Metropolitan Transport Research Unit

Heavy Goods Vehicles - do they pay for the damage they cause?

Report prepared for Campaign for Better Transport








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CONTENTS

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Executive Summary

Background to costs and charges

There is considerable interest at the European and UK level in charging road freight vehicles in full for their external costs – those that they impose on others that are not included (internalised) in their normal operating costs. Congestion, environmental damage, road wear and accidents are examples of these external costs which are not internalised. In order to include some or all of these costs, there are now different approaches in place across the EU which charge HGVs for road use: motorway tolls in France, Spain and Italy, and "in vehicle" distance charging[1] in Germany, Austria, the Czech Republic, Slovakia and Switzerland. France is currently preparing to introduce an "ecotax" on HGVs on the non-motorway strategic network.

Without such charging, there is a rationale for balancing grants to modes which have lower marginal external costs. However these do not reduce road freight inefficiencies such as empty running, depot location, port of landing and general logistics practices which would arise from the generation of a freight system working at optimal efficiency.

In the context of changing size and weight limits, for example longer, heavier HGVs (LHVs or "Megatrucks") proper charging is also seen as critical to extracting the benefits from any increase in capacity. Without this, they are likely to be counter-productive[2] because they would not be well utilised – i.e. suffer from the load factors already common in the UK. Around 29% of HGV travel is empty running and 47% of those carrying goods are less than full (either by weight or volume)[3]. Elements of such charges would include environmental damage, the cost of building and maintaining roads, and the delay costs imposed on other users.

This report focuses on the question of how taxes and charges can be said to "pay" for HGVs' external costs, and what those costs may be, using existing values from European and UK research.

It does not revisit the values that are commonly used for environmental damage such as air pollution, although some are clearly inadequate. This extends to the price of carbon, currently insufficient to ensure that reduction targets are met. Thus areas of further research are also identified.

Different approaches to costs and charges

Since the 1960s there have been various attempts to count the real costs of using HGVs on Britain's roads[4]. Until 1995 an annual statement of costs and income for different vehicle types was published, entitled the "Allocation of Road Track Costs"[5]. This covered elements such as road building and maintenance, lighting, policing and accidents.

Many different weights of HGV had their own ratio of income to cost, partly because damage to road surfaces rises extremely rapidly as axle weights increase. For example, the heaviest HGV axle does over 150,000 times more damage than a typical car axle. Other aspects of damage, also much

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1 Using an on board unit or OBU, for example see *Lorry Road User Charging (LRUC) A way forward for the UK,* MTRU, October 2010

2 For example see section 7 and 8 of *Longer and Heavier Vehicles for freight transport,* European Commission Joint Research Centre, July 2009

3 *Impact Assessment of Longer Semi-Trailers*, DfT 20/12/2010, Table 5

4 Starting with: *Road Track Costs,* Ministry of Transport 1968

5 *Allocation of Road Track Costs 1995/96,* Department of Transport 1995

higher than cars and vans, are related to gross weight, size or handling characteristics. In the original Road Track document, environmental impacts such as noise and air pollution, were not assessed in terms of money values, although they were acknowledged.

Since that time there has been considerable activity in terms of trying to put specific costs on environmental impacts such as noise, air pollution, and greenhouse gas emissions, and in measuring impacts on health and safety. The DfT has built on the work undertaken for Road Track Costs to develop a rationale for central Government grants to freight transport modes (rail and water) which is designed to remove the largest HGVs from the road network and thus save accidents and other costs (or reduce any damage which is not being repaired).

Originally the amount which could be paid was related to the lorry miles which would be reduced – hence the name "Sensitive Lorry Miles" (SLM) values. In 2010 this was replaced, after a consultative process[6], by an approach entitled "Mode Shift Benefit" (MSB) values[7]. This report considers these in more detail in later sections.

There has thus been a continuing interest in developing the idea of what HGV costs really are, and, combined with this, to what extent the tax income from HGV use would cover these costs. There are two basic ideas as to how this should be approached.

The first is **marginal external cost**, which includes additional congestion and road maintenance as costs, but assumes the road network has been built and does not include an allowance for this. This approach seeks to match the marginal cost per mile of the external impacts of road freight to the perceived cost per mile of using a particular HGV Obviously, the impacts of a 44 tonne articulated vehicle are much greater than a 7.5 tonne rigid HGV.

The second is the **fully allocated cost** model, which similarly identifies costs according to HGV characteristics, but includes the capital cost of the road network. This can be either as a notional depreciation and/or cost of capital, or on the basis of the typical annual spend on road construction.

In the fully allocated cost model case, congestion is often left out of the cost side since it is borne by road users as a group. However it should be noted that strictly speaking a significant amount of the congestion costs are borne by cars and are not part of the road freight user group.

Finally it must be noted that internalising either capital or congestion costs will result in a more efficient use of vehicles and a better distribution of sizes within the fleet. Low utilisation of vehicle capacity (both from empty running and part loads) is a persistent UK problem.

Thus the report explores the different approaches which can be used, to work out whether HGVs "pay their way". It illustrates how the answer differs significantly according to what assumptions are made. It reviews the state of play in relation to the issue and what might be done in future.

As a starting point, this report reviews the values used for the marginal cost approach in the light of recent studies, bearing in mind the omissions and limitations and issues such as the mandatory targets included in the Climate Change Bill for reducing greenhouse gas emissions. It goes on to assess the scale of undercharging using different assumptions.

The main conclusions of the report are set out below.

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6 *Review of SLM values: Phase 1 report,* DfT 2008

7 See *Mode Shift Benefit Technical Report,* DfT 2009

Conclusions

This report has ten main conclusions.

