89]
- Improve the vision of the passenger side both through the windscreen and through the side door window and to the rear.
- Develop procurement and other contractual processes to ensure that where construction, infrastructure or any other project or development is supported, partially or in full, via EU funding, that the use of trucks which meet the new direct vision, and revised underrun standards as a contractual requirement for that funding, both in construction work and in the operation of major infrastructure projects.[90]
- Devise a new simple test procedure to reduce the frequency of VRUs going under the front of the HGV or its wheels.
- Adopt legislation for mandatory fitting of all new passenger cars and light trucks and vans under 3.5 tonnes with Autonomous Emergency Braking (AEB) systems which operate at all speeds, as well as those that can detect cyclists.
- Adopt legislation for the mandatory fitting of all new vehicles with an overridable assisting Intelligent Speed Assistance (ISA) system.
- Encourage Member States to roll out digital speed map information and make this available to public and private operators covering the entire road network including a function to update changes to speed limits.
- Mandate indicator lights which flash alongside the truck or the trailer of a truck to show that a truck is turning, making this more visible to cyclists in the surroundings.[91]

3.3 CO-OPERATIVE INTELLIGENT TRANSPORT SYSTEMS

Cooperative Intelligent Transport Systems (C-ITS) use technologies that allow road vehicles to communicate with other vehicles, with traffic signals and roadside infrastructure as well as with other road users. As yet cyclists are only starting to benefit from these in-vehicle safety technologies. ITS can detect the presence of VRUs and can also act to prevent a collision. A recent example from Spain promoted by the government is the application "Comobity".[92] More research is needed to find out how well current systems detect cyclists and are able to prevent deaths and injuries.[93] New ITS are also emerging and the use of personal devices by cyclists are on the rise, some could help cyclists themselves for example for navigation and safe route choice but could also be a cause for concern with distraction. ITS is already being built into e-bikes with, for example, haptic handle bars which give feedback warnings and in VRU safety equipment.

A recently published EU report on C-ITS (under the EU Directive on ITS) highlighted the challenge posed by unequipped users, including cyclists.[94] A recent EU funded project VRUITS has come up with a list of recommendations on how VRUs, including cyclists, can be integrated and reap the full benefits of C-ITS.[95] This covers issues such as integration of C-ITS into bicycles, the need for research into use cases in order to assess risk amongst VRUs of C-ITS. It also looks at the different implications of using C-ITS applications in smart phones including also challenges regarding sensor accuracy. It has prepared a road map for deployment of VRU applications. One of its key recommendations is that cyclists could benefit from the development of a statement of principles (similar to the HMI Statement of Principles for in-vehicle systems) for ITS.[96]

Recommendations to the EU

- Develop an HMI Statement of Principles for use of ITS by cyclists[97].
- Develop EU guidelines and regulations for the use of mobile devices by cyclists, with a target to minimise distraction[98].
- Encourage research on vehicle detection systems to warn cyclists.

[89] ETSC (2015), Position Paper: Revision of the General Safety Regulation. http://goo.gl/zdX0w0
[90] ETSC (2015) Reducing Road Risk at Work Through Public Procurement. http://goo.gl/5k91dR
[91] Proposal from Germany to amend UN regulation No. 48 concerning the activation of side marker lamps for turning heavy goods vehicle https://goo.gl/K0nyJA
[92] Comobity: allows the drivers to know the presence of cyclists or pedestrians on the road and therefore can take precautionary rules to prevent collisions. Research is still needed on effectiveness and application. http://goo.gl/LZmfnD
[93] Hynd, D., et al. (2015) Benefit and Feasibility of a Range of New Technologies and Unregulated Measures in the fields of Vehicle Occupant Safety and Protection of Vulnerable Road Users, Transport Research Laboratory. http://goo.gl/tmwYqp
[94] European Commission (2016) C-ITS Platform Final Report. http://goo.gl/B6JVFD
[95] VRUITS (2016) Recommended practices for improving usability of ITS applications and the integration of VRUs in C-ITS systems. http://goo.gl/3uK6hz
[96] European Commission (2008) European State of Principles of in-vehicle systems. http://goo.gl/ldvZ7l
[97] VRUITS (2016) Recommended practices for improving usability of ITS applications and the integration of VRUs in C-ITS systems. http://goo.gl/3uK6hz
[98] VRUITS (2016) Recommended practices for improving usability of ITS applications and the integration of VRUs in C-ITS systems. http://goo.gl/3uK6hz

3.4 PASSIVE SAFETY FOR THE BICYCLE

The technical safety of bicycles has a much higher potential for improvement that could be exploited. An ISO norm 4210 covers technical bicycle safety[99]. The Testing Institute Velotech[100] in Germany found that there is still potential to improve norms regarding the testing of bicycles.

