

## Summary

# The potential for reducing the number of killed or seriously injured road users in Norway in the period 2018-2030

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*The number of killed or seriously injured road users in Norway can be reduced substantially. This is the main finding of an analysis of the potential for improving road safety by means of 33 road safety measures. It is, in principle, possible to realise the target of a maximum of 500 killed or seriously injured road users in 2024, by implementing all measures consistently. This means, for example, building motorways, installing road lighting, doubling police enforcement and stimulating a faster renewal of the car fleet. A target of not more than 350 killed or seriously injured road users in 2030 appears to be more difficult to reach by means of the road safety measures included in the analysis. Based on injury data collected by the emergency medical clinic in Oslo (Oslo skadelegevakt), the potential for reducing injuries to pedestrians and cyclists by means of improved road maintenance, in particular winter maintenance, has been estimated. It was estimated that pedestrian injuries can be reduced by 23-30% and cyclist injuries can be reduced by 5-10%.*

## Road safety in Norway can be improved

Norway has a high level of road safety compared to other countries with the same level of motorisation. There were 106 road accident fatalities in 2017; the lowest number since 1947. The number of fatalities has declined sharply after the year 2000. It is a political objective to continue improving road safety in Norway. Targets have been set for a maximum of 500 killed or seriously injured road users in 2024 (the number was 771 in 2017) and a maximum of 350 killed or seriously injured road users in 2030. Can these targets be realised? To what extent can road safety measures contribute to a further reduction of the number of killed or seriously injured road users in Norway?

To answer these questions, the potential for improving road safety by means of 33 road safety measures has been analysed. Table S.1 lists these road safety measures. There are seven infrastructure measures, 17 vehicle-related measures and nine enforcement measures.

## Maximum use of road safety measures

For each road safety measure, the maximum conceivable use of the measure has been defined. Maximum use is intended to represent a level of implementation that can be attained, and is thus not entirely hypothetical or unrealistic.

For motorways and median guard rails, a list of projects that will be implemented before 2024 has been provided and it has been assumed that all projects will be implemented.

Table S.1: Road safety measures included in the analyses.

Infrastructure measures	Vehicle-related measures	Enforcement etc.
New motorways	Electronic stability control	Speed enforcement
Median guard rails	Frontal air bags	Seat belt enforcement
Median rumble strips	Side-impact air bags	Random breath testing
Road lighting	Crashworthiness	Drug enforcement
Roundabouts	Design for pedestrian protection	Drive- and rest-hour enforcement
Upgrading pedestrian crossings	Seat belt reminder	Speed cameras
Speed limit from 80 to 70 km/h	Autonomous cruise control	Section control
	Emergency brake assistance	Increasing fixed penalties
	Lane departure warning	Safety management in firms
	Speed limit information	
	E-call	
	Electronic driver license	
	Faster renewal of car fleet	
	Complete renewal of car fleet	
	Intelligent speed adaptation	
	Alcolock	
	Seat belt ignition interlock	

Median rumble strips can be installed on 5,000 kilometres of road. Road lighting is assumed to be installed on all roads that do not have it (38,600 kilometres). It is estimated that about 2,000 junctions can be rebuilt into roundabouts and about 1,000 pedestrian crossings upgraded. Lowering the speed limit from 80 to 70 km/h applies to 10,400 km of road having high injury costs per vehicle kilometre.

For all vehicle-related measures currently in use, full penetration, i.e. all vehicles have the safety systems, represents the maximum potential level of implementation. This applies to most of the vehicle-related measures listed in Table S.1. Furthermore, it has been assumed that E-call and electronic driver license will be introduced before 2030. Faster renewal of the car fleet means that the time it takes to turn over completely is shortened. Complete renewal of the car fleet means that all cars in 2018 have the level of safety a new car is predicted to have by the year 2030. This prediction is based on a study of the relationship between car age and car safety.

Intelligent speed adaptation, alcolocks and seat belt ignition interlock is hardly used at all today. It has been assumed that these systems can be installed in all cars. This is intended to represent a situation in which speeding, drink-driving and non-use of seat belts have been eliminated.

For enforcement, doubling current levels is regarded as feasible. This applies to enforcement performed by police officers. The share of vehicle kilometres driven on roads with fixed speed cameras can be doubled. For section control, a tenfold increase in the share of vehicle kilometres performed on roads with the measure is regarded as feasible. Fixed penalties are assumed to increase by 50%. Safety management in firms is assumed to be applied by almost all transport firms at a level that will reduce accident involvement by 59%. These assumptions are based on a literature survey and data collected from Norwegian transport firms.

## Baseline predictions

A forecast of the number of traffic fatalities and seriously injured road users in 2024 and 2030, assuming that no new safety measures are introduced has been made. This is referred to as a baseline forecast. The baseline forecast does not include the effects of road safety measures that contributed to the past decline in the number of killed or seriously injured road users. It therefore predicts that the number of killed or seriously injured road users will decline at a slower annual rate than observed after the year 2000. The baseline forecast does, however, include the expected renewal of the car fleet and the increasing penetration of safety systems associated with this renewal. The reason for including this in the baseline forecast is that the effect of vehicle safety measures is estimated as the extra gain obtained by reaching 100% penetration, compared to actual penetration in a given year. Actual penetration must then be part of the baseline to correctly estimate the attainable gain by 100% penetration.

The baseline predicted number of fatalities is 120 in 2018, 103 in 2024 and 89 in 2030. The baseline predicted number of seriously injured road users is 609 in 2018, 563 in 2024 and 523 in 2030.

