

Road crash costs

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Summary

The social costs of road crashes in the Netherlands in 2020 are estimated at € 27 billion (between € 15 and € 36 billion), equivalent to 3% (1.9-4.5%) of the gross domestic product (GDP). This is significantly higher than other traffic-related social costs such as traffic congestion (€ 3.5 to € 4.6 billion) and environmental damage (€ 7.3 billion). The costs amount to about € 6.5 million per road death and € 0.7 million per serious road injury. Half the costs are attributable to serious road injuries, while the share attributable to road deaths is smaller (15%). The other costs (about one third of them) are the result of road crashes with less serious outcomes. The costs exceed those of previous estimates and their bandwidth has increased, mainly because new research shows that the human costs are considerably higher than was assumed.

About three quarters of the total costs are human costs, while the damage to vehicles is the second highest cost item (14% of the total costs). Other cost items are medical costs, loss of production, settlement costs and congestion costs.

In the Netherlands, the costs of road crashes are higher than in most other European countries. In Europe, the costs range from 0.4% to 4.1% of the GDP. The differences are mainly caused by differences in cost valuation methods. Information about the costs of road crashes is used in, for example, the preparation and evaluation of road safety policy and in cost-benefit analyses of road safety measures.

1 What are the costs of road crashes for society?

The social costs of road crashes in 2020 are estimated at € 27 billion (with a bandwidth of € 15 to € 36 billion) [1]. This is equivalent to 3.3% of the gross domestic product (1.9-4.5%). The costs are about € 6.5 million per road death and € 0.7 million per serious road injury.

More than half the total costs of road crashes are attributable to serious road injuries, while the share attributable to road deaths is smaller (15%). Slightly injured casualties (treated in the A&E department of a hospital), and crashes with property damage only (PDO), have a cost share that is almost equal to that of the road death share: 17% and 13% respectively. A relatively small share of the costs (3%) is attributable to other injuries, see *Figure 1*.

The costs are both 'hard' economic costs – such as medical costs and damage to vehicles – and human costs. The human costs involve loss of life years and quality of life. Three quarters of the total costs are human costs (See the question [What types of road crash costs do we distinguish?](#)).

Costs by injury severity

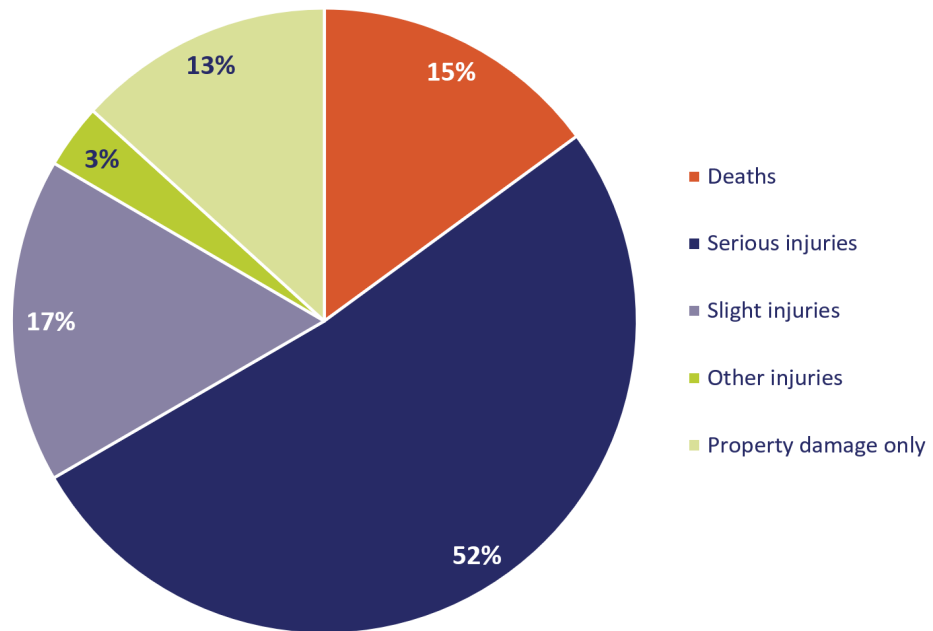


Figure 1. Shares of deaths, serious/slight/other injuries and property damage only crashes of the total road crash costs (2020). Source: [1].

The data for 2020 are based on a recent update of the social road crash costs [1] [2]. In the present study, the same calculation methods were used as had been used in the studies for 2009 [3] and 2018 [4], while they were updated with new data and research results, among which new values for the human costs of road deaths and serious road injuries (see the question [What types of road crash costs do we distinguish?](#)). In addition, new data on vehicle damage, insurance costs and congestion costs were used. Some, mainly smaller, cost items were simply updated, for which the costs from previous studies were adjusted for inflation and the development of the number of victims.

