POLICY OPTIONS FOR CARBON EFFICIENT HEAVY VEHICLES

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Abstract
Road freight transport has been growing and is expected to grow further in the future. The past ten years heavy vehicles have become cleaner, but not more fuel efficient. Consequently, in the Netherlands CO₂ emissions by heavy vehicles have increased and will increase further if current policies remain unchanged.

This paper ‘Policy options for carbon efficient heavy vehicles’ presents an overview of possible CO₂ emission reduction measures in the road freight sector till 2020, and an analysis on the effectiveness and efficiency of six different policy options to reduce CO₂ emissions. Substantial fuel savings are technically feasible, but these measures cost money and will not be implemented automatically by the transport sector. Some policy options turn out to be highly effective, but social cost-effectiveness varies widely. Public support for most instruments might be limited, because the instruments increase the cost of fuel and/or transport.

Keywords: Heavy vehicles, CO₂ emission reduction, Reduction measures, Policy options, Cost-effectiveness.
1. Introduction

‘The Inconvenient Truth’ has provided Al Gore the Nobel Prize and has put climate change top of the policy bill in nearly all countries of the world. The European Commission presented in January 2008 an ambitious action plan ‘20 20 by 2020: Europe's climate change opportunity’ to reduce the emission of green house gasses (GHG) with at least 20% by 2020. The recent climate conference in Copenhagen has not changed this European ambition. But, it is said that the current policies on transport will not be effective enough to reduce CO₂ emissions from transport enough to meet these targets.

The Dutch government has set an even higher national objective of achieving a 30% reduction in greenhouse gas emissions by 2020, compared to 1990 levels. In its ‘Clean and Efficient programme’, the Dutch government has set a goal for the entire traffic and transport sector to reduce CO₂ emissions in 2020 by 13 Mton to 17 Mton compared to forecast trends under unchanged policy. A study was commissioned as part of the ‘Clean and Efficient programme’ into measures to achieve further efficiency improvements in the road freight transport sector: standards, economic instruments or incentives. The KiM Netherlands Institute for Transport Policy Analysis (KiM) conducted this study (Francke, Annema and Wouters, 2009).

Heavy Vehicles CO₂ Emissions in the Netherlands’ Past and Future

During the 1990-2006 period road freight transport in the Netherlands increased by about 50%. In the same period, the associated CO₂ emissions increased by 30%. On average, there has been an annual reduction of 1% in fuel consumption and CO₂ emissions per ton kilometre. This can largely be attributed to the use of larger vehicles and more trailer trucks.

If policy remains unchanged, CO₂ emissions from road freight transport will by 2020 continue to increase to 6,4 Mton to 8,7 Mton, depending on the future scenario. This takes into account autonomous reductions in CO₂ emissions per ton kilometre of 1 to 1,5% per year. Increased CO₂ emissions from road freight transport can be attributed to economic growth, which leads to the increased flows of goods.

Research Methods

The main goal of this study is to gain a better insight in the effectiveness and efficiency of policy instruments to further reduce CO₂ emissions in the road freight sector. KiM conducted this study for the Dutch Ministry of Transport, Public Works and Water Management.

Three main questions had to be answered by this research:
1. Identify: Which measures exist to reduce carbon emissions in road freight transport and which policy options exist to implement these measures?
2. Describe: How do these policy options work and have their effect? For example, how does it trigger the (technical) measures (fuel, vehicle, driving, logistics, production and consumption) and who will incur the costs and benefits?
3. Assess: Compare the policy options on different criteria including social costs and benefits.

Based on an international literature review and interviews with several experts a summary is made of the main characteristics of the various measures and policy instruments for CO₂ emission reduction by Heavy Goods Vehicles (> 3,5 tonnes GVW). Subsequently, six policy options were chosen covering economic instruments, standards and incentives. The assessment of the policy options is based on a standard framework used in the Netherlands.
This framework includes the consideration of legitimacy (foundation for and different roles of government), effectiveness (contribution to policy objectives) and efficiency (ratio of public costs and benefits). The nature and extent of the effects of the instruments are described qualitatively and where possible the effects are quantified and valued on money.

