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Reducing CO_2 Emissions in Goods Transport

Discussion Paper:

CURRENT DUTCH DEBATE ON CO_2 EMISSION REDUCTION IN ROAD FREIGHT TRANSPORT

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Current Dutch debate on CO_2 emission reduction in road freight transport
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Summary

The Dutch government is aiming to stabilise CO_2 emissions arising from transport by 2020, using 1990 as a comparison. In 2008 three important Dutch advisory bodies for the Dutch government published a plan for CO_2 emission reduction in transport. In this recommendation, specific attention is paid to road freight transport. The advisory bodies propose:

- CO_2 pricing policies for road freight transport at a European level;
- Introduction of specific CO_2 reduction policies that promote introduction of fuel-efficient vehicles. The advisory bodies recommend research into the effectiveness of the Japanese 'Top Runner Programme';
- Introduction of flanking policies (e.g. encouraging innovation, modal shifts, speed measures and improved spatial planning).

This paper demonstrates that the current knowledge on the effects and costs of these options for road freight transport is rather poor. Only some limited information on CO_2 effects and costs is available for road charging schemes, emissions trading and technical measures for the introduction of fuel-efficient vehicles.

Points for discussion in Leipzig

1. If politicians want reduction of CO_2 in road freight transport in 2020/2030 compared to business-as-usual, pricing policies seem inevitable.
2. The current knowledge on effects and costs of pricing policies is currently insufficient for choosing between different pricing options. Emissions trading seems rather cost-effective, provided that low cost CDM (Clean Development Mechanism) and JI (Joint Implementation) options are available.
3. It has been recommended to carry out research into the effectiveness of the Japanese 'Top Runner Programme'. If this programme is effective, it would seem advisable to implement such a scheme in Europe as soon as possible.
4. The flanking instruments such as subsidy programmes and programmes aimed at stimulating logistical innovations are useful for 'lessening' the pain of pricing instruments and emission standards. If these were the only voluntary instruments to be implemented, the CO_2 impact would seem rather low.
5. Modal shift policies will have relatively little CO_2 impact, because the overlap of the markets for the different freight modes is limited.

1. INTRODUCTION

In this paper a short overview is given of the current Dutch debate on CO_2 emission reduction in road freight transport. The percentage of lorry/truck CO_2 emissions in total transport emissions amounted to roughly 16% in 2007. The contents of this paper cover:

- CO_2 emission developments from 1995 – 2005 (section 2)
- Future expectations in emissions (section 3)
- The policy debate (section 4)
- Effectiveness and costs of policy options proposed (section 5).

2. CO_2 DEVELOPMENTS 1995 – 2005

The CO_2 emissions arising from road freight transport on Dutch territory increased by around 11% during the 1995 – 2005 period (Statistics Netherlands (CBS)). Total vehicle kilometres (lorries and trucks) increased by approximately 13% in that period. Therefore, according to these data, a slight improvement in fuel efficiency of road freight vehicles (CO_2 emissions per vehicle kilometre driven) occurred between 1995 and 2005. However, it is uncertain whether this conclusion is valid, as the data used was not very precise.

Francke (2007) has analysed the growth of freight transport on Dutch territory from 1995 – 2005. His main conclusions are:

- The growth of freight transport (all modes) in the Netherlands was consistent with the Dutch GDP growth rate, albeit slower due to the increasing role of the service sector in the Dutch economy and the change in the nature of goods from base materials to manufactured goods;
- International trade grew significantly and shifted increasingly towards intercontinental goods movements, resulting in a particular increase in freight transport via Dutch airports and harbours;
- The average ratio between value (in euros) and weight increased by 50% in goods imports and exports. This implies that the growth of transported weight of imports and exports was only half of the volume growth of imports and exports (in euros);
- The average ‘handling factor’ of goods in the Netherlands increased;
- The average length of haul on Dutch territory only increased by a limited amount;
- No substantial changes took place in the distribution over the different modes of transport. Rail and air freight increased but their market share remained limited;
- The loading capacity of vehicles and ships increased due to economies of scale, but this increase did not result in improved utilisation.

