



Ministry of Infrastructure
and Water Management

Change to external costs and infrastructure costs of goods transport due to the modal shift

KiM | Netherlands Institute for Transport Policy Analysis

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Summary

In this study, the term modal shift in goods transport relates to the shifting of cargo flows from road transport to rail and inland shipping. In the short term (over the coming years), a policy focus on modal shift could be effective on four international primary routes (goods transport corridors) through the Netherlands. In other words: policy measures in the field of modal shift could result in a reduction of the costs that relate to the external effects and the use of the infrastructure by goods transport. The external effects we include are (1) greenhouse gas emissions, (2) air pollutant emissions, (3) noise, (4) traffic accidents, (5) congestion, and (6) emissions released during the production of electricity and fuels for means of goods transport. For the long term (2050), it is uncertain whether a policy focus on modal shift will prove effective.

The fact that policy measures aimed at bringing about a modal shift in the goods transport corridors over the coming years could be effective has two causes. Firstly, a proportion of the cargo in those corridors currently transported by road could be transported by rail or inland shipping, at a lower commercial cost. If the policy measures can remove other obstacles than the transport costs, the transport of (part of) those cargoes could shift from the road to another mode of transport. Secondly, the sum of the costs relating to external effects and the wear of the infrastructure per transport performance (tonne km) in the goods transport corridors is currently lower for rail and inland shipping than for road transport.

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A further logical decision criterion for policy focus (in addition to effectiveness) is that the balance of the social benefits and costs (the efficiency of the policy focus) is positive. That aspect is beyond the scope of this study.

The focus of this study is on the goods transport corridors, because railway lines and waterways run approximately parallel to the infrastructure for goods transport by road. The corridor East comprises the A12/A15 motorways (road transport), the Betuwe route (rail) and the Waal (inland shipping).

Furthermore, these corridors involve relatively large volumes of goods transport by road ('heavy cargo flows'). This makes a modal shift in these corridors relatively promising. The transport performance (tonne km) of goods transport by road on the Dutch part of the corridors is around 15% of the total transport performance of goods transport by road in the Netherlands.

The fact that it is uncertain whether a policy focus on the modal shift can be effective in the long term (2050) has two causes. Firstly, the effect of innovations in the goods transport market and of future policy on commercial transport costs is uncertain. Secondly, the effect of those innovations and that policy on the infrastructure costs and on the costs of external effects as a consequence of goods transport is uncertain. Future innovations and future policy in the field of climate could for example mean that certain vehicles or vessels are no longer permitted to emit greenhouse gases.





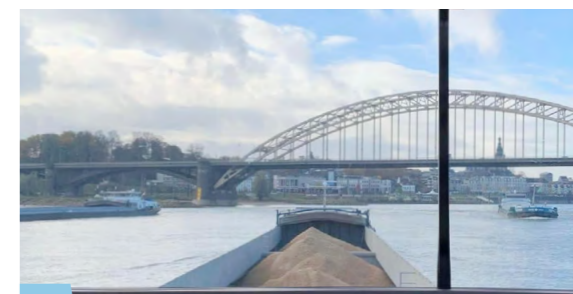
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ACKNOWLEDGEMENTS AND COLOPHON







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1 Why a modal shift?

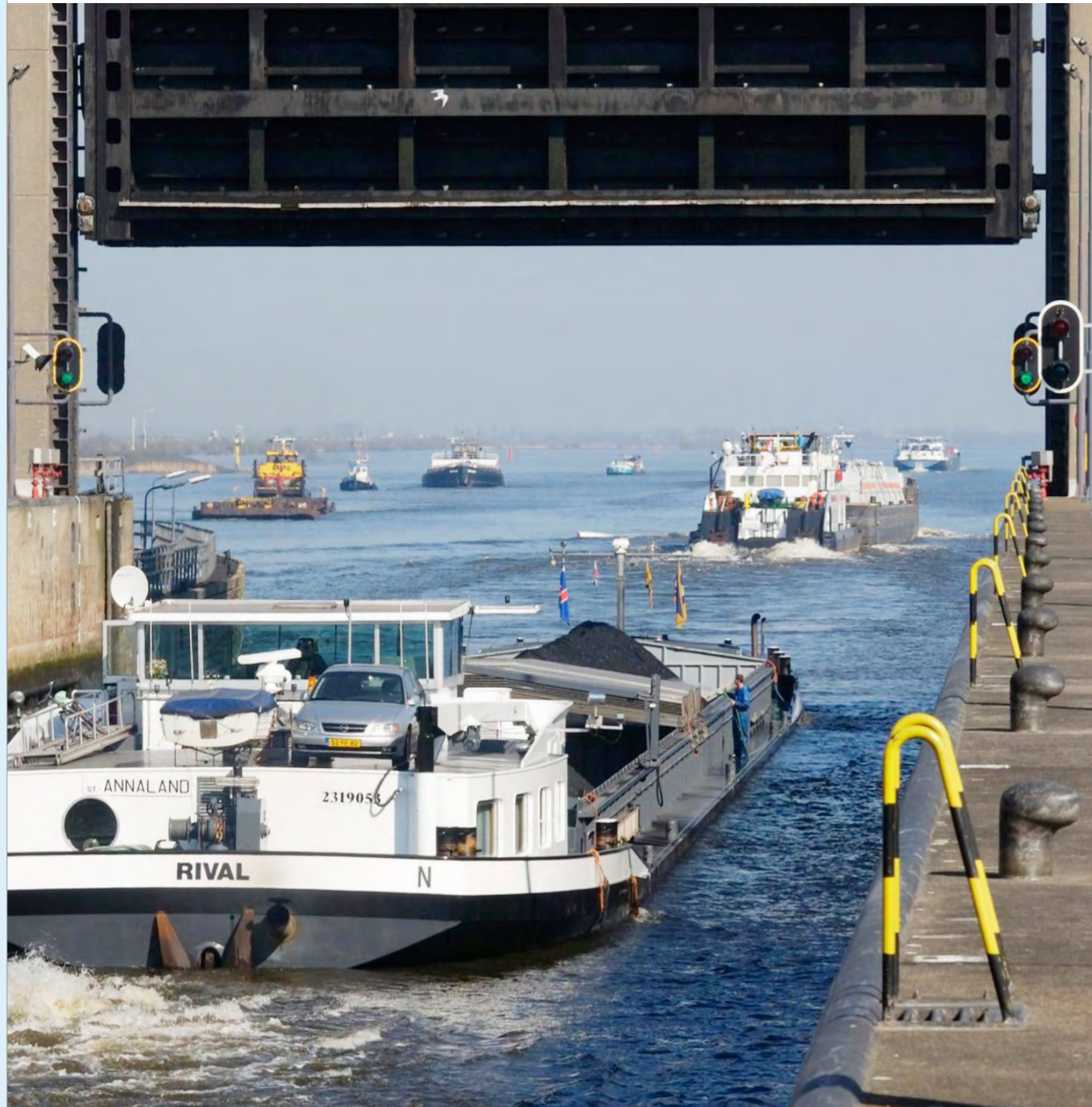
External effects of goods transport

This study considers the external costs and the infrastructure costs of goods transport for government and whether a policy focus on modal shift could reduce those costs. External costs are costs that result from external effects. External effects occur when the consequences of (economic) activities for one party on the welfare of another party, are not charged for via prices. Goods transport is one activity that involves effects that are not expressed in the prices. The external effects we have considered in this study are listed below.

	Greenhouse gas emissions		Noise
	Air pollutant emissions		Traffic accidents
	Congestion		Emissions from the energy production for means of goods transport

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We also examine the effect of goods transport on the wear caused to the infrastructure.

Is a modal shift effective?

In this study, the term modal shift in goods transport relates to the shifting of cargo flows from road transport to rail and inland shipping. For certain shippers and logistic service providers, it may be attractive to shift from the current transport of goods by road to another mode of transport. At the same time, policymakers and researchers often assume that the external costs per transport performance (tonne km) of goods transport by road are and will remain higher than those of goods transport by rail and inland shipping. In this study, we examine both aspects by providing an answer to the following questions:

- 1 To what extent is a modal shift possible or what is the Modal Shift Potential?
- 2 How great are the differences in external costs and infrastructure costs for government per transport performance (tonne km) between the different modes of transport?

The infrastructure costs for government are equivalent to the use-dependent share of the average infrastructure costs less the average infrastructure charges.

A policy focused on a modal shift can only be effective if the answer to question 1 is 'yes' and if the answer to question 2 is that the sum of the external costs and infrastructure costs for government per transport performance by road are higher than those for rail and inland shipping. In other words, effectiveness relates to the question of the benefits society can gain from a modal shift in terms of reducing (the costs of) external effects of, and wear on the infrastructure by, goods transport. We do not consider the social costs and benefits of modal-shift measures (the efficiency of the policy focus).



