



Sensitive Lorry Miles

Results of Analysis

May 2003

Introduction

Sensitive Lorry Miles (SLMs) have been used for assessing the external benefits generated by the transference of freight from road to rail through the payment of Freight Facilities Grants (FFG), for both rail and water freight, and Track Access Grants (TAG), since 1991. They are paid on a “per lorry mile removed” basis, with different values assigned for different road categories. They form an essential tool in the appraisal of grant schemes where it is not feasible to carry out a detailed calculation of the individual elements for each application. (The SRA’s Appraisal Criteria¹ should be consulted for guidance on the applicability of SLM values.) The last review of the values was carried out by the (then) Department of Transport in 1996. This was not a comprehensive review and resulted in an increase of the value per motorway mile from 10p to 20p. The focus when re-evaluating the motorway figure was on valuing congestion through COBA modelling. In the motorway value, a significant proportion of the figure was approximated from unvalued benefits such as local air pollution and climate change. The other values, for all other road types, remained as calculated in 1991. Rural values were not reviewed and their derivation is unclear. The values prior to this revaluation are given in Table 1 below.

Table 1: Previous SLM values

		pence per mile (1996 values)
Rural	Motorway	20
	Grade-separated dual carriageway	20
	Non grade-separated dual carriageway	20
	Single carriageway	100
Urban	Motorway	20
	Grade-separated dual carriageway	20
	Non grade-separated dual carriageway	150
	Single carriageway	150

The Strategic Rail Authority (SRA) has revisited the issue of Sensitive Lorry Mile values in order to produce more robust figures. The previous values are now considered to be out of date, as they do not accurately reflect the costs to society of lorries on roads or more recent research on these costs. Together with the Department for Transport (DfT), the SRA have worked with Arup Transport Planning and L.E.K. Consulting to produce revised values that reflect as accurately as possible the available evidence, both hard scientific and softer qualitative information. Rigorous analysis is necessary to enable funding decisions to be made on an equitable basis and to ensure that public money is used effectively.

After extensive analysis of all the available research, a weighted average value of 51p per lorry mile has been agreed upon (based upon the average use of different road types by Heavy Goods Vehicles (HGVs)). Considerable work has been carried out as there are conflicting opinions and bodies of work available for several of the elements that make up the SLM values. Principal areas of discussion between the SRA and DfT have centred on the categories of congestion, pollution and climate change. The agreed values by category of externality can be seen in Table 2 below.

¹ *Appraisal Criteria - A guide to the appraisal of support for passenger and freight rail services*, SRA, April 2003

Table 2: SRA proposal for values of external benefits of rail and road freight (pence per lorry mile)

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principle	Other	Trunk & Principle	Other	
Accidents	1.5	1.5	1.5	3.8	3.1	3.8	3.1	2.9
Noise	4.0	4.0	4.0	11.0	9.0	2.0	4.0	3.8
Pollution	5.7	5.7	5.7	18.8	22.8	3.9	4.8	6.3
Climate Change	2.7	2.7p	2.7	2.6	2.5	2.4	2.0	2.5
Infrastructure Costs	5.7	5.7	5.7	9.1	28.7	11.2	35.3	12.5
Road Congestion	79.0	37.0	6.3	121.9	135.5	45.8	10.6	43.9
Unquantified	8.0	8.0	16.0	8.0	9.0	21.5	22.0	16.9
Taxation	-29.0	-29.0	-29.0	-29.0	-28.0	-29.0	-28.0	-28.9
Rail Costs	-8.8	-8.8	-8.8	-8.8	-8.8	-8.8	-8.8	-8.8
TOTAL	68.8	26.8	4.1	137.5	173.8	52.8	45.0	51.1

Background

The SRA commissioned research to look at both the methods and quantification of the externalities associated with road and rail freight. Work has been carried out by both Arup Transport Planning and L.E.K. Consulting. The SRA has consulted extensively with the Department for Transport (DfT), in particular the Railways Economics and Major Projects department (REMP), the Scottish Executive, Welsh Assembly Government, Department for Environment, Food and Rural Affairs (DEFRA) and the Highways Agency. These discussions and analyses have informed the SRA's decision on values and road classifications.