The bandwidth of the total costs (€ 15 - € 36 billion) is based on the 95% confidence interval of the value of a statistical life (from which the human costs are inferred (see the question: [What types of road crash costs do we distinguish?](#)). Moreover, uncertainty about the number of slight injuries and about the extent of the total vehicle damage was incorporated in the bandwidth. This concerns damage not paid by insurers, for example damage to one’s own vehicle that is only insured for third-party liability or damage that is not claimed. The increased bandwidth in costs, however, mainly reflects uncertainties in the estimate of human costs.

The figures only present the costs that are consequential to the road crashes. The costs made to prevent road crashes, amounted to € 2,3 billion - € 3,1 billion in 2007 [5]. More recent estimates of these costs have not been made.

2 How do the costs compare to previous estimates?

The estimate of social road crash costs in 2020, € 27 billion, is considerably higher than previous estimates: € 17 billion in 2018 [3] and € 12.5 billion in 2009 [4]. The main reason for the higher estimate for 2020 is that we used new values for human costs of road deaths and serious injuries as found in the international VALOR research (see the question [How do we define the human costs of road crashes?](#)). For the Netherlands, the new values are more than twice as high as previous estimates. This greatly affects the total costs, because human costs constitute a large share of them, and now, with the new values, even more so. In addition, several new data sources were used, for example for vehicle damage and congestion costs, and the real costs (disregarding inflation) increased. The real cost increases concern general increases in, for example, the costs of vehicle repair and insurance. All these factors result in a cost increase of more than € 10 billion compared to the estimated 2018 costs. Inflation results in a relatively minor cost increase: an increase of € 1,3 billion between 2018 and 2020. In contrast with the factors that increase the total costs, the 2020 number of casualties is lower than it was in 2018, which results in a decrease in total costs of € 2 billion (see *Figure 2*).

The same factors explain the difference with the 2009 estimate. The impact of the new human cost values is greater, because the 2009 estimate did not include the human costs of slight injuries (which the 2018 estimate did). The impact of inflation is stronger, but the cost effect of a decrease in casualties is smaller. For, the 2020 number of serious injuries exceeds the 2009 number, while the number of road deaths and slight injuries did decrease.

Explanation higher social costs 2020

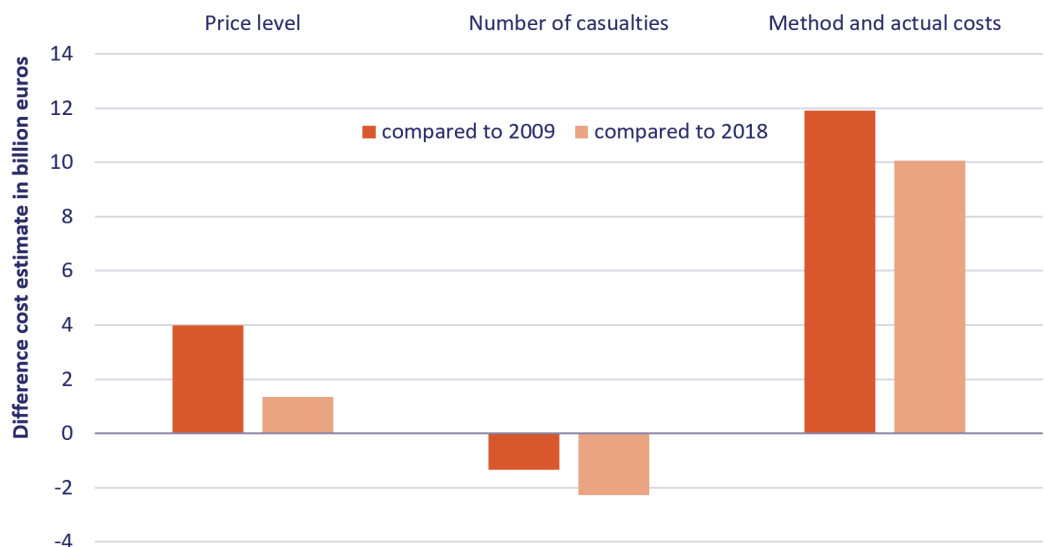


Figure 2. Explanation for the difference of the cost estimate in 2020 (represented as the base line) compared to previous estimates for 2009 and 2018 [1].

3 Who bears the road crash costs?

The brunt of the road crash costs, 90% (€ 24 billion), are borne by private individuals, see *Figure 3*. This is mainly caused by human costs accounting for such a large share of the total costs (see the question [What type of road crash costs do we distinguish?](#)). The human costs are borne by road casualties and their loved ones. In addition, part of the vehicle damage and medical costs are borne by the road casualties. People not involved in a road crash also bear part of the costs, such as congestion costs and insured costs. The latter are indirectly paid by means of insurance premiums by all insured individuals. Companies bear approximately 5% of the road crash costs (€ 1.3 billion), among which damage to company vehicles, insurance costs and congestion costs. A relatively small share of the costs, an estimated 1% (€ 350 million), is borne by the government. They concern the medical costs that are not paid by insurers and settlement costs (police, fire brigade and legal costs). The distribution of 4% of the costs, particularly production loss costs, is unknown.