Contents
This paper first describes the various (technical) measures for improved fuel efficiency and reduction of carbon emissions in section 2 (research question 1). But, these measures cost money and effort and will not be implemented automatically by carriers and shippers. Several policy options are presented for governments to influence the behaviour of carriers to implement the measures. The policy options are assessed on effectiveness, economic efficiency and also on public support in section 3 (research questions 2 and 3). Finally, our research findings are presented in section 4.

2. Different Measures for Fuel Savings

An often heard argument in the road freight sector is that extra energy or fuel can only marginally be saved. The fuel expenses already consist of 25% to 40% of total costs, so carriers (and shippers) have a clear motivation to keep these costs to a minimum (no need for further governmental intervention). In reality all kind of disturbances can occur. For example, smaller firms are less flexible to adjust their fleet to new needs, or just-in-time requirements from clients leads to inefficiency. Also transporters may lack the proper information or consider the methods too complex or expensive to implement (Eye for Transport 2008). In reality there certainly is room for further improvement of efficiency and fuel-consumption.

The literature describes a broad range of measures to increase the efficiency of – and consequently reduce the CO$_2$ emissions produced by – road freight transport. The different measures can be grouped into four main categories: volume reduction, technical vehicles measures, behavioural measures, and the use of biofuels. Table 1 presents an overview of possible CO$_2$ emission reduction measures till 2020.

<table>
<thead>
<tr>
<th>Category</th>
<th>Reduction measure</th>
<th>% reduction in 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume reduction</td>
<td>operational efficiency logistics</td>
<td>0 - 10 %</td>
</tr>
<tr>
<td></td>
<td>higher maximum loading capacity</td>
<td>3 - 5 %</td>
</tr>
<tr>
<td></td>
<td>modal shift</td>
<td>0 - 10 %</td>
</tr>
<tr>
<td>likely potential</td>
<td>overlap between measures</td>
<td>3 - 15 %</td>
</tr>
<tr>
<td>Technical</td>
<td>low rolling resistance tyres</td>
<td>2 - 6 %</td>
</tr>
<tr>
<td></td>
<td>entire vehicle</td>
<td>7.5 - 15 %</td>
</tr>
<tr>
<td>likely potential</td>
<td>reasonably certain</td>
<td>7.5 - 15 %</td>
</tr>
<tr>
<td>Behaviour</td>
<td>training fuel efficient driver behaviour</td>
<td>0 - 5 %</td>
</tr>
<tr>
<td></td>
<td>lower maximum speedlimit</td>
<td>0 - 3 %</td>
</tr>
<tr>
<td></td>
<td>buying of more efficient vehicles (fit for purpose)</td>
<td>? %</td>
</tr>
<tr>
<td>likely potential</td>
<td>uncertain, overlap</td>
<td>0 - 5 %</td>
</tr>
<tr>
<td>Biofuels</td>
<td>Cleaner fuels: blending with biofuels, hybrids</td>
<td>0 - 20 %</td>
</tr>
<tr>
<td>Total potential</td>
<td>uncertain</td>
<td>10 - 30%</td>
</tr>
</tbody>
</table>
The different reduction measures were all assessed separately. We are not familiar with research work that explicitly concerns the interaction between different reduction measures. But surely the separate effects can not be simply added up due to certain overlapping working areas. And besides overlap, rebound effects should be taken into account as well. For example: higher efficiency leads to lower transport costs which in turn partly attracts more transport.

Let us now look more closely at the four categories of reduction measures.

2.1 Description of different reduction measures

**Volume**
Volume reduction means lesser transport for example by lesser production or consumption, rearranging supply chains, holding bigger inventories, or modal shift. When sub optimal situations persists, trade organisations play an important role in disclosing and sharing information and best practices. ‘Believers’ think that up to 20% extra emission reduction is possible, but sceptics say that most cost-effective measures will already have been taken by a professional and cost-driven sector.

**Technical**
In the literature most attention goes to different technical measures for more efficient vehicles, for example better engines, aerodynamics, rolling resistance, size, weight and load capacity, speed control etc… Again, most cost-effective measures will already have been taken. Another problem is that most remaining measures produce only small reductions in fuel efficiency which are not clearly visible for an individual carrier.

**Behaviour**
After the technical properties of a vehicle, the driving performance of truck drivers is considered the next most influential factor to fuel consumption. But the total potential of behavioural measures strongly depends on the amount of drivers that actually show and keep on showing improved performance. In addition, experts say that fuel efficient driver training courses should be repeated at least once a year, because newly learned driving behaviour does not seem to stick well.