3.5 E-BIKES

Pedelecs are a type of bicycle where the cyclist's pedalling power is supported by a battery-powered electric motor, primarily designed to aid the rider when starting off or when cycling uphill. Other kinds of e-bikes, such as the more powerful Speed Pedelecs (S-Pedelecs) and power-on-demand e-bikes (those whose motors can provide assistance regardless of whether the rider is pedalling or not) are beyond the scope of this report and need specific investigation regarding their road safety impact.

In the last few years the use of pedelecs in Europe has been increasing and is expected to continue growing especially for use in longer journeys. However, the road safety consequences of the potentially higher average speed that pedelecs can achieve are not clear. A study by GDV suggests that the use of pedelecs does not result in a higher risk of collision.[101] A Dutch study revealed that pedelec users are more likely to be involved in a collision that requires treatment at an emergency department. However, collisions involving pedelecs are about as severe as collisions with traditional bicycles.[102] Germany is collecting separate data on cyclists killed and seriously injured on pedelecs.[103] In 2015 they represented around 9.4 %, (36 of 383) of all cyclist deaths[104] this corresponds with the steep rise of the number of pedelecs on the road in Germany, more than 500,000 were sold in 2015.

The use of pedelecs in Europe has been increasing and is expected to continue growing.

Recommendations to the EU

- Improve data collection on collisions involving different types of electrically assisted cycles.
- Maintain the current definition of pedelecs – with a designed speed of 25km/h and a pedal-assisted maximum continuous output of 250W which is cut when the vehicle reaches its designed speed.

---

[99] ISO Norm http://goo.gl/wyX33O
[100] http://www.velotech.de/
[101] GDV (2014), Pedelec-Naturalistic Cycling Study. https://goo.gl/HZ3SpM
[102] J. P. Schepers et al. (2014), The Safety of Electrically Assisted Bicycles Compared to Classic Bicycles. http://goo.gl/lB4bI9 n.b. Self-selection might have affected this overrepresentation in this study. Currently cyclists who are less fit or who have little cycling experience, older and thus potentially more physically fragile, may be overrepresented among pedelec riders.
[103] A breakdown between pedelecs and other kinds of more powerful pedelecs in Germany shows that there were 2 deaths in 2014 and 4 in 2015 with the faster ones.
[104] Statisches Bundesamt (2016) Destatis Verkehr Verkehrsunfaelle December 2015 https://goo.gl/fK7Qlw

HUMAN BEHAVIOUR

The infrastructure and vehicle developments presented in the sections above can only be fully effective if they are also supplemented by correct user behaviour on the roads. The Dutch sustainable safety principles also put an onus on street designers to provide environments and infrastructure that are clear to people. One should also consider that some highway layouts can promote aggressive behaviour such as inconsistent road widths which can lead to collisions from alongside or behind as users switch places and are uncertain about positioning.[105]

Integrating cycling into the traffic system thus requires that motorised road users act in a way which cyclists can predict and react to safely, and vice versa. Such behaviour can be achieved through an optimal combination of education on safe road use, as well as enforcement of traffic rules.[106] The first part of this section looks at driver behaviour and the second part at cyclist behaviour.

4.1 ENFORCEMENT OF THE RULES FOR DRIVERS

Sustained intensive enforcement that is well explained and publicised has a long-lasting effect on driver behaviour.[107] Traffic law enforcement is a very cost-effective means of enhancing road safety[108].

Enforcement of rules relating to risky behaviour that could affect cyclists such as speeding, overtaking without keeping a proper lateral distance, distraction, drink driving and compliance with driving and resting hours in relation to fatigue could all benefit cyclist safety. Sanctions should be linked to relative risk and graded for example for higher speeds in 30 km/h zones. However, it should be noted that this will only make a difference if speed enforcement is increased. The main legislative framework for enforcement at EU level is set by the Cross Border Enforcement Directive and the EU's Road Safety Strategy. Traffic law enforcement should be a priority in national policing plans. Resources should be ear marked and targets set in line with best practice of preparing national enforcement plans. Along with enforcement the EU also has a framework on driver training for professional drivers which is due for revision.