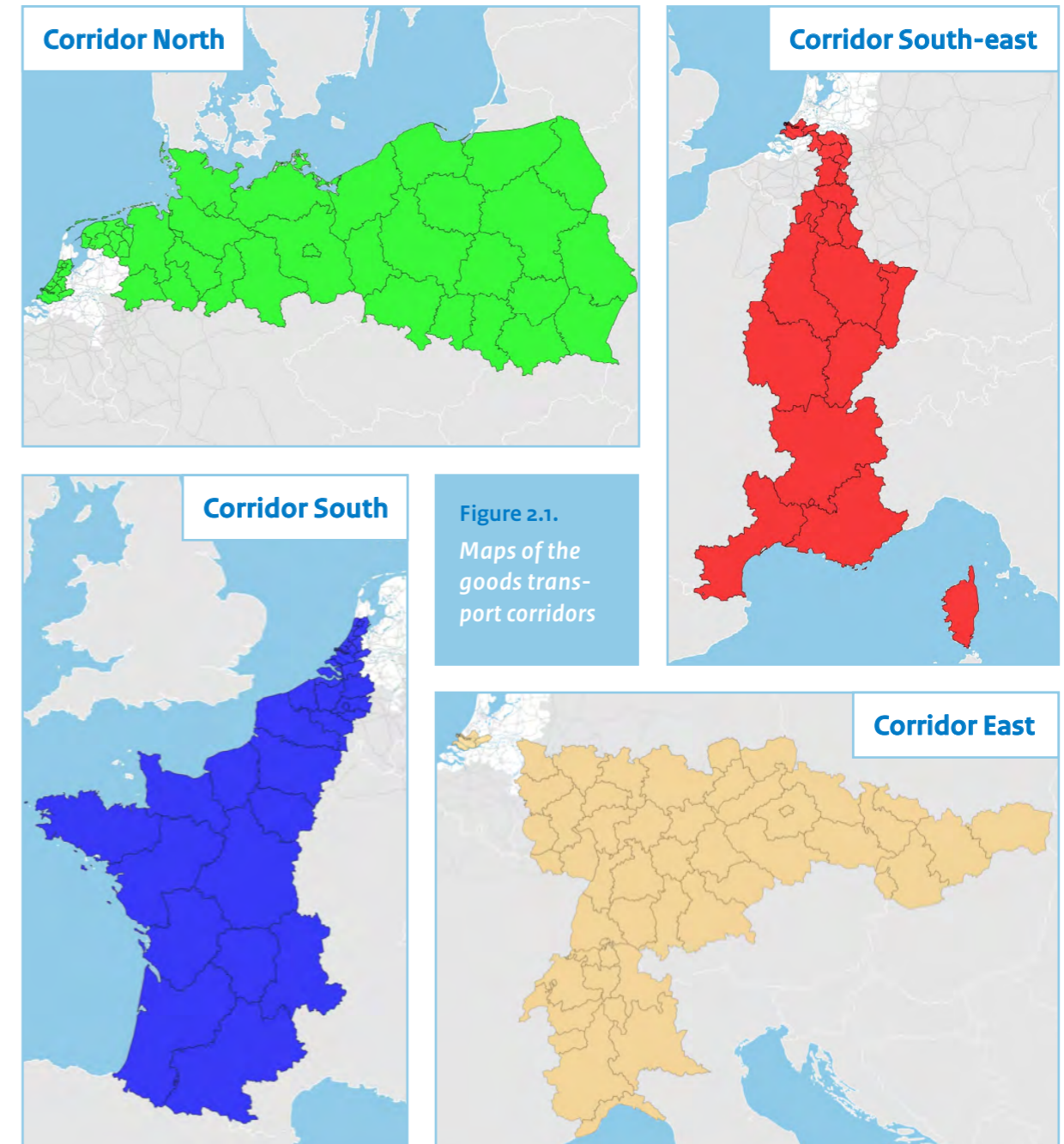
2 The Modal Shift Potential

In this part of the brochure, we go in search of an answer to the first research question:

To what extent is a modal shift possible?

Goods transport corridors

In this study, we do not consider all goods transport by road in the Netherlands, but only goods transport by road along a number of international corridors. Figure 2.1 visualises those corridors. We have opted for this approach because above all in the Netherlands, the railways, inland waterways and motorways in the corridors run practically parallel to each other. As a consequence, any modal shift would only result in a limited increase in the transport distance (and hence the total transport performance of road, rail and inland shipping together). The external and infrastructure costs for government in the corridors will therefore fall further than outside the corridors. Furthermore, along these corridors, there are 'heavy' cargo flows carried by road, making it easier to combine those flows into larger deliveries by rail or inland shipping than outside the corridors. For these reasons, a modal shift in the corridors is relatively promising. All the goods transport by road along the corridors that starts or finishes in the regions in and around the seaports of Rotterdam and Amsterdam has been included in the analyses. The transport performance (tonne km) of goods transport by road on the Dutch part of these corridors amounts to around 15% of the total transport performance of goods transport by road in the Netherlands.



Modal Shift Potential (MSP) in the goods transport corridors

Our analyses reveal that a proportion of the cargo carried along the goods transport corridors by road could be transported by rail or inland shipping at least 10% more cheaply (including the costs of pre and post-transport and the time costs for transshipment). From the point of view of the commercial transport costs, those cargoes could shift from road to rail or inland shipping. The weight of the potentially shifted cargo as a share of the total weight transported by road is referred to by the term Modal Shift Potential (MSP). As such, the MSP can be interpreted as the maximum (share of the) weight transported by road that could shift to another mode of transport, if all barriers besides transport costs (for example the low frequency of rail services) are removed.