3. OUTLOOK

The Netherlands Bureau for Economic Policy Analysis (CPB) *et al.* (2006) published four new long-term scenarios for a variety of possible developments in the Netherlands, regarding the economy, housing, demographics, spatial developments, the environment, etc. To the Dutch government these scenarios provide important input for long-term strategic decision-making. The design of these scenarios is based on two key future uncertainties, i.e. the extent of international cooperation/globalisation and the policy philosophy adopted by the national institutions. Will there be more emphasis in politics on free market and economic efficiency, or more on strong government intervention and equity? For a qualitative overview of the scenarios, see "Four Futures of Europe" (CPB, 2003a). A quantitative representation can be found in "Quantifying Four Scenarios for Europe" (CPB, 2003b).

As shown in section 2, the amount of freight transport on Dutch territory (and the consequent amount of CO_2 emissions) is determined to a large extent by international developments and economic growth. Table 1 shows developments for these two aspects per scenario.

Table 1: Assumptions regarding 'international cooperation' and GDP growth per scenario

Scenario	**Global Economy (GE)**	**Transatlantic Markets (TM)**	**Strong Europe (SE)**	**Regional Communities (RC)**
International cooperation	Large amount of international cooperation; hardly any trade barriers; European Union expands to the east	Various global economic blocks will remain; further trade liberalisation between Europe and United States	Also a large amount of international cooperation; greater emphasis on fair trade and sustainability	Hardly any international cooperation; conservation of national sovereignty is important
Average Dutch GDP growth per year (2002 – 2040)	2.6%	1.9%	1.6%	0.7%

Based on these four scenarios, future CO_2 emissions in road freight transport have been estimated (CPB *et al.*, 2006) (figure 1). As demonstrated, only RC predicts modest CO_2 emissions growth; in the three other scenarios the growth varies from relatively high (roughly 30% from 2000 – 2020 in TM and SE) to very high (50% in GE). The expected freight volume growth in TM, SE and GE is the most important explanatory factor.

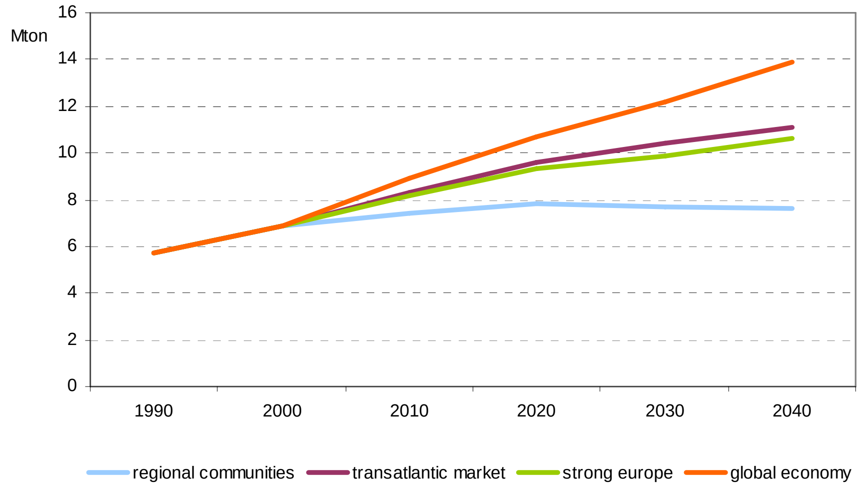

Figure 1: CO_2 emissions from lorries and trucks on Dutch territory, 1990 – 2040 (in Mtons)

4. THE POLICY DEBATE

The Dutch government is aiming to stabilise CO_2 emissions arising from transport by 2020, using 1990 as a comparison (Dutch Ministry of Housing, Spatial Planning and the Environment (VROM), 2007). This requires a transport emissions reduction by 2020 of roughly 13-17 Mtons, compared to business-as-usual. Right now the government is making plans to meet this ambitious goal, in which road freight transport forms a focus area. NGOs and advisory bodies have provided input into the policy-making process.

Dutch NGOs and trade unions have pleaded for the introduction of a ‘climate law’ to reduce greenhouse gases by 50% by 2030 (compared to 1990)[1]. In the climate law the Dutch economy is only allowed to emit an annual fixed amount of CO_2, called the 'CO_2 budget'. Emissions trading will be put in place in order to meet the CO_2 budget (becoming stricter each year) in the most efficient way. According to this plan, transport will best be included in a European transport emissions trading scheme.