**Biofuels**
The carbon footprint of so-called first generation biofuels is heavily debated (for example OECD 2007) and large production of second generation biofuels still appears to be a long way away. Hybrid, full-electric and hydrogen heavy vehicles are possible, but seem especially effective for urban and regional transport only. Longer range carriers have problems with the storage of large and heavy fuel cells or hydrogen tanks. Biofuels will play an important role in achieving higher CO$_2$ emission reduction goals after 2020 (for 2050 reduction goals are mentioned in the range of 50% to 80%).

Although fuel is a major cost factor in road freight transport, the above mentioned (technical) reduction options are not automatically applied. In the Netherlands stabilisation of CO$_2$ emissions in 2020 compared to 1990 is only possible through very costly measures that are not cost effective for transporters and shippers. In the next section we look at six policy
options to achieve a further reduction of CO₂ emissions in road freight transport in the Netherlands.

3. Policy Options for Reducing CO₂ Emissions

A government can employ three main types of policy instruments to promote desired developments: economic instruments, standards and information and innovation incentives (Koopmans 2006):

- **Economic instruments**: Economic (pricing) instruments offer the possibility for different actors to choose their own adaptation strategy. According to classical economic theory this leads to the most efficient solutions. But public support for (extra) economic instruments is an important issue.

- **Standards**: Standards are very effective for reaching an objective, because they set the actual (maximum) norm. But standards can also be less efficient from a societal benefits point of view, because of the restriction of the market and due to implementation and enforcement costs. Support for new standards is probably inversely proportional to the severity of the norm.

- **Incentives**: Information and innovation incentives serve well in awareness and learning processes. But the effects are often hard to predict. Generally there is a lot of public support for this type of instrument.

3.1 Six Policy Options in this Study

In this section we analyse the impact and social costs and benefits of six policy options to achieve a further reduction of CO₂ emissions in road freight transport in the Netherlands. These six policy instruments we look at are:

1. Kilometre levy for road freight transport;
2. CO₂ levy on diesel fuel;
3. Inclusion of road freight transport in an emission trading scheme (ETS);
4. CO₂ emission standards or fuel consumption standards for heavy vehicles;
5. Standards for heavy goods vehicles regarding low rolling resistance tyres (LRRT);
6. Encouragement of a reduction in CO₂ emissions by means of a public information and innovation programme.

Policy options 1 and 2 are economic instruments, option 3 is a combination of an economic instrument and a standard, options 4 and 5 are standards, and option 6 is an incentive instrument.

Figure 1 depicts the analysis results of the instruments to reduce CO₂ emissions until 2020, assuming introduction in 2013. The position of the individual instruments in the figure depends on their effectiveness and efficiency. Effectiveness was measured in terms of cumulative reduction of CO₂ emissions in kilotons (kton), while efficiency was measured in terms of social cost-effectiveness. Effects outside of CO₂ reduction are expressed in monetary terms. In the next section the individual performance of the six instruments is described and assessed.

3.2 Description and Assessment of Policy Options in the Netherlands

In order to assess the instruments, their economic legitimacy, effectiveness, social efficiency and degree of public support were analysed. Government intervention is legitimate for all instruments, because the road freight transport sector takes too little account for CO₂
emissions by itself. To improve comparability between instruments we assume that all instruments can be implemented by 2013. Several variations in the degree to which the instruments are deployed were analysed. See tables 2 and 3 for the outcomes of our analysis.

Figure 1- Different policy options in perspective

1. Kilometre levy for road freight transport
This option means that carriers pay per driven kilometre, differentiated to time, road, location and environmental characteristics. We have analysed this option with a low levy (1.7 cnt/km) and a high levy (average of 7.7 cnt/km and 13.5 cnt/km for vehicles heavier than 12 tonnes).
In theory carriers want to avoid or minimalize the extra costs by more efficient planning and/or loading, by passing on the increased costs to the shipper and ultimately the consumer. In reality the price-sensitivity is relatively low in the road freight transport sector.
The social cost-effectiveness of the low-levy option is relatively poor due to high system costs and a low pricing incentive. On the other hand, the high-levy option is very cost-effective. But, an important contribution comes from external benefits due to lesser congestion and more road safety. We assume these benefits to lie between 30 and 40 cnt/km (estimated from Maibach et al, 2008). The calculations are sensitive to these external benefits.