This note shows the outcome of the research and discusses the possible evidence bases. The note is structured to take each category of externality in turn. The categories for consideration are:

- Accidents
- Noise
- Pollution
- Climate Change
- Road Infrastructure Costs
- Road Congestion
- Road Tax
- Rail External Costs

It is clear that on some issues there is considerable uncertainty and that more research would be required to value all the externalities. Therefore, there is also a category included for Unquantified Benefits which is discussed separately.

The values that were derived from SRA research are contained in Table 3 below:

Table 3: SRA derived values of net externalities of rail freight (pence per lorry mile)

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principle	Other	Trunk & Principle	Other	
Accidents	4	4	4	10	8	10	8	7.5
Noise	4	4	4	11	9	2	4	3.8
Pollution	22	22	22	52	61	18	20	23.4
Climate Change	5	5	5	5	4	4	3	4.3
Infrastructure Costs	5	5	5	8	26	10	32	11.2
Road Congestion	94	44	7	124	124	43	6	44.0
Unquantified	10	10	10	10	10	10	10	10.0
Taxation	-29	-29	-29	-29	-28	-29	-28	-28.9
Rail Costs	-10	-10	-10	-10	-10	-10	-10	-10.0
TOTAL	105	55	18	181	204	58	45	65.3

Table 4 below shows, for each externality, the range of values revealed by L.E.K.'s work. The table shows that the SRA has not selected the highest value in every case, but rather taken the value where the balance of evidence is, most persuasive. The work carried out by Arup primarily considered the model produced by ITS Leeds in their report for the DETR "Surface Transport Costs and Charges" (STCC)².

Table 4: Sources and range of values revealed by L.E.K.

		Source	Value
Accidents	Low	Arup/ITS	3p
	High	CfIT/DTLR	10-67p
	L.E.K.	ECMT/INFRAS	7.5p
Noise	Low	Arup/ITS	0p
	High	ECMT	10p
	L.E.K.	ITS (mid point)	3.8p
Pollution	Low	ECMT	12p
	High	Madison	61p
	L.E.K.	INFRAS + Arup/ITS	23.4p

A full bibliography is presented in Appendix A.

Road Types

The SRA and the DfT have agreed to seven different road categories. These have been developed to take into account the different type and level of impacts of lorries on different locations, different roads and under different conditions. The road categories represent an amalgamation of the road classifications that are available in the DfT's National Transport Model.

² *Surface Transport Costs & Charges - Great Britain 1998*, Institute of Transport Studies (ITS)/ AEA Technology Environment, 2001

The current and proposed road types are shown in the table below, with the nearest approximation possible between the two (it should be noted that this correspondence is not exact):

Proposed	Motorway			London & Conurbation		Rural & Urban	
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principal	Other	Trunk & Principal	Other
Current	Motorway, Rural Dual, Urban Dual (grade-separated)			Urban Dual (non grade-separated), Urban Single		Rural single	

Values have been established for the different externalities by road type. These are discussed more fully below.

Accidents

The analysis of the value of accidents has led the SRA to propose the following values by road type (pence per lorry mile):

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principal	Other	Trunk & Principal	Other	
Value	4	4	4	10	8	10	8	7.5

The average weighted value of 7.5p is based on the research presented by INFRAS (2000) and ECMT (1998). The INFRAS work is based on European wide research into the value of accident costs and the ECMT research represents the lower bound estimate of a series of European studies. The 7.5p in this case represents the average for trucks and vans (although it was recognised that the value would be higher for trucks). Further evidence for this value has been provided by Europe Economics (1999) who recommended a range between 5p and 7p taking into account the adjustment required for HGVs; this is based on Maddison et al (1996). In addition to the variety of research that has been undertaken across Europe, other areas of debate include the attribution of responsibility. L.E.K. have identified a long-standing theoretical argument which suggests that all accidents involving a vehicle should be accounted for in the marginal external costs, rather than merely those where the vehicle can be shown to be responsible for causing the accident. This draws on Forkenbrock’s “Comparison of external costs of rail and truck freight transportation” (2001). Research by NERA, which attempts to attribute fault to the different vehicles involved in the accident and to factor the marginal cost, accordingly produces a figure of 3p. This has been ratified by DfT who recommend that the value should be focused on the UK experience and practice.