Disregarding human costs, a picture emerges of a distribution of costs that are mainly financial (*Figure 4*). Private individuals once again bear the brunt (58%) of the costs, such as vehicle damage and insurance costs. The cost share for companies is 20% and 5% is borne by the government.

Cost bearing parties

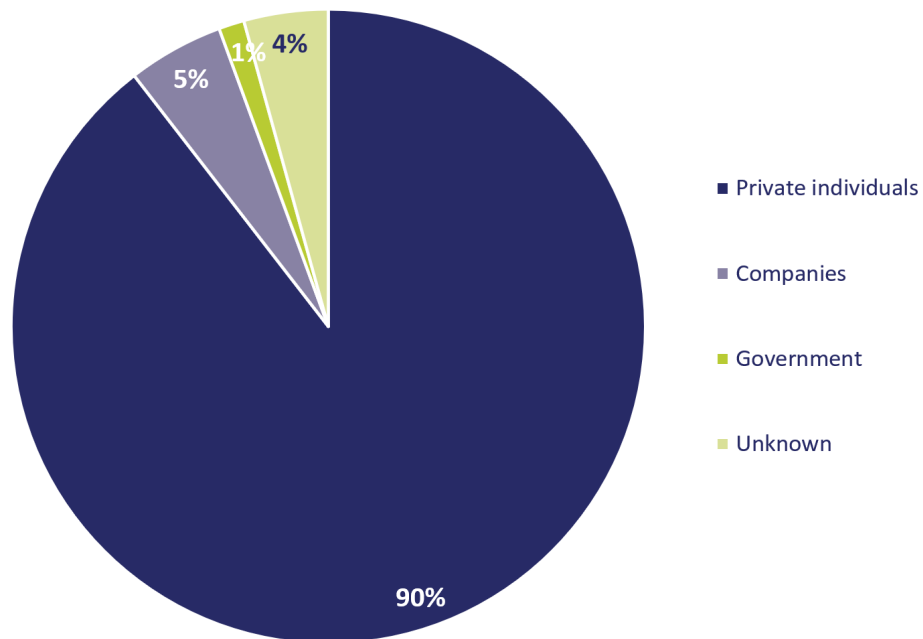


Figure 3. Distribution of road crash costs among the cost bearing parties [1].

Parties bearing the non-human costs

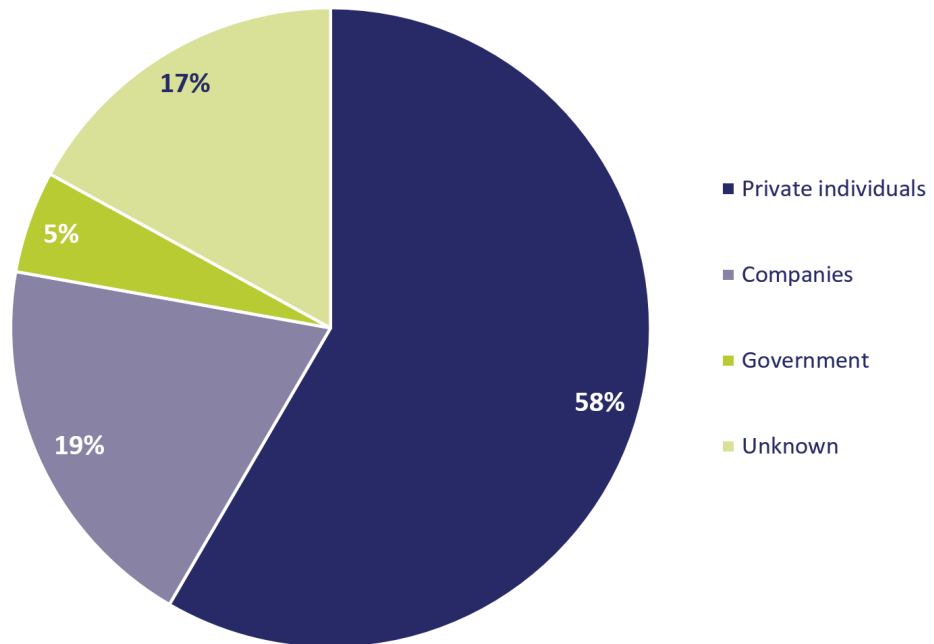


Figure 4. Distribution of road crash costs among cost bearing parties, excluding human costs. Source: [1], edited by SWOV.