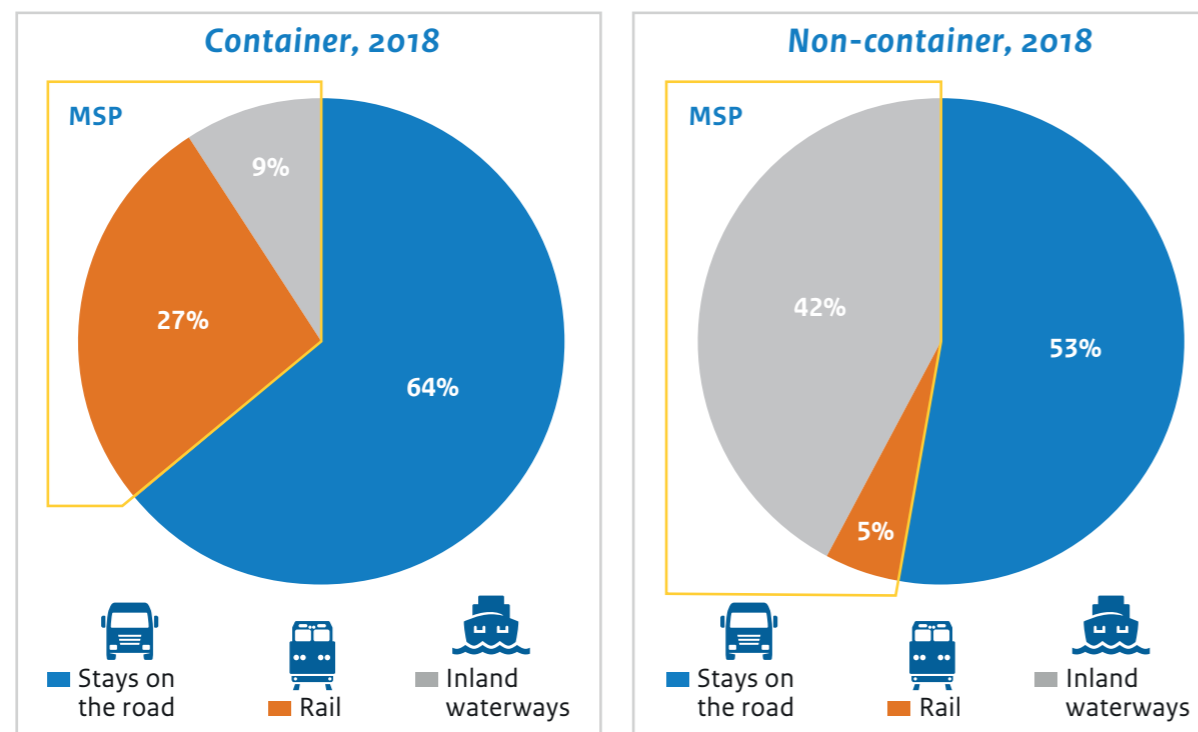
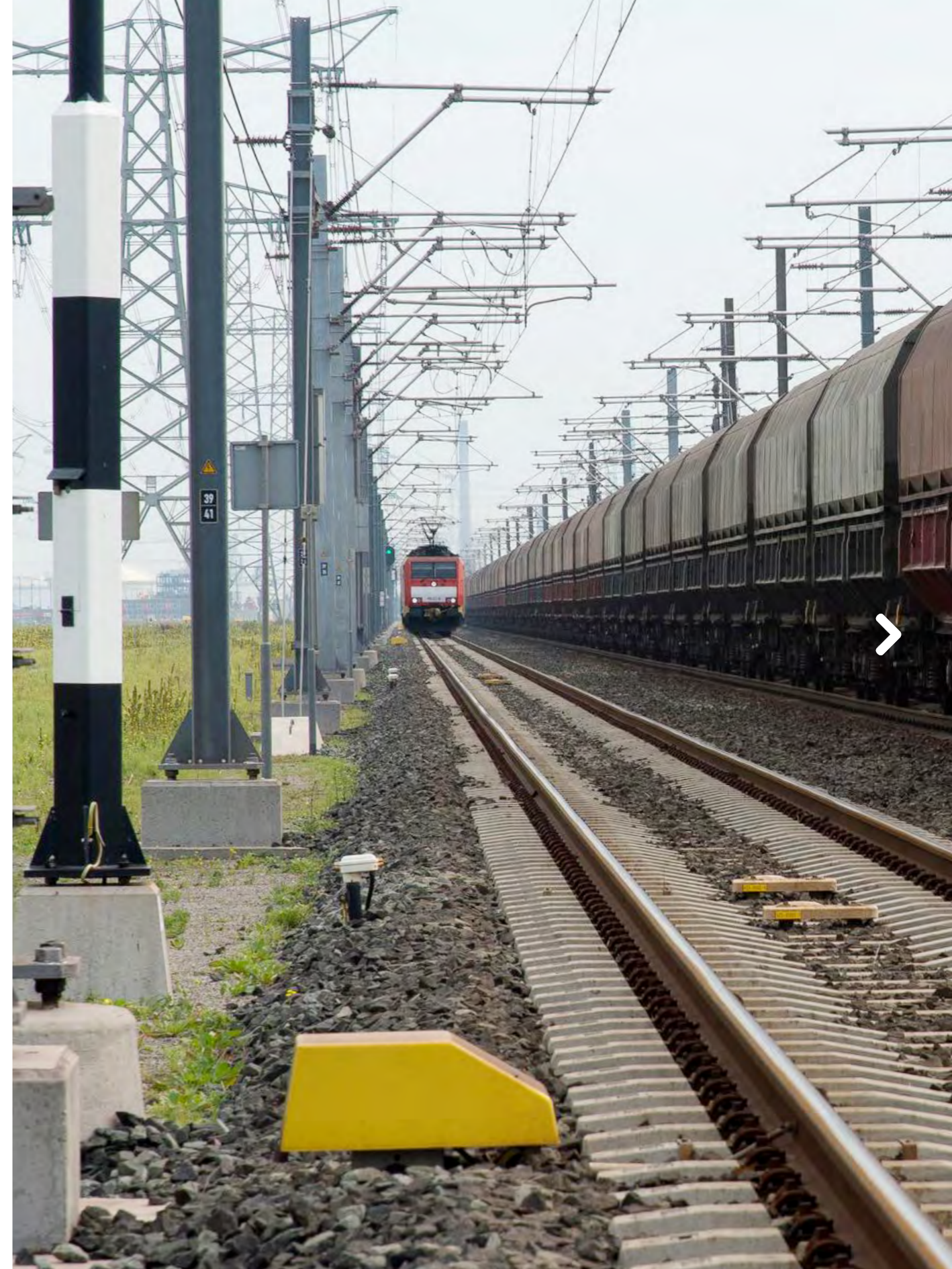
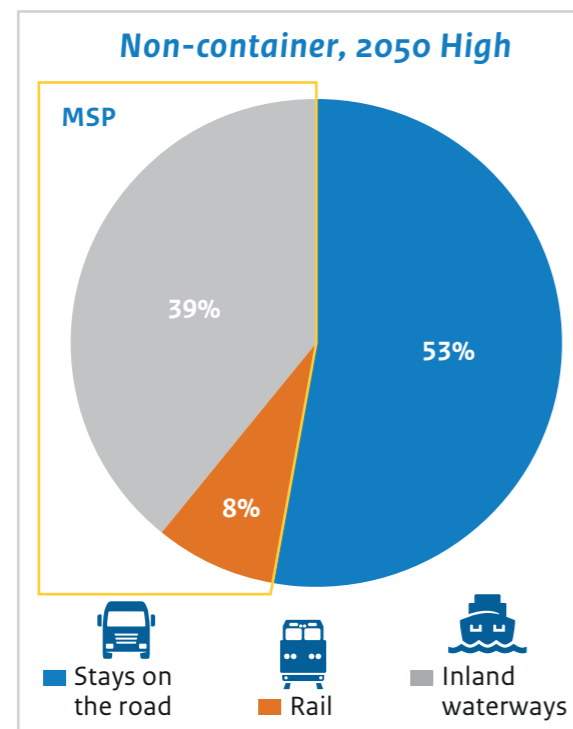
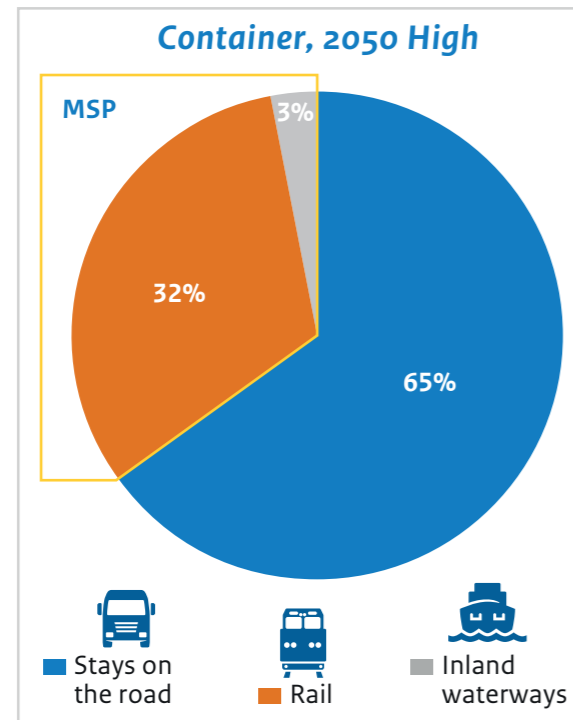


Figure 2.2 Modal Shift Potential (MSP) for weight transported by road along the goods transport corridors East, Southeast, South and North, 2018





The MSPs in the goods transport corridors are in the order of magnitude of 36-54% (see figures 2.2-2.4), depending on the goods segment (container or non-container) and the analysis year (2018 for the present day and 2050 for the two future visions). The two possible future visions in 2050 are based on the High and Low scenarios from the exploratory study into Welfare, Prosperity and the Living Environment (WLO).¹ The distribution of MSP across rail and inland shipping differs according to the goods segments. In container transport, the majority of the MSP relates to rail, and in non-container transport to inland shipping.

From the point of view of commercial transport costs, the answer to question 1 is therefore that there is potential for a modal shift.

Figure 2.3 Modal Shift Potential (MSP) for weight transported by road along the goods transport corridors East, Southeast, South and North, 2050, WLO-scenario High

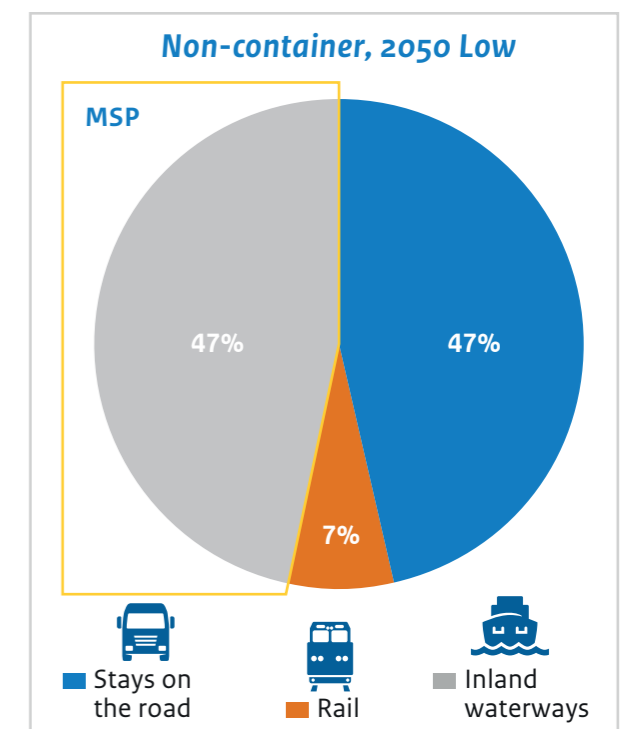
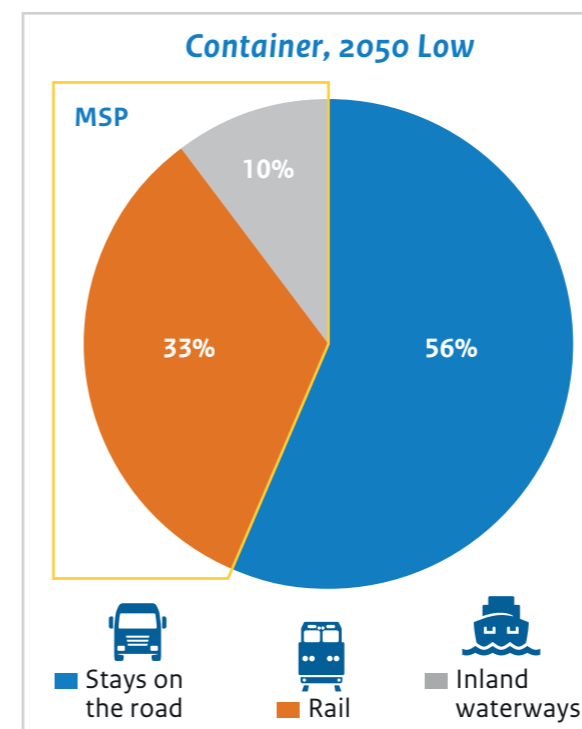


Figure 2.4 Modal Shift Potential (MSP) for weight transported by road along the goods transport corridors East, Southeast, South and North, 2050, WLO-scenario Low

¹ The study 'The Netherlands in 2030-2050: Two reference scenarios – An exploratory study into Welfare, Prosperity and the Living Environment' (WLO), is the basis for many policy decisions in the field of the physical living environment in the Netherlands. The WLO was drawn up by PBL Netherlands Environmental Assessment Agency and CPB Netherlands Bureau for Economic Policy Analysis. <https://www.wlo2015.nl/>



3 Differences in external costs and infrastructure costs between modes of transport

In this section of the brochure, we discuss our second research question: How great are the differences in external costs and infrastructure costs for government per transport performance (tonne km) between the different modes of transport?