Recommendations to the EU

- Support Member States in preparing national enforcement plans with annual targets for compliance in the areas of speeding, drink driving and distraction, especially in urban areas where there are high numbers of pedestrians and cyclists.
- Encourage a Zero Tolerance[109] approach to use of drugs and alcohol to cover all road users.
- Strengthen the Cross Border Enforcement Directive within the context of the revision in 2016 by ensuring greater convergence in enforcement of road safety related road traffic rules and developing common minimum standards for enforcement.
- Link sanctions to relative risk: graded sanctions should be applied for higher speeds in 30 km/h and 50 km/h zones where there are higher numbers of cyclists.
- Development of principle of road usage with due consideration of all other road users.
- Within the upcoming revision of Directive 2003/59 concerning initial and periodic training of professional drivers improve HGV and bus driver awareness of what it is like to be a cyclist interacting with large vehicles.[110] Consider extending this training to van drivers.
- Revise the Directive 2006/126/EC and include training of interaction with vulnerable road users as part of the syllabus of training of all drivers.
- Examine expanding post-licence continuous training for non-professional drivers as set out in European Road Safety Strategy.[111]

[105] Transport for London (2014) London Cycling Design Standards, https://goo.gl/FxNSuF
[106] ETSC (2012), Raising the Bar – Review of Cycling Safety Policies in the European Union. http://goo.gl/3hwdui
[107] The effect of enforcement of cyclist behaviour has not yet been researched but is likely also to be similar.
[108] ETSC (2015) Enforcement in the EU Vision 2020. http://goo.gl/A3TXnN
[109] A tolerance level for alcohol could be set at either 0.1 or 0.2g/l. In ETSC (2012), Raising the Bar – Review of Cycling Safety Policies in the European Union. http://goo.gl/3hwdui
[110] 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. http://goo.gl/wSihAx
[111] European Commission (2010) Road Safety Policy Orientations; http://goo.gl/bbXqFB

4.2 SAFE AND CREDIBLE SPEED LIMITS

The impact of speed on cycle crash risk and severity highlights the value of speed management as "hidden infrastructure".[112] The speed management regime for each road should be adapted to the needs of the users and the specific characteristics of the traffic mix. Speed is the factor most quoted as a cause in traffic collisions resulting in deaths and as such, it plays an important role in diminishing or increasing the severity of collisions.[113] Speed management also requires a holistic approach including vehicle safety (ISA), infrastructure measures and enforcement.

Recommendations to the EU

- Encourage Member States to adopt zones with a speed limit of 30km/h in residential areas and areas used by many pedestrians and cyclists, and a maximum speed of 50km/h elsewhere in urban areas. These should be coupled with self-explaining infrastructure measures to support the enforcement of the speed limits.

Recommendations to member states

- Encourage local authorities to adopt zones with a speed limit of 30km/h in residential areas and areas used by many cyclists.
- Prepare national enforcement plans with yearly targets for compliance in the areas of speeding, distraction and drink driving, especially in urban areas, where there are high numbers cyclists.
- Strengthen enforcement against illegal parking when pedestrian and cyclist facilities are abused by parking on footpaths and cyclists' lanes.
- Map high risk sites for cyclists and use this to inform and direct enforcement actions of especially speeding.

4.3 PASSIVE SAFETY FOR CYCLISTS: HELMETS

Cycle helmets are designed to protect the cyclist's head and skull in the event of a crash. Helmets sold in the EU have to conform with international standards which prescribe the protection they need to offer. Current EU helmet standards requires impacts of up to around 15-20km/h to be absorbed. Walker shows that the standard currently in use for the EU, EN1078, is less stringent than the Snell B-90 and Snell B-95 standards that were applied in the UK during the 1990s.[114] The helmets currently on the market in Europe should be revised to provide more protection to cyclists and, in particular, protection in the case of multiple impacts (car front followed by road surface, in particular).

As with other protective equipment, helmets provide an additional amount of protection to cyclists and they should be encouraged to wear them. Evidence for the effectiveness of helmets has shown different results. Case-control studies comparing helmeted and non-helmeted cycling casualties show that there is evidence that wearing a helmet at the time of a crash does reduce the severity of injury.[115] The OECD's recent report cites studies which indicate a reduced risk of head injury for a 'single' cyclist in case of a crash, and may slightly increase neck or facial injuries. Though re-analysis suggest this effect is less than previously thought[116].

However time-series research documenting head injuries before and after high increases in helmet wearing which have come about for example after mandating use, has shown more limited safety effectiveness of increased bicycle helmet use[117]. Possible explanations include; the reduction in cycling use[118] and reduction in a 'safety in numbers' effect[119]; risk taking behaviour by protective equipment wearers[120]; changes in risk perception of drivers in contact with cyclists[121].