The 2009 distribution of costs among the cost bearing parties was studied on the basis of data such as those on financial flows (for example in health care) [6]. For the 2020 cost distribution, the same distribution among private individuals, companies and government was used per cost item. The increase in human costs particularly increased the share of private individuals compared to 2009.

4 What type of road crash costs do we distinguish?

The road crash costs can be subdivided into six cost items [4] [7] [8]; see Figure 5. Three quarters of the total costs are human costs. The second largest cost item are property damage costs (14%); other cost items are relatively minor ones.

Cost items

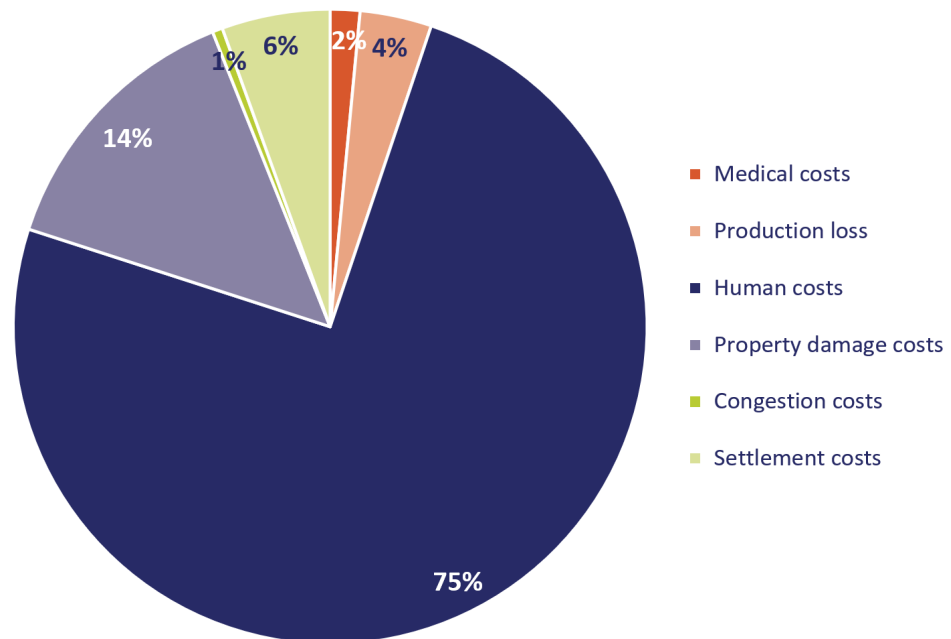


Figure 2. Estimate of the cost item shares of the total road crash costs in 2020 [1].

Medical costs

Medical costs are the result of the medical treatment of casualties, for example hospital, rehabilitation and medicine costs. In the Netherlands, costs for people who come to visit in hospital and (early) funeral costs are also included in the medical costs.

Production loss

Loss of production consists of costs of the casualties' temporary or permanent inability to work and the entire production loss of road deaths. Some countries also include loss of unpaid production, such as housekeeping and voluntary work, costs for employers to recruit and train replacement staff, and cost of vocational rehabilitation. However, these costs are not included in the Netherlands.

Human costs

Human costs for casualties and their relatives and friends are costs in the form of suffering, pain, sorrow and loss of quality of life and enjoyment of life. Human costs are related to road deaths as well as to serious and slightly injured casualties. Also see the question [How do we define the human costs of road crashes?](#)

Property damage costs

Property damage includes damage to vehicles, cargo, roads and roadside furniture, and to personal possessions. Vehicle damage is always by far the largest cost item in this category [9],

and in the Netherlands these are the only costs included in the calculation (passenger cars, delivery vehicles, trucks and motorcycles).

Settlement costs

Settlement costs relate to deployment of police and fire brigade in the event of crashes, administrative costs of insurers and legal costs. Legal costs include costs of detection, prosecution, trial and punishment of those who cause a crash, and costs for legal aid.

Other costs

In the Netherlands, other costs only include costs of congestion on account of crashes. In some other countries, other costs also include the cost of vehicle unavailability, such as the cost of replacement transport.

5 How do we define the human costs of road crashes?

Human costs of road crashes are costs in the form of suffering, pain, sorrow and loss of quality of life and enjoyment of life for casualties and their loved ones. The intangible damage related to road deaths can be expressed in terms of money in a number of steps. The Netherlands and most other European countries do this on the basis of the amount that people are willing to pay for a decrease in the risk of a fatal crash (willingness to pay, WTP) [8]. This is usually determined with a questionnaire study ('stated preferences'). This can be used to derive the so-called 'Value of a Statistical Life' (VSL) and the 'Value of a Statistical Serious Injury' (VSSI). The calculation of the human costs of road deaths and serious road injuries is based on the VSL and VSSI. The intangible damage of less severe injuries is derived from this.