2. CO$_2$ levy on diesel fuel
This option means that the diesel fuel price is increased by a CO$_2$ levy. We have analysed this option with a low levy (2.5% increase based on CO$_2$ price of € 20 per ton) and a high levy (12.5% increase based on CO$_2$ price of € 50 per ton). We assume no increase in fuel price for private traffic. TNO has investigated the costs of both a physical and fiscal administrative division for paying for diesel between fuel heavy vehicles and private cars (TNO 2008). In theory carriers want to avoid or minimalize the extra costs by more efficient planning and/or loading, by passing on the increased costs to the shipper and ultimately the consumer. In
reality the price-sensitivity is relatively low in the road freight transport sector (same working as a kilometre levy).

Due to the limited size of The Netherlands a Dutch CO\textsubscript{2} levy will lead to substantial refuelling across the border. We assume 1\% for the low levy option and 5\% for the high levy option. Cost-effectiveness of both analysed options is poor due to high administrative costs and across border refuelling. The cost-effectiveness of a CO\textsubscript{2} levy increases significantly if the levy is imposed EU-wide.

<table>
<thead>
<tr>
<th>Effects</th>
<th>CO\textsubscript{2} emission reduction in Mton in 2020</th>
<th>long term CO\textsubscript{2} emission reduction</th>
<th>reduction of oil-dependency</th>
<th>local emissions NO\textsubscript{x}, PM\textsubscript{10}</th>
<th>accessibility</th>
<th>road safety</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a kilometre levy low</td>
<td>approx. 0,1</td>
<td>approx. 0,1</td>
<td>+</td>
<td>o</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>1b kilometre levy high</td>
<td>0,3 - 0,4</td>
<td>0,3 - 0,4</td>
<td>+</td>
<td>o</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>2a CO\textsubscript{2} levy low</td>
<td>approx. 0,1</td>
<td>approx. 0,1</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>2b CO\textsubscript{2} levy high</td>
<td>0,3 - 0,4</td>
<td>0,3 - 0,4</td>
<td>o</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3a road freight in current EU-ETS</td>
<td>2 - 5</td>
<td>approx. 0,1</td>
<td>+</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>3b traffic and road freight in separate EU-ETS</td>
<td>2 - 5</td>
<td>0,4 - 0,8</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>3c road freight in separate EU-ETS</td>
<td>2 - 5</td>
<td>2 - 5</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>4 fuel consumption standards (EU)</td>
<td>0,7 - 1,0</td>
<td>0,7 - 1,0</td>
<td>++</td>
<td>+</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>5 LRRT standards (EU)</td>
<td>0,2 - 0,5</td>
<td>0,2 - 0,5</td>
<td>+</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>6 information and incentives</td>
<td>approx. 0,1</td>
<td>approx. 0,1</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

3. Inclusion of road freight transport in an emission trading scheme (ETS)

This options means the adoption of the road freight sector in the EU Emission Trading Scheme (ETS), a cap-and-trade-system. The European Commission sets a limit to the total permitted CO\textsubscript{2} emissions over all sectors. We have analysed this option with a CO\textsubscript{2} emission reduction target for the transport sector of minus 10\% in 2020 compared to 2005. The price per ton CO\textsubscript{2} in 2020 depends on the future growth scenario and varies between € 35 in a low growth scenario and € 50 to € 65 in a high growth scenario (Blom et al., 2007). We consider these estimations as very uncertain. Fuel producers will try to offer fuel with a lower CO\textsubscript{2} portion (biofuels) or buy CO\textsubscript{2} emission rights from other sectors. This system will lead to higher diesel fuel price (2\% to 5\%) which to a larger extent will simply be paid for by carriers. To a smaller extent it will lead to behavioural adjustments (all in conformity with the effects as described above with the kilometre levy and CO\textsubscript{2} levy).

The cost-effectiveness is highly dependent on the estimated price per ton CO\textsubscript{2} but reasonable in this example, because most of the CO\textsubscript{2} emission reduction will take place in other sectors.
Some ‘carbon leakage’ (energy intensive industries leaving the EU) will occur due to a higher price of energy.