---

[114] Walker, B. (2005) Heads Up. http://goo.gl/w0A1mV

[115] Thomson, R.S. (1989) A case-control study of the effectiveness of bicycle safety helmets. http://goo.gl/s4zPBw

[116] Elvik, R. (2011) Publication bias and time-trend bias in meta-analysis of bicycle helmet efficacy: A re-analysis of Attewell, Glase and McFadden, 2001 http://goo.gl/jGtH2Z

[117] Middaugh-Bonney, T. et al (2010) Bicycle-related head injury rate in Canada over the past 10 years http://goo.gl/o7pDzO
Robinson, D. (2001) Changes in head injury with the New Zealand bicycle helmet law http://goo.gl/0z9tku
Robinson, D. (1996) Head injuries and bicycle helmet laws http://goo.gl/0N0v8
Robinson D. (2006) No clear evidence from countries that have enforced the wearing of helmets http://goo.gl/ROUP1K

[118] http://goo.gl/CBM4CT

[119] Robinson DL, 2005. Safety in numbers in Australia: more walkers and bicyclists, safer walking and bicycling. Health Promotion Journal of Australia 2005;16:47-51. http://goo.gl/BnjO2S
Jacobsen PL, 2003. Safety in numbers: more walkers and bicyclists, safer walking and bicycling. Injury Prevention http://goo.gl/AT2k6K

[120] Morrongiello BA, Walpole B, Lasenby J, 2007. Understanding children's injury-risk behavior: Wearing safety gear can lead to increased risk taking. Accident Analysis & Prevention 2007 May;39(3):618-23. https://goo.gl/mBwPl7

[121] Walker I, 2007. Drivers overtaking bicyclists: Objective data on the effects of riding position, helmet use, vehicle type and apparent gender. Accident Analysis & Prevention 2007 Mar;39(2):417-25

According to the German In-Depth Accident Study (GIDAS), use of helmets might result in 33% reductions of cyclist head injuries of severity AIS3+.

Nevertheless, head and brain injuries sustained by cyclists could be reduced by bringing cycle helmets into general use. According to the German In-Depth Accident Study (GIDAS), use of helmets might result in 33% reductions of cyclist head injuries of severity AIS3+, isolated soft tissue injuries by 15% and skull and base of skull fractures by 46%.[122]

Recently conducted research in Ireland was based on 37 fatal cyclist collision scenarios. In primary impacts between cyclists and cars the main areas of injury are to the torso or lower limbs and a helmet offers little extra protection except when a car runs into the back of a cyclist thus causing the head to strike the windscreen or bonnet. The helmet then provides protection by reducing forces on the head.

Most head injuries were found to occur at secondary impact, usually with the ground and as long as the impact occurs against an area of the head that is above a line near to the rim of the helmet, the helmet provided significant protection. In 26 out of 32 secondary impact cases, helmets would have reduced the Head Injury Criterion scores (HIC-scores) on the cyclist's head by approximately 75%.[123]

Research from Spain analysed a total of 11,529 collisions and 4,645 injuries suffered by 2,345 cyclists between 2010 and 2012.[124] The main conclusion of the study is that as injuries of cyclists and hospitalisation or medical leave increase, the percentage of head injuries also increases and that helmets are an effective protective measure.

Designers of awareness-raising campaigns and activities for the use of helmets should also aim to send a balanced message, one which does not dissuade people from cycling by portraying it as an inherently dangerous activity.[125] Due to the excellent health benefits of cycling, road safety interventions that reduce the numbers of cycling may have a public health disbenefit[126]. Therefore, the promotion or encouragement of helmet use must not reduce the numbers of commuter cyclists. This should be seen within the context of an overall cycling strategy including road safety measures.

Recommendation to the EU

- Revise standards for testing bicycle helmets to increase the safety standard currently in use to offer high levels of protection.

Recommendation to member states

- Encourage helmet wearing among cyclists, without discouraging cycling or other negative side effects such as risk compensation.