Electric rail transport delivers the best performance

The consultancy agency CE Delft has investigated the external costs and infrastructure costs and charges per transport performance (tonne km) for the various modes of goods transport. The key figures on this subject show that at present (based on data for 2018), electric transport by rail (the green bars in figures 3.1 and 3.2) delivers the best performance on the external effects 'air pollution' and 'greenhouse gas emissions', on the total costs of all external effects, and on the total of the external and infrastructure costs for government.

The key figures are an approximation of the marginal external costs and the marginal infrastructure costs for government resulting from goods transport along the corridors in the Netherlands. The vertical lines shown with each bar in figures 3.1 and 3.2 show the uncertainty in respect of the data, methods and assumptions used in calculating the key figures for external costs and infrastructure costs for government. In other words, they show the bandwidth of the outcomes.

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Goods transport by road (grey bars) has the highest external costs per transport performance on all external effects, except air pollution. The mode of transport with the highest external effect for air pollution is inland shipping (blue bars).

The picture for the foreign section of the goods transport corridors (not shown in a figure) is very similar to the picture for the Dutch section.

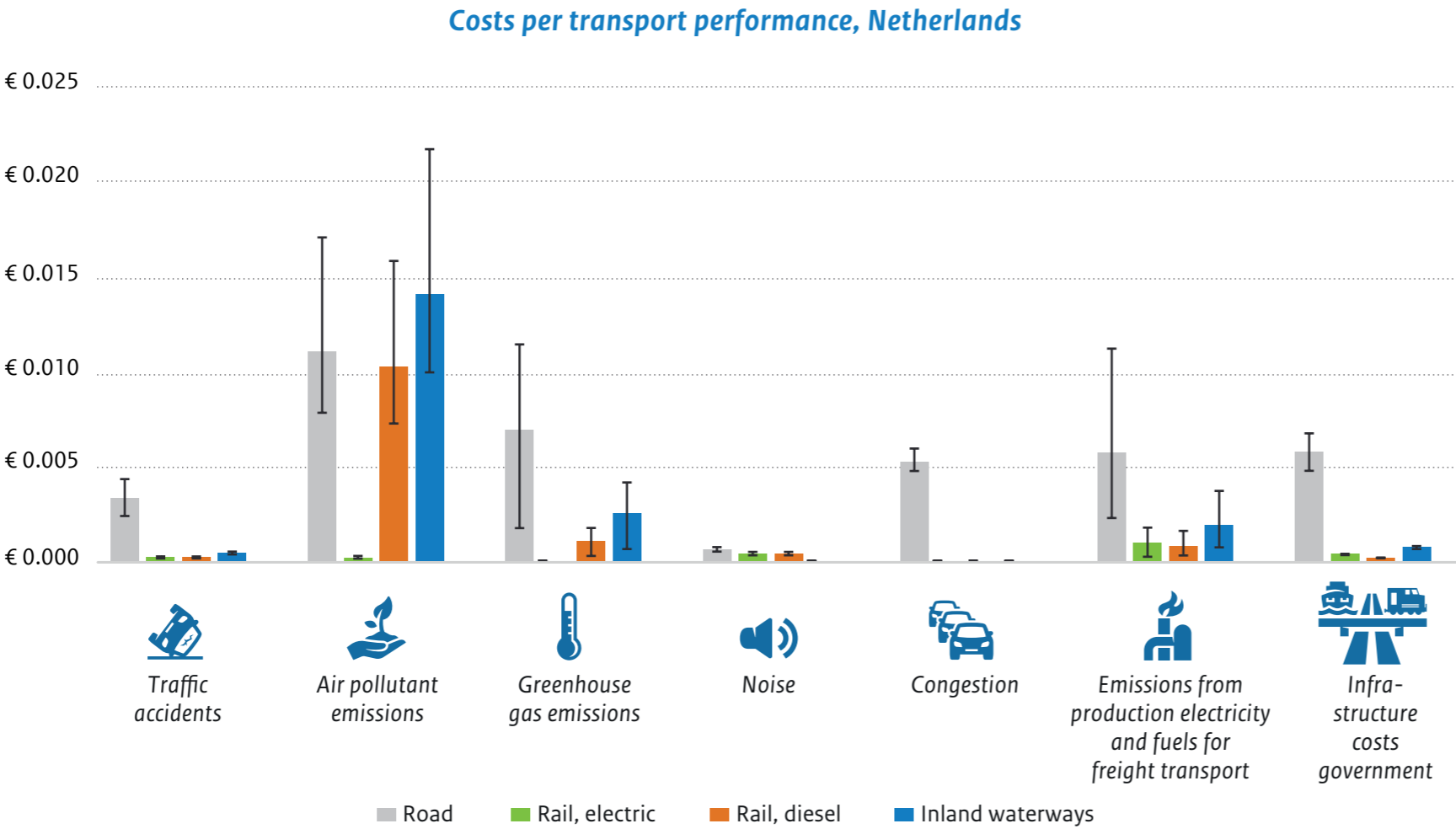


Figure 3.1 Marginal external costs and marginal infrastructure costs for government per transport performance for goods transport along the 4 goods corridors in the Netherlands in €/tonne km, 2018





Costs per transport performance, Netherlands

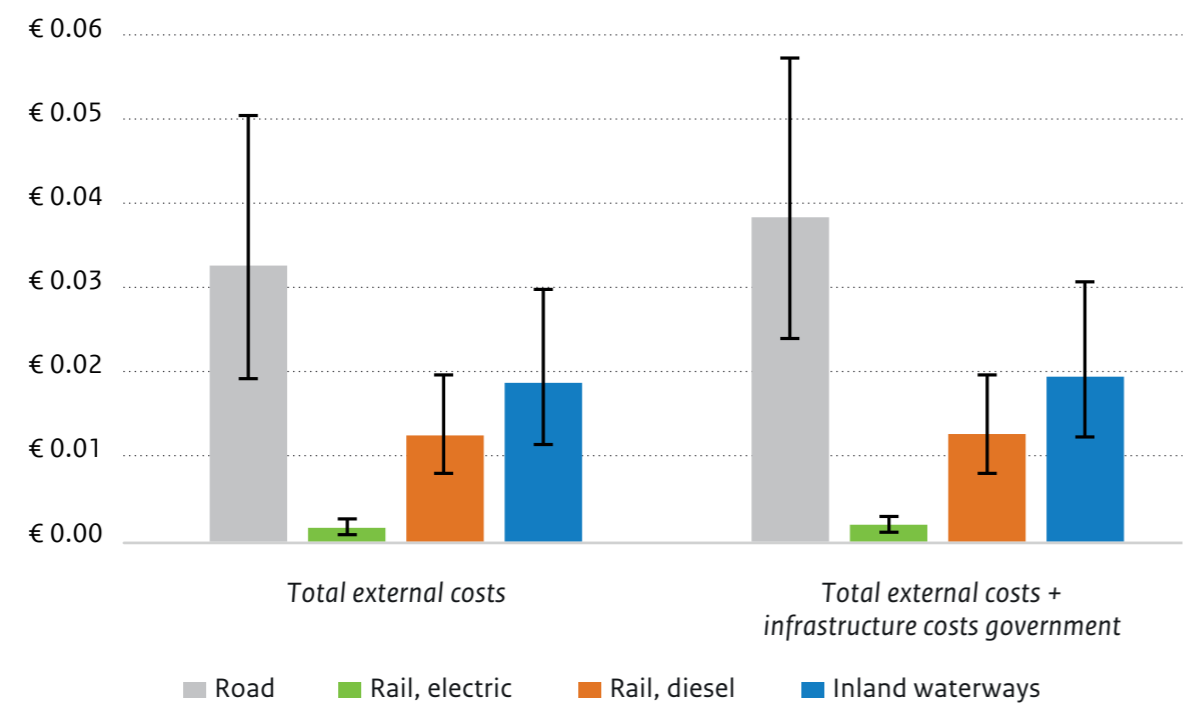


Figure 3.2 Total marginal external costs and sum of total marginal external costs and marginal infrastructure costs for government per transport performance for goods transport along the 4 goods corridors in the Netherlands in €/tonne km, 2018

Gains per shifted transport performance

Figure 3.3 shows that in the reference year 2018, the sum of external costs and infrastructure costs for government is reduced by 95% if one transport performance (tonne km) in the goods transport corridors in the Netherlands shifts from road to electric rail transport. For a shift from road to diesel-rail transport, the gain is 67% and from road to inland shipping 49%.