1) The largest HGVs, including all articulated vehicles and the heaviest rigids, impose high external costs which, even using the DfT 2006 Mode Shift Benefit (MSB) estimates, are not recovered by a very considerable margin. This leads to poor economic efficiency and misallocation of scarce resources.
2) A minimum estimate is that less than 40% of these costs are being charged at present – an underpayment of about £5billion a year which should be charged to the heaviest HGVs, although this income would be moderated by the reduced HGV traffic that would result.
3) Some of the current values have simply become out of date (e.g. carbon, accident, pcu values) and need to be refreshed, others such as air pollution need to be reviewed.
4) Some new values need to be added to the current DfT marginal cost calculations including:
    - Long run marginal infrastructure costs
    - Underspend on maintaining the local road network
    - Non-monetised environmental impacts
    - Wider health impacts.
5) In particular the road space value (passenger car unit – pcu) for heavy articulated vehicles is out of date at only 2.9 times the value for cars in conditions where congestion can occur. Even on motorways this should be at least 4, and much higher on local roads.
6) Improved account of marginal environmental costs needs to be taken, recent research on environmental capital and landscape values for infrastructure schemes should be reviewed as part of this process.
7) The changes required would raise the level of unpaid marginal costs which should be charged to ensure economic efficiency. This increase would be more than 50% over the MSB level, depending on which costs and revenues are included and revised.
8) A comparison with full cost allocation does not change this conclusion – while congestion costs would be reduced, since some are internalised within road goods transport, road construction costs would have to be added.
9) In the case of the full cost allocation model, a contribution to general tax revenue would be expected, reducing the notional offsetting income from HGVs in the MSB.
10) The long term results of such an approach would not simply act to reduce external costs, including accidents, environmental damage and climate change. They would encourage more efficiency in the road freight sector by providing a direct stimulus to improving utilisation (load factors).

It is clear that there are areas of work needed to refine the way environmental costs are treated, and refresh the existing elements which have an established rationale behind their monetisation. This should not detract from the serious failure to charge the heaviest HGVs their proper costs and the need for action to remedy this. In this sense the adoption of the vignette for the UK instead of the systems now common across the EU represents a missed opportunity.

1 Introduction

Background to costs and charges

There is considerable interest at the European and UK level in charging road freight vehicles in full for their external costs – those that they impose on others that are not included (internalised) in their normal operating costs. Congestion, environmental damage, road wear and accidents are examples of these external costs which are not internalised. In order to include some or all of these costs, there are now different approaches in place across the EU which charge HGVs for road use: motorway tolls in France, Spain and Italy, and "in vehicle" distance charging[8] in Germany, Austria, the Czech Republic, Slovakia and Switzerland. France is currently preparing to introduce an "ecotax" on HGVs on the non-motorway strategic network.

The UK has opted for a simple "vignette" style charge to replace part of annual Vehicle Excise Duty (VED). However, this is designed to capture some income from foreign vehicles rather than recoup external costs. It has thus been set at a level which does not seek in any way to raise additional money to meet the costs imposed by HGVs which are not currently charged for. Without such charging, there is a rationale for balancing grants to modes which have lower marginal external costs. However these do not reduce road freight inefficiencies such as empty running, depot location, port of landing and general logistics practices which would arise from the generation of a freight system working at optimal efficiency.

In the context of changing size and weight limits, for example longer, heavier HGVs (LHVs or "Megatrucks") proper charging is also seen as critical to extracting the benefits from any increase in capacity. Without this, they are likely to be counter-productive[9] because they would not be well utilised – i.e. suffer from the load factors already common in the UK. Around 29% of HGV travel is empty running and 47% of those carrying goods are less than full (either by weight or volume). Elements of such charges would include environmental damage, the cost of building and maintaining roads, and the delay costs imposed on other users.

In general terms, cars pay much more tax and charges relative to their costs than heavy vehicles. For HGVs it is clear from most studies that they do not cover the costs for which there are established values, especially road construction and maintenance, carbon and congestion.

This report focuses on the question of how taxes and charges can be said to "pay" for HGVs' external costs, and what those costs may be, using existing values from European and UK research.

It does not revisit the values that are commonly used for environmental damage such as air pollution, although some are clearly inadequate. This extends to the price of carbon, currently insufficient to ensure that reduction targets are met. Thus areas of further research are identified.

Different approaches to costs and charges

Since the 1960s there have been various attempts to count the real costs of using HGVs on Britain's roads[10]. Until 1995 an annual statement of costs and income for different vehicle types was

[8] Using an on board unit or OBU, for example see *Lorry Road User Charging (LRUC) A way forward for the UK,* MTRU, October 2010

[9] For example see section 7 and 8 of *Longer and Heavier Vehicles for freight transport,* European Commission Joint Research Centre, July 2009

[10] Starting with: *Road Track Costs,* Ministry of Transport 1968

published, entitled the "Allocation of Road Track Costs"[11]. This covered elements such as road building and maintenance, lighting, policing and accidents.

Many different weights of HGV had their own ratio of income to cost, partly because damage to road surfaces rises extremely rapidly as axle weights increase, broadly in line with the 4th power law. For example, the heaviest HGV axle does over 150,000 times more damage than a typical car axle. Other aspects of damage, also much higher than cars and vans, are related to gross weight, size or handling characteristics. In the original Road Track document, environmental impacts such as noise and air pollution, were not assessed in terms of money values, although they were acknowledged.

Since that time there has been considerable activity in terms of trying to put specific costs on environmental impacts such as noise, air pollution, and greenhouse gas emissions, and in measuring impacts on health and safety. The DfT has built on the work undertaken for Road Track Costs to develop a rationale for central Government grants to freight transport modes (rail and water) which is designed to remove the largest HGVs from the road network and thus save accidents and other costs (or reduce any damage which is not being repaired).