In 2008 three important advisory bodies[2] for the Dutch government produced a plan for CO_2 emissions reduction for transport. Their recommendations devoted specific attention to road freight transport. The current climate policy for road freight transport is completely inadequate in their view, particularly due to high predictions in the CO_2 growth in this sector (see section 3).

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[1] http://www.green4sure.nl/pdf/3189_pop_versie_def_ENGELS_op%20scherm.pdf

[2] The Dutch Energy Council, Council for Housing, Spatial Planning and the Environment, Advisory Council for Transport, Public Works and Water Management. (http://www.vromraad.nl/Download/a065e.pdf).

The advisory bodies propose:

1. CO_2 pricing policies at a European level. These policies are required to reduce CO_2 emissions by a significant amount. The pricing policies will not only lead to improvements in energy efficiency and the use of alternative fuels, but also to improvements in logistics and supply chains. Three options for pricing could be considered: a) introduction of a European CO_2 levy on fossil fuels, b) including road freight transport in the European emissions trading scheme, c) introduction of a European road charging system (including CO_2 differentiation);
2. Introduction of dedicated CO_2 reduction policies, i.e. policies that specifically promote introduction of fuel-efficient vehicles. The advisory bodies recommend research into the effectiveness of the Japanese ‘Top Runner Programme’. If this programme proves effective, they advise the implementation of such a scheme in Europe as soon as possible;
3. Introduction of flanking policies (e.g. encouraging innovation, modal shift, speed measures, improved spatial planning). Flanking policy contributes indirectly to CO_2 emissions reduction by facilitating attractive alternatives that result in a smaller carbon footprint. Firstly, it can encourage innovations that for various reasons would otherwise fail to emerge in the marketplace. Secondly, the government can make it easier for parties to implement certain mitigation measures. By combining improved spatial planning with good public transport, for example, the same mobility needs can be catered for with lower CO_2 emissions. As a third option, the scope for emissions reduction can be increased through improved knowledge and skills. By adopting a more fuel-efficient driving style, for example, a trip from A to B can be accomplished with lower CO_2 emissions.

In the advisory bodies' view, vigorous CO_2 reduction policy (pricing and introduction of fuel standards) may have undesired socio-economic impacts. By means of suitable flanking policy, these risks can be reduced and steps taken to ensure that any ‘pain’ resulting from higher transport costs or other effects of climate policy are alleviated.

5. EFFECTS AND COSTS OF THE VARIOUS OPTIONS PROPOSED

What do we know about the costs and effectiveness of the policy options proposed? Not very much, is the (perhaps worrying) conclusion (see also the McKinnon paper (2008), p.2). McKinnon mentions lack of data regarding the freight transport system, limited knowledge of demand elasticities for freight transport, unknown inter-relationships between freight transport and other economic activities, etc. The main probable reason for this poor knowledge is that until recently, the focus has almost exclusively been on passenger cars and CO_2 emissions reduction (and to a lesser extent on aviation). Freight road transport seems to have been almost ‘forgotten’.

A short review is given below of the current knowledge per policy option proposed.

Effects of fuel levy increases
In the 1990s, Dings *et al. (*1999*)* estimated a fuel price elasticity for fuel consumption of road freight transport of –0.3. This number is based on a literature review (very limited data) and modelling with the Dutch freight transport model 'SMILE'. The uncertainty is high, as Dings (1999) points out. This rough estimate implies that a levy increase of 10 to 20 eurocents/litre (a 10-20% price increase) would result in a CO_2 emissions reduction of 3-6% compared to business-as-usual. Based on a rough calculation, we estimate the cost effectiveness of this option at around 150-200 €/tonne of CO_2 avoided[3].