On the foreign section of the goods transport corridors, the fall is 80% (from road to electric-rail), 59% (from road to diesel-rail) and 44% (from road to inland shipping).

This provides us with an answer to our second research question: for goods transport by road, the total of external costs and infrastructure costs for government per transport performance along the goods corridors is currently clearly higher than for transport by rail and inland shipping.

Gains per transport performance of different modal shifts, 2018

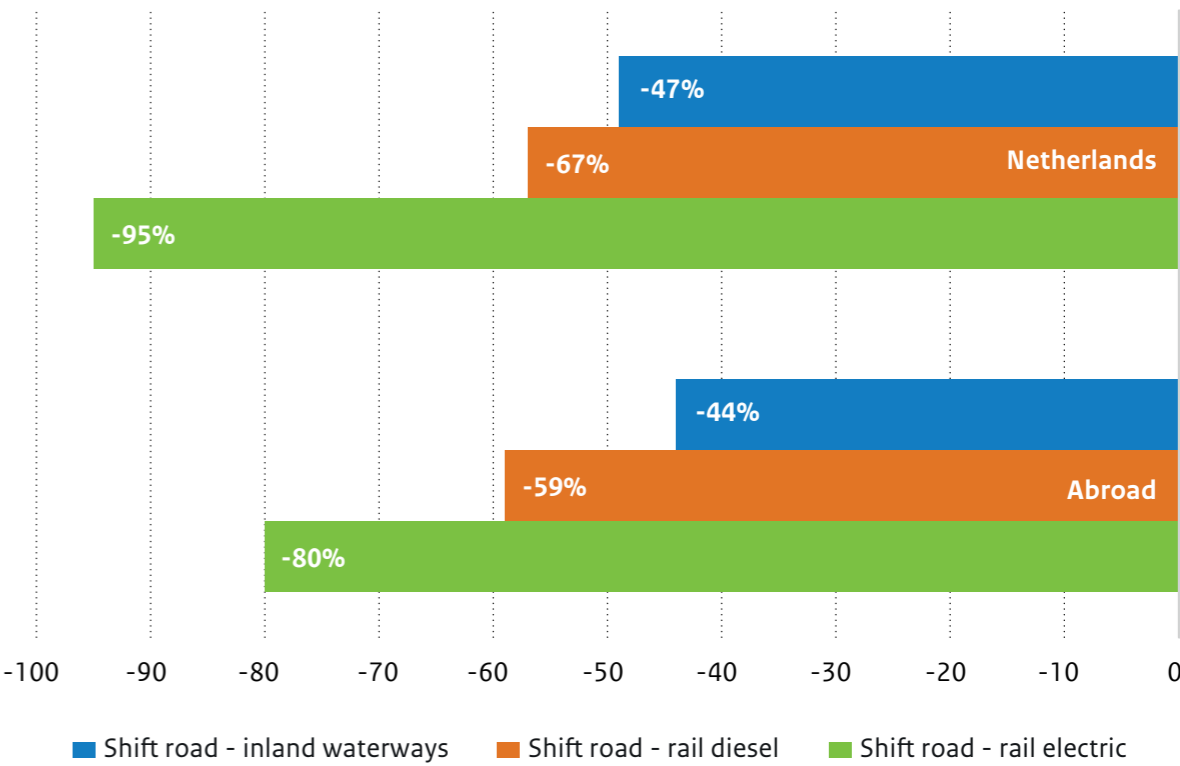
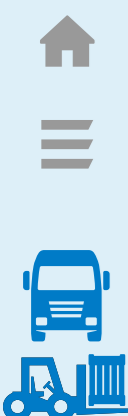


Figure 3.3 Percentage change in external costs and infrastructure costs for government from the shift of 1 tonne km along the goods transport corridors, 2018



External costs and infrastructure costs of goods transport further in the future (2050)

It is uncertain how external costs per transport performance (€/tonne km) will develop in the future. This uncertainty relates to the question of how the sustainability of goods transport (external effect per tonne km)² and the valuation of the external effects (€ per unit external effect) will develop.

As a formula:

€/tonne km = units/tonne km x €/unit

Gains per transport performance of different modal shifts, Netherlands, 2050

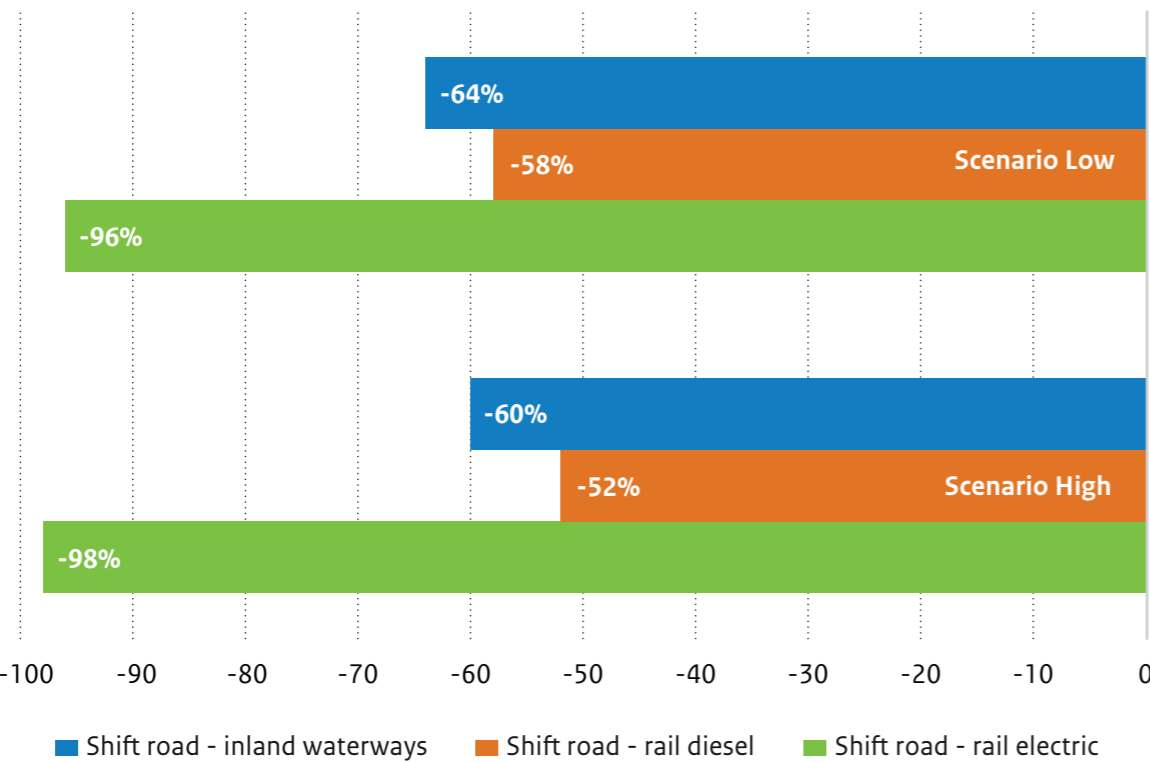


Figure 3.4 Percentage change in external costs and infrastructure costs for government from the shift of 1 tonne km along the goods transport corridors, Netherlands, 2050



In our study, in addition to key figures for external costs for goods transport in 2018, we have also used key figures for 2050 produced by CE Delft. Because of a lack of data, we have been forced to not consider the foreign section of the goods transport corridors.

We use key figures for two possible future visions in 2050, based on the High and Low scenarios of the exploratory study into Welfare, Prosperity and the Living Environment (WLO). Because the WLO scenarios were compiled policy-neutral, the key figures for external and infrastructure costs apply to a policy-neutral future. Based on the future visions, the shifting of 1 tonne km from the road to rail or inland shipping in 2050 will also result in a (relative) reduction in the sum of external costs and infrastructure costs for government; see figure 3.4. This outcome is however surrounded by much uncertainty.

² For example the number of tonnes of CO₂ (in the external effect greenhouse gas emissions) or the number of traffic accident victims (in the external effect traffic accidents) per tonne km.

4 From Modal Shift Potential to change in external costs and infrastructure costs



In this section we show how the MSPs translate into a change in external costs and infrastructure costs for government relating to goods transport along the corridors. The presented changes will therefore only be achieved if the MSPs are realised in full. This is not entirely probable, because it is likely that not all obstacles to a modal shift can be removed by introducing measures. The set of modal shift measures taken will at the end of the day determine what proportion of the MSP-related change to external costs and infrastructure costs will be realised.

Dutch section of goods transport corridors, 2018

For the Netherlands, the largest cost reductions will be achieved in the external effects ‘greenhouse gas emissions’ and ‘congestion’; see figure 4.1. For air pollutant emissions, external costs will rise slightly because they are higher for inland shipping per transport performance than for road transport, and because the MSP (total of container and non-container segment) to inland shipping is 4 times greater than to rail. The fall in external costs of air pollution due to the modal shift to rail will therefore be more than negated.

If the MSP is realised in full, the total external costs of goods transport along the 4 corridors in the Netherlands will fall by between €45 million and €118 million per year; see figure 4.2. For infrastructure costs for government, the cost reduction amounts to between €22 million and €32 million. For the sum of external costs and infrastructure costs for government, the fall occupies a bandwidth of between €67 million and €150 million per year for the Dutch section of the goods transport corridors.