In the recent international study 'VALOR', the latest scientific insights were applied in a WTP study, in which the VSL and VSSI were determined for the Netherlands and three other countries (Belgium, Germany and France). The Dutch VSL in 2020 was estimated to be € 6,3 million, with a 95% reliability interval of € 3.4 to € 9.0 million [10] [11]. The share of 'intangible damages for fatal injury' comes down to almost € 5.8 million [1]. The other part of the VSL concerns consumption loss.¹ The VSL in the Netherlands is similar to that in the other three countries that took part in the VALOR study, and is at the upper bound of the VSL bandwidth that was found in other countries [11].

The VSSI in the Netherlands was estimated to be € 1.0 million, with a 95% confidence interval of € 0.5 to € 1.4 million [10] [11]. The VSSI equals the human costs of serious injuries. The VSSI was determined for road injuries with an injury severity of MAIS3+, which is more serious than the injury severity of serious road injuries in the Dutch definition (MAIS2+). The human costs of serious road injuries with an injury severity of MAIS2+ were estimated to be € 0.7 million and

¹ The VSL consists of an immaterial and a tangible component (consumption loss), while consumption loss is also part of the loss of production. To prevent double counting, consumption loss is deducted from the VSL, which results in an estimate of the human costs. For more details, see [12] and [13].

those of a slight injury (treated at an A&E hospital department) at approximately € 40,000 [1]. These values are derived from the VSSI by means of 'Disability Adjusted Life Years' (DALYs), a measure to quantify loss of quality of life.

The VSL found in the VALOR studies (€ 6.3 million) is more than twice as high as the VSL used in previous estimates of the road crash costs (€ 3.0 million, price level 2020) based on a 2001 study [9] [14] [15]. The new VSL shows that people are more appreciative of road safety than they were about twenty years ago. The increased valuation can be explained by the rise in prosperity, but its effect is probably limited [11]. Although the same method was used as in the previous VSL study, differences in method details may also affect the results. Other explanations for the higher VSL are issues for further research. The human costs of a serious road injury (€ 0.7 million; injury severity of MAIS2+) are also more than twice as high as previous estimates that were based on foreign literature (€ 0.3 million, 2020 price level) [14]. As a percentage of the VSL the values are in the same order of magnitude (10% in 2020 versus 12% in previous estimates) [1].

The VOSL and human costs do not refer to the valuation for a specific individual, but to the valuation for a decrease in the risk of a fatal crash or serious injury. After all, most people do not wish to die or get injured at any price. The 'willingness to pay' is based on people making a trade-off between risk and money. Every day people take decisions in which they make such a trade-off, consciously or unconsciously. Think of the choice of food, choosing driving speed, the choice of whether or not to have a smoke detector, or the decision whether or not to work out.

6 How are the costs calculated?

Three methods are used to establish the various cost items [7] [8] (also see the question: [What types of road crash costs do we distinguish?](#)).

1. The 'Restitution costs method' is used to determine the *medical costs*, the *property damage* and the *settlement costs*. This method uses the costs of deployment of people and resources required to (as much as possible) restore the damage for casualties and their relatives. Examples are the costs of medical personnel, the costs of vehicle repair companies and the costs of emergency services.
2. The 'Human capital method' is used to determine *production loss*. This method determines the value of the production that would have been made by the casualties if they had not been injured or killed. Production loss actually includes both paid production and unpaid production (for example, housekeeping and voluntary work). However, in the Netherlands and most other countries only paid production is included in the calculations.
3. The 'Willingness to pay method' is used to calculate the *human costs*. This method usually uses a questionnaire study ('stated preferences') to determine the amount that people are willing to pay for a certain reduction of the crash risk. Also see the question [How do we define the human costs of road crashes?](#)

Large quantities of data are required to determine all the costs using these methods. Per cost item, the necessary data include [4] [16]:

- *Medical costs*: number of days that a casualty spent in hospital, the average cost per day of hospital or nursing home care and the number of ambulance trips per year. Most medical costs are determined using VeiligheidNL's burden of injury model, which uses data from medical records and cost estimations from various studies.
- *Production loss*: duration of absenteeism and disability, remaining number of life years and production per person. Among the data used are, for example, disability insurance data and economic statistics of Statistics Netherlands and the Netherlands Bureau for Economic Policy Analysis.
- *Human costs*: results of a survey about the amount people are willing to pay for a reduced crash risk.
- *Property damage*: insurance data on vehicle damage and estimates of damage unknown to insurers due to it not being insured or claimed.
- *Settlement costs*: time spent by the police on road crashes, number of times the fire department turns out for road crashes, budgets of fire department and police, financial data of insurers, and number of criminal cases following a road crash. The data are supplied by, among others, Statistics Netherlands and the Ministry of Security and Justice.
- *Congestion costs*: travel delays due to road crashes, and economic valuation of travel time and travel time unreliability.