## Four alternatives for the use of the measures

Four alternatives for use the road safety measures have been developed:

1. **Maximum use of current measures:** All currently used measures are implemented at the maximum level. Complete renewal of the car fleet, intelligent speed adaptation, alcolocks and seat belt ignition interlocks are not included.
2. **New technology:** Intelligent speed adaptation, alcolocks and seat belt ignition interlocks are applied at the maximum level. These measures replace traditional enforcement. All other measures are used as in alternative 1.
3. **New car fleet:** The vehicle-related measures are replaced by a single measure: Complete renewal of the car fleet. All other measures are used as in alternative 1.
4. **New car fleet and new technology:** Complete renewal of the car fleet and intelligent speed adaptation, alcolocks and seat belt ignition interlocks are introduced to the maximum extent. Infrastructure measure are retained as in alternative 1.

Figure S.1 shows the estimated number of killed or injured road users associated with these alternatives. The number of fatalities is clearly below 100 in all alternatives. The number of seriously injured road users is 329-382. The highest number of killed or seriously injured road users in 2024 is 442. This is below the target of 500, suggesting that the target can be attained if all road safety measures are implemented at the maximum level. The lowest number of killed or seriously injured road users in 2030 is 376, which is above the target of 350. However, the estimated number of killed or seriously injured road users resulting from use of the road safety measures (376) has a 95% confidence interval from 338 to 414. Thus, it cannot be ruled out that even the target for 2030 can be realised.

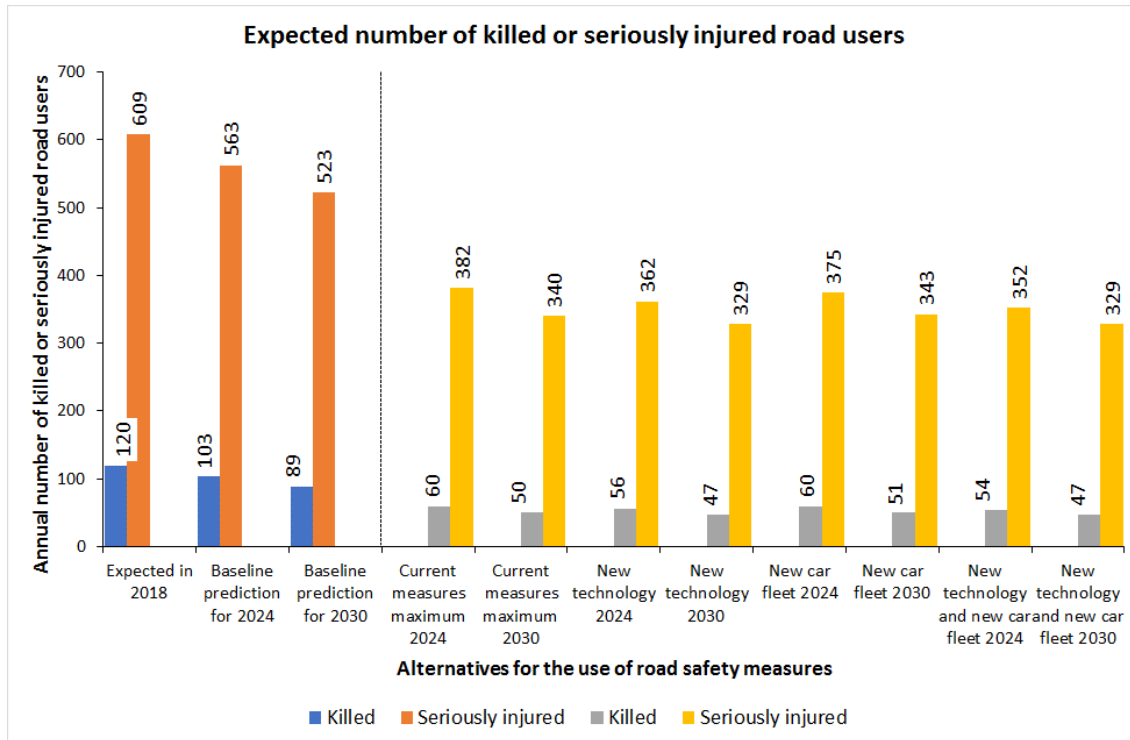


Figure S.1: Expected number of killed or seriously injured road users in 2024 and 2030 according to four alternatives for the use of road safety measures.

## Injuries to pedestrians and cyclists

A large number of pedestrians and cyclists are injured in traffic. The emergency medical clinic in Oslo recorded cyclist injuries in 2014 and pedestrian injuries in 2016 as part of two research projects. A total of 2,184 injured cyclists were recorded. A total of 6,309 injured pedestrians were recorded. The number of injured pedestrians is greater than the total number of police reported injury accidents in Norway as a whole.

Most pedestrians are injured when they fall. Falls among pedestrians are not defined as a reportable accident, and police statistics do not include any of these accidents. Many falls are associated with snow or ice. An estimate has been made of the number of injuries to pedestrians or cyclists that can be prevented by improving winter maintenance (and, for cyclists, removing loose gravel earlier in the spring). It is difficult to estimate the potential for improving safety very precisely, but a reduction of pedestrian injuries by 23-30% has been estimated. For cyclists, the estimated reduction of the number of injuries is 5-10%.

The police recorded 125 injured cyclists in 2014 and 106 injured pedestrians in 2016. Thus, police data grossly understate the size of the problem and the potential benefit of making walking and cycling safer.