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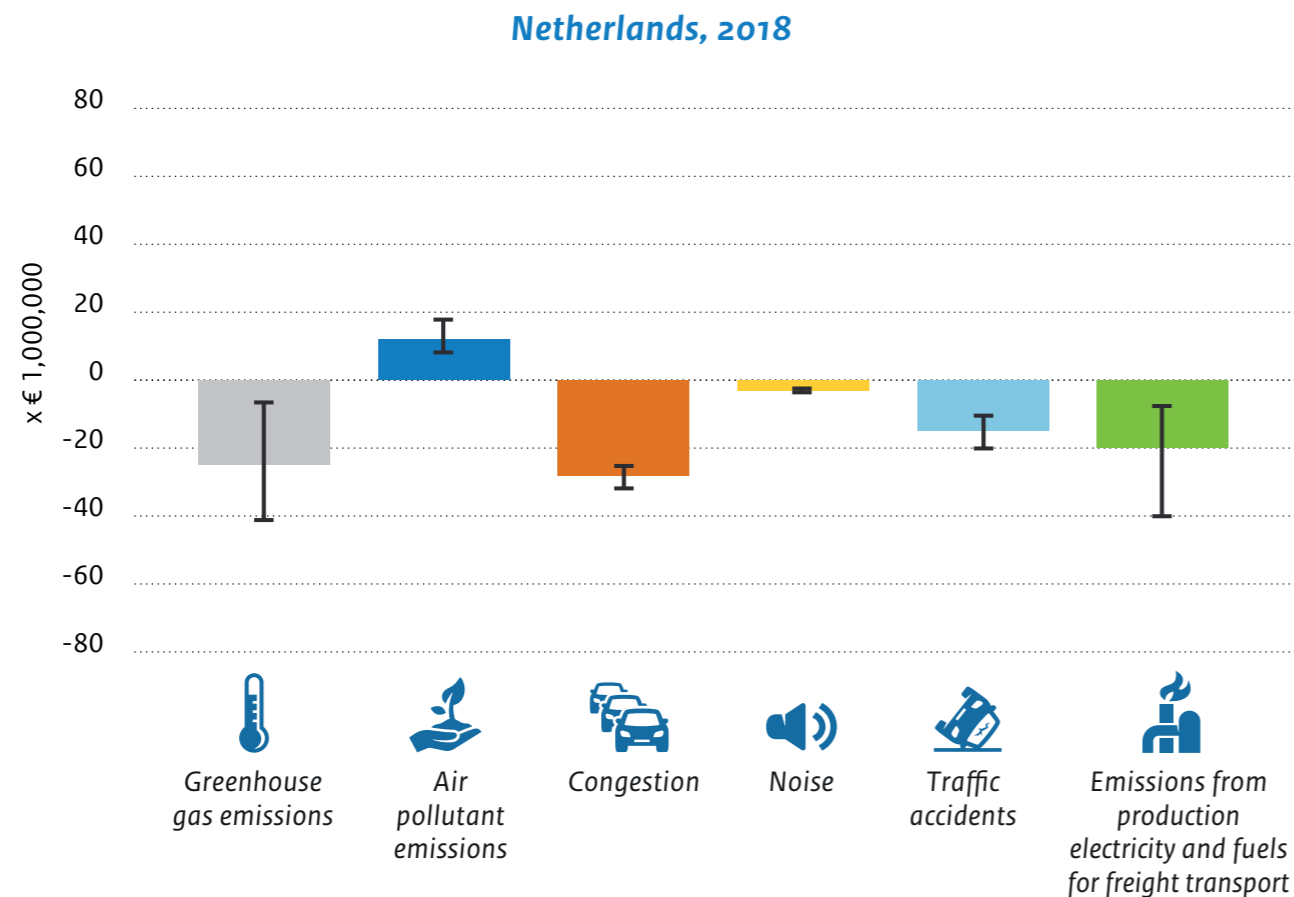


Figure 4.1 Change in external costs from realisation of MSP along goods transport corridors Netherlands, 2018

Foreign section of goods transport corridors, 2018

For the foreign section of the goods transport corridors, the greatest cost reductions will be realised on the external effects 'congestion' and 'traffic accidents'; see figure 4.3. Compared with the Netherlands, the greatest cost increase in the external effect 'air pollutant emissions' stands out. The cost increase has two causes. Firstly, the decline in transport performance on the road and the rise in transport performance in inland shipping on the foreign section of the goods transport corridors are greater than in the Dutch section. Secondly, the difference between road and inland shipping in external costs per transport performance for air pollutant emissions is higher in other countries than in the Netherlands.

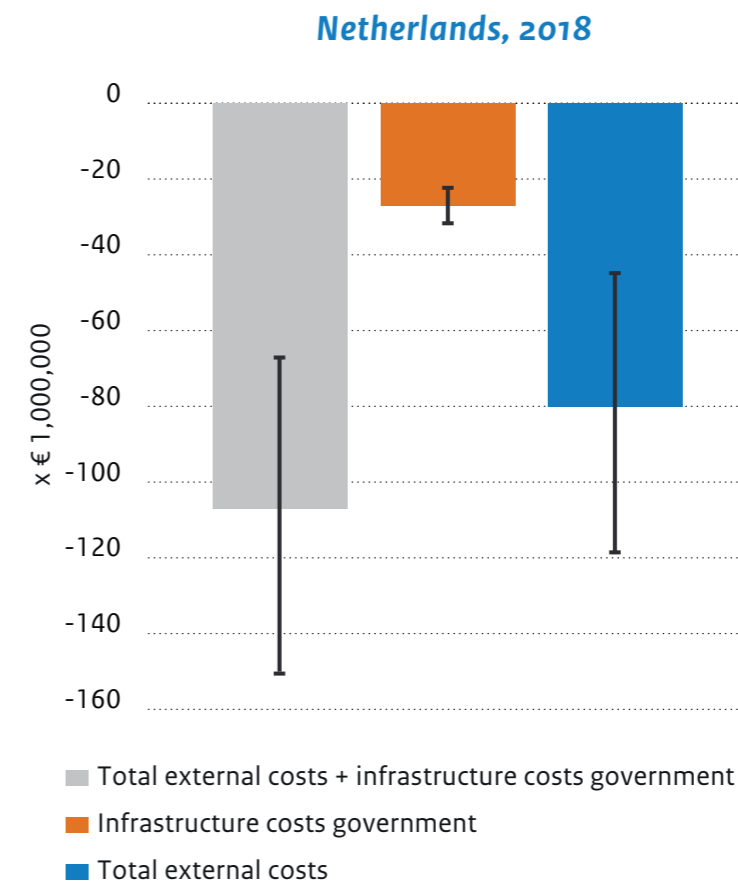
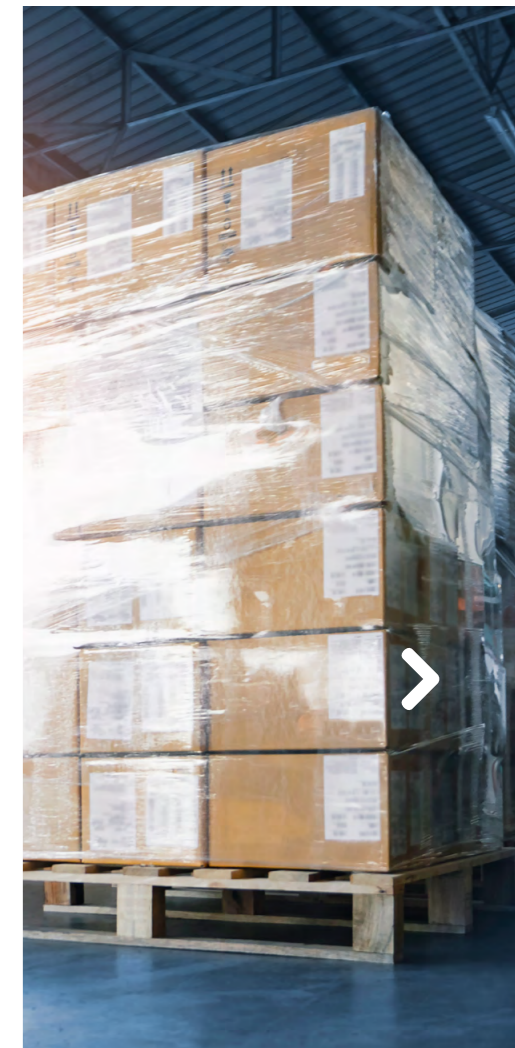


Figure 4.2 Change in external costs and infrastructure costs for government from realisation of MSP along goods transport corridors Netherlands, 2018



If the MSP is realised in full, the total external costs of goods transport along the 4 corridors abroad will fall by between €51 million and €88 million per year in 2018. In respect of infrastructure costs for government, the fall amounts to between €35 million and €48 million; see figure 4.4. For the total external and infrastructure costs for government, the fall amounts to between €86 million and €136 million per year.