Effects of road charging
Currently, more is known about the impact of road charging schemes. The reason is that the Dutch Minister of Transport has planned to introduce a road charging scheme for road freight transport, starting in 2011. The goal of this policy is to convert fixed taxes (Eurovignet and a yearly road tax) to variable taxes. It is not intended to be a CO_2 measure. In the research process forming the basis of this decision, the impacts of two charging variants have been assessed (Ecorys, 2007; Ecorys and Muconsult, 2007). A 'low' pricing variant with 1.7 eurocents per kilometre on all Dutch roads, and a 'high' variant with 7.7 eurocents per kilometre on all roads (and 13.5 eurocents per kilometre for heavy trucks with a GVW of more than 12 tons, as in the German MAUT system). The impact is roughly a 1% reduction in vehicle kilometres (in the short term) on all roads for the 'low' variant, and 4% for the 'high' variant. De Ceuster *et al.* (2008) have estimated the impacts of the introduction of various possible road charging schemes in Flanders and the Netherlands with the Tremove model, one of which is similar to the 'high' variant mentioned above. They estimated an impact of a 3.4% reduction in vehicle kilometres on all roads for this variant – fairly similar to the Dutch estimates. De Ceuster *et al.* (2008) demonstrate limited modal shift effects with the Tremove model. However, the study does show that some shift to inland shipping will occur in the Netherlands. German experiences with MAUT (10-15 eurocents per kilometre for vehicles with a GVW of more than 12 tons on trunk roads) show a limited reduction of vehicle kilometres on trunk roads during the first year after introduction (-3.6%), and a small increase on other roads (+0.6%). German researchers saw hardly any modal shift due to the MAUT. Utilisation of lorries and trucks on trunk roads improved during the first year after introduction (empty running decreased by 9%). A year later this figure for empty running did not improve further. A (slight) increase of vehicle sales with a GVW of 10-12 tons occurred during the first year after introduction.

Based on a rough calculation, we estimate the cost effectiveness of this option at around 180-230 €/tonne CO_2 avoided[4]. This is somewhat higher than the fuel levy option due to investment costs in on-board GPS devices.

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[3] From a macro-economic point of view the costs are related to the 'lost' amount of fuel use. To reduce this amount the freight sector has to act, i.e. make costs. In this calculation it is important to know how the government will spend the extra revenues. We have assumed that the extra revenues will be spent in such a way that the societal benefits (in euros) equal the amount of extra levies (in euros) that the freight transport sector has to pay.

[4] From a macro-economic point of view the costs are related to the 'lost' amount of vehicle kilometres. To reduce this amount the freight sector has to act, i.e. make costs. In this calculation it is important to know how the government will spend the extra revenues. We

Emissions trading
Dutch thinking regarding this option is still in its infancy. Only Blom *et al.* (2007) has done some rough analysis (in their own words) on the price effects of incorporation of transportation into EU ETS. The effect of integrating transport into the current EU ETS on the price of tradable EU allowances (EUa) was determined, under various reduction scenarios:

- 22% emissions reduction by 2020 (compared to 1990), with 50% Clean Development Mechanism (CDM) and Joint Implementation (JI);
- 28% emissions reduction by 2020 (compared to 1990), without CDM/JI..

Their starting point for analysing the effects of incorporating the transport sector into the EU ETS was a common cap-and-trade system, in which transport emissions are capped at the same reduction percentage as the industry. This situation is compared with the situation in which only the current EU ETS sectors trade and no additional climate policy in the transport sector is assumed. Inclusion of the transport sector in the EU ETS would mean a significant *de facto* intensification of climate policy in the transport sector. Blom *et al.* (2007) further assumes that fuel suppliers will be the trading entity (upstream). When compared to a downstream scheme, the upstream trading option can limit transaction costs of implementing the system, whilst still making full use of the reduction potential of transport users.

- Their findings regarding abatement costs are in line with findings in other literature: CO_2 abatement is more expensive in the transport sector than in the current ETS sectors. However, they also conclude that there is significant potential for 'no regret' abatement measures in both sectors, with higher economical benefit than costs.
- In their first scenario, inclusion of the transport sector in the EU ETS leads to an increase of the EUa price from € 50 to € 65 per ton of CO_2. These figures are valid if all transport modes are included. If only freight transport is included the price increase will probably very modest. In the second scenario, the target cannot be reached by the EU ETS sector alone, according to the cost curve used by Blom *et al.* (2007). When transport is included, the target is achievable, albeit at high EUa price: € 480 per ton of CO_2. However, Blom *et al.* (2007) expect that, at these high reduction levels, the uncertainties in the data increase significantly.
- The calculations show that the EUa price is very sensitive to the availability of low/high cost CDM and JI.
- As long as the EUa price increase remains limited as in the first scenario, the overall effects on competitiveness of inclusion of transport in EU ETS are expected to be small. However, this by no means excludes significant effects at a sector or firm level.