Originally the amount which could be paid was related to the lorry miles which would be reduced – hence the name "Sensitive Lorry Miles" (SLM) values. In 2010 this was replaced, after a consultative process[12], by an approach entitled "Mode Shift Benefit" (MSB) values[13]. This report considers these in more detail in later sections.

There has thus been a continuing interest in developing the idea of what HGV costs really are, and, combined with this, to what extent the tax income from HGV use would cover these costs. There are two basic ideas as to how this should be approached.

The first is **marginal external cost**, which includes additional congestion and road maintenance as costs, but assumes the road network has been built and does not include an allowance for this. This approach seeks to match the marginal cost per mile of the external impacts of road freight to the perceived cost per mile of using a particular HGV Obviously, the impacts of a 44 tonne articulated vehicle are much greater than a 7.5 tonne rigid HGV.

The second is the **fully allocated cost** model, which similarly identifies costs according to HGV characteristics, but includes the capital cost of the road network. This can be either as a notional depreciation and/or cost of capital, or on the basis of the typical annual spend on road construction.

In the fully allocated cost model case, congestion is often left out of the cost side since it is borne by road users as a group. However it should be noted that strictly speaking a significant amount of the congestion costs are borne by cars and are not part of the road freight user group.

Finally it must be noted that internalising either capital or congestion costs will result in a more efficient use of vehicles and a better distribution of sizes within the fleet. Low utilisation of vehicle capacity (both from empty running and part loads) is a persistent UK problem.

Thus the report explores the different approaches which can be used, to work out whether HGVs "pay their way". It illustrates how the answer differs significantly according to what assumptions are made. It reviews the state of play in relation to the issue and what might be done in future.

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11 *Allocation of Road Track Costs 1995/96,* Department of Transport 1995

12 *Review of SLM values: Phase 1 report,* DfT 2008

13 See *Mode Shift Benefit Technical Report,* DfT 2009

2 The two basic approaches to road use costs and charges

Introduction: full versus marginal costing

The original road track costs publications started with the total cost to the Government of providing the road network (building and maintenance) and then tried to estimate what proportion should be paid by HGVs of different weights and types. Such calculations *for any one year* add together the following costs:

- running the road network, including maintenance, lighting, policing
- allowance for the capital involved in the building of the road network (either related to annual expenditure, or a rate of return on the total historic cost)
- accidents
- environmental impact

This approach is generally known as the total cost coverage or fully allocated cost.

One problem with this is that annual road building expenditure can go up or down unrelated to levels of demand and congestion. To get around this, calculating what the size of road network should be, working out its total cost and estimating a return on capital (or depreciation) has been proposed. This is clearly open to errors from estimating the size required, the cost, and the interest rate.

In addition, while this approach gives an overview of costs and revenues, economists prefer to maximise efficiency in the current situation ignoring historical costs. This would be better achieved if the true additional cost of using an individual road vehicle for an extra kilometre is charged to the user at the point of use. This is called marginal external cost (MEC) pricing, and is the option most often studied.

It is very important that two conditions are met as closely as possible for efficiency to be achieved. The first is that the marginal cost is fully paid and perceived by the user, and the second is that charging operates as closely as possible to the point at which the costs occur, both in terms of when and where. In practice this is hard to achieve perfectly, but charging per mile, for example, is close. Annual duties are not very useful for marginal cost pricing because they are not perceived as running costs. It is the most clearly perceived costs which change behaviour.

In the marginal cost scenario, the capital cost of the road network or any additional building is set to one side. Instead the calculation is based on the cost of the extra congestion which would be caused by an additional kilometre from an individual vehicle. This is then added to the cost of the extra environmental damage from that vehicle, road maintenance, accidents and any other costs not paid directly by the user.

However, it is also possible to extend short run marginal costs to include capital expenditure set to build enough capacity to limit or reduce congestion to the current or to a desired level. This would have the effect of reducing congestion costs but increasing road track costs beyond maintenance, lighting, etc. This is often referred to as "long run marginal cost"[14] and is not included in the DfT's Mode Shift Benefit (MSB) values mentioned earlier.

[14] For example see para 2.1 of *Handbook on estimation of external costs in the transport sector,* Mailbach et al, part of IMPACT D1 study, 2008.

Thus in one sense congestion and road building costs are partially substitutes for each other in the two approaches, although it is possible to combine elements of both. However, one or the other should be included in any assessment which seeks to create a complete picture of HGV costs. It is possible to create variations on how either are calculated but this basic principle holds. Examples of the different approaches can be found in work undertaken for the DfT in 2001[15].

The final issue for marginal external costs is how to monetise some of the environmental impacts in a comparable manner to other costs. This is an area where there has been a great deal of work but no complete answer – values can be derived from survey data (with the associated willingness to pay issues), or the cost of mitigation, but reliable data is hard to find. For example, the MSB costs add 10% to monetised costs (excluding congestion and infrastructure) to allow for these hard to monetise costs such as severance and landscape. This is an area where further work is required.

Implications for charges

At first sight it may seem that differences between the two are theoretical, but they can produce significantly different levels of cost. In addition, there are implications for any charges, such as VED or fuel duty.

In the allocated cost model, the aim is to retrieve costs and any appropriate sum towards general Government revenue. In the original Road Track Cost calculations the surplus from cars was said to contribute towards meeting all the environmental costs for all road vehicles, which were, however, unquantified. At the time, cars paid much more than their identified costs, and HGVs paid less or more than these costs according to their weight and axle loads, with the heaviest not meeting costs. This disparity was justified because it was policy based, and rail freight, for example, was financially supported by Government. The structure of rail freight charging has, of course, changed significantly since privatisation.