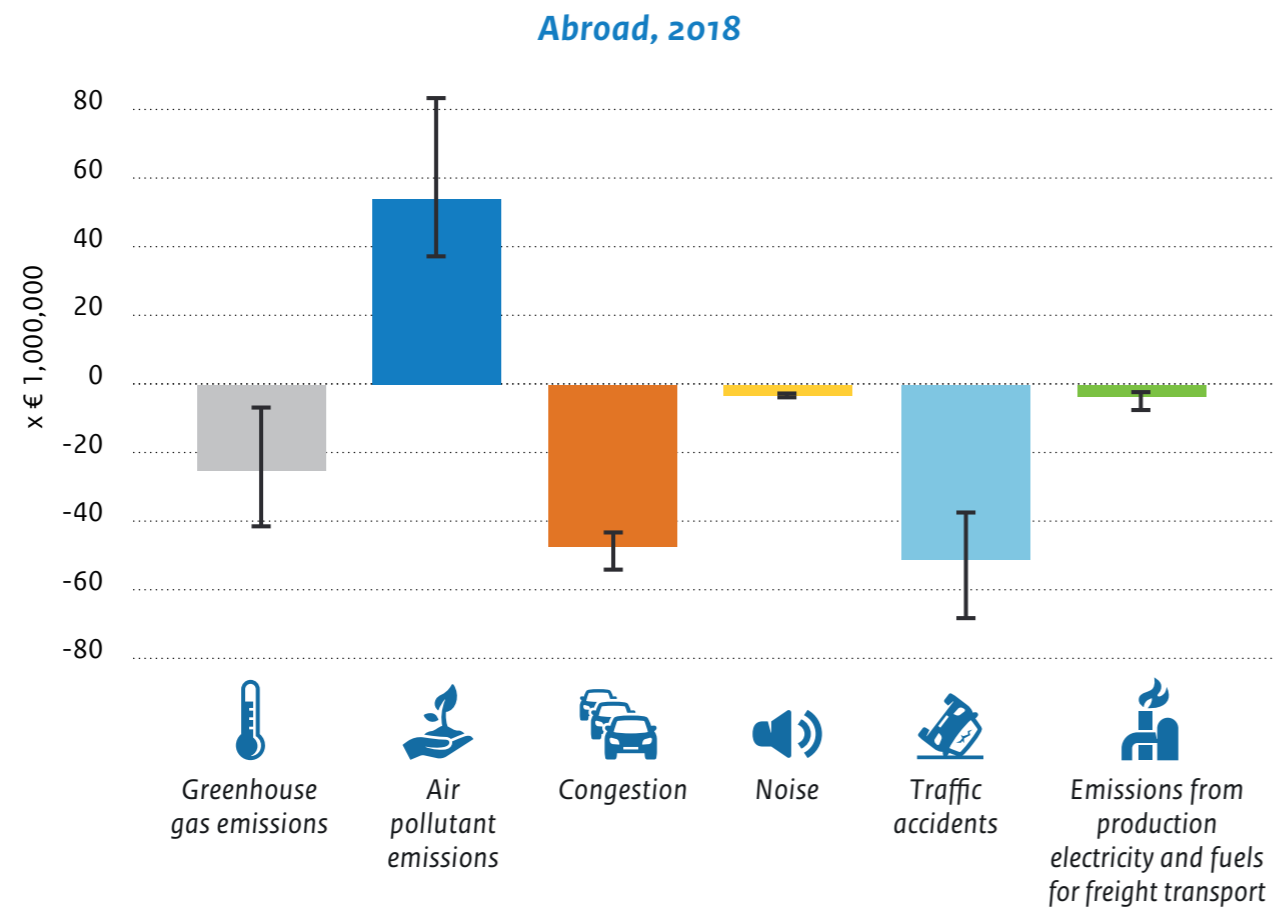


Figure 4.3 Change in external costs from realisation of MSP along goods transport corridors abroad, 2018

Translating MSPs for 2050 into changes in external costs and infrastructure costs for government, 2050

In the case of the WLO scenarios High and Low for 2050, the MSPs along the goods transport corridors also translate into a reduction in external costs and infrastructure costs for government (not reproduced in a figure). The differences between the two scenarios are considerable, which indicates that the outcomes are extremely sensitive to the future development of population and economy. The results are also sensitive to policy and innovations from the goods transport market, not accounted for in the WLO scenarios.

This is because policy and innovations that have an effect over and above the WLO scenarios can influence both commercial transport costs (and hence the scale of the MSPs) and external costs per transport performance. The uncertainty concerning the effect on external costs per transport performance alone makes the outcome extremely uncertain. We were unable to investigate the uncertainty concerning the effect on commercial transport costs. For these reasons, it is uncertain whether a policy focus on a modal shift could be effective in 2050.

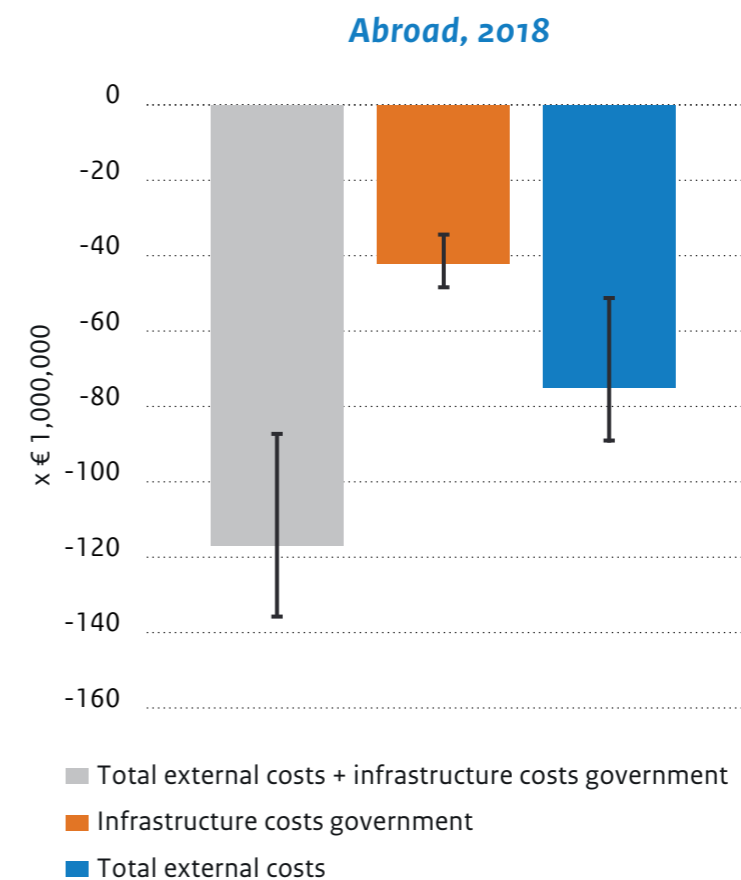
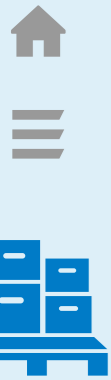
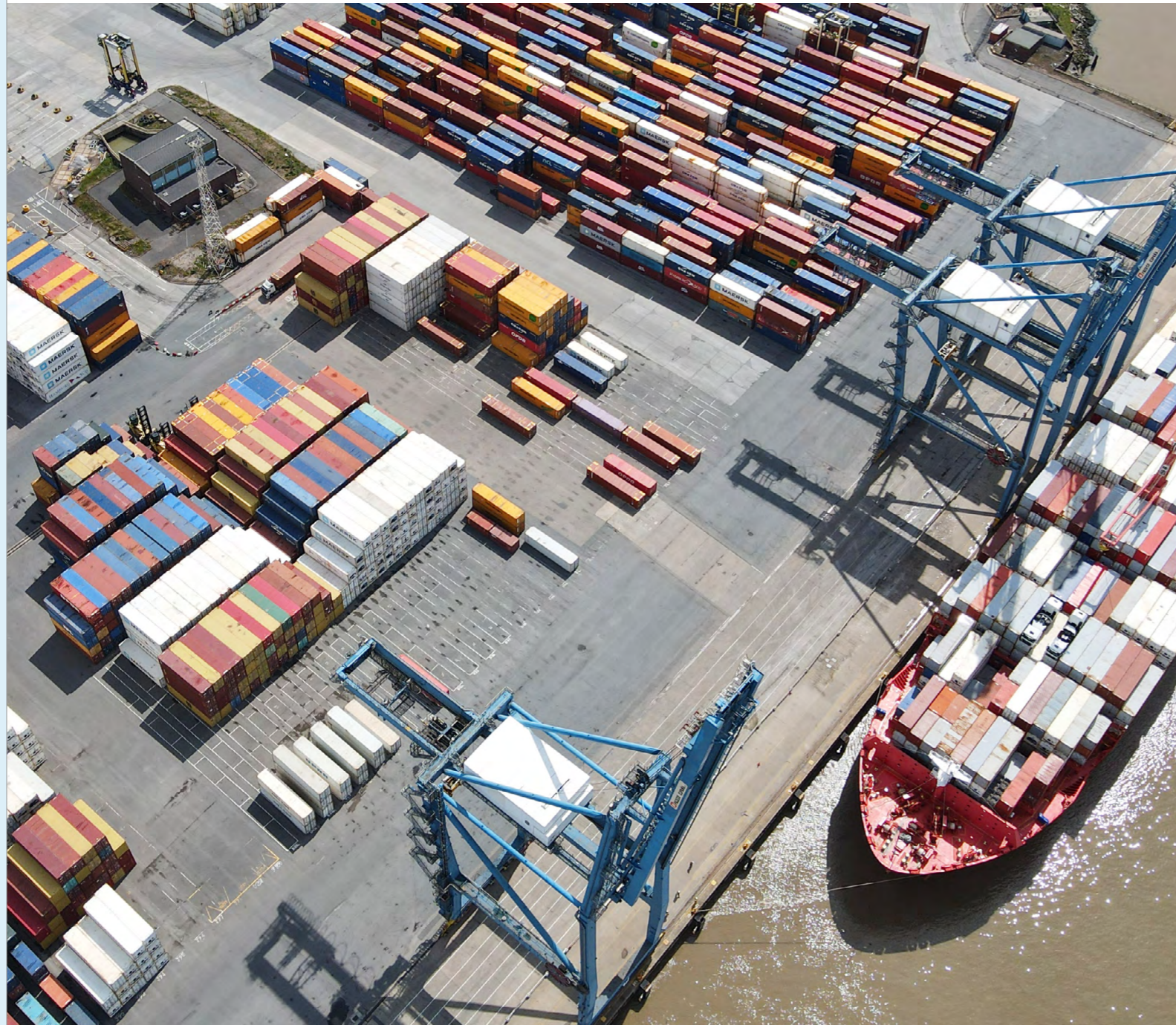