We also analysed a separate ETS-system for all road transport and road freight transport alone. These options will stimulate the transport sector to achieve all CO\(_2\) emission reduction by itself. But the costs of reducing CO\(_2\) will be higher, because reduction measures have to be found in the transport sector alone and these will be more costly. Also the transaction costs of a separate ETS-system will be relatively high. Positively, in this case no ‘carbon leakage’ will occur. Probably most reduction will take place in the private car sector. When an ETS-system is introduced for road freight transport alone, the costs of CO\(_2\) emission reduction will be even higher still.

**Table 3 – Cost-effectiveness of the six policy options**

<table>
<thead>
<tr>
<th>Cost-effects</th>
<th>total costs</th>
<th>total benefits</th>
<th>accumulated CO(_2) reduction till 2020</th>
<th>social cost-effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>million euros</td>
<td>million euros</td>
<td>kton CO(_2)</td>
<td>€ / ton CO(_2)</td>
</tr>
<tr>
<td>1a kilometre levy low</td>
<td>510 - 560</td>
<td>270 - 340</td>
<td>600 - 750</td>
<td>300 to 420</td>
</tr>
<tr>
<td>1b kilometre levy high</td>
<td>1.100 - 1.300</td>
<td>1.300 - 1.700</td>
<td>2.400 - 3.000</td>
<td>-100 to -130</td>
</tr>
<tr>
<td>2a NL CO(_2) levy low</td>
<td>680 - 870</td>
<td>280 - 360</td>
<td>900 - 1.150</td>
<td>approx. 460</td>
</tr>
<tr>
<td>2a EU CO(_2) levy low</td>
<td>270 - 340</td>
<td>280 - 360</td>
<td>900 - 1.150</td>
<td>approx. -10</td>
</tr>
<tr>
<td>2b NL CO(_2) levy high</td>
<td>1.300 - 1.650</td>
<td>620 - 790</td>
<td>2.200 - 2.850</td>
<td>approx. 310</td>
</tr>
<tr>
<td>2b EU CO(_2) levy high</td>
<td>620 - 790</td>
<td>620 - 790</td>
<td>2.200 - 2.850</td>
<td>approx. 0</td>
</tr>
<tr>
<td>3a roadfreight in current EU-ETS</td>
<td>500 - 1.800</td>
<td>100 - 400</td>
<td>16.800 - 36.400</td>
<td>20 to 40</td>
</tr>
<tr>
<td>3b traffic and roadfreight in separate EU-ETS</td>
<td>higher</td>
<td>high</td>
<td>16.800 - 36.400</td>
<td>50 to 100</td>
</tr>
<tr>
<td>3c roadfreight in separate EU-ETS</td>
<td>higher</td>
<td>high</td>
<td>16.800 - 36.400</td>
<td>100 to 250</td>
</tr>
<tr>
<td>4 EU-fuel consumption standards</td>
<td>530 - 720</td>
<td>-</td>
<td>3.400 - 4.400</td>
<td>approx. 160</td>
</tr>
<tr>
<td>5 EU- LRRT standards</td>
<td>-50 tot -210</td>
<td>-</td>
<td>1.100 - 2.400</td>
<td>-40 to -90</td>
</tr>
<tr>
<td>6 information and incentives</td>
<td>low</td>
<td>low</td>
<td>limited</td>
<td>unclear</td>
</tr>
<tr>
<td>6a the new driving programme</td>
<td>low</td>
<td>low</td>
<td>500 - 1.000</td>
<td>negative</td>
</tr>
<tr>
<td>6b green labels</td>
<td>low</td>
<td>low</td>
<td>limited</td>
<td>negative</td>
</tr>
<tr>
<td>6c heavy vehicle of the future programme</td>
<td>low</td>
<td>low</td>
<td>?</td>
<td>unclear</td>
</tr>
<tr>
<td>6d 2nd generation biofuels</td>
<td>high</td>
<td>high</td>
<td>?</td>
<td>unclear</td>
</tr>
<tr>
<td>6e sustainable purchase policy by the government</td>
<td>low</td>
<td>low</td>
<td>?</td>
<td>unclear</td>
</tr>
</tbody>
</table>