7 How do costs in the Netherlands compare to costs in other countries?

Costs as a percentage of the gross domestic product

With 3.3% of the gross domestic product (GDP) the Netherlands is among the countries with relatively high costs of road crashes, while we occupy 10th place from the road safety perspective (number of deaths per inhabitant) [17]. In Europe, the costs range from 0.4% to 4.1% of the GDP (6). In international studies, they range from 0.5% to 6.7% of the GDP [18].

Costs by country

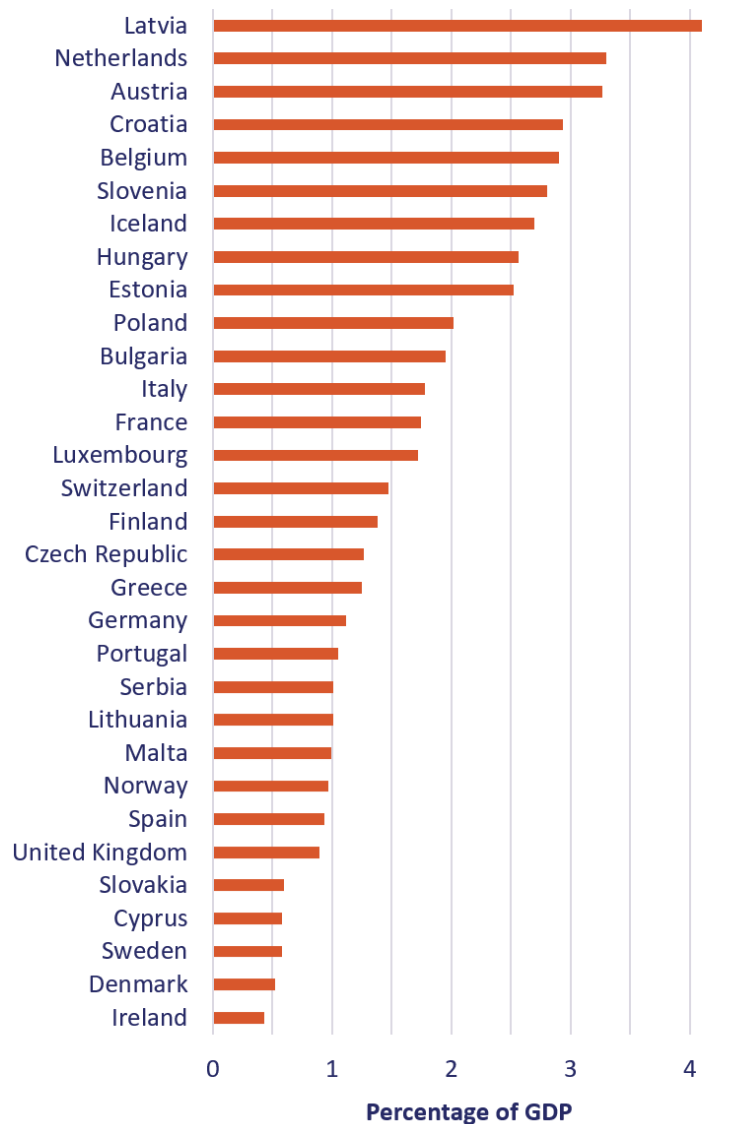


Figure 3. Road crash costs, as a percentage of the GDP, in 31 European countries, based on a European review [8]. The figures for the Netherlands and Belgium are more recent estimates [1] [19].

Rather than by differences in the level of road safety, the differences in total costs between countries are mainly explained by differences in the way the costs are calculated, in particular the human costs [8] [18]. Also, there are many countries that, unlike the Netherlands, do not take into account underregistration of casualties and crashes, or do not include property damage only crashes in their cost estimates. Furthermore, countries differ in the cost items they include. As has been advocated by international road safety organisations such as IRTAD, FERSI and ETSC [20], greater uniformity in the methods used is therefore required for proper comparison of the costs of road crashes in different countries. When the cost estimates in European countries are corrected for methodological shortcomings, the costs of road crashes in Europe are estimated at a minimum of 3% of the GDP [21].

Costs of a road death and a serious road injury

In the Netherlands, the costs per road death, estimated at € 6.5 million in 2020 [1], are higher than in most other countries. In Europe, these costs range from € 0.8 million to € 3.4 million [8] (price level 2020²). The higher costs per road death in the Netherlands can be explained by the higher human cost values, which were determined in the recent VALOR study in the Netherlands, Belgium, Germany and France [10] [11] (see the question [How do we define the human costs of road crashes?](#)). In Belgium, the results of that study were likewise applied in new cost calculations, which results in costs per road death that are in the same order of magnitude as those in the Netherlands (€ 6.8 million) [19]. In other European countries, older human cost estimates are used, which are much lower. In several countries, moreover, these estimates were not based on the 'willingness to pay' method, which results in higher values than other methods [8] [9]. In the US, where the 'willingness to pay' method is also used, the costs per road death compare to those in the Netherlands.