Figure 4.4 Change in external costs and infrastructure costs for government from realisation of MSP along goods transport corridors abroad, 2018



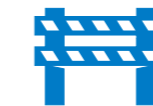


5 Policy action points



Payback time

As demonstrated, policy aimed at realising a modal shift along the goods transport corridors could be effective over the coming years. This implies that it is perfectly defensible to invest in modal-shift measures that have a payback time of several years. For measures with a long payback time, and that involve large amounts, the situation is different. In those situations, there is a risk that the estimated future benefits of the modal-shift measure(s) will not be earned back. Additional policy (for example in the field of sustainability or accessibility) could mean that the future reduction in external costs and infrastructure costs for government proves disappointing. Another action point for policy that emerges from this situation is that the costs and benefits of government measures in goods transport must always be evaluated in their full context.



Barriers to realising MSPs

The savings in external costs and infrastructure costs for government based on the MSPs can only be achieved if the estimated MSPs are realised in full. This is probably impossible because to achieve that target, not only small but also large barriers to a modal shift need to be removed. This raises the question about what the optimum number and composition of measures aimed at a modal shift would be. The obvious answer is to first focus policy on measures with relatively low costs and high benefits. As more measures are taken, it will become increasingly difficult to identify measures that deliver a positive cost benefit balance.

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This latter element is a logical criterion in deciding whether or not to take modal-shift measures. The resultant policy action point is that the ex ante evaluation of a set of modal-shift measures could result in a prioritisation of those measures from most to least efficient.



Flanking policy?

In the event of a modal shift from road to inland shipping, the costs per transport performance rise for the external effect 'air pollutant emissions'. Policy aimed at a modal shift could further increase the total reduction in external costs if flanking policy brings about a situation in which inland shipping becomes cleaner, in comparison with road transport, for the external effect 'air pollutant emissions'.



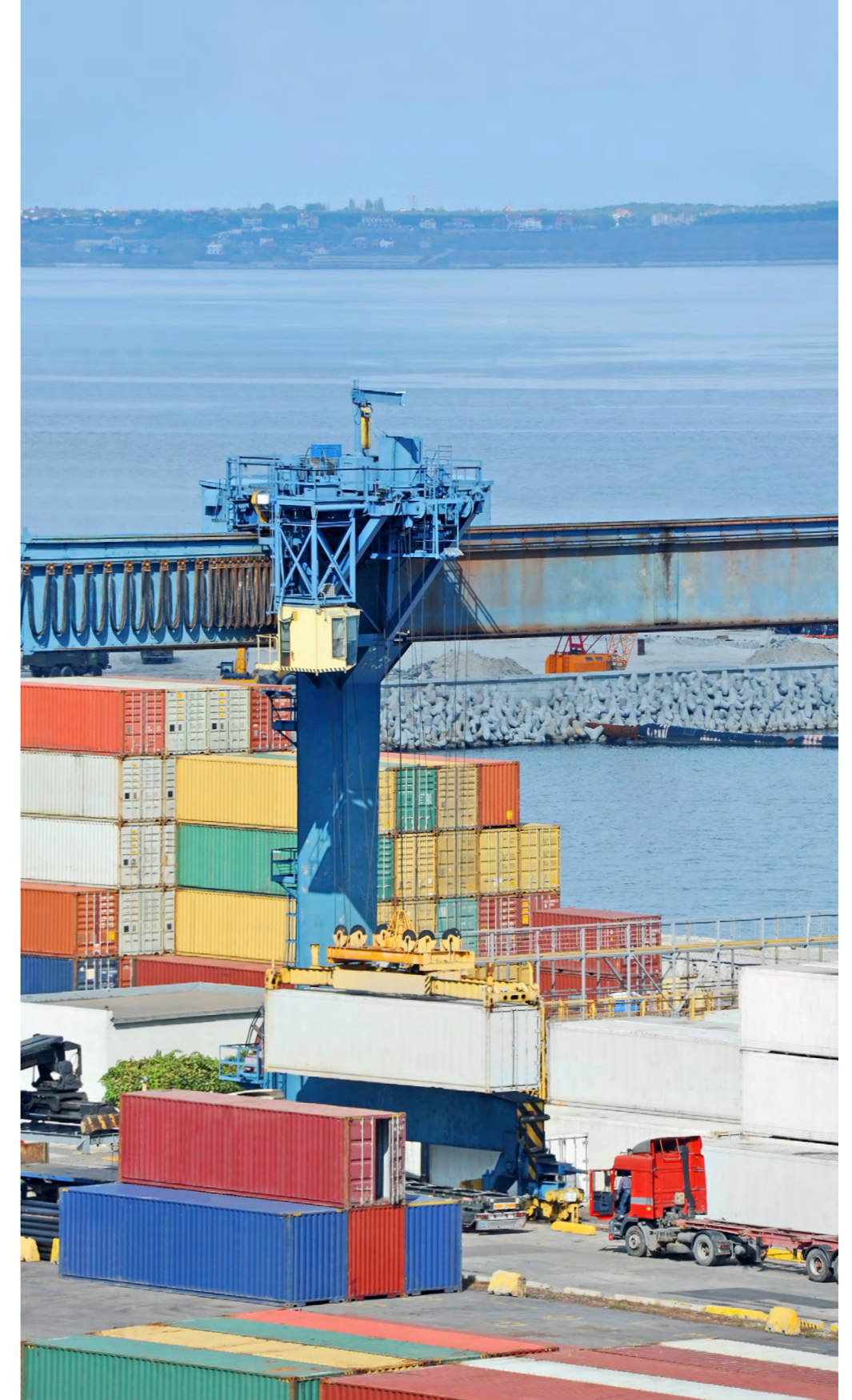
Prioritisation

If we consider all the external effects plus the wear on the infrastructure, at present a modal shift to electric rail along the goods transport corridors will result in the greatest (external) cost reduction per transport performance. This is followed by a shift to diesel-rail and finally to inland shipping. This means that a prioritisation of modal-shift measures according to the mode of transport could be worthwhile, if it takes into account the available capacity on the rail and inland shipping networks.



Effects abroad

The analysis for 2018 reveals that a realisation of the MSPs results in a reduction in internal costs abroad as well. Overall, the effects abroad are not taken into account in the national cost-benefit balance in a social cost benefit analysis; only the climate impact (greenhouse gas emissions) forms an exception. However, a modal shift also results in a reduction in external costs abroad in respect of other external effects than greenhouse gas emissions. In particular this applies to congestion and traffic accidents. This could provide grounds for including the effects of the modal shift abroad in a social cost benefit analysis, over and above the effects at national level.





Acknowledgements

Method

For this study we investigated existing literature on Modal Shift Potential (MSP) in goods transport, and the potential benefits to society of a modal shift, in terms of lower external costs and infrastructure costs for government. The MSPs in this study were determined according to the goods transport model BasGoed and a transport costs model for goods transport. Research agency Dat.mobility carried out the analyses on behalf of KiM.

For key figures and external costs and infrastructure costs and charges for goods transport, we made use of studies by research agency CE Delft.

The model we used to translate the MSPs into changes to external and infrastructure costs for government was developed by KiM itself, in-house.

The insights from our study are a snapshot in time. As a result of future changes to commercial transport costs for goods transport, measures that make goods transport more sustainable and the valuation of examination effects, the outcomes of this study may change. Our estimate is that the insights from this study will certainly continue to apply for the coming years.

Background report

For more information on the method used and the results, consult the background report to this brochure, which can be downloaded via the website www.kimnet.nl

Jonkeren, O. (2023). *Verandering in externe kosten en infrastructuurkosten van het goederenvervoer door modal shift*. Backgroundreport. The Hague: Kennisinstituut voor Mobiliteitsbeleid (KiM).

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