4. CO\(_2\) emission standards or fuel consumption standards for heavy vehicles

This option means setting a standard for the emission of CO\(_2\) from heavy vehicles analogous to the emission standards for private cars. Setting an EU-standard instead of different systems per Member State seems far more efficient. Conform Japan’s ‘Top-Runner-programme’
(Smokers 2007) we assume in this case a norm of 5% more efficient heavy vehicles in 2015 than the most efficient of its class in 2002. This means that on average heavy vehicles will become 10% more efficient over this time period. A different standard per class of heavy vehicles is preferred to prevent undesired substitution between classes, but is also difficult due to the existence of many different combinations. Different testing methods exist, for example test sites, live test trajectories, or engine testing in combination with modelling, but all are quite expensive. Penetration of more efficient heavy vehicles is dependent on new purchases and thus relatively slow. Also real reduction figures can stay behind test results as is the case in the private cars industry.

On average heavy vehicles will become € 8.000 to € 10.000 more expensive (Uyterlinde 2008). The cost effectiveness of this option is not so good because off relatively high costs and limited CO\textsubscript{2} emission reduction effects.

5. Standards for heavy goods vehicles regarding low rolling resistance tyres (LRRT)

This option means setting a norm for more efficient, low rolling resistance tyres, which save on fuel and thus reduce CO\textsubscript{2} emission. We assume extra costs of € 50 per tyre (ECN 2007, Smokers 2007), but carriers safe money on fuel costs. Setting a EU-standard instead of different systems per Member State seems far more efficient. The government incurs some implementation and enforcement costs. With implementation from 2013, we assume the LRRT can be adopted for a full 100% by 2020. We assume no trade-off with safety and noise issues. Maybe apart from tyre-producers, support for this option seems to be very realistic. The cost-effectiveness of the LRRT-option is very good. Even without government interference one expects the LRRT to find its way to the market. The question rises why not more LRRT’s are used right now (2-5 % in the Netherlands)? Maybe the market is not well informed yet, maybe out-of-pocket money counts more than future savings, maybe it is just too much trouble for relatively small earnings. An energy-label on tyres can function as an extra incentive.

6. Encouragement of a reduction in CO\textsubscript{2} emissions by means of a public information and innovation programme.

This options means helping carriers to find possibilities for more efficiency and further reduction of CO\textsubscript{2} emissions. Examples are driver training programmes, sharing best practices in platforms, or subsidy programmes for the development of cleaner engines and biofuels. This type of instrument appeals to the motivation of carriers to operate more efficient. It also boosts a greener image. But it is very hard to make a quantitative estimation of the effects of an information and innovation programme, because it lacks a ‘hard and direct’ incentive to reduce CO\textsubscript{2} emissions. The question is how much of these stimulated behavioural changes would not take place anyway, even without governmental support. ‘Free-rider’ and ‘rent-seeking’ issues are real and present. After all, carriers already want to be as efficient as possible. Support for these kinds of instruments is never a problem. Cost-effectiveness can not be determined due to lack of quantification. Only McKinnon (2008) suggest some figures of around € 20 to € 80 per ton avoided CO\textsubscript{2} emission, but he indicates that these figures are “very approximate”. Still, as ‘flanking’ policies, these type of instruments can ‘ease the pain’ of more far-reaching policy options.

4. Conclusions

CO\textsubscript{2} emissions in the road freight sector will increase if governmental policy is left unchanged. Substantial fuel savings are technically feasible, but these measures cost money
and will not be implemented automatically by the transport sector. For The Netherlands six policy instruments were compared in this analysis.

**Some instruments are highly effective**

The standardisation instruments (e.g. normative guidelines for heavy vehicles regarding CO\(_2\) emissions, standards regarding low rolling resistance tyres and the cap of an emission trading system) are effective, as they actually prescribe a minimum reduction, regardless of circumvention or evasion. There is, however, a risk that the impact of such instruments will not be achieved until after 2020, because actual implementation must withstand time-consuming EU processes.

Including road freight transport in a current or separate emission trading system (ETS) will have the greatest effect in 2020 (CO\(_2\) emissions reduced by 2 Mton to 5 Mton per year). When included in the current EU-ETS, actual reduction of emissions in the road freight transport sector in the Netherlands would be limited to approximately 0.1 Mton in 2020, as it would be cheaper for road freight transport to buy emission rights elsewhere.