The SRA believes that the evidence produced by L.E.K. is persuasive and represents the consensus of current European research and is not restricted to UK experience only. The SRA believe that there is a case for considering the attribution of responsibility differently to NERA as it is unreasonable to assume that no vehicle-vehicle accidents would be prevented in the absence of one of the vehicles involved.

Noise

From the analysis the SRA has determined the following values for noise externalities (pence per lorry mile):

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principal	Other	Trunk & Principal	Other	
Value	4	4	4	11	9	2	4	3.8

The SRA have proposed a weighted average of 3.8p based on L.E.K.'s review of the different data sources. L.E.K. proposed that an average of the range supplied by ITS (0-7p) was applied evenly over the motorway types with higher values attributed to London & Conurbation roads on the basis of lower background noise and increased residential impact (and therefore greater marginal impact) and slightly lower for Rural & Urban.

The DfT has accepted the ITS source and commented further that noise benefit depends to a large extent on the existence of background noise. (The marginal impact of the removal of a lorry on a highly congested road will be lower than on a less trafficked road.) Their recommendation therefore has been to apply more benefit to those roads where there is low background noise and lower values to the high background noise environments. The SRA have accepted this advice. The Department further argued for a different method of calculating the average of the ITS range which would result in a slightly lower value for each road type, which they believe would be more in line with expected emerging European guidelines. SRA believes the value should be based on the best evidence currently available rather than anticipating emerging EU guidelines. A simple arithmetic average provides a reasonable estimate until further guidance from EU Directives is forthcoming.

The SRA has acknowledged the validity of the background noise issue. However, it is appropriate to include a mean ITS value for motorways and a much higher value for less busy roads across the network as the majority of lorries leaving the network for rail will be from the motorway/principal road network.

Pollution

The SRA had proposed the following values for pollution effects (pence per lorry mile):

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principal	Other	Trunk & Principal	Other	
Value	22	22	22	52	61	18	20	23.4

There is much debate about the impact of pollution on society especially relating to health and mortality. The work undertaken by L.E.K. has indicated that a value of 23.4p would be consistent with European studies. Their analysis indicated that in addition to the COMEAP (1999) research which forms the basis of for acute mortalities proposed in ITS and Arup, there is research by INFRAS (2000) drawing on World Health Organisation studies which includes a wide range of non-fatal health costs. L.E.K. have derived a value from their analysis which uses ECMT (1998) research (which has been accepted by the European Commission in assessing State Aids) and adds the INFRAS adjustment for other non-fatal health costs to cover a range of health impacts (including acute and chronic mortalities, chronic bronchitis, restricted activity days and asthma) and non-health impacts (e.g. building and crop damage).

In the course of consultation with the DfT, a range of values have been put forward by them which highlight the level of uncertainty that surrounds this issue. The research carried out by L.E.K. reflected the mid-range value from accepted available literature. However, in order to achieve consistency across appraisal of public funding, it is necessary to utilise current Government values, pending the development of further acceptable evidence.

The adopted values for pollution effects are (pence per lorry mile):

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principal	Other	Trunk & Principal	Other	
Value	5.7	5.7	5.7	18.8	22.8	3.9	4.8	6.3

The base source for this recommended position on the external cost of pollution due to lorry freight is the ITS study. The ITS report presents three valuation “cases” (“low”, “medium” and “high”) which differ, mainly, in the monetary value attached to the various health effects. In particular, the low and medium cases used a “years of life lost” (“YOLL”) approach whereas the high case used the “value of statistical life” (“VSL”) methodology. Work for SRA by Arup has recommended that the high case should be adopted for SLMs and this would support the SRA approach of adopting the DfT’s higher value.