In most European countries the costs of a serious road injury³ are between 10% and 20% of the costs of a road death. With 11 % of the costs of a road death, the costs of a serious road injury are relatively low in the Netherlands. In absolute amounts, there are large differences between countries in the costs per serious road injury; in 2020 these ranged from € 30,000 to € 1.0 million. In the Netherlands, the value (€ 0.7 million) is within this range.

8 How do the costs compare to other traffic-related costs?

The road crash costs of approximately € 27 billion (€ 15 - € 36 billion) are significantly higher than other social costs related to traffic: the costs of congestion are estimated at € 3.5 to € 4.6 billion (main road network only) [3], and the costs of environmental damage due to road traffic at € 7.3 billion (source: KiM, personal communication; edited by SWOV⁴). Similar to road crash costs, the costs of environmental damage have a broad bandwidth (€ 5.7 to € 18.1 billion).

² The amounts of the European study [8] have been converted from the 2015 price level to the 2020 price level on the basis of the GDP deflator for the EU (source: World Bank, World Development Indicators).

³ These are the costs of a serious road injury as defined in each country; the definitions differ between countries.

⁴ KiM calculated the costs for 2018. The costs are expressed at the 2020 price level by correcting for inflation (consumer price index; source: Statistics Netherlands, Statline). Congestion costs were also adapted to labour cost developments (source: Statistics Netherlands, Statline) with an income elasticity of 0.5 (see [22]). The effect of the Covid-1 pandemic on congestion costs was not incorporated.

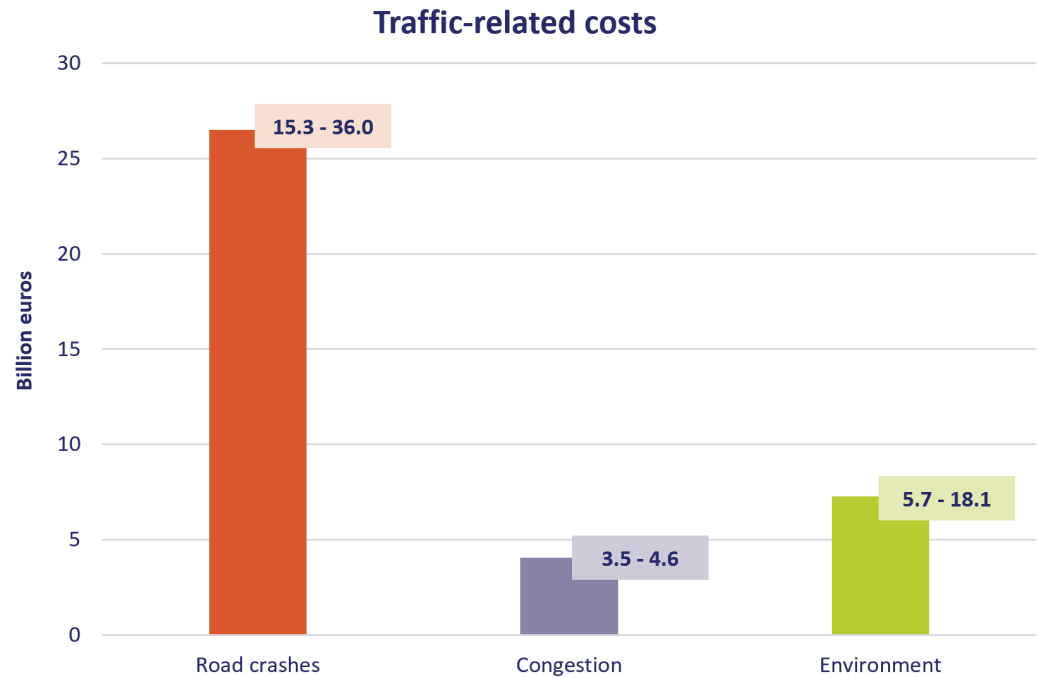


Figure 7. Estimated social costs related to traffic, 2018 (KiM [3]).

Congestion costs are not just the costs of direct loss of travel time, but also the costs of unreliability of travel times, adaptation of travel behaviour to congestion (detours, other times of travel etc.) and indirect costs, such as effects on public transport. Environmental costs are the costs resulting from air pollutant emissions, CO₂ emissions and noise pollution, such as costs of health damage and damage to buildings [23]. Particularly the costs of CO₂ emissions are uncertain and are the cause of broad fluctuation margins.