CO_2 emissions and fuel standards
CO_2 emissions and fuel standards will lead to implementation of technical measures, such as more fuel-efficient vehicles, lighter vehicles, hybrids, biofuels, fuel cells, etc.

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have assumed that the extra revenues will be spent in such a way that the societal benefits (in euros) equal the amount of extra levies (in euros) that the freight transport sector has to pay.

Wouters and Annema (2007) have reviewed literature on the cost-effectiveness of technical measures. This information is scarce and uncertain. One main cause of uncertainty is the assumptions used to estimate future cost reductions of technologies, due to learning and scale effects. Wouters and Annema (2007) found that a 10% reduction in 2020 compared to business-as-usual in road freight transport is attainable with technical measures, with costs between 100-200 €/ton of CO_2 reduction. These cost-effectiveness figures are technical costs: the extra investment costs of fuel-efficient technologies and the subsequent fuel savings have been taken into account. To make these figures comparable with the macro-economic cost-effectiveness figures (see above), lost government revenues should also be taken into account. The estimates would be roughly 250-450 €/ton of CO_2 reduction, including lost government revenues. Smokers *et al.* (2007) cite an unpublished report by the Graz University of Technology for the European Commission on the cost-effectiveness of technical CO_2 reduction measures. They report far lower cost-effectiveness for technical measures (below 50 €/tonne, also only technical costs) with a fuel reduction potential of around 5% per vehicle km driven. Biofuels form a special case: the cost-effectiveness for first-generation biofuels currently in use – based on feed crops – is around 200 €/ton CO_2 reduction (ECMT, 2007 and IEA, 2004). However, currently there is much debate among researchers and politicians regarding biofuels (see Eickhout *et al.*, 2008). The debate circles around the uncertain CO_2 emission effects of the first-generation bio fuels ('well-to-wheel'), and the question of whether these bio fuels are sustainable with respect to food prices and land use. The second-generation bio fuels – based on grassy and woody materials – are more promising according to experts, but more research and development is required to lower the production costs of these bio fuels (IEA, 2004).

Flanking instruments

In the Netherlands a subsidy programme called *Transportbesparing* [Transport Savings] existed between 1998 and 2005. The aim of the programme was to make freight transport more efficient (i.e. resulting in fewer vehicle kilometres). This programme was succeeded by the innovation programme '*Duurzame logistiek*' [Sustainable Logistics]. These kinds of flanking instruments appear useful for 'lessening' the pain of pricing instruments and emission standards. If these were the only voluntary instruments to be implemented, the CO_2 impact would seem rather low. However, this statement has not been scientifically proven. The reason is – and perhaps here lies the major problem with these kinds of voluntary policies – that it is very hard to measure the impacts of such policies quantitatively. Some impact will occur, but exactly how much is unknown.

Modal shift

In the Netherlands 'modal shift' was seen in the 1990s as a promising way to make freight transport more environmentally friendly. This picture has now changed, the main reason being the increasing awareness of the fact that the markets for the different freight modes overlap less than most people seem to think. For example, different modes carry different kinds of goods. An average road cargo is valued at 1674 €/ton, whereas this is 924 €/tonne for rail and 86 €/tonne for inland shipping (EEA, 2004, TERM fact sheet 13a). The prices reflect the difference in bulk ('cheap') versus more processed and manufactured materials and goods ('more expensive'). The distance of the goods transported also determines modal choice. An average ton of goods carried by road travels about 110 km, a distance over which rail or inland waterways prove less efficient, because road transport is needed to and from the loading point. So modal shift may be an option, but only for specific market segments. In Annema (2005) a few additional comments are made on 'modal shift' from an environmental perspective:

- Improving environmental performance of each freight mode would seem more effective than general environmental policies aimed at modal shift;
- It is important to use specific environmental data per transport mode instead of average data. An analysis in Den Boer *et al.* (2008) shows that environmental performance generally depends more on installed technology (diesel versus electric) and logistical characteristics than on mode alone.
- It is important not only to look at differences in CO_2 and PM_{10} emission performance in the short term but also to estimate differences in the emission performance of the modes in the long term.
- 'Environment' means more than just the impact of harmful emissions. For this reason it is also important in the case of policy plans for new infrastructure (rail) to consider the effects on noise levels, biodiversity, landscapes and scenic areas, as well as changes in emissions.

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