4.4 BEHAVIOUR: CYCLISTS

Cyclists should receive at least a minimum level of road safety education and awareness of the risks imposed by the current traffic system through training and education. The full understanding of road signs and signals is a minimum requirement. But additional efforts are needed to train cyclists so that they can correctly assess and predict traffic situations and assess other users' behaviour.[127]

The training should also cover skills and attitudes and should be practice oriented and include looking at the benefits of cycling. Training courses and information campaigns are provided by local, central authorities as well as insurers throughout the EU, with abundant examples of education and awareness raising campaigns from several Member States.[128] Most often such campaigns and initiatives have a dual objective of improving the road skills of existing cyclists and promoting cycling to people who do not cycle often. Before wider implementation of all such training programmes and campaigns they should be assessed on their effectiveness and unintended

[122] Otte D., Wiese B., (2012), Comparison of Injury Situation of Pedestrians and Cyclists in Car Frontal Impacts and Assessment of Influence Parameter on Throw Distance and Injury Severity
[123] K. Fingleton, M. Gilchrist (2013), UCA Dublin, A study of the protective capabilities of cycle-helmets in collisions involving motor-vehicles based on computer simulated reconstructions.
[124] MAPFRE Foundation (2013) Does the Bicycle Helmet Protect? https://goo.gl/7shTMo
[125] ETSC (2012), Raising the Bar – Review of Cycling Safety Policies in the European Union. http://goo.gl/3hwdui
[126] De Jong, Piet, The Health Impact of Mandatory Bicycle Helmet Laws (February 24, 2010). Risk Analysis, 2012. Available at SSRN: http://ssrn.com/abstract=1368064 or http://dx.doi.org/10.2139/ssrn.1368064
[127] ETSC (2012), Raising the Bar – Review of Cycling Safety Policies in the European Union. http://goo.gl/3hwdui
[128] The MAPFRE Foundation has developed educational resources and materials with the aim of promoting risk prevention and road safety education for cyclists including for pedelec riders. For example this infographic on cycling on a cycle lane: http://goo.gl/MVKPfx, on pedelecs: http://goo.gl/GFCVMi, A multimedia video library: https://goo.gl/zeL9hT, specifically for children: https://goo.gl/zeL9hT and seniors: http://goo.gl/4L6QcV

negative side effects. Sanctions should also be introduced and enforced for cyclists which reflect the risk they pose to themselves or other road users. Following this logic, these sanctions should also be differentiated from other motor vehicle users.

Recommendations to member states

- Provide all citizens (not just cyclists) with adequate training regarding cycling skills. This training covers rules relating to the use of cycling infrastructure and governing the interaction between cyclists and motorised traffic at junction and other points of conflict. This could be part of a broader safety training programme for children and young adults.[129]
- Improve enforcement of illegal cycle behaviour where they increase risk to themselves or other road users.
- Encourage a Zero Tolerance approach to use of drugs and alcohol to cover all road users, including cyclists.[130]
- Run awareness campaigns alerting cyclists of dangers posed by distracted cycling (mobile phone use/ earphones) use of alcohol and drugs and lack of visibility in traffic, without discouraging cycling.

[129] OECD (2013) Cycling, Health and Safety. http://goo.gl/qPHEf4
[130] A tolerance level for alcohol could be set at either 0.1 or 0.2g/l. In ETSC (2012), Raising the Bar – Review of Cycling Safety Policies in the European Union. http://goo.gl/3hwdui

SAFETY WITHIN CYCLING STRATEGIES

An EU cycling strategy would provide a structure to motivate more action on cycling at a national level. National level commitment, to cycling and to cycling safety is important to set a common framework for action. Top level co-ordination between cycling and other policies helps deliver more cycling and better safety. Countries and cities which have successfully improved bicycle safety have done so via a co-ordinated set of policies and measures at both the tactical (design of specific safety interventions) and strategic ("safe system" approach) levels. An EU cycling strategy should also encourage member states to nominate ambassadors and set up centres of excellence for knowledge sharing at a national level as in The Netherlands, Denmark, Germany and at regional level in Flanders and in Baden-Württemberg, where a cycling strategy was published recently . Moreover, it should stress the importance of allocating budget to realise the objectives of national cycling plans including safety and research measures.

An EU cycling strategy would provide a structure to motivate more action in cycling at a national level.

Recommendations to the EU

- The EU Cycling Strategy should encourage national governments to include targets (including to reduce deaths/serious injuries and increase modal share of cycling), measures and resources to improve safety of cyclists and promote cycling safety in their national Cycling Strategies.

Recommendations to member states

- Design and implement cycling safety strategies.
- Include targets and measures to improve safety of cyclists and promote cycling in the national Cycling Strategies.
- Recognise the importance of the health, environmental and congestion benefits of cycling.
- Promote the 'comfort' and 'ease' of cycling networks with the aim of overcoming the fears concerning safety and enticing more people to cycle.