In the marginal cost model, the individual user should face the true cost of use, and thus any excess revenue elsewhere, for example from car drivers, is not available as a subsidy to HGVs. The use of averaging over different vehicle weights and road types is also less acceptable in marginal cost pricing – the point is to price accurately at the point of use. This is the principle behind proposals for national road pricing, which varies the charge per mile by vehicle and road type and by the level of congestion.

Thus the marginal cost approach promotes economic efficiency by making the relationship between cost of travel and the benefit from the travel clear to the user. As a result, it promotes a reduction in unnecessary travel which will reduce the costs imposed on Government and other third parties such as congestion, road damage, accidents and environmental damage.

This MEC approach is the one which underlies the Mode Shift Benefit (MSB) tables and has been a useful source of information for this report, particularly in relation to the treatment of road maintenance. The MSB scheme is due for renewal in 2015 and is being reviewed now.

Implications for tax revenues

For the full cost allocation approach, the Government simply wants to get a view on how much the sector costs the public purse and what revenues it gets back specifically from that sector. Sales tax

[15] See Table 4.1, *Surface Transport Costs and Charges, Sansom et al.,* ITS & AEA Technology, DfT 2001

revenue (VAT) is thus not usually counted against HGV environmental costs because it is reclaimed by the operators. This raises the issue of hypothecation – simply collecting tax from a group of users and investing it on their behalf is not usually seen as the role of Government. Indeed, the payment of tax for general Government expenditure is essential, before any specific additional revenue can be said to be hypothecated. This issue was discussed further in the review of SLM values[16].

Once the general picture is assessed, the Government can go on to decide what additional level of tax to apply, taking into account its various policies for reducing congestion, improving the environment and safety, and addressing climate change. In regard to the latter, this objective is slightly different in that in future years there will be a mandatory reduction target. Thus the issue is now defined as how much it costs to reduce emissions (usually called the **abatement cost**), rather than estimating the marginal damage cost. This is one area where the current MSB underestimates the carbon costs of HGVs.

Charges in the marginal cost model are calculated at the point of use, this is sometimes referred to in Government appraisal as the perceived user cost. As previously stated, for businesses this means that all VAT should be ignored since it is claimed back and is not a perceived cost. This is the approach currently recommended in the Government's Guidance for Appraisal (webtag)[17] and also followed for the MSB. It should be noted that for private motoring, including commuting, the VAT cannot be claimed back and is thus included in the motoring costs and revenues.

Environmental charges are also very different from conventional taxes. New thinking on how environmental charges are constructed suggests that the final outcome is to avoid damage and thus raise as little income as possible in the long term. If new revenues are raised on this basis, they may be recycled. Thus they may appear at the point of use but be returned elsewhere in the business sector, or, for example, to repair damage which has accumulated as a result of the over use of HGVs. An obvious example is the £12bn estimated backlog in local authority road maintenance. They are, however, unlikely to be paid back to the specific user.

This approach needs to be considered carefully in relation to marginal cost pricing. However, some environmental costs are in fact values derived from surveys of what people would be willing to pay to avoid various degrees of nuisance or damage and are highly variable and income dependent. The cost of these as currently estimated depends very much on the assumptions behind the survey. If the level of charge was to be based on its ability to achieve Government policies, it may well be much higher.

Approach in this report

As a starting point, this report reviews the values used for the marginal cost approach in the light of recent studies, bearing in mind the omissions and limitations and issues such as the mandatory targets included in the Climate Change Bill for reducing greenhouse gas emissions. It goes on to assess the scale of undercharging using different assumptions.

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[16] See paras 42-43 of *Review of SLM values: Phase 1 report,* DfT June 2008

[17] See: webtag, Unit 3.5.6, para 1.1.9
http://www.webtag.org.uk/webdocuments/3_Expert/5_Economy_Objective/3.5.6.htm

3 Calculating all the external costs of road use

Real costs – different methods of valuation

Apart from congestion costs there are two basic types of cost which are outside the normal expenditure of transport operators. These externalities are the focus of attention in a marginal cost analysis. The first type is a measurable market price – for example the cost of repairing roads. The second contains a group of costs for which there is no market price but there is a value, which can sometimes be monetised. Examples are health, carbon emissions, environmental quality and safety.

In the case of HGVs, it is possible to calculate the direct cost of using the road network in terms of maintenance, and the cost of construction. The second group, including health, climate change and road accidents, are wide ranging, less easy to monetise, and subject both to variation and disagreement between practitioners. There have been arguments that this second group are often not really appropriate for valuation in the same way as the cost of laying tarmac. However, Governments in the UK and elsewhere have put considerable effort into calculating some of these social costs so that they can be included in a cost benefit analysis. These figures are becoming common in transport appraisal, but must be used with caution.

The reason for this is that there is usually a double uncertainty in preparing any valuations. The first is measuring the impact itself. For example, how many people are affected by how much noise? How do different levels of noise affect health and social well being? How many people will suffer what level of air pollution? Will that pollution lead to a shorter life, or a hospital admission, or a day off work?

The second problem is that people then have to be surveyed in order to get them to put a value on many of the effects listed above. The values given by individuals are notoriously variable in relation to life expectancy, as might be expected. The usual approach, known as "willingness to pay" (WTP) is not examined in detail in this report. However, most studies are based on limited surveys and this means that there is considerable variation in the values obtained. Even for accidents, where some costs such as Police and NHS, are available, in the case of a fatal accident, what is the real value of a human life? This variation is reflected in recent studies, as shown in the Table below.