As part of their work for SRA, L.E.K. reviewed the available literature on externalities. It is clear that within the scientific literature there remains considerable uncertainty in the many relationships needed to reach an estimate for these costs. This uncertainty includes the range of pollutants considered, the extent to which the presence of these pollutants is attributable to road transport in general and the different types of road transport in particular, the “dose-response” link between exposure to pollution and the likelihood of a “health end-point” (i.e. illness), and the value to be associated with the occurrence or avoidance of that end-point. The YOLL and VSL methodologies are both criticised in the literature and there is general, although not universal, acceptance that a “willingness to pay” (“WTP”) method is to be preferred. The studies necessary for this method are complicated and involve considerable time and resources, although some have now been set up. It is “early days” in regard to this approach, but initial findings appear to support the rejection of the concept of a differential quality of life factor (namely that the more seriously ill a person is, the less they value an extension of their life) which is central to the YOLL approach. This would also support the adoption of DfT’s medium view.

Climate Change

The SRA proposed the following values for the impact of climate change (pence per lorry mile):

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principal	Other	Trunk & Principal	Other	
Value	5	5	5	5	4	4	3	4.3

These values have been established by L.E.K. drawing on European research and the work carried out by ITS/Arup. ITS proposed a range of values for CO₂ of between £7-£30/tonne and this is further supported by INFRAS and ECMT which provide values of £88/tonne and £34/tonne respectively. DfT have proposed a range of values based on the most recent DEFRA research. The medium position in their range is broken down as follows (pence per lorry mile):

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principal	Other	Trunk & Principal	Other	
Value	2.7	2.7	2.7	2.6	2.5	2.4	2.0	2.5

The SRA has accepted that these values represent the latest DEFRA research and acknowledge that there is uncertainty about the way in which emissions will be controlled in the future. The SRA accepts the use of current Government values.

Road Infrastructure Costs

The SRA proposed the following values to reflect the infrastructure cost savings from modal shift (pence per lorry mile):

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principal	Other	Trunk & Principal	Other	
Value	5.7	5.7	5.7	9.1	28.7	11.2	35.3	12.5

The values proposed by the SRA reflect the recommendations of both L.E.K. and the DfT based on the research carried out by ITS and Arup on this issue.

Road Congestion

The analysis carried out by L.E.K. produced values for the congestion benefits accruing from modal shift as follows (pence per lorry mile):

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principal	Other	Trunk & Principal	Other	
Value	94	44	7	124	124	43	6	44.0

This value adjusts the average congestion cost to reflect the proportion of traffic that travels on highly congested roads (22%). The derivation of the value of congestion stems from the use of speed-flow curves. These are taken from the ITS STCC study and define the relationship between speed and flow on different motorway types. It is widely recognised that speed-flow curves consistently understate delay costs. As such the value of time for these trips should be higher to reflect higher journey time penalties. This is consistent with the way in which passenger time is treated in the PDFH. This methodology attributes a time penalty over and above normal journey times.

The DfT proposed the following values to reflect congestion costs (pence per lorry mile), which have been accepted by the SRA:

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principal	Other	Trunk & Principal	Other	
Value	79	37	6.3	122	135.5	45.8	10.6	43.9

Discussions with the DfT have indicated that there is scope for further research to establish more accurately the decongestion benefits of modal shift. The DfT has recommended values which are based on the ITS STCC

model. These take inner and outer conurbation and rural motorway values and weight them to give a single motorway value. These are then split into high, medium and low motorway values based on the proportions of traffic as proposed by Arup. The DfT has also included 25% uplift for reliability effects resulting from reduced demand. This value has been derived from applications of the INCA model used in the Midlands-Manchester Multi-Modal Study and discussions between ITEA Division and HMT. It is recognised that this value is coarse and more work is required to quantify this more fully.