9 Why is it important to determine road crash costs?

First, the costs of road crashes provide insight into the extent of road safety as a social problem, and particularly in the socio-economic impact of road crashes. They can for example be seen as an indicator for the results of road safety policies, of course in addition to numbers of casualties and other indicators [24]. Information about the costs of road crashes is also commonly used in the preparation and evaluation of road safety policies, both at a national level, for example in the Strategic Plan Road Safety 2030 [25] and at the international level, for example in the Policy Orientations on Road Safety of the European Commission [26]. Furthermore, cost information makes it possible to compare costs of road crashes to costs in other policy sectors, in traffic and transport (environmental damage, congestion; also see the question [How do the costs compare to other traffic-related costs?](#)), as well as in other sectors, such as environmental policy, health care or other safety policy sectors. Moreover, information about the social costs gives insight into

opportunities for cost savings and can be used to prioritize policy objectives. Finally, also on the level of road crash costs making international comparisons is useful, although this requires that the methods used to calculate the costs are harmonised to a greater extent. Also see the question [How do costs in the Netherlands compare to costs in other countries?](#)

Secondly, information about the costs of road crashes is used in cost-benefit analyses (also see the question [What are social cost-benefit analyses?](#)). These use the costs per casualty or crash to express the road safety effect of policy measures as a monetary value. This value is then balanced against the cost of the measures.

10 What are social cost-benefit analyses?

A social cost-benefit analysis (CBA) determines the economic and other welfare effects of an investment, for example, of an investment in road safety improvement. This means that a CBA answers the question whether the benefits of an investment outweigh the costs from a social point of view. The costs and benefits are usually considered for a long-term period, for example for a 30-year period. Whenever possible, a CBA expresses the effects in monetary values. This is not just the case for road safety effects, but also for effects on, for example, the environment and mobility. In this way a CBA makes it possible to judge the social return of an investment.

An overview of the social costs and benefits may be used to prioritise separate measures or packages of measures. In addition, a CBA is used to strike a balance between investments in different policy areas. Such choices have to be made when developing policy plans, determining the state budget, and prioritising or phasing investment options. A CBA helps summarise a great deal of information in a rational framework. In the Netherlands, CBAs are often used when deciding about (major) infrastructure projects and other spatial planning investments. Sometimes, CBAs are mandatory, as is the case with investments in the context of the Dutch Multi-Year Programme for Infrastructure, Spatial Planning and Transport (MIRT). In order to safeguard quality and uniformity of CBAs, manuals and methodologies were developed to carry out CBAs, among which a general guideline for CBAs [27]. This also describes how the consequences of measures on road safety can be taken into account.

CBAs of road safety measures often show that the benefits exceed the costs. This is partly because of the high costs of road crashes, and, therefore, the resulting high savings (benefits). As early as 2000, a number of planning agencies [28] concluded that investments in road safety are cost-effective. In the Netherlands, for example, the benefit-cost ratio of investments in Sustainable Safety measures during the period 1998-2007 was calculated to be nearly 4:1 [29] [30]. International overviews of CBAs [31] [32] also indicate that road safety measures generally have higher benefits than costs.

11 What is known about the benefits of road safety investments?

The benefits of road safety investments consist of savings in road crash costs. The 2020 social road crash costs are estimated at € 27 billion (see the question [What are the costs of road crashes for society?](#)). Therefore, if no road crashes were to occur at all, this would bring social cost savings of € 27 billion annually (compared to the situation in 2020), among which savings in human costs in the form of prevented suffering and loss of quality of life (see the question [How do we define the human costs of road crashes?](#)). On the other hand, investments would be needed to reduce the number of road crashes and casualties. By way of indication: the total amount needed to reduce the number of road deaths to (almost) zero by 2050 is estimated at € 15 billion [33]. Although this is a rough indication, the estimate shows that the benefits of investments would quickly exceed the costs.

The favourable benefit-cost ratio of road safety investments is also apparent from the social cost-benefit analyses (CBAs); see the question [What are social cost-benefit analyses?](#). A cost-benefit ratio of investments in Sustainable Safety measures during the period 1998-2007, among which improvements in infrastructure and vehicle safety and intensified enforcement, showed the total benefits to be approximately € 2 billion. The costs of the measures amounted to € 0.5 billion, which results in a benefit-cost ratio of 4 : 1. As early as 2000, several national research agencies [28] also concluded road safety investments to be cost-effective. Furthermore, international overviews of CBAs [31] [32] also show that road safety measures generally have higher benefits than costs.

Publications and sources

Below you will find the list of references that are used in this fact sheet; all sources can be consulted or retrieved. Via [Publications](#) you can find more literature on the subject of road safety.

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Topics:

Road safety in numbers; Policy

Figures:

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SWOV

SWOV Institute for Road Safety Research

PO 93113

2509 AC The Hague

Bezuidenhoutseweg 62

+31 70 317 33 33

info@swov.nl

www.swov.nl

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