Table 3.1
Comparison of external costs in 5 European and UK studies
Cost per vehicle kilometre, all HGVs

	SLM 2003	McKinnon 2007	INFRAS 2004	CE Delft 2007	MSB 2008 (artic only)
Social and Environmental externalities	27.9p	14.6p	47.4p	0 – 90p	31.5p
Marginal congestion costs	Ave 27.3p From 3.9p Mway low to 84.2p conurbation	Ave 9.7p From 4.2p rural any time to 72.9p urban	From 4.2p uncongested M-way, to £12.11 congested urban	From 23.3p off peak to 38.9 urban peak	Ave 52.4p From 24.1p Mway low to 100.2p Mway high

The SLM values[18] were used by the Department for Transport to assess the value of reducing HGV traffic until 2010. They were originated by the Strategic Rail Authority's consultants, who reviewed a range of studies, and then scrutinised by the DfT. The second source above is a recent UK study of HGV costs[19] at the low valuation end, and the third is one of the more recent EU reports, which tried to assess the externalities of all freight modes (including rail and air)[20]. The fourth is a recent overview of European studies including the UK[21]. The fifth is the UK's Mode Shift benefit report, which combines locally derived values with some from another EU overview report[22]

The detailed definitions of the external costs are also slightly different, for example McKinnon uses a recent DEFRA value for air pollution which is based on the health impacts involving hospitalisation and premature death only. INFRAS has upstream and downstream effects (such as oil refining) which are included in a less accurate fashion in the SLM study. PM10s from tyres and brakes are included in INFRAS (as the new Euro standard engines are introduced this is at least as important as exhaust PM10s).

Nor are the valuations consistently in one direction, as the comparison between the SLM and MSB values and McKinnon study shows.

Table 3.2
Comparison of Sensitive Lorry Miles average values (pence) and Mckinnon (converted to miles)

	SLM	**Mckinnon**	**MSB**
Accidents	2.9	7.4	2.8
Noise	3.8	0.8	7.0
Pollution	6.3	2.7	2.5
Climate Change	2.5	3.1	3.8
Infrastructure	12.5	9.0	9.0
Congestion	43.9	15.7	52.4
Unquantified	16.9	0	6.4

Note: These are in different years' prices and not directly comparable across studies, what they show is the wide variation in importance between cost elements

It should be noted that the unquantified amount in SLM is meant to represent a group of known impacts, which did not have a current Willingness To Pay (WTP) study. The SLM report listed them as:

- driver frustration/stress (comparable to journey ambience in Government Guidance on appraisal)
- fear of accidents
- restrictions on cycling and walking

[18] See DfT Sustainable Distribution Fund http://www.dft.gov.uk/pgr/freight/railfreight/slmp/
[19] *Internalising the External Costs of Road Freight Transport in the UK,* Piecyk & McKinnon, 2007
[20] *External costs of transport,* IWW/INFRAS, October 2004
[21] *Handbook on estimating external costs in the transport sector* – part of IMPACT, December 2007
[22] *Handbook on estimation of external costs in the transport sector,* Mailbach et al, part of IMPACT D1 study, 2008.

- upstream and downstream effects
- community severance
- visual intrusion

The MSM report includes a similar but not identical list:

- up and downstream processes
- soil and Water Pollution
- nature and Landscape
- driver frustration / stress
- fear of accidents
- community severance (including restrictions on cycling and walking)
- visual intrusion

This is not exhaustive, for example other impacts from HGVs include:

- loss of unique habitats (although this is referenced in MSB)
- damage to underground structures (including gas and water mains, electricity and telecommunications)
- low frequency noise (vibration) associated with the largest vehicles.

It should be noted that there are some quite basic difference in assumptions, for example zero for the "other" category in Mckinnon, significant values in the original SLM (at 2005 prices), and values with a zero for landscape impacts in MSB (2010 prices). The latter is interesting – the EU study which it used concluded that it was infrastructure that caused landscape damage not its use by vehicles.

It is doubtful whether this is the whole story even for cars, where noise, pollution and movement itself will have a visual and severance impact. It certainly does not apply to large HGVs travelling through sensitive environments, or close to people in such environments, both in terms of noise and visibility. In townscapes rather than landscapes, use is clearly the most important factor for cars or HGVs.

This illustrates the difficulties of creating convincing monetary values for some of these factors, but does not mean that they are insignificant or can be ignored. In fact, the failure of large HGVs to meet the currently monetised costs is so great that applying these, for example as a per mile charge, would have a major role in reducing such costs without calculating the precise values.

4 Do HGVs meet their external costs?

Mode Shift Benefit (MSB) values

As a starting point it is possible to take the MSB values for marginal external costs and revenues and use them to find out how far HGVs pay their way. It should be noted that the MSB is designed for a specific purpose and thus some costs have been omitted – including an allowance for annual road construction.

On the revenue side the inclusion of annual VED (or vignette) is not really suitable for marginal cost calculations but is small compared to fuel duty revenue. Whether all the fuel duty should be included, or only that part which has been designated an environmental tax (the 1993 fuel duty escalator), makes a far greater difference – counting only the excess would reduce the revenue per mile by over 50%. Other approaches count the fuel duty above another base level, for example home heating[23]. Clearly the reduction in notional income is more important in a fully allocated cost approach where a contribution to general revenue is required.

However, the MSB table is the most recent DfT estimate of average marginal external costs per mile for all articulated HGVs considered as a whole. These were considered to be the highest cost type of vehicle, although the heaviest rigids also have high costs. The average marginal external cost is 83.9p per mile in 2010 prices, but there are wide variations on different road types as shown below.