**Social cost-effectiveness varies widely**

A kilometre levy, involving a high rate, is best in terms of social cost-effectiveness. EU standardisation of tyre rolling resistance is also cost-effective. The question is however, why are not more efficient tyres yet in use, while they theoretically can result in significant reductions in transport costs? The market may not be correctly informed or the additional costs may be underestimated. The social benefits (excluding CO\(_2\) reduction) of an EU-wide CO\(_2\) levy on diesel balance the social costs.

As regards to the other instruments, the social cost-effectiveness is relatively poor compared to the instruments mentioned above. Standardisation of fuel consumption significantly increases vehicle costs. If the kilometre levy for road freight transport is low, the social cost-effectiveness will be relatively poor, as only limited benefits would be gained compared to the high initial system costs for collecting the levy.

The social cost-effectiveness of a CO\(_2\) levy on diesel for road freight transport alone is relatively poor, due to high system costs for separate fuelling systems (administrative or physical). A CO\(_2\) levy on diesel fuel in the Netherlands alone is subject to high social costs, as some of the road transport companies will refuel their vehicles abroad.

If road freight transport is included in the current ETS, ‘leakage effects’ will occur (i.e. ‘carbon leakage’). The idea is that the inclusion of road freight transport in the current ETS will result in such higher costs for emission rights within the European Union (EU), that energy-intensive companies will move away from the EU. For a separate emission trading system in Europe for road traffic in general or for road freight transport specifically, the costs for emission reductions for road traffic and the transaction costs will be relatively high.

**No support for certain instruments**

The implementation of certain instruments depends on social support, legal options and – ultimately – political will. In the Netherlands the road freight sector does not support new economic instruments that increase the burden for transporters and shippers. In the face of recent agreements with the road freight sector concluded as part of the covenant on
sustainability, it is also unlikely that the introduction of extra pricing instruments will occur during the current government’s term of office. Transporters and shippers prefer the continuation of current ‘flanking’ policies in the form of information, incentive and innovation programmes. The sector does, however, support legal standards for heavy vehicle fuel consumption and tyre rolling resistance, provided that the standards apply throughout the EU and that comparable standards are introduced for other modes of transport as well.

**Combination of instruments**

The various policy instruments analysed here are not mutually exclusive. A combination of a CO₂ levy with road freight transport in any type of emission trading system is not likely to be implemented due to the lack of public support and the inefficiency of such an approach. Synergy benefits can be obtained by, on the one hand, introducing levies or standards, and on the other hand, implementing flanking measures in the form of information, incentive and innovation programmes. Although the effectiveness of flanking measures is limited, they do slightly ‘relieve the pain’ caused by the other instruments.

Establishing standards regarding low rolling resistance tyres is efficient and cost-effective, which means that it can be effectively combined with other instruments.

If realising substantial emission reductions in the road freight transport sector itself is desirable, this can be achieved by including road freight transport in the EU-ETS, combined with the establishment of guidelines for heavy vehicles regarding CO₂ emissions. Standardisation will ensure that a greater part of the reduction is actually achieved within the road freight transport sector.

**Short-term possibilities**

Pricing using a CO₂ levy at the EU level is effective, but currently lacks support. As long as support is lacking and without a concrete proposal from the European Commission, a Dutch kilometre levy can only achieve limited emission reductions.

There is a long EU road to travel before a standard for heavy vehicle fuel consumption, expressed in terms of CO₂ emissions per kilometre driven or capacity supplied, can be legally specified. In working to achieve that goal, however, there are still benefits to be gained from the immediate implementation of unambiguous CO₂ test methods and CO₂ energy labels. This applies first to heavy vehicle engines and in the longer term to the heavy vehicles themselves. In taking this approach, a labelling system can be developed that can be implemented relatively soon as part of an incentive scheme for more fuel-efficient heavy vehicles or as a differentiating factor in a kilometre levy scheme.

5. **Discussion**

Some options turn out to be highly effective, but social cost-effectiveness varies widely. Public support for most instruments might be limited, because the instruments increase the cost of fuel and/or transport. The ‘Clean and Efficient programme’ is currently being evaluated in the Netherlands. It has not been decided yet if and which additional instrument(s) will complement current policies to further reduce CO₂ emissions in the road freight sector.
6. References