The outcome of the two different approaches is, however, a common view of the appropriate value to use and the DfT values have been adopted.

The SRA has consulted fully with the DfT in respect of these values and recognises the basis of their recommendations. There is considerable need to investigate the impacts of congestion and potential decongestion benefits and it is recommended that in the medium to long term research be commissioned through an independent body such as CfIT or SACTRA, the results of which could inform policy across the transport investment spectrum.

Taxation

As recommended in the Green Book⁴, it is necessary that taxation relating to fuel and Vehicle Excise Duty (VED) should be netted off the total benefits. This figure has been agreed as follows (pence per lorry mile):

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principal	Other	Trunk & Principal	Other	
Value	29	29	29	29	28	29	28	29

The SRA believes there is scope for further research to establish the relationship between vehicle ownership and modal shift, as it is unlikely that this is a one for one relationship but recognises that the VED proportion of the taxation figure is very small.

Unquantified Benefits

The analysis discussed above neglects some categories of benefits which are recognised but where there is currently insufficient evidence to support a value. These include the following:

- Driver frustration/stress
- Fear of accidents
- Restrictions on cycling and walking
- Upstream and downstream effects
- Community severance
- Visual intrusion

These unquantifiable externalities are recognised in the Guidance on the Methodology for Multi-Modal Studies (GOMMMS) and by INFRAS. GOMMMS particularly references driver stress and frustration, and the fear of accidents. These are recognised as real impacts experienced by drivers. The decline in traffic resulting from modal shift will reduce these impacts. GOMMMS also references the impact of schemes on landscape and the

⁴ *Appraisal and Evaluation in Central Government, The Green Book*, HM Treasury, January 2003

impact of HGVs on the landscape through visual intrusion should be considered in this category. However, none of these impacts has been quantified.

INFRAS considers community severance, and upstream and downstream effects which are knock-on effects of the presence of HGVs on roads. These might include energy consumption, production and maintenance costs. The relative importance of these issues in the overall environmental cost is considered. Severance of communities due to high flows of traffic is considered to be a small part of the overall cost. However, upstream and downstream effects are more significant.

Overall, these costs are extremely difficult to quantify. However, the SRA believe that these are significant when considering the impact of modal shift from road to rail and should be given a value pending further research/guidance.

The assignment of values to these externalities has been discussed with the DfT and the following values assigned by road type (pence per lorry mile). These values take into account the high impact of lorries in rural areas.

	Motorway			London & Conurbation		Rural & Urban		Weighted Average
	High Congestion	Medium Congestion	Low Congestion	Trunk & Principal	Other	Trunk & Principal	Other	
Value	8	8	16	8	9	21.5	22	16.9

Rail Costs

Rail freight also has an impact on society. The range of impacts is similar and includes noise, pollution and climate change. These are lower per unit of freight than the road externalities hence the social benefits of the modal shift. L.E.K. estimated that a value of 10p across all road categories would be appropriate to account for these externalities. Discussions with the DfT, in the context of the costs of pollution, have indicated that a value closer to 9p would be more consistent with the agreed approach for valuing the effects of pollution from road freight and this has been agreed by the SRA. It should be noted that infrastructure costs and congestion costs are not addressed as externalities for rail (unlike road) as the railway usage charges already capture the appropriate costs.

Conclusion

The SRA's Appraisal Criteria indicate that values of time should be indexed to reflect changes in GDP. Accordingly, SLM values will also reflect these changes.

The SRA believes that these values will represent robust analysis of the costs to society of HGVs on roads and the impact of modal shift. These are pragmatic values which reflect the paucity of information in some areas and the consensus of opinion in others. It is recognised that these values should be revised as more research emerges in the different fields and it is recommended that both the DfT and the SRA commission research which will inform SLM values in the future.

Appendix A: SLM bibliography

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