Table 4.1: MSB values (pence per mile)

	Motorway		A Roads	Other Roads	Weighted average
	High	Low			
Congestion	100.2	24.1	75.9	85.2	52.4
Accidents	0.5	0.5	5.7	5.6	2.8
Noise	8.6	6	7.2	9.1	7
Pollution	1.9	1.8	3.3	3.8	2.5
Climate Change	3.6	3.6	4.2	4.2	3.8
Infrastructure	4.7	4.7	10.8	68.7	9
Other (road)	6.4	6.4	6.4	6.4	6.4
Total	125.9	47.1	113.5	183	83.9
Tax income	34.4	34.5	33.6	34.8	34.1
Marginal cost gap	91.5	12.6	79.9	148.2	49.8

Source: MSB Technical Report
Note: Motorway high and low refer to level of congestion
Tax income is fuel duty + annual VED
Climate change value is 2006 methodology

A simple calculation multiplying the number of articulated vehicle miles in 2012 (8.1 billion) produces a figure for the failure to meet external costs from this source alone of just over £4billion (£4.2billion at the current cost of carbon – see below). This does not include large rigid vehicles (up to 32 tonnes gvw), which have similar costs to artics. This would bring the figure to about £5billion.

[23] Fowkes Nash & Tweddle 1988, Preferred Option

However, there are reasons to believe that the current MSB figures would need to be revised to better represent the true costs. These changes fall into two categories:

i) Where the MSB method of monetisation needs to be reviewed or expanded: for example the inclusion of some road construction costs, recognition of the rising maintenance backlog on the non-trunk network, and more detailed environmental costs including use of the current value of carbon. Issues to be considered are:

- Long run marginal infrastructure costs
- Underspend on maintaining the local road network
- Value of carbon and trend
- PCU values for different HGVs
- Non-monetised environmental impacts
- Accidents

ii) Where the base data on which total costs were calculated has changed: for example infrastructure costs depend on traffic levels which have changed generally and for HGVs, and the other key input, the level of expenditure on maintenance and construction, has also fluctuated. Key issues are:

- Amount of spend
- Traffic overall
- HGV traffic
- Type of HGV
- Level of congestion

1) Reviewing and expanding the MSB methods

The aim of this section is to identify changes to the MSB approach which would make it more suitable for assessing overall costs as well as providing the basis for mode shift grants. The key issues are set out below with an indication of their impact on overall costs. It should be noted that MSB focusses on articulated HGVs. This does not mean that they cover all the costs for HGVs, in other words the heaviest rigids (which also have high costs) carry on imposing significant external costs which are unpaid for. For the purposes of this report, it must be recognised that any method of retrieving external costs, in whole or in part, should extend to the heaviest rigid vehicles.

Long run marginal infrastructure costs

Total capital and revenue expenditure on roads in the UK has been around £8billion per year at outturn prices for the last 8 years[24] (see Table 4.3 later in this section). The figure used by MSB was for 2006, and only covered maintenance, amounting to £3.87billion at 2010 prices[25]. This was allocated to individual HGV types. Clearly the long run marginal cost for any given period (for example 2015 to 2020) would have to be based on total predicted expenditure for that period. For the Strategic Road Network this is expected to rise significantly. Without taking this into account, the introduction of long run marginal cost would increase average artic costs per mile by around 10-12p. It should be noted that, insofar as this expenditure reduces congestion and this is included in the calculation, there will be no double counting.

[24] Table TSGB1303 (formerlyTSGB0118) *UK Public Expenditure on Transport by function1: from 2005/06*

[25] MSB spreadsheet used for 2008 Technical Report

Underspend on maintaining the local road network

Every year the Alarm survey[26] publishes the outturn figures for local authority spending on road maintenance, including potholes. This identified the backlog estimated by the local authorities which has risen in the 2014 survey to £12billion (£10.5billion in the 2013 survey). This is a difficult figure to verify, but has widespread acceptance as a working estimate. Given that it would take time to catch up, spending an extra £1billion a year for the next decade or so would be needed to clear it. The situation is not the same on the strategic network where DfT have not identified any backlog. For example, the new Highways Agency arm's length company will have funding to resurface 80% of the strategic network in the next 10 years – an average wait of about 6-7 years. Contrasting with this, in local authority areas outside London, principal roads will on average have to wait 33 years. Using the same assumptions as the MSB cost allocations, the cost could add about 3-4p per mile (average all roads) to the artic costs in 2012.

Value of carbon and trend

The 2008 MSB used an earlier version of carbon costs which has now been replaced and is included in Webtag. Using this would increase the carbon cost per mile from 3.8p per mile to 6.5p (see Table 4.1).

Pcu values for different HGVs

The passenger car unit (pcu) seeks to define the road space occupied by different vehicles, with the average car as 1. There has been considerable debate over the use of a narrow range of values, for example the largest artic counts as 2.9 cars, only slightly more than a bus (2.5). In assessing pcus there are considerable difficulties because they vary according to traffic flow and road type (as do many of the external costs studied in this report).

One alternative value is straightforward to calculate: nose to tail, stop start conditions at very low speeds. This is a close equivalent of the comparative length of vehicles to the average private car, plus a small gap – say 0.5m. This would be more than 4.

Other values are harder to calculate and include the road space occupied when:

1) larger vehicles overtake other large vehicles with small differences between speeds – a phenomenon familiar to any driver on a motorway
2) headways between larger vehicles
3) larger, low acceleration vehicles have to wait for an acceptable gap to turn right at uncontrolled or signal controlled junctions
4) larger, low acceleration vehicles move through a left or right turn manoeuvre without problems of road geometry (i.e. undertaking it within one lane)
5) larger, low acceleration vehicles move through a left or right turn manoeuvre where the road geometry requires use of another lane, overhanging the footway or very slow speed

It should be noted that 1 and 2 above should be measured in terms of time and space.