RESEARCH AND EVALUATION

For road safety, the annual deaths and serious injuries on Europe's roads carries a heavy cost and burden to our society. Investing in research and development at European level to prevent these collisions from occurring in the first place must be a priority in EU research programmes.

Sound policies are based on known, effective, science based countermeasures, which in turn are grounded in good research.[135]

An EU network of scientists has been formed called 'Scientists 4 Cycling'[136], there is also an annual International Conference on Cycling Safety. Much research has been undertaken so far, a useful action would be for the EU to come up with an overview of what has been undertaken so far and what the main gaps are.[137]

Other EU co-funded projects have considered VRUs from a safety viewpoint, although keeping a vehicle-centred focus. The VRUITS project takes a VRU-centric approach to come to recommendations for ITS applications aimed at improving the safety, mobility and comfort of VRUs, leading to a full integration of the VRUs in the traffic system.

The specific priorities for cycling safety are outlined below. Road safety research should continue to benefit more from European funds under the research framework programme, as these funds have been reduced in recent years. Related to this is the need to ensure the dissemination of knowledge about successful measures (good practice) and research results among decision makers and practitioners.

Recommendations to the EU

General recommendations

- Under Horizon 2020 commission an overview study of EU funded research undertaken so far on cycling safety.[138]
- Optimise models to monetise the various costs and benefits associated with cycling.

Data and statistics

- Identify and improve methods to estimate the rates of cycling.
- Consider how to improve registration of deaths and injuries and tackle underreporting.
- Analyse single bicycle collisions, including how they are recorded, as a matter of priority.

Infrastructure safety

- Research on infrastructure changes needed for pedelecs.
- Continue research on merits of introducing technology to inform drivers of cyclists covering the issue of distraction.

Vehicle safety

- Invest in cycling labs and test tracks to test bike/car interaction.
- Research the impact of thicker A-pillar to direct vision of drivers and impact on cyclist safety.
- Encourage research on road safety implications of electrically assisted cycles.
- Identify methods of preventing tampering with the electric motor, motor control or the drive train of a pedelec to increase either its power or the vehicle maximum speed.
- Consider how to overcome the challenge of integrating cyclists into the future automated driving landscape.
- Continue research into the effectiveness of measures to reduce blind spot-areas around HGVs and to alert road users of impending near-side turning collisions, with the goal of achieving the highest safety levels for cyclists.
- Further investigate scope for Automatic Emergency Braking for left/right turning HGVs to avoid cyclists being run over. Research into the protection offered to cyclists by current vehicle front tests aimed primarily at pedestrian protection.
- Research into the relationship between vehicle design and cyclist injury outcome.

[135] ETSC (2012) ETSC Input to Regulation Establishing Horizon 2020 The Framework Programme for Research and Innovation (2014-2020) http://goo.gl/GJEhgx
[136] Scientists for Cycling https://goo.gl/h9Z2M9
[137] International Conference on Cycling Safety https://events.unibo.it/icsc2016
[138] In-depth Understanding of Accident Causation for Vulnerable Road Users (2015) http://goo.gl/pdvBIM

Passive safety for cyclists

- Continue research into how ITS applications can be developed and adapted to improve the safety of cyclists.
- Invest in research into good lighting for cyclists.

Road user behaviour

- Research on cyclist behaviour in different scenarios and with different user groups.
- Identify and test effective and innovative methods of enforcing traffic rules for cyclists.
- Research the benefits and practicalities of 'rider assistance' for cyclists e.g. stability and steering assisting, warning and navigation systems.
- Identify appropriate designs for cycling helmets to protect the cyclist in a real world environment, study the impact of helmet wearing, if mandatory versus voluntary and investigate why cyclists don't wear helmets.

Road safety research should continue to benefit more from European funds under the research framework programme.

BIBLIOGRAPHY

OECD (2013) Cycling, Health and Safety. http://goo.gl/qPHEf4

Aldred, R. (2015) Near Miss Bike Survey of existing cyclists near miss experiences http://goo.gl/5044Eo

Baden Wuertemberg Cycle Strategy (German) http://goo.gl/o6OahX

Belgian Road Safety Institute, (2014) Analysis of the risk of serious or fatal injuries in traffic according to age and mode of transport http://goo.gl/qEnNw5

Committee of the Regions 'An EU Roadmap for Cycling' Draft Opinion. http://goo.gl/tcbGRN