Looking at comparative lengths, and comparative headways in free flowing dual carriageway traffic (around 5-6 seconds for an articulated HGV[27]) a value closer to 4 would be appropriate. This does not take into account other road types and conditions where it would be much higher. It is hard to

[26] ALARM: Annual Local Authority Road Maintenance Survey Asphalt Industry Association and ADEPT

[27] See DfT Table TRA3107: *Time difference between HGVs and the vehicle in front in Great Britain*

predict how this might change costs because pcus are used both for infrastructure costs and probably for congestion. The latter is potentially very significant but with higher uncertainty.

Non-monetised environmental impacts

MSB has covered some of the research and increased this with a value which is towards the lower end of many studies. This is, however, an area where more work is required and where a range figure should probably be used. The lack of specific severance and visual intrusion impacts to accompany landscape is an important omission.

Accidents

It is not clear why MSB uses a low value for accidents which is just lower than the old SLM value and much lower than Mckinnon. It is important not to use average figures for accident costs because the pattern of HGV accidents is different from other vehicles. This is an area where older figures appear to have been updated rather than refreshed and further work is required to check the current values. One important factor is that HGVs are more likely to be involved in fatal accidents, (which have a far higher cost compared to non-fatal) - five times more so on minor roads. This is shown in the Table below.

Table 4.2: HGV traffic and fatal accidents by road type

Traffic in billion veh kms	HGV traffic	All motorised traffic	HGV %	% fatalities involving at least 1 HGV	**Ratio of HGV to all motor vehicles**
Motorway	10.9	99.8	10.9%	52.3%	**480%**
A	11.7	217.3	5.4%	18.1%	**335%**
Minor	2.4	167.0	1.4%	7.2%	**514%**

Source: Traffic statistics table TRA0104, Accident statistics Table RAS 30017, both DfT

2) Reviewing base data

This section considers how the input data to the MSB methods have changed since 2006, and how this might influence the costs values, starting with total road expenditure.

Amount of spend

Table 4.3: Changes in the amount of spend from 2006 through the recession

		2005/06	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**	**2012/13**
National Roads	**Total**	**2,760**	**3,370**	**3,260**	**3,487**	**4,131**	**3,584**	**3,097**	**2,859**
	Capital	1,085	1,560	1,450	1,556	2,548	2,156	1,741	1,618
	Current	1,675	1,810	1,810	1,931	1,583	1,428	1,356	1,241
Local Roads	**Total**	**4,963**	**4,946**	**5,156**	**5,668**	**5,993**	**5,861**	**5,165**	**5,019**
	Capital	2,766	2,763	2,931	3,430	3,556	3,736	3,245	3,118
	Current	2,197	2,183	2,226	2,238	2,437	2,125	1,921	1,901

Source: Table TSGB1303

Overall expenditure is expected to rise significantly in 2015-20 for the national network (motorway and trunk), although the local picture for all road types is far less clear. This is partly because money for local roads is now flowing through many different routes including EU funding via Local Enterprise Partnerships (LEPs). If the national capital programme doubles for 2015-20 as appears likely, this would add about 6p per mile to the MSB cost.

Traffic overall and HGV traffic

Statistics are now published in a slightly different form so that comparisons between now and 2006 (actually the average for 3 years) is difficult. However, it has been possible to undertake a comparison for total traffic and total HGV traffic by type of road (critical to the calculation of costs) for Great Britain. MSB used England only. The results are shown in the following table.

Table 4.4: Comparison of traffic levels 2006 and 2012 (billion vehicle kilometres)

GB	**All traffic 2012**	**All traffic 2006**	**Change 2012/2006**	**HGV 2012**	**HGV 2006**	**Change 2012/2006**
Motorway	90.0	89.7	100%	11	12.2	90%
Trunk	47.3	48.2	98%	5.4	6.2	87%
Principal	135.6	141.1	96%	6.2	7.1	87%
Other	144.2	150.6	96%	168.1	175.5	96%
Total	417.1	429.6	97%	190.7	201	95%

Source: Table TRA0204: Road traffic (vehicle kilometres) by vehicle type and road class in Great Britain, Annual 2006