CROW (2016) PPT from POLIS Workshop http://goo.gl/AQrx3L

Cycling Expertise (2010) State of the Art Design for Cycling Facilities (Empfehlungen für Radverkehrsanlagen) CyE Infrastructure factsheet CyE i-1 http://goo.gl/ejd50L

De Jong, Piet, The Health Impact of Mandatory Bicycle Helmet Laws (February 24, 2010). Risk Analysis, 2012. Available at SSRN: http://ssrn.com/abstract=1368064 or http://dx.doi.org/10.2139/ssrn.1368064

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. http://goo.gl/wSihAx

Directive 2008/96/EC of 19 November 2008 on road infrastructure safety management http://goo.gl/IFx1kT

Elvik, R. (2011) Publication bias and time-trend bias in meta-analysis of bicycle helmet efficacy: A re-analysis of Attewell, Glase and McFadden, 2001 http://goo.gl/jGtH2Z

EuroNCAP (2015) EuroNCAP 2020 Roadmap http://goo.gl/BfNX3o

European Commission (2008) European State of Principles of in-vehicle systems. http://goo.gl/ldvZ7l

European Commission (2008) Public Procurement for a Better Environment. http://goo.gl/qmWI5T

European Commission (2010) Road Safety Policy Orientations; http://goo.gl/bbXqFB

European Commission (2013) First Milestone Towards a Serious Injury Strategy http://goo.gl/qEnNw5

European Commission (2016) C-ITS Platform Final Report. http://goo.gl/B6JVFD

European Parliament (2015) Report on the Transport White Paper Mid Term Review. http://goo.gl/CriQ9

ETSC (1999) Safety of Pedestrians and Cyclists in Urban Areas. http://goo.gl/1S8hKo

ETSC (2010) 4th Road Safety Performance Index Report. Chapter 3: Tackling the Three Main Killers on the Roads. http://goo.gl/ShtNW

ETSC (2012) ETSC Input to Regulation Establishing Horizon 2020 The Framework Programme for Research and Innovation (2014-2020) http://goo.gl/GJEhgx

ETSC (2012) Raising the Bar – Review of Cycling Safety Policies in the European Union http://goo.gl/wUmdg3

ETSC (2015) Enforcement in the EU Vision 2020. http://goo.gl/A3TXnN

ETSC, (2015) PIN Report "Making Walking and Cycling on Europe's Roads Safer' (2015). http://goo.gl/FVDAZW

ETSC (2015) Reducing Road Risk at Work Through Public Procurement. http://goo.gl/5k91dR

ETSC (2015) Position Paper: Revision of the General Safety Regulation. http://goo.gl/zdX0w0

ETSC (2016) A Proposal for a Strategy to Reduce the Number of People Seriously Injured on Europe's Roads http://etsc.eu/wp-content/uploads/201602serious_injuries_position_final.pdf

ETSC (2016) Position on Revision of the Pedestrian Protection Regulation. http://goo.gl/8xbtG3

K. Fingleton, M. Gilchrist (2013), UCA Dublin, A study of the protective capabilities of cycle-helmets in collisions involving motor-vehicles based on computer simulated reconstructions.

Geus, B.d. & Hendriksen, I. (2015). Cycling for Transport, physical activity and health: what about pedelecs? . In: Gerike, R. & Parkin, J. (red.), Cycling futures: From research into practice Ashgate

GDV (2014) Pedelec-Naturalistic Cycling Study. https://goo.gl/HZ3SpM

Hendriksen, I. & Van Gijlswijk, R. (2010). Fietsen is groen, gezond en voordelig: Onderbouwing van 10 argumenten om te fietsen [Cycle use is green, healty and cheap: Evidence in support of 10 reasons to use bicycles] TNO Kwaliteit van Leven: Preventie en Zorg, Leiden.

Hynd, D., et al. (2015) Benefit and Feasibility of a Range of New Technologies and Unregulated Measures in the fields of Vehicle Occupant Safety and Protection of Vulnerable Road Users, Transport Research Laboratory. http://goo.gl/tmwYqp

In-depth Understanding of Accident Causation for Vulnerable Road Users (2015) http://goo.gl/pdvBIM

International Conference on Cycling Safety https://events.unibo.it/icsc2016

Jacobsen (2003) Safety in numbers: more walkers and bicyclists, safer walking and bicycling. Injury Prevention. http://goo.gl/FEPfrl

Luxembourg Presidency (2015) Luxembourg EU Presidency Declaration on Cycling calling for the European Commission to develop an EU level strategic document on cycling. http://goo.gl/Hi1BVE