Type of HGV

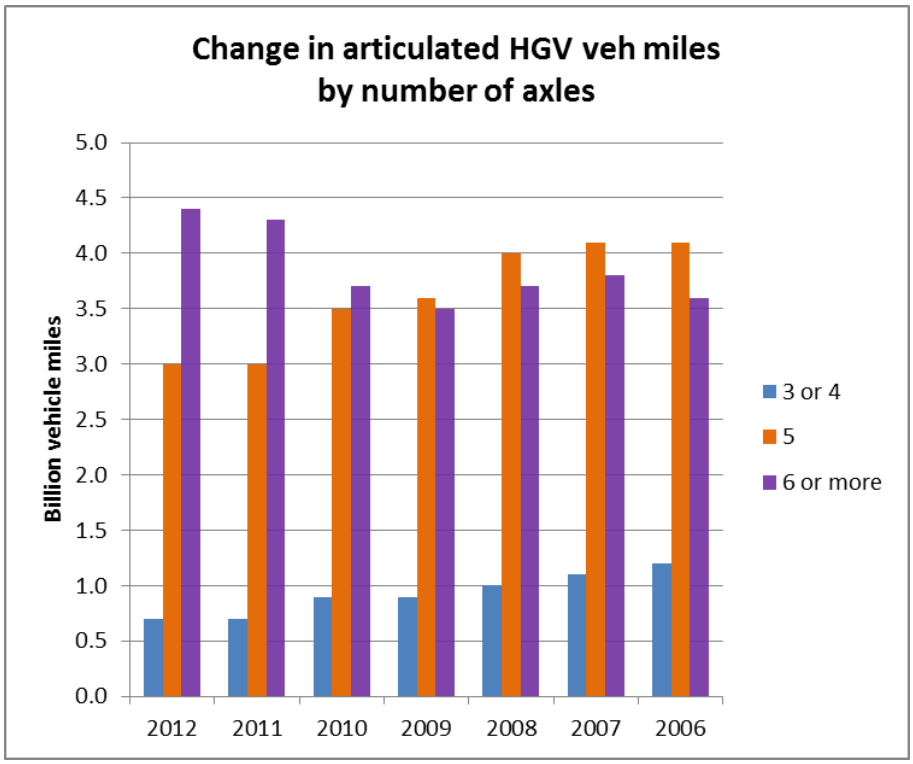
It is also possible to compare the proportion of different sizes of articulated vehicles for England 2006 and for Great Britain between 2006 and 2012. The latter will be slightly too high in absolute terms, but provide a good approximation of the proportions of each different size of HGV. This is important because the largest, heaviest HGVs have the highest marginal costs. For example, the MSB figures show that the 6 axle articulated HGVs in the Table below are 2.6 times more damaging than 4 axle articulated HGVs. Thus an increase in the proportion of the largest means an overall increase in damage caused. This increase in the average damage per vehicle goes some way to compensate for the slight decrease (8%) in total HGV kilometres. Table 4.5 shows the change between England 2006 and GB 2012, and Figure 4.1 shows the change for GB 2006 to 2012.

Table 4.5: Proportion of artics by axle number 2006 and 2012

Billion vehicle kilometres	MSB England only		DfT all GB	
Artics	2006	% total	2012	% total
3 or 4 axle artic HGV	1.9	13%	1.1	8%
5 axle artic HGV	6.6	47%	4.9	38%
6 or more axle artic HGV	5.7	40%	7.0	54%
Totals	14.2	100%	13.0	100%

Source: TRA 3105: Heavy goods vehicle traffic by axle configuration and road category in Great Britain 2006 and 2012.

Figure 4.1



Source: TRA 3105

Level of congestion

As a result of the recession it is clear that congestion has not grown as quickly as forecast. In future years the DfT has produced forecasts which show traffic growing strongly and, assuming future road construction, that congestion will grow even faster. This has two effects:

1) Roads which were not in the highest congestion category had lower marginal costs will move to a higher category, increasing costs significantly
2) The categories themselves will show higher average costs due to higher levels of traffic.

This will inevitably lead to HGV external congestion costs rising strongly with increased traffic, in some cases whether or not the number of HGVs increases. Given the sensitivity of costs to congestion this means that ongoing increases in marginal costs should be built in to any estimate which is to be used over a period of time. The 2013 Road Traffic Forecast table is reproduced below.

Table 4.6: Predicted traffic and congestion increases

		2010-2040 % change			% of traffic in very congested conditions[8]
	Road Type	Total Traffic	Congestion (Lost Sec's/Mile)	Vehicle Speed	
Central	SRN	46%	114%	-8%	15%
	Non-SRN	41%	56%	-9%	14%
	All	43%	61%	-9%	15%

Source: National Road Traffic Forecasts 2013

Note: SRN = Strategic Road Network. % of traffic in congested conditions is 2040 forecast

5 Conclusions

This report has ten main conclusions.

11) The largest HGVs, including all articulated vehicles and the heaviest rigids, impose high external costs which, even using the DfT 2006 Mode Shift Benefit (MSB) estimates, are not recovered by a very considerable margin. This leads to poor economic efficiency and misallocation of scarce resources.
12) A minimum estimate is that less than 40% of these costs are being charged at present – an underpayment of about £5billion a year which should be charged to the heaviest HGVs, although this income would be moderated by the reduced HGV traffic that would result.
13) Some of the current values have simply become out of date (e.g. carbon, accident, pcu values) and need to be refreshed, others such as air pollution need to be reviewed.
14) Some new values need to be added to the current DfT marginal cost calculations including:
    - Long run marginal infrastructure costs
    - Underspend on maintaining the local road network
    - Non-monetised environmental impacts
    - Wider health impacts.
15) In particular the road space value (passenger car unit – pcu) for heavy articulated vehicles is out of date at only 2.9 times the value for cars in conditions where congestion can occur. Even on motorways this should be at least 4, and much higher on local roads.
16) Improved account of marginal environmental costs needs to be taken, recent research on environmental capital and landscape values for infrastructure schemes should be reviewed as part of this process.
17) The changes required would raise the level of unpaid marginal costs which should be charged to ensure economic efficiency. This increase would be more than 50% over the MSB level, depending on which costs and revenues are included and revised.
18) A comparison with full cost allocation does not change this conclusion – while congestion costs would be reduced, since some are internalised within road goods transport, road construction costs would have to be added.
19) In the case of the full cost allocation model, a contribution to general tax revenue would be expected, reducing the notional offsetting income from HGVs in the MSB.
20) The long term results of such an approach would not simply act to reduce external costs, including accidents, environmental damage and climate change. They would encourage more efficiency in the road freight sector by providing a direct stimulus to improving utilisation (less empty running and higher load factors).

It is clear that there are areas of work needed to refine the way environmental costs are treated, and refresh the existing elements which have an established rationale behind their monetisation. This should not detract from the serious failure to charge the heaviest HGVs their proper costs and the need for action to remedy this. In this sense the adoption of the vignette for the UK instead of the systems now common across the EU represents a missed opportunity.