MAPFRE Foundation (2013) Does the Bicycle Helmet Protect? https://goo.gl/7shTMo

Middaugh-Bonney, T. et al (2010) Bicycle-related head injury rate in Canada over the past 10 years http://goo.gl/o7pDzO

Morrongiello BA, Walpole B, Lasenby J, (2007) Understanding children's injury-risk behavior: Wearing safety gear can lead to increased risk taking. Accident Analysis & Prevention 2007 May;39(3):618-23. https://goo.gl/mBwPl7

OECD (1979) Traffic safety in Residential Areas

OECD, (2013) Cycling Health and Safety. http://goo.gl/qPHEf4

Otte D., Wiese B. (2012) Comparison of Injury Situation of Pedestrians and Cyclists in Car Frontal Impacts and Assessment of Influence Parameter on Throw Distance and Injury Severity

Paris Declaration of the Transport, Health and Environment pan-European Progamme (2014) http://goo.gl/tcbGRN

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, amending Directive 2007/46/EC and repealing Directives 2003/102/EC and 2005/66/EC. http://goo.gl/2aCVLk

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 therefore. http://goo.gl/2aCVLk

Robinson, D. (1996) Head injuries and bicycle helmet laws http://goo.gl/0N0v8

Robinson, D. (2001) Changes in head injury with the New Zealand bicycle helmet law http://goo.gl/0z9tku

Robinson D. (2005) Safety in numbers in Australia: more walkers and bicyclists, safer walking and bicycling. Health Promotion Journal of Australia 2005;16:47-51. http://goo.gl/BnjO2S

Robinson D. (2006) No clear evidence from countries that have enforced the wearing of helmets

http://goo.gl/ROUP1K

Schepers J. P. et al. (2014) The Safety of Electrically Assisted Bicycles Compared to Classic Bicycles. http://goo.gl/lB4bI9

Scientists for Cycling https://goo.gl/h9Z2M9

Statisches Bundesamt (2016) Destatis Verkehr Verkehrsunfaelle December 2015 https://goo.gl/fK7Qlw

SUSTRANS, Bike Life Edinburgh (2015) http://goo.gl/cKoNJq

SWOV (2006) Advancing Sustainable Safety. National Road Safety Outlook for 2005-2020. SWOV, Leidenscham, 2006. http://goo.gl/L5gMGC

SWOV (2010) H. Stipdonk, M. Reurings, The safety effect of exchanging car mobility for bicycle mobility. https://goo.gl/XCH42S

Thomson, R.S. (1989) A case-control study of the effectiveness of bicycle safety helmets. http://goo.gl/s4zPBw

Thornton 2011 Department for Transport in July 2011, "Climate Change and Transport Choices" https://goo.gl/6iVERh

Tira M. and Zazzi M. (2007) Pianificare le reti ciclabili territoriali, Gangemi, Roma

TNO (2016) Overview of Main Accident Scenarios in Car-to-Cyclist Accidents for use in AEB-System Test Protocol. https://goo.gl/yGFrSB

Transport for London (2014) Attitudes to Cycling Report http://goo.gl/pjNdJd

Transport for London (2014) Roads Task Force https://goo.gl/72Rq7G

Transport for London (2014) London Cycling Design Standards, https://goo.gl/FxNSuF

Transport for London pedal cyclists fatality report (2014) http://goo.gl/PQ2UuL

Twisk, D. et al (2015) Challenges in Reducing Bicycle Casualties with High Volume Cycle Use: Lessons from the Netherlands https://goo.gl/iVfdVP

VRUITS (2016) Recommended practices for improving usability of ITS applications and the integration of VRUs in C-ITS systems. http://goo.gl/3uK6hz

Walker, B. (2005) Heads Up. http://goo.gl/w0A1mV

Walker I, (2007) Drivers overtaking bicyclists: Objective data on the effects of riding position, helmet use, vehicle type and apparent gender. Accident Analysis & Prevention 2007 Mar;39(2):417-25

Wegman, F. et al (2012) How to make Cycling Good for Road Safety? http://goo.gl/rnmW1L

WHO (2015) HEAT Health Economic Assessment Tools for Walking and Cycling http://goo.gl/BceunG

Woodcock, J. et al (2014) Health Effects of the London bicycle sharing system: health impact modelling study. http://goo.gl/QZJbzY

European Transport Safety Council

20 Avenue des Celtes
B-1040 Brussels
information@etsc.eu
Tel: +32 2 230 4106
www.etsc.eu
@ETSC_EU

ETSC
European Transport Safety Council

Graphic Design: mazout.nu